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REPORT

OPERABLE UNIT 3 FEASIBILITY STUDY PHASE 1 TREATABILITY STUDIES

216 Paterson Plank Road
Carlstadt, New Jersey

Prepared For: 216 Paterson Plank Road Cooperating PRP Group

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1.0 INTRODUCTION

On behalf of the 216 Paterson Plank Road Cooperating PRP Group, this report presents the results of Phase 1 of the Treatability Study program. The Treatment Study is part of the Feasibility Study (FS) for Operable Unit 3 (OU-3) at the 216 Paterson Plank Road Site (Site[1]) in Carlstadt, New Jersey (Figure 1).

OU-3 addresses Site-related impacts to deep groundwater in the glacial deposits and bedrock, which have been the subject of extensive investigations as described in the Revised Off-Property Groundwater Investigation Report (Golder, 2008a). OU-3 is the final operable unit for the Site and follows the interim measures implemented under OU-1 and the final remedy for soils and shallow groundwater addressed as OU-2. As such, the OU-3 remedy is expected to complement the source control and treatment measures included as part of OU-1 and OU-2 so as to achieve the Site-wide remedial action objectives.

USEPA requested treatability studies to assess the applicability of two (2) potential remedial technologies for OU-3, retained in the Remedial Action Objectives and Remedial Alternatives Report (Golder, June 2008b): Enhanced Anaerobic Bioremediation (EAB); and in situ Chemical Oxidation (ISCO). This report provides the results of additional delineation of groundwater impacts and a bench-scale treatability study of ISCO conducted according to an approved Work Plan (Golder, 2009), together with a workplan for Phase 2 activities including a field-scale pilot test of EAB. In addition, this report presents additional surface water and groundwater data collected as part of the ongoing operation and maintenance monitoring program.

[1] The Site is also sometimes referred to as the former Scientific Chemical Processing Site or SCP Site. The Site includes the property located at 216 Paterson Plank Road (i.e., on-property area) and related off-property groundwater impacts.

2.0 BACKGROUND

2.1 Description of Property

The 6-acre 216 Paterson Plank Road property (Figure 2) is a former chemical recycling and waste processing facility, which ceased operation in 1980, and is located in a light industrial/commercial area of Carlstadt, New Jersey. The property is bordered to the southwest by Paterson Plank Road, to the northwest by Gotham Parkway, to the southeast by a trucking company, and to the northeast by Peach Island Creek. The Site was placed on USEPA's National Priorities List (NPL) in 1983.

2.2 Site Geology

The stratigraphy at the Site consists of the following units, from youngest to oldest:

- Man-Made Fill;
- Marine and Marsh Sediments;
- Glaciolacustrine Varved Deposits;
- Glacial Till; and
- Bedrock.

The geologic units that are relevant to OU-3 include the Glaciolacustrine Varved Unit, which serves as a confining unit, and the underlying Glacial Till and Bedrock Units. These units are described in detail in the following sections.

2.2.1 Glaciolacustrine Varved Unit

The glaciolacustrine varved unit at the Site can be correlated with the varved silts and silty clays of Glacial Lake Hackensack, although the lower portions may belong to the Glacial Lake Bayonne stage (see Stanford and Harper, 1991). This unit has been broadly subdivided into the following horizons:

- An upper, stiff to medium stiff, bedded, varved horizon, which is significantly sandier than the lower horizon. This horizon also displays distinct banding with stringers and intercalations of silty sand and silt.
- A lower, very soft to soft, highly plastic clayey horizon. This horizon consists of a clayey silt to massive clay, wherein the varved nature is more difficult to recognize because of the higher clay content.

The boundary between these two horizons is sharp, and recognizable by a marked drop in the standard penetration test (SPT) blow counts when the lower horizon is encountered. Additionally, the upper horizon is generally lighter reddish brown in color with local variegated tones that may be grayish, brownish gray or gray, and contains distinct alternating seams and stringers of fine sand and silt. The lower horizon is characteristically brown, brick red to purple in color and is characterized by silty clay and clay. At several locations, a basal sand and gravel intercalation has been reported.

Based on a review of the published literature, the elevation across the Site, and their lithologic character, the two horizons may be considered to be different facies of glaciolacustrine deposition (Stanford, 1994), and/or the result of weathering and desiccation of the upper zone of glaciolacustrine deposits in the Hackensack lowlands (Averill et al. 1980; Argon, 1980; Harris, 1972).

The glaciolacustrine unit ranges in thickness from approximately 5 feet to over 20 feet. The geotechnical properties, particularly the SPT blow counts, are distinctly different between the two horizons. SPT blow counts in the lower horizon are generally below 2 blows/ft. The upper horizon is generally stiffer, with blow counts as high as 28, indicating a generally coarser texture with intercalated seams of silt and sand, and possibly desiccation (see Averill et al. 1980; Harris, 1972). No evidence of desiccation was noted during the Off-Property Investigation (Golder, 2008b), other than the variegated coloration mentioned above.

2.2.2 Glacial Till Unit (Soft Till and Lodgment Till)

Informally correlated with the Rahway Till (Stanford et al, 1994), this unit consists of a heterogeneous mixture of red, yellow-brown, reddish-brown, and reddish-gray clay, silt, sand, and gravel. At most locations, a softer glacial overlies a much harder, over-consolidated glacial till. The softer till horizon was not intercepted in boreholes northwest of the Site (MW-15D and MW-19D). The over-consolidated lower glacial till is a distinct horizon that is characteristic of a basal, lodgment till (Luteneggen et al. 1983; Averill et al. 1980) and is generally continuous across the Site. This till appears to thin in areas west of the Site and was absent in RMW-12D. SPT blow counts are generally greater than 50 in the basal lodgment till. The softer till displays significantly lower blow counts, typically 20 to 30.

Based on the above observations, the glacial tills beneath the Site can be subdivided as follows:

- The upper horizon, herein informally called the *Soft Till*, ranges in thickness from 0 to 17 feet; and
- The over-consolidated lower horizon, called the *Lodgment Till*, ranges in thickness from 0 to 30 feet.

The Lodgment Till displays a composition similar to the bedrock, containing clasts entirely composed of the underlying siltstone or sandstone, set in a clayey silt or silty clay matrix. In the Soft Till, however, the clasts may also include metamorphic rock fragments such as quartzite and gneiss and occasional well-rounded to sub-rounded quartzite gravel.

2.2.3 Bedrock Unit

The bedrock beneath the Site area has been assigned to the siltstone-mudstone-sandstone facies of the Passaic Formation (Parker, 1994) and has been intercepted by numerous boreholes including core-holes that have been sampled and logged. Bedrock consists of fining-upward sequences of intercalated

massive siltstone and mudstone and laminated siltstone with occasional interbeds of micaceous, fine to medium grained sandstone. The bedrock is brick red, reddish brown or brown in color, and this coloration dominates all overlying glacial deposits. Rhythmic cycles of gray bed sequences 10 to 20 feet thick or "Van Houten Cycles" (Olsen, 1980) occur sporadically throughout the lower portions of the core samples. The regional strike trend of the Passaic strata in northern New Jersey is northeasterly with a north-westerly dip.

Joints measured in sparse outcrops in this portion of Bergen County trend N10°E and N65°W and are subvertical and vertical in orientation and parallel with bedrock strike and sub-parallel with the dip direction, respectively. Very few vertical fractures have been intercepted in the off-Property boreholes although a few steeply dipping fractures were intercepted by the core-holes and indeed much of the observed bedrock discontinuities were bedding plane partings or dissolution enhanced, vuggy intervals of reddish siltstone and mudstone. Some of the vugs are infilled with secondary minerals. Occasionally fractures at angles with the bedding plane have also been intercepted. Bedrock dips in this part of the Weehawken Quadrangle are gentle, and generally range from 15 degrees to 10 degrees northwesterly. In all the rock cores collected, bedding plane dips were determined to be essentially sub-horizontal.

2.3 Site Hydrogeology

Previous Site investigations have included multiple rounds of continuous water level monitoring of several till and bedrock monitoring wells as well as monitoring of surface water levels in Peach Island Creek. Hydrogeologic testing (packer and slug) was also performed on six (6) till monitoring wells and four (4) bedrock monitoring wells. Relevant results from these studies (Golder, 1997; 2003) are summarized below:

- There was generally a seven-day cycle of fluctuations in water level for all till and bedrock monitoring wells. A weekly high was recorded on Mondays and lows were recorded on Fridays/Saturdays, indicating that water levels are influenced by extraction wells in the vicinity operating during the week and idling on the weekends. Groundwater observations indicate that flow direction can vary over a wide range. This variability is apparently due to anthropogenic influences in the area, coupled with the low natural hydraulic gradients. Variations in pumping rates from different pumping centers can relatively easily overcome the low natural hydraulic gradients to affect groundwater flow direction. A well survey based on NJDEP records identified pumping wells in several locations in the vicinity of the site. One cooling water pumping well, located about 2,300 feet from the Site along strike, had a relatively high yield of 250 gpm, and may induce hydraulic gradients in a northerly direction. It has been shown that drawdown from pumping wells along strike within the bedrock formation can be significant at distances of 2,400 feet (Carswell, 1976). Thus, effects could potentially occur at the Site, and in particular, at well MW-20R, which is only 1,750 feet from the pumping well.
- There was an approximate 12-hour fluctuation cycle in several of the till monitoring wells and all bedrock monitoring wells coinciding with tidal fluctuations observed in Peach Island Creek. These 12-hour fluctuations reflect tidal influence that do not appear to affect the predominant groundwater flow directions.

- Horizontal hydraulic gradients in both the till and bedrock range between approximately 0.001 ft/ft and 0.0008 ft/ft with higher gradients associated with periods when off-Site pumping was active.
- Vertical hydraulic gradients between the till and bedrock well clusters were variable; some well clusters indicated slightly upward gradients and slightly downward gradients at different times, correlated to off-Site pumping. Vertical gradients between the till and shallow bedrock ranged from 0.0005 (upward) to 0.030 (downward) when pumping was absent, and from 0.002 (downward) to 0.032 (downward) during the pumping period.
- Hydrogeologic testing indicated till hydraulic conductivities ranging from $3.2x10^{-6}$ centimeters per second (cm/s) at location MW-10D to $7.1x10^{-4}$ cm/s at location MW-16D with a geometric mean value of $7.0x10^{-5}$ cm/s. The bedrock hydraulic conductivities ranged from $3.1x10^{-5}$ cm/s at location MW-8R to $1.2x10^{-2}$ cm/s at location MW-11R with a geometric mean value of $4.3x10^{-4}$ cm/s.

2.4 Groundwater Quality

The contaminants of concern (COCs) on-Site include chlorinated aliphatic hydrocarbons (CAHs), consisting predominantly of chloroethenes (tetrachloroethene (PCE), trichloroethene (TCE), cis-1,2-dichloroethene (DCE) and vinyl chloride); and localized aromatic hydrocarbons, predominantly benzene, toluene, ethylbenzene and xylenes, known collectively as BTEX. BTEX impacts are primarily localized to the south corner of the Property where two wells also show impacts from 1,4-dioxane[2].

Concentrations of VOCs decrease substantially with increasing horizontal and vertical distance from the property based on Site-wide sampling. The highest level of VOCs in the bedrock wells was detected in MW-13R (560 µg/L of total VOCs) located adjacent to the northwest corner of the property, but these concentrations decline to trace levels within 600 to 1,000 feet horizontally. Concentrations also decline vertically, with only trace VOC levels detected in MW-23R located adjacent to but deeper than MW-13R. Similarly, the highest levels of VOCs in the till wells are also located in the northern corner of the property in MW-5D (6,281 µg/L of total VOCs). These concentrations decline to 51 µg/L in MW-25D approximately 1,000 feet to the northwest and 5 µg/L in MW-26D located approximately 950 feet to the north.

Till monitoring well MW-21D (Figure 3), located in the southern corner of the property (i.e., generally upgradient), contains elevated levels of benzene, 1,1-dichloroethane, and 1,4-dioxane. This "signature" is distinct to this area of the Site with these compounds only sporadically detected and at much lower concentrations in other till and bedrock monitoring wells, including adjacent well MW-22D[3]. Additional delineation has been conducted in connection with this study and is discussed in greater detail in Section 4.2.

Based on concentration trend analyses over a 12 year period (Golder, 2009) it is observed that:

[2] 1,4-dioxane is an emerging contaminant of concern to USEPA and was first sampled in 2006 at the Agency's request.
[3] 1,4-dioxane alone is detected in MW-22D but at significantly lower concentrations than the adjacent MW-21D.

- Chlorinated ethene contamination has declined in almost all till and bedrock wells and there is strong evidence of complete natural degradation to non-toxic end-product ethene.
- Chlorinated ethanes and methanes show trends similar to those for chlorinated ethenes.
- BTEX compounds are also generally at low levels (typically ND) in all wells, other than MW-21D.

The evidence of natural attenuation processes provided by sharply reduced contaminant concentrations is further substantiated by geochemical data that suggest that many wells exhibit conditions that are conducive to anaerobic biodegradation of COCs. One (1) well in particular, MW-21D, shows exceptionally strong evidence for anaerobic biodegradation. The presence of co-mingled contamination in the MW-21D area (i.e., benzene and chlorinated ethenes) suggests that benzene is acting as the electron donor to promote degradation of the chlorinated ethenes (i.e., the electron acceptor). From a natural attenuation perspective, the remaining major concern in the area of MW-21D is the presence of the biologically recalcitrant compound 1,4-dioxane.

Overall, the geochemistry data indicate that anaerobic conditions prevail and that multiple terminal electron-acceptor process (TEAPs) are occurring, including iron reduction, sulfate reduction and limited methanogenesis, which are known to support the degradation of chlorinated VOCs. Elevated concentrations of ultimate non-toxic daughter compounds (methane, ethane, and ethene) and intermediate biodegradation products, that in numerous wells exceed the concentrations of parent compounds, show that complete reduction of PCE and TCE, and of chlorinated ethane and chlorinated methane parent compounds is occurring at the Site.

3.0 CANDIDATE TECHNOLOGIES

As noted in Section 1, USEPA has requested treatability testing of two technologies in connection with the OU-3 Feasibility Study: Enhanced anaerobic bioremendation and in-situ chemical oxidation.

3.1 Enhanced Anaerobic Bioremediation

This technology addresses contaminated groundwater by utilizing already active microorganisms in the subsurface and adding additional carbon sources to the system to further stimulate biological degradation. Four (4) primary pathways exist for the biologically mediated degradation of organic compounds: aerobic oxidation, anaerobic oxidation, aerobic cometabolism and anaerobic reductive dechlorination. Success of a particular pathway requires compatible geochemical conditions, appropriate nutrients, contact between contaminant and microorganism and adequate time. For this Site, with moderately anaerobic conditions (Oxidation Reduction Potential (ORP) +100 mV to -300 mV), stimulating anaerobic degradation is the most viable pathway.

A significant body of laboratory and field research and applications over the past decade has shown that indigenous bacteria (i.e., naturally present in the subsurface) possess the capability to biodegrade chlorinated ethenes and ethanes to non-chlorinated environmentally acceptable end products such as ethene, ethane and chloride. The biodegradation reactions occur under a wide range of environmental conditions, and by a variety of different bacteria. The chlorinated compounds serve as electron acceptors with simple organic carbon compounds (such as fatty acids and alcohols) serving as the electron donors. Many environments can support active reductive dechlorination. However, in most environments the addition of nutrients and/or electron donors (i.e., biostimulation) can enhance the on-going biological activity.

Reductive dechlorination refers to reactions where a chlorinated solvent (e.g., PCE) is utilized as an electron acceptor while one of its chlorine atoms is replaced by hydrogen. Hydrogen is made available in the subsurface through fermentative processes which degrade natural organic carbon in the subsurface. The addition of easily degradable carbon to the subsurface, i.e., simple fatty acids and alcohols, provides readily available organic carbon for fermentation and associated production of elevated concentrations of hydrogen. The hydrogen is then utilized by halorespiring microorganisms, e.g. Dehalococcoides sp., which can metabolize hydrogen as a substrate and reduce chlorinated compounds. The degradation of chlorinated ethenes via this pathway is a step-wise process where the parent to daughter decay chain is shown below:

PCE → TCE→ cis-1,2-DCE → vinyl chloride → ethene → ethane

This technology was retained for chlorinated impacts to groundwater in the northern portion of the Site (Golder, June 2008).

3.2 In-situ Chemical Oxidation (ISCO)

In-situ chemical oxidation (ISCO) involves the delivery of chemical oxidants to contaminated media to destroy the contaminants by converting them to innocuous compounds (e.g., CO2) through oxidation reactions.

Chemical oxidants (and, if necessary, their activators) are delivered directly to the groundwater through specially designed injection wells. A considerable volume of chemicals is typically required to be introduced through frequent repeat injections. ISCO is a non-specific technology, and will treat all compounds that are capable of oxidation, not simply contaminants of concern (COCs). Injection of a sufficient volume of oxidant to both overcome the natural oxidant demand (NOD) and consume the COCs is therefore necessary. Repeated injections are typically necessary with ISCO applications as ISCO reagents in the subsurface have relatively short half-lives, the organic material that sorbs many compounds is consumed by the oxidant, and the redistribution of contaminants sorbed to soils typically occurs on a time scale that is longer than the half-life of the oxidant. Determining the NOD is therefore a critical design consideration. Another important design consideration is delivery of the oxidants to the contaminants so that the desired reaction can occur. Because of the non-specific nature of this technology and the necessity of overcoming NOD, this technology is typically effective for localized, high concentration areas of contamination (e.g., the area around MW-21D) but is not suitable for disperse, low concentration plumes.

Oxidants retained for this Site (Golder, 2008) include: catalyzed hydrogen peroxide (H_2O_2) and persulfate ($S_2O_8^{2-}$) for the MW-21D area. Activated persulfate has been demonstrated to be effective in treating groundwater impacted with 1,4-dioxane (Felix-Navarro et al., 2007, Cronk, 2006, Klozur™ case study), and provides fewer Health and Safety concerns than catalyzed hydrogen peroxide, and is therefore the preferred oxidant for the MW-21D area.

Persulfate salts dissociate in water to persulfate anions ($S_2O_8^{2-}$). The reaction stoichiometry for sodium persulfate (typically provided as a crystalline solid $NaS_2O_8^{2-}$) includes the reduction of persulfate ($S_2O_8^{2-}$) to sulfate (SO_4^{2-}) and the concomitant oxidation of target contaminants. The oxidative strength of persulfate may be increased by activating the sulfate free radical ($SO^{-}_4\bullet$) through the addition of various activators. Free radicals are molecular fragments that have an unpaired electron, making them highly reactive. The sulfate radical has a higher standard oxidation potential (2.5v) than sodium persulfate (2.0v) and is therefore better able to oxidize more recalcitrant compounds, such as 1,4-dioxane. Reactions involving the sulfate radical can produce other free radicals (such as they hydroxyl radical, also formed in catalyzed hydrogen peroxide and ozone oxidation systems) which further increases the oxidative power of the application. Persulfate may be activated by the addition of heat, a ferrous salt, peroxide, or through alkaline conditions. The naturally alkalinity of the Site (average pH in wells screened in the till is 8.4, and is 9.4 in wells screened in the bedrock) suggests that elevated pH activation of the

persulfate may be the most effective activation at the Site. Alkaline activation is typically achieved through the simultaneous injection of sodium hydroxide or potassium hydroxide.

4.0 FIELDWORK RESULTS

4.1 Surface Water and Groundwater Monitoring

Analytical results from the quarterly monitoring conducted during 2006 through 2009 are summarized and tabulated in Appendix A. The data quality narrative is provided in Appendix B. The current monitoring program includes sampling of surface water points SW-01 through SW-04 located along Peach Island Creek on a quarterly basis for Target Compound List (TCL) volatile organic compounds (VOCs) and annually for semi-volatile compounds (SVOCs), TCL pesticides/PCBs and Target Analyte List (TAL) metals. Groundwater sampling is performed annually for off-property shallow fill zone monitoring wells (MW-8S, MW-9S, MW-11S, and MW-12S) and till monitoring wells (MW-5D, RMW-8D, RMW-11D, RMW-12D, and RMW-13D) for full TCL and TAL parameters.

4.2 Additional Groundwater Delineation

Additional delineation activities were conducted according to the Work Plan for Additional Groundwater Delineation (Golder, 2009). The Site has two distinct areas of impacted deep groundwater that constitute OU-3. Each of the areas has a different chemical "signature": The northern corner of the Site (proximal to MW-5D) and downgradient areas are impacted with predominantly chlorinated ethenes; and the southern corner of the Site (proximal to MW-21D) is impacted predominantly with 1,4-dioxane and to a lesser extent 1,1-dichloroethane and benzene.

The objective of the delineation work was to address the following data gaps:

Northern Corner

Groundwater and soil samples were collected for VOC analysis from a boring in the till in the area between existing monitoring wells RMW-11D and RMW-12D (B09-5), to aid in the assessment of the till groundwater quality and to assess the adequacy of the current monitoring well network in this area.

Groundwater and soil samples were also collected for VOC analysis from a till boring proximal to MW-23R (B09-4) to assess a possible location for the Enhanced Anaerobic Bioremediation (EAB) Pilot-Scale Test. The locations for both borings in the northern area are shown on Figures 2 and 3.

Southern Corner

Additional delineation in the southern corner was undertaken to investigate the vertical and lateral extent of the elevated 1,4-dioxane observed in existing wells MW-21D and MW-22D. A new bedrock monitoring well, MW-21R, was installed to permit the assessment of the impact of 1,4-dioxane in bedrock. Till groundwater samples were collected from three borings (B09-1, B09-2, and B09-3) and during installation of MW-21R for VOC and 1,4-dioxane analysis to assess the horizontal and vertical extent of 1,4-dioxane within the till. Groundwater and soil samples were taken for bench-scale testing during installation of the

new monitoring well from the depth corresponding to the screen interval of MW-21D. Groundwater samples for VOC and 1,4-dioxane analysis were taken from the new monitoring well MW-21R, as well as from existing monitoring wells MW-8R and MW-18D, which were not previously sampled for 1,4-dioxane, to assist the delineation of this compound southeast of the Site.

4.2.1 Field Procedures

Soil Borings and Monitoring Well Installation

Drilling was conducted by Boart Longyear Company, Environmental & Infrastructure Drilling Services (Boart Longyear) of Windsor, New Jersey using rotosonic methods. All utilities were marked-out prior to mobilization to the Site. All field work was conducted in accordance with the Site Health and Safety Plan developed for the investigation, pilot-test, and routine sampling activities (see Appendix C).

Delineation borings of the till in the northern and southern areas were installed using a 6-inch core barrel and a 7-inch override casing bored through the overburden and set into the varved clay. A 4-inch core barrel with a 6-inch sonic casing was then advanced through the till to the top of bedrock. Groundwater samples from the borings were collected from each 10-foot interval in the till, where groundwater was present, using a 2-inch diameter screen set with a neoprene packer on the top to seal the screen to the casing. The casing was backed-off to open the 4-foot long screen section and the well was purged and sampled using a Whaler pump with a check valve. During purging, field parameters were monitored in a flow-through cell until parameters stabilized indicating that formation water was passing through the cell, at which point the flow-through cell was disconnected and a groundwater sample collected[4]. The borings were then grouted in accordance with New Jersey procedures for well decommissioning.

The new bedrock well (MW-21R) was installed using a 7-inch core barrel and 8-inch override casing bored through the overburden and set into the varved clay layer. A falling-head test was conducted to verify the integrity of the seal. Once the seal was confirmed, a 6-inch core barrel and a 7-inch override casing were then advanced through the till and set into the bedrock. Groundwater samples were collected from the till during this phase, as described above. A 4-inch core barrel and a 6-inch override casing was then bored 20 feet into the bedrock unit. A 2-inch stainless steel screen and casing was then set as the permanent bedrock well. The annular space above the sandpack between the 2-inch stainless steel [SOMETHING MISSING] screen and 6-inch override casing was pressure grouted. Development of the well was accomplished by over-pumping and surging with a small submersible pump.

Plastic-sleeved rotosonic cores were collected continuously at each boring location. Each sample was logged and visual observations were recorded on the soil boring logs (Appendix D). The plastic sleeve of the core sample was cut at discrete intervals to allow scanning with a photo-ionization detector (PID). Soil samples were collected from the till using an EnCore® sampler in BO9-4 and BO9-5 for VOC

[4] BO9-1-28, BO9-2-35, and BO9-2-45 purged dry and were sampled following recharge.

analysis. Samples from each interval of interest at MW-21R (i.e., Soft-till, Lodgment-till and bedrock) were collected for bench-scale treatability testing. Samples from the Soft-till at MW-21R were analyzed for VOCs, 1,4-dioxane, metals, and select conventional parameters (TOC, Fe+2, and alkalinity).

Drilling equipment was pressure washed at a designated on-site decontamination pad prior to the initial borehole, between boreholes, and after the last borehole was completed.

All sampling equipment was decontaminated in accordance with NJDEP's Field Sampling Procedures Manual (NJDEP, 2005) between sample locations. All investigation derived waste (IDW) was containerized in 55-gallon steel drums and staged on-Site. Liquid IDW was added to the on-Site groundwater collection system for treatment and disposal.

Monitoring Well Sampling Procedures

Groundwater samples collected from monitoring wells MW-18D, MW-8R, and MW-21R were collected using low flow purge and sampling methods in accordance with the NJDEP Field Procedures Manual; dedicated Teflon lined polyethylene tubing was employed in each of the monitoring wells.

Temperature, pH, eH, specific conductance, turbidity, and dissolved oxygen were monitored continuously as indicator parameters together with water levels. A summary of field parameters is presented in Table 1. Samples were collected following stabilization of indicator parameters, and a minimum of one volume of the tubing had been removed. Groundwater samples from monitoring wells were analyzed for TCL VOCs and 1,4-dioxane.

QA/QC

Quality Assurance/Quality Control (QA/QC) samples, including one (1) matrix spike/matrix spike duplicate (MS/MSD), one (1) field duplicate, and one (1) rinsate blank (where appropriate), for every 20 primary samples, were submitted for analysis. A trip blank was also submitted for VOC analysis for each day samples were sent to the laboratory.

4.2.2 Results

Northern Area

The lithology encountered in the borings is presented in cross-section on Figure 4. Soil sample results are presented in Table 4 and on Figure 4 and indicate the highest concentration of VOCs in the sample collected in boring B09-4 within the soft till at 20 feet below ground surface (bgs) (total VOC concentration of 78.9 mg/kg primarily consisting of TCE and PCE with concentrations of 49 mg/kg and 13 mg/kg respectively). Soil samples from B09-5 indicated the highest concentrations of VOCs in the sample

collected within the soft till at 20 bgs (total VOC concentration of 0.39 mg/kg mainly consisting of TCE, 0.24 mg/kg).

Groundwater samples were taken in boring B09-4, located proximal to MW-23R (Figures 3 and 4), in the soft till interval from 26-30 feet bgs and in the lodgment till interval from 31-35 feet bgs (see Figure 4). Results are presented in Tables 1 and 2 and indicate total VOC concentrations ranging from 391 µg/L in the lodgment till interval to 406 µg/L in the soft till interval. Consistent with proximal till wells, detection predominantly consist of the chlorinated solvents PCE, TCE, and cis-1,2-dichloroethene. Concentrations of VOCs were slightly higher in the more shallow interval (Table 2) with TCE and PCE concentrations of 130 µg/L and 21 µg/L, respectively.

Groundwater samples in boring B09-5 were collected in the soft till (26-30 feet bgs) and in the lodgment till (32-36 feet bgs). Concentrations of VOCs were higher in the deeper interval with TCE and PCE concentrations of 410 µg/L and 45 µg/L, respectively. Concentrations of VOCs measured in B09-5 were higher than measured recently in proximal monitoring wells RMW-11D and RMW-12D.

Southern Area

The lithology encountered in the borings is presented in cross-section on Figure 5 and 6.

1,4-dioxane was detected in groundwater at concentrations ranging from 5.1 in B09-2 to 4,300 µg/L in B09-3. The highest concentrations were observed in the soft till and were an order of magnitude higher than in groundwater samples collected from the lodgment till in B09-1, B09-3, and MW-21R. 1,4-dioxane was detected in the new bedrock well MW-21R below the Groundwater Quality Standards (GWQS) at an estimated concentration of 1.1 J µg/L in the field duplicate sample (and was non-detect in the primary sample). The vertical profile samples indicate that 1,4-dioxane impacts are essentially limited to the till, and are primarily concentrated in the upper Soft Till.

Laterally, 1,4-dioxane concentrations were above the GWQS at some interval in all delineation borings installed in the southern area. The distribution of 1,4-dioxane may suggest a narrow plume oriented roughly northwest-southeast with maximum concentrations (greater than 1000 µg/L) located in the soft till about B09-3, MW-21R, and MW-22D and with concentrations dropping off to the southwest towards B09-1 and northeast towards B09-2. Groundwater impacted with 1,4-dioxane, however, appears to extend as far as MW-18D and is also not delineated northeast of B09-3. Additional borings and groundwater samples will be necessary to delineate the extent of 1,4-dioxane in this area, as further discussed in Section 6.0.

Soil samples and groundwater samples were collected during installation of MW-21R from the depth range (24-28 feet bgs) corresponding to the screen interval of MW-21D for bench-scale treatability tests, as discussed in the following section.

4.3 Summary and Conclusions

Groundwater and soil samples collected in the location proposed for the EAB pilot test, proximal to MW-23R, indicate that this location is suitable for the Pilot-Scale Test, having significant concentrations of chlorinated solvents, being relatively reducing, and being located side-gradient of the plume centerline in an accessible area. Concentrations of VOCs measured in B09-5 were higher than measured recently in proximal monitoring wells RMW-11D and RMW-12D. Installation of a permanent monitoring well at this location and redevelopment and sampling of RMW-11D and RMW-12D are recommended.

Groundwater samples collected to assess the extent of 1,4-dioxane impacts in the southern corner of the Site have established that impacts are essentially limited to the till (particularly the shallower soft till) but the lateral distribution has not yet been delineated. Further delineation is necessary to determine the applicability of ISCO as a potential remedial alternative.

5.0 BENCH-SCALE TREATABILITY TESTS

ISCO bench-scale tests were conducted on till soils and groundwater collected in the MW-21D area by Golder at the Golder Treatability Testing Laboratory located in Montreal, Canada to assess whether treatment using ISCO can be effective and to gather information to design an effective pilot-scale test. The specific objective of these bench tests was to:

- Assess whether ISCO will treat Site contaminants
- Determine the best actuator (catalyst)
- Assess the buffering capacity of Site lithologies
- Assess the potential for metals mobilization during treatment
- Assess the expected natural oxidant demand (NOD)
- Develop dosage levels and intervals for the Pilot-test design

The Bench Test Report is included as Appendix E, and is summarized in this section. Based on previous experience, and published case histories for 1,4-dioxane, sodium persulfate ($Na_2S_2O_8^{2-}$) was the oxidant used in the bench tests, and both sodium hydroxide (NaOH) and VTX, a commercial chelated iron catalyst, were tested as possible catalysts to activate the persulfate radical formation. Because alkaline activation of persulfate (NaOH) requires maintaining a pH of greater than 10, the buffering capacity of the groundwater and Site lithologies was measured.

Since chemical oxidation does is not limited to VOCs, a wide range of naturally occurring compounds other than the targeted contaminants react with and consume oxidant, so that stoichiometry for contaminant oxidation represents only a small fraction of the actual oxidant demand. The quantity of oxidant required to remediate soil and groundwater is a function of both the mass of contaminants to be oxidized and the Natural Oxidant Demand (NOD) of the soil. NOD is a measure of the loss of oxidant (persulfate) due both to its reaction with the soil matrix and to auto-decomposition.

5.1 Bench Test Set Up

Groundwater samples were collected from the Soft Till at a depth interval corresponding to the screen interval of MW-21D. Soil samples were collected during the installation of MW-21R from the bedrock, lodgment till and soft till for NOD tests.

For the oxidant dosing curve, tests were performed over a period of up to 45-days at 3 different dosage levels for both alkaline activated persulfate and the chelated-iron activated persulfate. Tests were conducted at room temperature in zero-air space 40 ml vials containing groundwater and the oxidant/activator. The dosing concentrations (5 g/L, 25 g/L, and 50 g/L) were determined based on the initial sampling analytical results. The quantity of sodium hydroxide required to increase the pH of the

groundwater above 10 and activate the persulfate was evaluated using a titration curve. For the VTX catalyst, the target iron concentration was 200 mg/L.

Control samples (vials without added persulfate) were used to evaluate VOC loss through evaporation/decomposition during the course of the tests. The pH, ORP, DO, persulfate and sulfate concentration were also measured using sacrificial vials. Because initial results indicated matrix effects that interfered with achieving reporting limits below the NJ GWQS for 1,4-dioxane, a second series of tests using larger volumes to support a different extraction method were conducted. These tests were conducted using alkaline activated persulfate doses of 1 g/L, 5 g/L, 25 g/L, and 50 g/L. Chelated-iron activate persulfate was not tested in the second series of tests because intermediate results indicated that chelated iron activation has a much lower 1,4-dioxane removal efficiency than NaOH activation, and that undesirable by-products were produced in the chelated iron persulfate activated samples.

Natural Oxidant Demand (NOD) tests were conducted by Chemco Inc. Laboatory using the FMC Klozur^{tm} Activated Persulfate Treatability Protocol, where the amount of oxidant naturally consumed by the soil was measured during the course of treatment. The NOD measurements were done using native rock and soils from the Site and four different concentrations of persulfate: 1 g/L, 5 g/L, 25 g/L activated with NaOH. The reaction time was set at 48 hours. Afterwards the residual persulfate concentration was measured using a back titration method.

5.2 Results

The test results indicated that a dosage of 0.21 g of NaOH per L of groundwater was necessary to maintain the pH above 12, and activate the persulfate. The buffering capacity of the groundwater was qualified as low, based on the required dosage. Likewise, the buffering capacity of the three lithologies (Soft Till, Lodgment Till, and bedrock) were also qualified as low, requiring NaOH doses ranging from 1.5 g NaOH per kg soil (Soft Till and Bedrock) to 3.0 g NaOH per kg soil (Lodgment Till).

The NOD of the soils and rock were tested for the alkaline activated persulfate, as the chelated iron activated persulfate had a much lower 1,4-dioxane removal efficiency. The results ranged from 1.23 g/kg in the Lodgment Till to 10.1 g/kg in the Soft Till. It is important to note that these results represents the ideal condition where the oxidant is uniformly mixed with the soil matrix, and should be used only as a semi-quantitative tool to estimate the oxidant dosing required for the pilot-scale field test. In actuality, the total NOD will depend on the oxidant contact time. From past experience, using these NOD tests for estimating the oxidant requirement is adequate in most cases. In general, for ISCO to be economically feasible, the NOD should generally be less than 15 g/kg of soil. The lodgment till NOD is considered low and the soft till (10.1 g/kg) NOD is as considered medium.

The results for the chelated-iron activated persulfate bench tests indicate that even at a dosage of 50 g of persulfate per liter of groundwater, the final concentrations of 1,4-dioxane and other VOCs were still high.

The 1,4-dioxane removal efficiencies measured after 15-days reaction time for the three dosages tested were: 9.1% for the 5 g/L dose, 19.1% for the 25 g/L dose, and 51.7% for the 50 g/L dose. During the treatment, some by-products were formed: bromodicholomethane, bromoform, bromomethane, dibromochloromethane, 1,1-Dichloroethane, 1,2-dichloroethane, dichloromethane, 1,1,2-trichloroethane, chloromethane.

In the bench tests with alkaline activation (NaOH), the concentration of 1,4-dioxane dropped from 1033 µg/L (the mean of the three controls) to less than 50 µg/L in under 15-days for all doses tested. The concentration of all the other detected VOCs also dropped to concentrations below the method detection limit (RDL) after a 15-day reaction even with lowest oxidant dosage tested (5 g/L), indicating that 1,4-dioxane is the rate-limiting compound. Because all the tested dosages had good VOC removal efficiencies, a single test was performed at a lower persulfate concentration of 1 g/l and analyzed for 1,4-dioxane. The 1,4-dioxane concentration after a 15-day reaction was 768 µg/L, suggesting that this dosage was too low and the reaction time too short.

A second series of bench tests was conducted using larger sample volumes. The samples dosed with 5 g/L persulfate decreased to 145 µg/L in 15 days and to < 3 µg/L after 30 days and the samples dosed with 25 g/L and 50 g/L decreased to <3 µg/L after 30 days. Based on these results, it appears that a dosage of 5 g/L is enough to degrade the concentrations of all the VOCs in a reasonable time frame. Further, residual persulfate analysis indicated that significant concentration of persulfate was still present in the treated groundwater after a 45-day reaction, suggesting that oxidization could continue for more than 45 days.

5.3 Conclusions

Based on the treatability study results, sodium persulfate with alkaline (NaOH) activation would be suitable for a pilot-scale test with the following recommended doses:

- Sodium persulfate: 12.9 g of sodium persulfate per kg of soil based on the soft till NOD and the site groundwater (this assumes a soil density of 1800 kg/m3, a water filled porosity of 50%, and groundwater persulfate dosage of 10 g/L)
- Sodium hydroxide: 7.4 g of NaOH per kg of soil, based on the soil soft till/ site groundwater requirements and the NaOH required to neutralize the persulfate-generated acid, at the recommended persulfate dose of 12.9 g of sodium persulfate per kg of soil.

With these chemical doses, it is expected that it will be possible to maintain alkaline conditions (i.e., pH over 10) in the saturated impacted groundwater and significantly decrease the 1,4-dioxane and other VOC concentrations. It would also be expected that at least 2 injections using the recommended dosages would be required.

ISCO may mobilize pre-existing redox- and/or pH-sensitive heavy metals and groundwater should be monitored to determine if mobilization occurs and if attenuation is achieved within an acceptable transport

distance and timeframe. In most cases, the metals return to their initial oxidation state after treatment, once the groundwater leaves the treatment zone, and precipitate back into the formation. Alkaline conditions are not favorable for the mobilization of many metals. In fact, a commonly used method to remove soluble metal ions from solution is to precipitate the ion as a metal hydroxide. By injecting sodium hydroxide and raising the pH value of the groundwater during treatment, such hydroxide compounds may form and precipitate into the formation. Any associated reduction in permeability of the formation will be evaluated during the pilot-test. Metals susceptible to leaching at elevated pH values include Pb, Zn, As, and Cr. Analytical results (Table 4) for soils collected in the target treatment zone indicate that concentrations of these metals are comparatively low.

6.0 WORKPLAN FOR PHASE 2 TREATABILITY STUDIES

The objectives of the proposed Phase 2 work are to:

- Collect additional groundwater samples from borings in the southern corner of the Site to further delineate the horizontal extent of 1,4-dioxane (Section 6.1). At least five (5) soil borings will be completed to bedrock and will include collection of groundwater samples in both the Soft Till and Lodgment Till from each boring.
- Assess the efficacy and design parameters for EAB as a treatment alternative in the area of MW-5D by conducting a pilot-test injection of sodium lactate (Section 6.2). One (1) injection well and three (3) monitoring wells will be installed.
- Installation of new monitoring well MW-29D in the vicinity of previous boring BO9-5 and redevelopment and sampling of existing monitoring wells RMW-11D and RMW-12D. This work will be undertaken as part of the EAB pilot test drilling and sampling program.

A work plan for a field-scale pilot test of ISCO will be submitted, as appropriate, following delineation of 1,4-dioxane.

The following Sections generally describe each task to be performed. Detailed procedures to perform the field work, quality assurance, and data validation are discussed in the Quality Assurance Project Plan (QAPP) and SOPs provided in Appendix F. All field work will be conducted in accordance with the Health and Safety Plan (HASP) (Appendix C).

6.1 Additional Delineation

Additional delineation in the southern corner of the site is necessary to determine the lateral extent of the elevated 1,4-dioxane observed in existing wells MW-21D and MW-22D, and the subsequent profile borings. The primary objective of this additional delineation will be to determine the lateral extent of the area with the highest 1,4-dioxane concentrations (greater than 1,000 µg/L) for the purpose of evaluating the ISCO technology and in particular scoping a field pilot injection of NaOH activated persulfate.

The horizontal extent of 1,4-dioxane within the till will be assessed with four (4) additional borings (B10-1 through B10-4) at the approximate locations shown in Figure 7, with possible additional borings (B10-5 through B10-6), contingent on results obtained from these primary borings.

Groundwater samples collected from these delineation borings will be sent to the laboratory for analysis for VOCs and 1,4-dioxane with a rapid turnaround time (72 hours) and the results will be used to gauge the need to take additional borings. If the concentration of 1,4-dioxane in any sample collected from primary boring B10-1 exceeds 1,000 µg/L, contingent boring B10-5 will be drilled and if the concentration in primary boring B10-2 exceeds 1,000 µg/L, contingent boring B10-6 will be drilled.

6.2 Enhanced Anaerobic Bioremediation Pilot Test

The EAB pilot test will consist of a five (5) well design shown in Figure 8 and may be subject to minor changes based on access considerations. The well design includes one (1) new injection well and four (4) monitoring wells (MW-23R and three new wells).

The geochemical parameters measured in adjacent well RMW-13D suggest that conditions are relatively reducing (ORP = -92 mV) and anaerobic (DO = non-detect) with the presence of low concentrations of methane (0.038 mg/L) and sulfate (39 mg/L). The limited concentration of methane suggests that some methanogenesis may be occurring but is not controlling the redox condition. The presence of elevated sulfate suggests that the current redox condition is likely iron-reducing to sulfate-reducing. The total organic carbon (TOC) of 4.94 mg/L suggests that a limited quantity of organic substrate is available to promote biodegradation and is consistent with the observed redox condition. TOC values of >20 mg/L are typically indicative of robust biodegradation systems. The total dissolved VOC concentration is 614 µg/L with a molar ratio of parent compounds (PCE+TCE) to daughter products (cis-1,2-DCE+vinyl chloride) of approximately 0.05. This ratio is significantly different than the ratio observed at MW-5D (~2.5) suggesting that more robust reductive dechlorination is occurring at MW-5D. The more limited biodegradation at RMW-13D is likely due to carbon limited conditions that exist and may be enhanced through the addition of a low concentrations of readily available carbon substrate (i.e., lactate).

6.2.1 Objectives

The objectives of the pilot test are as follows:

- Establish deliverability of amendments to the subsurface;
- Assess amendment consumption in the subsurface;
- Evaluate ROI of an injection point;
- Evaluate appropriate dosage;
- Assess treatment efficiency;
- Provide information for remedial alternative evaluation in the Feasibility Study;
- Provide information for full-scale remedial design.

6.2.2 Monitoring and Injection Well Installation

The approximate locations of the pilot test well array are shown on Figure 8. The injection point (IP-01) will be installed close to the existing bedrock monitoring well MW-23R, Monitoring Point MP-01 will be installed 5 feet south-southeast (SSE) of IP-01, monitoring Point MP-02 will be installed 10 feet north-northeast (NNE) of IP-01, and monitoring Point MP-03 will be installed 15 feet north-northwest (NNW) of IP-01. All locations will be drilled to the top of bedrock (approximately 36 feet bgs) and the wells will be screened within the Till units. The Soft Till unit is expected to be intercepted at approximately 15 feet bgs and the Lodgment Till contact is anticipated to be intercepted at approximately 34 feet bgs. Based on

lithologies observed in B09-4, the screened interval length for the injection well is expected to be 20 feet (subject to field verification): monitoring well screen lengths will be 5 feet. Existing monitoring well MW-23R will be monitored to assess any impact of the injected amendments in the bedrock.

New monitoring well MW-29D will be installed as part of the EAB drilling program in the vicinity of previous boring B09-5 as shown on Figure 8. The well will be screened 33-38 feet bgs.

6.2.3 Baseline Sampling

Baseline samples for the EAB pilot test will be collected from the injection well (IP-01) and monitoring wells MP-01, MP-02, MP-03, and MW-23R at least two weeks after the newly installed wells are fully developed and prior to the first round of amendment injection. Baseline samples will be analyzed for:

- **Volatile Organic Compounds (VOCs) (by SOM01.2 Trace) –** TCL VOCs which includes Tetrachloroethene (PCE), Trichloroethene (TCE), *cis*-1,2-Dichloroethene (cis-1,2-DCE), Vinyl Chloride. Enhanced anaerobic bioremediation degrades CAHs through a reductive process resulting in the formation of lesser chlorinated compounds, e.g., PCE → TCE → cis-1,2-DCE → VC → ethene → ethane. Progress of remediation is monitored by evaluating the loss of more chlorinated compounds and the formation of less chlorinated compounds and non-toxic daughter products, i.e., ethene and ethane.
- **Natural Attenuation Parameters (NAPs) –** Includes Total Organic Carbon (TOC), Alkalinity as $CaCO_3$, Nitrate/Nitrite as N, Sulfate, Sulfide, Methane, Ethene, Ethane, and Hydrogen. TOC is a critical parameter for classifying the extent of impact and also evaluating the amount of added carbon from biostimulation and its consumption. Alkalinity is a proxy measure of CO_2 which is an ultimate breakdown product for oxidative degradation of carbon compounds and also measures the buffering capacity of the system. Nitrate/Nitrite as N, Sulfate, Sulfide and methane are used to determine the Terminal Electron Accepting Process (TEAP) that is functioning as Nitrate and Sulfate are electron accepters (EAs) for respiration in the absence of oxygen and sulfide and methane are byproducts of respiration. Methane production suggests that methanogenic organisms are active. Hydrogen is the predominant electron donor (ED) used by dechlorinating organisms and is important for tracking nutrient availability and usage.
- **Volatile Fatty Acids (VFAs) –** Includes the following short-chained (less than 6 carbon) carboxylic acids: lactic ($C_3H_6O_3$); propionic (CH_3CH_2COOH); and, acetic (CH_3COOH) acids. As lactate will be used as the organic substrate, the presence of its subsequent fermentations products, i.e., propionic, and acetic acids is evidence of the activity of the microbial process and can be used to determine how efficient the fermentation process is occurring. Volatile fatty acids may also be used as a tracer to determine the flow-path of treated water.
- **Field Parameters** – Includes pH, Specific Conductivity, Dissolved Oxygen (DO), Oxidation-Reduction Potential (ORP), Ferrous iron, Temperature and Water Level. pH measurement is important as biological processes are pH sensitive. DO must be below 0.5 mg/L for anaerobic bioremediation pathways to function as most dechlorinating organism are obligate anaerobes. ORP is influenced by biological activity that is occurring in the system and can assist in determining the active TEAP.

New monitoring well MW-29D and existing monitoring wells RMW-11D and RMW-12D (following redevelopment) will be sampled as part of the baseline sampling event for VOC parameters.

6.2.4 Amendment Injection

It is anticipated that sodium lactate ($NaC_3H_5O_3$) will be used as the carbon source for injection because it is readily assimilable by microorganisms and provides the most control and flexibility to the system. A conservative tracer (e.g., sodium bromide) will also be included in the injectate to track the flow-path and flow-rate of injectant.

The approximate dosage of lactate to be introduced during each injection event during the first phase of the pilot-scale study was calculated based on a goal of achieving 200 mg/L of total organic carbon (TOC) in the anticipated treatment zone. The pilot-scale study layout has been designed based on a 15 foot radius of influence (ROI) from the injection well during a relatively short-term test. A 15 foot ROI, assuming a 10 foot long screen, results in an estimated treatment volume of approximately 7,070 ft^3 (Appendix G). Assuming a porosity of 20%, a saturated volume of approximately 40,032 L and a mass of lactate necessary to achieve 200 mg/L of 8 kg is calculated. Lactate will be injected as an approximately 32 g/L solution requiring approximately 100 gallons of water. A further 20 gallons of unamended water will be injected to flush the amendment into the formation after lactate injection.

In addition to lactate, 2.6 kg of sodium bromide (NaBr) will be added to produce a bromide concentration of approximately 50 mg/L in the formation. Sodium bromide will be tracked in the formation using both specific conductivity measurements and a specific test for bromide (EPA Method 9211 using an ion selective electrode in a data logger).

Data loggers will be placed in the pilot test wells (MP-01, MP-02, MP-03, and MW-23R) to monitor water levels and inform the rate of injection. Based on available hydrogeologic data, it is anticipated that injections will be performed using a pressurized injection system. Backpressures will be limited to a maximum of approximately 30 psi (lithostatic pressure) to avoid opening existing fractures in the formation or creating any new fractures. A flow rate of approximately 1 to 5 gpm is anticipated.

Six (6) injections at monthly intervals are anticipated, but the number and frequency of injections may vary based on progress monitoring results. If results of the pilot test indicate it is appropriate, the pilot test may be extended for further evaluation of full-scale treatment.

6.2.5 Progress Monitoring

Samples will be collected from wells IP-01, MP-01, MP-02, MP-03, and MW-23R immediately before each injection event and analyzed for the same parameters as the baseline event (VOCs [by SOM01.2 Low][5], NAPs, and VFAs.

[5] The concentrations of these compounds in the injection well and monitoring wells will be elevated and the purpose of these samples is to evaluate the efficiently of amendment injection or stimulating biodegradation of the chlorinated ethenes. Therefore,

6.3 Drilling Procedures

All utilities will be appropriately marked-out prior to mobilization to the Site. Borings and wells will be installed using rotosonic methods. Sonic drilling is a dual cased system that employs high frequency vibration to obtain continuous core samples of unconsolidated formations and many consolidated formations (including bedrock), and to advance casing for well construction and other purposes. This method was used for the delineation borings taken in December 2009 – January 2010.

Delineation borings in the till in the southern area of the Site will be installed using a 6-inch core barrel and a 7-inch override casing bored through the overburden and set into the varved clay. A 4-inch core barrel with a 6-inch sonic casing will then be advanced through the till to the top of bedrock. Groundwater samples from the borings will be collected from each 10-foot interval in the till using a 2-inch diameter screen set with a neoprene packer on the top to seal the screen to the casing and the well will be purged prior to sampling. Field parameters will monitored during the purging using a flow-through cell until parameters stabilize and indicate that formation water is passing through the cell, at which point the groundwater sample will be collected. Borings will be grouted on completion in accordance with New Jersey standard procedures for well decommissioning.

Injection and monitoring well installations will utilize a 4-inch core barrel and 6-inch override casing bored through the overburden and set into the varved clay layer. A 2-inch core barrel and a 4-inch override casing will then be advanced through the Till to the screened interval depth. A 2-inch PVC screen and casing will be set as the permanent well. The annular space above the sandpack between the 2-inch screen and 4-inch override casing will be pressure grouted. Well development will be accomplished by surging and pumping with a small submersible pump or air lift system.

During the investigation, plastic-sleeved rotosonic cores will be collected continuously at each drilling location. Each sample will be visually logged and screened using a photo-ionization detector (PID).

6.4 Decontamination Procedures

Drilling equipment will be pressure washed prior to the initial borehole, between boreholes, and after the last borehole is completed. All such activities will be performed at a designated decontamination pad.

All sampling equipment will be decontaminated in accordance with NJDEP's Field Sampling Procedures Manual (NJDEP, 2005) between sample locations. All investigation derived waste (IDW) will be containerized in 55-gallon steel drums and staged on-Site. Liquid IDW (i.e., decontamination water) will be added to the on-Site groundwater collection system for treatment and disposal.

analysis of VOCs by SOM01.2 Low will be used for this objective. If concentrations in these wells decline sufficiently, analysis by SOM01.2 Trace will be re-evaluated.

6.5 Sampling and Analysis

Sampling and analytical procedures are provided in detail in the QAPP (Appendix F) and associated attachments. Analytical methods are summarized below to provide an overview of the proposed sampling and analytical program.

CompuChem of Cary, North Carolina will be the primary provider of analytical services for delineation and pilot test activities. CompuChem is a participant in the USEPA Contract Laboratory Program (CLP). Microseeps, Inc. of Pittsburgh, Pennsylvania (Microseeps) will provide specialist analytical services for select parameters (methane, ethene, ethane, volatile fatty acids, and hydrogen). CompuChem and Microseeps, Inc have both previously provided analytical services for this Site. The chemical analyses will be conducted using the following United States Environmental Protection Agency (USEPA) method guidelines:

- VOCs following USEPA CLP Statement of Work (SoW) SOM01.2 Analytical Method for the Analysis of Low/Medium Concentrations of Volatile Organic Compounds (October, 2006, Updated February 12, 2007, Amended April 11, 2007);
- VOCs and 1,4-Dioxane following USEPA CLP SoW SOM01.2 Analytical Method for the Analysis of Trace Concentrations of Volatile Organic Compounds (October, 2006, Updated February 12, 2007, Amended April 11, 2007);
- TOC following Standard Method 5310B Total Organic Carbon by High-Temperature Combustion;
- Sulfate, Nitrite, Nitrate by USEPA MCAWW[6] 300.0 Determination of Inorganic Anions by Ion Chromatography;
- Sulfide following Standard Method 4500-S2F, Sulfide by Iodometry;
- pH following Standard Method 4500H-B Electrometric Method;
- Bicarbonate following Standard Method 2320B Titration Method;
- Methane, ethane, and ethene following laboratory specific Analytical Method AM20GAX Standard Operating Procedure for the Analysis of Biodegradation Indicator Gases, Revision 9.0, (November 2008);
- Volatile Fatty Acids following laboratory specific Standard Operating Procedure for the Analyses of Low Level Volatile Fatty Acids by Ion Chromatography, Revision 5.0, (November 2008);
- Hydrogen laboratory specific Analytical Method AM20GAX Standard Operating Procedure for the Analysis of Biodegradation Indicator Gases, Revision 9.0, (November 2008);

Quality Assurance / Quality Control (QA/QC) samples, including one (1) matrix spike/matrix spike duplicate (MS/MSD), one (1) field duplicate, and one (1) rinsate blank, will be submitted for each monitoring event. A trip blank will also be submitted for VOC analysis for each day samples are sent to the laboratory.

[6] USEPA, 1983, Methods for Chemical Analysis of Water and Wastes, EPA600/4-79-20, Office of Research and Development, Washington, D.C.

6.5.1 Sample Handling, Custody And Shipment

Sample Handling

The laboratory will supply appropriately prepared sample containers. Preservation procedures and analytical holding times will be in accordance with the published analytical methods and USEPA Region II guidelines as further detailed below.

Sample Preservation

Sample containers will be kept closed until the time they are to be filled. After filling, the containers will be securely closed, residue wiped from the sides of the containers, and immediately placed in a cooler containing ice. Samples shall be cooled to approximately 4°C immediately after collection. This temperature will be maintained for samples during storage and shipment to the laboratory and a temperature blank will be placed in each cooler returned to the laboratory. Samples requiring chemical preservatives will be collected into pre-preserved containers supplied by the laboratory.

Sample Identification

All samples shall be marked for identification from the time of collection and packaging through shipping and storage. Marking shall be on a sample label attached to the sample container. Sample identification shall include, as a minimum:

- Project name and/or code;
- Sample identification number;
- Analysis requested;
- Chemical preservatives;
- Sample date and time (military time); and,
- Initials of the individual performing the sampling.

Each sample will be assigned a unique sample identification (ID) to be recorded on the sample label. Each sample ID will be recorded in the field notebook, a Sample Field Information Form and on chain-of-custody (COC) documentation.

Sample Custody

Chain of Custody (COC) procedures have been established to ensure sample traceability from the time of collection through completion of analysis. All samples will be handled under strict COC procedures beginning in the field. The following procedure will be used to maintain COC of samples.

Samples and sample containers must be kept under proper COC during field sampling. If custody of the samples (and sample bottles) is exchanged during field sampling, such transfer must be documented on the COC form. The departing field staff should sign indicating the custody has been relinquished, and the

arriving field staff should sign indicating responsibility for the custody of the samples. The COC form and Field notebook (and/or field information form) should include the sample identification information described above and any special comments related to the sample.

When shipping samples to the laboratory, all sample bottles and requested analyses will be noted on the COC form. Where multiple analytical methods are available for a particular analysis, the specific method number should be listed on the COC form.

One member of the sampling team will sign the COC form relinquishing custody to the laboratory. If using an overnight courier service, record the tracking number on the COC. The COC form will be sealed inside the shipping container with the samples. The paperwork should be sealed inside a plastic bag to prevent damage from water condensation. The courier does not need to sign the COC form if it is sealed within the shipping container using custody seals. If the samples are hand delivered to the laboratory by field staff, the COC form will be signed at the laboratory when the samples are delivered, and the shipping container does not need to be sealed as long as it is kept under proper COC until delivered to the laboratory. If possible, COC seals should be signed and dated, and the serial numbers listed on the COC form.

6.5.2 Data Validation

All laboratory data for samples collected during this sampling event will be validated according to USEPA Region II guidelines and method-specific criteria.

7.0 SCHEDULE AND REPORTING

Figure 9 provides a preliminary schedule for the proposed Phase 2 work and associated reporting. For purposes of scheduling, it is assumed that the additional delineation activities will indicate that a field-scale ISCO pilot test is appropriate and the delineation results will be reported in an interim deliverable that will include the workplan for conducting the ISCO pilot test. The final Phase 2 Treatability Studies Report will include the results from the EAB pilot test, and the results from the ISCO pilot test. Intermediate results will be included in monthly progress reports to facilitate an on-going evaluation of the feasibility of the technologies prior to formal completion of the pilot tests.

8.0 REFERENCES

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TABLE 1
FIELD SAMPLING PARAMETERS
216 PATERSON PLANK ROAD SITE
CARLSTADT, NEW JERSEY

Field Parameters								
Well ID	Date Sampled	Temperature [° C]	pH [std]	Specific Conductance [mS/cm]	Turbidity [ntu]	Dissolved Oxygen [mg/l]	Redox Potential [mV]	Depth to Water [ft-bgs]
Groundwater - Monitoring Wells								
MW-8R	12/17/2009	10.33	7.96	2.7	129	0	-172	3.42
MW-18D	12/17/2009	12.65	7.25	2.16	80.9	0.15	14	3.63
MW-21R	5/6/2010	17.08	9.58	1.23	130	0.04	-53	10.24
Groundwater Profile Boring Samples								
B09-4-35	1/13/2010	8.95	8.95	0.633	>999	0	-78	8.1
B09-4-30	1/13/2010	8	8.88	0.798	>999	4.79	179	7.42
B09-1-28	1/4/2010	12.98	8.01	1.11	>999	0	-7	9.9
B09-1-38	1/5/2010	8.5	8.61	0.884	>999	0	317	10.9
B09-1-48	1/5/2010	8.5	8.1	1.21	>999	1.1	310	9.5
B09-1-58	1/5/2010	13.5	8.3	0.938	>999	5.61	-143	10.8
B09-2-35	12/14/2009	12.48	8.31	1.02	>999	0	-415	7.6
B09-2-45	12/14/2009	14.12	6.69	1.11	>999	7.57	-72	NM
B09-2-55	12/14/2009	16.15	8.03	1.25	>999	0	-323	NM
B09-2-65	12/14/2009	16.48	7.79	0.81	>999	8.41	185	16.17
B09-3-40	1/7/2010	12.55	10.52	4.19	>999	1.48	-47	10.6
B09-3-60	1/7/2010	9.73	10.56	0.829	>999	6.88	-37	8
B09-3-50	1/7/2010	10.39	5.57	0.927	>999	7.03	217	9.88
B09-3-30	1/7/2010	9.76	8.57	1.17	>999	7.3	67	9.6
B09-5-30	1/12/2010	5.98	7.59	0.521	>999	14.11	351	13.6
B09-5-36	1/12/2010	13.33	8.8	0.849	>999	0	-382	5.2
MW-21R-38	12/17/2009	10.5	8.61	1.09	>999	10.91	242	18.1
MW-21R-48	12/17/2009	10.9	8.31	0.914	>999	0	329	9.8
MW-21R-58	12/18/2009	20.6	8.09	2.01	>999	0	-15	10.5
MW-21R-Bench Test	12/17/2009	14.9	7.58	2.06	0	0	-120	11.3

Turbidity measurements of >999 or -5 indicate value outside of meter range.
NA - Not Applicable
NA - Not Measured

Sample Date	Table by	QC'd by
12/14/2009 - 1/13/2010	SLS 3/10/2010	ELD 3/16/10
5/6/2010	HAL 6/10/2010	MM 6/10/2010

Golder Associates

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TABLE 2
Groundwater Profile Samples
Validated Analytical Data
Carlstadt

		Sample ID	B09-1			B09-1			B09-1			B09-1			B09-2			B09-2		
		Sample Date	1/4/2010			1/4/2010			1/5/2010			1/5/2010			12/14/2009			12/14/2009		
		N=Normal, FD=Field Duplicate	N			N			N			N			N			N		
		Start Depth	24			34			44			54			31			41		
		End Depth	28			38			48			58			35			45		
Parameter	NJDEP GWQS*	Unit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit
Inorganics																				
Aluminum	200	ug/l	NDR			NDR			NDR			NDR			NDR			NDR		
Antimony	6	ug/l	NDR			NDR			NDR			NDR			NDR			NDR		
Arsenic	3	ug/l	NDR			NDR			NDR			NDR			NDR			NDR		
Barium	6000	ug/l	NDR			NDR			NDR			NDR			NDR			NDR		
Beryllium	1	ug/l	NDR			NDR			NDR			NDR			NDR			NDR		
Cadmium	4	ug/l	NDR			NDR			NDR			NDR			NDR			NDR		
Calcium	NS	ug/l	NDR			NDR			NDR			NDR			NDR			NDR		
Chromium	70	ug/l	NDR			NDR			NDR			NDR			NDR			NDR		
Cobalt	100	ug/l	NDR			NDR			NDR			NDR			NDR			NDR		
Copper	1300	ug/l	NDR			NDR			NDR			NDR			NDR			NDR		
Iron (Dissolved)	300	ug/l	NDR			NDR			NDR			NDR			NDR			NDR		
Iron (Total)	300	ug/l	NDR			NDR			NDR			NDR			NDR			NDR		
Lead	5	ug/l	NDR			NDR			NDR			NDR			NDR			NDR		
Magnesium	NS	ug/l	NDR			NDR			NDR			NDR			NDR			NDR		
Manganese	50	ug/l	NDR			NDR			NDR			NDR			NDR			NDR		
Mercury	2	ug/l	NDR			NDR			NDR			NDR			NDR			NDR		
Nickel	100	ug/l	NDR			NDR			NDR			NDR			NDR			NDR		
Potassium	NS	ug/l	NDR			NDR			NDR			NDR			NDR			NDR		
Selenium	40	ug/l	NDR			NDR			NDR			NDR			NDR			NDR		
Silver	40	ug/l	NDR			NDR			NDR			NDR			NDR			NDR		
Sodium	50000	ug/l	NDR			NDR			NDR			NDR			NDR			NDR		
Thallium	2	ug/l	NDR			NDR			NDR			NDR			NDR			NDR		
Vanadium	NS	ug/l	NDR			NDR			NDR			NDR			NDR			NDR		
Zinc	2000	ug/l	NDR			NDR			NDR			NDR			NDR			NDR		
Natural Attenuation Parameters																				
Alkalinity, Total	NS	mg/l	NDR			NDR			NDR			NDR			NDR			NDR		
Chloride	250000	mg/l	NDR			NDR			NDR			NDR			NDR			NDR		
Nitrate	10000	mg/l	NDR			NDR			NDR			NDR			NDR			NDR		
Nitrite	1000	mg/l	NDR			NDR			NDR			NDR			NDR			NDR		
Sulfate	250000	mg/l	NDR			NDR			NDR			NDR			NDR			NDR		
Sulfide	NS	mg/l	NDR			NDR			NDR			NDR			NDR			NDR		
Total Organic Carbon	NS	mg/l	NDR			NDR			NDR			NDR			NDR			NDR		
Volatile Organic Compounds																				
1,1,1-Trichloroethane	30	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,1,2,2-Tetrachloroethane	1	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,1,2-Trichloroethane	3	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,1-Dichloroethane	50	ug/l	0.19	J	0.5	0.32	J	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,1-Dichloroethene	1	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,2,3-Trichlorobenzene	NS	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,2,4-Trichlorobenzene	9	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5

Checked by: ELD Date: 4/27/2010

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TABLE 2
Groundwater Profile Samples
Validated Analytical Data
Carlstadt

		Sample ID	B09-1			B09-1			B09-1			B09-1			B09-2			B09-2		
		Sample Date	1/4/2010			1/4/2010			1/5/2010			1/5/2010			12/14/2009			12/14/2009		
		N=Normal, FD=Field Duplicate	N			N			N			N			N			N		
		Start Depth	24			34			44			54			31			41		
		End Depth	28			38			48			58			35			45		
Parameter	NJDEP GWQS*	Unit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit
1,2-Dibromo-3-chloropropane	0.02	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,2-Dibromoethane	0.03	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,2-Dichlorobenzene	600	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,2-Dichloroethane	2	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,2-Dichloropropane	1	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,3-Dichlorobenzene	600	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,4-Dichlorobenzene	75	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,4-Dioxane	10	ug/l	***240***		17	***420***		50	***340***		17	***97***		4	***39***		2	***36***		2
2-Butanone	300	ug/l	5.7		5	< 5	U	5	< 5	U	5	< 5	U	5	3.8	J	5	< 5	U	5
2-Hexanone	300	ug/l	< 5	U	5	< 5	U	5	< 5	U	5	< 5	U	5	< 5	U	5	< 5	U	5
4-Methyl-2-pentanone	NS	ug/l	71		5	5.7		5	69		5	6.4		5	< 5	U	5	< 5	U	5
Acetone	6000	ug/l	33		5	< 13	U	13	1100		50	3100		130	< 18	U	18	< 13	U	13
Benzene	1	ug/l	0.19	J	0.5	< 0.5	U	0.5	< 0.5	U	0.5	0.2	J	0.5	***1.8***		0.5	***2.1***		0.5
Bromochloromethane	NS	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Bromodichloromethane	1	ug/l	***3***		0.5	***7***		0.5	***5.9***		0.5	***3.1***		0.5	< 0.5	U	0.5	0.26	J	0.5
Bromoform	4	ug/l	< 0.5	U	0.5	0.16	J	0.5	0.2	J	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Bromomethane	10	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Carbon Disulfide	700	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Carbon Tetrachloride	1	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Chlorobenzene	50	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Chloroethane	5	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Chloroform	70	ug/l	6.5		0.5	8.2		0.5	7.6		0.5	6.8		0.5	4.8		0.5	5.8		0.5
Chloromethane	NS	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	0.54		0.5	< 0.5	U	0.5	< 0.5	U	0.5
cis-1,2-Dichloroethene	70	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	1.3		0.5	1.5		0.5
cis-1,3-Dichloropropene	1	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Cyclohexane	NS	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Dibromochloromethane	1	ug/l	0.88		0.5	***2.5***		0.5	***2***		0.5	0.93		0.5	< 0.5	U	0.5	< 0.5	U	0.5
Dichlorodifluoromethane	1000	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Ethylbenzene	700	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	0.16	J	0.5	0.15	J	0.5
Freon 113	NS	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Isopropylbenzene	700	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
m,p-Xylenes	NS	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	0.29	J	0.5	0.24	J	0.5
Methyl Acetate	7000	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Methyl Cyclohexane	NS	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Methyl tert-Butyl Ether	70	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Methylene Chloride	3	ug/l	0.26	J	0.5	< 0.5	U	0.5	0.13	J	0.5	0.23	J	0.5	< 0.5	U	0.5	< 0.5	U	0.5
o-Xylene	NS	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	0.16	J	0.5	0.13	J	0.5
Styrene	100	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Tetrachloroethene	1	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Toluene	600	ug/l	0.11	J	0.5	< 0.5	U	0.5	0.11	J	0.5	0.15	J	0.5	0.75		0.5	0.64		0.5
trans-1,2-Dichloroethene	100	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5

Checked by: ELD Date: 4/27/2010

R2-0001259

TABLE 2
Groundwater Profile Samples
Validated Analytical Data
Carlstadt

		Sample ID	B09-1			B09-1			B09-1			B09-1			B09-2			B09-2		
		Sample Date	1/4/2010			1/4/2010			1/5/2010			1/5/2010			12/14/2009			12/14/2009		
		N=Normal, FD=Field Duplicate	N			N			N			N			N			N		
		Start Depth	24			34			44			54			31			41		
		End Depth	28			38			48			58			35			45		
Parameter	NJDEP GWQS*	Unit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit
trans-1,3-Dichloropropene	1	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Trichloroethene	1	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	***3.2***		0.5	***4.2***		0.5
Trichlorofluoromethane	2000	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Vinyl Chloride	1	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	0.67	J	0.5	0.75	J	0.5

Notes:
ug/l = micrograms per liter
mg/l = milligrams per liter
Qualifier = Validated Qualifier
ReptLimit = Reporting Limit
NA - Not Applicable
NS - No Standard Available
Qualifier: J - Result or reporting limit is estimated.
U - Result was not detected at or above the method detection limit.
UJ - Detection limit is estimated.
R - Data is rejected.
* NJDEP GWQS: Higher of the Practical Quantitation Limit and Ground Water Quality Criterion (N.J.A.C. 7:9C) 11/2009, as well as Interim Groundwater Quality Critieria.
Results greater than the NJDEP GWQS are shown in ***bold/italics***

Checked by: ELD Date: 4/27/2010

R2-0001260

TABLE 2
Groundwater Profile Samples
Validated Analytical Data
Carlstadt

		Sample ID	B09-2			B09-2			B09-3			B09-3			B09-3			B09-3		
		Sample Date	12/14/2009			12/14/2009			1/7/2010			1/7/2010			1/7/2010			1/7/2010		
		N=Normal, FD=Field Duplicate	N			N			N			N			N			N		
		Start Depth	51			61			26			36			46			56		
		End Depth	55			65			30			40			50			60		
Parameter	NJDEP GWQS*	Unit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit
Inorganics																				
Aluminum	200	ug/l	NDR			NDR			NDR			NDR			NDR			NDR		
Antimony	6	ug/l	NDR			NDR			NDR			NDR			NDR			NDR		
Arsenic	3	ug/l	NDR			NDR			NDR			NDR			NDR			NDR		
Barium	6000	ug/l	NDR			NDR			NDR			NDR			NDR			NDR		
Beryllium	1	ug/l	NDR			NDR			NDR			NDR			NDR			NDR		
Cadmium	4	ug/l	NDR			NDR			NDR			NDR			NDR			NDR		
Calcium	NS	ug/l	NDR			NDR			NDR			NDR			NDR			NDR		
Chromium	70	ug/l	NDR			NDR			NDR			NDR			NDR			NDR		
Cobalt	100	ug/l	NDR			NDR			NDR			NDR			NDR			NDR		
Copper	1300	ug/l	NDR			NDR			NDR			NDR			NDR			NDR		
Iron (Dissolved)	300	ug/l	NDR			NDR			NDR			NDR			NDR			NDR		
Iron (Total)	300	ug/l	NDR			NDR			NDR			NDR			NDR			NDR		
Lead	5	ug/l	NDR			NDR			NDR			NDR			NDR			NDR		
Magnesium	NS	ug/l	NDR			NDR			NDR			NDR			NDR			NDR		
Manganese	50	ug/l	NDR			NDR			NDR			NDR			NDR			NDR		
Mercury	2	ug/l	NDR			NDR			NDR			NDR			NDR			NDR		
Nickel	100	ug/l	NDR			NDR			NDR			NDR			NDR			NDR		
Potassium	NS	ug/l	NDR			NDR			NDR			NDR			NDR			NDR		
Selenium	40	ug/l	NDR			NDR			NDR			NDR			NDR			NDR		
Silver	40	ug/l	NDR			NDR			NDR			NDR			NDR			NDR		
Sodium	50000	ug/l	NDR			NDR			NDR			NDR			NDR			NDR		
Thallium	2	ug/l	NDR			NDR			NDR			NDR			NDR			NDR		
Vanadium	NS	ug/l	NDR			NDR			NDR			NDR			NDR			NDR		
Zinc	2000	ug/l	NDR			NDR			NDR			NDR			NDR			NDR		
Natural Attenuation Parameters																				
Alkalinity, Total	NS	mg/l	NDR			NDR			NDR			NDR			NDR			NDR		
Chloride	250000	mg/l	NDR			NDR			NDR			NDR			NDR			NDR		
Nitrate	10000	mg/l	NDR			NDR			NDR			NDR			NDR			NDR		
Nitrite	1000	mg/l	NDR			NDR			NDR			NDR			NDR			NDR		
Sulfate	250000	mg/l	NDR			NDR			NDR			NDR			NDR			NDR		
Sulfide	NS	mg/l	NDR			NDR			NDR			NDR			NDR			NDR		
Total Organic Carbon	NS	mg/l	NDR			NDR			NDR			NDR			NDR			NDR		
Volatile Organic Compounds																				
1,1,1-Trichloroethane	30	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,1,2,2-Tetrachloroethane	1	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,1,2-Trichloroethane	3	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,1-Dichloroethane	50	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,1-Dichloroethene	1	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,2,3-Trichlorobenzene	NS	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,2,4-Trichlorobenzene	9	ug/l	0.19	J	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5

Checked by: ELD Date: 4/27/2010

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TABLE 2
Groundwater Profile Samples
Validated Analytical Data
Carlstadt

Sample ID			B09-2			B09-2			B09-3			B09-3			B09-3			B09-3		
Sample Date			12/14/2009			12/14/2009			1/7/2010			1/7/2010			1/7/2010			1/7/2010		
N=Normal, FD=Field Duplicate			N			N			N			N			N			N		
Start Depth			51			61			26			36			46			56		
End Depth			55			65			30			40			50			60		
Parameter	NJDEP GWQS*	Unit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit
1,2-Dibromo-3-chloropropane	0.02	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,2-Dibromoethane	0.03	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,2-Dichlorobenzene	600	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,2-Dichloroethane	2	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,2-Dichloropropane	1	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,3-Dichlorobenzene	600	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,4-Dichlorobenzene	75	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,4-Dioxane	10	ug/l	***28***		2	5.1		2	***440***		25	***4300***		250	***63***		6.3	5.6		2
2-Butanone	300	ug/l	< 5	U	5	< 5	U	5	2.2	J	5	< 5	U	5	< 5	U	5	2.2	J	5
2-Hexanone	300	ug/l	< 5	U	5	< 5	U	5	< 5	U	5	< 5	U	5	< 5	U	5	< 5	U	5
4-Methyl-2-pentanone	NS	ug/l	< 5	U	5	< 5	U	5	16		5	2.1	J	5	23		5	18		5
Acetone	6000	ug/l	< 9.5	U	9.5	< 9.1	U	9.1	< 14	U	14	< 6.2	U	6.2	< 10	U	10	66		5
Benzene	1	ug/l	***1.4***		0.5	< 0.5	U	0.5	< 0.5	U	0.5	0.17	J	0.5	< 0.5	U	0.5	0.16	J	0.5
Bromochloromethane	NS	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Bromodichloromethane	1	ug/l	0.87		0.5	***4***		0.5	***5.8***		0.5	***1.7***		0.5	***6.7***		0.5	***5.2***		0.5
Bromoform	4	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	0.12	J	0.5	< 0.5	U	0.5	0.84		0.5	< 0.5	U	0.5
Bromomethane	10	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Carbon Disulfide	700	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Carbon Tetrachloride	1	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Chlorobenzene	50	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Chloroethane	5	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Chloroform	70	ug/l	3.9		0.5	8.8		0.5	7.5		0.5	2.4		0.5	9.2		0.5	10		0.5
Chloromethane	NS	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	0.11	J	0.5
cis-1,2-Dichloroethene	70	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	0.19	J	0.5	< 0.5	U	0.5	< 0.5	U	0.5
cis-1,3-Dichloropropene	1	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Cyclohexane	NS	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Dibromochloromethane	1	ug/l	0.23	J	0.5	***1.1***		0.5	***2***		0.5	0.55		0.5	***2.5***		0.5	***1.8***		0.5
Dichlorodifluoromethane	1000	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Ethylbenzene	700	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	1.6		0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Freon 113	NS	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Isopropylbenzene	700	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
m,p-Xylenes	NS	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	4.5		0.5	0.23	J	0.5	< 0.5	U	0.5	0.16	J	0.5
Methyl Acetate	7000	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Methyl Cyclohexane	NS	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Methyl tert-Butyl Ether	70	ug/l	0.12	J	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Methylene Chloride	3	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	0.18	J	0.5
o-Xylene	NS	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	0.34	J	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Styrene	100	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Tetrachloroethene	1	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Toluene	600	ug/l	1.3		0.5	0.15	J	0.5	0.37	J	0.5	0.13	J	0.5	0.18	J	0.5	0.19	J	0.5
trans-1,2-Dichloroethene	100	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5

Checked by: ELD Date: 4/27/2010

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TABLE 2
Groundwater Profile Samples
Validated Analytical Data
Carlstadt

		Sample ID	B09-2			B09-2			B09-3			B09-3			B09-3			B09-3		
		Sample Date	12/14/2009			12/14/2009			1/7/2010			1/7/2010			1/7/2010			1/7/2010		
		N=Normal, FD=Field Duplicate	N			N			N			N			N			N		
		Start Depth	51			61			26			36			46			56		
		End Depth	55			65			30			40			50			60		
Parameter	NJDEP GWQS*	Unit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit
trans-1,3-Dichloropropene	1	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Trichloroethene	1	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Trichlorofluoromethane	2000	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Vinyl Chloride	1	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5

Notes:
ug/l = micrograms per liter
mg/l = milligrams per liter
Qualifier = Validated Qualifier
ReptLimit = Reporting Limit
NA - Not Applicable
NS - No Standard Available
Qualifier: J - Result or reporting limit is estimated.
U - Result was not detected at or above the method detection limit.
UJ - Detection limit is estimated.
R - Data is rejected.
* NJDEP GWQS: Higher of the Practical Quantitation Limit and Ground Water Quality Criterion (N.J.A.C. 7:9C) 11/2009, as well as Interim Groundwater Quality Critieria.
Results greater than the NJDEP GWQS are shown in ***bold/italics***

Checked by: ELD Date: 4/27/2010

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TABLE 2
Groundwater Profile Samples
Validated Analytical Data
Carlstadt

			Sample ID	B09-4			B09-4			B09-5			B09-5			MW-21R			MW-21R		
			Sample Date	1/13/2010			1/13/2010			1/12/2010			1/12/2010			12/17/2009			12/17/2009		
			N=Normal, FD=Field Duplicate	N			N			N			N			FD			N		
			Start Depth	26			31			26			32			24			24		
			End Depth	30			35			30			36			28			28		
Parameter	NJDEP GWQS*	Unit		Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit
Inorganics																					
Aluminum	200	ug/l		NDR			NDR			NDR			NDR			452000		200	447000		200
Antimony	6	ug/l		NDR			NDR			NDR			NDR			< 60	R	60	< 60	R	60
Arsenic	3	ug/l		NDR			NDR			NDR			NDR			90.5		10	88.8		10
Barium	6000	ug/l		NDR			NDR			NDR			NDR			3700	J	200	3730	J	200
Beryllium	1	ug/l		NDR			NDR			NDR			NDR			23.3		5	23.1		5
Cadmium	4	ug/l		NDR			NDR			NDR			NDR			34.8		5	34.6		5
Calcium	NS	ug/l		NDR			NDR			NDR			NDR			1050000	J	10000	658000	J	5000
Chromium	70	ug/l		NDR			NDR			NDR			NDR			767		10	788		10
Cobalt	100	ug/l		NDR			NDR			NDR			NDR			378		50	374		50
Copper	1300	ug/l		NDR			NDR			NDR			NDR			1950	J	25	1950	J	25
Iron (Dissolved)	300	ug/l		NDR			NDR			NDR			NDR			4960	J	100	11600	J	100
Iron (Total)	300	ug/l		NDR			NDR			NDR			NDR			936000	J	200	978000	J	200
Lead	5	ug/l		NDR			NDR			NDR			NDR			421	J	10	427	J	10
Magnesium	NS	ug/l		NDR			NDR			NDR			NDR			359000		5000	323000		5000
Manganese	50	ug/l		NDR			NDR			NDR			NDR			22200	J	15	20300	J	15
Mercury	2	ug/l		NDR			NDR			NDR			NDR			6.3		0.2	5.9		0.2
Nickel	100	ug/l		NDR			NDR			NDR			NDR			834		40	834		40
Potassium	NS	ug/l		NDR			NDR			NDR			NDR			75900	J	5000	70000	J	5000
Selenium	40	ug/l		NDR			NDR			NDR			NDR			< 35	R	35	< 35	R	35
Silver	40	ug/l		NDR			NDR			NDR			NDR			< 10	U	10	< 10	U	10
Sodium	50000	ug/l		NDR			NDR			NDR			NDR			314000	J	5000	140000	J	5000
Thallium	2	ug/l		NDR			NDR			NDR			NDR			220		25	210		25
Vanadium	NS	ug/l		NDR			NDR			NDR			NDR			829	J	50	828	J	50
Zinc	2000	ug/l		NDR			NDR			NDR			NDR			9210	J	60	5560	J	60
Natural Attenuation Parameters																					
Alkalinity, Total	NS	mg/l		NDR			NDR			NDR			NDR			221		10	164		10
Chloride	250000	mg/l		NDR			NDR			NDR			NDR			1800		25	1600		25
Nitrate	10000	mg/l		NDR			NDR			NDR			NDR			< 2.5	U	2.5	< 2.5	U	2.5
Nitrite	1000	mg/l		NDR			NDR			NDR			NDR			< 2.5	U	2.5	< 2.5	U	2.5
Sulfate	250000	mg/l		NDR			NDR			NDR			NDR			94		50	93		50
Sulfide	NS	mg/l		NDR			NDR			NDR			NDR			< 1	U	1	< 1	U	1
Total Organic Carbon	NS	mg/l		NDR			NDR			NDR			NDR			26.4	J	1	27.8	J	1
Volatile Organic Compounds																					
1,1,1-Trichloroethane	30	ug/l		1.4	J	6.3	0.93	J	4.2	1.1		0.5	6.9	J	18	< 0.5	R	0.5	< 0.5	R	0.5
1,1,2,2-Tetrachloroethane	1	ug/l		< 6.3	U	6.3	< 4.2	U	4.2	< 0.5	U	0.5	< 18	R	18	< 0.5	R	0.5	< 0.5	R	0.5
1,1,2-Trichloroethane	3	ug/l		< 6.3	U	6.3	< 4.2	U	4.2	< 0.5	U	0.5	< 18	R	18	< 0.5	R	0.5	< 0.5	R	0.5
1,1-Dichloroethane	50	ug/l		2.7	J	6.3	4.8		4.2	0.41	J	0.5	30	J	18	87	J	5	56	J	2.5
1,1-Dichloroethene	1	ug/l		< 6.3	U	6.3	***11***		4.2	0.74		0.5	***72***	J	18	< 0.5	R	0.5	< 0.5	R	0.5
1,2,3-Trichlorobenzene	NS	ug/l		< 6.3	U	6.3	< 4.2	U	4.2	< 0.5	U	0.5	< 18	R	18	< 0.5	R	0.5	< 0.5	R	0.5
1,2,4-Trichlorobenzene	9	ug/l		< 6.3	U	6.3	< 4.2	U	4.2	< 0.5	U	0.5	< 18	R	18	< 0.5	R	0.5	< 0.5	R	0.5

Checked by: ELD Date: 4/27/2010

R2-0001264

TABLE 2
Groundwater Profile Samples
Validated Analytical Data
Carlstadt

		Sample ID	B09-4			B09-4			B09-5			B09-5			MW-21R			MW-21R		
		Sample Date	1/13/2010			1/13/2010			1/12/2010			1/12/2010			12/17/2009			12/17/2009		
		N=Normal, FD=Field Duplicate	N			N			N			N			FD			N		
		Start Depth	26			31			26			32			24			24		
		End Depth	30			35			30			36			28			28		
Parameter	NJDEP GWQS*	Unit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit
1,2-Dibromo-3-chloropropane	0.02	ug/l	< 6.3	U	6.3	< 4.2	U	4.2	< 0.5	U	0.5	< 18	R	18	< 0.5	R	0.5	< 0.5	R	0.5
1,2-Dibromoethane	0.03	ug/l	< 6.3	U	6.3	< 4.2	U	4.2	< 0.5	U	0.5	< 18	R	18	< 0.5	R	0.5	< 0.5	R	0.5
1,2-Dichlorobenzene	600	ug/l	< 6.3	U	6.3	< 4.2	U	4.2	< 0.5	U	0.5	< 18	R	18	< 0.5	R	0.5	< 0.5	R	0.5
1,2-Dichloroethane	2	ug/l	***8.6***		6.3	***9.8***		4.2	< 0.5	U	0.5	***17***	J	18	< 0.5	R	0.5	< 0.5	R	0.5
1,2-Dichloropropane	1	ug/l	< 6.3	U	6.3	< 4.2	U	4.2	< 0.5	U	0.5	< 18	R	18	< 0.5	R	0.5	< 0.5	R	0.5
1,3-Dichlorobenzene	600	ug/l	< 6.3	U	6.3	< 4.2	U	4.2	< 0.5	U	0.5	< 18	R	18	< 0.5	R	0.5	< 0.5	R	0.5
1,4-Dichlorobenzene	75	ug/l	< 6.3	U	6.3	< 4.2	U	4.2	< 0.5	U	0.5	< 18	R	18	< 0.5	R	0.5	< 0.5	R	0.5
1,4-Dioxane	10	ug/l	< 2	U	2	< 2	U	2	< 2	U	2	5.4		2	2500	J	100	1600	J	71
2-Butanone	300	ug/l	< 63	U	63	< 42	U	42	< 5	U	5	< 180	R	180	< 5	R	5	< 5	R	5
2-Hexanone	300	ug/l	< 63	U	63	< 42	U	42	< 5	U	5	< 180	R	180	< 5	R	5	< 5	R	5
4-Methyl-2-pentanone	NS	ug/l	72		63	120		42	49		5	71	J	180	< 5	R	5	< 5	R	5
Acetone	6000	ug/l	< 63	U	63	< 42	U	42	< 10	U	10	< 180	U	180	< 28	R	28	< 28	R	28
Benzene	1	ug/l	< 6.3	U	6.3	< 4.2	U	4.2	< 0.5	U	0.5	< 18	R	18	1.5	J	0.5	1.2	J	0.5
Bromochloromethane	NS	ug/l	< 6.3	U	6.3	< 4.2	U	4.2	< 0.5	U	0.5	< 18	R	18	< 0.5	R	0.5	< 0.5	R	0.5
Bromodichloromethane	1	ug/l	***6.5***		6.3	0.37	J	4.2	***7.2***		0.5	< 18	R	18	1.4	J	0.5	1.7	J	0.5
Bromoform	4	ug/l	< 6.3	U	6.3	< 4.2	U	4.2	< 0.5	U	0.5	< 18	R	18	< 0.5	R	0.5	< 0.5	R	0.5
Bromomethane	10	ug/l	< 6.3	U	6.3	< 4.2	U	4.2	< 0.5	U	0.5	< 18	R	18	< 0.5	R	0.5	< 0.5	R	0.5
Carbon Disulfide	700	ug/l	< 6.3	U	6.3	< 4.2	U	4.2	< 0.5	U	0.5	< 18	R	18	< 0.5	R	0.5	< 0.5	R	0.5
Carbon Tetrachloride	1	ug/l	< 6.3	U	6.3	< 4.2	U	4.2	< 0.5	U	0.5	< 18	R	18	< 0.5	R	0.5	< 0.5	R	0.5
Chlorobenzene	50	ug/l	< 6.3	U	6.3	< 4.2	U	4.2	< 0.5	U	0.5	< 18	R	18	< 0.5	R	0.5	< 0.5	R	0.5
Chloroethane	5	ug/l	< 6.3	U	6.3	< 4.2	U	4.2	< 0.5	U	0.5	< 18	R	18	18	J	0.5	13	J	0.5
Chloroform	70	ug/l	9.9		6.3	17		4.2	9.9		0.5	< 18	R	18	3.6	J	0.5	4.4	J	0.5
Chloromethane	NS	ug/l	< 6.3	U	6.3	< 4.2	U	4.2	< 0.5	U	0.5	< 18	R	18	< 0.5	R	0.5	< 0.5	R	0.5
cis-1,2-Dichloroethene	70	ug/l	***91***		6.3	***100***		4.2	0.4	J	0.5	***440***	J	18	< 0.5	R	0.5	< 0.5	R	0.5
cis-1,3-Dichloropropene	1	ug/l	< 6.3	U	6.3	< 4.2	U	4.2	< 0.5	U	0.5	< 18	R	18	< 0.5	R	0.5	< 0.5	R	0.5
Cyclohexane	NS	ug/l	< 6.3	U	6.3	< 4.2	U	4.2	< 0.5	U	0.5	< 18	R	18	< 0.5	R	0.5	< 0.5	R	0.5
Dibromochloromethane	1	ug/l	***2.3***	J	6.3	< 4.2	U	4.2	***2.6***		0.5	< 18	R	18	0.41	J	0.5	0.54	J	0.5
Dichlorodifluoromethane	1000	ug/l	< 6.3	U	6.3	< 4.2	U	4.2	< 0.5	U	0.5	< 18	R	18	< 0.5	R	0.5	< 0.5	R	0.5
Ethylbenzene	700	ug/l	< 6.3	U	6.3	< 4.2	U	4.2	< 0.5	U	0.5	< 18	R	18	< 0.5	R	0.5	< 0.5	R	0.5
Freon 113	NS	ug/l	9.9		6.3	6.5		4.2	1.9		0.5	38	J	18	< 0.5	R	0.5	< 0.5	R	0.5
Isopropylbenzene	700	ug/l	< 6.3	U	6.3	< 4.2	U	4.2	< 0.5	U	0.5	< 18	R	18	< 0.5	R	0.5	< 0.5	R	0.5
m,p-Xylenes	NS	ug/l	9		6.3	< 4.2	U	4.2	< 0.5	U	0.5	< 18	R	18	< 0.5	R	0.5	< 0.5	R	0.5
Methyl Acetate	7000	ug/l	< 6.3	U	6.3	< 4.2	U	4.2	< 0.5	U	0.5	< 18	R	18	< 0.5	R	0.5	< 0.5	R	0.5
Methyl Cyclohexane	NS	ug/l	< 6.3	U	6.3	< 4.2	U	4.2	< 0.5	U	0.5	< 18	R	18	< 0.5	R	0.5	< 0.5	R	0.5
Methyl tert-Butyl Ether	70	ug/l	< 6.3	U	6.3	< 4.2	U	4.2	< 0.5	U	0.5	< 18	R	18	< 0.5	R	0.5	< 0.5	R	0.5
Methylene Chloride	3	ug/l	< 6.3	U	6.3	< 4.2	U	4.2	< 0.5	U	0.5	< 18	R	18	1.7	J	0.5	1.3	J	0.5
o-Xylene	NS	ug/l	3.7	J	6.3	< 4.2	U	4.2	< 0.5	U	0.5	< 18	R	18	< 0.5	R	0.5	< 0.5	R	0.5
Styrene	100	ug/l	< 6.3	U	6.3	< 4.2	U	4.2	< 0.5	U	0.5	< 18	R	18	< 0.5	R	0.5	< 0.5	R	0.5
Tetrachloroethene	1	ug/l	***21***		6.3	***13***		4.2	***3.3***		0.5	***45***	J	18	< 0.5	R	0.5	< 0.5	R	0.5
Toluene	600	ug/l	17		6.3	5.5		4.2	1		0.5	9.1	J	18	< 0.5	R	0.5	< 0.5	R	0.5
trans-1,2-Dichloroethene	100	ug/l	< 6.3	U	6.3	< 4.2	U	4.2	< 0.5	U	0.5	< 18	R	18	< 0.5	R	0.5	< 0.5	R	0.5

Checked by: ELD Date: 4/27/2010

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TABLE 2
Groundwater Profile Samples
Validated Analytical Data
Carlstadt

		Sample ID	B09-4			B09-4			B09-5			B09-5			MW-21R			MW-21R		
		Sample Date	1/13/2010			1/13/2010			1/12/2010			1/12/2010			12/17/2009			12/17/2009		
		N=Normal, FD=Field Duplicate	N			N			N			N			FD			N		
		Start Depth	26			31			26			32			24			24		
		End Depth	30			35			30			36			28			28		
Parameter	NJDEP GWQS*	Unit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit
trans-1,3-Dichloropropene	1	ug/l	< 6.3	U	6.3	< 4.2	U	4.2	< 0.5	U	0.5	< 18	R	18	< 0.5	R	0.5	< 0.5	R	0.5
Trichloroethene	1	ug/l	***130***		6.3	***75***		4.2	***20***		0.5	***410***	J	18	2.1	J	0.5	2.2	J	0.5
Trichlorofluoromethane	2000	ug/l	< 6.3	U	6.3	< 4.2	U	4.2	< 0.5	U	0.5	< 18	R	18	< 0.5	R	0.5	< 0.5	R	0.5
Vinyl Chloride	1	ug/l	< 6.3	U	6.3	***4.5***		4.2	< 0.5	U	0.5	***22***	J	18	1.4	J	0.5	1.1	J	0.5

Notes:
ug/l = micrograms per liter
mg/l = milligrams per liter
Qualifier = Validated Qualifier
ReptLimit = Reporting Limit
NA - Not Applicable
NS - No Standard Available
Qualifier: J - Result or reporting limit is estimated.
U - Result was not detected at or above the method detection limit.
UJ - Detection limit is estimated.
R - Data is rejected.
* NJDEP GWQS: Higher of the Practical Quantitation Limit and Ground Water Quality Criterion (N.J.A.C. 7:9C) 11/2009, as well as Interim Groundwater Quality Critieria.
Results greater than the NJDEP GWQS are shown in ***bold/italics***

Checked by: ELD Date: 4/27/2010

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TABLE 2
Groundwater Profile Samples
Validated Analytical Data
Carlstadt

		Sample ID	MW-21R			MW-21R			MW-21R		
		Sample Date	12/17/2009			12/17/2009			12/18/2009		
		N=Normal, FD=Field Duplicate	N			N			N		
		Start Depth	34			44			54		
		End Depth	38			48			58		
Parameter	NJDEP GWQS*	Unit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit
Inorganics											
Aluminum	200	ug/l	307000		200	129000		200	90400		200
Antimony	6	ug/l	< 60	R	60	< 60	R	60	< 60	R	60
Arsenic	3	ug/l	24.5		10	20.3		10	9.1	J	10
Barium	6000	ug/l	3640	J	200	1430	J	200	1230	J	200
Beryllium	1	ug/l	17.1		5	7.5		5	4.7	J	5
Cadmium	4	ug/l	17.2		5	6.8		5	3.6	J	5
Calcium	NS	ug/l	1300000	J	10000	486000	J	5000	420000	J	5000
Chromium	70	ug/l	445		10	235		10	138		10
Cobalt	100	ug/l	256		50	109		50	66.8		50
Copper	1300	ug/l	527	J	25	534	J	25	100	J	25
Iron (Dissolved)	300	ug/l	11600		100	10800		100	4620		100
Iron (Total)	300	ug/l	433000	J	100	206000	J	100	118000	J	100
Lead	5	ug/l	285	J	10	122	J	10	50.5	J	10
Magnesium	NS	ug/l	284000		5000	104000		5000	88000		5000
Manganese	50	ug/l	21300	J	15	9780	J	15	3510	J	15
Mercury	2	ug/l	0.22		0.2	0.15	J	0.2	< 0.2	U	0.2
Nickel	100	ug/l	575		40	236		40	145		40
Potassium	NS	ug/l	86800	J	5000	31600	J	5000	31200	J	5000
Selenium	40	ug/l	< 35	R	35	< 35	R	35	< 35	R	35
Silver	40	ug/l	< 10	U	10	< 10	U	10	< 10	U	10
Sodium	50000	ug/l	466000		5000	72300		5000	121000		5000
Thallium	2	ug/l	106		25	33.9		25	21.2	J	25
Vanadium	NS	ug/l	561	J	50	266	J	50	182	J	50
Zinc	2000	ug/l	2740	J	60	3030	J	60	627	J	60
Natural Attenuation Parameters											
Alkalinity, Total	NS	mg/l	210		10	94.4		10	33.3		10
Chloride	250000	mg/l	1400		25	130		2.5	610		10
Nitrate	10000	mg/l	< 2.5	U	2.5	0.62		0.25	< 1	R	1
Nitrite	1000	mg/l	< 2.5	U	2.5	< 0.25	U	0.25	< 1	R	1
Sulfate	250000	mg/l	74		50	31		5	190		20
Sulfide	NS	mg/l	< 1	U	1	< 1	U	1	< 1	U	1
Total Organic Carbon	NS	mg/l	6.72	J	1	4.36	J	1	9.4		1
Volatile Organic Compounds											
1,1,1-Trichloroethane	30	ug/l	< 0.5	R	0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,1,2,2-Tetrachloroethane	1	ug/l	< 0.5	R	0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,1,2-Trichloroethane	3	ug/l	< 0.5	R	0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,1-Dichloroethane	50	ug/l	13	J	0.5	0.33	J	0.5	< 0.5	U	0.5
1,1-Dichloroethene	1	ug/l	< 0.5	R	0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,2,3-Trichlorobenzene	NS	ug/l	< 0.5	R	0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,2,4-Trichlorobenzene	9	ug/l	< 0.5	R	0.5	< 0.5	U	0.5	< 0.5	U	0.5

Checked by: ELD Date: 4/27/2010

R2-0001267

TABLE 2
Groundwater Profile Samples
Validated Analytical Data
Carlstadt

		Sample ID	MW-21R			MW-21R			MW-21R		
		Sample Date	12/17/2009			12/17/2009			12/18/2009		
		N=Normal, FD=Field Duplicate	N			N			N		
		Start Depth	34			44			54		
		End Depth	38			48			58		
Parameter	NJDEP GWQS*	Unit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit
1,2-Dibromo-3-chloropropane	0.02	ug/l	< 0.5	R	0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,2-Dibromoethane	0.03	ug/l	< 0.5	R	0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,2-Dichlorobenzene	600	ug/l	< 0.5	R	0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,2-Dichloroethane	2	ug/l	< 0.5	R	0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,2-Dichloropropane	1	ug/l	< 0.5	R	0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,3-Dichlorobenzene	600	ug/l	< 0.5	R	0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,4-Dichlorobenzene	75	ug/l	< 0.5	R	0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,4-Dioxane	10	ug/l	2000	J	200	75		2	76		4.2
2-Butanone	300	ug/l	< 5	R	5	< 5	U	5	< 5	U	5
2-Hexanone	300	ug/l	< 5	R	5	< 5	U	5	< 5	U	5
4-Methyl-2-pentanone	NS	ug/l	< 5	R	5	< 5	U	5	< 5	U	5
Acetone	6000	ug/l	< 7	R	7	< 7.2	U	7.2	< 12	U	12
Benzene	1	ug/l	0.69	J	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Bromochloromethane	NS	ug/l	< 0.5	R	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Bromodichloromethane	1	ug/l	2.9	J	0.5	5.8		0.5	3.8		0.5
Bromoform	4	ug/l	< 0.5	R	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Bromomethane	10	ug/l	< 0.5	R	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Carbon Disulfide	700	ug/l	< 0.5	R	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Carbon Tetrachloride	1	ug/l	< 0.5	R	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Chlorobenzene	50	ug/l	< 0.5	R	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Chloroethane	5	ug/l	3.2	J	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Chloroform	70	ug/l	5.7	J	0.5	9.2		0.5	10		0.5
Chloromethane	NS	ug/l	< 0.5	R	0.5	< 0.5	U	0.5	< 0.5	U	0.5
cis-1,2-Dichloroethene	70	ug/l	< 0.5	R	0.5	< 0.5	U	0.5	< 0.5	U	0.5
cis-1,3-Dichloropropene	1	ug/l	< 0.5	R	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Cyclohexane	NS	ug/l	< 0.5	R	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Dibromochloromethane	1	ug/l	0.76	J	0.5	1.7		0.5	1.1		0.5
Dichlorodifluoromethane	1000	ug/l	< 0.5	R	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Ethylbenzene	700	ug/l	< 0.5	R	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Freon 113	NS	ug/l	< 0.5	R	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Isopropylbenzene	700	ug/l	< 0.5	R	0.5	< 0.5	U	0.5	< 0.5	U	0.5
m,p-Xylenes	NS	ug/l	< 0.5	R	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Methyl Acetate	7000	ug/l	< 0.5	R	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Methyl Cyclohexane	NS	ug/l	< 0.5	R	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Methyl tert-Butyl Ether	70	ug/l	< 0.5	R	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Methylene Chloride	3	ug/l	0.36	J	0.5	< 0.5	U	0.5	0.3	J	0.5
o-Xylene	NS	ug/l	< 0.5	R	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Styrene	100	ug/l	< 0.5	R	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Tetrachloroethene	1	ug/l	< 0.5	R	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Toluene	600	ug/l	< 0.5	R	0.5	< 0.5	U	0.5	0.11	J	0.5
trans-1,2-Dichloroethene	100	ug/l	< 0.5	R	0.5	< 0.5	U	0.5	< 0.5	U	0.5

Checked by: ELD Date: 4/27/2010

R2-0001268

TABLE 2
Groundwater Profile Samples
Validated Analytical Data
Carlstadt

		Sample ID	MW-21R			MW-21R			MW-21R		
		Sample Date	12/17/2009			12/17/2009			12/18/2009		
		N=Normal, FD=Field Duplicate	N			N			N		
		Start Depth	34			44			54		
		End Depth	38			48			58		
Parameter	NJDEP GWQS*	Unit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit
trans-1,3-Dichloropropene	1	ug/l	< 0.5	R	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Trichloroethene	1	ug/l	< 0.5	R	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Trichlorofluoromethane	2000	ug/l	< 0.5	R	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Vinyl Chloride	1	ug/l	< 0.5	R	0.5	< 0.5	U	0.5	< 0.5	U	0.5

Notes:
ug/l = micrograms per liter
mg/l = milligrams per liter
Qualifier = Validated Qualifier
ReptLimit = Reporting Limit
NA - Not Applicable
NS - No Standard Available
Qualifier: J - Result or reporting limit is estimated.
U - Result was not detected at or above the method detection limit.
UJ - Detection limit is estimated.
R - Data is rejected.
* NJDEP GWQS: Higher of the Practical Quantitation Limit and Ground Water Quality Criterion (N.J.A.C. 7:9C) 11/2009, as well as Interim Groundwater Quality Critieria.
Results greater than the NJDEP GWQS are shown in ***bold/italics***

Checked by: ELD Date: 4/27/2010

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TABLE 3
Groundwater Monitoring Well Samples
Validated Analytical Data
Carlstadt

			Sample ID	MW-8R			MW-18D			MW-21R			MW-21R		
			Sample Date	12/17/2009			12/17/2009			5/6/2010			5/6/2010		
			N=Normal, FD=Field Duplicate	N			N			FD			N		
Parameter	NJDEP GWQS*	Unit		Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit
Volatile Organic Compounds															
1,1,1-Trichloroethane	30	ug/l		< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,1,2,2-Tetrachloroethane	1	ug/l		< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,1,2-Trichloroethane	3	ug/l		< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,1-Dichloroethane	50	ug/l		0.93		0.5	0.67		0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,1-Dichloroethene	1	ug/l		< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,2,3-Trichlorobenzene	NS	ug/l		< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,2,4-Trichlorobenzene	9	ug/l		< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,2-Dibromo-3-chloropropane	0.02	ug/l		< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,2-Dibromoethane	0.03	ug/l		< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,2-Dichlorobenzene	600	ug/l		< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,2-Dichloroethane	2	ug/l		< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,2-Dichloropropane	1	ug/l		< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,3-Dichlorobenzene	600	ug/l		< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,4-Dichlorobenzene	75	ug/l		< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,4-Dioxane	10	ug/l		***15***		2	***46***		2	1.1	J	2	< 2	U	2
2-Butanone	300	ug/l		< 5	U	5	< 5	U	5	< 5	U	5	< 5	U	5
2-Hexanone	300	ug/l		< 5	U	5	< 5	U	5	< 5	U	5	< 5	U	5
4-Methyl-2-pentanone	NS	ug/l		< 5	U	5	< 5	U	5	< 5	U	5	< 5	U	5
Acetone	6000	ug/l		< 5	U	5	< 5	U	5	< 5	U	5	< 5	U	5
Benzene	1	ug/l		< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Bromochloromethane	NS	ug/l		< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Bromodichloromethane	1	ug/l		< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Bromoform	4	ug/l		< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Bromomethane	10	ug/l		< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Carbon Disulfide	700	ug/l		< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Carbon Tetrachloride	1	ug/l		< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Chlorobenzene	50	ug/l		< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Chloroethane	5	ug/l		< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Chloroform	70	ug/l		< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Chloromethane	NS	ug/l		< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
cis-1,2-Dichloroethene	70	ug/l		< 0.5	U	0.5	0.85		0.5	0.76		0.5	0.79		0.5
cis-1,3-Dichloropropene	1	ug/l		< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Cyclohexane	NS	ug/l		< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Dibromochloromethane	1	ug/l		< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Dichlorodifluoromethane	1000	ug/l		< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Ethylbenzene	700	ug/l		< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Freon 113	NS	ug/l		< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5

Checked by: ELD Date: 4/27/2010

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TABLE 3
Groundwater Monitoring Well Samples
Validated Analytical Data
Carlstadt

			Sample ID	MW-8R			MW-18D			MW-21R			MW-21R		
			Sample Date	12/17/2009			12/17/2009			5/6/2010			5/6/2010		
			N=Normal, FD=Field Duplicate	N			N			FD			N		
Parameter	NJDEP GWQS*	Unit		Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit
Isopropylbenzene	700	ug/l		< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
m,p-Xylenes	NS	ug/l		< 0.5	U	0.5	< 0.5	U	0.5	0.14	J	0.5	0.14	J	0.5
Methyl Acetate	7000	ug/l		< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Methyl Cyclohexane	NS	ug/l		< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Methyl tert-Butyl Ether	70	ug/l		0.59		0.5	7.8		0.5	< 0.5	U	0.5	< 0.5	U	0.5
Methylene Chloride	3	ug/l		0.35	J	0.5	< 0.5	U	0.5	0.24	J	0.5	< 0.5	U	0.5
o-Xylene	NS	ug/l		< 0.5	U	0.5	< 0.5	U	0.5	0.077	J	0.5	0.073	J	0.5
Styrene	100	ug/l		< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Tetrachloroethene	1	ug/l		< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Toluene	600	ug/l		< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
trans-1,2-Dichloroethene	100	ug/l		< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
trans-1,3-Dichloropropene	1	ug/l		< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Trichloroethene	1	ug/l		< 0.5	U	0.5	< 0.5	U	0.5	0.32	J	0.5	0.34	J	0.5
Trichlorofluoromethane	2000	ug/l		< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Vinyl Chloride	1	ug/l		< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5

Notes:
ug/l = micrograms per liter
Qualifier = Validated Qualifier
ReptLimit = Reporting Limit
NS - No Standard Available
Qualifier: J - Result or reporting limit is estimated.
U - Result was not detected at or above the method detection limit.
* NJDEP GWQS: Higher of the Practical Quantitation Limit and Ground Water Quality Criterion (N.J.A.C. 7:9C) 11/2009, as well as Interim Groundwater Quality Critieria.
Results greater than the NJDEP GWQS are shown in ***bold/italics***

Checked by: ELD Date: 4/27/2010

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TABLE 4
Soil Samples
Validated Analytical Data
Carlstadt

Sample ID:		B09-4			B09-4			B09-4			B09-5			B09-5		
Sample Date:		01/13/2010			01/13/2010			01/13/2010			01/12/2010			01/12/2010		
N=Normal, FD=Field Duplicate:		N			N			N			N			N		
Start Depth:		16			26			31			16			26		
End Depth:		20			30			35			20			30		
Parameter	Unit	Result	Qual	ReptLimit	Result	Qual	ReptLimit	Result	Qual	ReptLimit	Result	Qual	ReptLimit	Result	Qual	ReptLimit
Inorganics																
Aluminum	mg/kg	NDR			NDR			NDR			NDR			NDR		
Antimony	mg/kg	NDR			NDR			NDR			NDR			NDR		
Arsenic	mg/kg	NDR			NDR			NDR			NDR			NDR		
Barium	mg/kg	NDR			NDR			NDR			NDR			NDR		
Beryllium	mg/kg	NDR			NDR			NDR			NDR			NDR		
Cadmium	mg/kg	NDR			NDR			NDR			NDR			NDR		
Calcium	mg/kg	NDR			NDR			NDR			NDR			NDR		
Chromium	mg/kg	NDR			NDR			NDR			NDR			NDR		
Cobalt	mg/kg	NDR			NDR			NDR			NDR			NDR		
Copper	mg/kg	NDR			NDR			NDR			NDR			NDR		
Iron	mg/kg	NDR			NDR			NDR			NDR			NDR		
Lead	mg/kg	NDR			NDR			NDR			NDR			NDR		
Magnesium	mg/kg	NDR			NDR			NDR			NDR			NDR		
Manganese	mg/kg	NDR			NDR			NDR			NDR			NDR		
Mercury	mg/kg	NDR			NDR			NDR			NDR			NDR		
Nickel	mg/kg	NDR			NDR			NDR			NDR			NDR		
Potassium	mg/kg	NDR			NDR			NDR			NDR			NDR		
Selenium	mg/kg	NDR			NDR			NDR			NDR			NDR		
Silver	mg/kg	NDR			NDR			NDR			NDR			NDR		
Sodium	mg/kg	NDR			NDR			NDR			NDR			NDR		
Thallium	mg/kg	NDR			NDR			NDR			NDR			NDR		
Vanadium	mg/kg	NDR			NDR			NDR			NDR			NDR		
Zinc	mg/kg	NDR			NDR			NDR			NDR			NDR		
Natural Attenuation Parameters																
Alkalinity, Total	mg/kg	NDR			NDR			NDR			NDR			NDR		
Ferrous Iron	mg/kg	NDR			NDR			NDR			NDR			NDR		
Total Organic Carbon	mg/kg	NDR			NDR			NDR			NDR			NDR		
Volatile Organic Compounds																
1,1,1-Trichloroethane	ug/kg	7.8		7.2	< 5.7	U	5.7	< 6	U	6	< 6	U	6	< 6	U	6
1,1,2,2-Tetrachloroethane	ug/kg	< 7.2	U	7.2	< 5.7	U	5.7	< 6	U	6	< 6	U	6	< 6	U	6
1,1,2-Trichloroethane	ug/kg	< 7.2	UJ	7.2	< 5.7	U	5.7	< 6	U	6	< 6	U	6	< 6	U	6
1,1-Dichloroethane	ug/kg	140		7.2	< 5.7	U	5.7	< 6	U	6	< 6	U	6	< 6	U	6
1,1-Dichloroethene	ug/kg	100		7.2	< 5.7	U	5.7	< 6	U	6	< 6	U	6	< 6	U	6
1,2,3-Trichlorobenzene	ug/kg	< 7.2	UJ	7.2	< 5.7	U	5.7	< 6	U	6	< 6	UJ	6	< 6	U	6
1,2,4-Trichlorobenzene	ug/kg	< 7.2	UJ	7.2	< 5.7	U	5.7	< 6	U	6	< 6	UJ	6	< 6	U	6
1,2-Dibromo-3-chloropropane	ug/kg	< 7.2	U	7.2	< 5.7	U	5.7	< 6	U	6	< 6	U	6	< 6	U	6
1,2-Dibromoethane	ug/kg	< 7.2	U	7.2	< 5.7	U	5.7	< 6	U	6	< 6	U	6	< 6	U	6

Checked by: TGS Date: 3/31/2010

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TABLE 4
Soil Samples
Validated Analytical Data
Carlstadt

Sample ID:	B09-4			B09-4			B09-4			B09-5			B09-5		
Sample Date:	01/13/2010			01/13/2010			01/13/2010			01/12/2010			01/12/2010		
N=Normal, FD=Field Duplicate:	N			N			N			N			N		
Start Depth:	16			26			31			16			26		
End Depth:	20			30			35			20			30		
Parameter	Unit	Result	Qual	ReptLimit	Result	Qual	ReptLimit	Result	Qual	ReptLimit	Result	Qual	ReptLimit	Result	Qual	ReptLimit
1,2-Dichlorobenzene	ug/kg	< 7.2	UJ	7.2	< 5.7	U	5.7	< 6	U	6	< 6	UJ	6	< 6	U	6
1,2-Dichloroethane	ug/kg	3.5	J	7.2	< 5.7	U	5.7	< 6	U	6	< 6	U	6	< 6	U	6
1,2-Dichloropropane	ug/kg	< 7.2	U	7.2	< 5.7	U	5.7	< 6	U	6	< 6	U	6	< 6	U	6
1,3-Dichlorobenzene	ug/kg	< 7.2	UJ	7.2	< 5.7	U	5.7	< 6	U	6	< 6	UJ	6	< 6	U	6
1,4-Dichlorobenzene	ug/kg	< 7.2	UJ	7.2	< 5.7	U	5.7	< 6	U	6	< 6	UJ	6	< 6	U	6
1,4-Dioxane	ug/kg	< 140	U	140	< 110	U	110	< 120	U	120	< 120	U	120	< 120	U	120
2-Butanone	ug/kg	< 14	U	14	< 11	U	11	< 12	U	12	< 12	U	12	< 12	U	12
2-Hexanone	ug/kg	< 14	U	14	< 11	U	11	< 12	U	12	< 12	U	12	< 12	U	12
4-Methyl-2-pentanone	ug/kg	4.6	J	14	< 11	U	11	< 12	U	12	< 12	U	12	< 12	U	12
Acetone	ug/kg	< 52	U	52	< 11	U	11	< 12	U	12	< 14	U	14	< 12	U	12
Benzene	ug/kg	5	J	7.2	< 5.7	U	5.7	< 6	U	6	< 6	U	6	< 6	U	6
Bromochloromethane	ug/kg	< 7.2	U	7.2	< 5.7	U	5.7	< 6	U	6	< 6	U	6	< 6	U	6
Bromodichloromethane	ug/kg	< 7.2	U	7.2	< 5.7	U	5.7	< 6	U	6	< 6	U	6	< 6	U	6
Bromoform	ug/kg	< 7.2	U	7.2	< 5.7	U	5.7	< 6	U	6	< 6	U	6	< 6	U	6
Bromomethane	ug/kg	< 7.2	U	7.2	< 5.7	U	5.7	< 6	U	6	< 6	U	6	< 6	U	6
Carbon Disulfide	ug/kg	0.97	J	7.2	< 5.7	U	5.7	< 6	U	6	< 6	U	6	< 6	U	6
Carbon Tetrachloride	ug/kg	< 7.2	U	7.2	< 5.7	U	5.7	< 6	U	6	< 6	U	6	< 6	U	6
Chlorobenzene	ug/kg	130	J	7.2	< 5.7	U	5.7	< 6	U	6	7.5	J	6	< 6	U	6
Chloroethane	ug/kg	< 7.2	U	7.2	< 5.7	U	5.7	< 6	U	6	< 6	U	6	< 6	U	6
Chloroform	ug/kg	48		7.2	< 5.7	U	5.7	< 6	U	6	< 6	U	6	< 6	U	6
Chloromethane	ug/kg	< 7.2	U	7.2	< 5.7	U	5.7	< 6	U	6	< 6	U	6	< 6	U	6
cis-1,2-Dichloroethene	ug/kg	1400	J	1900	< 5.7	U	5.7	< 6	U	6	< 6	U	6	< 6	U	6
cis-1,3-Dichloropropene	ug/kg	< 7.2	UJ	7.2	< 5.7	U	5.7	< 6	U	6	< 6	U	6	< 6	U	6
Cyclohexane	ug/kg	< 7.2	U	7.2	< 5.7	U	5.7	< 6	U	6	< 6	U	6	< 6	U	6
Dibromochloromethane	ug/kg	< 7.2	U	7.2	< 5.7	U	5.7	< 6	U	6	< 6	U	6	< 6	U	6
Dichlorodifluoromethane	ug/kg	< 7.2	U	7.2	< 5.7	U	5.7	< 6	U	6	< 6	U	6	< 6	U	6
Ethylbenzene	ug/kg	200	J	7.2	< 5.7	U	5.7	< 6	U	6	6.8		6	< 6	U	6
Freon 113	ug/kg	140		7.2	< 5.7	U	5.7	< 6	U	6	< 6	U	6	< 6	U	6
Isopropylbenzene	ug/kg	1.2	J	7.2	< 5.7	U	5.7	< 6	U	6	< 6	U	6	< 6	U	6
m,p-Xylenes	ug/kg	7500		1900	< 5.7	U	5.7	< 6	U	6	34		6	3.9	J	6
Methyl Acetate	ug/kg	< 7.2	U	7.2	< 5.7	U	5.7	< 6	U	6	< 6	U	6	< 6	U	6
Methyl Cyclohexane	ug/kg	< 7.2	U	7.2	< 5.7	U	5.7	< 6	U	6	< 6	U	6	< 6	U	6
Methyl tert-Butyl Ether	ug/kg	< 7.2	U	7.2	< 5.7	U	5.7	< 6	U	6	< 6	U	6	< 6	U	6
Methylene Chloride	ug/kg	< 10	U	10	< 5.7	U	5.7	< 6	U	6	< 6	U	6	< 6	U	6
o-Xylene	ug/kg	220	J	7.2	< 5.7	U	5.7	< 6	U	6	8.6		6	< 6	U	6
Styrene	ug/kg	< 7.2	UJ	7.2	< 5.7	U	5.7	< 6	U	6	< 6	U	6	< 6	U	6
Tetrachloroethene	ug/kg	13000		1900	< 5.7	U	5.7	< 6	U	6	44		6	8.5		6

Checked by: TGS Date: 3/31/2010

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TABLE 4
Soil Samples
Validated Analytical Data
Carlstadt

Sample ID:	B09-4			B09-4			B09-4			B09-5			B09-5		
Sample Date:	01/13/2010			01/13/2010			01/13/2010			01/12/2010			01/12/2010		
N=Normal, FD=Field Duplicate:	N			N			N			N			N		
Start Depth:	16			26			31			16			26		
End Depth:	20			30			35			20			30		
Parameter	Unit	Result	Qual	ReptLimit	Result	Qual	ReptLimit	Result	Qual	ReptLimit	Result	Qual	ReptLimit	Result	Qual	ReptLimit
Toluene	ug/kg	7000		1900	< 5.7	U	5.7	< 6	U	6	32		6	3.1	J	6
trans-1,2-Dichloroethene	ug/kg	< 7.2	U	7.2	< 5.7	U	5.7	< 6	U	6	< 6	U	6	< 6	U	6
trans-1,3-Dichloropropene	ug/kg	< 7.2	UJ	7.2	< 5.7	U	5.7	< 6	U	6	< 6	U	6	< 6	U	6
Trichloroethene	ug/kg	49000		1900	< 5.7	U	5.7	2.3	J	6	240		6	23		6
Trichlorofluoromethane	ug/kg	< 7.2	U	7.2	< 5.7	U	5.7	< 6	U	6	< 6	U	6	< 6	U	6
Vinyl Chloride	ug/kg	< 7.2	U	7.2	< 5.7	U	5.7	< 6	U	6	< 6	U	6	< 6	U	6

Notes:
ug/kg = micrograms per kilogram
mg/kg = milligrams per kilogram
NDR = No Data Reported
Qual = Validated Qualifier
ReptLimit = Reporting Limit
Qualifier: J - Result or reporting limit is estimated.
U - Result was not detected at or above the method detection limit.
UJ - Detection limit is estimated.

Checked by: TGS Date: 3/31/2010

R2-0001274

TABLE 4
Soil Samples
Validated Analytical Data
Carlstadt

Sample ID:		MW-21R			MW-21R		
Sample Date:		12/17/2009			12/17/2009		
N=Normal, FD=Field Duplicate:		FD			N		
Start Depth:		24			24		
End Depth:		28			28		
Parameter	Unit	Result	Qual	ReptLimit	Result	Qual	ReptLimit
Inorganics							
Aluminum	mg/kg	7390		23.2	7310		23.1
Antimony	mg/kg	< 7	UJ	7	< 6.9	UJ	6.9
Arsenic	mg/kg	1	J	1.2	1.1	J	1.2
Barium	mg/kg	88	J	23.2	137	J	23.1
Beryllium	mg/kg	< 0.58	U	0.58	< 0.58	U	0.58
Cadmium	mg/kg	< 0.58	U	0.58	< 0.58	U	0.58
Calcium	mg/kg	19000		579	19800		577
Chromium	mg/kg	12.1		1.2	13		1.2
Cobalt	mg/kg	6.6		5.8	6.9		5.8
Copper	mg/kg	10.4	J	2.9	11	J	2.9
Iron	mg/kg	13200		11.6	12700		11.5
Lead	mg/kg	7.4		1.2	6.9		1.2
Magnesium	mg/kg	5510		579	5280		577
Manganese	mg/kg	434		1.7	434		1.7
Mercury	mg/kg	< 0.12	U	0.12	< 0.12	U	0.12
Nickel	mg/kg	15		4.6	15		4.6
Potassium	mg/kg	1790	J	579	1740	J	577
Selenium	mg/kg	1.2	J	4.1	1.2	J	4
Silver	mg/kg	< 1.2	U	1.2	< 1.2	U	1.2
Sodium	mg/kg	< 579	U	579	< 577	U	577
Thallium	mg/kg	< 2.9	U	2.9	< 2.9	U	2.9
Vanadium	mg/kg	18.3	J	5.8	26.8	J	5.8
Zinc	mg/kg	33	J	7	33.7	J	6.9
Natural Attenuation Parameters							
Alkalinity, Total	mg/kg	262	J	10	255	J	10
Ferrous Iron	mg/kg	59.4	J	0.4	25.4	J	0.4
Total Organic Carbon	mg/kg	1178	J	115.9	668.5	J	115.5
Volatile Organic Compounds							
1,1,1-Trichloroethane	ug/kg	< 5.8	U	5.8	< 5.8	U	5.8
1,1,2,2-Tetrachloroethane	ug/kg	< 5.8	U	5.8	< 5.8	U	5.8
1,1,2-Trichloroethane	ug/kg	< 5.8	U	5.8	< 5.8	U	5.8
1,1-Dichloroethane	ug/kg	< 5.8	U	5.8	< 5.8	U	5.8
1,1-Dichloroethene	ug/kg	< 5.8	U	5.8	< 5.8	U	5.8
1,2,3-Trichlorobenzene	ug/kg	< 5.8	U	5.8	< 5.8	U	5.8
1,2,4-Trichlorobenzene	ug/kg	< 5.8	U	5.8	< 5.8	U	5.8
1,2-Dibromo-3-chloropropane	ug/kg	< 5.8	U	5.8	< 5.8	U	5.8
1,2-Dibromoethane	ug/kg	< 5.8	U	5.8	< 5.8	U	5.8

Checked by: TGS Date: 3/31/2010

R2-0001275

TABLE 4
Soil Samples
Validated Analytical Data
Carlstadt

Sample ID:		MW-21R			MW-21R		
Sample Date:		12/17/2009			12/17/2009		
N=Normal, FD=Field Duplicate:		FD			N		
Start Depth:		24			24		
End Depth:		28			28		
Parameter	Unit	Result	Qual	ReptLimit	Result	Qual	ReptLimit
1,2-Dichlorobenzene	ug/kg	< 5.8	U	5.8	< 5.8	U	5.8
1,2-Dichloroethane	ug/kg	< 5.8	U	5.8	< 5.8	U	5.8
1,2-Dichloropropane	ug/kg	< 5.8	U	5.8	< 5.8	U	5.8
1,3-Dichlorobenzene	ug/kg	< 5.8	U	5.8	< 5.8	U	5.8
1,4-Dichlorobenzene	ug/kg	< 5.8	U	5.8	< 5.8	U	5.8
1,4-Dioxane	ug/kg	< 120	U	120	< 120	U	120
2-Butanone	ug/kg	< 12	U	12	< 12	U	12
2-Hexanone	ug/kg	< 12	U	12	< 12	U	12
4-Methyl-2-pentanone	ug/kg	< 12	U	12	< 12	U	12
Acetone	ug/kg	< 12	U	12	< 12	U	12
Benzene	ug/kg	< 5.8	U	5.8	< 5.8	U	5.8
Bromochloromethane	ug/kg	< 5.8	U	5.8	< 5.8	U	5.8
Bromodichloromethane	ug/kg	< 5.8	U	5.8	< 5.8	U	5.8
Bromoform	ug/kg	< 5.8	U	5.8	< 5.8	U	5.8
Bromomethane	ug/kg	< 5.8	U	5.8	< 5.8	U	5.8
Carbon Disulfide	ug/kg	< 5.8	U	5.8	< 5.8	U	5.8
Carbon Tetrachloride	ug/kg	< 5.8	U	5.8	< 5.8	U	5.8
Chlorobenzene	ug/kg	< 5.8	U	5.8	< 5.8	U	5.8
Chloroethane	ug/kg	< 5.8	U	5.8	< 5.8	U	5.8
Chloroform	ug/kg	< 5.8	U	5.8	< 5.8	U	5.8
Chloromethane	ug/kg	< 5.8	U	5.8	< 5.8	U	5.8
cis-1,2-Dichloroethene	ug/kg	< 5.8	U	5.8	< 5.8	U	5.8
cis-1,3-Dichloropropene	ug/kg	< 5.8	U	5.8	< 5.8	U	5.8
Cyclohexane	ug/kg	< 5.8	U	5.8	< 5.8	U	5.8
Dibromochloromethane	ug/kg	< 5.8	U	5.8	< 5.8	U	5.8
Dichlorodifluoromethane	ug/kg	< 5.8	U	5.8	< 5.8	U	5.8
Ethylbenzene	ug/kg	< 5.8	U	5.8	< 5.8	U	5.8
Freon 113	ug/kg	< 5.8	U	5.8	< 5.8	U	5.8
Isopropylbenzene	ug/kg	< 5.8	U	5.8	< 5.8	U	5.8
m,p-Xylenes	ug/kg	< 5.8	U	5.8	< 5.8	U	5.8
Methyl Acetate	ug/kg	< 5.8	U	5.8	< 5.8	U	5.8
Methyl Cyclohexane	ug/kg	< 5.8	U	5.8	< 5.8	U	5.8
Methyl tert-Butyl Ether	ug/kg	< 5.8	U	5.8	< 5.8	U	5.8
Methylene Chloride	ug/kg	0.88	J	5.8	0.72	J	5.8
o-Xylene	ug/kg	< 5.8	U	5.8	< 5.8	U	5.8
Styrene	ug/kg	< 5.8	U	5.8	< 5.8	U	5.8
Tetrachloroethene	ug/kg	< 5.8	U	5.8	< 5.8	U	5.8

Checked by: TGS Date: 3/31/2010

R2-0001276

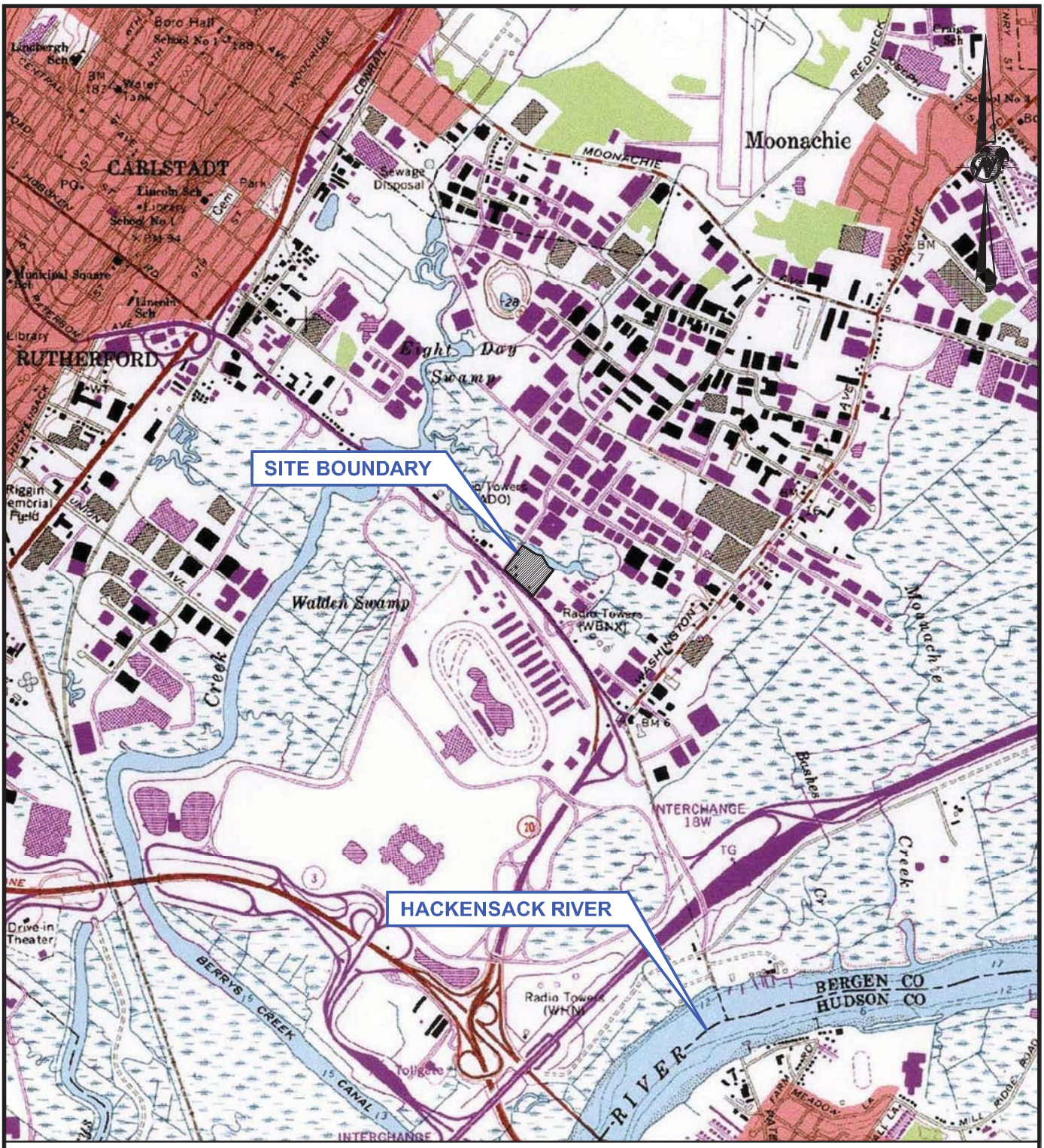
TABLE 4
Soil Samples
Validated Analytical Data
Carlstadt

Sample ID:		MW-21R			MW-21R		
Sample Date:		12/17/2009			12/17/2009		
N=Normal, FD=Field Duplicate:		FD			N		
Start Depth:		24			24		
End Depth:		28			28		
Parameter	Unit	Result	Qual	ReptLimit	Result	Qual	ReptLimit
Toluene	ug/kg	< 5.8	U	5.8	< 5.8	U	5.8
trans-1,2-Dichloroethene	ug/kg	< 5.8	U	5.8	< 5.8	U	5.8
trans-1,3-Dichloropropene	ug/kg	< 5.8	U	5.8	< 5.8	U	5.8
Trichloroethene	ug/kg	< 5.8	U	5.8	< 5.8	U	5.8
Trichlorofluoromethane	ug/kg	< 5.8	U	5.8	< 5.8	U	5.8
Vinyl Chloride	ug/kg	< 5.8	U	5.8	< 5.8	U	5.8

Notes:
ug/kg = micrograms per kilogram
mg/kg = milligrams per kilogram
NDR = No Data Reported
Qual = Validated Qualifier
ReptLimit = Reporting Limit
Qualifier: J - Result or reporting limit is estimated.
U - Result was not detected at or above the method detection limit.
UJ - Detection limit is estimated.

Checked by: TGS Date: 3/31/2010

R2-0001277



REFERENCE

1.) BASE MAP TAKEN FROM U.S.G.S. 7.5 MINUTE QUADRANGLE OF WEEHAWKEN, NEW JERSEY, DATED 1967 AND PHOTOREVISED 1981.

2000 0 2000
APPROXIMATE SCALE FEET

NJ Authorization #24GA28029100

Golder Associates
Philadelphia USA

FILE No.	9436222ZC05
PROJECT No.	943-6222
REV.	0

SCALE	AS SHOWN
DATE	09/02/10
DESIGN	HAL
CADD	MJS
CHECK	HAL
REVIEW	PSF

TITLE

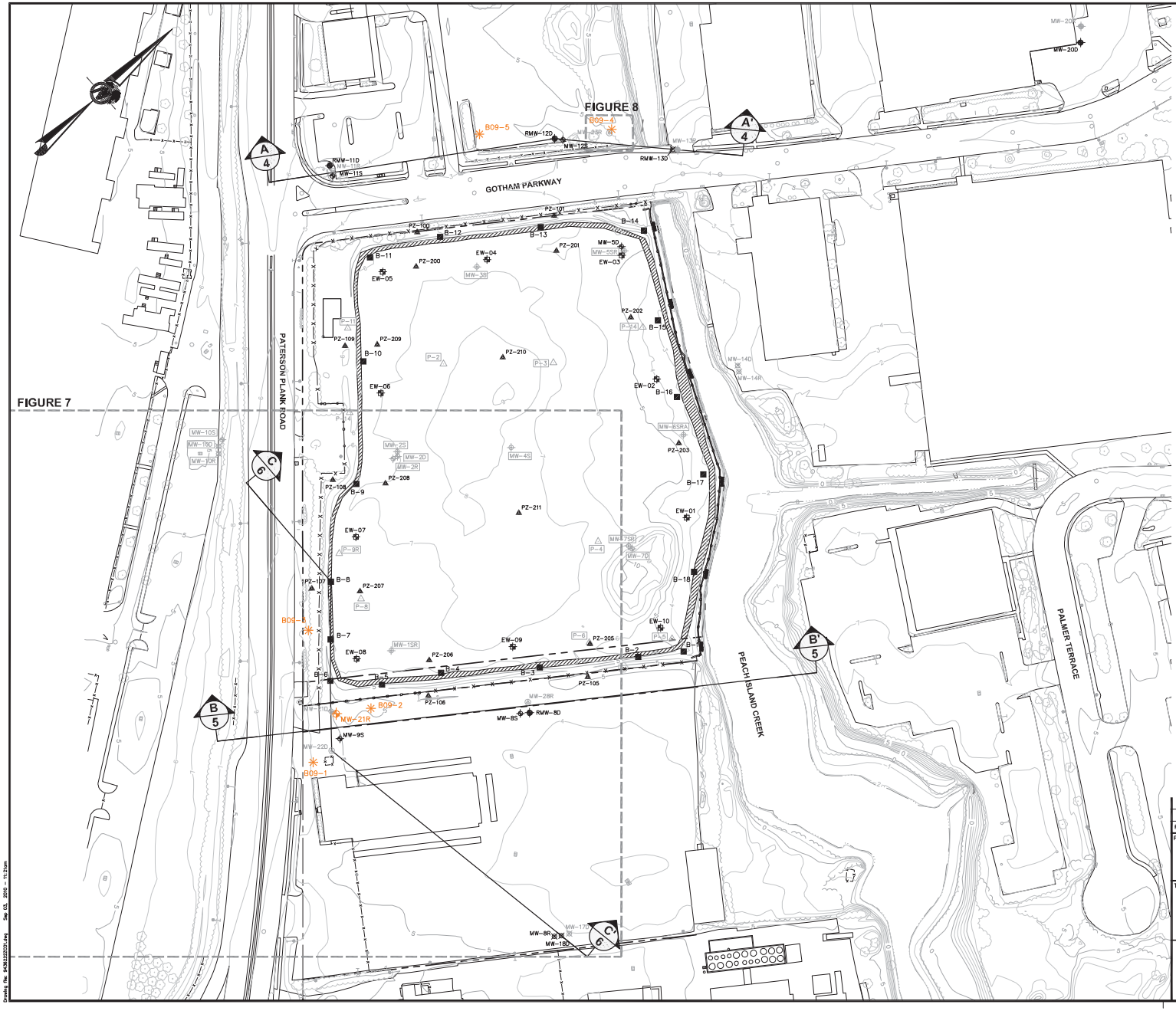
SITE LOCATION MAP

216 PATERSON PLANK ROAD SITE

FIGURE 1

Drawing file: 9436222ZC05.dwg Sep 03, 2010 - 11:24am

R2-0001278



LEGEND

- A/4 — DETAIL OR CROSS SECTION DESIGNATION
- FIGURE No. WHERE DETAIL OR CROSS SECTION IS PRESENTED
- 5 — EXISTING GROUND CONTOURS
- EDGE OF STREAM
- PROPERTY LINE
- EXISTING SLURRY WALL
- MW-8D — MONITORING WELL (INSTALLED DURING THE REMEDIAL INVESTIGATION)
- MW-8D — DECOMMISSIONED WELL
- MW-18D — MONITORING WELL (INSTALLED DURING THE OFF-PROPERTY INVESTIGATION -JULY 1996)
- MW-18D — MONITORING WELL (INSTALLED DURING THE OFF-PROPERTY INVESTIGATION - AUGUST 1998)
- MW-15R — MONITORING WELL (INSTALLED DURING THE OFF-PROPERTY INVESTIGATION - NOVEMBER 2002)
- MW-25D — MONITORING WELL (INSTALLED DURING THE OFF-PROPERTY INVESTIGATION - 2007)
- P-4 — SHALLOW PIEZOMETER (INSTALLED DURING THE REMEDIAL INVESTIGATION)
- MW-4S — EXTRACTION WELL (INSTALLED DURING THE REMEDIAL INVESTIGATION AND RETROFITTED FOR SHALLOW GROUNDWATER EXTRACTION)
- B-6 — SLURRY WALL CONSTRUCTION INVESTIGATION BORING (INSTALLED DURING OU-1 REMEDIAL DESIGN, 1992)
- B09-2 — SOIL BORING (2009-2010)
- MW-21 — MONITORING WELL (2009)
- EW-02 — EXTRACTION WELL (2009)
- PZ-202 — PIEZOMETER (2009)

NOTES

1.) ALL LOCATIONS ARE APPROXIMATE.

2.) WELLS SHOWN IN GRAY WERE NOT SAMPLED IN 2009.

REFERENCES

1.) BASE MAP SHOWN TAKEN FROM DIGITAL FILE 3074-02-TOPO.DWG, ENTITLED "BOROUGH OF CARLSTADT BLOCK 124 LOTS 1 THROUGH 5," DATED DECEMBER 8, 2005, PREPARED BY PROMAPS.

2.) HORIZONTAL DATUM REFERENCES THE NEW JERSEY STATE PLANE COORDINATE SYSTEM, NORTH AMERICAN DATUM OF 1983 (NAD 83). VERTICAL DATUM REFERENCES THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD 88).

3.) AS-BUILT SHEET PILE, PIEZOMETER, EXTRACTION WELL AND CARRIER PIPE LOCATIONS/LIMITS TAKEN FROM DIGITAL CAD FILE RBSU007938.DWG FIGURE 3 OF 7 ENTITLED "AS-BUILT GROUNDWATER RECOVERY SYSTEM AND PIEZOMETER SURVEY," PREPARED BY MASER CONSULTING P.A., DATED MARCH 9, 2009.

4.) NEW FENCE AND MAINTENANCE BUILDING LOCATIONS/LIMITS TAKEN FROM DIGITAL CAD FILE RBSU008761.DWG, FIGURE 7 OF 7, ENTITLED "AS-BUILT FINAL SITE CONDITION SURVEY," PREPARED BY MASER CONSULTING P.A., DATED MARCH 17, 2009.

5.) MONITORING WELL LOCATIONS MW-24D, MW-24R, MW-25D, MW-25R, MW-26D, MW-27R, AND MW-28R SURVEYED ON AUGUST 6, 2007, PROVIDED BY JAMES M. STEWART, INC.

6.) MONITORING WELLS (1996 AND RI WELLS) SURVEYED BY GEOD CORPORATION (OCTOBER 1996). WELLS INSTALLED IN 1998 SURVEYED BY GEOD CORPORATION. WELLS INSTALLED IN 2002 SURVEYED BY JAMES M. STEWART, INC., WELL AND BORINGS INSTALLED IN 2009-2010 BY VARGO ASSOCIATES.

7.) SOIL BORINGS B09-1 THROUGH B09-5 AND MONITORING WELL MW-21R FROM DIGITAL CAD FILE VARGO SURVEY OF 216 PATERSON PLANK ROAD.DWG, DATED JANUARY 25, 2010, PREPARED BY VARGO ASSOCIATES.

8.) NEW EXTRACTION WELLS AND PIEZOMETERS WERE INSTALLED IN 2009 AS PART OF THE OU2 REMEDY. LOCATIONS SHOWN ARE TAKEN FROM DIGITAL FILE "RBSU007938.dwg," ENTITLED "AS-BUILT GROUND WATER RECOVERY SYSTEM AND PEIZOMETER SURVEY," DATED MARCH 9, 2009, PROVIDED BY MASER CONSULTING P.A..

60 0 60 120
SCALE FEET

REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW

PROJECT

216 PATERSON PLANK ROAD SITE
CARLSTADT, BERGEN COUNTY, NEW JERSEY

TITLE

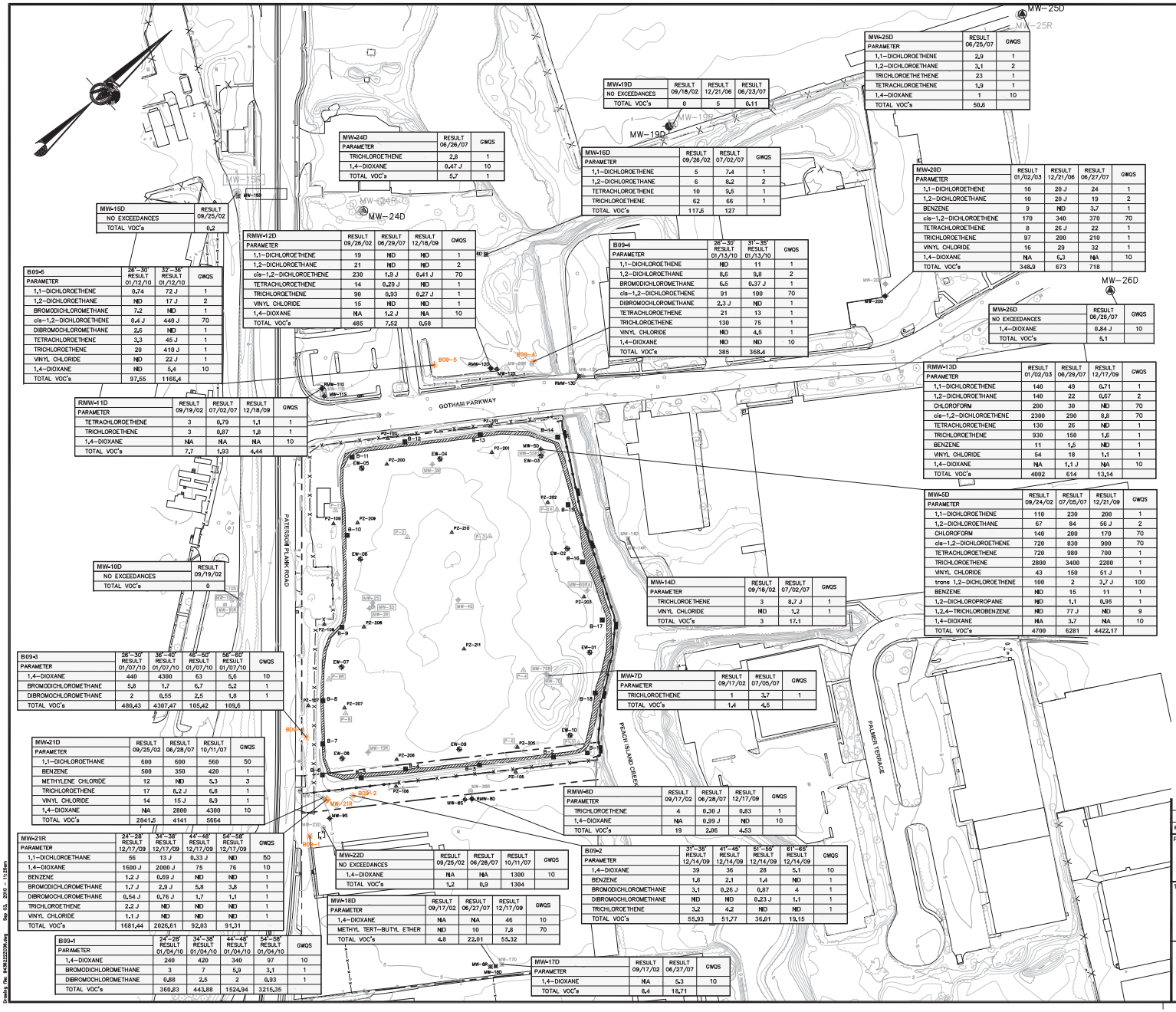
SITE PLAN

Golder Associates
Mt. Laurel, New Jersey
NJ Authorization #24GA28029100

PROJECT No.	943-6222		FILE No.	9436222ZC01	
DESIGN	MFM	09/02/10	SCALE	AS SHOWN	REV. 0
CADD	MJS	09/02/10	FIGURE 2		
CHECK	HAL	09/02/10			
REVIEW	PSF	09/02/10			

Drawing file: 9436222ZC01.dwg Sep 03, 2010 - 11:21am

R2-0001279



MW-25D	RESULT 06/25/07	GWQS
1,1-DICHLOROETHENE	2,9	1
1,2-DICHLOROETHANE	3,1	2
TRICHLOROETHETHENE	23	1
TETRACHLOROETHENE	1,9	1
1,4-DIOXANE	1	10
TOTAL VOC's	50,6	

MW-19D	RESULT 09/18/02	RESULT 12/21/06	RESULT 06/23/07
NO EXCEEDANCES			
TOTAL VOC's	0	5	0,11

MW-24D	RESULT 06/26/07	GWQS
TRICHLOROETHENE	2,8	1
1,4-DIOXANE	0,47 J	10
TOTAL VOC's	5,7	1

MW-16D	RESULT 09/26/02	RESULT 07/02/07	GWQS
1,1-DICHLOROETHENE	5	7,4	1
1,2-DICHLOROETHANE	6	8,2	2
TETRACHLOROETHENE	10	9,5	1
TRICHLOROETHENE	62	66	1
TOTAL VOC's	117,6	127	

MW-20D	RESULT 01/02/03	RESULT 12/21/06	RESULT 06/27/07	GWQS
1,1-DICHLOROETHENE	10	20 J	24	1
1,2-DICHLOROETHANE	10	20 J	19	2
BENZENE	9	ND	3,7	1
cis-1,2-DICHLOROETHENE	170	340	370	70
TETRACHLOROETHENE	8	26 J	22	1
TRICHLOROETHENE	97	200	210	1
VINYL CHLORIDE	16	29	32	1
1,4-DIOXANE	NA	6,3	NA	10
TOTAL VOC's	348,9	673	718	

MW-15D	RESULT 09/25/02
NO EXCEEDANCES	
TOTAL VOC's	0,2

RMW-12D	RESULT 09/28/02	RESULT 06/29/07	RESULT 12/18/09	GWQS
1,1-DICHLOROETHENE	19	ND	ND	1
1,2-DICHLOROETHANE	21	ND	ND	2
cis-1,2-DICHLOROETHENE	230	1,9 J	0,41 J	70
TETRACHLOROETHENE	14	0,29 J	ND	1
TRICHLOROETHENE	90	0,93	0,27 J	1
VINYL CHLORIDE	15	ND	ND	1
1,4-DIOXANE	NA	1,2 J	NA	10
TOTAL VOC's	485	7,52	0,68	

B09-4	26'-30' RESULT 01/13/10	31'-35' RESULT 01/13/10	GWQS
1,1-DICHLOROETHENE	ND	11	1
1,2-DICHLOROETHANE	8,6	9,8	2
BROMODICHLOROMETHANE	6,5	0,37 J	1
cis-1,2-DICHLOROETHENE	91	100	70
DIBROMOCHLOROMETHANE	2,3 J	ND	1
TETRACHLOROETHENE	21	13	1
TRICHLOROETHENE	130	75	1
VINYL CHLORIDE	ND	4,5	1
1,4-DIOXANE	ND	ND	10
TOTAL VOC's	385	368,4	

MW-26D	RESULT 06/26/07	GWQS
NO EXCEEDANCES		
1,4-DIOXANE	0,84 J	10
TOTAL VOC's	5,1	

B09-6	26'-30' RESULT 01/12/10	32'-36' RESULT 01/12/10	GWQS
1,1-DICHLOROETHENE	0,74	72 J	1
1,2-DICHLOROETHANE	ND	17 J	2
BROMODICHLOROMETHANE	7,2	ND	1
cis-1,2-DICHLOROETHENE	0,4 J	440 J	70
DIBROMOCHLOROMETHANE	2,6	ND	1
TETRACHLOROETHENE	3,3	45 J	1
TRICHLOROETHENE	20	410 J	1
VINYL CHLORIDE	ND	22 J	1
1,4-DIOXANE	ND	5,4	10
TOTAL VOC's	97,55	1166,4	

RMW-11D	RESULT 09/19/02	RESULT 07/02/07	RESULT 12/18/09	GWQS
TETRACHLOROETHENE	3	0,79	1,1	1
TRICHLOROETHENE	3	0,87	1,8	1
1,4-DIOXANE	NA	NA	NA	10
TOTAL VOC's	7,7	1,93	4,44	

RMW-13D	RESULT 01/02/03	RESULT 06/29/07	RESULT 12/17/09	GWQS
1,1-DICHLOROETHENE	140	49	0,71	1
1,2-DICHLOROETHANE	140	22	0,67	2
CHLOROFORM	200	30	ND	70
cis-1,2-DICHLOROETHENE	2300	290	8,8	70
TETRACHLOROETHENE	130	26	ND	1
TRICHLOROETHENE	930	150	1,6	1
BENZENE	11	1,5	ND	1
VINYL CHLORIDE	54	18	1,1	1
1,4-DIOXANE	NA	1,1 J	NA	10
TOTAL VOC's	4002	614	13,14	

MW-5D	RESULT 09/24/02	RESULT 07/05/07	RESULT 12/21/09	GWQS
1,1-DICHLOROETHENE	110	230	200	1
1,2-DICHLOROETHANE	67	84	56 J	2
CHLOROFORM	140	200	170	70
cis-1,2-DICHLOROETHENE	720	830	900	70
TETRACHLOROETHENE	720	980	700	1
TRICHLOROETHENE	2800	3400	2200	1
VINYL CHLORIDE	43	150	51 J	1
trans 1,2-DICHLOROETHENE	100	2	3,7 J	100
BENZENE	ND	15	11	1
1,2-DICHLOROPROPANE	ND	1,1	0,95	1
1,2,4-TRICHLOROBENZENE	ND	77 J	ND	9
1,4-DIOXANE	NA	3,7	NA	10
TOTAL VOC's	4700	6281	4422,17	

MW-10D	RESULT 09/19/02
NO EXCEEDANCES	
TOTAL VOC's	0

MW-14D	RESULT 09/18/02	RESULT 07/02/07	GWQS
TRICHLOROETHENE	3	8,7 J	1
VINYL CHLORIDE	ND	1,2	1
TOTAL VOC's	3	17,1	

B09-3	26'-30' RESULT 01/07/10	36'-40' RESULT 01/07/10	46'-50' RESULT 01/07/10	56'-60' RESULT 01/07/10	GWQS
1,4-DIOXANE	440	4300	63	5,6	10
BROMODICHLOROMETHANE	5,8	1,7	6,7	5,2	1
DIBROMOCHLOROMETHANE	2	0,55	2,6	1,8	1
TOTAL VOC's	480,43	4307,47	195,42	109,6	

MW-7D	RESULT 09/17/02	RESULT 07/05/07	GWQS
TRICHLOROETHENE	1	3,7	1
TOTAL VOC's	1,4	4,5	

MW-21D	RESULT 09/25/02	RESULT 06/28/07	RESULT 10/11/07	GWQS
1,1-DICHLOROETHANE	600	600	560	50
BENZENE	500	350	420	1
METHYLENE CHLORIDE	12	ND	5,3	3
TRICHLOROETHENE	17	8,2 J	6,8	1
VINYL CHLORIDE	14	15 J	8,9	1
1,4-DIOXANE	NA	2800	4300	10
TOTAL VOC's	2041,5	4141	5664	

RMW-10D	RESULT 09/17/02	RESULT 06/28/07	RESULT 12/17/09	GWQS
TRICHLOROETHENE	4	0,30 J	0,83	1
1,4-DIOXANE	NA	0,99 J	ND	10
TOTAL VOC's	19	2,06	4,53	

MW-21R	24'-28' RESULT 12/17/09	34'-38' RESULT 12/17/09	44'-48' RESULT 12/17/09	54'-58' RESULT 12/17/09	GWQS
1,1-DICHLOROETHANE	56	13 J	0,33 J	ND	50
1,4-DIOXANE	1600 J	2000 J	75	76	10
BENZENE	1,2 J	0,69 J	ND	ND	1
BROMODICHLOROMETHANE	1,7 J	2,9 J	5,8	3,8	1
DIBROMOCHLOROMETHANE	0,54 J	0,76 J	1,7	1,1	1
TRICHLOROETHENE	2,2 J	ND	ND	ND	1
VINYL CHLORIDE	1,1 J	ND	ND	ND	1
TOTAL VOC's	1681,44	2026,61	92,03	91,31	

MW-22D	RESULT 09/25/02	RESULT 06/28/07	RESULT 10/11/07	GWQS
NO EXCEEDANCES				
1,4-DIOXANE	NA	NA	1300	10
TOTAL VOC's	1,2	0,9	1304	

B09-2	31'-35' RESULT 12/14/09	41'-45' RESULT 12/14/09	51'-55' RESULT 12/14/09	61'-65' RESULT 12/14/09	GWQS
1,4-DIOXANE	39	36	28	5,1	10
BENZENE	1,8	2,1	1,4	ND	1
BROMODICHLOROMETHANE	3,1	0,26 J	0,87	4	1
DIBROMOCHLOROMETHANE	ND	ND	0,23 J	1,1	1
TRICHLOROETHENE	3,2	4,2	ND	ND	1
TOTAL VOC's	55,93	51,77	36,01	19,15	

MW-18D	RESULT 09/17/02	RESULT 06/27/07	RESULT 12/17/09	GWQS
1,4-DIOXANE	NA	NA	46	10
METHYL TERT-BUTYL ETHER	ND	10	7,8	70
TOTAL VOC's	4,8	22,01	55,32	

B09-1	24'-28' RESULT 01/04/10	34'-38' RESULT 01/04/10	44'-48' RESULT 01/04/10	54'-58' RESULT 01/04/10	GWQS
1,4-DIOXANE	240	420	340	97	10
BROMODICHLOROMETHANE	3	7	5,9	3,1	1
DIBROMOCHLOROMETHANE	0,88	2,5	2	0,93	1
TOTAL VOC's	360,83	443,88	1524,94	3215,35	

MW-17D	RESULT 09/17/02	RESULT 06/27/07	GWQS
1,4-DIOXANE	NA	5,3	10
TOTAL VOC's	8,4	18,71	

LEGEND

- EXISTING GROUND CONTOURS
- EDGE OF STREAM
- PROPERTY LINE
- EXISTING SLURRY WALL
- MW-8D — MONITORING WELL (INSTALLED DURING THE REMEDIAL INVESTIGATION)
- MW-8D — DECOMMISSIONED WELL
- MW-18D — MONITORING WELL (INSTALLED DURING THE OFF-PROPERTY INVESTIGATION -JULY 1996)
- MW-18D — MONITORING WELL (INSTALLED DURING THE OFF-PROPERTY INVESTIGATION – AUGUST 1998)
- MW-15R — MONITORING WELL (INSTALLED DURING THE OFF-PROPERTY INVESTIGATION – NOVEMBER 2002)
- MW-25D — MONITORING WELL (INSTALLED DURING THE OFF-PROPERTY INVESTIGATION – 2007)
- P-4 — SHALLOW PIEZOMETER (INSTALLED DURING THE REMEDIAL INVESTIGATION)
- MW-4S — EXTRACTION WELL (INSTALLED DURING THE REMEDIAL INVESTIGATION AND RETROFITTED FOR SHALLOW GROUNDWATER EXTRACTION)
- B-6 — SLURRY WALL CONSTRUCTION INVESTIGATION BORING (INSTALLED DURING OU-1 REMEDIAL DESIGN, 1992)
- B09-2 — SOIL BORING (2009-2010)
- MW-21 — MONITORING WELL (2009)
- EW-02 — EXTRACTION WELL (2009)
- PZ-202 — PIEZOMETER (2009)

NOTES

1.) ALL LOCATIONS ARE APPROXIMATE.

2.) GROUNDWATER QUALITY STANDARDS BASED ON "NEW JERSEY REGISTER" N.J.A.C. 7:9-6 "GROUNDWATER STANDARDS" JANUARY 7, 1993 (UPDATED AUGUST 24, 2007).

3.) ALL VALUES REPORTED IN PARTS PER BILLION (ppb).

4.) VALUES INDICATED AS TOTAL VOC's INCLUDE ADDITIONAL CONSTITUENTS FOR WHICH MEASURED LEVELS DID NOT EXCEED THE GROUNDWATER QUALITY STANDARD.

5.) "NA" INDICATES SAMPLE WAS NOT ANALYZED.

REFERENCES

1.) BASE MAP SHOWN TAKEN FROM DIGITAL FILE 3074-02-TOPO.DWG, ENTITLED "BOROUGH OF CARLSTADT BLOCK 124 LOTS 1 THROUGH 5," DATED DECEMBER 8, 2005, PREPARED BY PROMAPS.

2.) HORIZONTAL DATUM REFERENCES THE NEW JERSEY STATE PLANE COORDINATE SYSTEM, NORTH AMERICAN DATUM OF 1983 (NAD 83), VERTICAL DATUM REFERENCES THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD 88).

3.) AS-BUILT SHEET PILE, PIEZOMETER, EXTRACTION WELL AND CARRIER PIPE LOCATIONS/LIMITS TAKEN FROM DIGITAL CAD FILE RBSU007938.DWG FIGURE 3 OF 7 ENTITLED "AS-BUILT GROUNDWATER RECOVERY SYSTEM AND PIEZOMETER SURVEY," PREPARED BY MASER CONSULTING P.A., DATED MARCH 9, 2009.

4.) NEW FENCE AND MAINTENANCE BUILDING LOCATIONS/LIMITS TAKEN FROM DIGITAL CAD FILE RBSU008761.DWG, FIGURE 7 OF 7, ENTITLED "AS-BUILT FINAL SITE CONDITION SURVEY," PREPARED BY MASER CONSULTING P.A., DATED MARCH 17, 2009.

5.) MONITORING WELL LOCATIONS MW-24D, MW-24R, MW-25D, MW-25R, MW-26D, MW-27R, AND MW-28R SURVEYED ON AUGUST 6, 2007, PROVIDED BY JAMES M. STEWART, INC.

6.) MONITORING WELLS (1996 AND R WELLS), PIEZOMETERS, AND EXTRACTION WELLS SURVEYED BY GEOD CORPORATION (OCTOBER 1996). WELLS INSTALLED IN 1998 SURVEYED BY GEOD CORPORATION. WELLS INSTALLED IN 2002 SURVEYED BY JAMES M. STEWART, INC., WELL AND BORINGS INSTALLED IN 2009-2010 BY VARGO ASSOCIATES.

7.) SOIL BORINGS B09-1 THROUGH B09-5 AND MONITORING WELL MW-21R FROM DIGITAL CAD FILE VARGO SURVEY OF 216 PATERSON PLANK ROAD.DWG, DATED JANUARY 25, 2010, PREPARED BY VARGO ASSOCIATES.

8.) NEW EXTRACTION WELLS AND PIEZOMETERS WERE INSTALLED IN 2009 AS PART OF THE OU2 REMEDY. LOCATIONS SHOWN ARE TAKEN FROM DIGITAL FILE "RBSU007938.dwg," ENTITLED "AS-BUILT GROUND WATER RECOVERY SYSTEM AND PEIZOMETER SURVEY," DATED MARCH 9, 2009, PROVIDED BY MASER CONSULTING P.A..

80 0 80 160
SCALE FEET

REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW

PROJECT

216 PATERSON PLANK ROAD SITE
CARLSTADT, BERGEN COUNTY, NEW JERSEY

TITLE

TILL GROUNDWATER QUALITY

NJ Authorization #24GA28029100
Golder Associates
Mt. Laurel, New Jersey

PROJECT No.	943-6222	FILE No.	943622ZC06
DESIGN	MFM	09/02/10	SCALE AS SHOWN REV. 0
CADD	RG	09/02/10	
CHECK	HAL	09/02/10	FIGURE 3
REVIEW	PSF	09/02/10	

Drawing file: 943622ZC06.dwg Sep 03, 2010 - 11:28am

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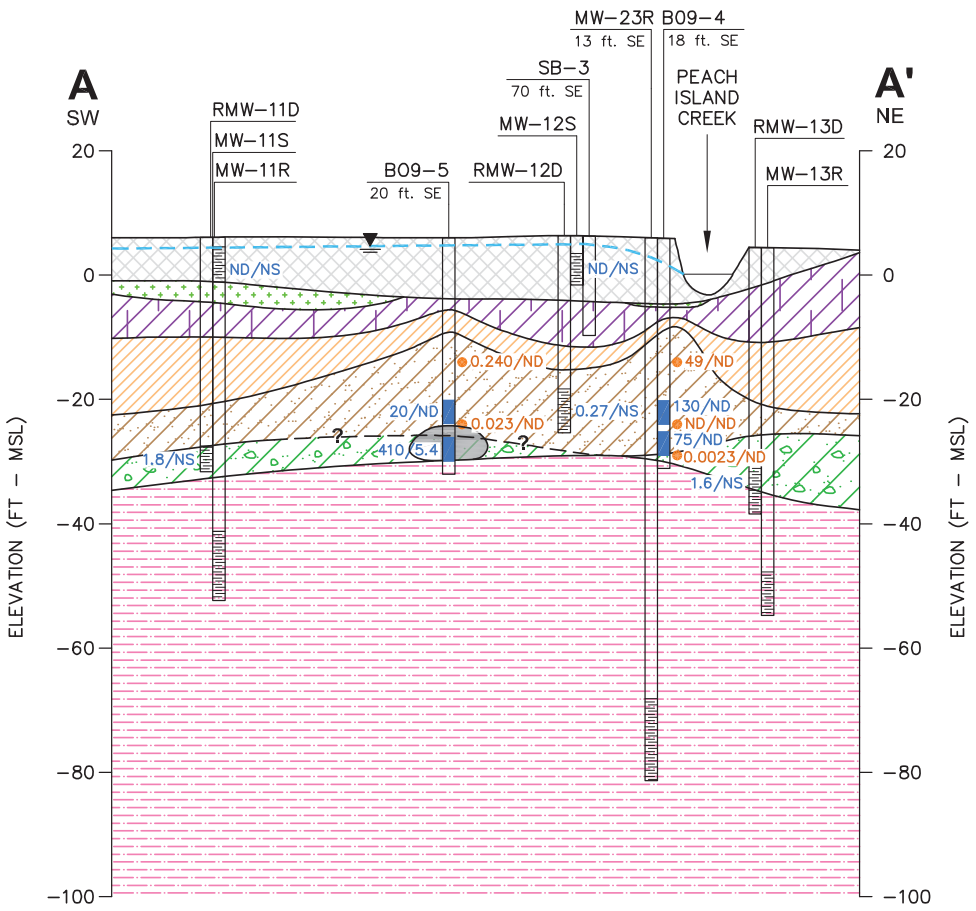


LEGEND

- APPROXIMATE GROUNDWATER ELEVATION (FILL)
- B09–5 / 20 ft. SE — BOREHOLE LABEL / PROJECTED DISTANCE
- TOP OF BOREHOLE
- GROUNDWATER SAMPLE INTERVAL (2009–2010)
- SOIL SAMPLE (2009–2010)
- SCREENED INTERVAL (2009 ANNUAL SAMPLING)
- BOTTOM OF BOREHOLE
- 20/ND — TRICHLOROETHENE / 1,4–DIOXANE (ug/L)
- 240/ND — TRICHLOROETHENE / 1,4–DIOXANE (mg/kg)
- FILL
- PEAT
- GRAY SILT / BEDDED CLAY (UPPER HORIZON GLACIOLACUSTRINE VARVED CLAY)
- VARVED CLAY (LOWER HORIZON GLACIOLACUSTRINE VARVED CLAY)
- BOULDER (FLOAT) – UNCONSOLIDATED GNEISSIC SCHIST
- SOFT TILL
- LODGEMENT TILL
- BEDROCK

100 0 100 HORIZONTAL SCALE FEET

20 0 20 VERTICAL SCALE FEET

NOTES

1.) SUBSURFACE INFORMATION OBTAINED DURING FIELD WORK IN DECEMBER 2009/JANUARY 2010, THE OFF–PROPERTY INVESTIGATION (1996–2007) SUPPLEMENTED WITH BOREHOLE INFORMATION OBTAINED FROM THE FOLLOWING PREVIOUS INVESTIGATIONS : DAMES AND MOORE, 1990 "FINAL REPORT – REMEDIAL INVESTIGATION SCP SITE, CARLSTADT, NEW JERSEY" DATED MARCH 1, 1990; AND CANONIE ENVIRONMENTAL, 1991 "INTERIM REMEDY REMEDIAL DESIGN REPORT", DATED JULY 19, 1991.

2.) FOR PRESENTATION PURPOSES THE CROSS SECTIONS WERE CONSTRUCTED DEPICTING MONITORING WELL CLUSTERS AS A SINGLE BOREHOLE WITH MULTIPLE WELL SCREENS. THE WELLS ARE IN REALITY SEPARATE AND DISTINCT.

3.) NOT ALL BORINGS AND/OR WELLS LIE ALONG THE LINE OF SECTION; SOME HAVE BEEN PROJECTED ONTO THE LINE OF SECTION, AND PROJECTION DISTANCE NOTED.

4.) ND = NOT DETECTED, NS = NOT SAMPLED.

REFERENCES

1.) TOPOGRAPHIC DATA AND SURFACE FEATURES BASED ON INFORMATION BY TAYLOR, WISEMAN & TAYLOR CONSULTING ENGINEERS / SURVEYORS / PLANNERS / LANDSCAPE ARCHITECTS, MOUNT LAUREL, NEW JERSEY, DATED JUNE 12, 1992.

2.) MONITORING WELLS (1996 AND RI WELLS), PIEZOMETERS, AND EXTRACTION WELLS SURVEYED BY GEOD CORPORATION (OCTOBER 1996). WELLS INSTALLED IN 1998 SURVEYED BY GEOD CORPORATION. WELLS INSTALLED IN 2002 AND 2007 SURVEYED BY JAMES M. STEWART, INC. WELL AND BORINGS INSTALLED IN 2009–2010 BY VARGO ASSOCIATES.

REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW

PROJECT

216 PATERSON PLANK ROAD NPL SITE
CARLSTADT, NEW JERSEY

TITLE

GEOLOGIC CROSS SECTION A-A'

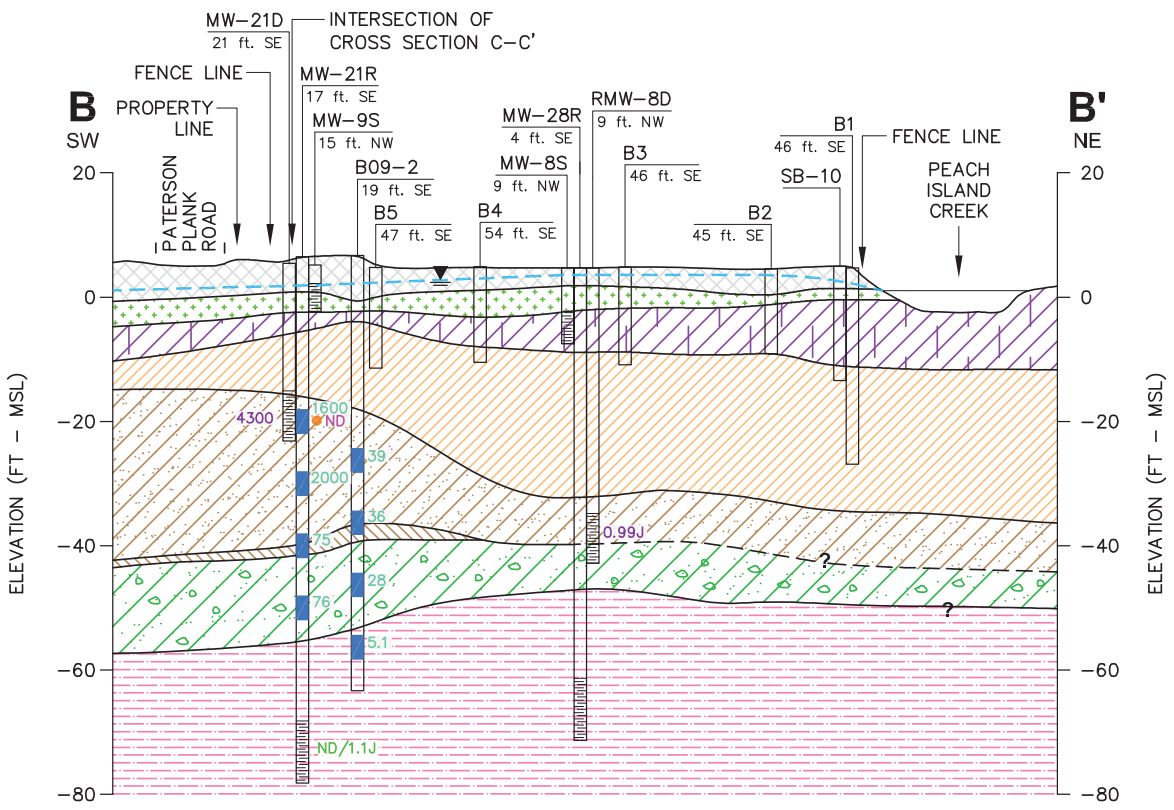
Golder Associates
Mt. Laurel, New Jersey
NJ Authorization #24GA28029100

PROJECT No.	943–6222		FILE No.	943622222C02	
DESIGN	HAL	09/02/10	SCALE	AS SHOWN	REV. 0
CADD	MJS	09/02/10			
CHECK	HAL	09/02/10			
REVIEW	PSF	09/02/10			

FIGURE 4

Drawing file: 943622222C02.dwg Sep 03, 2010 – 11:22am

R2-0001281



LEGEND

- APPROXIMATE GROUNDWATER ELEVATION (FILL)
- B09–2 / 19 ft. SE — BOREHOLE LABEL / PROJECTED DISTANCE
- TOP OF BOREHOLE
- GROUNDWATER SAMPLE INTERVAL (2009–2010)
- SOIL SAMPLE (2009–2010)
- SCREENED INTERVAL
- BOTTOM OF BOREHOLE
- 1600 — 1,4–DIOXANE (DECEMBER 2009) (ug/L)
- ND — 1,4–DIOXANE (2009) (ug/kg)
- 4300 — 1,4–DIOXANE (2007) (ug/L)
- ND/1.1J — 1,4–DIOXANE (2010) (ug/L) (PRIMARY/FIELD DUPLICATE)
- FILL
- PEAT
- GRAY SILT / BEDDED CLAY (UPPER HORIZON GLACIOLACUSTRINE VARVED CLAY)
- VARVED CLAY (LOWER HORIZON GLACIOLACUSTRINE VARVED CLAY)
- LOWER CLAY
- SOFT TILL
- LODGEMENT TILL
- BEDROCK

HORIZONTAL SCALE: 100 0 100 FEET

VERTICAL SCALE: 20 0 20 FEET

NOTES

1.) SUBSURFACE INFORMATION OBTAINED DURING FIELD WORK IN DECEMBER 2009/JANUARY 2010, THE OFF–PROPERTY INVESTIGATION (1996–2007) SUPPLEMENTED WITH BOREHOLE INFORMATION OBTAINED FROM THE FOLLOWING PREVIOUS INVESTIGATIONS : DAMES AND MOORE, 1990 "FINAL REPORT – REMEDIAL INVESTIGATION SCP SITE, CARLSTADT, NEW JERSEY" DATED MARCH 1, 1990; AND CANONIE ENVIRONMENTAL, 1991 "INTERIM REMEDY REMEDIAL DESIGN REPORT", DATED JULY 19, 1991.

2.) FOR PRESENTATION PURPOSES THE CROSS SECTIONS WERE CONSTRUCTED DEPICTING MONITORING WELL CLUSTERS AS A SINGLE BOREHOLE WITH MULTIPLE WELL SCREENS. THE WELLS ARE IN REALITY SEPARATE AND DISTINCT.

3.) NOT ALL BORINGS AND/OR WELLS LIE ALONG THE LINE OF SECTION; SOME HAVE BEEN PROJECTED ONTO THE LINE OF SECTION, AND PROJECTION DISTANCE NOTED.

4.) ND = NOT DETECTED, NS = NOT SAMPLED.

REFERENCES

1.) TOPOGRAPHIC DATA AND SURFACE FEATURES BASED ON INFORMATION BY TAYLOR, WISEMAN & TAYLOR CONSULTING ENGINEERS / SURVEYORS / PLANNERS / LANDSCAPE ARCHITECTS, MOUNT LAUREL, NEW JERSEY, DATED JUNE 12, 1992.

2.) MONITORING WELLS (1996 AND RI WELLS), PIEZOMETERS, AND EXTRACTION WELLS SURVEYED BY GEOD CORPORATION (OCTOBER 1996). WELLS INSTALLED IN 1998 SURVEYED BY GEOD CORPORATION. WELLS INSTALLED IN 2002 AND 2007 SURVEYED BY JAMES M. STEWART, INC. WELL AND BORINGS INSTALLED IN 2009–2010 BY VARGO ASSOCIATES.

REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW

PROJECT

216 PATERSON PLANK ROAD NPL SITE
CARLSTADT, NEW JERSEY

TITLE

GEOLOGIC CROSS SECTION B-B'

NJ Authorization #24GA28029100
Golder Associates
Mt. Laurel, New Jersey

PROJECT No.	943–6222		FILE No.	943622 2C03	
DESIGN	HAL	09/02/10	SCALE	AS SHOWN	REV. 0
CADD	MJS	09/02/10			
CHECK	HAL	09/02/10			
REVIEW	PSF	09/02/10			

FIGURE 5

Drawing file: 943622 2C03.dwg Sep 03, 2010 – 11:23am

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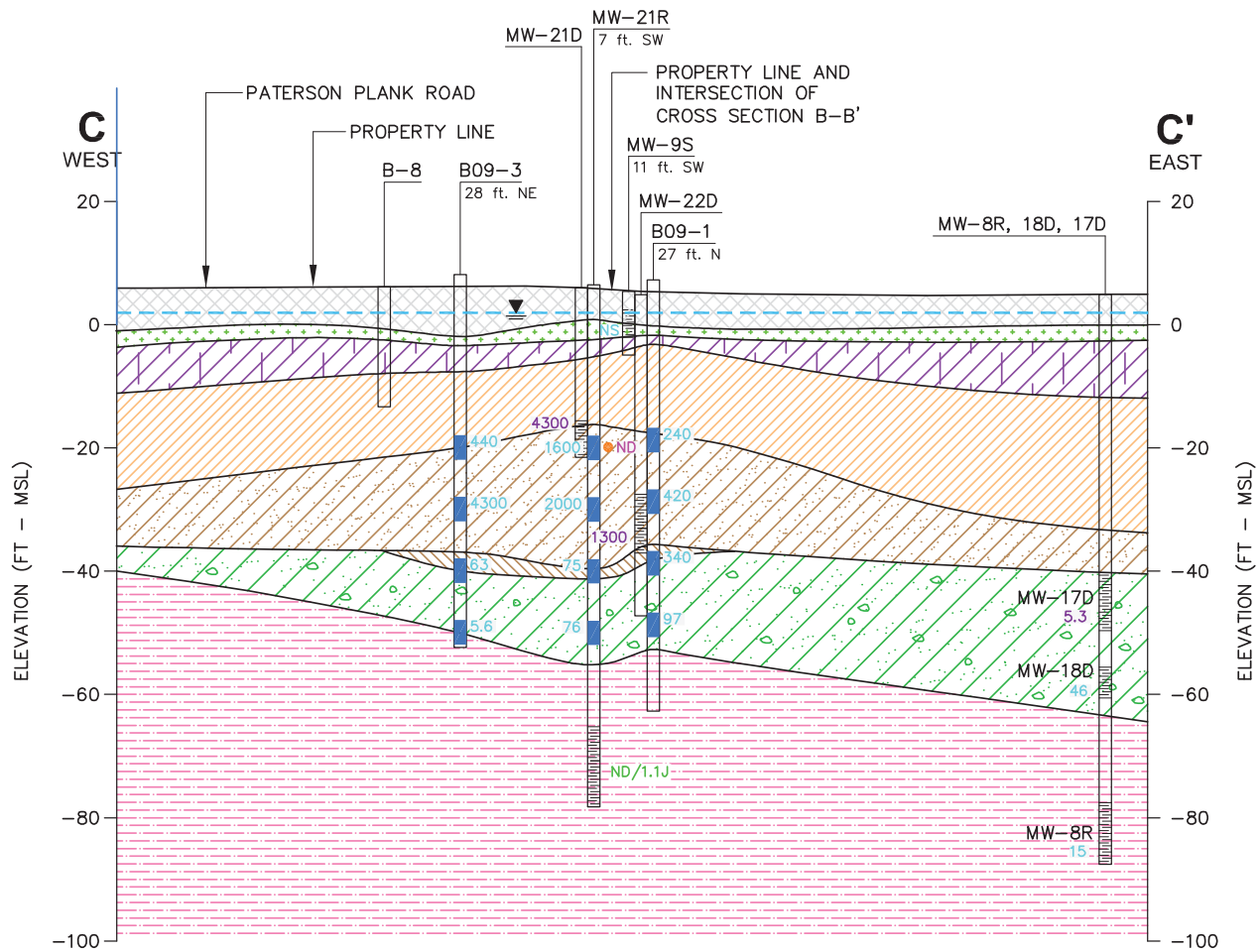


LEGEND

- APPROXIMATE GROUNDWATER ELEVATION (FILL)
- B09–3 / 28 ft. NE — BOREHOLE LABEL / PROJECTED DISTANCE
- TOP OF BOREHOLE
- GROUNDWATER SAMPLE INTERVAL (2009–2010)
- SOIL SAMPLE (2009–2010)
- SCREENED INTERVAL
- BOTTOM OF BOREHOLE
- 1600 — 1,4–DIOXANE (DECEMBER 2009) (ug/L)
- ND — 1,4–DIOXANE (2009) (ug/kg)
- 1300 — 1,4–DIOXANE (2007) (ug/L)
- ND/1.1J — 1,4–DIOXANE (2010) (ug/L) (PRIMARY/FIELD DUPLICATE)
- FILL
- PEAT
- GRAY SILT / BEDDED CLAY (UPPER HORIZON GLACIOLACUSTRINE VARVED CLAY)
- VARVED CLAY (LOWER HORIZON GLACIOLACUSTRINE VARVED CLAY)
- LOWER CLAY
- SOFT TILL
- LODGEMENT TILL
- BEDROCK

100 0 100
HORIZONTAL SCALE FEET

20 0 20
VERTICAL SCALE FEET

NOTES

1.) SUBSURFACE INFORMATION OBTAINED DURING FIELD WORK IN DECEMBER 2009/JANUARY 2010, THE OFF–PROPERTY INVESTIGATION (1996–2007) SUPPLEMENTED WITH BOREHOLE INFORMATION OBTAINED FROM THE FOLLOWING PREVIOUS INVESTIGATIONS : DAMES AND MOORE, 1990 "FINAL REPORT – REMEDIAL INVESTIGATION SCP SITE, CARLSTADT, NEW JERSEY" DATED MARCH 1, 1990; AND CANONIE ENVIRONMENTAL, 1991 "INTERIM REMEDY REMEDIAL DESIGN REPORT", DATED JULY 19, 1991.

2.) FOR PRESENTATION PURPOSES THE CROSS SECTIONS WERE CONSTRUCTED DEPICTING MONITORING WELL CLUSTERS AS A SINGLE BOREHOLE WITH MULTIPLE WELL SCREENS. THE WELLS ARE IN REALITY SEPARATE AND DISTINCT.

3.) NOT ALL BORINGS AND/OR WELLS LIE ALONG THE LINE OF SECTION; SOME HAVE BEEN PROJECTED ONTO THE LINE OF SECTION, AND PROJECTION DISTANCE NOTED.

4.) ND = NOT DETECTED, NS = NOT SAMPLED.

REFERENCES

1.) TOPOGRAPHIC DATA AND SURFACE FEATURES BASED ON INFORMATION BY TAYLOR, WISEMAN & TAYLOR CONSULTING ENGINEERS / SURVEYORS / PLANNERS / LANDSCAPE ARCHITECTS, MOUNT LAUREL, NEW JERSEY, DATED JUNE 12, 1992.

2.) MONITORING WELLS (1996 AND RI WELLS), PIEZOMETERS, AND EXTRACTION WELLS SURVEYED BY GEOD CORPORATION (OCTOBER 1996). WELLS INSTALLED IN 1998 SURVEYED BY GEOD CORPORATION. WELLS INSTALLED IN 2002 AND 2007 SURVEYED BY JAMES M. STEWART, INC. WELL AND BORINGS INSTALLED IN 2009–2010 BY VARGO ASSOCIATES.

REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW

PROJECT
216 PATERSON PLANK ROAD NPL SITE
CARLSTADT, NEW JERSEY

TITLE
GEOLOGIC CROSS SECTION C-C'

Golder Associates
Mt. Laurel, New Jersey
NJ Authorization #24GA28029100

PROJECT No.	943–6222		FILE No.	943622ZC04	
DESIGN	HAL	09/02/10	SCALE	AS SHOWN	REV. 0
CADD	MJS	09/02/10			
CHECK	HAL	09/02/10			
REVIEW	PSF	09/02/10			

FIGURE 6

Drawing file: 943622ZC04.dwg Sep 03, 2010 – 11:23am

R2-0001283

LEGEND

MW-8D	MONITORING WELL (SEE REFERENCE 3)
✳	SOIL BORING (2009-2010) (SEE REFERENCE 3)
●	PROPOSED DELINEATION PROFILE BORING
2800	1,4 DIOXANE CONCENTRATION (ug/L) JUNE, 2007
(1300)	1,4 DIOXANE CONCENTRATION (ug/L) OCTOBER, 2007
46	1,4 DIOXANE CONCENTRATION (ug/L) DECEMBER, 2009
ND/1.1J	1,4 DIOXANE CONCENTRATION (ug/L) MAY, 2010 (PRIMARY/FIELD DUPLICATE)
NM	NOT MEASURED
	SITE PROPERTY-BOUNDARY
	CONTOUR LINE
	STREAM
	FENCE
	UTILITY POLE
	EXISTING SLURRY WALL (SEE NOTE 5)
	PERIMETER ACCESS ROAD AND PARKING AREAS
	PROPOSED CONTINGENT DELINEATION PROFILE BORING

NOTES

1.) GRID SYSTEM SHOWN REFERENCES THE NEW JERSEY STATE PLANE COORDINATE SYSTEM (NAD27); VERTICAL DATUM IS NAVD 1929.

2.) MAXIMUM 1,4-DIOXANE CONCENTRATIONS IN PROFILE BORING REPRESENTED.

3.) AN ESTIMATED CONCENTRATION OF 1.1 ug/L 1,4 DIOXANE WAS DETECTED IN THE FIELD DUPLICATE SAMPLE IN MW-21R.

4.) PROPOSED CONTINGENT DELINEATION PROFILE BORINGS DEPENDENT ON RESULTS FROM PRIMARY DELINEATION PROFILE BORING.

REFERENCES

1.) TOPOGRAPHIC DATA AND SURFACE FEATURES BASED ON INFORMATION BY TAYLOR, WISEMAN & TAYLOR CONSULTING ENGINEERS / SURVEYORS / PLANNERS / LANDSCAPE ARCHITECTS, MOUNT LAUREL, NEW JERSEY, DATED JUNE 12, 1992.

2.) IMAGE LICENSED FROM GOOGLE EARTH PRO.

3.) MONITORING WELLS (1996 AND RI WELLS), PIEZOMETERS, AND EXTRACTION WELLS SURVEYED BY GEOD CORPORATION (OCTOBER 1996). WELLS INSTALLED IN 1998 SURVEYED BY GEOD CORPORATION. WELLS INSTALLED IN 2002 SURVEYED BY JAMES M. STEWART, INC., WELL AND BORINGS INSTALLED IN 2009-2010 BY VARGO ASSOCIATES.

SCALE: 30 0 30 60 FEET

REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW

PROJECT

216 PATERSON PLANK ROAD NPL SITE
CARLSTADT, NEW JERSEY

TITLE

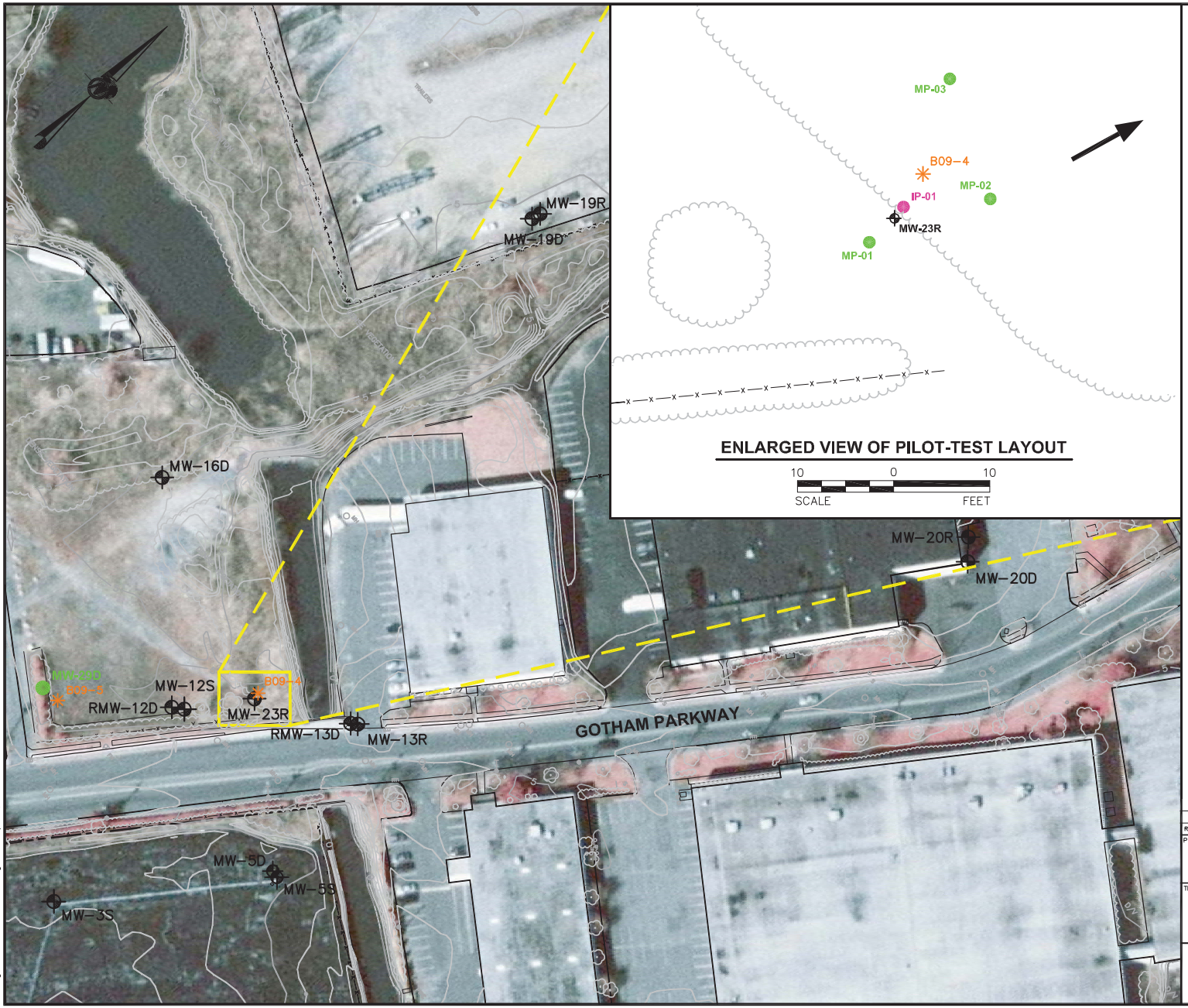
PROPOSED 1,4 DIOXANE DELINEATION BORINGS

Golder Associates
Philadelphia USA

PROJECT No.	943-6222	FILE No.	9436222C07		
DESIGN	HAL	09/02/10	SCALE	AS SHOWN	REV. 0
CADD	RG	09/02/10			
CHECK	HAL	09/02/10			
REVIEW	PSF	09/02/10			

FIGURE 7

R2-0001284



LEGEND

- EXISTING MONITORING WELL
- PROPOSED MONITORING WELL
- PROPOSED INJECTION WELL
- SOIL BORING (2009–2010) (SEE REFERENCE 3)
- PROPERTY BOUNDARY
- PREDOMINANT GROUNDWATER FLOW DIRECTION

REFERENCES

1.) BASE MAP SHOWN TAKEN FROM DIGITAL FILE 3074–02–TOPO.DWG, ENTITLED "BOROUGH OF CARLSTADT BLOCK 124 LOTS 1 THROUGH 5," DATED DECEMBER 8, 2005, PREPARED BY PROMAPS.

2.) 2005 AERIAL PHOTO BASE PROVIDED BY GLOBEXPLORER™.

3.) MONITORING WELLS (1996 AND RI WELLS), PIEZOMETERS, AND EXTRACTION WELLS SURVEYED BY GEOD CORPORATION (OCTOBER 1996). WELLS INSTALLED IN 1998 SURVEYED BY GEOD CORPORATION. WELLS INSTALLED IN 2002 SURVEYED BY JAMES M. STEWART, INC., WELL AND BORINGS INSTALLED IN 2009–2010 BY VARGO ASSOCIATES.

80 0 80
SCALE FEET

REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW

PROJECT

216 PATERSON PLANK ROAD NPL SITE
CARLSTADT, NEW JERSEY

TITLE

GOTHAM PARKWAY PILOT TEST LAYOUT

NJ Authorization #24GA28029100
Golder Associates
Mt. Laurel, New Jersey

PROJECT No.	943–6222		FILE No.	94362222C08	
DESIGN	MJB	09/02/10	SCALE	AS SHOWN	REV. 0
CADD	RG	09/02/10	FIGURE 8		
CHECK	HAL	09/02/10			
REVIEW	PSF	09/02/10			

Drawing file: 94362222C08.dwg Sep 03, 2010 – 11:26am

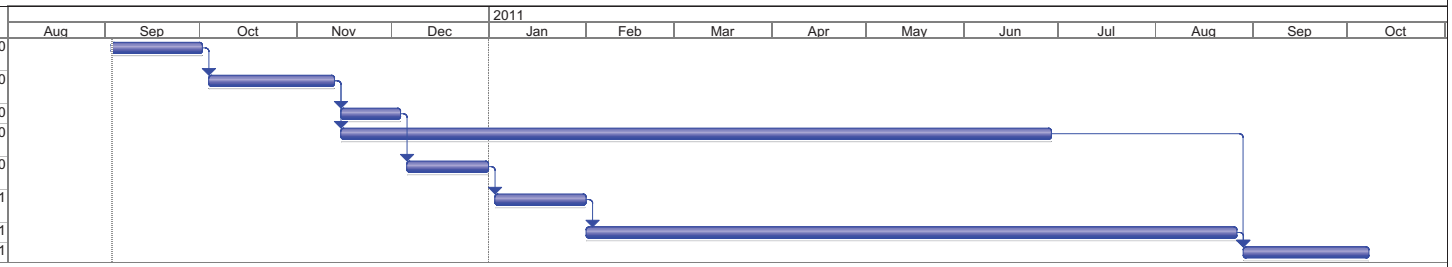
R2-0001285

September 2010

Figure 9
Preliminary Schedule for Additional Delineation and OU-3 Pilot Study
216 Paterson Plank Road Site
Carlstadt, New Jersey

943-6222

ID	Task Name	Duration	Start
1	USEPA Review and Approval of Phase 1 Treatability Studies Report	21 days	Fri 9/3/10
2	Additional Delineation Fieldwork and EAB Well Installation	30 days	Mon 10/4/10
3	Additional Delineation Laboratory Testing	15 days	Mon 11/15/10
4	Pilot-Scale Test Implementation for Enhanced Anaerobic Bioremediation	162 days	Mon 11/15/10
5	Additional Delineation Report and ISCO Pilot Test Work Plan	20 days	Mon 12/6/10
6	USEPA Review and Approval of ISCO Pilot Study Work Plan	21 days	Mon 1/3/11
7	ISCO Pilot Test Implementation	149 days	Tue 2/1/11
8	Phase 2 Treatability Study Report Preparation	30 days	Mon 8/29/11



Project: 9436222 treat study schedule
Date: Fri 9/3/10

Task
Split
Progress
Milestone
Summary
Project Summary
External Tasks
External Milestone
Deadline

943-6222\OU-3\04-Pilot-Test Workplan\9436222 treat study scheduleFullWP (rev).mpp

R2-0001286

APPENDIX A

2006-2009 SURFACE WATER AND GROUNDWATER RESULTS

APPENDIX A

Operations and Maintenance Surface Water and Groundwater Results

Surface Water (2006 through 2009 Quarterly Events)

Surface water was sampled in Peach Island Creek each quarter at four locations: SW-01 (downstream), SW-02 (downstream), SW-03(adjacent), and SW-04 (upstream). Additionally, a field duplicate was collected each quarter at one of the points (with the exception of fourth quarter 2009, where a field duplicate was collected from MW-5D). Samples were analyzed for TCL VOCs the first three quarters and for TCL VOCs, SVOCs, pesticides/PCBs, and TAL metals during the fourth quarter (annual) sampling events[1]. Field parameters collected during sampling are provided in Table A1 and analytical results are provided in Table A2.

First Quarter 2006 Sampling Results

The results from this sampling event indicate low levels of four VOCs detected at one or more sampling points with total VOCs ranging from 6 µg/L (SW-02) to 16 µg/L (SW-04) and total VOCs was dominated by acetone, which was detected at all sampling locations at concentrations between 6 µg/L and 8 µg/L. Other compounds detected at estimated concentrations were cis-1,2-dichloroethene in SW-01 (2 µg/L), chlorobenzene in SW-03 (1 µg/L), and 2-butanone in SW-04 (9 µg/L).

Second Quarter 2006 Sampling Results

Acetone was detected at low levels in SW-02 and SW-04 at estimated concentrations of 3 µg/L in both samples.

Third Quarter 2006 Sampling Results

The results from this sampling event indicate low levels of two VOCs detected at one or more sampling points with total VOCs ranging from 9 µg/L (SW-03 and SW-04) to 21 µg/L (SW-02) and total VOCs was dominated by acetone, which was detected at all sampling locations except SW-01 at concentrations between 7 µg/L and 21 µg/L. Toluene was detected at an estimated concentration of 2 µg/L in SW-03.

Fourth Quarter 2006 Sampling Results

The results from this sampling event indicate low levels of three VOCs were detected in SW-03 and SW-04. No VOCs were detected in SW-01 or SW-02. Chlorobenzene was detected in SW-03 at an

[1] In 2007, samples were analyzed for TCL VOCs in March and November and for TCL VOCs, SVOCs, pesticides/PCBs, and TAL metals in July

estimated concentration of 0.7 µg/L. Chlorobenzene, chloroform, and toluene were detected in up-gradient sample SW-04 at estimated concentrations of 2 µg/L, 2 µg/L, and 1 µg/L, respectively. There were no detections of PCBs. Chlordane (trans) was detected in upgradient sample SW-04 at an estimated concentration of 0.018 µg/L and bis(2-ethylhexyl)phthalate was detected at an estimated concentration of 4 µg/L in SW-01. There were detections of 13 inorganic analytes in one or more of these unfiltered samples. Overall, the types and concentrations of inorganic compounds detected were generally consistent at each individual sampling point location Concentrations measured for all inorganic compounds are consistent with values measured in previous sampling events at each sampling location.

First Quarter 2007 Sampling Results

The results from this sampling event indicate low levels of three VOCs detected with total VOCs ranging from 8 µg/L (acetone in SW-04) to 18 µg/L (acetone in SW-02). Acetone was detected at all sampling locations at concentrations between 8 µg/L and 18 µg/L. Other compounds detected at estimated concentrations were cis-1,2-dichloroethene in SW-03 (3 µg/L) and vinyl chloride in SW-03 (1 µg/L).

Second/Third Quarter 2007 Sampling Results

The results from this sampling event indicate low levels of fourteen VOCs were detected at one or more sampling point with total VOCs ranging from 3.84 µg/L (in the field duplicate sample for SW-01) to 11.25 µg/L (SW-04). The compounds 1,2-dichlorobenzene, 2-butanone, chloroform, and cis-1,2-dichloroethene were detected at all sampling locations at low levels (all concentrations were less than 1 µg/L, except 2-butanone which was detected at concentrations ranging from 3.3 µg/L to 5.7 µg/L). Compounds detected in one or more sampling locations at concentrations less than 2 µg/L include: 1,1,1-trichloroethane, 1,1-dichloroethane, benzene, chlorobenzene, chloroethane, ethylbenzene, tetrachloroethene, toluene, trichloroethene and total xylenes. There were no detections of PCBs or SVOCs. Heptachlor epoxide was detected in upgradient sample SW-04 at an estimated concentration of 0.019 µg/L. There were detections of 15 inorganic analytes in one or more of these unfiltered samples. Overall, the types and concentrations of inorganic compounds detected were generally consistent at each individual sampling point location. Concentrations measured for all inorganic compounds are consistent with values measured in previous sampling events at each sampling location.

Fourth Quarter 2007 Sampling Results

The results from this sampling event indicate low levels of five VOCs were detected at one or more sampling point with total VOCs ranging from 0.17 µg/L (toluene in SW-03) to 0.71 µg/L (SW-04). Compounds detected in one or more sampling locations at concentrations less than 1 µg/L include: chloroform, cis-1,2-dichloroethene, tetrachloroethene, toluene, and trichloroethene.

First Quarter 2008 Sampling Results

The results from this sampling event indicate low levels of twelve VOCs were detected at one or more sampling points with total VOCs ranging from 1.51 µg/L (SW-02) to 11.89 µg/L (SW-01). There was insufficient water to access the SW-04 sampling point. The compounds chlorobenzene, cis-1,2-dichloroethene, toluene, and TCE were detected at all sampling locations at low levels (all concentrations were less than 2 µg/L). Compounds detected in one or more sampling locations at concentrations less than 2 µg/L include: 1,1-dichloroethane, 1,2-dichlorobenzene, acetone, chloroform, ethylbenzene, PCE, vinyl chloride, and total xylenes.

Second Quarter 2008 Sampling Results

The results from this sampling event indicate low levels of thirteen VOCs were detected at one or more sampling points with total VOCs ranging from 0.68 µg/L (in the field duplicate sample for SW-02) to 10.49 µg/L (SW-04). The compounds chlorobenzene, cis-1,2-dichloroethene, toluene, and TCE were detected at all sampling locations at low levels (all concentrations were less than 1 µg/L, except toluene which was detected at 3 µg/L in SW-02). Compounds detected in one or more sampling locations at concentrations less than 2 µg/L include: 1,1,1-trichloroethane, 1,1-dichloroethane, 1,2-dichlorobenzene, carbon disulfide, chloroform, ethylbenzene, vinyl chloride, and total xylenes. Acetone was detected at a concentration of 8.6 µg/L in SW-04.

Third Quarter 2008 Sampling Results

Due to a shipping error, the analysis of the surface water samples collected during this event was canceled.

Fourth Quarter 2008 Sampling Results

The results from this sampling event indicate low levels of thirteen VOCs were detected at one or more sampling point with total VOCs ranging from 1.82 µg/L (in the field duplicate sample for SW-01) to 9.37 µg/L (SW-04). The compounds 2-butanone, chlorobenzene, cis-1,2-dichloroethene, and toluene were detected at all sampling locations at low levels (all concentrations were less than 2 µg/L, except 2-butanone which was detected at 3.2 µg/L in SW-04). Compounds detected in one or more sampling locations at concentrations less than 1 µg/L include: 1,1-dichloroethane, 1,2-dichloroethene, benzene, chloroform, ethylbenzene, PCE, TCE, vinyl chloride, and total xylenes. There were no detections of PCBs or SVOCs. Heptachlor epoxide was detected in upgradient sample SW-04 at an estimated concentration of 0.011 µg/L. There were detections of 17 inorganic analytes in one or more of these unfiltered samples. Overall, the types and concentrations of inorganic compounds detected were generally consistent at each individual sampling point location with slightly higher concentrations of some inorganics at sampling point SW-01. Concentrations of some inorganics (Al, Cr, Cu, Fe, Pb, Hg, V) were elevated in this sampling event in SW-

03 and SW-04 but were otherwise consistent with values measured in previous sampling events at each sampling location.

First Quarter 2009 Sampling Results

The results from this sampling event indicate low levels of nine VOCs were detected at one or more sampling point with total VOCs ranging from 15.1 ug/L (SW-01) to 22.7 µg/L in the field duplicate sample for SW-02. The compounds acetone, cis-1,2-dichloroethene, PCE, and chlorobenzene were detected at all sampling locations at low levels (except acetone, all concentrations were less than 1 µg/L, acetone values ranged from 13-19 µg/L). Compounds detected in one or more sampling locations at concentrations less than or equal to 3 µg/L include: carbon disulfide, 1,1-dichloroethane, 2-butanone, TCE, and toluene.

Second Quarter 2009 Sampling Results

The results from this sampling event indicate low levels of seven VOCs were detected at one or more sampling point with total VOCs ranging from 0.64 µg/L (SW-01) to 28.2 µg/L (SW-03). The compounds acetone, carbon disulfide, methylene chloride, cis-1,2-dichloroethene, TCE, toluene, and PCE were detected at low levels (except acetone and methylene chloride, all concentrations were less than 1 µg/L: acetone values ranged from 8.5 to 25 µg/L and methylene chloride was detected at 3.2 µg/L in SW-03).

Third Quarter 2009 Sampling Results

The results from this sampling event indicate low levels of six VOCs were detected at one or more sampling point with total VOCs ranging from 0.39 µg/L (SW-01) to 1.8 µg/L (SW-04). The compounds cis-1,2-dichloroethene and TCE were detected in all sampling locations at concentrations less than 1 µg/L. Compounds detected in one or more sampling locations at concentrations less than 1 µg/L include: chloroform, toluene, tetrachloroethene, and chlorobenzene.

Fourth Quarter 2009 Sampling Results – Annual Event

The results from this sampling event indicate low levels of five VOCs were detected at one or more sampling point with total VOCs ranging from 0.94 ug/L (SW-01) to 3.44 µg/L (SW-04). The compound cis-1,2-dichloroethene was detected in all sampling locations at concentrations ranging from 0.94 µg/L to 2.4 µg/L. Compounds detected in one or more sampling locations at concentrations less than 1 µg/L include: bromodichloromethane, toluene, 1,1,2-trichloroethane, and PCE. There were no detections of PCBs or SVOCs. 4,4-DDT was detected at low levels in upgradient samples SW-04 and SW-02 at estimated concentrations of 0.037 µg/L and 0.046 µg/L, respectively. Beta-BHC was detected at an estimated concentration of 0.02 µg/L in SW-03. There were detections of 18 inorganic analytes in one or more of these unfiltered samples. Overall, the types and concentrations of inorganic compounds detected were generally consistent at each individual sampling point location with slightly higher concentrations of

some inorganics at sampling point SW-01. Concentrations measured for all inorganic compounds are consistent with values measured in previous sampling events at each sampling location.

Groundwater (2009 Annual Event)

Samples were analyzed for TCL VOCs, SVOCs, pesticides/PCBs, and TAL metals during the fourth quarter (annual) sampling event. Field parameters collected during sampling are provided in Table A1 and analytical results are provided in Table A3.

Fill Zone

The off-property fill zone monitoring wells consist of MW-8S, MW-9S, MW-11S and MW-12S (Table A3). Low levels of VOCs were detected in MW-8S, MW-9S, and MW-12S with concentrations below the New Jersey Groundwater Quality Standards (GWQS). Cis-1,2-dichloroethene (0.15 µg/L) and benzene (0.26 µg/L) were also detected in MW-8S, and cis-1,2-dichloroethene (0.1 µg/L) and toluene (0.1 µg/L) were detected in MW-9S.

Eight (8) SVOCs (2-methylnaphthalene, acenaphthene, dibenzofuran, fluorene, phenanthrene, fluoranthene, pyrene, and bis(2-ethylhexyl) phthalate) were detected at levels ranging from 1.9 µg/L (pyrene) to 18 µg/L (bis(2-ethylhexyl) phthalate) in MW-9S. Only the bis(2-ethylhexyl) phthalate) detection exceeded the GWQS (3 µg/L). SVOCs were not detected in MW-8S, MW-11S, or MW-12S. There were no detections of pesticides or PCBs.

Consistent with previous sampling events, inorganics were detected in unfiltered samples taken from the fill monitoring wells. Twenty different inorganics were detected, nine of which (aluminum, arsenic, cadmium, chromium, iron, lead, manganese, nickel, sodium) exceeded the GWQS in at least one fill well. Aluminum, iron, manganese, and lead exceeded the GWQS in all four wells.

Till Zone

The current till zone monitoring wells consist of MW-5D, RMW-8D RMW-11D, RMW-12D, and RMW-13D (Table A3). The total VOC concentrations range from 4.3 µg/L in RMW-12D to 4,703 µg/L in MW-5D. There were no exceedances in RMW-8D and RMW-12D. In RMW-13D, vinyl chloride (1.1 µg/L) and trichloroethene (1.6 µg/L) were slightly over the GWQS (1 µg/L for both compounds). In RMW-11D, trichloroethene (1.8 µg/L) and tetrachloroethene (1.1 µg/L) were slightly over the GWQS (1 µg/L for both compounds). In MW-5D, 8 compounds exceeded the GWQS: 1,1-dichloroethene, 1,2-dichloroethane, benzene, chloroform, cis-1,2-dichloroethene, tetrachloroethene, trichloroethene, and vinyl chloride.

Phenol was the only SVOC detected in any till monitoring well and was detected in RMW-8D at a concentration (2.5 µg/L) well below the GWQS (2000 µg/L). No pesticides or PCBs were detected in any till monitoring well. Inorganics were consistently detected in unfiltered samples taken from the till monitoring wells. Nineteen different inorganics were detected, 6 of which (aluminum, chromium, iron, lead, manganese, and sodium) exceeded the GWQS in at least one till well.

TABLE A1
FIELD SAMPLING PARAMETERS
216 PATERSON PLANK ROAD SITE
CARLSTADT, NEW JERSEY

Field Parameters								
Well ID	Date Sampled	Temperature [°C]	pH [std]	Specific Conductance [mS/cm]	Turbidity [ntu]	Dissolved Oxygen [mg/l]	Redox Potential [mV]	Depth to Water [ft-bgs]
Surface water								
SW-01	3/10/2006	6.23	7.44	7.23	104	6.54	89	NA
SW-02	3/10/2006	6.92	7.3	7.55	38.8	10.08	32	NA
SW-03	3/10/2006	7.02	6.57	6.12	44.2	7.32	5	NA
SW-04	3/10/2006	8.42	7.16	4.29	288	9.67	-93	NA
SW-01	5/24/2006	17.1	7.28	4.09	185	5.32	17	NA
SW-02	5/24/2006	17.9	7.30	4.01	0	5.87	4	NA
SW-03	5/24/2006	17.7	6.21	3.54	233	6.32	47	NA
SW-04	5/24/2006	17.9	7.17	7.89	300	6.01	23	NA
SW-01	8/2/2006	30.6	7.48	4.18	38.5	4.48	91	NA
SW-02	8/2/2006	31.7	8.67	3.77	559	10.69	36	NA
SW-03	8/2/2006	31.7	8.63	3.35	283	12.34	-107	NA
SW-04	8/2/2006	31.9	7.32	3.06	318	10.5	-184	NA
SW-01	11/7/2006	10.4	7.32	4.10	52.5	4.30	33	NA
SW-02	11/7/2006	8.8	7.26	3.10	30.4	4.99	20	NA
SW-03	11/7/2006	10.5	7.20	2.56	279	4.13	-25	NA
SW-04	11/7/2006	9.4	7.12	1.65	0	2.42	-213	NA
SW-01	3/22/2007	5.1	7.32	4.91	43.4	0.52	65	NA
SW-02	3/22/2007	5.78	7.43	0.90	38.2	2.62	33	NA
SW-03	3/22/2007	6.48	7.25	1.10	0	4.19	-229	NA
SW-04	3/22/2007	8.35	7.32	0.9	10.7	5.78	-74	NA
SW-1	7/5/2007	21.7	6.89	0.901	47.3	3.46	83	NA
SW-2	7/5/2007	21.6	6.81	0.736	0	4.13	52	NA
SW-3	7/5/2007	22.5	7.04	0.43	20	5.7	100	NA
SW-4	7/5/2007	22.5	6.78	0.871	25.3	4.67	82	NA
SW-1	7/12/2007	22.7	6.85	5.08	63.7	4.03	101	N/A
SW-2	7/12/2007	21.4	6.91	2.03	35.5	4.25	94	N/A
SW-3	7/12/2007	22.1	6.84	1.92	120	4.44	118	N/A
SW-4	7/12/2007	21.6	6.67	1.9	112	4.59	91	N/A
SW-01	11/13/2007	8.1	6.89	7.78	40.4	8.4	170	NA
SW-02	11/13/2007	7.4	6.88	6.13	25.1	8.56	147	NA
SW-03	11/13/2007	7.4	6.68	5.24	21.5	9.55	140	NA
SW-04	11/13/2007	7.8	6.67	4.34	31.0	9.14	157	NA
SW-1	3/21/2008	5.88	7.65	1.13	238	NM	89	NA
SW-2	3/21/2008	3.58	7.7	1.03	189	NM	87	NA
SW-3	3/21/2008	3.85	7.55	1.47	233	NM	44	NA
SW-1	6/2/2008	23.47	7.69	5.3	335	8.93	32	NA
SW-2	6/2/2008	25.89	7.49	4.9	36.7	9.1	-18	NA
SW-3	6/2/2008	26.78	7.42	4.64	772	9.48	-2	NA
SW-4	6/2/2008	29.19	7.7	3.43	59.2	7.18	-16	NA
SW-1	12/3/2008	4.92	7.1	4.62	20	7.38	121	NA
SW-2	12/3/2008	4.2	6.99	2.24	31.3	7.29	114	NA
SW-3	12/3/2008	6.32	6.89	2.03	33.9	7.3	75	NA
SW-4	12/3/2008	4.67	6.97	1.45	50.3	6.18	69	NA
SW-1	4/2/2009	11.2	7.85	11.2	66.2	6.49	78	NA
SW-2	4/2/2009	12	7.3	4.52	654	11.09	-45	NA
SW-3	4/2/2009	16.8	7.03	2.22	714	10.09	-14	NA
SW-4	4/2/2009	17.5	7.49	2.14	> 999	5.24	33	NA
SW-1	7/10/2009	33.61	7.56	3.94	65.7	8.11	83	NA
SW-2	7/10/2009	22.76	7.57	2.65	136	6.57	48	NA
SW-3	7/10/2009	24.04	7.84	2.28	706	9.66	42	NA
SW-4	7/10/2009	28.68	8.95	1.43	24.4	14.66	21	NA
SW-1	10/22/2009	13.28	7.67	15	124	6.45	80	NA
SW-2	10/22/2009	12.36	7.72	14.7	136	6.12	64	NA
SW-3	10/22/2009	14.86	8.05	11.6	-5	7.92	-72	NA
SW-4	10/22/2009	15.13	7.94	11.8	-5	7.79	50	NA
SW-1	12/21/2009	-0.02	6.74	4.88	254	8.42	191	NA
SW-2	12/21/2009	0	6.67	4.86	120	8.39	195	NA
SW-3	12/21/2009	0.24	6.48	3.77	-5	7.61	173	NA
SW-4	12/21/2009	0.3	5.43	3.28	584	8.7	239	NA

Golder Associates
R2-0001294

TABLE A1
FIELD SAMPLING PARAMETERS
216 PATERSON PLANK ROAD SITE
CARLSTADT, NEW JERSEY

Groundwater - Monitoring Wells								
MW-5D	12/21/2009	14.07	7.8	2.06	115	0.42	9	8.66
MW-8S	12/18/2009	12.21	6.48	0.008	-5	NM	92	2.42
RMW-8D	12/17/2009	12.33	11.01	0.864	0	0	-173	4.13
MW-9S	12/17/2009	15.4	6.37	1.34	75.7	2.4	-145	4.63
MW-11S	12/18/2009	7.34	8.65	0.9	79	10.62	95	1.61
RMW-11D	12/18/2009	11.64	10.34	0.324	24.7	0	-34	4.61
MW-12S	12/18/2009	8.99	7.02	0.494	279	6.86	74	0.4
RMW-12D	12/18/2009	10.42	7.77	0.265	112	2.03	61	2.34
RMW-13D	12/17/2009	13.59	6.47	0.146	198	0	-11	3.07

Turbidity measurements of >999 or -5 indicate value outside of meter range.

NA - Not Applicable
NM - Not Measured

Sample Date	Table by	QC'd by
3/10/2006	HAL 8/12/2010	MAK 8/12/2010
5/24/2006	MAK 8/17/2010	JAB 8/17/2010
8/2/2006	TGS 8/7/2006	DKL 8/13/2010
11/17/2006	MAK 8/17/2010	JAB 8/17/2010
3/22/2007	MAK 8/17/2010	JAB 8/17/2010
7/5/2007	JML 7/6/2007	TGS 7/6/2007
7/12/2007	JML 9/13/2007	KB 9/13/2007
11/13/2007	MAK 8/17/2010	JAB 8/17/2010
3/21/2008	FGM 3/24/2008	TGS 4/22/2008
6/2/2008	TGS 06/03/08	DKL 08/13/10
12/3/2008	HAL 08/10/10	MAK 8/12/2010
4/2/2009	TGS 04/03/09	HAL 3/10/2010
7/10/2009	HAL 3/10/2010	SLS 3/10/2010
10/22/2009	FGM 10/23/2009	CEJ 10/23/2009
12/21/2009	FGM 12/22/2009	HAL 3/16/2010
12/17/2009 - 12/21/2009	FGM 12/22/2009	CEJ 12/23/09

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R2-0001295

Surface Water Samples
Validated Analytical Data
Carlstadt

Notes:
ug/l = micrograms per liter
Qualifier = Validated Qualifier
ReptLimit = Reporting Limit
NDR - No Data Reported
NS - No Standard Available
Qualifier: J - Result or reporting limit is estimated.
U - Result was not detected at or above the method detection limit.
UJ - Detection limit is estimated.
R - Data is rejected.
* NJDEP SWQS: Surface Water Quality Standards (N.J.A.C. 7:9B) 1/2010
Results greater than the NJDEP SWQS are shown in ***bold/italics***

TABLE A2
Surface Water Samples
Validated Analytical Data
Carlstadt

		Sample ID	SW-1			SW-1			SW-1			SW-1			SW-1			SW-1			SW-1			SW-1		
		Sample Date	3/10/2006			3/10/2006			5/24/2006			8/2/2006			8/2/2006			11/7/2006			3/22/2007			7/5/2007		
		N=Normal, FD=Field Duplicate	FD			N			N			FD			N			N			N			FD		
Parameter	NJDEP SWQS*	Unit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit
Inorganics																										
Aluminum	NS	ug/l	NDR			NDR			NDR			NDR			NDR			456		200	NDR			1500	J	200
Antimony	5.6	ug/l	NDR			NDR			NDR			NDR			NDR			< 60	U	60	NDR			< 60	U	60
Arsenic	0.017	ug/l	NDR			NDR			NDR			NDR			NDR			< 10	U	10	NDR			< 10	U	10
Barium	2000	ug/l	NDR			NDR			NDR			NDR			NDR			< 200	U	200	NDR			< 200	U	200
Beryllium	6	ug/l	NDR			NDR			NDR			NDR			NDR			< 5	U	5	NDR			< 5	U	5
Cadmium	3.4	ug/l	NDR			NDR			NDR			NDR			NDR			< 5	U	5	NDR			0.73	J	5
Calcium	NS	ug/l	NDR			NDR			NDR			NDR			NDR			76100		5000	NDR			20200		5000
Chromium	92	ug/l	NDR			NDR			NDR			NDR			NDR			< 10	U	10	NDR			31.7	J	10
Cobalt	NS	ug/l	NDR			NDR			NDR			NDR			NDR			< 50	U	50	NDR			1.2	J	50
Copper	1300	ug/l	NDR			NDR			NDR			NDR			NDR			< 25	U	25	NDR			23.8	J	25
Iron	NS	ug/l	NDR			NDR			NDR			NDR			NDR			919		100	NDR			3730	J	100
Lead	5	ug/l	NDR			NDR			NDR			NDR			NDR			4.4		3	NDR			***15.7***		3
Magnesium	NS	ug/l	NDR			NDR			NDR			NDR			NDR			129000		5000	NDR			16200		5000
Manganese	NS	ug/l	NDR			NDR			NDR			NDR			NDR			214		15	NDR			265		15
Mercury	0.05	ug/l	NDR			NDR			NDR			NDR			NDR			***0.19***	J	0.2	NDR			4	R	0.2
Nickel	500	ug/l	NDR			NDR			NDR			NDR			NDR			3.8	J	40	NDR			< 40	U	40
Potassium	NS	ug/l	NDR			NDR			NDR			NDR			NDR			53100	J	5000	NDR			8080	J	5000
Selenium	170	ug/l	NDR			NDR			NDR			NDR			NDR			< 5	U	5	NDR			< 5	U	5
Silver	170	ug/l	NDR			NDR			NDR			NDR			NDR			< 10	U	10	NDR			< 10	U	10
Sodium	NS	ug/l	NDR			NDR			NDR			NDR			NDR			948000	J	10000	NDR			129000		5000
Thallium	0.24	ug/l	NDR			NDR			NDR			NDR			NDR			< 10	U	10	NDR			< 10	U	10
Vanadium	NS	ug/l	NDR			NDR			NDR			NDR			NDR			< 50	U	50	NDR			6.9	J	50
Zinc	7400	ug/l	NDR			NDR			NDR			NDR			NDR			< 20	U	20	NDR			91.3		20
PCBs																										
Aroclor 1016	0.000064	ug/l	NDR			NDR			NDR			NDR			NDR			< 1	U	1	NDR			< 1	U	1
Aroclor 1221	0.000064	ug/l	NDR			NDR			NDR			NDR			NDR			< 2	U	2	NDR			< 2	U	2
Aroclor 1232	0.000064	ug/l	NDR			NDR			NDR			NDR			NDR			< 1	U	1	NDR			< 1	U	1
Aroclor 1242	0.000064	ug/l	NDR			NDR			NDR			NDR			NDR			< 1	U	1	NDR			< 1	U	1
Aroclor 1248	0.000064	ug/l	NDR			NDR			NDR			NDR			NDR			< 1	U	1	NDR			< 1	U	1
Aroclor 1254	0.000064	ug/l	NDR			NDR			NDR			NDR			NDR			< 1	U	1	NDR			< 1	U	1
Aroclor 1260	0.000064	ug/l	NDR			NDR			NDR			NDR			NDR			< 1	U	1	NDR			< 1	U	1
Aroclor 1262	0.000064	ug/l	NDR			NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Aroclor 1268	0.000064	ug/l	NDR			NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Pesticides																										
4,4-DDD	0.00031	ug/l	NDR			NDR			NDR			NDR			NDR			< 0.1	U	0.1	NDR			< 0.1	U	0.1
4,4-DDE	0.00022	ug/l	NDR			NDR			NDR			NDR			NDR			< 0.1	U	0.1	NDR			< 0.1	U	0.1
4,4-DDT	0.00022	ug/l	NDR			NDR			NDR			NDR			NDR			< 0.1	U	0.1	NDR			< 0.1	U	0.1
Aldrin	0.000049	ug/l	NDR			NDR			NDR			NDR			NDR			< 0.05	U	0.05	NDR			< 0.05	U	0.05
alpha-BHC	0.0026	ug/l	NDR			NDR			NDR			NDR			NDR			< 0.05	U	0.05	NDR			< 0.05	U	0.05
alpha-Chlordane	NS	ug/l	NDR			NDR			NDR			NDR			NDR			< 0.05	U	0.05	NDR			< 0.05	U	0.05
alpha-Endosulfan	62	ug/l	NDR			NDR			NDR			NDR			NDR			< 0.05	U	0.05	NDR			< 0.05	U	0.05
beta-BHC	0.0091	ug/l	NDR			NDR			NDR			NDR			NDR			< 0.05	U	0.05	NDR			< 0.05	U	0.05
beta-Endosulfan	62	ug/l	NDR			NDR			NDR			NDR			NDR			< 0.1	U	0.1	NDR			< 0.1	U	0.1
delta-BHC	NS	ug/l	NDR			NDR			NDR			NDR			NDR			< 0.05	U	0.05	NDR			< 0.05	U	0.05
Dieldrin	0.000052	ug/l	NDR			NDR			NDR			NDR			NDR			< 0.1	U	0.1	NDR			< 0.1	U	0.1
Endosulfan Sulfate	62	ug/l	NDR			NDR			NDR			NDR			NDR			< 0.1	U	0.1	NDR			< 0.1	U	0.1
Endrin	0.059	ug/l	NDR			NDR			NDR			NDR			NDR			< 0.1	U	0.1	NDR			< 0.1	U	0.1
Endrin Aldehyde	0.059	ug/l	NDR			NDR			NDR			NDR			NDR			< 0.1	U	0.1	NDR			< 0.1	U	0.1
Endrin Ketone	NS	ug/l	NDR			NDR			NDR			NDR			NDR			< 0.1	U	0.1	NDR			< 0.1	U	0.1
gamma-BHC	0.98	ug/l	NDR			NDR			NDR			NDR			NDR			< 0.05	U	0.05	NDR			< 0.05	U	0.05
gamma-Chlordane	NS	ug/l	NDR			NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Heptachlor	0.000079	ug/l	NDR			NDR			NDR			NDR			NDR			< 0.05	U	0.05	NDR			< 0.05	U	0.05
Heptachlor Epoxide	0.000039	ug/l	NDR			NDR			NDR			NDR			NDR			< 0.05	U	0.05	NDR			< 0.05	U	0.05
Methoxychlor	40	ug/l	NDR			NDR			NDR			NDR			NDR			< 0.5	U	0.5	NDR			< 0.5	U	0.5
Toxaphene	0.00028	ug/l	NDR			NDR			NDR			NDR			NDR			< 5	U	5	NDR			< 5	U	5
trans-Chlordane	NS	ug/l	NDR			NDR			NDR			NDR			NDR			< 0.05	U	0.05	NDR			< 0.05	U	0.05

TABLE A2
Surface Water Samples
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			Sample ID	SW-1			SW-1			SW-1			SW-1			SW-1			SW-1			SW-1			SW-1		
			Sample Date	3/10/2006			3/10/2006			5/24/2006			8/2/2006			8/2/2006			11/7/2006			3/22/2007			7/5/2007		
			N=Normal, FD=Field Duplicate	FD			N			N			FD			N			N			N			FD		
Parameter	NJDEP SWQS*	Unit		Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit
Semivolatile Organic Compounds																											
1,2,4,5-Tetrachlorobenzene	0.97	ug/l		NDR			NDR			NDR			NDR			NDR			NDR			NDR			NDR		
2,3,4,6-Tetrachlorophenol	NS	ug/l		NDR			NDR			NDR			NDR			NDR			NDR			NDR			NDR		
2,4,5-Trichlorophenol	1800	ug/l		NDR			NDR			NDR			NDR			NDR			< 25	U	25	NDR			< 25	U	25
2,4,6-Trichlorophenol	0.58	ug/l		NDR			NDR			NDR			NDR			NDR			< 10	U	10	NDR			< 10	U	10
2,4-Dichlorophenol	77	ug/l		NDR			NDR			NDR			NDR			NDR			< 10	U	10	NDR			< 10	U	10
2,4-Dimethylphenol	380	ug/l		NDR			NDR			NDR			NDR			NDR			< 10	U	10	NDR			< 10	U	10
2,4-Dinitrophenol	69	ug/l		NDR			NDR			NDR			NDR			NDR			< 25	U	25	NDR			< 25	U	25
2,4-Dinitrotoluene	0.11	ug/l		NDR			NDR			NDR			NDR			NDR			< 10	U	10	NDR			< 10	U	10
2,6-Dinitrotoluene	NS	ug/l		NDR			NDR			NDR			NDR			NDR			< 10	U	10	NDR			< 10	U	10
2-Chloronaphthalene	1000	ug/l		NDR			NDR			NDR			NDR			NDR			< 10	U	10	NDR			< 10	U	10
2-Chlorophenol	81	ug/l		NDR			NDR			NDR			NDR			NDR			< 10	U	10	NDR			< 10	U	10
2-Methylnaphthalene	NS	ug/l		NDR			NDR			NDR			NDR			NDR			< 10	U	10	NDR			< 10	U	10
2-Methylphenol	NS	ug/l		NDR			NDR			NDR			NDR			NDR			< 10	U	10	NDR			< 10	U	10
2-Nitroaniline	NS	ug/l		NDR			NDR			NDR			NDR			NDR			< 25	U	25	NDR			< 25	U	25
2-Nitrophenol	NS	ug/l		NDR			NDR			NDR			NDR			NDR			< 10	U	10	NDR			< 10	U	10
3,3'-Dichlorobenzidine	0.021	ug/l		NDR			NDR			NDR			NDR			NDR			< 10	U	10	NDR			< 10	U	10
3-Nitroaniline	NS	ug/l		NDR			NDR			NDR			NDR			NDR			< 25	U	25	NDR			< 25	U	25
4,6-Dinitro-2-methylphenol	13	ug/l		NDR			NDR			NDR			NDR			NDR			< 25	U	25	NDR			< 25	U	25
4-Bromophenyl Phenyl Ether	NS	ug/l		NDR			NDR			NDR			NDR			NDR			< 10	U	10	NDR			< 10	U	10
4-Chloro-3-methylphenol	NS	ug/l		NDR			NDR			NDR			NDR			NDR			< 10	U	10	NDR			< 10	U	10
4-Chloroaniline	NS	ug/l		NDR			NDR			NDR			NDR			NDR			< 10	U	10	NDR			< 10	U	10
4-Chlorophenyl-phenylether	NS	ug/l		NDR			NDR			NDR			NDR			NDR			< 10	U	10	NDR			< 10	U	10
4-Methylphenol	NS	ug/l		NDR			NDR			NDR			NDR			NDR			< 10	U	10	NDR			< 10	U	10
4-Nitroaniline	NS	ug/l		NDR			NDR			NDR			NDR			NDR			< 25	U	25	NDR			< 25	U	25
4-Nitrophenol	NS	ug/l		NDR			NDR			NDR			NDR			NDR			< 25	U	25	NDR			< 25	U	25
Acenaphthene	670	ug/l		NDR			NDR			NDR			NDR			NDR			< 10	U	10	NDR			< 10	U	10
Acenaphthylene	NS	ug/l		NDR			NDR			NDR			NDR			NDR			< 10	U	10	NDR			< 10	U	10
Acetophenone	NS	ug/l		NDR			NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Anthracene	8300	ug/l		NDR			NDR			NDR			NDR			NDR			< 10	U	10	NDR			< 10	U	10
Atrazine	NS	ug/l		NDR			NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Benzaldehyde	NS	ug/l		NDR			NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Benzo[a]anthracene	0.038	ug/l		NDR			NDR			NDR			NDR			NDR			< 10	U	10	NDR			< 10	U	10
Benzo[a]pyrene	0.0038	ug/l		NDR			NDR			NDR			NDR			NDR			< 10	U	10	NDR			< 10	U	10
Benzo[b]fluoranthene	0.038	ug/l		NDR			NDR			NDR			NDR			NDR			< 10	U	10	NDR			< 10	U	10
Benzo[g,h,i]perylene	NS	ug/l		NDR			NDR			NDR			NDR			NDR			< 10	U	10	NDR			< 10	U	10
Benzo[k]fluoranthene	0.38	ug/l		NDR			NDR			NDR			NDR			NDR			< 10	U	10	NDR			< 10	U	10
Biphenyl	NS	ug/l		NDR			NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Bis(2-chloroethoxy)methane	NS	ug/l		NDR			NDR			NDR			NDR			NDR			< 10	U	10	NDR			< 10	U	10
Bis(2-chloroethyl) Ether	0.03	ug/l		NDR			NDR			NDR			NDR			NDR			< 10	U	10	NDR			< 10	U	10
Bis(2-chloroisopropyl) Ether	1400	ug/l		NDR			NDR			NDR			NDR			NDR			< 10	U	10	NDR			< 10	U	10
Bis(2-ethylhexyl) Phthalate	1.2	ug/l		NDR			NDR			NDR			NDR			NDR			4	J	10	NDR			< 10	U	10
Butylbenzyl Phthalate	150	ug/l		NDR			NDR			NDR			NDR			NDR			< 10	U	10	NDR			< 10	U	10
Caprolactum	NS	ug/l		NDR			NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Carbazole	NS	ug/l		NDR			NDR			NDR			NDR			NDR			< 10	U	10	NDR			< 10	U	10
Chrysene	3.8	ug/l		NDR			NDR			NDR			NDR			NDR			< 10	U	10	NDR			< 10	U	10
Dibenzo[a,h]anthracene	0.0038	ug/l		NDR			NDR			NDR			NDR			NDR			< 10	U	10	NDR			< 10	U	10
Dibenzofuran	NS	ug/l		NDR			NDR			NDR			NDR			NDR			< 10	U	10	NDR			< 10	U	10
Diethyl Phthalate	17000	ug/l		NDR			NDR			NDR			NDR			NDR			< 10	U	10	NDR			< 10	U	10
Dimethyl Phthalate	NS	ug/l		NDR			NDR			NDR			NDR			NDR			< 10	U	10	NDR			< 10	U	10
Di-n-Butyl Phthalate	2000	ug/l		NDR			NDR			NDR			NDR			NDR			< 10	U	10	NDR			< 10	U	10
Di-n-octyl Phthalate	NS	ug/l		NDR			NDR			NDR			NDR			NDR			< 10	U	10	NDR			< 10	U	10
Fluoranthene	130	ug/l		NDR			NDR			NDR			NDR			NDR			< 10	U	10	NDR			< 10	U	10
Fluorene	1100	ug/l		NDR			NDR			NDR			NDR			NDR			< 10	U	10	NDR			< 10	U	10
Hexachlorobenzene	0.00028	ug/l		NDR			NDR			NDR			NDR			NDR			< 10	U	10	NDR			< 10	U	10
Hexachlorobutadiene	0.44	ug/l		NDR			NDR			NDR			NDR			NDR			< 10	U	10	NDR			< 10	U	10
Hexachlorocyclopentadiene	40	ug/l		NDR			NDR			NDR			NDR			NDR			< 10	U	10	NDR			< 10	U	10
Hexachloroethane	1.4	ug/l		NDR			NDR			NDR			NDR			NDR			< 10	U	10	NDR			< 10	U	10
Indeno[1,2,3-cd]pyrene	0.038	ug/l		NDR			NDR			NDR			NDR			NDR			< 10	U	10	NDR			< 10	U	10
Isophorone	35	ug/l		NDR			NDR			NDR			NDR			NDR			< 10	U	10	NDR			< 10	U	10
Naphthalene	NS	ug/l		NDR			NDR			NDR			NDR			NDR			< 10	U	10	NDR			< 10	U	10
Nitrobenzene	17	ug/l		NDR			NDR			NDR			NDR			NDR			< 10	U	10	NDR			< 10	U	10
N-Nitroso-di-n-propylamine	0.005	ug/l		NDR			NDR			NDR			NDR			NDR			< 10	U	10	NDR			< 10	U	10
N-Nitrosodiphenylamine	3.3	ug/l		NDR			NDR			NDR			NDR			NDR			< 10	U	10	NDR			< 10	U	10
Pentachlorophenol	0.27	ug/l		NDR			NDR			NDR			NDR			NDR			< 25	U	25	NDR			< 25	U	25
Phenanthrene	NS	ug/l		NDR			NDR			NDR			NDR			NDR			< 10	U	10	NDR			< 10	U	10
Phenol	10000	ug/l		NDR			NDR			NDR			NDR			NDR			< 10	U	10	NDR			< 10	U	10

TABLE A2
Surface Water Samples
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			Sample ID	SW-1			SW-1			SW-1			SW-1			SW-1			SW-1			SW-1			SW-1		
			Sample Date	3/10/2006			3/10/2006			5/24/2006			8/2/2006			8/2/2006			11/7/2006			3/22/2007			7/5/2007		
			N=Normal, FD=Field Duplicate	FD			N			N			FD			N			N			N			FD		
Parameter	NJDEP SWQS*	Unit		Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit
Pyrene	830	ug/l		NDR			NDR			NDR			NDR			NDR			< 10	U	10	NDR			< 10	U	10
Volatile Organic Compounds																											
1,1,1-Trichloroethane	120	ug/l		< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR		
1,1,2,2-Tetrachloroethane	4.7	ug/l		< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR		
1,1,2-Trichloroethane	13	ug/l		< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR		
1,1-Dichloroethane	NS	ug/l		< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR		
1,1-Dichloroethene	4.7	ug/l		< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR		
1,2,3-Trichlorobenzene	NS	ug/l		NDR			NDR			NDR			NDR			NDR			NDR			NDR			NDR		
1,2,4-Trichlorobenzene	21	ug/l		NDR			NDR			NDR			NDR			NDR			NDR			< 10	U	10	NDR		
1,2-Dibromo-3-chloropropane	NS	ug/l		NDR			NDR			NDR			NDR			NDR			NDR			< 10	U	10	NDR		
1,2-Dibromoethane	NS	ug/l		NDR			NDR			NDR			NDR			NDR			NDR			< 10	U	10	NDR		
1,2-Dichlorobenzene	2000	ug/l		< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR		
1,2-Dichloroethane	0.29	ug/l		< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR		
1,2-Dichloropropane	0.5	ug/l		< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR		
1,3-Dichlorobenzene	2200	ug/l		< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR		
1,4-Dichlorobenzene	550	ug/l		< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR		
2-Butanone	NS	ug/l		< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR		
2-Hexanone	NS	ug/l		< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR		
4-Methyl-2-pentanone	NS	ug/l		< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR		
Acetone	NS	ug/l		8	J	10	8	J	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	15		10	NDR		
Benzene	0.15	ug/l		< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR		
Bromochloromethane	NS	ug/l		NDR			NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Bromodichloromethane	0.55	ug/l		< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR		
Bromoform	4.3	ug/l		< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR		
Bromomethane	47	ug/l		< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR		
Carbon Disulfide	NS	ug/l		< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR		
Carbon Tetrachloride	0.33	ug/l		< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR		
Chlorobenzene	210	ug/l		< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR		
Chloroethane	NS	ug/l		< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR		
Chloroform	68	ug/l		< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR		
Chloromethane	NS	ug/l		< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR		
cis-1,2-Dichloroethene	NS	ug/l		1	J	10	2	J	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR		
cis-1,3-Dichloropropene	0.34	ug/l		< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR		
Cyclohexane	NS	ug/l		NDR			NDR			NDR			NDR			NDR			NDR			< 10	U	10	NDR		
Dibromochloromethane	0.4	ug/l		< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR		
Dichlorodifluoromethane	NS	ug/l		NDR			NDR			NDR			NDR			NDR			NDR			< 10	U	10	NDR		
Ethylbenzene	530	ug/l		< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR		
Freon 113	NS	ug/l		NDR			NDR			NDR			NDR			NDR			NDR			< 10	U	10	NDR		
Isopropylbenzene	NS	ug/l		NDR			NDR			NDR			NDR			NDR			NDR			< 10	U	10	NDR		
m,p-Xylenes	NS	ug/l		NDR			NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Methyl Acetate	NS	ug/l		NDR			NDR			NDR			NDR			NDR			NDR			< 10	U	10	NDR		
Methyl Cyclohexane	NS	ug/l		NDR			NDR			NDR			NDR			NDR			NDR			< 10	U	10	NDR		
Methyl tert-Butyl Ether	70	ug/l		NDR			NDR			NDR			NDR			NDR			NDR			< 10	U	10	NDR		
Methylene Chloride	2.5	ug/l		< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR		
o-Xylene	NS	ug/l		NDR			NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Styrene	NS	ug/l		< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR		
Tetrachloroethene	0.34	ug/l		< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR		
Toluene	1300	ug/l		< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR		
trans-1,2-Dichloroethene	590	ug/l		< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR		
trans-1,3-Dichloropropene	0.34	ug/l		< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR		
Trichloroethene	1	ug/l		< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR		
Trichlorofluoromethane	NS	ug/l		NDR			NDR			NDR			NDR			NDR			NDR			< 10	U	10	NDR		
Vinyl Chloride	0.082	ug/l		< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR		
Xylenes, Total	NS	ug/l		< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR		

TABLE A2
Surface Water Samples
Validated Analytical Data
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		Sample ID	SW-1			SW-1			SW-1			SW-1			SW-1			SW-1			SW-1			SW-1		
		Sample Date	7/5/2007			7/11/2007			7/11/2007			11/13/2007			11/13/2007			3/21/2008			6/2/2008			6/2/2008		
		N=Normal, FD=Field Duplicate	N			FD			N			FD			N			N			FD			N		
Parameter	NJDEP SWQS*	Unit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit
Inorganics																										
Aluminum	NS	ug/l	807	J	200	NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Antimony	5.6	ug/l	< 60	U	60	NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Arsenic	0.017	ug/l	< 10	U	10	NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Barium	2000	ug/l	< 200	U	200	NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Beryllium	6	ug/l	< 5	U	5	NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Cadmium	3.4	ug/l	0.92	J	5	NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Calcium	NS	ug/l	19700		5000	NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Chromium	92	ug/l	19.2	J	10	NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Cobalt	NS	ug/l	0.73	J	50	NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Copper	1300	ug/l	22.2	J	25	NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Iron	NS	ug/l	2720	J	100	NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Lead	5	ug/l	***17.4***		3	NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Magnesium	NS	ug/l	15700		5000	NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Manganese	NS	ug/l	256		15	NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Mercury	0.05	ug/l	0.16	R	0.2	NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Nickel	500	ug/l	< 40	U	40	NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Potassium	NS	ug/l	7780	J	5000	NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Selenium	170	ug/l	< 5	U	5	NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Silver	170	ug/l	< 10	U	10	NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Sodium	NS	ug/l	128000		5000	NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Thallium	0.24	ug/l	< 10	U	10	NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Vanadium	NS	ug/l	5.5	J	50	NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Zinc	7400	ug/l	93.4		20	NDR			NDR			NDR			NDR			NDR			NDR			NDR		
PCBs																										
Aroclor 1016	0.000064	ug/l	< 1	U	1	NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Aroclor 1221	0.000064	ug/l	< 2	U	2	NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Aroclor 1232	0.000064	ug/l	< 1	U	1	NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Aroclor 1242	0.000064	ug/l	< 1	U	1	NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Aroclor 1248	0.000064	ug/l	< 1	U	1	NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Aroclor 1254	0.000064	ug/l	< 1	U	1	NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Aroclor 1260	0.000064	ug/l	< 1	U	1	NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Aroclor 1262	0.000064	ug/l	NDR			NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Aroclor 1268	0.000064	ug/l	NDR			NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Pesticides																										
4,4-DDD	0.00031	ug/l	< 0.1	U	0.1	NDR			NDR			NDR			NDR			NDR			NDR			NDR		
4,4-DDE	0.00022	ug/l	< 0.1	U	0.1	NDR			NDR			NDR			NDR			NDR			NDR			NDR		
4,4-DDT	0.00022	ug/l	< 0.1	U	0.1	NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Aldrin	0.000049	ug/l	< 0.05	U	0.05	NDR			NDR			NDR			NDR			NDR			NDR			NDR		
alpha-BHC	0.0026	ug/l	< 0.05	U	0.05	NDR			NDR			NDR			NDR			NDR			NDR			NDR		
alpha-Chlordane	NS	ug/l	< 0.05	U	0.05	NDR			NDR			NDR			NDR			NDR			NDR			NDR		
alpha-Endosulfan	62	ug/l	< 0.05	U	0.05	NDR			NDR			NDR			NDR			NDR			NDR			NDR		
beta-BHC	0.0091	ug/l	< 0.05	U	0.05	NDR			NDR			NDR			NDR			NDR			NDR			NDR		
beta-Endosulfan	62	ug/l	< 0.1	U	0.1	NDR			NDR			NDR			NDR			NDR			NDR			NDR		
delta-BHC	NS	ug/l	< 0.05	U	0.05	NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Dieldrin	0.000052	ug/l	< 0.1	U	0.1	NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Endosulfan Sulfate	62	ug/l	< 0.1	U	0.1	NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Endrin	0.059	ug/l	< 0.1	U	0.1	NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Endrin Aldehyde	0.059	ug/l	< 0.1	U	0.1	NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Endrin Ketone	NS	ug/l	< 0.1	U	0.1	NDR			NDR			NDR			NDR			NDR			NDR			NDR		
gamma-BHC	0.98	ug/l	< 0.05	U	0.05	NDR			NDR			NDR			NDR			NDR			NDR			NDR		
gamma-Chlordane	NS	ug/l	NDR			NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Heptachlor	0.000079	ug/l	< 0.05	U	0.05	NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Heptachlor Epoxide	0.000039	ug/l	< 0.05	U	0.05	NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Methoxychlor	40	ug/l	< 0.5	U	0.5	NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Toxaphene	0.00028	ug/l	< 5	U	5	NDR			NDR			NDR			NDR			NDR			NDR			NDR		
trans-Chlordane	NS	ug/l	< 0.05	U	0.05	NDR			NDR			NDR			NDR			NDR			NDR			NDR		

TABLE A2
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		Sample ID	SW-1			SW-1			SW-1			SW-1			SW-1			SW-1			SW-1			SW-1		
		Sample Date	7/5/2007			7/11/2007			7/11/2007			11/13/2007			11/13/2007			3/21/2008			6/2/2008			6/2/2008		
		N=Normal, FD=Field Duplicate	N			FD			N			FD			N			N			FD			N		
Parameter	NJDEP SWQS*	Unit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit
Semivolatile Organic Compounds																										
1,2,4,5-Tetrachlorobenzene	0.97	ug/l	NDR			NDR			NDR			NDR			NDR			NDR			NDR			NDR		
2,3,4,6-Tetrachlorophenol	NS	ug/l	NDR			NDR			NDR			NDR			NDR			NDR			NDR			NDR		
2,4,5-Trichlorophenol	1800	ug/l	< 25	U	25	NDR			NDR			NDR			NDR			NDR			NDR			NDR		
2,4,6-Trichlorophenol	0.58	ug/l	< 10	U	10	NDR			NDR			NDR			NDR			NDR			NDR			NDR		
2,4-Dichlorophenol	77	ug/l	< 10	U	10	NDR			NDR			NDR			NDR			NDR			NDR			NDR		
2,4-Dimethylphenol	380	ug/l	< 10	U	10	NDR			NDR			NDR			NDR			NDR			NDR			NDR		
2,4-Dinitrophenol	69	ug/l	< 25	U	25	NDR			NDR			NDR			NDR			NDR			NDR			NDR		
2,4-Dinitrotoluene	0.11	ug/l	< 10	U	10	NDR			NDR			NDR			NDR			NDR			NDR			NDR		
2,6-Dinitrotoluene	NS	ug/l	< 10	U	10	NDR			NDR			NDR			NDR			NDR			NDR			NDR		
2-Chloronaphthalene	1000	ug/l	< 10	U	10	NDR			NDR			NDR			NDR			NDR			NDR			NDR		
2-Chlorophenol	81	ug/l	< 10	U	10	NDR			NDR			NDR			NDR			NDR			NDR			NDR		
2-Methylnaphthalene	NS	ug/l	< 10	U	10	NDR			NDR			NDR			NDR			NDR			NDR			NDR		
2-Methylphenol	NS	ug/l	< 10	U	10	NDR			NDR			NDR			NDR			NDR			NDR			NDR		
2-Nitroaniline	NS	ug/l	< 25	U	25	NDR			NDR			NDR			NDR			NDR			NDR			NDR		
2-Nitrophenol	NS	ug/l	< 10	U	10	NDR			NDR			NDR			NDR			NDR			NDR			NDR		
3,3'-Dichlorobenzidine	0.021	ug/l	< 10	U	10	NDR			NDR			NDR			NDR			NDR			NDR			NDR		
3-Nitroaniline	NS	ug/l	< 25	U	25	NDR			NDR			NDR			NDR			NDR			NDR			NDR		
4,6-Dinitro-2-methylphenol	13	ug/l	< 25	U	25	NDR			NDR			NDR			NDR			NDR			NDR			NDR		
4-Bromophenyl Phenyl Ether	NS	ug/l	< 10	U	10	NDR			NDR			NDR			NDR			NDR			NDR			NDR		
4-Chloro-3-methylphenol	NS	ug/l	< 10	U	10	NDR			NDR			NDR			NDR			NDR			NDR			NDR		
4-Chloroaniline	NS	ug/l	< 10	U	10	NDR			NDR			NDR			NDR			NDR			NDR			NDR		
4-Chlorophenyl-phenylether	NS	ug/l	< 10	U	10	NDR			NDR			NDR			NDR			NDR			NDR			NDR		
4-Methylphenol	NS	ug/l	< 10	U	10	NDR			NDR			NDR			NDR			NDR			NDR			NDR		
4-Nitroaniline	NS	ug/l	< 25	U	25	NDR			NDR			NDR			NDR			NDR			NDR			NDR		
4-Nitrophenol	NS	ug/l	< 25	U	25	NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Acenaphthene	670	ug/l	< 10	U	10	NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Acenaphthylene	NS	ug/l	< 10	U	10	NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Acetophenone	NS	ug/l	NDR			NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Anthracene	8300	ug/l	< 10	U	10	NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Atrazine	NS	ug/l	NDR			NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Benzaldehyde	NS	ug/l	NDR			NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Benzo[a]anthracene	0.038	ug/l	< 10	U	10	NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Benzo[a]pyrene	0.0038	ug/l	< 10	U	10	NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Benzo[b]fluoranthene	0.038	ug/l	< 10	U	10	NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Benzo[g,h,i]perylene	NS	ug/l	< 10	U	10	NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Benzo[k]fluoranthene	0.38	ug/l	< 10	U	10	NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Biphenyl	NS	ug/l	NDR			NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Bis(2-chloroethoxy)methane	NS	ug/l	< 10	U	10	NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Bis(2-chloroethyl) Ether	0.03	ug/l	< 10	U	10	NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Bis(2-chloroisopropyl) Ether	1400	ug/l	< 10	U	10	NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Bis(2-ethylhexyl) Phthalate	1.2	ug/l	< 10	U	10	NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Butylbenzyl Phthalate	150	ug/l	< 10	U	10	NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Caprolactum	NS	ug/l	NDR			NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Carbazole	NS	ug/l	< 10	U	10	NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Chrysene	3.8	ug/l	< 10	U	10	NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Dibenzo[a,h]anthracene	0.0038	ug/l	< 10	U	10	NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Dibenzofuran	NS	ug/l	< 10	U	10	NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Diethyl Phthalate	17000	ug/l	< 10	U	10	NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Dimethyl Phthalate	NS	ug/l	< 10	U	10	NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Di-n-Butyl Phthalate	2000	ug/l	< 10	U	10	NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Di-n-octyl Phthalate	NS	ug/l	< 10	U	10	NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Fluoranthene	130	ug/l	< 10	U	10	NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Fluorene	1100	ug/l	< 10	U	10	NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Hexachlorobenzene	0.00028	ug/l	< 10	U	10	NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Hexachlorobutadiene	0.44	ug/l	< 10	U	10	NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Hexachlorocyclopentadiene	40	ug/l	< 10	U	10	NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Hexachloroethane	1.4	ug/l	< 10	U	10	NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Indeno[1,2,3-cd]pyrene	0.038	ug/l	< 10	U	10	NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Isophorone	35	ug/l	< 10	U	10	NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Naphthalene	NS	ug/l	< 10	U	10	NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Nitrobenzene	17	ug/l	< 10	U	10	NDR			NDR			NDR			NDR			NDR			NDR			NDR		
N-Nitroso-di-n-propylamine	0.005	ug/l	< 10	U	10	NDR			NDR			NDR			NDR			NDR			NDR			NDR		
N-Nitrosodiphenylamine	3.3	ug/l	< 10	U	10	NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Pentachlorophenol	0.27	ug/l	< 25	U	25	NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Phenanthrene	NS	ug/l	< 10	U	10	NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Phenol	10000	ug/l	< 10	U	10	NDR			NDR			NDR			NDR			NDR			NDR			NDR		

TABLE A2
Surface Water Samples
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Sample ID			SW-1			SW-1			SW-1			SW-1			SW-1			SW-1			SW-1			SW-1		
Sample Date			7/5/2007			7/11/2007			7/11/2007			11/13/2007			11/13/2007			3/21/2008			6/2/2008			6/2/2008		
N=Normal, FD=Field Duplicate			N			FD			N			FD			N			N			FD			N		
Parameter	NJDEP SWQS*	Unit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit
Pyrene	830	ug/l	< 10	U	10	NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Volatile Organic Compounds																										
1,1,1-Trichloroethane	120	ug/l	NDR			< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,1,2,2-Tetrachloroethane	4.7	ug/l	NDR			< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,1,2-Trichloroethane	13	ug/l	NDR			< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,1-Dichloroethane	NS	ug/l	NDR			< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,1-Dichloroethene	4.7	ug/l	NDR			< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,2,3-Trichlorobenzene	NS	ug/l	NDR			NDR			NDR			NDR			NDR			NDR			NDR			NDR		
1,2,4-Trichlorobenzene	21	ug/l	NDR			< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,2-Dibromo-3-chloropropane	NS	ug/l	NDR			< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,2-Dibromoethane	NS	ug/l	NDR			< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,2-Dichlorobenzene	2000	ug/l	NDR			0.17	J	0.5	0.16	J	0.5	< 0.5	U	0.5	< 0.5	U	0.5	0.52		0.5	< 0.5	U	0.5	0.34	J	0.5
1,2-Dichloroethane	0.29	ug/l	NDR			< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,2-Dichloropropane	0.5	ug/l	NDR			< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,3-Dichlorobenzene	2200	ug/l	NDR			< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,4-Dichlorobenzene	550	ug/l	NDR			< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
2-Butanone	NS	ug/l	NDR			3.3	J	5	< 5	U	5	< 5	U	5	< 5	U	5	< 5	U	5	< 5	U	5	< 5	U	5
2-Hexanone	NS	ug/l	NDR			< 5	U	5	< 5	UJ	5	< 5	U	5	< 5	U	5	< 5	U	5	< 5	U	5	< 5	U	5
4-Methyl-2-pentanone	NS	ug/l	NDR			< 5	U	5	< 5	UJ	5	< 5	U	5	< 5	U	5	< 5	U	5	< 5	U	5	< 5	U	5
Acetone	NS	ug/l	NDR			< 5	U	5	< 5	U	5	< 5.6	U	5.6	< 5	U	5	10		5	< 5	U	5	< 5	U	5
Benzene	0.15	ug/l	NDR			< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Bromochloromethane	NS	ug/l	NDR			NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Bromodichloromethane	0.55	ug/l	NDR			< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Bromoform	4.3	ug/l	NDR			< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Bromomethane	47	ug/l	NDR			< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Carbon Disulfide	NS	ug/l	NDR			< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Carbon Tetrachloride	0.33	ug/l	NDR			< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Chlorobenzene	210	ug/l	NDR			< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	0.19	J	0.5	0.15	J	0.5	0.25	J	0.5
Chloroethane	NS	ug/l	NDR			< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Chloroform	68	ug/l	NDR			0.11	J	0.5	0.11	J	0.5	< 0.5	U	0.5	0.11	J	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Chloromethane	NS	ug/l	NDR			< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
cis-1,2-Dichloroethene	NS	ug/l	NDR			0.15	J	0.5	0.14	J	0.5	0.36	J	0.5	0.31	J	0.5	0.5		0.5	0.37	J	0.5	0.46	J	0.5
cis-1,3-Dichloropropene	0.34	ug/l	NDR			< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Cyclohexane	NS	ug/l	NDR			< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Dibromochloromethane	0.4	ug/l	NDR			< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Dichlorodifluoromethane	NS	ug/l	NDR			< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Ethylbenzene	530	ug/l	NDR			< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Freon 113	NS	ug/l	NDR			< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Isopropylbenzene	NS	ug/l	NDR			< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
m,p-Xylenes	NS	ug/l	NDR			NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Methyl Acetate	NS	ug/l	NDR			< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Methyl Cyclohexane	NS	ug/l	NDR			< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Methyl tert-Butyl Ether	70	ug/l	NDR			< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Methylene Chloride	2.5	ug/l	NDR			< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
o-Xylene	NS	ug/l	NDR			NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Styrene	NS	ug/l	NDR			< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Tetrachloroethene	0.34	ug/l	NDR			< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	0.11	J	0.5	0.18	J	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Toluene	1300	ug/l	NDR			< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	0.1	J	0.5	< 0.5	U	0.5	0.14	J	0.5
trans-1,2-Dichloroethene	590	ug/l	NDR			< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
trans-1,3-Dichloropropene	0.34	ug/l	NDR			< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Trichloroethene	1	ug/l	NDR			0.11	J	0.5	< 0.5	U	0.5	0.14	J	0.5	0.14	J	0.5	0.18	J	0.5	0.16	J	0.5	0.17	J	0.5
Trichlorofluoromethane	NS	ug/l	NDR			< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Vinyl Chloride	0.082	ug/l	NDR			< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Xylenes, Total	NS	ug/l	NDR			< 0.5	U	0.5	< 0.5	U	0.5	< 1.5	U	1.5	< 1.5	U	1.5	0.22	J	1.5	< 1.5	U	1.5	< 1.5	U	1.5

TABLE A2
Surface Water Samples
Validated Analytical Data
Carlstadt

Sample ID Sample Date N=Normal, FD=Field Duplicate			SW-1 12/3/2008 FD			SW-1 12/3/2008 N			SW-1 4/2/2009 N			SW-1 7/10/2009 N			SW-1 10/22/2009 N			SW-1 12/21/2009 N			SW-2 3/10/2006 N			SW-2 5/24/2006 N		
Parameter	NJDEP SWQS*	Unit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit
Inorganics																										
Aluminum	NS	ug/l	363		200	276	J	200	NDR			NDR			NDR			614		200	NDR			NDR		
Antimony	5.6	ug/l	< 60	U	60	< 60	U	60	NDR			NDR			NDR			< 2	U	2	NDR			NDR		
Arsenic	0.017	ug/l	< 10	U	10	< 10	U	10	NDR			NDR			NDR			***4.3***		1	NDR			NDR		
Barium	2000	ug/l	45.8	J	200	46.8	J	200	NDR			NDR			NDR			60.2	J	10	NDR			NDR		
Beryllium	6	ug/l	< 5	U	5	< 5	U	5	NDR			NDR			NDR			< 1	U	1	NDR			NDR		
Cadmium	3.4	ug/l	< 5	U	5	< 5	U	5	NDR			NDR			NDR			1.8	J	1	NDR			NDR		
Calcium	NS	ug/l	62600		5000	64000		5000	NDR			NDR			NDR			61800		5000	NDR			NDR		
Chromium	92	ug/l	4.5	J	10	4.6	J	10	NDR			NDR			NDR			9.4	J	2	NDR			NDR		
Cobalt	NS	ug/l	2.7	J	50	2.7	J	50	NDR			NDR			NDR			< 1	U	1	NDR			NDR		
Copper	1300	ug/l	4.4	J	25	4.5	J	25	NDR			NDR			NDR			15.4	J	2	NDR			NDR		
Iron	NS	ug/l	578		100	626		100	NDR			NDR			NDR			995		100	NDR			NDR		
Lead	5	ug/l	< 3	U	3	< 3	U	3	NDR			NDR			NDR			***6.2***	J	1	NDR			NDR		
Magnesium	NS	ug/l	106000		5000	109000		5000	NDR			NDR			NDR			85900		5000	NDR			NDR		
Manganese	NS	ug/l	504		15	523		15	NDR			NDR			NDR			528		1	NDR			NDR		
Mercury	0.05	ug/l	***0.46***		0.2	***0.36***		0.2	NDR			NDR			NDR			***0.55***		0.2	NDR			NDR		
Nickel	500	ug/l	2.5	J	40	2.7	J	40	NDR			NDR			NDR			5.1		1	NDR			NDR		
Potassium	NS	ug/l	46400	J	5000	47600	J	5000	NDR			NDR			NDR			39400	J	5000	NDR			NDR		
Selenium	170	ug/l	< 5	U	5	< 5	U	5	NDR			NDR			NDR			12.3		5	NDR			NDR		
Silver	170	ug/l	< 10	U	10	< 10	U	10	NDR			NDR			NDR			< 1	U	1	NDR			NDR		
Sodium	NS	ug/l	883000		10000	889000		10000	NDR			NDR			NDR			737000		10000	NDR			NDR		
Thallium	0.24	ug/l	< 10	U	10	< 10	U	10	NDR			NDR			NDR			< 1	U	1	NDR			NDR		
Vanadium	NS	ug/l	2.1	J	50	1.6	J	50	NDR			NDR			NDR			< 5	U	5	NDR			NDR		
Zinc	7400	ug/l	30		20	35.9		20	NDR			NDR			NDR			43.3	J	2	NDR			NDR		
PCBs																										
Aroclor 1016	0.000064	ug/l	< 1.1	U	1.1	< 1	U	1	NDR			NDR			NDR			< 1	U	1	NDR			NDR		
Aroclor 1221	0.000064	ug/l	< 2.1	U	2.1	< 2.1	U	2.1	NDR			NDR			NDR			< 1	U	1	NDR			NDR		
Aroclor 1232	0.000064	ug/l	< 1.1	U	1.1	< 1	U	1	NDR			NDR			NDR			< 1	U	1	NDR			NDR		
Aroclor 1242	0.000064	ug/l	< 1.1	U	1.1	< 1	U	1	NDR			NDR			NDR			< 1	U	1	NDR			NDR		
Aroclor 1248	0.000064	ug/l	< 1.1	U	1.1	< 1	U	1	NDR			NDR			NDR			< 1	U	1	NDR			NDR		
Aroclor 1254	0.000064	ug/l	< 1.1	U	1.1	< 1	U	1	NDR			NDR			NDR			< 1	U	1	NDR			NDR		
Aroclor 1260	0.000064	ug/l	< 1.1	U	1.1	< 1	U	1	NDR			NDR			NDR			< 1	U	1	NDR			NDR		
Aroclor 1262	0.000064	ug/l	NDR			NDR			NDR			NDR			NDR			< 1	U	1	NDR			NDR		
Aroclor 1268	0.000064	ug/l	NDR			NDR			NDR			NDR			NDR			< 1	U	1	NDR			NDR		
Pesticides																										
4,4-DDD	0.00031	ug/l	< 0.11	U	0.11	< 0.1	U	0.1	NDR			NDR			NDR			< 0.1	U	0.1	NDR			NDR		
4,4-DDE	0.00022	ug/l	< 0.11	U	0.11	< 0.1	U	0.1	NDR			NDR			NDR			< 0.1	U	0.1	NDR			NDR		
4,4-DDT	0.00022	ug/l	< 0.11	U	0.11	< 0.1	U	0.1	NDR			NDR			NDR			< 0.1	U	0.1	NDR			NDR		
Aldrin	0.000049	ug/l	< 0.053	U	0.053	< 0.051	U	0.051	NDR			NDR			NDR			< 0.05	U	0.05	NDR			NDR		
alpha-BHC	0.0026	ug/l	< 0.053	U	0.053	< 0.051	U	0.051	NDR			NDR			NDR			< 0.05	U	0.05	NDR			NDR		
alpha-Chlordane	NS	ug/l	< 0.053	U	0.053	< 0.051	U	0.051	NDR			NDR			NDR			< 0.05	U	0.05	NDR			NDR		
alpha-Endosulfan	62	ug/l	< 0.053	U	0.053	< 0.051	U	0.051	NDR			NDR			NDR			< 0.05	U	0.05	NDR			NDR		
beta-BHC	0.0091	ug/l	< 0.053	U	0.053	< 0.051	U	0.051	NDR			NDR			NDR			< 0.05	U	0.05	NDR			NDR		
beta-Endosulfan	62	ug/l	< 0.11	U	0.11	< 0.1	U	0.1	NDR			NDR			NDR			< 0.1	U	0.1	NDR			NDR		
delta-BHC	NS	ug/l	< 0.053	U	0.053	< 0.051	U	0.051	NDR			NDR			NDR			< 0.05	U	0.05	NDR			NDR		
Dieldrin	0.000052	ug/l	< 0.11	U	0.11	< 0.1	U	0.1	NDR			NDR			NDR			< 0.1	U	0.1	NDR			NDR		
Endosulfan Sulfate	62	ug/l	< 0.11	U	0.11	< 0.1	U	0.1	NDR			NDR			NDR			< 0.1	U	0.1	NDR			NDR		
Endrin	0.059	ug/l	< 0.11	U	0.11	< 0.1	U	0.1	NDR			NDR			NDR			< 0.1	U	0.1	NDR			NDR		
Endrin Aldehyde	0.059	ug/l	< 0.11	U	0.11	< 0.1	U	0.1	NDR			NDR			NDR			< 0.1	U	0.1	NDR			NDR		
Endrin Ketone	NS	ug/l	< 0.11	U	0.11	< 0.1	U	0.1	NDR			NDR			NDR			< 0.1	U	0.1	NDR			NDR		
gamma-BHC	0.98	ug/l	< 0.053	U	0.053	< 0.051	U	0.051	NDR			NDR			NDR			< 0.05	U	0.05	NDR			NDR		
gamma-Chlordane	NS	ug/l	< 0.053	U	0.053	< 0.051	U	0.051	NDR			NDR			NDR			NDR			NDR			NDR		
Heptachlor	0.000079	ug/l	< 0.053	U	0.053	< 0.051	U	0.051	NDR			NDR			NDR			< 0.05	U	0.05	NDR			NDR		
Heptachlor Epoxide	0.000039	ug/l	< 0.053	U	0.053	< 0.051	U	0.051	NDR			NDR			NDR			< 0.05	U	0.05	NDR			NDR		
Methoxychlor	40	ug/l	< 0.53	U	0.53	< 0.51	U	0.51	NDR			NDR			NDR			< 0.5	U	0.5	NDR			NDR		
Toxaphene	0.00028	ug/l	< 5.3	U	5.3	< 5.1	U	5.1	NDR			NDR			NDR			< 5	U	5	NDR			NDR		
trans-Chlordane	NS	ug/l	NDR			NDR			NDR			NDR			NDR			< 0.05	U	0.05	NDR			NDR		

TABLE A2
Surface Water Samples
Validated Analytical Data
Carlstadt

		Sample ID	SW-1			SW-1			SW-1			SW-1			SW-1			SW-1			SW-2			SW-2		
		Sample Date	12/3/2008			12/3/2008			4/2/2009			7/10/2009			10/22/2009			12/21/2009			3/10/2006			5/24/2006		
		N=Normal, FD=Field Duplicate	FD			N			N			N			N			N			N			N		
Parameter	NJDEP SWQS*	Unit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit
Semivolatile Organic Compounds																										
1,2,4,5-Tetrachlorobenzene	0.97	ug/l	NDR			NDR			NDR			NDR			NDR			< 5	U	5	NDR			NDR		
2,3,4,6-Tetrachlorophenol	NS	ug/l	NDR			NDR			NDR			NDR			NDR			< 5	U	5	NDR			NDR		
2,4,5-Trichlorophenol	1800	ug/l	< 26	U	26	< 25	U	25	NDR			NDR			NDR			< 5	U	5	NDR			NDR		
2,4,6-Trichlorophenol	0.58	ug/l	< 10	U	10	< 10	U	10	NDR			NDR			NDR			< 5	U	5	NDR			NDR		
2,4-Dichlorophenol	77	ug/l	< 10	U	10	< 10	U	10	NDR			NDR			NDR			< 5	U	5	NDR			NDR		
2,4-Dimethylphenol	380	ug/l	< 10	U	10	< 10	U	10	NDR			NDR			NDR			< 5	U	5	NDR			NDR		
2,4-Dinitrophenol	69	ug/l	< 26	U	26	< 25	U	25	NDR			NDR			NDR			< 10	U	10	NDR			NDR		
2,4-Dinitrotoluene	0.11	ug/l	< 10	U	10	< 10	U	10	NDR			NDR			NDR			< 5	U	5	NDR			NDR		
2,6-Dinitrotoluene	NS	ug/l	< 10	U	10	< 10	U	10	NDR			NDR			NDR			< 5	U	5	NDR			NDR		
2-Chloronaphthalene	1000	ug/l	< 10	U	10	< 10	U	10	NDR			NDR			NDR			< 5	U	5	NDR			NDR		
2-Chlorophenol	81	ug/l	< 10	U	10	< 10	U	10	NDR			NDR			NDR			< 5	U	5	NDR			NDR		
2-Methylnaphthalene	NS	ug/l	< 10	U	10	< 10	U	10	NDR			NDR			NDR			< 5	U	5	NDR			NDR		
2-Methylphenol	NS	ug/l	< 10	U	10	< 10	U	10	NDR			NDR			NDR			< 5	U	5	NDR			NDR		
2-Nitroaniline	NS	ug/l	< 26	U	26	< 25	U	25	NDR			NDR			NDR			< 10	U	10	NDR			NDR		
2-Nitrophenol	NS	ug/l	< 10	U	10	< 10	U	10	NDR			NDR			NDR			< 5	U	5	NDR			NDR		
3,3'-Dichlorobenzidine	0.021	ug/l	< 10	U	10	< 10	U	10	NDR			NDR			NDR			< 5	U	5	NDR			NDR		
3-Nitroaniline	NS	ug/l	< 26	U	26	< 25	U	25	NDR			NDR			NDR			< 10	U	10	NDR			NDR		
4,6-Dinitro-2-methylphenol	13	ug/l	< 26	U	26	< 25	U	25	NDR			NDR			NDR			< 10	U	10	NDR			NDR		
4-Bromophenyl Phenyl Ether	NS	ug/l	< 10	U	10	< 10	U	10	NDR			NDR			NDR			< 5	U	5	NDR			NDR		
4-Chloro-3-methylphenol	NS	ug/l	< 10	U	10	< 10	U	10	NDR			NDR			NDR			< 5	U	5	NDR			NDR		
4-Chloroaniline	NS	ug/l	< 10	U	10	< 10	U	10	NDR			NDR			NDR			< 5	U	5	NDR			NDR		
4-Chlorophenyl-phenylether	NS	ug/l	< 10	U	10	< 10	U	10	NDR			NDR			NDR			< 5	U	5	NDR			NDR		
4-Methylphenol	NS	ug/l	< 10	U	10	< 10	U	10	NDR			NDR			NDR			< 5	U	5	NDR			NDR		
4-Nitroaniline	NS	ug/l	< 26	U	26	< 25	U	25	NDR			NDR			NDR			< 10	U	10	NDR			NDR		
4-Nitrophenol	NS	ug/l	< 26	U	26	< 25	U	25	NDR			NDR			NDR			< 10	U	10	NDR			NDR		
Acenaphthene	670	ug/l	< 10	U	10	< 10	U	10	NDR			NDR			NDR			< 5	U	5	NDR			NDR		
Acenaphthylene	NS	ug/l	< 10	U	10	< 10	U	10	NDR			NDR			NDR			< 5	U	5	NDR			NDR		
Acetophenone	NS	ug/l	NDR			NDR			NDR			NDR			NDR			< 5	U	5	NDR			NDR		
Anthracene	8300	ug/l	< 10	U	10	< 10	U	10	NDR			NDR			NDR			< 5	U	5	NDR			NDR		
Atrazine	NS	ug/l	NDR			NDR			NDR			NDR			NDR			< 5	U	5	NDR			NDR		
Benzaldehyde	NS	ug/l	NDR			NDR			NDR			NDR			NDR			< 5	U	5	NDR			NDR		
Benzo[a]anthracene	0.038	ug/l	< 10	U	10	< 10	U	10	NDR			NDR			NDR			< 5	U	5	NDR			NDR		
Benzo[a]pyrene	0.0038	ug/l	< 10	U	10	< 10	U	10	NDR			NDR			NDR			< 5	U	5	NDR			NDR		
Benzo[b]fluoranthene	0.038	ug/l	< 10	U	10	< 10	U	10	NDR			NDR			NDR			< 5	U	5	NDR			NDR		
Benzo[g,h,i]perylene	NS	ug/l	< 10	U	10	< 10	U	10	NDR			NDR			NDR			< 5	U	5	NDR			NDR		
Benzo[k]fluoranthene	0.38	ug/l	< 10	U	10	< 10	U	10	NDR			NDR			NDR			< 5	U	5	NDR			NDR		
Biphenyl	NS	ug/l	NDR			NDR			NDR			NDR			NDR			< 5	U	5	NDR			NDR		
Bis(2-chloroethoxy)methane	NS	ug/l	< 10	U	10	< 10	U	10	NDR			NDR			NDR			< 5	U	5	NDR			NDR		
Bis(2-chloroethyl) Ether	0.03	ug/l	< 10	U	10	< 10	U	10	NDR			NDR			NDR			< 5	U	5	NDR			NDR		
Bis(2-chloroisopropyl) Ether	1400	ug/l	< 10	U	10	< 10	U	10	NDR			NDR			NDR			< 5	U	5	NDR			NDR		
Bis(2-ethylhexyl) Phthalate	1.2	ug/l	< 10	U	10	< 10	U	10	NDR			NDR			NDR			< 5	U	5	NDR			NDR		
Butylbenzyl Phthalate	150	ug/l	< 10	U	10	< 10	U	10	NDR			NDR			NDR			< 5	U	5	NDR			NDR		
Caprolactum	NS	ug/l	NDR			NDR			NDR			NDR			NDR			< 5	U	5	NDR			NDR		
Carbazole	NS	ug/l	< 10	U	10	< 10	U	10	NDR			NDR			NDR			< 5	U	5	NDR			NDR		
Chrysene	3.8	ug/l	< 10	U	10	< 10	U	10	NDR			NDR			NDR			< 5	U	5	NDR			NDR		
Dibenzo[a,h]anthracene	0.0038	ug/l	< 10	U	10	< 10	U	10	NDR			NDR			NDR			< 5	U	5	NDR			NDR		
Dibenzofuran	NS	ug/l	< 10	U	10	< 10	U	10	NDR			NDR			NDR			< 5	U	5	NDR			NDR		
Diethyl Phthalate	17000	ug/l	< 10	U	10	< 10	U	10	NDR			NDR			NDR			< 5	U	5	NDR			NDR		
Dimethyl Phthalate	NS	ug/l	< 10	U	10	< 10	U	10	NDR			NDR			NDR			< 5	U	5	NDR			NDR		
Di-n-Butyl Phthalate	2000	ug/l	< 10	U	10	< 10	U	10	NDR			NDR			NDR			< 5	U	5	NDR			NDR		
Di-n-octyl Phthalate	NS	ug/l	< 10	U	10	< 10	U	10	NDR			NDR			NDR			< 5	U	5	NDR			NDR		
Fluoranthene	130	ug/l	< 10	U	10	< 10	U	10	NDR			NDR			NDR			< 5	U	5	NDR			NDR		
Fluorene	1100	ug/l	< 10	U	10	< 10	U	10	NDR			NDR			NDR			< 5	U	5	NDR			NDR		
Hexachlorobenzene	0.00028	ug/l	< 10	U	10	< 10	U	10	NDR			NDR			NDR			< 5	U	5	NDR			NDR		
Hexachlorobutadiene	0.44	ug/l	< 10	U	10	< 10	U	10	NDR			NDR			NDR			< 5	U	5	NDR			NDR		
Hexachlorocyclopentadiene	40	ug/l	< 10	U	10	< 10	U	10	NDR			NDR			NDR			< 5	U	5	NDR			NDR		
Hexachloroethane	1.4	ug/l	< 10	U	10	< 10	U	10	NDR			NDR			NDR			< 5	U	5	NDR			NDR		
Indeno[1,2,3-cd]pyrene	0.038	ug/l	< 10	U	10	< 10	U	10	NDR			NDR			NDR			< 5	U	5	NDR			NDR		
Isophorone	35	ug/l	< 10	U	10	< 10	U	10	NDR			NDR			NDR			< 5	U	5	NDR			NDR		
Naphthalene	NS	ug/l	< 10	U	10	< 10	U	10	NDR			NDR			NDR			< 5	U	5	NDR			NDR		
Nitrobenzene	17	ug/l	< 10	U	10	< 10	U	10	NDR			NDR			NDR			< 5	U	5	NDR			NDR		
N-Nitroso-di-n-propylamine	0.005	ug/l	< 10	U	10	< 10	U	10	NDR			NDR			NDR			< 5	U	5	NDR			NDR		
N-Nitrosodiphenylamine	3.3	ug/l	< 10	U	10	< 10	U	10	NDR			NDR			NDR			< 5	U	5	NDR			NDR		
Pentachlorophenol	0.27	ug/l	< 26	U	26	< 25	U	25	NDR			NDR			NDR			< 10	U	10	NDR			NDR		
Phenanthrene	NS	ug/l	< 10	U	10	< 10	U	10	NDR			NDR			NDR			< 5	U	5	NDR			NDR		
Phenol	10000	ug/l	< 10	U	10	< 10	U	10	NDR			NDR			NDR			< 5	U	5	NDR			NDR		

Golder Associates
R2-0001304

TABLE A2
Surface Water Samples
Validated Analytical Data
Carlstadt

		Sample ID	SW-1			SW-1			SW-1			SW-1			SW-1			SW-1			SW-2			SW-2		
		Sample Date	12/3/2008			12/3/2008			4/2/2009			7/10/2009			10/22/2009			12/21/2009			3/10/2006			5/24/2006		
		N=Normal, FD=Field Duplicate	FD			N			N			N			N			N			N			N		
Parameter	NJDEP SWQS*	Unit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit
Pyrene	830	ug/l	< 10	U	10	< 10	U	10	NDR			NDR			NDR			< 5	U	5	NDR			NDR		
Volatile Organic Compounds																										
1,1,1-Trichloroethane	120	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 10	U	10	< 10	U	10
1,1,2,2-Tetrachloroethane	4.7	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 10	U	10	< 10	U	10
1,1,2-Trichloroethane	13	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 10	U	10	< 10	U	10
1,1-Dichloroethane	NS	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 10	U	10	< 10	U	10
1,1-Dichloroethene	4.7	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 10	U	10	< 10	U	10
1,2,3-Trichlorobenzene	NS	ug/l	NDR			NDR			NDR			NDR			NDR			< 0.5	U	0.5	NDR			NDR		
1,2,4-Trichlorobenzene	21	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	NDR			NDR		
1,2-Dibromo-3-chloropropane	NS	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	NDR			NDR		
1,2-Dibromoethane	NS	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	NDR			NDR		
1,2-Dichlorobenzene	2000	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 10	U	10	< 10	U	10
1,2-Dichloroethane	0.29	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 10	U	10	< 10	U	10
1,2-Dichloropropane	0.5	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 10	U	10	< 10	U	10
1,3-Dichlorobenzene	2200	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 10	U	10	< 10	U	10
1,4-Dichlorobenzene	550	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 10	U	10	< 10	U	10
2-Butanone	NS	ug/l	< 5	U	5	1.2	J	5	< 5	U	5	< 5	U	5	< 5	U	5	< 5	U	5	< 10	U	10	< 10	U	10
2-Hexanone	NS	ug/l	< 5	U	5	< 5	U	5	< 5	U	5	< 5	U	5	< 5	U	5	< 5	U	5	< 10	U	10	< 10	U	10
4-Methyl-2-pentanone	NS	ug/l	< 5	U	5	< 5	U	5	< 5	U	5	< 5	U	5	< 5	U	5	< 5	U	5	< 10	U	10	< 10	U	10
Acetone	NS	ug/l	< 5.8	U	5.8	< 5.2	U	5.2	13		5	< 5	U	5	< 5	U	5	< 5	U	5	6	J	10	3	J	10
Benzene	0.15	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 10	U	10	< 10	U	10
Bromochloromethane	NS	ug/l	NDR			NDR			NDR			NDR			NDR			< 0.5	U	0.5	NDR			NDR		
Bromodichloromethane	0.55	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 10	U	10	< 10	U	10
Bromoform	4.3	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 10	U	10	< 10	U	10
Bromomethane	47	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 10	U	10	< 10	U	10
Carbon Disulfide	NS	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	0.11	J	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 10	U	10	< 10	U	10
Carbon Tetrachloride	0.33	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 10	U	10	< 10	U	10
Chlorobenzene	210	ug/l	0.3	J	0.5	0.28	J	0.5	0.2	J	0.5	< 0.5	U	0.5	0.12	J	0.5	< 0.5	U	0.5	< 10	U	10	< 10	U	10
Chloroethane	NS	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 10	U	10	< 10	U	10
Chloroform	68	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 10	U	10	< 10	U	10
Chloromethane	NS	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 10	U	10	< 10	U	10
cis-1,2-Dichloroethene	NS	ug/l	0.87		0.5	0.91		0.5	0.97		0.5	0.26	J	0.5	0.16	J	0.5	0.94		0.5	< 10	U	10	< 10	U	10
cis-1,3-Dichloropropene	0.34	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 10	U	10	< 10	U	10
Cyclohexane	NS	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	NDR			NDR		
Dibromochloromethane	0.4	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 10	U	10	< 10	U	10
Dichlorodifluoromethane	NS	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	NDR			NDR		
Ethylbenzene	530	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 10	U	10	< 10	U	10
Freon 113	NS	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	NDR			NDR		
Isopropylbenzene	NS	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	NDR			NDR		
m,p-Xylenes	NS	ug/l	NDR			NDR			NDR			NDR			NDR			< 0.5	U	0.5	NDR			NDR		
Methyl Acetate	NS	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	NDR			NDR		
Methyl Cyclohexane	NS	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	NDR			NDR		
Methyl tert-Butyl Ether	70	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	NDR			NDR		
Methylene Chloride	2.5	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 10	U	10	< 10	U	10
o-Xylene	NS	ug/l	NDR			NDR			NDR			NDR			NDR			< 0.5	U	0.5	NDR			NDR		
Styrene	NS	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 10	U	10	< 10	U	10
Tetrachloroethene	0.34	ug/l	0.23	J	0.5	0.26	J	0.5	***0.52***		0.5	0.11	J	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 10	U	10	< 10	U	10
Toluene	1300	ug/l	0.17	J	0.5	0.18	J	0.5	< 0.5	U	0.5	0.11	J	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 10	U	10	< 10	U	10
trans-1,2-Dichloroethene	590	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 10	U	10	< 10	U	10
trans-1,3-Dichloropropene	0.34	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 10	U	10	< 10	U	10
Trichloroethene	1	ug/l	0.25	J	0.5	0.27	J	0.5	0.33	J	0.5	0.16	J	0.5	0.11	J	0.5	< 0.5	U	0.5	< 10	U	10	< 10	U	10
Trichlorofluoromethane	NS	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	NDR			NDR		
Vinyl Chloride	0.082	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 10	U	10	< 10	U	10
Xylenes, Total	NS	ug/l	< 1.5	U	1.5	< 1.5	U	1.5	< 1.5	U	1.5	< 1.5	U	1.5	< 1.5	U	1.5	NDR			< 10	U	10	< 10	U	10

TABLE A2
Surface Water Samples
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		Sample ID	SW-2			SW-2			SW-2			SW-2			SW-2			SW-2			SW-2			SW-2		
		Sample Date	8/2/2006			11/7/2006			3/22/2007			3/22/2007			7/5/2007			7/11/2007			11/13/2007			3/21/2008		
		N=Normal, FD=Field Duplicate	N			N			FD			N			N			N			N			FD		
Parameter	NJDEP SWQS*	Unit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit
Inorganics																										
Aluminum	NS	ug/l	NDR			281		200	NDR			NDR			275		200	NDR			NDR			NDR		
Antimony	5.6	ug/l	NDR			< 60	U	60	NDR			NDR			< 60	U	60	NDR			NDR			NDR		
Arsenic	0.017	ug/l	NDR			< 10	U	10	NDR			NDR			< 10	U	10	NDR			NDR			NDR		
Barium	2000	ug/l	NDR			< 200	U	200	NDR			NDR			< 200	U	200	NDR			NDR			NDR		
Beryllium	6	ug/l	NDR			< 5	U	5	NDR			NDR			< 5	U	5	NDR			NDR			NDR		
Cadmium	3.4	ug/l	NDR			< 5	U	5	NDR			NDR			0.44	J	5	NDR			NDR			NDR		
Calcium	NS	ug/l	NDR			70600		5000	NDR			NDR			15600		5000	NDR			NDR			NDR		
Chromium	92	ug/l	NDR			< 10	U	10	NDR			NDR			< 10	U	10	NDR			NDR			NDR		
Cobalt	NS	ug/l	NDR			< 50	U	50	NDR			NDR			< 50	U	50	NDR			NDR			NDR		
Copper	1300	ug/l	NDR			< 25	U	25	NDR			NDR			17.3	J	25	NDR			NDR			NDR		
Iron	NS	ug/l	NDR			873		100	NDR			NDR			795	J	100	NDR			NDR			NDR		
Lead	5	ug/l	NDR			3.4		3	NDR			NDR			***5.4***		3	NDR			NDR			NDR		
Magnesium	NS	ug/l	NDR			90300		5000	NDR			NDR			10200		5000	NDR			NDR			NDR		
Manganese	NS	ug/l	NDR			525		15	NDR			NDR			91.9		15	NDR			NDR			NDR		
Mercury	0.05	ug/l	NDR			***0.42***		0.2	NDR			NDR			***0.26***		0.2	NDR			NDR			NDR		
Nickel	500	ug/l	NDR			4.2	J	40	NDR			NDR			< 40	U	40	NDR			NDR			NDR		
Potassium	NS	ug/l	NDR			36000	J	5000	NDR			NDR			5090	J	5000	NDR			NDR			NDR		
Selenium	170	ug/l	NDR			< 5	U	5	NDR			NDR			< 5	U	5	NDR			NDR			NDR		
Silver	170	ug/l	NDR			< 10	U	10	NDR			NDR			< 10	U	10	NDR			NDR			NDR		
Sodium	NS	ug/l	NDR			694000	J	10000	NDR			NDR			82500		5000	NDR			NDR			NDR		
Thallium	0.24	ug/l	NDR			< 10	U	10	NDR			NDR			< 10	U	10	NDR			NDR			NDR		
Vanadium	NS	ug/l	NDR			< 50	U	50	NDR			NDR			2.4	J	50	NDR			NDR			NDR		
Zinc	7400	ug/l	NDR			20.9		20	NDR			NDR			31.5		20	NDR			NDR			NDR		
PCBs																										
Aroclor 1016	0.000064	ug/l	NDR			< 1	U	1	NDR			NDR			< 1	U	1	NDR			NDR			NDR		
Aroclor 1221	0.000064	ug/l	NDR			< 2	U	2	NDR			NDR			< 2	U	2	NDR			NDR			NDR		
Aroclor 1232	0.000064	ug/l	NDR			< 1	U	1	NDR			NDR			< 1	U	1	NDR			NDR			NDR		
Aroclor 1242	0.000064	ug/l	NDR			< 1	U	1	NDR			NDR			< 1	U	1	NDR			NDR			NDR		
Aroclor 1248	0.000064	ug/l	NDR			< 1	U	1	NDR			NDR			< 1	U	1	NDR			NDR			NDR		
Aroclor 1254	0.000064	ug/l	NDR			< 1	U	1	NDR			NDR			< 1	U	1	NDR			NDR			NDR		
Aroclor 1260	0.000064	ug/l	NDR			< 1	U	1	NDR			NDR			< 1	U	1	NDR			NDR			NDR		
Aroclor 1262	0.000064	ug/l	NDR			NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Aroclor 1268	0.000064	ug/l	NDR			NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Pesticides																										
4,4-DDD	0.00031	ug/l	NDR			< 0.1	U	0.1	NDR			NDR			< 0.1	U	0.1	NDR			NDR			NDR		
4,4-DDE	0.00022	ug/l	NDR			< 0.1	U	0.1	NDR			NDR			< 0.1	U	0.1	NDR			NDR			NDR		
4,4-DDT	0.00022	ug/l	NDR			< 0.1	U	0.1	NDR			NDR			< 0.1	U	0.1	NDR			NDR			NDR		
Aldrin	0.000049	ug/l	NDR			< 0.05	U	0.05	NDR			NDR			< 0.05	U	0.05	NDR			NDR			NDR		
alpha-BHC	0.0026	ug/l	NDR			< 0.05	U	0.05	NDR			NDR			< 0.05	U	0.05	NDR			NDR			NDR		
alpha-Chlordane	NS	ug/l	NDR			< 0.05	U	0.05	NDR			NDR			< 0.05	U	0.05	NDR			NDR			NDR		
alpha-Endosulfan	62	ug/l	NDR			< 0.05	U	0.05	NDR			NDR			< 0.05	U	0.05	NDR			NDR			NDR		
beta-BHC	0.0091	ug/l	NDR			< 0.05	U	0.05	NDR			NDR			< 0.05	U	0.05	NDR			NDR			NDR		
beta-Endosulfan	62	ug/l	NDR			< 0.1	U	0.1	NDR			NDR			< 0.1	U	0.1	NDR			NDR			NDR		
delta-BHC	NS	ug/l	NDR			< 0.05	U	0.05	NDR			NDR			< 0.05	U	0.05	NDR			NDR			NDR		
Dieldrin	0.000052	ug/l	NDR			< 0.1	U	0.1	NDR			NDR			< 0.1	U	0.1	NDR			NDR			NDR		
Endosulfan Sulfate	62	ug/l	NDR			< 0.1	U	0.1	NDR			NDR			< 0.1	U	0.1	NDR			NDR			NDR		
Endrin	0.059	ug/l	NDR			< 0.1	U	0.1	NDR			NDR			< 0.1	U	0.1	NDR			NDR			NDR		
Endrin Aldehyde	0.059	ug/l	NDR			< 0.1	U	0.1	NDR			NDR			< 0.1	U	0.1	NDR			NDR			NDR		
Endrin Ketone	NS	ug/l	NDR			< 0.1	U	0.1	NDR			NDR			< 0.1	U	0.1	NDR			NDR			NDR		
gamma-BHC	0.98	ug/l	NDR			< 0.05	U	0.05	NDR			NDR			< 0.05	U	0.05	NDR			NDR			NDR		
gamma-Chlordane	NS	ug/l	NDR			NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Heptachlor	0.000079	ug/l	NDR			< 0.05	U	0.05	NDR			NDR			< 0.05	U	0.05	NDR			NDR			NDR		
Heptachlor Epoxide	0.000039	ug/l	NDR			< 0.05	U	0.05	NDR			NDR			< 0.05	U	0.05	NDR			NDR			NDR		
Methoxychlor	40	ug/l	NDR			< 0.5	U	0.5	NDR			NDR			< 0.5	U	0.5	NDR			NDR			NDR		
Toxaphene	0.00028	ug/l	NDR			< 5	U	5	NDR			NDR			< 5	U	5	NDR			NDR			NDR		
trans-Chlordane	NS	ug/l	NDR			< 0.05	U	0.05	NDR			NDR			< 0.05	U	0.05	NDR			NDR			NDR		

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		Sample ID	SW-2			SW-2			SW-2			SW-2			SW-2			SW-2			SW-2			SW-2		
		Sample Date	8/2/2006			11/7/2006			3/22/2007			3/22/2007			7/5/2007			7/11/2007			11/13/2007			3/21/2008		
		N=Normal, FD=Field Duplicate	N			N			FD			N			N			N			N			FD		
Parameter	NJDEP SWQS*	Unit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit
Semivolatile Organic Compounds																										
1,2,4,5-Tetrachlorobenzene	0.97	ug/l	NDR			NDR			NDR			NDR			NDR			NDR			NDR			NDR		
2,3,4,6-Tetrachlorophenol	NS	ug/l	NDR			NDR			NDR			NDR			NDR			NDR			NDR			NDR		
2,4,5-Trichlorophenol	1800	ug/l	NDR			< 25	U	25	NDR			NDR			< 25	U	25	NDR			NDR			NDR		
2,4,6-Trichlorophenol	0.58	ug/l	NDR			< 10	U	10	NDR			NDR			< 10	U	10	NDR			NDR			NDR		
2,4-Dichlorophenol	77	ug/l	NDR			< 10	U	10	NDR			NDR			< 10	U	10	NDR			NDR			NDR		
2,4-Dimethylphenol	380	ug/l	NDR			< 10	U	10	NDR			NDR			< 10	U	10	NDR			NDR			NDR		
2,4-Dinitrophenol	69	ug/l	NDR			< 25	U	25	NDR			NDR			< 25	U	25	NDR			NDR			NDR		
2,4-Dinitrotoluene	0.11	ug/l	NDR			< 10	U	10	NDR			NDR			< 10	U	10	NDR			NDR			NDR		
2,6-Dinitrotoluene	NS	ug/l	NDR			< 10	U	10	NDR			NDR			< 10	U	10	NDR			NDR			NDR		
2-Chloronaphthalene	1000	ug/l	NDR			< 10	U	10	NDR			NDR			< 10	U	10	NDR			NDR			NDR		
2-Chlorophenol	81	ug/l	NDR			< 10	U	10	NDR			NDR			< 10	U	10	NDR			NDR			NDR		
2-Methylnaphthalene	NS	ug/l	NDR			< 10	U	10	NDR			NDR			< 10	U	10	NDR			NDR			NDR		
2-Methylphenol	NS	ug/l	NDR			< 10	U	10	NDR			NDR			< 10	U	10	NDR			NDR			NDR		
2-Nitroaniline	NS	ug/l	NDR			< 25	U	25	NDR			NDR			< 25	U	25	NDR			NDR			NDR		
2-Nitrophenol	NS	ug/l	NDR			< 10	U	10	NDR			NDR			< 10	U	10	NDR			NDR			NDR		
3,3'-Dichlorobenzidine	0.021	ug/l	NDR			< 10	U	10	NDR			NDR			< 10	U	10	NDR			NDR			NDR		
3-Nitroaniline	NS	ug/l	NDR			< 25	U	25	NDR			NDR			< 25	U	25	NDR			NDR			NDR		
4,6-Dinitro-2-methylphenol	13	ug/l	NDR			< 25	U	25	NDR			NDR			< 25	U	25	NDR			NDR			NDR		
4-Bromophenyl Phenyl Ether	NS	ug/l	NDR			< 10	U	10	NDR			NDR			< 10	U	10	NDR			NDR			NDR		
4-Chloro-3-methylphenol	NS	ug/l	NDR			< 10	U	10	NDR			NDR			< 10	U	10	NDR			NDR			NDR		
4-Chloroaniline	NS	ug/l	NDR			< 10	U	10	NDR			NDR			< 10	U	10	NDR			NDR			NDR		
4-Chlorophenyl-phenylether	NS	ug/l	NDR			< 10	U	10	NDR			NDR			< 10	U	10	NDR			NDR			NDR		
4-Methylphenol	NS	ug/l	NDR			< 10	U	10	NDR			NDR			< 10	U	10	NDR			NDR			NDR		
4-Nitroaniline	NS	ug/l	NDR			< 25	U	25	NDR			NDR			< 25	U	25	NDR			NDR			NDR		
4-Nitrophenol	NS	ug/l	NDR			< 25	U	25	NDR			NDR			< 25	U	25	NDR			NDR			NDR		
Acenaphthene	670	ug/l	NDR			< 10	U	10	NDR			NDR			< 10	U	10	NDR			NDR			NDR		
Acenaphthylene	NS	ug/l	NDR			< 10	U	10	NDR			NDR			< 10	U	10	NDR			NDR			NDR		
Acetophenone	NS	ug/l	NDR			NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Anthracene	8300	ug/l	NDR			< 10	U	10	NDR			NDR			< 10	U	10	NDR			NDR			NDR		
Atrazine	NS	ug/l	NDR			NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Benzaldehyde	NS	ug/l	NDR			NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Benzo[a]anthracene	0.038	ug/l	NDR			< 10	U	10	NDR			NDR			< 10	U	10	NDR			NDR			NDR		
Benzo[a]pyrene	0.0038	ug/l	NDR			< 10	U	10	NDR			NDR			< 10	U	10	NDR			NDR			NDR		
Benzo[b]fluoranthene	0.038	ug/l	NDR			< 10	U	10	NDR			NDR			< 10	U	10	NDR			NDR			NDR		
Benzo[g,h,i]perylene	NS	ug/l	NDR			< 10	U	10	NDR			NDR			< 10	U	10	NDR			NDR			NDR		
Benzo[k]fluoranthene	0.38	ug/l	NDR			< 10	U	10	NDR			NDR			< 10	U	10	NDR			NDR			NDR		
Biphenyl	NS	ug/l	NDR			NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Bis(2-chloroethoxy)methane	NS	ug/l	NDR			< 10	U	10	NDR			NDR			< 10	U	10	NDR			NDR			NDR		
Bis(2-chloroethyl) Ether	0.03	ug/l	NDR			< 10	U	10	NDR			NDR			< 10	U	10	NDR			NDR			NDR		
Bis(2-chloroisopropyl) Ether	1400	ug/l	NDR			< 10	U	10	NDR			NDR			< 10	U	10	NDR			NDR			NDR		
Bis(2-ethylhexyl) Phthalate	1.2	ug/l	NDR			< 10	U	10	NDR			NDR			< 10	U	10	NDR			NDR			NDR		
Butylbenzyl Phthalate	150	ug/l	NDR			< 10	U	10	NDR			NDR			< 10	U	10	NDR			NDR			NDR		
Caprolactum	NS	ug/l	NDR			NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Carbazole	NS	ug/l	NDR			< 10	U	10	NDR			NDR			< 10	U	10	NDR			NDR			NDR		
Chrysene	3.8	ug/l	NDR			< 10	U	10	NDR			NDR			< 10	U	10	NDR			NDR			NDR		
Dibenzo[a,h]anthracene	0.0038	ug/l	NDR			< 10	U	10	NDR			NDR			< 10	U	10	NDR			NDR			NDR		
Dibenzofuran	NS	ug/l	NDR			< 10	U	10	NDR			NDR			< 10	U	10	NDR			NDR			NDR		
Diethyl Phthalate	17000	ug/l	NDR			< 10	U	10	NDR			NDR			< 10	U	10	NDR			NDR			NDR		
Dimethyl Phthalate	NS	ug/l	NDR			< 10	U	10	NDR			NDR			< 10	U	10	NDR			NDR			NDR		
Di-n-Butyl Phthalate	2000	ug/l	NDR			< 10	U	10	NDR			NDR			< 10	U	10	NDR			NDR			NDR		
Di-n-octyl Phthalate	NS	ug/l	NDR			< 10	U	10	NDR			NDR			< 10	U	10	NDR			NDR			NDR		
Fluoranthene	130	ug/l	NDR			< 10	U	10	NDR			NDR			< 10	U	10	NDR			NDR			NDR		
Fluorene	1100	ug/l	NDR			< 10	U	10	NDR			NDR			< 10	U	10	NDR			NDR			NDR		
Hexachlorobenzene	0.00028	ug/l	NDR			< 10	U	10	NDR			NDR			< 10	U	10	NDR			NDR			NDR		
Hexachlorobutadiene	0.44	ug/l	NDR			< 10	U	10	NDR			NDR			< 10	U	10	NDR			NDR			NDR		
Hexachlorocyclopentadiene	40	ug/l	NDR			< 10	U	10	NDR			NDR			< 10	U	10	NDR			NDR			NDR		
Hexachloroethane	1.4	ug/l	NDR			< 10	U	10	NDR			NDR			< 10	U	10	NDR			NDR			NDR		
Indeno[1,2,3-cd]pyrene	0.038	ug/l	NDR			< 10	U	10	NDR			NDR			< 10	U	10	NDR			NDR			NDR		
Isophorone	35	ug/l	NDR			< 10	U	10	NDR			NDR			< 10	U	10	NDR			NDR			NDR		
Naphthalene	NS	ug/l	NDR			< 10	U	10	NDR			NDR			< 10	U	10	NDR			NDR			NDR		
Nitrobenzene	17	ug/l	NDR			< 10	U	10	NDR			NDR			< 10	U	10	NDR			NDR			NDR		
N-Nitroso-di-n-propylamine	0.005	ug/l	NDR			< 10	U	10	NDR			NDR			< 10	U	10	NDR			NDR			NDR		
N-Nitrosodiphenylamine	3.3	ug/l	NDR			< 10	U	10	NDR			NDR			< 10	U	10	NDR			NDR			NDR		
Pentachlorophenol	0.27	ug/l	NDR			< 25	U	25	NDR			NDR			< 25	U	25	NDR			NDR			NDR		
Phenanthrene	NS	ug/l	NDR			< 10	U	10	NDR			NDR			< 10	U	10	NDR			NDR			NDR		
Phenol	10000	ug/l	NDR			< 10	U	10	NDR			NDR			< 10	U	10	NDR			NDR			NDR		

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		Sample ID	SW-2			SW-2			SW-2			SW-2			SW-2			SW-2			SW-2			SW-2		
		Sample Date	8/2/2006			11/7/2006			3/22/2007			3/22/2007			7/5/2007			7/11/2007			11/13/2007			3/21/2008		
		N=Normal, FD=Field Duplicate	N			N			FD			N			N			N			N			FD		
Parameter	NJDEP SWQS*	Unit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit
Pyrene	830	ug/l	NDR			< 10	U	10	NDR			NDR			< 10	U	10	NDR			NDR			NDR		
Volatile Organic Compounds																										
1,1,1-Trichloroethane	120	ug/l	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR			< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,1,2,2-Tetrachloroethane	4.7	ug/l	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR			< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,1,2-Trichloroethane	13	ug/l	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR			< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,1-Dichloroethane	NS	ug/l	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR			< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,1-Dichloroethene	4.7	ug/l	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR			< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,2,3-Trichlorobenzene	NS	ug/l	NDR			NDR			NDR			NDR			NDR			NDR			NDR			NDR		
1,2,4-Trichlorobenzene	21	ug/l	NDR			NDR			< 10	U	10	< 10	U	10	NDR			< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,2-Dibromo-3-chloropropane	NS	ug/l	NDR			NDR			< 10	U	10	< 10	U	10	NDR			< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,2-Dibromoethane	NS	ug/l	NDR			NDR			< 10	U	10	< 10	U	10	NDR			< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,2-Dichlorobenzene	2000	ug/l	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR			0.15	J	0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,2-Dichloroethane	0.29	ug/l	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR			< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,2-Dichloropropane	0.5	ug/l	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR			< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,3-Dichlorobenzene	2200	ug/l	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR			< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,4-Dichlorobenzene	550	ug/l	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR			< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
2-Butanone	NS	ug/l	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR			3.3	J	5	< 5	U	5	< 5	U	5
2-Hexanone	NS	ug/l	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR			< 5	UJ	5	< 5	UJ	5	< 5	U	5
4-Methyl-2-pentanone	NS	ug/l	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR			< 5	UJ	5	< 5	UJ	5	< 5	U	5
Acetone	NS	ug/l	21		10	< 10	U	10	15		10	18		10	NDR			< 5	U	5	< 6.1	U	6.1	< 7.7	U	7.7
Benzene	0.15	ug/l	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR			< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Bromochloromethane	NS	ug/l	NDR			NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Bromodichloromethane	0.55	ug/l	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR			< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Bromoform	4.3	ug/l	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR			< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Bromomethane	47	ug/l	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR			< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Carbon Disulfide	NS	ug/l	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR			< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Carbon Tetrachloride	0.33	ug/l	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR			< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Chlorobenzene	210	ug/l	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR			0.2	J	0.5	< 0.5	U	0.5	0.39	J	0.5
Chloroethane	NS	ug/l	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR			< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Chloroform	68	ug/l	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR			0.11	J	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Chloromethane	NS	ug/l	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR			< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
cis-1,2-Dichloroethene	NS	ug/l	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR			0.17	J	0.5	0.43	J	0.5	0.69		0.5
cis-1,3-Dichloropropene	0.34	ug/l	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR			< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Cyclohexane	NS	ug/l	NDR			NDR			< 10	U	10	< 10	U	10	NDR			< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Dibromochloromethane	0.4	ug/l	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR			< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Dichlorodifluoromethane	NS	ug/l	NDR			NDR			< 10	U	10	< 10	U	10	NDR			< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Ethylbenzene	530	ug/l	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR			< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Freon 113	NS	ug/l	NDR			NDR			< 10	U	10	< 10	U	10	NDR			< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Isopropylbenzene	NS	ug/l	NDR			NDR			< 10	U	10	< 10	U	10	NDR			< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
m,p-Xylenes	NS	ug/l	NDR			NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Methyl Acetate	NS	ug/l	NDR			NDR			< 10	U	10	< 10	U	10	NDR			< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Methyl Cyclohexane	NS	ug/l	NDR			NDR			< 10	U	10	< 10	U	10	NDR			< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Methyl tert-Butyl Ether	70	ug/l	NDR			NDR			< 10	U	10	< 10	U	10	NDR			< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Methylene Chloride	2.5	ug/l	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR			< 0.5	U	0.5	< 0.52	U	0.52	< 0.5	U	0.5
o-Xylene	NS	ug/l	NDR			NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Styrene	NS	ug/l	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR			< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Tetrachloroethene	0.34	ug/l	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR			< 0.5	U	0.5	< 0.5	U	0.5	0.12	J	0.5
Toluene	1300	ug/l	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR			< 0.5	U	0.5	< 0.5	U	0.5	0.28	J	0.5
trans-1,2-Dichloroethene	590	ug/l	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR			< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
trans-1,3-Dichloropropene	0.34	ug/l	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR			< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Trichloroethene	1	ug/l	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR			< 0.5	U	0.5	0.17	J	0.5	0.1	J	0.5
Trichlorofluoromethane	NS	ug/l	NDR			NDR			< 10	U	10	< 10	U	10	NDR			< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Vinyl Chloride	0.082	ug/l	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR			< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Xylenes, Total	NS	ug/l	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR			< 0.5	U	0.5	< 1.5	U	1.5	< 1.5	U	1.5

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TABLE A2
Surface Water Samples
Validated Analytical Data
Carlstadt

		Sample ID	SW-2			SW-2			SW-2			SW-2			SW-2			SW-2			SW-2			SW-2		
		Sample Date	3/21/2008			6/2/2008			12/3/2008			4/2/2009			4/2/2009			7/10/2009			10/22/2009			12/21/2009		
		N=Normal, FD=Field Duplicate	N			N			N			FD			N			N			N			N		
Parameter	NJDEP SWQS*	Unit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit
Inorganics																										
Aluminum	NS	ug/l	NDR			NDR			1340		200	NDR			NDR			NDR			NDR			277		200
Antimony	5.6	ug/l	NDR			NDR			< 60	U	60	NDR			NDR			NDR			NDR			< 2	U	2
Arsenic	0.017	ug/l	NDR			NDR			< 10	U	10	NDR			NDR			NDR			NDR			***0.65***	J	1
Barium	2000	ug/l	NDR			NDR			56.7	J	200	NDR			NDR			NDR			NDR			50.9	J	10
Beryllium	6	ug/l	NDR			NDR			< 5	U	5	NDR			NDR			NDR			NDR			< 1	UJ	1
Cadmium	3.4	ug/l	NDR			NDR			< 5	U	5	NDR			NDR			NDR			NDR			< 1	U	1
Calcium	NS	ug/l	NDR			NDR			45700		5000	NDR			NDR			NDR			NDR			62900		5000
Chromium	92	ug/l	NDR			NDR			13.6		10	NDR			NDR			NDR			NDR			10.9	J	2
Cobalt	NS	ug/l	NDR			NDR			< 50	U	50	NDR			NDR			NDR			NDR			< 1	U	1
Copper	1300	ug/l	NDR			NDR			23.3	J	25	NDR			NDR			NDR			NDR			9.8	J	2
Iron	NS	ug/l	NDR			NDR			2700		100	NDR			NDR			NDR			NDR			459		100
Lead	5	ug/l	NDR			NDR			***19.9***		3	NDR			NDR			NDR			NDR			3.1	J	1
Magnesium	NS	ug/l	NDR			NDR			45500		5000	NDR			NDR			NDR			NDR			81000		5000
Manganese	NS	ug/l	NDR			NDR			553		15	NDR			NDR			NDR			NDR			452		1
Mercury	0.05	ug/l	NDR			NDR			***1.3***		0.2	NDR			NDR			NDR			NDR			***0.27***		0.2
Nickel	500	ug/l	NDR			NDR			7	J	40	NDR			NDR			NDR			NDR			4.4		1
Potassium	NS	ug/l	NDR			NDR			19400	J	5000	NDR			NDR			NDR			NDR			37300	J	5000
Selenium	170	ug/l	NDR			NDR			< 5	U	5	NDR			NDR			NDR			NDR			3.6	J	5
Silver	170	ug/l	NDR			NDR			< 10	U	10	NDR			NDR			NDR			NDR			< 1	U	1
Sodium	NS	ug/l	NDR			NDR			381000		5000	NDR			NDR			NDR			NDR			672000		5000
Thallium	0.24	ug/l	NDR			NDR			< 10	U	10	NDR			NDR			NDR			NDR			< 1	UJ	1
Vanadium	NS	ug/l	NDR			NDR			5.3	J	50	NDR			NDR			NDR			NDR			< 5	U	5
Zinc	7400	ug/l	NDR			NDR			65.9		20	NDR			NDR			NDR			NDR			29.2	J	2
PCBs																										
Aroclor 1016	0.000064	ug/l	NDR			NDR			< 1	U	1	NDR			NDR			NDR			NDR			< 1	U	1
Aroclor 1221	0.000064	ug/l	NDR			NDR			< 2.1	U	2.1	NDR			NDR			NDR			NDR			< 1	U	1
Aroclor 1232	0.000064	ug/l	NDR			NDR			< 1	U	1	NDR			NDR			NDR			NDR			< 1	U	1
Aroclor 1242	0.000064	ug/l	NDR			NDR			< 1	U	1	NDR			NDR			NDR			NDR			< 1	U	1
Aroclor 1248	0.000064	ug/l	NDR			NDR			< 1	U	1	NDR			NDR			NDR			NDR			< 1	U	1
Aroclor 1254	0.000064	ug/l	NDR			NDR			< 1	U	1	NDR			NDR			NDR			NDR			< 1	U	1
Aroclor 1260	0.000064	ug/l	NDR			NDR			< 1	U	1	NDR			NDR			NDR			NDR			< 1	U	1
Aroclor 1262	0.000064	ug/l	NDR			NDR			NDR			NDR			NDR			NDR			NDR			< 1	U	1
Aroclor 1268	0.000064	ug/l	NDR			NDR			NDR			NDR			NDR			NDR			NDR			< 1	U	1
Pesticides																										
4,4-DDD	0.00031	ug/l	NDR			NDR			< 0.1	U	0.1	NDR			NDR			NDR			NDR			< 0.1	U	0.1
4,4-DDE	0.00022	ug/l	NDR			NDR			< 0.1	U	0.1	NDR			NDR			NDR			NDR			< 0.1	U	0.1
4,4-DDT	0.00022	ug/l	NDR			NDR			< 0.1	U	0.1	NDR			NDR			NDR			NDR			***0.046***	J	0.1
Aldrin	0.000049	ug/l	NDR			NDR			< 0.051	U	0.051	NDR			NDR			NDR			NDR			< 0.05	U	0.05
alpha-BHC	0.0026	ug/l	NDR			NDR			< 0.051	U	0.051	NDR			NDR			NDR			NDR			< 0.05	U	0.05
alpha-Chlordane	NS	ug/l	NDR			NDR			< 0.051	U	0.051	NDR			NDR			NDR			NDR			< 0.05	U	0.05
alpha-Endosulfan	62	ug/l	NDR			NDR			< 0.051	U	0.051	NDR			NDR			NDR			NDR			< 0.05	U	0.05
beta-BHC	0.0091	ug/l	NDR			NDR			< 0.051	U	0.051	NDR			NDR			NDR			NDR			< 0.05	U	0.05
beta-Endosulfan	62	ug/l	NDR			NDR			< 0.1	U	0.1	NDR			NDR			NDR			NDR			< 0.1	U	0.1
delta-BHC	NS	ug/l	NDR			NDR			< 0.051	U	0.051	NDR			NDR			NDR			NDR			< 0.05	U	0.05
Dieldrin	0.000052	ug/l	NDR			NDR			< 0.1	U	0.1	NDR			NDR			NDR			NDR			< 0.1	U	0.1
Endosulfan Sulfate	62	ug/l	NDR			NDR			< 0.1	U	0.1	NDR			NDR			NDR			NDR			< 0.1	U	0.1
Endrin	0.059	ug/l	NDR			NDR			< 0.1	U	0.1	NDR			NDR			NDR			NDR			< 0.1	U	0.1
Endrin Aldehyde	0.059	ug/l	NDR			NDR			< 0.1	U	0.1	NDR			NDR			NDR			NDR			< 0.1	U	0.1
Endrin Ketone	NS	ug/l	NDR			NDR			< 0.1	U	0.1	NDR			NDR			NDR			NDR			< 0.1	U	0.1
gamma-BHC	0.98	ug/l	NDR			NDR			< 0.051	U	0.051	NDR			NDR			NDR			NDR			< 0.05	U	0.05
gamma-Chlordane	NS	ug/l	NDR			NDR			< 0.051	U	0.051	NDR			NDR			NDR			NDR			NDR		
Heptachlor	0.000079	ug/l	NDR			NDR			< 0.051	U	0.051	NDR			NDR			NDR			NDR			< 0.05	U	0.05
Heptachlor Epoxide	0.000039	ug/l	NDR			NDR			< 0.051	U	0.051	NDR			NDR			NDR			NDR			< 0.05	U	0.05
Methoxychlor	40	ug/l	NDR			NDR			< 0.51	U	0.51	NDR			NDR			NDR			NDR			< 0.5	U	0.5
Toxaphene	0.00028	ug/l	NDR			NDR			< 5.1	U	5.1	NDR			NDR			NDR			NDR			< 5	U	5
trans-Chlordane	NS	ug/l	NDR			NDR			NDR			NDR			NDR			NDR			NDR			< 0.05	U	0.05

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TABLE A2
Surface Water Samples
Validated Analytical Data
Carlstadt

		Sample ID	SW-2			SW-2			SW-2			SW-2			SW-2			SW-2			SW-2			SW-2		
		Sample Date	3/21/2008			6/2/2008			12/3/2008			4/2/2009			4/2/2009			7/10/2009			10/22/2009			12/21/2009		
		N=Normal, FD=Field Duplicate	N			N			N			FD			N			N			N			N		
Parameter	NJDEP SWQS*	Unit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit
Semivolatile Organic Compounds																										
1,2,4,5-Tetrachlorobenzene	0.97	ug/l	NDR			NDR			NDR			NDR			NDR			NDR			NDR			< 5	U	5
2,3,4,6-Tetrachlorophenol	NS	ug/l	NDR			NDR			NDR			NDR			NDR			NDR			NDR			< 5	U	5
2,4,5-Trichlorophenol	1800	ug/l	NDR			NDR			< 25	U	25	NDR			NDR			NDR			NDR			< 5	U	5
2,4,6-Trichlorophenol	0.58	ug/l	NDR			NDR			< 10	U	10	NDR			NDR			NDR			NDR			< 5	U	5
2,4-Dichlorophenol	77	ug/l	NDR			NDR			< 10	U	10	NDR			NDR			NDR			NDR			< 5	U	5
2,4-Dimethylphenol	380	ug/l	NDR			NDR			< 10	U	10	NDR			NDR			NDR			NDR			< 5	U	5
2,4-Dinitrophenol	69	ug/l	NDR			NDR			< 25	U	25	NDR			NDR			NDR			NDR			< 10	U	10
2,4-Dinitrotoluene	0.11	ug/l	NDR			NDR			< 10	U	10	NDR			NDR			NDR			NDR			< 5	U	5
2,6-Dinitrotoluene	NS	ug/l	NDR			NDR			< 10	U	10	NDR			NDR			NDR			NDR			< 5	U	5
2-Chloronaphthalene	1000	ug/l	NDR			NDR			< 10	U	10	NDR			NDR			NDR			NDR			< 5	U	5
2-Chlorophenol	81	ug/l	NDR			NDR			< 10	U	10	NDR			NDR			NDR			NDR			< 5	U	5
2-Methylnaphthalene	NS	ug/l	NDR			NDR			< 10	U	10	NDR			NDR			NDR			NDR			< 5	U	5
2-Methylphenol	NS	ug/l	NDR			NDR			< 10	U	10	NDR			NDR			NDR			NDR			< 5	U	5
2-Nitroaniline	NS	ug/l	NDR			NDR			< 25	U	25	NDR			NDR			NDR			NDR			< 10	U	10
2-Nitrophenol	NS	ug/l	NDR			NDR			< 10	U	10	NDR			NDR			NDR			NDR			< 5	U	5
3,3'-Dichlorobenzidine	0.021	ug/l	NDR			NDR			< 10	U	10	NDR			NDR			NDR			NDR			< 5	U	5
3-Nitroaniline	NS	ug/l	NDR			NDR			< 25	U	25	NDR			NDR			NDR			NDR			< 10	U	10
4,6-Dinitro-2-methylphenol	13	ug/l	NDR			NDR			< 25	U	25	NDR			NDR			NDR			NDR			< 10	U	10
4-Bromophenyl Phenyl Ether	NS	ug/l	NDR			NDR			< 10	U	10	NDR			NDR			NDR			NDR			< 5	U	5
4-Chloro-3-methylphenol	NS	ug/l	NDR			NDR			< 10	U	10	NDR			NDR			NDR			NDR			< 5	U	5
4-Chloroaniline	NS	ug/l	NDR			NDR			< 10	U	10	NDR			NDR			NDR			NDR			< 5	U	5
4-Chlorophenyl-phenylether	NS	ug/l	NDR			NDR			< 10	U	10	NDR			NDR			NDR			NDR			< 5	U	5
4-Methylphenol	NS	ug/l	NDR			NDR			< 10	U	10	NDR			NDR			NDR			NDR			< 5	U	5
4-Nitroaniline	NS	ug/l	NDR			NDR			< 25	U	25	NDR			NDR			NDR			NDR			< 10	U	10
4-Nitrophenol	NS	ug/l	NDR			NDR			< 25	U	25	NDR			NDR			NDR			NDR			< 10	U	10
Acenaphthene	670	ug/l	NDR			NDR			< 10	U	10	NDR			NDR			NDR			NDR			< 5	U	5
Acenaphthylene	NS	ug/l	NDR			NDR			< 10	U	10	NDR			NDR			NDR			NDR			< 5	U	5
Acetophenone	NS	ug/l	NDR			NDR			NDR			NDR			NDR			NDR			NDR			< 5	U	5
Anthracene	8300	ug/l	NDR			NDR			< 10	U	10	NDR			NDR			NDR			NDR			< 5	U	5
Atrazine	NS	ug/l	NDR			NDR			NDR			NDR			NDR			NDR			NDR			< 5	U	5
Benzaldehyde	NS	ug/l	NDR			NDR			NDR			NDR			NDR			NDR			NDR			< 5	U	5
Benzo[a]anthracene	0.038	ug/l	NDR			NDR			< 10	U	10	NDR			NDR			NDR			NDR			< 5	U	5
Benzo[a]pyrene	0.0038	ug/l	NDR			NDR			< 10	U	10	NDR			NDR			NDR			NDR			< 5	U	5
Benzo[b]fluoranthene	0.038	ug/l	NDR			NDR			< 10	U	10	NDR			NDR			NDR			NDR			< 5	U	5
Benzo[g,h,i]perylene	NS	ug/l	NDR			NDR			< 10	U	10	NDR			NDR			NDR			NDR			< 5	U	5
Benzo[k]fluoranthene	0.38	ug/l	NDR			NDR			< 10	U	10	NDR			NDR			NDR			NDR			< 5	U	5
Biphenyl	NS	ug/l	NDR			NDR			NDR			NDR			NDR			NDR			NDR			< 5	U	5
Bis(2-chloroethoxy)methane	NS	ug/l	NDR			NDR			< 10	U	10	NDR			NDR			NDR			NDR			< 5	U	5
Bis(2-chloroethyl) Ether	0.03	ug/l	NDR			NDR			< 10	U	10	NDR			NDR			NDR			NDR			< 5	U	5
Bis(2-chloroisopropyl) Ether	1400	ug/l	NDR			NDR			< 10	U	10	NDR			NDR			NDR			NDR			< 5	U	5
Bis(2-ethylhexyl) Phthalate	1.2	ug/l	NDR			NDR			< 10	U	10	NDR			NDR			NDR			NDR			< 5	U	5
Butylbenzyl Phthalate	150	ug/l	NDR			NDR			< 10	U	10	NDR			NDR			NDR			NDR			< 5	U	5
Caprolactum	NS	ug/l	NDR			NDR			NDR			NDR			NDR			NDR			NDR			< 5	U	5
Carbazole	NS	ug/l	NDR			NDR			< 10	U	10	NDR			NDR			NDR			NDR			< 5	U	5
Chrysene	3.8	ug/l	NDR			NDR			< 10	U	10	NDR			NDR			NDR			NDR			< 5	U	5
Dibenzo[a,h]anthracene	0.0038	ug/l	NDR			NDR			< 10	U	10	NDR			NDR			NDR			NDR			< 5	U	5
Dibenzofuran	NS	ug/l	NDR			NDR			< 10	U	10	NDR			NDR			NDR			NDR			< 5	U	5
Diethyl Phthalate	17000	ug/l	NDR			NDR			< 10	U	10	NDR			NDR			NDR			NDR			< 5	U	5
Dimethyl Phthalate	NS	ug/l	NDR			NDR			< 10	U	10	NDR			NDR			NDR			NDR			< 5	U	5
Di-n-Butyl Phthalate	2000	ug/l	NDR			NDR			< 10	U	10	NDR			NDR			NDR			NDR			< 5	U	5
Di-n-octyl Phthalate	NS	ug/l	NDR			NDR			< 10	U	10	NDR			NDR			NDR			NDR			< 5	U	5
Fluoranthene	130	ug/l	NDR			NDR			< 10	U	10	NDR			NDR			NDR			NDR			< 5	U	5
Fluorene	1100	ug/l	NDR			NDR			< 10	U	10	NDR			NDR			NDR			NDR			< 5	U	5
Hexachlorobenzene	0.00028	ug/l	NDR			NDR			< 10	U	10	NDR			NDR			NDR			NDR			< 5	U	5
Hexachlorobutadiene	0.44	ug/l	NDR			NDR			< 10	U	10	NDR			NDR			NDR			NDR			< 5	U	5
Hexachlorocyclopentadiene	40	ug/l	NDR			NDR			< 10	U	10	NDR			NDR			NDR			NDR			< 5	U	5
Hexachloroethane	1.4	ug/l	NDR			NDR			< 10	U	10	NDR			NDR			NDR			NDR			< 5	U	5
Indeno[1,2,3-cd]pyrene	0.038	ug/l	NDR			NDR			< 10	U	10	NDR			NDR			NDR			NDR			< 5	U	5
Isophorone	35	ug/l	NDR			NDR			< 10	U	10	NDR			NDR			NDR			NDR			< 5	U	5
Naphthalene	NS	ug/l	NDR			NDR			< 10	U	10	NDR			NDR			NDR			NDR			< 5	U	5
Nitrobenzene	17	ug/l	NDR			NDR			< 10	U	10	NDR			NDR			NDR			NDR			< 5	U	5
N-Nitroso-di-n-propylamine	0.005	ug/l	NDR			NDR			< 10	U	10	NDR			NDR			NDR			NDR			< 5	U	5
N-Nitrosodiphenylamine	3.3	ug/l	NDR			NDR			< 10	U	10	NDR			NDR			NDR			NDR			< 5	U	5
Pentachlorophenol	0.27	ug/l	NDR			NDR			< 25	U	25	NDR			NDR			NDR			NDR			< 10	U	10
Phenanthrene	NS	ug/l	NDR			NDR			< 10	U	10	NDR			NDR			NDR			NDR			< 5	U	5
Phenol	10000	ug/l	NDR			NDR			< 10	U	10	NDR			NDR			NDR			NDR			< 5	U	5

TABLE A2
Surface Water Samples
Validated Analytical Data
Carlstadt

		Sample ID	SW-2			SW-2			SW-2			SW-2			SW-2			SW-2			SW-2			SW-2		
		Sample Date	3/21/2008			6/2/2008			12/3/2008			4/2/2009			4/2/2009			7/10/2009			10/22/2009			12/21/2009		
		N=Normal, FD=Field Duplicate	N			N			N			FD			N			N			N			N		
Parameter	NJDEP SWQS*	Unit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit
Pyrene	830	ug/l	NDR			NDR			< 10	U	10	NDR			NDR			NDR			NDR			< 5	U	5
Volatile Organic Compounds																										
1,1,1-Trichloroethane	120	ug/l	< 0.5	U	0.5	0.1	J	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,1,2,2-Tetrachloroethane	4.7	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,1,2-Trichloroethane	13	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,1-Dichloroethane	NS	ug/l	< 0.5	U	0.5	0.25	J	0.5	< 0.5	U	0.5	< 0.5	U	0.5	0.1	J	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,1-Dichloroethene	4.7	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,2,3-Trichlorobenzene	NS	ug/l	NDR			NDR			NDR			NDR			NDR			NDR			NDR			< 0.5	U	0.5
1,2,4-Trichlorobenzene	21	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,2-Dibromo-3-chloropropane	NS	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,2-Dibromoethane	NS	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,2-Dichlorobenzene	2000	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,2-Dichloroethane	0.29	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,2-Dichloropropane	0.5	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,3-Dichlorobenzene	2200	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,4-Dichlorobenzene	550	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
2-Butanone	NS	ug/l	< 5	U	5	< 5	U	5	1.1	J	5	2.2	J	5	3	J	5	< 5	U	5	< 5	U	5	< 5	U	5
2-Hexanone	NS	ug/l	< 5	U	5	< 5	U	5	< 5	U	5	< 5	U	5	< 5	U	5	< 5	U	5	< 5	U	5	< 5	U	5
4-Methyl-2-pentanone	NS	ug/l	< 5	U	5	< 5	U	5	< 5	U	5	< 5	U	5	< 5	U	5	< 5	U	5	< 5	U	5	< 5	U	5
Acetone	NS	ug/l	< 7.1	U	7.1	< 5	U	5	< 5.5	U	5.5	19		5	16		5	8.5		5	< 5	U	5	< 5	U	5
Benzene	0.15	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Bromochloromethane	NS	ug/l	NDR			NDR			NDR			NDR			NDR			NDR			NDR			< 0.5	U	0.5
Bromodichloromethane	0.55	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	0.14	J	0.5
Bromoform	4.3	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Bromomethane	47	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Carbon Disulfide	NS	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Carbon Tetrachloride	0.33	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Chlorobenzene	210	ug/l	0.33	J	0.5	0.59		0.5	0.32	J	0.5	0.24	J	0.5	0.23	J	0.5	< 0.5	U	0.5	0.33	J	0.5	< 0.5	U	0.5
Chloroethane	NS	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Chloroform	68	ug/l	< 0.5	U	0.5	0.82		0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Chloromethane	NS	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
cis-1,2-Dichloroethene	NS	ug/l	0.69		0.5	0.41	J	0.5	1.5		0.5	0.34	J	0.5	0.52		0.5	0.51		0.5	0.42	J	0.5	1.2		0.5
cis-1,3-Dichloropropene	0.34	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Cyclohexane	NS	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Dibromochloromethane	0.4	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Dichlorodifluoromethane	NS	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Ethylbenzene	530	ug/l	< 0.5	U	0.5	0.25	J	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Freon 113	NS	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Isopropylbenzene	NS	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
m,p-Xylenes	NS	ug/l	NDR			NDR			NDR			NDR			NDR			NDR			NDR			< 0.5	U	0.5
Methyl Acetate	NS	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Methyl Cyclohexane	NS	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Methyl tert-Butyl Ether	70	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Methylene Chloride	2.5	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
o-Xylene	NS	ug/l	NDR			NDR			NDR			NDR			NDR			NDR			NDR			< 0.5	U	0.5
Styrene	NS	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Tetrachloroethene	0.34	ug/l	0.14	J	0.5	< 0.5	U	0.5	***0.37***	J	0.5	***0.71***		0.5	***0.88***		0.5	0.15	J	0.5	0.14	J	0.5	< 0.5	U	0.5
Toluene	1300	ug/l	0.23	J	0.5	3		0.5	0.24	J	0.5	0.12	J	0.5	0.15	J	0.5	< 0.5	U	0.5	0.12	J	0.5	< 0.5	U	0.5
trans-1,2-Dichloroethene	590	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
trans-1,3-Dichloropropene	0.34	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Trichloroethene	1	ug/l	0.12	J	0.5	0.33	J	0.5	0.3	J	0.5	0.11	J	0.5	0.13	J	0.5	0.15	J	0.5	0.2	J	0.5	< 0.5	U	0.5
Trichlorofluoromethane	NS	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Vinyl Chloride	0.082	ug/l	< 0.5	U	0.5	***0.28***	J	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Xylenes, Total	NS	ug/l	< 1.5	U	1.5	1.8		1.5	0.25	J	1.5	< 1.5	U	1.5	< 1.5	U	1.5	< 1.5	U	1.5	< 1.5	U	1.5	NDR		

TABLE A2
Surface Water Samples
Validated Analytical Data
Carlstadt

		Sample ID	SW-3			SW-3			SW-3			SW-3			SW-3			SW-3			SW-3			SW-3		
		Sample Date	3/10/2006			5/24/2006			8/2/2006			11/7/2006			11/7/2006			3/22/2007			7/5/2007			7/11/2007		
		N=Normal, FD=Field Duplicate	N			N			N			FD			N			N			N			N		
Parameter	NJDEP SWQS*	Unit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit
Inorganics																										
Aluminum	NS	ug/l	NDR			NDR			NDR			592		200	418		200	NDR			390		200	NDR		
Antimony	5.6	ug/l	NDR			NDR			NDR			< 60	U	60	< 60	U	60	NDR			< 60	U	60	NDR		
Arsenic	0.017	ug/l	NDR			NDR			NDR			< 10	U	10	< 10	U	10	NDR			< 10	U	10	NDR		
Barium	2000	ug/l	NDR			NDR			NDR			< 200	U	200	< 200	U	200	NDR			< 200	U	200	NDR		
Beryllium	6	ug/l	NDR			NDR			NDR			< 5	U	5	< 5	U	5	NDR			< 5	U	5	NDR		
Cadmium	3.4	ug/l	NDR			NDR			NDR			< 5	U	5	< 5	U	5	NDR			< 5	U	5	NDR		
Calcium	NS	ug/l	NDR			NDR			NDR			69100		5000	69400		5000	NDR			11100		5000	NDR		
Chromium	92	ug/l	NDR			NDR			NDR			14.3		10	10.7		10	NDR			< 10	U	10	NDR		
Cobalt	NS	ug/l	NDR			NDR			NDR			< 50	U	50	< 50	U	50	NDR			< 50	U	50	NDR		
Copper	1300	ug/l	NDR			NDR			NDR			< 25	U	25	< 25	U	25	NDR			34.7		25	NDR		
Iron	NS	ug/l	NDR			NDR			NDR			2120		100	1650		100	NDR			848	J	100	NDR		
Lead	5	ug/l	NDR			NDR			NDR			***5.9***		3	4		3	NDR			***5.9***		3	NDR		
Magnesium	NS	ug/l	NDR			NDR			NDR			72400		5000	72100		5000	NDR			< 5000	U	5000	NDR		
Manganese	NS	ug/l	NDR			NDR			NDR			769		15	767		15	NDR			67.8		15	NDR		
Mercury	0.05	ug/l	NDR			NDR			NDR			***1.1***	J	0.2	***0.78***	J	0.2	NDR			***0.36***		0.2	NDR		
Nickel	500	ug/l	NDR			NDR			NDR			8.9	J	40	8.6	J	40	NDR			< 40	U	40	NDR		
Potassium	NS	ug/l	NDR			NDR			NDR			27400	J	5000	26900	J	5000	NDR			2530	J	5000	NDR		
Selenium	170	ug/l	NDR			NDR			NDR			< 5	U	5	< 5	U	5	NDR			< 5	U	5	NDR		
Silver	170	ug/l	NDR			NDR			NDR			< 10	U	10	< 10	U	10	NDR			< 10	U	10	NDR		
Sodium	NS	ug/l	NDR			NDR			NDR			511000	J	5000	510000	J	5000	NDR			39000		5000	NDR		
Thallium	0.24	ug/l	NDR			NDR			NDR			< 10	U	10	< 10	U	10	NDR			< 10	U	10	NDR		
Vanadium	NS	ug/l	NDR			NDR			NDR			< 50	U	50	< 50	U	50	NDR			3.1	J	50	NDR		
Zinc	7400	ug/l	NDR			NDR			NDR			40.7		20	30.8		20	NDR			39.6		20	NDR		
PCBs																										
Aroclor 1016	0.000064	ug/l	NDR			NDR			NDR			< 1	U	1	< 1	U	1	NDR			NDR			< 1	U	1
Aroclor 1221	0.000064	ug/l	NDR			NDR			NDR			< 2	U	2	< 2	U	2	NDR			NDR			< 2	U	2
Aroclor 1232	0.000064	ug/l	NDR			NDR			NDR			< 1	U	1	< 1	U	1	NDR			NDR			< 1	U	1
Aroclor 1242	0.000064	ug/l	NDR			NDR			NDR			< 1	U	1	< 1	U	1	NDR			NDR			< 1	U	1
Aroclor 1248	0.000064	ug/l	NDR			NDR			NDR			< 1	U	1	< 1	U	1	NDR			NDR			< 1	U	1
Aroclor 1254	0.000064	ug/l	NDR			NDR			NDR			< 1	U	1	< 1	U	1	NDR			NDR			< 1	U	1
Aroclor 1260	0.000064	ug/l	NDR			NDR			NDR			< 1	U	1	< 1	U	1	NDR			NDR			< 1	U	1
Aroclor 1262	0.000064	ug/l	NDR			NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Aroclor 1268	0.000064	ug/l	NDR			NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Pesticides																										
4,4-DDD	0.00031	ug/l	NDR			NDR			NDR			< 0.1	U	0.1	< 0.1	U	0.1	NDR			NDR			< 0.1	U	0.1
4,4-DDE	0.00022	ug/l	NDR			NDR			NDR			< 0.1	U	0.1	< 0.1	U	0.1	NDR			NDR			< 0.1	U	0.1
4,4-DDT	0.00022	ug/l	NDR			NDR			NDR			< 0.1	U	0.1	< 0.1	U	0.1	NDR			NDR			< 0.1	U	0.1
Aldrin	0.000049	ug/l	NDR			NDR			NDR			< 0.05	U	0.05	< 0.05	U	0.05	NDR			NDR			< 0.05	U	0.05
alpha-BHC	0.0026	ug/l	NDR			NDR			NDR			< 0.05	U	0.05	< 0.05	U	0.05	NDR			NDR			< 0.05	U	0.05
alpha-Chlordane	NS	ug/l	NDR			NDR			NDR			< 0.05	U	0.05	< 0.05	U	0.05	NDR			NDR			< 0.05	U	0.05
alpha-Endosulfan	62	ug/l	NDR			NDR			NDR			< 0.05	U	0.05	< 0.05	U	0.05	NDR			NDR			< 0.05	U	0.05
beta-BHC	0.0091	ug/l	NDR			NDR			NDR			< 0.05	U	0.05	< 0.05	U	0.05	NDR			NDR			< 0.05	U	0.05
beta-Endosulfan	62	ug/l	NDR			NDR			NDR			< 0.1	U	0.1	< 0.1	U	0.1	NDR			NDR			< 0.1	U	0.1
delta-BHC	NS	ug/l	NDR			NDR			NDR			< 0.05	U	0.05	< 0.05	U	0.05	NDR			NDR			< 0.05	U	0.05
Dieldrin	0.000052	ug/l	NDR			NDR			NDR			< 0.1	U	0.1	< 0.1	U	0.1	NDR			NDR			< 0.1	U	0.1
Endosulfan Sulfate	62	ug/l	NDR			NDR			NDR			< 0.1	U	0.1	< 0.1	U	0.1	NDR			NDR			< 0.1	U	0.1
Endrin	0.059	ug/l	NDR			NDR			NDR			< 0.1	U	0.1	< 0.1	U	0.1	NDR			NDR			< 0.1	U	0.1
Endrin Aldehyde	0.059	ug/l	NDR			NDR			NDR			< 0.1	U	0.1	< 0.1	U	0.1	NDR			NDR			< 0.1	U	0.1
Endrin Ketone	NS	ug/l	NDR			NDR			NDR			< 0.1	U	0.1	< 0.1	U	0.1	NDR			NDR			< 0.1	U	0.1
gamma-BHC	0.98	ug/l	NDR			NDR			NDR			< 0.05	U	0.05	< 0.05	U	0.05	NDR			NDR			< 0.05	U	0.05
gamma-Chlordane	NS	ug/l	NDR			NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Heptachlor	0.000079	ug/l	NDR			NDR			NDR			< 0.05	U	0.05	< 0.05	U	0.05	NDR			NDR			< 0.05	U	0.05
Heptachlor Epoxide	0.000039	ug/l	NDR			NDR			NDR			< 0.05	U	0.05	< 0.05	U	0.05	NDR			NDR			< 0.05	U	0.05
Methoxychlor	40	ug/l	NDR			NDR			NDR			< 0.5	U	0.5	< 0.5	U	0.5	NDR			NDR			< 0.5	U	0.5
Toxaphene	0.00028	ug/l	NDR			NDR			NDR			< 5	U	5	< 5	U	5	NDR			NDR			< 5	U	5
trans-Chlordane	NS	ug/l	NDR			NDR			NDR			< 0.05	U	0.05	< 0.05	U	0.05	NDR			NDR			< 0.05	U	0.05

TABLE A2
Surface Water Samples
Validated Analytical Data
Carlstadt

		Sample ID	SW-3			SW-3			SW-3			SW-3			SW-3			SW-3			SW-3			SW-3		
		Sample Date	3/10/2006			5/24/2006			8/2/2006			11/7/2006			11/7/2006			3/22/2007			7/5/2007			7/11/2007		
		N=Normal, FD=Field Duplicate	N			N			N			FD			N			N			N			N		
Parameter	NJDEP SWQS*	Unit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit
Semivolatile Organic Compounds																										
1,2,4,5-Tetrachlorobenzene	0.97	ug/l	NDR			NDR			NDR			NDR			NDR			NDR			NDR			NDR		
2,3,4,6-Tetrachlorophenol	NS	ug/l	NDR			NDR			NDR			NDR			NDR			NDR			NDR			NDR		
2,4,5-Trichlorophenol	1800	ug/l	NDR			NDR			NDR			< 26	U	26	< 25	U	25	NDR			NDR			< 25	U	25
2,4,6-Trichlorophenol	0.58	ug/l	NDR			NDR			NDR			< 10	U	10	< 10	U	10	NDR			NDR			< 10	U	10
2,4-Dichlorophenol	77	ug/l	NDR			NDR			NDR			< 10	U	10	< 10	U	10	NDR			NDR			< 10	U	10
2,4-Dimethylphenol	380	ug/l	NDR			NDR			NDR			< 10	U	10	< 10	U	10	NDR			NDR			< 10	U	10
2,4-Dinitrophenol	69	ug/l	NDR			NDR			NDR			< 26	U	26	< 25	U	25	NDR			NDR			< 25	U	25
2,4-Dinitrotoluene	0.11	ug/l	NDR			NDR			NDR			< 10	U	10	< 10	U	10	NDR			NDR			< 10	U	10
2,6-Dinitrotoluene	NS	ug/l	NDR			NDR			NDR			< 10	U	10	< 10	U	10	NDR			NDR			< 10	U	10
2-Chloronaphthalene	1000	ug/l	NDR			NDR			NDR			< 10	U	10	< 10	U	10	NDR			NDR			< 10	U	10
2-Chlorophenol	81	ug/l	NDR			NDR			NDR			< 10	U	10	< 10	U	10	NDR			NDR			< 10	U	10
2-Methylnaphthalene	NS	ug/l	NDR			NDR			NDR			< 10	U	10	< 10	U	10	NDR			NDR			< 10	U	10
2-Methylphenol	NS	ug/l	NDR			NDR			NDR			< 10	U	10	< 10	U	10	NDR			NDR			< 10	U	10
2-Nitroaniline	NS	ug/l	NDR			NDR			NDR			< 26	U	26	< 25	U	25	NDR			NDR			< 25	U	25
2-Nitrophenol	NS	ug/l	NDR			NDR			NDR			< 10	U	10	< 10	U	10	NDR			NDR			< 10	U	10
3,3'-Dichlorobenzidine	0.021	ug/l	NDR			NDR			NDR			< 10	U	10	< 10	U	10	NDR			NDR			< 10	U	10
3-Nitroaniline	NS	ug/l	NDR			NDR			NDR			< 26	U	26	< 25	U	25	NDR			NDR			< 25	U	25
4,6-Dinitro-2-methylphenol	13	ug/l	NDR			NDR			NDR			< 26	U	26	< 25	U	25	NDR			NDR			< 25	U	25
4-Bromophenyl Phenyl Ether	NS	ug/l	NDR			NDR			NDR			< 10	U	10	< 10	U	10	NDR			NDR			< 10	U	10
4-Chloro-3-methylphenol	NS	ug/l	NDR			NDR			NDR			< 10	U	10	< 10	U	10	NDR			NDR			< 10	U	10
4-Chloroaniline	NS	ug/l	NDR			NDR			NDR			< 10	U	10	< 10	U	10	NDR			NDR			< 10	U	10
4-Chlorophenyl-phenylether	NS	ug/l	NDR			NDR			NDR			< 10	U	10	< 10	U	10	NDR			NDR			< 10	U	10
4-Methylphenol	NS	ug/l	NDR			NDR			NDR			< 10	U	10	< 10	U	10	NDR			NDR			< 10	U	10
4-Nitroaniline	NS	ug/l	NDR			NDR			NDR			< 26	U	26	< 25	U	25	NDR			NDR			< 25	U	25
4-Nitrophenol	NS	ug/l	NDR			NDR			NDR			< 26	U	26	< 25	U	25	NDR			NDR			< 25	U	25
Acenaphthene	670	ug/l	NDR			NDR			NDR			< 10	U	10	< 10	U	10	NDR			NDR			< 10	U	10
Acenaphthylene	NS	ug/l	NDR			NDR			NDR			< 10	U	10	< 10	U	10	NDR			NDR			< 10	U	10
Acetophenone	NS	ug/l	NDR			NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Anthracene	8300	ug/l	NDR			NDR			NDR			< 10	U	10	< 10	U	10	NDR			NDR			< 10	U	10
Atrazine	NS	ug/l	NDR			NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Benzaldehyde	NS	ug/l	NDR			NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Benzo[a]anthracene	0.038	ug/l	NDR			NDR			NDR			< 10	U	10	< 10	U	10	NDR			NDR			< 10	U	10
Benzo[a]pyrene	0.0038	ug/l	NDR			NDR			NDR			< 10	U	10	< 10	U	10	NDR			NDR			< 10	U	10
Benzo[b]fluoranthene	0.038	ug/l	NDR			NDR			NDR			< 10	U	10	< 10	U	10	NDR			NDR			< 10	U	10
Benzo[g,h,i]perylene	NS	ug/l	NDR			NDR			NDR			< 10	U	10	< 10	U	10	NDR			NDR			< 10	U	10
Benzo[k]fluoranthene	0.38	ug/l	NDR			NDR			NDR			< 10	U	10	< 10	U	10	NDR			NDR			< 10	U	10
Biphenyl	NS	ug/l	NDR			NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Bis(2-chloroethoxy)methane	NS	ug/l	NDR			NDR			NDR			< 10	U	10	< 10	U	10	NDR			NDR			< 10	U	10
Bis(2-chloroethyl) Ether	0.03	ug/l	NDR			NDR			NDR			< 10	U	10	< 10	U	10	NDR			NDR			< 10	U	10
Bis(2-chloroisopropyl) Ether	1400	ug/l	NDR			NDR			NDR			< 10	U	10	< 10	U	10	NDR			NDR			< 10	U	10
Bis(2-ethylhexyl) Phthalate	1.2	ug/l	NDR			NDR			NDR			< 10	U	10	< 10	U	10	NDR			NDR			< 10	U	10
Butylbenzyl Phthalate	150	ug/l	NDR			NDR			NDR			< 10	U	10	< 10	U	10	NDR			NDR			< 10	U	10
Caprolactum	NS	ug/l	NDR			NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Carbazole	NS	ug/l	NDR			NDR			NDR			< 10	U	10	< 10	U	10	NDR			NDR			< 10	U	10
Chrysene	3.8	ug/l	NDR			NDR			NDR			< 10	U	10	< 10	U	10	NDR			NDR			< 10	U	10
Dibenzo[a,h]anthracene	0.0038	ug/l	NDR			NDR			NDR			< 10	U	10	< 10	U	10	NDR			NDR			< 10	U	10
Dibenzofuran	NS	ug/l	NDR			NDR			NDR			< 10	U	10	< 10	U	10	NDR			NDR			< 10	U	10
Diethyl Phthalate	17000	ug/l	NDR			NDR			NDR			< 10	U	10	< 10	U	10	NDR			NDR			< 10	U	10
Dimethyl Phthalate	NS	ug/l	NDR			NDR			NDR			< 10	U	10	< 10	U	10	NDR			NDR			< 10	U	10
Di-n-Butyl Phthalate	2000	ug/l	NDR			NDR			NDR			< 10	U	10	< 10	U	10	NDR			NDR			< 10	U	10
Di-n-octyl Phthalate	NS	ug/l	NDR			NDR			NDR			< 10	U	10	< 10	U	10	NDR			NDR			< 10	U	10
Fluoranthene	130	ug/l	NDR			NDR			NDR			< 10	U	10	< 10	U	10	NDR			NDR			< 10	U	10
Fluorene	1100	ug/l	NDR			NDR			NDR			< 10	U	10	< 10	U	10	NDR			NDR			< 10	U	10
Hexachlorobenzene	0.00028	ug/l	NDR			NDR			NDR			< 10	U	10	< 10	U	10	NDR			NDR			< 10	U	10
Hexachlorobutadiene	0.44	ug/l	NDR			NDR			NDR			< 10	U	10	< 10	U	10	NDR			NDR			< 10	U	10
Hexachlorocyclopentadiene	40	ug/l	NDR			NDR			NDR			< 10	U	10	< 10	U	10	NDR			NDR			< 10	U	10
Hexachloroethane	1.4	ug/l	NDR			NDR			NDR			< 10	U	10	< 10	U	10	NDR			NDR			< 10	U	10
Indeno[1,2,3-cd]pyrene	0.038	ug/l	NDR			NDR			NDR			< 10	U	10	< 10	U	10	NDR			NDR			< 10	U	10
Isophorone	35	ug/l	NDR			NDR			NDR			< 10	U	10	< 10	U	10	NDR			NDR			< 10	U	10
Naphthalene	NS	ug/l	NDR			NDR			NDR			< 10	U	10	< 10	U	10	NDR			NDR			< 10	U	10
Nitrobenzene	17	ug/l	NDR			NDR			NDR			< 10	U	10	< 10	U	10	NDR			NDR			< 10	U	10
N-Nitroso-di-n-propylamine	0.005	ug/l	NDR			NDR			NDR			< 10	U	10	< 10	U	10	NDR			NDR			< 10	U	10
N-Nitrosodiphenylamine	3.3	ug/l	NDR			NDR			NDR			< 10	U	10	< 10	U	10	NDR			NDR			< 10	U	10
Pentachlorophenol	0.27	ug/l	NDR			NDR			NDR			< 26	U	26	< 25	U	25	NDR			NDR			< 25	U	25
Phenanthrene	NS	ug/l	NDR			NDR			NDR			< 10	U	10	< 10	U	10	NDR			NDR			< 10	U	10
Phenol	10000	ug/l	NDR			NDR			NDR			< 10	U	10	< 10	U	10	NDR			NDR			< 10	U	10

TABLE A2
Surface Water Samples
Validated Analytical Data
Carlstadt

		Sample ID	SW-3			SW-3			SW-3			SW-3			SW-3			SW-3			SW-3			SW-3		
		Sample Date	3/10/2006			5/24/2006			8/2/2006			11/7/2006			11/7/2006			3/22/2007			7/5/2007			7/11/2007		
		N=Normal, FD=Field Duplicate	N			N			N			FD			N			N			N			N		
Parameter	NJDEP SWQS*	Unit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit
Pyrene	830	ug/l	NDR			NDR			NDR			< 10	U	10	< 10	U	10	NDR			NDR			< 10	U	10
Volatile Organic Compounds																										
1,1,1-Trichloroethane	120	ug/l	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR			0.1	J	0.5
1,1,2,2-Tetrachloroethane	4.7	ug/l	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR			< 0.5	U	0.5
1,1,2-Trichloroethane	13	ug/l	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR			< 0.5	U	0.5
1,1-Dichloroethane	NS	ug/l	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR			0.24	J	0.5
1,1-Dichloroethene	4.7	ug/l	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR			< 0.5	U	0.5
1,2,3-Trichlorobenzene	NS	ug/l	NDR			NDR			NDR			NDR			NDR			NDR			NDR			NDR		
1,2,4-Trichlorobenzene	21	ug/l	NDR			NDR			NDR			NDR			NDR			< 10	U	10	NDR			< 0.5	U	0.5
1,2-Dibromo-3-chloropropane	NS	ug/l	NDR			NDR			NDR			NDR			NDR			< 10	U	10	NDR			< 0.5	U	0.5
1,2-Dibromoethane	NS	ug/l	NDR			NDR			NDR			NDR			NDR			< 10	U	10	NDR			< 0.5	U	0.5
1,2-Dichlorobenzene	2000	ug/l	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR			0.23	J	0.5
1,2-Dichloroethane	0.29	ug/l	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR			< 0.5	U	0.5
1,2-Dichloropropane	0.5	ug/l	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR			< 0.5	U	0.5
1,3-Dichlorobenzene	2200	ug/l	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR			< 0.5	U	0.5
1,4-Dichlorobenzene	550	ug/l	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR			< 0.5	U	0.5
2-Butanone	NS	ug/l	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR			3.9	J	5
2-Hexanone	NS	ug/l	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR			< 5	U	5
4-Methyl-2-pentanone	NS	ug/l	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR			< 5	U	5
Acetone	NS	ug/l	6	J	10	< 10	U	10	7	J	10	< 10	U	10	< 10	U	10	13		10	NDR			< 5	U	5
Benzene	0.15	ug/l	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR			***0.19***	J	0.5
Bromochloromethane	NS	ug/l	NDR			NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Bromodichloromethane	0.55	ug/l	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR			< 0.5	U	0.5
Bromoform	4.3	ug/l	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR			< 0.5	U	0.5
Bromomethane	47	ug/l	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR			< 0.5	U	0.5
Carbon Disulfide	NS	ug/l	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR			< 0.5	U	0.5
Carbon Tetrachloride	0.33	ug/l	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR			< 0.5	U	0.5
Chlorobenzene	210	ug/l	1	J	10	< 10	U	10	< 10	U	10	0.7	J	10	< 10	U	10	< 10	U	10	NDR			1.1		0.5
Chloroethane	NS	ug/l	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR			0.21	J	0.5
Chloroform	68	ug/l	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR			0.46	J	0.5
Chloromethane	NS	ug/l	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR			< 0.5	U	0.5
cis-1,2-Dichloroethene	NS	ug/l	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	3	J	10	NDR			0.32	J	0.5
cis-1,3-Dichloropropene	0.34	ug/l	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR			< 0.5	U	0.5
Cyclohexane	NS	ug/l	NDR			NDR			NDR			NDR			NDR			< 10	U	10	NDR			< 0.5	U	0.5
Dibromochloromethane	0.4	ug/l	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR			< 0.5	U	0.5
Dichlorodifluoromethane	NS	ug/l	NDR			NDR			NDR			NDR			NDR			< 10	U	10	NDR			< 0.5	U	0.5
Ethylbenzene	530	ug/l	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR			0.24	J	0.5
Freon 113	NS	ug/l	NDR			NDR			NDR			NDR			NDR			< 10	U	10	NDR			< 0.5	U	0.5
Isopropylbenzene	NS	ug/l	NDR			NDR			NDR			NDR			NDR			< 10	U	10	NDR			< 0.5	U	0.5
m,p-Xylenes	NS	ug/l	NDR			NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Methyl Acetate	NS	ug/l	NDR			NDR			NDR			NDR			NDR			< 10	U	10	NDR			< 0.5	U	0.5
Methyl Cyclohexane	NS	ug/l	NDR			NDR			NDR			NDR			NDR			< 10	U	10	NDR			< 0.5	U	0.5
Methyl tert-Butyl Ether	70	ug/l	NDR			NDR			NDR			NDR			NDR			< 10	U	10	NDR			< 0.5	U	0.5
Methylene Chloride	2.5	ug/l	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR			< 0.5	U	0.5
o-Xylene	NS	ug/l	NDR			NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Styrene	NS	ug/l	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR			< 0.5	U	0.5
Tetrachloroethene	0.34	ug/l	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR			0.19	J	0.5
Toluene	1300	ug/l	< 10	U	10	< 10	U	10	2	J	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR			1.9		0.5
trans-1,2-Dichloroethene	590	ug/l	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR			< 0.5	U	0.5
trans-1,3-Dichloropropene	0.34	ug/l	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR			< 0.5	U	0.5
Trichloroethene	1	ug/l	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR			0.2	J	0.5
Trichlorofluoromethane	NS	ug/l	NDR			NDR			NDR			NDR			NDR			< 10	U	10	NDR			< 0.5	U	0.5
Vinyl Chloride	0.082	ug/l	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	***1***	J	10	NDR			< 0.5	U	0.5
Xylenes, Total	NS	ug/l	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR			1.1		0.5

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TABLE A2
Surface Water Samples
Validated Analytical Data
Carlstadt

		Sample ID	SW-3			SW-3			SW-3			SW-3			SW-3			SW-3			SW-3			SW-3		
		Sample Date	11/13/2007			3/21/2008			6/2/2008			12/3/2008			4/2/2009			7/10/2009			10/22/2009			12/21/2009		
		N=Normal, FD=Field Duplicate	N			N			N			N			N			N			N			N		
Parameter	NJDEP SWQS*	Unit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit
Inorganics																										
Aluminum	NS	ug/l	NDR			NDR			NDR			3550		200	NDR			NDR			NDR			305		200
Antimony	5.6	ug/l	NDR			NDR			NDR			< 60	U	60	NDR			NDR			NDR			< 2	U	2
Arsenic	0.017	ug/l	NDR			NDR			NDR			< 10	U	10	NDR			NDR			NDR			***3.1***		1
Barium	2000	ug/l	NDR			NDR			NDR			85.5	J	200	NDR			NDR			NDR			58.9	J	10
Beryllium	6	ug/l	NDR			NDR			NDR			< 5	U	5	NDR			NDR			NDR			< 1	U	1
Cadmium	3.4	ug/l	NDR			NDR			NDR			1.3	J	5	NDR			NDR			NDR			< 1	U	1
Calcium	NS	ug/l	NDR			NDR			NDR			47500		5000	NDR			NDR			NDR			61000		5000
Chromium	92	ug/l	NDR			NDR			NDR			78.3		10	NDR			NDR			NDR			4.9	J	2
Cobalt	NS	ug/l	NDR			NDR			NDR			2.6	J	50	NDR			NDR			NDR			< 1	U	1
Copper	1300	ug/l	NDR			NDR			NDR			66.5		25	NDR			NDR			NDR			23.9	J	2
Iron	NS	ug/l	NDR			NDR			NDR			7880		100	NDR			NDR			NDR			559		100
Lead	5	ug/l	NDR			NDR			NDR			***36.6***		3	NDR			NDR			NDR			3.4	J	1
Magnesium	NS	ug/l	NDR			NDR			NDR			44500		5000	NDR			NDR			NDR			72800		5000
Manganese	NS	ug/l	NDR			NDR			NDR			628		15	NDR			NDR			NDR			486		1
Mercury	0.05	ug/l	NDR			NDR			NDR			***9.2***		0.2	NDR			NDR			NDR			***0.33***		0.2
Nickel	500	ug/l	NDR			NDR			NDR			16.1	J	40	NDR			NDR			NDR			4.8		1
Potassium	NS	ug/l	NDR			NDR			NDR			18500	J	5000	NDR			NDR			NDR			32100	J	5000
Selenium	170	ug/l	NDR			NDR			NDR			< 5	U	5	NDR			NDR			NDR			8.5		5
Silver	170	ug/l	NDR			NDR			NDR			< 10	U	10	NDR			NDR			NDR			< 1	U	1
Sodium	NS	ug/l	NDR			NDR			NDR			365000		5000	NDR			NDR			NDR			605000		5000
Thallium	0.24	ug/l	NDR			NDR			NDR			< 10	U	10	NDR			NDR			NDR			< 1	U	1
Vanadium	NS	ug/l	NDR			NDR			NDR			11.5	J	50	NDR			NDR			NDR			1.5	J	5
Zinc	7400	ug/l	NDR			NDR			NDR			176		20	NDR			NDR			NDR			48.6	J	2
PCBs																										
Aroclor 1016	0.000064	ug/l	NDR			NDR			NDR			< 1	U	1	NDR			NDR			NDR			< 1	U	1
Aroclor 1221	0.000064	ug/l	NDR			NDR			NDR			< 2.1	U	2.1	NDR			NDR			NDR			< 1	U	1
Aroclor 1232	0.000064	ug/l	NDR			NDR			NDR			< 1	U	1	NDR			NDR			NDR			< 1	U	1
Aroclor 1242	0.000064	ug/l	NDR			NDR			NDR			< 1	U	1	NDR			NDR			NDR			< 1	U	1
Aroclor 1248	0.000064	ug/l	NDR			NDR			NDR			< 1	U	1	NDR			NDR			NDR			< 1	U	1
Aroclor 1254	0.000064	ug/l	NDR			NDR			NDR			< 1	U	1	NDR			NDR			NDR			< 1	U	1
Aroclor 1260	0.000064	ug/l	NDR			NDR			NDR			< 1	U	1	NDR			NDR			NDR			< 1	U	1
Aroclor 1262	0.000064	ug/l	NDR			NDR			NDR			NDR			NDR			NDR			NDR			< 1	U	1
Aroclor 1268	0.000064	ug/l	NDR			NDR			NDR			NDR			NDR			NDR			NDR			< 1	U	1
Pesticides																										
4,4-DDD	0.00031	ug/l	NDR			NDR			NDR			< 0.1	U	0.1	NDR			NDR			NDR			< 0.05	U	0.05
4,4-DDE	0.00022	ug/l	NDR			NDR			NDR			< 0.1	U	0.1	NDR			NDR			NDR			< 0.05	U	0.05
4,4-DDT	0.00022	ug/l	NDR			NDR			NDR			< 0.1	U	0.1	NDR			NDR			NDR			< 0.05	U	0.05
Aldrin	0.000049	ug/l	NDR			NDR			NDR			< 0.051	U	0.051	NDR			NDR			NDR			< 0.025	U	0.025
alpha-BHC	0.0026	ug/l	NDR			NDR			NDR			< 0.051	U	0.051	NDR			NDR			NDR			< 0.025	U	0.025
alpha-Chlordane	NS	ug/l	NDR			NDR			NDR			< 0.051	U	0.051	NDR			NDR			NDR			< 0.025	U	0.025
alpha-Endosulfan	62	ug/l	NDR			NDR			NDR			< 0.051	U	0.051	NDR			NDR			NDR			< 0.025	U	0.025
beta-BHC	0.0091	ug/l	NDR			NDR			NDR			< 0.051	U	0.051	NDR			NDR			NDR			***0.02***	J	0.025
beta-Endosulfan	62	ug/l	NDR			NDR			NDR			< 0.1	U	0.1	NDR			NDR			NDR			< 0.05	U	0.05
delta-BHC	NS	ug/l	NDR			NDR			NDR			< 0.051	U	0.051	NDR			NDR			NDR			< 0.025	U	0.025
Dieldrin	0.000052	ug/l	NDR			NDR			NDR			< 0.1	U	0.1	NDR			NDR			NDR			< 0.05	U	0.05
Endosulfan Sulfate	62	ug/l	NDR			NDR			NDR			< 0.1	U	0.1	NDR			NDR			NDR			< 0.05	U	0.05
Endrin	0.059	ug/l	NDR			NDR			NDR			< 0.1	U	0.1	NDR			NDR			NDR			< 0.05	U	0.05
Endrin Aldehyde	0.059	ug/l	NDR			NDR			NDR			< 0.1	U	0.1	NDR			NDR			NDR			< 0.05	U	0.05
Endrin Ketone	NS	ug/l	NDR			NDR			NDR			< 0.1	U	0.1	NDR			NDR			NDR			< 0.05	U	0.05
gamma-BHC	0.98	ug/l	NDR			NDR			NDR			< 0.051	U	0.051	NDR			NDR			NDR			< 0.025	U	0.025
gamma-Chlordane	NS	ug/l	NDR			NDR			NDR			< 0.051	U	0.051	NDR			NDR			NDR			NDR		
Heptachlor	0.000079	ug/l	NDR			NDR			NDR			< 0.051	U	0.051	NDR			NDR			NDR			< 0.025	U	0.025
Heptachlor Epoxide	0.000039	ug/l	NDR			NDR			NDR			< 0.051	U	0.051	NDR			NDR			NDR			< 0.025	U	0.025
Methoxychlor	40	ug/l	NDR			NDR			NDR			< 0.51	U	0.51	NDR			NDR			NDR			< 0.25	U	0.25
Toxaphene	0.00028	ug/l	NDR			NDR			NDR			< 5.1	U	5.1	NDR			NDR			NDR			< 2.5	U	2.5
trans-Chlordane	NS	ug/l	NDR			NDR			NDR			NDR			NDR			NDR			NDR			< 0.025	U	0.025

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TABLE A2
Surface Water Samples
Validated Analytical Data
Carlstadt

		Sample ID	SW-3			SW-3			SW-3			SW-3			SW-3			SW-3			SW-3			SW-3		
		Sample Date	11/13/2007			3/21/2008			6/2/2008			12/3/2008			4/2/2009			7/10/2009			10/22/2009			12/21/2009		
		N=Normal, FD=Field Duplicate	N			N			N			N			N			N			N			N		
Parameter	NJDEP SWQS*	Unit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit
Semivolatile Organic Compounds																										
1,2,4,5-Tetrachlorobenzene	0.97	ug/l	NDR			NDR			NDR			NDR			NDR			NDR			NDR			< 5	U	5
2,3,4,6-Tetrachlorophenol	NS	ug/l	NDR			NDR			NDR			NDR			NDR			NDR			NDR			< 5	U	5
2,4,5-Trichlorophenol	1800	ug/l	NDR			NDR			NDR			< 26	U	26	NDR			NDR			NDR			< 5	U	5
2,4,6-Trichlorophenol	0.58	ug/l	NDR			NDR			NDR			< 11	U	11	NDR			NDR			NDR			< 5	U	5
2,4-Dichlorophenol	77	ug/l	NDR			NDR			NDR			< 11	U	11	NDR			NDR			NDR			< 5	U	5
2,4-Dimethylphenol	380	ug/l	NDR			NDR			NDR			< 11	U	11	NDR			NDR			NDR			< 5	U	5
2,4-Dinitrophenol	69	ug/l	NDR			NDR			NDR			< 26	U	26	NDR			NDR			NDR			< 10	U	10
2,4-Dinitrotoluene	0.11	ug/l	NDR			NDR			NDR			< 11	U	11	NDR			NDR			NDR			< 5	U	5
2,6-Dinitrotoluene	NS	ug/l	NDR			NDR			NDR			< 11	U	11	NDR			NDR			NDR			< 5	U	5
2-Chloronaphthalene	1000	ug/l	NDR			NDR			NDR			< 11	U	11	NDR			NDR			NDR			< 5	U	5
2-Chlorophenol	81	ug/l	NDR			NDR			NDR			< 11	U	11	NDR			NDR			NDR			< 5	U	5
2-Methylnaphthalene	NS	ug/l	NDR			NDR			NDR			< 11	U	11	NDR			NDR			NDR			< 5	U	5
2-Methylphenol	NS	ug/l	NDR			NDR			NDR			< 11	U	11	NDR			NDR			NDR			< 5	U	5
2-Nitroaniline	NS	ug/l	NDR			NDR			NDR			< 26	U	26	NDR			NDR			NDR			< 10	U	10
2-Nitrophenol	NS	ug/l	NDR			NDR			NDR			< 11	U	11	NDR			NDR			NDR			< 5	U	5
3,3'-Dichlorobenzidine	0.021	ug/l	NDR			NDR			NDR			< 11	U	11	NDR			NDR			NDR			< 5	U	5
3-Nitroaniline	NS	ug/l	NDR			NDR			NDR			< 26	U	26	NDR			NDR			NDR			< 10	U	10
4,6-Dinitro-2-methylphenol	13	ug/l	NDR			NDR			NDR			< 26	U	26	NDR			NDR			NDR			< 10	U	10
4-Bromophenyl Phenyl Ether	NS	ug/l	NDR			NDR			NDR			< 11	U	11	NDR			NDR			NDR			< 5	U	5
4-Chloro-3-methylphenol	NS	ug/l	NDR			NDR			NDR			< 11	U	11	NDR			NDR			NDR			< 5	U	5
4-Chloroaniline	NS	ug/l	NDR			NDR			NDR			< 11	U	11	NDR			NDR			NDR			< 5	U	5
4-Chlorophenyl-phenylether	NS	ug/l	NDR			NDR			NDR			< 11	U	11	NDR			NDR			NDR			< 5	U	5
4-Methylphenol	NS	ug/l	NDR			NDR			NDR			< 11	U	11	NDR			NDR			NDR			< 5	U	5
4-Nitroaniline	NS	ug/l	NDR			NDR			NDR			< 26	U	26	NDR			NDR			NDR			< 10	U	10
4-Nitrophenol	NS	ug/l	NDR			NDR			NDR			< 26	U	26	NDR			NDR			NDR			< 10	U	10
Acenaphthene	670	ug/l	NDR			NDR			NDR			< 11	U	11	NDR			NDR			NDR			< 5	U	5
Acenaphthylene	NS	ug/l	NDR			NDR			NDR			< 11	U	11	NDR			NDR			NDR			< 5	U	5
Acetophenone	NS	ug/l	NDR			NDR			NDR			NDR			NDR			NDR			NDR			< 5	U	5
Anthracene	8300	ug/l	NDR			NDR			NDR			< 11	U	11	NDR			NDR			NDR			< 5	U	5
Atrazine	NS	ug/l	NDR			NDR			NDR			NDR			NDR			NDR			NDR			< 5	U	5
Benzaldehyde	NS	ug/l	NDR			NDR			NDR			NDR			NDR			NDR			NDR			< 5	U	5
Benzo[a]anthracene	0.038	ug/l	NDR			NDR			NDR			< 11	U	11	NDR			NDR			NDR			< 5	U	5
Benzo[a]pyrene	0.0038	ug/l	NDR			NDR			NDR			< 11	U	11	NDR			NDR			NDR			< 5	U	5
Benzo[b]fluoranthene	0.038	ug/l	NDR			NDR			NDR			< 11	U	11	NDR			NDR			NDR			< 5	U	5
Benzo[g,h,i]perylene	NS	ug/l	NDR			NDR			NDR			< 11	U	11	NDR			NDR			NDR			< 5	U	5
Benzo[k]fluoranthene	0.38	ug/l	NDR			NDR			NDR			< 11	U	11	NDR			NDR			NDR			< 5	U	5
Biphenyl	NS	ug/l	NDR			NDR			NDR			NDR			NDR			NDR			NDR			< 5	U	5
Bis(2-chloroethoxy)methane	NS	ug/l	NDR			NDR			NDR			< 11	U	11	NDR			NDR			NDR			< 5	U	5
Bis(2-chloroethyl) Ether	0.03	ug/l	NDR			NDR			NDR			< 11	U	11	NDR			NDR			NDR			< 5	U	5
Bis(2-chloroisopropyl) Ether	1400	ug/l	NDR			NDR			NDR			< 11	U	11	NDR			NDR			NDR			< 5	U	5
Bis(2-ethylhexyl) Phthalate	1.2	ug/l	NDR			NDR			NDR			< 11	U	11	NDR			NDR			NDR			< 5	U	5
Butylbenzyl Phthalate	150	ug/l	NDR			NDR			NDR			< 11	U	11	NDR			NDR			NDR			< 5	U	5
Caprolactum	NS	ug/l	NDR			NDR			NDR			NDR			NDR			NDR			NDR			< 5	U	5
Carbazole	NS	ug/l	NDR			NDR			NDR			< 11	U	11	NDR			NDR			NDR			< 5	U	5
Chrysene	3.8	ug/l	NDR			NDR			NDR			< 11	U	11	NDR			NDR			NDR			< 5	U	5
Dibenzo[a,h]anthracene	0.0038	ug/l	NDR			NDR			NDR			< 11	U	11	NDR			NDR			NDR			< 5	U	5
Dibenzofuran	NS	ug/l	NDR			NDR			NDR			< 11	U	11	NDR			NDR			NDR			< 5	U	5
Diethyl Phthalate	17000	ug/l	NDR			NDR			NDR			< 11	U	11	NDR			NDR			NDR			< 5	U	5
Dimethyl Phthalate	NS	ug/l	NDR			NDR			NDR			< 11	U	11	NDR			NDR			NDR			< 5	U	5
Di-n-Butyl Phthalate	2000	ug/l	NDR			NDR			NDR			< 11	U	11	NDR			NDR			NDR			< 5	U	5
Di-n-octyl Phthalate	NS	ug/l	NDR			NDR			NDR			< 11	U	11	NDR			NDR			NDR			< 5	U	5
Fluoranthene	130	ug/l	NDR			NDR			NDR			< 11	U	11	NDR			NDR			NDR			< 5	U	5
Fluorene	1100	ug/l	NDR			NDR			NDR			< 11	U	11	NDR			NDR			NDR			< 5	U	5
Hexachlorobenzene	0.00028	ug/l	NDR			NDR			NDR			< 11	U	11	NDR			NDR			NDR			< 5	U	5
Hexachlorobutadiene	0.44	ug/l	NDR			NDR			NDR			< 11	U	11	NDR			NDR			NDR			< 5	U	5
Hexachlorocyclopentadiene	40	ug/l	NDR			NDR			NDR			< 11	U	11	NDR			NDR			NDR			< 5	U	5
Hexachloroethane	1.4	ug/l	NDR			NDR			NDR			< 11	U	11	NDR			NDR			NDR			< 5	U	5
Indeno[1,2,3-cd]pyrene	0.038	ug/l	NDR			NDR			NDR			< 11	U	11	NDR			NDR			NDR			< 5	U	5
Isophorone	35	ug/l	NDR			NDR			NDR			< 11	U	11	NDR			NDR			NDR			< 5	U	5
Naphthalene	NS	ug/l	NDR			NDR			NDR			< 11	U	11	NDR			NDR			NDR			< 5	U	5
Nitrobenzene	17	ug/l	NDR			NDR			NDR			< 11	U	11	NDR			NDR			NDR			< 5	U	5
N-Nitroso-di-n-propylamine	0.005	ug/l	NDR			NDR			NDR			< 11	U	11	NDR			NDR			NDR			< 5	U	5
N-Nitrosodiphenylamine	3.3	ug/l	NDR			NDR			NDR			< 11	U	11	NDR			NDR			NDR			< 5	U	5
Pentachlorophenol	0.27	ug/l	NDR			NDR			NDR			< 26	U	26	NDR			NDR			NDR			< 10	U	10
Phenanthrene	NS	ug/l	NDR			NDR			NDR			< 11	U	11	NDR			NDR			NDR			< 5	U	5
Phenol	10000	ug/l	NDR			NDR			NDR			< 11	U	11	NDR			NDR			NDR			< 5	U	5

Golder Associates
R2-0001316

TABLE A2
Surface Water Samples
Validated Analytical Data
Carlstadt

		Sample ID	SW-3			SW-3			SW-3			SW-3			SW-3			SW-3			SW-3			SW-3		
		Sample Date	11/13/2007			3/21/2008			6/2/2008			12/3/2008			4/2/2009			7/10/2009			10/22/2009			12/21/2009		
		N=Normal, FD=Field Duplicate	N			N			N			N			N			N			N			N		
Parameter	NJDEP SWQS*	Unit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit
Pyrene	830	ug/l	NDR			NDR			NDR			< 11	U	11	NDR			NDR			NDR			< 5	U	5
Volatile Organic Compounds																										
1,1,1-Trichloroethane	120	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 2.5	U	2.5	< 2.5	U	2.5	< 0.5	U	0.5
1,1,2,2-Tetrachloroethane	4.7	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 2.5	U	2.5	< 2.5	U	2.5	< 0.5	U	0.5
1,1,2-Trichloroethane	13	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 2.5	U	2.5	< 2.5	U	2.5	< 0.5	U	0.5
1,1-Dichloroethane	NS	ug/l	< 0.5	U	0.5	0.24	J	0.5	0.12	J	0.5	< 0.5	U	0.5	0.12	J	0.5	< 2.5	U	2.5	< 2.5	U	2.5	< 0.5	U	0.5
1,1-Dichloroethene	4.7	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 2.5	U	2.5	< 2.5	U	2.5	< 0.5	U	0.5
1,2,3-Trichlorobenzene	NS	ug/l	NDR			NDR			NDR			NDR			NDR			NDR			NDR			< 0.5	U	0.5
1,2,4-Trichlorobenzene	21	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 2.5	U	2.5	< 2.5	U	2.5	< 0.5	U	0.5
1,2-Dibromo-3-chloropropane	NS	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 2.5	U	2.5	< 2.5	U	2.5	< 0.5	U	0.5
1,2-Dibromoethane	NS	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 2.5	U	2.5	< 2.5	U	2.5	< 0.5	U	0.5
1,2-Dichlorobenzene	2000	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 2.5	U	2.5	< 2.5	U	2.5	< 0.5	U	0.5
1,2-Dichloroethane	0.29	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	***0.32***	J	0.5	< 0.5	U	0.5	< 2.5	U	2.5	< 2.5	U	2.5	< 0.5	U	0.5
1,2-Dichloropropane	0.5	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 2.5	U	2.5	< 2.5	U	2.5	< 0.5	U	0.5
1,3-Dichlorobenzene	2200	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 2.5	U	2.5	< 2.5	U	2.5	< 0.5	U	0.5
1,4-Dichlorobenzene	550	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 2.5	U	2.5	< 2.5	U	2.5	< 0.5	U	0.5
2-Butanone	NS	ug/l	< 5	U	5	< 5	U	5	< 5	U	5	1.4	J	5	2.3	J	5	< 25	U	25	< 25	U	25	< 5	U	5
2-Hexanone	NS	ug/l	< 5	U	5	< 5	U	5	< 5	U	5	< 5	U	5	< 5	U	5	< 25	U	25	< 25	U	25	< 5	U	5
4-Methyl-2-pentanone	NS	ug/l	< 5	U	5	< 5	U	5	< 5	U	5	< 5	U	5	< 5	U	5	< 25	U	25	< 25	U	25	< 5	U	5
Acetone	NS	ug/l	< 16	U	16	< 7.4	U	7.4	< 5	U	5	< 6.8	U	6.8	17		5	25		25	< 25	U	25	< 5.5	U	5.5
Benzene	0.15	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 2.5	U	2.5	< 2.5	U	2.5	< 0.5	U	0.5
Bromochloromethane	NS	ug/l	NDR			NDR			NDR			NDR			NDR			NDR			NDR			< 0.5	U	0.5
Bromodichloromethane	0.55	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 2.5	U	2.5	< 2.5	U	2.5	0.16	J	0.5
Bromoform	4.3	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 2.5	U	2.5	< 2.5	U	2.5	< 0.5	U	0.5
Bromomethane	47	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 2.5	U	2.5	< 2.5	U	2.5	< 0.5	U	0.5
Carbon Disulfide	NS	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	0.17	J	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 2.5	U	2.5	< 2.5	U	2.5	< 0.5	U	0.5
Carbon Tetrachloride	0.33	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 2.5	U	2.5	< 2.5	U	2.5	< 0.5	U	0.5
Chlorobenzene	210	ug/l	< 0.5	U	0.5	1.3		0.5	0.25	J	0.5	0.8		0.5	0.26	J	0.5	< 2.5	U	2.5	< 2.5	U	2.5	< 0.5	U	0.5
Chloroethane	NS	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 2.5	U	2.5	< 2.5	U	2.5	< 0.5	U	0.5
Chloroform	68	ug/l	< 0.5	U	0.5	1.1		0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 2.5	U	2.5	< 2.5	U	2.5	< 0.5	U	0.5
Chloromethane	NS	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 2.5	U	2.5	< 2.5	U	2.5	< 0.5	U	0.5
cis-1,2-Dichloroethene	NS	ug/l	< 0.5	U	0.5	1.1		0.5	0.28	J	0.5	1.4		0.5	0.73		0.5	< 2.5	U	2.5	0.73	J	2.5	1.4		0.5
cis-1,3-Dichloropropene	0.34	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 2.5	U	2.5	< 2.5	U	2.5	< 0.5	U	0.5
Cyclohexane	NS	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 2.5	U	2.5	< 2.5	U	2.5	< 0.5	U	0.5
Dibromochloromethane	0.4	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 2.5	U	2.5	< 2.5	U	2.5	< 0.5	U	0.5
Dichlorodifluoromethane	NS	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 2.5	U	2.5	< 2.5	U	2.5	< 0.5	U	0.5
Ethylbenzene	530	ug/l	< 0.5	U	0.5	0.16	J	0.5	< 0.5	U	0.5	0.11	J	0.5	< 0.5	U	0.5	< 2.5	U	2.5	< 2.5	U	2.5	< 0.5	U	0.5
Freon 113	NS	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 2.5	U	2.5	< 2.5	U	2.5	< 0.5	U	0.5
Isopropylbenzene	NS	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 2.5	U	2.5	< 2.5	U	2.5	< 0.5	U	0.5
m,p-Xylenes	NS	ug/l	NDR			NDR			NDR			NDR			NDR			NDR			NDR			< 0.5	U	0.5
Methyl Acetate	NS	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 2.5	U	2.5	< 2.5	U	2.5	< 0.5	U	0.5
Methyl Cyclohexane	NS	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 2.5	U	2.5	< 2.5	U	2.5	< 0.5	U	0.5
Methyl tert-Butyl Ether	70	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 2.5	U	2.5	< 2.5	U	2.5	< 0.5	U	0.5
Methylene Chloride	2.5	ug/l	< 0.67	U	0.67	< 0.72	U	0.72	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	***3.2***		2.5	< 2.5	U	2.5	< 0.5	U	0.5
o-Xylene	NS	ug/l	NDR			NDR			NDR			NDR			NDR			NDR			NDR			< 0.5	U	0.5
Styrene	NS	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 2.5	U	2.5	< 2.5	U	2.5	< 0.5	U	0.5
Tetrachloroethene	0.34	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	0.3	J	0.5	***0.64***		0.5	< 2.5	U	2.5	< 2.5	U	2.5	< 0.5	U	0.5
Toluene	1300	ug/l	0.17	J	0.5	1.3		0.5	0.86		0.5	0.38	J	0.5	0.12	J	0.5	< 2.5	U	2.5	< 2.5	U	2.5	< 0.5	U	0.5
trans-1,2-Dichloroethene	590	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 2.5	U	2.5	< 2.5	U	2.5	< 0.5	U	0.5
trans-1,3-Dichloropropene	0.34	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 2.5	U	2.5	< 2.5	U	2.5	< 0.5	U	0.5
Trichloroethene	1	ug/l	< 0.5	U	0.5	0.18	J	0.5	0.18	J	0.5	0.27	J	0.5	< 0.5	U	0.5	< 2.5	U	2.5	0.52	J	2.5	< 0.5	U	0.5
Trichlorofluoromethane	NS	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 2.5	U	2.5	< 2.5	U	2.5	< 0.5	U	0.5
Vinyl Chloride	0.082	ug/l	< 0.5	U	0.5	***0.51***		0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 2.5	U	2.5	< 2.5	U	2.5	< 0.5	U	0.5
Xylenes, Total	NS	ug/l	< 1.5	U	1.5	0.64	J	1.5	0.6	J	1.5	0.36	J	1.5	< 1.5	U	1.5	< 7.5	U	7.5	< 7.5	U	7.5	NDR		

TABLE A2
Surface Water Samples
Validated Analytical Data
Carlstadt

		Sample ID	SW-4			SW-4			SW-4			SW-4			SW-4			SW-4			SW-4			SW-4		
		Sample Date	3/10/2006			5/24/2006			5/24/2006			8/2/2006			11/7/2006			3/22/2007			7/5/2007			7/11/2007		
		N=Normal, FD=Field Duplicate	N			FD			N			N			N			N			N			N		
Parameter	NJDEP SWQS*	Unit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit
Inorganics																										
Aluminum	NS	ug/l	NDR			NDR			NDR			NDR			631		200	NDR			132	J	200	NDR		
Antimony	5.6	ug/l	NDR			NDR			NDR			NDR			< 60	U	60	NDR			< 60	U	60	NDR		
Arsenic	0.017	ug/l	NDR			NDR			NDR			NDR			< 10	U	10	NDR			< 10	U	10	NDR		
Barium	2000	ug/l	NDR			NDR			NDR			NDR			< 200	U	200	NDR			< 200	U	200	NDR		
Beryllium	6	ug/l	NDR			NDR			NDR			NDR			< 5	U	5	NDR			< 5	U	5	NDR		
Cadmium	3.4	ug/l	NDR			NDR			NDR			NDR			< 5	U	5	NDR			< 5	U	5	NDR		
Calcium	NS	ug/l	NDR			NDR			NDR			NDR			67500		5000	NDR			20200		5000	NDR		
Chromium	92	ug/l	NDR			NDR			NDR			NDR			16.8		10	NDR			11.8	J	10	NDR		
Cobalt	NS	ug/l	NDR			NDR			NDR			NDR			1.4	J	50	NDR			< 50	U	50	NDR		
Copper	1300	ug/l	NDR			NDR			NDR			NDR			< 25	U	25	NDR			17.5	J	25	NDR		
Iron	NS	ug/l	NDR			NDR			NDR			NDR			3070		100	NDR			780	J	100	NDR		
Lead	5	ug/l	NDR			NDR			NDR			NDR			***6.5***		3	NDR			2.4	J	3	NDR		
Magnesium	NS	ug/l	NDR			NDR			NDR			NDR			50500		5000	NDR			11200		5000	NDR		
Manganese	NS	ug/l	NDR			NDR			NDR			NDR			1160		15	NDR			88.9		15	NDR		
Mercury	0.05	ug/l	NDR			NDR			NDR			NDR			***1.3***		0.2	NDR			***0.65***		0.2	NDR		
Nickel	500	ug/l	NDR			NDR			NDR			NDR			22.4	J	40	NDR			< 40	U	40	NDR		
Potassium	NS	ug/l	NDR			NDR			NDR			NDR			15500	J	5000	NDR			6820	J	5000	NDR		
Selenium	170	ug/l	NDR			NDR			NDR			NDR			< 5	U	5	NDR			< 5	U	5	NDR		
Silver	170	ug/l	NDR			NDR			NDR			NDR			< 10	U	10	NDR			< 10	U	10	NDR		
Sodium	NS	ug/l	NDR			NDR			NDR			NDR			352000	J	5000	NDR			90000		5000	NDR		
Thallium	0.24	ug/l	NDR			NDR			NDR			NDR			< 10	U	10	NDR			< 10	U	10	NDR		
Vanadium	NS	ug/l	NDR			NDR			NDR			NDR			< 50	U	50	NDR			2.2	J	50	NDR		
Zinc	7400	ug/l	NDR			NDR			NDR			NDR			55.5		20	NDR			28.7		20	NDR		
PCBs																										
Aroclor 1016	0.000064	ug/l	NDR			NDR			NDR			NDR			< 1	U	1	NDR			NDR			< 1	U	1
Aroclor 1221	0.000064	ug/l	NDR			NDR			NDR			NDR			< 2	U	2	NDR			NDR			< 2	U	2
Aroclor 1232	0.000064	ug/l	NDR			NDR			NDR			NDR			< 1	U	1	NDR			NDR			< 1	U	1
Aroclor 1242	0.000064	ug/l	NDR			NDR			NDR			NDR			< 1	U	1	NDR			NDR			< 1	U	1
Aroclor 1248	0.000064	ug/l	NDR			NDR			NDR			NDR			< 1	U	1	NDR			NDR			< 1	U	1
Aroclor 1254	0.000064	ug/l	NDR			NDR			NDR			NDR			< 1	U	1	NDR			NDR			< 1	U	1
Aroclor 1260	0.000064	ug/l	NDR			NDR			NDR			NDR			< 1	U	1	NDR			NDR			< 1	U	1
Aroclor 1262	0.000064	ug/l	NDR			NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Aroclor 1268	0.000064	ug/l	NDR			NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Pesticides																										
4,4-DDD	0.00031	ug/l	NDR			NDR			NDR			NDR			< 0.1	U	0.1	NDR			NDR			< 0.1	U	0.1
4,4-DDE	0.00022	ug/l	NDR			NDR			NDR			NDR			< 0.1	U	0.1	NDR			NDR			< 0.1	U	0.1
4,4-DDT	0.00022	ug/l	NDR			NDR			NDR			NDR			< 0.1	U	0.1	NDR			NDR			< 0.1	U	0.1
Aldrin	0.000049	ug/l	NDR			NDR			NDR			NDR			< 0.05	U	0.05	NDR			NDR			< 0.05	U	0.05
alpha-BHC	0.0026	ug/l	NDR			NDR			NDR			NDR			< 0.05	U	0.05	NDR			NDR			< 0.05	U	0.05
alpha-Chlordane	NS	ug/l	NDR			NDR			NDR			NDR			< 0.05	U	0.05	NDR			NDR			< 0.05	U	0.05
alpha-Endosulfan	62	ug/l	NDR			NDR			NDR			NDR			< 0.05	U	0.05	NDR			NDR			< 0.05	U	0.05
beta-BHC	0.0091	ug/l	NDR			NDR			NDR			NDR			< 0.05	U	0.05	NDR			NDR			< 0.05	U	0.05
beta-Endosulfan	62	ug/l	NDR			NDR			NDR			NDR			< 0.1	U	0.1	NDR			NDR			< 0.1	U	0.1
delta-BHC	NS	ug/l	NDR			NDR			NDR			NDR			< 0.05	U	0.05	NDR			NDR			< 0.05	U	0.05
Dieldrin	0.000052	ug/l	NDR			NDR			NDR			NDR			< 0.1	U	0.1	NDR			NDR			< 0.1	U	0.1
Endosulfan Sulfate	62	ug/l	NDR			NDR			NDR			NDR			< 0.1	U	0.1	NDR			NDR			< 0.1	U	0.1
Endrin	0.059	ug/l	NDR			NDR			NDR			NDR			< 0.1	U	0.1	NDR			NDR			< 0.1	U	0.1
Endrin Aldehyde	0.059	ug/l	NDR			NDR			NDR			NDR			< 0.1	U	0.1	NDR			NDR			< 0.1	U	0.1
Endrin Ketone	NS	ug/l	NDR			NDR			NDR			NDR			< 0.1	U	0.1	NDR			NDR			< 0.1	U	0.1
gamma-BHC	0.98	ug/l	NDR			NDR			NDR			NDR			< 0.05	U	0.05	NDR			NDR			< 0.05	U	0.05
gamma-Chlordane	NS	ug/l	NDR			NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Heptachlor	0.000079	ug/l	NDR			NDR			NDR			NDR			< 0.05	U	0.05	NDR			NDR			< 0.05	U	0.05
Heptachlor Epoxide	0.000039	ug/l	NDR			NDR			NDR			NDR			< 0.05	U	0.05	NDR			NDR			***0.019***	J	0.05
Methoxychlor	40	ug/l	NDR			NDR			NDR			NDR			< 0.5	U	0.5	NDR			NDR			< 0.5	U	0.5
Toxaphene	0.00028	ug/l	NDR			NDR			NDR			NDR			< 5	U	5	NDR			NDR			< 5	U	5
trans-Chlordane	NS	ug/l	NDR			NDR			NDR			NDR			0.018	J	0.05	NDR			NDR			< 0.05	U	0.05

Golder Associates
R2-0001318

TABLE A2
Surface Water Samples
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		Sample ID	SW-4			SW-4			SW-4			SW-4			SW-4			SW-4			SW-4			SW-4		
		Sample Date	3/10/2006			5/24/2006			5/24/2006			8/2/2006			11/7/2006			3/22/2007			7/5/2007			7/11/2007		
		N=Normal, FD=Field Duplicate	N			FD			N			N			N			N			N			N		
Parameter	NJDEP SWQS*	Unit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit
Semivolatile Organic Compounds																										
1,2,4,5-Tetrachlorobenzene	0.97	ug/l	NDR			NDR			NDR			NDR			NDR			NDR			NDR			NDR		
2,3,4,6-Tetrachlorophenol	NS	ug/l	NDR			NDR			NDR			NDR			NDR			NDR			NDR			NDR		
2,4,5-Trichlorophenol	1800	ug/l	NDR			NDR			NDR			NDR			< 25	U	25	NDR			NDR			< 25	U	25
2,4,6-Trichlorophenol	0.58	ug/l	NDR			NDR			NDR			NDR			< 10	U	10	NDR			NDR			< 10	U	10
2,4-Dichlorophenol	77	ug/l	NDR			NDR			NDR			NDR			< 10	U	10	NDR			NDR			< 10	U	10
2,4-Dimethylphenol	380	ug/l	NDR			NDR			NDR			NDR			< 10	U	10	NDR			NDR			< 10	U	10
2,4-Dinitrophenol	69	ug/l	NDR			NDR			NDR			NDR			< 25	U	25	NDR			NDR			< 25	U	25
2,4-Dinitrotoluene	0.11	ug/l	NDR			NDR			NDR			NDR			< 10	U	10	NDR			NDR			< 10	U	10
2,6-Dinitrotoluene	NS	ug/l	NDR			NDR			NDR			NDR			< 10	U	10	NDR			NDR			< 10	U	10
2-Chloronaphthalene	1000	ug/l	NDR			NDR			NDR			NDR			< 10	U	10	NDR			NDR			< 10	U	10
2-Chlorophenol	81	ug/l	NDR			NDR			NDR			NDR			< 10	U	10	NDR			NDR			< 10	U	10
2-Methylnaphthalene	NS	ug/l	NDR			NDR			NDR			NDR			< 10	U	10	NDR			NDR			< 10	U	10
2-Methylphenol	NS	ug/l	NDR			NDR			NDR			NDR			< 10	U	10	NDR			NDR			< 10	U	10
2-Nitroaniline	NS	ug/l	NDR			NDR			NDR			NDR			< 25	U	25	NDR			NDR			< 25	U	25
2-Nitrophenol	NS	ug/l	NDR			NDR			NDR			NDR			< 10	U	10	NDR			NDR			< 10	U	10
3,3'-Dichlorobenzidine	0.021	ug/l	NDR			NDR			NDR			NDR			< 10	U	10	NDR			NDR			< 10	U	10
3-Nitroaniline	NS	ug/l	NDR			NDR			NDR			NDR			< 25	U	25	NDR			NDR			< 25	U	25
4,6-Dinitro-2-methylphenol	13	ug/l	NDR			NDR			NDR			NDR			< 25	U	25	NDR			NDR			< 25	U	25
4-Bromophenyl Phenyl Ether	NS	ug/l	NDR			NDR			NDR			NDR			< 10	U	10	NDR			NDR			< 10	U	10
4-Chloro-3-methylphenol	NS	ug/l	NDR			NDR			NDR			NDR			< 10	U	10	NDR			NDR			< 10	U	10
4-Chloroaniline	NS	ug/l	NDR			NDR			NDR			NDR			< 10	U	10	NDR			NDR			< 10	U	10
4-Chlorophenyl-phenylether	NS	ug/l	NDR			NDR			NDR			NDR			< 10	U	10	NDR			NDR			< 10	U	10
4-Methylphenol	NS	ug/l	NDR			NDR			NDR			NDR			< 10	U	10	NDR			NDR			< 10	U	10
4-Nitroaniline	NS	ug/l	NDR			NDR			NDR			NDR			< 25	U	25	NDR			NDR			< 25	U	25
4-Nitrophenol	NS	ug/l	NDR			NDR			NDR			NDR			< 25	U	25	NDR			NDR			< 25	U	25
Acenaphthene	670	ug/l	NDR			NDR			NDR			NDR			< 10	U	10	NDR			NDR			< 10	U	10
Acenaphthylene	NS	ug/l	NDR			NDR			NDR			NDR			< 10	U	10	NDR			NDR			< 10	U	10
Acetophenone	NS	ug/l	NDR			NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Anthracene	8300	ug/l	NDR			NDR			NDR			NDR			< 10	U	10	NDR			NDR			< 10	U	10
Atrazine	NS	ug/l	NDR			NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Benzaldehyde	NS	ug/l	NDR			NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Benzo[a]anthracene	0.038	ug/l	NDR			NDR			NDR			NDR			< 10	U	10	NDR			NDR			< 10	U	10
Benzo[a]pyrene	0.0038	ug/l	NDR			NDR			NDR			NDR			< 10	U	10	NDR			NDR			< 10	U	10
Benzo[b]fluoranthene	0.038	ug/l	NDR			NDR			NDR			NDR			< 10	U	10	NDR			NDR			< 10	U	10
Benzo[g,h,i]perylene	NS	ug/l	NDR			NDR			NDR			NDR			< 10	U	10	NDR			NDR			< 10	U	10
Benzo[k]fluoranthene	0.38	ug/l	NDR			NDR			NDR			NDR			< 10	U	10	NDR			NDR			< 10	U	10
Biphenyl	NS	ug/l	NDR			NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Bis(2-chloroethoxy)methane	NS	ug/l	NDR			NDR			NDR			NDR			< 10	U	10	NDR			NDR			< 10	U	10
Bis(2-chloroethyl) Ether	0.03	ug/l	NDR			NDR			NDR			NDR			< 10	U	10	NDR			NDR			< 10	U	10
Bis(2-chloroisopropyl) Ether	1400	ug/l	NDR			NDR			NDR			NDR			< 10	U	10	NDR			NDR			< 10	U	10
Bis(2-ethylhexyl) Phthalate	1.2	ug/l	NDR			NDR			NDR			NDR			< 10	U	10	NDR			NDR			< 10	U	10
Butylbenzyl Phthalate	150	ug/l	NDR			NDR			NDR			NDR			< 10	U	10	NDR			NDR			< 10	U	10
Caprolactum	NS	ug/l	NDR			NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Carbazole	NS	ug/l	NDR			NDR			NDR			NDR			< 10	U	10	NDR			NDR			< 10	U	10
Chrysene	3.8	ug/l	NDR			NDR			NDR			NDR			< 10	U	10	NDR			NDR			< 10	U	10
Dibenzo[a,h]anthracene	0.0038	ug/l	NDR			NDR			NDR			NDR			< 10	U	10	NDR			NDR			< 10	U	10
Dibenzofuran	NS	ug/l	NDR			NDR			NDR			NDR			< 10	U	10	NDR			NDR			< 10	U	10
Diethyl Phthalate	17000	ug/l	NDR			NDR			NDR			NDR			< 10	U	10	NDR			NDR			< 10	U	10
Dimethyl Phthalate	NS	ug/l	NDR			NDR			NDR			NDR			< 10	U	10	NDR			NDR			< 10	U	10
Di-n-Butyl Phthalate	2000	ug/l	NDR			NDR			NDR			NDR			< 10	U	10	NDR			NDR			< 10	U	10
Di-n-octyl Phthalate	NS	ug/l	NDR			NDR			NDR			NDR			< 10	U	10	NDR			NDR			< 10	U	10
Fluoranthene	130	ug/l	NDR			NDR			NDR			NDR			< 10	U	10	NDR			NDR			< 10	U	10
Fluorene	1100	ug/l	NDR			NDR			NDR			NDR			< 10	U	10	NDR			NDR			< 10	U	10
Hexachlorobenzene	0.00028	ug/l	NDR			NDR			NDR			NDR			< 10	U	10	NDR			NDR			< 10	U	10
Hexachlorobutadiene	0.44	ug/l	NDR			NDR			NDR			NDR			< 10	U	10	NDR			NDR			< 10	U	10
Hexachlorocyclopentadiene	40	ug/l	NDR			NDR			NDR			NDR			< 10	U	10	NDR			NDR			< 10	U	10
Hexachloroethane	1.4	ug/l	NDR			NDR			NDR			NDR			< 10	U	10	NDR			NDR			< 10	U	10
Indeno[1,2,3-cd]pyrene	0.038	ug/l	NDR			NDR			NDR			NDR			< 10	U	10	NDR			NDR			< 10	U	10
Isophorone	35	ug/l	NDR			NDR			NDR			NDR			< 10	U	10	NDR			NDR			< 10	U	10
Naphthalene	NS	ug/l	NDR			NDR			NDR			NDR			< 10	U	10	NDR			NDR			< 10	U	10
Nitrobenzene	17	ug/l	NDR			NDR			NDR			NDR			< 10	U	10	NDR			NDR			< 10	U	10
N-Nitroso-di-n-propylamine	0.005	ug/l	NDR			NDR			NDR			NDR			< 10	U	10	NDR			NDR			< 10	U	10
N-Nitrosodiphenylamine	3.3	ug/l	NDR			NDR			NDR			NDR			< 10	U	10	NDR			NDR			< 10	U	10
Pentachlorophenol	0.27	ug/l	NDR			NDR			NDR			NDR			< 25	U	25	NDR			NDR			< 25	U	25
Phenanthrene	NS	ug/l	NDR			NDR			NDR			NDR			< 10	U	10	NDR			NDR			< 10	U	10
Phenol	10000	ug/l	NDR			NDR			NDR			NDR			< 10	U	10	NDR			NDR			< 10	U	10

TABLE A2
Surface Water Samples
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		Sample ID	SW-4			SW-4			SW-4			SW-4			SW-4			SW-4			SW-4			SW-4		
		Sample Date	3/10/2006			5/24/2006			5/24/2006			8/2/2006			11/7/2006			3/22/2007			7/5/2007			7/11/2007		
		N=Normal, FD=Field Duplicate	N			FD			N			N			N			N			N			N		
Parameter	NJDEP SWQS*	Unit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit
Pyrene	830	ug/l	NDR			NDR			NDR			NDR			< 10	U	10	NDR			NDR			< 10	U	10
Volatile Organic Compounds																										
1,1,1-Trichloroethane	120	ug/l	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR			< 0.5	U	0.5
1,1,2,2-Tetrachloroethane	4.7	ug/l	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR			< 0.5	U	0.5
1,1,2-Trichloroethane	13	ug/l	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR			< 0.5	U	0.5
1,1-Dichloroethane	NS	ug/l	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR			0.21	J	0.5
1,1-Dichloroethene	4.7	ug/l	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR			< 0.5	U	0.5
1,2,3-Trichlorobenzene	NS	ug/l	NDR			NDR			NDR			NDR			NDR			NDR			NDR			NDR		
1,2,4-Trichlorobenzene	21	ug/l	NDR			NDR			NDR			NDR			NDR			< 10	U	10	NDR			< 0.5	U	0.5
1,2-Dibromo-3-chloropropane	NS	ug/l	NDR			NDR			NDR			NDR			NDR			< 10	U	10	NDR			< 0.5	U	0.5
1,2-Dibromoethane	NS	ug/l	NDR			NDR			NDR			NDR			NDR			< 10	U	10	NDR			< 0.5	U	0.5
1,2-Dichlorobenzene	2000	ug/l	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR			0.18	J	0.5
1,2-Dichloroethane	0.29	ug/l	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR			< 0.5	U	0.5
1,2-Dichloropropane	0.5	ug/l	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR			< 0.5	U	0.5
1,3-Dichlorobenzene	2200	ug/l	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR			< 0.5	U	0.5
1,4-Dichlorobenzene	550	ug/l	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR			< 0.5	U	0.5
2-Butanone	NS	ug/l	9	J	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR			5.7		5
2-Hexanone	NS	ug/l	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR			< 5	U	5
4-Methyl-2-pentanone	NS	ug/l	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR			< 5	U	5
Acetone	NS	ug/l	7	J	10	< 10	U	10	3	J	10	9	J	10	< 10	U	10	8	J	10	NDR			< 5	U	5
Benzene	0.15	ug/l	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR			***0.16***	J	0.5
Bromochloromethane	NS	ug/l	NDR			NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Bromodichloromethane	0.55	ug/l	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR			< 0.5	U	0.5
Bromoform	4.3	ug/l	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR			< 0.5	U	0.5
Bromomethane	47	ug/l	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR			< 0.5	U	0.5
Carbon Disulfide	NS	ug/l	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR			< 0.5	U	0.5
Carbon Tetrachloride	0.33	ug/l	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR			< 0.5	U	0.5
Chlorobenzene	210	ug/l	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	2	J	10	< 10	U	10	NDR			0.88		0.5
Chloroethane	NS	ug/l	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR			< 0.5	U	0.5
Chloroform	68	ug/l	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	2	J	10	< 10	U	10	NDR			0.36	J	0.5
Chloromethane	NS	ug/l	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR			< 0.5	U	0.5
cis-1,2-Dichloroethene	NS	ug/l	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR			0.29	J	0.5
cis-1,3-Dichloropropene	0.34	ug/l	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR			< 0.5	U	0.5
Cyclohexane	NS	ug/l	NDR			NDR			NDR			NDR			NDR			< 10	U	10	NDR			< 0.5	U	0.5
Dibromochloromethane	0.4	ug/l	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR			< 0.5	U	0.5
Dichlorodifluoromethane	NS	ug/l	NDR			NDR			NDR			NDR			NDR			< 10	U	10	NDR			< 0.5	U	0.5
Ethylbenzene	530	ug/l	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR			0.23	J	0.5
Freon 113	NS	ug/l	NDR			NDR			NDR			NDR			NDR			< 10	U	10	NDR			< 0.5	U	0.5
Isopropylbenzene	NS	ug/l	NDR			NDR			NDR			NDR			NDR			< 10	U	10	NDR			< 0.5	U	0.5
m,p-Xylenes	NS	ug/l	NDR			NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Methyl Acetate	NS	ug/l	NDR			NDR			NDR			NDR			NDR			< 10	U	10	NDR			< 0.5	U	0.5
Methyl Cyclohexane	NS	ug/l	NDR			NDR			NDR			NDR			NDR			< 10	U	10	NDR			< 0.5	U	0.5
Methyl tert-Butyl Ether	70	ug/l	NDR			NDR			NDR			NDR			NDR			< 10	U	10	NDR			< 0.5	U	0.5
Methylene Chloride	2.5	ug/l	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR			< 0.5	U	0.5
o-Xylene	NS	ug/l	NDR			NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Styrene	NS	ug/l	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR			< 0.5	U	0.5
Tetrachloroethene	0.34	ug/l	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR			0.17	J	0.5
Toluene	1300	ug/l	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	1	J	10	< 10	U	10	NDR			1.8		0.5
trans-1,2-Dichloroethene	590	ug/l	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR			< 0.5	U	0.5
trans-1,3-Dichloropropene	0.34	ug/l	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR			< 0.5	U	0.5
Trichloroethene	1	ug/l	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR			0.17	J	0.5
Trichlorofluoromethane	NS	ug/l	NDR			NDR			NDR			NDR			NDR			< 10	U	10	NDR			< 0.5	U	0.5
Vinyl Chloride	0.082	ug/l	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR			< 0.5	U	0.5
Xylenes, Total	NS	ug/l	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	< 10	U	10	NDR			1.1		0.5

TABLE A2
Surface Water Samples
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		Sample ID	SW-4			SW-4			SW-4			SW-4			SW-4			SW-4			SW-4			SW-4		
		Sample Date	11/13/2007			6/2/2008			12/3/2008			4/2/2009			7/10/2009			7/10/2009			10/22/2009			10/22/2009		
		N=Normal, FD=Field Duplicate	N			N			N			N			FD			N			FD			N		
Parameter	NJDEP SWQS*	Unit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit
Inorganics																										
Aluminum	NS	ug/l	NDR			NDR			837		200	NDR			NDR			NDR			NDR			NDR		
Antimony	5.6	ug/l	NDR			NDR			< 60	U	60	NDR			NDR			NDR			NDR			NDR		
Arsenic	0.017	ug/l	NDR			NDR			< 10	U	10	NDR			NDR			NDR			NDR			NDR		
Barium	2000	ug/l	NDR			NDR			65.4	J	200	NDR			NDR			NDR			NDR			NDR		
Beryllium	6	ug/l	NDR			NDR			< 5	U	5	NDR			NDR			NDR			NDR			NDR		
Cadmium	3.4	ug/l	NDR			NDR			1	J	5	NDR			NDR			NDR			NDR			NDR		
Calcium	NS	ug/l	NDR			NDR			46300		5000	NDR			NDR			NDR			NDR			NDR		
Chromium	92	ug/l	NDR			NDR			40.2		10	NDR			NDR			NDR			NDR			NDR		
Cobalt	NS	ug/l	NDR			NDR			< 50	U	50	NDR			NDR			NDR			NDR			NDR		
Copper	1300	ug/l	NDR			NDR			150		25	NDR			NDR			NDR			NDR			NDR		
Iron	NS	ug/l	NDR			NDR			4820		100	NDR			NDR			NDR			NDR			NDR		
Lead	5	ug/l	NDR			NDR			***11.6***		3	NDR			NDR			NDR			NDR			NDR		
Magnesium	NS	ug/l	NDR			NDR			22900		5000	NDR			NDR			NDR			NDR			NDR		
Manganese	NS	ug/l	NDR			NDR			667		15	NDR			NDR			NDR			NDR			NDR		
Mercury	0.05	ug/l	NDR			NDR			***4.6***		0.2	NDR			NDR			NDR			NDR			NDR		
Nickel	500	ug/l	NDR			NDR			28.6	J	40	NDR			NDR			NDR			NDR			NDR		
Potassium	NS	ug/l	NDR			NDR			8290	J	5000	NDR			NDR			NDR			NDR			NDR		
Selenium	170	ug/l	NDR			NDR			< 5	U	5	NDR			NDR			NDR			NDR			NDR		
Silver	170	ug/l	NDR			NDR			< 10	U	10	NDR			NDR			NDR			NDR			NDR		
Sodium	NS	ug/l	NDR			NDR			197000		5000	NDR			NDR			NDR			NDR			NDR		
Thallium	0.24	ug/l	NDR			NDR			< 10	U	10	NDR			NDR			NDR			NDR			NDR		
Vanadium	NS	ug/l	NDR			NDR			5	J	50	NDR			NDR			NDR			NDR			NDR		
Zinc	7400	ug/l	NDR			NDR			76.9		20	NDR			NDR			NDR			NDR			NDR		
PCBs																										
Aroclor 1016	0.000064	ug/l	NDR			NDR			< 1	U	1	NDR			NDR			NDR			NDR			NDR		
Aroclor 1221	0.000064	ug/l	NDR			NDR			< 2	U	2	NDR			NDR			NDR			NDR			NDR		
Aroclor 1232	0.000064	ug/l	NDR			NDR			< 1	U	1	NDR			NDR			NDR			NDR			NDR		
Aroclor 1242	0.000064	ug/l	NDR			NDR			< 1	U	1	NDR			NDR			NDR			NDR			NDR		
Aroclor 1248	0.000064	ug/l	NDR			NDR			< 1	U	1	NDR			NDR			NDR			NDR			NDR		
Aroclor 1254	0.000064	ug/l	NDR			NDR			< 1	U	1	NDR			NDR			NDR			NDR			NDR		
Aroclor 1260	0.000064	ug/l	NDR			NDR			< 1	U	1	NDR			NDR			NDR			NDR			NDR		
Aroclor 1262	0.000064	ug/l	NDR			NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Aroclor 1268	0.000064	ug/l	NDR			NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Pesticides																										
4,4-DDD	0.00031	ug/l	NDR			NDR			< 0.1	U	0.1	NDR			NDR			NDR			NDR			NDR		
4,4-DDE	0.00022	ug/l	NDR			NDR			< 0.1	U	0.1	NDR			NDR			NDR			NDR			NDR		
4,4-DDT	0.00022	ug/l	NDR			NDR			< 0.1	U	0.1	NDR			NDR			NDR			NDR			NDR		
Aldrin	0.000049	ug/l	NDR			NDR			< 0.05	U	0.05	NDR			NDR			NDR			NDR			NDR		
alpha-BHC	0.0026	ug/l	NDR			NDR			< 0.05	U	0.05	NDR			NDR			NDR			NDR			NDR		
alpha-Chlordane	NS	ug/l	NDR			NDR			< 0.05	U	0.05	NDR			NDR			NDR			NDR			NDR		
alpha-Endosulfan	62	ug/l	NDR			NDR			< 0.05	U	0.05	NDR			NDR			NDR			NDR			NDR		
beta-BHC	0.0091	ug/l	NDR			NDR			< 0.05	U	0.05	NDR			NDR			NDR			NDR			NDR		
beta-Endosulfan	62	ug/l	NDR			NDR			< 0.1	U	0.1	NDR			NDR			NDR			NDR			NDR		
delta-BHC	NS	ug/l	NDR			NDR			< 0.05	U	0.05	NDR			NDR			NDR			NDR			NDR		
Dieldrin	0.000052	ug/l	NDR			NDR			< 0.1	U	0.1	NDR			NDR			NDR			NDR			NDR		
Endosulfan Sulfate	62	ug/l	NDR			NDR			< 0.1	U	0.1	NDR			NDR			NDR			NDR			NDR		
Endrin	0.059	ug/l	NDR			NDR			< 0.1	U	0.1	NDR			NDR			NDR			NDR			NDR		
Endrin Aldehyde	0.059	ug/l	NDR			NDR			< 0.1	U	0.1	NDR			NDR			NDR			NDR			NDR		
Endrin Ketone	NS	ug/l	NDR			NDR			< 0.1	U	0.1	NDR			NDR			NDR			NDR			NDR		
gamma-BHC	0.98	ug/l	NDR			NDR			< 0.05	U	0.05	NDR			NDR			NDR			NDR			NDR		
gamma-Chlordane	NS	ug/l	NDR			NDR			< 0.05	U	0.05	NDR			NDR			NDR			NDR			NDR		
Heptachlor	0.000079	ug/l	NDR			NDR			< 0.05	U	0.05	NDR			NDR			NDR			NDR			NDR		
Heptachlor Epoxide	0.000039	ug/l	NDR			NDR			***0.011***	J	0.05	NDR			NDR			NDR			NDR			NDR		
Methoxychlor	40	ug/l	NDR			NDR			< 0.5	U	0.5	NDR			NDR			NDR			NDR			NDR		
Toxaphene	0.00028	ug/l	NDR			NDR			< 5	U	5	NDR			NDR			NDR			NDR			NDR		
trans-Chlordane	NS	ug/l	NDR			NDR			NDR			NDR			NDR			NDR			NDR			NDR		

TABLE A2
Surface Water Samples
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		Sample ID	SW-4			SW-4			SW-4			SW-4			SW-4			SW-4			SW-4			SW-4		
		Sample Date	11/13/2007			6/2/2008			12/3/2008			4/2/2009			7/10/2009			7/10/2009			10/22/2009			10/22/2009		
		N=Normal, FD=Field Duplicate	N			N			N			N			FD			N			FD			N		
Parameter	NJDEP SWQS*	Unit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit
Semivolatile Organic Compounds																										
1,2,4,5-Tetrachlorobenzene	0.97	ug/l	NDR			NDR			NDR			NDR			NDR			NDR			NDR			NDR		
2,3,4,6-Tetrachlorophenol	NS	ug/l	NDR			NDR			NDR			NDR			NDR			NDR			NDR			NDR		
2,4,5-Trichlorophenol	1800	ug/l	NDR			NDR			< 27	U	27	NDR			NDR			NDR			NDR			NDR		
2,4,6-Trichlorophenol	0.58	ug/l	NDR			NDR			< 11	U	11	NDR			NDR			NDR			NDR			NDR		
2,4-Dichlorophenol	77	ug/l	NDR			NDR			< 11	U	11	NDR			NDR			NDR			NDR			NDR		
2,4-Dimethylphenol	380	ug/l	NDR			NDR			< 11	U	11	NDR			NDR			NDR			NDR			NDR		
2,4-Dinitrophenol	69	ug/l	NDR			NDR			< 27	U	27	NDR			NDR			NDR			NDR			NDR		
2,4-Dinitrotoluene	0.11	ug/l	NDR			NDR			< 11	U	11	NDR			NDR			NDR			NDR			NDR		
2,6-Dinitrotoluene	NS	ug/l	NDR			NDR			< 11	U	11	NDR			NDR			NDR			NDR			NDR		
2-Chloronaphthalene	1000	ug/l	NDR			NDR			< 11	U	11	NDR			NDR			NDR			NDR			NDR		
2-Chlorophenol	81	ug/l	NDR			NDR			< 11	U	11	NDR			NDR			NDR			NDR			NDR		
2-Methylnaphthalene	NS	ug/l	NDR			NDR			< 11	U	11	NDR			NDR			NDR			NDR			NDR		
2-Methylphenol	NS	ug/l	NDR			NDR			< 11	U	11	NDR			NDR			NDR			NDR			NDR		
2-Nitroaniline	NS	ug/l	NDR			NDR			< 27	U	27	NDR			NDR			NDR			NDR			NDR		
2-Nitrophenol	NS	ug/l	NDR			NDR			< 11	U	11	NDR			NDR			NDR			NDR			NDR		
3,3'-Dichlorobenzidine	0.021	ug/l	NDR			NDR			< 11	U	11	NDR			NDR			NDR			NDR			NDR		
3-Nitroaniline	NS	ug/l	NDR			NDR			< 27	U	27	NDR			NDR			NDR			NDR			NDR		
4,6-Dinitro-2-methylphenol	13	ug/l	NDR			NDR			< 27	U	27	NDR			NDR			NDR			NDR			NDR		
4-Bromophenyl Phenyl Ether	NS	ug/l	NDR			NDR			< 11	U	11	NDR			NDR			NDR			NDR			NDR		
4-Chloro-3-methylphenol	NS	ug/l	NDR			NDR			< 11	U	11	NDR			NDR			NDR			NDR			NDR		
4-Chloroaniline	NS	ug/l	NDR			NDR			< 11	U	11	NDR			NDR			NDR			NDR			NDR		
4-Chlorophenyl-phenylether	NS	ug/l	NDR			NDR			< 11	U	11	NDR			NDR			NDR			NDR			NDR		
4-Methylphenol	NS	ug/l	NDR			NDR			< 11	U	11	NDR			NDR			NDR			NDR			NDR		
4-Nitroaniline	NS	ug/l	NDR			NDR			< 27	U	27	NDR			NDR			NDR			NDR			NDR		
4-Nitrophenol	NS	ug/l	NDR			NDR			< 27	U	27	NDR			NDR			NDR			NDR			NDR		
Acenaphthene	670	ug/l	NDR			NDR			< 11	U	11	NDR			NDR			NDR			NDR			NDR		
Acenaphthylene	NS	ug/l	NDR			NDR			< 11	U	11	NDR			NDR			NDR			NDR			NDR		
Acetophenone	NS	ug/l	NDR			NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Anthracene	8300	ug/l	NDR			NDR			< 11	U	11	NDR			NDR			NDR			NDR			NDR		
Atrazine	NS	ug/l	NDR			NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Benzaldehyde	NS	ug/l	NDR			NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Benzo[a]anthracene	0.038	ug/l	NDR			NDR			< 11	U	11	NDR			NDR			NDR			NDR			NDR		
Benzo[a]pyrene	0.0038	ug/l	NDR			NDR			< 11	U	11	NDR			NDR			NDR			NDR			NDR		
Benzo[b]fluoranthene	0.038	ug/l	NDR			NDR			< 11	U	11	NDR			NDR			NDR			NDR			NDR		
Benzo[g,h,i]perylene	NS	ug/l	NDR			NDR			< 11	U	11	NDR			NDR			NDR			NDR			NDR		
Benzo[k]fluoranthene	0.38	ug/l	NDR			NDR			< 11	U	11	NDR			NDR			NDR			NDR			NDR		
Biphenyl	NS	ug/l	NDR			NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Bis(2-chloroethoxy)methane	NS	ug/l	NDR			NDR			< 11	U	11	NDR			NDR			NDR			NDR			NDR		
Bis(2-chloroethyl) Ether	0.03	ug/l	NDR			NDR			< 11	U	11	NDR			NDR			NDR			NDR			NDR		
Bis(2-chloroisopropyl) Ether	1400	ug/l	NDR			NDR			< 11	U	11	NDR			NDR			NDR			NDR			NDR		
Bis(2-ethylhexyl) Phthalate	1.2	ug/l	NDR			NDR			< 11	U	11	NDR			NDR			NDR			NDR			NDR		
Butylbenzyl Phthalate	150	ug/l	NDR			NDR			< 11	U	11	NDR			NDR			NDR			NDR			NDR		
Caprolactum	NS	ug/l	NDR			NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Carbazole	NS	ug/l	NDR			NDR			< 11	U	11	NDR			NDR			NDR			NDR			NDR		
Chrysene	3.8	ug/l	NDR			NDR			< 11	U	11	NDR			NDR			NDR			NDR			NDR		
Dibenzo[a,h]anthracene	0.0038	ug/l	NDR			NDR			< 11	U	11	NDR			NDR			NDR			NDR			NDR		
Dibenzofuran	NS	ug/l	NDR			NDR			< 11	U	11	NDR			NDR			NDR			NDR			NDR		
Diethyl Phthalate	17000	ug/l	NDR			NDR			< 11	U	11	NDR			NDR			NDR			NDR			NDR		
Dimethyl Phthalate	NS	ug/l	NDR			NDR			< 11	U	11	NDR			NDR			NDR			NDR			NDR		
Di-n-Butyl Phthalate	2000	ug/l	NDR			NDR			< 11	U	11	NDR			NDR			NDR			NDR			NDR		
Di-n-octyl Phthalate	NS	ug/l	NDR			NDR			< 11	U	11	NDR			NDR			NDR			NDR			NDR		
Fluoranthene	130	ug/l	NDR			NDR			< 11	U	11	NDR			NDR			NDR			NDR			NDR		
Fluorene	1100	ug/l	NDR			NDR			< 11	U	11	NDR			NDR			NDR			NDR			NDR		
Hexachlorobenzene	0.00028	ug/l	NDR			NDR			< 11	U	11	NDR			NDR			NDR			NDR			NDR		
Hexachlorobutadiene	0.44	ug/l	NDR			NDR			< 11	U	11	NDR			NDR			NDR			NDR			NDR		
Hexachlorocyclopentadiene	40	ug/l	NDR			NDR			< 11	U	11	NDR			NDR			NDR			NDR			NDR		
Hexachloroethane	1.4	ug/l	NDR			NDR			< 11	U	11	NDR			NDR			NDR			NDR			NDR		
Indeno[1,2,3-cd]pyrene	0.038	ug/l	NDR			NDR			< 11	U	11	NDR			NDR			NDR			NDR			NDR		
Isophorone	35	ug/l	NDR			NDR			< 11	U	11	NDR			NDR			NDR			NDR			NDR		
Naphthalene	NS	ug/l	NDR			NDR			< 11	U	11	NDR			NDR			NDR			NDR			NDR		
Nitrobenzene	17	ug/l	NDR			NDR			< 11	U	11	NDR			NDR			NDR			NDR			NDR		
N-Nitroso-di-n-propylamine	0.005	ug/l	NDR			NDR			< 11	U	11	NDR			NDR			NDR			NDR			NDR		
N-Nitrosodiphenylamine	3.3	ug/l	NDR			NDR			< 11	U	11	NDR			NDR			NDR			NDR			NDR		
Pentachlorophenol	0.27	ug/l	NDR			NDR			< 27	U	27	NDR			NDR			NDR			NDR			NDR		
Phenanthrene	NS	ug/l	NDR			NDR			< 11	U	11	NDR			NDR			NDR			NDR			NDR		
Phenol	10000	ug/l	NDR			NDR			< 11	U	11	NDR			NDR			NDR			NDR			NDR		

TABLE A2
Surface Water Samples
Validated Analytical Data
Carlstadt

		Sample ID	SW-4			SW-4			SW-4			SW-4			SW-4			SW-4			SW-4			SW-4		
		Sample Date	11/13/2007			6/2/2008			12/3/2008			4/2/2009			7/10/2009			7/10/2009			10/22/2009			10/22/2009		
		N=Normal, FD=Field Duplicate	N			N			N			N			FD			N			FD			N		
Parameter	NJDEP SWQS*	Unit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit
Pyrene	830	ug/l	NDR			NDR			< 11	U	11	NDR			NDR			NDR			NDR			NDR		
Volatile Organic Compounds																										
1,1,1-Trichloroethane	120	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,1,2,2-Tetrachloroethane	4.7	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,1,2-Trichloroethane	13	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,1-Dichloroethane	NS	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	0.19	J	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,1-Dichloroethene	4.7	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,2,3-Trichlorobenzene	NS	ug/l	NDR			NDR			NDR			NDR			NDR			NDR			NDR			NDR		
1,2,4-Trichlorobenzene	21	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,2-Dibromo-3-chloropropane	NS	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,2-Dibromoethane	NS	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,2-Dichlorobenzene	2000	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,2-Dichloroethane	0.29	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	***0.94***		0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,2-Dichloropropane	0.5	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,3-Dichlorobenzene	2200	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,4-Dichlorobenzene	550	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
2-Butanone	NS	ug/l	< 5	U	5	< 5	U	5	3.2	J	5	2.9	J	5	< 5	U	5	< 5	U	5	< 5	U	5	< 5	U	5
2-Hexanone	NS	ug/l	< 5	U	5	< 5	U	5	< 5	U	5	< 5	U	5	< 5	U	5	< 5	U	5	< 5	U	5	< 5	U	5
4-Methyl-2-pentanone	NS	ug/l	< 5	U	5	< 5	U	5	< 5	U	5	< 5	U	5	< 5	U	5	< 5	U	5	< 5	U	5	< 5	U	5
Acetone	NS	ug/l	< 10	U	10	8.6		5	< 7.6	U	7.6	17		5	17		5	16		5	< 5	U	5	< 5	U	5
Benzene	0.15	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	0.12	J	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Bromochloromethane	NS	ug/l	NDR			NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Bromodichloromethane	0.55	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Bromoform	4.3	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Bromomethane	47	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Carbon Disulfide	NS	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	0.14	J	0.5	0.18	J	0.5	0.15	J	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Carbon Tetrachloride	0.33	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Chlorobenzene	210	ug/l	< 0.5	U	0.5	0.14	J	0.5	1.6		0.5	0.15	J	0.5	< 0.5	U	0.5	< 0.5	U	0.5	0.46	J	0.5	0.5		0.5
Chloroethane	NS	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Chloroform	68	ug/l	< 0.5	U	0.5	0.23	J	0.5	0.28	J	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	0.11	J	0.5	0.11	J	0.5
Chloromethane	NS	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
cis-1,2-Dichloroethene	NS	ug/l	0.43	J	0.5	0.14	J	0.5	0.95		0.5	0.21	J	0.5	0.13	J	0.5	0.13	J	0.5	0.66		0.5	0.69		0.5
cis-1,3-Dichloropropene	0.34	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Cyclohexane	NS	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Dibromochloromethane	0.4	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Dichlorodifluoromethane	NS	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Ethylbenzene	530	ug/l	< 0.5	U	0.5	0.1	J	0.5	0.16	J	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Freon 113	NS	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Isopropylbenzene	NS	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
m,p-Xylenes	NS	ug/l	NDR			NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Methyl Acetate	NS	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Methyl Cyclohexane	NS	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Methyl tert-Butyl Ether	70	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Methylene Chloride	2.5	ug/l	< 0.51	U	0.51	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
o-Xylene	NS	ug/l	NDR			NDR			NDR			NDR			NDR			NDR			NDR			NDR		
Styrene	NS	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Tetrachloroethene	0.34	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	***0.83***		0.5	< 0.5	U	0.5	< 0.5	U	0.5	0.15	J	0.5	0.15	J	0.5
Toluene	1300	ug/l	0.18	J	0.5	0.56		0.5	0.65		0.5	0.17	J	0.5	< 0.5	U	0.5	< 0.5	U	0.5	0.17	J	0.5	0.18	J	0.5
trans-1,2-Dichloroethene	590	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
trans-1,3-Dichloropropene	0.34	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Trichloroethene	1	ug/l	0.1	J	0.5	0.16	J	0.5	< 0.5	U	0.5	0.11	J	0.5	< 0.5	U	0.5	< 0.5	U	0.5	0.17	J	0.5	0.18	J	0.5
Trichlorofluoromethane	NS	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Vinyl Chloride	0.082	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	***0.78***		0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Xylenes, Total	NS	ug/l	< 1.5	U	1.5	0.56	J	1.5	0.5	J	1.5	< 1.5	U	1.5	< 1.5	U	1.5	< 1.5	U	1.5	< 1.5	U	1.5	< 1.5	U	1.5

TABLE A2
Surface Water Samples
Validated Analytical Data
Carlstadt

			Sample ID Sample Date N=Normal, FD=Field Duplicate	SW-4 12/21/2009 N	
Parameter	NJDEP SWQS*	Unit	Result	Qualifier	ReptLimit
Inorganics					
Aluminum	NS	ug/l	364		200
Antimony	5.6	ug/l	< 2	U	2
Arsenic	0.017	ug/l	***2.2***		1
Barium	2000	ug/l	65.1	J	10
Beryllium	6	ug/l	< 1	U	1
Cadmium	3.4	ug/l	< 1	U	1
Calcium	NS	ug/l	84000		5000
Chromium	92	ug/l	5.4	J	2
Cobalt	NS	ug/l	< 1	U	1
Copper	1300	ug/l	18	J	2
Iron	NS	ug/l	697		100
Lead	5	ug/l	3.2	J	1
Magnesium	NS	ug/l	63200		5000
Manganese	NS	ug/l	424		1
Mercury	0.05	ug/l	***0.39***		0.2
Nickel	500	ug/l	5		1
Potassium	NS	ug/l	29200	J	5000
Selenium	170	ug/l	4.8	J	5
Silver	170	ug/l	< 1	U	1
Sodium	NS	ug/l	523000		5000
Thallium	0.24	ug/l	< 1	U	1
Vanadium	NS	ug/l	< 5	U	5
Zinc	7400	ug/l	52.2	J	2
PCBs					
Aroclor 1016	0.000064	ug/l	< 1	U	1
Aroclor 1221	0.000064	ug/l	< 1	U	1
Aroclor 1232	0.000064	ug/l	< 1	U	1
Aroclor 1242	0.000064	ug/l	< 1	U	1
Aroclor 1248	0.000064	ug/l	< 1	U	1
Aroclor 1254	0.000064	ug/l	< 1	U	1
Aroclor 1260	0.000064	ug/l	< 1	U	1
Aroclor 1262	0.000064	ug/l	< 1	U	1
Aroclor 1268	0.000064	ug/l	< 1	U	1
Pesticides					
4,4-DDD	0.00031	ug/l	< 0.1	U	0.1
4,4-DDE	0.00022	ug/l	< 0.1	U	0.1
4,4-DDT	0.00022	ug/l	***0.037***	J	0.1
Aldrin	0.000049	ug/l	< 0.05	U	0.05
alpha-BHC	0.0026	ug/l	< 0.05	U	0.05
alpha-Chlordane	NS	ug/l	< 0.05	U	0.05
alpha-Endosulfan	62	ug/l	< 0.05	U	0.05
beta-BHC	0.0091	ug/l	< 0.05	U	0.05
beta-Endosulfan	62	ug/l	< 0.1	U	0.1
delta-BHC	NS	ug/l	< 0.05	U	0.05
Dieldrin	0.000052	ug/l	< 0.1	U	0.1
Endosulfan Sulfate	62	ug/l	< 0.1	U	0.1
Endrin	0.059	ug/l	< 0.1	U	0.1
Endrin Aldehyde	0.059	ug/l	< 0.1	U	0.1
Endrin Ketone	NS	ug/l	< 0.1	U	0.1
gamma-BHC	0.98	ug/l	< 0.05	U	0.05
gamma-Chlordane	NS	ug/l	NDR		
Heptachlor	0.000079	ug/l	< 0.05	U	0.05
Heptachlor Epoxide	0.000039	ug/l	< 0.05	U	0.05
Methoxychlor	40	ug/l	< 0.5	U	0.5
Toxaphene	0.00028	ug/l	< 5	U	5
trans-Chlordane	NS	ug/l	< 0.05	U	0.05

Golder Associates
R2-0001324

TABLE A2
Surface Water Samples
Validated Analytical Data
Carlstadt

		Sample ID Sample Date N=Normal, FD=Field Duplicate	SW-4 12/21/2009 N		
Parameter	NJDEP SWQS*	Unit	Result	Qualifier	ReptLimit
Semivolatile Organic Compounds					
1,2,4,5-Tetrachlorobenzene	0.97	ug/l	< 5	U	5
2,3,4,6-Tetrachlorophenol	NS	ug/l	< 5	U	5
2,4,5-Trichlorophenol	1800	ug/l	< 5	U	5
2,4,6-Trichlorophenol	0.58	ug/l	< 5	U	5
2,4-Dichlorophenol	77	ug/l	< 5	U	5
2,4-Dimethylphenol	380	ug/l	< 5	U	5
2,4-Dinitrophenol	69	ug/l	< 10	U	10
2,4-Dinitrotoluene	0.11	ug/l	< 5	U	5
2,6-Dinitrotoluene	NS	ug/l	< 5	U	5
2-Chloronaphthalene	1000	ug/l	< 5	U	5
2-Chlorophenol	81	ug/l	< 5	U	5
2-Methylnaphthalene	NS	ug/l	< 5	U	5
2-Methylphenol	NS	ug/l	< 5	U	5
2-Nitroaniline	NS	ug/l	< 10	U	10
2-Nitrophenol	NS	ug/l	< 5	U	5
3,3'-Dichlorobenzidine	0.021	ug/l	< 5	U	5
3-Nitroaniline	NS	ug/l	< 10	U	10
4,6-Dinitro-2-methylphenol	13	ug/l	< 10	U	10
4-Bromophenyl Phenyl Ether	NS	ug/l	< 5	U	5
4-Chloro-3-methylphenol	NS	ug/l	< 5	U	5
4-Chloroaniline	NS	ug/l	< 5	U	5
4-Chlorophenyl-phenylether	NS	ug/l	< 5	U	5
4-Methylphenol	NS	ug/l	< 5	U	5
4-Nitroaniline	NS	ug/l	< 10	U	10
4-Nitrophenol	NS	ug/l	< 10	U	10
Acenaphthene	670	ug/l	< 5	U	5
Acenaphthylene	NS	ug/l	< 5	U	5
Acetophenone	NS	ug/l	< 5	U	5
Anthracene	8300	ug/l	< 5	U	5
Atrazine	NS	ug/l	< 5	U	5
Benzaldehyde	NS	ug/l	< 5	U	5
Benzo[a]anthracene	0.038	ug/l	< 5	U	5
Benzo[a]pyrene	0.0038	ug/l	< 5	U	5
Benzo[b]fluoranthene	0.038	ug/l	< 5	U	5
Benzo[g,h,i]perylene	NS	ug/l	< 5	U	5
Benzo[k]fluoranthene	0.38	ug/l	< 5	U	5
Biphenyl	NS	ug/l	< 5	U	5
Bis(2-chloroethoxy)methane	NS	ug/l	< 5	U	5
Bis(2-chloroethyl) Ether	0.03	ug/l	< 5	U	5
Bis(2-chloroisopropyl) Ether	1400	ug/l	< 5	U	5
Bis(2-ethylhexyl) Phthalate	1.2	ug/l	< 5	U	5
Butylbenzyl Phthalate	150	ug/l	< 5	U	5
Caprolactum	NS	ug/l	< 5	U	5
Carbazole	NS	ug/l	< 5	U	5
Chrysene	3.8	ug/l	< 5	U	5
Dibenzo[a,h]anthracene	0.0038	ug/l	< 5	U	5
Dibenzofuran	NS	ug/l	< 5	U	5
Diethyl Phthalate	17000	ug/l	< 5	U	5
Dimethyl Phthalate	NS	ug/l	< 5	U	5
Di-n-Butyl Phthalate	2000	ug/l	< 5	U	5
Di-n-octyl Phthalate	NS	ug/l	< 5	U	5
Fluoranthene	130	ug/l	< 5	U	5
Fluorene	1100	ug/l	< 5	U	5
Hexachlorobenzene	0.00028	ug/l	< 5	U	5
Hexachlorobutadiene	0.44	ug/l	< 5	U	5
Hexachlorocyclopentadiene	40	ug/l	< 5	U	5
Hexachloroethane	1.4	ug/l	< 5	U	5
Indeno[1,2,3-cd]pyrene	0.038	ug/l	< 5	U	5
Isophorone	35	ug/l	< 5	U	5
Naphthalene	NS	ug/l	< 5	U	5
Nitrobenzene	17	ug/l	< 5	U	5
N-Nitroso-di-n-propylamine	0.005	ug/l	< 5	U	5
N-Nitrosodiphenylamine	3.3	ug/l	< 5	U	5
Pentachlorophenol	0.27	ug/l	< 10	U	10
Phenanthrene	NS	ug/l	< 5	U	5
Phenol	10000	ug/l	< 5	U	5

TABLE A2
Surface Water Samples
Validated Analytical Data
Carlstadt

		Sample ID Sample Date N=Normal, FD=Field Duplicate	SW-4 12/21/2009 N		
Parameter	NJDEP SWQS*	Unit	Result	Qualifier	ReptLimit
Pyrene	830	ug/l	< 5	U	5
Volatile Organic Compounds					
1,1,1-Trichloroethane	120	ug/l	< 0.5	U	0.5
1,1,2,2-Tetrachloroethane	4.7	ug/l	< 0.5	U	0.5
1,1,2-Trichloroethane	13	ug/l	0.16	J	0.5
1,1-Dichloroethane	NS	ug/l	< 0.5	U	0.5
1,1-Dichloroethene	4.7	ug/l	< 0.5	U	0.5
1,2,3-Trichlorobenzene	NS	ug/l	< 0.5	U	0.5
1,2,4-Trichlorobenzene	21	ug/l	< 0.5	U	0.5
1,2-Dibromo-3-chloropropane	NS	ug/l	< 0.5	U	0.5
1,2-Dibromoethane	NS	ug/l	< 0.5	U	0.5
1,2-Dichlorobenzene	2000	ug/l	< 0.5	U	0.5
1,2-Dichloroethane	0.29	ug/l	< 0.5	U	0.5
1,2-Dichloropropane	0.5	ug/l	< 0.5	U	0.5
1,3-Dichlorobenzene	2200	ug/l	< 0.5	U	0.5
1,4-Dichlorobenzene	550	ug/l	< 0.5	U	0.5
2-Butanone	NS	ug/l	< 5	U	5
2-Hexanone	NS	ug/l	< 5	U	5
4-Methyl-2-pentanone	NS	ug/l	< 5	U	5
Acetone	NS	ug/l	< 6.9	U	6.9
Benzene	0.15	ug/l	< 0.5	U	0.5
Bromochloromethane	NS	ug/l	< 0.5	U	0.5
Bromodichloromethane	0.55	ug/l	0.24	J	0.5
Bromoform	4.3	ug/l	< 0.5	U	0.5
Bromomethane	47	ug/l	< 0.5	U	0.5
Carbon Disulfide	NS	ug/l	< 0.5	U	0.5
Carbon Tetrachloride	0.33	ug/l	< 0.5	U	0.5
Chlorobenzene	210	ug/l	< 0.5	U	0.5
Chloroethane	NS	ug/l	< 0.5	U	0.5
Chloroform	68	ug/l	< 0.5	U	0.5
Chloromethane	NS	ug/l	< 0.5	U	0.5
cis-1,2-Dichloroethene	NS	ug/l	2.4		0.5
cis-1,3-Dichloropropene	0.34	ug/l	< 0.5	U	0.5
Cyclohexane	NS	ug/l	< 0.5	U	0.5
Dibromochloromethane	0.4	ug/l	< 0.5	U	0.5
Dichlorodifluoromethane	NS	ug/l	< 0.5	U	0.5
Ethylbenzene	530	ug/l	< 0.5	U	0.5
Freon 113	NS	ug/l	< 0.5	U	0.5
Isopropylbenzene	NS	ug/l	< 0.5	U	0.5
m,p-Xylenes	NS	ug/l	< 0.5	U	0.5
Methyl Acetate	NS	ug/l	< 0.5	U	0.5
Methyl Cyclohexane	NS	ug/l	< 0.5	U	0.5
Methyl tert-Butyl Ether	70	ug/l	< 0.5	U	0.5
Methylene Chloride	2.5	ug/l	< 0.5	U	0.5
o-Xylene	NS	ug/l	< 0.5	U	0.5
Styrene	NS	ug/l	< 0.5	U	0.5
Tetrachloroethene	0.34	ug/l	***0.53***		0.5
Toluene	1300	ug/l	0.11	J	0.5
trans-1,2-Dichloroethene	590	ug/l	< 0.5	U	0.5
trans-1,3-Dichloropropene	0.34	ug/l	< 0.5	U	0.5
Trichloroethene	1	ug/l	< 0.5	U	0.5
Trichlorofluoromethane	NS	ug/l	< 0.5	U	0.5
Vinyl Chloride	0.082	ug/l	< 0.5	U	0.5
Xylenes, Total	NS	ug/l	NDR		

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Groundwater Monitoring Well Samples
Validated Analytical Data
Carlstadt

Notes:
ug/l = micrograms per liter
Qualifier = Validated Qualifier
ReptLimit = Reporting Limit
NS - No Standard Available
Qualifier: J - Result or reporting limit is estimated.
U - Result was not detected at or above the method detection limit.
UJ - Detection limit is estimated.
R - Data is rejected.
* NJDEP GWQS: Higher of the Practical Quantitation Limit and Ground Water Quality Criterion (N.J.A.C. 7:9C) 11/2009, as well as Interim Groundwater Quality Critieria.
Results greater than the NJDEP GWQS are shown in ***bold/italics***

TABLE A3
Groundwater Monitoring Well Samples
Validated Analytical Data
Carlstadt

Sample ID			MW-11S			MW-12S			MW-8S			MW-9S			MW-5D			MW-5D			RMW-11D		
Sample Date			12/18/2009			12/18/2009			12/18/2009			12/17/2009			12/21/2009			12/21/2009			12/18/2009		
N=Normal, FD=Field Duplicate			N			N			N			N			FD			N			N		
Parameter	NJDEP GWQS*	Unit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit
Inorganics																							
Aluminum	200	ug/l	***9080***		200	***2910***		200	***4630***		200	***7730***		200	< 200	U	200	< 200	U	200	***267***	J	200
Antimony	6	ug/l	2.9	J	2	< 2	U	2	< 2	U	2	3.8	J	2	< 2	U	2	< 2	U	2	< 2	U	2
Arsenic	3	ug/l	***8.6***		1	0.85	J	1	***34***		1	***34.6***		1	1.1		1	0.87	J	1	0.24	J	1
Barium	6000	ug/l	113	J	10	52	J	10	280	J	10	701	J	10	23.4		10	24.7	J	10	30.8	J	10
Beryllium	1	ug/l	< 1	U	1	< 1	U	1	< 1	U	1	< 1	U	1	< 1	U	1	< 1	U	1	< 1	U	1
Cadmium	4	ug/l	< 1	U	1	< 1	U	1	< 1	U	1	***11.2***		1	0.16	J	1	< 1	U	1	< 1	U	1
Calcium	NS	ug/l	60700		5000	55200		5000	78600		5000	89800		5000	277000		5000	260000		5000	11900		5000
Chromium	70	ug/l	***566***	J	2	15.7	J	2	37.5	J	2	***91.6***	J	2	13		2	13.7	J	2	17.7	J	2
Cobalt	100	ug/l	4.8		1	2.2	J	1	2.7	J	1	10.8		1	0.34	J	1	< 1	U	1	5.9		1
Copper	1300	ug/l	34.8	J	2	35	J	2	250	J	2	971	J	2	1.8	J	2	< 2	U	2	4.5	J	2
Iron	300	ug/l	***8410***		100	***2580***		100	***13500***		100	***45700***		100	< 100	U	100	< 100	U	100	***599***		100
Lead	5	ug/l	***20.4***		1	***8.6***		1	***28.9***		1	***270***		1	0.28	J	1	< 1	U	1	1.5	J	1
Magnesium	NS	ug/l	9330		5000	9620		5000	22100		5000	26300		5000	16900		5000	16100		5000	300	J	5000
Manganese	50	ug/l	***183***		1	***58.4***		1	***2150***		1	***2850***		2	***105***		1	***111***		1	30		1
Mercury	2	ug/l	0.18	J	0.2	0.1	J	0.2	0.12	J	0.2	0.67		0.2	< 0.2	U	0.2	< 0.2	U	0.2	< 0.2	U	0.2
Nickel	100	ug/l	***142***		1	7.8		1	17.9		1	***114***		1	7.5		1	7.5		1	15.5		1
Potassium	NS	ug/l	2790	J	5000	3180	J	5000	15400	J	5000	11200	J	5000	< 5000	U	5000	1630	J	5000	14300	J	5000
Selenium	40	ug/l	0.63	J	5	0.29	J	5	3.5	J	5	3.4	J	5	2.7	J	5	2.3	J	5	< 5	U	5
Silver	40	ug/l	< 1	U	1	< 1	U	1	< 1	U	1	< 1	U	1	< 1	U	1	< 1	U	1	< 1	U	1
Sodium	50000	ug/l	42300		5000	4210	J	5000	***126000***		5000	***170000***		5000	***66700***		5000	***64100***		5000	24600		5000
Thallium	2	ug/l	< 1	U	1	< 1	U	1	< 1	U	1	< 1	U	1	< 1	U	1	< 1	U	1	< 1	U	1
Vanadium	NS	ug/l	1.3	J	5	7.5		5	9.7		5	41		5	0.48	J	5	< 5	U	5	8.5		5
Zinc	2000	ug/l	55.7	J	2	97	J	2	193	J	2	1790	J	2	7.4		2	6.3	J	2	30.8	J	2
PCBs																							
Aroclor 1016	0.5	ug/l	< 1	U	1	< 1	U	1	< 1	U	1	< 1	U	1	< 1	U	1	< 1	U	1	< 1	U	1
Aroclor 1221	0.5	ug/l	< 1	U	1	< 1	U	1	< 1	U	1	< 1	U	1	< 1	U	1	< 1	U	1	< 1	U	1
Aroclor 1232	0.5	ug/l	< 1	U	1	< 1	U	1	< 1	U	1	< 1	U	1	< 1	U	1	< 1	U	1	< 1	U	1
Aroclor 1242	0.5	ug/l	< 1	U	1	< 1	U	1	< 1	U	1	< 1	U	1	< 1	U	1	< 1	U	1	< 1	U	1
Aroclor 1248	0.5	ug/l	< 1	U	1	< 1	U	1	< 1	U	1	< 1	U	1	< 1	U	1	< 1	U	1	< 1	U	1
Aroclor 1254	0.5	ug/l	< 1	U	1	< 1	U	1	< 1	U	1	< 1	U	1	< 1	U	1	< 1	U	1	< 1	U	1
Aroclor 1260	0.5	ug/l	< 1	U	1	< 1	U	1	< 1	U	1	< 1	U	1	< 1	U	1	< 1	U	1	< 1	U	1
Aroclor 1262	0.5	ug/l	< 1	U	1	< 1	U	1	< 1	U	1	< 1	U	1	< 1	U	1	< 1	U	1	< 1	U	1
Aroclor 1268	0.5	ug/l	< 1	U	1	< 1	U	1	< 1	U	1	< 1	U	1	< 1	U	1	< 1	U	1	< 1	U	1
Pesticides																							
4,4-DDD	0.1	ug/l	< 0.1	U	0.1	< 0.1	U	0.1	< 0.1	U	0.1	< 0.1	U	0.1	< 0.1	U	0.1	< 0.1	U	0.1	< 0.1	U	0.1
4,4-DDE	0.1	ug/l	< 0.1	U	0.1	< 0.1	U	0.1	< 0.1	U	0.1	< 0.1	U	0.1	< 0.1	U	0.1	< 0.1	U	0.1	< 0.1	U	0.1
4,4-DDT	0.1	ug/l	< 0.1	U	0.1	< 0.1	U	0.1	< 0.1	U	0.1	< 0.1	U	0.1	< 0.1	U	0.1	< 0.1	U	0.1	< 0.1	U	0.1
Aldrin	0.04	ug/l	< 0.05	U	0.05	< 0.05	U	0.05	< 0.05	U	0.05	< 0.05	U	0.05	< 0.05	U	0.05	< 0.05	U	0.05	< 0.05	U	0.05
alpha-BHC	0.02	ug/l	< 0.05	U	0.05	< 0.05	U	0.05	< 0.05	U	0.05	< 0.05	U	0.05	< 0.05	U	0.05	< 0.05	U	0.05	< 0.05	U	0.05
alpha-Chlordane	NS	ug/l	< 0.05	U	0.05	< 0.05	U	0.05	< 0.05	U	0.05	< 0.05	U	0.05	< 0.05	U	0.05	< 0.05	U	0.05	< 0.05	U	0.05
alpha-Endosulfan	40	ug/l	< 0.05	U	0.05	< 0.05	U	0.05	< 0.05	U	0.05	< 0.05	U	0.05	< 0.05	U	0.05	< 0.05	U	0.05	< 0.05	U	0.05
beta-BHC	0.04	ug/l	< 0.05	U	0.05	< 0.05	U	0.05	< 0.05	U	0.05	< 0.05	U	0.05	< 0.05	U	0.05	< 0.05	U	0.05	< 0.05	U	0.05
beta-Endosulfan	40	ug/l	< 0.1	U	0.1	< 0.1	U	0.1	< 0.1	U	0.1	< 0.1	U	0.1	< 0.1	U	0.1	< 0.1	U	0.1	< 0.1	U	0.1
delta-BHC	NS	ug/l	< 0.05	U	0.05	< 0.05	U	0.05	< 0.05	U	0.05	< 0.05	U	0.05	< 0.05	U	0.05	< 0.05	U	0.05	< 0.05	U	0.05
Dieldrin	0.03	ug/l	< 0.1	U	0.1	< 0.1	U	0.1	< 0.1	U	0.1	< 0.1	U	0.1	< 0.1	U	0.1	< 0.1	U	0.1	< 0.1	U	0.1
Endosulfan Sulfate	40	ug/l	< 0.1	U	0.1	< 0.1	U	0.1	< 0.1	U	0.1	< 0.1	U	0.1	< 0.1	U	0.1	< 0.1	U	0.1	< 0.1	U	0.1
Endrin	2	ug/l	< 0.1	U	0.1	< 0.1	U	0.1	< 0.1	U	0.1	< 0.1	U	0.1	< 0.1	U	0.1	< 0.1	U	0.1	< 0.1	U	0.1
Endrin Aldehyde	NS	ug/l	< 0.1	U	0.1	< 0.1	U	0.1	< 0.1	U	0.1	< 0.1	U	0.1	< 0.1	U	0.1	< 0.1	U	0.1	< 0.1	U	0.1
Endrin Ketone	NS	ug/l	< 0.1	U	0.1	< 0.1	U	0.1	< 0.1	U	0.1	< 0.1	U	0.1	< 0.1	U	0.1	< 0.1	U	0.1	< 0.1	U	0.1
gamma-BHC	0.03	ug/l	< 0.05	U	0.05	< 0.05	U	0.05	< 0.05	U	0.05	< 0.05	U	0.05	< 0.05	U	0.05	< 0.05	U	0.05	< 0.05	U	0.05
Heptachlor	0.05	ug/l	< 0.05	U	0.05	< 0.05	U	0.05	< 0.05	U	0.05	< 0.05	U	0.05	< 0.05	U	0.05	< 0.05	U	0.05	< 0.05	U	0.05

Checked by: ELD Date: 4/27/2010

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TABLE A3
Groundwater Monitoring Well Samples
Validated Analytical Data
Carlstadt

			Sample ID	MW-11S			MW-12S			MW-8S			MW-9S			MW-5D			MW-5D			RMW-11D		
			Sample Date	12/18/2009			12/18/2009			12/18/2009			12/17/2009			12/21/2009			12/21/2009			12/18/2009		
			N=Normal, FD=Field Duplicate	N			N			N			N			FD			N			N		
Parameter	NJDEP GWQS*	Unit		Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit
Heptachlor Epoxide	0.2	ug/l		< 0.05	U	0.05	< 0.05	U	0.05	< 0.05	U	0.05	< 0.05	U	0.05	< 0.05	U	0.05	< 0.05	U	0.05	< 0.05	U	0.05
Methoxychlor	40	ug/l		< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Toxaphene	2	ug/l		< 5	U	5	< 5	U	5	< 5	U	5	< 5	U	5	< 5	U	5	< 5	U	5	< 5	U	5
trans-Chlordane	NS	ug/l		< 0.05	U	0.05	< 0.05	U	0.05	< 0.05	U	0.05	< 0.05	U	0.05	< 0.05	U	0.05	< 0.05	U	0.05	< 0.05	U	0.05
Semivolatile Organic Compounds																								
1,2,4,5-Tetrachlorobenzene	NS	ug/l		< 4.9	U	4.9	< 5.3	U	5.3	< 5	U	5	< 4.9	U	4.9	< 5	U	5	< 5	U	5	< 5	U	5
2,3,4,6-Tetrachlorophenol	200	ug/l		< 4.9	U	4.9	< 5.3	U	5.3	< 5	U	5	< 4.9	U	4.9	< 5	U	5	< 5	U	5	< 5	U	5
2,4,5-Trichlorophenol	700	ug/l		< 4.9	U	4.9	< 5.3	U	5.3	< 5	U	5	< 4.9	U	4.9	< 5	U	5	< 5	U	5	< 5	U	5
2,4,6-Trichlorophenol	20	ug/l		< 4.9	U	4.9	< 5.3	U	5.3	< 5	U	5	< 4.9	U	4.9	< 5	U	5	< 5	U	5	< 5	U	5
2,4-Dichlorophenol	20	ug/l		< 4.9	U	4.9	< 5.3	U	5.3	< 5	U	5	< 4.9	U	4.9	< 5	U	5	< 5	U	5	< 5	U	5
2,4-Dimethylphenol	100	ug/l		< 4.9	U	4.9	< 5.3	U	5.3	< 5	U	5	< 4.9	U	4.9	< 5	U	5	< 5	U	5	< 5	U	5
2,4-Dinitrophenol	40	ug/l		< 9.8	U	9.8	< 11	U	11	< 10	U	10	< 9.8	U	9.8	< 10	U	10	< 10	U	10	< 10	U	10
2,4-Dinitrotoluene	NS	ug/l		< 4.9	U	4.9	< 5.3	U	5.3	< 5	U	5	< 4.9	U	4.9	< 5	U	5	< 5	U	5	< 5	U	5
2,6-Dinitrotoluene	NS	ug/l		< 4.9	U	4.9	< 5.3	U	5.3	< 5	U	5	< 4.9	U	4.9	< 5	U	5	< 5	U	5	< 5	U	5
2-Chloronaphthalene	600	ug/l		< 4.9	U	4.9	< 5.3	U	5.3	< 5	U	5	< 4.9	U	4.9	< 5	U	5	< 5	U	5	< 5	U	5
2-Chlorophenol	40	ug/l		< 4.9	U	4.9	< 5.3	U	5.3	< 5	U	5	< 4.9	U	4.9	< 5	U	5	< 5	U	5	< 5	U	5
2-Methylnaphthalene	30	ug/l		< 4.9	U	4.9	< 5.3	U	5.3	< 5	U	5	5.1		4.9	< 5	U	5	< 5	U	5	< 5	U	5
2-Methylphenol	NS	ug/l		< 4.9	U	4.9	< 5.3	U	5.3	< 5	U	5	< 4.9	U	4.9	< 5	U	5	< 5	U	5	< 5	U	5
2-Nitroaniline	NS	ug/l		< 9.8	U	9.8	< 11	U	11	< 10	U	10	< 9.8	U	9.8	< 10	U	10	< 10	U	10	< 10	U	10
2-Nitrophenol	NS	ug/l		< 4.9	U	4.9	< 5.3	U	5.3	< 5	U	5	< 4.9	U	4.9	< 5	U	5	< 5	U	5	< 5	U	5
3,3'-Dichlorobenzidine	30	ug/l		< 4.9	U	4.9	< 5.3	U	5.3	< 5	R	5	< 4.9	R	4.9	< 5	U	5	< 5	U	5	< 5	U	5
3-Nitroaniline	NS	ug/l		< 9.8	U	9.8	< 11	U	11	< 10	U	10	< 9.8	U	9.8	< 10	U	10	< 10	U	10	< 10	U	10
4,6-Dinitro-2-methylphenol	1	ug/l		< 9.8	U	9.8	< 11	U	11	< 10	U	10	< 9.8	U	9.8	< 10	U	10	< 10	U	10	< 10	U	10
4-Bromophenyl Phenyl Ether	NS	ug/l		< 4.9	U	4.9	< 5.3	U	5.3	< 5	U	5	< 4.9	U	4.9	< 5	U	5	< 5	U	5	< 5	U	5
4-Chloro-3-methylphenol	100	ug/l		< 4.9	U	4.9	< 5.3	U	5.3	< 5	U	5	< 4.9	U	4.9	< 5	U	5	< 5	U	5	< 5	U	5
4-Chloroaniline	30	ug/l		< 4.9	U	4.9	< 5.3	U	5.3	< 5	R	5	< 4.9	R	4.9	< 5	U	5	< 5	U	5	< 5	U	5
4-Chlorophenyl-phenylether	NS	ug/l		< 4.9	U	4.9	< 5.3	U	5.3	< 5	U	5	< 4.9	U	4.9	< 5	U	5	< 5	U	5	< 5	U	5
4-Methylphenol	NS	ug/l		< 4.9	U	4.9	< 5.3	U	5.3	< 5	U	5	< 4.9	U	4.9	< 5	U	5	< 5	U	5	< 5	U	5
4-Nitroaniline	NS	ug/l		< 9.8	U	9.8	< 11	U	11	< 10	U	10	< 9.8	U	9.8	< 10	U	10	< 10	U	10	< 10	U	10
4-Nitrophenol	NS	ug/l		< 9.8	U	9.8	< 11	U	11	< 10	U	10	< 9.8	U	9.8	< 10	U	10	< 10	U	10	< 10	U	10
Acenaphthene	400	ug/l		< 4.9	U	4.9	< 5.3	U	5.3	< 5	U	5	11		4.9	< 5	U	5	< 5	U	5	< 5	U	5
Acenaphthylene	100	ug/l		< 4.9	U	4.9	< 5.3	U	5.3	< 5	U	5	< 4.9	U	4.9	< 5	U	5	< 5	U	5	< 5	U	5
Acetophenone	700	ug/l		< 4.9	U	4.9	< 5.3	U	5.3	< 5	U	5	< 4.9	U	4.9	< 5	U	5	< 5	U	5	< 5	U	5
Anthracene	2000	ug/l		< 4.9	U	4.9	< 5.3	U	5.3	< 5	U	5	< 4.9	U	4.9	< 5	U	5	< 5	U	5	< 5	U	5
Atrazine	3	ug/l		< 4.9	U	4.9	< 5.3	U	5.3	< 5	U	5	< 4.9	U	4.9	< 5	U	5	< 5	U	5	< 5	U	5
Benzaldehyde	NS	ug/l		< 4.9	U	4.9	< 5.3	U	5.3	< 5	U	5	< 4.9	U	4.9	< 5	U	5	< 5	U	5	< 5	U	5
Benzo[a]anthracene	0.1	ug/l		< 4.9	U	4.9	< 5.3	U	5.3	< 5	U	5	< 4.9	U	4.9	< 5	U	5	< 5	U	5	< 5	U	5
Benzo[a]pyrene	0.1	ug/l		< 4.9	U	4.9	< 5.3	U	5.3	< 5	U	5	< 4.9	U	4.9	< 5	U	5	< 5	U	5	< 5	U	5
Benzo[b]fluoranthene	0.2	ug/l		< 4.9	U	4.9	< 5.3	U	5.3	< 5	U	5	< 4.9	U	4.9	< 5	U	5	< 5	U	5	< 5	U	5
Benzo[g,h,i]perylene	100	ug/l		< 4.9	U	4.9	< 5.3	U	5.3	< 5	U	5	< 4.9	U	4.9	< 5	U	5	< 5	U	5	< 5	U	5
Benzo[k]fluoranthene	0.5	ug/l		< 4.9	U	4.9	< 5.3	U	5.3	< 5	U	5	< 4.9	U	4.9	< 5	U	5	< 5	U	5	< 5	U	5
Biphenyl	400	ug/l		< 4.9	U	4.9	< 5.3	U	5.3	< 5	U	5	< 4.9	U	4.9	< 5	U	5	< 5	U	5	< 5	U	5
Bis(2-chloroethoxy)methane	NS	ug/l		< 4.9	U	4.9	< 5.3	U	5.3	< 5	U	5	< 4.9	U	4.9	< 5	U	5	< 5	U	5	< 5	U	5
Bis(2-chloroethyl) Ether	7	ug/l		< 4.9	U	4.9	< 5.3	U	5.3	< 5	U	5	< 4.9	U	4.9	< 5	U	5	< 5	U	5	< 5	U	5
Bis(2-chloroisopropyl) Ether	300	ug/l		< 4.9	U	4.9	< 5.3	U	5.3	< 5	U	5	< 4.9	U	4.9	< 5	U	5	< 5	U	5	< 5	U	5
Bis(2-ethylhexyl) Phthalate	3	ug/l		< 4.9	U	4.9	< 5.3	U	5.3	< 5	U	5	***18***		4.9	< 5	U	5	< 5	U	5	< 5	U	5
Butylbenzyl Phthalate	100	ug/l		< 4.9	U	4.9	< 5.3	U	5.3	< 5	U	5	< 4.9	U	4.9	< 5	U	5	< 5	U	5	< 5	U	5
Caprolactum	5000	ug/l		< 4.9	U	4.9	< 5.3	U	5.3	< 5	U	5	< 4.9	U	4.9	< 5	U	5	< 5	U	5	< 5	U	5
Carbazole	NS	ug/l		< 4.9	U	4.9	< 5.3	U	5.3	< 5	U	5	< 4.9	U	4.9	< 5	U	5	< 5	U	5	< 5	U	5
Chrysene	5	ug/l		< 4.9	U	4.9	< 5.3	U	5.3	< 5	U	5	< 4.9	U	4.9	< 5	U	5	< 5	U	5	< 5	U	5
Dibenzo[a,h]anthracene	0.3	ug/l		< 4.9	U	4.9	< 5.3	U	5.3	< 5	U	5	< 4.9	U	4.9	< 5	U	5	< 5	U	5	< 5	U	5
Dibenzofuran	NS	ug/l		< 4.9	U	4.9	< 5.3	U	5.3	< 5	U	5	8.1		4.9	< 5	U	5	< 5	U	5	< 5	U	5

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TABLE A3
Groundwater Monitoring Well Samples
Validated Analytical Data
Carlstadt

			Sample ID	MW-11S			MW-12S			MW-8S			MW-9S			MW-5D			MW-5D			RMW-11D		
			Sample Date	12/18/2009			12/18/2009			12/18/2009			12/17/2009			12/21/2009			12/21/2009			12/18/2009		
			N=Normal, FD=Field Duplicate	N			N			N			N			FD			N			N		
Parameter	NJDEP GWQS*	Unit		Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit
Diethyl Phthalate	6000	ug/l		< 4.9	U	4.9	< 5.3	U	5.3	< 5	U	5	< 4.9	U	4.9	< 5	U	5	< 5	U	5	< 5	U	5
Dimethyl Phthalate	100	ug/l		< 4.9	U	4.9	< 5.3	U	5.3	< 5	U	5	< 4.9	U	4.9	< 5	U	5	< 5	U	5	< 5	U	5
Di-n-Butyl Phthalate	700	ug/l		< 4.9	U	4.9	< 5.3	U	5.3	< 5	U	5	< 4.9	U	4.9	< 5	U	5	< 5	U	5	< 5	U	5
Di-n-octyl Phthalate	100	ug/l		< 4.9	U	4.9	< 5.3	U	5.3	< 5	U	5	< 4.9	U	4.9	< 5	U	5	< 5	U	5	< 5	U	5
Fluoranthene	300	ug/l		< 4.9	U	4.9	< 5.3	U	5.3	< 5	U	5	2.5	J	4.9	< 5	U	5	< 5	U	5	< 5	U	5
Fluorene	300	ug/l		< 4.9	U	4.9	< 5.3	U	5.3	< 5	U	5	9.4		4.9	< 5	U	5	< 5	U	5	< 5	U	5
Hexachlorobenzene	0.02	ug/l		< 4.9	U	4.9	< 5.3	U	5.3	< 5	U	5	< 4.9	U	4.9	< 5	U	5	< 5	U	5	< 5	U	5
Hexachlorobutadiene	1	ug/l		< 4.9	U	4.9	< 5.3	U	5.3	< 5	U	5	< 4.9	U	4.9	< 5	U	5	< 5	U	5	< 5	U	5
Hexachlorocyclopentadiene	40	ug/l		< 4.9	U	4.9	< 5.3	U	5.3	< 5	R	5	< 4.9	R	4.9	< 5	U	5	< 5	U	5	< 5	U	5
Hexachloroethane	7	ug/l		< 4.9	U	4.9	< 5.3	U	5.3	< 5	U	5	< 4.9	U	4.9	< 5	U	5	< 5	U	5	< 5	U	5
Indeno[1,2,3-cd]pyrene	0.2	ug/l		< 4.9	U	4.9	< 5.3	U	5.3	< 5	U	5	< 4.9	U	4.9	< 5	U	5	< 5	U	5	< 5	U	5
Isophorone	40	ug/l		< 4.9	U	4.9	< 5.3	U	5.3	< 5	U	5	< 4.9	U	4.9	< 5	U	5	< 5	U	5	< 5	U	5
Naphthalene	300	ug/l		< 4.9	U	4.9	< 5.3	U	5.3	< 5	U	5	< 4.9	U	4.9	< 5	U	5	< 5	U	5	< 5	U	5
Nitrobenzene	6	ug/l		< 4.9	U	4.9	< 5.3	U	5.3	< 5	U	5	< 4.9	U	4.9	< 5	U	5	< 5	U	5	< 5	U	5
N-Nitroso-di-n-propylamine	10	ug/l		< 4.9	U	4.9	< 5.3	U	5.3	< 5	U	5	< 4.9	U	4.9	< 5	U	5	< 5	U	5	< 5	U	5
N-Nitrosodiphenylamine	10	ug/l		< 4.9	U	4.9	< 5.3	U	5.3	< 5	U	5	< 4.9	U	4.9	< 5	U	5	< 5	U	5	< 5	U	5
Pentachlorophenol	0.3	ug/l		< 9.8	U	9.8	< 11	U	11	< 10	U	10	< 9.8	U	9.8	< 10	U	10	< 10	U	10	< 10	U	10
Phenanthrene	100	ug/l		< 4.9	U	4.9	< 5.3	U	5.3	< 5	U	5	5.7		4.9	< 5	U	5	< 5	U	5	< 5	U	5
Phenol	2000	ug/l		< 4.9	U	4.9	< 5.3	U	5.3	< 5	U	5	< 4.9	U	4.9	< 5	U	5	< 5	U	5	< 5	U	5
Pyrene	200	ug/l		< 4.9	U	4.9	< 5.3	U	5.3	< 5	U	5	1.9	J	4.9	< 5	U	5	< 5	U	5	< 5	U	5
Volatile Organic Compounds																								
1,1,1-Trichloroethane	30	ug/l		< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	8.5		0.5	9.1		0.5	< 0.5	U	0.5
1,1,2,2-Tetrachloroethane	1	ug/l		< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,1,2-Trichloroethane	3	ug/l		< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	0.78		0.5	0.81		0.5	< 0.5	U	0.5
1,1-Dichloroethane	50	ug/l		< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	33	J	100	34	J	100	0.13	J	0.5
1,1-Dichloroethene	1	ug/l		< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	***200***		100	***180***		100	< 0.5	U	0.5
1,2,3-Trichlorobenzene	NS	ug/l		< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,2,4-Trichlorobenzene	9	ug/l		< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,2-Dibromo-3-chloropropane	0.02	ug/l		< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,2-Dibromoethane	0.03	ug/l		< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,2-Dichlorobenzene	600	ug/l		< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	2.7		0.5	2.7		0.5	< 0.5	U	0.5
1,2-Dichloroethane	2	ug/l		< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	***56***	J	0.5	***58***	J	0.5	0.65		0.5
1,2-Dichloropropane	1	ug/l		< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	0.95		0.5	0.96		0.5	< 0.5	U	0.5
1,3-Dichlorobenzene	600	ug/l		< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,4-Dichlorobenzene	75	ug/l		< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,4-Dioxane	10	ug/l		NDR			NDR			NDR			NDR			NDR			NDR			NDR		
2-Butanone	300	ug/l		< 5	U	5	< 5	U	5	< 5	U	5	< 5	U	5	< 5	U	5	< 5	U	5	< 5	U	5
2-Hexanone	300	ug/l		< 5	U	5	< 5	U	5	< 5	U	5	< 5	U	5	< 5	U	5	< 5	U	5	< 5	U	5
4-Methyl-2-pentanone	NS	ug/l		< 5	U	5	< 5	U	5	< 5	U	5	< 5	U	5	< 5	U	5	< 5	U	5	< 5	U	5
Acetone	6000	ug/l		< 5	U	5	< 5	U	5	< 19	U	19	< 18	U	18	< 5	U	5	< 5	U	5	< 5.8	U	5.8
Benzene	1	ug/l		< 0.5	U	0.5	< 0.5	U	0.5	0.26	J	0.5	< 0.5	U	0.5	***11***		0.5	***12***		0.5	< 0.5	U	0.5
Bromochloromethane	NS	ug/l		< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Bromodichloromethane	1	ug/l		< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Bromoform	4	ug/l		< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Bromomethane	10	ug/l		< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Carbon Disulfide	700	ug/l		< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Carbon Tetrachloride	1	ug/l		< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Chlorobenzene	50	ug/l		< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	16		0.5	16		0.5	< 0.5	U	0.5
Chloroethane	5	ug/l		< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Chloroform	70	ug/l		< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	***170***		100	***180***		100	< 0.5	U	0.5
Chloromethane	NS	ug/l		< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
cis-1,2-Dichloroethene	70	ug/l		< 0.5	U	0.5	< 0.5	U	0.5	0.15	J	0.5	0.1	J	0.5	***900***		100	***900***		100	0.76		0.5

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Golder Associates
R2-0001330

TABLE A3
Groundwater Monitoring Well Samples
Validated Analytical Data
Carlstadt

			Sample ID	MW-11S			MW-12S			MW-8S			MW-9S			MW-5D			MW-5D			RMW-11D		
			Sample Date	12/18/2009			12/18/2009			12/18/2009			12/17/2009			12/21/2009			12/21/2009			12/18/2009		
			N=Normal, FD=Field Duplicate	N			N			N			N			FD			N			N		
Parameter	NJDEP GWQS*	Unit		Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit
cis-1,3-Dichloropropene	1	ug/l		< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Cyclohexane	NS	ug/l		< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	0.73		0.5	0.77		0.5	< 0.5	U	0.5
Dibromochloromethane	1	ug/l		< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Dichlorodifluoromethane	1000	ug/l		< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Ethylbenzene	700	ug/l		< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	1.5		0.5	1.4		0.5	< 0.5	U	0.5
Freon 113	NS	ug/l		< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 100	U	100	58	J	0.5	< 0.5	U	0.5
Isopropylbenzene	700	ug/l		< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	0.39	J	0.5	0.39	J	0.5	< 0.5	U	0.5
m,p-Xylenes	NS	ug/l		< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	0.28	J	0.5	0.28	J	0.5	< 0.5	U	0.5
Methyl Acetate	7000	ug/l		< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Methyl Cyclohexane	NS	ug/l		< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	1		0.5	1		0.5	< 0.5	U	0.5
Methyl tert-Butyl Ether	70	ug/l		< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Methylene Chloride	3	ug/l		< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	0.17	J	0.5	0.18	J	0.5	< 0.5	U	0.5
o-Xylene	NS	ug/l		< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	4.5		0.5	4.4		0.5	< 0.5	U	0.5
Styrene	100	ug/l		< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Tetrachloroethene	1	ug/l		< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	***700***		100	***780***		100	***1.1***		0.5
Toluene	600	ug/l		< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	0.1	J	0.5	0.77		0.5	0.78		0.5	< 0.5	U	0.5
trans-1,2-Dichloroethene	100	ug/l		< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	3.7	J	0.5	4.8	J	0.5	< 0.5	U	0.5
trans-1,3-Dichloropropene	1	ug/l		< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Trichloroethene	1	ug/l		< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	***2200***		100	***2400***		100	***1.8***		0.5
Trichlorofluoromethane	2000	ug/l		< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	1.2		0.5	1.3		0.5	< 0.5	U	0.5
Vinyl Chloride	1	ug/l		< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5	***51***	J	0.5	***53***	J	0.5	< 0.5	U	0.5

Checked by: ELD Date: 4/27/2010

TABLE A3
Groundwater Monitoring Well Samples
Validated Analytical Data
Carlstadt

			Sample ID	RMW-12D			RMW-13D			RMW-8D		
			Sample Date	12/18/2009			12/17/2009			12/17/2009		
			N=Normal, FD=Field Duplicate	N			N			N		
Parameter	NJDEP GWQS*	Unit		Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit
Inorganics												
Aluminum	200	ug/l		***495***		200	***6730***		200	< 200	U	200
Antimony	6	ug/l		< 2	U	2	< 2	U	2	< 2	U	2
Arsenic	3	ug/l		0.53	J	1	2.8		1	2.3		1
Barium	6000	ug/l		31.6	J	10	93.1	J	10	32	J	10
Beryllium	1	ug/l		< 1	U	1	< 1	U	1	< 1	U	1
Cadmium	4	ug/l		< 1	U	1	1.9	J	1	< 1	U	1
Calcium	NS	ug/l		31200		5000	8350		5000	71600		5000
Chromium	70	ug/l		34.1	J	2	***74.4***	J	2	< 2	U	2
Cobalt	100	ug/l		1.3	J	1	6.4		1	< 1	U	1
Copper	1300	ug/l		18.1	J	2	77.7	J	2	2.2	J	2
Iron	300	ug/l		***1010***		100	***9990***		100	256		100
Lead	5	ug/l		2.4	J	1	***48.6***		1	< 1	U	1
Magnesium	NS	ug/l		3420	J	5000	5000		5000	162	J	5000
Manganese	50	ug/l		48.9		1	***172***		1	3.7		1
Mercury	2	ug/l		< 0.2	U	0.2	0.13	J	0.2	< 0.2	U	0.2
Nickel	100	ug/l		50.4		1	38.3		1	3.3	J	1
Potassium	NS	ug/l		6230	J	5000	2160	J	5000	4620	J	5000
Selenium	40	ug/l		< 5	U	5	0.34	J	5	< 5	U	5
Silver	40	ug/l		< 1	U	1	< 1	U	1	< 1	U	1
Sodium	50000	ug/l		6560		5000	12100		5000	***59900***		5000
Thallium	2	ug/l		< 1	U	1	< 1	U	1	< 1	U	1
Vanadium	NS	ug/l		< 5	U	5	18.7		5	43.1		5
Zinc	2000	ug/l		72.9	J	2	427	J	2	5.4	J	2
PCBs												
Aroclor 1016	0.5	ug/l		< 1	U	1	< 1	U	1	< 1	U	1
Aroclor 1221	0.5	ug/l		< 1	U	1	< 1	U	1	< 1	U	1
Aroclor 1232	0.5	ug/l		< 1	U	1	< 1	U	1	< 1	U	1
Aroclor 1242	0.5	ug/l		< 1	U	1	< 1	U	1	< 1	U	1
Aroclor 1248	0.5	ug/l		< 1	U	1	< 1	U	1	< 1	U	1
Aroclor 1254	0.5	ug/l		< 1	U	1	< 1	U	1	< 1	U	1
Aroclor 1260	0.5	ug/l		< 1	U	1	< 1	U	1	< 1	U	1
Aroclor 1262	0.5	ug/l		< 1	U	1	< 1	U	1	< 1	U	1
Aroclor 1268	0.5	ug/l		< 1	U	1	< 1	U	1	< 1	U	1
Pesticides												
4,4-DDD	0.1	ug/l		< 0.11	U	0.11	< 0.1	U	0.1	< 0.1	U	0.1
4,4-DDE	0.1	ug/l		< 0.11	U	0.11	< 0.1	U	0.1	< 0.1	U	0.1
4,4-DDT	0.1	ug/l		< 0.11	U	0.11	< 0.1	U	0.1	< 0.1	U	0.1
Aldrin	0.04	ug/l		< 0.054	U	0.054	< 0.05	U	0.05	< 0.05	U	0.05
alpha-BHC	0.02	ug/l		< 0.054	U	0.054	< 0.05	U	0.05	< 0.05	U	0.05
alpha-Chlordane	NS	ug/l		< 0.054	U	0.054	< 0.05	U	0.05	< 0.05	U	0.05
alpha-Endosulfan	40	ug/l		< 0.054	U	0.054	< 0.05	U	0.05	< 0.05	U	0.05
beta-BHC	0.04	ug/l		< 0.054	U	0.054	< 0.05	U	0.05	< 0.05	U	0.05
beta-Endosulfan	40	ug/l		< 0.11	U	0.11	< 0.1	U	0.1	< 0.1	U	0.1
delta-BHC	NS	ug/l		< 0.054	U	0.054	< 0.05	U	0.05	< 0.05	U	0.05
Dieldrin	0.03	ug/l		< 0.11	U	0.11	< 0.1	U	0.1	< 0.1	U	0.1
Endosulfan Sulfate	40	ug/l		< 0.11	U	0.11	< 0.1	U	0.1	< 0.1	U	0.1
Endrin	2	ug/l		< 0.11	U	0.11	< 0.1	U	0.1	< 0.1	U	0.1
Endrin Aldehyde	NS	ug/l		< 0.11	U	0.11	< 0.1	U	0.1	< 0.1	U	0.1
Endrin Ketone	NS	ug/l		< 0.11	U	0.11	< 0.1	U	0.1	< 0.1	U	0.1
gamma-BHC	0.03	ug/l		< 0.054	U	0.054	< 0.05	U	0.05	< 0.05	U	0.05
Heptachlor	0.05	ug/l		< 0.054	U	0.054	< 0.05	U	0.05	< 0.05	U	0.05

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TABLE A3
Groundwater Monitoring Well Samples
Validated Analytical Data
Carlstadt

			Sample ID	RMW-12D			RMW-13D			RMW-8D		
			Sample Date	12/18/2009			12/17/2009			12/17/2009		
			N=Normal, FD=Field Duplicate	N			N			N		
Parameter	NJDEP GWQS*	Unit		Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit
Heptachlor Epoxide	0.2	ug/l		< 0.054	U	0.054	< 0.05	U	0.05	< 0.05	U	0.05
Methoxychlor	40	ug/l		< 0.54	U	0.54	< 0.5	U	0.5	< 0.5	U	0.5
Toxaphene	2	ug/l		< 5.4	U	5.4	< 5	U	5	< 5	U	5
trans-Chlordane	NS	ug/l		< 0.054	U	0.054	< 0.05	U	0.05	< 0.05	U	0.05
Semivolatile Organic Compounds												
1,2,4,5-Tetrachlorobenzene	NS	ug/l		< 5.4	U	5.4	< 5.3	U	5.3	< 5	U	5
2,3,4,6-Tetrachlorophenol	200	ug/l		< 5.4	U	5.4	< 5.3	U	5.3	< 5	U	5
2,4,5-Trichlorophenol	700	ug/l		< 5.4	U	5.4	< 5.3	U	5.3	< 5	U	5
2,4,6-Trichlorophenol	20	ug/l		< 5.4	U	5.4	< 5.3	U	5.3	< 5	U	5
2,4-Dichlorophenol	20	ug/l		< 5.4	U	5.4	< 5.3	U	5.3	< 5	U	5
2,4-Dimethylphenol	100	ug/l		< 5.4	U	5.4	< 5.3	U	5.3	< 5	U	5
2,4-Dinitrophenol	40	ug/l		< 11	U	11	< 11	U	11	< 10	U	10
2,4-Dinitrotoluene	NS	ug/l		< 5.4	U	5.4	< 5.3	U	5.3	< 5	U	5
2,6-Dinitrotoluene	NS	ug/l		< 5.4	U	5.4	< 5.3	U	5.3	< 5	U	5
2-Chloronaphthalene	600	ug/l		< 5.4	U	5.4	< 5.3	U	5.3	< 5	U	5
2-Chlorophenol	40	ug/l		< 5.4	U	5.4	< 5.3	U	5.3	< 5	U	5
2-Methylnaphthalene	30	ug/l		< 5.4	U	5.4	< 5.3	U	5.3	< 5	U	5
2-Methylphenol	NS	ug/l		< 5.4	U	5.4	< 5.3	U	5.3	< 5	U	5
2-Nitroaniline	NS	ug/l		< 11	U	11	< 11	U	11	< 10	U	10
2-Nitrophenol	NS	ug/l		< 5.4	U	5.4	< 5.3	U	5.3	< 5	U	5
3,3'-Dichlorobenzidine	30	ug/l		< 5.4	U	5.4	< 5.3	U	5.3	< 5	U	5
3-Nitroaniline	NS	ug/l		< 11	U	11	< 11	U	11	< 10	U	10
4,6-Dinitro-2-methylphenol	1	ug/l		< 11	U	11	< 11	U	11	< 10	U	10
4-Bromophenyl Phenyl Ether	NS	ug/l		< 5.4	U	5.4	< 5.3	U	5.3	< 5	U	5
4-Chloro-3-methylphenol	100	ug/l		< 5.4	U	5.4	< 5.3	U	5.3	< 5	U	5
4-Chloroaniline	30	ug/l		< 5.4	U	5.4	< 5.3	U	5.3	< 5	U	5
4-Chlorophenyl-phenylether	NS	ug/l		< 5.4	U	5.4	< 5.3	U	5.3	< 5	U	5
4-Methylphenol	NS	ug/l		< 5.4	U	5.4	< 5.3	U	5.3	< 5	U	5
4-Nitroaniline	NS	ug/l		< 11	U	11	< 11	U	11	< 10	U	10
4-Nitrophenol	NS	ug/l		< 11	U	11	< 11	U	11	< 10	U	10
Acenaphthene	400	ug/l		< 5.4	U	5.4	< 5.3	U	5.3	< 5	U	5
Acenaphthylene	100	ug/l		< 5.4	U	5.4	< 5.3	U	5.3	< 5	U	5
Acetophenone	700	ug/l		< 5.4	U	5.4	< 5.3	U	5.3	< 5	U	5
Anthracene	2000	ug/l		< 5.4	U	5.4	< 5.3	U	5.3	< 5	U	5
Atrazine	3	ug/l		< 5.4	U	5.4	< 5.3	U	5.3	< 5	U	5
Benzaldehyde	NS	ug/l		< 5.4	U	5.4	< 5.3	U	5.3	< 5	U	5
Benzo[a]anthracene	0.1	ug/l		< 5.4	U	5.4	< 5.3	U	5.3	< 5	U	5
Benzo[a]pyrene	0.1	ug/l		< 5.4	U	5.4	< 5.3	U	5.3	< 5	U	5
Benzo[b]fluoranthene	0.2	ug/l		< 5.4	U	5.4	< 5.3	U	5.3	< 5	U	5
Benzo[g,h,i]perylene	100	ug/l		< 5.4	U	5.4	< 5.3	U	5.3	< 5	U	5
Benzo[k]fluoranthene	0.5	ug/l		< 5.4	U	5.4	< 5.3	U	5.3	< 5	U	5
Biphenyl	400	ug/l		< 5.4	U	5.4	< 5.3	U	5.3	< 5	U	5
Bis(2-chloroethoxy)methane	NS	ug/l		< 5.4	U	5.4	< 5.3	U	5.3	< 5	U	5
Bis(2-chloroethyl) Ether	7	ug/l		< 5.4	U	5.4	< 5.3	U	5.3	< 5	U	5
Bis(2-chloroisopropyl) Ether	300	ug/l		< 5.4	U	5.4	< 5.3	U	5.3	< 5	U	5
Bis(2-ethylhexyl) Phthalate	3	ug/l		< 5.4	U	5.4	< 5.3	U	5.3	< 5	U	5
Butylbenzyl Phthalate	100	ug/l		< 5.4	U	5.4	< 5.3	U	5.3	< 5	U	5
Caprolactum	5000	ug/l		< 5.4	U	5.4	< 5.3	U	5.3	< 5	U	5
Carbazole	NS	ug/l		< 5.4	U	5.4	< 5.3	U	5.3	< 5	U	5
Chrysene	5	ug/l		< 5.4	U	5.4	< 5.3	U	5.3	< 5	U	5
Dibenzo[a,h]anthracene	0.3	ug/l		< 5.4	U	5.4	< 5.3	U	5.3	< 5	U	5
Dibenzofuran	NS	ug/l		< 5.4	U	5.4	< 5.3	U	5.3	< 5	U	5

Checked by: ELD Date: 4/27/2010

Golder Associates
R2-0001333

TABLE A3
Groundwater Monitoring Well Samples
Validated Analytical Data
Carlstadt

			Sample ID	RMW-12D			RMW-13D			RMW-8D		
			Sample Date	12/18/2009			12/17/2009			12/17/2009		
			N=Normal, FD=Field Duplicate	N			N			N		
Parameter	NJDEP GWQS*	Unit		Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit
Diethyl Phthalate	6000	ug/l		< 5.4	U	5.4	< 5.3	U	5.3	< 5	U	5
Dimethyl Phthalate	100	ug/l		< 5.4	U	5.4	< 5.3	U	5.3	< 5	U	5
Di-n-Butyl Phthalate	700	ug/l		< 5.4	U	5.4	< 5.3	U	5.3	< 5	U	5
Di-n-octyl Phthalate	100	ug/l		< 5.4	U	5.4	< 5.3	U	5.3	< 5	U	5
Fluoranthene	300	ug/l		< 5.4	U	5.4	< 5.3	U	5.3	< 5	U	5
Fluorene	300	ug/l		< 5.4	U	5.4	< 5.3	U	5.3	< 5	U	5
Hexachlorobenzene	0.02	ug/l		< 5.4	U	5.4	< 5.3	U	5.3	< 5	U	5
Hexachlorobutadiene	1	ug/l		< 5.4	U	5.4	< 5.3	U	5.3	< 5	U	5
Hexachlorocyclopentadiene	40	ug/l		< 5.4	U	5.4	< 5.3	U	5.3	< 5	U	5
Hexachloroethane	7	ug/l		< 5.4	U	5.4	< 5.3	U	5.3	< 5	U	5
Indeno[1,2,3-cd]pyrene	0.2	ug/l		< 5.4	U	5.4	< 5.3	U	5.3	< 5	U	5
Isophorone	40	ug/l		< 5.4	U	5.4	< 5.3	U	5.3	< 5	U	5
Naphthalene	300	ug/l		< 5.4	U	5.4	< 5.3	U	5.3	< 5	U	5
Nitrobenzene	6	ug/l		< 5.4	U	5.4	< 5.3	U	5.3	< 5	U	5
N-Nitroso-di-n-propylamine	10	ug/l		< 5.4	U	5.4	< 5.3	U	5.3	< 5	U	5
N-Nitrosodiphenylamine	10	ug/l		< 5.4	U	5.4	< 5.3	U	5.3	< 5	U	5
Pentachlorophenol	0.3	ug/l		< 11	U	11	< 11	U	11	< 10	U	10
Phenanthrene	100	ug/l		< 5.4	U	5.4	< 5.3	U	5.3	< 5	U	5
Phenol	2000	ug/l		< 5.4	U	5.4	< 5.3	U	5.3	2.5	J	5
Pyrene	200	ug/l		< 5.4	U	5.4	< 5.3	U	5.3	< 5	U	5
Volatile Organic Compounds												
1,1,1-Trichloroethane	30	ug/l		< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,1,2,2-Tetrachloroethane	1	ug/l		< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,1,2-Trichloroethane	3	ug/l		< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,1-Dichloroethane	50	ug/l		< 0.5	U	0.5	0.26	J	0.5	< 0.5	U	0.5
1,1-Dichloroethene	1	ug/l		< 0.5	U	0.5	0.71		0.5	< 0.5	U	0.5
1,2,3-Trichlorobenzene	NS	ug/l		< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,2,4-Trichlorobenzene	9	ug/l		< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,2-Dibromo-3-chloropropane	0.02	ug/l		< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,2-Dibromoethane	0.03	ug/l		< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,2-Dichlorobenzene	600	ug/l		< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,2-Dichloroethane	2	ug/l		< 0.5	U	0.5	0.67		0.5	< 0.5	U	0.5
1,2-Dichloropropane	1	ug/l		< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,3-Dichlorobenzene	600	ug/l		< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,4-Dichlorobenzene	75	ug/l		< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
1,4-Dioxane	10	ug/l		NDR			NDR			NDR		
2-Butanone	300	ug/l		< 5	U	5	< 5	U	5	< 5	U	5
2-Hexanone	300	ug/l		< 5	U	5	< 5	U	5	< 5	U	5
4-Methyl-2-pentanone	NS	ug/l		< 5	U	5	< 5	U	5	< 5	U	5
Acetone	6000	ug/l		< 5	U	5	< 6.9	U	6.9	< 5	U	5
Benzene	1	ug/l		< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Bromochloromethane	NS	ug/l		< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Bromodichloromethane	1	ug/l		< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Bromoform	4	ug/l		< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Bromomethane	10	ug/l		< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Carbon Disulfide	700	ug/l		< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Carbon Tetrachloride	1	ug/l		< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Chlorobenzene	50	ug/l		< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Chloroethane	5	ug/l		< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Chloroform	70	ug/l		< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Chloromethane	NS	ug/l		< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
cis-1,2-Dichloroethene	70	ug/l		0.41	J	0.5	8.8		0.5	3.7		0.5

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TABLE A3
Groundwater Monitoring Well Samples
Validated Analytical Data
Carlstadt

		Sample ID	RMW-12D			RMW-13D			RMW-8D		
		Sample Date	12/18/2009			12/17/2009			12/17/2009		
		N=Normal, FD=Field Duplicate	N			N			N		
Parameter	NJDEP GWQS*	Unit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit	Result	Qualifier	ReptLimit
cis-1,3-Dichloropropene	1	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Cyclohexane	NS	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Dibromochloromethane	1	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Dichlorodifluoromethane	1000	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Ethylbenzene	700	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Freon 113	NS	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Isopropylbenzene	700	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
m,p-Xylenes	NS	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Methyl Acetate	7000	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Methyl Cyclohexane	NS	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Methyl tert-Butyl Ether	70	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Methylene Chloride	3	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
o-Xylene	NS	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Styrene	100	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Tetrachloroethene	1	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Toluene	600	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
trans-1,2-Dichloroethene	100	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
trans-1,3-Dichloropropene	1	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Trichloroethene	1	ug/l	0.27	J	0.5	***1.6***		0.5	0.83		0.5
Trichlorofluoromethane	2000	ug/l	< 0.5	U	0.5	< 0.5	U	0.5	< 0.5	U	0.5
Vinyl Chloride	1	ug/l	< 0.5	U	0.5	***1.1***		0.5	< 0.5	U	0.5

Checked by: ELD Date: 4/27/2010

APPENDIX B

DATA QUALITY NARRATIVE

Appendix B

Data Quality Assessment
Additional Groundwater Delineation and Groundwater and Surface Water Monitoring – 2009, 2010
216 Paterson Plank Road Site
Carlstadt, New Jersey

This report presents the findings of the data quality review performed on the analyses of environmental samples collected for the additional groundwater delineation and groundwater and surface water monitoring event (Event) conducted at the 216 Paterson Plan Road Site located in Carlstadt, New Jersey (Site). Groundwater monitoring well samples were collected between December 17, 2009 and December 21, 2009, and on May 6, 2010. Surface water samples were collected on April 2, July 10, October 22, and December 21, 2009. Groundwater and soil Profile samples were collected between December 14, 2009 and January 13, 2010. The chemical data for samples collected at the Site were assessed to identify quality issues which could affect the use of the data for decision making purposes.

For the surface water sampling events conducted in April, July and October, 2009, four (4) primary samples, as well as one (1) surface water field duplicate, one (1) surface water matrix spike/matrix spike duplicate (MS/MSD) samples, and one (1) surface water trip blank for quality control (QC) purposes, were collected for chemical analysis per event. The samples were analyzed for Target Compound List (TCL) Volatile Organic Compounds (VOCs). These samples were analyzed by the following United States Environmental Protection Agency (USEPA) method guidelines:

- TCL VOCs following USEPA Contract Laboratory Protocol (CLP) Statement of Work (SOW) for Low Concentration Organic Analysis, OLC03.2, (December 2000).

For the surface water sampling event in December, 2009, four (4) primary surface water samples were collected for chemical analysis. The updated USEPA CLP SOW was used for the analysis of the samples collected during this sampling event. These samples were analyzed for TCL VOCs, TCL Semivolatile Organic Compounds (SVOCs), TCL Pesticides, TCL Polychlorinated Biphenyls (PCBs) and Target Analyte List (TAL) Metals. These samples were analyzed by the following USEPA method guidelines:

- TCL VOCs, SVOCs, Pesticides, and PCBs following USEPA Contract Laboratory Program (CLP) Statement of Work (SOW) for Organic Analysis; Multi-Media, Multi-Concentration, SOM01.1 (May, 2005);
- Modifications Updating SOM01.1 to SOM01.2, October 5, 2006 (Updated February 12, 2007) Amended April 11, 2007;
- TAL Metals following USEPA SOW for Inorganic Analysis; Multi-Media, Multi-Concentration ILM05.3 (March, 2004); and,
- ILM05.3 to ILM05.4 Summary of Changes (December 1, 2006).

For the groundwater monitoring well sampling event conducted in December, 2009, 11 primary samples, one (1) field duplicate, one (1) rinsate blank and one (1) groundwater trip blank for QC purposes were collected for chemical analysis during the sampling event. These samples were analyzed for TCL VOCs, TCL SVOCs, TCL Pesticides, TCL PCBs and TAL Metals. The samples were analyzed by the following USEPA method guidelines:

- TCL VOCs (trace) and 1,4-dioxane (trace SIM) following USEPA CLP SOW for Organic Analysis; Multi-Media, Multi-Concentration, SOM01.1 (May, 2005); and,
- Modifications Updating SOM01.1 to SOM01.2, October 5, 2006 (Updated February 12, 2007) Amended April 11, 2007;
- TCL SVOCs, TCL Pesticides, and TCL PCBs following USEPA Contract Laboratory Program (CLP) Statement of Work (SOW) for Organic Analysis; Multi-Media, Multi-Concentration, SOM01.1 (May, 2005); and,
- Modifications Updating SOM01.1 to SOM01.2, October 5, 2006 (Updated February 12, 2007) Amended April 11, 2007;
- TAL Metals following USEPA SOW for Inorganic Analysis; Multi-Media, Multi-Concentration ILM05.3 (March, 2004); and,
- ILM05.3 to ILM05.4 Summary of Changes (December 1, 2006).

For the groundwater monitoring well sampling event conducted in May, 2010, one (1) primary sample, one (1) field duplicate, one (1) rinsate blank and one (1) groundwater trip blank for QC purposes were collected for chemical analysis during the sampling event. These samples were analyzed for TCL VOCs and 1,4-Dioxane. The samples were analyzed by the following USEPA method guidelines:

- TCL VOCs (trace) and 1,4-dioxane (trace SIM) following USEPA CLP SOW for Organic Analysis; Multi-Media, Multi-Concentration, SOM01.1 (May, 2005); and,
- Modifications Updating SOM01.1 to SOM01.2, October 5, 2006 (Updated February 12, 2007) Amended April 11, 2007.

For the groundwater Profile samples collected in December, 2009, and January, 2010, 20 primary groundwater samples and one (1) field duplicate sample, one (1) MS/MSD, one (1) rinsate blank and eight (8) groundwater trip blanks for QC purposes were collected for chemical analysis during the sampling event. All of these samples were analyzed for TCL VOCs and 1,4-Dioxane; select samples from this sampling set were also analyzed for TAL Metals and Natural Attenuation Parameters (NAPs) which include: Chloride, Nitrate, Nitrite, Sulfate, Alkalinity, Sulfide, and Total Organic Carbon (TOC). The samples were analyzed by the following USEPA method guidelines:

- TCL VOCs (trace) and 1,4-dioxane (trace SIM) following USEPA CLP SOW for Organic Analysis; Multi-Media, Multi-Concentration, SOM01.1 (May, 2005); and,
- Modifications Updating SOM01.1 to SOM01.2, October 5, 2006 (Updated February 12, 2007) Amended April 11, 2007;

- TAL Metals following USEPA SOW for Inorganic Analysis; Multi-Media, Multi-Concentration ILM05.3 (March, 2004); and,
- ILM05.3 to ILM05.4 Summary of Changes (December 1, 2006);
- Chloride, nitrate, nitrite and sulfate following USEPA Methods for Chemical Analysis of Water and Wastes (MCAWW[1]) Method 300.0;
- Alkalinity following USEPA MCAWW Method 310.2;
- Sulfide following Standard Method 4500S-2-F, Sulfide by Iodometry; and,
- TOC following either: Standard Method 5310B, Total Organic Carbon by High-Temperature Combustion or USEPA SW846[2] 9060 Total Organic Carbon (September, 1986).

Five (5) soil samples were also collected during the Profile sampling event and analyzed for TCL VOCs; one (1) additional primary soil sample, as well as one (1) field duplicate sample, one MS/MSD sample, one (1) rinsate blank and one (1) soil trip blank were collected and analyzed for TCL VOCs, TAL Metals, and NAPs which include: Alkalinity, Ferrous Iron and TOC. The Profile samples were analyzed by the following USEPA method guidelines:

- TCL VOCs (trace) and 1,4-dioxane (trace SIM) following USEPA CLP SOW for Organic Analysis; Multi-Media, Multi-Concentration, SOM01.1 (May, 2005); and,
- Modifications Updating SOM01.1 to SOM01.2, October 5, 2006 (Updated February 12, 2007) Amended April 11, 2007;
- TAL Metals following USEPA SOW for Inorganic Analysis; Multi-Media, Multi-Concentration ILM05.3 (March, 2004); and,
- ILM05.3 to ILM05.4 Summary of Changes (December 1, 2006);
- Ferrous Iron following Standard Method[3] 3500-FE-D Phenanthroline Method;
- Chloride, nitrate, nitrite and sulfate following USEPA Methods for Chemical Analysis of Water and Wastes (MCAWW[4]) Method 300.0;
- Alkalinity following USEPA MCAWW Method 310.2;
- Sulfide following Standard Method 4500S-2-F, Sulfide by Iodometry; and,
- TOC following either: Standard Method 5310B, Total Organic Carbon by High-Temperature Combustion or USEPA SW846 9060 Total Organic Carbon (September, 1986).

CompuChem of Cary, North Carolina, performed the analyses following all of the above USEPA, MCAWW and Standard Method guidelines.

[1] USEPA, 1983, Methods for Chemical Analysis of Water and Wastes, EPA600/4-79-20, Office of Research and Development, Washington, D.C.
[2] USEPA, 1996, Test methods for evaluating solid waste, physical/chemical methods (SW-846): 3rd edition, Environmental Protection Agency, National Center for Environmental Publications, Cincinnati, Ohio, accessed at URL http://www.epa.gov/epaoswer/hazwaste/test/sw846.htm
[3] SM20, Standard Methods for the Examination of Water and Wastewater, 20th Edition.
[4] USEPA, 1983, Methods for Chemical Analysis of Water and Wastes, EPA600/4-79-20, Office of Research and Development, Washington, D.C.

Information regarding the sample point identifications, analytical parameters, QC samples, sampling dates, and contract laboratory sample delivery group (SDG) designations are summarized in Table B1.

The data quality review followed guidelines provided by:

- USEPA Region II Standard Operating Procedures (SOP) No. HW-34, Revision 1, Organic Analysis of Trace Concentration of VOCs SOM01.2 Data Validation, August, 2007, for Trace VOCs;
- USEPA Region II SOP No. HW-33, Revision 1, Organic Analysis of Low/Medium concentration of VOCs SOM01.2 Data Validation, August 2007 for VOCs;
- USEPA Region II SOP No. HW-35, Revision 1, Organic Analysis of Low/Medium Concentration of Semivolatile Organic Compounds SOM01.2, August 2007 for SVOCs;
- USEPA Region II SOP No. HW-36, Revision 1, Organic Analysis of Low/Medium Concentration of Pesticide Organic Compounds SOM01.2, August 2007 for Pesticides;
- USEPA Region II SOP No. HW-37, Revision 1, Organic Analysis of Low/Medium Concentration of Aroclor Organic Compounds SOM01.2, August 2007 for PCBs; and,
- USEPA Region II SOP No. HW-2, Revision 13, Validation of Metals for CLP based on SOW ILM05.3, September 2006, as applicable to ILM05.4 for metals and the above referenced NAP methods.

Chemical results for the samples collected at the Site were qualified on the basis of outlying precision or accuracy parameters or on the basis of professional judgment. The following definitions provide brief explanations of the qualifiers which may have been assigned to data during the data review process:

J	The analyte was reported above the method detection limit; however, the associated numerical value is the approximate concentration of the analyte in the sample.
R	The sample result was rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria.
U	The analyte was analyzed for, but was not detected above the method detection limit.
UJ	The analyte was not detected above the method detection limit. The associated quality control measurements indicate the quantitation limit is approximate.

In general, the data generated as part of the Additional Groundwater Delineation and Groundwater and Surface Water Monitoring met the QC criteria established in the respective USEPA methods, MCAWW methods, Standard Methods and Region II Data Validation SOPs. The following bulleted items highlight qualifications to specific parameters. Although these qualifications were applied to some of the samples collected during these events, the qualifications may not have been required or applied to all samples. Table B2 details all qualifications applied to data, with applicable qualifier comments.

- Alkalinity in certain Profile soil samples were qualified as estimated (J) due to being analyzed outside of hold time.
- Nitrate in certain groundwater Profile samples were rejected due to being analyzed outside of hold time.
- All detected VOCs for certain groundwater Profile samples were qualified as estimated (J) when the pH was greater than 2, and was analyzed past 7 days.
- Certain non detect VOCs (with the exception of acetone, carbon disulfide, cyclohexane, and toluene) for particular groundwater Profile samples were rejected (R) when the pH was greater than 2, and was analyzed past 7 days.
- A number of inorganic compounds for groundwater Profile samples and groundwater monitoring well samples, as well as surface water samples were qualified as non detect (U) due to laboratory blank contamination, when the sample result was less than the Contract Required Quantitation Limit (CRQL).
- Many inorganic compounds for certain groundwater Profile samples and groundwater monitoring well samples, as well as surface water samples were qualified as estimated (J) due to laboratory initial calibration and continuing calibration blank contamination, when the sample result was greater than the CRQL but less than ten (10) times the blank result.
- 1,1,2-trichloro-1,2,2-trifluoroethane, 1,2-dichloroethane and vinyl chloride were qualified as estimated (J) for groundwater monitoring well samples when the results were detected above the laboratory calibration limit.
- Carbon disulfide, 1,1-dichloroethane, trans-1,2-dichloroethene, and vinyl chloride were qualified as estimated (J) for groundwater Profile samples and groundwater monitoring well samples as well as for some surface water samples when specific deuterated monitoring compounds (DMC) recovered above QC limits.
- Certain VOCs were qualified as estimated (J for detects, UJ for not detected) for Profile soil samples when DMCs recovered below QC limits.
- 3,3'-dichlorobenzidine, 4-chloroaniline, and Hexachlorocyclopentadiene for certain groundwater monitoring well samples were rejected (R) due to serious deficiencies associated with DMC recoveries.
- Iron, ferrous iron, sodium, and TOC for certain groundwater Profile samples and Profile soil samples were qualified as estimated (J) when the relative percent difference (RPD) between the results of the primary and field duplicate samples were greater than quality control (QC) limits.
- The reporting limits for certain surface water samples for beryllium and thallium were qualified as estimated (UJ) since internal standards were below laboratory QC criteria.
- Barium, copper, vanadium and zinc were qualified as estimated (J) for groundwater monitoring well samples, Profile soil samples, and surface water samples since the laboratory duplicate relative percent difference was greater than QC criteria.
- Cyclohexane in certain groundwater Profile samples were rejected (R) due to significant laboratory method blank contamination.
- Acetone, carbon disulfide, cyclohexane, dichlorodifluoromethane and methylene chloride in certain surface water, groundwater Profile samples, Profile soil and groundwater monitoring well samples were qualified as non detect (U) due to laboratory method blank contamination.
- The reporting limits for certain Profile soil samples were qualified as estimated (UJ) when the matrix spike (MS) recovery was below QC criteria.
- Barium and copper were qualified as estimated (J) for groundwater Profile samples when the MS recovery was above QC criteria.

- Antimony and selenium results for certain groundwater Profile samples were rejected (R) when the MS recovery was significantly below QC criteria.
- TOC for certain groundwater Profile samples were qualified as estimated (J) due to rinsate blank contamination.
- Acetone, beryllium, chromium and toluene results were qualified as non detect (U) in certain groundwater Profile samples and groundwater monitoring well samples, as well as surface water samples, due to rinsate blank contamination.
- Acetone and toluene for certain groundwater Profile samples were rejected (R) due to significant rinsate blank contamination.
- Certain inorganic compounds were qualified in some groundwater monitoring well samples and surface water samples, as well as some groundwater Profile samples and soil samples as estimated (J) when the percent difference of the laboratory serial dilution was above QC limits.
- Acetone and methylene chloride in certain groundwater Profile samples and groundwater monitoring well samples, as well as surface water samples were qualified as non detect (U) due to storage blank contamination.
- Acetone in certain groundwater Profile samples and groundwater monitoring well samples were qualified as non detect (U) due to rinsate blank contamination.
- Carbon disulfide was rejected (R) in certain groundwater Profile samples due to significant trip blank contamination.
- Acetone, carbon disulfide and toluene were qualified as non detect (U) in certain groundwater Profile samples and groundwater monitoring well samples due to trip blank contamination.

Based on the data quality assessment, the analytical data for the samples collected during this Event were determined to be acceptable for their intended use. Acceptable levels of accuracy and precision, based on LCS, MS/MSD, field duplicate, laboratory duplicate and surrogate recoveries, were achieved for the data. In addition, the data completeness (i.e. the ratio of the amount of valid data obtained to the amount expected) was 96.3%.

SAMPLE AND ANALYSIS SUMMARY
ADDITIONAL GROUNDWATER DELINEATION AND GROUNDWATER AND SURFACE WATER MONITORING - 2009
216 PATERSON PLANK ROAD SITE
CARLSTADT, NEW JERSEY

Lab SDG	Field ID	Matrix	Sample Date	VOCs by OLC03.2	VOCs by SOMO1.2	SVOCs, Pest, PCBs by SOMO1.2	1,4 Dioxane by SOM01.2 Trace SIM	Metals by ILM05.4	NAPs*	TOC by EPA 9060	TOC by SM5310B	Total Ferrous Iron by SM3500-FE-D	Alkalinity by EPA 310.2	MS/MSD	Duplicate	Trip/Rinse Blank
April 2009																
0904021	SW-01	SW	4/2/2009	x												
0904021	SW-02	SW	4/2/2009	x												
0904021	SW-02FD	SW	4/2/2009	x											x	
0904021	SW-03	SW	4/2/2009	x												
0904021	SW-04	SW	4/2/2009	x										x		
0904021	TBSW-040209	TB	4/2/2009	x												x
Lab SDG	**Field ID**	**Matrix**	**Sample Date**	**VOCs by OLC03.2**	**VOCs by SOMO1.2**	**SVOCs, Pest, PCBs by SOMO1.2**	**1,4 Dioxane by SOM01.2 Trace SIM**		**NAPs***					**MS/MSD**	**Duplicate**	**Trip/Rinse Blank**
July 2009																
0907090	SW-01	SW	7/10/2009	x												
0907090	SW-02	SW	7/10/2009	x												
0907090	SW-03	SW	7/10/2009	x										x		
0907090	SW-04	SW	7/10/2009	x												
0907090	SW-04FD	SW	7/10/2009	x											x	
0907090	TB071009	TB	7/10/2009	x												x
Lab SDG	**Field ID**	**Matrix**	**Sample Date**	**VOCs by OLC03.2**	**VOCs by SOMO1.2**	**SVOCs, Pest, PCBs by SOMO1.2**	**1,4 Dioxane by SOM01.2 Trace SIM**	**Metals by ILM05.4**	**NAPs***	**TOC by EPA 9060**	**TOC by SM5310B**	**Total Ferrous Iron by SM3500-FE-D**	**Alkalinity by EPA 310.2**	**MS/MSD**	**Duplicate**	**Trip/Rinse Blank**
October 2009																
0910201	SW-01	SW	10/22/2009	x												
0910201	SW-02	SW	10/22/2009	x										x		
0910201	SW-03	SW	10/22/2009	x												
0910201	SW-04	SW	10/22/2009	x												
0910201	SW-04FD	SW	10/22/2009	x											x	
0910201	TB102209	TB	10/22/2009	x												x

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R2-0001343

SAMPLE AND ANALYSIS SUMMARY
ADDITIONAL GROUNDWATER DELINEATION AND GROUNDWATER AND SURFACE WATER MONITORING - 2009
216 PATERSON PLANK ROAD SITE
CARLSTADT, NEW JERSEY

Lab SDG	Field ID	Matrix	Sample Date	VOCs by OLC03.2	VOCs by SOMO1.2	SVOCs, Pest, PCBs by SOMO1.2	1,4 Dioxane by SOM01.2 Trace SIM	Metals by ILM05.4	NAPs*	TOC by EPA 9060	TOC by SM5310B	Total Ferrous Iron by SM3500-FE-D	Alkalinity by EPA 310.2	MS/MSD	Duplicate	Trip/Rinse Blank
December 2009																
Groundwater Monitoring Well Sampling																
0912109	MW-8R	GW	12/17/2009		x		x									
0912178	MW-11S	GW	12/18/2009		x	x		x								
0912178	MW-12D	GW	12/18/2009		x	x		x								
0912178	MW-12S	GW	12/18/2009		x	x		x								
0912178	MW-13D	GW	12/17/2009		x	x		x								
0912178	MW-5D	GW	12/21/2009		x	x		x								
0912178	MW-5D FD	GW	12/21/2009		x	x		x							x	
0912178	MW-8S	GW	12/18/2009		x	x		x								
0912178	MW-9S	GW	12/17/2009		x	x		x								
0912109	MW-18D	GW	12/17/2009		x		x									
0912178	RB121709	RB	12/17/2009		x	x		x								x
0912178	RMW-11D	GW	12/18/2009		x	x		x								
0912178	RMW-8D	GW	12/17/2009		x	x		x								
0912178	TB122109	TB	12/21/2009		x	x										x
Groundwater Profile Sampling																
0912109	B09-2-35	GW	12/14/2009		x		x									
0912109	B09-2-45	GW	12/14/2009		x		x									
0912109	B09-2-55	GW	12/14/2009		x		x									
0912109	B09-2-65	GW	12/14/2009		x		x									
0912109/0912173	FDMW-21R-28	GW	12/17/2009		x		x	x	x						x	
0912109/0912173	MW-21-58	GW	12/18/2009		x		x	x	x							
0912109/0912173	MW-21R-28	GW	12/17/2009		x		x	x	x							
0912109/0912173	MW-21R-38	GW	12/17/2009		x		x	x	x							
0912109/0912173	MW-21R-48	GW	12/17/2009		x		x	x	x					x		
0912109/0912173	RB01-121709GW	RB	12/17/2009		x		x	x	x							x
0912109	TBGW121409	TB	12/14/2009		x		x									x
0912109	TBGW-121709	TB	12/17/2009		x		x									x
0912109	TBGW-121809	TB	12/18/2009		x		x									x
Profile Soil Sampling																
1001053	B09-4-20	SO	1/13/2010		x											
1001053	B09-4-30	SO	1/13/2010		x											
1001053	B09-4-35	SO	1/13/2010		x											
1001053	B09-5-20	SO	1/12/2010		x											
1001053	B09-5-30	SO	1/12/2010		x											
0912169/0912170	FDMW-21R-28	SO	12/17/2009		x			x		x		x	x		x	
0912169/0912170	MW-21R-28	SO	12/17/2009		x			x		x		x	x	x		
0912171	RB-01-121709	RB	12/17/2009		x			x			x		x			x
0912171	TBSOIL121709	TB	12/17/2009		x											x
Surface Water Sampling																
0912178	SW-01	GW	12/21/2009		x	x		x								
0912178	SW-02	GW	12/21/2009		x	x		x								
0912178	SW-03	GW	12/21/2009		x	x		x						x		
0912178	SW-04	GW	12/21/2009		x	x		x								

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SAMPLE AND ANALYSIS SUMMARY
ADDITIONAL GROUNDWATER DELINEATION AND GROUNDWATER AND SURFACE WATER MONITORING - 2009
216 PATERSON PLANK ROAD SITE
CARLSTADT, NEW JERSEY

Lab SDG	Field ID	Matrix	Sample Date	VOCs by OLC03.2	VOCs by SOMO1.2	SVOCs, Pest, PCBs by SOMO1.2	1,4 Dioxane by SOM01.2 Trace SIM	Metals by ILM05.4	NAPs*	TOC by EPA 9060	TOC by SM5310B	Total Ferrous Iron by SM3500-FE-D	Alkalinity by EPA 310.2	MS/MSD	Duplicate	Trip/Rinse Blank
January 2010																
Groundwater Profile Sampling																
1001003	B09-1-28	GW	1/4/2010		x		x									
1001003	B-09-1-38	GW	1/4/2010		x		x									
1001003	B09-1-48	GW	1/5/2010		x		x									
1001003	B09-1-58	GW	1/5/2010		x		x									
1001003	B09-3-30	GW	1/7/2010		x		x									
1001003	B09-3-40	GW	1/7/2010		x		x									
1001003	B09-3-50	GW	1/7/2010		x		x									
1001003	B09-3-60	GW	1/7/2010		x		x									
1001003	B09-4-30	GW	1/13/2010		x		x									
1001003	B09-4-35	GW	1/13/2010		x		x									
1001003	B09-5-30	GW	1/12/2010		x		x									
1001003	B09-5-36	GW	1/12/2010		x		x									
1001003	TBGW-010410	TB	1/4/2010		x		x									x
1001003	TBGW-010510	TB	1/5/2010		x		x									x
1001003	TBGW-010710	TB	1/7/2010		x		x									x
1001003	TBGW-11210	TB	1/12/2010		x		x									x
1001003	TBGW-11310	TB	1/13/2010		x		x									x
May 2010																
Groundwater Monitoring Well Sampling																
1005062	MW-21R	GW	5/6/2010		x		x							x		
1005062	MW-21R-FD	GW	5/6/2010		x		x								x	
1005062	RBGW-050610	GW	5/6/2010		x		x									x
1005062	TBGW-050610	GW	5/6/2010		x		x									x

Notes:
GW - Groundwater
MS/MSD - Matrix Spike/Matrix Spike Duplicate
NAPs* - Chloride, Nitrate, Nitrite, Sulfate, alkalinity, Total Sulfide, Total Organic Carbon and Total Iron
PCBs- Polychloriated Biphenyls
Pest-Pesticides
QC - Quality Control
RB - Rinsate Blank
SDG - Sample Delivery Group
SIM - Selected Ion Monitoring
SO - Soil Sample
SVOCs-Semivolatile Organic Compounds
SW - Surface Water
TB - Trip Blank
TOC - Total Organic Carbon
VOCs-Volatile Organic Compounds

DATA QUALIFIER SUMMARY
ADDITIONAL GROUNDWATER DELINEATION AND GROUNDWATER AND SURFACE WATER MONITORING - 2009
216 PATERSON PLANK ROAD SITE
CARLSTADT, NEW JERSEY

SDG	Field ID	Matrix	Analysis	Analyte	New Result	New RL	QUAL	Comments
1001003	B09-5-30	GW	VOCs	Acetone	-	10	U	Storage blank contamination.
1001003	B09-1-28	GW	VOCs	Carbon Disulfide	ND	-	U	Method blank contamination.
1001003	B09-1-38	GW	VOCs	Acetone	-	13	U	Storage blank contamination.
1001003	B09-1-38	GW	VOCs	Carbon Disulfide	ND	-	U	Method blank contamination.
1001003	B09-1-48	GW	VOCs	Carbon Disulfide	ND	-	U	Method blank contamination.
1001003	B09-1-58	GW	VOCs	Carbon Disulfide	ND	-	U	Method blank contamination.
0912109	B09-2-35	GW	VOCs	Acetone	ND	18	U	Storage blank contamination,
0912109	B09-2-35	GW	VOCs	Carbon Disulfide	ND	-	U	Trip blank contamination.
0912109	B09-2-35	GW	VOCs	Cyclohexane	ND	-	U	Method blank contamination.
0912109	B09-2-35	GW	VOCs	Methylene Chloride	ND	-	U	Method blank contamination.
0912109	B09-2-35	GW	VOCs	Vinyl chloride	-	-	J	DMC % recovery above QC limits.
0912109	B09-2-45	GW	VOCs	Acetone	ND	13	U	Storage blank contamination.
0912109	B09-2-45	GW	VOCs	Carbon Disulfide	ND	-	U	Trip blank contamination.
0912109	B09-2-45	GW	VOCs	Cyclohexane	ND	-	U	Method blank contamination.
0912109	B09-2-45	GW	VOCs	Methylene Chloride	ND	-	U	Method blank contamination.
0912109	B09-2-45	GW	VOCs	Vinyl chloride	-	-	J	DMC % recovery above QC limits.
0912109	B09-2-55	GW	VOCs	Acetone	ND	9.5	U	Storage blank contamination.
0912109	B09-2-55	GW	VOCs	Carbon Disulfide	ND	-	U	Trip blank contamination.
0912109	B09-2-55	GW	VOCs	Methylene Chloride	ND	-	U	Method blank contamination.
0912109	B09-2-65	GW	VOCs	Acetone	ND	9.1	U	Storage blank contamination.
0912109	B09-2-65	GW	VOCs	Carbon Disulfide	ND	-	U	Trip blank contamination.
0912109	B09-2-65	GW	VOCs	Cyclohexane	ND	-	U	Method blank contamination.
0912109	B09-2-65	GW	VOCs	Methylene Chloride	ND	-	U	Method blank contamination.
1001003	B09-3-30	GW	VOCs	Acetone	-	14	U	Trip blank contamination.
1001003	B09-3-30	GW	VOCs	Carbon Disulfide	ND	-	U	Method blank contamination.
1001003	B09-3-40	GW	VOCs	Acetone	-	6.2	U	Trip blank contamination.
1001003	B09-3-40	GW	VOCs	Carbon Disulfide	ND	-	U	Method blank contamination.
1001003	B09-3-50	GW	VOCs	Acetone	-	10	U	Trip blank contamination.
1001003	B09-3-50	GW	VOCs	Carbon Disulfide	ND	-	U	Method blank contamination.
1001003	B09-3-60	GW	VOCs	Carbon Disulfide	ND	-	U	Method blank contamination.
1001053	B09-4-20	SO	VOCs	1,1,2-Trichloroethane	-	-	UJ	DMC recovery below QC limits.
1001053	B09-4-20	SO	VOCs	1,2,3-trichlorobenzene	-	-	UJ	DMC recovery below QC limits.
1001053	B09-4-20	SO	VOCs	1,2,4-trichlorobenzene	-	-	UJ	DMC recovery below QC limits.
1001053	B09-4-20	SO	VOCs	1,2-dichlorobenzene	-	-	UJ	DMC recovery below QC limits.
1001053	B09-4-20	SO	VOCs	1,3-dichlorobenzene	-	-	UJ	DMC recovery below QC limits.
1001053	B09-4-20	SO	VOCs	1,4-dichlorobenzene	-	-	UJ	DMC recovery below QC limits.
1001053	B09-4-20	SO	VOCs	Acetone	-	52	U	Method blank contamination.
1001053	B09-4-20	SO	VOCs	Chlorobenzene	-	-	J	DMC recovery below QC limits.
1001053	B09-4-20	SO	VOCs	Cis-1,3-dichloropropene	-	-	UJ	DMC recovery below QC limits.
1001053	B09-4-20	SO	VOCs	Cyclohexane	ND	-	U	Method blank contamination.
1001053	B09-4-20	SO	VOCs	Ethylbenzene	-	-	J	DMC recovery below QC limits.
1001053	B09-4-20	SO	VOCs	Isopropylbenzene	-	-	J	DMC recovery below QC limits.
1001053	B09-4-20	SO	VOCs	Methylene Chloride	-	10	U	Method blank contamination.
1001053	B09-4-20	SO	VOCs	o-xylene	-	-	J	DMC recovery below QC limits.
1001053	B09-4-20	SO	VOCs	Styrene	-	-	UJ	DMC recovery below QC limits.
1001053	B09-4-20	SO	VOCs	Trans-1,3-dichloropropene	-	-	UJ	DMC recovery below QC limits.
1001003	B09-4-30	GW	VOCs	Acetone	ND	-	U	Storage blank contamination.
1001053	B09-4-30	SO	VOCs	Acetone	ND	-	U	Method blank contamination.
1001053	B09-4-30	SO	VOCs	Cyclohexane	ND	-	U	Method blank contamination.
1001003	B09-4-35	GW	VOCs	Acetone	ND	-	U	Storage blank contamination.
1001053	B09-4-35	SO	VOCs	Acetone	ND	-	U	Method blank contamination.
1001053	B09-4-35	SO	VOCs	Cyclohexane	ND	-	U	Method blank contamination.
1001053	B09-5-20	SO	VOCs	1,2,3-trichlorobenzene	-	-	UJ	DMC recovery below QC limits.
1001053	B09-5-20	SO	VOCs	1,2,4-trichlorobenzene	-	-	UJ	DMC recovery below QC limits.
1001053	B09-5-20	SO	VOCs	1,2-dichlorobenzene	-	-	UJ	DMC recovery below QC limits.
1001053	B09-5-20	SO	VOCs	1,3-dichlorobenzene	-	-	UJ	DMC recovery below QC limits.
1001053	B09-5-20	SO	VOCs	1,4-dichlorobenzene	-	-	UJ	DMC recovery below QC limits.
1001053	B09-5-20	SO	VOCs	Acetone	-	14	U	Method blank contamination.
1001053	B09-5-20	SO	VOCs	Chlorobenzene	-	-	J	DMC recovery below QC limits.
1001053	B09-5-20	SO	VOCs	Cyclohexane	ND	-	U	Method blank contamination.
1001053	B09-5-20	SO	VOCs	Methylene Chloride	ND	-	U	Method blank contamination.
1001003	B09-5-30	GW	VOCs	Carbon Disulfide	ND	-	U	Method blank contamination.
1001053	B09-5-30	SO	VOCs	Acetone	ND	-	U	Method blank contamination.
1001053	B09-5-30	SO	VOCs	Cyclohexane	ND	-	U	Method blank contamination.
1001003	B09-5-36	GW	VOCs	Acetone	ND	-	U	Storage blank contamination.
1001003	B09-5-36	GW	VOCs	All detect VOCs	-	-	J	Analyzed past 7days, pH greater than 2.
1001003	B09-5-36	GW	VOCs	All ND VOCs (except acetone)	-	-	R	Analyzed past 7days, pH greater than 2.
0912109	FDMW-21R-28	GW	Metals	Antimony	-	-	R	MS recovery less than 30%.
0912109	FDMW-21R-28	GW	Metals	Barium	-	-	J	MS recovery above QC limits, between 126-150%.
0912109	FDMW-21R-28	GW	Metals	Calcium	-	-	J	Serial dilution %D above QC limits.
0912109	FDMW-21R-28	GW	Metals	Copper	-	-	J	MS recovery above QC limits, between 126-150%.
0912109	FDMW-21R-28	GW	Metals	Iron	-	-	J	Serial dilution %D above QC limits.
0912173	FDMW-21R-28	GW	Metals	Iron	-	-	J	Field duplicate RPD above QC limits.
0912109	FDMW-21R-28	GW	Metals	Lead	-	-	J	Serial dilution %D above QC limits.
0912109	FDMW-21R-28	GW	Metals	Manganese	-	-	J	Serial dilution %D above QC limits.
0912109	FDMW-21R-28	GW	Metals	Potassium	-	-	J	Serial dilution %D above QC limits.
0912109	FDMW-21R-28	GW	Metals	Selenium	-	-	R	MS recovery less than 30%.
0912109	FDMW-21R-28	GW	Metals	Sodium	-	-	J	Field duplicate RPD above QC limits.
0912109	FDMW-21R-28	GW	Metals	Vanadium	-	-	J	Serial dilution %D above QC limits.
0912109	FDMW-21R-28	GW	Metals	Zinc	-	-	J	Serial dilution %D above QC limits.
0912109	FDMW-21R-28	GW	NAPs	TOC	-	-	J	Rinsate blank contamination, sample result >CRQL and less than 10x blank contamination.
0912109	FDMW-21R-28	GW	VOCs	Acetone	ND	28	R	Rinsate blank contamination.
0912109	FDMW-21R-28	GW	VOCs	All detect VOCs	-	-	J	Analyzed past 7days, pH greater than 2.
0912109	FDMW-21R-28	GW	VOCs	All ND VOCs (except acetone, toluene, carbon disulfide, and cyclohexane)	-	-	R	Analyzed past 7days, pH greater than 2.
0912109	FDMW-21R-28	GW	VOCs	Carbon Disulfide	ND	-	R	Trip blank contamination.
0912109	FDMW-21R-28	GW	VOCs	Cyclohexane	ND	-	R	Method blank contamination.
0912109	FDMW-21R-28	GW	VOCs	Toluene	ND	-	R	Rinsate blank contamination.
0912169	FDMW-21R-28	SO	Metals	Antimony	-	-	UJ	MS recovery % below QC limits
0912169	FDMW-21R-28	SO	Metals	Barium	-	-	J	Laboratory duplicate %RPD above QC limits.
0912169	FDMW-21R-28	SO	Metals	Beryllium	ND	-	U	Rinsate blank contamination.
0912169	FDMW-21R-28	SO	Metals	Copper	-	-	J	ICB contamination, sample result >CRQL and less than 10x blank contamination.
0912169	FDMW-21R-28	SO	Metals	Potassium	-	-	J	Serial Dilution %D above QC limits.
0912169	FDMW-21R-28	SO	Metals	Sodium	ND	-	U	ICB contamination, sample result <CRQL.
0912169	FDMW-21R-28	SO	Metals	Vanadium	-	-	J	Laboratory duplicate %RPD above QC limits.
0912169	FDMW-21R-28	SO	Metals	Zinc	-	-	J	Laboratory duplicate %RPD above QC limits.
0912170	FDMW-21R-28	SO	NAPs	alkalinity	-	-	J	Analyzed outside of holding time.
0912170	FDMW-21R-28	SO	NAPs	Ferrous Iron	-	-	J	Field duplicate RPD above QC limits.
0912169	FDMW-21R-28	SO	NAPs	TOC	-	-	J	Field duplicate RPD above QC limits.
0912169	FDMW-21R-28	SO	VOCs	Cyclohexane	ND	-	U	Method blank contamination.
0912178	MW-11S	GW	Metals	Antimony	-	-	J	ICB contamination, sample result >CRQL and less than 10x blank contamination.
0912178	MW-11S	GW	Metals	Barium	-	-	J	Serial Dilution %D above QC limits.

DATA QUALIFIER SUMMARY
ADDITIONAL GROUNDWATER DELINEATION AND GROUNDWATER AND SURFACE WATER MONITORING - 2009
216 PATERSON PLANK ROAD SITE
CARLSTADT, NEW JERSEY

SDG	Field ID	Matrix	Analysis	Analyte	New Result	New RL	QUAL	Comments
0912178	MW-11S	GW	Metals	Beryllium	ND	-	U	CCB contamination, sample result <CRQL.
0912178	MW-11S	GW	Metals	Cadmium	ND	-	U	CCB contamination, sample result <CRQL.
0912178	MW-11S	GW	Metals	Chromium	-	-	J	Serial Dilution %D above QC limits.
0912178	MW-11S	GW	Metals	Copper	-	-	J	Laboratory duplicate %RPD above QC limits.
0912178	MW-11S	GW	Metals	Potassium	-	-	J	Serial Dilution %D above QC limits.
0912178	MW-11S	GW	Metals	Thallium	ND	-	U	ICB contamination, sample result <CRQL.
0912178	MW-11S	GW	Metals	Zinc	-	-	J	Laboratory duplicate %RPD above QC limits.
0912178	MW-11S	GW	VOCs	Acetone	ND	-	U	Storage blank contamination.
0912178	MW-11S	GW	VOCs	Carbon Disulfide	ND	-	U	Method blank contamination.
0912178	MW-12D	GW	Metals	Antimony	ND	-	U	ICB contamination, sample result <CRQL.
0912178	MW-12D	GW	Metals	Barium	-	-	J	Serial Dilution %D above QC limits.
0912178	MW-12D	GW	Metals	Chromium	-	-	J	Serial Dilution %D above QC limits.
0912178	MW-12D	GW	Metals	Cobalt	-	-	J	CCB contamination, sample result >CRQL and less than 10x blank contamination.
0912178	MW-12D	GW	Metals	Copper	-	-	J	Laboratory duplicate %RPD above QC limits.
0912178	MW-12D	GW	Metals	Lead	-	-	J	ICB contamination, sample result >CRQL and less than 10x blank contamination.
0912178	MW-12D	GW	Metals	Potassium	-	-	J	Serial Dilution %D above QC limits.
0912178	MW-12D	GW	Metals	Vanadium	ND	-	U	CCB contamination, sample result <CRQL.
0912178	MW-12D	GW	Metals	Zinc	-	-	J	Laboratory duplicate %RPD above QC limits.
0912178	MW-12D	GW	VOCs	Acetone	ND	-	U	Storage blank contamination.
0912178	MW-12D	GW	VOCs	Carbon Disulfide	ND	-	U	Method blank contamination.
0912178	MW-12S	GW	Metals	Antimony	ND	-	U	ICB contamination, sample result <CRQL.
0912178	MW-12S	GW	Metals	Barium	-	-	J	Serial Dilution %D above QC limits.
0912178	MW-12S	GW	Metals	Cadmium	ND	-	U	CCB contamination, sample result <CRQL.
0912178	MW-12S	GW	Metals	Chromium	-	-	J	Serial Dilution %D above QC limits.
0912178	MW-12S	GW	Metals	Cobalt	-	-	J	CCB contamination, sample result >CRQL and less than 10x blank contamination.
0912178	MW-12S	GW	Metals	Copper	-	-	J	Laboratory duplicate %RPD above QC limits.
0912178	MW-12S	GW	Metals	Potassium	-	-	J	Serial Dilution %D above QC limits.
0912178	MW-12S	GW	Metals	Silver	ND	-	U	CCB contamination, sample result <CRQL.
0912178	MW-12S	GW	Metals	Zinc	-	-	J	Laboratory duplicate %RPD above QC limits.
0912178	MW-12S	GW	VOCs	Acetone	ND	-	U	Storage blank contamination.
0912178	MW-12S	GW	VOCs	Carbon Disulfide	ND	-	U	Method blank contamination.
0912178	MW-13D	GW	Metals	Antimony	ND	-	U	ICB contamination, sample result <CRQL.
0912178	MW-13D	GW	Metals	Barium	-	-	J	Serial Dilution %D above QC limits.
0912178	MW-13D	GW	Metals	Beryllium	ND	-	U	CCB contamination, sample result <CRQL.
0912178	MW-13D	GW	Metals	Cadmium	-	-	J	CCB contamination, sample result >CRQL and less than 10x blank contamination.
0912178	MW-13D	GW	Metals	Chromium	-	-	J	Serial Dilution %D above QC limits.
0912178	MW-13D	GW	Metals	Copper	-	-	J	Laboratory duplicate %RPD above QC limits.
0912178	MW-13D	GW	Metals	Potassium	-	-	J	Serial Dilution %D above QC limits.
0912178	MW-13D	GW	Metals	Silver	ND	-	U	ICB contamination, sample result <CRQL.
0912178	MW-13D	GW	Metals	Thallium	ND	-	U	ICB contamination, sample result <CRQL.
0912178	MW-13D	GW	Metals	Zinc	-	-	J	Laboratory duplicate %RPD above QC limits.
0912178	MW-13D	GW	VOCs	Acetone	-	6.9	U	Rinsate blank contamination.
0912178	MW-13D	GW	VOCs	Carbon Disulfide	ND	-	U	Method blank contamination.
0912109	MW-18D	GW	VOCs	Acetone	ND	-	U	Rinsate blank contamination.
0912109	MW-18D	GW	VOCs	Carbon Disulfide	ND	-	U	Trip blank contamination.
0912109	MW-21-58	GW	Metals	Antimony	-	-	R	MS recovery less than 30%.
0912109	MW-21-58	GW	Metals	Barium	-	-	J	MS recovery above QC limits, between 126-150%.
0912109	MW-21-58	GW	Metals	Calcium	-	-	J	Serial dilution %D above QC limits.
0912109	MW-21-58	GW	Metals	Copper	-	-	J	MS recovery above QC limits, between 126-150%.
0912109	MW-21-58	GW	Metals	Iron	-	-	J	Serial dilution %D above QC limits.
0912109	MW-21-58	GW	Metals	Lead	-	-	J	Serial dilution %D above QC limits.
0912109	MW-21-58	GW	Metals	Manganese	-	-	J	Serial dilution %D above QC limits.
0912109	MW-21-58	GW	Metals	Potassium	-	-	J	Serial dilution %D above QC limits.
0912109	MW-21-58	GW	Metals	Selenium	-	-	R	MS recovery less than 30%.
0912109	MW-21-58	GW	Metals	Vanadium	-	-	J	Serial dilution %D above QC limits.
0912109	MW-21-58	GW	Metals	Zinc	-	-	J	Serial dilution %D above QC limits.
0912109	MW-21-58	GW	NAPs	Nitrate as N	-	-	R	Analyzed outside of holding time.
0912109	MW-21-58	GW	NAPs	Nitrite as N	-	-	R	Analyzed outside of holding time.
0912109	MW-21-58	GW	VOCs	Acetone	ND	12	U	Trip blank contamination.
0912109	MW-21-58	GW	VOCs	Carbon Disulfide	ND	-	U	Method blank contamination.
0912109	MW-21-58	GW	VOCs	Cyclohexane	ND	-	U	Method blank contamination.
1005062	MW-21R	GW	VOCs	Acetone	ND	-	U	Rinsate blank contamination.
1005062	MW-21R	GW	VOCs	Carbon Disulfide	ND	-	U	Trip blank contamination.
1005062	MW-21R	GW	VOCs	Toluene	ND	-	U	Trip blank contamination.
0912109	MW-21R-28	GW	Metals	Antimony	-	-	R	MS recovery less than 30%.
0912109	MW-21R-28	GW	Metals	Barium	-	-	J	MS recovery above QC limits, between 126-150%.
0912109	MW-21R-28	GW	Metals	Calcium	-	-	J	Serial dilution %D above QC limits.
0912109	MW-21R-28	GW	Metals	Copper	-	-	J	MS recovery above QC limits, between 126-150%.
0912173	MW-21R-28	GW	Metals	Iron	-	-	J	Field duplicate RPD above QC limits.
0912109	MW-21R-28	GW	Metals	Iron	-	-	J	Serial dilution %D above QC limits.
0912109	MW-21R-28	GW	Metals	Lead	-	-	J	Serial dilution %D above QC limits.
0912109	MW-21R-28	GW	Metals	Manganese	-	-	J	Serial dilution %D above QC limits.
0912109	MW-21R-28	GW	Metals	Potassium	-	-	J	Serial dilution %D above QC limits.
0912109	MW-21R-28	GW	Metals	Selenium	-	-	R	MS recovery less than 30%.
0912109	MW-21R-28	GW	Metals	Sodium	-	-	J	Field duplicate RPD above QC limits.
0912109	MW-21R-28	GW	Metals	Vanadium	-	-	J	Serial dilution %D above QC limits.
0912109	MW-21R-28	GW	Metals	Zinc	-	-	J	Serial dilution %D above QC limits.
0912109	MW-21R-28	GW	NAPs	TOC	-	-	J	Rinsate blank contamination, sample result >CRQL and less than 10x blank contamination.
0912109	MW-21R-28	GW	VOCs	Acetone	ND	28	R	Rinsate blank contamination.
0912109	MW-21R-28	GW	VOCs	All detect VOCs	-	-	J	Analyzed past 7days, pH greater than 2.
0912109	MW-21R-28	GW	VOCs	All ND VOCs (except acetone, toluene, carbon disulfide, and cyclohexane)	-	-	R	Analyzed past 7days, pH greater than 2.
0912109	MW-21R-28	GW	VOCs	Carbon Disulfide	ND	-	R	Trip blank contamination.
0912109	MW-21R-28	GW	VOCs	Cyclohexane	ND	-	R	Method blank contamination.
0912109	MW-21R-28	GW	VOCs	Toluene	ND	-	R	Rinsate blank contamination.
0912169	MW-21R-28	SO	Metals	Antimony	-	-	UJ	MS recovery % below QC limits
0912169	MW-21R-28	SO	Metals	Barium	-	-	J	Laboratory duplicate %RPD above QC limits.
0912169	MW-21R-28	SO	Metals	Beryllium	ND	-	U	Rinsate blank contamination.
0912169	MW-21R-28	SO	Metals	Copper	-	-	J	ICB contamination, sample result >CRQL and less than 10x blank contamination.
0912169	MW-21R-28	SO	Metals	Potassium	-	-	J	Serial Dilution %D above QC limits.
0912169	MW-21R-28	SO	Metals	Sodium	ND	-	U	ICB contamination, sample result <CRQL.
0912169	MW-21R-28	SO	Metals	Vanadium	-	-	J	Laboratory duplicate %RPD above QC limits.
0912169	MW-21R-28	SO	Metals	Zinc	-	-	J	Laboratory duplicate %RPD above QC limits.
0912170	MW-21R-28	SO	NAPs	alkalinity	-	-	J	Analyzed outside of holding time.
0912170	MW-21R-28	SO	NAPs	Ferrous Iron	-	-	J	Field duplicate RPD above QC limits.
0912169	MW-21R-28	SO	NAPs	TOC	-	-	J	Field duplicate RPD above QC limits.
0912169	MW-21R-28	SO	VOCs	Cyclohexane	ND	-	U	Method blank contamination.
0912109	MW-21R-38	GW	Metals	Antimony	-	-	R	MS recovery less than 30%.
0912109	MW-21R-38	GW	Metals	Barium	-	-	J	MS recovery above QC limits, between 126-150%.
0912109	MW-21R-38	GW	Metals	Calcium	-	-	J	Serial dilution %D above QC limits.
0912109	MW-21R-38	GW	Metals	Copper	-	-	J	MS recovery above QC limits, between 126-150%.

DATA QUALIFIER SUMMARY
ADDITIONAL GROUNDWATER DELINEATION AND GROUNDWATER AND SURFACE WATER MONITORING - 2009
216 PATERSON PLANK ROAD SITE
CARLSTADT, NEW JERSEY

SDG	Field ID	Matrix	Analysis	Analyte	New Result	New RL	QUAL	Comments
0912109	MW-21R-38	GW	Metals	Iron	-	-	J	Serial dilution %D above QC limits.
0912109	MW-21R-38	GW	Metals	Lead	-	-	J	Serial dilution %D above QC limits.
0912109	MW-21R-38	GW	Metals	Manganese	-	-	J	Serial dilution %D above QC limits.
0912109	MW-21R-38	GW	Metals	Potassium	-	-	J	Serial dilution %D above QC limits.
0912109	MW-21R-38	GW	Metals	Selenium	-	-	R	MS recovery less than 30%.
0912109	MW-21R-38	GW	Metals	Silver	ND	-	U	CCB contamination, sample result <CRQL.
0912109	MW-21R-38	GW	Metals	Vanadium	-	-	J	Serial dilution %D above QC limits.
0912109	MW-21R-38	GW	Metals	Zinc	-	-	J	Serial dilution %D above QC limits.
0912109	MW-21R-38	GW	NAPs	TOC	-	-	J	Rinsate blank contamination, sample result >CRQL and less than 10x blank contamination.
0912109	MW-21R-38	GW	VOCs	Acetone	ND	28	R	Rinsate blank contamination.
0912109	MW-21R-38	GW	VOCs	All detect VOCs	-	-	J	Analyzed past 7days, pH greater than 2.
0912109	MW-21R-38	GW	VOCs	All ND VOCs (except acetone, toluene, and carbon disulfide)	-	-	R	Analyzed past 7days, pH greater than 2.
0912109	MW-21R-38	GW	VOCs	Carbon Disulfide	ND	-	R	Trip blank contamination.
0912109	MW-21R-38	GW	VOCs	Toluene	ND	-	R	Rinsate blank contamination.
0912109	MW-21R-48	GW	Metals	Antimony	-	-	R	MS recovery less than 30%.
0912109	MW-21R-48	GW	Metals	Barium	-	-	J	MS recovery above QC limits, between 126-150%.
0912109	MW-21R-48	GW	Metals	Calcium	-	-	J	Serial dilution %D above QC limits.
0912109	MW-21R-48	GW	Metals	Copper	-	-	J	MS recovery above QC limits, between 126-150%.
0912109	MW-21R-48	GW	Metals	Iron	-	-	J	Serial dilution %D above QC limits.
0912109	MW-21R-48	GW	Metals	Lead	-	-	J	Serial dilution %D above QC limits.
0912109	MW-21R-48	GW	Metals	Manganese	-	-	J	Serial dilution %D above QC limits.
0912109	MW-21R-48	GW	Metals	Potassium	-	-	J	Serial dilution %D above QC limits.
0912109	MW-21R-48	GW	Metals	Selenium	-	-	R	MS recovery less than 30%.
0912109	MW-21R-48	GW	Metals	Vanadium	-	-	J	Serial dilution %D above QC limits.
0912109	MW-21R-48	GW	Metals	Zinc	-	-	J	Serial dilution %D above QC limits.
0912109	MW-21R-48	GW	NAPs	TOC	-	-	J	Rinsate blank contamination, sample result >CRQL and less than 10x blank contamination.
0912109	MW-21R-48	GW	VOCs	Acetone	ND	7.2	U	Rinsate blank contamination.
0912109	MW-21R-48	GW	VOCs	Carbon Disulfide	ND	-	U	Trip blank contamination.
0912109	MW-21R-48	GW	VOCs	Cyclohexane	ND	-	U	Method blank contamination.
0912109	MW-21R-48	GW	VOCs	Toluene	ND	-	U	Rinsate blank contamination.
1005062	MW-21-R-FD	GW	VOCs	Acetone	ND	-	U	Rinsate blank contamination.
1005062	MW-21-R-FD	GW	VOCs	Carbon Disulfide	ND	-	U	Trip blank contamination.
1005062	MW-21-R-FD	GW	VOCs	Toluene	ND	-	U	Trip blank contamination.
0912178	MW-5D	GW	Metals	Barium	-	-	J	Serial Dilution %D above QC limits.
0912178	MW-5D	GW	Metals	Chromium	-	-	J	Serial Dilution %D above QC limits.
0912178	MW-5D	GW	Metals	Cobalt	ND	-	U	CCB contamination, sample result <CRQL.
0912178	MW-5D	GW	Metals	Copper	ND	-	U	CCB contamination, sample result <CRQL.
0912178	MW-5D	GW	Metals	Potassium	-	-	J	Serial Dilution %D above QC limits.
0912178	MW-5D	GW	Metals	Vanadium	ND	-	U	CCB contamination, sample result <CRQL.
0912178	MW-5D	GW	Metals	Zinc	-	-	J	Laboratory duplicate %RPD above QC limits.
0912178	MW-5D	GW	VOCs	1,1,2-Trichloro-1,2,2-trifluoroethane	-	-	J	Detected above instrument upper calibration limit.
0912178	MW-5D	GW	VOCs	1,2-dichloroethane	-	-	J	Detected above instrument upper calibration limit.
0912178	MW-5D	GW	VOCs	Acetone	ND	-	U	Storage blank contamination.
0912178	MW-5D	GW	VOCs	Carbon Disulfide	ND	-	U	Method blank contamination.
0912178	MW-5D	GW	VOCs	trans-1,2-dichloroethene	-	-	J	DMC % recovery above QC limits.
0912178	MW-5D	GW	VOCs	Vinyl Chloride	-	-	J	Detected above instrument upper calibration limit.
0912178	MW-5D FD	GW	Metals	Barium	-	-	J	Serial Dilution %D above QC limits.
0912178	MW-5D FD	GW	Metals	Cadmium	ND	-	U	CCB contamination, sample result <CRQL.
0912178	MW-5D FD	GW	Metals	Chromium	-	-	J	Serial Dilution %D above QC limits.
0912178	MW-5D FD	GW	Metals	Cobalt	ND	-	U	CCB contamination, sample result <CRQL.
0912178	MW-5D FD	GW	Metals	Copper	ND	-	U	CCB contamination, sample result <CRQL.
0912178	MW-5D FD	GW	Metals	Lead	ND	-	U	ICB contamination, sample result <CRQL.
0912178	MW-5D FD	GW	Metals	Potassium	-	-	J	Serial Dilution %D above QC limits.
0912178	MW-5D FD	GW	Metals	Vanadium	ND	-	U	CCB contamination, sample result <CRQL.
0912178	MW-5D FD	GW	Metals	Zinc	-	-	J	Laboratory duplicate %RPD above QC limits.
0912178	MW-5D FD	GW	VOCs	1,1,2-Trichloro-1,2,2-trifluoroethane	-	-	J	Detected above instrument upper calibration limit.
0912178	MW-5D FD	GW	VOCs	1,2-dichloroethane	-	-	J	Detected above instrument upper calibration limit.
0912178	MW-5D FD	GW	VOCs	Acetone	ND	-	U	Storage blank contamination.
0912178	MW-5D FD	GW	VOCs	Carbon Disulfide	ND	-	U	Method blank contamination.
0912178	MW-5D FD	GW	VOCs	trans-1,2-dichloroethene	-	-	J	DMC % recovery above QC limits.
0912178	MW-5D FD	GW	VOCs	Vinyl Chloride	-	-	J	Detected above instrument upper calibration limit.
0912109	MW-8R	GW	VOCs	Carbon Disulfide	ND	-	U	Trip blank contamination.
0912178	MW-8S	GW	Metals	Antimony	ND	-	U	ICB contamination, sample result <CRQL.
0912178	MW-8S	GW	Metals	Barium	-	-	J	Serial Dilution %D above QC limits.
0912178	MW-8S	GW	Metals	Beryllium	ND	-	U	CCB contamination, sample result <CRQL.
0912178	MW-8S	GW	Metals	Cadmium	ND	-	U	CCB contamination, sample result <CRQL.
0912178	MW-8S	GW	Metals	Chromium	-	-	J	Serial Dilution %D above QC limits.
0912178	MW-8S	GW	Metals	Cobalt	-	-	J	CCB contamination, sample result >CRQL and less than 10x blank contamination.
0912178	MW-8S	GW	Metals	Copper	-	-	J	Laboratory duplicate %RPD above QC limits.
0912178	MW-8S	GW	Metals	Potassium	-	-	J	Serial Dilution %D above QC limits.
0912178	MW-8S	GW	Metals	Silver	ND	-	U	CCB contamination, sample result <CRQL.
0912178	MW-8S	GW	Metals	Thallium	ND	-	U	ICB contamination, sample result <CRQL.
0912178	MW-8S	GW	Metals	Zinc	-	-	J	Laboratory duplicate %RPD above QC limits.
0912178	MW-8S	GW	SVOCs	3,3'Dichlorobenzidine	-	-	R	DMC recovery below QC limits, 0% recovery.
0912178	MW-8S	GW	SVOCs	4-Chloroaniline	-	-	R	DMC recovery below QC limits, 0% recovery.
0912178	MW-8S	GW	SVOCs	Hexachlorocyclopentadiene	-	-	R	DMC recovery below QC limits, 0% recovery.
0912178	MW-8S	GW	VOCs	Acetone	-	19	U	Storage blank contamination
0912178	MW-8S	GW	VOCs	Carbon Disulfide	ND	-	U	Method blank contamination.
0912178	MW-9S	GW	Metals	Antimony	-	-	J	ICB contamination, sample result >CRQL and less than 10x blank contamination.
0912178	MW-9S	GW	Metals	Barium	-	-	J	Serial Dilution %D above QC limits.
0912178	MW-9S	GW	Metals	Beryllium	ND	-	U	CCB contamination, sample result <CRQL.
0912178	MW-9S	GW	Metals	Chromium	-	-	J	Serial Dilution %D above QC limits.
0912178	MW-9S	GW	Metals	Copper	-	-	J	Laboratory duplicate %RPD above QC limits.
0912178	MW-9S	GW	Metals	Potassium	-	-	J	Serial Dilution %D above QC limits.
0912178	MW-9S	GW	Metals	Silver	ND	-	U	ICB contamination, sample result <CRQL.
0912178	MW-9S	GW	Metals	Thallium	ND	-	U	ICB contamination, sample result <CRQL.
0912178	MW-9S	GW	Metals	Zinc	-	-	J	Laboratory duplicate %RPD above QC limits.
0912178	MW-9S	GW	SVOCs	3,3'Dichlorobenzidine	-	-	R	DMC recovery below QC limits, 0% recovery.
0912178	MW-9S	GW	SVOCs	4-Chloroaniline	-	-	R	DMC recovery below QC limits, 0% recovery.
0912178	MW-9S	GW	SVOCs	Hexachlorocyclopentadiene	-	-	R	DMC recovery below QC limits, 0% recovery.
0912178	MW-9S	GW	VOCs	Acetone	-	18	U	Rinsate blank contamination.
0912178	MW-9S	GW	VOCs	Carbon Disulfide	ND	-	U	Method blank contamination.
0912178	RMW-11D	GW	Metals	Aluminum	-	-	J	CCB contamination, sample result >CRQL and less than 10x blank contamination.
0912178	RMW-11D	GW	Metals	Antimony	ND	-	U	ICB contamination, sample result <CRQL.
0912178	RMW-11D	GW	Metals	Barium	-	-	J	Serial Dilution %D above QC limits.
0912178	RMW-11D	GW	Metals	Chromium	-	-	J	Serial Dilution %D above QC limits.
0912178	RMW-11D	GW	Metals	Copper	-	-	J	Laboratory duplicate %RPD above QC limits.

DATA QUALIFIER SUMMARY
ADDITIONAL GROUNDWATER DELINEATION AND GROUNDWATER AND SURFACE WATER MONITORING - 2009
216 PATERSON PLANK ROAD SITE
CARLSTADT, NEW JERSEY

SDG	Field ID	Matrix	Analysis	Analyte	New Result	New RL	QUAL	Comments
0912178	RMW-11D	GW	Metals	Lead	-	-	J	ICB contamination, sample result >CRQL and less than 10x blank contamination.
0912178	RMW-11D	GW	Metals	Potassium	-	-	J	Serial Dilution %D above QC limits.
0912178	RMW-11D	GW	Metals	Silver	ND	-	U	ICB contamination, sample result <CRQL.
0912178	RMW-11D	GW	Metals	Zinc	-	-	J	Laboratory duplicate %RPD above QC limits.
0912178	RMW-11D	GW	VOCs	Acetone	-	5.8	U	Storage blank contamination
0912178	RMW-11D	GW	VOCs	Carbon Disulfide	ND	-	U	Method blank contamination.
0912178	RMW-8D	GW	Metals	Aluminum	ND	-	U	CCB contamination, sample result <CRQL.
0912178	RMW-8D	GW	Metals	Antimony	ND	-	U	ICB contamination, sample result <CRQL.
0912178	RMW-8D	GW	Metals	Barium	-	-	J	Serial Dilution %D above QC limits.
0912178	RMW-8D	GW	Metals	Chromium	ND	-	U	Rinsate blank contamination.
0912178	RMW-8D	GW	Metals	Cobalt	ND	-	U	CCB contamination, sample result <CRQL.
0912178	RMW-8D	GW	Metals	Copper	-	-	J	CCB contamination, sample result >CRQL and less than 10x blank contamination.
0912178	RMW-8D	GW	Metals	Lead	ND	-	U	ICB contamination, sample result <CRQL.
0912178	RMW-8D	GW	Metals	Nickel	-	-	J	ICB contamination, sample result >CRQL and less than 10x blank contamination.
0912178	RMW-8D	GW	Metals	Potassium	-	-	J	Serial Dilution %D above QC limits.
0912178	RMW-8D	GW	Metals	Zinc	-	-	J	Laboratory duplicate %RPD above QC limits.
0912178	RMW-8D	GW	VOCs	Acetone	ND	-	U	Rinsate blank contamination.
0912178	RMW-8D	GW	VOCs	Carbon Disulfide	ND	-	U	Method blank contamination.
0912178	SW-01	SW	Metals	Antimony	ND	-	U	ICB contamination, sample result <CRQL.
0912178	SW-01	SW	Metals	Barium	-	-	J	Serial Dilution %D above QC limits.
0912178	SW-01	SW	Metals	Cadmium	-	-	J	CCB contamination, sample result >CRQL and less than 10x blank contamination.
0912178	SW-01	SW	Metals	Chromium	-	-	J	Serial Dilution %D above QC limits.
0912178	SW-01	SW	Metals	Cobalt	ND	-	U	CCB contamination, sample result <CRQL.
0912178	SW-01	SW	Metals	Copper	-	-	J	Laboratory duplicate %RPD above QC limits.
0912178	SW-01	SW	Metals	Lead	-	-	J	ICB contamination, sample result >CRQL and less than 10x blank contamination.
0912178	SW-01	SW	Metals	Potassium	-	-	J	Serial Dilution %D above QC limits.
0912178	SW-01	SW	Metals	Silver	ND	-	U	CCB contamination, sample result <CRQL.
0912178	SW-01	SW	Metals	Vanadium	ND	-	U	CCB contamination, sample result <CRQL.
0912178	SW-01	SW	Metals	Zinc	-	-	J	Laboratory duplicate %RPD above QC limits.
0907090	SW-01	SW	VOCs	Acetone	ND	-	U	Method blank contamination.
0912178	SW-01	SW	VOCs	Acetone	ND	-	U	Storage blank contamination.
0904021	SW-01	SW	VOCs	Carbon Disulfide	-	-	J	DMC % recovery above QC limits.
0912178	SW-01	SW	VOCs	Carbon Disulfide	ND	-	U	Method blank contamination.
0907090	SW-01	SW	VOCs	Cyclohexane	ND	-	U	Method blank contamination.
0907090	SW-01	SW	VOCs	Methylene Chloride	ND	-	U	Method blank contamination.
0904021	SW-01	SW	VOCs	Methylene Chloride	ND	-	U	Storage blank contamination.
0912178	SW-02	SW	Metals	Antimony	ND	-	U	ICB contamination, sample result <CRQL.
0912178	SW-02	SW	Metals	Barium	-	-	J	Serial Dilution %D above QC limits.
0912178	SW-02	SW	Metals	Beryllium	-	-	UJ	Internal Standard relative intensity below QC limits.
0912178	SW-02	SW	Metals	Cadmium	ND	-	U	CCB contamination, sample result <CRQL.
0912178	SW-02	SW	Metals	Chromium	-	-	J	Serial Dilution %D above QC limits.
0912178	SW-02	SW	Metals	Cobalt	ND	-	U	CCB contamination, sample result <CRQL.
0912178	SW-02	SW	Metals	Copper	-	-	J	Laboratory duplicate %RPD above QC limits.
0912178	SW-02	SW	Metals	Lead	-	-	J	ICB contamination, sample result >CRQL and less than 10x blank contamination.
0912178	SW-02	SW	Metals	Potassium	-	-	J	Serial Dilution %D above QC limits.
0912178	SW-02	SW	Metals	Silver	ND	-	U	CCB contamination, sample result <CRQL.
0912178	SW-02	SW	Metals	Thallium	-	-	UJ	Internal Standard relative intensity below QC limits.
0912178	SW-02	SW	Metals	Zinc	-	-	J	Laboratory duplicate %RPD above QC limits.
0904021	SW-02	SW	VOCs	1,1-Dichloroethane	-	-	J	DMC % recovery above QC limits.
0912178	SW-02	SW	VOCs	Acetone	ND	-	U	Storage blank contamination.
0912178	SW-02	SW	VOCs	Carbon Disulfide	ND	-	U	Method blank contamination.
0907090	SW-02	SW	VOCs	Cyclohexane	ND	-	U	Method blank contamination.
0907090	SW-02	SW	VOCs	Methylene Chloride	ND	-	U	Method blank contamination.
0904021	SW-02	SW	VOCs	Methylene Chloride	ND	-	U	Storage blank contamination.
0904021	SW-02FD	SW	VOCs	Methylene Chloride	ND	-	U	Storage blank contamination.
0912178	SW-03	SW	Metals	Antimony	ND	-	U	ICB contamination, sample result <CRQL.
0912178	SW-03	SW	Metals	Barium	-	-	J	Serial Dilution %D above QC limits.
0912178	SW-03	SW	Metals	Cadmium	ND	-	U	ICB contamination, sample result <CRQL.
0912178	SW-03	SW	Metals	Chromium	-	-	J	Serial Dilution %D above QC limits.
0912178	SW-03	SW	Metals	Cobalt	ND	-	U	ICB contamination, sample result <CRQL.
0912178	SW-03	SW	Metals	Copper	-	-	J	Laboratory duplicate %RPD above QC limits.
0912178	SW-03	SW	Metals	Lead	-	-	J	ICB contamination, sample result >CRQL and less than 10x blank contamination.
0912178	SW-03	SW	Metals	Potassium	-	-	J	Serial Dilution %D above QC limits.
0912178	SW-03	SW	Metals	Silver	ND	-	U	ICB contamination, sample result <CRQL.
0912178	SW-03	SW	Metals	Zinc	-	-	J	Laboratory duplicate %RPD above QC limits.
0912178	SW-03	SW	VOCs	Acetone	-	5.5	U	Storage blank contamination.
0912178	SW-03	SW	VOCs	Carbon Disulfide	ND	-	U	Method blank contamination.
0907090	SW-03	SW	VOCs	Cyclohexane	ND	-	U	Method blank contamination.
0904021	SW-03	SW	VOCs	Dichlorodifluoromethane	ND	-	U	Method blank contaminations.
0904021	SW-03	SW	VOCs	Methylene Chloride	ND	-	U	Storage blank contamination.
0912178	SW-04	SW	Metals	Antimony	ND	-	U	ICB contamination, sample result <CRQL.
0912178	SW-04	SW	Metals	Barium	-	-	J	Serial Dilution %D above QC limits.
0912178	SW-04	SW	Metals	Cadmium	ND	-	U	CCB contamination, sample result <CRQL.
0912178	SW-04	SW	Metals	Chromium	-	-	J	CCB contamination, sample result >CRQL and less than 10x blank contamination.
0912178	SW-04	SW	Metals	Cobalt	ND	-	U	CCB contamination, sample result <CRQL.
0912178	SW-04	SW	Metals	Copper	-	-	J	Laboratory duplicate %RPD above QC limits.
0912178	SW-04	SW	Metals	Lead	-	-	J	ICB contamination, sample result >CRQL and less than 10x blank contamination.
0912178	SW-04	SW	Metals	Potassium	-	-	J	Serial Dilution %D above QC limits.
0912178	SW-04	SW	Metals	Vanadium	ND	-	U	CCB contamination, sample result <CRQL.
0912178	SW-04	SW	Metals	Zinc	-	-	J	Laboratory duplicate %RPD above QC limits.
0912178	SW-04	SW	VOCs	Acetone	-	6.9	U	Storage blank contamination.
0904021	SW-04	SW	VOCs	Carbon Disulfide	-	-	J	DMC % recovery above QC limits.
0907090	SW-04	SW	VOCs	Carbon Disulfide	-	-	J	DMC % recovery above QC limits.
0912178	SW-04	SW	VOCs	Carbon Disulfide	ND	-	U	Method blank contamination.
0907090	SW-04	SW	VOCs	Cyclohexane	ND	-	U	Method blank contamination.
0904021	SW-04	SW	VOCs	Dichlorodifluoromethane	ND	-	U	Method blank contaminations.
0907090	SW-04	SW	VOCs	Methylene Chloride	ND	-	U	Method blank contamination.
0904021	SW-04	SW	VOCs	Methylene Chloride	ND	-	U	Storage blank contamination.
0910201	SW-04FD	SW	VOCs	Acetone	ND	-	U	Storage blank contamination.
0907090	SW-04FD	SW	VOCs	Carbon Disulfide	-	-	J	DMC % recovery above QC limits.
0907090	SW-04FD	SW	VOCs	Cyclohexane	ND	-	U	Method blank contamination.
0907090	SW-04FD	SW	VOCs	Methylene Chloride	ND	-	U	Method blank contamination.
0910201	SW-1	SW	VOCs	Acetone	ND	-	U	Storage blank contamination.
0910201	SW-2	SW	VOCs	Acetone	ND	-	U	Storage blank contamination.
0910201	SW-4	SW	VOCs	Acetone	ND	-	U	Storage blank contamination.

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ADDITIONAL GROUNDWATER DELINEATION AND GROUNDWATER AND SURFACE WATER MONITORING - 2009
216 PATERSON PLANK ROAD SITE
CARLSTADT, NEW JERSEY

SDG	Field ID	Matrix	Analysis	Analyte	New Result	New RL	QUAL	Comments

Abbreviations:
%D - percent Difference
CCB - Continuing Calibration Blank
CRQL - Contract Required Quantitation Limit
DMC - Deuterated Monitoring Compounds
FD - Field duplicate
GW - Groundwater
MS - Matrix Spike
NAPs - Natural Attenuation Parameters which include: Chloride, Nitrate, Nitrite, Sulfate, Alkalinity, Sulfide and Total Organic Carbon (TOC), and Total Iron
ND - Not Detected
Pest/PCBs - Pesticides/Polychlorinated Biphenyls
QC - Quality Control
QUAL - Qualifier
RL - Reporting Limit
SDG - Sample Delivery Group
SVOC - Semivolatile Organic Compounds
SW - Surface Water
TOC - Total Organic Carbon
VOC - Volatile Organic Compounds

APPENDIX C

HEALTH AND SAFETY PLAN

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1.0 GENERAL INFORMATION AND SCOPE OF WORK

1.1 Purpose

This Health and Safety/Contingency Plan (HASP) has been prepared by Golder Associates Inc. (Golder Associates) for investigation, pilot-test, and routine sampling activities at the 216 Paterson Plank Road Site (Site) Carlstadt, Bergen County, New Jersey. The purpose of this HASP is to assign responsibilities, establish personal protection standards, specify safe operating procedures, and provide for likely contingencies that may arise while conducting field activities at the Site.

This plan was prepared in accordance with "Guidance for Conducting Remedial Investigations and Feasibility Studies (RI/FS) under CERCLA" and the NIOSH/OSHA/USCG/EPA "Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities" as well as 29 CFR 1910.120, 29 CFR 1926 and applicable Federal and state regulations and guidelines. This HASP will be reviewed as necessary once field and/or laboratory data become available and amended, if appropriate, to ensure that the proper level(s) of protection and controls are used to manage the risk to on-site workers.

This HASP covers anticipated field activities including drilling, well installation, sampling of groundwater, sampling of surface water, manual nutrient injection and all non-intrusive tasks such as site walks and inspections. This HASP also covers chemical injection, in the event that an ISCO pilot test is conducted.

1.2 Site Background/History/Description

The 6-acre Site is a former chemical recycling and waste processing facility which ceased operation in 1980 and is located in a light industrial/commercial area of Carlstadt, New Jersey. The property is bordered to the southwest by Paterson Plank Road, to the northwest by Gotham Parkway, to the southeast by a trucking company, and to the northeast by Peach Island Creek. The Site was placed on USEPA's National Priorities List (NPL) in 1983.

Previous investigations on the Site have determined that soils and groundwater are contaminated with volatiles and semi-volatile compounds, pesticides, PCBs, and inorganic compounds.

Work on this project will take place at locations primarily outside the 216 Paterson Plank Road property and adjacent to the public rights-of-way which surround the property. Intrusive activities in all areas will require compliance with 29 CFR 1910.120 and additional precautions may be necessary due to the public's proximity to these areas. Unauthorized persons entering work areas will be asked to immediately leave. Should they ignore this request, Carlstadt Police will be notified and asked to come to the Site.

1.3 Project Safety Requirements

The level of protection and the procedures specified in this HASP are based on the information currently available to Golder Associates and represent the minimum health and safety requirements to be observed by all Site personnel executing field investigations. Unknown conditions at the Site may exist and known conditions may change. Should any hazardous situation arise which is obviously beyond the scope of the personal protection provided by this HASP, work activities will be immediately halted pending discussion with the Health and Safety Officer (HSO) and Project Manager, and revision of the specified health and safety procedures. Any revision of the health and safety procedures will be recorded in the Field Procedure Change Authorization Form, shown in Attachment 1, and will require authorization from the HSO and the Project Manager.

All Site personnel engaged in on-site activities should read this document carefully and complete the Safety Briefing Form in Attachment 2. Personnel who have any questions or concerns regarding implementation of this plan are encouraged to request clarification from the HSO or the Site Health and Safety Coordinator (SHSC). All personnel should follow the designated health and safety procedures, be alert to the hazards associated with working close to vehicles, equipment and waterways, and above all else, use common sense and exercise reasonable caution at all times.

1.3.1 Designated Safety Personnel and Chain of Command

Personnel responsible for implementing this HASP include the following:

Jim Valenti	Golder Project Health and Safety Officer
Heather Lin	Site Health and Safety Coordinator
Robert J. Illes, P.G.	Project Manager

Each subcontractor will have a designated Site Health and Safety Coordinator. Health and Safety Coordinators are responsible for assuring that the designated procedures are implemented in the field. The Golder Associates Site Health and Safety Coordinator is responsible for coordinating site safety activities.

The Health and Safety Coordinator has overall responsibility for establishing appropriate health and safety procedures for the project and will have the requisite authority to implement those procedures including, if necessary, the authority to temporarily shut the project down for health and safety reasons.

The Project Manager also has the authority to take whatever actions may be necessary, based on the advice and direction of the Health and Safety Officer, to provide a safe working environment for all project personnel.

The ultimate responsibility for the health and safety of the individual employee rests with the employee, and his or her colleagues. Each employee is responsible for exercising the utmost care and good judgment in protecting his or her own health and safety and that of fellow employees. Should any employee observe a potentially unsafe condition or situation, it is the responsibility of that employee to immediately bring the observed condition to the attention of the appropriate health and safety personnel as designated above, and to follow-up the verbal notification by completing the "Unsafe Conditions and Practices" report form provided in Attachment 3.

Should an employee find himself or herself in a potentially hazardous situation, the employee shall immediately discontinue the hazardous procedure(s) and either personally effect appropriate preventative or corrective measures, or immediately notify the Site Health and Safety Coordinator or Project Manager of the nature of the hazard. In the event of an immediately dangerous or life threatening situation, the employee always has "stop work" authority.

Unsafe work practices or procedures are never justified by "extenuating circumstances" such as budget or time constraints, equipment breakdown, changing or unexpected conditions, etc. In fact, the opposite is true. Under stressful circumstances all project personnel must be mindful of the potential to consciously or unconsciously compromise health and safety standards, and be especially safety conscious. All Site personnel are required to consider "safety first" at all times.

1.3.2 Medical Surveillance and Training

All personnel engaged in on-site activities on this project which have potential for exposure to chemical hazards should have a baseline physical examination(s) and be participants in their employer's medical surveillance program. This program should meet, at a minimum, the requirements of 29 CFR 1910.120(f). Procedures beyond baseline physical and routine medical surveillance are not planned for the tasks listed in this document. However, if site conditions change or new information is revealed the HSO/Project Manager reserves the right to modify or update the medical surveillance requirements.

All personnel conducting work activities which have potential for exposure to chemical hazards should be trained in accordance with 29 CFR 1910.120(e), including respiratory protection, personal protective clothing, decontamination and hazard recognition. Personnel should have completed appropriate refresher courses as detailed in 29 CFR 1910.120(e). Supervisory personnel will have completed the

supervisor training requirement detailed in 29 CFR 1910.120(e). Personnel who operate specialized equipment (e.g., backhoes) will be trained, and must be qualified, to operate such equipment.

These training requirements apply to all employees conducting work on Site unless the employer can demonstrate that the operation does not involve employee exposure or the reasonable possibility for employee exposure to chemical hazards. Some non-intrusive activities (e.g., site visits and general reconnaissance, supply delivery, surveying activities, etc.) meet this exemption. The training requirements for other non-intrusive activities will be reviewed on a case-by-case basis because Site conditions are subject to change. The SHSC will make the determination on a case by case basis and can consult the HSO, as necessary.

1.3.3 First Aid

A basic first aid kit shall be available in all field vehicles during all field work. This kit shall be of an appropriate size in relation to the number of personnel on-site and shall include, at a minimum, two pairs of latex gloves, CPR barrier, and eye wash solution in addition to typical first aid supplies. All first aid must be readily available within the Golder vehicle.

1.3.4 Communications

All field teams will be equipped with a mobile telephone. Since cellular coverage on the Site can be unreliable, coverage will be checked at the beginning of each work day. A list of mobile phone numbers will be kept with this HASP and at the Golder Mt. Laurel Office.

The protective equipment requirements for some tasks may necessitate the use of respiratory protection, which could adversely affect communications. In such instances, the field team will review the following basic hand signal communications during a safety briefing prior to donning respiratory protection equipment.

SITUATION	HAND SIGNAL
Out of air/can't breathe	Hand clutching throat
Need assistance	Hands on top of head
Thumbs up	OK/I'm all right/I understand
Thumbs down	No/Negative

1.4 General Hygiene and Conduct Guidelines

The following general personal hygiene and work practice guidelines are intended to prevent injuries and adverse health effects. These guidelines represent the minimum standard procedures for reducing potential risks associated with various aspects of this project and are to be followed by Site personnel at all times.

- A multi-purpose dry chemical fire extinguisher, a complete field first aid kit, and a bottle of emergency eye wash solution shall be maintained in every field vehicle (other than vehicles used for transportation purposes to and from the Site).
- Thoroughly wash hands and, if necessary, face before eating, smoking, or putting anything in your mouth (i.e., avoid hand to mouth contamination) and upon leaving the Site.
- Eating, drinking, chewing gum or tobacco, and smoking are permitted only in areas designated by the SHSC. Under no circumstances will these activities be permitted in the immediate vicinity of any intrusive activities (e.g., drilling or injection).
- Be alert to potentially changing exposure conditions, such as perceptible odors.
- Do not, under any circumstances, enter or ride in or on any backhoe bucket, materials hoist, or any other similar device not specifically designed for carrying passengers.
- Be alert to the symptoms of fatigue and heat/cold stress and their effects on the normal caution and judgment of personnel.
- Noise may pose a health and safety hazard. A good rule of thumb is if it is necessary to shout to communicate at a distance of 3 feet over continuous noise, hearing protection should be worn. Likewise, any impact noises from activities which are loud enough to cause discomfort indicate the need for hearing protection. Hearing protection is available and should be included in the standard field kit along with hard hat and safety glasses.
- Always use an appropriate level of personal protection as required by this HASP.
- Be aware of the affect of inclement weather (rain, snow, ice, lightning, etc.) on Site safety. Be prepared to suspend activities as conditions warrant.

1.5 Site Safety Meetings

The SHSC will conduct a Site safety briefing for all personnel on their initial arrival at Site. The topics to be covered are determined by the task activities, and should include:

- Weather related safety issues.
- Hazards specific to the task(s) and protective equipment.
- Unusual site conditions/areas.
- Safety problems and issues.

- Changes in the HASP.

The date, time, and attendees of each meeting will be documented on the form included as Attachment 2 and maintained on-site until the task is complete.

1.6 Acronyms and Definitions

As used in the HASP, the following terms have been defined:

ACGIH - American Conference of Governmental Industrial Hygienists

Authorized Personnel - Any person, such as task-specific personnel, project personnel, oversight personnel, contractor and consultants whose presence in the work area is authorized.

Breathing Zone - The worker's breathing zone is an imaginary sphere with a 6-9 inch radius measured from the worker's nose.

Contamination-Reduction Zone - The area designated for removal of contaminants from personnel and equipment. This area is adjacent to the Exclusion Zone. These areas might be used in certain situations where appropriate.

Contractor/Consultant - Any person or firm, retained or hired by the Respondents and/or their contractors, to carry out and/or supervise any portion of the activities conducted at the Site.

Exclusion Zone - The work area restricted to those directly involved in the ongoing work, has designated personal protective equipment (PPE), and meet training and medical monitoring requirements. The Exclusion Zone will be defined by a minimum 25-foot radius around the work area, where possible, and should be suitably marked.

HASP - Health and Safety/Contingency Plan.

HSO - Health and Safety Officer.

IDLH - Immediately Dangerous to Life and Health.

MSDS - Material Safety Data Sheets, which provide information on the physical, chemical, and hazardous properties of chemical compounds.

NIOSH - National Institute of Occupational Safety and Health.

On-site - Areas within the Site boundary.

Off-site - Areas outside the Site boundary.

OSHA - Occupational Safety and Health Administration.

Oversight Personnel - Any person, designated by the state or federal government, who is assigned to carry out oversight work.

PEL - Permissible Exposure Limit (as established by OSHA).

PPE - Personal Protective Equipment.

PPM - Parts per million; expressed on a weight basis for solids and liquids and as a volume basis (PPM(v)) for gases and vapors.

SHSC – Site Health and Safety Coordinator.

Site – The 216 Paterson Plank Road Site.

Support Zone - The area outside the Exclusion Zone that is considered clean for the purpose of the HASP. It is used for transfer of equipment and materials into the work site (i.e., support) and providing communications between the various zones. These areas might be used in certain situations, where appropriate.

TLV® - Threshold Limit Value (as established by the ACGIH).

2.0 HAZARD EVALUATION

Potential Site hazards include chemical hazards, physical hazards, and biological hazards. Each of these potential hazards is addressed below. A potential hazard analysis for each task is presented in Table 1.

2.1 Potential Chemical Hazards

Results of past sampling activities at the Site indicate VOC contamination of groundwater and surface water. Table 2 summarizes airborne exposure limits and health effects for the chemicals of concern found at the Site during previous investigations and compounds that have the potential to be generated during oxidant injection activities.

Potential hazards include:

(1) Inhalation of organic vapors due to the presence of VOCs in the groundwater and surface water.

(2) Inadvertent ingestion of potentially toxic substances via hand to mouth contact or deliberate ingestion of materials inadvertently contaminated with potentially toxic materials.

(3) Dermal exposure and possible percutaneous (skin) absorption of certain lipophilic (readily absorbed through the skin) organic chemicals.

(4) Dermal exposure to caustic substances injected during possible ISCO pilot test

(5) Inhalation of irritating substances (sodium persulfate) during possible ISCO pilot test.

Exposure via the ingestion route can be controlled effectively by the means of good personal hygiene habits, and prohibition of smoking, eating, drinking and chewing in contaminated areas. Similarly, dermal exposure can be eliminated by good personal hygiene and appropriate clothing. Control of potential inhalation exposures is addressed in Section 3 below. Hazards posed by sodium persulfate[1] will be controlled by heeding manufacture's warnings and by storing and handling the material according to their guidelines.

2.2 Potential Physical Hazards

2.2.1 Heat Stress

Working in protective clothing can greatly increase the likelihood of developing heat stress. This can result in health effects ranging from transient heat fatigue to serious illness or death. The Site Health and Safety Coordinator will be responsible for monitoring workers for signs and symptoms of heat stress.

[1] If ISCO pilot test is conducted

Workers shall monitor themselves and others for signs of heat stress when ambient temperatures exceed 80 degrees Fahrenheit (70 degrees when wearing Tyvek® coveralls; see Attachment 8, SWP 4).

2.2.2 Cold Stress

Personnel exposed to cold temperatures (especially during windy conditions) may be subjected to cold stress in the form of frost nip, frost bite or hypothermia. The Site Health and Safety Coordinator will be responsible for monitoring workers for signs and symptoms of cold stress. Workers shall monitor themselves and others for signs of frost nip when cold weather occurs. Extra caution will be exercised when working in windy conditions and/or when clothing becomes wet (see Attachment 8, SWP 5).

2.2.3 Traffic Hazards/Heavy Equipment

Traffic along public roadways adjacent to the Site will be an important hazard to recognize during Site activities. All personnel will stay off of the public roads and wear orange reflective safety vests. If working in an area of heavy traffic, notify the Project Manager and use extreme caution. The following precautions are required:

- Check with local authorities for appropriate regulations, and traffic control requirements. Generally, the local police department will provide traffic control services;
- Adequate barricades, channelization cones, flashing lights, flagmen, and warning signs shall be provided at all project sites adjacent to or in public traffic lanes;
- Adequate safety precautions must be observed when parking vehicles. Whenever a vehicle or heavy equipment is parked, the parking brake must be set. Equipment parked on inclines must have the wheels chocked or track mechanism blocked and the parking brake set; and
- Hard hats and reflective clothing must be worn while performing work in the vicinity of moving traffic.
- Site Control work zones will be established in accordance with Section 4.2 during drilling and chemical injection activities.

See Attachment 8 (SWP 18, SWP 21) for additional safe work practices on heavy equipment.

2.2.4 Overhead Hazards

Overhead hazards occur whenever there is moving equipment such as hoists, conveyors, drilling tools, etc., protrusions from machinery, or structural members present above eye level, or whenever an employee must work where there are other work activities being conducted above him (or her).

Be alert for potential overhead hazards; When working "below grade", be sure to keep all hand-tools, equipment and materials such as pipe, braces, lumber, etc., well back from the edge of the trench or hole so it doesn't get kicked in on your head; and

Always wear a hard hat when working in the vicinity of potential overhead hazards whether it is a "hard-hat area" or not. All hardhats must comply with ANSI Z89.1-1986

If excavation or drilling activities are performed in the vicinity of overhead lines, an alternative method should be considered. If an excavator or drill rig must be used, maintain the minimum specified clearance from all active power lines.

See Attachment 8 (SWP 11) for additional safe work practices for overhead hazards.

2.2.5 Drilling Activities

Some field work will be conducted in close proximity to drill rigs and related equipment. This machinery may only be operated by qualified, designated personnel. Any drill rig should be inspected by a competent mechanic and certified to be in safe operating condition before use. In particular, the emergency shut-off switch for any drill rig should be tested daily. Before drilling, the following guidelines should be followed:

- Inform staff of the emergency shut-off switch on the rig and have the driller test it daily;
- Get as much site-specific information as possible concerning ground conditions and surface obstructions. Ask the Project Manager and, if possible, the Client or Client Contact;
- Use available soils information (i.e., previous reports, US Geological Survey Surficial Geology Maps, colleagues who have had experience in the area) to ascertain potential subsurface conditions;
- Each drilling location should be inspected by the GAI field leader and subcontractor supervisor and approved as safe for drilling. Consider access requirements, and look for evidence of underground services (i.e., buried utility lines, wire, conduits, tanks, service boxes, plugs, exposed pipe, trenches, etc.), and locate the boreholes accordingly;
- Always utilize state, local, or 811 utility location services to get clearance to proceed at each drilling location. Plan at least 48 hours in advance prior to scheduled work;
- Look for surface and overhead features that may represent a hazard. Overhead power lines are a major concern and must be avoided or de-energized. Even without direct contact, electricity can arc from the power lines to another object;
- Do not pile drill spoil such that it could endanger workers;
- Drill rigs should not be operated within 12 feet of lines less than 132 KV; within 20 feet of lines 132 to 330 KV; or within 26 feet of lines greater than 330 KV;

- Drill rig should not be moved from one location to the next with the mast raised; and,
- Drill rig equipment should be safety inspected by the subcontractor on a daily basis dependent on specific use, field conditions, and manufacturer's recommendations.

During drilling the following guidelines should be followed:

- Identify a safe viewing area where you can observe the drilling operations, but not so close that you are either in danger of being struck by the equipment swinging from wirelines or winch cables;
- Always make sure you have a route of escape, should things go wrong. Be aware of wind direction and consider escaping upwind if subsurface contaminants are involved;
- Make sure the drill crew knows where you are **at all times**;
- Approach the drill rig during times when it is safest to do so. If necessary, signal the operator first and make sure the equipment is stopped before you approach;
- Avoid the temptation to act as the driller's helper. Do not handle heavy rods or equipment. Remember that the drilling contractor is responsible for providing the necessary drilling equipment and personnel who are trained in its safe use. This also includes traffic control needs, unless otherwise specifically indicated by GAI project manager (i.e. for road drilling where GAI provided the necessary traffic control);
- Know where everyone is at all times;
- Never use gasoline or any other combustible solvent as a cleaning agent. It is a fire and explosion hazard;
- Use a personal fall arrest system while working at any height above 5 feet on the mast or on top of the rig;
- Do not perform maintenance while the rig is running;
- Do not remove any blocking or jacks from under rig while the rig is drilling;
- Stand clear of cables as much as possible while pulling pipe or while the rig is under a heavy strain;
- When racking drill rods for rotary drilling/sampling, the total length of rods racked shall not be more than 1.5 times the height of the mast;
- Do not wear loose clothing or jewelry around moving machinery;
- Be on guard for pinch and shear hazards for fingers and toes--especially around the drill string;
- Practice good housekeeping--keep excess spoil material and unnecessary equipment well out of the way;
- When jumping batteries during cold weather starting, be sure of terminal connections. Connect the positive terminal first, then the negative terminal. Batteries can explode, spraying acid to eyes and skin; wear protective goggles and clothing;
- Communicate effectively; if using hand signals, make sure everyone knows what they are;
- Know where fire extinguisher(s) are and how to use them. Check the charge condition before the start of project activities, and periodically thereafter;
- All hoses carrying high pressure air or fluids should have safety chains or cables at connectors;

- Lighting on the site or rig shall be properly installed and sufficient in quantity to provide adequate illumination for night work. All receptacles shall be protected with a ground fault circuit interrupter (GFCI);
- Weight indicators should be standard equipment;
- All hooks shall have safety latches and be checked between borings;
- Do not ride on hook ropes or other traveling lines on rig;
- Keep walkways clear;
- Using a properly calibrated real-time air quality instrumentation, monitor for suspected airborne gas hazards (combustible and/or toxic as applicable);
- Ear protection must be worn by employees working in close proximity to equipment that generates noise (85 dB(A) or greater);
- Observe proper lifting techniques;
- Fuel tanks should be properly installed according to local fire codes with appropriate secondary contaminant;
- Wastewater and drilling fluids must be properly diverted or contained;
- Containerize drilling spoils and fluids suspected to be contaminated as required by environmental regulatory requirements;
- Protect the public by use of proper barricades, ramps over pipes, warning signs and guard rails;
- Use caution during welding activities, remain at a safe distance and do not look directly at the welding arc. The drillers will need to wear welding goggles and gloves; properly ground arcwelding equipment; properly vent PVC solvent glue vapors from installed well casings before cutting or welding the casings; and
- Have a first-aid safety kit handy.

After drilling the following guidelines should be followed:

- Properly decontaminate all drilling equipment, as required, before leaving. This includes drilling tools, pipe, pumping equipment, and mud-pits, in addition to the drill rig and drill string;
- Never leave a borehole open for an extended period. Always backfill and compact the near surface soil after you have completed sampling, any instrumentation installation(s) and documentation activities. Open drill holes represent a potential hazard to yourself and others; and,
- Clean up waste materials from drilling operations, such as discarded containers, hoses, damaged tools or blocking, and wasted pipe and casing, etc. Dispose of properly.

See Attachment 8 (SWP 1, SWP 17, SWP-21) for additional information regarding drilling.

2.2.6 Surface Water Hazards

Some field work will be conducted in and/or in close proximity to Peach Island Creek. Only field personnel that have the ability to swim and are comfortable working in or around water shall perform this work. Field personnel that do not meet this requirement will inform the Project Safety Officer / Project

Manger. This field work will be performed by field personnel wading into the creek and/or using a small boat. For all field work performed on or near water, where the danger of drowning exists, OSHA standard 29 CFR 1926.106, titled "Working Over or Near Water", will apply. The regulation states:

- Employees working over or near water, where the danger of drowning exists, shall be provided with U.S. Coast Guard-approved life jacket or buoyant work vests;
- Prior to and after each use, the buoyant work vests or life preservers shall be inspected for defects which would alter their strength or buoyancy. Defective units shall not be used; and,
- Ring buoys with at least 90 feet of line shall be provided and readily available for emergency rescue operations. Distance between ring buoys shall not exceed 200 feet.

Since the field work will be conducted in shallow water (3-4 feet), a lifesaving skiff will not be necessary (see Attachment 8, SWP25).

2.2.7 Noise

Noise may pose a health and safety hazard, particularly during construction activities. A good rule of thumb is that if it is necessary to shout in order to communicate at a distance of three feet in steady state (continuous) noise, hearing protection should be worn. Likewise, noises from activities which are loud enough to cause discomfort would also indicate the use of hearing protection. Hearing protection is available and should be included in the standard field kit along with hard hat and safety glasses.

See Attachment 8 for additional safe work practices for noise.

2.2.8 Slips, Trips and Falls

There are many situations that can cause slips, trips, and falls, such as ice, wet spots or uneven walking surfaces. The controls needed to prevent these hazards are usually obvious, but too often ignored, such as keeping walkways and stairs clear of scrap and debris; coiling up extension cords, lines, and hoses when not in use; keeping electrical and other wires out of the way; wearing lug soles in icy weather; clearing parking lots, stairs, and walkways in snowy weather; and using salt/sand as needed. Be aware of your surroundings and take the time to maintain an orderly worksite. This will reduce chances of slips, trips and falls.

See Attachment 8 (SWP 14) for additional safe work practices for slips, trips and falls.

2.2.9 Other Physical Hazards

All Site employees should take note of physical hazards which are identified during Site safety briefings and take the necessary precautions, including wearing the appropriate safety equipment to reduce

possibility of physical accidents. These hazards include, but are not limited to: steep slopes, holes or gullies covered by vegetation (trips and falls); sharp debris (puncture wound); overhead utilities, public traffic, and slippery, congested walking surfaces (falls).

Field personnel must be alert to the hazards associated with site vehicles, heavy equipment, and powered hand-held equipment operations. These hazards include noise, crushing injuries, overhead hazards, and pinch points. Personnel must be alert to weather-related hazards (e.g., lightning) or the possibility of increased hazard due to weather (e.g., slipping on mud or ice).

2.3 Potential Biological Hazards

The Site area may contain ticks, which can transmit Rocky Mountain Spotted Fever and Lyme Disease. During tick season (March to November), Site workers should routinely check for ticks. Light colored clothing should be worn and any openings (shirt and pant cuffs) should be secured to inhibit tick movement from clothing to skin. The use of insect repellents should be considered if its use will not interfere with sampling activities ***(check with Project Manager in advance of use for sample interference concerns)***. Field personnel will acquaint themselves with the symptoms of tick-borne diseases detailed below and will contact a physician as well as the HSO if disease is suspected.

Symptoms of Rocky Mountain Spotted Fever include fever chills, headache, abdominal muscle pain, and nausea. A red rash develops at the wrist and ankles two to five days after exposure. Symptoms develop two to fourteen days after exposure. Symptoms of Lyme Disease include fatigue and stiffness (particularly in the neck). There may be a red circular, or bull's-eye rash. Fever may be present. Symptoms develop a few days to two years after exposure. Personnel exhibiting symptoms of Rocky Mountain Spotted Fever or Lyme Disease should consult a medical professional immediately.

Skin-sensitizing (poisonous) vegetation produces a bumpy, swollen rash at the point of contact. This rash is easily spread if the oil gets on the fingers. Wash affected area(s) including tools as soon as possible. Use over-the-counter medications to reduce the irritation. Avoid scratching the rash. Cover the affected area(s) with clean dressings. Severe exposure may necessitate evaluation by a medical professional (see Attachment 8, SWP3).

2.4 Signs, Symptoms, and Control of Exposure

The health effects associated with the chemical contaminants at the Site are varied. Personnel who experience any of the following symptoms should report the occurrence to the SHSC promptly (see Table 2 for COCs and airborne exposure information)

- skin, eye, or respiratory system irritations;
- skin rashes/burns;
- headaches, dizziness;
- nausea/GI tract problems;
- muscle spasms/tremors;
- chills; and/or
- fatigue.

Note that the above symptoms are not necessarily caused by chemical exposure. Any serious medical problem should be referred to professional medical care. If personnel experience any of the above symptoms, the SHSC shall evacuate the area, if necessary, (in an upwind direction if possible) and evaluate affected personnel for signs and symptoms of exposure. Qualified personnel may take first aid measures if the symptoms are minor; otherwise, affected persons are to be transported to the designated medical facility. The activity will not resume until the appropriate level of protection is used. Atmospheric conditions will be evaluated by monitoring for concentrations of VOCs, O_2, and SO_2 as described in Section 3.

3.0 SITE MONITORING AND ACTION LEVELS

3.1 Non-Intrusive Tasks

During non-intrusive activities such as site walks (Table 3), air monitoring will not be required. Field team personnel are to be aware of any conditions that would indicate potential airborne chemical exposure (e.g. odor, visible plume or smoke, non-aqueous liquids, etc.). If such indicators are encountered, discontinue work and contact the HSO. A PID will be used for surface water sampling (Table 3) at the bank of Peach Island Creek and during sampling (Attachment 8, SWP 15).

3.2 Intrusive Tasks

Intrusive activities that will be subject to routine air monitoring (see Table 3) include well drilling and ISCO injection activities. At a minimum, a photoionization detector (PID) for VOCs, a combustible gas meter, and a particulate dust meter will be used during drilling activities. A PID will be used for groundwater sampling on initial opening of the well, when samples are not collected using low-flow purging and sampling techniques, or when previous measurements indicate more regular monitoring is prudent. Low-flow purging and sampling techniques minimize the amount of water being withdrawn from the well along with potential exposure. It is currently anticipated that all groundwater samples will be collected using low-flow purging and sampling techniques. Air monitoring when performing manual nutrient injections will be conducted on initial opening of the well or when initial measurements indicate more regular monitoring is prudent.

Contaminants of concern in soil that cannot be detected by PIDs include: aldrin, dieldrin, arsenic and lead. As a result, potential exposure risk has been calculated using the *Safety! Now* exposure extrapolation tool (see Table 4, "COC DustLevel Worksheet"). Based on concentrations in soil, exposures are expected to be below acceptable limits and respiratory equipment will not be required. On-site dust monitoring will be conducted using a real-time dust meter during drilling at regular intervals to evaluate airborne exposure and any upgrade in PPE that may be required.

3.3 VOC Monitoring

A variety of VOCs have been detected in the groundwater at the Site. VOCs that are of most concern from an inhalation standpoint are those that are moderately to highly toxic and have odor thresholds (i.e., lowest concentration of a chemical that can be detected by sense of smell by > 50% of exposed persons) higher than their corresponding TLV®/PEL. VOC monitoring will be conducted during all intrusive field activities.

The field personnel shall have a PID (Minirae®, Photovac MicroTip II® or equivalent) on-site at all times during field activities requiring VOC monitoring. Background levels should be established upwind of any work area. The employee breathing zone shall be monitored at least every 15 minutes, or whenever there is any indication that concentrations may have changed (odors, visible gases, stained appearance of excavated soils, etc.) since the last measurement. If the exact nature of the contaminant(s) is unknown, any consistent readings 1 ppm above background level in the breathing zone for more than five minutes, or any readings in the breathing zone greater than 10 ppm above background level other than a momentary peak, or any instantaneous peak >25 ppm above background level shall be the action level for leaving the impacted area. The HSO must be advised of such conditions and approve the revised procedures, e.g., donning Level C air purifying respirators. Prolonged concentrations above 25 ppm above background levels or numerous peaks will be evaluated by the HSO and Project Manager for possible upgrading to Level "B" respiratory protection.

Given the rapid "break through" time of some substances, Level C air purifying respirator cartridges will be replaced after each day of use or immediately upon an indication of "break through" (perceptible odors inside of the mask), whichever occurs first. High humidity situations (>80% relative humidity) may require cartridge replacement at a more frequent rate (every 4 hours).

Engineering controls such as additional ventilation or work up-wind of source may be used in place of respiratory protection if it is demonstrated through monitoring that the engineering controls are effective in reducing exposures to airborne concentrations.

3.4 Explosive-Fire Air Monitoring

During oxidant injection, the following parameters will be monitored at least every 15 minutes in the injection and monitoring well head spaces using combustible gas meters: LEL, O_2, and SO_2. During drilling activities, a combustible gas meter will be used to monitor LEL levels at least every 15 minutes (Table 3).

4.0 ON-SITE CONTROL

4.1 Site Communication System

Personnel will operate using the “buddy system” during intrusive activities. Each individual shall maintain visual/aural contact with another individual at all times. Field personnel will also be required to contact the Golder Associates Mt. Laurel, NJ office daily to verify location and safe conditions.

4.2 Site Safety Zone and Access Control

It is anticipated that on-site safety zones will be required for drilling activities and for caustic oxidant injections. The minimum size exclusion zone will be a 25-foot radius from the edges of the work zone. MSDS sheets for selected injection compounds are included in Attachment 4. Monitoring will be periodically conducted at the downwind perimeters of the Exclusion Zone to assure that the concentrations are similar to background concentrations. If perimeter concentrations are greater than background concentrations for more than five minutes, the downwind perimeter shall be extended to a point where downwind and background concentrations are similar. If perimeter monitoring indicates a need to extend the Exclusion Zone to a point where the Exclusion Zone intersects a Site boundary, or an area open to the general population, work will immediately cease. Exposed materials will be contained or covered and perimeter monitoring will continue until ambient air concentrations upwind and downwind of the Exclusion Zone are equal. The limits of the Exclusion Zone will be marked with high visibility fluorescent flagging tape or four or more traffic cones or similar devices.

The Exclusion Zone will be accessed through the Contamination Reduction Zone (CRZ). The CRZ shall be used to decontaminate both personnel and small equipment items. It shall contain decontamination materials (e.g., wash tubs, brushes, and PPE disposal bags) and shall be configured to allow the decontamination of the field crew while upwind of the Exclusion Zone to the extent practicable. The SHSC or his designee will assure that all personnel entering the Exclusion Zone wear the required protective equipment and that upgraded level of protection equipment is readily available.

As work activities will be conducted throughout the Site, a centralized decontamination facility may be used for the decontamination of field equipment and personnel. All decontamination materials and liquids from all areas will be collected in 55-gallon drums or other suitable containers and staged for proper disposal in accordance with Federal and local regulations.

4.3 Personal Protective Clothing and Respiratory Protection

RESPIRATORY	PROTECTION
LEVEL D	NA
LEVEL C	Air-Purifying Respirator
LEVEL B	Supplied Air Respirator
LEVEL A	Supplied Air Respirator (full face)
CLOTHING	**PROTECTION**
LEVEL 1	Standard work clothes, steel toed boots, safety glasses, hard hats (when an overhead hazard is possible); and hearing protection (during excessive noise producing activities)
LEVEL 2	Liner latex gloves and outer NBR gloves (as needed)
LEVEL 3	Tyvek® or polycoated Tyvek® coveralls with Level 2 gloves, face shield (during chemical mixing and injections)

At a minimum, initial PPE for all field activities will be D-2 (Respiratory Level D and Clothing Level 2). Minimum initial PPE for well drilling will be D-3 (Respiratory Level D and Clothing Level 3). Upgrading will be determined by air monitoring results during intrusive activities. Persons should make sound Site-specific judgments during the implementation of the work and use higher degree of clothing protection if needed to improve personal hygiene (use gloves or Tyvek® in dirty conditions) and respirators/dust masks, if desired. Similarly, for well drilling, the SHSC may suggest downgrading from Level D-3 to Level D-2 (with prior approval of the SHO and Project Manager) if splash hazard is not determined to be a concern (after initiating these activities).

If conditions are found which are beyond the available level(s) of protection, personnel are to leave the area immediately and obtain the required protective equipment. Should the personnel suspect an inhalation hazard (e.g. unusual and continuous odors, dizziness, or respiratory irritation), they are to immediately move upwind from the area. Such areas shall be noted on a map and the SHSC will be notified. Other Site personnel will be notified by the SHSC. Work will not proceed in these areas until the nature of the hazard has been assessed by air monitoring and additional protective measures are employed to the satisfaction of the Site SHSC. Re-entry will be from an upwind position (when possible). Monitoring will precede re-entry. Personnel who experienced symptoms will not re-enter the area until symptoms have subsided and additional equipment/precautions are employed as determined by the monitoring. An examination by a physician may be prudent depending on the symptoms and duration. In no case shall any person use Level B respiratory protection without approval of Project Manager.

Some field operations may involve the injection of caustic oxidation agents. Chemical exposure to all oxidizing agents will be minimized regardless of the chemical. In addition to the personal protective equipment described above, the following are required when handling or mixing ISCO injection materials:

- Waterproof chemical splash apron or equivalent;
- Goggles and face shield or full face respirator – **NO Contact Lenses**;
- Dust mask when solid chemicals are mixed;
- Chemical resistant rubber safety boots; and,
- Use of compatible materials.

Site equipment preventative maintenance described in Section 5.4 and air monitoring (Section 3.4) during chemical oxidation injections must also be followed.

4.4 Decontamination

Decontamination procedures will vary with respect to the level of PPE required. The following decontamination procedures shall be followed:

Decontamination Procedures for Level D2 Work

The primary decontamination objective for this level of PPE is to maintain good hygiene during the work and to minimize the off-site transport of any contaminants. Good hygiene can be maintained by the regular washing of hands and face and removing loose soil from boots or clothing, to the extent practicable.

Prior to leaving the Site, loose soil shall be removed from personnel and equipment. Visibly soiled boots and clothing shall be cleaned (via dry or wet brushing, wiping, scraping, shaking, patting, water washing, or other physical means) to remove the visible loose soil. It is recommended that personnel have a change of shoes for wearing off-site. Equipment can be decontaminated in a similar manner.

Decontamination Procedures for Work in Higher Levels of PPE

All personnel involved in activities with potential chemical hazards requiring a higher level of protection than PPE Level D2 and/or contaminated personnel shall decontaminate prior to leaving the Site. The decontamination area will require:

- 2 wash tubs (1 wash, 1 rinse);
- several scrub brushes;
- disposable towels and plastic bags;
- seating to facilitate boot removal;

- decontamination solution (e.g. Alconox);
- duct tape;
- hand soap; and,
- skin wash water source.

Personnel will follow the decontamination procedure below. At a minimum all personnel will wash their hands, face, and boots (if visually soiled) upon leaving the Site. Clothing that is visually free of loose soil may be worn off-site. Loose soil may be removed by scraping, wiping, patting, shaking, or otherwise removed to allow wearing off-site. The SHSC shall inspect personnel and non-disposable protective equipment for cleanliness prior to release from the Site. The following decontamination procedures shall be used, as appropriate:

Station 1: Equipment Drop
Deposit visibly soiled equipment used on-site (hand tools, sampling devices and containers, monitoring instruments, clipboards, etc.) on plastic drop cloths. Segregation at the drop reduces the probability of cross contamination. During hot weather operations, a cool down station may be set up within this area. Cover for reuse the following day or decontaminate.

Station 2: Outer Garment, Boots and Gloves Wash and Rinse (if applicable)
Scrub boots, outer gloves and splash garments (if worn) with decon solution. Rinse off with water. Alternatively remove and discard in covered container.

Station 3: Outer Glove Removal (if applicable)
Remove outer gloves. Deposit in container with plastic liner.

Station 4: Cartridge or Respirator Change (if applicable)
If worker leaves exclusion zone to change cartridges (or respirator), this is the last step in the decontamination procedure. Worker's canister is exchanged, new outer gloves donned, joints taped, if necessary, and worker returns to duty.

Station 5: Boot, Gloves and Inner Garment Removal (if applicable)
Boots, protective suit, inner gloves removed and deposited in disposal containers (when not re-usable).

Station 6: Respirator Removal (if applicable)
Respirator is removed. Avoid touching face with fingers, respirator deposited on plastic sheet.

Station 7: Field Wash
Hands and face are thoroughly washed. Shower as soon as possible (off-site showering is acceptable as along as gross contamination is removed from clothing, hands and face prior to exiting the decontamination area).

Monitoring equipment and hand tools shall be retrieved and decontaminated as needed using methods appropriate for the type of equipment. Equipment shall be wrapped in plastic for overnight storage. Prior to use each day, the SHSC shall inspect the equipment for cleanliness.

All chemicals brought to the Site will have the appropriate Material Safety Data Sheet(s) (MSDS) provided to the SHSC. MSDS are located in Attachment 4.

5.0 CONTINGENCY AND EMERGENCY RESPONSE PLANS

If an unanticipated, potentially hazardous situation arises such as explosion, vapor release, unusual or excessive odors, Site personnel shall temporarily cease operations, move away to a safe area, and contact the SHSC. The following procedures have been established to deal with emergencies that might occur during Site activities.

Prior to starting intrusive work, Site personnel will familiarize themselves with the location the Meadowland Hospital facilities. In the event of a serious emergency (e.g. medical problems beyond routine first aid and fire beyond incipient stage), Site personnel shall call 911, inform them of the nature of the emergency, and then notify the SHSC. When help arrives, Site personnel shall defer all emergency response authority to appropriate responding agency personnel. Emergency notification information is summarized in Attachment 5 of this document.

5.1 Medical Emergency Response Plan

Other than removal of outer protective garments and gross contamination (e.g., mud), immediate emergency treatment of injuries should take precedence over personal decontamination. Should any person on the Site be injured or become ill, initiate the following emergency response plan and notify the on-site SHSC/Project Manager as soon as possible:

1. If able, the injured person should proceed to the nearest available source of first aid. If the injured party is extremely muddy, remove outer garments and if necessary, wash the injured area with soap and water. If the "injury" involves a potential overexposure to hazardous gases or vapors (headache, dizziness, nausea, disorientation), get the victim to fresh air and take him or her to the Meadowlands Medical Center (see Directions in Section 5.9 and Attachment 6) for a complete physical examination as soon as possible.

   If the injury involves foreign material in the eyes, immediately flush the eyes with emergency eye wash solution and/or rinse with copious amounts of potable water. Obtain or administer first aid as required. If further medical treatment is required, seek professional medical assistance as discussed below.

   Severe injuries involving large quantities of blood require that first aid providers don Tyvek coveralls and safety glasses in addition to gloves.

2. If the victim is unconscious or unable to move, or if there is any evidence of spinal injury, do not move the injured person unless absolutely necessary to save his or her life until the nature of the injury has been determined. Administer rescue breathing using a CPR barrier if the victim is not breathing, control severe bleeding and immediately seek medical assistance as discussed below.

3. If further medical treatment is required and

   a. the injury is not severe, take the injured party to the hospital by private automobile (see Attachment 6).
   b. the injury is severe, immediately call Ambulance and/or Fire/Rescue (see Attachment 5).

In both cases, if decontamination is not undertaken, appropriate precautions should be taken to avoid transfer of contaminants to vehicles and other facilities. This can be done by using plastic sheeting or the exposure blanket contained in the first aid kit.

4. Any injured person taken to the hospital shall be accompanied by an individual designated by the SHSC to ensure prompt and proper medical attention. After proper medical treatment has been obtained, the designated companion should notify the HSO and prepare a written report. Site personnel shall maintain their medical insurance identification at the Site whenever they are on Site.

   In the event that any personnel are injured at the Site, all available technical information and supporting documentation shall be provided to any treating physicians, or treating health care workers or facilities.

5.2 Fire and Explosions

Dry chemical fire extinguishers are effective for fires involving ordinary combustibles such as wood, grass, flammable liquids, and electrical equipment. They are appropriate for small, localized fires such as a drum of burning refuse, a small burning gasoline spill, a vehicle engine fire, etc. No attempt should be made to use these extinguishers for well-established fires or large areas or volumes of flammable liquids.

NOTE: Dry chemical or inert gas fire extinguishers should NOT be used on sodium persulfate fires. Large volumes of water (8 pounds of water per pound of sodium persulfate) should be used to extinguish the fire.

In the case of fire, prevention is the best contingency plan. There will be no smoking on Site except in pre-designated areas. In the event of a fire during intrusive tasks, personnel shall attempt to extinguish the fire with on-site fire extinguishers. If a fire cannot be controlled in this manner, personnel shall notify the SHSC and follow the procedure outlined below.

Catalytic converters on the underside of vehicles are sufficiently hot to ignite dry grass. Personnel should avoid driving over dry grass that is higher than the ground clearance of the vehicle, and be aware of the potential fire hazard posed by the catalytic converter, at all times. Never allow a running vehicle to sit in a stationary position over dry grass or other combustible materials.

In the event of a fire or explosion:

1. If the situation can be readily controlled with available resources without jeopardizing the health and safety of Site personnel, take immediate action to do so. If not:

2. Isolate the fire to prevent spreading, if possible.

3. Clear the area of all personnel working in the immediate vicinity.

4. Immediately notify Site emergency personnel and the Carlstadt Fire Department (201) 483-4300, or 911 using a standard phone.

5.3 Chemical Exposure First Aid

In an event of exposure to chemicals through inhalation:

1. Move the victim to an up-wind location for fresh air.
2. Signal for help.
3. Initiate CPR to revive the victim, if necessary.
4. Contact the Paramedics (Ambulance), if necessary.

For exposure through dermal route (including eyes):

1. Wash the affected area with copious fluids for at least fifteen (15) minutes (Signal for help if necessary).
2. If irritation persists, seek professional medical care.

For ingestion:

1. Drink a large amount of water to dilute the contaminant(s).
2. Transport the victim to the hospital. Take a copy of this HASP to the hospital.

If decontamination is not undertaken prior to transporting the victim to the hospital, appropriate precautions (such as use of plastic sheeting or exposure blanket from the first aid kit) should be taken to avoid transfer of contaminants to vehicles and other facilities.

5.4 ISCO Injection Preventative Maintenance

Preventative maintenance procedures will be implemented during oxidant injections. Injection system (pumps, piping, joints, etc.) will be inspected daily prior to start up and equipment conditions recorded. System conditions will also be inspected prior to re-start after any required stoppages due to system alteration, maintenance, relocation or solution preparation. A leak test will be performed prior chemical injection or prior any modification of the system (e.g.; valve replacement, etc.) with water at a pressure equal to three times the chemical working pressure.

Any items noted during the inspections will be rectified prior to continuing operations. Actions taken will be noted.

Chemical injections will occur with pre-determined masses of oxidant and catalyst to be injected into the injection wells.

Chemicals will be delivered to injection wells from batch solution tanks via an injection pumps. The solution volume, concentration, and pH will be recorded prior to injection and total injected volumes will be recorded by noting the changes in tank elevation and the time differential between readings.

To minimize health and safety issues, the operation parameters will be:

- Restricted chemical flows (< 10 L/min)
- Low pressure (< 20 psig)
- Low temperature (< 60 °C)
- Low concentration solution (dependant on oxidant/activator selected)
- The use of compatible materials. Persulfate is a strong oxidizer (MSDS is provided in Attachment 4) and can pose a fire hazard either through heat of reaction or the release of oxygen may exacerbate other fire hazards. Small liquid spills can be collected using a non-combustible material such as vermiculite and place into a HDPE container for later disposal
- Spills should be neutralized and a neutralizing agent (calcium carbonate) must be kept available.

5.5 Major Vapor Emission Plan

A vapor emission control plan shall be instituted during intrusive test activities with the potential for a release of VOCs. The major components of this plan are described in the following sections.

5.5.1 Monitoring Requirements

The upwind and downwind perimeters of the work area (or exclusion zone, if it has been determined that one needed to be set up) shall be monitored for VOCs using a PID. Monitoring will initially be conducted hourly, and will be reduced if initial monitoring indicate this is appropriate. The following action levels/response actions will be taken:

- If total VOC levels exceed 5 ppm above background at the downwind perimeters of the work area the wind direction will be noted and work activities must be halted and monitoring continued.
- If, after halting work the VOC levels decrease below 5 ppm above background at the downwind perimeter of the work area, work activities can resume.
- If, after halting work the VOC levels are greater than 5 ppm but less than 25 ppm over background at the perimeter of the work area, VOC levels at 200 feet downwind of the work area perimeter (or half the distance to the nearest non-Site work-related receptor, whichever is less) will be measured. If the VOC levels are below 5 ppm over background at this location, work activities can resume. Otherwise, engineering controls should be used to mitigate VOC emissions.
- If the VOC levels are above 25 ppm at the perimeter of the work area, work activities must be shut down. When work activities are shut down, downwind air monitoring, as directed by the

SHSC, will be conducted to ensure that the nearest receptor is not impacted at levels exceeding those specified below as a major vapor emission. Engineering controls shall be applied to control VOC emissions as appropriate.

Boundary checks of fugitive emissions of organic vapors will be monitored daily at the nearest receptor or property boundary downwind from the injection points. A PID will be used to monitor organic vapors.

If PID readings during any given check exceed 5 ppm the air monitoring with the PID then the injections will be stopped. If noticeable odors are encountered during the boundary checks, related to the injection activity, the injections will be stopped.

Injections can only continue once the events leading to the termination of the injection have been reviewed and control measures have been implemented to reduce the re-occurrence of the same conditions. Control measure may include reducing the injection rate and the use of fans and blowers to improve local ventilation.

5.5.2 Major Vapor Emission

A major vapor emission is identified as VOC levels greater than 5 ppm over background measured at a location 200 feet downwind of the work area perimeter (or exclusion zone) or half the distance to the nearest receptor, whichever is less.

- If the above levels are measured, all work activities must be shutdown and engineering controls should be used to mitigate VOC emissions.
- If, after the work is halted, or as the result of an emergency, VOC levels persist above 5 ppm above background at a distance of 200 feet downwind of the work area perimeter (or half the distance to the nearest receptor, whichever is less) for an extended period of time, then air monitoring should be conducted within 20 feet of the perimeter of the nearest receptor (20 foot zone).
- If efforts to abate the emission source are unsuccessful and if the VOC levels persist at above 5 ppm above background for more than 30 minutes in the 20-foot zone, then the Major Vapor Emission Response Plan, as presented below, shall be placed into effect. If VOC levels are greater than 10 ppm in the 20-foot zone for any period of time, the Major Vapor Emission Response Plan shall be placed into effect immediately.
- If, after the work is halted, efforts to abate the emission source are successful, and VOC levels are below 5 ppm above background at a location 200 feet downwind of the work area (or half the distance to the nearest receptor, whichever is less), work activities can resume.

5.5.3 Response Plan

The Major Vapor Emission Response Plan shall include, at a minimum, the following activities:

- All Emergency Response Contacts as listed in the HASP for the project will go into effect;
- The local police or emergency management/response authorities will immediately be contacted by the SHSC and advised of the situation; and
- Continuous air monitoring will be conducted, with recordings made on 30-minute intervals, within the 20-foot zone. If readings below 5 ppm are sustained for a minimum of 30 minutes, air monitoring at the 20-foot zone may be halted or modified by the HSO.

5.6 Unforeseen Circumstances

The health and safety procedures specified in this plan are based on the best information available at the time. Unknown conditions may exist, and known conditions may change. This plan cannot account for every unknown or anticipate every contingency. Should personnel suspect or encounter areas of substantially higher levels of contamination, or should any situation arise which is obviously beyond the scope of the safety procedures specified herein, work activities shall be halted pending discussions with the Health and Safety Officer and implementation of appropriate protective measures.

5.7 Accident and Incident Reports

If an incident or accident occurs, the HSO and PM shall be notified and the Incident Report (shown in Attachment 7) shall be completed. The report shall be completed by eyewitnesses (if possible) along with assistance from the SHSC. The report will be forwarded to the Health and Safety Officer as soon as possible for further investigation or follow up.

5.8 Emergency Contacts

Emergency notification information is summarized in Attachment 5 of this document.

5.9 Directions to Hospital

The directions listed below should be followed to get from the Site to the Mountainside Hospital:

- Head northwest on NJ-120/Paterson Plank Rd toward Gotham Pkwy;
- Slight right toward NJ-120/Paterson Plank Rd;
- Turn left at NJ-120/Paterson Plank Rd;
- Take the ramp onto NJ-120;
- Take the ramp onto NJ-3E;
- Take the Meadowland Pkwy exit;
- Turn left at Meadowlands Pkwy
- Hospital is at 55 Meadowlands Pkwy.

A map showing the location of the hospital relative to the Site is provided as Attachment 6.

Table 1
Task Hazard Analysis
216 Paterson Plank Road Site

This table details site activities and anticipated associated risks by class: Biological, Chemical, or Physical. Personal Protective Equipment level, weather, air temperature and season may effect the magnitude of some types of risk. Site personnel shall use prudent judgment at all times.

Task/Activity	Hazard		
	Biological	Chemical	Physical
Walk Through	L	L-M	L-M
Groundwater Sampling	L	L-M	L-M
Drilling, Rock Coring	L	L-M	M
Chemical Injection	L	M - H	L-M
Surface Water Sampling	L	L	M

Many of the chemicals identified in the on site media can enter through the skin. This route of entry must be protected whenever skin contact is probable.

L: Low
M: Moderate
H: high

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Table 2
Airborne Exposure Limit Information
216 Paterson Plank Road Site

Chemical	OSHA PEL	NIOSH REL	ACGIH TLV	IDLH	Ionization Potential, eVolts	MicroTip II Response Factor	Odor Threshold, ppm
aldrin	0.250 mg/m3	NE	0.25 mg/m3	10mg/kg	NR	NR	--
arsenic	0.010 mg/m3	0.002 mg/m3 C	0.01 mg/m3	20 mg/m3	NA	NA	--
benzene	1 ppm	0.1 ppm	10 ppm	3000 ppm Ca	9.24	0.6	34 - 119
cyanide (HCN)	4.7 ppm short term	4.7 ppm short term	10 ppm ceiling	50 ppm	13.9	NR	0.1 - 5.0
carbon dioxide	9000 mg/m3	9000 mg/m3	TWA 5000 ppm; ST 30,000 ppm	40,000 ppm	NA	NA	odorless
dieldrin	0.250 mg/m3	NE	0.25 mg/m3	10 mg/kg	NR	NR	--
hydrogen sulfide	10 ppm	10 ppm C	10 ppm	300 ppm	10.46	NR	0.001 - 0.13
lead	0.05 mg/m3	0.1 mg/m3	0.15 mg/m3	700 mg/m3	NA	NA	--
methane	NE	NE	NE	5% (LEL)	13	NR	odorless
PAH, fluoranthrene	0.2 mg/m3	0.1 mg/m3	0.2 mg/m3	700 mg/m3 Ca	varies	NR	--
PAH, phenanthrene	0.2 mg/m3	0.1 mg/m3	0.2 mg/m3	700 mg/m3 Ca	varies	NR	--
PAH, pyrene	0.2 mg/m3	0.1 mg/m3	0.2 mg/m3	700 mg/m3 Ca	varies	NR	--
PCBs, 54% chlorine	0.5 mg/m3 skin	0.001 mg/m3	0.5 mg/m3	5 mg/m3, Ca	unknown	unknown	--
sulfur dioxide	13 mg/m3	5 mg/m3	TWA 2 ppm; ST 5 ppm	100 ppm	12.32	NA	1
tetrachloroethylene	25 ppm	minimize	25 ppm	500 ppm, Ca	9.32	NR	47
trichloroethene	50 ppm	25 ppm	50 ppm	1000 ppm Ca	9.45	0.6	82
vinyl chloride	1 ppm	NA Ca	1 ppm	NE	9.99	2.32	--
1,4-Dioxane	360 mg/m3	3.6 mg/m3	TWA 20 ppm	Ca [500 ppm]	9.13	NR	--

OSHA PEL: Occupational Safety and Health Adminstration Permissable Exposure Limit
NIOSH REL: National Institute of Occupational Safety and Health Recommended Exposure Limit
ACGIH TLV: American Conference of Governmental Industrial Hygienists Threshold Limit Value
IDLH: Immediately Dangerous to Life or Health
ppm: parts per million
Ca: carcinogen
lowest feasible: reduce exposure to lowest feasible concentration
minimize: minimize exposure
mg/m3: milligrams per cubic meter
mg/kg: milligrams per kilogram of body weight (Sax)
NE: Not Established
NA: Not Applicable
NR: Not Reported
"--": not available

Table 3
Levels of Personal Protection and Upgrade Criteria
216 Paterson Plank Road Site

Task	Initial Level of Protection	Air Monitoring Equipment	Upgrade Criteria	Upgraded Level of Protection
Walk Through	D1	NA	Condition Dependent	Condition Dependent
Groundwater Sampling	D2	PID	VOCs continuously greater than background, or >5 ppm above background for short intervals or any peak >10 ppm	C2
			Continuously greater than 25 ppm, or frequent peaks greater than 50 ppm	Temporarily cease work until concentration subsides and evacuate immediate area or B2
Drilling, Rock Coring	D2	PID	VOCs continuously greater than background, or >5 ppm above background for short intervals or any peak >10 ppm	C2
			Continuously greater than 25 ppm, or frequent peaks greater than 50 ppm	Temporarily cease work until concentration subsides and evacuate immediate area or B2
		Real Time Dust Meter	If the Dust Meter is >2.5 mg/m3 (in breathing zone) (1)	Cease work and evacuate area. Upgrade to level C for emergency stabilization/ demobilization purposes only. Evaluate if mechanical ventilation is feasible. Contact PM and HSC for further options.
Chemical Injection	D3	PID	VOCs continuously greater than background, or >5 ppm above background for short intervals or any peak >10 ppm	C2
			Continuously greater than 25 ppm, or frequent peaks greater than 50 ppm	Temporarily cease work until concentration subsides and evacuate immediate area or B2
		MSA 361	LEL:>10%, <20%	Continue with Caution
			>20%	Temporarily cease work until concentration subsides and evacuate immediate area
			H2S:>10 ppm for more than 1 hour, or >15 ppm for more than 15 minutes, or >25 ppm at any time	Temporarily cease work until concentration subsides and evacuate immediate area or B2

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Table 3
Levels of Personal Protection and Upgrade Criteria
216 Paterson Plank Road Site

Task	Initial Level of Protection	Air Monitoring Equipment	Upgrade Criteria	Upgraded Level of Protection
Well Installation	D1	PID	VOCs continuously greater than background, or >5 ppm above background for short intervals or any peak >10 ppm	C2
			Continuously greater than 25 ppm, or frequent peaks greater than 50 ppm	Temporarily cease work until concentration subsides and evacuate immediate area or B2
Surface Water Sampling	D1, modified	PID	VOCs continuously greater than background, or >5 ppm above background for short intervals or any peak >10 ppm	C2
			Continuously greater than 25 ppm, or frequent peaks greater than 50 ppm	Temporarily cease work until concentration subsides and evacuate immediate area or B2
Drill Rig/ Equipment Decontamination	D1 plus Goggles or Faceshield, Gloves Rain suit	NA	NA	NA

1) These thresholds can be

Condition Dependent: Personnel are to use prudent judgement and select additional PPE based on current Site conditions (e.g., wet or muddy) to prevent unnecessary contamination.

Site personnel are permitted, with HSO approval , to substitute protective aprons and/or gauntlets when exposure to water/sediment samples is readily controlled. This substitution is permitted to reduce the possibility of heat stress caused by working in full coverall protection.

Table 4
COC Dust Level Worksheet
216 Paterson Pland Road Site

Chemical	Exposure Limit (mg/m3)	Exposure Limit Based on Single Compound (EL Mix, mg/m3)	Dust Quotient for Each Compound (level/limit)	Problem from Single Compound [5mg/m3)/ELmix]
Aldrin	0.25	3.91E+4	6.40E+00	0.000
Dieldrin	0.25	7.27E+4	3.44E+00	0.000
Arsenic	0.01	6.37	3.93E+04	0.785
Lead	0.05	9.47	2.64E+04	0.528
		Sum	6.57E+04	
[1] Dust Exposure Level at Mixture PEL =		3.807		1.313

[1] If this level is less than 1, significant exposure could occur, use respiratory protection. If level is >2, no respiratory protection required unless visible dust is present.

Safety Factor :If you are confindent in the data representing the site use 2; less confidence use 4. If you have no confindence use 10 or 20.

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ATTACHMENT 1

EXAMPLE FIELD PROCEDURES CHANGE AUTHORIZATION

ATTACHMENT 1

Example Field Procedures Change Authorization

Instruction Number: _____ Date:_____

Duration of Authorization Requested ___ Today only

___ Duration of Task

Description of Procedures Modification:

Justification:

Person Requesting Change: Verbal Authorization Received From:

Name	Name	Time
Title	Title	
Signature	Approved By	

(Signature of person named above to be obtained within 48 hours of verbal authorization)

ATTACHMENT 2

SITE HEALTH AND SAFETY PLAN ACKNOWLEDGEMENT

ATTACHMENT 2

SITE HEALTH AND SAFETY PLAN ACKNOWLEDGEMENT

I have read understand and agree to follow the provisions detailed in the Health and Safety/Contingency Plan for the Caldwell trucking Company Superfund Site.

I am aware of emergency procedures, equipment locations, and emergency telephone numbers.

I understand that my failure to comply with these provisions may lead to disciplinary actions and/or my dismissal from the Site.

Printed Name	Organization	Signature	Date/Time

This form is to be kept on file on Site. Copies should be made available to personnel from all companies involved with Site work.

ATTACHMENT 3

EXAMPLE REPORT FORM FOR UNSAFE CONDITIONS AND PRACTICES

ATTACHMENT 3
EXAMPLE
REPORT FORM FOR UNSAFE CONDITIONS AND PRACTICES

DESCRIPTION OF UNSAFE CONDITION OR PRACTICE _____

_____

_____

_____

_____

DESCRIPTION OF CIRCUMSTANCES SURROUNDING UNSAFE CONDITION OR PRACTICE _____

_____

_____

_____

_____

IS THIS AN EXISTING CONDITION OR POTENTIAL HAZARD? _____

REPORTED TO _____

REPORTED BY _____ **DATE** _____

COMMENTS _____

_____

_____

_____

_____

REPORT RECEIVED BY _____

DATE _____

ATTACHMENT 4

MSDS SHEETS

MATERIAL SAFETY DATA SHEET

Sodium Persulfate

MSDS Ref. No.: 7775-27-1
Date Approved: 04/30/2006
Revision No.: 12

This document has been prepared to meet the requirements of the U.S. OSHA Hazard Communication Standard, 29 CFR 1910.1200; the Canada's Workplace Hazardous Materials Information System (WHMIS) and, the EC Directive, 2001/58/EC.

1. PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME:	Sodium Persulfate
SYNONYMS:	Sodium Peroxydisulfate; Disodium Peroxydisulfate
GENERAL USE:	Polymerization initiator. Etchant and cleaner in manufacture of printed circuit boards. Booster in hair bleaching formulations in cosmetics. Secondary oil recovery systems as a polymerization initiator and a gel breaker.

MANUFACTURER

FMC CORPORATION
FMC Peroxygens
1735 Market Street
Philadelphia, PA 19103
(215) 299-6000 (General Information)

EMERGENCY TELEPHONE NUMBERS

(303) 595-9048 (Medical - U.S. - Call Collect)

For leak, fire, spill, or accident emergencies, call:
(800) 424-9300 (CHEMTREC - U.S.A. & Canada)

2. HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW:

- White, odorless, crystals
- Oxidizer.
- Decomposes in storage under conditions of moisture (water/water vapor) and/or excessive heat causing release of oxides of sulfur and oxygen that supports combustion. Decomposition could form a high temperature melt. See Section 10 ("Stability and Reactivity").

POTENTIAL HEALTH EFFECTS: Airborne persulfate dust may be irritating to eyes, nose, lungs, throat and skin upon contact. Exposure to high levels of persulfate dust may cause difficulty in breathing in sensitive persons.

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3. COMPOSITION / INFORMATION ON INGREDIENTS

Chemical Name	CAS#	Wt.%	EC No.	EC Class
Sodium Persulfate	7775-27-1	>99	231-892-1	Not classified

4. FIRST AID MEASURES

EYES: Flush with plenty of water. Get medical attention if irritation occurs and persists.

SKIN: Wash with plenty of soap and water. Get medical attention if irritation occurs and persists.

INGESTION: Rinse mouth with water. Dilute by giving 1 or 2 glasses of water. Do not induce vomiting. Never give anything by mouth to an unconscious person. See a medical doctor immediately.

INHALATION: Remove to fresh air. If breathing difficulty or discomfort occurs and persists, contact a medical doctor.

NOTES TO MEDICAL DOCTOR: This product has low oral toxicity and is not irritating to the eyes and skin. Flooding of exposed areas with water is suggested, but gastric lavage or emesis induction for ingestions must consider possible aggravation of esophageal injury and the expected absence of system effects. Treatment is controlled removal of exposure followed by symptomatic and supportive care.

5. FIRE FIGHTING MEASURES

EXTINGUISHING MEDIA: Deluge with water.

FIRE / EXPLOSION HAZARDS: Product is non-combustible. On decomposition releases oxygen which may intensify fire. Presence of water accelerates decomposition.

FIRE FIGHTING PROCEDURES: Do not use carbon dioxide or other gas filled fire extinguishers; they will have no effect on decomposing persulfates. Wear full protective clothing and self-contained breathing apparatus.

FLAMMABLE LIMITS: Non-combustible

SENSITIVITY TO IMPACT: No data available

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SENSITIVITY TO STATIC DISCHARGE: Not available

6. ACCIDENTAL RELEASE MEASURES

RELEASE NOTES: Spilled material should be collected and put in approved DOT container and isolated for disposal. Isolated material should be monitored for signs of decomposition (fuming/smoking). If spilled material is wet, dissolve with large quantity of water and dispose as a hazardous waste. All disposals should be carried out according to regulatory agencies procedures.

7. HANDLING AND STORAGE

HANDLING: Use adequate ventilation when transferring product from bags or drums. Wear respiratory protection if ventilation is inadequate or not available. Use eye and skin protection. Use clean plastic or stainless steel scoops only.

STORAGE: Store (unopened) in a cool, clean, dry place away from point sources of heat, e.g. radiant heaters or steam pipes. Use first in, first out storage system. Avoid contamination of opened product. In case of fire or decomposition (fuming/smoking) deluge with plenty of water to control decomposition. For storage, refer to NFPA Bulletin 430 on storage of liquid and solid oxidizing materials.

COMMENTS: VENTILATION: Provide mechanical general and/or local exhaust ventilation to prevent release of dust into work environment. Spills should be collected into suitable containers to prevent dispersion into the air.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

EXPOSURE LIMITS

Chemical Name	ACGIH	OSHA	Supplier
Sodium Persulfate	0.1 mg/m^3 (TWA)		

ENGINEERING CONTROLS: Provide mechanical local general room ventilation to prevent release of dust into the work environment. Remove contaminated clothing immediately and wash before reuse.

PERSONAL PROTECTIVE EQUIPMENT

EYES AND FACE: Use cup type chemical goggles. Full face shield may be used.

RESPIRATORY: Use approved dust respirator when airborne dust is expected.

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PROTECTIVE CLOTHING: Normal work clothes. Rubber or neoprene footwear.

GLOVES: Rubber or neoprene gloves. Thoroughly wash the outside of gloves with soap and water prior to removal. Inspect regularly for leaks.

9. PHYSICAL AND CHEMICAL PROPERTIES

ODOR:	None
APPEARANCE:	White crystals
AUTOIGNITION TEMPERATURE:	Not applicable. No evidence of combustion up to 800°C. Decomposition will occur upon heating.
BOILING POINT:	Not applicable
COEFFICIENT OF OIL / WATER:	Not applicable
DENSITY / WEIGHT PER VOLUME:	Not available
EVAPORATION RATE:	Not applicable (Butyl Acetate = 1)
FLASH POINT:	Non-combustible
MELTING POINT:	Decomposes
ODOR THRESHOLD:	Not applicable
OXIDIZING PROPERTIES:	Oxidizer
PERCENT VOLATILE:	Not applicable
pH:	typically 5.0 - 7.0 @ 25 °C (1% solution)
SOLUBILITY IN WATER:	73 % @ 25 °C (by wt.)
SPECIFIC GRAVITY:	2.6 (H_2O=1)
VAPOR DENSITY:	Not applicable (Air = 1)
VAPOR PRESSURE:	Not applicable

10. STABILITY AND REACTIVITY

CONDITIONS TO AVOID:	Heat, moisture and contamination.
STABILITY:	Stable (becomes unstable in presence of heat, moisture and/or contamination).
POLYMERIZATION:	Will not occur
INCOMPATIBLE MATERIALS:	Acids, alkalis, halides (fluorides, chlorides, bromides and iodides), combustible materials, most metals and heavy metals, oxidizable materials, other oxidizers, reducing agents, cleaners, and organic or carbon containing compounds. Contact

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with incompatible materials can result in a material decomposition or other uncontrolled reactions.

HAZARDOUS DECOMPOSITION PRODUCTS: Oxygen that supports combustion and oxides of sulfur.

COMMENTS: PRECAUTIONARY STATEMENT: Use of persulfates in chemical reactions requires appropriate precautions and design considerations for pressure and thermal relief.

Decomposing persulfates will evolve large volumes of gas and/or vapor, can accelerate exponentially with heat generation, and create significant and hazardous pressures if contained and not properly controlled or mitigated.

Use with alcohols in the presence of water has been demonstrated to generate conditions that require rigorous adherence to process safety methods and standards to prevent escalation to an uncontrolled reaction.

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11. TOXICOLOGICAL INFORMATION

EYE EFFECTS: Non-irritating (rabbit) [FMC Study Number: ICG/T-79.029]

SKIN EFFECTS: Non-irritating (rabbit) [FMC Study Number: ICG/T-79.029]

DERMAL LD_{50}: > 10 g/kg [FMC Study Number: ICG/T-79.029]

ORAL LD_{50}: 895 mg/kg (rat) [FMC Study Number: ICG/T-79.029]

INHALATION LC_{50}: 5.1 mg/l (rat) [FMC I95-2017]

SENSITIZATION: May be sensitizing to allergic persons. [FMC Study Number: ICG/T-79.029]

TARGET ORGANS: Eyes, skin, respiratory passages

ACUTE EFFECTS FROM OVEREXPOSURE: Dust may be harmful and irritating. May be harmful if swallowed.

CHRONIC EFFECTS FROM OVEREXPOSURE: Sensitive persons may develop dermatitis and asthma [Respiration 38:144, 1979]. Groups of male and female rats were fed 0, 300 or 3000 ppm sodium persulfate in the diet for 13 weeks, followed by 5000 ppm for 5 weeks. Microscopic examination of tissues revealed some injury to the gastrointestinal tract at the high dose (3000 ppm) only. This effect is not unexpected for an oxidizer at high concentrations. [Ref. FMC I90-1151, Toxicologist 1:149, 1981].

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CARCINOGENICITY:

NTP:	Not listed
IARC:	Not listed
OSHA:	Not listed
OTHER:	ACGIH: Not listed

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12. ECOLOGICAL INFORMATION

ECOTOXICOLOGICAL INFORMATION:

Bluegill sunfish, 96-hour LC_{50} = 771 mg/L [FMC Study I92-1250]
Rainbow trout, 96-hour LC_{50} = 163 mg/L [FMC Study I92-1251]
Daphnia, 48-hour LC_{50} = 133 mg/L [FMC Study I92-1252]
Grass shrimp, 96-hour LC_{50} = 519 mg/L [FMC Study I92-1253]

CHEMICAL FATE INFORMATION: Biodegradability does not apply to inorganic substances.

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13. DISPOSAL CONSIDERATIONS

DISPOSAL METHOD: Dispose as a hazardous waste in accordance with local, state and federal regulatory agencies.

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14. TRANSPORT INFORMATION

U.S. DEPARTMENT OF TRANSPORTATION (DOT)

PROPER SHIPPING NAME:	Sodium Persulfate
PRIMARY HAZARD CLASS / DIVISION:	5.1 (Oxidizer)
UN/NA NUMBER:	UN 1505
PACKING GROUP:	III
LABEL(S):	5.1 (Oxidizer)
PLACARD(S):	5.1 (Oxidizer)
MARKING(S):	Sodium Persulfate, UN 1505
ADDITIONAL INFORMATION:	Hazardous Substance/RQ: Not applicable

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49 STCC Number: 4918733

This material is shipped in 225 lb. fiber drums, 55 lb. poly bags and 1000 - 2200 lb. IBC's (supersacks).

INTERNATIONAL MARITIME DANGEROUS GOODS (IMDG)

PROPER SHIPPING NAME: Sodium Persulfate

INTERNATIONAL CIVIL AVIATION ORGANIZATION (ICAO) / INTERNATIONAL AIR TRANSPORT ASSOCIATION (IATA)

PROPER SHIPPING NAME: Sodium Persulfate

OTHER INFORMATION:

Protect from physical damage. Do not store near acids, moisture or heat.

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15. REGULATORY INFORMATION

UNITED STATES

SARA TITLE III (SUPERFUND AMENDMENTS AND REAUTHORIZATION ACT)

SECTION 302 EXTREMELY HAZARDOUS SUBSTANCES (40 CFR 355, APPENDIX A):
Not applicable

SECTION 311 HAZARD CATEGORIES (40 CFR 370):
Fire Hazard, Immediate (Acute) Health Hazard

SECTION 312 THRESHOLD PLANNING QUANTITY (40 CFR 370):
The Threshold Planning Quantity (TPQ) for this product, if treated as a mixture, is 10,000 lbs; however, this product contains the following ingredients with a TPQ of less than 10,000 lbs.:
None

SECTION 313 REPORTABLE INGREDIENTS (40 CFR 372):
Not listed

CERCLA (COMPREHENSIVE ENVIRONMENTAL RESPONSE COMPENSATION AND LIABILITY ACT)

CERCLA DESIGNATION & REPORTABLE QUANTITIES (RQ) (40 CFR 302.4):
Unlisted, RQ = 100 lbs., Ignitability

TSCA (TOXIC SUBSTANCE CONTROL ACT)

TSCA INVENTORY STATUS (40 CFR 710):

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Listed

RESOURCE CONSERVATION AND RECOVERY ACT (RCRA)
RCRA IDENTIFICATION OF HAZARDOUS WASTE (40 CFR 261):
Waste Number: D001

CANADA

WHMIS (WORKPLACE HAZARDOUS MATERIALS INFORMATION SYSTEM):

Product Identification Number: 1505
Hazard Classification / Division: Class C (Oxidizer), Class D, Div. 2, Subdiv. B. (Toxic)
Ingredient Disclosure List: Listed

INTERNATIONAL LISTINGS

Sodium persulfate:
Australia (AICS): Listed
China: Listed
Japan (ENCS): (1)-1131
Korea: KE-12369
Philippines (PICCS): Listed

HAZARD, RISK AND SAFETY PHRASE DESCRIPTIONS:

EC Symbols: (Not classified as hazardous)

EC Risk Phrases: (Not classified as hazardous)

EC Safety Phrases: (Not classified as hazardous)

16. OTHER INFORMATION

HMIS

Health	1
Flammability	0
Physical Hazard	1
Personal Protection (PPE)	J

Protection = J (Safety goggles, gloves, apron & combination dust & vapor respirator)

HMIS = Hazardous Materials Identification System

Degree of Hazard Code:
4 = Severe

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3 = Serious
2 = Moderate
1 = Slight
0 = Minimal

NFPA

Health	1
Flammability	0
Reactivity	1
Special	OX

SPECIAL = OX (Oxidizer)

NFPA = National Fire Protection Association

Degree of Hazard Code:
4 = Extreme
3 = High
2 = Moderate
1 = Slight
0 = Insignificant

REVISION SUMMARY:
This MSDS replaces Revision #11, dated February 22, 2005.
Changes in information are as follows:
Section 1 (Product and Company Identification)
Section 3 (Composition / Information on Ingredients)
Section 16 (Other Information)

FMC Logo - FMC Corporation Trademark

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ATTACHMENT 5

EMERGENCY CONTACTS

Attachment 5

EMERGENCY NOTIFICATION NUMBERS

Medical	**911** or **(201) 438-4300**	Carlstadt Emergency
Police	**911 or (201) 438-4300**	Carlstadt Emergency
Fire	**911 or (201) 438-4300**	Carlstadt Emergency
Hospital	**(201) 392-3210**	Meadowlands Hospital Meadowlands Park Seacucus, NJ
USEPA Project Manager	**(212) 637-3914**	Stephanie Vaughn (work)
NJDEP Project Manager	**(609) 633-1455**	Riché Outlaw (work)
Golder Project Manager	**(856) 793-2005**	Robert J. Illes (work)
Golder Health & Safety Officer	**(856) 793-2005**	Jim Valenti (work)
Site Health & Safety Coordinator	**(856) 793-2005**	Heather Lin (work)
	(609) 634-6476	Heather Lin (cell)

ATTACHMENT 6

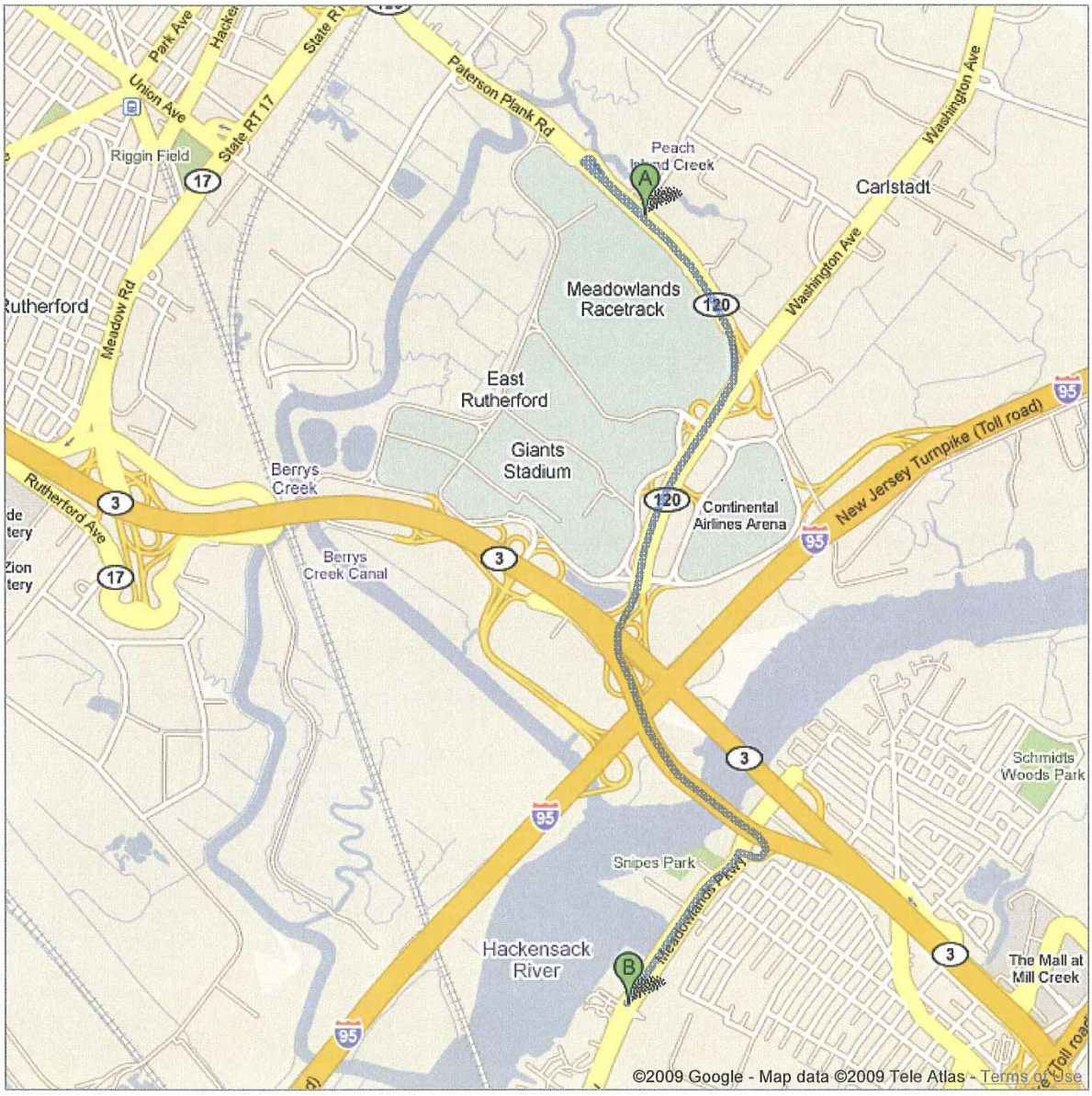
HOSPITAL ROUTE MAP

Google Maps

Directions to 55 Meadowlands Pkwy, Secaucus, NJ 07094

3.3 mi – about **6 mins**

Directions from Carlstadt site to Meadowlands Medical Center



ATTACHMENT 7

EXAMPLE INCIDENT REPORT FORM

ATTACHMENT 7
EXAMPLE
INCIDENT REPORT FORM

In the event of any injury, accident or illness requiring medical attention beyond minor first aid, please complete this form. Retain two copies for your files and send the original to Linda Laganella in the Cherry Hill, NJ office.

Employee's office mailing address: Location of office (if different):

_____ _____
_____ _____
_____ _____
_____ _____

EMPLOYEE INFORMATION:

Employee's name:_____

Length of time with Company:_____

S.S.#:_____-_____-_____ Sex: M F Birth Date:_____

Home address:

_____
_____
_____

Occupation:_____

Department or group:_____

PROJECT INFORMATION:

Project number: _____ Project Manager: _____

Project short title: _____ Field Supervisor: _____

Project Description (briefly describe the project, location, employee's role, etc.):

_____
_____
_____
_____
_____

-over-

ACCIDENT/EXPOSURE INFORMATION:

Description of accident/incident (briefly describe how the accident/incident occurred, what task the employee was working on at the time, working conditions, etc.)

_____

_____

_____

_____

_____

INJURY/ILLNESS INFORMATION:

Description of injury/illness (please describe the nature of the injury/illness, body part(s) affected, and the object/agent which caused the injury/illness):

_____

_____

_____

_____

_____

Name and address of attending physician:

_____

_____

_____

_____

Name and address of hospital (if admitted):

_____

_____

_____

_____

Report prepared by:_____

Title:_____

Date:_____

ATTACHMENT 8

SAFE WORKING PRACTICES DOCUMENTS

SWP 01	Drilling
SWP 03	Biological Exposure Risks
SWP 04	Heat Stress
SWP 05	Cold Environment-Cold Stress
SWP 11	Overhead Hazards
SWP 14	Slips, Trips, and Falls
SWP 15	Groundwater Sampling
SWP 17	Underground Utilities
SWP 18	Working Around Heavy Equipment
SWP 21	Hearing Protection
SWP 25	Working on or Over Water

1.0 SCOPE

This SWP applies to all Golder Associates Inc. and Golder Construction Services (Golder) staff that work on projects that include drilling activities.

2.0 DRILLING

Drilling techniques include auger, rotary, percussion, and sonic which all have high-speed rotating and moving components which require caution to avoid injury when working.

Drilling can be safely undertaken in all types of terrain and in all types of conditions, if proper precautions are taken. Because of the variety of situations staff may experience, it is important to recognize and be aware of potential hazards associated with this operation.

3.0 KEY HAZARDS

- Impact by moving equipment;
- Encountering subsurface utilities;
- Mast contact with overhead wires;
- Traversing uneven ground to drill, document and sample:
- Clothing, fingers or other body parts caught in high speed and high torque rotating equipment.
- Noise generated by the equipment or surroundings
- Dust generated by equipment

4.0 PRECAUTIONS

Before Drilling:

- Inform staff of the emergency shut-off switch on the rig and have the driller test it daily.
- Get as much site-specific information as possible concerning ground conditions and surface obstructions. Ask the Project Manager and, if possible, the Client or Client Contact.
- Use available soils information (i.e., previous reports, US Geological Survey Surficial Geology Maps, colleagues who have had experience in the area) to ascertain potential subsurface conditions.
- Each drilling location should be inspected by the GAI field leader and subcontractor supervisor and approved as safe for drilling. Consider access requirements, and look for evidence of underground services (i.e., buried utility lines, wire, conduits, tanks, service boxes, plugs, exposed pipe, trenches, etc.), and locate the boreholes accordingly (see Test Pit).
- Always utilize state, local, or 811 utility location services to get clearance to proceed at each drilling location. Plan at least 48 hours in advance prior to scheduled work.
- Look for surface and overhead features that may represent a hazard. Overhead power lines are a major concern and must be avoided or de-energized. Even without direct contact, electricity can arc from the power lines to another object (see Test Pit)
- Do not pile drill spoil such that it could endanger workers (see Test Pit)

- Drill rigs should not be operated within 12 feet of lines less than 132 KV; within 20 feet of lines 132 to 330 KV; or within 26 feet of lines greater than 330 KV.
- Drill rig should not be moved from one location to the next with the mast raised.
- Drill rig equipment should be safety inspected by the subcontractor on a daily basis dependent on specific use, field conditions, and manufacturer's recommendations.

During Drilling

- Identify a safe viewing area where you can observe the drilling operations, but not so close that you are either in danger of being struck by the equipment swinging from wirelines or winch cables.
- Always make sure you have a route of escape, should things go wrong. Be aware of wind direction and consider escaping upwind if subsurface contaminants are involved
- Make sure the drill crew knows where you are **at all times**.
- Approach the drill rig during times when it is safest to do so. If necessary, signal the operator first and make sure the equipment is stopped before you approach.
- Avoid the temptation to act as the driller's helper. Do not handle heavy rods or equipment. Remember that the drilling contractor is responsible for providing the necessary drilling equipment and personnel who are trained in its safe use. This also includes traffic control needs, unless otherwise specifically indicated by GAI project manager (i.e. for road drilling where GAI provided the necessary traffic control.)
- Know where everyone is at all times;
- Never use gasoline or any other combustible solvent as a cleaning agent. It is a fire and explosion hazard;
- Use a personal fall arrest system while working at any height above 5 feet on the mast or on top of the rig;
- Do not perform maintenance while the rig is running;
- Do not remove any blocking or jacks from under rig while the rig is drilling;
- Stand clear of cables as much as possible while pulling pipe or while the rig is under a heavy strain;
- When racking drill rods for rotary drilling/sampling, the total length of rods racked shall not be more than 1.5 times the height of the mast;
- Do not wear loose clothing or jewelry around moving machinery;
- Be on guard for pinch and shear hazards for fingers and toes--especially around the drill string;
- Practice good housekeeping--keep excess spoil material and unnecessary equipment well out of the way;
- When jumping batteries during cold weather starting, be sure of terminal connections. Connect the positive terminal first, then the negative terminal. Batteries can explode, spraying acid to eyes and skin; wear protective goggles and clothing;
- Communicate effectively; if using hand signals, make sure everyone knows what they are;
- Know where fire extinguisher(s) are and how to use them. Check the charge condition before the start of project activities, and periodically thereafter;

- All hoses carrying high pressure air or fluids should have safety chains or cables at connectors;
- Lighting on the site or rig shall be properly installed and sufficient in quantity to provide adequate illumination for night work. All receptacles shall be protected with a ground fault circuit interrupter (GFCI);
- Weight indicators should be standard equipment;
- All hooks shall have safety latches and be checked between borings;
- Do not ride on hook ropes or other traveling lines on rig;
- Keep walkways clear;
- Using a properly calibrated real-time air quality instrumentation,, monitor for suspected airborne gas hazards (combustible and/or toxic as applicable);
- Ear protection must be worn by employees working in close proximity to equipment that generates noise (85 dB(A) or greater);
- Wear required respiratory protective equipment when hazards from toxic chemicals are suspected (See Respiratory Protection);
- Observe proper lifting techniques;
- Fuel tanks should be properly installed according to local fire codes with appropriate secondary contaminant;
- Wastewater and drilling fluids must be properly diverted or contained;
- Containerize drilling spoils and fluids suspected to be contaminated as required by environmental regulatory requirements;
- Protect the public by use of proper barricades, ramps over pipes, warning signs and guard rails;
- Use caution during welding activities, remain at a safe distance and do not look directly at the welding arc. The drillers will need to wear welding goggles and gloves; properly ground arc-welding equipment; properly vent PVC solvent glue vapors from installed well casings before cutting or welding the casings; and
- Have a first-aid safety kit handy.

After Drilling

- Properly decontaminate all drilling equipment, as required, before leaving. This includes drilling tools, pipe, pumping equipment, and mud-pits, in addition to the drill rig and drill string;
- Never leave a borehole open for an extended period. Always backfill and compact the near surface soil after you have completed sampling, any instrumentation installation(s) and documentation activities. Open drill holes represent a potential hazard to yourself and others.
- Clean up waste materials from drilling operations, such as discarded containers, hoses, damaged tools or blocking, and wasted pipe and casing, etc. Dispose of properly.

MINIMUM PERSONAL PROTECTIVE EQUIPMENT REQUIRED

- Hard Hat
- Steel Toe Safety Boots
- High Visibility Vest
- Hearing Protection
- Safety Glasses
- Close fitting clothing
- Dust Mask (Respirator if required)
- Gloves

TRAINING

- OSHA 10 hour Construction Safety course
- First Aid and CPR courses

APPLICABLE OSHA REGULATION PARTS

The following are the major OSHA standards impacted by this work: 29 CFR 1926

- .21 Safety Training
- .23 First Aid
- .52 Noise Exposure
- .59 Hazard Communication
- .96 Foot Protection
- .100 Head Protection
- .101 Hearing Protection
- .102 Eye and Face Protection
- .103 Respiratory Protection
- .351 Arc Welding
- .403 General Electrical
- .404 Wiring
- .500-503 Fall Protection
- .601 Motor Vehicles
- Subpart Z – Toxic and Hazardous Substances

1.0 SCOPE

This SWP applies to all Golder Associates Inc. and Golder Construction Services (Golder) staff that work in the field in locations where there may be biological exposure risks to hazardous flora and fauna.

2.0 BIOLOGICAL EXPOSURE RISKS – HAZARDOUS FLORA AND FAUNA INFORMATION

The scope of services for this project may create opportunities for site personnel to come in contact with potentially dangerous plants and animals. Precautionary measures should be taken to reduce possible contact with hazardous flora and fauna which may include, but not be limited to: application of bug spray, caution and care in handling collected organisms including wearing gloves, avoiding or leaving an area identified as containing a suspected hazardous plant or animal (e.g. poisonous snake) until the hazardous organism has been properly identified and/or removed.

If a field team member comes in contact with or is bitten or stung by any hazardous plant or animal, always follow the proper first aid procedures and contact the Site Safety Officer immediately.

In general, almost any terrestrial animal can be hazardous at times. Larger mammals and some birds may attack if you are in their territory, too close to their nest, between them and their offspring, etc. Also, if you are handling/attempting to handle wildlife, there may be a risk of bites or scratches leading to infection, excessive bleeding, or worse. Please always use caution when working with/around wildlife. Although they are often wary and will stay away from you, there are specific situations/times where this is not the case.

3.0 HAZARDOUS INSECTS

Poisonous Spiders

- **Widow Spiders** (genus *Latrodectus*) Southern Black Widow, Northern Black Widow, Brown Widow, and Red Widow
- **Recluse Spiders** (genus *Loxosceles*) - Brown Recluse, Mediterranean Recluse, Chilean Recluse

While the poisonous spiders listed above are not known to be aggressive, spider bites can occur when the spiders are disturbed or feel threatened. Be careful of reaching under objects where the spider is hiding or when putting on clothing, gloves or shoes that have been sitting or stored for a long time into which the spider has crawled. The most common symptoms are intense pain, rigid abdominal muscles, muscle cramping, malaise, local sweating, nausea, vomiting, and hypertension. Blisters frequently appear at the bite site, which can become necrotic. If bitten, remain calm, and seek medical attention (contact your physician, hospital and/or poison control center). Apply an ice pack directly to the bite area to relieve swelling and pain. If possible to do so without further endangerment, collect the spider (even a mangled specimen has diagnostic value) for positive identification by a spider expert.

Bees, Wasps, Yellow jackets, Mosquitoes and Fire Ants

The hazards associated with insect bites and stings are based on allergic reactions to the venom produced by the insect. Anyone who has a history of severe allergic reactions to bee stings should carry an anaphylactic kit with an Epinephrine syringe (epi-pen), with them at all times when working in the field. If an epi-pen is unavailable, remove the victim from the area (to avoid further stinging), monitor for signs of anaphylactic shock, and seek medical attention.

Tick Identification

- Ticks are divided into two families, "soft" ticks and "hard" ticks. Their only source of nutrition is blood sucked from their hosts.
- Hard ticks live on the ground in vegetation, such as grassy meadows, woods, brush, weeds, and leaf litter.
- Ticks produce a cement-like substance that helps anchor them to the host.
- Ticks inject saliva (the saliva may also contain disease organisms, such as *Borrelia burgdorferi* which cause Lyme disease) containing a kind of anticoagulant into the blood pool to keep the blood from clotting.
- The Brown Dog Tick (*Rhipicephalus sanguineus*) has evolved to live indoors and can be found living inside your home. Brown Dog Ticks do not feed on humans.
- **Treatment for Ticks**
- Use a small pair of curved forceps or tweezers, wear some gloves so you don't spread bacteria from the tick to your hands.
- Using tweezers, flip the tick over onto its back. Grasp tick firmly with the tweezers as close to the skin as possible. Gently pulling until the tick comes free. Do Not Twist or turn.
- Once removed, rinse it down a sink or flush it down a toilet. Consider keeping it in a tightly closed jar or taped to a piece of paper. You may need to show the tick to the doctor if you become ill from the tick bite.
- The area of the bite should leave a small crater or indentation where the head and mouthparts were embedded. If significant portions of the head or mouthparts remain, they may need to be removed by a doctor.
- Cleanse the bite area with soap and water or a mild disinfectant. Observe the area for several days for any reaction to the bite, such as a rash or signs of infection. Apply antibiotic cream to the area.
- Remember to wash your hands thoroughly after handling any tick or instruments that touched a tick. Clean and disinfect any instruments that were used.
- Most tick bites are probably harmless and may cause no problems. Ticks that have never fed, if handled properly, will not cause any harm. The earlier a tick is removed, the less the likelihood that the tick transmitted any disease.

Poison Ivy (*Rhus radicans*) Identification

- Three forms of poison ivy, 1) Erect woody shrub, 2) Running Shrub 3) Woody Vine.
- Three leaflets, two to four inches long, dull or glossy green with pointed tips.
- The middle leaflet is generally larger than the two laterals.
- The margins of the leaflets are variable, appearing irregularly toothed, lobed, or smooth.
- The leaves are positioned *alternately* on the stems.
- Woody vines grow on trees or objects for support and have aerial roots along the stem.

- **Treatment for Poison Ivy**
- Have a 'poison ivy action kit' ready, with rubbing alcohol,
- a large bottle of water, some soap and gloves,
- Cleanse exposed areas with rubbing alcohol.
- Next, wash the exposed areas with water only (no soap yet, since soap can move the urushiol, which is the oil from the poison ivy that triggers the rash, around your body and actually make the reaction worse).
- Now, take a shower with soap and warm water.
- Lastly, put gloves on and wipe everything you had with you, including shoes, tools, and your clothes, with rubbing alcohol and water.
- Apply Ivy-Block to exposed areas to prevent Poison Ivy.

Do NOT burn these poisonous plants! The smoke will irritate your skin badly, and if it enters your nasal passages, throat and lungs it will likely cause serious problems and could result in death.

Poison Oak Identification

- Grows in the Eastern United States (from New Jersey to Texas) as a low shrub.
- Grows in the Western United States (along the Pacific coast) as 6-foot-tall clumps or vines up to 30 feet long.
- Oak-like leaves, usually in clusters of three.
- Can have clusters of yellow berries.
- **Treatment for Poison Oak**
- Initial treatment consists of washing the area with water immediately after contact with the plants. To relieve symptoms, use wet compresses and take cool baths.
- Nonprescription antihistamines and calamine lotion also may help relieve symptoms.
- Moderate or severe cases of the rash may require treatment by a health professional, who may prescribe corticosteroid pills, creams, or ointments.

Do NOT burn these poisonous plants! The smoke will irritate your skin badly, and if it enters your nasal passages, throat and lungs it will likely cause serious problems and could result in death.

Poison Sumac Identification

- Grows exclusively in very wet or flooded soils.
- Ranges in eastern United States and Canada.
- Pinnate leaves, 25-50 cm long.
- 7 - 13 leaflets to each leaf, leaflets are 4-10 cm long.
- Red Leaf veins.
- Small white or grey berry, produced in panicles 10-20 cm long.
- Panicles distinguish it from other sumacs which have red berries.

Treatment for Poison Sumac

- Immediately wash everything that might have touched the plant.
- Soothe itching with cool, wet compresses.
- Add ground oatmeal (approximately 5 cups) or baking soda to a cool bath and soak for 15 to 30 minutes you can even add baking soda or epsom salts to your bath, or make a paste of either of these and apply it to the rash.
- Opt for lotions containing calamine, alcohol and zinc acetate; these will dry the blisters and help speed healing and leave rash open to air. That will help it heal.

- Take an oral antihistamine if you are extremely uncomfortable or if the rash is covering a large area of your body.

Do NOT burn these poisonous plants! The smoke will irritate your skin badly, and if it enters your nasal passages, throat and lungs it will likely cause serious problems and could result in death.

Wild Parsnip Identification

- Pinnately compound leaves, with a main stem and 5 to 15 leaflets.
- Yellow flowers, in flat-topped umbrella-like clusters at the top of the plant.
- Wild parsnip rosettes are among the first plants to become green in spring, and its flowers turn a prominent yellow in midsummer. After flowering and going to seed, plants die and turn brown in fall, but first year rosettes remain green until frost.
- Grows throughout the United States along: Roadsides, abandoned fields, unmowed pastures, edges of woods, prairie restorations.

Treatment for Wild Parsnip

- Take Ibuprophen for help with swelling and pain. The burned area can be covered with a cool, wet cloth. If blisters are present, do not pop them and if the blisters rupture, leave the skin "bandage" in place. To avoid infection, keep the area clean and apply an antibiotic cream.
- Adding Domeboro powder to cool cloth compresses can help dry any of the seeping blisters.
- Doctors will recommend a topical or systemic cortisone-steroid for extreme discomfort. See a doctor for serious cases.
- Washing with Fels-Naptha soap will not help.

Snakes

- leave snakes alone;
- wear rubber boots, long trousers and long sleeved shirts; the fangs of a snake will not normally penetrate such clothing;
- be noisy when walking in the bush; stamp your feet;
- look carefully when walking through grass; and
- do not place bare hands in hollow logs, under piles of wood or rubbish. **WEAR GLOVES.**

Snake Bite Victims

Most snake bites occur on the limbs, with 75% of reported cases being on the lower limbs. If anyone is bitten be more concerned about the casualty than about identifying the snake. Unconsciousness and breathing failure may occur. The only widely acceptable treatment for venomous snakebites involves the use of antivenin. If someone is bitten by a venomous snake, seek immediate medical attention at the nearest hospital or medical facility. Stay calm, remove any rings that could restrict circulation if tissues swell, keep the bitten limb below the level of the heart, and immediately seek medical attention.

Symptoms of Snake Bite

- headache
- double-vision
- drowsiness
- nausea
- pain or tightness in the chest or abdomen
- giddiness or faintness
- diarrhea

These symptoms do not appear immediately, but from about 15 minutes to 2 hours after being bitten. If a snake bite is suspected, act promptly and obtain medical assistance without delay - **HOWEVER, STAY CALM.**

Signs of Snake Bite

Look for:

- 2 puncture marks about 1 cm apart at the site of the bite, although sometimes they may only be a fang scratch on the skin (although this depends on the size of the snake)
- swelling of the area around the bite
- bruising
- sweating
- vomiting
- breathing difficulties

Management of Snake Bite Victims

- keep the victim at rest
- reassure the victim
- immediately apply a pressure immobilization bandage over the bitten area and around the limb
- apply the bandage firmly enough to compress tissues, but not so firmly as to restrict the flow of blood to the limb below the bandage
- bandage from the bite to the fingers or toes, then up to the armpit or groin

- bandage as much of the limb as possible
- if assistance is available, get them to seek medical aid urgently. It is better to wait for the arrival of an ambulance or ambulance officer rather then to move the victim, but isolation and other circumstances should determine what is to be done
- periodically observe and record the pulse and breathing
- carry out EAR/CPR if breathing or circulation fails

As a precaution: **Do not catch a snake and do not handle one unless you are sure it is not venomous.** In addition, for a short time after a snake is killed, its reflexes may continue to work. Those reflexes typically cause the body to writhe slowly for awhile, but they can cause a convulsive contraction and a bite, so you should not handle a freshly killed venomous snake. Though US medical professionals may not agree on every aspect of what to do for snakebite first aid, they are nearly unanimous in their views of what not to do. Among their recommendations:

WARNING - WHAT NOT TO DO

- **NEVER** wash the venom off the skin; the venom will help identify what type of snake is involved - EMERGENCY DECONTAMINATION PROCEDURES DO NOT APPLY;
- **NEVER** cut or excise the bitten area. Such measures have not been proven useful and may cause further injury.
- **NEVER** try to suck the venom out of the wound; and
- **NEVER** use a constrictive bandage or tourniquet. This cuts blood flow completely and may result in loss of the affected limb.
- **NEVER** ice or any other type of cooling on the bite. Research has shown this to be potentially harmful.

Timber Rattlers Identification

- The Timber Rattler is an endangered species.
- Adult timber rattlers average 35 to 50 inches in total length.
- The tail is short and thick, all black, and tipped with a tan rattle.
- Timber rattlers are diurnal (active during the day) and nocturnal (active after dark) in the summer, but only diurnal in the spring and fall.
- This venomous species can inflict a serious bite, and people are urged to walk away from them when encountered. Records show that there is a greater risk of being bitten if an attempt is made to kill them
- During the summer, they inhabit deciduous forests and open valleys. Rock fissures and crevices provide communal dens for over wintering.
- Timber rattlers begin emerging from hibernation in April to early May.

Treatment for Timber Rattlers

- Moderate symptoms will include mild swelling, discoloration, and pain at the wound site, and may also include general tingling, weakness, rapid pulse, and dimness of vision, nausea, vomiting, and shortness of breath.
- For moderate symptoms, apply a band 3/4 inch to 11/2 inches wide to the limb, 2 to 4 inches above the wound (but not around a joint, or on the head, neck, or trunk). Make it snug, but loose enough so you can slip a finger under it. Check the victim's pulse beyond the band periodically; to be sure blood is flowing past the band. Loosen the band if it becomes too tight.
- Severe symptoms include rapid swelling and numbness, followed by severe pain at the wound site; there may also be pinpoint-size pupils, facial twitching, slurred speech, convulsions, paralysis, and loss of consciousness. For severe symptoms, apply the band, and then make a shallow cut-just through the skin-through each fang puncture, 1/2 inch long and parallel with the long axis of the limb. (Make no cuts on the head, neck, or trunk). Apply a suction cup for 30 minutes, or use your mouth to such out the venom. Don't apply ice packs or any other kind of cold therapy. Continue treatment until you can get medical help. Most people who die of snakebite today die because they didn't seek medical help or delayed too long in going to the hospital. Preventive medicine is the best method for dealing with snakebites.
- Begin first aid treatment by keeping the victim calm and immobile, preferably lying down. Immobilize the bitten limb, at or below heart level. If the victim will be able to get to a hospital within 4 or 5 hours-and no symptoms develop-no more first aid is necessary.

4.0 HAZARDOUS FRESHWATER AND SALTWATER LIFE

Fin spines

Many fish have sharp spines in their fins that can cause puncture wounds if not handled properly. Although most do not have toxins/venom in their spines, the wound may still get infected if not properly cleansed and bandaged. Sharp teeth that may cause moderate to severe lacerations if not handled properly. The following sections provide examples of fishes and/or organisms that may require special handling or avoidance.

Stingrays

Stingray skin can be slippery, and need to be handled with gloves. If a stingray stings you, seek immediate medical attention. Infection can develop from bacteria entering the wound via seawater or from the stinger (spine) itself. A stingray spine can also break off in the wound and cause infection if it is not removed; however, **the spine is serrated, so if the spine breaks off in the wound, do not remove it yourself**. Instead, apply first aid for a puncture wound, including flushing/rinsing the wound with fresh water or hydrogen peroxide if available, and seek immediate medical attention. Sometimes the spine will stick into the person without breaking off of the animal. In this case, cut the spine from the animal close to the base of the tail, leaving as much of it sticking out of the wound as possible. The pain of the stingray toxin can be alleviated before reaching a medical facility by applying a heat compress to the wound or soaking it in clean, hot water which breaks down the protein-based toxin.

Catfishes

Catfishes have spines very similar to stingrays. Treat as you would for a stingray wound.

Scorpionfishes, Leatherjackets, Toadfishes

Some, if not all species of fish in these groups have poisonous spines in their dorsal, pectoral, and/or anal fins. The spines are very sharp and the toxin in them can cause varying degrees of reaction. By far, the scorpionfishes have the most potent toxin in their spines and some species can be much larger than others. In the case of being stung by any of these fish, apply first aid for a puncture wound, and watch for signs of reaction to the toxins. Seek medical attention if necessary. The pain of the toxin can be alleviated before reaching medical facilities by applying a heat compress to the wound or soaking it in clean, hot water.

Sea Urchins

Sea urchins have sharp spines that project out and protect their main body, or test, from all angles. While some species have poisonous or toxic spines, the primary hazard is from puncture wounds where the spine breaks off in the wound and the resulting infection. The spines, like the rest of the urchin's body, are primarily made of calcium that can be brittle and hard to remove. If someone gets stuck with urchin spines, flush the area well with water and hydrogen peroxide (if available). If the wound is large or there are large pieces of spine embedded in the wound, apply first aid as you would for a normal puncture wound and monitor for signs of allergic reaction to possible toxins. Applying a heat pack in the immediate area of the wound may relieve some of the pain associated with the toxin if it is present. It may be necessary to go to the hospital to get the pieces of spine removed.

Jellyfish

Most species of Jellyfish have stinging cells, called nematocysts, which trigger or "fire" upon touch. If jellyfish are encountered in the net, the use of gloves in handling them can prevent the person from being stung, as the nematocysts are usually very small and will not penetrate the glove. However, be cautious after handling jellyfish even with a glove, as some of the nematocysts can rub off and remain on the glove and still fire long after the jellyfish has been removed. If someone gets stung by a jellyfish, it is best to rinse the area with vinegar (do not use fresh water, as that can cause more nematocysts to fire). Different species of jellies have various levels of toxin in their sting. There is a potential for allergic reaction, so monitor the victim and seek medical attention if necessary.

Corals and Sponges

Corals and Sponges have stinging cells similar to Jellyfish. If someone is stung by a species of coral or sponge, treat the same as above for jellyfish.

Crabs/Crayfish/Lobsters

All of the above can have very strong and very sharp claws. Use caution when handling them.

Oysters/Mussels/Clams

Oysters and Mussels have extremely sharp edges that can cut easily. Care should be taken when handling and always wear gloves.

American Alligator (may encounter on land or in the water).

The best treatment for alligator wounds is avoidance or prevention of encounters. When left alone, alligators will stay away from humans and pose little threat. The springtime is when alligator breeding season begins in Florida. During breeding season, male alligators become very territorial and will defend their area against intruders. Following the breeding, in June-July, females will lay their eggs in nests created in the preceding months. These nests are mounds of mud, leaves and other vegetation and can be ~1 meter tall and ~2 meters wide. Look out for these nests near the shoreline of swamps, rivers, and estuaries, as female alligators remain near the nest, in nearby water or other shelter, throughout the incubation period, which averages 65 days, and will defend her nest if danger threatens. If someone is attacked by an alligator, apply first aid, including pressure to any open wounds, and seek immediate medical attention.

1.0 SCOPE

This SWP applies to all Golder Associates Inc. and Golder Construction Services (Golder) staff that work in the field in locations where there is potential for heat stress conditions to develop.

2.0 HEAT STRESS

Employees may experience heat stress due to a combination of elevated ambient temperatures and the concurrent use of personal protection equipment; this depends in part on the location of the site, the type of work, and the time of year. The project manager (PM) should consider the need to monitor heat stress during the project planning stage. The Site Safety Officer (SSO) and/or field staff will evaluate heat stress using the techniques specified below whenever the ambient temperature exceeds 21°C or 70°F.

3.0 HEAT STRESS RELATED PROBLEMS

- **Heat Rash** - caused by continuous exposure to heat and humid air and aggravated by chafing clothes. Decreases ability to tolerate heat, as well as being a nuisance;
- **Heat Cramps** - caused by profuse perspiration with inadequate fluid intake and chemical replacement. Signs: muscle spasms and pain in the extremities and abdomen;
- **Heat Exhaustion** - caused by increased stress on various organs to meet increased demands to cool the body. Signs: shallow breathing; pale, cool, moist skin; profuse sweating; dizziness, and lassitude. If symptoms occur, the employee should leave the work area and proceed to the nearest air-conditioned location, drinks liquids such as water or Gatorade, and rest until the symptoms pass. Contact the Golder PM immediately; and
- **Heat Stroke** - the most severe form of heat stress. Body must be cooled immediately to prevent severe injury and/or death. Signs: red, hot, dry skin; no perspiration; nausea; dizziness and confusion; strong, rapid pulse; coma. Medical help must be obtained immediately. If heat stroke is suspected, implement emergency response plan. Remove excess clothing and cool the person by sponging with cool or luke warm water. Never place ice on the person or throw water on the individual. Contact the Golder Project Manager as soon as time permits.

4.0 HEAT STRESS MANAGEMENT

4.1 Heat Stress Monitoring

The American Conference of Governmental Industrial Hygienists (1992) states that workers should not be permitted to work when their deep body temperature exceeds 38°C (100.4°F).

For strenuous field activities that are part of ongoing site work activities in hot weather, the following procedures shall be used to monitor the body's physiological response to heat, and to monitor the work cycle of each site worker. There are two phases to this monitoring: initial work/rest cycle determination and physiological monitoring. The initial work/rest cycle is used to estimate how long the first work shifts

of the day should be. Heart rate monitoring of each worker will establish the length of the successive work periods.

4.2 Determination of Initial work/Rest Cycles

Measure the air temperature with a standard thermometer. Estimate the fraction of sunshine by judging what percent the sun is out: 100% sunshine - no cloud cover = 1.0; 50 % sunshine and 50% cloud cover = 0.5; 0% sunshine = full cloud cover = 0.0.

Plug these variable into the following equation to determine the adjusted temperature:
T (^{o}C, adjusted) = T (^{o}C, actual) + (7.2 x fraction sunshine)

Use the chart below to determine the length of the first work shift. At the first break, initiate the heart rate monitoring as described in the next section.

ADJUSTED TEMPERATURE	NORMAL WORK CLOTHING	IMPERMEABLE CLOTHING
21° - 25°C (70-77°F)	150 Minutes	120 Minutes
25° - 28°C (77-82°F)	120 Minutes	90 Minutes
28° - 31°C (82-88°F)	90 Minutes	60 Minutes
31° - 32°C (88-90°F)	60 Minutes	30 Minutes
>32°C (>90°F)	45 Minutes	15 Minutes

4.3 Heart Rate Monitoring

Heart rate (HR) should be measured by radial pulse for 30 seconds as early as possible in the resting period. The HR at the beginning of the rest period should not exceed 110 beats/minute. If the HR is higher, the next work period should be shortened by 33 percent while the length of the rest period stays the same. If the pulse rate still exceeds 110 beats/minute at the beginning of the next rest period, the following work period should be further shortened by 33 percent while the length of the rest period stays the same.

4.4 Heat Stress Prevention

The best approach is preventive heat stress management. In general:

- have workers drink additional water before beginning work;

- provide disposable cups of water that is maintained at 10 to 16°C (50 to 60 °F);
- urge workers to drink one to two cups of water every 20 minutes or at each rest break for a total of four to eight litres per day;
- provide a cool, preferably air-conditioned area for rest breaks;
- discourage the drinking of alcohol at night and discourage the intake of coffee during working hours;
- monitor for signs of heat stress;
- acclimatize workers to site work conditions by slowly increasing workloads, i.e., do not begin site work activities with extremely demanding activities; and
- Reschedule your work hours so that you are not working in the heat of the day between 10 am and 2 pm.

4.5 Sun Protection

- Employees are encouraged to maximize use of the shade provided by trees, buildings and other structures. Where there is limited access to natural shade, fixed or portable shade structures may be used and will be provided where practical.
- Rotate your work with others between indoor/shaded areas and outdoor/exposed locations to minimize time spent in the sun.
- The selection of appropriate protective clothing will take into account both the need to block out UV and the need to reduce the effects of heat.
- It is recommended that Golder employees tight woven clothing which has a minimum UPF of at least 30. Clothing should be lightweight, loose fitting and have a collar to assist with keeping cool.
- Hats provide shade and the bigger the brim the greater the amount of shade that is provided. Hats should be made of close-weave material and have a wide brim or be legionnaire-style. In circumstances where the wearing of a broad-brimmed hat causes difficulties due to their size sunscreen and other protective measures should be used instead.
- Safety glasses will be supplied to protect the eyes from effects of UV radiation and potential eye injuries from flying objects, dust or chemical splashes. Safety glasses complying with **ANSI Z87.1-2003** are recommended.
- Sunscreen does not offer complete protection and should always be used in conjunction with other protection such as protective clothing. Broad spectrum and water-resistant sunscreen with a sun protection factor (SPF) of 30+ should be used.
- Staff using sunscreen are encouraged to regularly check use by dates to ensure sunscreen is not out of date.
- Sunscreen will be placed in an easily accessible location and employees instructed in correct application and use. Sunscreen should be generously applied to all areas of exposed skin at least twenty minutes before going outside and should be reapplied at least every two hours.

1.0 SCOPE

This SWP applies to all Golder Associates Inc. and Golder Construction Services (Golder) staff that work in the field in locations where there is potential for cold stress conditions to develop.

2.0 COLD ENVIRONMENT – COLD STRESS

In a cold environment, body heat must be conserved to maintain the core temperature at normal levels and to ensure an adequate blood flow to the brain and extremities. Feelings of cold and discomfort should not be ignored, since these may be early warning signals. The effects of cold are such that problems can occur before the worker is aware of them, and furthermore, over-exposure to cold may affect judgment.

3.0 MAIN FACTORS INVOLVED IN CAUSING COLD STRESS

- Temperature
- Humidity
- Movement of air
- Radiant temperature of the surroundings
- Clothing/physical activity

4.0 COLD STRESS RELATED PROBLEMS

- Frostbite is a condition in which the skin and underlying tissues freeze. Usually affects fingers, hands, toes, feet, ears and nose.
- Hypothermia is a condition in which a person's body temperature falls below 95^0 F or 35 degrees Centigrade. Hypothermia occurs when more heat is lost from the body than the body can produce. It usually happens when a person is exposed to extremely cold temperatures but it can occur even at moderate temperatures. It does not have to be freezing outside for a person to become hypothermic. For example, falling into cold water or wearing wet clothing in cold weather can bring on hypothermia. Failing to wear a hat in cold weather can also lead to hypothermia, since a large amount of body heat escapes from the head. Extreme fatigue, hunger or lack of fluids can also lead to hypothermia. As well, excessive wind can increase the amount of heat lost and cause hypothermia.

5.0 FROSTBITE MANAGEMENT

- Move person to a warm dry area. Don't leave the person alone.
- Minimize walking on frozen feet.
- Do not apply any lotions or ointments to frozen skin.
- Remove any wet or tight clothing that may cut off blood flow to the affected area.
- DO NOT rub the affected area, because rubbing causes damage to the skin and tissue.

- Gently place the affected are in a warm (105ºF) water bath and monitor the water temperature to slowly warm the tissue. Don't pour warm water directly on the affected area because it will warm the tissue too fast causing tissue damage. Warming takes about 25-40 minutes.
- After the affected area has been warmed, it may become puffy and blister. The affected area may have a burning feeling or numbness. When normal feeling, movement, and skin color have returned, the affected area should be dried and wrapped to keep it warm. NOTE: If there is a chance the affected are may get cold again, do not warm the skin. If the skin is warmed and then becomes cold again, it will cause severe tissue damage.
- Seek medical attention as soon as possible and contact the Site Safety Officer.

6.0 HYPOTHERMIA MANAGEMENT

The most obvious sign of hypothermia is a low core body temperature. The person with hypothermia may not realize that his or her prolonged exposure to cold requires emergency medical care. Other signs and symptoms include:

- apathy or loss of interest in surroundings
- lethargy or difficulty moving
- confusion
- drowsiness
- loss of coordination
- cold skin
- shock caused by decreased blood flow
- slurred speech
- uncontrollable shivering
- weakness

If a person is suspected of suffering from hypothermia, contact the Site Safety Officer, and apply first aid.

6.1 What should be done (land):

- Move the person to a warm, dry area. Don't leave the person alone. Remove any wet clothing and replace with warm, drying clothing or wrap the person in blankets.
- Have the person drink warm, sweet drinks (sugar water or sports-type drinks) if they are alert. Avoid drinks with caffeine (coffee, tea or hot chocolate) or alcohol.
- Have the person move their arms and legs to create muscle heat. If they are unable to do this, place warm bottles or hot packs in the arm pits, groin, neck and head areas. DO NOT rub the person's body or place them in a warm bath. This may stop their heart.

6.2 What should be done (water):

- DO NOT remove any clothing. Button, buckle, zip and tighten any collars, cuffs, shoes, and hoods because the layer of trapped water closest to the body provides a layer of

insulation that slows the loss of heat. Keep the head out of the water and put on a hat or hood.

- Get out of the water as quickly as possible or climb on anything floating. DO NOT attempt to swim unless a floating object technical water rescue can be reached because swimming or other physical activity uses the body's heat and reduces survival time by about 50 percent.
- If getting out of the water is not possible, wait quietly and conserve body heat by folding arms across the chest, keeping thighs together, bending knees, and crossing ankles. If another person is in the water, huddle together with chests held closely.

7.0 PRECAUTIONS

- Use the buddy system.
- Recognize the environment and workplace conditions that lead to potential cold-induced illnesses and injuries.
- Learn the sign and symptoms of cold induced illnesses/injuries and what to do to help the worker.
- Dress appropriately for expected weather conditions. Dress in a minimum of three layers (a skin layer to absorb moisture and keep the skin dry, an insulating layer, and an outer protective layer), wear a hat and gloves, in addition to underwear that will keep water away from the skin.
- Take frequent short breaks in warm dry shelters to allow the body to warm up.
- Perform work during the warmest part of the day.
- Eat warm, high calorie foods like hot pasta dishes.
- Avoid vasodilators, which allow the body to lose heat faster - which can accelerate hypothermia. These include alcohol and drugs;
- Avoid vasoconstrictors, including tobacco products, which constrict blood vessels and can accelerate the onset of frostbite;
- Avoid touching cold metal with bare skin; and
- Keep active.

1.0 SCOPE

This Standard Work Procedures (SWP) applies to all Golder Associates Inc. and Golder Construction Services (Golder) staff working on project sites where overhead hazards are present.

2.0 OVERHEAD HAZARDS

Overhead hazards occur whenever there is moving equipment such as hoists, conveyors, drilling tools, etc., protrusions from machinery, or structural members present above eye level, or whenever an employee must work where there are other work activities being conducted above.

3.0 PRECAUTIONS

- Be alert for potential overhead hazards, “look up and live”.
- Crane booms, excavator arms and high voltage transmission lines do not mix. If a crane must be used, the crane operator must maintain the minimum specified clearance from all active power lines.
- If an excavation must be performed in the vicinity of overhead lines, an alternative method should be considered. If an excavator must be used, maintain the minimum specified clearance from all active power lines.
- When working below ground level or where activities may be conducted above your work area, be sure to keep all hand-tools, equipment and materials such as pipe, braces, timber, etc. well back from the edge of the trench or hole so it doesn't get dislodged and fall on you.
- Always wear a hard hat when working in the vicinity of potential overhead hazards whether it is a "hard-hat area" or not.

4.0 REGULATIONS

- Employees working in areas where there is a possible danger of head injury from impact, or from falling or flying objects, or from electrical shock and burns shall be protected by protective helmets.
- Hard Hats for the protection of employees against impact and penetration of falling and flying objects shall meet the specifications contained in American National Standards Institute, ANSI Z89.1-1969, *Safety Requirements for Industrial Head Protection*.
- Hard Hats for the head protection of employees exposed to high voltage electrical shock and burns shall meet the specifications contained in American National Standards Institute, ANSI Z89.2-1971.

1.0 SLIPS, TRIPS AND FALLS

Over half of all office injuries are the result of falls. The majority of falls occur on slippery, uneven, defective, cluttered or obstructed walking surfaces. A significant number of debilitating falls are the result of a person falling out of his or her own chair, typically while in the process of sitting down, or leaning back. Falls from elevations while reaching for an overhead object are also common, and frequently cause severe injuries.

2.0 PRECAUTIONS WHEN IN THE OFFICE - HOUSEKEEPING

- Watch your step! Wipe up spilled liquids immediately. Tripping hazards such as defective floors, missing floor tiles, loose or matted carpeting, bunched-up floor mats, extension cords, phone cords, etc., should be corrected or reported and repaired immediately. Don't carry loads that are so large or bulky that the line of vision is impaired.
- Be careful when sitting down. Sitting on the edge of a seat, sitting too far back, or kicking the chair out from under one's self can result in a fall and fractured vertebrae. Occasionally check the mechanical condition of chairs commonly used.
- Be especially careful going up and down stairs. Avoid using stairs if both arms are loaded. Watch your step and if possible always have one hand free to use a railing. Maintain 3 points of contact when ascending/descending.

3.0 PRECAUTIONS WHEN OUT IN THE FIELD

In the field, falls are the second leading cause of work-related deaths.

4.0 TYPES OF FALLS

Falls are of two basic types: elevated falls and same-level falls. Same-level falls are most frequent, but elevated falls are more severe.

- Same-Level Falls: high frequency--low severity
- Elevated Falls: lower frequency--high severity

Same-level falls are generally slips or trips. Injury results when the individual hits a walking or working surface or strikes some other object during the fall. Over 60 percent of elevated falls are from less than 10 feet.

5.0 SAME-LEVEL FALLS

Examples of same-level falls are described below.

6.0 SLIP AND FALL

Slips are primarily caused by a slippery surface and compounded by wearing the wrong footwear. In normal walking, two types of slips occur. The first of these occurs as the heel of the forward foot contacts the walking surface. Then, the front foot slips forward, and the person falls backward.

The second type of fall occurs when the rear foot slips backward. The force to move forward is on the sole of the rear foot. As the rear heal is lifted and the force moves forward to the front of the sole, the foot slips back and the person falls.

The force that allows you to walk without slipping is commonly referred to as "traction." Common experience shows that dry concrete sidewalks have good traction, while icy surfaces or freshly waxed floors can have low traction. Technically, traction is measured as the "coefficient of friction." A higher coefficient of friction means more friction, and therefore more traction. The coefficient of friction depends on two things: the quality of both the walking surface and the soles of your shoes.

To prevent slips and falls, a high coefficient of friction (COF) between the shoe and walking surface is needed. On icy, wet, and oily surfaces, the COF can be as low as 0.10 with shoes that are not slip resistant. A COF of 0.40 to 0.50 or more is needed for excellent traction. To put these figures in perspective, a brushed concrete surface and a rubber heel will often show a COF greater than 1.0. Leather soles on a wet smooth surface, such as ceramic tile or ice, may have a COF as low as 0.10.

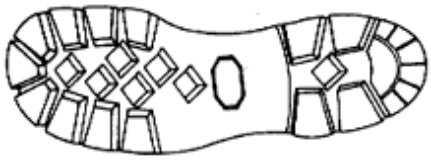


Figure 1. Shoes with soft rubber soles and heels with rubber cleats provide a high coefficient of friction (COF).

Providing dry walking and working surfaces and slip-resistant footwear are the answer to slips and their resultant falls and injuries. Obviously, high heels, with minimal heel-to-surface contact, taps on heels, and shoes with leather or other hard, smooth-surfaced soles lead to slips, falls, and injuries. Shoes with rubber-cleated, soft soles and heels provide a high COF and are recommended for most agricultural work.

In work areas where the walking and working surface is likely to be slippery, non-skid strips or floor coatings should be used. Since a COF of 0.40 to 0.50 is preferred for walking and working surfaces, we should strive for a surface which provides a minimum of 50 percent of this friction. If the working surface is very slippery, no footwear will provide a safe COF.

Trip and Fall Trips occur when the front foot strikes an object and is suddenly stopped. The upper body is then thrown forward, and a fall occurs.

As little as a 3/8" rise in a walkway can cause a person to "stub" his toe resulting in a trip and fall. The same thing can happen going up a flight of stairs: Only a slight difference in the height of subsequent steps and a person can trip and fall.

7.0 CONTRIBUTING FACTORS

Proper housekeeping in work and walking areas can contribute to safety and the prevention of falls. Not only is it important to maintain a safe working environment and walking surface, these areas must also be kept free of obstacles which can cause slips and trips. One method which promotes good housekeeping in work environments is the painting of yellow lines to identify working and walking areas. These areas should never be obstructed by objects of any kind.

Adequate lighting to ensure proper vision is also important in the prevention of slips and falls. Moving from light to dark areas, or vice versa, can cause temporary vision problems that might be just enough to cause a person to slip on an oil spill or trip over a misplaced object.

Carrying an oversized object can also obstruct one's vision and result in a slip or a trip. This is a particularly serious problem on stairs.

8.0 BEHAVIORS THAT LEAD TO FALLS

In addition to wearing the wrong footwear, there are specific behaviors which can lead to slips, trips, and falls. Walking too fast or running can cause major problems. In normal walking, the most force is exerted when the heel strikes the ground, but in fast walking or running, one lands harder on the heel of the front foot and pushes harder off the sole of the rear foot; thus, a greater COF is required to prevent slips and falls. Rapid changes in direction create a similar problem.

Other problems that can lead to slips, trips and falls are: distractions; not watching where one is going; carrying materials which obstruct view; wearing sunglasses in low-light areas; and failure to use handrails. These and other behaviors, caused by lack of knowledge, impatience, or bad habits developed from past experiences, can lead to falls, injuries, or even death.

1.0 SCOPE

This SWP applies to Golder Associates Inc. and Golder Construction Services (Golder) staff working on a project where groundwater sampling is conducted.

2.0 DEFINITIONS

Photo ionizing air monitoring instrument – A direct reading air monitoring instrument equipped with an ultraviolet light source that ionizes organic vapors with ionization potentials less than that of the lamp.

Flame ionizing air monitoring instrument – A direct reading air monitoring instrument equipped with a hydrogen flame that ionizes (through combustion) all combustible organic vapors.

3.0 KEY HAZARDS

- Chemical exposure via inhalation, skin contact or ingestion (See Chemical Exposure Risks SWP);
- Compressed gases for calibration (See Compressed Gases SWP);
- Heat or cold stress (See Inclement Weather, Heat Stress and Cold Stress SWPs);
- Lightning and high winds (See Inclement Weather SWP);
- Drilling (See Drilling SWP);
- Motor vehicles (See Motor Vehicles and Driving on Company Business SWPs);
- Slips, Trips and Falls (See Slips, Trips and Falls SWP);
- Electrical device hazards;
- Excavations (See Trenching and Shoring SWP);
- Working near or over water (See Working Over Water SWP);
- Heavy lifting and
- Insect Bites and Stings (See Biological Exposure Risks SWP).

If any of these hazards are anticipated on the project site, the corresponding SWP must be included in the Health and Safety Plan (HASP).

4.0 CHEMICAL HAZARDS

Groundwater sampling often involves using line-operated pumps to extract water from the subsurface. Ensure that the generator utilized is equipped with ground fault interrupter (GFI) circuitry to prevent possible shock hazards. Collect development or purge water in containers as required for proper disposal. Use secure areas for waste storage to protect the public and client staff from investigation derived waste (IDW). If internal combustion engines (generators) are used, they must be in an area with adequate ventilation, and free of combustible materials (i.e. dry grass, gasoline, etc.).

Keep your face as far from the opening of the well as possible to avoid inhaling volatile contaminants. Avoid any direct contact with a skin surface or eyes with groundwater. Continuous air monitoring should be performed utilizing a photo ionizing or flame ionizing instrument that can measure a minimum of 0.5 PPM organic vapor. Calibrate the air monitoring instrument daily as described in the literature provided. In general, total organic vapor readings of less than 1 PPM are safe. Steady breathing zone measurements at 1 PPM or above warrant engineering controls (ventilation) or personal protective equipment (respiratory protection) to reduce exposure. Concentrations in the well opening that exceed 500 PPM could indicate a large quantity of organic vapor, which poses not only a toxicity risk, but also a flammability risk. Wells with high organic vapor concentrations should be sampled carefully with a minimum of ferrous tools or other sources of ignition.

The site-specific Health and Safety Plan (HASP) addressing both known and reasonably anticipated hazards should be prepared prior to the commencement of work. Chemical hazards and their means of detection and control should be reviewed prior to field mobilization.

Maintain material safety data sheets (MSDS) or equivalent for all chemicals of concern at the site including any chemicals required as part of the sampling program (i.e. calibration gas, sample preservatives, etc.). Detailed chemical safety information can be found at www.osha.gov and www.cdc.gov/NIOSH.

5.0 PRECAUTIONS

Sampling groundwater often occurs at sites that contain known hazardous wastes are adjacent to similar sites. Follow all local regulations in regards to working at such properties.

This project presents construction related hazards such as trips, falls, and slips, and resulting injuries which are typical of undeveloped or industrial sites

- Wear proper footwear, including steel toes for earthwork;
- Clean boots and testing equipment, since slips may result from mud on a hard surface;
- Never jump across obstacles (i.e.: anchor trenches) and
- Do not walk on improvised plank bridges across ditches or anchor trenches unless they have been inspected by a competent person.
- Observe site traffic rules and right-of-way practices at all times. Heavy equipment and trucks should be assumed to have the right-of-way. Generally, the following rules apply to determining the right-of-way:
- Heavier equipment has the right-of-way.
- Loaded trucks and equipment have precedence over unloaded ones.
- Equipment moving down slope has precedence over one going upslope.
- Other general site vehicle operation rules are as follows:
- Observe speed limits within the site which usually do not exceed 15 miles per hour;

- Do not follow another vehicle too closely as material may fall off the vehicle or be thrown by the tires when in motion;
- Large equipment may have a significant "blind spot" on the right side of the vehicle. Avoid passing heavy equipment unless specifically instructed to do so by the operator of that equipment. Assume the equipment operator does not know you are present in an area and maneuver accordingly;
- Listen for and heed back-up alarms from heavy equipment and
- When possible, make eye contact with equipment operators.
- Park the company vehicle near the work location to mark your presence in the area. Wear high visibility clothing (reflective vests) to aid the operator in noticing your presence. Use extreme caution when operating in dusty conditions. Drive with your headlights on to increase your visibility. If conditions become dusty and significantly reduce visibility across the site, leave the area and wait for conditions to improve and contact the Golder Project Manager.
- Do not ride on the contractor's equipment, and do not attempt to operate any such equipment.
- Do not ride on anything that does not have a seat designed for human occupancy.
- Wear your seatbelt at all times when operating a motor vehicle.

Because monitoring wells may provide habitat for insects such as bees, spiders, and wasps, use caution when initially opening the well. When opening the well protective cover, open the cover and stand back for a few minutes to allow any flying insects an opportunity to leave. Prior to removing the well cap, inspect the inside of the protective casing to make sure no inhabitants are present.

6.0 MINIMUM PERSONAL PROTECTIVE EQUIPMENT REQUIRED

- Hard hat, as required
- Safety glasses (splash goggles should be made available depending on the known hazards that may be present in the groundwater)
- Respirator with appropriate cartridges, as required
- High visibility clothing (reflective vest)
- Steel-toed and shank safety boots
- Nitrile gloves (or appropriate gloves depending on the known hazards that may be present in the groundwater)

7.0 TRAINING

- 40-hour HAZWOPER or equivalent local requirement (8-hour annual refresher required).
- OSHA 10-hour Construction Safety
- Emergency First Aid/CPR Course
- Golder and/or site-specific training (including HASP review)

8.0 REFERENCES

- 29 CFR 1910.1000: Air Contaminants

- 29 CFR 1926.59: Hazard Communication
- 29 CFR 1926 Subpart E: Personal Protective and Life Saving Equipment

1.0 SCOPE

This Standard Work Procedure (SWP) applies to all Golder Associates Inc. and Golder Construction Services (Golder) staff working on projects where underground (buried) utilities may be impacted.

2.0 INTRODUCTION

Before hand auguring, drilling, excavating, trenching, concrete coring, etc activities begin, the Site Safety Officer (SSO) should assure that the client or Subcontractor has located and identified all utilities, (i.e., electricity, natural gas lines, etc.) which might be located in the work area and has deactivated them as needed.

3.0 PRECAUTIONS

If the locations of the underground utilities cannot be identified by the client or Subcontractor, the Golder personnel shall identify underground services using one or a combination of the following:

- Contact the relevant utility companies to obtain information as to the location of underground utilities in the work area
- Engage the services of a specialist underground service locating company to assist identifying services
- Conduct a detailed site reconnaissance or interviews with knowledgeable personnel to identify possible underground services

Check State specific laws governing utility locates. Some jurisdictions require the subcontractor (driller, excavator, etc.) to take responsibility for ensuring that the locates are performed.

The 811 utility one-call service should be used as the first step to all locates.

The degree of investigation into the locations of underground services will be based on the risk of damage posed to these services by the field activities proposed (i.e. hand augering poses a significantly lower risk than excavation). The Project Manager will stipulate the minimum level of enquires to be made for each field activity.

If no information can be obtained, excavation, drilling, concrete coring, etc. will be conducted very carefully and will be halted immediately when unexpected difficulties or hard objects are encountered and the location of the drilling, concrete coring, etc. moved to a different location. Indicators such as pea gravel, sand, or other backfill material may also indicate the presence of utilities in the area and caution should be

exercised if encountered. Hand excavation or probing may reduce the risk of utility breach if work is located in suspect areas or materials.

If utilities require deactivation, the deactivation should be certified by the proper utility company or client personnel and the certification retained in the daily field log.

FILL OUT ALL AVAILABLE INFORMATION PRIOR TO CALLING IN A UTILITY LOCATE REQUEST.
CALL AT LEAST 72 HOURS (3 BUSINESS DAYS) PRIOR TO BEGINNING FIELD WORK.

NOTIFICATION LEAD TIME SUBJECT TO LOCAL LAWS AND REGULATIONS

CALL BEFORE YOU DIG!

IMPORTANT: FILL OUT ALL AVAILABLE INFORMATION PRIOR TO CALLING IN A UTILITY LOCATE REQUEST. CALL AT LEAST 72 HOURS (3 BUSINESS DAYS) PRIOR TO BEGINNING FIELD WORK.

NOTIFICATION LEAD TIME SUBJECT TO LOCAL LAWS AND REGULATIONS

PROJECT INFORMATION:

Project:	**Project No:**

GENERAL INFORMATION:

Golder Contract Number:	**Time/Date:**
Ticket Number:	**Person:**
Primary Contact (Field):	**Phone/Pager:**
Secondary Contact (PM):	**Phone/Pager:**

LOCATE INFORMATION:

State:	**City:**
County:	**Other:**
Township/Range/Section/1/4 Section/*1/4-1/4 Section:	
Address or Nearest Intersection:	
Type of Work:	**Overhead Power Conflicts? YES NO**

LOCATE INSTRUCTIONS: (BE AS SPECIFIC AS POSSIBLE)

IMPORTANT: IF FEASIBLE FLAG OR MARK AREAS OF THE PROPOSED EXPLORATION. MAKE SURE TO REQUEST A MINIMUM 50 FT RADIUS AROUND EACH PROPOSED EXPLORATION LOCATION SUCH THEY CAN ME MOVED IN THE EVENT OF A UTILITY CONFLICT.

UTILITIES THAT WILL BE CONTACTED:

Utility	Utility

DISTRIBUTION: FILE

(PROJECT MANAGER)

(FIELD REPRESENTATIVE)

BY: _____

1.0 SCOPE

This Standard Work Procedures (SWP) applies to all Golder Associates Inc. and Golder Construction Services (Golder) staff visiting sites where heavy equipment may be in use. Such sites include surface and underground mines, remediation areas, and construction sites. Heavy equipment activity may change daily or hourly, with differing potential hazards that need to be identified and addressed.

2.0 KEY HAZARDS

- Hauling and dump trucks
- Shovels and draglines
- Excavators
- Bulldozers
- Mobile drill rigs
- Cranes
- Other mobile equipment, such as water trucks, graders, and pick-up trucks

One of the most important points to remember about working around any piece of heavy equipment is that the operator has a limited field of vision. Always make eye contact with the operator of the equipment prior to moving into swing/operating radius.

3.0 PRECAUTIONS

- Make arrangements-discuss protocols with the operator during daily tailgate meetings, at shift change, or when operators and/or operations change.
- Never approach an operational piece of heavy equipment until the operator is aware of your presence, your desire to approach, and signals the OK – where possible use radio contact.
- Stand in a safe location well outside the maximum extended reach of the shovel, dragline, or excavator arm, and out of the way of other mobile equipment. With an excavator, the optimum location is within the quadrant of the operator's visual coverage.
- When contact is made either by radio or visual contact, advise the operator of your wish to approach the equipment. The operator may want to complete a task prior to shutting down. If so, remain at the same location until the operator signals the OK to advance. Usually this will involve lowering the bucket to the ground; however practices may vary between sites. It is advisable to check with the site superintendent/foreman before entering areas where heavy equipment is in operation.
- Advise the operator of your task and requirements. Complete your task, advise the operator that you have completed your work, and depart the work area.

4.0 SAFE DRIVING PRACTICES

- All pieces of haulage equipment and large mobile equipment will have the right-of-way on all roadways. All other equipment will give way and will keep a safe distance until the roadway is cleared.
- In areas of traffic congestion and narrow travel-ways, the smallest vehicle shall always yield to larger vehicles.
- When following heavy equipment, a safe travelling distance should be maintained at all times. The driver's side mirror should always be visible to you, and hence you to the operator.
- On the majority of operating surface mines, all traffic travels on the left-hand side of the road. However practices may vary between sites. Check with the site superintendent/foreman before travelling on site roadways.
- Overtaking hauling and dump trucks should be done only when the truck operator tells you to do so. Visual and/or radio contact must be made with the operator.

5.0 RESPONSIBILITIES

It is your responsibility to understand the traffic and equipment operating rules of the site. Ask the site superintendent/foreman for this information upon entering the site for the first time. This information should be reviewed during daily tailgate meetings.

6.0 MINIMUM PERSONAL PROTECTIVE EQUIPMENT REQUIRED

- Hard Hat
- Safety Boots
- High Visibility Vest
- Hearing Protection
- Safety Glasses

1.0 SCOPE

This Standard Work Procedures (SWP) applies to all Golder Associates Inc. and Golder Construction Services (Golder) staff working in high noise environments.

2.0 DEFINITION

Noise induced hearing loss is an insidious, debilitating disease. Employees are advised of the potentially harmful effects of excessive noise and should make every effort to limit their exposure both at work and at home. Although noise-induced hearing loss is one of the most common occupational illnesses, it is often ignored because there are no visible effects, it usually develops over a long period of time, and, except in very rare cases, there is no pain. What does occur is a progressive loss of communication, socialization, and responsiveness to the environment.

Work-related hearing loss continues to be a critical workplace safety and health issue. Noise-induced hearing loss is preventable, but once acquired, hearing loss is permanent and irreversible. Prevention measures must be taken by employers and workers to ensure the protection of workers' hearing. The following table below is the Occupational Safety and Health Administrations (OSHA) permissible sound exposure limits found in 29 Code of Federal Regulations (CFR) 1910.95 Table G-16.

Duration per day (hours of exposure)	Sound level (dBA, slow response)
8	90
6	92
4	95
3	97
2	100
1-1/2	102
1	105
1/2	110
1/4 or less	115

3.0 HAZARDS

Golder shall administer a hearing conservation program when employees are exposed to sounds equal or greater than 85 dB(A) on an 8 hour Time-Weighted Average (TWA) bases. Golder will provide earplugs and/or earmuffs to all employees who work where peak noise levels may equal or exceed 85 dB(A) at no cost to the employee. Unless specific noise readings are available to demonstrate otherwise, noise levels near heavy equipment, drill rigs, pile drivers, concrete coring devices, etc. should be assumed to equal or

exceed 85 dB(A). Employees shall use the issued hearing protection devices when in any of the following situations:

- When work area safety requirements include hearing protection
- When working in an area of steady state (continuous) noise that interferes with normal speech between individuals who are standing at a distance of three feet apart
- When working in an area of any impact noise (such as driving casing or piles) where the noise is loud enough to cause discomfort
- When in areas where signs are posted requiring hearing protection
- When noise levels measured with a properly calibrated sound level meter equal or exceed 85 dB(A)
- At sound levels at or above 105dB dual hearing protection must be implemented
- At no time shall employees be exposed to sounds either protected or unprotected above 115dB continuously or 140dB with impact/impulsive pressure.

4.0 POSSIBLE CONSEQUENCES

Permanent hearing loss or impairment can result from prolonged exposure to noise at levels above 85 dB(A) on an 8 hour TWA basis. Hearing loss or impairment can also result from shorter exposures at higher sound levels.

5.0 TRAINING

Employees required to work in areas where peak noise levels may equal or exceed 85 dB(A) will be provided with appropriate training regarding hearing conservation before commencing work in these areas. Training will include addressing ambient conditions, as well as changed conditions. Refresher training will be provided as conditions change, or, at a minimum, on an annual basis. Records of training will be maintained in the employee's personnel file, as required in 29 CFR 1910.95 and 1910.120.

6.0 MEDICAL MONITORING

All Golder technical employees participate in the company's medical monitoring program which includes annual or biennial physicals. The medical monitoring program consists of regular, annual, biennial, or periodic physical examinations including audiometric testing in accordance with 29 CFR 1910.95 and 29 CFR 1910.120(f). Prior to beginning employment with Golder, all new employees complete a pre-employment physical examination at no cost to the prospective employee that, among other items, includes a baseline audiogram for the employee. Prior to the baseline audiogram the employee must not be exposed to workplace noise by at least 14 hours. In the event that a standard threshold shift is determined during a regular, periodic audiogram, the employee will be notified within 21 days of the determination. In addition, employee work habits, Personal Protective Equipment (PPE) and site situations will be evaluated

to determine what alternative hearing conservation methods would be appropriate. This evaluation will be conducted in consultation with a qualified medical professional.

Medical monitoring results (including audiograms) are provided to the employee after completion of the physical examination and evaluation of the data by Golder's occupational medical physician or other licensed physician. Audiogram results are retained by Golder with the employee's medical monitoring records for a period of time in accordance with the provisions of 29 CFR 1910.95(m) and 1910.1020(d).

7.0 CONTROL MEASURES

- Where reasonable and practicable, Golder will reduce the worker's exposure to high noise situations through the use of engineering, and administrative controls. Should these controls not be sufficient or effective, PPE will be used to protect the worker
- Employees shall complete a hazard assessment prior to starting work in an area of high noise, to ensure that all hazards are accounted for, and the appropriate PPE is utilized. Employees shall comply with all ear plugs/muffs manufacturer's guidelines, and government standards regarding ear protection
- Noise levels will be monitored at regular intervals throughout the work period to ensure worker safety. If the noise monitoring confirms excessive noise at a worksite, sound level measurements will be used to evaluate the efficacy of the planned PPE. In the event that planned PPE will not provide sufficient hearing protection, the site safety contact will consult with the office or regional Health and Safety Coordinator to develop an alternative approach to protect worker hearing
- Hearing protection PPE will be inspected prior to the start of work each day to ensure that the PPE is functioning as designed, and if the PPE is in anyway compromised, it is replaced. Hearing PPE will be provided by Golder at no cost to the employee

8.0 PERSONAL PROTECTIVE EQUIPMENT

- Ear plugs (Compliant with American National Standards Institute (ANSI) S3.19-1974.)
- Ear muffs (Compliant with ANSI S3.19-1974.)

9.0 JOB STEPS & PRECAUTIONS

- Workers shall read and understand the SWPs regarding Hearing Protection and PPE
- A site specific Health and Safety Plan (HASP) will contain a hazard assessment that will be completed prior to work commencing to determine the hazards as well as the required PPE
- PPE will be inspected daily to ensure it is in good working order

10.0 APPLICABLE OSHA REGULATION PARTS

- 29 CFR 1910.95 (Occupational Health and Environment Control)
- ANSI S3.19-1974 (Test method)

1.0 SCOPE

This Standard Work Procedure (SWP) applies to all Golder Associates Inc. and Golder Construction Services (Golder) staff that work on or over water.

2.0 WORKING ON OR OVER WATER

Over or on water work is undertaken for various activities including: barge drilling, geophysics, piling and inspection, dredging, aquatic sampling, and transport. This work can occur over lakes, rivers, and in marine environments.

3.0 KEY HAZARDS

- Falling overboard, drowning
- Falls or slips associated with wet surfaces or rough water
- Overturning or capsizing due to improperly loaded or overloaded vessels
- Collisions with other vessels or debris
- Pinch points between the vessel and another vessel, a dock/pier, and/or equipment hung over the side of the vessel.
- Seasickness
- Weather Changes
- Hypothermia

4.0 PRECAUTIONS

- Only trained and qualified persons should operate the controls of boats, barges, or other maritime vessels. For all work carried out over water, the owner, either Golder or sub-contractors, shall be responsible for the safe operation, maintenance and general sea-worthiness of the vessel.
- Perform a equipment and/or vehicle check prior to work activities and sailing of the vessel.
- Workers are required to wear an approved Personal Floatation Device (PFD) that is sufficiently buoyant to keep the workers head above water. This does not apply in situations where either the depth of water is too shallow to allow the PFD to function properly, or a sufficient fall protection system has been implemented to prevent falls into the water. Employees working over or near water, where the danger of drowning exists, shall be provided with U.S. Coast Guard-approved life jacket or buoyant work vests. PFDs should provide thermal insulation if work is in cold climate.

- All buoyancy and lifesaving equipment is to be marked with reflective material, including PFD's (should have whistle and/or light beacon if used on vessel), life rafts, lifeboats, and buoys. Prior to and after each use, the buoyant work vests or life preservers shall be inspected for defects which would alter their strength or buoyancy. Defective units shall not be used, tagged as defective, and removed from the vessel. If needed, ring buoys with at least 90 feet (27.4 meters) of Floating (nylon) line shall be provided and readily available for emergency rescue operations. The distance between the ring buoys shall not exceed 200 linear feet (61 meters).
- In addition, at least one lifesaving skiff shall be immediately available at locations where employees are working over or adjacent to water.
- If a boat is to be used for the transportation of workers, it is required to be conspicuously marked with a safe maximum load, a safe maximum horsepower (if equipped with an outboard motor in excess of 10 HP), and that it be marked with a loading water line to make overloading apparent.
- Never attempt to jump across two transfer points such as boats, barges, other maritime vessels, docks, and/or piers, even if the vessel is tied off to a fixed point. There may be obstructions, slipping or tripping hazards, uneven surfaces, and/or turbulent water conditions that could cause a person to fall between the transfer point into the water and/or crushed against the vessels or structures. This particularly applies during inclement weather and/or during turbulent water conditions.
- Prior to the start of work activities employees, sub-contractors, and/or the crew of the vessel should review the "man overboard" procedures.
- Employees working above the water and/or near the water shall not be permitted to work alone if there is the danger of drowning.
- Required safety equipment includes: PFDs, communication device (radio, satellite phone, etc), visual distress signal (lights, red flares, etc), navigation lights (required from sunset to sunrise) sound producing device (whistle, air horn, etc) first-aid supplies, readily available fire extinguisher(s), and backfire flame arrestor (on gas outboard motors).
- Deck lighting or spotlights/floodlights are to be used to ensure all work areas on board are sufficiently illuminated to enable work to be carried out safely.
- A radio or other method of communication with a land based station is required. If the vessel is in excess of 18 feet (5.5 meters) in length, an Emergency Position Indication Radio Beacon (EPIRB) is required for locating the vessel in the event of an accident.
- For stationary vessels (i.e. Barges), anchor points must be placed in a safe manner to prevent long anchor lines from being snagged and dragged by other vessels. All anchor points are to be well marked with buoys, and attachment points to shore are to be similarly well marked.
- Obtain as much site-specific information as possible concerning tidal/river conditions, known navigational hazards, and water depths. This is essential if you are operating the vessel and generally useful if you are working with a contractor owner/operator. Service clearance is also required, underwater/underground cables and pipelines may be present in the area.
- Use current tidal and marine charts, check weather forecasts and conditions for the area of interest, and determine what traffic may be present (barges, log booms, freighters, ferries, etc.). Verify weather, visibility and tidal conditions prior to embarking.

- The operator of a vessel is responsible for operating his/her vessel within the safe maximum load, and any posted power limits or speeds.
- The operator of the vessel is responsible for having the proper state numbering and letters on the vessel. The lettering and numbering shall be in contrasting color to the vessel, greater than 3 inches in height, and located on each side of the forward part of the vessel. The state decal shall be located within 6 inches of the registration number.
- A site-specific Health and Safety Plan (HASP) shall be completed prior to the work activities. The HASP will cover such topics as emergency action plan and contact information, hazard identification and control, additional training requirements, Personal Protective Equipment (PPE), Material Safety Data Sheets (MSDS), special instructions, etc. The HASP shall be reviewed and signed off by all employees before for the start of any work activities.
- A task-specific Job Safety Analysis (JSA) may be required prior to the work activities. The JSA will include a breakdown of the tasks, hazard identification of the tasks, control measures, and a risk score (after controls are in place). The risk score will be developed using the hazard analysis matrix. The JSA shall be reviewed and signed off by all employees before the start of any work activities.
- Prior to the start of work activities, employees and/or Golder subcontractors shall perform a safety meeting prior to the day's work activities, in the event of scope of work changes, or in the event of any environmental changes, Employees will sign off on the toolbox meetings and a copy will be retained with the site specific HASP.

5.0 MINIMUM PERSONAL PROTECTIVE EQUIPMENT REQUIRED

Employees working over or near water, where the danger of drowning exists, shall be provided with U.S. Coast Guard-approved life jacket or buoyant work vests. Prior to and after each use, the buoyant work vests or life preservers shall be inspected for defects which would alter their strength or buoyancy. Defective units shall not be used, tagged as defective, and removed from the vessel.

6.0 TRAINING

Employees working over and/or on water shall be trained on the associated hazard through this SWP, the site specific HASP, and/or the task specific JSA.

7.0 FILING A FLOAT PLAN

Before going out on a vessel the Coast Guard strongly recommends to leave a float plan with a local marina and your local office to assist with a potential resuce. The Coast Guard will not receive a copy of the float plan unless they are needed to provide actaual assistance. A float plan should:

- Describe the vessel, its number, size, make, capacity, horsepower, and type of engine.
- List where you are going, the route, and your expected return time.
- Give the number of passengers, their names and addresses, and a contact in case of an emergency.

8.0 APPLICABLE OSHA REGULATIONS PARTS

- 29 CFR 1926.106 "Working over or near water"

9.0 RELATED STANDARD WORK PROCEDURES

- US SWP Cold Water Operations

Appendix A - Float Plan

1. Name of person reporting and telephone number
   _____
   (_____) _____
2. Description of boat
   Type_____ Color_____ Trim_____
   Registration No._____ Length_____
   Name _____ Make_____ Other _____
3. Engine type_____ H. P._____
   No. of engines _____ Fuel capacity_____
4. Survival equipment ❑ PFDs ❑ Paddles ❑ Smoke signals ❑ Anchor
5. Radio ❑ Yes ❑ No Type _____ Frequency _____
6. Mobile phone ❑ Yes ❑ No (_____) _____
7. Automobile license number _____
   Type_____ Trailer license_____
   Color_____ Make of auto_____
   Where parked_____
8. Persons on board

Name	Age	Address & Telephone

9. Do any of the persons on board have a medical problem?
   ❑ Yes ❑ No If yes, what?_____
10. Trip expectations. Leave at_____ ❑ am ❑ pm
    From _____ going to_____

    Expect to return by (time) _____ ❑ am ❑ pm and
    not later than _____ ❑ am ❑ pm
11. Any other pertinent information?_____
    _____
12. If not returned by (time) call the Coast Guard or (local authority) _____ ❑ am ❑ pm
13. Telephone numbers
    (_____) _____ (_____) _____

APPENDIX D

BORING LOGS

RECORD OF BOREHOLE B09-1

SHEET 1 of 1

PROJECT: Carlstadt OU-3
PROJECT NUMBER: 943-6222
DRILLED DEPTH: 65.5 ft
AZIMUTH: N/A
LOCATION: Carlstadt, NJ

DRILL METHOD: Rotosonic
DRILL RIG: 1423 Minisonic
DATE STARTED: 1/4/10
DATE COMPLETED: 1/6/10
WEATHER: Partly Sunny

DATUM: NJ STATE PLANE NAD 83
COORDS: N: 725,035.7 E: 2,164,808.7
GS ELEVATION: 7.3 ft
TOC ELEVATION:
TEMPERATURE: 23F

INCLINATION: -90
DEPTH W.L.:
ELEVATION W.L.:
DATE W.L.:
TIME W.L.:

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES PID (ppm)	NUMBER	TYPE	REC / ATT	Sample Notes
0		0.0 - 0.5 Asphalt-Subbase (soft dig)	Asphalt		0.5	0.0				
	5	0.5 - 9.0 FILL- Wet, brown loose/soft gravelly silty SAND (FILL), some subangular coarse gravel and rock fragments, cobbles. No odor.	FILL			0.0	1	ROTO SONIC	2.8 / 10.0	
5						0.0				
	0				-1.7	0.0				
10		9.0 - 10.5 FILL- Moist, orange, loose silty gravelly SAND (FILL), some rock fragments, cobbles. No odor.	FILL		9.0 -3.2	0.0				
	-5	10.5 - 11.5 Moist, dark brown, soft PEAT, little organic fibrous stems. No odor.	PEAT		-4.2	0.0				
		11.5 - 12.0 Moist, olive-green, soft varved silty CLAY. No odor.	CL		12.0	0.0	2	ROTO SONIC	10.0 / 10.0	
15		12.0 - 14.0 Moist, orange brown, firm bedded CLAY, trace fines. No odor.	CL		-6.7 14.0	0.0				
	-10	14.0 - 21.0 Moist, orange brown, soft silty CLAY. No odor.				0.0				
20					-13.7	0.0				
	-15	21.0 - 23.0 Moist, grayish-orange, soft silty CLAY, trace organics. No odor.	CL		21.0 -15.7	0.0				
		23.0 - 28.0 Moist, orange-brown to gray brown silty CLAY, trace gravel.	CL		23.0	0.0	3	ROTO SONIC	10.0 / 10.0	
25						0.0				
	-20				-20.7	0.0				Sampled GW- B09-1-28
		28.0 - 46.0 Wet, reddish brown, soft clayey SILT (SOFT TILL), little coarse to fine subangular gravel, trace subrounded cobbles. No odor.	SOFT TILL		28.0	0.0				
30						0.0				
	-25					0.0				
35						0.0	4	ROTO SONIC	10.0 / 10.0	
	-30					0.0				Sampled GW- B09-1-38
40						0.0				
	-35					0.0	5	ROTO SONIC	5.0 / 5.0	
45						0.0				
					-38.7	0.0				
	-40	46.0 - 48.0 Moist, red-brown, firm CLAY, trace silt, little some coarse gravel. No odor.	CL		46.0 -40.7	0.0	6	ROTO SONIC	5.0 / 5.0	Sampled GW- B09-1-48
50		48.0 - 63.0 Moist, reddish brown, dense subangular coarse to fine Gravel with fine sandy SILT (fines), trace rounded cobbles (LODGMENT TILL). No odor.			48.0	0.0				
	-45					0.0				
55			Lodgment TILL			0.0	7	ROTO SONIC	6.0 / 10.0	
	-50					0.0				Sampled GW- B09-1-58
60						0.0				
	-55				-55.7	0.0	8	ROTO SONIC	4.3 / 5.5	
		63.0 - 65.0 Weathered BEDROCK-SILTSTONE- Dry, very fine sandy SILT with flat, subrounded Gravel and Siltstone fragements. Powdery, dry due to sonic vibrations on weathered bedrock.	Weathered Bedrock		63.0 -57.7	0.0				
65		65.0 - 65.5 BEDROCK-Competent SILTSTONE	Bedrock			0.0				
	-60	Boring completed at 65.5 ft								
70										
	-65									

LOG SCALE: 1 in = 9.5 ft
DRILLING COMPANY: Boart Longyear
DRILLER: Rick Tabor

GA INSPECTOR: JLH
CHECKED BY: Heather L
DATE: 3/10/10

Golder Associates

R2-0001455

AA BOREHOLE RECORD NO WELL 943-6222 B09-1 THRU B09-5.GPJ GOLDER NJ-PA 05-24-06.GDT 5/13/10

RECORD OF BOREHOLE B09-2

SHEET 1 of 1

PROJECT: Carlstadt OU-3
PROJECT NUMBER: 943-6222
DRILLED DEPTH: 70.0 ft
AZIMUTH: N/A
LOCATION: Carlstadt, NJ

DRILL METHOD: Rotosonic
DRILL RIG: 1423 Minisonic
DATE STARTED: 12/11/09
DATE COMPLETED: 12/14/09
WEATHER: Sunny

DATUM: NJ STATE PLANE NAD 83
COORDS: N: 725,135.1 E: 2,164,806.8
GS ELEVATION: 6.7 ft
TOC ELEVATION:
TEMPERATURE: 21F

INCLINATION: -90
DEPTH W.L.:
ELEVATION W.L.:
DATE W.L.:
TIME W.L.:

DEPTH (ft)	ELEVATION (ft)	DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	PID (ppm)	NUMBER	TYPE	REC / ATT	Sample Notes
0	5	0.0 - 0.5 Asphalt-Subbase (soft dig)	Asphalt		0.5	5.6				
5	0	0.5 - 7.5 FILL- Wet, grayish black, loose gravelly silty SAND (FILL), some subangular coarse gravel and rock fragments. Slight odor.	FILL		-0.8	1.4 5.0 2.3	1	ROTO SONIC	7.0 / 10.0	
10	-5	7.5 - 9.0 Moist, dark brown, soft PEAT, little organic fibrous stems. No odor.	PEAT		7.5 -2.3	18.9				
		9.0 - 10.5 Very moist, grayish Clayey soft SILT/ SILTY CLAY. No odor.	CL		9.0 -3.8	14.7 1.3				
15	-10	10.5 - 20.0 Moist, Mottled, firm varved CLAY (silt sand varves). No odor.	CL		10.5	0.0 0.0 0.0 0.0	2 3	ROTO SONIC ROTO SONIC	5.0 / 5.0 5.0 / 5.0	
20	-15	20.0 - 25.0 No Recovery, Washed out, very loose/soft. No odor.	CL		-13.3 20.0	0.0 NA NA NA	4	ROTO SONIC	0.0 / 5.0	
25	-20	25.0 - 27.0 Wet, orange brown, soft, silty CLAY. No odor.	CL		-18.3 25.0 -20.3	0.0 0.0	5	ROTO SONIC	3.5 / 5.0	
		27.0 - 30.0 Wet, reddish brown, clayey SILT (SOFT TILL). No odor.	ML		27.0 -23.3	0.0				
30	-25	30.0 - 43.0 Wet, reddish brown, soft clayey SILT (SOFT TILL), little coarse to fine subangular gravel, trace subrounded cobbles. No odor.	TILL		30.0	0.0 0.0 0.0 0.0 0.0	6	ROTO SONIC	9.0 / 10.0	Sampled GW- B09-2-35
35	-30					0.0 0.0	7	ROTO SONIC	5.0 / 5.0	
40	-35				-36.3					
		43.0 - 45.5 Moist, reddish brown, sandy CLAY. No odor.	CL		43.0 -38.8	0.0				Sampled GW- B09-2-45
45	-40	45.5 - 60.0 Moist, reddish brown, dense subangular coarse to fine Gravel with fine sandy SILT (fines) matrix (LODGMENT TILL). No odor.	Lodgment TILL		45.5	0.0 0.0 0.0 0.0 0.0	8	ROTO SONIC	9.2 / 10.0	
50	-45									
55	-50					0.0 0.0 0.0	9	ROTO SONIC	10.0 / 10.0	Sampled GW- B09-2-55
60	-55				-53.3					
		60.0 - 65.0 Weathered BEDROCK-SILTSTONE- Dry, very fine sandy SILT with flat, subrounded Gravel and Siltstone fragments. Powdery, dry due to sonic vibrations on weathered bedrock.	Weathered Bedrock		60.0 -58.3	0.0 0.0 0.0				
65	-60	65.0 - 69.0 Weathered bedrock with SILSTONE fragments. No odor.	Bedrock		65.0 -62.3	0.0 0.0 0.0	10	ROTO SONIC	5.0 / 5.0	Sampled GW- B09-2-65
70	-65	69.0 - 70.0 BEDROCK-Competent SILTSTONE Boring completed at 70.0 ft	Bedrock		-63.3					

LOG SCALE: 1 in = 9.5 ft
DRILLING COMPANY: Boart Longyear
DRILLER: Rick Tabor

GA INSPECTOR: JLH
CHECKED BY: Heather L
DATE: 3/10/10

Golder Associates

R2-0001456

AA BOREHOLE RECORD NO WELL 943-6222 B09-1 THRU B09-5.GPJ GOLDER NJ-PA 05-24-06.GDT 5/13/10

RECORD OF BOREHOLE B09-3

SHEET 1 of 1

PROJECT: Carlstadt OU-3
PROJECT NUMBER: 943-6222
DRILLED DEPTH: 60.5 ft
AZIMUTH: N/A
LOCATION: Carlstadt, NJ

DRILL METHOD: Rotosonic
DRILL RIG: 1423 Minisonic
DATE STARTED: 1/7/10
DATE COMPLETED: 1/8/10
WEATHER: Partly Sunny

DATUM: NJ STATE PLANE NAD 83
COORDS: N: 725,142.5 E: 2,164,681.3
GS ELEVATION: 8.1 ft
TOC ELEVATION:
TEMPERATURE: 30F

INCLINATION: -90
DEPTH W.L.:
ELEVATION W.L.:
DATE W.L.:
TIME W.L.:

DEPTH (ft)	ELEVATION (ft)	DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	PID (ppm)	NUMBER	TYPE	REC / ATT	Sample Notes
0		0.0 - 0.3 Topsoil-Vegatation.	Topsoil							
		0.3 - 1.5 FILL-Moist, gray-brown silty SAND with coarse to fine subangular gravel.	FILL		6.6 1.5	0.0				
5	5	1.5 - 9.0 FILL-Slightly moist, gray brown to grey gravelly silty SAND, little timber, cobbles, subangular rock fragments. No odor.	FILL			0.0 0.0 0.0	1	ROTO SONIC	5.2 / 10.0	
	0				-0.9	0.0				
10		9.0 - 10.0 Moist, red brown, soft sandy SILT, little fine subangular gravel.	ML		-1.9	0.0				
		10.0 - 11.5 Moist, dark brown to black PEAT, little black organic Silt. Organic odor.	PEAT		10.0 -3.4 11.5	0.0				
	-5	11.5 - 15.7 Moist, dark olive green, very soft silty varved CLAY. No odor.	CL			0.0 0.0	2	ROTO SONIC	10.0 / 10.0	
15					-7.6					
		15.7 - 17.5 Slightly moist, orange-brown hard CLAY.	CL		15.7 -9.4	0.0				
	-10	17.5 - 20.0 Very moist, red brown, soft fine sandy SILT, little subrounded fine gravel.	ML		17.5 -11.9	0.0				
20		20.0 - 28.0 Very moist, gray-brown, very soft silty (massive) silty CLAY.	CL		20.0	0.0 0.0 0.0	3	ROTO SONIC	8.1 / 10.0	
	-15					0.0				
25					-19.9					
	-20	28.0 - 29.5 Very moist, orange brown, loose silty fine SAND, little subrounded fine gravel. No odor. (SOFT TILL)	SW CL		28.0 -21.4 30.0	0.0				Sampled GW- B09-3-30
30		29.5 - 30.0 Very moist, gray brown, soft silty Clay, trace fine Sand. No odor.				0.0				
	-25	30.0 - 39.0 Wet, orange-brown (Soft Till) soft fine sandy SILT, little coarse to fine subrounded gravel, trace cobbles. No odor.	SW			0.0 0.0	4	ROTO SONIC	9.2 / 10.0	
35						0.0				
	-30				-30.9					
40		39.0 - 43.0 Wet, orange brown, loose silty fine-medium SAND, little fine subrounded Gravel.	SW		39.0	0.0				Sampled GW- B09-3-40
	-35				-34.9	0.0				
		43.0 - 45.0 Moist, orange brown, soft Clayey SILT. No odor.	ML		43.0 -36.9					
45		45.0 - 48.0 Moist, orange brown, firm to hard silty CLAY, little coarse to fine subrounded g1ravel. No odor.	CL		45.0	0.0	5	ROTO SONIC	10.0 / 10.0	
	-40				-39.9	0.0				
		48.0 - 58.0 Wet, orange brown, hard Clayey SILT and Coarse to fine subangular GRAVEL (Lodgment Till), trace weathered Siltstone fragments and cobbles. No odor.	Lodgment TILL		48.0	0.0				Sampled GW- B09-3-50
50						0.0				
	-45					0.0				
55						0.0	6	ROTO SONIC	10.5 / 10.5	
	-50				-49.9	0.0				
		58.0 - 60.0 WEATHERED BEDROCK- Siltstone fragments.	Weathered Bedrock		58.0 -51.9					
60		60.0 - 60.5 Top of Competent Bedrock (SILTSTONE).	Bedrock							Sampled GW- B09-3-60
	-55	Boring completed at 60.5 ft								
65										
	-60									
70										
	-65									

LOG SCALE: 1 in = 9.5 ft
DRILLING COMPANY: Boart Longyear
DRILLER: Rick Tabor

GA INSPECTOR: JLH
CHECKED BY: Heather L
DATE: 3/10/10

Golder Associates

R2-0001457

AA BOREHOLE RECORD NO WELL 943-6222 B09-1 THRU B09-5.GPJ GOLDER NJ-PA 05-24-06.GDT 5/13/10

RECORD OF BOREHOLE B09-4

SHEET 1 of 1

PROJECT: Carlstadt OU-3
PROJECT NUMBER: 943-6222
DRILLED DEPTH: 37.0 ft
AZIMUTH: N/A
LOCATION: Carlstadt, NJ

DRILL METHOD: Rotosonic
DRILL RIG: 1423 Minisonic
DATE STARTED: 1/13/10
DATE COMPLETED: 1/13/10
WEATHER: Sunny

DATUM: NJ STATE PLANE NAD 83
COORDS: N: 725,848.9 E: 2,164,468.2
GS ELEVATION: 6.0 ft
TOC ELEVATION:
TEMPERATURE: 30F

INCLINATION: -90
DEPTH W.L.:
ELEVATION W.L.:
DATE W.L.:
TIME W.L.:

DEPTH (ft)	ELEVATION (ft)	DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	PID (ppm)	NUMBER	TYPE	REC / ATT	Sample Notes
0	5	0.0 - 0.4 Topsoil-Vegatation	Topsoil		0.4					
		0.4 - 10.5 FILL- Moist, dark brown loose/soft fine sandy SILT and subangular gravel and rock fragments, trace clay. No odor.	FILL			0.0 0.0 0.0	1	ROTO SONIC	3.5 / 10.0	
10	-5	10.5 - 12.5 Moist, dark brown PEAT. No odor.	PEAT		-4.5 10.5 -6.5	0.0				
		12.5 - 15.5 Moist, tan brown stiff CLAY, trace Silt. No odor.	CL		12.5 -9.5	3.2 9.8	2	ROTO SONIC	10.0 / 10.0	
15	-10	15.5 - 20.0 Very moist, grayish light brown very soft Clayey SILT (Glacial Soft Till). No odor.	ML		15.5	12.4 16.4 6.6 6.1				Sampled Soil- B09-4-20
20	-15	20.0 - 23.0 Very moist, grayish orange-brown very soft Clayey SILT, trace fine Sand (Glacial Soft Till) No odor.	ML		-14.0 20.0 -17.0	1.9 2.1	3	ROTO SONIC	5.0 / 5.0	
		23.0 - 26.0 Wet, grayish orange brown, very soft Clayey SILT (Glacial Soft Till), little fine Sand, trace fine gravel.	ML		23.0 -20.0	0.0 0.0				
25	-20	26.0 - 34.0 Wet, orange brown, soft, loose Silty fine SAND, little coarse to fine subrounded gravel, (Glacial Soft Till), No odor.	ML		26.0	0.0 0.0 0.0	4	ROTO SONIC	5.0 / 5.0	Sampled GW- B09-4-30
30	-25					0.0 0.0	5	ROTO SONIC	6.2 / 7.0	Sampled Soil- B09-4-30
35	-30	34.0 - 36.0 Wet, orange brown, hard Clayey SILT and Coarse to fine subangular GRAVEL (Lodgment Till), trace weathered Siltstone fragments. No odor.	Lodgment TILL		-28.0 34.0 -30.0	0.0 0.0				Sampled GW- B09-4-35 Sampled Soil- B09-4-35
		36.0 - 37.0 BEDROCK-Orange-brown SILTSTONE.	Bedrock		36.0 -31.0					
40	-35	Boring completed at 37.0 ft								

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: Boart Longyear
DRILLER: Rick Tabor

GA INSPECTOR: JLH
CHECKED BY: Heather L
DATE: 3/10/10

Golder Associates

R2-0001458

AA BOREHOLE RECORD NO WELL 943-6222 B09-1 THRU B09-5.GPJ GOLDER NJ-PA 05-24-06.GDT 5/13/10

RECORD OF BOREHOLE B09-5

SHEET 1 of 1

PROJECT: Carlstadt OU-3
PROJECT NUMBER: 943-6222
DRILLED DEPTH: 38.0 ft
AZIMUTH: N/A
LOCATION: Carlstadt, NJ

DRILL METHOD: Rotosonic
DRILL RIG: 1423 Minisonic
DATE STARTED: 1/11/10
DATE COMPLETED: 1/12/10
WEATHER: Sunny

DATUM: NJ STATE PLANE NAD 83
COORDS: N: 725,721.1 E: 2,164,361.1
GS ELEVATION: 5.9 ft
TOC ELEVATION:
TEMPERATURE: 30F

INCLINATION: -90
DEPTH W.L.:
ELEVATION W.L.:
DATE W.L.:
TIME W.L.:

DEPTH (ft)	ELEVATION (ft)	DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	PID (ppm)	NUMBER	TYPE	REC / ATT	Sample Notes
0	5	0.0 - 0.2 Topsoil-Vegatation	Topsoil		0.2					
		0.2 - 9.8 FILL- Moist, dark brown loose/soft fine sandy SILT and subangular gravel and rock fragments. No odor.	FILL			0.0 0.0 0.0	1	ROTO SONIC	3.0 / 10.0	
5	0				-3.9					
10	-5	9.8 - 10.0 Moist, gray-brown clayey SILT, trace silt varves.	ML		10.0	0.0				
		10.0 - 14.0 Moist, mottled (yellow, gray, brown) very soft varved silty CLAY. No odor	CL			3.6 4.1	2	ROTO SONIC	5.0 / 5.0	
					-8.1	12.1				
		14.0 - 15.0 Moist, orange brown hard CLAY. No odor.	CL		14.0 -9.1					
15	-10	15.0 - 20.0 Very moist, grayish orange-brown very soft Clayey SILT (Glacial Soft Till). No odor.	ML		15.0	44.1 3.6 4.1 2.9	3	ROTO SONIC	3.5 / 5.0	
					-14.1					
20	-15	20.0 - 25.0 Wet, grayish orange brown, very soft Clayey SILT (Glacial Soft Till), little fine Sand, trace fine gravel.	ML		20.0	3.0 3.1 4.4 4.1	4	ROTO SONIC	5.0 / 5.0	Sampled Soil- B09-5-20
					-19.1					
25	-20	25.0 - 31.0 Wet, orange brown, soft to firm gravelly Clayey SILT (Glacial Soft Till), trace fine Sand. No odor.	ML		25.0	2.4 1.1 0.0	5	ROTO SONIC	5.0 / 5.0	
30	-25				-25.1	0.0 0.0	6	ROTO SONIC	2.0 / 2.0	Sampled Soil- B09-5-30 Sampled GW- B09-5-30
		31.0 - 36.0 Unconsolidated Gnessic Schist BOULDER-with consistent black Biotite banding.	Boulder		31.0	NA	7	ROTO SONIC	3.0 / 3.0	
35	-30				-30.1					Sampled GW- B09-5-36
		36.0 - 38.0 Weathered orange-brown SILTSTONE (Bedrock). Hard drilling at 38'-Competent SILTSTONE.	Bedrock		36.0	0.0	8	ROTO SONIC	3.0 / 3.0	
					-32.1					
		Boring completed at 38.0 ft								
40	-35									

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: Boart Longyear
DRILLER: Rick Tabor

GA INSPECTOR: JLH
CHECKED BY: Heather L
DATE: 3/10/10

Golder Associates

R2-0001459

AA BOREHOLE RECORD NO WELL 943-6222 B09-1 THRU B09-5.GPJ GOLDER NJ-PA 05-24-06.GDT 5/13/10

RECORD OF BOREHOLE MW-21R

SHEET 1 of 1

PROJECT: Carlstadt OU-3
PROJECT NUMBER: 943-6222
DRILLED DEPTH: 85.0 ft
AZIMUTH: N/A
LOCATION: Carlstadt, NJ

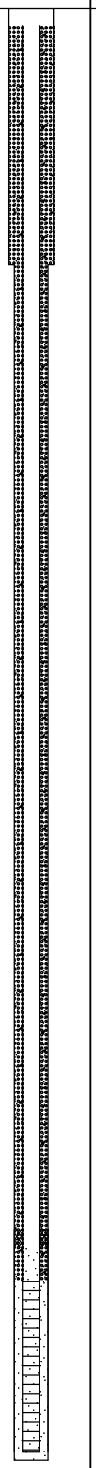
DRILL METHOD: Rotosonic
DRILL RIG: 1423 Minisonic
DATE STARTED: 12/16/09
DATE COMPLETED: 12/22/09
WEATHER: Sunny

DATUM: NJ STATE PLANE NAD 83
COORDS: N: 725,097.9 E: 2,164,782.4
GS ELEVATION: 6.8 ft
TOC ELEVATION: 6.5 ft
TEMPERATURE: 25F

INCLINATION: -90
DEPTH W.L.:
ELEVATION W.L.:
DATE W.L.:
TIME W.L.:

DEPTH (ft)	ELEVATION (ft)	DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	PID (ppm)	NUMBER	TYPE	REC / ATT
0	5	0.0 - 0.4 Asphalt-Subbase (soft dig)	Asphalt		0.4	0.0	1	ROTO SONIC	7.1 / 10.0
5	0	0.4 - 6.0 FILL- Wet, grayish black, loose gravelly silty SAND (FILL), some subangular coarse gravel and rock fragments. No odor.	FILL		0.8	0.0			
		6.0 - 9.2 Moist, dark brown, soft PEAT, little organic fibrous stems.	PEAT		6.0 -2.4	0.0			
10	-5	9.2 - 12.0 Very moist, grayish Clayey soft SILT/ SILTY CLAY. No odor.	CL		9.2 -5.2	0.0	2	ROTO SONIC	5.0 / 5.0
15	-10	12.0 - 17.0 Moist, mottled, firm varved CLAY (silt sand varves). No odor.	CL		12.0 -10.2	0.0	3	ROTO SONIC	6.0 / 6.0
20	-15	17.0 - 23.0 Wet, orange brown, soft, silty CLAY. No odor.	CL		17.0 -16.2	0.0	4	ROTO SONIC	7.0 / 7.0
25	-20	23.0 - 30.0 Wet, reddish brown, clayey SILT (SOFT TILL). No odor.	ML		23.0 -23.2	0.0	5	ROTO SONIC	10.0 / 10.0
30	-25	30.0 - 46.4 Wet, reddish brown, soft clayey SILT (SOFT TILL), little coarse to fine subangular gravel, trace subrounded cobbles. No odor.	TILL		30.0 -39.6	0.0	6	ROTO SONIC	10.0 / 10.0
45	-40	46.4 - 48.0 Moist, reddish brown, sandy CLAY, trace coarse rounded gravel. No odor.	CL		-41.2 48.0	0.0			
50	-45	48.0 - 62.0 Wet, reddish brown, dense subangular coarse to fine Gravel with fine sandy SILT (fines) matrix (LODGMENT TILL)	Lodgment TILL		-55.2	0.0	7	ROTO SONIC	10.0 / 10.0
55	-50					0.0			
60	-55	62.0 - 65.0 Wathered BEDROCK-SILTSTONE- Dry, very fine sandy SILT with flat, subrounded Gravel and Siltstone fragments. Powdery, dry due to sonic vibrations on weathered bedrock.	Weathered Bedrock		62.0 -58.2	0.0	8	ROTO SONIC	6.5 / 7.0
65	-60	65.0 - 85.0 BEDROCK-Competent SILTSTONE	Bedrock		65.0	0.0	9	ROTO SONIC	10.0 / 10.0
70	-65					0.0			
75	-70					0.0	10	ROTO SONIC	10.0 / 10.0
80	-75					0.0			
85	-80	Boring completed at 85.0 ft			-78.2				

MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES



WELL CONSTRUCTION DETAILS

MW-21R
Borehole Diameter: 10inch
WELL CASING
Interval: 8" outer casing 0-15',; 2 in PVC 0-74.5'
Material: PVC
Diameter: 2 inch
Joint Type: Threaded
WELL SCREEN
Interval: 74.5-84.5ft bgs
Material: PVC
Diameter: 2 inch
Slot Size: 0.010
End Cap: yes
FILTER PACK
Interval: 72.5-85ft bgs
Type: #1 SAND
Quantity: 400lbs
FILTER PACK SEAL
Interval: 71.5-72.5ft bgs
Type: #00 SAND
Quantity: 50lbs
ANNULUS SEAL
Interval: 0-71.5ft bgs
Type: Cement/Bentonite
Quantity: 1100lbs

LOG SCALE: 1 in = 11 ft
DRILLING COMPANY: Boart Longyear
DRILLER: Rick Tabor

GA INSPECTOR: JLH
CHECKED BY: Heather L
DATE: 3/10/10

Golder Associates

AA BOREHOLE RECORD 943-6222 B09-1 THRU B09-5.GPJ GOLDER NJ-PA 05-24-06.GDT 5/13/10

R2-0001460

REPORT

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July 9, 2010

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BENCH-SCALE ISCO LABORATORY TESTS

Treatment of VOCs Impacted Groundwater Using Activated Persulfate at the 216 Paterson Plank Road NPL Site Carlstadt, New-Jersey

Submitted to:
Golder Associates Inc.
200 Century Parkway, Suite C
Mt. Laurel, New Jersey, 08054

Reference Number: 001-09-1223-3026-Rev0

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1.0 BACKGROUND

1.1 Site Geology

The geology at the 216 Paterson Plank Road Site (Site[1]) in Carlstadt, New Jersey is characterized by the presence of unconsolidated and consolidated deposits as described herein.

Unconsolidated Deposits

- Man-Made Fill: consisting of a mixture of soil, sand and gravel, and significant quantities of varying sizes of debris;
- Marine and Marsh Sediments: intertidal and recent fluvial deposits consisting of fluvial and estuarine sands, silts, clays and gravels overlain by the intertidal silts, clays, salt marsh and meadow-mat deposits;
- Glacial Deposits: consisting of stratified glaciolacustrine silts, silty clays and clays, often varved (including the older Glacial Lake Bayonne and younger, Glacial Lake Hackensack deposits), and outwash sands, silts and gravels; the stratified deposits generally overlie unstratified deposits which include glacial till (Rahway Till) and pro-glacial fan-delta deposits; and
- Pre-glacial Deposits: consisting of sands, gravels and silts infilling buried bedrock valleys carved by the pre-glacial, ancestral Passaic and Hackensack rivers.

Consolidated Deposits

- Bedrock: consisting of Triassic and Jurassic age, bedded, gently west-dipping, sandstones, siltstones, and conglomerates, interbedded with basalt lava flows and sills of the Newark Basin.

The geologic units of immediate interest are the Glacial Till and (possibly) the underlying bedrock. The till consists of a heterogeneous mixture of red, yellow-brown, reddish-brown, and reddish-gray clay, silt, sand, and gravel. At most locations, a softer glacial till has been recognized to overlie a much harder, over-consolidated glacial till. The over-consolidated glacial till is a distinct horizon that is characteristic of a basal, lodgment till which has been found to be generally continuous across the Site. Standard Penetration Test (SPT) blow counts (i.e. N) are generally greater than 50 in the basal lodgment till. The softer till displays significantly lower blow counts, typically 20 to 30.

The glacial tills beneath the Site have been subdivided as follows:

1) the upper horizon is informally called the Soft Till and ranges in thickness to 17 feet and is approximately 30 feet below ground surface (bgs); and

2) the over-consolidated lower horizon is called the Lodgment Till and ranges in thickness from 0 to 30 feet and is approximately 35-40 feet bgs.

The Lodgment Till displays a composition similar to the bedrock, with clasts entirely composed of the underlying siltstone or sandstone, set in a clayey silt or silty clay matrix. In the Soft Till, however, the clasts may also

[1] The Site is also sometimes referred to as the former Scientific Chemical Processing Site or SCP Site. The Site includes the property located at 216 Paterson Plank Road (i.e., on-property area) and related off-property groundwater impacts.

include metamorphic rock fragments such as quartzite and gneiss and occasional well-rounded to sub-rounded quartzite gravel.

Horizontal hydraulic gradients in 1996 averaged approximately 0.001 ft/ft for the till unit and 0.0006 ft/ft in the bedrock unit and hydrogeologic testing indicated till hydraulic conductivities ranging from $3.2x10^{-6}$ centimetres per second (cm/s) to $7.1x10^{-4}$ cm/s with a geometric mean value of $7.0x10^{-5}$ cm/s. Groundwater flows generally northward, but is influenced by area pumping and (to a lesser extent) by tidal action.

1.2 Conceptual Site Model

The on-property portion of the site includes a slurry wall tied into a varved clay (which overlies the till), an infiltration barrier over the top of the site, and a groundwater extraction system for the interior.

The off-property portion of the site (i.e. the portion of the site of concern) has two (2) distinct impacted areas with differing chemical signatures: the northern corner of the Site (proximal to MW-5D) which is impacted with predominantly chlorinated ethenes, and the southern corner of the Site (proximal to MW-21D) which is impacted predominantly with 1,4-dioxane with exceedances of other VOCs, including 1,1-dichloroethane and benzene. It is proposed to pilot test two remedial technologies: enhanced anaerobic bioremediation (EAB) of chlorinated ethenes in the northern corner of the Site, with in-situ chemical oxidation (ISCO) as a back-up option if EAB is demonstrated to be ineffective; and ISCO treatment of the 1,4-dioxane and other volatile organic compounds (VOCs) in the southern corner of the site. Soil borings were taken to collect samples to better delineate the impact of 1,4-dioxane in the southern corner of the site and to conduct these bench-scale tests in December 2009.

1,4-dioxane has been detected in a number of wells across the Site screened in the soft till, lodgment till, and bedrock at low levels (below standards). However, in the southern corner of the site, the highest concentrations were detected in two wells (MW-21D and MW-22D) screened in the soft till 50 feet apart with concentrations between 1,300 µg/L and 4,300 µg/L, well above the standards.

2.0 MANDATE AND OBJECTIVE

ISCO bench-scale tests were conducted by the Golder at Golder Treatability Testing laboratory located in Montreal, Canada on soils and groundwater collected in the MW-21D area to verify that the treatment can be effective and to gather information to design an effective pilot-scale test. The objective of these bench tests were to:

- Confirm that ISCO will treat Site contaminants (i.e. 1,4-dioxane and other VOCs);
- Determine the best oxidant activation technique;
- Assess the buffering capacity of Site lithologies and groundwater;
- Assess the potential for metals mobilization during treatment;
- Assess the expected natural oxidant demand (NOD) on different lithologies; and,
- Develop dosage levels and intervals for the Pilot-test design.

3.0 DESCRIPTION OF THE TECHNOLOGY TESTED

The oxidant chemicals that are commonly used in ISCO are hydrogen peroxide, permanganate, ozone and, more recently, persulfate. In the last few years there has been increasing interest in sodium persulfate as an oxidant for the destruction of a broad range of soil and groundwater contaminants. Successful remediation of hydrocarbon impacted sites has been demonstrated at lab, pilot and full-scale levels. (FMC, not dated)

Based on previous experience and published case histories for 1,4-dioxane (i.e., the main contaminant of concern), it is anticipated that sodium persulfate ($Na_2S_2O_8^{2-}$) could be efficient for the Site, with either sodium hydroxide (NaOH) or chelated iron to serve as a catalyst to activate the persulfate radical formation.

Persulfate is typically manufactured as sodium, potassium, and ammonium salts. The solubility of potassium persulfate is too low for remediation applications, and the reaction of ammonium persulfate may produce toxic ammonia. Therefore, sodium persulfate ($Na_2S_2O_8$) is most commonly used for remediation work. The solubility of $Na_2S_2O_8$ is high (73 grams (g) /100 g H2O @ 25 °C) (FMC, not dated) and the density of a 20 g/L solution (1.146 g/mL (millilitre)) (FMC, 2006) at 25 °C is greater than water. The sulphate radical ($SO4^{-}$) formed after the activation of the persulfate anion ($S_2O_8^{-2}$) is a powerful oxidant and one of the strongest oxidants used in remediation. The standard oxidation - reduction potential for the reaction is 2.6 V, as compared to 2.8V for Fenton's reagent (i.e., peroxide activated by iron) and 1.7 V for permanganate anion ($MnO4^{-}$). The persistence of the oxidant into the formation is a key factor in the choice of an oxidant. The greater the persistence of the oxidant, the greater the contact time for advective and diffusive transport and ultimately the delivery of oxidant to targeted zones in the subsurface. In relatively low permeability media such as tills and bedrock, the oxidant may need to be active for a few weeks prior to reaching the impacted zone. Also, a persistent oxidant decreases the potential for rebound effects (i.e., groundwater concentration increase after treatment due to contaminant desorption or contaminant flux coming from non-treated zone).

Persulfate can be used to perform direct oxidation of the contaminant or it can be activated to form sulphate radicals, thereby providing free radical reaction mechanisms similar to the hydroxyl radical pathways generated by Fenton's chemistry (i.e., peroxide activated by ferrous iron).

Once the persulfate is activated by heat, peroxide, iron or alkaline pH, it results in the formation of sulphate free radicals (SO4-•) as represented in Equations 1 through 4 below. The sulphate radicals can also produce hydroxyl radicals (see Equation 2 below). Free radicals are molecular fragments that have an unpaired electron causing them to be strong oxidizing agents and are known to rapidly oxidize many VOCs (Cronk, 2008).

$$NaS_2O_8 + \text{Activator} \rightarrow 2SO_4\text{-}^{\bullet} + Na \qquad (1)$$

$$SO_4^{\bullet}\text{-} + H_2O \rightarrow OH\text{-}^{\bullet} + HSO_4^{-} \qquad (2)$$

$$SO_4\text{-}^{\bullet} + RH \rightarrow R^{\bullet} + HSO_4^{-} \qquad (3)$$

$$OH\text{-}\bullet + RH \Rightarrow R\bullet + H_2O \qquad (4)$$

Where: RH represents an organic compound,

R• represents oxidized organic compound.

Note: Free radical chemistry is not necessarily stoichiometric or straightforward.

In addition to its oxidizing strength, persulfate and sulphate radical oxidation has several advantages over other oxidant systems as follows:

- the reaction is kinetically fast but the radicals are generated over a long period (up to 3-4 months) in comparison with Fenton's reagents where the hydroxyl radicals have a half-life of only a few hours;
- the persulfate radical is more stable than the hydroxyl radical and thus able to transport greater distances in the subsurface;
- persulfate is less sensitive to carbonate than Fenton's reagent for which carbonate is a hydroxyl scavenger;
- persulfate has less affinity for natural soil organics, so the NOD is often less than the permanganate ion; and
- persulfate produces no gas (hydrogen peroxide generates heat and significant quantities of gases).

These attributes combine to make persulfate a potential viable option for the chemical oxidation of the VOCs at the site.

Stoichiometry represents only a small fraction of the actual oxidant demand. The quantity of oxidant required to remediate soil and groundwater is a function of the mass of contaminants to be oxidized and the Natural Oxidant Demand (NOD) of the soil. Since the chemical oxidation is not specific to VOCs, a wide range of naturally occurring species other than the targeted contaminants reacts with the oxidant and this is what creates the NOD The NOD consumes oxidant and is often greater than the demand imposed by the target compounds. Persulfate reacts with organic matter and reduced chemical species (e.g., inorganic ferrous iron). However, persulfate does not appear to react as readily with soil organic matter as other oxidants such as permanganate (Brown et al., 2003).

3.1 Methodology

The following section presents the details of the procedures used to conduct this bench scale testing.

Two persulfate activation methods were tested during the bench-scale tests study: alkaline activation using sodium hydroxide and VTX, a commercial chelated iron catalyst.

VTX is a catalyst which is non-hazardous, non-toxic and non-corrosive. VTX is a formulation of ferric iron and complex polycarboxylates. There are no other heavy metals present in the product. The organic polycarboxylate portion of the formulation is readily biodegradable and has been granted approval by the United States Environmental Protection Agency (USEPA) and is listed on the Toxic Substance Control Act (TSCA) Inventory of approved chemicals for use in the environment. The advantage of chelated iron is that no groundwater pH adjustment is required to activate persulfate contrarily to the alkaline activation. Otherwise, acidification of the

groundwater down to pH between 3 and 5 is required for the activation of the persulfate using non-chelated iron such as ferrous sulfate, which is not recommended since it may increase the metals mobilization.

The requirement for alkaline activation is that enough sodium hydroxide (NaOH) must be added to maintain the pH above 10. Under pH 10, no activation takes place (i.e., no radical is formed). The NaOH demand arises from three sources: soil, groundwater acidity and the generation of acid formed during the decomposition of persulfate.

4.0 GROUNDWATER AND SOIL SAMPLING

Groundwater and soils were sampled at the Site on December 17th, 2009 by a Golder technician. The samples were collected during the installation of MW-21R as part of the Additional Groundwater Delineation activities. The Soft Till corresponds to the screen interval of MW-21D (-21 to -28 bgs).

The groundwater samples were collected in a 1-L glass amber jar numbered and filled with no air space to avoid VOC loss by volatilization. Overall, 15 liters of groundwater were collected using a low flow sampling technique for these bench scale tests. In addition soil samples coming from the bedrock, lodgment till and soft till were collected for NOD tests.

The groundwater and soil samples were placed in a cooler, kept at 4°C and were shipped directly to Maxxam Analytics in Mississauga, Canada, the laboratory responsible for the analysis and characterization. The remaining soils and groundwater were then shipped to the Golder Montreal treatability testing laboratory.

4.1 Initial Characterization

Prior to performing the batch testing, the initial chemical composition of the water provided to Golder Montreal was analyzed for a list of fifty (50) VOCs, including 1,4-dioxane. The results are presented in Table 2.

4.2 Preparation of the Samples

Special precautions were taken to reduce volatilization of the VOCs to a minimum. Control samples were taken to estimate the loss of VOCs through handling. A control is a test performed using the same protocol as the tested samples but without chemical addition (oxidant and activators).

Here is a table presenting the correspondence between samples names and the reactant dosage and activator used:

Sample Name	Activator	Oxydant	Oxydant dosage (g/L)
A1D1	NaOH	Sodium Persulfate	5
A1D2			25
A1D3			50
A2D1	VTX	Sodium Persulfate	5
A2D2			25
A2D3			50
Control	None	None	0

4.3 ISCO Experimental Set 1

The chemical oxidation processes were tested using sodium persulfate as the oxidant. The tests were performed in 45-mL glass vials. The bench-scale tests consisted of adding the chemicals into the vials first, then gently pouring the impacted groundwater to achieve zero headspace. After the vial was capped, it was manually shaken to dissolve the chemicals. The series of steps described above were repeated for each condition tested and all the reactive solutions were prepared individually. All the samples were kept at room temperature (i.e., between 19.8 and 21.7°C) and stored in a dark environment. The concentrations of persulfate tested were determined based on the concentration range of the VOCs found in the native groundwater. The following three (3) does were tested:

- 5 g persulfate per liter of groundwater;
- 25 g persulfate per liter of groundwater; and
- 50 g persulfate per liter of groundwater.

In order to analyze the VOCs over time, duplicate vials were used. At the designated time intervals (15 and 45 days), vials were sent to the laboratory for analysis and some vials were used to measure pH, ORP (i.e., redox potential), temperature, dissolved oxygen (DO), conductivity, sulphate and residual persulfate concentration.

Each one of those three dosages was activated using two different catalysts: alkaline activation (NaOH) and VTX catalyst.

For the VTX catalyst, the target iron concentration was 200 ppm. The quantity of VTX required to obtain the targeted iron concentration is 20 mL per liter of groundwater.

The sodium hydroxide (NaOH) concentration required depends on the buffering capacity of the groundwater and soils, and on the generation of acid formed during the decomposition of persulfate. The amount of NaOH needed to raise groundwater pH above 10 for the Site groundwater and soils was determined experimentally performing a titration curve. To address the persulfate decomposition, 2 moles of NaOH per mole of persulfate need to be added to neutralize the persulfate-generated acid, which is the equivalent of 0,34 g of NaOH per g of persulfate.

Total NaOH Demand = NaOH needed to raise soil and groundwater pH above 10 + 2 moles NaOH / mole Klozur persulfate.

4.4 ISCO Experimental Set 2

For the three dosages tested in the experimental set 1, the alkaline activation intermediate results showed concentrations of 1,4-Dioxane had decreased to below the detection limits of 50 µg/L. The detection limit of the laboratory method initially used (purge and trap GC/MS) were above the 1,4-dioxane remedial objective of 10 µg/l. It was inferred from loss of signal for internal standards and poor surrogate recoveries when samples were analyzed with little or no dilution, that matrix interference was affecting the detection limits, and dilutions were required to reduce these effects to the point where reliable internal and surrogate responses could be obtained. These effects could be produced by strong basic pH and/or presence of oxidant. Also for some samples, a signal was obtained for the mass 88 which is the most prominent ion in the mass spectrum of 1,4-dioxane, but the qualifier ions were well below expected ratios, implying a presence of a co-eluting interfering

compound. Reporting limits in these cases were raised since confident identification of 1,4-dioxane was not possible.

A second set of samples was therefore prepared to use an alternative analytical method, less sensitive to the interference encountered with the purge and trap GC/MS method. For the second set of tests, the analyses were performed using liquid-liquid extraction followed by GC/MS analysis. This second method was successful in decreasing the reported detection limit down to 3 µg/L. However, the volume of groundwater required by that method was 1 liter instead of 45 mL and the number of tests for the second set was therefore limited by the quantity of groundwater still available. The dosages and reaction time tested in the second set were:

- 1 g persulfate per liter of groundwater (15-day reaction time);
- 5 g persulfate per liter of groundwater (15 and 30-day reaction time);
- 25 g persulfate per liter of groundwater (30-day reaction time); and
- 50 g persulfate per liter of groundwater (30-day reaction time).

Since the intermediate results showed that the VTX activation has a much lower 1,4-dioxane removal efficiency than NaOH activation and formed undesirable by-products such as methylene chloride (dichloromethane) bromomethane, bromodichloromethane, the second set of experiments was only conducted using sodium hydroxide activation. To perform the second set of experimental tests, six (6) groundwater bottles were dedicated. The appropriate amount of reactant was directly poured into the bottle. The bottle was gently shaken to ensure all chemicals were dissolved.

Control samples were analyzed at the beginning of the second set to verify the baseline concentration. The quantity of groundwater available for the second set of analyses was limited, so duplicates and final controls were not performed.

4.5 NOD

Soil natural oxidant demand (NOD or SOD in Appendix A) tests were performed to determine the loss of persulfate due to reaction with matrix components (i.e., reduced species and organic matter) as well as through auto-decomposition. The NOD is dependent upon the soil or rock composition as well as the concentration of persulfate and the catalyst used. The NOD measurements were done using native rock soils from the site and four different concentrations of persulfate: 1 g/L, 5 g/L, 25 g/L and 125g/L activated with NaOH. The reaction time was set at 48 hours. Afterwards, the residual persulfate concentration was measured using a back titration method. The complete method used is included in Appendix A.

Four samples were analyzed: one soft till, one lodgment till and two bedrock. The bedrock cores were crushed prior to NOD testing in order to obtain more conservative values. The NOD analyses were performed by Chemco Inc. Laboratory using the FMC Klozur^{tm} Activated Persulfate Treatability Protocol.

4.6 Laboratory Protocols

The groundwater was analyzed by Maxxam Analytics. As described in Section 4.4, the following two methods were used to analyze 1,4-dioxane and additional VOCs:

- CAM SOP-00226: performed using Purge & Trap GC/MS. For the 1,4-dioxane analysis, SIM mode was used and was specific for 1,4-dioxane only. Full scan mode analysis was performed for other VOCs; and
- BRL SOP-00217: performed using liquid-liquid extraction followed by GC/MS analysis. This method also is run using SIM mode and is also specific for 1,4-dioxane only.

This laboratory is accredited by the Ontario, Canada provincial Authority. The following table summarizes the analytical methods and the laboratory used.

Parameter	Media	Method	Laboratory
VOCs	Water	CAM SOP-00226	Maxxam Mississauga
1,4-Dioxane	Water	CAM SOP-00226	Maxxam Mississauga
1,4-Dioxane	Water	BRL SOP-00217	Maxxam Mississauga
NOD	Soil, roc	Klozur[tm] Activated Persulfate Treatability Protocol	Chemco Inc.

The ORP, pH, temperature and conductivity were measured using a portable multi-probe analyzer. The sulphate and DO were analyzed using a portable colorimeter. The residual persulfate was measured through a titration method similar to the NOD method.

4.6.1 Comparison between Canadian and American Analysis Methods

The method USEPA Contract Laboratory Program (CLP) Statement of Work (SOW) for Multi-Media, Multi-Concentration Organics Analysis (SOM01.1) and its modifications (SOM01.2) covers a broad range of organic compounds. Volatile Organic Compounds (VOCs), including 1,4-dioxane, can be isolated/detected/quantitated utilizing purge and trap gas chromatography/mass spectrometer (GC/MS) techniques. Full scan mode is specified for compounds with higher concentrations and selective ion monitoring (SIM) mode is used for compounds with trace concentrations. Maxxam (CAM SOP-00226) uses the more universal USEPA Method SW846 8260B as a reference method. SOW SOM01.2 is used specifically for contract work for the USEPA Superfund program and provides the methods to be used, as well as the specific contractual requirements, which USEPA evaluates data.

Deuterated dioxane is specified to be used as a system monitoring compound when 1,4-dioxane is being tested. The method used at Maxxam Ontario for 1,4-dioxane uses deuterated dioxane as an isotope dilution standard as prescribed by the Ontario Ministry of Environment in its Protocol for Analytical Methods. The isotope dilution technique is generally considered to lead to higher accuracy than the system monitoring compound approach, but becomes costly when applied to a larger number of analytes.

4.7 Quality Assurance/Quality Control (QA/QC)

The QA/QC program included one control sample per time point and one duplicate for the higher dosage per time point for the first set of experiments. As mentioned in Section 4.3.1, only one control sample was analyzed at the beginning of the test for the second set of experiments since the quantity of groundwater available was limited. In addition, the usual laboratory controls (duplicates, blanks and surrogates) were done. The laboratory certificates of analysis are included in Appendix E.

5.0 RESULTS AND DISCUSSION

5.1 Identification of Applicable Standards

The results were compared to the New Jersey Groundwater Quality Standards (NJ GWQS).

5.2 Initial Characterization

The initial characterization was conducted by Maxxam Mississauga once they received the samples shipped directly to them from New Jersey. These analyses were done between December 29, 2009 and January 4, 2010. Once the characterization was completed, the samples (i.e., remaining bottles) were sent to the Montreal Golder treatability testing laboratory.

The results from these analyses revealed a concentration of 1,4-dioxane of 1,600 µg/L. The following VOCs were also detected in the groundwater tested:

- Benzene : 67 µg/L;
- 1,1-dichloroethane (1,1-DCA): 40 µg/L;
- Cis-1,2-dichloroethylene (cis-1,2-DCE): 2 µg/L;
- Ethylbenzene: 1 µg/L;
- TCE: 5 µg/L;
- Vinyl Chloride (VC): 3 µg/L; and
- Chloroethane: 61 µg/l.

1,4-dioxane, benzene, TCE, VC and 1,1-DCA were present at concentrations above the NJ GWQS.

Prior to adding the chemicals, the physico-chemical properties of the groundwater (see Table 1) were:

- pH: 6,7-7,1;
- ORP: +55-+66 mV;
- DO: 7,1-9,2 ppm;
- Conductivity: 2185-2891 mV/cm; and
- Temperature: 6,5-8,3 °C.

These values fall within the expected range for groundwater.

5.3 Buffer Capacity of the Groundwater

The quantity of sodium hydroxide required to increase the pH of the groundwater above 10 and activate the persulfate (i.e., the buffer capacity of the groundwater) was evaluated using a titration curve. The titration curve was plotted using the site groundwater and by adding sodium hydroxide as 10 g/l stock solution. The test indicated that a dosage of 0,21 g of NaOH (as 100%) per L of groundwater was needed in order to keep a pH above 12. Figure 1 shows the titration curve obtained for the two trials. The buffer capacity of the groundwater is

qualified as low. So, a small quantity of NaOH is required to increase the groundwater pH above the target of 10.

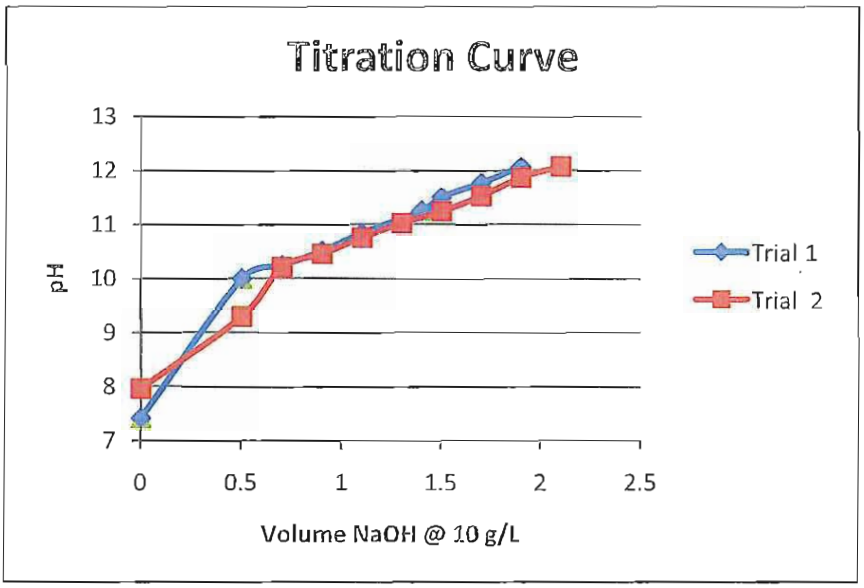

Figure 1: Buffer Capacity of Groundwater (100 mL of groundwater titrated against NaOH 10 g/L at room temperature)

5.3.1 Buffer Capacity of the Soil or Rock

Two samples of soil coming from the lodgment till, one coming from the soft till and one from the bedrock were sent to Chemco Inc. laboratory for the evaluation of the buffer capacity of the soil. Prior titration with NaOH, the bedrock sample was crushed in order to get conservative values. The NaOH requirement (as 100% NaOH) in order to raise the pH to 11 (10,0 being the minimum acceptable) were the following:

- Lodgment till: 1,5-2,0 g of NaOH per kg of soil;
- Soft till: 3,0 g of NaOH per kg of soil; and
- Bedrock: 1,5 g of NaOH per kg of soil.

The pH was stable for the 48-hour testing period. The results, are attached in Appendix A. The soil matrix NaOH requirements are qualified as low, because low concentrations of NaOH in solution are required to bring the pH of the soil above pH 10 (i.e., low buffering capacity).

5.3.2 NOD

The NOD report is included in Appendix A. The NODs of the four soils and rock tested for the alkaline activation were:

- Soft Till: 10,1 g per kg of soil;
- Lodgment Till: 1,23 -2,01 g per kg of soil; and

- Bedrock: 7,0 g per kg of soil.

It appears that the NOD of the soft till is much higher than the persulfate requirement for the lodgment till. The bedrock NOD is unexpectedly high, but it is important to keep in mind that it is a conservative number since the contact surface between the oxidant and the rock was increased in comparison with the in-situ conditions (i.e., crushing was performed).

As discussed earlier, the NOD results from persulfate scavengers (i.e., metals, organics, carbonate and bicarbonate). As the NOD increases, it means that the scavenger's concentrations are higher. The NOD values reported in the literature vary greatly (i.e., from 0,1 for sand/bedrock to 500 g per kg of soil consisting of peat) because the NOD is site specific. Usually, the NOD increases as follows: bedrock < sandy till < clay till < peat moss.

The NOD measured is for a 48-hour period and it results from an ideal condition where the oxidant is uniformly mixed with the soil matrix. Therefore, it should be used as a semi-quantitative tool to determine the oxidant dosing required for the pilot-scale field test. In fact, the total NOD will depend on the oxidant contact time. Performing NOD tests for longer than 48 hours can be useful, but gives unrealistic NOD because the reaction kinetics for contaminant oxidation is often much faster than the reaction kinetics for NOD kinetic. Only limited reaction kinetics data for persulfate is available in the literature, but the following graph shows a comparison of the permanganate oxidation of TCE with permanganate oxidation of NOD kinetic; it is very useful to understand the NOD effect (Carus, 2004).

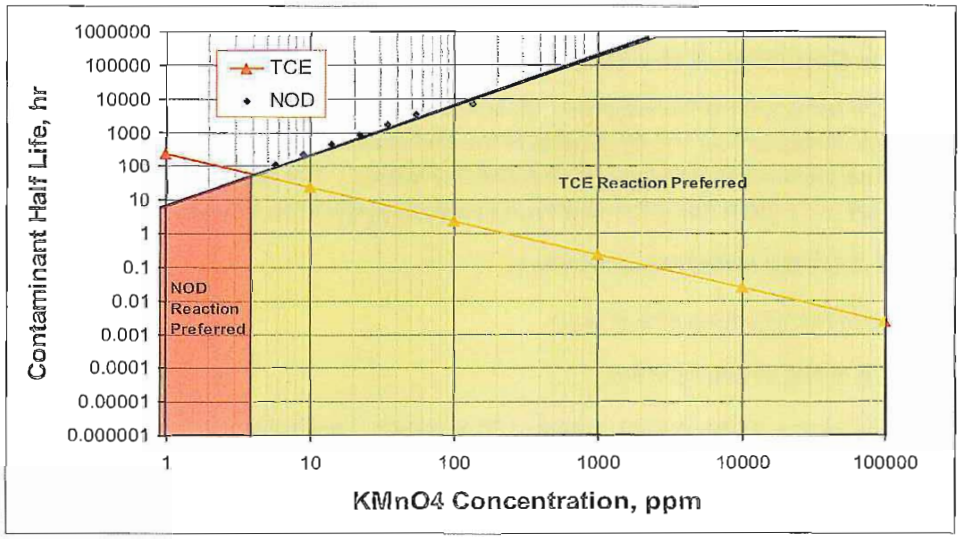

Figure 2: Permanganate Oxidation - TCE and NOD Half-life

Figure 2 shows that beyond a certain oxidant concentration, the half-life of TCE is shorter than the half-life of NOD. The half-life is the time it takes for one-half of the contaminant to react. The rate of the reaction is proportional to the rate constant; thus the larger the rate constant, the shorter the half-life. Figure 2 illustrates the

fact that at high oxidant concentration, the oxidant reacts faster with the TCE than with the NOD. So, the preferred reaction for contaminant oxidation is when the oxidant is dosed in excess.

We know from past experience that using 48-hour NOD for estimating the oxidant requirement is adequate in most cases and to be economically feasible, the NOD (48 hours test) will usually be less than 15 g of oxidant per kg of soil. The lodgment till NOD (1,23 -2,01 g/kg) is qualified as low. Bedrock (7,0 g/kg) and soft till (10,1 g/kg) NOD are qualified as medium, but they are acceptable.

5.3.3 Persulfate Activated by VTX

The results of the treatment using persulfate activated by VTX are presented in Tables 2. Even at a dosage of 50 g of persulfate per liter of groundwater, the final concentration of 1,4-dioxane and other VOCs were still high.

The 1,4-dioxane removal efficiencies measured after a 15-day reaction for the three dosages tested are:

- 5 g persulfate per liter of groundwater : 1000 ug/L → 9.1%;
- 25 g persulfate per liter of groundwater : 890 ug/L → 19.1%; and
- 50 g persulfate per liter of groundwater: 700 ug/L → 51.7%.

It was impossible to determine the efficiencies of VTX after a 45-day reaction for dosages higher than 5 g/l because the reported laboratory detection limit (RDL) was too high. As discussed earlier, the laboratory had interference issues. The 1,4-dioxane removal efficiency measured with a 5 g/l dosage of persulfate was negligible after a 45-day reaction.

During the treatment, some by-products were formed: bromodicholomethane, bromoform, bromomethane, dibromochlromethane, 1,1-Dichloroethane, 1,2-dichloroethane, dichloromethane, 1,1,2-trichloroethane, chloromethane. These VOCs are not used in the Montreal treatability testing laboratory, therefore, it cannot come from cross-contamination during sample manipulation. Transport contamination hypothesis is also rejected since the other samples (other than the VTX samples) sent in the same container did not present any concentration of other VOCs. The laboratory QC/QC checks did not reveal any non-conformity regarding the method requirements.

The persulfate iron activation is the weaker mode of activation and consequently the reaction does not generate enough energy to oxidize VOCs completely to carbon dioxide and water.

The pH of the solution decreased significantly during the treatment from pH 7 to below pH 2 (see Table 1). The acidification of the groundwater is the result of the formation of sulphuric acid as a by-product of the oxidation reaction as shown in the following simplified reaction:

$$S_2O_8^{-2} + 2H^+ + 2e^- \rightarrow 2HSO_4^{-2}$$

As expected, the ORP increased significantly during the treatment because an oxidation reaction was taking place in the vials. The ORP was initially around +60 mv and rose up to +600 mv after 15 days and was stable even after the 45-day reaction. The concentration of sulphate increased over time for each concentration while the residual persulfate decreased over time. The sulphate increased because it is the end product of the persulfate oxidation as shown by the following simplified reaction:

$$S_2O_8^{-2} \rightarrow 2SO_4^{-2}$$

So, for each g/l of sodium persulfate added, the end product is 0,8 g/l sulphate. The residual persulfate analysis revealed that after a 15-day reaction, almost no persulfate had reacted. After a 45-day reaction, between 25 and 40% of the persulfate had reacted. So, persulfate was still present in the vials after a 45-day reaction and the oxidation reaction was not yet completed. It appears that the persistency of persulfate activated with chelated iron is high. Golder's experience is that residual persulfate can persist in the subsurface for 2-3 months.

5.3.4 Persulfate Alkaline Activation

The results of the treatment using persulfate activated by NaOH are presented in Tables 2. The concentration of 1,4-dioxane in the first set of experiment decreased from 1,033 µg/L (mean of the three controls) to less than 50 µg/L in less than 15 days for the dosages of 5, 25 and 25 g/l. The concentration of all the detected VOCs (benzene - 67 µg/L, 1,1-DCA - 40 µg/L, cis-1,2-DCE - 2 µg/L, ethylbenzene - 1 µg/L, TCE - 5 µg/L, VC- 3 µg/L and chloroethane - 61 µg/l) dropped to concentrations below the reported detection limit (RDL) after a 15-day reaction with the lowest oxidant dosage tested (i.e., 5 g/L).

Since all of the tested dosages resulted in good VOC removal efficiencies, a single test was performed at a lower persulfate concentration of 1 g/l and analyzed for 1,4-dioxane. The 1,4-dioxane concentration after a 15-day reaction was 768 µg/L. It appears that the concentration of oxidant was probably too low and the reaction time too short. Since chemical oxidation is a second order reaction, as the oxidant concentration decreases, the oxidation reaction slows down. Chemical oxidation second order reactions can be described by the following equation:

$$d[COD]dt = k\,[oxidant] \times [COD]$$

[COD] : contaminant of concern concentration

[oxidant] : oxidant concentration

t: time in days

k: second order kinetic constant

As discussed in Section 4.3, with the purge & trap GC/MS method used to analyze the 1,4-dioxane, it was not possible to lower the reported detection limit below 10 µg/l (i.e., remedial objective) due to matrix interference. So, some supplementary tests were performed in 1-L glass reactor using a liquid-liquid extraction method followed by GC/MS analysis of 1,4-dioxane in order to lower the RDL. *Note: For A1D1, there is two analyses done at 15 days reaction time, therefore to differentiate the sample, the second set analyzed using liquid-liquid extraction was named CO-A1D1 (supp).*) The following results for 1,4-dioxane after treatment were obtained:

- 5 g/l persulfate after 15-days: 145 µg/L → 87.9 %; this represent the CO-A1D1 (supp)
- 5 g/l persulfate after 30-days : < 3 µg/L → 99.8 %; this represent the CO-A1D1 (supp)
- 25 g/l persulfate after 30-days : < 3 µg/L → 99.8 %; this represent the CO-A1D2 and

50 g/l persulfate after 30-days: < 3 µg/L. → 99.7 % this represent the CO-A1D3

Based on these results, it appears that a dosage of 5 g/L is enough to degrade the concentrations of all the VOCs in a reasonable timeframe. The residual persulfate analysis (Table 1) revealed that a significant concentration of persulfate was still present in the treated groundwater after a 45-day reaction. These results

demonstrated the persistency of the persulfate. In regard to the sulphate concentrations presented in table 1, the increasing concentration over time is the expected trend. As the persulfate reacted, the concentration of sulphate increased since it is a by-product of the persulfate degradation. The objective of this analysis performed using colorimetric method is not to do a mass balance but it is used as an indicator of the persulfate degradation.

Figure 3 compares the results obtained with VTX and alkaline activation.

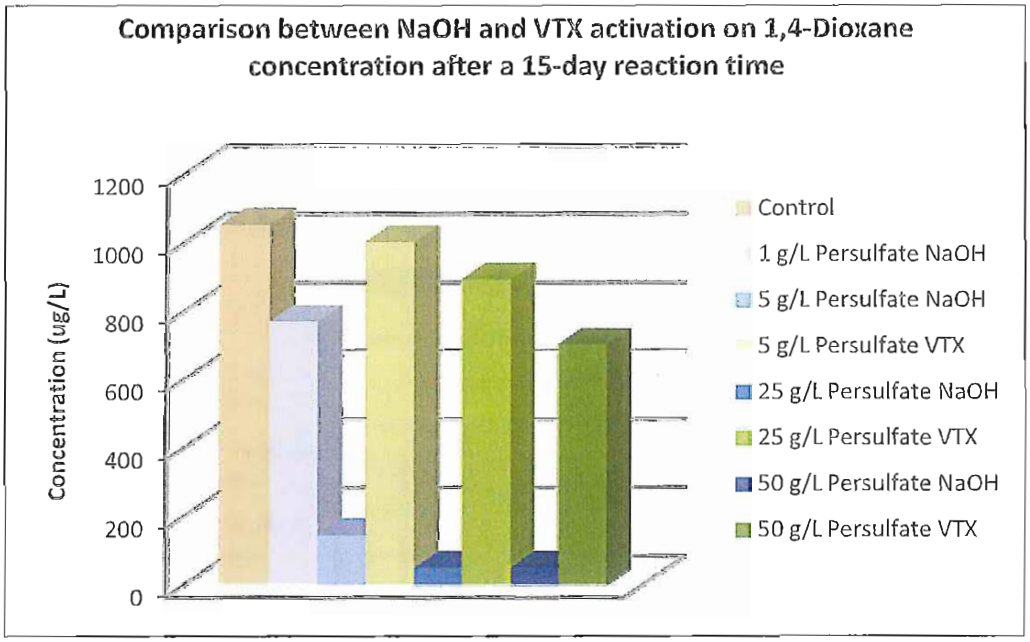

Figure 3: Comparison between VTX and alkaline activation of persulfate for the treatment on 1,4-dioxane impacted groundwater (average values presented)

5.4 Quality Assurance/Quality Control (QA/QC)

The QA/QC program included 4 duplicates, 4 controls and the usual laboratory control (duplicates, blanks and surrogates). The laboratory certificates of analysis are included in Appendix E. The laboratory controls have met the method requirements and the QA/QC controls were reported as acceptable.

Golder duplicate results and relative percent difference (RDP) are presented in Table 3. The RDP maximum allowed value was fixed at 30%. RDP were calculated only when the sample and its duplicate had detectable concentrations. In addition, if the RDP is calculated for concentrations lower than five (5) times the laboratory detection limit, it is assumed that the RDP values are not reliable. The RDPs of the targeted VOCs (i.e., 1,4-dioxane and other measured VOCs listed in Section 5.2 varied between 0.0 and 4.9%. For the by-products of VTX oxidation, the 30% RDP maximal accepted value was exceeded for chloroform for which an RDP of 44.2% was measured.

It is very difficult to obtain low variability in duplicates when bench-scale testing is performed for VOCs because the samples (i.e., groundwater and chemical addition) can lose VOCs by evaporation. In order to verify that the VOC removal is not solely attributable to VOC loss during manipulation and other potential mechanisms not involving chemical oxidation, control samples were prepared as described in Section 4.3. The results of the control samples revealed a small loss of VOCs concentrations during the treatment. Nonetheless the chemical reaction is the main driver for the 1,4-Dioxane and VOCs reduction to concentrations below the applicable groundwater criteria. The concentrations of 1,4-dioxane in the control samples over time are shown on Figure 5. The concentration of 1,4-dioxane was relatively stable during the treatability testing, about 24% of the 1,4-dioxane was lost over a 4-month period between the initial characterization and the last control taken. This loss occurred mainly at the beginning of the tests (i.e., the first 2 weeks) when the bottles were opened to transfer the groundwater in reactors and to add the chemicals. The other VOCs showed the same behavior (see Table 2, CO-C results).

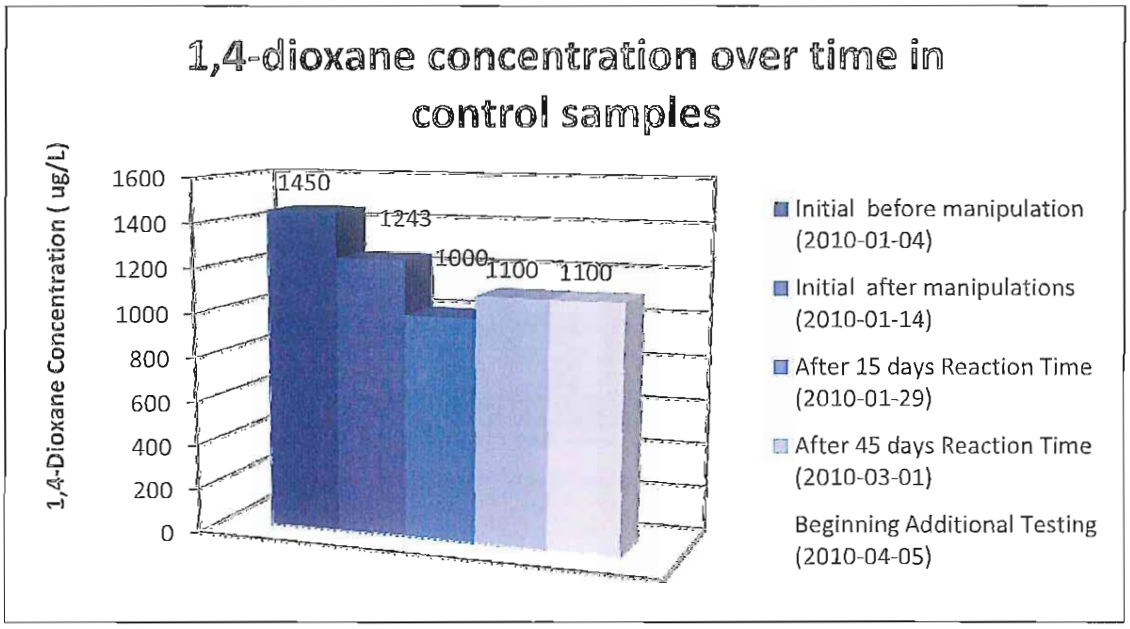

Figure 4: 1,4-dioxane concentrations in control samples

6.0 RECOMMENDATIONS AND CONCLUSIONS

Based on the treatability study results, Golder recommends using sodium persulfate with alkaline (NaOH) activation for the pilot-scale test. The VTX activation resulted in low 1,4-dioxane removal efficiency and generation of undesirable by-products during treatment.

The recommended chemical dosages are the following:

- Sodium persulfate: 12,9 g of sodium persulfate per kg of soil based on the soft till NOD and the groundwater requirements (assumptions: soil density of 1800 kg/m^3; water filled porosity of 50% and groundwater persulfate dosage of 10 g/L); and

- Sodium hydroxide: 7,4 g of NaOH (as 100%) per kg of soil based on the soil soft till/groundwater requirements and the NaOH required to neutralize the persulfate-generated acid for a persulfate dosage of 12,9 g of sodium persulfate per kg of soil.

With these chemical dosages, it is expected that it will be possible to keep alkaline conditions (i.e., pH over 10) in the saturated impacted groundwater and significantly decrease the 1,4-dioxane and other VOC concentrations below the groundwater remedial objectives. In order to limit any rebound issues, it is recommended to perform at least 2 injections using the recommended dosages.

The metals mobilization was not evaluated during the bench-scale study. It should be evaluated during the pilot-test. ISCO may mobilize pre-existing redox and/or pH-sensitive metals. Therefore, groundwater shall be monitored to determine if mobilization occurs and if attenuation is achieved within an acceptable transport distance and timeframe. Usually, metal mobilization is not an issue because the metals return to their initial oxidation state after treatment, when the groundwater leaves the treatment zone and precipitates back into the formation. Also, alkaline conditions are not favorable for the mobilization of many metals. The most commonly used method to remove soluble metal ions from solution is to precipitate the ion as a metal hydroxide. By raising the pH value of the groundwater, by injecting sodium hydroxide, the metallic hydroxide compounds will become insoluble and will precipitate into the formation. Reduction of formation permeability needs to be evaluated during the pilot-test. Figure 5 presents hydroxide solubility curve showing the solubility of the common metal ions and their respective solubility versus pH. The metals susceptible of leaching at pH over 10 will be Pb, Zn and Cr, as they are amphoteric (i.e., soluble at both alkaline and acid conditions). Arsenic (As) can also be mobilized under alkaline pH.

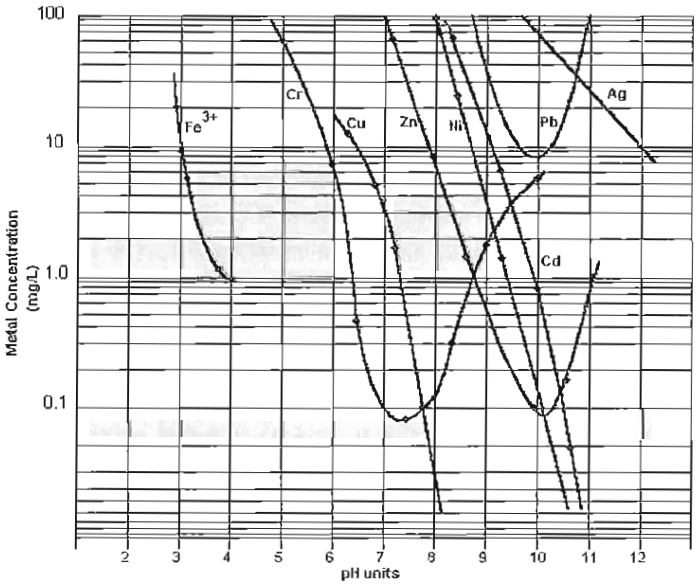

Figure 5: Hydroxide solubility curve of common heavy metals (source: Hoffland Environnemental, website)

The solubility curves are theoretical values and the mobility of metals during ISCO treatment is a result of many factors including level of adsorption/desorption on the soil matrix. The pilot-test is the best way to evaluate potential metal mobilization.

An injection system such as the system illustrated in Appendix D should be used. The main equipment required for the make-up and the delivery of the chemical solution are:

- Diaphragm pumps;
- Tanks equipped with a secondary spill containment, atmospheric vent, top entry port to allow addition of chemicals, feed hopper, mechanical mixer and a top entry quick-connect fitting for attachment of a chemical hose for re-circulation mixing;
- Solid persulfate (powder) or stock solution;
- 55 USg 25% (w/w) sodium hydroxide plastic drums;
- Compressed air;
- Water delivery to the tank: clean potable water;
- Hoses, connectors, etc.; and
- Monitoring equipment (Pressure gauge, Flow meter, colorimeter, etc.)

All the equipment parts that may come into contact with the chemical (fittings, seals, gaskets, diaphragm, etc.) shall be chemically compatible with the chemicals used. The pump discharge flow shall be returned to the top of the solution tank via a chemical hose for solution make up, mixing and safe operation of the pump. The injection system shall be designed to relieve pressure that may build up upon normal decomposition, and includes overpressure relief in zones between valves.

The injection could be made through existing monitoring wells or preferably using a Geoprobe assembly (for the soft till) or using dedicated injection wells screened in the targeted zone. Taking into account the low permeability of the formation, a tight injection grid may be required (i.e., short well spacing).

Persulfate is a white odorless crystal and it is a strong oxidizer. Sodium hydroxide is supplied as solid white pellets or as a solution and is corrosive. These chemicals can cause severe chemical burns to body tissue if mishandled. Chemicals will be stored in a cool, dry, well-ventilated area away from incompatible substances such as acids, water, flammable liquids, organic halogens, aluminum, zinc, and tin. These chemicals shall be handled following the product material safety data sheet (MSDS) and supplier recommendations. Field personnel shall wear the appropriate personal protective equipment (PPE) when handling or mixing. This includes chemical goggles, dust mask, chemical resistant gloves, chemical resistant clothing such as DuPont™ Tychem® clothing. Neutralization chemicals specified by the chemical supplier shall be available on site in case of spills. Chemical compatibility of all underground utilities and structures located in the treatment zone (i.e., in contact with the chemical) shall be verified prior to injection.

Prior to, during and after the oxidant injection, the groundwater quality shall be monitored within the treatment area and downstream for the following parameters:

- Sulphate and persulfate concentration in groundwater: by-product and residual oxidant of the ISCO;

- Physical parameters (pH, ORP, conductivity and temperature): the pH should be above 10 in the treatment zone for persulfate alkaline activation but the pH also needs to be monitored to assess pH variations outside the treatment zone;
- Dissolved metals (including hexavalent chromium, Cr VI): ISCO may mobilize pre-existing redox- and/or pH-sensitive metals.

A detailed work and heath and safety plan shall be prepared prior to performing the pilot-scale testing.

7.0 LIMITATIONS

The tests and recommendations are for the treatment of VOCs in groundwater samples and do not take into account the treatment of additional VOC sources from possible DNAPL or the residual phase.

This report has been prepared for the exclusive use of the Site representatives. The factual information, interpretations, comments and recommendations contained herein are specific to the project described in this report and do not apply to any other project or site. The results enclosed in this report can vary for each sample and they are strictly valid only for the samples tested.

Conclusions and recommendations performed are based on the bench-scale tests conducted with specific native soil, bedrock and groundwater samples and they are strictly valid only for the samples tested. Reagent selection and dosing, pH adjustment requirement, gas generation evaluation, chemical oxidation effectiveness and quantity of reagent required for a full-scale treatment can be different compared to the real site requirements. Factors such as the effects of scale, the subsurface heterogeneity, the preferential flow paths, the variable permeability and presence of free DNAPL can compromise the remediation effectiveness.

Unless otherwise specified, the interpretations, comments and recommendations presented in this report have been formulated following the scope of work and the general limitations described below as well as in light of our knowledge of the current and/or planned use of the site, the applicable regulations, standards and guidelines, and the professional rules and practices recognized and accepted at the time of the study, always taking into account the location of the site.

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Unless otherwise specified, the results of previous or simultaneous work provided by sources other than Golder and quoted and/or used in this report are considered as having been obtained according to recognized and accepted professional rules and practices, and therefore deemed valid.

8.0 REFERENCES

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Report Signature Page

We trust the present report meets your current requirements. Should you have any questions, please contact the undersigned.

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Bench Scale Testing for the ISCO Treatment of VOCs Impacted Groundwater

TABLE 1

PHYSICO-CHEMICAL RESULTS

Date [1] / Reaction Time Completed [2]	Sample	pH	ORP	DO	Conductivity	Temperature	Residual Persulfate	Sulfate measured
			mV	mg/L	us/cm	Celsius	g/L	mg/L
01/14/2010 Reaction time= 0 day	A1D1	6.66	63	9.2	2291	6.5	-	-
	A1D2	6.85	66	9.7	2891	7	-	-
	A1D3	6.95	66	7.4	2809	7.2	-	-
	A2D1	7.1	61	8.3	2344	7.4	-	-
	A2D2	7.13	55	7.1	2185	7.8	-	-
	A2D3	7.11	57	8.2	2598	8.1	-	-
	Control	7.12	59	8.1	2438	8.3	0	19
02/02/2010 Reaction time= 15 day	A1D1	13.4	130	N/A	> 3999	21.4	1.2	90
	A1D2	13.7	180	N/A	> 3999	21.7	16.8	590
	A1D3	13.9	203	N/A	> 3999	21.2	41.7	3400
	A2D1	-	438	N/A	> 3999	20.9	6.0	8
	A2D2	1.48	589	N/A	> 3999	20.8	16.2	110
	A2D3	0.63	609	N/A	> 3999	20.7	46.3	520
	Control	5.33	215	N/A	> 3999	19.8	-	-
03/01/2010 Reaction time= 45 day	A1D1	12.66	99	N/A	> 3999	20.4	6.3	270
	A1D2	12.37	136	N/A	> 3999	20.3	15.0	620
	A1D3	12.41	251	N/A	> 3999	20.4	38.2	6300
	A2D1	7.74	195	N/A	> 3999	20.3	2.5	190
	A2D2	1.85	596	N/A	> 3999	20.2	12.6	320
	A2D3	1.26	636	N/A	> 3999	20.4	30.0	1290
	Control	8.92	198	N/A	> 3999	20.3	-	-

Notes:

1: This represents the date on which the physico-chemical measurements were taken.

2: This represents the number of days that the chemical oxidation was undergoing when the measurements were taken.

N/A : Not available, persulfate created interferences which inhibited DO measurement using colometric method. Over-estimation of the actual D

- : Not analyzed

> 3999 : the conductivity value is above the detection limit of the instrument used

Bench Scale Testing for the ISCO Treatment of VOCs Impacted Groundwater

TABLE 2 (page 2 of 8)

VOCs ANALYTICAL RESULTS

Parameters	Name on laboratory certificate	Sample #5	Sample #5	CO-A1D1			CO-A1D1 (supp)	
			dup-lab	T1	T2	T3	T2	T4
	Dosage	0 g/L Persulfate Initial		5 g/L Persulfate NaOH			5 g/L Persulfate NaOH	
	Reaction time (days)	-	-	0	15	45	15	30
	Date sampled [2]	1/4/2010	1/4/2010	1/14/2010	1/29/2010	3/1/2010	3/14/2010	4/27/2010
Volatil organic compounds (ug/L)	NJ GWQS[1] criteria							
1,2,3-Trichlorobenzene	N/A	< 5	< 5	< 3	< 1	< 1	-	-
1,2,4-Trichlorobenzene	9	< 5	< 5	< 3	< 1	< 1	-	-
1,4-Dioxane	10	1600	-	1200	< 50	< 50	145	< 3
Acetone (2-Propanone)	6000	< 100	< 100	< 50	< 30	< 30	-	-
Benzene	1	67	68	36	< 0.3	< 0.3	-	-
Bromodichloromethane	1	< 1	< 1	< 0.5	< 0.3	< 0.3	-	-
Bromoform	4	< 2	< 2	< 1	< 0.5	< 0.5	-	-
Bromomethane	10	< 5	< 5	< 3	< 1	< 1	-	-
Carbon Tetrachloride	1	< 1	< 1	< 0.5	< 0.3	< 0.3	-	-
Chlorobenzene	50	< 1	< 1	< 0.5	< 0.3	< 0.3	-	-
Chloroform	70	< 1	< 1	< 0.5	< 0.3	< 0.3	-	-
Dibromochloromethane	1	< 2	< 2	< 1	< 0.5	< 0.5	-	-
1,2-Dichlorobenzene	600	< 2	< 2	< 1	< 0.5	< 0.5	-	-
Methyl Acetate	7000	< 10	< 10	< 5	< 3	< 3	-	-
1,1,2-Trichlorotrifluoroethane	N/A	< 2	< 2	< 1	< 0.5	< 0.5	-	-
1,3-Dichlorobenzene	600	< 2	< 2	< 1	< 0.5	< 0.5	-	-
1,4-Dichlorobenzene	75	< 2	< 2	< 1	< 0.5	< 0.5	-	-
Carbon Disulfide	700	< 5	< 5	< 3	< 1	< 1	-	-
Dichlorodifluoromethane (FREON 12)	1000	< 10	< 10	< 3	< 1	< 1	-	-
1,1-Dichloroethane	50	40	41	28	< 0.3	< 0.3	-	-
1,2-Dichloroethane	2	< 3	< 3	< 1	< 0.5	< 0.5	-	-
1,1-Dichloroethylene	1	< 1	< 1	< 0.5	< 0.3	< 0.3	-	-
cis-1,2-Dichloroethylene	70	2	2	1.6	< 0.3	< 0.3	-	-
trans-1,2-Dichloroethylene	100	< 1	< 1	< 0.5	< 0.3	< 0.3	-	-
1,2-Dichloropropane	1	< 1	< 1	< 0.5	< 0.3	< 0.3	-	-
cis-1,3-Dichloropropene	1	< 2	< 2	< 1	< 0.5	< 0.5	-	-
trans-1,3-Dichloropropene	1	< 2	< 2	< 1	< 0.5	< 0.5	-	-
Ethylbenzene	700	1	2	< 0.5	< 0.3	< 0.3	-	-
Ethylene Dibromide	0.03	< 2	< 2	< 1	< 0.5	< 0.5	-	-
Cyclohexane	N/A	< 5	< 5	< 3	< 1	< 1	-	-
Methylene Chloride(Dichloromethane)	3	< 5	< 5	< 3	< 1	< 1	-	-
Methyl Isobutyl Ketone	N/A	< 50	< 50	< 30	< 10	< 10	-	-
Methyl Ethyl Ketone (2-Butanone)	300	< 50	< 50	< 30	< 10	< 10	-	-
Methyl t-butyl ether (MTBE)	70	< 2	< 2	< 1	< 0.5	< 0.5	-	-
Styrene	100	< 2	< 2	< 1	< 0.5	< 0.5	-	-
1,1,1,2-Tetrachloroethane	1	< 1	< 1	< 0.5	< 0.3	< 0.3	-	-
1,1,2,2-Tetrachloroethane	1	< 2	< 2	< 1	< 0.5	< 0.5	-	-
Tetrachloroethylene	1	< 1	< 1	< 0.5	< 0.3	< 0.3	-	-
Toluene	600	< 2	< 2	< 1	< 0.5	< 0.5	-	-
1,1,1-Trichloroethane	30	< 1	< 1	< 0.5	< 0.3	< 0.3	-	-
1,1,2-Trichloroethane	3	< 2	< 2	< 1	< 0.5	< 0.5	-	-
Trichloroethylene	1	5	5	3.6	< 0.3	< 0.3	-	-
Vinyl Chloride	1	3	3	2	< 0.5	< 0.5	-	-
p+m-Xylene	1000	< 1	< 1	< 0.5	< 0.3	< 0.3	-	-
o-Xylene	1000	< 1	< 1	< 0.5	< 0.3	< 0.3	-	-
Xylene (Total)	1000	< 1	< 1	< 0.5	< 0.3	< 0.3	-	-
Methyl Butyl Ketone (2-Hexanone)	300	< 50	< 50	< 30	< 10	< 10	-	-
Chloroethane	5	61	62	40	< 0.5	< 0.5	-	-
Chloromethane	N/A	< 5	< 5	< 3	< 1	< 1	-	-
Trichlorofluoromethane (FREON 11)	2000	< 2	< 2	< 1	< 0.5	< 0.5	-	-

Notes:

5 :Value exceeding NJ GWQS criteria

N/A: :Not criteria applicable

- : Not analyzed / No result available

1 : New Jersey Groundwater Quality Standards

2 : This represents the date on which the samples were cold down to 4 °C to stop the oxidation reaction and sent for analysis.

Bench Scale Testing for the ISCO Treatment of VOCs Impacted Groundwater

TABLE 2 (page 3 of 8)

VOCs ANALYTICAL RESULTS

Parameters	Name on laboratory certificate	CO-A1D2				CO-A1D3		
		T1	T2	T4	T3	T1	T2	Dup-1
	Dosage	25 g/L Persulfate NaOH				50 g/L Persulfate NaOH		
	Reaction time (days)	0	15	30	45	0	15	15
	Date sampled [2]	1/14/2010	1/29/2010	4/27/2010	3/1/2010	1/14/2010	1/29/2010	1/29/2010
Volatil organic compounds (ug/L)	NJ GWQS[1] criteria							
1,2,3-Trichlorobenzene	N/A	< 5	< 1	-	< 5	< 1	< 1	< 1
1,2,4-Trichlorobenzene	9	< 5	< 1	-	< 5	< 1	< 1	< 1
1,4-Dioxane	10	1600	< 50	< 3	< 200	1300	< 50	< 50
Acetone (2-Propanone)	6000	< 100	< 30	-	< 100	< 20	< 30	< 30
Benzene	1	55	< 0.3	-	< 1	48	< 0.3	< 0.3
Bromodichloromethane	1	< 1	< 0.3	-	< 1	< 0.2	< 0.3	< 0.3
Bromoform	4	< 2	< 0.5	-	< 2	< 0.4	< 0.5	< 0.5
Bromomethane	10	< 5	< 1	-	< 5	< 1	< 1	< 1
Carbon Tetrachloride	1	< 1	< 0.3	-	< 1	< 0.2	< 0.3	< 0.3
Chlorobenzene	50	< 1	< 0.3	-	< 1	< 0.2	< 0.3	< 0.3
Chloroform	70	< 1	< 0.3	-	< 1	0.3	< 0.3	< 0.3
Dibromochloromethane	1	< 2	< 0.5	-	< 2	< 0.4	< 0.5	< 0.5
1,2-Dichlorobenzene	600	< 2	< 0.5	-	< 2	< 0.4	< 0.5	< 0.5
Methyl Acetate	7000	< 10	< 3	-	< 10	< 2	< 3	< 3
1,1,2-Trichlorotrifluoroethane	N/A	< 2	< 0.5	-	< 2	< 0.4	< 0.5	< 0.5
1,3-Dichlorobenzene	600	< 2	< 0.5	-	< 2	< 0.4	< 0.5	< 0.5
1,4-Dichlorobenzene	75	< 2	< 0.5	-	< 2	< 0.4	< 0.5	< 0.5
Carbon Disulfide	700	< 5	< 1	-	< 5	< 1	< 1	< 1
Dichlorodifluoromethane (FREON 12)	1000	< 5	< 1	-	< 5	< 1	< 1	< 1
1,1-Dichloroethane	50	38	< 0.3	-	< 1	35	< 0.3	< 0.3
1,2-Dichloroethane	2	< 2	< 0.5	-	< 2	< 0.4	< 0.5	< 0.5
1,1-Dichloroethylene	1	< 1	< 0.3	-	< 1	< 0.2	< 0.3	< 0.3
cis-1,2-Dichloroethylene	70	2	< 0.3	-	< 1	2	< 0.3	< 0.3
trans-1,2-Dichloroethylene	100	< 1	< 0.3	-	< 1	0.3	< 0.3	< 0.3
1,2-Dichloropropane	1	< 1	< 0.3	-	< 1	< 0.2	< 0.3	< 0.3
cis-1,3-Dichloropropene	1	< 2	< 0.5	-	< 2	< 0.4	< 0.5	< 0.5
trans-1,3-Dichloropropene	1	< 2	< 0.5	-	< 2	< 0.4	< 0.5	< 0.5
Ethylbenzene	700	< 1	< 0.3	-	< 1	0.6	< 0.3	< 0.3
Ethylene Dibromide	0.03	< 2	< 0.5	-	< 2	< 0.4	< 0.5	< 0.5
Cyclohexane	N/A	< 5	< 1	-	< 5	2	< 1	< 1
Methylene Chloride(Dichloromethane)	3	< 5	< 1	-	< 5	1	< 1	< 1
Methyl Isobutyl Ketone	N/A	< 50	< 10	-	< 50	< 10	< 10	< 10
Methyl Ethyl Ketone (2-Butanone)	300	< 50	< 10	-	< 50	< 10	< 10	< 10
Methyl t-butyl ether (MTBE)	70	< 2	< 0.5	-	< 2	< 0.4	< 0.5	< 0.5
Styrene	100	< 2	< 0.5	-	< 2	< 0.4	< 0.5	< 0.5
1,1,1,2-Tetrachloroethane	1	< 1	< 0.3	-	< 1	< 0.2	< 0.3	< 0.3
1,1,2,2-Tetrachloroethane	1	< 2	< 0.5	-	< 2	< 0.4	< 0.5	< 0.5
Tetrachloroethylene	1	< 1	< 0.3	-	< 1	< 0.2	< 0.3	< 0.3
Toluene	600	< 2	< 0.5	-	< 2	0.8	< 0.5	< 0.5
1,1,1-Trichloroethane	30	< 1	< 0.3	-	< 1	< 0.2	< 0.3	< 0.3
1,1,2-Trichloroethane	3	< 2	< 0.5	-	< 2	< 0.4	< 0.5	< 0.5
Trichloroethylene	1	5	< 0.3	-	< 1	4.7	< 0.3	< 0.3
Vinyl Chloride	1	2	< 0.5	-	< 2	2.2	< 0.5	< 0.5
p+m-Xylene	1000	< 1	< 0.3	-	< 1	< 0.2	< 0.3	< 0.3
o-Xylene	1000	< 1	< 0.3	-	< 1	0.3	< 0.3	< 0.3
Xylene (Total)	1000	< 1	< 0.3	-	< 1	0.3	< 0.3	< 0.3
Methyl Butyl Ketone (2-Hexanone)	300	< 50	< 10	-	< 50	< 10	< 10	< 10
Chloroethane	5	2	< 0.5	-	< 2	0.4	< 0.5	< 0.5
Chloromethane	N/A	5	< 1	-	< 5	1	< 1	< 1
Trichlorofluoromethane (FREON 11)	2000	2	< 0.5	-	< 2	0.4	< 0.5	< 0.5

Notes:

5 :Value exceeding NJ GWQS criteria

N/A: :Not criteria applicable

- : Not analyzed / No result available

1 : New Jersey Groundwater Quality Standards

2 : This reprensents the date at which the samples were sent for analysis and cold down to 4 °C to stop the oxidation reaction.

Bench Scale Testing for the ISCO Treatment of VOCs Impacted Groundwater

TABLE 2 (page 4 of 8)

VOCs ANALYTICAL RESULTS

Parameters	Name on laboratory certificate	CO-A1D3 (continued)			CO-A1D4	CO-A2D1		
		T4	T3	Dup -2	T2	T1	T2	T3
	Dosage	50 g/L Persulfate NaOH			1 g/L Persulfate NaOH	5 g/L Persulfate VTX		
	Reaction time (days)	30	45	45	15	0	15	45
	Date sampled [2]	4/27/2010	3/1/2010	3/1/2010	3/14/2010	1/14/2010	1/29/2010	3/1/2010
Volatil organic compounds (ug/L)	NJ GWQS[1] criteria							
1,2,3-Trichlorobenzene	N/A	-	< 10	< 10	-	< 3	< 10	< 1
1,2,4-Trichlorobenzene	9	-	< 10	< 10	-	< 3	< 10	< 1
1,4-Dioxane	10	< 3	< 500	< 500	768	1100	1000	1100
Acetone (2-Propanone)	6000	-	< 300	< 300	-	< 50	< 200	44
Benzene	1	-	< 3	< 3	-	21	30	24
Bromodichloromethane	1	-	< 3	< 3	-	< 0.5	< 2	< 0.3
Bromoform	4	-	< 5	< 5	-	< 1	< 4	6.2
Bromomethane	10	-	< 10	< 10	-	< 3	< 10	< 1
Carbon Tetrachloride	1	-	< 3	< 3	-	< 0.5	< 2	< 0.3
Chlorobenzene	50	-	< 3	< 3	-	< 0.5	< 2	< 0.3
Chloroform	70	-	< 3	< 3	-	< 0.5	< 2	< 0.3
Dibromochloromethane	1	-	< 5	< 5	-	< 1	< 4	< 0.5
1,2-Dichlorobenzene	600	-	< 5	< 5	-	< 1	< 4	< 0.5
Methyl Acetate	7000	-	< 30	< 30	-	< 5	< 20	< 3
1,1,2-Trichlorotrifluoroethane	N/A	-	< 5	< 5	-	< 1	< 4	< 0.5
1,3-Dichlorobenzene	600	-	< 5	< 5	-	< 1	< 4	< 0.5
1,4-Dichlorobenzene	75	-	< 5	< 5	-	< 1	< 4	< 0.5
Carbon Disulfide	700	-	< 10	< 10	-	< 3	< 10	< 1
Dichlorodifluoromethane (FREON 12)	1000	-	< 10	< 10	-	< 3	< 10	< 1
1,1-Dichloroethane	50	-	< 3	< 3	-	28	28	29
1,2-Dichloroethane	2	-	< 5	< 5	-	< 1	< 4	< 2
1,1-Dichloroethylene	1	-	< 3	< 3	-	< 0.5	< 2	< 0.3
cis-1,2-Dichloroethylene	70	-	< 3	< 3	-	1.5	< 2	1.1
trans-1,2-Dichloroethylene	100	-	< 3	< 3	-	< 0.5	< 2	< 0.3
1,2-Dichloropropane	1	-	< 3	< 3	-	< 0.5	< 2	< 0.3
cis-1,3-Dichloropropene	1	-	< 5	< 5	-	< 1	< 4	< 0.5
trans-1,3-Dichloropropene	1	-	< 5	< 5	-	< 1	< 4	< 0.5
Ethylbenzene	700	-	< 3	< 3	-	< 0.5	< 2	< 0.3
Ethylene Dibromide	0.03	-	< 5	< 5	-	< 1	< 4	0.7
Cyclohexane	N/A	-	< 10	< 10	-	< 3	< 10	< 1
Methylene Chloride(Dichloromethane)	3	-	< 10	< 10	-	< 3	< 10	1
Methyl Isobutyl Ketone	N/A	-	< 100	< 100	-	< 30	< 100	< 10
Methyl Ethyl Ketone (2-Butanone)	300	-	< 100	< 100	-	< 30	< 100	< 10
Methyl t-butyl ether (MTBE)	70	-	< 5	< 5	-	< 1	< 4	< 0.5
Styrene	100	-	< 5	< 5	-	< 1	< 4	< 0.5
1,1,1,2-Tetrachloroethane	1	-	< 3	< 3	-	< 0.5	< 2	< 0.3
1,1,2,2-Tetrachloroethane	1	-	< 5	< 5	-	< 1	< 4	< 0.5
Tetrachloroethylene	1	-	< 3	< 3	-	< 0.5	< 2	< 0.3
Toluene	600	-	< 5	< 5	-	< 1	< 4	< 0.5
1,1,1-Trichloroethane	30	-	< 3	< 3	-	< 0.5	< 2	< 0.3
1,1,2-Trichloroethane	3	-	< 5	< 5	-	< 1	< 4	< 0.5
Trichloroethylene	1	-	< 3	< 3	-	3.5	3	1.9
Vinyl Chloride	1	-	< 5	< 5	-	< 1	< 4	< 0.5
p+m-Xylene	1000	-	< 3	< 3	-	< 0.5	< 2	< 0.3
o-Xylene	1000	-	< 3	< 3	-	< 0.5	< 2	< 0.3
Xylene (Total)	1000	-	< 3	< 3	-	< 0.5	< 2	< 0.3
Methyl Butyl Ketone (2-Hexanone)	300	-	< 100	< 100	-	< 30	< 100	< 10
Chloroethane	5	-	< 5	< 5	-	42	38	44
Chloromethane	N/A	-	< 10	< 10	-	< 3	< 10	< 1
Trichlorofluoromethane (FREON 11)	2000	-	< 5	< 5	-	< 1	< 4	< 0.5

Notes:

5 :Value exceeding NJ GWQS criteria

N/A: :Not criteria applicable

-: Not analyzed / No result available

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Bench Scale Testing for the ISCO Treatment of VOCs Impacted Groundwater

TABLE 2 (page 5 of 8)

VOCs ANALYTICAL RESULTS

Parameters	Name on laboratory certificate	CO-A2D2			CO-A2D3			
		T1	T2	T3	T1	T1	T2	Dup-3
	Dosage	25 g/L Persulfate VTX			50 g/L Persulfate VTX			
	Reaction time (days)	0	15	45	0	Lab Dup	15	15
	Date sampled [2]	1/14/2010	1/29/2010	3/1/2010	1/14/2010	1/14/2010	1/29/2010	1/29/2010
Volatil organic compounds (ug/L)	NJ GWQS[1] criteria							
1,2,3-Trichlorobenzene	N/A	< 3	< 5	< 50	< 3	< 3	< 10	< 10
1,2,4-Trichlorobenzene	9	< 3	< 5	< 50	< 3	< 3	< 10	< 10
1,4-Dioxane	10	1100	890	< 2000	1400	1500	700	700
Acetone (2-Propanone)	6000	< 50	< 100	< 1000	< 50	< 50	< 200	< 200
Benzene	1	15	7	< 10	40	48	< 2	< 2
Bromodichloromethane	1	< 0.5	< 1	< 10	< 0.5	< 0.5	55	70
Bromoform	4	< 1	28	< 20	< 1	< 1	5	< 4
Bromomethane	10	< 3	380	1300	< 3	< 3	3500	4000
Carbon Tetrachloride	1	< 0.5	< 1	< 10	< 0.5	< 0.5	< 2	< 2
Chlorobenzene	50	< 0.5	< 1	< 10	< 0.5	< 0.5	< 2	< 2
Chloroform	70	< 0.5	< 1	< 10	< 0.5	< 0.5	30	47
Dibromochloromethane	1	< 1	3	< 20	< 1	< 1	38	41
1,2-Dichlorobenzene	600	< 1	< 2	< 20	< 1	< 1	< 4	< 4
Methyl Acetate	7000	< 5	16	< 100	< 5	< 5	< 20	< 20
1,1,2-Trichlorotrifluoroethane	N/A	< 1	< 2	< 20	< 1	< 1	< 4	< 4
1,3-Dichlorobenzene	600	< 1	< 2	< 20	< 1	< 1	< 4	< 4
1,4-Dichlorobenzene	75	< 1	< 2	< 20	< 1	< 1	< 4	< 4
Carbon Disulfide	700	< 3	< 5	< 50	< 3	< 3	< 10	< 10
Dichlorodifluoromethane (FREON 12)	1000	< 3	< 5	< 50	< 3	< 3	< 10	< 10
1,1-Dichloroethane	50	29	28	38	33	36	74	82
1,2-Dichloroethane	2	< 1	3	< 20	< 1	< 1	16	20
1,1-Dichloroethylene	1	< 0.5	< 1	< 10	< 0.5	< 0.5	< 2	< 2
cis-1,2-Dichloroethylene	70	1.6	< 1	< 10	1.8	2	< 2	< 2
trans-1,2-Dichloroethylene	100	< 0.5	< 1	< 10	< 0.5	< 0.5	< 2	< 2
1,2-Dichloropropane	1	< 0.5	< 1	< 10	< 0.5	< 0.5	3	4
cis-1,3-Dichloropropene	1	< 1	< 2	< 20	< 1	< 1	< 4	< 4
trans-1,3-Dichloropropene	1	< 1	< 2	< 20	< 1	< 1	< 4	< 4
Ethylbenzene	700	< 0.5	< 1	< 10	< 0.5	0.6	< 2	< 2
Ethylene Dibromide	0.03	< 1	< 2	< 20	< 1	< 1	< 4	< 4
Cyclohexane	N/A	< 3	< 5	< 50	< 3	< 3	< 10	< 10
Methylene Chloride(Dichloromethane)	3	< 3	< 5	390	< 3	< 3	1200	1400
Methyl Isobutyl Ketone	N/A	< 30	< 50	< 500	< 30	< 30	< 100	< 100
Methyl Ethyl Ketone (2-Butanone)	300	< 30	< 50	< 500	< 30	< 30	< 100	< 100
Methyl t-butyl ether (MTBE)	70	< 1	< 2	< 20	< 1	< 1	< 4	< 4
Styrene	100	< 1	< 2	< 20	< 1	< 1	< 4	< 4
1,1,1,2-Tetrachloroethane	1	< 0.5	< 1	< 10	< 0.5	< 0.5	< 2	< 2
1,1,2,2-Tetrachloroethane	1	< 1	< 2	< 20	< 1	< 1	< 4	< 4
Tetrachloroethylene	1	< 0.5	< 1	< 10	< 0.5	< 0.5	< 2	< 2
Toluene	600	< 1	< 2	< 20	< 1	< 1	< 4	< 4
1,1,1-Trichloroethane	30	< 0.5	< 1	< 10	< 0.5	< 0.5	3	3
1,1,2-Trichloroethane	3	< 1	< 2	< 20	< 1	< 1	10	13
Trichloroethylene	1	3.4	< 1	< 10	4.1	4.6	< 2	< 2
Vinyl Chloride	1	2	< 2	< 20	2	2	< 4	< 4
p+m-Xylene	1000	< 0.5	< 1	< 10	< 0.5	< 0.5	< 2	< 2
o-Xylene	1000	< 0.5	< 1	< 10	< 0.5	< 0.5	< 2	< 2
Xylene (Total)	1000	< 0.5	< 1	< 10	< 0.5	< 0.5	< 2	< 2
Methyl Butyl Ketone (2-Hexanone)	300	< 30	< 50	< 500	< 30	< 30	< 100	< 100
Chloroethane	5	45	40	59	49	49	84	80
Chloromethane	N/A	< 3	140	7800	< 3	< 3	19000	22000
Trichlorofluoromethane (FREON 11)	2000	< 1	< 2	< 20	< 1	< 1	< 4	< 4

Notes:

5 :Value exceeding NJ GWQS criteria

N/A: :Not criteria applicable

- : Not analyzed / No result available

1 : New Jersey Groundwater Quality Standards

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Bench Scale Testing for the ISCO Treatment of VOCs Impacted Groundwater

TABLE 2 (page 6 of 8)

VOCs ANALYTICAL RESULTS

Parameters	Name on laboratory certificate	CO-A2D3 (continued)		CO-C			CO-C # 2
		T3	Dup-4	T1	T2	T3	T1
	Dosage	50 g/L Persulfate VTX		0 g/L Persulfate Control			0 g/L Persulfate Control
	Reaction time (days)	45	45	0	15	45	0
	Date sampled [2]	3/1/2010	3/1/2010	1/14/2010	1/29/2010	3/1/2010	4/5/2010
Volatil organic compounds (ug/L)	NJ GWQS[1] criteria						
1,2,3-Trichlorobenzene	N/A	< 300	< 300	< 1	< 1	< 1	-
1,2,4-Trichlorobenzene	9	< 300	< 300	< 1	< 1	< 1	-
1,4-Dioxane	10	< 10000	< 10000	1000	1000	1100	1100
Acetone (2-Propanone)	6000	< 5000	< 5000	< 30	< 30	< 20	-
Benzene	1	< 50	< 50	31	< 0.3	< 0.2	-
Bromodichloromethane	1	< 50	< 50	< 0.3	< 0.3	< 0.2	-
Bromoform	4	< 100	< 100	< 0.5	< 0.5	< 0.4	-
Bromomethane	10	2500	2400	< 1	< 1	< 1	-
Carbon Tetrachloride	1	< 50	< 50	< 0.3	< 0.3	< 0.2	-
Chlorobenzene	50	< 50	< 50	< 0.3	< 0.3	< 0.2	-
Chloroform	70	150	140	< 0.3	< 0.3	0.2	-
Dibromochloromethane	1	< 100	< 100	< 0.5	< 0.5	< 0.4	-
1,2-Dichlorobenzene	600	< 100	< 100	< 0.5	< 0.5	< 0.4	-
Methyl Acetate	7000	< 500	< 500	< 3	< 3	< 2	-
1,1,2-Trichlorotrifluoroethane	N/A	< 100	< 100	< 0.5	< 0.5	< 0.4	-
1,3-Dichlorobenzene	600	< 100	< 100	< 0.5	< 0.5	< 0.4	-
1,4-Dichlorobenzene	75	< 100	< 100	< 0.5	< 0.5	< 0.4	-
Carbon Disulfide	700	< 300	< 300	< 1	< 1	< 1	-
Dichlorodifluoromethane (FREON 12)	1000	< 300	< 300	< 1	< 1	< 1	-
1,1-Dichloroethane	50	150	150	28	30	32	-
1,2-Dichloroethane	2	< 100	< 100	< 0.5	< 0.5	< 0.4	-
1,1-Dichloroethylene	1	< 50	< 50	< 0.3	< 0.3	< 0.2	-
cis-1,2-Dichloroethylene	70	< 50	< 50	1.6	1.4	1.2	-
trans-1,2-Dichloroethylene	100	< 50	< 50	< 0.3	< 0.3	< 0.2	-
1,2-Dichloropropane	1	< 50	< 50	< 0.3	< 0.3	< 0.2	-
cis-1,3-Dichloropropene	1	< 100	< 100	< 0.5	< 0.5	< 0.4	-
trans-1,3-Dichloropropene	1	< 100	< 100	< 0.5	< 0.5	< 0.4	-
Ethylbenzene	700	< 50	< 50	< 0.3	< 0.3	< 0.2	-
Ethylene Dibromide	0.03	< 100	< 100	< 0.5	< 0.5	< 0.4	-
Cyclohexane	N/A	< 300	< 300	< 1	< 1	< 1	-
Methylene Chloride(Dichloromethane)	3	5600	5800	< 1	1	< 1	-
Methyl Isobutyl Ketone	N/A	< 3000	< 3000	< 10	< 10	< 10	-
Methyl Ethyl Ketone (2-Butanone)	300	< 3000	< 3000	< 10	< 10	< 10	-
Methyl t-butyl ether (MTBE)	70	< 100	< 100	< 0.5	< 0.5	< 0.4	-
Styrene	100	< 100	< 100	< 0.5	< 0.5	< 0.4	-
1,1,1,2-Tetrachloroethane	1	< 50	< 50	< 0.3	< 0.3	< 0.2	-
1,1,2,2-Tetrachloroethane	1	< 100	< 100	< 0.5	< 0.5	< 0.4	-
Tetrachloroethylene	1	< 50	< 50	< 0.3	< 0.3	< 0.2	-
Toluene	600	< 100	< 100	< 0.5	< 0.5	< 0.4	-
1,1,1-Trichloroethane	30	< 50	< 50	< 0.3	< 0.3	< 0.2	-
1,1,2-Trichloroethane	3	< 100	< 100	< 0.5	< 0.5	< 0.4	-
Trichloroethylene	1	< 50	< 50	3.6	3.2	2.7	-
Vinyl Chloride	1	< 100	< 100	1.6	1.5	< 0.4	-
p+m-Xylene	1000	< 50	< 50	< 0.3	< 0.3	< 0.2	-
o-Xylene	1000	< 50	< 50	< 0.3	< 0.3	< 0.2	-
Xylene (Total)	1000	< 50	< 50	< 0.3	< 0.3	< 0.2	-
Methyl Butyl Ketone (2-Hexanone)	300	< 3000	< 3000	< 10	< 10	< 10	-
Chloroethane	5	< 100	< 100	-	37	42	-
Chloromethane	N/A	72000	74000	-	< 1	< 1	-
Trichlorofluoromethane (FREON 11)	2000	< 100	< 100	-	< 0.5	< 0.4	-

Notes:

5 :Value exceeding NJ GWQS criteria

N/A: :Not criteria applicable

- : Not analyzed / No result available

1 : New Jersey Groundwater Quality Standards

2 : This reprensents the date at which the samples were sent for analysis and cold down to 4 °C to stop the oxidation reactio

Bench Scale Testing for the ISCO Treatment of VOCs Impacted Groundwater

TABLE 3 (page 7 de 8)

GOLDER DUPLICATA RESULTS AND RDP

Parameters	CO-A1D3					
	T2	Dup-1	RDP (%)	T3	Dup -2	RDP (%)
	50 g/L Persulfate NaOH					
	15	15		45	45	
Volatil organic compounds (ug/L)						
1,2,3-Trichlorobenzene	< 1	< 1	-	< 10	< 10	-
1,2,4-Trichlorobenzene	< 1	< 1	-	< 10	< 10	-
1,4-Dioxane	< 50	< 50	-	< 500	550	-
Acetone (2-Propanone)	< 30	< 30	-	< 300	< 300	-
Benzene	< 0.3	< 0.3	-	< 3	< 3	-
Bromodichloromethane	< 0.3	< 0.3	-	< 3	< 3	-
Bromoform	< 0.5	< 0.5	-	< 5	< 5	-
Bromomethane	< 1	< 1	-	< 10	< 10	-
Carbon Tetrachloride	< 0.3	< 0.3	-	< 3	< 3	-
Chlorobenzene	< 0.3	< 0.3	-	< 3	< 3	-
Chloroform	< 0.3	< 0.3	-	< 3	< 3	-
Dibromochloromethane	< 0.5	< 0.5	-	< 5	< 5	-
1,2-Dichlorobenzene	< 0.5	< 0.5	-	< 5	< 5	-
Methyl Acetate	< 3	< 3	-	< 30	< 30	-
1,1,2-Trichlorotrifluoroethane	< 0.5	< 0.5	-	< 5	< 5	-
1,3-Dichlorobenzene	< 0.5	< 0.5	-	< 5	< 5	-
1,4-Dichlorobenzene	< 0.5	< 0.5	-	< 5	< 5	-
Carbon Disulfide	< 1	< 1	-	< 10	< 10	-
Dichlorodifluoromethane (FREON 12)	< 1	< 1	-	< 10	< 10	-
1,1-Dichloroethane	< 0.3	< 0.3	-	< 3	< 3	-
1,2-Dichloroethane	< 0.5	< 0.5	-	< 5	< 5	-
1,1-Dichloroethylene	< 0.3	< 0.3	-	< 3	< 3	-
cis-1,2-Dichloroethylene	< 0.3	< 0.3	-	< 3	< 3	-
trans-1,2-Dichloroethylene	< 0.3	< 0.3	-	< 3	< 3	-
1,2-Dichloropropane	< 0.3	< 0.3	-	< 3	< 3	-
cis-1,3-Dichloropropene	< 0.5	< 0.5	-	< 5	< 5	-
trans-1,3-Dichloropropene	< 0.5	< 0.5	-	< 5	< 5	-
Ethylbenzene	< 0.3	< 0.3	-	< 3	< 3	-
Ethylene Dibromide	< 0.5	< 0.5	-	< 5	< 5	-
Cyclohexane	< 1	< 1	-	< 10	< 10	-
Methylene Chloride(Dichloromethane)	< 1	< 1	-	< 10	< 10	-
Methyl Isobutyl Ketone	< 10	< 10	-	< 100	< 100	-
Methyl Ethyl Ketone (2-Butanone)	< 10	< 10	-	< 100	< 100	-
Methyl t-butyl ether (MTBE)	< 0.5	< 0.5	-	< 5	< 5	-
Styrene	< 0.5	< 0.5	-	< 5	< 5	-
1,1,1,2-Tetrachloroethane	< 0.3	< 0.3	-	< 3	< 3	-
1,1,2,2-Tetrachloroethane	< 0.5	< 0.5	-	< 5	< 5	-
Tetrachloroethylene	< 0.3	< 0.3	-	< 3	< 3	-
Toluene	< 0.5	< 0.5	-	< 5	< 5	-
1,1,1-Trichloroethane	< 0.3	< 0.3	-	< 3	< 3	-
1,1,2-Trichloroethane	< 0.5	< 0.5	-	< 5	< 5	-
Trichloroethylene	< 0.3	< 0.3	-	< 3	< 3	-
Vinyl Chloride	< 0.5	< 0.5	-	< 5	< 5	-
p+m-Xylene	< 0.3	< 0.3	-	< 3	< 3	-
o-Xylene	< 0.3	< 0.3	-	< 3	< 3	-
Xylene (Total)	< 0.3	< 0.3	-	< 3	< 3	-
Methyl Butyl Ketone (2-Hexanone)	< 10	< 10	-	< 100	< 100	-
Chloroethane	< 0.5	< 0.5	-	< 5	< 5	-
Chloromethane	< 1	< 1	-	< 10	< 10	-
Trichlorofluoromethane (FREON 11)	< 0.5	< 0.5	-	< 5	< 5	-

Note

-: Not applicable; result equal to RDL

RDP: $\frac{\text{Result-duplicata}}{\text{Mean (Result and Duplicate)}} \times 100$

Bench Scale Testing for the ISCO Treatment of VOCs Impacted Groundwater

TABLE 3 (page 8 de 8)

GOLDER DUPLICATA RESULTS AND RDP

Parameters	CO-A2D3					
	T2	Dup-3	RDP (%)	T3	Dup-4	RDP (%)
	50 g/L Persulfate VTX					
	15	15		45	45	
Volatil organic compounds (ug/L)						
1,2,3-Trichlorobenzene	< 10	< 10	-	< 300	< 300	-
1,2,4-Trichlorobenzene	< 10	< 10	-	< 300	< 300	-
1,4-Dioxane	700	700	0.0	< 10000	< 10000	-
Acetone (2-Propanone)	< 200	< 200	-	< 5000	< 5000	-
Benzene	< 2	< 2	-	< 50	< 50	-
Bromodichloromethane	55	70	24.0	< 50	< 50	-
Bromoform	5	< 4	-	< 100	< 100	-
Bromomethane	3500	4000	13.3	2500	2400	4.1
Carbon Tetrachloride	< 2	< 2	-	< 50	< 50	-
Chlorobenzene	< 2	< 2	-	< 50	< 50	-
Chloroform	30	47	44.2	150	140	6.9
Dibromochloromethane	38	41	7.6	< 100	< 100	-
1,2-Dichlorobenzene	< 4	< 4	-	< 100	< 100	-
Methyl Acetate	< 20	< 20	-	< 500	< 500	-
1,1,2-Trichlorotrifluoroethane	< 4	< 4	-	< 100	< 100	-
1,3-Dichlorobenzene	< 4	< 4	-	< 100	< 100	-
1,4-Dichlorobenzene	< 4	< 4	-	< 100	< 100	-
Carbon Disulfide	< 10	< 10	-	< 300	< 300	-
Dichlorodifluoromethane (FREON 12)	< 10	< 10	-	< 300	< 300	-
1,1-Dichloroethane	74	82	10.3	150	150	0.0
1,2-Dichloroethane	16	20	22.2	< 100	< 100	-
1,1-Dichloroethylene	< 2	< 2	-	< 50	< 50	-
cis-1,2-Dichloroethylene	< 2	< 2	-	< 50	< 50	-
trans-1,2-Dichloroethylene	< 2	< 2	-	< 50	< 50	-
1,2-Dichloropropane	3	4	28.6	< 50	< 50	-
cis-1,3-Dichloropropene	< 4	< 4	-	< 100	< 100	-
trans-1,3-Dichloropropene	< 4	< 4	-	< 100	< 100	-
Ethylbenzene	< 2	< 2	-	< 50	< 50	-
Ethylene Dibromide	< 4	< 4	-	< 100	< 100	-
Cyclohexane	< 10	< 10	-	< 300	< 300	-
Methylene Chloride(Dichloromethane)	1200	1400	15.4	5600	5800	3.5
Methyl Isobutyl Ketone	< 100	< 100	-	< 3000	< 3000	-
Methyl Ethyl Ketone (2-Butanone)	< 100	< 100	-	< 3000	< 3000	-
Methyl t-butyl ether (MTBE)	< 4	< 4	-	< 100	< 100	-
Styrene	< 4	< 4	-	< 100	< 100	-
1,1,1,2-Tetrachloroethane	< 2	< 2	-	< 50	< 50	-
1,1,2,2-Tetrachloroethane	< 4	< 4	-	< 100	< 100	-
Tetrachloroethylene	< 2	< 2	-	< 50	< 50	-
Toluene	< 4	< 4	-	< 100	< 100	-
1,1,1-Trichloroethane	3	3	0.0	< 50	< 50	-
1,1,2-Trichloroethane	10	13	26.1	< 100	< 100	-
Trichloroethylene	< 2	< 2	-	< 50	< 50	-
Vinyl Chloride	< 4	< 4	-	< 100	< 100	-
p+m-Xylene	< 2	< 2	-	< 50	< 50	-
o-Xylene	< 2	< 2	-	< 50	< 50	-
Xylene (Total)	< 2	< 2	-	< 50	< 50	-
Methyl Butyl Ketone (2-Hexanone)	< 100	< 100	-	< 3000	< 3000	-
Chloroethane	84	80	4.9	< 100	< 100	-
Chloromethane	19000	22000	14.6	72000	74000	2.7
Trichlorofluoromethane (FREON 11)	< 4	< 4	-	< 100	< 100	-

Note

- : Not applicable; result equal to RDL

RDP: $\frac{\text{Result-duplicata}}{\text{Mean (Result and Duplicate)}} \times 100$

APPENDIX A

NOD - Chemco Report

CHEMCO Inc.

SOLUTIONS AND ENVIRONMENTAL PRODUCTS
WATER - SOIL - AIR

SOD Lab report

Persulfate Oxidation Chemistry is a technology used for the in situ or ex-situ treatment of chlorinated and non-chlorinated organics in via chemical oxidation both soil and groundwater. Activation of the persulphate to form sulphate radicals is a potent tool for remediation of a wide variety of contaminant. This test is a method to determine the Soil Oxidant Demand (SOD) in soil. The SOD will be dependent upon the soil composition as well as the concentration of persulfate utilized. SOD is the first step in the determination of a two week treatability study protocol for Klozur ™ activated persulfate test (if required).

Reference

Klozur ™ Activated Persulfate treatability protocol for Klozur ™ activated persulphate. Method from FMC (see attached document in Annex A)

Soil Sample to be evaluated – (see pictures in Annex C)

1- **Bedrock 21 - 28**
2- **Bedrock 75 – 80**
3- **MW-21R logement Ti 4**
4- **MW-21R logement Ti 11**

Materials and methods

Tests were performed to measure the amount of oxidant naturally consumed by the soil (Soil Oxidant Demand) in the course of treatment. The amount and rate of oxidant consumption is used to determine oxidant dosing and reaction conditions requirement for soil and groundwater treatment.
Tests were performed using a soil to water ratio of 30gr/200ml. Alkaline Activated Persulphate oxidant systems were tested using 1, 5, 25, 125 g/L persulphate concentration. To activate the persulfate, the alkaline activation method was chosen using a molar ratio of persulfate to Sodium Hydroxide of 1:2. After 48 hours, persulphate concentration in the solution was measured by a standard back titration with permanganate (Annex B). The SOD can be determined as:

$$SOD = V^* (C_0 - C_f) / m_S$$

Where
- V = volume of the groundwater used in the sample
- C_0 = initial concentration of persulfate at time 0
- C_f = concentration of persulfate after 48 hours
- m_S = mass of soil used in the sample

The SOD can be determined by averaging the 3 lowest SOD values for the different initial persulphate concentrations.

Results and discussion

Based on the titration result obtained the SOD values are the following for the submitted soil samples:

Bedrock 21 – 28	**SOD – 10.1 g/kg**
Bedrock 75 – 80	**SOD – 7.0 g/kg**
MW-21R logement Ti 4	**SOD – 1.23 g/kg**
MW-21R logement Ti 11	**SOD – 2.07 g/kg**

Note that in order to raise the pH to 11, the soil has required 2.0 g/kg of soil of sodium hydroxide 100 %. This amount was dosed in addition to the 1 :2 molar ratio for the sodium persulphate: sodium hydroxide thus giving an initial pH of 11.15 which became 11.64 after 48 hours. This fall in line with the optimal pH desired for the alkaline activation of sodium persulphate is 11.0 (10.0 being the minimum acceptable).

Report by: Claude Grenon, Chemist march. 4th, 2010

Appendix A

Klozur[tm] Activated Persulfate Treatability Protocol Template

The following is a template for a two week treatability protocol for Klozur [tm] activated persulfate.

Part I: SOD Determination

Soil oxidant demand (SOD) is a measure of the loss of persulfate due to reaction with soil matrix components as well as through auto-decomposition. SOD will be dependent upon soil composition as well as the concentration of persulfate utilized. It is recommended that duplicates for each concentration be run.

Procedure

1. To determine an estimate of the SOD a series of Klozur[tm] persulphate concentrations need to be titrated to obtain an estimate the demand.

2. Using 1 g/L, 5 g/L, 25 g/L and 125 g/L as the series of dosages for testing.

3. Using the groundwater from the site (or distilled water if groundwater is not available), prepare the individual Klozur[tm] persulphate solutions at the concentrations determined in Step 2.

4. Add 200 ml of the persulfate solution to a 250 ml amber jar. Repeat for all persulfate solutions. If you know the porosity of the soil and assume that is filled with water you can make your soil and water mix similar to the site. Thus mimicking one of the site conditions.

5. To each jar, add 40 grams of site soil.

6. Add requisite amount of activator to sample jar:

FeEDTA Activation –

it is recommended that a minimum150 ppm of Fe be added.

Alkaline Activation –

The amount of NaOH to be added must be determined via titration of the soil and groundwater prior to SOD study. Use standard titration methods on a sample containing 40 g soil and 200 mL of groundwater. Enough NaOH should be added to maintain a constant pH of 11. Additional NaOH should be added to counter the formation of HSO_4^- generated by persulfate decomposition. This additional amount equals 2 moles NaOH per mole of persulfate. This molar amount is equivalent to 0.35 grams of NaOH per gram of persulfate.

H_2O_2 Activation –

The recommended dosing of peroxide equals 5 moles peroxide per mole of persulfate.

7. Cap each jar and place on shaker table. Rotate at low velocity, 50 – 100 rpm.

8. If constant temperature bath available, maintain samples at 20 °C, or else maintain at room temperature. (Exception: if heat activation is being utilized, maintain samples at activation temperature).

9. After 48 hours, allow the soil to settle and decant of the aqueous portion. Measure persulfate concentration in the aqueous portion either by standard back titration (via permanganate or cerium sulfate) or via spectrometer at 450 nm.

10. The Soil Oxidant Demand can be determined as follows:

$$SOD = V * (C_0 - C_f) / m_s$$

Where V = volume of the groundwater used in the sample
C_0 = initial concentration of persulfate at time 0
C_f = concentration of persulfate after 48 hours
M_s = mass of soil used in the sample

The average SOD can be determined by averaging the SOD values for the three different initial persulfate concentrations.

Appendix B

Klozur[tm] Persulfate Titration Procedure

Equipment needed:

20 mL pipette
250 mL Erlenmeyer flask
Stir bar / magnetic plate
Burette
100 mL flask

Chemicals needed:

1 N H_2SO_4
0.5 N ferrous ammonium sulfate
0.5 N $KMnO_4$ or 0.5 N $Ce(SO_4)_2$
Ferroin indicator if using $Ce(SO_4)_2$

Procedure:

1. Pipette 2 – 20 mL of the solution containing the persulfate into a 250 mL Erlenmeyer flask.

2. Add about 50 mL of a 1 N H_2SO_4 solution

3. Add exactly 40 mL of 0.5 N ferrous ammonium sulfate solution. Swirl constantly while adding.

4. Let stand for one minute

5. Titrate with 0.5 N $KMnO_4$ to a permanent pink endpoint or with 0.5 N $Ce(SO_4)_2$ to a Ferroin indicator endpoint.

6. Run a blank titration on exactly 40 mL of ferrous ammonium sulfate solution, as used above, in 50 mL of 1 N H_2SO_4.

Calculation

g/L Klozur[tm] persulfate = (A-B)*C*119 / D

where:

A = mL $KmnO_4$ or $Ce(SO_4)_2$ solution for titrating the blank
B = mL $KmnO_4$ or $Ce(SO_4)_2$ solution for titrating the sample
C = normality of the $KmnO_4$ or $Ce(SO_4)_2$ solution used
D = volume of sample in mL

APPENDIX B

Protocol

Methodology – Measurement of Buffer Capacity of Site Groundwater

Prepared by: Peneloppe Theriault

Revised by: Eric Bergeron

Buffering capacity

1. Take 100 mL of groundwater
2. Set up a burette with 10g/L NaOH solution. Install the burette inside the fume hood if possible.
3. Slowly dose 10g/ NaOH into the beaker until the pH reaches 12 and maintains above 12 for 30 minutes.
4. Record the volume of NaOH solution after each addition of NaOH record the on a data sheet.
5. Add more NaOH solution if the pH drops during the test. Record the pH values and the cumulative volume of NaOH solution added.
6. Repeat the trial, if the second value is different by +10% from the first, conduct third trial.

Methodology – Samples Preparation

Prepared by: Peneloppe Theriault

Revised by: Eric Bergeron

Step 1: Vials preparation

1. Place in each vial marked with the appropriate amount of Klozur persulfate and activator (either NaOH or VTX) based on the excel spreadsheet attached to this procedure.
2. Completely fill the vial with groundwater. No air space or air bubble should be present in the vial.
3. Gently shake the vial to ensure all reactants have been dissolved.
4. Using the appropriate vials slowly pour a small amount into a 50 mL container and measure the ORP, conductivity, temperature and the pH using the pen probe and record the results.
5. After using the same sample measure the dissolved oxygen using a colorimeter.
6. Store the vials at room temperature until their reaction time is completed.

STEP 2 : Analysis

7. After the appropriate reaction time, take 6 vials and send them to Maxxam for analysis of VOC.
8. Take the seventh vial and slowly pour it into a 50 mL container. Measure the ORP, conductivity, temperature and the pH using a pen probe and record the results.
9. Take the eigth vial and measure the DO and sulfate concentration using the colorimeter as well as the residual persulfate using the back titration method.

APPENDIX C

Photos

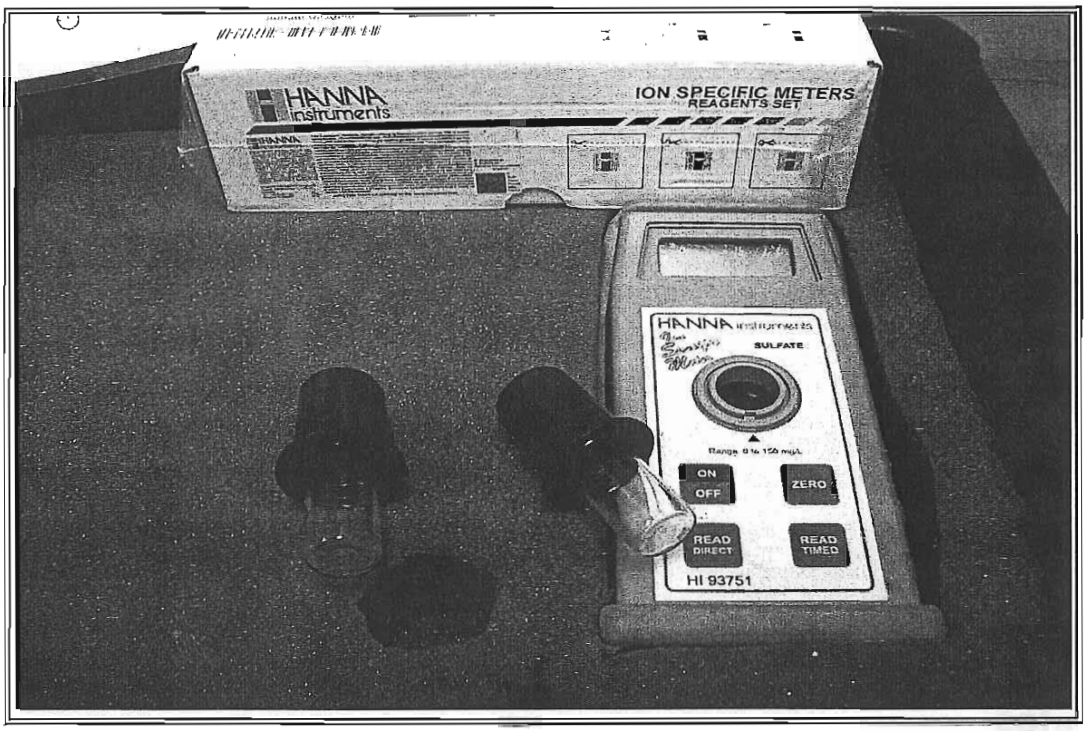


PHOTO 1: Sulfate Colorimeter

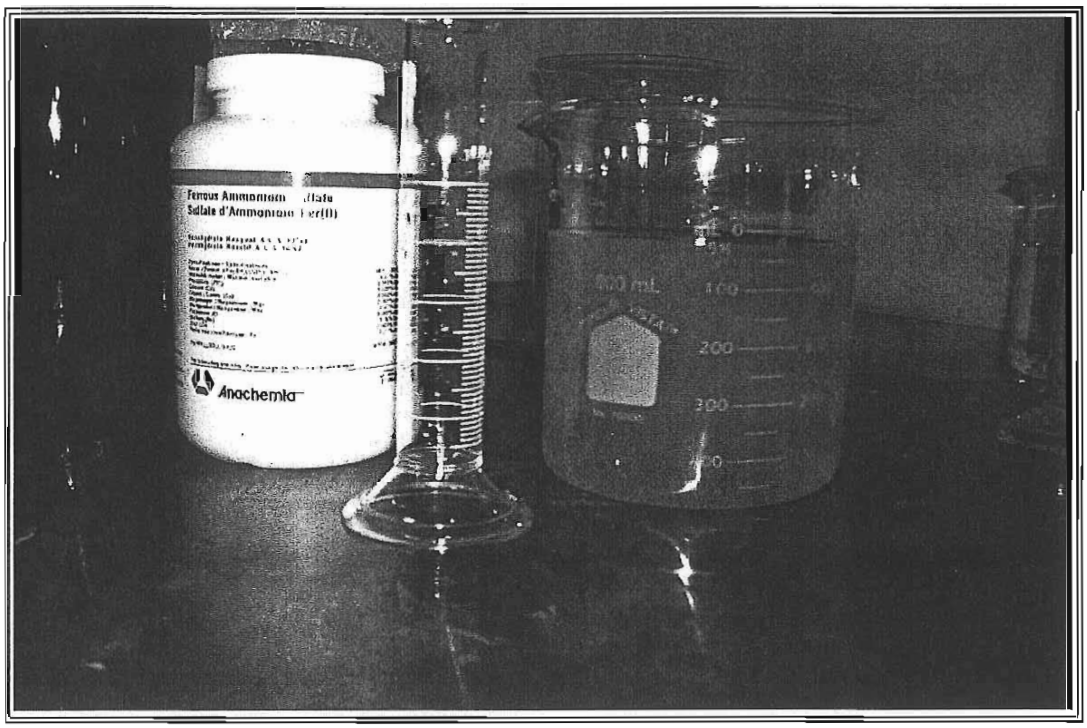


PHOTO 2: Ferrous Ammonium Sulfate Preparation for Back Titration

PHOTO 3: Back Titration Apparatus

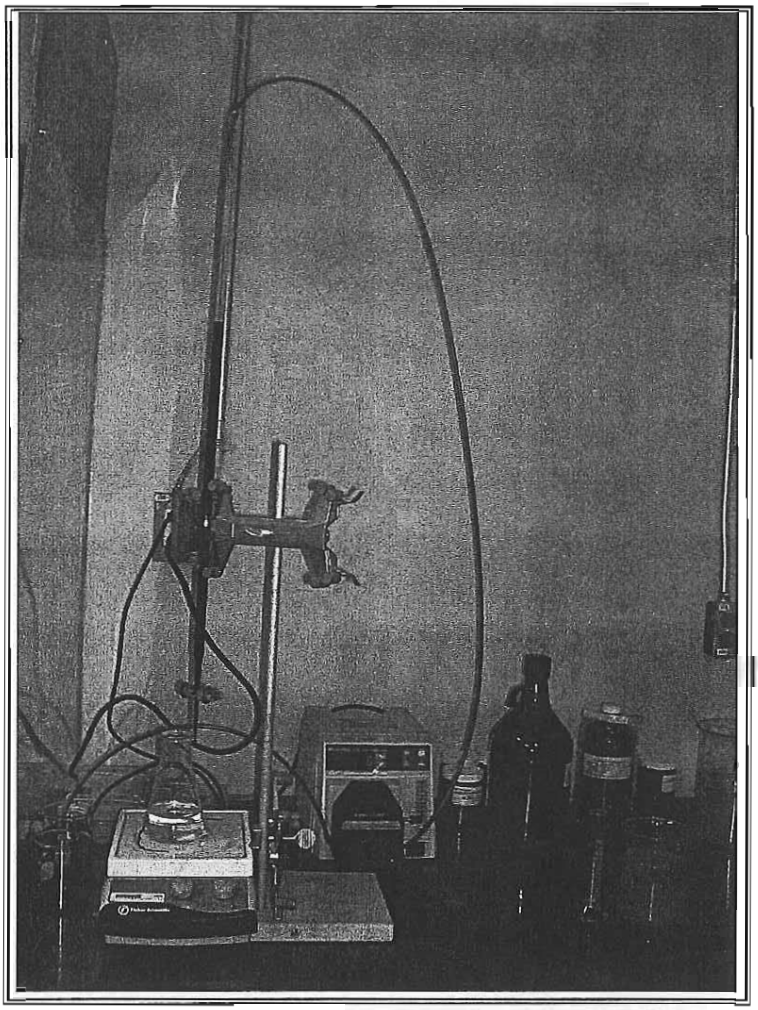
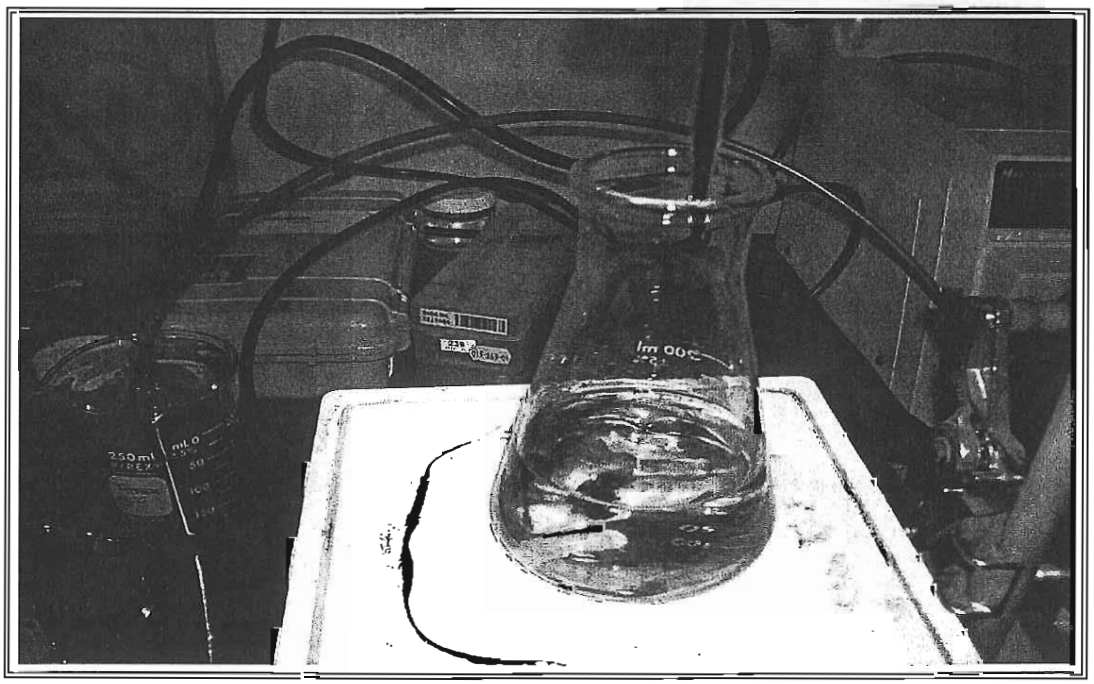
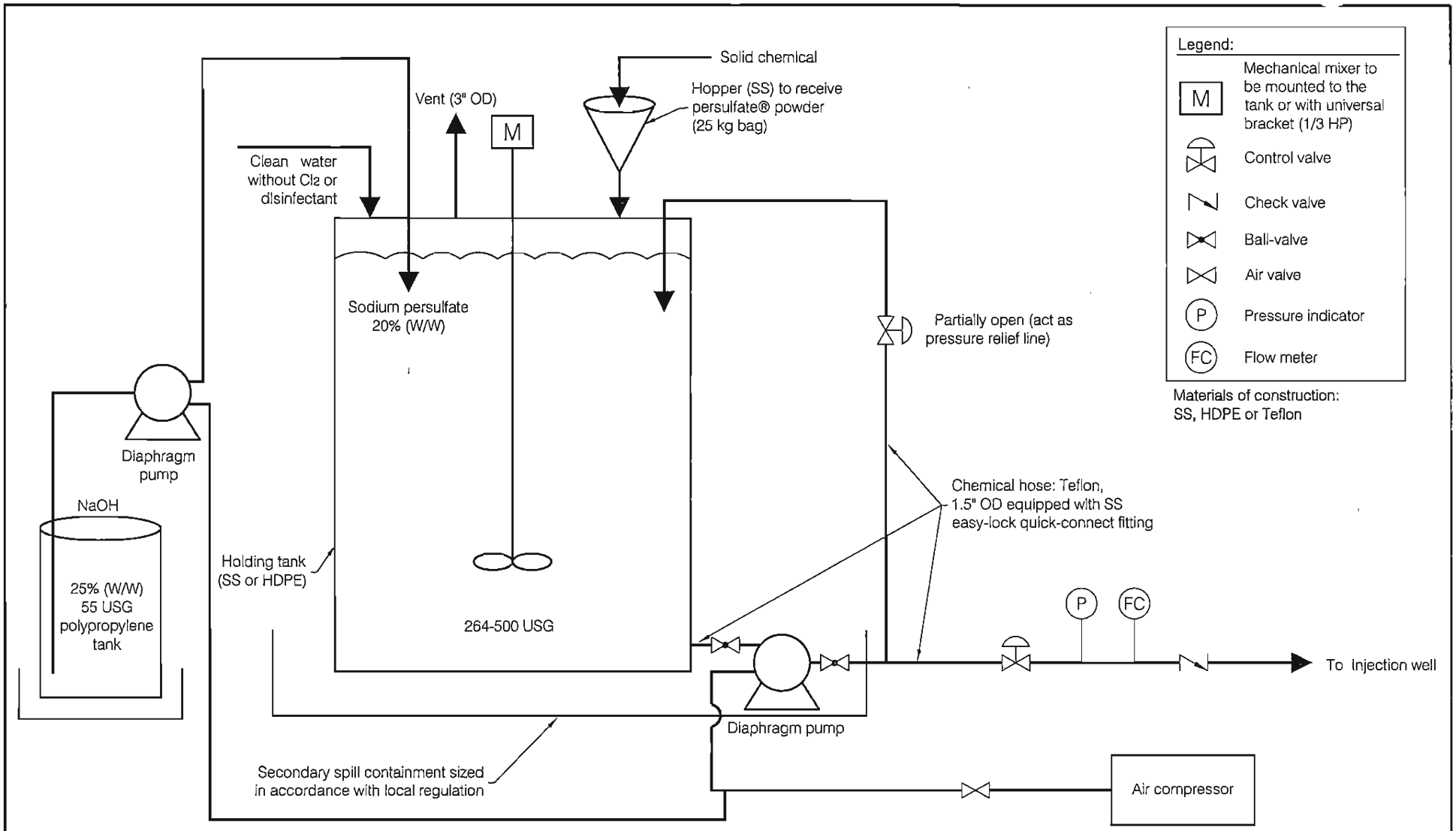


PHOTO 4: Turning Point Back Titration



APPENDIX D

Pilot-Scale Figure



Date:	*2010-05-21*	Scale:	*Not to scale*
Drawn by:	*S. Betnesky*	Planned by:	*P. Thériault*
Checked by:	*É. Bergeron*	Approved by:	*É. Bergeron*
Drawing no:	*0912233026-01*	Project no:	*09-1223-3026*

TREATMENT OF VOCs IMPACTED GROUNDWATER USING ACTIVATED PERSULFATE AT 218 PATERSON PLANK ROAD NPL SITE, CARLSTADT, NEW JERSEY

CONFIDENTIAL

Golder Associates
9200, l'Acadie Blvd., Suite 10
Montréal (Québec) H4N 2T2
Tel.: (514) 383-0990 Fax: (514) 383-5332

ISCO SCHEMATIC INJECTION SYSTEM

FIGURE 1

APPENDIX E

Maxxam Certificates

Attention: Eric Bergeron
Golder Associates Ltd
9200 Boul L'Acadie
Bureau 10
Montreal, PQ
H4N 2T2

Report Date: 2010/01/04

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: A9H3308
Received: 2009/12/23, 13:19

Sample Matrix: Water
Samples Received: 1

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Method Reference
1,4-Dioxane in water (1)	1	N/A	2010/01/04	CAM SOP-00226	EPA 8260 modified
Volatile Organic Compounds in Water	1	N/A	2009/12/30	CAM SOP-00226	EPA 8260 modified
Non-Routine Volatile Organic Compounds	1	N/A	2009/12/29	CAM SOP-00226	EPA 8260 modified

* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.
* Results relate only to the items tested.

(1) Sample(s) analyzed using methodologies that have been subjected to Maxxam's standard validation process for the submitted matrix however is not an Accredited method.

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.

CHRISTINE MCLEAN, Project Manager
Email: christine.mclean@maxxamanalytics.com
Phone# (905) 817-5700

==========

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. SCC and CALA have approved this reporting process and electronic report format.

For Service Group specific validation please refer to the Validation Signature Page

Total cover pages: 1

R2-0001507

Golder Associates Ltd

Maxxam Job #: A9H3308
Report Date: 2010/01/04

VOLATILE ORGANICS BY GC/MS (WATER)

Maxxam ID		ES7422	ES7422		
	Units	SAMPLE #5	SAMPLE #5 Lab-Dup	RDL	QC Batch
Volatile Organics					
1,2,3-Trichlorobenzene	ug/L	<5	<5	5	2044392
1,2,4-Trichlorobenzene	ug/L	<5	<5	5	2044392
1,4-Dioxane	ug/L	1600		200	2044991
Acetone (2-Propanone)	ug/L	<100	<100	100	2044386
Dichlorodifluoromethane (FREON 12)	ug/L	<10	<10	10	2044392
Benzene	ug/L	67	68	1	2044386
Bromodichloromethane	ug/L	<1	<1	1	2044386
Bromoform	ug/L	<2	<2	2	2044386
Bromomethane	ug/L	<5	<5	5	2044386
Carbon Tetrachloride	ug/L	<1	<1	1	2044386
Chlorobenzene	ug/L	<1	<1	1	2044386
Chloroform	ug/L	<1	<1	1	2044386
Dibromochloromethane	ug/L	<2	<2	2	2044386
1,2-Dichlorobenzene	ug/L	<2	<2	2	2044386
Methyl Acetate	ug/L	<10	<10	10	2044392
1,1,2-Trichlorotrifluoroethane	ug/L	<2	<2	2	2044392
1,3-Dichlorobenzene	ug/L	<2	<2	2	2044386
1,4-Dichlorobenzene	ug/L	<2	<2	2	2044386
Carbon Disulfide	ug/L	<5	<5	5	2044392
1,1-Dichloroethane	ug/L	40	41	1	2044386
1,2-Dichloroethane	ug/L	<3(1)	<3	3	2044386
1,1-Dichloroethylene	ug/L	<1	<1	1	2044386
cis-1,2-Dichloroethylene	ug/L	2	2	1	2044386
trans-1,2-Dichloroethylene	ug/L	<1	<1	1	2044386
1,2-Dichloropropane	ug/L	<1	<1	1	2044386
cis-1,3-Dichloropropene	ug/L	<2	<2	2	2044386
trans-1,3-Dichloropropene	ug/L	<2	<2	2	2044386
Ethylbenzene	ug/L	1	2	1	2044386
Ethylene Dibromide	ug/L	<2	<2	2	2044386
Cyclohexane	ug/L	<5	<5	5	2044392
Methylene Chloride(Dichloromethane)	ug/L	<5	<5	5	2044386
Methyl Isobutyl Ketone	ug/L	<50	<50	50	2044386
Methyl Ethyl Ketone (2-Butanone)	ug/L	<50	<50	50	2044386
Methyl t-butyl ether (MTBE)	ug/L	<2	<2	2	2044386
Styrene	ug/L	<2	<2	2	2044386

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
(1) - Detection limit for 1,2-dichloroethane was raised due to interference from coeluting benzene.

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R2-0001508

Golder Associates Ltd

Maxxam Job #: A9H3308
Report Date: 2010/01/04

VOLATILE ORGANICS BY GC/MS (WATER)

Maxxam ID		ES7422	ES7422		
	Units	SAMPLE #5	SAMPLE #5 Lab-Dup	RDL	QC Batch
1,1,1,2-Tetrachloroethane	ug/L	<1	<1	1	2044386
1,1,2,2-Tetrachloroethane	ug/L	<2	<2	2	2044386
Tetrachloroethylene	ug/L	<1	<1	1	2044386
Toluene	ug/L	<2	<2	2	2044386
1,1,1-Trichloroethane	ug/L	<1	<1	1	2044386
1,1,2-Trichloroethane	ug/L	<2	<2	2	2044386
Trichloroethylene	ug/L	5	5	1	2044386
Vinyl Chloride	ug/L	3	3	2	2044386
p+m-Xylene	ug/L	<1	<1	1	2044386
o-Xylene	ug/L	<1	<1	1	2044386
Xylene (Total)	ug/L	<1	<1	1	2044386
Methyl Butyl Ketone (2-Hexanone)	ug/L	<50	<50	50	2044392
Chloroethane	ug/L	61	62	2	2044386
Chloromethane	ug/L	<5	<5	5	2044386
Trichlorofluoromethane (FREON 11)	ug/L	<2	<2	2	2044386
Surrogate Recovery (%)					
4-Bromofluorobenzene	%	85	85		2044386
D4-1,2-Dichloroethane	%	85	87		2044386
D6-Benzene	%	118			2044991
D8-Toluene	%	105	105		2044386

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

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R2-0001509

Golder Associates Ltd

Maxxam Job #: A9H3308
Report Date: 2010/01/04

GENERAL COMMENTS

Sample ES7422-01: VOC Analysis: Due to high concentrations of target analytes, sample required dilution. Detection limits were adjusted accordingly.

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R2-0001510

Golder Associates Ltd

Maxxam Job #: A9H3308
Report Date: 2010/01/04

QUALITY ASSURANCE REPORT

			Matrix Spike		Spiked Blank		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	Units	Value (%)	QC Limits
2044386	4-Bromofluorobenzene	2009/12/29	96	70 - 130	94	70 - 130	86	%		
2044386	D4-1,2-Dichloroethane	2009/12/29	89	70 - 130	89	70 - 130	91	%		
2044386	D8-Toluene	2009/12/29	105	70 - 130	104	70 - 130	105	%		
2044386	Acetone (2-Propanone)	2009/12/30	93	60 - 140	90	60 - 140	<10	ug/L	NC	40
2044386	Benzene	2009/12/30	NC(1)	70 - 130	102	70 - 130	<0.1	ug/L	1.2	40
2044386	Bromodichloromethane	2009/12/30	93	70 - 130	89	70 - 130	<0.1	ug/L	NC	40
2044386	Bromoform	2009/12/30	80	70 - 130	72	70 - 130	<0.2	ug/L	NC	40
2044386	Bromomethane	2009/12/30	117	60 - 140	115	60 - 140	<0.5	ug/L	NC	40
2044386	Carbon Tetrachloride	2009/12/30	95	70 - 130	84	70 - 130	<0.1	ug/L	NC	40
2044386	Chlorobenzene	2009/12/30	102	70 - 130	96	70 - 130	<0.1	ug/L	NC	40
2044386	Chloroform	2009/12/30	95	70 - 130	93	70 - 130	<0.1	ug/L	NC	40
2044386	Dibromochloromethane	2009/12/30	99	70 - 130	91	70 - 130	<0.2	ug/L	NC	40
2044386	1,2-Dichlorobenzene	2009/12/30	99	70 - 130	93	70 - 130	<0.2	ug/L	NC	40
2044386	1,3-Dichlorobenzene	2009/12/30	105	70 - 130	97	70 - 130	<0.2	ug/L	NC	40
2044386	1,4-Dichlorobenzene	2009/12/30	106	70 - 130	97	70 - 130	<0.2	ug/L	NC	40
2044386	1,1-Dichloroethane	2009/12/30	103	70 - 130	98	70 - 130	<0.1	ug/L	2.0	40
2044386	1,2-Dichloroethane	2009/12/30	91	70 - 130	91	70 - 130	<0.2	ug/L	NC	40
2044386	1,1-Dichloroethylene	2009/12/30	106	70 - 130	104	70 - 130	<0.1	ug/L	NC	40
2044386	cis-1,2-Dichloroethylene	2009/12/30	105	70 - 130	100	70 - 130	<0.1	ug/L	NC	40
2044386	trans-1,2-Dichloroethylene	2009/12/30	106	70 - 130	102	70 - 130	<0.1	ug/L	NC	40
2044386	1,2-Dichloropropane	2009/12/30	112	70 - 130	109	70 - 130	<0.1	ug/L	NC	40
2044386	cis-1,3-Dichloropropene	2009/12/30	100	70 - 130	92	70 - 130	<0.2	ug/L	NC	40
2044386	trans-1,3-Dichloropropene	2009/12/30	99	70 - 130	90	70 - 130	<0.2	ug/L	NC	40
2044386	Ethylbenzene	2009/12/30	110	70 - 130	103	70 - 130	<0.1	ug/L	NC	40
2044386	Ethylene Dibromide	2009/12/30	103	70 - 130	98	70 - 130	<0.2	ug/L	NC	40
2044386	Methylene Chloride(Dichloromethane)	2009/12/30	108	70 - 130	103	70 - 130	<0.5	ug/L	NC	40
2044386	Methyl Isobutyl Ketone	2009/12/30	105	70 - 130	102	70 - 130	<5	ug/L	NC	40
2044386	Methyl Ethyl Ketone (2-Butanone)	2009/12/30	99	60 - 140	95	60 - 140	<5	ug/L	NC	40
2044386	Methyl t-butyl ether (MTBE)	2009/12/30	96	70 - 130	88	70 - 130	<0.2	ug/L	NC	40
2044386	Styrene	2009/12/30	116	70 - 130	109	70 - 130	<0.2	ug/L	NC	40
2044386	1,1,1,2-Tetrachloroethane	2009/12/30	98	70 - 130	90	70 - 130	<0.1	ug/L	NC	40
2044386	1,1,2,2-Tetrachloroethane	2009/12/30	102	70 - 130	96	70 - 130	<0.2	ug/L	NC	40
2044386	Tetrachloroethylene	2009/12/30	100	70 - 130	92	70 - 130	<0.1	ug/L	NC	40
2044386	Toluene	2009/12/30	112	70 - 130	102	70 - 130	<0.2	ug/L	NC	40
2044386	1,1,1-Trichloroethane	2009/12/30	89	70 - 130	82	70 - 130	<0.1	ug/L	NC	40
2044386	1,1,2-Trichloroethane	2009/12/30	100	70 - 130	95	70 - 130	<0.2	ug/L	NC	40
2044386	Trichloroethylene	2009/12/30	95	70 - 130	90	70 - 130	<0.1	ug/L	NC	40
2044386	Vinyl Chloride	2009/12/30	99	70 - 130	94	70 - 130	<0.2	ug/L	NC	40
2044386	p+m-Xylene	2009/12/30	107	70 - 130	99	70 - 130	<0.1	ug/L	NC	40
2044386	o-Xylene	2009/12/30	109	70 - 130	100	70 - 130	<0.1	ug/L	NC	40

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R2-0001511

Golder Associates Ltd

Maxxam Job #: A9H3308
Report Date: 2010/01/04

QUALITY ASSURANCE REPORT

			Matrix Spike		Spiked Blank		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	Units	Value (%)	QC Limits
2044386	Chloroethane	2009/12/30	101	70 - 130	101	70 - 130	<0.2	ug/L	0.8	40
2044386	Chloromethane	2009/12/30	97	60 - 140	89	60 - 140	<0.5	ug/L	NC	40
2044386	Trichlorofluoromethane (FREON 11)	2009/12/30	89	70 - 130	86	70 - 130	<0.2	ug/L	NC	40
2044386	Xylene (Total)	2009/12/30					<0.1	ug/L	NC	40
2044392	1,2,3-Trichlorobenzene	2009/12/29	79	70 - 130	72	70 - 130	<0.5	ug/L	NC	40
2044392	1,2,4-Trichlorobenzene	2009/12/29	76	70 - 130	71	70 - 130	<0.5	ug/L	NC	40
2044392	Dichlorodifluoromethane (FREON 12)	2009/12/29	77	60 - 140	72	60 - 140	<1	ug/L	NC	40
2044392	Methyl Acetate	2009/12/29	107	60 - 140	113	60 - 140	<1	ug/L	NC	40
2044392	1,1,2-Trichlorotrifluoroethane	2009/12/29	96	60 - 140	98	60 - 140	<0.2	ug/L	NC	40
2044392	Carbon Disulfide	2009/12/29	108	60 - 140	111	60 - 140	<0.5	ug/L	NC	40
2044392	Cyclohexane	2009/12/29	108	60 - 140	108	60 - 140	<0.5	ug/L	NC	40
2044392	Methyl Butyl Ketone (2-Hexanone)	2009/12/29	103	60 - 140	97	60 - 140	<5	ug/L	NC	40
2044991	D6-Benzene	2010/01/04	115	60 - 140	106	60 - 140	102	%		
2044991	1,4-Dioxane	2010/01/04	NC(1)	60 - 140	111	60 - 140	<20	ug/L	NC	40

N/A = Not Applicable
RPD = Relative Percent Difference
Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.
Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.
Spiked Blank: A blank matrix to which a known amount of the analyte has been added. Used to evaluate analyte recovery.
Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.
Surrogate: A pure or isotopically labeled compound whose behavior mirrors the analytes of interest. Used to evaluate extraction efficiency.
NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spiked amount was not sufficiently significant to permit a reliable recovery calculation.
NC (RPD): The RPD was not calculated. The level of analyte detected in the parent sample and its duplicate was not sufficiently significant to permit a reliable calculation.
(1) - The recovery in the matrix spike was not calculated (NC). Because of the high concentration of this analyte in the parent sample, the relative difference between the spiked and unspiked concentrations is not sufficiently significant to permit a reliable recovery calculation.

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R2-0001512

Validation Signature Page

Maxxam Job #: A9H3308

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

CRISTINA CARRIERE, Scientific Services

TROY CARRIERE, B.Sc., C.Chem, Scientific Specialist

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. SCC and CALA have approved this reporting process and electronic report format.

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Votre # du projet: 09-1223-3026
Chantier:ISCO-NY
Votre # Bordereau: E782215

Attention: Pénéloppe Thériault
GOLDER ASSOCIES LTEE
Montreal
9200, boul. l'Acadie
bureau 10
Montréal, PQ
Canada H4N 2T2

Date du rapport: 2010/01/13

CERTIFICAT D'ANALYSES

 # DE DOSSIER MAXXAM: B001390
Reçu: 2010/01/12, 12:40

Matrice: EAU SOUTERRAINE
Nombre d'échantillons reçus: 1

Analyses	Quantité	Date de l' extraction	Date Analysé	Méthode de laboratoire	Méthode d'analyse
Métaux par ICPMS	1	2010/01/12	2010/01/13	STL SOP-00006/7	MA.200- Mét 1.1

clé de cryptage

Veuillez adresser toute question concernant ce certificat d'analyse à votre chargé(e) de projets

LEILA SABOURI, B. Sc., Biochimiste, Chargée de projets
Email: leila.sabouri@maxxamanalytics.com
Phone# (514) 448-9001 Ext:4227

==========

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Veuillez vous référer à la page des signatures de validation pour le détail des validations par département.

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R2-0001514

Dossier Maxxam: B001390
Date du rapport: 2010/01/13

GOLDER ASSOCIES LTEE
Votre # du projet: 09-1223-3026
Nom de projet: ISCO-NY
Initiales du préleveur: PT

MÉTAUX (EAU SOUTERRAINE)

ID Maxxam		J64032		
Date d'échantillonnage		2010/01/12		
# Bordereau		E782215		
	Unités	**TEST-FE**	**LDR**	**Lot CQ**
MÉTAUX				
Fer (Fe)	ug/L	20000	100	722472

LDR = Limite de détection rapportée
Lot CQ = Lot contrôle qualité

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Dossier Maxxam: B001390
Date du rapport: 2010/01/13

GOLDER ASSOCIES LTEE
Votre # du projet: 09-1223-3026
Nom de projet: ISCO-NY
Initiales du préleveur: PT

REMARQUES GÉNÉRALES

État des échantillons à l'arrivée:
Métaux par ICPMS: Arrivé sans préservatif, préservé à l'arrivée au laboratoire.: J64032

MÉTAUX (EAU SOUTERRAINE)

Veuillez noter que les résultats n'ont pas été corrigés ni pour la récupération des échantillons de contrôle qualité, ni pour le blanc de méthode.

Les résultats s'appliquent seulement pour les paramètres analysés.

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R2-0001516

GOLDER ASSOCIES LTEE
Attention: Pénéloppe Thériault
Votre # du projet: 09-1223-3026
P.O. #:
Nom de projet: ISCO-NY

Rapport Assurance Qualité

Dossier Maxxam: B001390

Lot AQ/CQ Num Init	Type CQ	Paramètre	Date Analysé aaaa/mm/jj	Valeur	Réc	Unités
722472 SC5	Blanc fortifié	Fer (Fe)	2010/01/13		94	%
	Blanc de méthode	Fer (Fe)	2010/01/13	ND, LDR=100		ug/L

Blanc fortifié: Blanc auquel a été ajouté une quantité connue d'un ou de plusieurs composés chimiques d'intérêts. Sert à évaluer la récupération des composés d'intérêts.
Blanc de méthode: Une partie aliquote de matrice pure soumise au même processus analytique que les échantillons, du prétraitement au dosage. Sert à évaluer toutes contaminations du laboratoire.
LDR = Limite de détection rapportée
Réc = Récupération

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Page des signatures de validation

Dossier Maxxam: B001390

Les résultats analytiques ainsi que les données de contrôle-qualité contenus dans ce rapport furent vérifiés et validés par les personnes suivantes:

Marie-Claude Lauzier

CHIMISTE Marie-Claude Lauzier 2003-110 QUÉBEC

MARIE-CLAUDE LAUZIER, B.Sc., chimiste, Analyste 2

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MaXXam Analytique

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www.maxxamanalytics.com

Page ____ de ____

E-782215

Info. Facturation	Info. Rapport (si différent de Facturation)
Compagnie : Golder	Compagnie :
Adresse : 9700 blv. Acadie, Mtl	Adresse :
Attention de : P. Thèriault	Attention de :
Téléphone : 514-383-0990	Téléphone :
Telecopieur :	Telecopieur :
Échantillonneur : P.T	Échantillonneur :

Je déclare par la présente comprendre et accepter les conditions et modalités de Maxxam telles que décrites au verso du présent formulaire.

No. de commande :

No. de cotation :

Projet / Site : ~~[illegible]~~ ISCo-NY

No. de projet : 09-1223-3026

Identification de l'échantillon (point de prélèvement)	Échantillon Type d'eau: Sol	Eau	Autre	Prélèvement (date / heure)	à filtrer	nombre de contenants	HP (C_{10}-C_{50})	H & G Min. ☐ H & G Tot. ☐	COV (EPA 624) ☐ BTEX ☐ HAM ☐	Phénols (GC/MS) ☐ Phénols (Color) ☐	HAP	BPC (Congénères) (GC-MS)	Métaux Lourds (Cd, Cr, Cu, Ni, Pb, Zn)	Métaux ICP politique - 13 élé.-sol** ☐ 16 élé. eau*** ☐	Mercure ☐ Sélénium-sol ☐ Autres	F ☐ Cl ☐ SO_4 ☐ NO_2 ☐ NO_3 ☐ NO_2+NO_3 ☐	NTK ☐ NH_3 ☐ P-Tot. ☐	pH ☐ Conductivité ☐ MES ☐	Sulfure (SH_2) ☐ Soufre (S-Tot.) ☐	CN-Tot. ☐ CN-Ox. ☐ CN Libre ☐	DBO_5 ☐ DCO ☐ Turbidité ☐ COT ☐	RDS ☐ RMD ☐	CUM ART. 10 ☐ ART. 11 ☐	Eau Potable : ORG. ☐ INOR. ☐ THM ☐	COLIF (Fec.) ☐ COLIF (Tot.) ☐ BHAA ☐	Explosif EPA 8095 ☐ EPA 8330 ☐	Autre (spécifier) :	Fer total		
Test-Fe	S			12/01	N	1																						X		

LÉGENDE : ** Métaux 13 éléments (Ag, As, Ba, Cd, Co, Cr, Cu, Sn, Mn, Mo, Ni, Pb, Zn).
*** Métaux 16 éléments (Al, Sb, Ag, As, Ba, Cd, Cr, Co, Cu, Mn, Mo, Ni, Pb, Se, Na, Zn).

Types d'eau : S = Souterraine P = Potable DL = Déchet liquide
Sur = Surface E = Eau usée C = Captage

Normes/Réglement Applicables : ____________ **(À remplir)**

Délais : ☒ 24h ☐ 48h ☐ 72h ☐ Régulier ☐ Date : ________

A moins d'être clairement identifié, tout échantillon d'eau reçu chez Maxxam sera considéré comme non-potable et ne sera pas soumis aux exigences du règlement sur la qualité de l'eau potable.

Condition générale à la réception : 7°7°6°C

Chaîne de responsabilité

Déssaisi par : Penelope Thèriault	Date : 12/01	Heure : 10hr	Reçu par : Golder Labo
Déssaisi par :	Date : 12/1/10	Heure : 12 25	Reçu par : [signature]
Nombre de glacières :	Température de réception : 10-01-12 12:40	[signature]	

Remarques : Ne pas filtrer échantillon malgré qu'il n'y ait pas d'agent de conservation.

Transport des échantillons : ☐ Par client ☐ Personnel MAXXAM ☐ Courrier (spécifier) :

2010/01/13 15:15

KEENVCOCFORMQ - 01/09 — BLANC : MAXXAM ANALYTIQUE INC — BLEU : FACTURATION — JAUNE : RETOURNER AU CLIENT AVEC RAPPORT FINAL — ROSE : CLIENT

R2-0001519

Your Project #: 09-1223-3026
Site: ISCO-NY
Your C.O.C. #: NONE

Attention: Eric Bergeron
Golder Associates Ltd
9200 Boul L'Acadie
Bureau 10
Montreal, PQ
H4N 2T2

Report Date: 2010/01/26

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B005461
Received: 2010/01/16, 09:52

Sample Matrix: Water
Samples Received: 6

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Method Reference
1,4-Dioxane in water (1)	6	N/A	2010/01/22	CAM SOP-00226	EPA 8260 modified
Volatile Organic Compounds in Water	5	N/A	2010/01/22	CAM SOP-00226	EPA 8260 modified
Volatile Organic Compounds in Water	1	N/A	2010/01/25	CAM SOP-00226	EPA 8260 modified
Non-Routine Volatile Organic Compounds	6	N/A	2010/01/22	CAM SOP-00226	EPA 8260 modified

* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.
* Results relate only to the items tested.

(1) Sample(s) analyzed using methodologies that have been subjected to Maxxam's standard validation process for the submitted matrix however is not an Accredited method.

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.

CHRISTINE MCLEAN, Project Manager
Email: christine.mclean@maxxamanalytics.com
Phone# (905) 817-5700

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Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. SCC and CALA have approved this reporting process and electronic report format.

For Service Group specific validation please refer to the Validation Signature Page

Total cover pages: 1

R2-0001520

Maxxam Job #: B005461
Report Date: 2010/01/26

Golder Associates Ltd
Client Project #: 09-1223-3026
Project name: ISCO-NY

VOLATILE ORGANICS BY GC/MS (WATER)

Maxxam ID		EW0739		EW0740		EW0741		
	Units	CO-A1D1-T1	RDL	CO-A1D2-T1	RDL	CO-A1D3-T1	RDL	QC Batch
Volatile Organics								
1,2,3-Trichlorobenzene	ug/L	<3	3	<5	5	<1	1	2059091
1,2,4-Trichlorobenzene	ug/L	<3	3	<5	5	<1	1	2059091
1,4-Dioxane	ug/L	1200	100	1600	200	1300	200	2059092
Acetone (2-Propanone)	ug/L	<50	50	<100	100	<20	20	2059090
Benzene	ug/L	36	0.5	55	1	48(1)	0.2	2059090
Bromodichloromethane	ug/L	<0.5	0.5	<1	1	<0.2	0.2	2059090
Bromoform	ug/L	<1	1	<2	2	<0.4	0.4	2059090
Bromomethane	ug/L	<3	3	<5	5	<1	1	2059090
Carbon Tetrachloride	ug/L	<0.5	0.5	<1	1	<0.2	0.2	2059090
Chlorobenzene	ug/L	<0.5	0.5	<1	1	<0.2	0.2	2059090
Chloroform	ug/L	<0.5	0.5	<1	1	0.3	0.2	2059090
Dibromochloromethane	ug/L	<1	1	<2	2	<0.4	0.4	2059090
1,2-Dichlorobenzene	ug/L	<1	1	<2	2	<0.4	0.4	2059090
Methyl Acetate	ug/L	<5	5	<10	10	<2	2	2059091
1,1,2-Trichlorotrifluoroethane	ug/L	<1	1	<2	2	<0.4	0.4	2059091
1,3-Dichlorobenzene	ug/L	<1	1	<2	2	<0.4	0.4	2059090
1,4-Dichlorobenzene	ug/L	<1	1	<2	2	<0.4	0.4	2059090
Carbon Disulfide	ug/L	<3	3	<5	5	<1	1	2059091
Dichlorodifluoromethane (FREON 12)	ug/L	<3	3	<5	5	<1	1	2059090
1,1-Dichloroethane	ug/L	28	0.5	38	1	35	0.2	2059090
1,2-Dichloroethane	ug/L	<1	1	<2	2	<0.4	0.4	2059090
1,1-Dichloroethylene	ug/L	<0.5	0.5	<1	1	<0.2	0.2	2059090
cis-1,2-Dichloroethylene	ug/L	1.6	0.5	2	1	2.0	0.2	2059090
trans-1,2-Dichloroethylene	ug/L	<0.5	0.5	<1	1	0.3	0.2	2059090
1,2-Dichloropropane	ug/L	<0.5	0.5	<1	1	<0.2	0.2	2059090
cis-1,3-Dichloropropene	ug/L	<1	1	<2	2	<0.4	0.4	2059090
trans-1,3-Dichloropropene	ug/L	<1	1	<2	2	<0.4	0.4	2059090
Ethylbenzene	ug/L	<0.5	0.5	<1	1	0.6	0.2	2059090
Ethylene Dibromide	ug/L	<1	1	<2	2	<0.4	0.4	2059090
Cyclohexane	ug/L	<3	3	<5	5	2	1	2059091
Methylene Chloride(Dichloromethane)	ug/L	<3	3	<5	5	1	1	2059090
Methyl Isobutyl Ketone	ug/L	<30	30	<50	50	<10	10	2059090
Methyl Ethyl Ketone (2-Butanone)	ug/L	<30	30	<50	50	<10	10	2059090
Methyl t-butyl ether (MTBE)	ug/L	<1	1	<2	2	<0.4	0.4	2059090
Styrene	ug/L	<1	1	<2	2	<0.4	0.4	2059090

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
(1) - The result reported is beyond the appropriate range of the instrument. Therefore, this result should be viewed with discretion.

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R2-0001521

Maxxam Job #: B005461
Report Date: 2010/01/26

Golder Associates Ltd
Client Project #: 09-1223-3026
Project name: ISCO-NY

VOLATILE ORGANICS BY GC/MS (WATER)

Maxxam ID		EW0739		EW0740		EW0741		
	Units	CO-A1D1-T1	RDL	CO-A1D2-T1	RDL	CO-A1D3-T1	RDL	QC Batch
1,1,1,2-Tetrachloroethane	ug/L	<0.5	0.5	<1	1	<0.2	0.2	2059090
1,1,2,2-Tetrachloroethane	ug/L	<1	1	<2	2	<0.4	0.4	2059090
Tetrachloroethylene	ug/L	<0.5	0.5	<1	1	<0.2	0.2	2059090
Toluene	ug/L	<1	1	<2	2	0.8	0.4	2059090
1,1,1-Trichloroethane	ug/L	<0.5	0.5	<1	1	<0.2	0.2	2059090
1,1,2-Trichloroethane	ug/L	<1	1	<2	2	<0.4	0.4	2059090
Trichloroethylene	ug/L	3.6	0.5	5	1	4.7	0.2	2059090
Vinyl Chloride	ug/L	2	1	2	2	2.2	0.4	2059090
p+m-Xylene	ug/L	<0.5	0.5	<1	1	<0.2	0.2	2059090
o-Xylene	ug/L	<0.5	0.5	<1	1	0.3	0.2	2059090
Xylene (Total)	ug/L	<0.5	0.5	<1	1	0.3	0.2	2059090
Methyl Butyl Ketone (2-Hexanone)	ug/L	<30	30	<50	50	<10	10	2059091
Chloroethane	ug/L	40	1	50	2	48	0.4	2059090
Chloromethane	ug/L	<3	3	<5	5	<1	1	2059090
Trichlorofluoromethane (FREON 11)	ug/L	<1	1	<2	2	<0.4	0.4	2059090
Surrogate Recovery (%)								
4-Bromofluorobenzene	%	95		96		99		2059091
D4-1,2-Dichloroethane	%	89		92		90		2059090
D6-Benzene	%	129		112		121		2059092
D8-Toluene	%	101		100		98		2059090

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

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R2-0001522

Maxxam Job #: B005461
Report Date: 2010/01/26

Golder Associates Ltd
Client Project #: 09-1223-3026
Project name: ISCO-NY

VOLATILE ORGANICS BY GC/MS (WATER)

Maxxam ID		EW0743		EW0744	EW0745		EW0745		
	Units	CO-A2D1-T1	QC Batch	CO-A2D2-T1	CO-A2D3-T1	QC Batch	CO-A2D3-T1 Lab-Dup	RDL	QC Batch
Volatile Organics									
1,2,3-Trichlorobenzene	ug/L	<3	2059091	<3	<3	2059091	<3	3	2059091
1,2,4-Trichlorobenzene	ug/L	<3	2059091	<3	<3	2059091	<3	3	2059091
1,4-Dioxane	ug/L	1100	2059092	1100	1400	2059092	1500	100	2059092
Acetone (2-Propanone)	ug/L	<50	2059090	<50	<50	2059090	<50	50	2059090
Benzene	ug/L	21	2059090	15	40	2059090	48	0.5	2059090
Bromodichloromethane	ug/L	<0.5	2059090	<0.5	<0.5	2059090	<0.5	0.5	2059090
Bromoform	ug/L	<1	2059090	<1	<1	2059090	<1	1	2059090
Bromomethane	ug/L	<3	2059090	<3	<3	2059090	<3	3	2059090
Carbon Tetrachloride	ug/L	<0.5	2059090	<0.5	<0.5	2059090	<0.5	0.5	2059090
Chlorobenzene	ug/L	<0.5	2059090	<0.5	<0.5	2059090	<0.5	0.5	2059090
Chloroform	ug/L	<0.5	2059090	<0.5	<0.5	2059090	<0.5	0.5	2059090
Dibromochloromethane	ug/L	<1	2059090	<1	<1	2059090	<1	1	2059090
1,2-Dichlorobenzene	ug/L	<1	2059090	<1	<1	2059090	<1	1	2059090
Methyl Acetate	ug/L	<5	2059091	<5	<5	2059091	<5	5	2059091
1,1,2-Trichlorotrifluoroethane	ug/L	<1	2059091	<1	<1	2059091	<1	1	2059091
1,3-Dichlorobenzene	ug/L	<1	2059090	<1	<1	2059090	<1	1	2059090
1,4-Dichlorobenzene	ug/L	<1	2059090	<1	<1	2059090	<1	1	2059090
Carbon Disulfide	ug/L	<3	2059091	<3	<3	2059091	<3	3	2059091
Dichlorodifluoromethane (FREON 12)	ug/L	<3	2059090	<3	<3	2059090	<3	3	2059090
1,1-Dichloroethane	ug/L	28	2059090	29	33	2059090	36	0.5	2059090
1,2-Dichloroethane	ug/L	<1	2059090	<1	<1	2059090	<1	1	2059090
1,1-Dichloroethylene	ug/L	<0.5	2059090	<0.5	<0.5	2059090	<0.5	0.5	2059090
cis-1,2-Dichloroethylene	ug/L	1.5	2059090	1.6	1.8	2059090	2.0	0.5	2059090
trans-1,2-Dichloroethylene	ug/L	<0.5	2059090	<0.5	<0.5	2059090	<0.5	0.5	2059090
1,2-Dichloropropane	ug/L	<0.5	2059090	<0.5	<0.5	2059090	<0.5	0.5	2059090
cis-1,3-Dichloropropene	ug/L	<1	2059090	<1	<1	2059090	<1	1	2059090
trans-1,3-Dichloropropene	ug/L	<1	2059090	<1	<1	2059090	<1	1	2059090
Ethylbenzene	ug/L	<0.5	2059090	<0.5	<0.5	2059090	0.6	0.5	2059090
Ethylene Dibromide	ug/L	<1	2059090	<1	<1	2059090	<1	1	2059090
Cyclohexane	ug/L	<3	2059091	<3	<3	2059091	<3	3	2059091
Methylene Chloride(Dichloromethane)	ug/L	<3	2059090	<3	<3	2059090	<3	3	2059090
Methyl Isobutyl Ketone	ug/L	<30	2059090	<30	<30	2059090	<30	30	2059090
Methyl Ethyl Ketone (2-Butanone)	ug/L	<30	2059090	<30	<30	2059090	<30	30	2059090
Methyl t-butyl ether (MTBE)	ug/L	<1	2059090	<1	<1	2059090	<1	1	2059090
Styrene	ug/L	<1	2059090	<1	<1	2059090	<1	1	2059090

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

R2-0001523

Maxxam Job #: B005461
Report Date: 2010/01/26

Golder Associates Ltd
Client Project #: 09-1223-3026
Project name: ISCO-NY

VOLATILE ORGANICS BY GC/MS (WATER)

Maxxam ID		EW0743		EW0744	EW0745		EW0745		
	Units	CO-A2D1-T1	QC Batch	CO-A2D2-T1	CO-A2D3-T1	QC Batch	CO-A2D3-T1 Lab-Dup	RDL	QC Batch
1,1,1,2-Tetrachloroethane	ug/L	<0.5	2059090	<0.5	<0.5	2059090	<0.5	0.5	2059090
1,1,2,2-Tetrachloroethane	ug/L	<1	2059090	<1	<1	2059090	<1	1	2059090
Tetrachloroethylene	ug/L	<0.5	2059090	<0.5	<0.5	2059090	<0.5	0.5	2059090
Toluene	ug/L	<1	2059090	<1	<1	2059090	<1	1	2059090
1,1,1-Trichloroethane	ug/L	<0.5	2059090	<0.5	<0.5	2059090	<0.5	0.5	2059090
1,1,2-Trichloroethane	ug/L	<1	2059090	<1	<1	2059090	<1	1	2059090
Trichloroethylene	ug/L	3.5	2059090	3.4	4.1	2059090	4.6	0.5	2059090
Vinyl Chloride	ug/L	<1	2059090	2	2	2059090	2	1	2059090
p+m-Xylene	ug/L	<0.5	2059090	<0.5	<0.5	2059090	<0.5	0.5	2059090
o-Xylene	ug/L	<0.5	2059090	<0.5	<0.5	2059090	<0.5	0.5	2059090
Xylene (Total)	ug/L	<0.5	2059090	<0.5	<0.5	2059090	<0.5	0.5	2059090
Methyl Butyl Ketone (2-Hexanone)	ug/L	<30	2059091	<30	<30	2059091	<30	30	2059091
Chloroethane	ug/L	39	2059090	42	45	2059090	49	1	2059090
Chloromethane	ug/L	<3	2059090	<3	<3	2059090	<3	3	2059090
Trichlorofluoromethane (FREON 11)	ug/L	<1	2059090	<1	<1	2059090	<1	1	2059090
Surrogate Recovery (%)									
4-Bromofluorobenzene	%	97	2059091	97	96	2059091	97		2059091
D4-1,2-Dichloroethane	%	95	2059090	99	99	2059091	95		2059090
D6-Benzene	%	84	2059092	104	96	2059092	102		2059092
D8-Toluene	%	102	2059091	104	104	2059091	104		2059091

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

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R2-0001524

Maxxam Job #: B005461
Report Date: 2010/01/26

Golder Associates Ltd
Client Project #: 09-1223-3026
Project name: ISCO-NY

GENERAL COMMENTS

VOC Analysis: Due to high concentrations of target analytes, samples required dilution. Detection limits were adjusted accordingly.

Sample EW0741-01: VOC Analysis: The results for the analysis of duplicate vials show significantly different results for benzene. Since the differences for this compound were greater than that due to precision of the method, this appears to be due to differences in the contents of the vials.

Sample EW0744-01: VOC Analysis: The results for the analysis of duplicate vials show significantly different results for benzene. Since the differences for this compound were greater than that due to precision of the method, this appears to be due to differences in the contents of the vials.

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R2-0001525

Maxxam Job #: B005461
Report Date: 2010/01/26

Golder Associates Ltd
Client Project #: 09-1223-3026
Project name: ISCO-NY

QUALITY ASSURANCE REPORT

			Matrix Spike		Spiked Blank		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	Units	Value (%)	QC Limits
2059090	4-Bromofluorobenzene	2010/01/22	100	70 - 130	99	70 - 130	93	%		
2059090	D4-1,2-Dichloroethane	2010/01/22	88	70 - 130	88	70 - 130	88	%		
2059090	D8-Toluene	2010/01/22	101	70 - 130	102	70 - 130	101	%		
2059090	Acetone (2-Propanone)	2010/01/22	143(1, 2)	60 - 140	92	60 - 140	<10	ug/L	NC	40
2059090	Benzene	2010/01/22	NC(3)	70 - 130	99	70 - 130	<0.1	ug/L	18.6	40
2059090	Bromodichloromethane	2010/01/22	95	70 - 130	91	70 - 130	<0.1	ug/L	NC	40
2059090	Bromoform	2010/01/22	103	70 - 130	96	70 - 130	<0.2	ug/L	NC	40
2059090	Bromomethane	2010/01/22	84	60 - 140	76	60 - 140	<0.5	ug/L	NC	40
2059090	Carbon Tetrachloride	2010/01/22	102	70 - 130	98	70 - 130	<0.1	ug/L	NC	40
2059090	Chlorobenzene	2010/01/22	97	70 - 130	95	70 - 130	<0.1	ug/L	NC	40
2059090	Chloroform	2010/01/22	97	70 - 130	94	70 - 130	<0.1	ug/L	NC	40
2059090	Dibromochloromethane	2010/01/22	98	70 - 130	93	70 - 130	<0.2	ug/L	NC	40
2059090	1,2-Dichlorobenzene	2010/01/22	92	70 - 130	89	70 - 130	<0.2	ug/L	NC	40
2059090	1,3-Dichlorobenzene	2010/01/22	99	70 - 130	96	70 - 130	<0.2	ug/L	NC	40
2059090	1,4-Dichlorobenzene	2010/01/22	99	70 - 130	96	70 - 130	<0.2	ug/L	NC	40
2059090	Dichlorodifluoromethane (FREON 12)	2010/01/22	92	60 - 140	80	60 - 140	<0.5	ug/L	NC	40
2059090	1,1-Dichloroethane	2010/01/22	94	70 - 130	95	70 - 130	<0.1	ug/L	9.5	40
2059090	1,2-Dichloroethane	2010/01/22	91	70 - 130	87	70 - 130	<0.2	ug/L	NC	40
2059090	1,1-Dichloroethylene	2010/01/22	108	70 - 130	105	70 - 130	<0.1	ug/L	NC	40
2059090	cis-1,2-Dichloroethylene	2010/01/22	102	70 - 130	99	70 - 130	<0.1	ug/L	NC	40
2059090	trans-1,2-Dichloroethylene	2010/01/22	102	70 - 130	100	70 - 130	<0.1	ug/L	NC	40
2059090	1,2-Dichloropropane	2010/01/22	102	70 - 130	100	70 - 130	<0.1	ug/L	NC	40
2059090	cis-1,3-Dichloropropene	2010/01/22	104	70 - 130	101	70 - 130	<0.2	ug/L	NC	40
2059090	trans-1,3-Dichloropropene	2010/01/22	97	70 - 130	93	70 - 130	<0.2	ug/L	NC	40
2059090	Ethylbenzene	2010/01/22	106	70 - 130	105	70 - 130	<0.1	ug/L	NC	40
2059090	Ethylene Dibromide	2010/01/22	98	70 - 130	94	70 - 130	<0.2	ug/L	NC	40
2059090	Methylene Chloride(Dichloromethane)	2010/01/22	96	70 - 130	92	70 - 130	<0.5	ug/L	NC	40
2059090	Methyl Isobutyl Ketone	2010/01/22	107	70 - 130	92	70 - 130	<5	ug/L	NC	40
2059090	Methyl Ethyl Ketone (2-Butanone)	2010/01/22	128	60 - 140	90	60 - 140	<5	ug/L	NC	40
2059090	Methyl t-butyl ether (MTBE)	2010/01/22	100	70 - 130	94	70 - 130	<0.2	ug/L	NC	40
2059090	Styrene	2010/01/22	93	70 - 130	93	70 - 130	<0.2	ug/L	NC	40
2059090	1,1,1,2-Tetrachloroethane	2010/01/22	97	70 - 130	93	70 - 130	<0.1	ug/L	NC	40
2059090	1,1,2,2-Tetrachloroethane	2010/01/22	91	70 - 130	88	70 - 130	<0.2	ug/L	NC	40
2059090	Tetrachloroethylene	2010/01/22	100	70 - 130	97	70 - 130	<0.1	ug/L	NC	40
2059090	Toluene	2010/01/22	99	70 - 130	99	70 - 130	<0.2	ug/L	NC	40
2059090	1,1,1-Trichloroethane	2010/01/22	98	70 - 130	94	70 - 130	<0.1	ug/L	NC	40
2059090	1,1,2-Trichloroethane	2010/01/22	91	70 - 130	88	70 - 130	<0.2	ug/L	NC	40
2059090	Trichloroethylene	2010/01/22	102	70 - 130	97	70 - 130	<0.1	ug/L	11.5	40
2059090	Vinyl Chloride	2010/01/22	90	70 - 130	88	70 - 130	<0.2	ug/L	NC	40
2059090	p+m-Xylene	2010/01/22	105	70 - 130	104	70 - 130	<0.1	ug/L	NC	40

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R2-0001526

Maxxam Job #: B005461
Report Date: 2010/01/26

Golder Associates Ltd
Client Project #: 09-1223-3026
Project name: ISCO-NY

QUALITY ASSURANCE REPORT

			Matrix Spike		Spiked Blank		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	Units	Value (%)	QC Limits
2059090	o-Xylene	2010/01/22	105	70 - 130	104	70 - 130	<0.1	ug/L	NC	40
2059090	Chloroethane	2010/01/22	77	70 - 130	91	70 - 130	<0.2	ug/L	8.6	40
2059090	Chloromethane	2010/01/22	88	60 - 140	81	60 - 140	<0.5	ug/L	NC	40
2059090	Trichlorofluoromethane (FREON 11)	2010/01/22	92	70 - 130	90	70 - 130	<0.2	ug/L	NC	40
2059090	Xylene (Total)	2010/01/22					<0.1	ug/L	NC	40
2059091	4-Bromofluorobenzene	2010/01/22	104	70 - 130	102	70 - 130	99	%		
2059091	D4-1,2-Dichloroethane	2010/01/22	97	70 - 130	100	70 - 130	100	%		
2059091	D8-Toluene	2010/01/22	99	70 - 130	100	70 - 130	101	%		
2059091	1,2,3-Trichlorobenzene	2010/01/22	97	70 - 130	99	70 - 130	<0.5	ug/L	NC	40
2059091	1,2,4-Trichlorobenzene	2010/01/22	95	70 - 130	97	70 - 130	<0.5	ug/L	NC	40
2059091	Methyl Acetate	2010/01/22	111	60 - 140	106	60 - 140	<1	ug/L	NC	40
2059091	1,1,2-Trichlorotrifluoroethane	2010/01/22	101	60 - 140	92	60 - 140	<0.2	ug/L	NC	40
2059091	Carbon Disulfide	2010/01/22	99	60 - 140	98	60 - 140	<0.5	ug/L	NC	40
2059091	Cyclohexane	2010/01/22	115	60 - 140	103	60 - 140	<0.5	ug/L	NC	40
2059091	Methyl Butyl Ketone (2-Hexanone)	2010/01/22			80	60 - 140	<5	ug/L	NC	40
2059092	D6-Benzene	2010/01/22	122	60 - 140	95	60 - 140	96	%		
2059092	1,4-Dioxane	2010/01/22	118	60 - 140	124	60 - 140	<20	ug/L	6.3	40

N/A = Not Applicable
RPD = Relative Percent Difference
Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.
Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.
Spiked Blank: A blank matrix to which a known amount of the analyte has been added. Used to evaluate analyte recovery.
Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.
Surrogate: A pure or isotopically labeled compound whose behavior mirrors the analytes of interest. Used to evaluate extraction efficiency.
NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spiked amount was not sufficiently significant to permit a reliable recovery calculation.
NC (RPD): The RPD was not calculated. The level of analyte detected in the parent sample and its duplicate was not sufficiently significant to permit a reliable calculation.
(1) - Recovery or RPD for this parameter is outside control limits. The overall quality control for this analysis meets acceptability criteria.
(2) - The recovery was above the upper control limit. This may represent a high bias in some results for this specific analyte. For results that were not detected (ND), this potential bias has no impact.
(3) - The recovery in the matrix spike was not calculated (NC). Spiked concentration was less than 2x that native to the sample.

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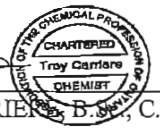
R2-0001527

Validation Signature Page

Maxxam Job #: B005461

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).



TROY CARRIERE, B.Sc., C.Chem, Scientific Specialist

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. SCC and CALA have approved this reporting process and electronic report format.

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Your Project #: 09-1223-3026
Site: ISCO-NY
Your C.O.C. #: E786249, E-786249

Attention: Eric Bergeron
Golder Associates Ltd
9200 Boul L'Acadie
Bureau 10
Montreal, PQ
H4N 2T2

Report Date: 2010/01/27

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B006190
Received: 2010/01/19, 09:09

Sample Matrix: Water
Samples Received: 1

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Method Reference
1,4-Dioxane in water (1)	1	N/A	2010/01/22	CAM SOP-00226	EPA 8260 modified
Volatile Organic Compounds in Water	1	N/A	2010/01/25	CAM SOP-00226	EPA 8260 modified
Non-Routine Volatile Organic Compounds	1	N/A	2010/01/22	CAM SOP-00226	EPA 8260 modified

* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.
* Results relate only to the items tested.

(1) Sample(s) analyzed using methodologies that have been subjected to Maxxam's standard validation process for the submitted matrix however is not an Accredited method.

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.

CHRISTINE MCLEAN, Project Manager
Email: christine.mclean@maxxamanalytics.com
Phone# (905) 817-5700

==========

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. SCC and CALA have approved this reporting process and electronic report format.

For Service Group specific validation please refer to the Validation Signature Page

Total cover pages: 1

R2-0001529

Maxxam Job #: B006190
Report Date: 2010/01/27

Golder Associates Ltd
Client Project #: 09-1223-3026
Project name: ISCO-NY

VOLATILE ORGANICS BY GC/MS (WATER)

Maxxam ID		EW4495		
Sampling Date		2010/01/14		
	Units	CO-C-T1	RDL	QC Batch
Volatile Organics				
1,2,3-Trichlorobenzene	ug/L	<1	1	2059091
1,2,4-Trichlorobenzene	ug/L	<1	1	2059091
1,4-Dioxane	ug/L	1000	50	2059092
Acetone (2-Propanone)	ug/L	<30	30	2059090
Benzene	ug/L	31	0.3	2059090
Bromodichloromethane	ug/L	<0.3	0.3	2059090
Bromoform	ug/L	<0.5	0.5	2059090
Bromomethane	ug/L	<1	1	2059090
Carbon Tetrachloride	ug/L	<0.3	0.3	2059090
Chlorobenzene	ug/L	<0.3	0.3	2059090
Chloroform	ug/L	<0.3	0.3	2059090
Dibromochloromethane	ug/L	<0.5	0.5	2059090
1,2-Dichlorobenzene	ug/L	<0.5	0.5	2059090
Methyl Acetate	ug/L	<3	3	2059091
1,1,2-Trichlorotrifluoroethane	ug/L	<0.5	0.5	2059091
1,3-Dichlorobenzene	ug/L	<0.5	0.5	2059090
1,4-Dichlorobenzene	ug/L	<0.5	0.5	2059090
Carbon Disulfide	ug/L	<1	1	2059091
Dichlorodifluoromethane (FREON 12)	ug/L	<1	1	2059090
1,1-Dichloroethane	ug/L	28	0.3	2059090
1,2-Dichloroethane	ug/L	<0.5	0.5	2059090
1,1-Dichloroethylene	ug/L	<0.3	0.3	2059090
cis-1,2-Dichloroethylene	ug/L	1.6	0.3	2059090
trans-1,2-Dichloroethylene	ug/L	<0.3	0.3	2059090
1,2-Dichloropropane	ug/L	<0.3	0.3	2059090
cis-1,3-Dichloropropene	ug/L	<0.5	0.5	2059090
trans-1,3-Dichloropropene	ug/L	<0.5	0.5	2059090
Ethylbenzene	ug/L	<0.3	0.3	2059090
Ethylene Dibromide	ug/L	<0.5	0.5	2059090
Cyclohexane	ug/L	<1	1	2059091
Methylene Chloride(Dichloromethane)	ug/L	<1	1	2059090
Methyl Isobutyl Ketone	ug/L	<10	10	2059090
Methyl Ethyl Ketone (2-Butanone)	ug/L	<10	10	2059090
Methyl t-butyl ether (MTBE)	ug/L	<0.5	0.5	2059090
Styrene	ug/L	<0.5	0.5	2059090

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

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R2-0001530

Maxxam Job #: B006190
Report Date: 2010/01/27

Golder Associates Ltd
Client Project #: 09-1223-3026
Project name: ISCO-NY

VOLATILE ORGANICS BY GC/MS (WATER)

Maxxam ID		EW4495		
Sampling Date		2010/01/14		
	Units	**CO-C-T1**	**RDL**	**QC Batch**
1,1,1,2-Tetrachloroethane	ug/L	<0.3	0.3	2059090
1,1,2,2-Tetrachloroethane	ug/L	<0.5	0.5	2059090
Tetrachloroethylene	ug/L	<0.3	0.3	2059090
Toluene	ug/L	<0.5	0.5	2059090
1,1,1-Trichloroethane	ug/L	<0.3	0.3	2059090
1,1,2-Trichloroethane	ug/L	<0.5	0.5	2059090
Trichloroethylene	ug/L	3.6	0.3	2059090
Vinyl Chloride	ug/L	1.6	0.5	2059090
p+m-Xylene	ug/L	<0.3	0.3	2059090
o-Xylene	ug/L	<0.3	0.3	2059090
Xylene (Total)	ug/L	<0.3	0.3	2059090
Methyl Butyl Ketone (2-Hexanone)	ug/L	<10	10	2059091
Surrogate Recovery (%)				
4-Bromofluorobenzene	%	97		2059091
D4-1,2-Dichloroethane	%	92		2059090
D6-Benzene	%	107		2059092
D8-Toluene	%	101		2059090

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

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R2-0001531

Maxxam Job #: B006190
Report Date: 2010/01/27

Golder Associates Ltd
Client Project #: 09-1223-3026
Project name: ISCO-NY

GENERAL COMMENTS

Sample EW4495-01: VOC Analysis: Due to high concentrations of target analytes, sample required dilution. Detection limits were adjusted accordingly.

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R2-0001532

Maxxam Job #: B006190
Report Date: 2010/01/27

Golder Associates Ltd
Client Project #: 09-1223-3026
Project name: ISCO-NY

QUALITY ASSURANCE REPORT

			Matrix Spike		Spiked Blank		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	Units	Value (%)	QC Limits
2059090	4-Bromofluorobenzene	2010/01/22	100	70 - 130	99	70 - 130	93	%		
2059090	D4-1,2-Dichloroethane	2010/01/22	88	70 - 130	88	70 - 130	88	%		
2059090	D8-Toluene	2010/01/22	101	70 - 130	102	70 - 130	101	%		
2059090	Acetone (2-Propanone)	2010/01/22	143(1, 2)	60 - 140	92	60 - 140	<10	ug/L	NC	40
2059090	Benzene	2010/01/22	NC(3)	70 - 130	99	70 - 130	<0.1	ug/L	18.6	40
2059090	Bromodichloromethane	2010/01/22	95	70 - 130	91	70 - 130	<0.1	ug/L	NC	40
2059090	Bromoform	2010/01/22	103	70 - 130	96	70 - 130	<0.2	ug/L	NC	40
2059090	Bromomethane	2010/01/22	84	60 - 140	76	60 - 140	<0.5	ug/L	NC	40
2059090	Carbon Tetrachloride	2010/01/22	102	70 - 130	98	70 - 130	<0.1	ug/L	NC	40
2059090	Chlorobenzene	2010/01/22	97	70 - 130	95	70 - 130	<0.1	ug/L	NC	40
2059090	Chloroform	2010/01/22	97	70 - 130	94	70 - 130	<0.1	ug/L	NC	40
2059090	Dibromochloromethane	2010/01/22	98	70 - 130	93	70 - 130	<0.2	ug/L	NC	40
2059090	1,2-Dichlorobenzene	2010/01/22	92	70 - 130	89	70 - 130	<0.2	ug/L	NC	40
2059090	1,3-Dichlorobenzene	2010/01/22	99	70 - 130	96	70 - 130	<0.2	ug/L	NC	40
2059090	1,4-Dichlorobenzene	2010/01/22	99	70 - 130	96	70 - 130	<0.2	ug/L	NC	40
2059090	Dichlorodifluoromethane (FREON 12)	2010/01/22	92	60 - 140	80	60 - 140	<0.5	ug/L	NC	40
2059090	1,1-Dichloroethane	2010/01/22	94	70 - 130	95	70 - 130	<0.1	ug/L	9.5	40
2059090	1,2-Dichloroethane	2010/01/22	91	70 - 130	87	70 - 130	<0.2	ug/L	NC	40
2059090	1,1-Dichloroethylene	2010/01/22	108	70 - 130	105	70 - 130	<0.1	ug/L	NC	40
2059090	cis-1,2-Dichloroethylene	2010/01/22	102	70 - 130	99	70 - 130	<0.1	ug/L	NC	40
2059090	trans-1,2-Dichloroethylene	2010/01/22	102	70 - 130	100	70 - 130	<0.1	ug/L	NC	40
2059090	1,2-Dichloropropane	2010/01/22	102	70 - 130	100	70 - 130	<0.1	ug/L	NC	40
2059090	cis-1,3-Dichloropropene	2010/01/22	104	70 - 130	101	70 - 130	<0.2	ug/L	NC	40
2059090	trans-1,3-Dichloropropene	2010/01/22	97	70 - 130	93	70 - 130	<0.2	ug/L	NC	40
2059090	Ethylbenzene	2010/01/22	106	70 - 130	105	70 - 130	<0.1	ug/L	NC	40
2059090	Ethylene Dibromide	2010/01/22	98	70 - 130	94	70 - 130	<0.2	ug/L	NC	40
2059090	Methylene Chloride(Dichloromethane)	2010/01/22	96	70 - 130	92	70 - 130	<0.5	ug/L	NC	40
2059090	Methyl Isobutyl Ketone	2010/01/22	107	70 - 130	92	70 - 130	<5	ug/L	NC	40
2059090	Methyl Ethyl Ketone (2-Butanone)	2010/01/22	128	60 - 140	90	60 - 140	<5	ug/L	NC	40
2059090	Methyl t-butyl ether (MTBE)	2010/01/22	100	70 - 130	94	70 - 130	<0.2	ug/L	NC	40
2059090	Styrene	2010/01/22	93	70 - 130	93	70 - 130	<0.2	ug/L	NC	40
2059090	1,1,1,2-Tetrachloroethane	2010/01/22	97	70 - 130	93	70 - 130	<0.1	ug/L	NC	40
2059090	1,1,2,2-Tetrachloroethane	2010/01/22	91	70 - 130	88	70 - 130	<0.2	ug/L	NC	40
2059090	Tetrachloroethylene	2010/01/22	100	70 - 130	97	70 - 130	<0.1	ug/L	NC	40
2059090	Toluene	2010/01/22	99	70 - 130	99	70 - 130	<0.2	ug/L	NC	40
2059090	1,1,1-Trichloroethane	2010/01/22	98	70 - 130	94	70 - 130	<0.1	ug/L	NC	40
2059090	1,1,2-Trichloroethane	2010/01/22	91	70 - 130	88	70 - 130	<0.2	ug/L	NC	40
2059090	Trichloroethylene	2010/01/22	102	70 - 130	97	70 - 130	<0.1	ug/L	11.5	40
2059090	Vinyl Chloride	2010/01/22	90	70 - 130	88	70 - 130	<0.2	ug/L	NC	40
2059090	p+m-Xylene	2010/01/22	105	70 - 130	104	70 - 130	<0.1	ug/L	NC	40

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R2-0001533

Maxxam Job #: B006190
Report Date: 2010/01/27

Golder Associates Ltd
Client Project #: 09-1223-3026
Project name: ISCO-NY

QUALITY ASSURANCE REPORT

			Matrix Spike		Spiked Blank		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	Units	Value (%)	QC Limits
2059090	o-Xylene	2010/01/22	105	70 - 130	104	70 - 130	<0.1	ug/L	NC	40
2059090	Xylene (Total)	2010/01/22					<0.1	ug/L	NC	40
2059091	4-Bromofluorobenzene	2010/01/22	104	70 - 130	102	70 - 130	99	%		
2059091	D4-1,2-Dichloroethane	2010/01/22	97	70 - 130	100	70 - 130	100	%		
2059091	D8-Toluene	2010/01/22	99	70 - 130	100	70 - 130	101	%		
2059091	1,2,3-Trichlorobenzene	2010/01/22	97	70 - 130	99	70 - 130	<0.5	ug/L	NC	40
2059091	1,2,4-Trichlorobenzene	2010/01/22	95	70 - 130	97	70 - 130	<0.5	ug/L	NC	40
2059091	Methyl Acetate	2010/01/22	111	60 - 140	106	60 - 140	<1	ug/L	NC	40
2059091	1,1,2-Trichlorotrifluoroethane	2010/01/22	101	60 - 140	92	60 - 140	<0.2	ug/L	NC	40
2059091	Carbon Disulfide	2010/01/22	99	60 - 140	98	60 - 140	<0.5	ug/L	NC	40
2059091	Cyclohexane	2010/01/22	115	60 - 140	103	60 - 140	<0.5	ug/L	NC	40
2059091	Methyl Butyl Ketone (2-Hexanone)	2010/01/22			80	60 - 140	<5	ug/L	NC	40
2059092	D6-Benzene	2010/01/22	122	60 - 140	95	60 - 140	96	%		
2059092	1,4-Dioxane	2010/01/22	118	60 - 140	124	60 - 140	<20	ug/L	6.3	40

N/A = Not Applicable
RPD = Relative Percent Difference
Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.
Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.
Spiked Blank: A blank matrix to which a known amount of the analyte has been added. Used to evaluate analyte recovery.
Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.
Surrogate: A pure or isotopically labeled compound whose behavior mirrors the analytes of interest. Used to evaluate extraction efficiency.
NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spiked amount was not sufficiently significant to permit a reliable recovery calculation.
NC (RPD): The RPD was not calculated. The level of analyte detected in the parent sample and its duplicate was not sufficiently significant to permit a reliable calculation.
(1) - Recovery or RPD for this parameter is outside control limits. The overall quality control for this analysis meets acceptability criteria.
(2) - The recovery was above the upper control limit. This may represent a high bias in some results for this specific analyte. For results that were not detected (ND), this potential bias has no impact.
(3) - The recovery in the matrix spike was not calculated (NC). Spiked concentration was less than 2x that native to the sample.

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R2-0001534

Validation Signature Page

Maxxam Job #: B006190

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

EWA PRANJIC, M.Sc., C.Chem, Scientific Specialist

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IMMEDIATE TEST

19-Jan-[illegible] [illegible]:09

NATALIE BUR[illegible]

B006190

J_L ENV-135

Maxxam Analytique

☐ 889 Montée de Liesse, Ville St-Laurent (Québec) H4T 1P5 Télép[illegible]
☐ 2690 Avenue Dalton, Sainte-Foy (Québec) G1P 3S4 Télép[illegible]
☐ 737 boul. Barette, Chicoutimi (Québec) G7J 4C4 Télép[illegible]

[illegible]ereau de transmission d'échantillons

[illegible]ns frais : 1-877-4MA-XXAM (462-8926) Page 1 de 1

E- 786249

Info. Facturation	Info. Rapport (si différent de Facturation)
Compagnie : Golder	Compagnie :
Adresse : 9200 blv. Acadie, MH	Adresse :
Attention de : P. Thériault	Attention de :
Téléphone : E Bergeron	Téléphone :
Telecopieur :	Telecopieur :
Échantillonneur : P.T.	Échantillonneur :

No. de commande :

Projet / Site : ISCO - NY

No. de cotation :

No. de projet : 07-1223 3026

Je déclare par la présente comprendre et accepter les conditions et modalités de Maxxam telles que décrites au verso du présent formulaire.

Identification de l'échantillon (point de prélèvement)	Échantillon Sol	Type d'eau	Autre	Prélèvement (date / heure)	à filtrer	nombre de contenants	HP (Cu-Co)	H & G Mét. ☐	COV (EPA 624) ☒	BTEX ☐ HAM ☐	Phénols (Color) ☐	HAP	SPC (Coagulants) (SO-MS)	Métaux Lourds (Cd, Cr, Co, Ni, Pb, Zn)	Métaux ICP polluants - 13 élé. eau*** ☐ 16 élé. eau** ☐	Mercure ☐ Sélénium-sol ☐ Autres	F ☐ Cl ☐ SO4 ☐ NO2 ☐ NO3 ☐ NO2 + NO3 ☐	NTK ☐ Nh3 ☐ P-Tot ☐	pH ☐ Conductivité ☐ MES ☐	Sulfure (S-Tot) ☐ Sulfate (SO4) ☐	CN-Tot ☐ CN-Cl ☐ CN Libre ☐	DBO5 ☐ DCO ☐ Turbidité ☐ COT ☐	RDS ☐ PND ☐	COM ART. 10 ☐ ART. 11 ☐	Eau Potable : OFG ☐ INOR ☐ THM ☐	COLIF (Fec) ☐ COLIF (TOT) ☐ BHAA ☐	Explosif EPA 8095 ☐ EPA 8330 ☐	Autre (spécifier) :			
CO-C-T1	1	S		14/01		6			X																								

6/6/50

LÉGENDE : ** Métaux 13 éléments (Ag, As, Ba, Cd, Co, Cr, Cu, Sn, Mn, Mo, Ni, Pb, Zn).
*** Métaux 16 éléments (Al, Sb, Ag, As, Ba, Cd, Cr, Co, Cu, Mn, Mo, Ni, Pb, Se, Na, Zn).

Types d'eau : S = Souterraine P = Potable DL = Déchet liquide
Sur = Surface E = Eau usée C = Captage

Normes/Règlement Applicables : _____ (À remplir)

Délais : ☐ 24h ☐ 48h ☐ 72h ☒ Régulier ☐ Date : _____

A moins d'être clairement identifié, tout échantillon d'eau reçu chez Maxxam sera considéré comme non-potable et ne sera pas soumis aux exigences du règlement sur la qualité de l'eau potable.

Condition générale à la réception : ENVOI DIRECT ONTARIO - See Christine McLean

Chaîne de responsabilité

Déssaisi par : P. Thériault	Date : 18/1/19	Heure : 12 30	Reçu par : [illegible]	
Déssaisi par :	Date : 18/01/19	Heure : 12:45 PM	Reçu par : [illegible]	

Nombre de glacières :

Température de réception :

Remarques : Faire les même analyses que dossier : #A9H3308

Transport des échantillons : ☐ Par client ☐ Personnel MAXXAM ☐ Courrier (spécifier) : 3 4 1

KEP/WC/COFORM/0 - 07/09 BLANC : MAXXAM ANALYTIQUE INC BLEU : FACTURATION JAUNE : RETOURNER AU CLIENT AVEC RAPPORT FINAL ROSE : CLIENT

Rec : 20FIA 2ERIA 10/01/19 4 09

R2-0001536

Your Project #: ISCO-NY
Site: 09-1223-3026
Your C.O.C. #: E786250, E-786250

Attention: Eric Bergeron
Golder Associates Ltd
9200 Boul L'Acadie
Bureau 10
Montreal, PQ
H4N 2T2

Report Date: 2010/02/09

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B011544
Received: 2010/01/30, 09:21

Sample Matrix: Water
Samples Received: 9

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Method Reference
1,4-Dioxane in water (1)	9	N/A	2010/02/05	CAM SOP-00226	EPA 8260 modified
Volatile Organic Compounds in Water	3	N/A	2010/02/04	CAM SOP-00226	EPA 8260 modified
Volatile Organic Compounds in Water	1	N/A	2010/02/05	CAM SOP-00226	EPA 8260 modified
Volatile Organic Compounds in Water	4	N/A	2010/02/06	CAM SOP-00226	EPA 8260 modified
Volatile Organic Compounds in Water	1	N/A	2010/02/09	CAM SOP-00226	EPA 8260 modified
Non-Routine Volatile Organic Compounds	9	N/A	2010/02/05	CAM SOP-00226	EPA 8260 modified

* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.
* Results relate only to the items tested.

(1) Sample(s) analyzed using methodologies that have been subjected to Maxxam's standard validation process for the submitted matrix however is not an Accredited method.

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.

CHRISTINE MCLEAN, Project Manager
Email: christine.mclean@maxxamanalytics.com
Phone# (905) 817-5700

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Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. SCC and CALA have approved this reporting process and electronic report format.

For Service Group specific validation please refer to the Validation Signature Page

Total cover pages: 1

R2-0001537

Maxxam Job #: B011544
Report Date: 2010/02/09

Golder Associates Ltd
Client Project #: ISCO-NY
Project name: 09-1223-3026

VOLATILE ORGANICS BY GC/MS (WATER)

Maxxam ID		EZ0124	EZ0125	EZ0126			EZ0127	EZ0127		
Sampling Date		2010/01/29	2010/01/29	2010/01/29			2010/01/29	2010/01/29		
	Units	CO-A1D1-T2	CO-A1D2-T2	CO-A1D3-T2	RDL	QC Batch	CO-A2D1-T2	CO-A2D1-T2 Lab-Dup	RDL	QC Batch
Volatile Organics										
1,2,3-Trichlorobenzene	ug/L	<1	<1	<1	1	2069131	<10		10	2069131
1,2,4-Trichlorobenzene	ug/L	<1	<1	<1	1	2069131	<10		10	2069131
1,4-Dioxane	ug/L	<50	<50	<50	50	2071544	1000	1000	400	2071544
Acetone (2-Propanone)	ug/L	<30	<30	<30	30	2069108	<200		200	2069108
Benzene	ug/L	<0.3	<0.3	<0.3	0.3	2069108	30		2	2069108
Bromodichloromethane	ug/L	<0.3	<0.3	<0.3	0.3	2069108	<2		2	2069108
Bromoform	ug/L	<0.5	<0.5	<0.5	0.5	2069108	<4		4	2069108
Bromomethane	ug/L	<1	<1	<1	1	2069108	<10		10	2069108
Carbon Tetrachloride	ug/L	<0.3	<0.3	<0.3	0.3	2069108	<2		2	2069108
Chlorobenzene	ug/L	<0.3	<0.3	<0.3	0.3	2069108	<2		2	2069108
Chloroform	ug/L	<0.3	<0.3	<0.3	0.3	2069108	<2		2	2069108
Dibromochloromethane	ug/L	<0.5	<0.5	<0.5	0.5	2069108	<4		4	2069108
1,2-Dichlorobenzene	ug/L	<0.5	<0.5	<0.5	0.5	2069108	<4		4	2069108
Methyl Acetate	ug/L	<3	<3	<3	3	2069131	<20		20	2069131
1,1,2-Trichlorotrifluoroethane	ug/L	<0.5	<0.5	<0.5	0.5	2069131	<4		4	2069131
1,3-Dichlorobenzene	ug/L	<0.5	<0.5	<0.5	0.5	2069108	<4		4	2069108
1,4-Dichlorobenzene	ug/L	<0.5	<0.5	<0.5	0.5	2069108	<4		4	2069108
Carbon Disulfide	ug/L	<1	<1	<1	1	2069131	<10		10	2069131
Dichlorodifluoromethane (FREON 12)	ug/L	<1	<1	<1	1	2069108	<10		10	2069108
1,1-Dichloroethane	ug/L	<0.3	<0.3	<0.3	0.3	2069108	28		2	2069108
1,2-Dichloroethane	ug/L	<0.5	<0.5	<0.5	0.5	2069108	<4		4	2069108
1,1-Dichloroethylene	ug/L	<0.3	<0.3	<0.3	0.3	2069108	<2		2	2069108
cis-1,2-Dichloroethylene	ug/L	<0.3	<0.3	<0.3	0.3	2069108	<2		2	2069108
trans-1,2-Dichloroethylene	ug/L	<0.3	<0.3	<0.3	0.3	2069108	<2		2	2069108
1,2-Dichloropropane	ug/L	<0.3	<0.3	<0.3	0.3	2069108	<2		2	2069108
cis-1,3-Dichloropropene	ug/L	<0.5	<0.5	<0.5	0.5	2069108	<4		4	2069108
trans-1,3-Dichloropropene	ug/L	<0.5	<0.5	<0.5	0.5	2069108	<4		4	2069108
Ethylbenzene	ug/L	<0.3	<0.3	<0.3	0.3	2069108	<2		2	2069108
Ethylene Dibromide	ug/L	<0.5	<0.5	<0.5	0.5	2069108	<4		4	2069108
Cyclohexane	ug/L	<1	<1	<1	1	2069131	<10		10	2069131
Methylene Chloride(Dichloromethane)	ug/L	<1	<1	<1	1	2069108	<10		10	2069108
Methyl Isobutyl Ketone	ug/L	<10	<10	<10	10	2069108	<100		100	2069108
Methyl Ethyl Ketone (2-Butanone)	ug/L	<10	<10	<10	10	2069108	<100		100	2069108
Methyl t-butyl ether (MTBE)	ug/L	<0.5	<0.5	<0.5	0.5	2069108	<4		4	2069108

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

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R2-0001538

Maxxam Job #: B011544
Report Date: 2010/02/09

Golder Associates Ltd
Client Project #: ISCO-NY
Project name: 09-1223-3026

VOLATILE ORGANICS BY GC/MS (WATER)

Maxxam ID		EZ0124	EZ0125	EZ0126			EZ0127	EZ0127		
Sampling Date		2010/01/29	2010/01/29	2010/01/29			2010/01/29	2010/01/29		
	Units	CO-A1D1-T2	CO-A1D2-T2	CO-A1D3-T2	RDL	QC Batch	CO-A2D1-T2	CO-A2D1-T2 Lab-Dup	RDL	QC Batch
Styrene	ug/L	<0.5	<0.5	<0.5	0.5	2069108	<4		4	2069108
1,1,1,2-Tetrachloroethane	ug/L	<0.3	<0.3	<0.3	0.3	2069108	<2		2	2069108
1,1,2,2-Tetrachloroethane	ug/L	<0.5	<0.5	<0.5	0.5	2069108	<4		4	2069108
Tetrachloroethylene	ug/L	<0.3	<0.3	<0.3	0.3	2069108	<2		2	2069108
Toluene	ug/L	<0.5	<0.5	<0.5	0.5	2069108	<4		4	2069108
1,1,1-Trichloroethane	ug/L	<0.3	<0.3	<0.3	0.3	2069108	<2		2	2069108
1,1,2-Trichloroethane	ug/L	<0.5	<0.5	<0.5	0.5	2069108	<4		4	2069108
Trichloroethylene	ug/L	<0.3	<0.3	<0.3	0.3	2069108	3		2	2069108
Vinyl Chloride	ug/L	<0.5	<0.5	<0.5	0.5	2069108	<4		4	2069108
p+m-Xylene	ug/L	<0.3	<0.3	<0.3	0.3	2069108	<2		2	2069108
o-Xylene	ug/L	<0.3	<0.3	<0.3	0.3	2069108	<2		2	2069108
Xylene (Total)	ug/L	<0.3	<0.3	<0.3	0.3	2069108	<2		2	2069108
Methyl Butyl Ketone (2-Hexanone)	ug/L	<10	<10	<10	10	2069131	<100		100	2069131
Chloroethane	ug/L	<0.5	<0.5	<0.5	0.5	2069108	38		4	2069108
Chloromethane	ug/L	<1	<1	<1	1	2069108	<10		10	2069108
Trichlorofluoromethane (FREON 11)	ug/L	<0.5	<0.5	<0.5	0.5	2069108	<4		4	2069108
Surrogate Recovery (%)										
4-Bromofluorobenzene	%	96	99	97		2069131	95			2069131
D4-1,2-Dichloroethane	%	117	124	130		2069108	119			2069108
D6-Benzene	%	83	75	72		2071544	77	77		2071544
D8-Toluene	%	104	102	99		2069108	102			2069131

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

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R2-0001539

Maxxam Job #: B011544
Report Date: 2010/02/09

Golder Associates Ltd
Client Project #: ISCO-NY
Project name: 09-1223-3026

VOLATILE ORGANICS BY GC/MS (WATER)

Maxxam ID		EZ0128			EZ0129			EZ0130		
Sampling Date		2010/01/29			2010/01/29			2010/01/29		
	Units	CO-A2D2-T2	RDL	QC Batch	CO-A2D3-T2	RDL	QC Batch	CO-C-T2	RDL	QC Batch
Volatile Organics										
1,2,3-Trichlorobenzene	ug/L	<5	5	2069131	<10	10	2069131	<1	1	2069131
1,2,4-Trichlorobenzene	ug/L	<5	5	2069131	<10	10	2069131	<1	1	2069131
1,4-Dioxane	ug/L	890	200	2071544	<700(1)	700	2071544	1000	50	2071544
Acetone (2-Propanone)	ug/L	<100	100	2069108	<200	200	2069108	<30	30	2069108
Benzene	ug/L	7	1	2069108	<2	2	2069108	<0.3	0.3	2069108
Bromodichloromethane	ug/L	<1	1	2069108	55	2	2069108	<0.3	0.3	2069108
Bromoform	ug/L	28	2	2069108	5	4	2069108	<0.5	0.5	2069108
Bromomethane	ug/L	380	5	2069108	3500	10	2069108	<1	1	2069108
Carbon Tetrachloride	ug/L	<1	1	2069108	<2	2	2069108	<0.3	0.3	2069108
Chlorobenzene	ug/L	<1	1	2069108	<2	2	2069108	<0.3	0.3	2069108
Chloroform	ug/L	<1	1	2069108	30	2	2069108	<0.3	0.3	2069108
Dibromochloromethane	ug/L	3	2	2069108	38	4	2069108	<0.5	0.5	2069108
1,2-Dichlorobenzene	ug/L	<2	2	2069108	<4	4	2069108	<0.5	0.5	2069108
Methyl Acetate	ug/L	16	10	2069131	<20	20	2069131	<3	3	2069131
1,1,2-Trichlorotrifluoroethane	ug/L	<2	2	2069131	<4	4	2069131	<0.5	0.5	2069131
1,3-Dichlorobenzene	ug/L	<2	2	2069108	<4	4	2069108	<0.5	0.5	2069108
1,4-Dichlorobenzene	ug/L	<2	2	2069108	<4	4	2069108	<0.5	0.5	2069108
Carbon Disulfide	ug/L	<5	5	2069131	<10	10	2069131	<1	1	2069131
Dichlorodifluoromethane (FREON 12)	ug/L	<5	5	2069108	<10	10	2069108	<1	1	2069108
1,1-Dichloroethane	ug/L	28	1	2069108	74	2	2069108	30	0.3	2069108
1,2-Dichloroethane	ug/L	3	2	2069108	16	4	2069108	<0.5	0.5	2069108
1,1-Dichloroethylene	ug/L	<1	1	2069108	<2	2	2069108	<0.3	0.3	2069108
cis-1,2-Dichloroethylene	ug/L	<1	1	2069108	<2	2	2069108	1.4	0.3	2069108
trans-1,2-Dichloroethylene	ug/L	<1	1	2069108	<2	2	2069108	<0.3	0.3	2069108
1,2-Dichloropropane	ug/L	<1	1	2069108	3	2	2069108	<0.3	0.3	2069108
cis-1,3-Dichloropropene	ug/L	<2	2	2069108	<4	4	2069108	<0.5	0.5	2069108
trans-1,3-Dichloropropene	ug/L	<2	2	2069108	<4	4	2069108	<0.5	0.5	2069108
Ethylbenzene	ug/L	<1	1	2069108	<2	2	2069108	<0.3	0.3	2069108
Ethylene Dibromide	ug/L	<2	2	2069108	<4	4	2069108	<0.5	0.5	2069108
Cyclohexane	ug/L	<5	5	2069131	<10	10	2069131	<1	1	2069131
Methylene Chloride(Dichloromethane)	ug/L	<5	5	2069108	1200	10	2069108	1	1	2069108
Methyl Isobutyl Ketone	ug/L	<50	50	2069108	<100	100	2069108	<10	10	2069108
Methyl Ethyl Ketone (2-Butanone)	ug/L	<50	50	2069108	<100	100	2069108	<10	10	2069108
Methyl t-butyl ether (MTBE)	ug/L	<2	2	2069108	<4	4	2069108	<0.5	0.5	2069108

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
(1) - Detection limits was raised due to matrix interference.

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R2-0001540

Maxxam Job #: B011544
Report Date: 2010/02/09

Golder Associates Ltd
Client Project #: ISCO-NY
Project name: 09-1223-3026

VOLATILE ORGANICS BY GC/MS (WATER)

Maxxam ID		EZ0128			EZ0129			EZ0130		
Sampling Date		2010/01/29			2010/01/29			2010/01/29		
	Units	CO-A2D2-T2	RDL	QC Batch	CO-A2D3-T2	RDL	QC Batch	CO-C-T2	RDL	QC Batch
Styrene	ug/L	<2	2	2069108	<4	4	2069108	<0.5	0.5	2069108
1,1,1,2-Tetrachloroethane	ug/L	<1	1	2069108	<2	2	2069108	<0.3	0.3	2069108
1,1,2,2-Tetrachloroethane	ug/L	<2	2	2069108	<4	4	2069108	<0.5	0.5	2069108
Tetrachloroethylene	ug/L	<1	1	2069108	<2	2	2069108	<0.3	0.3	2069108
Toluene	ug/L	<2	2	2069108	<4	4	2069108	<0.5	0.5	2069108
1,1,1-Trichloroethane	ug/L	<1	1	2069108	3	2	2069108	<0.3	0.3	2069108
1,1,2-Trichloroethane	ug/L	<2	2	2069108	10	4	2069108	<0.5	0.5	2069108
Trichloroethylene	ug/L	<1	1	2069108	<2	2	2069108	3.2	0.3	2069108
Vinyl Chloride	ug/L	<2	2	2069108	<4	4	2069108	1.5	0.5	2069108
p+m-Xylene	ug/L	<1	1	2069108	<2	2	2069108	<0.3	0.3	2069108
o-Xylene	ug/L	<1	1	2069108	<2	2	2069108	<0.3	0.3	2069108
Xylene (Total)	ug/L	<1	1	2069108	<2	2	2069108	<0.3	0.3	2069108
Methyl Butyl Ketone (2-Hexanone)	ug/L	<50	50	2069131	<100	100	2069131	<10	10	2069131
Chloroethane	ug/L	40	2	2069108	84	4	2069108	37	0.5	2069108
Chloromethane	ug/L	140	5	2069108	19000	10	2069108	<1	1	2069108
Trichlorofluoromethane (FREON 11)	ug/L	<2	2	2069108	<4	4	2069108	<0.5	0.5	2069108
Surrogate Recovery (%)										
4-Bromofluorobenzene	%	97		2069131	92		2069131	98		2069131
D4-1,2-Dichloroethane	%	98		2069131	123		2069108	102		2069131
D6-Benzene	%	119		2071544	65		2071544	81		2071544
D8-Toluene	%	102		2069131	95		2069108	103		2069131

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

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R2-0001541

Maxxam Job #: B011544
Report Date: 2010/02/09

Golder Associates Ltd
Client Project #: ISCO-NY
Project name: 09-1223-3026

VOLATILE ORGANICS BY GC/MS (WATER)

Maxxam ID		EZ0130		EZ0131			EZ0132		
Sampling Date		2010/01/29		2010/01/29			2010/01/29		
	Units	CO-C-T2 Lab-Dup	QC Batch	DUP-1	RDL	QC Batch	DUP-3	RDL	QC Batch
Volatile Organics									
1,2,3-Trichlorobenzene	ug/L	<1	2069131	<1	1	2069131	<10	10	2069131
1,2,4-Trichlorobenzene	ug/L	<1	2069131	<1	1	2069131	<10	10	2069131
1,4-Dioxane	ug/L			<50	50	2071544	<700(1)	700	2071544
Acetone (2-Propanone)	ug/L	<30	2069108	<30	30	2069108	<200	200	2069108
Benzene	ug/L	<0.3	2069108	<0.3	0.3	2069108	<2	2	2069108
Bromodichloromethane	ug/L	<0.3	2069108	<0.3	0.3	2069108	70	2	2069108
Bromoform	ug/L	<0.5	2069108	<0.5	0.5	2069108	<4	4	2069108
Bromomethane	ug/L	<1	2069108	<1	1	2069108	4000	10	2069108
Carbon Tetrachloride	ug/L	<0.3	2069108	<0.3	0.3	2069108	<2	2	2069108
Chlorobenzene	ug/L	<0.3	2069108	<0.3	0.3	2069108	<2	2	2069108
Chloroform	ug/L	<0.3	2069108	<0.3	0.3	2069108	47	2	2069108
Dibromochloromethane	ug/L	<0.5	2069108	<0.5	0.5	2069108	41	4	2069108
1,2-Dichlorobenzene	ug/L	<0.5	2069108	<0.5	0.5	2069108	<4	4	2069108
Methyl Acetate	ug/L	<3	2069131	<3	3	2069131	<20	20	2069131
1,1,2-Trichlorotrifluoroethane	ug/L	<0.5	2069131	<0.5	0.5	2069131	<4	4	2069131
1,3-Dichlorobenzene	ug/L	<0.5	2069108	<0.5	0.5	2069108	<4	4	2069108
1,4-Dichlorobenzene	ug/L	<0.5	2069108	<0.5	0.5	2069108	<4	4	2069108
Carbon Disulfide	ug/L	<1	2069131	<1	1	2069131	<10	10	2069131
Dichlorodifluoromethane (FREON 12)	ug/L	<1	2069108	<1	1	2069108	<10	10	2069108
1,1-Dichloroethane	ug/L	32	2069108	<0.3	0.3	2069108	82	2	2069108
1,2-Dichloroethane	ug/L	<0.5	2069108	<0.5	0.5	2069108	20	4	2069108
1,1-Dichloroethylene	ug/L	<0.3	2069108	<0.3	0.3	2069108	<2	2	2069108
cis-1,2-Dichloroethylene	ug/L	1.5	2069108	<0.3	0.3	2069108	<2	2	2069108
trans-1,2-Dichloroethylene	ug/L	<0.3	2069108	<0.3	0.3	2069108	<2	2	2069108
1,2-Dichloropropane	ug/L	<0.3	2069108	<0.3	0.3	2069108	4	2	2069108
cis-1,3-Dichloropropene	ug/L	<0.5	2069108	<0.5	0.5	2069108	<4	4	2069108
trans-1,3-Dichloropropene	ug/L	<0.5	2069108	<0.5	0.5	2069108	<4	4	2069108
Ethylbenzene	ug/L	<0.3	2069108	<0.3	0.3	2069108	<2	2	2069108
Ethylene Dibromide	ug/L	<0.5	2069108	<0.5	0.5	2069108	<4	4	2069108
Cyclohexane	ug/L	<1	2069131	<1	1	2069131	<10	10	2069131
Methylene Chloride(Dichloromethane)	ug/L	<1	2069108	<1	1	2069108	1400	10	2069108
Methyl Isobutyl Ketone	ug/L	<10	2069108	<10	10	2069108	<100	100	2069108
Methyl Ethyl Ketone (2-Butanone)	ug/L	<10	2069108	<10	10	2069108	<100	100	2069108

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
(1) - Detection limits was raised due to matrix interference.

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R2-0001542

Maxxam Job #: B011544
Report Date: 2010/02/09

Golder Associates Ltd
Client Project #: ISCO-NY
Project name: 09-1223-3026

VOLATILE ORGANICS BY GC/MS (WATER)

Maxxam ID		EZ0130		EZ0131			EZ0132		
Sampling Date		2010/01/29		2010/01/29			2010/01/29		
	Units	CO-C-T2 Lab-Dup	QC Batch	DUP-1	RDL	QC Batch	DUP-3	RDL	QC Batch
Methyl t-butyl ether (MTBE)	ug/L	<0.5	2069108	<0.5	0.5	2069108	<4	4	2069108
Styrene	ug/L	<0.5	2069108	<0.5	0.5	2069108	<4	4	2069108
1,1,1,2-Tetrachloroethane	ug/L	<0.3	2069108	<0.3	0.3	2069108	<2	2	2069108
1,1,2,2-Tetrachloroethane	ug/L	<0.5	2069108	<0.5	0.5	2069108	<4	4	2069108
Tetrachloroethylene	ug/L	<0.3	2069108	<0.3	0.3	2069108	<2	2	2069108
Toluene	ug/L	<0.5	2069108	<0.5	0.5	2069108	<4	4	2069108
1,1,1-Trichloroethane	ug/L	<0.3	2069108	<0.3	0.3	2069108	3	2	2069108
1,1,2-Trichloroethane	ug/L	<0.5	2069108	<0.5	0.5	2069108	13	4	2069108
Trichloroethylene	ug/L	3.5	2069108	<0.3	0.3	2069108	<2	2	2069108
Vinyl Chloride	ug/L	0.9	2069108	<0.5	0.5	2069108	<4	4	2069108
p+m-Xylene	ug/L	<0.3	2069108	<0.3	0.3	2069108	<2	2	2069108
o-Xylene	ug/L	<0.3	2069108	<0.3	0.3	2069108	<2	2	2069108
Xylene (Total)	ug/L	<0.3	2069108	<0.3	0.3	2069108	<2	2	2069108
Methyl Butyl Ketone (2-Hexanone)	ug/L	<10	2069131	<10	10	2069131	<100	100	2069131
Chloroethane	ug/L	38	2069108	<0.5	0.5	2069108	80	4	2069108
Chloromethane	ug/L	<1	2069108	<1	1	2069108	22000	10	2069108
Trichlorofluoromethane (FREON 11)	ug/L	<0.5	2069108	<0.5	0.5	2069108	<4	4	2069108
Surrogate Recovery (%)									
4-Bromofluorobenzene	%	95	2069131	99		2069131	93		2069131
D4-1,2-Dichloroethane	%	125	2069108	106		2069108	101		2069131
D6-Benzene	%			76		2071544	73		2071544
D8-Toluene	%	101	2069108	99		2069131	98		2069131

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

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R2-0001543

Maxxam Job #: B011544
Report Date: 2010/02/09

Golder Associates Ltd
Client Project #: ISCO-NY
Project name: 09-1223-3026

GENERAL COMMENTS

Sample	EZ0124-01: VOC Analysis: Due to the sample matrix, sample required dilution. Detection limits were adjusted accordingly.
Sample	EZ0125-01: VOC Analysis: Due to the sample matrix, sample required dilution. Detection limits were adjusted accordingly.
Sample	EZ0126-01: VOC Analysis: Due to the sample matrix, sample required dilution. Detection limits were adjusted accordingly.
Sample	EZ0127-01: VOC Analysis: Due to high concentrations of target and non-target analytes, sample required dilution. Detection limits were adjusted accordingly.
Sample	EZ0128-01: VOC Analysis: Due to high concentrations of target and non-target analytes, sample required dilution. Detection limits were adjusted accordingly.
Sample	EZ0129-01: VOC Analysis: Due to high concentrations of target analytes, sample required dilution. Detection limits were adjusted accordingly.
Sample	EZ0130-01: VOC Analysis: Due to high concentrations of target analytes, sample required dilution. Detection limits were adjusted accordingly.
Sample	EZ0131-01: VOC Analysis: Due to the sample matrix, sample required dilution. Detection limits were adjusted accordingly.

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Maxxam Job #: B011544
Report Date: 2010/02/09

Golder Associates Ltd
Client Project #: ISCO-NY
Project name: 09-1223-3026

QUALITY ASSURANCE REPORT

			Matrix Spike		Spiked Blank		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	Units	Value (%)	QC Limits
2069108	4-Bromofluorobenzene	2010/02/04	110	70 - 130	107	70 - 130	97	%		
2069108	D4-1,2-Dichloroethane	2010/02/04	122	70 - 130	111	70 - 130	112	%		
2069108	D8-Toluene	2010/02/04	100	70 - 130	100	70 - 130	102	%		
2069108	Acetone (2-Propanone)	2010/02/04	104	60 - 140	111	60 - 140	<10	ug/L	NC	40
2069108	Benzene	2010/02/04	105	70 - 130	94	70 - 130	<0.1	ug/L	NC	40
2069108	Bromodichloromethane	2010/02/04	117	70 - 130	97	70 - 130	<0.1	ug/L	NC	40
2069108	Bromoform	2010/02/04	109	70 - 130	84	70 - 130	<0.2	ug/L	NC	40
2069108	Bromomethane	2010/02/04	127	60 - 140	90	60 - 140	<0.5	ug/L	NC	40
2069108	Carbon Tetrachloride	2010/02/04	137 (1, 2)	70 - 130	110	70 - 130	<0.1	ug/L	NC	40
2069108	Chlorobenzene	2010/02/04	112	70 - 130	96	70 - 130	<0.1	ug/L	NC	40
2069108	Chloroform	2010/02/04	120	70 - 130	100	70 - 130	<0.1	ug/L	NC	40
2069108	Dibromochloromethane	2010/02/04	124	70 - 130	100	70 - 130	<0.2	ug/L	NC	40
2069108	1,2-Dichlorobenzene	2010/02/04	113	70 - 130	96	70 - 130	<0.2	ug/L	NC	40
2069108	1,3-Dichlorobenzene	2010/02/04	111	70 - 130	96	70 - 130	<0.2	ug/L	NC	40
2069108	1,4-Dichlorobenzene	2010/02/04	115	70 - 130	98	70 - 130	<0.2	ug/L	NC	40
2069108	Dichlorodifluoromethane (FREON 12)	2010/02/04	92	60 - 140	87	60 - 140	<0.5	ug/L	NC	40
2069108	1,1-Dichloroethane	2010/02/04	110	70 - 130	96	70 - 130	<0.1	ug/L	7.9	40
2069108	1,2-Dichloroethane	2010/02/04	130	70 - 130	107	70 - 130	<0.2	ug/L	NC	40
2069108	1,1-Dichloroethylene	2010/02/04	119	70 - 130	106	70 - 130	<0.1	ug/L	NC	40
2069108	cis-1,2-Dichloroethylene	2010/02/04	107	70 - 130	93	70 - 130	<0.1	ug/L	5.3	40
2069108	trans-1,2-Dichloroethylene	2010/02/04	108	70 - 130	95	70 - 130	<0.1	ug/L	NC	40
2069108	1,2-Dichloropropane	2010/02/04	111	70 - 130	97	70 - 130	<0.1	ug/L	NC	40
2069108	cis-1,3-Dichloropropene	2010/02/04	111	70 - 130	95	70 - 130	<0.2	ug/L	NC	40
2069108	trans-1,3-Dichloropropene	2010/02/04	116	70 - 130	100	70 - 130	<0.2	ug/L	NC	40
2069108	Ethylbenzene	2010/02/04	115	70 - 130	99	70 - 130	<0.1	ug/L	NC	40
2069108	Ethylene Dibromide	2010/02/04	116	70 - 130	100	70 - 130	<0.2	ug/L	NC	40
2069108	Methylene Chloride(Dichloromethane)	2010/02/04	112	70 - 130	98	70 - 130	<0.5	ug/L	NC	40
2069108	Methyl Isobutyl Ketone	2010/02/04	113	70 - 130	102	70 - 130	<5	ug/L	NC	40
2069108	Methyl Ethyl Ketone (2-Butanone)	2010/02/04	100	60 - 140	99	60 - 140	<5	ug/L	NC	40
2069108	Methyl t-butyl ether (MTBE)	2010/02/04	109	70 - 130	94	70 - 130	<0.2	ug/L	NC	40
2069108	Styrene	2010/02/04	120	70 - 130	106	70 - 130	<0.2	ug/L	NC	40
2069108	1,1,1,2-Tetrachloroethane	2010/02/04	122	70 - 130	99	70 - 130	<0.1	ug/L	NC	40
2069108	1,1,2,2-Tetrachloroethane	2010/02/04	114	70 - 130	98	70 - 130	<0.2	ug/L	NC	40
2069108	Tetrachloroethylene	2010/02/04	112	70 - 130	99	70 - 130	<0.1	ug/L	NC	40
2069108	Toluene	2010/02/04	107	70 - 130	94	70 - 130	<0.2	ug/L	NC	40
2069108	1,1,1-Trichloroethane	2010/02/04	121	70 - 130	100	70 - 130	<0.1	ug/L	NC	40
2069108	1,1,2-Trichloroethane	2010/02/04	107	70 - 130	93	70 - 130	<0.2	ug/L	NC	40
2069108	Trichloroethylene	2010/02/04	108	70 - 130	93	70 - 130	<0.1	ug/L	11.4	40
2069108	Vinyl Chloride	2010/02/04	104	70 - 130	92	70 - 130	<0.2	ug/L	NC	40
2069108	p+m-Xylene	2010/02/04	111	70 - 130	97	70 - 130	<0.1	ug/L	NC	40

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R2-0001545

Maxxam Job #: B011544
Report Date: 2010/02/09

Golder Associates Ltd
Client Project #: ISCO-NY
Project name: 09-1223-3026

QUALITY ASSURANCE REPORT

			Matrix Spike		Spiked Blank		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	Units	Value (%)	QC Limits
2069108	o-Xylene	2010/02/04	113	70 - 130	97	70 - 130	<0.1	ug/L	NC	40
2069108	Chloroethane	2010/02/04	97	70 - 130	89	70 - 130	<0.2	ug/L	2.7	40
2069108	Chloromethane	2010/02/04	104	60 - 140	87	60 - 140	<0.5	ug/L	NC	40
2069108	Trichlorofluoromethane (FREON 11)	2010/02/04	120	70 - 130	104	70 - 130	<0.2	ug/L	NC	40
2069108	Xylene (Total)	2010/02/04					<0.1	ug/L	NC	40
2069131	4-Bromofluorobenzene	2010/02/05	104	70 - 130	101	70 - 130	96	%		
2069131	D4-1,2-Dichloroethane	2010/02/05	94	70 - 130	96	70 - 130	93	%		
2069131	D8-Toluene	2010/02/05	104	70 - 130	101	70 - 130	105	%		
2069131	1,2,3-Trichlorobenzene	2010/02/05	105	70 - 130	98	70 - 130	<0.5	ug/L	NC	40
2069131	1,2,4-Trichlorobenzene	2010/02/05	102	70 - 130	97	70 - 130	<0.5	ug/L	NC	40
2069131	Methyl Acetate	2010/02/05	93	60 - 140	101	60 - 140	<1	ug/L	NC	40
2069131	1,1,2-Trichlorotrifluoroethane	2010/02/05	86	60 - 140	98	60 - 140	<0.2	ug/L	NC	40
2069131	Carbon Disulfide	2010/02/05	102	60 - 140	107	60 - 140	<0.5	ug/L	NC	40
2069131	Cyclohexane	2010/02/05	88	60 - 140	99	60 - 140	<0.5	ug/L	NC	40
2069131	Methyl Butyl Ketone (2-Hexanone)	2010/02/05	116	60 - 140	107	60 - 140	<5	ug/L	NC	40
2071544	D6-Benzene	2010/02/05	90	60 - 140	85	60 - 140	92	%		
2071544	1,4-Dioxane	2010/02/05	98	60 - 140	99	60 - 140	<20	ug/L	NC	40

N/A = Not Applicable
RPD = Relative Percent Difference
Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.
Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.
Spiked Blank: A blank matrix to which a known amount of the analyte has been added. Used to evaluate analyte recovery.
Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.
Surrogate: A pure or isotopically labeled compound whose behavior mirrors the analytes of interest. Used to evaluate extraction efficiency.
NC (RPD): The RPD was not calculated. The level of analyte detected in the parent sample and its duplicate was not sufficiently significant to permit a reliable calculation.
(1) - Recovery or RPD for this parameter is outside control limits. The overall quality control for this analysis meets acceptability criteria.
(2) - The recovery was above the upper control limit. This may represent a high bias in some results for this specific analyte. For results that were not detected (ND), this potential bias has no impact.

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R2-0001546

Validation Signature Page

Maxxam Job #: B011544

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

TROY CARRIERE, B.Sc., C.Chem, Scientific Specialist

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. SCC and CALA have approved this reporting process and electronic report format.

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Your P.O. #: ISCO-NY
Your Project #: 09-1223-3026
Your C.O.C. #: E786342, E-786342

Attention: Eric Bergeron
Golder Associates Ltd
9200 Boul L'Acadie
Bureau 10
Montreal, PQ
H4N 2T2

Report Date: 2010/03/18
This report supersedes all previous reports with the same Maxxam job number

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B025983
Received: 2010/03/04, 09:00

Sample Matrix: Water
Samples Received: 9

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Method Reference
1,4-Dioxane in water (1)	9	N/A	2010/03/10	CAM SOP-00226	EPA 8260 modified
Volatile Organic Compounds in Water	8	N/A	2010/03/09	CAM SOP-00226	EPA 8260 modified
Volatile Organic Compounds in Water	1	N/A	2010/03/10	CAM SOP-00226	EPA 8260 modified
Non-Routine Volatile Organic Compounds	9	N/A	2010/03/09	CAM SOP-00226	EPA 8260 modified

* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.
* Results relate only to the items tested.

(1) Sample(s) analyzed using methodologies that have been subjected to Maxxam's standard validation process for the submitted matrix however is not an Accredited method.

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.

CHRISTINE MCLEAN, Project Manager
Email: christine.mclean@maxxamanalytics.com
Phone# (905) 817-5700

==========

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. SCC and CALA have approved this reporting process and electronic report format.

For Service Group specific validation please refer to the Validation Signature Page

Total cover pages: 1

R2-0001548

Maxxam Job #: B025983
Report Date: 2010/03/18

Golder Associates Ltd
Client Project #: 09-1223-3026

Your P.O. #: ISCO-NY

VOLATILE ORGANICS BY GC/MS (WATER)

Maxxam ID		FG0058		FG0059	FG0059		FG0060		FG0061		FG0062		
Sampling Date		2010/03/01		2010/03/01	2010/03/01		2010/03/01		2010/03/01		2010/03/01		
	Units	CO-A1 D1-T3	RDL	CO-A1 D2-T3	CO-A1 D2-T3 Lab-Dup	RDL	CO-A1 D3-T3	RDL	CO-A2 D1-T3	RDL	CO-A2 D2-T3	RDL	QC Batch
Volatile Organics													
1,2,3-Trichlorobenzene	ug/L	<1	1	<5	<5	5	<10	10	<1	1	<50	50	2093535
1,2,4-Trichlorobenzene	ug/L	<1	1	<5	<5	5	<10	10	<1	1	<50	50	2093535
1,4-Dioxane	ug/L	<50	50	<200		200	<500	500	1100	50	<2000	2000	2093536
Acetone (2-Propanone)	ug/L	<30	30	<100	<100	100	<300	300	44	30	<1000	1000	2093512
Benzene	ug/L	<0.3	0.3	<1	<1	1	<3	3	24	0.3	<10	10	2093512
Bromodichloromethane	ug/L	<0.3	0.3	<1	<1	1	<3	3	<0.3	0.3	<10	10	2093512
Bromoform	ug/L	<0.5	0.5	<2	<2	2	<5	5	6.2	0.5	<20	20	2093512
Bromomethane	ug/L	<1	1	<5	<5	5	<10	10	<1	1	1300	50	2093512
Carbon Tetrachloride	ug/L	<0.3	0.3	<1	<1	1	<3	3	<0.3	0.3	<10	10	2093512
Chlorobenzene	ug/L	<0.3	0.3	<1	<1	1	<3	3	<0.3	0.3	<10	10	2093512
Chloroform	ug/L	<0.3	0.3	<1	<1	1	<3	3	<0.3	0.3	<10	10	2093512
Dibromochloromethane	ug/L	<0.5	0.5	<2	<2	2	<5	5	<0.5	0.5	<20	20	2093512
1,2-Dichlorobenzene	ug/L	<0.5	0.5	<2	<2	2	<5	5	<0.5	0.5	<20	20	2093512
Methyl Acetate	ug/L	<3	3	<10	<10	10	<30	30	<3	3	<100	100	2093535
1,1,2-Trichlorotrifluoroethane	ug/L	<0.5	0.5	<2	<2	2	<5	5	<0.5	0.5	<20	20	2093535
1,3-Dichlorobenzene	ug/L	<0.5	0.5	<2	<2	2	<5	5	<0.5	0.5	<20	20	2093512
1,4-Dichlorobenzene	ug/L	<0.5	0.5	<2	<2	2	<5	5	<0.5	0.5	<20	20	2093512
Carbon Disulfide	ug/L	<1	1	<5	<5	5	<10	10	<1	1	<50	50	2093535
Dichlorodifluoromethane (FREON 12)	ug/L	<1	1	<5	<5	5	<10	10	<1	1	<50	50	2093512
1,1-Dichloroethane	ug/L	<0.3	0.3	<1	<1	1	<3	3	29	0.3	38	10	2093512
1,2-Dichloroethane	ug/L	<0.5	0.5	<2	<2	2	<5	5	<2(1)	2	<20	20	2093512
1,1-Dichloroethylene	ug/L	<0.3	0.3	<1	<1	1	<3	3	<0.3	0.3	<10	10	2093512
cis-1,2-Dichloroethylene	ug/L	<0.3	0.3	<1	<1	1	<3	3	1.1	0.3	<10	10	2093512
trans-1,2-Dichloroethylene	ug/L	<0.3	0.3	<1	<1	1	<3	3	<0.3	0.3	<10	10	2093512
1,2-Dichloropropane	ug/L	<0.3	0.3	<1	<1	1	<3	3	<0.3	0.3	<10	10	2093512
cis-1,3-Dichloropropene	ug/L	<0.5	0.5	<2	<2	2	<5	5	<0.5	0.5	<20	20	2093512
trans-1,3-Dichloropropene	ug/L	<0.5	0.5	<2	<2	2	<5	5	<0.5	0.5	<20	20	2093512
Ethylbenzene	ug/L	<0.3	0.3	<1	<1	1	<3	3	<0.3	0.3	<10	10	2093512
Ethylene Dibromide	ug/L	<0.5	0.5	<2	<2	2	<5	5	0.7	0.5	<20	20	2093512
Cyclohexane	ug/L	<1	1	<5	<5	5	<10	10	<1	1	<50	50	2093535
Methylene Chloride(Dichloromethane)	ug/L	<1	1	<5	<5	5	<10	10	1	1	390	50	2093512
Methyl Isobutyl Ketone	ug/L	<10	10	<50	<50	50	<100	100	<10	10	<500	500	2093512

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
(1) - Detection limit for 1,2-dichloroethane was raised due to interference from coeluting benzene.

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R2-0001549

Maxxam Job #: B025983
Report Date: 2010/03/18

Golder Associates Ltd
Client Project #: 09-1223-3026

Your P.O. #: ISCO-NY

VOLATILE ORGANICS BY GC/MS (WATER)

Maxxam ID		FG0058		FG0059	FG0059		FG0060		FG0061		FG0062		
Sampling Date		2010/03/01		2010/03/01	2010/03/01		2010/03/01		2010/03/01		2010/03/01		
	Units	CO-A1 D1-T3	RDL	CO-A1 D2-T3	CO-A1 D2-T3 Lab-Dup	RDL	CO-A1 D3-T3	RDL	CO-A2 D1-T3	RDL	CO-A2 D2-T3	RDL	QC Batch
Methyl Ethyl Ketone (2-Butanone)	ug/L	<10	10	<50	<50	50	<100	100	<10	10	<500	500	2093512
Methyl t-butyl ether (MTBE)	ug/L	<0.5	0.5	<2	<2	2	<5	5	<0.5	0.5	<20	20	2093512
Styrene	ug/L	<0.5	0.5	<2	<2	2	<5	5	<0.5	0.5	<20	20	2093512
1,1,1,2-Tetrachloroethane	ug/L	<0.3	0.3	<1	<1	1	<3	3	<0.3	0.3	<10	10	2093512
1,1,2,2-Tetrachloroethane	ug/L	<0.5	0.5	<2	<2	2	<5	5	<0.5	0.5	<20	20	2093512
Tetrachloroethylene	ug/L	<0.3	0.3	<1	<1	1	<3	3	<0.3	0.3	<10	10	2093512
Toluene	ug/L	<0.5	0.5	<2	<2	2	<5	5	<0.5	0.5	<20	20	2093512
1,1,1-Trichloroethane	ug/L	<0.3	0.3	<1	<1	1	<3	3	<0.3	0.3	<10	10	2093512
1,1,2-Trichloroethane	ug/L	<0.5	0.5	<2	<2	2	<5	5	<0.5	0.5	<20	20	2093512
Trichloroethylene	ug/L	<0.3	0.3	<1	<1	1	<3	3	1.9	0.3	<10	10	2093512
Vinyl Chloride	ug/L	<0.5	0.5	<2	<2	2	<5	5	<0.5	0.5	<20	20	2093512
p+m-Xylene	ug/L	<0.3	0.3	<1	<1	1	<3	3	<0.3	0.3	<10	10	2093512
o-Xylene	ug/L	<0.3	0.3	<1	<1	1	<3	3	<0.3	0.3	<10	10	2093512
Xylene (Total)	ug/L	<0.3	0.3	<1	<1	1	<3	3	<0.3	0.3	<10	10	2093512
Methyl Butyl Ketone (2-Hexanone)	ug/L	<10	10	<50	<50	50	<100	100	<10	10	<500	500	2093535
Chloroethane	ug/L	<0.5	0.5	<2	<2	2	<5	5	44	0.5	59	20	2093512
Chloromethane	ug/L	<1	1	<5	<5	5	<10	10	<1	1	7800	50	2093512
Trichlorofluoromethane (FREON 11)	ug/L	<0.5	0.5	<2	<2	2	<5	5	<0.5	0.5	<20	20	2093512
Surrogate Recovery (%)													
4-Bromofluorobenzene	%	99		99	97		98		97		96		2093512
D4-1,2-Dichloroethane	%	109		111	112		114		111		117		2093512
D6-Benzene	%	120		113			103		92		78		2093536
D8-Toluene	%	101		100	100		99		101		99		2093512

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

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R2-0001550

Maxxam Job #: B025983
Report Date: 2010/03/18

Golder Associates Ltd
Client Project #: 09-1223-3026

Your P.O. #: ISCO-NY

VOLATILE ORGANICS BY GC/MS (WATER)

Maxxam ID		FG0063		FG0064		FG0065		FG0066	FG0066		
Sampling Date		2010/03/01		2010/03/01		2010/03/01		2010/03/01	2010/03/01		
	Units	CO-A2 D3-T3	RDL	CO-C-T3	RDL	DUP-2	RDL	DUP-4	DUP-4 Lab-Dup	RDL	QC Batch
Volatile Organics											
1,2,3-Trichlorobenzene	ug/L	<300	300	<1	1	<10	10	<300		300	2093535
1,2,4-Trichlorobenzene	ug/L	<300	300	<1	1	<10	10	<300		300	2093535
1,4-Dioxane	ug/L	<10000	10000	1100	40	550	500	<10000	<10000	10000	2093536
Acetone (2-Propanone)	ug/L	<5000	5000	<20	20	<300	300	<5000		5000	2093512
Benzene	ug/L	<50	50	<0.2	0.2	<3	3	<50		50	2093512
Bromodichloromethane	ug/L	<50	50	<0.2	0.2	<3	3	<50		50	2093512
Bromoform	ug/L	<100	100	<0.4	0.4	<5	5	<100		100	2093512
Bromomethane	ug/L	2500	300	<1	1	<10	10	2400		300	2093512
Carbon Tetrachloride	ug/L	<50	50	<0.2	0.2	<3	3	<50		50	2093512
Chlorobenzene	ug/L	<50	50	<0.2	0.2	<3	3	<50		50	2093512
Chloroform	ug/L	150	50	0.2	0.2	<3	3	140		50	2093512
Dibromochloromethane	ug/L	<100	100	<0.4	0.4	<5	5	<100		100	2093512
1,2-Dichlorobenzene	ug/L	<100	100	<0.4	0.4	<5	5	<100		100	2093512
Methyl Acetate	ug/L	<500	500	<2	2	<30	30	<500		500	2093535
1,1,2-Trichlorotrifluoroethane	ug/L	<100	100	<0.4	0.4	<5	5	<100		100	2093535
1,3-Dichlorobenzene	ug/L	<100	100	<0.4	0.4	<5	5	<100		100	2093512
1,4-Dichlorobenzene	ug/L	<100	100	<0.4	0.4	<5	5	<100		100	2093512
Carbon Disulfide	ug/L	<300	300	<1	1	<10	10	<300		300	2093535
Dichlorodifluoromethane (FREON 12)	ug/L	<300	300	<1	1	<10	10	<300		300	2093512
1,1-Dichloroethane	ug/L	150	50	32	0.2	<3	3	150		50	2093512
1,2-Dichloroethane	ug/L	<100	100	<0.4	0.4	<5	5	<100		100	2093512
1,1-Dichloroethylene	ug/L	<50	50	<0.2	0.2	<3	3	<50		50	2093512
cis-1,2-Dichloroethylene	ug/L	<50	50	1.2	0.2	<3	3	<50		50	2093512
trans-1,2-Dichloroethylene	ug/L	<50	50	<0.2	0.2	<3	3	<50		50	2093512
1,2-Dichloropropane	ug/L	<50	50	<0.2	0.2	<3	3	<50		50	2093512
cis-1,3-Dichloropropene	ug/L	<100	100	<0.4	0.4	<5	5	<100		100	2093512
trans-1,3-Dichloropropene	ug/L	<100	100	<0.4	0.4	<5	5	<100		100	2093512
Ethylbenzene	ug/L	<50	50	<0.2	0.2	<3	3	<50		50	2093512
Ethylene Dibromide	ug/L	<100	100	<0.4	0.4	<5	5	<100		100	2093512
Cyclohexane	ug/L	<300	300	<1	1	<10	10	<300		300	2093535
Methylene Chloride(Dichloromethane)	ug/L	5600	300	<1	1	<10	10	5800		300	2093512
Methyl Isobutyl Ketone	ug/L	<3000	3000	<10	10	<100	100	<3000		3000	2093512
Methyl Ethyl Ketone (2-Butanone)	ug/L	<3000	3000	<10	10	<100	100	<3000		3000	2093512

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

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R2-0001551

Maxxam Job #: B025983
Report Date: 2010/03/18

Golder Associates Ltd
Client Project #: 09-1223-3026

Your P.O. #: ISCO-NY

VOLATILE ORGANICS BY GC/MS (WATER)

Maxxam ID		FG0063		FG0064		FG0065		FG0066	FG0066		
Sampling Date		2010/03/01		2010/03/01		2010/03/01		2010/03/01	2010/03/01		
	Units	**CO-A2 D3-T3**	**RDL**	**CO-C-T3**	**RDL**	**DUP-2**	**RDL**	**DUP-4**	**DUP-4 Lab-Dup**	**RDL**	**QC Batch**
Methyl t-butyl ether (MTBE)	ug/L	<100	100	<0.4	0.4	<5	5	<100		100	2093512
Styrene	ug/L	<100	100	<0.4	0.4	<5	5	<100		100	2093512
1,1,1,2-Tetrachloroethane	ug/L	<50	50	<0.2	0.2	<3	3	<50		50	2093512
1,1,2,2-Tetrachloroethane	ug/L	<100	100	<0.4	0.4	<5	5	<100		100	2093512
Tetrachloroethylene	ug/L	<50	50	<0.2	0.2	<3	3	<50		50	2093512
Toluene	ug/L	<100	100	<0.4	0.4	<5	5	<100		100	2093512
1,1,1-Trichloroethane	ug/L	<50	50	<0.2	0.2	<3	3	<50		50	2093512
1,1,2-Trichloroethane	ug/L	<100	100	<0.4	0.4	<5	5	<100		100	2093512
Trichloroethylene	ug/L	<50	50	2.7	0.2	<3	3	<50		50	2093512
Vinyl Chloride	ug/L	<100	100	<0.4	0.4	<5	5	<100		100	2093512
p+m-Xylene	ug/L	<50	50	<0.2	0.2	<3	3	<50		50	2093512
o-Xylene	ug/L	<50	50	<0.2	0.2	<3	3	<50		50	2093512
Xylene (Total)	ug/L	<50	50	<0.2	0.2	<3	3	<50		50	2093512
Methyl Butyl Ketone (2-Hexanone)	ug/L	<3000	3000	<10	10	<100	100	<3000		3000	2093535
Chloroethane	ug/L	<100	100	42	0.4	<5	5	<100		100	2093512
Chloromethane	ug/L	72000	300	<1	1	<10	10	74000		300	2093512
Trichlorofluoromethane (FREON 11)	ug/L	<100	100	<0.4	0.4	<5	5	<100		100	2093512
Surrogate Recovery (%)											
4-Bromofluorobenzene	%	95		98		98		95			2093512
D4-1,2-Dichloroethane	%	115		115		120		119			2093512
D6-Benzene	%	70		85		111		65	90		2093536
D8-Toluene	%	98		102		101		99			2093512

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

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R2-0001552

Maxxam Job #: B025983
Report Date: 2010/03/18

Golder Associates Ltd
Client Project #: 09-1223-3026

Your P.O. #: ISCO-NY

GENERAL COMMENTS

VOC Analysis: Due to foaming and/or due to high concentrations of target / non-target analytes, the samples required dilution. Detection limits were adjusted accordingly.

Revised report: The result for vinyl chloride in "Dup-4" has been corrected.

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R2-0001553

Maxxam Job #: B025983
Report Date: 2010/03/18

Golder Associates Ltd
Client Project #: 09-1223-3026

Your P.O. #: ISCO-NY

QUALITY ASSURANCE REPORT

			Matrix Spike		Spiked Blank		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	Units	Value (%)	QC Limits
2093512	4-Bromofluorobenzene	2010/03/09	98	70 - 130	102	70 - 130	96	%		
2093512	D4-1,2-Dichloroethane	2010/03/09	94	70 - 130	95	70 - 130	96	%		
2093512	D8-Toluene	2010/03/09	100	70 - 130	102	70 - 130	101	%		
2093512	Acetone (2-Propanone)	2010/03/09	117	60 - 140	113	60 - 140	<10	ug/L	NC	40
2093512	Benzene	2010/03/09	102	70 - 130	104	70 - 130	<0.1	ug/L	NC	40
2093512	Bromodichloromethane	2010/03/09	79	70 - 130	103	70 - 130	<0.1	ug/L	NC	40
2093512	Bromoform	2010/03/09	85	70 - 130	106	70 - 130	<0.2	ug/L	NC	40
2093512	Bromomethane	2010/03/09	90	60 - 140	91	60 - 140	<0.5	ug/L	NC	40
2093512	Carbon Tetrachloride	2010/03/09	103	70 - 130	108	70 - 130	<0.1	ug/L	NC	40
2093512	Chlorobenzene	2010/03/09	102	70 - 130	104	70 - 130	<0.1	ug/L	NC	40
2093512	Chloroform	2010/03/09	99	70 - 130	103	70 - 130	<0.1	ug/L	NC	40
2093512	Dibromochloromethane	2010/03/09	81	70 - 130	104	70 - 130	<0.2	ug/L	NC	40
2093512	1,2-Dichlorobenzene	2010/03/09	99	70 - 130	101	70 - 130	<0.2	ug/L	NC	40
2093512	1,3-Dichlorobenzene	2010/03/09	105	70 - 130	105	70 - 130	<0.2	ug/L	NC	40
2093512	1,4-Dichlorobenzene	2010/03/09	105	70 - 130	107	70 - 130	<0.2	ug/L	NC	40
2093512	Dichlorodifluoromethane (FREON 12)	2010/03/09	82	60 - 140	90	60 - 140	<0.5	ug/L	NC	40
2093512	1,1-Dichloroethane	2010/03/09	99	70 - 130	101	70 - 130	<0.1	ug/L	NC	40
2093512	1,2-Dichloroethane	2010/03/09	100	70 - 130	103	70 - 130	<0.2	ug/L	NC	40
2093512	1,1-Dichloroethylene	2010/03/09	192(1, 2)	70 - 130	114	70 - 130	<0.1	ug/L	NC	40
2093512	cis-1,2-Dichloroethylene	2010/03/09	105	70 - 130	108	70 - 130	<0.1	ug/L	NC	40
2093512	trans-1,2-Dichloroethylene	2010/03/09	101	70 - 130	108	70 - 130	<0.1	ug/L	NC	40
2093512	1,2-Dichloropropane	2010/03/09	108	70 - 130	111	70 - 130	<0.1	ug/L	NC	40
2093512	cis-1,3-Dichloropropene	2010/03/09	91	70 - 130	95	70 - 130	<0.2	ug/L	NC	40
2093512	trans-1,3-Dichloropropene	2010/03/09	97	70 - 130	105	70 - 130	<0.2	ug/L	NC	40
2093512	Ethylbenzene	2010/03/09	108	70 - 130	112	70 - 130	<0.1	ug/L	NC	40
2093512	Ethylene Dibromide	2010/03/09	102	70 - 130	105	70 - 130	<0.2	ug/L	NC	40
2093512	Methylene Chloride(Dichloromethane)	2010/03/09	104	70 - 130	106	70 - 130	<0.5	ug/L	NC	40
2093512	Methyl Isobutyl Ketone	2010/03/09	95	70 - 130	90	70 - 130	<5	ug/L	NC	40
2093512	Methyl Ethyl Ketone (2-Butanone)	2010/03/09	113	60 - 140	106	60 - 140	<5	ug/L	NC	40
2093512	Methyl t-butyl ether (MTBE)	2010/03/09	109	70 - 130	108	70 - 130	<0.2	ug/L	NC	40
2093512	Styrene	2010/03/09	20(1, 3)	70 - 130	99	70 - 130	<0.2	ug/L	NC	40
2093512	1,1,1,2-Tetrachloroethane	2010/03/09	91	70 - 130	101	70 - 130	<0.1	ug/L	NC	40
2093512	1,1,2,2-Tetrachloroethane	2010/03/09	0.00(1, 3)	70 - 130	99	70 - 130	<0.2	ug/L	NC	40
2093512	Tetrachloroethylene	2010/03/09	101	70 - 130	106	70 - 130	<0.1	ug/L	NC	40
2093512	Toluene	2010/03/09	102	70 - 130	106	70 - 130	<0.2	ug/L	NC	40
2093512	1,1,1-Trichloroethane	2010/03/09	98	70 - 130	101	70 - 130	<0.1	ug/L	NC	40
2093512	1,1,2-Trichloroethane	2010/03/09	51(1, 3)	70 - 130	100	70 - 130	<0.2	ug/L	NC	40
2093512	Trichloroethylene	2010/03/09	286(1, 2)	70 - 130	105	70 - 130	<0.1	ug/L	NC	40
2093512	Vinyl Chloride	2010/03/09	89	70 - 130	96	70 - 130	<0.2	ug/L	NC	40

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R2-0001554

Maxxam Job #: B025983
Report Date: 2010/03/18

Golder Associates Ltd
Client Project #: 09-1223-3026

Your P.O. #: ISCO-NY

QUALITY ASSURANCE REPORT

			Matrix Spike		Spiked Blank		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	Units	Value (%)	QC Limits
2093512	p+m-Xylene	2010/03/09	107	70 - 130	114	70 - 130	<0.1	ug/L	NC	40
2093512	o-Xylene	2010/03/09	90	70 - 130	96	70 - 130	<0.1	ug/L	NC	40
2093512	Chloroethane	2010/03/09	101	70 - 130	98	70 - 130	<0.2	ug/L	NC	40
2093512	Chloromethane	2010/03/09	95	60 - 140	94	60 - 140	<0.5	ug/L	NC	40
2093512	Trichlorofluoromethane (FREON 11)	2010/03/09	93	70 - 130	102	70 - 130	<0.2	ug/L	NC	40
2093512	Xylene (Total)	2010/03/09					<0.1	ug/L	NC	40
2093535	1,2,3-Trichlorobenzene	2010/03/09			99	70 - 130	<0.5	ug/L	NC	40
2093535	1,2,4-Trichlorobenzene	2010/03/09			97	70 - 130	<0.5	ug/L	NC	40
2093535	Methyl Acetate	2010/03/09			117	60 - 140	<1	ug/L	NC	40
2093535	1,1,2-Trichlorotrifluoroethane	2010/03/09			109	60 - 140	<0.2	ug/L	NC	40
2093535	Carbon Disulfide	2010/03/09			128	60 - 140	<0.5	ug/L	NC	40
2093535	Cyclohexane	2010/03/09			106	60 - 140	<0.5	ug/L	NC	40
2093535	Methyl Butyl Ketone (2-Hexanone)	2010/03/09			125	60 - 140	<5	ug/L	NC	40
2093536	D6-Benzene	2010/03/10	60	60 - 140	106	60 - 140	106	%		
2093536	1,4-Dioxane	2010/03/10	97	60 - 140	108	60 - 140	<20	ug/L	NC	40

N/A = Not Applicable
RPD = Relative Percent Difference
Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.
Spiked Blank: A blank matrix to which a known amount of the analyte has been added. Used to evaluate analyte recovery.
Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.
Surrogate: A pure or isotopically labeled compound whose behavior mirrors the analytes of interest. Used to evaluate extraction efficiency.
NC (RPD): The RPD was not calculated. The level of analyte detected in the parent sample and its duplicate was not sufficiently significant to permit a reliable calculation.
(1) - Recovery or RPD for this parameter is outside control limits. The overall quality control for this analysis meets acceptability criteria.
(2) - The recovery was above the upper control limit. This may represent a high bias in some results for this specific analyte. For results that were not detected (ND), this potential bias has no impact. This may represent a low bias in some results for this specific analyte. This has been evaluated as being due to matrix effect associated with this particular sample and not the entire batch. Note:The sample was found to be strongly basic.
(3) - The recovery was below the lower control limit. This may represent a low bias in some results for this specific analyte. This has been evaluated as being due to matrix effect associated with this particular sample and not the entire batch. Note:The sample was found to be strongly basic.

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R2-0001555

Validation Signature Page

Maxxam Job #: B025983

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

BRAD NEWMAN, Scientific Specialist

CRISTINA CARRIERE, Scientific Services

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. SCC and CALA have approved this reporting process and electronic report format.

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Your P.O. #: ISCO-NY
Your Project #: 09-1223-3026
Your C.O.C. #: E786342, E-786342

Attention: Eric Bergeron
Golder Associates Ltd
9200 Boul L'Acadie
Bureau 10
Montreal, PQ
H4N 2T2

Report Date: 2010/04/09
This report supersedes all previous reports with the same Maxxam job number

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B025983
Received: 2010/03/04, 09:00

Sample Matrix: Water
Samples Received: 9

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Method Reference
1,4-Dioxane in water (1)	9	N/A	2010/03/10	CAM SOP-00226	EPA 8260 modified
Volatile Organic Compounds in Water	8	N/A	2010/03/09	CAM SOP-00226	EPA 8260 modified
Volatile Organic Compounds in Water	1	N/A	2010/03/10	CAM SOP-00226	EPA 8260 modified
Non-Routine Volatile Organic Compounds	9	N/A	2010/03/09	CAM SOP-00226	EPA 8260 modified

* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.
* Results relate only to the items tested.

(1) Sample(s) analyzed using methodologies that have been subjected to Maxxam's standard validation process for the submitted matrix however is not an Accredited method.

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.

CHRISTINE MCLEAN, Project Manager
Email: christine.mclean@maxxamanalytics.com
Phone# (905) 817-5700

==========

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Total cover pages: 1

R2-0001557

Maxxam Job #: B025983
Report Date: 2010/04/09

Golder Associates Ltd
Client Project #: 09-1223-3026

Your P.O. #: ISCO-NY

VOLATILE ORGANICS BY GC/MS (WATER)

Maxxam ID		FG0058		FG0059	FG0059		FG0060		FG0061		FG0062		
Sampling Date		2010/03/01		2010/03/01	2010/03/01		2010/03/01		2010/03/01		2010/03/01		
	Units	CO-A1 D1-T3	RDL	CO-A1 D2-T3	CO-A1 D2-T3 Lab-Dup	RDL	CO-A1 D3-T3	RDL	CO-A2 D1-T3	RDL	CO-A2 D2-T3	RDL	QC Batch
Volatile Organics													
1,2,3-Trichlorobenzene	ug/L	<1	1	<5	<5	5	<10	10	<1	1	<50	50	2093535
1,2,4-Trichlorobenzene	ug/L	<1	1	<5	<5	5	<10	10	<1	1	<50	50	2093535
1,4-Dioxane	ug/L	<50	50	<200		200	<500	500	1100	50	<2000	2000	2093536
Acetone (2-Propanone)	ug/L	<30	30	<100	<100	100	<300	300	44	30	<1000	1000	2093512
Benzene	ug/L	<0.3	0.3	<1	<1	1	<3	3	24	0.3	<10	10	2093512
Bromodichloromethane	ug/L	<0.3	0.3	<1	<1	1	<3	3	<0.3	0.3	<10	10	2093512
Bromoform	ug/L	<0.5	0.5	<2	<2	2	<5	5	6.2	0.5	<20	20	2093512
Bromomethane	ug/L	<1	1	<5	<5	5	<10	10	<1	1	1300	50	2093512
Carbon Tetrachloride	ug/L	<0.3	0.3	<1	<1	1	<3	3	<0.3	0.3	<10	10	2093512
Chlorobenzene	ug/L	<0.3	0.3	<1	<1	1	<3	3	<0.3	0.3	<10	10	2093512
Chloroform	ug/L	<0.3	0.3	<1	<1	1	<3	3	<0.3	0.3	<10	10	2093512
Dibromochloromethane	ug/L	<0.5	0.5	<2	<2	2	<5	5	<0.5	0.5	<20	20	2093512
1,2-Dichlorobenzene	ug/L	<0.5	0.5	<2	<2	2	<5	5	<0.5	0.5	<20	20	2093512
Methyl Acetate	ug/L	<3	3	<10	<10	10	<30	30	<3	3	<100	100	2093535
1,1,2-Trichlorotrifluoroethane	ug/L	<0.5	0.5	<2	<2	2	<5	5	<0.5	0.5	<20	20	2093535
1,3-Dichlorobenzene	ug/L	<0.5	0.5	<2	<2	2	<5	5	<0.5	0.5	<20	20	2093512
1,4-Dichlorobenzene	ug/L	<0.5	0.5	<2	<2	2	<5	5	<0.5	0.5	<20	20	2093512
Carbon Disulfide	ug/L	<1	1	<5	<5	5	<10	10	<1	1	<50	50	2093535
Dichlorodifluoromethane (FREON 12)	ug/L	<1	1	<5	<5	5	<10	10	<1	1	<50	50	2093512
1,1-Dichloroethane	ug/L	<0.3	0.3	<1	<1	1	<3	3	29	0.3	38	10	2093512
1,2-Dichloroethane	ug/L	<0.5	0.5	<2	<2	2	<5	5	<2(1)	2	<20	20	2093512
1,1-Dichloroethylene	ug/L	<0.3	0.3	<1	<1	1	<3	3	<0.3	0.3	<10	10	2093512
cis-1,2-Dichloroethylene	ug/L	<0.3	0.3	<1	<1	1	<3	3	1.1	0.3	<10	10	2093512
trans-1,2-Dichloroethylene	ug/L	<0.3	0.3	<1	<1	1	<3	3	<0.3	0.3	<10	10	2093512
1,2-Dichloropropane	ug/L	<0.3	0.3	<1	<1	1	<3	3	<0.3	0.3	<10	10	2093512
cis-1,3-Dichloropropene	ug/L	<0.5	0.5	<2	<2	2	<5	5	<0.5	0.5	<20	20	2093512
trans-1,3-Dichloropropene	ug/L	<0.5	0.5	<2	<2	2	<5	5	<0.5	0.5	<20	20	2093512
Ethylbenzene	ug/L	<0.3	0.3	<1	<1	1	<3	3	<0.3	0.3	<10	10	2093512
Ethylene Dibromide	ug/L	<0.5	0.5	<2	<2	2	<5	5	0.7	0.5	<20	20	2093512
Cyclohexane	ug/L	<1	1	<5	<5	5	<10	10	<1	1	<50	50	2093535
Methylene Chloride(Dichloromethane)	ug/L	<1	1	<5	<5	5	<10	10	1	1	390	50	2093512
Methyl Isobutyl Ketone	ug/L	<10	10	<50	<50	50	<100	100	<10	10	<500	500	2093512

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
(1) - Detection limit for 1,2-dichloroethane was raised due to interference from coeluting benzene.

R2-0001558

Maxxam Job #: B025983
Report Date: 2010/04/09

Golder Associates Ltd
Client Project #: 09-1223-3026

Your P.O. #: ISCO-NY

VOLATILE ORGANICS BY GC/MS (WATER)

Maxxam ID		FG0058		FG0059	FG0059		FG0060		FG0061		FG0062		
Sampling Date		2010/03/01		2010/03/01	2010/03/01		2010/03/01		2010/03/01		2010/03/01		
	Units	CO-A1 D1-T3	RDL	CO-A1 D2-T3	CO-A1 D2-T3 Lab-Dup	RDL	CO-A1 D3-T3	RDL	CO-A2 D1-T3	RDL	CO-A2 D2-T3	RDL	QC Batch
Methyl Ethyl Ketone (2-Butanone)	ug/L	<10	10	<50	<50	50	<100	100	<10	10	<500	500	2093512
Methyl t-butyl ether (MTBE)	ug/L	<0.5	0.5	<2	<2	2	<5	5	<0.5	0.5	<20	20	2093512
Styrene	ug/L	<0.5	0.5	<2	<2	2	<5	5	<0.5	0.5	<20	20	2093512
1,1,1,2-Tetrachloroethane	ug/L	<0.3	0.3	<1	<1	1	<3	3	<0.3	0.3	<10	10	2093512
1,1,2,2-Tetrachloroethane	ug/L	<0.5	0.5	<2	<2	2	<5	5	<0.5	0.5	<20	20	2093512
Tetrachloroethylene	ug/L	<0.3	0.3	<1	<1	1	<3	3	<0.3	0.3	<10	10	2093512
Toluene	ug/L	<0.5	0.5	<2	<2	2	<5	5	<0.5	0.5	<20	20	2093512
1,1,1-Trichloroethane	ug/L	<0.3	0.3	<1	<1	1	<3	3	<0.3	0.3	<10	10	2093512
1,1,2-Trichloroethane	ug/L	<0.5	0.5	<2	<2	2	<5	5	<0.5	0.5	<20	20	2093512
Trichloroethylene	ug/L	<0.3	0.3	<1	<1	1	<3	3	1.9	0.3	<10	10	2093512
Vinyl Chloride	ug/L	<0.5	0.5	<2	<2	2	<5	5	<0.5	0.5	<20	20	2093512
p+m-Xylene	ug/L	<0.3	0.3	<1	<1	1	<3	3	<0.3	0.3	<10	10	2093512
o-Xylene	ug/L	<0.3	0.3	<1	<1	1	<3	3	<0.3	0.3	<10	10	2093512
Xylene (Total)	ug/L	<0.3	0.3	<1	<1	1	<3	3	<0.3	0.3	<10	10	2093512
Methyl Butyl Ketone (2-Hexanone)	ug/L	<10	10	<50	<50	50	<100	100	<10	10	<500	500	2093535
Chloroethane	ug/L	<0.5	0.5	<2	<2	2	<5	5	44	0.5	59	20	2093512
Chloromethane	ug/L	<1	1	<5	<5	5	<10	10	<1	1	7800	50	2093512
Trichlorofluoromethane (FREON 11)	ug/L	<0.5	0.5	<2	<2	2	<5	5	<0.5	0.5	<20	20	2093512
Surrogate Recovery (%)													
4-Bromofluorobenzene	%	99		99	97		98		97		96		2093512
D4-1,2-Dichloroethane	%	109		111	112		114		111		117		2093512
D6-Benzene	%	120		113			103		92		78		2093536
D8-Toluene	%	101		100	100		99		101		99		2093512

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

R2-0001559

Maxxam Job #: B025983
Report Date: 2010/04/09

Golder Associates Ltd
Client Project #: 09-1223-3026

Your P.O. #: ISCO-NY

VOLATILE ORGANICS BY GC/MS (WATER)

Maxxam ID		FG0063		FG0064		FG0065		FG0066	FG0066		
Sampling Date		2010/03/01		2010/03/01		2010/03/01		2010/03/01	2010/03/01		
	Units	CO-A2 D3-T3	RDL	CO-C-T3	RDL	DUP-2	RDL	DUP-4	DUP-4 Lab-Dup	RDL	QC Batch
Volatile Organics											
1,2,3-Trichlorobenzene	ug/L	<300	300	<1	1	<10	10	<300		300	2093535
1,2,4-Trichlorobenzene	ug/L	<300	300	<1	1	<10	10	<300		300	2093535
1,4-Dioxane	ug/L	<10000	10000	1100	40	<600(1)	600	<10000	<10000	10000	2093536
Acetone (2-Propanone)	ug/L	<5000	5000	<20	20	<300	300	<5000		5000	2093512
Benzene	ug/L	<50	50	<0.2	0.2	<3	3	<50		50	2093512
Bromodichloromethane	ug/L	<50	50	<0.2	0.2	<3	3	<50		50	2093512
Bromoform	ug/L	<100	100	<0.4	0.4	<5	5	<100		100	2093512
Bromomethane	ug/L	2500	300	<1	1	<10	10	2400		300	2093512
Carbon Tetrachloride	ug/L	<50	50	<0.2	0.2	<3	3	<50		50	2093512
Chlorobenzene	ug/L	<50	50	<0.2	0.2	<3	3	<50		50	2093512
Chloroform	ug/L	150	50	0.2	0.2	<3	3	140		50	2093512
Dibromochloromethane	ug/L	<100	100	<0.4	0.4	<5	5	<100		100	2093512
1,2-Dichlorobenzene	ug/L	<100	100	<0.4	0.4	<5	5	<100		100	2093512
Methyl Acetate	ug/L	<500	500	<2	2	<30	30	<500		500	2093535
1,1,2-Trichlorotrifluoroethane	ug/L	<100	100	<0.4	0.4	<5	5	<100		100	2093535
1,3-Dichlorobenzene	ug/L	<100	100	<0.4	0.4	<5	5	<100		100	2093512
1,4-Dichlorobenzene	ug/L	<100	100	<0.4	0.4	<5	5	<100		100	2093512
Carbon Disulfide	ug/L	<300	300	<1	1	<10	10	<300		300	2093535
Dichlorodifluoromethane (FREON 12)	ug/L	<300	300	<1	1	<10	10	<300		300	2093512
1,1-Dichloroethane	ug/L	150	50	32	0.2	<3	3	150		50	2093512
1,2-Dichloroethane	ug/L	<100	100	<0.4	0.4	<5	5	<100		100	2093512
1,1-Dichloroethylene	ug/L	<50	50	<0.2	0.2	<3	3	<50		50	2093512
cis-1,2-Dichloroethylene	ug/L	<50	50	1.2	0.2	<3	3	<50		50	2093512
trans-1,2-Dichloroethylene	ug/L	<50	50	<0.2	0.2	<3	3	<50		50	2093512
1,2-Dichloropropane	ug/L	<50	50	<0.2	0.2	<3	3	<50		50	2093512
cis-1,3-Dichloropropene	ug/L	<100	100	<0.4	0.4	<5	5	<100		100	2093512
trans-1,3-Dichloropropene	ug/L	<100	100	<0.4	0.4	<5	5	<100		100	2093512
Ethylbenzene	ug/L	<50	50	<0.2	0.2	<3	3	<50		50	2093512
Ethylene Dibromide	ug/L	<100	100	<0.4	0.4	<5	5	<100		100	2093512
Cyclohexane	ug/L	<300	300	<1	1	<10	10	<300		300	2093535
Methylene Chloride(Dichloromethane)	ug/L	5600	300	<1	1	<10	10	5800		300	2093512
Methyl Isobutyl Ketone	ug/L	<3000	3000	<10	10	<100	100	<3000		3000	2093512

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
(1) - Original value reported has been determined to be unreliable. Reporting limit has been revised to the minimum level for which it can be confidently stated.

R2-0001560

Maxxam Job #: B025983
Report Date: 2010/04/09

Golder Associates Ltd
Client Project #: 09-1223-3026

Your P.O. #: ISCO-NY

VOLATILE ORGANICS BY GC/MS (WATER)

Maxxam ID		FG0063		FG0064		FG0065		FG0066	FG0066		
Sampling Date		2010/03/01		2010/03/01		2010/03/01		2010/03/01	2010/03/01		
	Units	CO-A2 D3-T3	RDL	CO-C-T3	RDL	DUP-2	RDL	DUP-4	DUP-4 Lab-Dup	RDL	QC Batch
Methyl Ethyl Ketone (2-Butanone)	ug/L	<3000	3000	<10	10	<100	100	<3000		3000	2093512
Methyl t-butyl ether (MTBE)	ug/L	<100	100	<0.4	0.4	<5	5	<100		100	2093512
Styrene	ug/L	<100	100	<0.4	0.4	<5	5	<100		100	2093512
1,1,1,2-Tetrachloroethane	ug/L	<50	50	<0.2	0.2	<3	3	<50		50	2093512
1,1,2,2-Tetrachloroethane	ug/L	<100	100	<0.4	0.4	<5	5	<100		100	2093512
Tetrachloroethylene	ug/L	<50	50	<0.2	0.2	<3	3	<50		50	2093512
Toluene	ug/L	<100	100	<0.4	0.4	<5	5	<100		100	2093512
1,1,1-Trichloroethane	ug/L	<50	50	<0.2	0.2	<3	3	<50		50	2093512
1,1,2-Trichloroethane	ug/L	<100	100	<0.4	0.4	<5	5	<100		100	2093512
Trichloroethylene	ug/L	<50	50	2.7	0.2	<3	3	<50		50	2093512
Vinyl Chloride	ug/L	<100	100	<0.4	0.4	<5	5	<100		100	2093512
p+m-Xylene	ug/L	<50	50	<0.2	0.2	<3	3	<50		50	2093512
o-Xylene	ug/L	<50	50	<0.2	0.2	<3	3	<50		50	2093512
Xylene (Total)	ug/L	<50	50	<0.2	0.2	<3	3	<50		50	2093512
Methyl Butyl Ketone (2-Hexanone)	ug/L	<3000	3000	<10	10	<100	100	<3000		3000	2093535
Chloroethane	ug/L	<100	100	42	0.4	<5	5	<100		100	2093512
Chloromethane	ug/L	72000	300	<1	1	<10	10	74000		300	2093512
Trichlorofluoromethane (FREON 11)	ug/L	<100	100	<0.4	0.4	<5	5	<100		100	2093512
Surrogate Recovery (%)											
4-Bromofluorobenzene	%	95		98		98		95			2093512
D4-1,2-Dichloroethane	%	115		115		120		119			2093512
D6-Benzene	%	70		85		111		65	90		2093536
D8-Toluene	%	98		102		101		99			2093512

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

R2-0001561

Maxxam Job #: B025983
Report Date: 2010/04/09

Golder Associates Ltd
Client Project #: 09-1223-3026

Your P.O. #: ISCO-NY

GENERAL COMMENTS

VOC Analysis: Due to foaming and/or due to high concentrations of target / non-target analytes, the samples required dilution. Detection limits were adjusted accordingly.

Revised report: The result for vinyl chloride in "Dup-4" has been corrected.

R2-0001562

Maxxam Job #: B025983
Report Date: 2010/04/09

Golder Associates Ltd
Client Project #: 09-1223-3026

Your P.O. #: ISCO-NY

QUALITY ASSURANCE REPORT

			Matrix Spike		Spiked Blank		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	Units	Value (%)	QC Limits
2093512	4-Bromofluorobenzene	2010/03/09	98	70 - 130	102	70 - 130	96	%		
2093512	D4-1,2-Dichloroethane	2010/03/09	94	70 - 130	95	70 - 130	96	%		
2093512	D8-Toluene	2010/03/09	100	70 - 130	102	70 - 130	101	%		
2093512	Acetone (2-Propanone)	2010/03/09	117	60 - 140	113	60 - 140	<10	ug/L	NC	40
2093512	Benzene	2010/03/09	102	70 - 130	104	70 - 130	<0.1	ug/L	NC	40
2093512	Bromodichloromethane	2010/03/09	79	70 - 130	103	70 - 130	<0.1	ug/L	NC	40
2093512	Bromoform	2010/03/09	85	70 - 130	106	70 - 130	<0.2	ug/L	NC	40
2093512	Bromomethane	2010/03/09	90	60 - 140	91	60 - 140	<0.5	ug/L	NC	40
2093512	Carbon Tetrachloride	2010/03/09	103	70 - 130	108	70 - 130	<0.1	ug/L	NC	40
2093512	Chlorobenzene	2010/03/09	102	70 - 130	104	70 - 130	<0.1	ug/L	NC	40
2093512	Chloroform	2010/03/09	99	70 - 130	103	70 - 130	<0.1	ug/L	NC	40
2093512	Dibromochloromethane	2010/03/09	81	70 - 130	104	70 - 130	<0.2	ug/L	NC	40
2093512	1,2-Dichlorobenzene	2010/03/09	99	70 - 130	101	70 - 130	<0.2	ug/L	NC	40
2093512	1,3-Dichlorobenzene	2010/03/09	105	70 - 130	105	70 - 130	<0.2	ug/L	NC	40
2093512	1,4-Dichlorobenzene	2010/03/09	105	70 - 130	107	70 - 130	<0.2	ug/L	NC	40
2093512	Dichlorodifluoromethane (FREON 12)	2010/03/09	82	60 - 140	90	60 - 140	<0.5	ug/L	NC	40
2093512	1,1-Dichloroethane	2010/03/09	99	70 - 130	101	70 - 130	<0.1	ug/L	NC	40
2093512	1,2-Dichloroethane	2010/03/09	100	70 - 130	103	70 - 130	<0.2	ug/L	NC	40
2093512	1,1-Dichloroethylene	2010/03/09	192(1, 2)	70 - 130	114	70 - 130	<0.1	ug/L	NC	40
2093512	cis-1,2-Dichloroethylene	2010/03/09	105	70 - 130	108	70 - 130	<0.1	ug/L	NC	40
2093512	trans-1,2-Dichloroethylene	2010/03/09	101	70 - 130	108	70 - 130	<0.1	ug/L	NC	40
2093512	1,2-Dichloropropane	2010/03/09	108	70 - 130	111	70 - 130	<0.1	ug/L	NC	40
2093512	cis-1,3-Dichloropropene	2010/03/09	91	70 - 130	95	70 - 130	<0.2	ug/L	NC	40
2093512	trans-1,3-Dichloropropene	2010/03/09	97	70 - 130	105	70 - 130	<0.2	ug/L	NC	40
2093512	Ethylbenzene	2010/03/09	108	70 - 130	112	70 - 130	<0.1	ug/L	NC	40
2093512	Ethylene Dibromide	2010/03/09	102	70 - 130	105	70 - 130	<0.2	ug/L	NC	40
2093512	Methylene Chloride(Dichloromethane)	2010/03/09	104	70 - 130	106	70 - 130	<0.5	ug/L	NC	40
2093512	Methyl Isobutyl Ketone	2010/03/09	95	70 - 130	90	70 - 130	<5	ug/L	NC	40
2093512	Methyl Ethyl Ketone (2-Butanone)	2010/03/09	113	60 - 140	106	60 - 140	<5	ug/L	NC	40
2093512	Methyl t-butyl ether (MTBE)	2010/03/09	109	70 - 130	108	70 - 130	<0.2	ug/L	NC	40
2093512	Styrene	2010/03/09	20(1, 3)	70 - 130	99	70 - 130	<0.2	ug/L	NC	40
2093512	1,1,1,2-Tetrachloroethane	2010/03/09	91	70 - 130	101	70 - 130	<0.1	ug/L	NC	40
2093512	1,1,2,2-Tetrachloroethane	2010/03/09	0.00(1, 3)	70 - 130	99	70 - 130	<0.2	ug/L	NC	40
2093512	Tetrachloroethylene	2010/03/09	101	70 - 130	106	70 - 130	<0.1	ug/L	NC	40
2093512	Toluene	2010/03/09	102	70 - 130	106	70 - 130	<0.2	ug/L	NC	40
2093512	1,1,1-Trichloroethane	2010/03/09	98	70 - 130	101	70 - 130	<0.1	ug/L	NC	40
2093512	1,1,2-Trichloroethane	2010/03/09	51(1, 3)	70 - 130	100	70 - 130	<0.2	ug/L	NC	40
2093512	Trichloroethylene	2010/03/09	286(1, 2)	70 - 130	105	70 - 130	<0.1	ug/L	NC	40
2093512	Vinyl Chloride	2010/03/09	89	70 - 130	96	70 - 130	<0.2	ug/L	NC	40

R2-0001563

Maxxam Job #: B025983
Report Date: 2010/04/09

Golder Associates Ltd
Client Project #: 09-1223-3026

Your P.O. #: ISCO-NY

QUALITY ASSURANCE REPORT

			Matrix Spike		Spiked Blank		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	Units	Value (%)	QC Limits
2093512	p+m-Xylene	2010/03/09	107	70 - 130	114	70 - 130	<0.1	ug/L	NC	40
2093512	o-Xylene	2010/03/09	90	70 - 130	96	70 - 130	<0.1	ug/L	NC	40
2093512	Chloroethane	2010/03/09	101	70 - 130	98	70 - 130	<0.2	ug/L	NC	40
2093512	Chloromethane	2010/03/09	95	60 - 140	94	60 - 140	<0.5	ug/L	NC	40
2093512	Trichlorofluoromethane (FREON 11)	2010/03/09	93	70 - 130	102	70 - 130	<0.2	ug/L	NC	40
2093512	Xylene (Total)	2010/03/09					<0.1	ug/L	NC	40
2093535	1,2,3-Trichlorobenzene	2010/03/09			99	70 - 130	<0.5	ug/L	NC	40
2093535	1,2,4-Trichlorobenzene	2010/03/09			97	70 - 130	<0.5	ug/L	NC	40
2093535	Methyl Acetate	2010/03/09			117	60 - 140	<1	ug/L	NC	40
2093535	1,1,2-Trichlorotrifluoroethane	2010/03/09			109	60 - 140	<0.2	ug/L	NC	40
2093535	Carbon Disulfide	2010/03/09			128	60 - 140	<0.5	ug/L	NC	40
2093535	Cyclohexane	2010/03/09			106	60 - 140	<0.5	ug/L	NC	40
2093535	Methyl Butyl Ketone (2-Hexanone)	2010/03/09			125	60 - 140	<5	ug/L	NC	40
2093536	D6-Benzene	2010/03/10	60	60 - 140	106	60 - 140	106	%		
2093536	1,4-Dioxane	2010/03/10	97	60 - 140	108	60 - 140	<20	ug/L	NC	40

N/A = Not Applicable
RPD = Relative Percent Difference
Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.
Spiked Blank: A blank matrix to which a known amount of the analyte has been added. Used to evaluate analyte recovery.
Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.
Surrogate: A pure or isotopically labeled compound whose behavior mirrors the analytes of interest. Used to evaluate extraction efficiency.
NC (RPD): The RPD was not calculated. The level of analyte detected in the parent sample and its duplicate was not sufficiently significant to permit a reliable calculation.
(1) - Recovery or RPD for this parameter is outside control limits. The overall quality control for this analysis meets acceptability criteria.
(2) - The recovery was above the upper control limit. This may represent a high bias in some results for this specific analyte. For results that were not detected (ND), this potential bias has no impact. This may represent a low bias in some results for this specific analyte. This has been evaluated as being due to matrix effect associated with this particular sample and not the entire batch. Note:The sample was found to be strongly basic.
(3) - The recovery was below the lower control limit. This may represent a low bias in some results for this specific analyte. This has been evaluated as being due to matrix effect associated with this particular sample and not the entire batch. Note:The sample was found to be strongly basic.

R2-0001564

Validation Signature Page

Maxxam Job #: B025983

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

BRAD NEWMAN, Scientific Specialist

CRISTINA CARRIERE, Scientific Services

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R2-0001565

Your Project #: 09-1223-3026
Site: ISCO-NY
Your C.O.C. #: E783781, E-783781

Attention: Pénéloppe Theriault
Golder Associates Ltd
9200 Boul L'Acadie
Bureau 10
Montreal, PQ
H4N 2T2

Report Date: 2010/04/09

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B040048
Received: 2010/04/06, 08:50

Sample Matrix: Water
Samples Received: 1

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Method Reference
1,4-Dioxane in water (1)	1	N/A	2010/04/08	CAM SOP-00226	EPA 8260 modified

* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.
* Results relate only to the items tested.

(1) Sample(s) analyzed using methodologies that have been subjected to Maxxam's standard validation process for the submitted matrix however is not an Accredited method.

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.

CHRISTINE MCLEAN, Project Manager
Email: christine.mclean@maxxamanalytics.com
Phone# (905) 817-5700

==========

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Total cover pages: 1

R2-0001566

Maxxam Job #: B040048
Report Date: 2010/04/09

Golder Associates Ltd
Client Project #: 09-1223-3026
Project name: ISCO-NY

VOLATILE ORGANICS BY GC/MS (WATER)

Maxxam ID		FM7095		
Sampling Date		2010/04/05		
	Units	**CO-C (SUPP#2)**	**RDL**	**QC Batch**
Volatile Organics				
1,4-Dioxane	ug/L	1100	200	2115970
Surrogate Recovery (%)				
D6-Benzene	%	108		2115970

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

R2-0001567

Maxxam Job #: B040048
Report Date: 2010/04/09

Golder Associates Ltd
Client Project #: 09-1223-3026
Project name: ISCO-NY

GENERAL COMMENTS

Sample FM7095-01: VOC Analysis: Due to the high concentration of the target analyte, sample required dilution. Detection limit was adjusted accordingly.

R2-0001568

Maxxam Job #: B040048
Report Date: 2010/04/09

Golder Associates Ltd
Client Project #: 09-1223-3026
Project name: ISCO-NY

QUALITY ASSURANCE REPORT

			Spiked Blank		Method Blank	
QC Batch	Parameter	Date	% Recovery	QC Limits	Value	Units
2115970	D6-Benzene	2010/04/08	105	60 - 140	116	%
2115970	1,4-Dioxane	2010/04/08	101	60 - 140	<20	ug/L

N/A = Not Applicable
Spiked Blank: A blank matrix to which a known amount of the analyte has been added. Used to evaluate analyte recovery.
Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.
Surrogate: A pure or isotopically labeled compound whose behavior mirrors the analytes of interest. Used to evaluate extraction efficiency.

R2-0001569

Validation Signature Page

Maxxam Job #: B040048

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Cristina Carriere

CRISTINA CARRIERE, Scientific Services

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R2-0001570

Your Project #: 09-1223-3026
Site: ISCO-NY
Your C.O.C. #: E783790, E-783790

Attention: Pénéloppe Theriault
Golder Associates Ltd
9200 Boul L'Acadie
Bureau 10
Montreal, PQ
H4N 2T2

Report Date: 2010/05/07

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B051356
Received: 2010/04/28, 09:03

Sample Matrix: Water
Samples Received: 3

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Method Reference
1,4-Dioxane in Water (8270Dmod)	3	2010/05/03	2010/05/03	BRL SOP-00217	EPA 8270D mod.

* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.
* Results relate only to the items tested.

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.

CHRISTINE MCLEAN, Project Manager
Email: christine.mclean@maxxamanalytics.com
Phone# (905) 817-5700

==========

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Total cover pages: 1

R2-0001571

Maxxam Job #: B051356
Report Date: 2010/05/07

Golder Associates Ltd
Client Project #: 09-1223-3026
Project name: ISCO-NY
Sampler Initials: PT

RESULTS OF ANALYSES OF WATER

Maxxam ID		FS1323	FS1324	FS1325		
Sampling Date		2010/04/27	2010/04/27	2010/04/27		
	Units	**CO-A1D1-SUPP#2**	**CO-A1D2-SUPP**	**CO-A1D3-SUPP**	**RDL**	**QC Batch**
Semivolatile Organics						
1,4-Dioxane	ug/L	<3	<3	<3	3	2139737
Surrogate Recovery (%)						
D8-1,4-Dioxane	%	24	24	24		2139737

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

R2-0001572

Maxxam Job #: B051356
Report Date: 2010/05/07

Golder Associates Ltd
Client Project #: 09-1223-3026
Project name: ISCO-NY
Sampler Initials: PT

GENERAL COMMENTS

MDLs for 1,4 dioxane adjusted for volume used for extaction (50ml).

R2-0001573

Maxxam Job #: B051356
Report Date: 2010/05/07

Golder Associates Ltd
Client Project #: 09-1223-3026
Project name: ISCO-NY
Sampler Initials: PT

QUALITY ASSURANCE REPORT

			Spiked Blank		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	Value	Units	Value (%)	QC Limits
2139737	D8-1,4-Dioxane	2010/05/03	22	10 - 55	22	%		
2139737	1,4-Dioxane	2010/05/03	113	60 - 130	<1	ug/L	0.7	25

N/A = Not Applicable
RPD = Relative Percent Difference
Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.
Spiked Blank: A blank matrix to which a known amount of the analyte has been added. Used to evaluate analyte recovery.
Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.
Surrogate: A pure or isotopically labeled compound whose behavior mirrors the analytes of interest. Used to evaluate extraction efficiency.

R2-0001574

Validation Signature Page

Maxxam Job #: B051356

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

Karen Nicol

KAREN NICOL, C.E.T., Supervisor, Semi-Volatiles

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R2-0001575

At Golder Associates we strive to be the most respected global group of companies specializing in ground engineering and environmental services. Employee owned since our formation in 1960, we have created a unique culture with pride in ownership, resulting in long-term organizational stability. Golder professionals take the time to build an understanding of client needs and of the specific environments in which they operate. We continue to expand our technical capabilities and have experienced steady growth with employees now operating from offices located throughout Africa, Asia, Australasia, Europe, North America and South America.

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South America	+ 55 21 3095 9500

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Golder Associés

R2-0001576

QAPP Worksheet #1 - Title and Approval Page

Site Name/Project Name: 216 Paterson Plank Road

Site Location: Carlstadt, New Jersey

Document Title: Quality Assurance Project Plan for the 216 Paterson Plank Road Cooperating Potentially Responsible Party (PRP) Group

Lead Organization: 216 Paterson Plank Road Cooperating PRP Group

Preparer's Name and Organizational Affiliation:
Cindi Lucas-Youmans, Christopher Landes, and Julie M. Lehrman
Golder Associates, Inc.

Preparer's Address, Telephone Number, and E-mail Address:
Golder Associates, Inc.
200 Century Parkway, Suite C
Mt. Laurel, NJ 08054
856-793-2005
clucas-youmans@golder.com
clandes@golder.com
jlehrman@golder.com

Preparation Date (Day/Month/Year): September 1, 2010

Investigative Organization's Project Manager/Date:

Signature 9-1-10 Date

Printed Name/Organization: Robert J. Illes/Golder Associates, Inc.

Investigative Organization's Project Data QA/QC Task Leader/Date:

for Signature 9/2/2010 Date

Printed Name/Organization: Julie M. Lehrman/Golder Associates, Inc.

Lead Organization's Project Coordinator/Date:

Signature 9/2/10 Date

Printed Name/Organization: P. Stephen Finn/Golder Associates, Inc.

QAPP Worksheet #2 - QAPP Identifying Information

Site Name/Project Name: 216 Paterson Plank Road
Site Location: Carlstadt, New Jersey
Site Number/Code: NJD070565403
Operable Unit: 3
Contractor Name: Golder Associates, Inc.
Contractor Number: Not Applicable

Contract Title: Not Applicable
Work Assignment Number: Not Applicable

Title: Quality Assurance Project Plan
Revision Number: 0
Revision Date:

1. Identify regulatory program: Cerclis, EPA ID: NJD070565403
2. Identify approval entity: USEPA Region II
3. The QAPP is (select one): ☐Generic ☒Project Specific
4. List dates of scoping sessions that were held:
   - March 12, 2009 (HAL, JML, CMLY, CDL)
   - March 18, 2009 (HAL, JML, RJI)
   - March 20, 2009 (HAL, MB, RJI)
   - March 31, 2009 (HAL, CMLY, CDL)
   - June 14, 2010 (HAL, CDL)
   - July 30, 2010 (HAL, RJI)
5. List dates and titles of QAPP documents written for previous site work, if applicable:
   - September 2007, Off-Property Groundwater Investigation Report.
6. List organizational partners (stakeholders) and connection with lead organization:

   Golder Associates Inc. is under contract with the 216 Paterson Plank Road Cooperating PRP Group (Group).
7. List data users:

   Golder Associates, Inc., 216 Paterson Plank Road Cooperating Potentially Responsible Party (PRP) Group, USEPA Region II, NJDEP
8. If any required QAPP elements and required information are not applicable to the project, then circle the omitted QAPP elements and required information on the attached table. Provide an explanation for their exclusions below:

   All required elements are included.

QAPP Worksheet #2 - QAPP Identifying Information

Required QAPP Element(s) and Corresponding QAPP Section(s)	Required Information	Crosswalk to QAPP Worksheets and Related Documents
Project Management and Objectives		
2.1 Title and Approval Page	- Title and Approval Page	QAPP Worksheet #1
2.2 Document Format and Table of Contents 2.2.1 Document Control Format 2.2.2 Document Control Numbering System 2.2.3 Table of Contents 2.2.4 QAPP Identifying Information	- Table of Contents - QAPP Identifying Information	QAPP Worksheet #2
2.3 Distribution List and Project Personnel Sign-Off Sheet 2.3.1 Distribution List 2.3.2 Project Personnel Sign-Off Sheet	- Distribution List - Project Personnel Sign-Off Sheet	QAPP Worksheets #3 & #4
2.4 Project Organization 2.4.1 Project Organizational Chart 2.4.2 Communication Pathways 2.4.3 Personnel Responsibilities and Qualifications 2.4.4 Special Training Requirements and Certification	- Project Organizational Chart - Communication Pathways - Personnel Responsibilities and Qualifications Table - Special Personnel Training Requirements Table	QAPP Worksheets #5, #6, #7 & #8
2.5 Project Planning/Problem Definition 2.5.1 Project Planning (Scoping) 2.5.2 Problem Definition, Site History, and Background	- Project Planning Session Documentation - Project Scoping Session Participants Sheet - Problem Definition, Site History, and Background - Site Maps (historical and present)	WP Section 2.0 & 6.0, QAPP Worksheets #9, #10 & #11, and AGDWP
2.6 Project Quality Objectives and Measurement Performance Criteria 2.6.1 Development of Project Quality Objectives Using the Systematic Planning Process 2.6.2 Measurement Performance Criteria	- Site-Specific PQOs - Measurement Performance Criteria Table	QAPP Worksheets #12, & QAPP Worksheets 1 through 30
2.7 Secondary Data Evaluation	- Sources of Secondary Data and Information - Secondary Data Criteria and Limitations Table	QAPP Worksheet #13
2.8 Project Overview and Schedule 2.8.1 Project Overview 2.8.2 Project Schedule	- Summary of Project Tasks - Reference Limits and Evaluation Table - Project Schedule/Timeline Table	WP Sections 6.0 & 7.0, QAPP Worksheets #14, #15, #16, and AGDWP
Measurement/Data Acquisition		
3.1 Sampling Tasks 3.1.1 Sampling Process Design and Rationale 3.1.2 Sampling Procedures and Requirements 3.1.2.1 Sampling Collection Procedures 3.1.2.2 Sample Containers, Volume, and Preservation 3.1.2.3 Equipment/Sample Containers Cleaning and Decontamination Procedures 3.1.2.3 Field Equipment Calibration, Maintenance, Testing, and Inspection Procedures 3.1.2.4 Supply Inspection and Acceptance Procedures 3.1.2.6 Field Documentation Procedures	- Sampling Design and Rationale - Sample Location Map - Sampling Locations and Methods/SOP Requirements Table - Analytical Methods/SOP Requirements Table - Field Quality Control Sample Summary Table - Sampling SOPs - Project Sampling SOP References Table - Field Equipment Calibration, Maintenance, Testing, and Inspection Table	WP Section 6.0, QAPP Worksheets #17, #18, #19, #20, #21, #22, QAPP Attachment 1, and AGDWP

Required QAPP Element(s) and Corresponding QAPP Section(s)	Required Information	Crosswalk to QAPP Worksheets and Related Documents
3.2 Analytical Tasks 3.2.1 Analytical SOPs 3.2.2 Analytical Instrument Calibration Procedures 3.2.3 Analytical Instrument and Equipment Maintenance, Testing, and Inspection Procedures 3.2.4 Analytical Supply Inspection and Acceptance Procedures	- Analytical SOPs - Analytical SOP References Table - Analytical Instrument Calibration Table - Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table	QAPP Worksheets #23, #24, #25. QAPP Attachment 2
3.3 Sample Collection Documentation, Handling, Tracking, and Custody Procedures 3.3.1 Sample Collection Documentation 3.3.2 Sample Handling and Tracking System 3.3.3 Sample Custody	- Sample Collection Documentation Handling, Tracking, and Custody SOPs - Sample Container Identification - Sample Handling Flow Diagram - Example Chain-of-Custody Form and Seal	QAPP Worksheet #26, #27, QAPP Attachment 1
3.4 Quality Control Samples 3.4.1 Sampling Quality Control Samples 3.4.2 Analytical Quality Control Samples	- QC Samples Table - Screening/Confirmatory Analysis Decision Tree	QAPP Worksheet #28
3.5 Data Management Tasks 3.5.1 Project Documentation and Records 3.5.2 Data Package Deliverables 3.5.3 Data Reporting Formats 3.5.4 Data Handling and Management 3.5.5 Data Tracking and Control	- Project Documents and Records Table - Analytical Services Table - Data Management SOPs	QAPP Worksheet #29 & #30
Assessment/Oversight		
4.1 Assessments and Response Actions 4.1.1 Planned Assessments 4.1.2 Assessment Findings and Corrective Action Responses	- Assessments and Response Actions - Planned Project Assessments Table - Audit Checklists - Assessment Findings and Corrective Action Responses Table	QAPP Worksheets #31 & #32
4.2 QA Management Reports	- QA Management Reports Table	QAPP Worksheet #33
4.3 Final Project Report		
Data Review		
5.1 Overview		
5.2 Data Review Steps 5.2.1 Step I: Verification 5.2.2 Step II: Validation 5.2.2.1 Step IIa Validation Activities 5.2.2.2 Step IIb Validation Activities 5.2.3 Step III: Usability Assessment 5.2.3.1 Data Limitations and Actions from Usability Assessment 5.2.3.2 Activities	- Verification (Step I) Process Table - Validation (Steps IIa and IIb) Process Table - Validation (Steps IIa and IIb) Summary Table - Usability Assessment	QAPP Worksheets #34, #35, #36 & #37
5.3 Streamlining Data Review 5.3.1 Data Review Steps To Be Streamlined 5.3.2 Criteria for Streamlining Data Review 5.3.3 Amounts and Types of Data Appropriate for Streamlining		

Notes:

QAPP	Quality Assurance Project Plan
WP	Operable Unit 3 Feasibility Study Phase 1 Treatability Studies
AGDWP	Additional Groundwater Delineation Work Plan (2009)

Attachments and Tables

Tables:

QAPP-1: Precision and Accuracy Limits-Natural Attenuation Parameters-Groundwater
QAPP-2: Precision and Accuracy Limits-Field Parameters-Groundwater/Surface Water

Attachments:

Attachment 1: Field Procedure SOPs
Attachment 2: Analytical SOPs (on CD)
Attachment 3: Laboratory Quality Manuals (on CD)

Acronyms And Abbreviations

Acronym	Definition
%	Percent
%R	Percent Recovery
AASHTO	American Association of State Highway and Transportation Officials
AES	Atomic Emission Spectrometry
AGDWP	Additional Goundwater Delineation Workplan
ASTM	American Society for Testing Materials
°C	Degrees Centigrade (Celsius)
CAS	Chemical Abstracts Service
CCV	Continuing Calibration Verification
CLP	Contract Laboratroy Program
COC	Chain of Custody
CQM	Corporate Quality Manual
CVAA	Cold Vapor Atomic Absorption
DO	Dissolved Oxygen
DOC	Dissolved Organic Carbon
DQI	Data Quality Indicators
EAB	Enhanced Anaerobic Bioremediation
ELAP	Environmental Laboratory Accrediation Program
g	Gram
GC	Gas Chromatograph
GC/FID	Gas Chromatograph/Flame Ionization Detector
GC/ECD	Gas Chromatograph/Electronic Conductivity Detector
GC/MS	Gas Chromatograph/Mass Spectrometer
HCl	Hydrochloric Acid
HNO3	Nitric Acid
HSCP	Health and Safety Contingency Plan
ICB	Initial Calibration Blank
ICP	Inductively Coupled Plasma
ICP-MS	Inductively Coupled Plasma-Mass Spectroscopy
ICV	Initial Calibration Verification
ISCO	In-situ Chemical Oxidation
LCS	Laboratory Control Sample
LCSD	Laboratory Control Sample Duplicate
MCAWW	Method for Chemical Analysis of Water and Wastes
MDL	Method Detection Limit
mg/kg	Milligrams per kilogram
mg/L	Milligrams per liter
ml	Milliliter
MPC	Measurement performance criteria
MS	Matrix Spike
MSD	Matrix Spike Duplicate
NaOH	Sodium Hydroxide
NAPs	Natural Attenuation Parameters
NELAC	National Environmental Laboratory Accrediation Conference
NIST	National Institute of Standards and Technology
NJDEP	New Jersey Department of Environmental Protection
NJGWQS	New Jersey Groundwater Quality Standard
NJSWQS	New Jersey Surface Water Quality Standard

N.S.	No Standard
NTU	Nephelometric Turbidity Units
O&M	Operations and Maintence
ORP	Oxidation-Reduction Potential
OU	Operable Unit
oz.	Ounce
P.E.	Professional Engineer
P.G.	Professional Geologist
PCBs	Polychlorinated biphenyls
PDI	Pre-Design Investigation
PID	Photoionization detector
PM	Project Manager
PQL	Practical Quantiation Limit
PQO	Project Quality Objective
PPE	Personal Protective Equipment
PRP	Potentially Responsible Party
PT	Performance Test
PTWP	OU-3 Pilot Test Work Plan
QA	Quality Assurance
QAM	Quality Assurance Manual
QM	Quality Manual
QSM	Quality Systems Manual
QAPP	Quality Assurance Project Plan
QC	Quality Control
QL	Quantitation Limit
RCRA	Resource Conservation and Recovery Act
RDWP	Remedial Design Work Plan
RPD	Relative Percent Difference
RSD	Relative Standard Deviation
SIM	Selective Ion Monitoring
SOP	Standard Operating Procedure
SOW	Statement of Work
SPCC	System Performance Check Compound
SRM	Standard Reference Materials
SVOC	Semivolatile Organic Compounds
SW-846	Test Methods for Evaluating Solid Waste, Physical/Chemical Methods
TBD	To Be Determined
TKN	Total Kjeldahl Nitrogen
TOC	Total Organic Carbon
ug/kg	Micrograms per kilogram
ug/L	Micrograms per liter
USEPA	United States Environmental Protection Agency
VOC	Volatile Organic Compounds
VTSR	Verified Time of Sample Receipt
ZnOAc	Zinc Acetate

QAPP Worksheet #3 - Distribution List

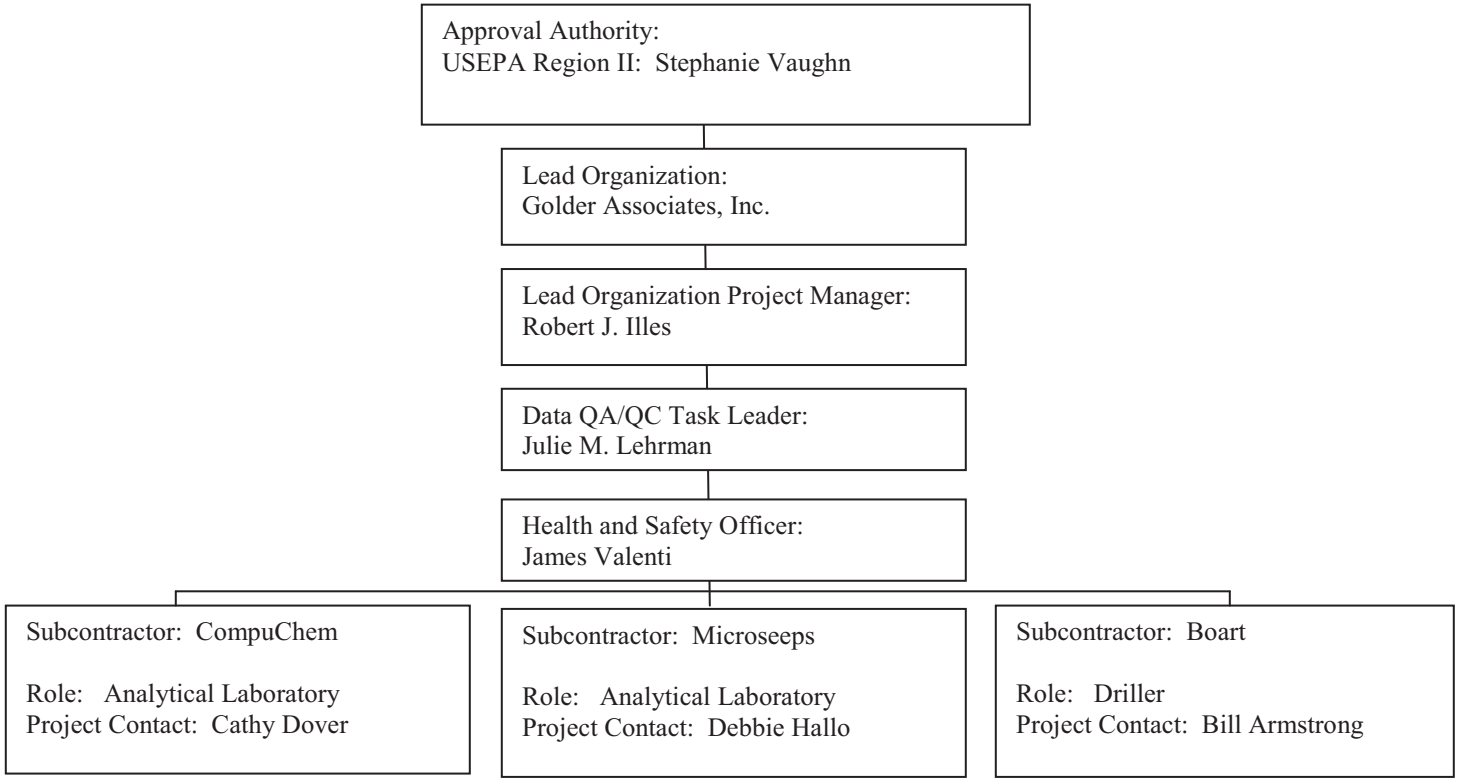
QAPP Recipients	Organization	Telephone Number	Fax Number	E-mail Address
Stephanie Vaughn	U.S. Environmental Protection Agency	212-637-4361	212-637-4429	vaughn.stephanie@epamail.epa.gov
Riché Outlaw	New Jersey Department of Environmental Protection	609-777-5610	609-633-1439	riche.outlaw@dep.state.nj.us
Multiple	Golder Associates Inc.	856-793-2005	856-793-2006	NA
Multiple	216 Paterson Plant Road PRP Group	NA	NA	NA

QAPP Worksheet #4 - Project Personnel Sign-Off Sheet

Organization: Golder Associates

Project Personnel	Title	Telephone Number	Signature	Date QAPP Read
P. Stephen Finn	Facility Coordinator	856-793-2005		
Robert J. Illes	Project Manager	856-793-2005		
Heather A. Lin	Investigation Task Leader	856-793-2005		
Mike Borda	EAB Task Leader	856-793-2005		
Julie M. Lehrman	QA/QC Task Leader	856-793-2005		

QAPP Worksheet #5 - Project Organizational Chart



QAPP Worksheet #6 - Communication Pathways

A list of project contacts is provided below.

Project Name: 216 Paterson Plank Road Projected Date(s) of Sampling: TBD Project Manager: Robert J. Illes			Site Name: 216 Paterson Plank Road Site Site Location: Carlstadt, New Jersey		
Name	Title	Affiliation	Phone #	E-mail Address	Project Role
Stephanie Vaughn	Project Manager	USEPA	212-637-4361	vaughn.stephanie@epamail.epa.gov	Case Manager
P. Stephen Finn	Principal	Golder Associates	856-793-2005	sfinn@golder.com	Facility Coordinator
Robert J. Illes	Principal	Golder Associates	856-793-2005	rilles@golder.com	Project Manager
Heather A. Lin	Project Geochemist	Golder Associates	856-793-2005	hlin@golder.com	Investigation Task Leader
Michael Borda	Project Geochemist	Golder Associates	856-793-2005	mborda@golder.com	EAB Task Leader
Julie M. Lehrman	Data QA/QC Task Leader	Golder Associates	856-793-2005	jlehrman@golder.com	Data QA/QC Task Leader

The Group's primary contact with the USEPA is Mr. P. Steve Finn from Golder Associates. Mr. Finn may contact the USEPA with progress updates, recommendations, proposed field changes, or questions. Mr. Finn will contact USEPA via telephone, email, or in writing. Mr. Finn, on behalf of the Group, will document important decisions reached via return email or in a confirmation letter.

The Group will maintain an open line of communication with the USEPA PM (Ms. Stephanie Vaughn) during the course of the project to discuss technical issues and/or obtain feedback on and approvals of alternative approaches that may arise during the investigation. Since the pilot tests are considered dynamic programs, interaction between the Group and the USEPA PM will be required to adapt the program so that it achieves its desired objectives as data are acquired and evaluated. As a result, the Group may have to contact USEPA during the course of the investigation to discuss one or more of the following issues such as:

- Approval of amendments to the QAPP;
- Initiation, notification and/or approval of real time modifications; and,
- Notification of delays or changes to field work;

Communication pathways for future activities will be supplied in the applicable work plan.

QAPP Worksheet #7 - Personnel Responsibilities and Qualification Table

Name	Title	Organizational Affiliation	Responsibilities	Education and Experience Qualifications
P. Stephen Finn, C.ENG	Facility Coordinator	Golder Associates Inc.	Representing the 216 Paterson Plank Road Cooperating PRP Group in communication with USEPA. Responsible for overall project strategy.	Mr. Finn is a Principal of Golder Associates with over 25 years of consulting experience including strategy development, investigation, feasibility studies, design, construction management, and review of completed remedial measures.
Robert J. Illes, P.G.	Project Manager	Golder Associates Inc.	Responsible for project management including technical review.	Mr. Illes is a Principal of Golder Associates with 22 year of experience in New Jersey. Mr. Illes has managed and directed numerous environmental remediation projects with responsibility for technical direction, project strategy, regulatory agency and client coordination.
James Valenti, PG	Health and Safety Coordinator	Golder Associates Inc.	Health and Safety Coordinator for Golder Associates Mt. Laurel NJ	Mr. Valenti is a Senior Consultant with over 30 years of experience. His responsibilities include overseeing and managing the day-to-day aspects of the Philadelphia Operations health and safety program as the Health and Safety Coordinator (HSC).
Heather A. Lin, Ph.D.	Investigation Task Leader	Golder Associates Inc.	Responsible for managing the delineation of 1,4-dioxane and assessing the applicability of ISCO as a remedial technology.	Dr. Lin is a Project Geochemist with six years of experience. She assists in evaluating site contamination data with regard to sources, transport, and physical/ chemical/biological transformation processes; plans, implements and supervises site investigation/characterization projects including laboratory testing and in-situ testing; and assists in the development of conceptual site models for use in understanding the physical environment.

QAPP Worksheet #7 - Personnel Responsibilities and Qualification Table

Name	Title	Organizational Affiliation	Responsibilities	Education and Experience Qualifications
Michael Borda, Ph.D.	EAB Task Leader	Golder Associates Inc.	Managing and interpreting the EAB Pilot Test	Dr. Michael Borda is a geochemist/microbiologist with two years of environmental remediation experience. Prior to joining Golder, Dr. Borda was a research assistant professor leading a group of scientists working on biological and non-biological mechanisms for the transformation of arsenic in soil and groundwater systems. Dr. Borda's areas of expertise include remedial design with an emphasis on in situ and ex situ engineered bioremediation.
Julie M. Lehrman, CHMM	Data QA/QC Task Leader	Golder Associates Inc.	Documenting compliance with the requirements and objectives of the QAPP. Overseeing subcontract laboratories and data quality review.	Ms. Lehrman is a Senior Project Chemist with 15 years of experience. She is responsible for quality assurance of environmental analytical data for Golder Associates' Mt. Laurel, NJ office and provides overall support to the Philadelphia operations for issues related to analytical chemistry, laboratory subcontracts, data validation, data management and RCRA Hazardous Waste.
Mark Ross	Vice President	CompuChem Laboratories	See CompuChem Laboratories QM, Appendix D.	See CompuChem Laboratories QM, Appendix D.
Cathy Dover	Project Manager	CompuChem Laboratories	See CompuChem Laboratories QM, Appendix D.	See CompuChem Laboratories QM, Appendix D.
Debbie Hallo	Project Manager	Microseeps	See Microseeps QSM, Section 3	See Microseeps QSM, Section 3, Appendix E.

QAPP Worksheet #8 - Special Personnel Training Requirements Table

Project team members with appropriate experience, technical skills and training have been selected to perform the project tasks. The subcontractors selected for drilling, laboratory analysis and other required project tasks were selected by Golder Associates based on qualifications and experience of the subcontractor to perform the required work. The subcontractors will meet the general requirements of USEPA Region II and NJDEP to perform these tasks. Special personnel training requirements for future activities will be described in the appropriate work plans.

QAPP Worksheet #9 - Project Scoping Session Participants Sheets

Project Name: 216 Paterson Plank Road Site **Projected Date(s) of Sampling:** TBD **Project Manager:** Robert J. Illes	**Site Name: 216 Paterson Plank Road Site** **Site Location: 216 Paterson Plank Road, Carlstadt, NJ**

Date of Sessions:

- March 12, 2009 (HAL, JML, CMLY, CDL)
- March 18, 2009 (HAL, JML, RJI)
- March 20, 2009 (HAL, MB, RJI)
- March 31, 2009 (HAL, CMLY, CDL)
- June 14, 2010 (HAL, CDL)
- July 30, 2010 (HAL, RJI)

Scoping Session Purpose: Workplan Scope

Name	Title	Affiliation	Phone #	E-mail Address	Project Role
Robert J. Illes (RJI)	Project Manager	Golder Associates	856-793-2005	RIlles@ golder.com	Project Manager
Heather A. Lin (HAL)	Project Geochemist	Golder Associates	856-793-2005	HLin@ golder.com	ISCO Task Leader
Michael Borda (MB)	Project Geochemist	Golder Associates	856-793-2005	MBorda@ golder.com	EAB Task Leader
Julie M. Lehrman (JML)	Data QA/QC Task Leader	Golder Associates	856-793-2005	jlehrman@ golder.com	Data QA/QC Task Leader
Cindi M. Lucas-Youmans (CMLY)	Project Environmental Chemist	Golder Associates	856-793-2005	clucas-youmans@ golder.com	QAPP Preparer
Christopher D. Landes (CDL)	Staff Environmental Scientist	Golder Associates	856-793-2005	clandes@ golder.com	QAPP Contributer

Topic: Internal meetings to discuss the projected activities for the pilot test and delineation and the additional information required to complete the workplan and the QAPP.

Outcome: The meetings described above represents several of a series of internal meetings of the core project team to discuss the technical details of the project scope and sampling design. Golder Associates routinely conducts several such informal internal scoping sessions during the course of a project. These sessions typically discuss and reach outcomes of the following:

- Identification of data gaps
- Detailed design technical strategies
- Specific details for bench tests and pilot tests and detailed design data acquisition including location, depth, parameters, and methods (field and analytical)
- Schedule for completion of project deliverables
- Project staff roles and responsibilities in preparing the Work Plans for implementation of the delineation and pilot tests.

The outcome of these discussions are summarized and captured in the work plans.

QAPP Worksheet #10 - Problem Definition

The problem to be addressed by the project:

- The primary scope for this project is described in the report, Operable Unit 3 Feasibility Study Phase 1 Treatability Studies, 216 Paterson Plank Road Site, Carlstadt, New Jersey (Golder, 2010). The overall objective of this project is to acquire data needed to evaluate Enhanced Anaerobic Bioremediation (EAB) as a potential remedy for VOC impacts in the northern corner of the Site (in vicinity of MW-13D) for groundwater for possible inclusion in the Feasibility Study for the 216 Paterson Plank Road Site (Site), and to delineate 1,4-dioxane in the southern corner of the Site. If necessary, this scope will include evaluation of Activated Persulfate In-situ Chemical Oxidation (ISCO) as a potentital remedy for the 1,4-dioxane impacts in the southern corner of the site, in the vicinity of MW-21D.

The following specific objectives related to this QAPP need to be met:

- Completion of an EAB pilot test in the northern corner of the Site.
- Delineate the lateral extent of 1,4-dioxane in the southern corner of the Site.
- If determined appropriate, completion of an ISCO pilot test in the southern corner of the Site.

In addition, quarterly monitoring of surface water in Peach Island Creek adjacent to the Site and and annual monitoring of shallow groundwater is being performed by the Golder Associates, Inc. on behalf of the 216 Paterson Plank Road Cooperating PRP Group. This routine monitoring is being performed to verify the continued effectiveness of the OU-2 Remedy. While this QAPP explicitly covers the specific activities described in the Operable Unit 3 Feasibility Study Phase 1 Treatability Studies report, it is intended to be general enough to cover ongoing groundwater and surface water sampling at the Site through remedy selection and implementation as well as other routine environmental sampling as may arise. As a result, while jobs and specific companies are identified as the responsibility party for each activity, specific individuals to fulfill each role will be identified in the appropriate Work Plans.

QAPP Worksheet #10 - Problem Definition

The environmental questions being asked include:

What is the efficacy of EAB in the northern corner of the Site?

What is the extent (for purposes of evaluating a final remedial action) of 1,4-dioxane impacts in the southern corner of the Site?

If determined appropriate, what is the efficacy of ISCO in the southern corner of the Site?

Does the OU-2 Remedy continue to effectively reduce the migration of hazardous substances, pollutants and contaminants out of the contaminated soils and groundwater above the clay layer?

Observations from any site reconnaissance reports:

Golder Associates personnel visited the site on April 3, 2009 during preparation of the Work Plan (to refine locations of proposed wells/borings), and in December 2009/January 2010 to conduct investigation activities described in Workplan for Additional Groundwater Delineation.

A synopsis of secondary data or information from site reports:

Relevant data from the Revised Off-Property Groundwater Investigation Report, Operable Unit No. 3 (Golder, 2008) have been summarized in Section 2.4 of the Operable Unit 3 Feasibility Study Phase 1 Treatability Studies.

The possible classes of contaminants and the affected matrices:

The primary Site contaminants of concern in groundwater in the northern corner of the Site are chlorinated aliphatic hydrocarbons, while the primary contaminants of concern in groundwater in the southern corner of the Site are 1,4-dioxane, benzene and 1,1-dichloroethane. Further information about the distribution of contaminants in groundwater are presented in Section 2.4 of the Operable Unit 3 Feasibility Study Phase 1 Treatability Studies report.

Groundwater samples will be collected from temporary and permanent wells for delineation, pilot test monitoring and Operations and Maintenance (O&M) monitoring. Surface water samples will be collected as part of the on-going monitoring of OU-2.

QAPP Worksheet #10 - Problem Definition

The rationale for inclusion of chemical and nonchemical analyses:

The objectives and rationale for inclusion of specific chemical analyses are discussed in Section 6.0 of the Operable Unit 3 Feasibility Study Phase 1 Treatability Studies.

The requirements for the on-going groundwater and surface water monitoring are established by the Operations and Maintenance Plan (O&M Plan), as set forth in the Interim Remedy Remedial Design Report (Canonie, 1991), as modified by the USEPA September 29, 1999 letter for the Interim Remedy at the 216 Paterson Plank Road Site.

The rationale for the inclusion of specific analyses for future activities will be provided in the applicable work plans.

Project decision conditions ("If..., then..." statements):

If the results from the delineation of 1,4-dioxane indicate that a pilot test is appropriate, then the completion of a pilot test will be proposed.

If the EAB pilot tests appears to be successfully treating the groundwater, the pilot test may be continued beyond the current schedule.

If the on-going groundwater and surface water monitoring results show loss of efficacy of the OU-2 Remedy, then appropriate maintenance of the remedy will be scheduled.

QAPP Worksheet #11- Project Quality Objectives/Systematic Planning Process Statements

Who will use the data?

Golder Associates, Inc., 216 Paterson Plank Road Cooperating PRP Group, USEPA Region II, NJDEP.

What will the data be used for?

The data will be used to:

- Collect design information for potential full-scale implementation of an EAB remedy in the till in the northern corner of the Site;
- Collect design information for possible ISCO Pilot test in the southern corner of the Site;
- Collect design information for potential full-scale implementation of an ISCO remedy in the soft till in the southern corner of the Site (if appropriate);
- Evaluate the horizontal extent of 1,4-dioxane in the soft till in the southern corner of the Site; and,
- Monitor groundwater and surface water quality following construction of the OU-2 Remedy.

What types of data are needed?

Volatile organic Compounds (VOCs), including 1,4-dioxane;

Semivolatile Organic Compounds (SVOCs):

Pesticides;

Polychlorinated Biphenyls (PCBs);

Metals;

Hydrogen Gas;

Volatile Fatty Acids;

Natural Attenuation Parameters (NAPs) such as:

- Methane, Ethane, Ethene, Total Organic Carbon (TOC), Dissolved Organic Carbon (DOC), Sulfate, Sulfide, Nitrate, Nitrite, Dissolved Iron, Iron (II), Carbonate, Bicarbonate, and Alkalinity.

Field Geochemical Parameters such as:

- Temperature, Dissolved Oxygen (DO), ORP, Iron (II), and Bromide.

Samples will be collected from the groundwater and surface water matrices. The analytical methods selected for each matrix and the specific analysis to be performed are provided in Worksheet #14. The types of data required for future sampling events will be provided in the future work plans or in an addendum to this QAPP.

QAPP Worksheet #11- Project Quality Objectives/Systematic Planning Process Statements

How "good" do the data need to be in order to support the environmental decision?

The overall Quality Assurance (QA) objective for this project is to develop and implement procedures for field sampling, sample custody, laboratory analysis, and data reporting that will provide results which are of known quality and can be evaluated using known standards. Specific procedures for sampling, chain-of-custody, laboratory instrument calibration, laboratory analysis, reporting of data, internal QC, preventive maintenance of field equipment, and corrective action are described in other sections of this document.

Two types of data will be generated: definitive data and screening data.

The majority of the data will be definitive analytical data that are suitable for final decision-making. Definitive data are usually generated at fixed environmental analytical laboratories, but can be obtained in the field if suitable calibration and documentation procedures are followed. Examples of definitive data to be generated are groundwater VOC data and soil VOC data.

Screening data are analytical data that are suitable for interim decision-making. Screening data usually require confirmation by definitive data prior to final decision making. Screening data are also usable to support definitive data. Examples of screening data anticipated are field measurements of geochemical parameters and the results from bench test analysis.

Within the broad category of definitive data, the Operable Unit 3 Feasibility Study Phase 1 Treatability Studies report calls for several different levels of data sensitivity. As a result, different analytical methods for the same parameter (e.g. VOCs) are invoked for different activities covered by this QAPP.

- The data from the EAB and possible ISCO pilot tests needs to be sufficiently sensitive to demonstrate changes in groundwater contaminant concentrations in response to the pilot test amendments. The sensitivity required to discern trends in these areas of demonstrated impact is less than that needed to delineate the extent of impacts.
- The data from the ongoing groundwater and surface water monitoring needs to demonstrate continued effectiveness of the OU-2 Remedy. The data, however, is not used to establish compliance with the numerical standards.

Historically, definitive environmental analyses for the Site have been performed following Contract Laboratory Program (CLP) procedures to provide results which are of known quality. While developing the DQO for this project, the available CLP methods, including SOM 01.2, OLC03.2, OLM04.2, ILM04.1 and ILM05.3 were evaluated for their ability to provide data of the sensitivity required for each project task. As a result of this evaluation, the analytical methods were changed from those used in previous work to those available in the the most recent CLP Statement of Work (SoW). A variety of analytical options will be utilized to tailor the analytical sensitivity to the project tasks and to balance analytical sensitivity with analytical costs. The specific method chosen for each project task is further described in Worksheet #14.

QAPP Worksheet #11- Project Quality Objectives/Systematic Planning Process Statements

How much data are needed? The number of samples anticipated is detailed in Sections 6.0 of the Operable Unit 3 Feasibility Study Phase 1 Treatability Studies. Since Golder Associates, Inc. will be using a phased, dynamic work-plan, specific sample numbers cannot be provided in the QAPP. The number of samples for future sampling activities will be provided in the applicable Work Plans.
Where, when, and how should the data be collected/generated? The work will be conducted following USEPA approval of the Operable Unit 3 Feasibility Study Phase 1 Treatability Studies. The routine monitoring will continue without interruption of the previously established schedule.
Who will collect and generate the data? Golder Associates Inc. and subcontracted laboratories. Data for the majority of the environmental analytical samples will be generated by CompuChem and Microseeps.
How will the data be reported? The data from the pilot test(s) and associated delineation sampling will be presented in the Pilot Study Report which will be submitted to the Agencies. The routine groundwater and surface water monitoring results along with future sampling activities will be reported in documents as agreed upon by the 216 Paterson Plank Road Cooperating PRP Group and USEPA Region II.
How will the data be archived? Golder Associates will maintain electronic copies of all laboratory deliverables as part of the project file. A copy of these electronic deliverables will be incorporated into the Site chemical database. An archived hard copy of the laboratory data will be maintained in a secure off-site storage facility as required by the Consent Decree of until such time as USEPA notifies the Group that retention is no longer required.

Measurement Performance Criteria

This section describes the approach to the Measurement Performance Criteria Tables using data quality indicators expressed as precision, accuracy, representativeness, completeness, comparability and sensitivity (PARCCS). Where possible, acceptance criteria are specified to help delineate minimum acceptability levels for use of data in the overall decision making process.

Precision

Precision refers to the degree to which repeated measurements are similar to one another. It measures the agreement (reproducibility) among individual measurements, obtained under prescribed similar conditions. Measurements that are precise are in close agreement with one another.

Field precision is assessed through the collection and measurement of field duplicates. A field duplicate sample is defined as two or more representative portions taken from the same sampling location, homogenized, split and submitted for identical analyses. The field duplicate sample is submitted to the laboratory blind (i.e. submitted as an individual sample and not identified as a field duplicate) so as to impartially represent field precision.

Precision in the laboratory is assessed through the calculation of relative percent differences (RPD) between sample results. The RPD is calculated according to the following formula.

$$RPD = \frac{2 \times |\text{Amount in Sample 1} - \text{Amount in Sample 2}|}{(\text{Amount in Sample 1} + \text{Amount in Sample 2})} \times 100$$

General precision control limits are provided in the Measurement Performance Criteria Tables (QAPP Worksheet #12). The precision control limits provided are based on the laboratory QC control limits, which are routinely re-evaluated following the procedures in the laboratory quality assurance policies and the requirements of the analytical methods. Should the laboratory QC limits change between the submission of this QAPP and the sample analyses, the limits in place at the time of sample analysis will be used to evaluate the data, and updated QAPP tables will be submitted as an addendum.

For organic analyses, field and laboratory precision shall be assessed through the analysis of field duplicate samples. For inorganic analyses, laboratory precision shall be assessed through the analysis of laboratory duplicate pairs and field and laboratory precision through the analysis of field duplicate samples. If the RPDs for field or laboratory duplicates are within evaluation criteria, the original field sample result should be used, and not

the duplicate sample result. If the RPDs for field or laboratory duplicates are not within evaluation criteria, the data will be qualified as estimated and the more conservative value should be used.

Accuracy

Accuracy is the degree of agreement between an observed value and an accepted reference or true value. The accuracy measurement is generally determined by the percent recovery (%R) of a known value. Accuracy as %R is determined by the following equation:

$$\%R = \frac{(\text{Amount in Spiked Sample} - \text{Amount in Sample})}{\text{Known amount added}} \times 100$$

Accuracy in the field is assessed through the use of equipment rinsate and trip blanks to assess the potential of cross contamination. In addition, field accuracy is assessed by the adherence to all sample handling, preservation, and holding time criteria.

Laboratory accuracy is assessed through the analysis of standard reference materials (SRM), laboratory control samples (LCS), Matrix Spike/Matrix Spike Duplicate (MS/MSD), surrogate compounds, and the determination of the %R for these measurements. General accuracy control limits are provided in Measurement Performance Criteria Tables (QAPP Worksheet #12). Where accuracy criteria are not met, data will be qualified as either estimated (minor deviation from accuracy criteria) or rejected (major deviation from accuracy criteria). Data qualified as rejected should not be used for decision making purposes.

Representativeness

Representativeness expresses the degree to which data accurately and precisely represents a characteristic of a population, a parameter variation at a sampling point, a process condition, or an environmental condition within a defined spatial and/or temporal boundary.

Representativeness is dependent upon the proper design of the sampling program and will be satisfied by ensuring that the Work Plan is followed and that proper sampling techniques are used. The sampling program was designed to provide data representative of Site conditions. During development of this program, consideration was given to historical activities, existing analytical data, physical setting and processes. Using the proper analytical procedures, appropriate methods, meeting sample holding times and meeting QC criteria for each parameter affirms representativeness in the laboratory. An additional assessment of representativeness will be

made through field duplicates. While field duplicates are primarily used to assess precision, they also indicate sample homogeneity and therefore the representativeness of the site.

Completeness

Completeness is a measure of the amount of valid data obtained from a measurement system compared to the amount of data that was expected under normal conditions. Data is considered valid and complete if all QC elements have met the criteria established in this QAPP. Qualified data may be considered usable and will be considered complete on a case by case basis.

Following completion of the analytical testing, the percent completeness will be calculated by the following equation:

$$Completeness = \frac{(number\ of\ valid\ measurements)}{(number\ of\ measurements\ planned)} \times 100$$

The laboratory and field completeness goal for this project is greater than 85 percent. Field measurements not collected from a specified location, or samples not collected due to environmental conditions, will be identified in the report. Data qualified by the laboratory or data reviewer as estimated is usable and therefore considered complete; however, data qualified as rejected are not usable and do not count toward completeness goals.

Comparability

Comparability is an expression of the confidence with which one data set can be compared to another. Comparability of data is achieved by ensuring site-wide sample collection and analyses follow the same protocol. Comparability depends upon the proper design of the sampling program and will be satisfied by following the Work Plan, SOPs, and using proper sampling techniques. The field manager will routinely oversee field activities and verify compliance to the Work Plan and field sampling SOPs identified in QAPP Worksheet #21.

Analytical data are comparable when similar analytical methods are used as identified in Worksheet #23. Appropriate laboratory personnel will review and have a working knowledge of the laboratory SOPs to be used during the analysis of samples for the investigation. Additionally, the laboratory QA manager will review all data generated, verify compliance with method requirements, and attest that QA objectives are met.

Sensitivity

Sensitivity is defined as the capability of a method or instrument to discriminate between measurement responses representing different levels of a variable of interest. Two measurement responses of interest in assessing sensitivity are the method detection limit (MDL) and the quantitation limit (QL). The MDL is defined as the minimum concentration of a substance that can be identified, measured and reported with a 99 percent confidence that the substance concentration is greater than zero, for a specific matrix containing the substance. The MDLs are determined as outlined in 40 CRF Part 136. The QL is defined as the level of measurement that can be reliably achieved within specified limits of precision and accuracy during routine laboratory operations. The QLs are generally 2-5 times greater than the MDLs.

The sensitivity for field measurements will be determined, in part, by the limitations of field instrumentation as described in the manufacturer's manual and specific field measurement SOPs. Other factors that will influence sensitivity include matrix and environmental conditions.

The MDL and QL goals for field investigations are identified in QAPP Worksheet #15. The laboratory will verify the QLs defined by a point on the calibration curve which is below the stated QL. Additionally the laboratory will provide MDL studies for each compound upon request by the USEPA and/or Golder Associates QA officer. Should the laboratory MDL or QL change between the submission of this QAPP and the sample analyses, the limits in place at the time of sample analysis will be used to evaluate the data, and updated QAPP tables will be submitted as an addendum.

12-1 Volatile Organic Compounds – Groundwater and Surface Water

Matrix	Groundwater, Surface Water
Analytical Group	VOCs[3,4]
Concentration Level	All

Sampling Procedure[1]	Analytical Method/SOP[2]	Data Quality Indicators (DQI)	Measurement Performance Criteria (MPC)	QC Sample and/or Activity	QC Sample Assesses Error for Sampling (S), Analytical (A) or Both (S&A)
GFP-4, GFP-9	1.2.3.4, 1.2.4.2, 2.4.4.3	Precision	<20% RPD	Field Duplicates	S & A
GFP-4, GFP-9	1.2.3.4, 1.2.4.2, 2.4.4.3	Accuracy	Meets CLP SOM01.2 method criteria.	Surrogate Recovery	A
GFP-4, GFP-9	1.2.3.4, 1.2.4.2, 2.4.4.3	Accuracy	Meets CLP SOM01.2 method criteria.	LCS and MS/MSD.	A
GFP-4, GFP-9	1.2.3.4, 1.2.4.2, 2.4.4.3	Accuracy	No target compounds >QL except common laboratory contaminants, acetone and chloride, 2-butanone which must be <5x QL; and methylene chloride and cyclohexane which must be <2.5x QL.	Method, Trip and Rinse Blanks.	S & A
GFP-4, GFP-9	1.2.3.4, 1.2.4.2, 2.4.4.3	Completeness	>85% sample collection, >85% laboratory analysis	Data Completeness Check	S & A
GFP-4, GFP-9	1.2.3.4, 1.2.4.2, 2.4.4.3	Sensitivity	Moisture and dilution adjusted QL meets criteria in Worksheet 15-6, 15-7, 15-8	Method Blanks	A

[1]Reference number from QAPP Worksheet #21
[2]Reference number from QAPP Worksheet #23
[3]SOP 1.2.4.2 (trace level analysis) will be followed unless target analyte concentrations require use of SOP 1.2.3.4 (low level analysis).
[3]SOP 1.2.4.2 (trace level analysis) does not include 1,4-dioxane in the target analyte list. When SOP 1.2.4.2 (trace level analysis) is used for groundwater analysis, 1,4-dioxane shall be quantiated as an SVOC following SOP 2.4.4.3 (SOM01.2 SVOC Flex Clause 1363.7)

12-2 Semivolatile Organic Compounds – Groundwater and Surface Water

Matrix	Groundwater, Surface Water
Analytical Group	SVOCs
Concentration Level	All

Sampling Procedure[1]	Analytical Method/SOP[2]	Data Quality Indicators (DQI)	Measurement Performance Criteria (MPC)	QC Sample and/or Activity	QC Sample Assesses Error for Sampling (S), Analytical (A) or Both (S&A)
GFP-4, GFP-9	2.4.4.3	Precision	< 20% RPD	Field Duplicates	S & A
GFP-4, GFP-9	2.4.4.3	Precision	Meets CLP SOM01.2 method criteria.	LCS/LCSD, MS/MSD or Laboratory Duplicate	A
GFP-4, GFP-9	2.4.4.3	Accuracy	Meets CLP SOM01.2 method criteria.	LCS or MS	A
GFP-4, GFP-9	2.4.4.3	Accuracy	No target compounds > QL	Method and Equipment Rinsate Blanks	S & A
GFP-4, GFP-9	2.4.4.3	Completeness	>85% sample collection, >85% laboratory analysis	Data Completeness Check	S & A
GFP-4, GFP-9	2.4.4.3	Sensitivity	Sample size and dilution adjusted QL meets criteria in Worksheet 15-9, 15-10	Method Blanks	A

[1]Reference number from QAPP Worksheet #21
[2]Reference number from QAPP Worksheet #23

12-3 Pesticides – Groundwater and Surface Water

Matrix	Groundwater, Surface Water
Analytical Group	Pesticides
Concentration Level	All

Sampling Procedure[1]	Analytical Method/SOP[2]	Data Quality Indicators (DQI)	Measurement Performance Criteria (MPC)	QC Sample and/or Activity	QC Sample Assesses Error for Sampling (S), Analytical (A) or Both (S&A)
GFP-4, GFP-9	2.1.2.3	Precision	< 20% RPD	Field Duplicates	S & A
GFP-4, GFP-9	2.1.2.3	Precision	Meets CLP SOM01.2 method criteria.	LCS/LCSD, MS/MSD or Laboratory Duplicate	A
GFP-4, GFP-9	2.1.2.3	Accuracy	Meets CLP SOM01.2 method criteria.	LCS or MS	A
GFP-4, GFP-9	2.1.2.3	Accuracy	No target compounds > QL	Method and Equipment Rinsate Blanks	S & A
GFP-4, GFP-9	2.1.2.3	Completeness	>85% sample collection, >85% laboratory analysis	Data Completeness Check	S & A
GFP-4, GFP-9	2.1.2.3	Sensitivity	Sample size and dilution adjusted QL meets criteria in Worksheet 15-11	Method Blanks	A

[1]Reference number from QAPP Worksheet #21
[2]Reference number from QAPP Worksheet #23

12-4 Polychlorinated Biphenyls – Groundwater and Surface Water

Matrix	Groundwater, Surface Water
Analytical Group	PCBs
Concentration Level	All

Sampling Procedure[1]	Analytical Method/SOP[2]	Data Quality Indicators (DQI)	Measurement Performance Criteria (MPC)	QC Sample and/or Activity	QC Sample Assesses Error for Sampling (S), Analytical (A) or Both (S&A)
GFP-4, GFP-9	2.1.2.4	Precision	< 20% RPD	Field Duplicates	S & A
GFP-4, GFP-9	2.1.2.4	Precision	Meets CLP SOM01.2 method criteria.	LCS/LCSD, MS/MSD or Laboratory Duplicate	A
GFP-4, GFP-9	2.1.2.4	Accuracy	Meets CLP SOM01.2 method criteria.	LCS or MS	A
GFP-4, GFP-9	2.1.2.4	Accuracy	No target compounds > QL	Method and Equipment Rinsate Blanks	S & A
GFP-4, GFP-9	2.1.2.4	Completeness	>85% sample collection, >85% laboratory analysis	Data Completeness Check	S & A
GFP-4, GFP-9	2.1.2.4	Sensitivity	Sample size and dilution adjusted QL meets criteria in Worksheet 15-12	Method Blanks	A

[1]Reference number from QAPP Worksheet #21
[2]Reference number from QAPP Worksheet #23

12-5 Metals – Groundwater and Surface Water

Matrix	Groundwater, Surface Water
Analytical Group	Metals
Concentration Level	All

Sampling Procedure[1]	Analytical Method/SOP[2, 3]	Data Quality Indicators (DQI)	Measurement Performance Criteria (MPC)	QC Sample and/or Activity	QC Sample Assesses Error for Sampling (S), Analytical (A) or Both (S&A)
GFP-4, GFP-9	3.1.1.4, 3.1.2.2, 3.3.4	Precision	< 20% RPD	Field Duplicates	S & A
GFP-4, GFP-9	3.1.1.4, 3.1.2.2, 3.3.4	Precision	Meets CLP ILM05.4 method criteria.	LCS/LCSD, MS/MSD or Laboratory Duplicate	A
GFP-4, GFP-9	3.1.1.4, 3.1.2.2, 3.3.4	Accuracy	Meets CLP ILM05.4 method criteria.	LCS or MS	A
GFP-4, GFP-9	3.1.1.4, 3.1.2.2, 3.3.4	Accuracy	No target compounds > QL	Method and Equipment Rinsate Blanks	S & A
GFP-4, GFP-9	3.1.1.4, 3.1.2.2, 3.3.4	Completeness	>85% sample collection, >85% laboratory analysis	Data Completeness Check	S & A
GFP-4, GFP-9	3.1.1.4, 3.1.2.2, 3.3.4	Sensitivity	Sample size and dilution adjusted QL meets criteria in Worksheet 15-13	Method Blanks	A

[1]Reference number from QAPP Worksheet #21
[2]Reference number from QAPP Worksheet #23
[3] Antimony, arsenic, chromium, cobalt, copper, lead, selenium, silver, thallium, and vanadium concentrations for groundwater shall be determined by MS-AES following 3.1.2.2. Mercury concentrations will be determined by 3.3.4. All other metals shall be determined by AES following 3.1.1.4.

12-6 Natural Attenuation Parameters – Groundwater

Matrix	Groundwater
Analytical Group	Natural Attenuation Parameters
Concentration Level	All

Sampling Procedure[1]	Analytical Method/SOP[2]	Data Quality Indicators (DQI)	Measurement Performance Criteria (MPC)	QC Sample and/or Activity	QC Sample Assesses Error for Sampling (S), Analytical (A) or Both (S&A)
GFP-4, GFP-9	Various (see below)	Precision	< 20% RPD	Field Duplicates	S & A
GFP-4, GFP-9	Various (see below)	Precision	Meets criteria in Table QAPP-4	LCS/LCSD, MS/MSD or Laboratory Duplicate	A
GFP-4, GFP-9	Various (see below)	Accuracy	Meets criteria in Table QAPP-4	LCS or MS	A
GFP-4, GFP-9	Various (see below)	Accuracy	No target compounds > QL	Method and Field Blanks	S & A
GFP-4, GFP-9	Various (see below)	Completeness	>85% sample collection, >85% laboratory analysis	Data Completeness Check	S & A
GFP-4, GFP-9	Various (see below)	Sensitivity	Sample size and dilution adjusted QL meets criteria in Worksheet 15-14	Method Blanks	A

The Natural Attenuation Parameters (NAPs): Alkalinity, Nitrate, Nitrite, pH, Sulfate, Sulfide, Total Organic Carbon, Methane, Ethane, Ethene, Hydrogen Gas, and Volatile Fatty Acids.

The analytical methods to be used for the NAPs include: 3.5.14.1, 3.5.1.1, 3.5.22.1, 3.5.17.1, 3.6.2.1, AM20GAx, and AM23G.

[1]Reference number from QAPP Worksheet #21
[2]Reference number from QAPP Worksheet #23

12-7 Field Parameters – Groundwater and Surface Water

Matrix	Groundwater, Surface Water
Analytical Group	Field Parameters
Concentration Level	All

Sampling Procedure[1]	Analytical Method/SOP[2]	Data Quality Indicators (DQI)	Measurement Performance Criteria (MPC)	QC Sample and/or Activity	QC Sample Assesses Error for Sampling (S), Analytical (A) or Both (S&A)
GFP-4, GFP-9	Various (see below)	Precision	Meets criteria in Table QAPP-5	Analytical Replicates	A
GFP-4, GFP-9	Various (see below)	Completeness	> 90% sample collection	Data Completeness Check	S & A

Field Parameters: Dissolved Oxygen, Ferrous Iron, Oxidation-Reduction Potential, pH, Specific Conductance, Temperature, and Turbidity

The analytical methods to be used include: G-6, G-7, G-8, G-9, and G-10.

[1]Reference number from QAPP Worksheet #21
[2]Reference number from QAPP Worksheet #23

QAPP Worksheet #13- Secondary Data Criteria and Limitations Table

Secondary Data	Data Source (Originating Organization, Report Title, and Date)	Data Generator(s) (Originating Org., Data Types, Data Generation/ Collection Dates)	How Data Will Be Used	Limitations on Data Use
Extent Groundwater Contamination	Revised Off-Property Groundwater Investigation Report, Operable Unit No. 3 (Golder, 2008), and Operable Unit 3 Feasibility Study Phase 1 Treatability Studies	Golder Associates, Inc.	Data will be used in conjunction with the current data to complete delineation of the site.	None

QAPP Worksheet #14 – Summary of Project Tasks

Sampling and Analysis Tasks:

Project sampling tasks are listed in the table below. Future project sampling and Analysis tasks will be described in the respective work plans.

Event	Purpose	Number of Events	Number of Samples per Event	Matrix	Analytes	Analytical Method
Investigation	Determine the horizontal extent of 1,4-dioxane in the area of MW-21D	1	20-32 (approx)	Groundwater	VOCs including 1,4-dioxane	SOM01.2 Low
ISCO Baseline sampling (possible)	Baseline sampling	1	5	Groundwater	VOCs	SOM01.2 Trace
					1,4-dioxane	SOM01.2 SVOC Flex Clause 1363.7
					metals	ILM05.4 AES & MS-AES
					sulfate	MCAWW 300.0
EAB Baseline sampling	Baseline sampling	1	5	Groundwater	VOCs	SOM01.2 Trace
					TOC	Standard Methods 5310B
					sulfide	Standard Methods 4500-S2F
					nitrate, nitrite, sulfate	MCAWW 300.0
					alkalinity	MCAWW 310.2
					hydrogen, methane, ethane, and ethene	Microseeps SOP AM20GAx
					Volatile Fatty Acids (VFA)	Microseeps SOP AM23G
EAB Injection Progress Monitoring	Progress Monitoring	6	5	Groundwater	VOCs	SOM01.2 Low
					TOC	Standard Methods 5310B
					sulfide	Standard Methods 4500-S2F

Event	Purpose	Number of Events	Number of Samples per Event	Matrix	Analytes	Analytical Method
					nitrate, nitrite, sulfate	MCAWW 300.0
					alkalinity	MCAWW 310.2
					hydrogen, methane, ethane, and ethene	Microseeps SOP AM20GAx
					Volatile Fatty Acids (VFA)	Microseeps SOP AM23G
ISCO Pilot Test Progress Monitoring (possible)	Progress Monitoring	3	5	Groundwater	VOCs including 1,4-dioxane	SOM01.2 Low
					sulfate	MCAWW 300.0
					Metals	ILM05.4 (AES & MS-AES)
Groundwater/ Surface Water monitoring	Monitoring	as required (annually)	-	Groundwater and Surface Water	VOCs	SOM01.2 Trace and Trace SIM
					1,2-Dibromo-3-chloropropane,	SOM01.2 Trace SIM
					1,2-Dibromoethane	
					SVOCs	SOM01.2 Low
					Pesticides	SOM01.2 Low
					PCBs	SOM01.2 Low
					Metals	ILM05.4 AES & MS-AES
Surface Water Monitoring	Monitoring	as required (quarterly)	-	Surface Water	VOCs	SOM01.2 Trace (and Trace SIM)
					1,2-Dibromo-3-chloropropane,	SOM01.2 Trace SIM

Quality Control Tasks:

Quality Control tasks are described in QAPP Worksheet #22, QAPP Worksheet #24, and the laboratory analytical Standard Operating Procedures (SOPs) provided in Attachment 2 of the QAPP. Additional Quality Control Tasks are described in QAPP Worksheet #33 - QA Management Reports. The data verification and validation, followed by a data usability assessment can also be considered a Quality Control Tasks. These activities are described in Worksheets #34, #35, and #36. Future quality control tasks not covered by these items will be described in the respective work plan.

Secondary Data:

Secondary data sources are described in QAPP Worksheet #13. The secondary data will be integrated with the data generated during the Off-Property Groundwater Investigation to form a revised site conceptual model. Future secondary data tasks will be described in the respective work plans.

Data Management Tasks:

Data management tasks, such as how the data will be reported and archived, are discussed in QAPP Worksheet #11. Future data management tasks will be detailed in the respective work plans.

Documentation and Records:

Field documentation procedures are provided in Attachment 1. The documentation of subcontract laboratory analytical data is described following QAPP Worksheet #34, entitled “Data Package Elements”. Documentation of data review tasks is included in the Data Review SOP.

Assessment/Audit Tasks:

Assessment and audit tasks are discussed in QAPP Worksheet #31.

Data Review Tasks:

Data review tasks are described in QAPP Worksheets #34, #35, and #36.

QAPP Worksheet #15 – Refernece Limits and Evaluation Tables

15-1 Volatile Organic Compounds – Groundwater and Surface Water

Analyte	CAS Number	Higher of PQL and Ground Water Quality Criterion (2008) (ug/L)	Surface Water Quality Standards Fresh Water Acute (2008) (ug/L)	Surface Water Quality Standards Fresh Water Chronic (2008) (ug/L)	Surface Water Quality Standards Fresh Water Human Health (2008) (ug/L)	Achievable Laboratory Limits by Trace Analysis (ug/L)	
						MDLs	QLs
Acetone	67-64-1	6000	N.S.	N.S.	N.S.	4.94	5.0
Benzene	71-43-2	1	N.S.	N.S.	0.15	TBD	0.5
Bromodichloromethane	75-27-4	1	N.S.	N.S.	0.55	0.08	0.5
Bromoform	75-25-2	4	N.S.	N.S.	4.3	0.15	0.5
Bromomethane	74-83-9	10	N.S.	N.S.	47	0.21	0.5
2-Butanone	78-93-3	300	N.S.	N.S.	N.S.	0.98	5
Carbon Disulfide	75-15-0	700	N.S.	N.S.	N.S.	TBD	0.5
Carbon Tetrachloride	56-23-5	1	N.S.	N.S.	0.33	0.05	0.5
Chlorobenzene	108-90-7	50	N.S.	N.S.	210	0.04	0.5
Chloroethane	75-00-3	5	N.S.	N.S.	N.S.	0.07	0.5
Chloroform	67-66-3	70	N.S.	N.S.	68	0.07	0.5
Chloromethane	74-87-3	N.S.	N.S.	N.S.	N.S.	0.06	0.5
Cyclohexane	110-82-7	N.S.	N.S.	N.S.	N.S.	0.19	0.5
1,2-Dibromo-3-chloropropane	96-12-8	0.02	N.S.	N.S.	N.S.	0.2	0.5
Dibromochloromethane	124-48-1	1	N.S.	N.S.	0.40	0.11	0.5
1,2-Dibromoethane	106-93-4	0.03	N.S.	N.S.	N.S.	0.1	0.5
1,2-Dichlorobenzene	95-50-1	600	N.S.	N.S.	2000	0.14	0.5
1,3-Dichlorobenzene	541-73-1	600	N.S.	N.S.	2200	0.13	0.5
1,4-Dichlorobenzene	106-46-7	75	N.S.	N.S.	550	0.12	0.5
Dichlorodifluoromethane	75-71-8	1000	N.S.	N.S.	N.S.	0.04	0.5
1,1-Dichloroethane	75-34-3	50	N.S.	N.S.	N.S.	0.04	0.5
1,2-Dichloroethane	107-06-2	2	N.S.	N.S.	0.29	0.07	0.5
1,1-Dichloroethene	75-35-4	1	N.S.	N.S.	4.7	0.06	0.5
cis-1,2-Dichloroethene	156-59-2	70	N.S.	N.S.	N.S.	0.07	0.5
trans-1,2-Dichloroethene	156-60-5	100	N.S.	N.S.	590	0.04	0.5
1,2-Dichloropropane	78-87-5	1	N.S.	N.S.	0.50	0.05	0.5
cis-1,3-Dichloropropene	10061-01-5	1	N.S.	N.S.	0.34	0.03	0.5
trans-1,3-Dichloropropene	10061-02-6	1	N.S.	N.S.	0.34	0.07	0.5
Ethylbenzene	100-41-4	700	N.S.	N.S.	530	0.05	0.5
Freon 113	76-13-1	N.S.	N.S.	N.S.	N.S.	0.1	0.5
2-Hexanone	591-78-6	300	N.S.	N.S.	N.S.	0.40	5
Isopropylbenzene	98-82-8	700	N.S.	N.S.	N.S.	0.13	0.5
Methyl Acetate	79-20-9	7000	N.S.	N.S.	N.S.	0.41	0.5
Methyl Cyclohexane	108-87-2	N.S.	N.S.	N.S.	N.S.	0.26	0.5
Methyl tert-Butyl Ether	1634-04-4	70	N.S.	N.S.	70	0.07	0.5
4-Methyl-2-pentanone	108-10-1	N.S.	N.S.	N.S.	N.S.	0.56	5

15-1 Volatile Organic Compounds – Groundwater and Surface Water

Analyte	CAS Number	Higher of PQL and Ground Water Quality Criterion (2008) (ug/L)	Surface Water Quality Standards Fresh Water Acute (2008) (ug/L)	Surface Water Quality Standards Fresh Water Chronic (2008) (ug/L)	Surface Water Quality Standards Fresh Water Human Health (2008) (ug/L)	Achievable Laboratory Limits by Trace Analysis (ug/L)	
						MDLs	QLs
Methylene Chloride	75-09-2	3	N.S.	N.S.	2.5	0.06	0.5
Styrene	100-42-5	100	N.S.	N.S.	N.S.	0.05	0.5
1,1,2,2-Tetrachloroethane	79-34-5	1	N.S.	N.S.	4.7	0.12	0.5
Tetrachloroethene	127-18-4	1	N.S.	N.S.	0.34	0.11	0.5
Toluene	108-88-3	600	N.S.	N.S.	1300	TBD	0.5
1,2,4-Trichlorobenzene	120-82-1	9	N.S.	N.S.	21	0.28	0.5
1,1,1-Trichloroethane	71-55-6	30	N.S.	N.S.	120	0.05	0.5
1,1,2-Trichloroethane	79-00-5	3	N.S.	N.S.	13	0.18	0.5
Trichloroethene	79-01-6	1	N.S.	N.S.	1.0	0.05	0.5
Trichlorofluoromethane	75-69-4	2000	N.S.	N.S.	N.S.	0.08	0.5
Vinyl Chloride	75-01-4	1	N.S.	N.S.	0.082	0.08	0.5
m,p-Xylene	179601-23-1	1000	N.S.	N.S.	N.S.	0.07	0.5
o-Xylene	95-47-6	1000	N.S.	N.S.	N.S.	0.06	0.5
Bromochloromethane	74-97-5	N.S.	N.S.	N.S.	N.S.	0.2	0.5
1,2,3-Trichlorobenzene	87-61-6	N.S.	N.S.	N.S.	N.S.	0.32	0.5
1,4-Dioxane (Note 4)	123-91-1	10	N.S.	N.S.	N.S.	0.51	2

Notes:

1) m,p-Xylenes and o-Xylene NJGWQS based on Total Xylenes (CAS #1330-20-7).

2) QL based on CLP SOM01.2 requirements. MDL based on CompuChem QC limits as of January 10, 2008 for analysis of aqueous samples following SOP 1.2.4.2. CompuChem routinely re-evaluates QC criteria using the procedures in the laboratory QM. The current laboratory limits at the time of sample submission will be used to evaluate analytical performance.

3) NJGWQS and NJSWQS provided as benchmarks for comparison to routine monitoring results. The data is not used for compliance determination.

4) The target compound list for SOP 1.2.4.2 (trace level analysis) does not include 1,4-dioxane. When SOP 1.2.4.2 (trace level analysis) is used, 1,4-dioxane shall be quantiated as an SVOC following SOP 2.4.4.3 (SOM01.2 SVOC Flex Clause 1363.7)

15-2 Volatile Organic Compounds – Groundwater and Surface Water

Analyte	CAS Number	Higher of PQL and Ground Water Quality Criterion (2008) (ug/L)	Surface Water Quality Standards Fresh Water Acute (2008) (ug/L)	Surface Water Quality Standards Fresh Water Chronic (2008) (ug/L)	Surface Water Quality Standards Fresh Water Human Health (2008) (ug/L)	Achievable Laboratory Limits by Trace SIM Analysis (ug/L)	
						MDLs	QLs
1,2-Dibromo-3-chloropropane	96-12-8	0.02	N.S.	N.S.	N.S.	0.028	0.05
1,2-Dibromoethane	106-93-4	0.03	N.S.	N.S.	N.S.	0.01	0.05

Notes:

1) QL based on CLP SOM01.2 requirements. MDL based on CompuChem QC limits as of January 10, 2008 for analysis of aqueous samples following SOP 1.2.4.2. CompuChem routinely re-evaluates QC criteria using the procedures in the laboratory QM. The current laboratory limits at the time of sample submission will be used to evaluate analytical performance.

2) NJGWQS and NJSWQS provided as benchmarks for comparison to routine monitoring results. The data is not used for compliance determination.

15-3 Volatile Organic Compounds – Groundwater and Surface Water

Analyte	CAS Number	Higher of PQL and Ground Water Quality Criterion (2008) (ug/L)	Surface Water Quality Standards Fresh Water Acute (2008) (ug/L)	Surface Water Quality Standards Fresh Water Chronic (2008) (ug/L)	Surface Water Quality Standards Fresh Water Human Health (2008) (ug/L)	Achievable Laboratory Limits by Low Level Analysis (ug/L)	
						MDLs	QLs
Acetone	67-64-1	6000	N.S.	N.S.	N.S.	7.41	10
Benzene	71-43-2	1	N.S.	N.S.	0.15	0.33	5
Bromodichloromethane	75-27-4	1	N.S.	N.S.	0.55	0.58	5
Bromoform	75-25-2	4	N.S.	N.S.	4.3	0.48	5
Bromomethane	74-83-9	10	N.S.	N.S.	47	0.62	5
2-Butanone	78-93-3	300	N.S.	N.S.	N.S.	1.42	10
Carbon Disulfide	75-15-0	700	N.S.	N.S.	N.S.	TBD	5
Carbon Tetrachloride	56-23-5	1	N.S.	N.S.	0.33	0.40	5
Chlorobenzene	108-90-7	50	N.S.	N.S.	210	0.49	5
Chloroethane	75-00-3	5	N.S.	N.S.	N.S.	0.86	5
Chloroform	67-66-3	70	N.S.	N.S.	68	0.35	5
Chloromethane	74-87-3	N.S.	N.S.	N.S.	N.S.	0.70	5
Cyclohexane	110-82-7	N.S.	N.S.	N.S.	N.S.	0.45	5
1,2-Dibromo-3-chloropropane	96-12-8	0.02	N.S.	N.S.	N.S.	2.18	5
Dibromochloromethane	124-48-1	1	N.S.	N.S.	0.40	0.75	5
1,2-Dibromoethane	106-93-4	0.03	N.S.	N.S.	N.S.	0.60	5
1,2-Dichlorobenzene	95-50-1	600	N.S.	N.S.	2000	0.60	5
1,3-Dichlorobenzene	541-73-1	600	N.S.	N.S.	2200	0.50	5
1,4-Dichlorobenzene	106-46-7	75	N.S.	N.S.	550	0.86	5
Dichlorodifluoromethane	75-71-8	1000	N.S.	N.S.	N.S.	0.65	5
1,1-Dichloroethane	75-34-3	50	N.S.	N.S.	N.S.	0.59	5
1,2-Dichloroethane	107-06-2	2	N.S.	N.S.	0.29	0.62	5
1,1-Dichloroethene	75-35-4	1	N.S.	N.S.	4.7	0.79	5
cis-1,2-Dichloroethene	156-59-2	70	N.S.	N.S.	N.S.	0.44	5
trans-1,2-Dichloroethene	156-60-5	100	N.S.	N.S.	590	0.85	5
1,2-Dichloropropane	78-87-5	1	N.S.	N.S.	0.50	0.82	5
cis-1,3-Dichloropropene	10061-01-5	N.S.	N.S.	N.S.	0.34	0.64	5
trans-1,3-Dichloropropene	10061-02-6	N.S.	N.S.	N.S.	0.34	0.44	5
1,4-Dioxane	123-91-1	10	N.S.	N.S.	N.S.	27.27	100
Ethylbenzene	100-41-4	700	N.S.	N.S.	530	0.80	5
Freon 113	76-13-1	N.S.	N.S.	N.S.	N.S.	1.10	5
2-Hexanone	591-78-6	300	N.S.	N.S.	N.S.	1.42	10
Isopropylbenzene	98-82-8	700	N.S.	N.S.	N.S.	0.44	5
Methyl Acetate	79-20-9	7000	N.S.	N.S.	N.S.	1.12	5
Methyl Cyclohexane	108-87-2	N.S.	N.S.	N.S.	N.S.	0.51	5
Methyl tert-Butyl Ether	1634-04-4	70	N.S.	N.S.	70	0.44	5

15-3 Volatile Organic Compounds – Groundwater and Surface Water

Analyte	CAS Number	Higher of PQL and Ground Water Quality Criterion (2008) (ug/L)	Surface Water Quality Standards Fresh Water Acute (2008) (ug/L)	Surface Water Quality Standards Fresh Water Chronic (2008) (ug/L)	Surface Water Quality Standards Fresh Water Human Health (2008) (ug/L)	Achievable Laboratory Limits by Low Level Analysis (ug/L)	
						MDLs	QLs
4-Methyl-2-pentanone	108-10-1	N.S.	N.S.	N.S.	N.S.	0.70	10
Methylene Chloride	75-09-2	3	N.S.	N.S.	2.5	0.72	5
Styrene	100-42-5	100	N.S.	N.S.	N.S.	0.51	5
1,1,2,2-Tetrachloroethane	79-34-5	1	N.S.	N.S.	4.7	0.79	5
Tetrachloroethene	127-18-4	1	N.S.	N.S.	0.34	0.55	5
Toluene	108-88-3	600	N.S.	N.S.	1300	0.54	5
1,2,4-Trichlorobenzene	120-82-1	9	N.S.	N.S.	21	0.82	5
1,1,1-Trichloroethane	71-55-6	30	N.S.	N.S.	120	0.69	5
1,1,2-Trichloroethane	79-00-5	3	N.S.	N.S.	13	0.87	5
Trichloroethene	79-01-6	1	N.S.	N.S.	1.0	0.72	5
Trichlorofluoromethane	75-69-4	2000	N.S.	N.S.	N.S.	0.37	5
Vinyl Chloride	75-01-4	1	N.S.	N.S.	0.082	0.38	5
m,p-Xylene	179601-23-1	1000	N.S.	N.S.	N.S.	0.73	5
o-Xylene	95-47-6	1000	N.S.	N.S.	N.S.	0.68	5
Bromochloromethane	74-97-5	N.S.	N.S.	N.S.	N.S.	0.94	5
1,2,3-Trichlorobenzene	87-61-6	N.S.	N.S.	N.S.	N.S.	0.94	5

Notes:

1) m,p-Xylenes and o-Xylene NJGWQS based on Total Xylenes (CAS #1330-20-7).

2) QL based on CLP SOM01.2 requirements. MDL based on CompuChem QC limits as of January 10, 2008 for analysis of aqueous samples following SOP 1.2.4.2. CompuChem routinely re-evaluates QC criteria using the procedures in the laboratory QM. The current laboratory limits at the time of sample submission will be used to evaluate analytical performance.

3) NJGWQS and NJSWQS provided as benchmarks for comparison to routine monitoring results. The data is not used for compliance determination.

4) SOP 1.2.4.2 (trace level analysis) will be followed for delineation sampling and for routine monitoring unless target analyte concentrations require use of SOP 1.2.3.4 (low level analysis).

15-4 Semivolatile Organic Compounds – Groundwater and Surface Water

Analyte	CAS Number	Higher of PQL and Ground Water Quality Criterion (2008) (ug/L)	Surface Water Quality Standards Fresh Water Acute (2008) (ug/L)	Surface Water Quality Standards Fresh Water Chronic (2008) (ug/L)	Surface Water Quality Standards Fresh Water Human Health (2008) (ug/L)	Achievable Laboratory Limits (ug/L)	
						MDLs	QLs
Acenaphthene	83-32-9	400	N.S.	N.S.	670	1.08	5
Acenaphthylene	208-96-8	100	N.S.	N.S.	N.S.	0.96	5
Acetophenone	98-86-2	700	N.S.	N.S.	N.S.	1.16	5
Anthracene	120-12-7	2000	N.S.	N.S.	8300	1.33	5
Atrazine	1912-24-9	3	N.S.	N.S.	N.S.	1.71	5
Benzaldehyde	100-52-7	N.S.	N.S.	N.S.	N.S.	1.34	5
Benzo[a]anthracene	56-55-3	0.1	N.S.	N.S.	0.038	1.31	5
Benzo[b]fluoranthene	205-99-2	0.2	N.S.	N.S.	0.038	1.22	5
Benzo[k]fluoranthene	207-08-9	0.5	N.S.	N.S.	0.38	2.33	5
Benzo[g,h,i]perylene	191-24-2	100	N.S.	N.S.	N.S.	1.67	5
Benzo[a]pyrene	50-32-8	0.1	N.S.	N.S.	0.0038	1.61	5
1,1-Biphenyl	92-52-4	400	N.S.	N.S.	N.S.	0.91	5
Bis(2-chloroethoxy)methane	111-91-1	N.S.	N.S.	N.S.	N.S.	1.17	5
Bis(2-chloroethyl) Ether	111-44-4	7	N.S.	N.S.	0.030	1.14	5
Bis(2-chloroisopropyl) Ether	108-60-1	300	N.S.	N.S.	1400	0.95	5
Bis(2-ethylhexyl) Phthalate	117-81-7	3	N.S.	N.S.	1.2	1.99	5
4-Bromophenyl Phenyl Ether	101-55-3	N.S.	N.S.	N.S.	N.S.	1.05	5
Butylbenzyl Phthalate	85-68-7	100	N.S.	N.S.	150	1.13	5
Caprolactam	105-60-2	5000	N.S.	N.S.	N.S.	0.90	5
Carbazole	86-74-8	N.S.	N.S.	N.S.	N.S.	1.08	5
4-Chloroaniline	106-47-8	30	N.S.	N.S.	N.S.	1.63	5
4-Chloro-3-methylphenol	59-50-7	100	N.S.	N.S.	N.S.	0.90	5
2-Chloronaphthalene	91-58-7	600	N.S.	N.S.	1000	0.92	5
2-Chlorophenol	95-57-8	40	N.S.	N.S.	81	1.02	5
4-Chlorophenyl-phenylether	7005-72-3	N.S.	N.S.	N.S.	N.S.	1.08	5
Chrysene	218-01-9	5	N.S.	N.S.	3.8	1.28	5
Dibenzo[a,h]anthracene	53-70-3	0.3	N.S.	N.S.	0.0038	1.58	5
Dibenzofuran	132-64-9	N.S.	N.S.	N.S.	N.S.	0.86	5
Di-n-Butyl Phthalate	84-74-2	700	N.S.	N.S.	2000	1.13	5
3,3'-Dichlorobenzidine	91-94-1	30	N.S.	N.S.	0.021	1.80	5
2,4-Dichlorophenol	120-83-2	20	N.S.	N.S.	77	0.82	5
Diethyl Phthalate	84-66-2	6000	N.S.	N.S.	17000	0.93	5
2,4-Dimethylphenol	105-67-9	100	N.S.	N.S.	380	0.94	5
Dimethyl Phthalate	131-11-3	100	N.S.	N.S.	N.S.	1.15	5
4,6-Dinitro-2-methylphenol	534-52-1	1	N.S.	N.S.	13	1.42	10
2,4-Dinitrophenol	51-28-5	40	N.S.	N.S.	69	0.81	10
2,4-Dinitrotoluene	121-14-2	N.S.	N.S.	N.S.	0.11	1.10	5

15-4 Semivolatile Organic Compounds – Groundwater and Surface Water

Analyte	CAS Number	Higher of PQL and Ground Water Quality Criterion (2008) (ug/L)	Surface Water Quality Standards Fresh Water Acute (2008) (ug/L)	Surface Water Quality Standards Fresh Water Chronic (2008) (ug/L)	Surface Water Quality Standards Fresh Water Human Health (2008) (ug/L)	Achievable Laboratory Limits (ug/L)	
						MDLs	QLs
2,6-Dinitrotoluene	606-20-2	N.S.	N.S.	N.S.	N.S.	1.07	5
Di-n-octyl Phthalate	117-84-0	100	N.S.	N.S.	N.S.	1.32	5
Fluoranthene	206-44-0	300	N.S.	N.S.	130	1.27	5
Fluorene	86-73-7	300	N.S.	N.S.	1100	0.88	5
Hexachlorobenzene	118-74-1	0.02	N.S.	N.S.	0.00028	1.28	5
Hexachlorobutadiene	87-68-3	1	N.S.	N.S.	0.44	0.91	5
Hexachlorocyclopentadiene	77-47-4	40	N.S.	N.S.	40	TBD	5
Hexachloroethane	67-72-1	7	N.S.	N.S.	1.4	0.76	5
Indeno[1,2,3-cd]pyrene	193-39-5	0.2	N.S.	N.S.	0.038	1.65	5
Isophorone	78-59-1	40	N.S.	N.S.	35	1.07	5
2-Methylnaphthalene	91-57-6	30	N.S.	N.S.	N.S.	0.90	5
2-Methylphenol	95-48-7	N.S.	N.S.	N.S.	N.S.	0.98	5
4-Methylphenol	106-44-5	N.S.	N.S.	N.S.	N.S.	2.93	5
Naphthalene	91-20-3	300	N.S.	N.S.	N.S.	0.90	5
2-Nitroaniline	88-74-4	N.S.	N.S.	N.S.	N.S.	0.92	10
3-Nitroaniline	99-09-2	N.S.	N.S.	N.S.	N.S.	1.29	10
4-Nitroaniline	100-01-6	N.S.	N.S.	N.S.	N.S.	1.59	10
Nitrobenzene	98-95-3	6	N.S.	N.S.	17	0.84	5
2-Nitrophenol	88-75-5	N.S.	N.S.	N.S.	N.S.	1.25	5
4-Nitrophenol	100-02-7	N.S.	N.S.	N.S.	N.S.	1.33	10
N-Nitrosodiphenylamine	86-30-6	10	N.S.	N.S.	3.3	3.8	5
N-Nitroso-di-n-propylamine	621-64-7	10	N.S.	N.S.	0.0050	1.15	5
Pentachlorophenol	87-86-5	0.3	N.S.	N.S.	0.27	0.78	10
Phenanthrene	85-01-8	100	N.S.	N.S.	N.S.	1.24	5
Phenol	108-95-2	2000	N.S.	N.S.	10000	0.78	5
Pyrene	129-00-0	200	N.S.	N.S.	830	1.46	5
1,2,4,5-Tetrachlorobenzene	95-94-3	N.S.	N.S.	N.S.	0.97	0.86	5
2,3,4,6-Tetrachlorophenol	58-90-2	200	N.S.	N.S.	N.S.	1.46	5
2,4,5-Trichlorophenol	95-95-4	700	N.S.	N.S.	1800	0.85	5
2,4,6-Trichlorophenol	88-06-2	20	N.S.	N.S.	0.58	0.98	5

Notes:

1) QL based on CLP SOM01.2 requirements. MDL based on CompuChem QC limits as of May 15, 2007 for analysis of aqueous samples following SOP 2.4.4.3. CompuChem routinely re-evaluates QC criteria using the procedures in the laboratory QM. The current laboratory limits at the time of sample submission will be used to evaluate analytical performance.
2) NJGWQS and NJSWQS provided as benchmarks for comparison to routine monitoring results. The data is not used for compliance determination.

15-5 Semivolatile Organic Compounds – Groundwater and Surface Water

Analyte	CAS Number	Higher of PQL and Ground Water Quality Criterion (2008) (ug/L)	Surface Water Quality Standards Fresh Water Acute (2008) (ug/L)	Surface Water Quality Standards Fresh Water Chronic (2008) (ug/L)	Surface Water Quality Standards Fresh Water Human Health (2008) (ug/L)	Achievable Laboratory Limits by SIM Analysis (ug/L)	
						MDLs	QLs
Acenaphthene	83-32-9	400	N.S.	N.S.	670	0.02	0.1
Acenaphthylene	208-96-8	100	N.S.	N.S.	N.S.	0.02	0.1
Anthracene	120-12-7	2000	N.S.	N.S.	8300	0.01	0.1
Benzo[a]anthracene	56-55-3	0.1	N.S.	N.S.	0.038	0.01	0.1
Benzo[b]fluoranthene	205-99-2	0.2	N.S.	N.S.	0.038	0.02	0.1
Benzo[k]fluoranthene	207-08-9	0.5	N.S.	N.S.	0.38	0.03	0.1
Benzo[g,h,i]perylene	191-24-2	100	N.S.	N.S.	N.S.	0.02	0.1
Benzo[a]pyrene	50-32-8	0.1	N.S.	N.S.	0.0038	0.02	0.1
Chrysene	218-01-9	5	N.S.	N.S.	3.8	0.01	0.1
Dibenzo[a,h]anthracene	53-70-3	0.3	N.S.	N.S.	0.0038	0.01	0.1
Fluoranthene	206-44-0	300	N.S.	N.S.	130	0.01	0.1
Fluorene	86-73-7	300	N.S.	N.S.	1100	0.02	0.1
Indeno[1,2,3-cd]pyrene	193-39-5	0.2	N.S.	N.S.	0.038	0.02	0.1
2-Methylnaphthalene	91-57-6	30	N.S.	N.S.	N.S.	0.02	0.1
Naphthalene	91-20-3	300	N.S.	N.S.	N.S.	0.03	0.1
Pentachlorophenol	87-86-5	0.3	N.S.	N.S.	0.27	0.15	0.2
Phenanthrene	85-01-8	100	N.S.	N.S.	N.S.	0.02	0.1
Pyrene	129-00-0	200	N.S.	N.S.	830	0.02	0.1
1,4-Dioxane	123-91-1	10	N.S.	N.S.	N.S.	0.51	2.0

Notes:
1) QL based on CLP SOM01.2 requirements. MDL based on CompuChem QC limits as of May 10, 2007 for analysis of aqueous samples following SOP 2.4.4.3. CompuChem routinely re-evaluates QC criteria using the procedures in the laboratory QM. The current laboratory limits at the time of sample submission will be used to evaluate analytical performance.
2) NJGWQS and NJSWQS provided as benchmarks for comparison to routine monitoring results. The data is not used for compliance determination.

15-6 Pesticides – Groundwater and Surface Water

Analyte	CAS Number	Higher of PQL and Ground Water Quality Criterion (2008) (ug/L)	Surface Water Quality Standards Fresh Water Acute (2008) (ug/L)	Surface Water Quality Standards Fresh Water Chronic (2008) (ug/L)	Surface Water Quality Standards Fresh Water Human Health (2008) (ug/L)	Achievable Laboratory Limits (ug/L)	
						MDLs	QLs
Aldrin	309-00-2	0.04	3.0	N.S.	0.000049	0.004	0.05
delta-BHC	319-86-8	N.S.	N.S.	N.S.	N.S.	0.004	0.05
alpha-BHC	319-84-6	0.02	N.S.	N.S.	0.0026	0.009	0.05
beta-BHC	319-85-7	0.04	N.S.	N.S.	0.0091	0.004	0.05
gamma-BHC	58-89-9	0.03	0.95	N.S.	0.98	0.011	0.05
alpha-Chlordane	5103-71-9	N.S	N.S.	N.S.	N.S.	0.005	0.05
gamma-Chlordane	5103-74-2	N.S	N.S.	N.S.	N.S.	0.003	0.01
4,4-DDT	50-29-3	0.1	1.1	0.0010	0.00022	0.015	0.1
4,4-DDD	72-54-8	0.1	N.S.	N.S.	0.00031	0.017	0.1
4,4-DDE	72-55-9	0.1	N.S.	N.S.	0.00022	0.005	0.1
Dieldrin	60-57-1	0.03	0.24	0.056	0.000052	0.009	0.1
alpha-Endosulfan	959-98-8	40	0.22	0.056	62	0.003	0.05
beta-Endosulfan	33213-65-9	40	0.22	0.056	62	0.009	0.1
Endosulfan Sulfate	1031-07-8	40	N.S.	N.S.	62	0.020	0.1
Endrin	72-20-8	2	0.086	0.036	0.059	0.015	0.1
Endrin Aldehyde	7421-93-4	N.S.	N.S.	N.S.	0.059	0.022	0.1
Endrin Ketone	53494-70-5	N.S.	N.S.	N.S.	N.S.	0.023	0.1
Heptachlor	76-44-8	0.05	0.52	0.0038	0.000079	0.007	0.05
Heptachlor Epoxide	1024-57-3	0.2	0.52	0.0038	0.000039	0.006	0.05
Methoxychlor	72-43-5	40	N.S.	0.03	40	0.124	0.5
Toxaphene	8001-35-2	2	0.73	0.0002	0.00028	0.44	5.0

Notes:
1) QL based on CLP SOM01.2 requirements. MDL based on CompuChem QC limits as of January 15, 2008 for analysis of aqueous samples following SOP 2.1.2.3. CompuChem routinely re-evaluates QC criteria using the procedures in the laboratory QM. The current laboratory limits at the time of sample submission will be used to evaluate analytical performance.
2) NJGWQS and NJSWQS provided as benchmarks for comparison to routine monitoring results. The data is not used for compliance determination.

15-7 Polychlorinated Biphenyls – Groundwater and Surface Water

Analyte	CAS Number	Higher of PQL and Ground Water Quality Criterion (2008) (ug/L)	Surface Water Quality Standards Fresh Water Acute (2008) (ug/L)	Surface Water Quality Standards Fresh Water Chronic (2008) (ug/L)	Surface Water Quality Standards Fresh Water Human Health (2008) (ug/L)	Achievable Laboratory Limits (ug/L)	
						MDLs	QLs
Aroclor 1016	12674-11-2	0.5	N.S.	0.014	0.000064	0.24	1
Aroclor 1221	11104-28-2	0.5	N.S.	0.014	0.000064	0.38	1
Aroclor 1232	11141-16-5	0.5	N.S.	0.014	0.000064	0.21	1
Aroclor 1242	53469-21-9	0.5	N.S.	0.014	0.000064	0.19	1
Aroclor 1248	12672-29-6	0.5	N.S.	0.014	0.000064	0.10	1
Aroclor 1254	11097-69-1	0.5	N.S.	0.014	0.000064	0.17	1
Aroclor 1260	11096-82-5	0.5	N.S.	0.014	0.000064	0.25	1
Aroclor 1262	37324-23-5	0.5	N.S.	0.014	0.000064	0.17	1
Aroclor 1268	11100-14-4	0.5	N.S.	0.014	0.000064	0.12	1

Notes:

1) QL based on CLP SOM01.2 requirements. MDL based on CompuChem QC limits as of February 27, 2008 for analysis of aqueous samples following SOP 2.1.2.4. CompuChem routinely re-evaluates QC criteria using the procedures in the laboratory QM. The current laboratory limits at the time of sample submission will be used to evaluate analytical performance.

3) NJGWQS and NJSWQS provided as benchmarks for comparison to routine monitoring results. The data is not used for compliance determination.

15-8 Metals – Groundwater and Surface Water

Analyte	CAS Number	Higher of PQL and Ground Water Quality Criterion (2008) (ug/L)	Surface Water Quality Standards Fresh Water Acute (2008) (ug/L)	Surface Water Quality Standards Fresh Water Chronic (2008) (ug/L)	Surface Water Quality Standards Fresh Water Human Health (2008) (ug/L)	Achievable Laboratory Limits (ug/L)	
						MDLs	QLs
Aluminum	7429-90-5	200	N.S.	N.S.	N.S.	24.0	200
Antimony	7440-36-0	6	N.S.	N.S.	5.6	0.079	2
Arsenic	7440-38-2	3	340	150	0.017	0.098	1
Barium	7440-39-3	6000	N.S.	N.S.	2000	0.500	200
Beryllium	7440-41-7	1	N.S.	N.S.	6.0	0.420	5
Cadmium	7440-43-9	4	N.S.	N.S.	3.4	0.370	5
Calcium	7440-70-2	N.S.	N.S.	N.S.	N.S.	20.8	5000
Chromium	7440-47-3	70	N.S.	N.S.	92	0.064	2
Cobalt	7440-48-4	100	N.S.	N.S.	N.S.	0.140	1
Copper	7440-50-8	1300	N.S.	N.S.	1300	0.091	2
Iron	7439-89-6	300	N.S.	N.S.	N.S.	9.400	100
Lead	7439-92-1	5	38	5.4	5.0	0.020	1
Magnesium	7439-95-4	N.S.	N.S.	N.S.	N.S.	15.6	5000
Manganese	7439-96-5	50	N.S.	N.S.	N.S.	0.260	15
Mercury	7439-97-6	2	1.4	0.77	0.050	0.055	0.2
Nickel	7440-02-0	100	N.S.	N.S.	500	0.690	40
Potassium	7440-09-7	N.S.	N.S.	N.S.	N.S.	11.7	5000
Selenium	7782-49-2	40	20	5.0	170	0.250	5
Silver	7440-22-4	40	N.S.	N.S.	170	0.013	1
Sodium	7440-23-5	50000	N.S.	N.S.	N.S.	89.1	5000
Thallium	7440-28-0	2	N.S.	N.S.	0.24	0.025	1
Vanadium	7440-62-2	N.S.	N.S.	N.S.	N.S.	0.024	1
Zinc	7440-66-6	2000	N.S.	N.S.	7400	4.0	60

Notes:

1) QL based on ILM05.4 requirements. MDL based on CompuChem QC limits as of January 2007 for analysis of aqueous samples following SOPs 3.1.1.4 and 3.1.2.2. CompuChem routinely re-evaluates QC criteria using the procedures in the laboratory QM. The current laboratory limits at the time of sample submission will be used to evaluate analytical performance.

2) Antimony, arsenic, chromium, cobalt, copper, lead, selenium, silver, thallium, and vanadium concentrations for groundwater shall be determined by MS-AES following 3.1.2.2. Mercury concentrations will be determined by 3.3.4. All other metals shall be determined by AES following 3.1.1.4.

3) NJGWQS and NJSWQS provided as benchmarks for comparison to routine monitoring results. The data is not used for compliance determination.

15-9 Natural Attenuation Parameters – Groundwater

Analyte	CAS Number	Higher of PQL and Ground Water Quality Criterion (2008) (ug/L)	Surface Water Quality Standards Fresh Water Acute (2008) (ug/L)	Surface Water Quality Standards Fresh Water Chronic (2008) (ug/L)	Surface Water Quality Standards Fresh Water Human Health (2008) (ug/L)	Achievable Laboratory Limits[1] (ug/L)	
						MDLs	QLs
Alkalinity (as Calcium Carbonate)	ALK	N.S.	N.S.	N.S.	N.S.	2.41	10
Nitrate	14797-55-8	10000	N.S.	N.S.	10000	0.017	0.050
Nitrite	14797-65-0	1000	N.S.	N.S.	N.S.	0.0027	0.050
Sulfate	14808-79-8	250000	N.S.	N.S.	N.S.	0.93	5.0
Total Organic Carbon	TOC	N.S.	N.S.	N.S.	N.S.	0.7	5.0
Sulfide	18496-25-8	N.S.	N.S.	N.S.	N.S.	0.15	0.50
pH	pH	6.5-8.5	N.S.	N.S.	N.S.	--	--
Total Phosphorous (TKP)	7723-14-0	N.S.	N.S.	N.S.	N.S.	0.015	0.10
Total Kjeldahl Nitrogen (TKN)	KN	N.S.	N.S.	N.S.	N.S.	0.10	0.25
Ethane	74-84-0	N.S.	N.S.	N.S.	N.S.	0.001	0.01
Ethene	74-85-1	N.S.	N.S.	N.S.	N.S.	0.003	0.01
Methane	74-82-8	N.S.	N.S.	N.S.	N.S.	0.003	0.015
Hydrogen Gas	1333-74-0	N.S.	N.S.	N.S.	N.S.	0.12	0.6
Acetic Acid	64-19-7	N.S.	N.S.	N.S.	N.S.	15	70
Propionic Acid	79-09-4	N.S.	N.S.	N.S.	N.S.	2.0	70
Butyric Acid	107-92-6	N.S.	N.S.	N.S.	N.S.	6.0	70
Pyruvic Acid	127-17-3	N.S.	N.S.	N.S.	N.S.	26	70
Lactic Acid	50-21-5	N.S.	N.S.	N.S.	N.S.	42	100
n-Pentanoic Acid	109-52-4	N.S.	N.S.	N.S.	N.S.	16	70
i-Pentanoic Acid	503-74-2	N.S.	N.S.	N.S.	N.S.	32	70
i-Hexanoic Acid	646-07-1	N.S.	N.S.	N.S.	N.S.	18	100
n-Hexanoic Acid	142-62-1	N.S.	N.S.	N.S.	N.S.	7	100

Notes:

1) MDL and QL based on CompuChem QC limits as of January 1, 2008 for analysis of aqueous samples following SOPs 3.5.1.1, 3.5.14.1, 3.5.17.1, 3.5.22.1, 3.6.2.1 or Microseeps QC limits for analysis of aqueous samples following SOPs AM23G, and AM20GAx. CompuChem and Microseeps routinely re-evaluates QC criteria using the procedures in the laboratory QM and QSM. The current laboratory limits at the time of sample submission will be used to evaluate analytical performance.

2) NJGWQS and NJSWQS provided as benchmarks for comparison to routine monitoring results. The data is not used for compliance determination.

QAPP Worksheet #16 - Project Schedule Timeline

The probable project schedule for the project work is shown in Figure 9 of the Operable Unit 3 Feasibility Study Phase 1 Treatability Studies. The schedule will be refined throughout the project and the monitoring aspects may be revised, subject to USEPA's approval.

The projected project schedule for future sampling events will be included in the applicable Work Plan.

QAPP Worksheet #17 - Sampling Design and Rationale

Sampling Design and Rationale for the EAB Pilot test is discussed in detail in section 6.0 of the Operable Unit 3 Feasibility Study Phase 1 Treatability Studies report. The proposed sampling locations are shown on Figures 8 of the Operable Unit 3 Feasibility Study Phase 1 Treatability Studies. The sampling design for the routine groundwater and surface water monitoring was established in the O&M Plan.

The sampling design and rationale will be discussed in the applicable work plans for future tasks.

QAPP Worksheet #18 - Sampling Locations and Methods/SOP Requirements Table

The proposed sampling locations for the EAB bench test are shown on Figure 8 of the Operable Unit 3 Feasibility Study Phase 1 Treatability Studies report.

All samples will be collected in accordance with the sampling SOPs located in Attachment 1. When required, field QC sample locations will be chosen by the field staff based on the environmental conditions and material availability.

Laboratory analytical requirements are provided in Worksheet #14.

Sampling locations will be provided in the work plan for future sampling events.

QAPP Worksheet #19 - Analytical SOP Requirements Table

Matrix	Analytical Group	Concentration Level	Analytical and Preparation SOP Reference[1]	Sample Volume	Containers (number, size, and type)	Preservation Requirements (chemical, temperature, light protected)	Maximum Holding Time (preparation/ analysis)
Groundwater, Surface Water	VOCs	All	1.2.3.4, 1.2.4.2	3 x 40 ml vial	3 x 40 ml glass vial	< 6°C; HCl; pH <2	10 days VTSR
Groundwater, Surface Water	SVOCs	All	2.4.4.3, 2.4.4.4	1000 ml	2 x 1000 ml amber glass bottle	<6°C	5 days from VTSR for extraction/40 days from extraction for analysis.
Groundwater, Surface Water	Pesticides	All	2.1.2.3, 2.1.3.2	1000 ml	1000 ml amber glass bottle	<6°C	5 days from VTSR for extraction/40 days from extraction for analysis.
Groundwater, Surface Water	PCBs	All	2.1.2.4, 2.1.3.3	1000 ml	1000 ml amber glass bottle	<6°C	5 days from VTSR for extraction/40 days from extraction for analysis.
Groundwater, Surface Water	Metals	All	3.1.1.4, 3.1.1.5, 3.1.2.1, 3.1.2.2 3.3.1, 3.3.4	500 ml	500 ml polyethylene bottle	HNO_3; pH <2; <6°C	26 days from VTSR for mercury; 180 days from VTSR for metals.
Groundwater, Surface Water	pH	All	3.5.14.1	40 ml	100 ml polyethylene bottle	< 6°C	As soon as possible after receipt by laboratory
Groundwater	NAPs - Alkalinity	All	3.5.1.1	100 ml	100 ml polyethylene bottle	<6°C	14 days
Groundwater	NAPs - Nitrate	All	3.5.22.1	100 ml	100 ml polyethylene bottle	< 6°C	48 hours
Groundwater	NAPs - Nitrite	All	3.5.22.1	50 ml	100 ml polyethylene bottle	< 6°C	48 hours
Groundwater	NAPs - Sulfate	All	3.5.22.1	250 ml	250 ml polyethylene bottle	< 6°C	28 days
Groundwater	NAPs - Sulfide	All	3.5.17.1	100 ml	500 ml polyethylene bottle	< 6°C, ZnOAc, NaOH	7 days
Groundwater	NAPs - Total Organic Carbon (TOC)	All	3.6.2.1	100 ml	100 ml amber glass bottle	<6°C, H_2SO_4; pH<2	28 days
Groundwater	NAPs – Methane, Ethane, Ethene	All	AM20GAx	40 ml	40 ml glass vial	<6°C, TSP; pH>10	14 days
Groundwater	Hydrogen Gas	All	AM20GAx	40 ml	40 ml glass vial	<6°C, TSP; pH>10	14 days
Groundwater	Volatile Fatty Acid	All	AM23G	40 ml	40 ml glass vial	< 6°C, BAK	14 days

QAPP Worksheet #19 - Analytical SOP Requirements Table

Matrix	Analytical Group	Concentration Level	Analytical and Preparation SOP Reference[1]	Sample Volume	Containers (number, size, and type)	Preservation Requirements (chemical, temperature, light protected)	Maximum Holding Time (preparation/ analysis)
Groundwater, Surface Water	Ferrous Iron	All	GFP-4, GFP-9	Field Measurement – Not Applicable	Field Measurement – Not Applicable	None	15 minutes
Groundwater, Surface Water	Dissolved Oxygen	All	GFP-4, GFP-9	Field Measurement – Not Applicable	Field Measurement – Not Applicable	None	15 minutes
Groundwater, Surface Water	Oxidation Reduction Potential	All	GFP-4, GFP-9	Field Measurement – Not Applicable	Field Measurement – Not Applicable	None	15 minutes
Groundwater, Surface Water	Specific Conductance	All	GFP-4, GFP-9	Field Measurement – Not Applicable	Field Measurement – Not Applicable	None	15 minutes
Groundwater, Surface Water	Turbidity	All	GFP-4, GFP-9	Field Measurement – Not Applicable	Field Measurement – Not Applicable	None	15 minutes
Groundwater, Surface Water	pH	All	GFP-4, GFP-9	Field Measurement – Not Applicable	Field Measurement – Not Applicable	None	15 minutes
Groundwater, Surface Water	Temperature	All	GFP-4, GFP-9	Field Measurement – Not Applicable	Field Measurement – Not Applicable	None	15 minutes

[1]Reference number from QAPP Worksheet #23

QAPP Worksheet #20 - Field Quality Control Sample Summary Table

Matrix	Analytical Group	Conc. Level	Analytical and Preparation SOP Reference[1]	# of Sampling Locations	# of Field Duplicate Pairs	# of MS (Organic and Inorganic)	# of Field Blanks	# of Equipment Blanks	No. of PT Samples[2]	Total No. of Samples to Lab
Groundwater, Surface Water	VOCs	All	1.2.3.4, 1.2.4.2	TBD	1 per 20 primary samples	1 per 20 primary samples	Daily trip blanks	1 rinsate blank per day, or 1 per 20 samples, whichever is more frequent, whenever field decontaminated equipment is used.	None	TBD
Groundwater, Surface Water	SVOCs	All	2.4.4.3, 2.4.4.4	TBD	1 per 20 primary samples	1 per 20 primary samples	Not Applicable	1 rinsate blank per day, or 1 per 20 samples, whichever is more frequent, whenever field decontaminated equipment is used.	None	TBD
Groundwater, Surface Water	Pesticides	All	2.1.2.3, 2.1.3.2	TBD	1 per 20 primary samples	1 per 20 primary samples	Not Applicable	1 rinsate blank per day, or 1 per 20 samples, whichever is more frequent, whenever field decontaminated equipment is used.	None	TBD
Groundwater, Surface Water	PCBs	All	2.1.2.4, 2.1.3.3	TBD	1 per 20 primary samples	1 per 20 primary samples	Not Applicable	1 rinsate blank per day, or 1 per 20 samples, whichever is more frequent, whenever field decontaminated equipment is used.	None	TBD
Groundwater, Surface Water	Metals	All	3.1.1.4, 3.1.1.5, 3.1.2.1, 3.1.2.2, 3.3.1, 3.3.4	TBD	1 per 20 primary samples	1 per 20 primary samples	Not Applicable	1 rinsate blank per day, or 1 per 20 samples, whichever is more frequent, whenever field decontaminated equipment is used.	None	TBD

QAPP Worksheet #20 - Field Quality Control Sample Summary Table

Matrix	Analytical Group	Conc. Level	Analytical and Preparation SOP Reference[1]	# of Sampling Locations	# of Field Duplicate Pairs	# of MS (Organic and Inorganic)	# of Field Blanks	# of Equipment Blanks	No. of PT Samples[2]	Total No. of Samples to Lab
Groundwater	NAPs - Alkalinity	All	3.5.1.1	TBD	1 per 20 primary samples	1 per 20 primary samples	Not Applicable	1 rinsate blank per day, or 1 per 20 samples, whichever is more frequent, whenever field decontaminated equipment is used.	None	TBD
Groundwater	NAPs - Nitrate	All	3.5.22.1	TBD	1 per 20 primary samples	1 per 20 primary samples	Not Applicable	1 rinsate blank per day, or 1 per 20 samples, whichever is more frequent, whenever field decontaminated equipment is used.	None	TBD
Groundwater	NAPs - Nitrite	All	3.5.22.1	TBD	1 per 20 primary samples	1 per 20 primary samples	Not Applicable	1 rinsate blank per day, or 1 per 20 samples, whichever is more frequent, whenever field decontaminated equipment is used.	None	TBD
Groundwater	NAPs - Sulfate	All	3.5.22.1	TBD	1 per 20 primary samples	1 per 20 primary samples	Not Applicable	1 rinsate blank per day, or 1 per 20 samples, whichever is more frequent, whenever field decontaminated equipment is used.	None	TBD
Groundwater	NAPs - Sulfide	All	3.5.17.1	TBD	1 per 20 primary samples	1 per 20 primary samples	Not Applicable	1 rinsate blank per day, or 1 per 20 samples, whichever is more frequent, whenever field decontaminated equipment is used.	None	TBD

QAPP Worksheet #20 - Field Quality Control Sample Summary Table

Matrix	Analytical Group	Conc. Level	Analytical and Preparation SOP Reference[1]	# of Sampling Locations	# of Field Duplicate Pairs	# of MS (Organic and Inorganic)	# of Field Blanks	# of Equipment Blanks	No. of PT Samples[2]	Total No. of Samples to Lab
Groundwater	NAPs - Total Organic Carbon (TOC)	All	3.6.2.1	TBD	1 per 20 primary samples	1 per 20 primary samples	Not Applicable	1 rinsate blank per day, or 1 per 20 samples, whichever is more frequent, whenever field decontaminated equipment is used.	None	TBD
Groundwater, Surface Water	NAPs – pH	All	3.5.14.1	TBD	1 per 20 primary samples	1 per 20 primary samples	Not Applicable	1 rinsate blank per day, or 1 per 20 samples, whichever is more frequent, whenever field decontaminated equipment is used.	None	TBD
Groundwater	NAPs – Methane, Ethane, Ethene	All	AM20GAx	TBD	1 per 20 primary samples	Not Applicable	Not Applicable	1 rinsate blank per day, or 1 per 20 samples, whichever is more frequent, whenever field decontaminated equipment is used.	None	TBD
Groundwater	Hydrogen Gas	All	AM20GAx	TBD	1 per 20 primary samples	Not Applicable	Not Applicable	1 rinsate blank per day, or 1 per 20 samples, whichever is more frequent, whenever field decontaminated equipment is used.	None	TBD
Groundwater	Volatile Fatty Acid	All	AM23G	TBD	1 per 20 primary samples	Not Applicable	Not Applicable	1 rinsate blank per day, or 1 per 20 samples, whichever is more frequent, whenever field decontaminated equipment is used.	None	TBD
Groundwater, Surface Water	Ferrous Iron	All	GFP-4, GFP-9	TBD	1 per 20 primary samples	Not Applicable	Not Applicable	Not Applicable	None	TBD
Groundwater, Surface Water	Dissolved Oxygen	All	GFP-4, GFP-9	TBD	Not Applicable	Not Applicable	Not Applicable	None	None	TBD

QAPP Worksheet #20 - Field Quality Control Sample Summary Table

Matrix	Analytical Group	Conc. Level	Analytical and Preparation SOP Reference[1]	# of Sampling Locations	# of Field Duplicate Pairs	# of MS (Organic and Inorganic)	# of Field Blanks	# of Equipment Blanks	No. of PT Samples[2]	Total No. of Samples to Lab
Groundwater, Surface Water	Oxidation Reduction Potential	All	GFP-4, GFP-9	TBD	Not Applicable	Not Applicable	Not Applicable	None	None	TBD
Groundwater, Surface Water	Specific Conductance	All	GFP-4, GFP-9	TBD	Not Applicable	Not Applicable	Not Applicable	None	None	TBD
Groundwater, Surface Water	Turbidity	All	GFP-4, GFP-9	TBD	Not Applicable	Not Applicable	Not Applicable	None	None	TBD
Groundwater, Surface Water	pH	All	GFP-4, GFP-9	TBD	Not Applicable	Not Applicable	Not Applicable	None	None	TBD
Groundwater, Surface Water	Temperature	All	GFP-4, GFP-9	TBD	Not Applicable	Not Applicable	Not Applicable	None	None	TBD

[1]Reference number from QAPP Worksheet #23

QAPP Worksheet #21 - Project Sampling SOPs Requirements Table

Reference Number	Title, Revision Date and/or Number	Originating Organization	Equipment Type	Modified for Project Work? (Check if yes)	Comments
GFP-1	Field Documentation	Golder Associates Inc.	Field notebook, field observation forms, digital camera, pens.	☐	Field procedure for documentation
GFP-2	Sampling Equipment Decontamination	Golder Associates Inc.	Scrub brushes, dish pans, distilled or deionized water, non-phosphate soap, solvent (if necessary).	☒	Field procedure for sampling equipment decontamination.
GFP-3	Field Measurement and Instrument Calibration Procedures	Golder Associates Inc.	Electronic water level meter and/or oil-water interface probe; Horiba or equivalent in-line flow through cell	☒	Field procedure for water level measurements, total well depth measurements, groundwater field parameter measurements; and VOC vapor measurements
GFP-4	Groundwater Sampling Procedure	Golder Associates Inc.	Various equipment including power sources, control boxes, pumps, flow-through cells, bailers. See GFP-4 for complete equipment list.	☒	Field procedure for groundwater well purging and groundwater sample collection
GFP-9	Surface Water Sampling Procedure	Golder Associates Inc.	Various supplies including filtration vessel and flow through cells. See GFP-9 for complete list.	☒	Field procedure for surface water sample collection
GFP-7	Sample Handling, Custody, and Shipment	Golder Associates Inc.	Sample containers, coolers, ice, chain of custody.	☒	Field procedures for sample packaging, custody and shipment.
GFP-8	Sodium Lactate Injection	Golder Associates Inc.		☒	Procedure for EAB nutrient injection.

QAPP Worksheet #22 - Field Equipment Calibration, Maintenance, Testing, and Inspection Table

Field Equipment	Calibration Activity	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person[1]	SOP Reference[2]
Electronic water level meter and/or an oil-water interface probe;				Check Battery	Prior to each measurement	Sufficient charge for proper operation	Change batteries if required	Golder Field Sampling Personnel	GFP-3, GFP-9
Photo ionization detector				Confirm that lamp voltage matches the lamp specified by the Health and Safety Plan	Daily	Correct lamp installed	Install correct lamp	Golder Field Sampling Personnel	GFP-3
Photo ionization Detector	Calibrate following manufacturer specification				Daily	Meets manufacturers specification	If readings do not meet manufacturers specifications, clean following manufacturers instructions, check/replace filters and other consumable parts, recalibrate or service as necessary. Obtain replacement instrument.	Golder Field Sampling Personnel	GFP-3
Photo ionization Detector		Clean lamp			As needed	Readings stabilize within manufacturers specification	If probe reading fails to stabilize check lamp for condensation and clean.	Golder Field Sampling Personnel	GFP-3
Generator				Check fuel level and oil levels	Continuously during operation	Sufficient fuel	Fill Tank	Golder Field Sampling Personnel	GFP-4
Grunfos Control box				Check power cords and electrical lines	When control box is plugged into generator	Cords are not frayed or worn	Obtain replacement control box	Golder Field Sampling Personnel	GFP-4
Grunfos Redi-Flo 2 Submersible pump				Check pump leads	Prior to installing pump in well	Leads are not frayed or worn	Obtain replacement pump	Golder Field Sampling Personnel	GFP-4

QAPP Worksheet #22 - Field Equipment Calibration, Maintenance, Testing, and Inspection Table

Field Equipment	Calibration Activity	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person[1]	SOP Reference[2]
Grunfos Redi-Flo 2 Submersible pump		Check coolant in pump			Daily	Coolant chamber properly filled with DI water	Replace dirty water with clean DI water. Fill chamber with DI water if level is low.	Golder Field Sampling Personnel	GFP-4
Grunfos Redi-Flo 2 Submersible pump		Decontaminate pump			At the beginning of the project and between sample locations	Pump has been cleaned	Perform decontamination procedure	Golder Field Sampling Personnel	GFP-4
Air Compressor				Check fuel level	Continuously during operation	Sufficient fuel	Fill Tank	Golder Field Sampling Personnel	GFP-4
Well Wizard Pump control box				Check batteries	Continuously during operation	Control box operating	Replace batteries	Golder Field Sampling Personnel	GFP-4
Peristaltic Pump		Decontaminate pump			At the beginning of the project and between sample locations	Pump has been cleaned	Perform decontamination procedur	Golder Field Sampling Personnel	GFP-4
Tubing				Check for kinks or breaks in tubing	Prior to use	No kinks or breaks in tubing	Replace tubing as necessary	Golder Field Sampling Personnel	GFP-4
Teflon-lined Bailer					Prior to use	Packaging undamaged	Do not use if damaged	Golder Field Sampling Personnel	GFP-4
Nylon well rope				Rope is clean and unfrayed	Prior to use	Rope is clean and unfrayed	Replace if damaged	Golder Field Sampling Personnel	GFP-4

QAPP Worksheet #22 - Field Equipment Calibration, Maintenance, Testing, and Inspection Table

Field Equipment	Calibration Activity	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person[1]	SOP Reference[2]
Multi-Gas Meter (combustible gas, oxygen, carbon monoxide, hydrogen sulfide)	Calibrate following manufacturer specifications				Daily	Meets manufacturers specification	If readings do not meet manufacturer's specification, clean following manufacturer's instructions, check/replace filters and other consumable parts, recalibrate or return for servicing as needed. Obtain replacement meter.	Golder Field Sampling Personnel	Health and Safety Contingency Plan (HSCP) PTWP Appendix B
Dust monitor	Calibrate following manufacturer specifications				Daily	Meets manufacturers specification	If readings do not meet manufacturer's specification, clean following manufacturer's instructions, check/replace filters and other consumable parts, recalibrate or return for servicing as needed. Obtain replacement meter.	Golder Field Sampling Personnel	Health and Safety Contingency Plan (HSCP) PTWP Appendix B

[1]Rental equipment will be maintained and tested by the company supplying the equipment. Golder personnel will field calibrate certain instruments used in field screening, such as PID. Subcontractors will be responsible for the calibration, maintenance, testing and inspection of their own equipment prior to use.
[2]Reference number from QAPP Worksheet #21

QAPP Worksheet #23 - Analytical SOP References Table

Reference Number	Title, Revision Date, and/or Number	Definitive, Screening or Engineering Data	Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work?
G-1	Standard Operating Procedures for Specific Conductance (COND) Calibration Golder SOP 101, Revision 0, May 27, 2005	Screening	Field Parameters	Horiba U-22 or equivalent in-line flow through cell	Golder Associates	☐
G-2a	Standard Operating Procedures for Dissolved Oxygen (DO) Calibration – Daily, Golder SOP 102a, Revision 2, January 22, 2008	Screening	Field Parameters	Horiba U-22 or equivalent in-line flow through cell	Golder Associates	☐
G-2b	Standard Operating Procedures for Dissolved Oxygen (DO) Calibration – Weekly, Golder SOP 102b, Revision 3, January 23, 2008	Screening	Field Parameters	Horiba U-22 or equivalent in-line flow through cell	Golder Associates	☐
G-3	Standard Operating Procedures for Temperature (TEMP) Calibration, Golder SOP 103, Revision 2, January 22, 2008	Screening	Field Parameters	Horiba U-22 or equivalent in-line flow through cell	Golder Associates	☐
G-4	Standard Operating Procedures for pH Calibration, Golder SOP 104, Revision 2, January 23, 2008	Screening	Field Parameters	Horiba U-22 or equivalent in-line flow through cell	Golder Associates	☐
G-5	Standard Operating Procedure for Turbidity Calibration, Golder SOP 105, Revision 0, May 27, 2008	Screening	Field Parameters	Horiba U-22 or equivalent in-line flow through cell	Golder Associates	☐
G-6	Standard Operating Procedure for Collection of Specific Conductance (COND), Golder SOP 201, Revision 0, May 27, 2005	Screening	Field Parameters	Horiba U-22 or equivalent in-line flow through cell	Golder Associates	☐
G-7	Standard Operating Procedures for Dissolved Oxygen (DO) Analysis, Golder SOP 202, Revision 1, January 23, 2008	Screening	Field Parameters	Horiba U-22 or equivalent in-line flow through cell	Golder Associates	☐
G-8	Standard Operating Procedures for Temperature (TEMP) Analysis, Golder SOP 203, Revision 1, January 23, 2008	Screening	Field Parameters	Horiba U-22 or equivalent in-line flow through cell	Golder Associates	☐
G-9	Standard Operating Procedures for pH Analysis, Golder SOP 204, Revision 1, January 23, 2008	Screening	Field Parameters	Horiba U-22 or equivalent in-line flow through cell	Golder Associates	☐
G-10	Standard Operating Procedures for Turbidity (TURB) Analysis, Golder SOP 205, Revision 0, May 27, 2005	Screening	Field Parameters	Horiba U-22 or equivalent in-line flow through cell	Golder Associates	☐

1.2.4.2	GC/MS Analysis of Trace Level Volatiles in Water Scan and SIM using EPA CLP SOW SOM01.2, Revision 4, February 24, 2009.	Definitive	VOCs	GC/MS	CompuChem	☐
2.1.2.3	GC/ECD Analysis of Pesticides in Aqueous and Solid Sample Extracts by EPA CLP SOW SOM01.2, Revision 4, February 4, 2009.	Definitive	Pesticides	GC/ECD	CompuChem	☐
2.1.2.4	GC/ECD Analysis of Polychlorinated Biphenyls (PCBs) as Aroclors in Water and Soil Extracts by EPA CLP SOW SOM01.2, Revision 4, February 4, 2009.	Definitive	PCBs	GC/ECD	CompuChem	☐
2.4.4.3	GC/MS Scan and SIM Analyses of Semivolatiles in Water and Soil Matrices by EPA CLP SOM01.2, Revision 6, February 4, 2009.	Definitive	SVOCs	GC/MS	CompuChem	☐
3.1.1.4	Determination of Metals by Inductively Coupled Plasma (ICP) by EPA CLP and NYSASP(ILM04.1, ILM05.4 SOW Documents), Revision 18, February 24, 2009.	Definitive	Metals	ICP	CompuChem	☐
3.1.2.2	Determination of Metals by Inductively Coupled Plasma -Mass Spectometry (ICP-MS) by EPA CLP, Revision 3, March 19, 2007.	Definitive	Metals	ICP-MS	CompuChem	☐
3.3.4	Automated Cold Vapor Determination for Mercury by CLP, SW-846, MCAWW, and NYSASP, Revision 21, July 23, 2007.	Definitive	Metals	CVAA	CompuChem	☐
3.5.1.1	Alkalinity In Waters and Leachates by MCAWW and Lachat, Revision 8, June 18, 2007.	Definitive	NAPs	Ion Analyzer	CompuChem	☐
3.5.14.1	pH Determination, Revision 6, August 21, 2007, Revision 6, August 21, 2007.	Definitive	NAPs	Electrode	CompuChem	☐
3.5.17.1	Determination of Sulfide in Aqueous Samples, Revision 4, July 6, 2007.	Definitive	NAPs	None (titrimetric determination)	CompuChem	☐
3.5.22.1	Determination of Inorganic Anions by Ion Chromatography, Revision 6, June 17, 2008.	Definitive	NAPs	IC	CompuChem	☐
3.6.2.1	Total Organic Carbon (TOC) in Water by Standard Methods and SW-846, Revision 13, June 20, 2008.	Definitive	NAPs	TOC analyzer	CompuChem	☐
AM20GAx	Analytical Method AM20GAx Standard Operating Procedure for the Analysis of Biodegradation Indicator Gases, Revision 9.0, November21, 2008.	Definitive	NAPs	FID, RGD	Microseeps	☐
AM23G	Standard Operating Procedure for the Analyses of Low Level Volatile Fatty Acids by Ion Chromatography, Revision 5.0, November 19, 2008.	Definitive	NAPs	IC	Microseeps	☐

Note:
Analytical SOPs provided by Golder Associates, CompuChem, and Microseeps are provided in Attachment 2.

QAPP Worksheet #24 - Analytical Instrument Calibration Table

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference[1]
Horiba U-22 or equivalent in-line flow cell	Conductivity – immerse probe in 1.00 mS/m and distilled water standards	Daily prior to use	Meets manufacturer specifications	Clean probe, recalibrate meter	Golder Associates Field Staff	G-1
Horiba U-22 or equivalent in-line flow cell	DO - Calibrate probe against HACH DO test kit ("Winkler" Method)	Weekly	Results from probe within ±0.2 mg/L of result from HACH kit.	Clean probe, replace DO membrane	Golder Associates Field Staff	G-2b
Horiba U-22 or equivalent in-line flow cell	DO – immerse probe in zero percent DO solution and air saturated water	Daily prior to use	Results for air saturated water must match Table 1 of SOP G-2a	Clean probe, replace DO membrane, repeat weekly calibration procedure	Golder Associates Field Staff	G-2a
Horiba U-22 or equivalent in-line flow cell	Temperature – Compare the termistor sensor results to the resut from an NIST certified thermometer in a room temperature water sample	Quarterly	Adjust meter to result from the NIST thermometer	Send probe for repair	Golder Associates Field Staff	G-3
Horiba U-22 or equivalent in-line flow cell	pH – immerse sensor in pH 7.00 buffer and either pH 4.00 or pH 9.00 buffer	Daily prior to use, check every 3 hours	±0.05 pH Units	Clean electrode, recalibrate meter	Golder Associates Field Staff	G-4
Horiba U-22 or equivalent in-line flow cell	Turbidity – immerse probe in 100 NTU and distilled water standards	Daily prior to use	Daily prior to use	Clean probe, recalibrate meter	Golder Associates Field Staff	G-5
GC/MS	Perform 5 point calibration in accordance with USEPA CLP Method SOM01.2.	Prior to beginning sample analysis and after failing CCV. Minimum frequency not defined.	RF for SPCCs > 0.050 Max %RSD for CCCs <30%	Corrective maintenance, re-calibrate instrument and re-analyze samples	CompuChem Analyst	1.2.3.4, 1.2.4.2,2.4.4.3

QAPP Worksheet #24 - Analytical Instrument Calibration Table

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference[1]
GC/ECD	Perform 5 point calibration in accordance with USEPA CLP Method SOM01.2.	Prior to beginning sample analysis and after failing CCV. Minimum frequency not defined.	%RSD <20% or curve with correlation coefficient >0.995; degradation of DDT, endrin <15% for pesticides	Corrective maintenance, re-calibrate instrument and re-analyze samples	CompuChem Analyst	2.1.2.3, 2.1.2.4
GC/ECD	Perform 5 point calibration in accordance with USEPA CLP Method SOM01.2.	Prior to beginning sample analysis and after failing CCV. Minimum frequency not defined.	Max %RSD 20% to use average response factor	Corrective maintenance, re-calibrate instrument and re-analyze samples	CompuChem Analyst	2.1.2.3, 2.1.2.4
ICP	Analyze ICV and interelement check standard.	Prior to beginning sample analysis. At least once per day.	ICV within ±10% of true value	corrective maintenance, re-calibrate instrument and re-analyze samples	CompuChem Analyst	3.1.1.4
ICP-MS	Analyze ICV and interelement check standard.	Prior to beginning sample analysis. At least once per day.	ICV within ±10% of true value	corrective maintenance, re-calibrate instrument and re-analyze samples	CompuChem Analyst	3.1.2.2
CVAA	Perform 5 point calibration	Prior to beginning sample analysis. At least once per day.	correlation coefficient >0.995; ICV ±10%	corrective maintenance, re-calibrate instrument and re-analyze samples	CompuChem Analyst	3.3.4
IC	Perform 5 point calibration	Monthly or after failing CCV.	correlation coefficient >0.995; CCV ±5%	Re-calibrate instrument with fresh standards	CompuChem Analyst	3.5.22.1
Colorimetric Detector	Perform 6 point calibration	At beginning of analytical shift or after failing CCV; sulfide – every 3 months or after failing CCV.	correlation coefficient >0.995; CCV ±10%	Re-calibrate instrument with fresh standards	CompuChem Analyst	3.5.12.1, 3.5.15.1
TOC Analyzer	Perform 6 point calibration	Monthly	correlation coefficient >0.995; CCV ±10%	Re-calibrate instrument with fresh standards	CompuChem Analyst	3.6.2.1

QAPP Worksheet #24 - Analytical Instrument Calibration Table

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference[1]
FID	Perform 6 point calibration	Prior to beginning sample analysis and after failing CCV. Minimum frequency not defined.	correlation coefficient >0.995; CCV±20%	Re-calibrate instrument with fresh standards	Microseeps Analyst	AM20GAx
RGD	Perform 6 point calibration	Prior to beginning sample analysis and after failing CCV. Minimum frequency not defined.	coefficient >0.995; CCV±20%	Re-calibrate instrument with fresh standards	Microseeps Analyst	AM20GAx
IC	Perform 8 point calibration	Prior to beginning sample analysis and after failing CCV. Minimum frequency not defined.	correlation coefficient >0.99; CCV±20%	Re-calibrate instrument with fresh standards	Microseeps Analyst	AM23G

[1]Reference number from QAPP Worksheet #23

QAPP Worksheet #25 – Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table

All analytical instrumentation will be inspected prior to use by the operator.

Golder Associates performs field equipment maintenance for equipment owned by Golder Associates at the frequency recommended by the field equipment manufacturer. Preventative maintenance and testing of rental equipment is the responsibility of the rental company.

CompuChem discusses preventative maintenance in Section 11.1.8 of the CompuChem QM. Microseeps discusses preventative maintenance in Section 5 of the Microseeps QSM. The laboratory quality manuals are provided in Attachment 3.

QAPP Worksheet #26 - Sample Handling System

SAMPLE COLLECTION, PACKAGING, AND SHIPMENT
Sample Collection (Personnel/Organization): Golder Associates, Inc.
Sample Packaging (Personnel/Organization): Golder Associates, Inc.
Coordination of Shipment (Personnel/Organization): Golder Associates, Inc.
Type of Shipment/Carrier: Commercial carrier such as FedEx or UPS
SAMPLE RECEIPT AND ANALYSIS – Groundwater and Surface Water Samples
Sample Receipt (Personnel/Organization): Sample Receiving Department, CompuChem Laboratories
Sample Custody and Storage (Personnel/Organization): Sample Receiving Department, CompuChem Laboratories
Sample Preparation (Personnel/Organization): See CompuChem Laboratories QM, Section 5.0
Sample Determinative Analysis (Personnel/Organization): See CompuChem Laboratories QM, Section 5.0
SAMPLE ARCHIVING – Groundwater and Surface Water Samples
Field Sample Storage (No. of days from sample collection): 90 days
Sample Extract/Dig estate Storage (No. of days from extraction/digestion): 90 days
Biological Sample Storage (No. of days from sample collection): Not Applicable
SAMPLE DISPOSAL – Groundwater and Surface Water Samples
Personnel/Organization: Environmental sample custodian, CompuChem Laboratories
Number of Days from Analysis: Samples are eligible for disposal 60 days after data submission to the client.
SAMPLE RECEIPT AND ANALYSIS – Groundwater and Hydrogen Gas Samples
Sample Receipt (Personnel/Organization): Sample Receiving Department, Microseeps Laboratories
Sample Custody and Storage (Personnel/Organization): Sample Receiving Department, Microseeps Laboratories
Sample Preparation (Personnel/Organization): See Microseeps Laboratories QSM, Section 4.0
Sample Determinative Analysis (Personnel/Organization): See Microseeps Laboratories QSM, Section 6.0

QAPP Worksheet #26 - Sample Handling System

SAMPLE ARCHIVING – Groundwater and Hydrogen Gas Samples
Field Sample Storage (No. of days from sample collection): 90 days
Sample Extract/Dig estate Storage (No. of days from extraction/digestion): 90 days
Biological Sample Storage (No. of days from sample collection): Not Applicable
SAMPLE DISPOSAL – Groundwater and Hydrogen Gas Samples
Personnel/Organization: Environmental sample custodian, Microseeps Laboratories
Number of Days from Analysis: Samples are eligible for disposal 60 days after data submission to the client.

QAPP Worksheet #27 – Sample Custody Requirements

Field Sample Custody Procedures (sample collection, packaging, shipment, and delivery to laboratory): Field sample custody procedures are documented in the field procedure SOP located in Attachment 1 of this QAPP.
Laboratory Sample Custody Procedures (receipt of samples, archiving, disposal): CompuChem Laboratories sample custody procedures are addressed in EQPM, Section 5, Sample Handling.
Laboratory Sample Custody Procedures (receipt of samples, archiving, disposal): Microseeps sample custody procedures are addressed in QSM, Section 4, Sample Management.
Sample Identification Procedures: Samples will be assigned unique site-specific identifiers following the standard discussed in the field procedure SOP located in Attachment 1 of this QAPP.
Chain-of-custody Procedures: Chain of custody procedures are described in the field procedure SOP located in Attachment 1 of this QAPP.

QAPP Worksheet #28 – QC Samples Tables
28-1 Volatile Organic Compounds – Groundwater and Surface Water

Matrix	Groundwater, Surface Water
Analytical Group	VOCs
Concentration Level	All
Sampling SOP[1]	GFP-4, GFP-9
Analytical Method/ SOP Reference[2]	1.2.3.4 & 1.2.4.2
Sampler's Name	TBD
Field Sampling Organization	Golder Associates Inc.
Analytical Organization	CompuChem
No. of Sample Locations	TBD

QC Sample:	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator	Measurement Performance Criteria
Trip Blank	1 per day	none	Qualify data as required	Golder Associates Data Validator	Accuracy	no results above QL
Method Blank	1 per instrument per analytical shift	no results above QL	If sufficient sample volume is available, reanalyze the samples	CompuChem Analyst	Accuracy	no results above QL
Method Blank	1 per instrument per analytical shift	none	Qualify data as required	Golder Associates Data Validator	Accuracy	no results above QL
Equipment Rinsate Blank	1 rinsate blank per day, or 1 per 20 samples, whichever is more frequent, whenever field decontaminated equipment is used.	none	Qualify data as required	Golder Associates Data Validator	Accuracy	no results above QL
Field Duplicates	1 per 20 samples	none	Qualify data as required	Golder Associates Data Validator	Precision	< 30% RPD
LCS	1 per analytical shift	Meets CLP SOM01.2 method criteria.	If more than 5% of the analytes do not meet the LCS accuracy criteria and sufficient sample volume is available, reanalyze the samples	CompuChem Analyst	Accuracy	Meets CLP SOM01.2 method criteria.

28-1 Volatile Organic Compounds – Groundwater and Surface Water

Matrix	Groundwater, Surface Water
Analytical Group	VOCs
Concentration Level	All
Sampling SOP[1]	GFP-4, GFP-9
Analytical Method/ SOP Reference[2]	1.2.3.4 & 1.2.4.2
Sampler's Name	TBD
Field Sampling Organization	Golder Associates Inc.
Analytical Organization	CompuChem
No. of Sample Locations	TBD

QC Sample:	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator	Measurement Performance Criteria
LCS	1 per analytical shift	Meets CLP SOM01.2 method criteria.	Qualify data as required	Golder Associates Data Validator	Accuracy	Meets CLP SOM01.2 method criteria.
Surrogate Spike	every sample	Meets CLP SOM01.2 method criteria.	If sufficient sample volume is available, reanalyze the samples	CompuChem Analyst	Accuracy	Meets CLP SOM01.2 method criteria.
Surrogate Spike	every sample	Meets CLP SOM01.2 method criteria.	Qualify data as required	Golder Associates Data Validator	Accuracy	Meets CLP SOM01.2 method criteria.
Matrix Spike	1 per 20 samples	Meets CLP SOM01.2 method criteria.	If the LCS meets acceptance criteria, no corrective action required. Otherwise, if sufficient sample volume is available, re-extract and reanalyze the samples	CompuChem Analyst	Accuracy	Meets CLP SOM01.2 method criteria.
Matrix Spike	1 per 20 samples	Meets CLP SOM01.2 method criteria.	Qualify data as required	Golder Associates Data Validator	Accuracy	Meets CLP SOM01.2 method criteria.

[1]Reference number from QAPP Worksheet #21
[2]Reference number from QAPP Worksheet #23

28-2 Semivolatile Organic Compounds – Groundwater and Surface Water

Matrix	Groundwater, Surface Water
Analytical Group	SVOCs
Concentration Level	All
Sampling SOP[1]	GFP-4, GFP-9
Analytical Method/ SOP Reference[2]	2.4.4.3
Sampler's Name	TBD
Field Sampling Organization	Golder Associates Inc.
Analytical Organization	CompuChem
No. of Sample Locations	TBD

QC Sample:	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator	Measurement Performance Criteria
Method Blank	1 per instrument per analytical shift	no results above QL	If sufficient sample volume is available, reanalyze the samples	CompuChem Analyst	Accuracy	no results above QL
Method Blank	1 per instrument per analytical shift	none	Qualify data as required	Golder Associates Data Validator	Accuracy	no results above QL
Equipment Rinsate Blank	1 rinsate blank per day, or 1 per 20 samples, whichever is more frequent, whenever field decontaminated equipment is used.	none	Qualify data as required	Golder Associates Data Validator	Accuracy	no results above QL
Field Duplicates	1 per 20 samples	none	Qualify data as required	Golder Associates Data Validator	Precision	< 30% RPD
LCS	1 per analytical shift	Meets CLP SOM01.2 method criteria.	If more than 5% of the analytes do not meet the LCS accuracy criteria and sufficient sample volume is available, reanalyze the samples	CompuChem Analyst	Accuracy	Meets CLP SOM01.2 method criteria.

28-2 Semivolatile Organic Compounds – Groundwater and Surface Water

Matrix	Groundwater, Surface Water
Analytical Group	SVOCs
Concentration Level	All
Sampling SOP[1]	GFP-4, GFP-9
Analytical Method/ SOP Reference[2]	2.4.4.3
Sampler's Name	TBD
Field Sampling Organization	Golder Associates Inc.
Analytical Organization	CompuChem
No. of Sample Locations	TBD

QC Sample:	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator	Measurement Performance Criteria
LCS	1 per analytical shift	Meets CLP SOM01.2 method criteria.	Qualify data as required	Golder Associates Data Validator	Accuracy	Meets CLP SOM01.2 method criteria.
Surrogate Spike	every sample	Meets CLP SOM01.2 method criteria.	If sufficient sample volume is available, reanalyze the samples	CompuChem Analyst	Accuracy	Meets CLP SOM01.2 method criteria.
Surrogate Spike	every sample	Meets CLP SOM01.2 method criteria.	Qualify data as required	Golder Associates Data Validator	Accuracy	Meets CLP SOM01.2 method criteria.
Matrix Spike	1 per 20 samples	Meets CLP SOM01.2 method criteria.	If the LCS meets acceptance criteria, no corrective action required. Otherwise, if sufficient sample volume is available, re-extract and reanalyze the samples	CompuChem Analyst	Accuracy	Meets CLP SOM01.2 method criteria.
Matrix Spike	1 per 20 samples	Meets CLP SOM01.2 method criteria.	Qualify data as required	Golder Associates Data Validator	Accuracy	Meets CLP SOM01.2 method criteria.

[1]Reference number from QAPP Worksheet #21
[2]Reference number from QAPP Worksheet #23

28-3 Pesticide Compounds – Groundwater and Surface Water

Matrix	Groundwater, Surface Water
Analytical Group	Pesticides
Concentration Level	All
Sampling SOP[1]	GFP-4, GFP-9
Analytical Method/ SOP Reference[2]	2.1.2.3
Sampler's Name	TBD
Field Sampling Organization	Golder Associates Inc.
Analytical Organization	CompuChem
No. of Sample Locations	TBD

QC Sample:	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator	Measurement Performance Criteria
Method Blank	1 per instrument per analytical shift	no results above QL	If sufficient sample volume is available, reanalyze the samples	CompuChem Analyst	Accuracy	no results above QL
Method Blank	1 per instrument per analytical shift	none	Qualify data as required	Golder Associates Data Validator	Accuracy	no results above QL
Equipment Rinsate Blank	1 rinsate blank per day, or 1 per 20 samples, whichever is more frequent, whenever field decontaminated equipment is used.	none	Qualify data as required	Golder Associates Data Validator	Accuracy	no results above QL
Field Duplicates	1 per 20 samples	none	Qualify data as required	Golder Associates Data Validator	Precision	< 30% RPD
LCS	1 per analytical shift	Meets CLP SOM01.2 method criteria.	If more than 5% of the analytes do not meet the LCS accuracy criteria and sufficient sample volume is available, reanalyze the samples	CompuChem Analyst	Accuracy	Meets CLP SOM01.2 method criteria.

28-3 Pesticide Compounds – Groundwater and Surface Water

Matrix	Groundwater, Surface Water
Analytical Group	Pesticides
Concentration Level	All
Sampling SOP[1]	GFP-4, GFP-9
Analytical Method/ SOP Reference[2]	2.1.2.3
Sampler's Name	TBD
Field Sampling Organization	Golder Associates Inc.
Analytical Organization	CompuChem
No. of Sample Locations	TBD

QC Sample:	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator	Measurement Performance Criteria
LCS	1 per analytical shift	Meets CLP SOM01.2 method criteria.	Qualify data as required	Golder Associates Data Validator	Accuracy	Meets CLP SOM01.2 method criteria.
Surrogate Spike	every sample	Meets CLP SOM01.2 method criteria.	If sufficient sample volume is available, reanalyze the samples	CompuChem Analyst	Accuracy	Meets CLP SOM01.2 method criteria.
Surrogate Spike	every sample	Meets CLP SOM01.2 method criteria.	Qualify data as required	Golder Associates Data Validator	Accuracy	Meets CLP SOM01.2 method criteria.
Matrix Spike	1 per 20 samples	Meets CLP SOM01.2 method criteria.	If the LCS meets acceptance criteria, no corrective action required. Otherwise, if sufficient sample volume is available, re-extract and reanalyze the samples	CompuChem Analyst	Accuracy	Meets CLP SOM01.2 method criteria.
Matrix Spike	1 per 20 samples	Meets CLP SOM01.2 method criteria.	Qualify data as required	Golder Associates Data Validator	Accuracy	Meets CLP SOM01.2 method criteria.

[1]Reference number from QAPP Worksheet #21
[2]Reference number from QAPP Worksheet #23

28-4 Polychlorinated Biphenyl Compounds – Groundwater and Surface Water

Matrix	Groundwater, Surface Water
Analytical Group	PCBs
Concentration Level	All
Sampling SOP[1]	GFP-4, GFP-9
Analytical Method/ SOP Reference[2]	2.1.2.4
Sampler's Name	TBD
Field Sampling Organization	Golder Associates Inc.
Analytical Organization	CompuChem
No. of Sample Locations	TBD

QC Sample:	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator	Measurement Performance Criteria
Method Blank	1 per instrument per analytical shift	no results above QL	If sufficient sample volume is available, reanalyze the samples	CompuChem Analyst	Accuracy	no results above QL
Method Blank	1 per instrument per analytical shift	none	Qualify data as required	Golder Associates Data Validator	Accuracy	no results above QL
Equipment Rinsate Blank	1 rinsate blank per day, or 1 per 20 samples, whichever is more frequent, whenever field decontaminated equipment is used.	none	Qualify data as required	Golder Associates Data Validator	Accuracy	no results above QL
Field Duplicates	1 per 20 samples	none	Qualify data as required	Golder Associates Data Validator	Precision	< 30% RPD
LCS	1 per analytical shift	Meets CLP SOM01.2 method criteria.	If more than 5% of the analytes do not meet the LCS accuracy criteria and sufficient sample volume is available, reanalyze the samples	CompuChem Analyst	Accuracy	Meets CLP SOM01.2 method criteria.

28-4 Polychlorinated Biphenyl Compounds – Groundwater and Surface Water

Matrix	Groundwater, Surface Water
Analytical Group	PCBs
Concentration Level	All
Sampling SOP[1]	GFP-4, GFP-9
Analytical Method/ SOP Reference[2]	2.1.2.4
Sampler's Name	TBD
Field Sampling Organization	Golder Associates Inc.
Analytical Organization	CompuChem
No. of Sample Locations	TBD

QC Sample:	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator	Measurement Performance Criteria
LCS	1 per analytical shift	Meets CLP SOM01.2 method criteria.	Qualify data as required	Golder Associates Data Validator	Accuracy	Meets CLP SOM01.2 method criteria.
Surrogate Spike	every sample	Meets CLP SOM01.2 method criteria.	If sufficient sample volume is available, reanalyze the samples	CompuChem Analyst	Accuracy	Meets CLP SOM01.2 method criteria.
Surrogate Spike	every sample	Meets CLP SOM01.2 method criteria.	Qualify data as required	Golder Associates Data Validator	Accuracy	Meets CLP SOM01.2 method criteria.
Matrix Spike	1 per 20 samples	Meets CLP SOM01.2 method criteria.	If the LCS meets acceptance criteria, no corrective action required. Otherwise, if sufficient sample volume is available, re-extract and reanalyze the samples	CompuChem Analyst	Accuracy	Meets CLP SOM01.2 method criteria.
Matrix Spike	1 per 20 samples	Meets CLP SOM01.2 method criteria.	Qualify data as required	Golder Associates Data Validator	Accuracy	Meets CLP SOM01.2 method criteria.

[1]Reference number from QAPP Worksheet #21
[2]Reference number from QAPP Worksheet #23

28-5 Metals – Groundwater and Surface Water

Matrix	Groundwater, Surface Water
Analytical Group	Metals
Concentration Level	All
Sampling SOP[1]	GFP-4, GFP-9
Analytical Method/ SOP Reference[2]	3.1.1.4, 3.1.2.2, 3.3.4
Sampler's Name	TBD
Field Sampling Organization	Golder Associates Inc.
Analytical Organization	CompuChem
No. of Sample Locations	TBD

QC Sample:	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator	Measurement Performance Criteria
Method Blank	1 per extraction batch	no results above QL	If sufficient sample volume is available, re-extract and reanalyze the samples	CompuChem Analyst	Accuracy	no results above QL
Method Blank	1 per extraction batch	no results above QL	Qualify data as required	Golder Associates Data Validator	Accuracy	no results above QL
Equipment Rinsate Blank	1 rinsate blank per day, or 1 per 20 samples, whichever is more frequent, whenever field decontaminated equipment is used.	none	Qualify data as required	Golder Associates Data Validator	Accuracy	no results above QL
Continuing Calibration Blank	1 per 10 samples	no results above QL	Reanalyze sample bracketed by compliant Continuing Calibration Blank	CompuChem Analyst	Accuracy	no results above QL
Continuing Calibration Verification	1 per 10 samples	90-110% of true value	Reanalyze sample bracketed by compliant Continuing Calibration Verification	CompuChem Analyst	Accuracy	90-110% of true value
Field Duplicates	1 per 20 samples	none	Qualify data as required	Golder Associates Data Validator	Precision	<30% RPD

28-5 Metals – Groundwater and Surface Water

Matrix	Groundwater, Surface Water
Analytical Group	Metals
Concentration Level	All
Sampling SOP[1]	GFP-4, GFP-9
Analytical Method/ SOP Reference[2]	3.1.1.4, 3.1.2.2, 3.3.4
Sampler's Name	TBD
Field Sampling Organization	Golder Associates Inc.
Analytical Organization	CompuChem
No. of Sample Locations	TBD

QC Sample:	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator	Measurement Performance Criteria
LCS	1 per extraction batch	Meets CLP ILMO5.4 method criteria.	If more than 5% of the analytes do not meet the LCS accuracy criteria and sufficient sample volume is available, reanalyze the samples	CompuChem Analyst	Accuracy	Meets CLP ILMO5.4 method criteria.
LCS	1 per extraction batch	Meets CLP ILMO5.4 method criteria.	Qualify data as required	Golder Associates Data Validator	Accuracy	Meets CLP ILMO5.4 method criteria.
Matrix Spike	1 per 20 samples	Meets CLP ILMO5.4 method criteria.	Qualify data as required	CompuChem Analyst	Accuracy	Meets CLP ILMO5.4 method criteria.
Matrix Spike	1 per 20 samples	Meets CLP ILMO5.4 method criteria.	Qualify data as required	Golder Associates Data Validator	Accuracy	Meets CLP ILMO5.4 method criteria.

[1]Reference number from QAPP Worksheet #21
[2]Reference number from QAPP Worksheet #23
[3]Antimony, arsenic, chromium, cobalt, copper, lead, selenium, silver, thallium, and vanadium concentrations for groundwater shall be determined by ICP-MS following 3.1.2.2. Mercury concentrations will be determined by 3.3.4. All other metals shall be determined by ICP following 3.1.1.4.

28-6 Natural Attenuation Parameters – Groundwater

Matrix	Groundwater
Analytical Group	Natural Attenuation Parameters
Concentration Level	All
Sampling SOP[1]	GFP-4, GFP-9
Analytical Method/ SOP Reference[2]	Various[3]
Sampler's Name	TBD
Field Sampling Organization	Golder Associates Inc.
Analytical Organization	CompuChem
No. of Sample Locations	TBD

QC Sample:	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator	Measurement Performance Criteria
Method Blank	1 per extraction batch	no results above QL	If sufficient sample volume is available, re-extract and reanalyze the samples	CompuChem Analyst	Accuracy	no results above QL
Method Blank	1 per extraction batch	no results above QL	Qualify data as required	Golder Associates Data Validator	Accuracy	no results above QL
Continuing Calibration Blank	1 per 10 samples	no results above QL	Reanalyze sample bracketed by compliant Continuing Calibration Blank	CompuChem Analyst	Accuracy	no results above QL
Continuing Calibration Verification	1 per 10 samples	90-110% of true value	Reanalyze sample bracketed by compliant Continuing Calibration Verification	CompuChem Analyst	Accuracy	90-110% of true value
Field Duplicates	1 per 20 samples	none	Qualify data as required	Golder Associates Data Validator	Precision	<30% RPD
LCS	1 per extraction batch	Meets laboratory QC limits in Table QAPP 1	If more than 5% of the analytes do not meet the LCS accuracy criteria and sufficient sample volume is available, reanalyze the samples	CompuChem Analyst	Accuracy	Meets laboratory QC limits in Table QAPP 1
LCS	Meets laboratory QC limits in Table QAPP-23	Meets laboratory QC limits in Table QAPP 1	Qualify data as required	Golder Associates Data Validator	Accuracy	Meets laboratory QC limits in Table QAPP 1

28-6 Natural Attenuation Parameters – Groundwater

Matrix	Groundwater
Analytical Group	Natural Attenuation Parameters
Concentration Level	All
Sampling SOP[1]	GFP-4, GFP-9
Analytical Method/ SOP Reference[2]	Various[3]
Sampler's Name	TBD
Field Sampling Organization	Golder Associates Inc.
Analytical Organization	CompuChem
No. of Sample Locations	TBD

QC Sample:	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator	Measurement Performance Criteria
Matrix Spike	1 per 20 samples	Meets laboratory QC limits in Table QAPP 1	If the LCS meets acceptance criteria, no corrective action required. Otherwise, if sufficient sample volume is available, re-extract and reanalyze the samples	CompuChem Analyst	Accuracy	Meets laboratory QC limits in Table QAPP 1
Matrix Spike	1 per 20 samples	Meets laboratory QC limits in Table QAPP 1	Qualify data as required	Golder Associates Data Validator	Accuracy	Meets laboratory QC limits in Table QAPP 1

[1]Reference number from QAPP Worksheet #21
[2]Reference number from QAPP Worksheet #23
[3] SOPs 3.5.1.1, 3.5.14.1, 3.5.17.1, 3.5.22.1, 3.6.2.1, AM20GAx, and AM23G.

QAPP Worksheet #29 - Project Documents and Records Table

Sample Collection Documents and Records	On-site Analysis Documents and Records	Off-site Analysis Documents and Records	Data Assessment Documents and Records	Other
Field Notes Sample Collection Forms Chain of Custody Forms Air bills Telephone Logs and Emails	Field Notes Sample Tracking Logs Equipment Calibration Logs Sample Preparation Logs Analytical Run Logs Equipment Maintenance, Testing and Inspection Logs Corrective Action Reports or Forms (if required) HSP Reports Reported Field Sample Results Reported QC Sample Results Reported Calibration Verification Sample Results Telephone Logs and Emails	Sample Receipt, Custody and Tracking Records Standard Traceability Logs Equipment Calibration Logs Sample Preparation Logs Analytical Run Logs Equipment Maintenance, Testing and Inspection Logs Corrective Action Reports or Forms (if required) Reported Field Sample Results Reported QC Sample Results Reported Calibration Standard and Calibration Verification Sample Results Instrument Printouts (raw data) for Field Samples, Standards, and QC Samples Electronic Data Deliverable reporting Field Sample and QC Sample results Telephone Logs and emails	Data Review Checklists Data Review Summary Data Usability Summaries Telephone Logs and Emails	

QAPP Worksheet #30 - Analytical Services Table

Matrix	Analytical Group	Concentration Level	Sample Location/ ID Numbers	Analytical SOP	Data Package Turnaround Time	Laboratory/Organization	Backup Laboratory/Organization
Groundwater and Surface Water	VOCs	All	TBD	1.2.3.4 & 1.2.4.2	Standard: 15 business days preliminary data/21days final deliverables	CompuChem	TBD if required
Groundwater and Surface Water	SVOCs	All	TBD	2.4.4.3	Standard: 15 business days preliminary data/21days final deliverables	CompuChem	TBD if required
Groundwater and Surface Water	Pesticides	All	TBD	2.1.2.3	Standard: 15 business days preliminary data/21days final deliverables	CompuChem	TBD if required
Groundwater and Surface Water	PCBs	All	TBD	2.1.2.4	Standard: 15 business days preliminary data/21days final deliverables	CompuChem	TBD if required
Groundwater and Surface Water	Metals	All	TBD	3.1.1.4, 3.1.2.2, 3.3.4	Standard: 15 business days preliminary data/21days final deliverables	CompuChem	TBD if required
Groundwater	Natural Attenuation Parameters	All	TBD	Various (see Footnote to Worksheet #12 and Worksheet #23)	Standard: 15 business days preliminary data/21days final deliverables	CompuChem	TBD if required
Groundwater	Natural Attenuation Parameters	All	TBD	Various (see Footnote to Worksheet #12 and Worksheet #23)	Standard: 15 business days preliminary data/21days final deliverables	Microseeps	TBD if required

QAPP Worksheet #31 - Planned Project Assessments Table

Assessment Type	Frequency	Internal or External	Organization Performing Assessment	Person(s) Responsible for Performing Assessment (Title and Organizational Affiliation)	Person(s) Responsible for Responding to Assessment Findings (Title and Organizational Affiliation)	Person(s) Responsible for Identifying and Implementing Corrective Actions (CA) (Title and Organizational Affiliation)	Person(s) Responsible for Monitoring Effectiveness of CA (Title and Organizational Affiliation)
Field Sampling Technical Systems Audit	As necessary	Internal	Golder Associates, Inc.	Task Leader or designee/Golder Associates Inc.	Golder Associates Field Sampling Personnel	Task Leader or designee/Golder Associates Inc.	Task Leader or designee/Golder Associates Inc.

No formal project assessments are planned. The Golder Associates Task Leader will review adherence to field sampling procedures at the beginning of each sample phase and as required throughout the sampling.

Golder Associates is regularly audited to maintain the NJDEP ELAP accreditation. All of the laboratories have a provision for periodic internal assessments provided in the respective laboratory QM. No additional assessment activities have been deemed necessary for the subcontract laboratories.

QAPP Worksheet #32 - Assessment Findings and Corrective Action Responses

Assessment Type	Nature of Deficiencies Documentation	Individual(s) Notified of Findings (Name, Title, Organization)	Timeframe of Notification	Nature of Corrective Action Response Documentation	Individual(s) Receiving Corrective Action Response (Name, Title, Org.)	Timeframe for Response
Field Sampling Technical Systems Audit	Verbal debriefing, internal memos, email and/or field log books	Project Manager, Golder Associates, Inc.	2 business days	Internal memo to project staff and to project file.	Task Leader /Golder Associates Inc.; Data QA/QC Task Leader/ Golder Associates Inc.	2 business days after notification

QAPP Worksheet #33 - QA Management Reports

Type of Report	Frequency (daily, weekly monthly, quarterly, annually, etc.)	Projected Delivery Date(s)	Person(s) Responsible for Report Preparation (Title and Organizational Affiliation)	Report Recipient(s) (Title and Organizational Affiliation)
Informal report of QA deficiencies requiring a major change to field procedures	As required	Monthly	Golder Associates, Inc.	216 Paterson Plank Road PRP Group
The results and data usability assessment for the investigation will be incorporated into the Pilot Test report.	Once	TBD	Golder Associates, Inc.	USEPA

QAPP Worksheet #34 - Sampling and Analysis Verification (Step I) Process Table

Verification Input	Description	Internal/ External	Responsible for Verification
Chain of Custody (COC)	COC forms will be reviewed by the field staff prior to sample submission to the laboratory to verify that the COC matches the cooler contents. COC forms will also be reviewed after sample submission to the laboratory by the Data QA/QC Task Leader or designee to verify that the sampling plan is being followed.	Int.	Golder Associates Inc.
Laboratory sample receipt documentation	The Data QA/QC Task Leader or designee will review the laboratory sample receipt documentation and compare to the COC. If discrepancies are found, the Data QA/QC Task Leader or designee will contact the field staff and laboratory to resolve any inconsistencies. All communications concerning changes to the sample identifications and required analyses, including telephone memoranda and emails, will be saved to the project file at Golder Associates.	Ext.	Golder Associates Inc.
Chemistry Analytical Data - Final Packages	All analytical data packages will be verified internally by the laboratory performing the work for completeness prior to submittal.	Ext.	CompuChem Laboratories
Chemistry Analytical Data - Final Packages	The Data QA/QC Task Leader or designee will verify that the analytical data packages contain all of the information required for data validation upon receipt. The data package elements required for each laboratory are described following Worksheet #34.	Int.	Golder Associates Inc.
Groundwater Field parameters	The tabulated field observation data will be checked to ensure no transcription errors occurred. The field observations are considered screening data and will not be formally validated.	Int.	Golder Associates Inc.

Data Package Elements

The laboratory report format for the soil and groundwater analyses performed by CompuChem Laboratories shall consist of the items below. Reports from Microseeps will include similar information, as necessary to conduct the sampling and analysis verification required.

Case Narrative

- Date of issuance
- Laboratory analysis performed
- Work order batch number
- Numbers of samples and respective matrices
- QC procedures utilized and also references to the acceptance criteria
- Laboratory report contents
- Project name and number
- Condition of samples 'as-received'
- Discussion of whether or not sample holding times were met
- Any deviations from intended analytical strategy
- Any deviations or modifications of the laboratory SOPs
- Discussion of technical problems or other observations which may have created analytical difficulties
- Discussion of any laboratory QC checks which failed to meet project criteria and the corrective actions pursued
- Signature of the Laboratory QA Officer or designee

Chemistry Data Package

- Chain of custody documentation
- Case narrative for each analyzed batch of samples
- Summary page indicating dates of analyses for samples and laboratory QC checks
- Cross referencing of laboratory sample to project sample identification numbers
- Description of data qualifiers to be used
- Sample preparation and analyses for samples (including instrument run logs)
- Sample results (results between the MDL and QL will be reported as estimated values)
- A QC summary package including the results of LCS, MS/MSD, surrogates, interference check samples, serial dilutions, laboratory duplicates, and method blanks;
- Raw data for sample results and laboratory QC samples (including LCS, MS/MSD, surrogates, interference check samples, serial dilutions, and method blanks)
- Results of (dated) initial calibration and continuing calibration checks, GC/MS and ICP/MS tuning results, and GC/ECD instrument performance checks.
- Electronic data deliverable containing the results for all field and QC samples.

QAPP Worksheet #35 - Sampling and Analysis Validation (Steps IIa and IIb) Process Table

Step IIa/IIb[1]	Validation Input	Description	Responsible for Validation (Name, Organization)
IIa	Final Chemistry Analytical Data Packages.	The Data QA/QC Task Leader or designee will review all definitive analytical chemistry data following the review levels defined in Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use (EPA-540-R-08-005, January 2009). All data will undergo a Stage I review, which will entail reviewing the data for sample receipt conditions, compliance of analytical methods with the project specifications, and compliance of compounds reported with the project specifications. Should data quality deficiencies be identified, the data reviewer will qualify the results following the guidance from the USEPA Region II Data Validation SOPs detailed in Worksheet #36, where applicable to the specific analytical methodologies.	Data QA/QC Task Leader or Designee/ Golder Associates, Inc.
IIb	Final Chemistry Analytical Data Packages.	The Data QA/QC Task Leader or designee will review the majority of the analytical chemistry data to Stage 2A as defined by Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use (EPA-540-R-08-005, January 2009). As provided by a Stage 2A review, the sample-related QC for the majority of the samples will be reviewed for compliance with the MPC defined in this QAPP. Specifically, the sample holding times, frequency of QC samples, method blanks, surrogate recoveries, LCS recoveries, MS/MSD recoveries, serial dilutions, and field quality control samples such as trip blanks and field duplicates will be evaluated relative to the specific QC criteria presented in the QAPP. In general, the review will follow the guidance from the USEPA Region II data validation SOPs detailed in Worksheet #36, where applicable to specific analytical methodologies. The data quality review will be complete after Stage 2A for the data from the EAB Injection Progress Monitoring Tasks.	Data QA/QC Task Leader or Designee/ Golder Associates, Inc.

[1]Validation Step IIa is the review of the data for compliance with methods, procedures and contracts. Validation Step IIb is the comparison with the MPC provided in this QAPP.

Step IIa/IIb[1]	Validation Input	Description	Responsible for Validation (Name, Organization)
IIb	Final Chemistry Analytical Data Packages.	The Data QA/QC Task Leader or designee will review the remaining analytical chemistry data to Stage 2B as defined by Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use (EPA-540-R-08-005, January 2009). In addition to the sample-related QC reviewed in Stage 2A, the instrument related QC will be reviewed for compliance with the MPC defined in this QAPP. Specifically, method specific instrument performance checks (e.g. mass spectrometry tunes, pesticide breakdown checks, ICP interference checks), initial calibration data, and continuing calibration data will be evaluated relative to the specific QC criteria presented in analytical methods and the QAPP. In general, the review will follow the guidance from the USEPA Region II data validation SOPs detailed in Worksheet #36, where applicable to specific analytical methodologies. A Stage 2B data quality review will be completed for the EAB Baseline samples, and the on-going Groundwater and Surface Water Monitoring Samples.	Data QA/QC Task Leader or Designee/ Golder Associates, Inc.

QAPP Worksheet #36 - Sampling and Analysis Validation (Steps IIa and IIb) Summary Table

Step IIa/IIb	Matrix	Analytical Group	Concentration Level	Validation Criteria	Data Validator (title and organizational affiliation)
IIa/IIb	All	VOCs	All	USEPA Region II SOP HW-33/VOA; USEPA Contract Laboratory Program Statement of Work for Organic analysis of Low/medium Concentration of Volatile Organic Compounds SOM01.2 Data Validation, Revision 1, August 2007	Data QA/QC Task Leader or Designee/ Golder Associates, Inc.
IIa/IIb	All	SVOCs	All	USEPA Region II SOP HW-35/SVOA Data Validation; USEPA Contract Laboratory Program Statement of Work for Organic Analysis of Low/Medium Concentration of Semivolatile Organic Compounds SOM01.2, Revision 1, August 2007	Data QA/QC Task Leader or Designee/ Golder Associates, Inc.
IIa/IIb	All	Pesticides	All	USEPA Region II SOP HW-36/Pesticide Data Validation; USEPA Contract Laboratory Program Statement of Work for Organic Analysis of Low/Medium Concentration of Pesticide Organic Compounds SOM01.2, Revision 1, August 2007	Data QA/QC Task Leader or Designee/ Golder Associates, Inc.
IIa/IIb	All	PCBs	All	USEPA Region II SOP HW-37/Aroclor Validation of Data; USEPA Contract Laboratory Program Statement of Work for Organic Analysis of Low/Medium Concentration of Aroclor Organic Compounds SOM01.2, Revision 1, August 2007	Data QA/QC Task Leader or Designee/ Golder Associates, Inc.
IIa/IIb	All	Metals	All	USEPA Region II SOP HW-2, Validation of Metals for the Contract Laboratory Program (CLP) based on SOW ILM05.3, Revision 13, September 2006	Data QA/QC Task Leader or Designee/ Golder Associates, Inc.
IIa/IIb	All	Natural Attenuation Parameters	All	The laboratory QC summaries will be compared to the laboratory QC limits and the requirements of the individual analytical methods.	Data QA/QC Task Leader or Designee/ Golder Associates, Inc.

QAPP Worksheet #37 – Data Usability Assessment

Summarize the usability assessment process:

After the data has been reviewed for compliance with the analytical methods and the MPC as specified in QAPP Worksheet #35, the Data QA/QC Task Leader or designee will provide an preliminary summary of potential data usability concerns to the Golder Project Manager or Design Manager.

The data obtained will then be both qualitatively and quantitatively assessed for data usability on a project-wide, matrix-specific, parameter-specific, and/or unit-specific basis cooperatively by the Data QA/QC Task Leader or Design Manager or their designees. Factors to be considered in this overall assessment of field and laboratory data will include, but not be limited to the following:

- Were samples obtained using the methodologies proposed in the Operable Unit 3 Feasibility Study Phase 1 Treatability Studies or in accordance with modified methods developed during the course of the work?
- Were proposed analyses performed according to the methods identified in this QAPP or in accordance with modified methods selected during the course of the work?
- Were samples obtained from the proposed sampling locations?
- Do analytical results exhibit elevated detection limits due to matrix interference or contaminants present at high concentrations?
- Were target analytes not expected to be present at the facility, or a given unit, identified?
- Were field and laboratory data validated according to the validation protocols, including project-specific QC objectives as proposed in this QAPP?
- Which chemical data sets were found to be unusable based on the data validation results?
- Which chemical data were found to be usable based on the data validation results?
- What effects do qualifiers, applied as a result of data validation, have on the ability to implement project decisions?
- Can valid conclusions be drawn for all matrices at each unit and/or area under investigation?
- Were issues requiring corrective action fully resolved?
- For cases where the proposed procedures and/or requirements have not been met, has the effect of these issues on the project objectives been evaluated?

Identify the personnel responsible for performing the usability assessment:

The Golder Associates Data QA/QC Task Leader her designee will be responsible for performing the usability assessment.

Describe the documentation that will be generated during usability assessment and how usability assessment results will be presented so that they identify trends, relationships (correlations), and anomalies:

The usability assessment will be presented as part of the OU-3 Pilot Test report and subsequent reports. A standalone document describing the usability assessment is not anticipated.

QAPP-1
Precision and Accuracy Limits - Natural Attenuation Parameters - Groundwater
Carlstadt Superfund Site
Carlstadt, New Jersey

Matrix	Groundwater, Surface Water
Analytical Method/SOP	See Note 3
Concentration Level	All

Compound	CAS Number	MS/MSD Recovery Window (%)	MS/MSD RPD (%)	LCS Recovery Limits (%)	LCS/LCSD RPD (%)
Alkalinity (as Calcium Carbonate)	ALK	75-125	0-20	90-110	N/A
Nitrate	14797-55-8	90-110	0-20	90-110	N/A
Nitrite	14797-65-0	90-110	0-20	90-110	N/A
Sulfate	14808-79-8	90-110	0-20	90-110	N/A
Total Organic Carbon	TOC	75-125	0-20	90-110	N/A
Sulfide	18496-25-8	75-125	0-20	90-110	NA
pH	pH	N/A	N/A	=+-0.1	N/A
Ethane	74-84-0	70-130	0-20	75-125	0-30
Ethene	74-85-1	70-130	0-20	75-125	0-30
Methane	74-82-8	70-130	0-20	75-125	0-30
Hydrogen Gas	1333-74-0	70-130	0-20	75-125	0-30
Acetic Acid	64-19-7	70-130	0-30	70-130	N/A
Propionic Acid	79-09-4	70-130	0-30	70-130	N/A
Butyric Acid	107-92-6	70-130	0-30	70-130	N/A
Pyruvic Acid	127-17-3	70-130	0-30	70-130	N/A
Lactic Acid	50-21-5	70-130	0-30	70-130	N/A
n-Pentanoic Acid	109-52-4	70-130	0-30	70-130	N/A
i-Pentanoic Acid	503-74-2	70-130	0-30	70-130	N/A
i-Hexanoic Acid	646-07-1	70-130	0-30	70-130	N/A
n-Hexanoic Acid	142-62-1	70-130	0-30	70-130	N/A

Note:
1) Recovery windows based on CompuChem and Microseeps QC limits as of April 2009. CompuChem and Microseeps routinely re-evaluate QC criteria using the procedures in the laboratory QM and QSM The current laboratory limits at the time of sample submission will be used to evaluate analytical performance.
2) See Acronym list for definitions
3) The analytical methods for the NAPs include:
3.5.1.1, 3.5.14.1, 3.5.17.1, 3.5.22.1, 3.6.2.1, AM23G and AM20GAx.

QAPP-2
Precision and Accuracy Limits - Field Parameters - Groundwater/Surface Water
Carlstadt Superfund Site
Carlstadt, New Jersey

Matrix	Groundwater, Surface Water	
Analytical Method/SOP	See Note 2.	
Concentration Level	All	
Compound	**CAS Number**	**Precision Criterion**
Dissolved Oxygen	None	± 0.2 mg/L
Ferrous Iron	16887-00-6	± 0.2 mg/L
ORP	74-84-0	± 15 mV
pH	74-85-1	± 0.1 pH Units
Specific Conductance	74-82-8	± 3%
Temperature	14797-55-8	± 0.2 °C
Turbidity	14797-65-0	± 5%

Note:
1) See Acronym list for definitions
2) The analytical methods to be used include: G-6, G-7, G-8, G-9, and G-10.

ATTACHMENT 1

FIELD PROCEDURES SOPs

STANDARD OPERATING PROCEDURE

GFP-1 FIELD DOCUMENTATION

Standard Operating Procedure

GFP-1 Field Documentation

This Standard Operating Procedure (SOP) provides general guidance for the documentation of significant site activities, which is a crucial part of the field investigation process. For example, documentation must be maintained to trace the possession and handling of samples from the time of collection through transfer to the courier, and for proof of instrument calibration. Documentation can take many forms, and may include sample labels, sample seals, field logbooks, field information forms, chain of custody records, sample analysis request forms, and laboratory sample logs.

The pertinent details of significant field activities, whether part of the site inspection or a sampling event, must be recorded in a field logbook. When samples are collected, documentation in the form of a sample chain-of-custody form must be completed. Proper documentation is necessary to protect Golder's and/or our client's interest by providing a record of the actual (in contrast to the proposed or approved) field work that may become the subject of enforcement actions.

Field Log Books

Field log books are required to be maintained for each project. The log book must be bound and water resistant. The cover of the book should have, at a minimum, the project name and number. The company name, office address and phone number should be marked inside the cover. Alternatively, a business card may be attached to provide this information.

All pertinent field activities occurring during the work day must be documented in the field book on a daily basis with permanent ink; pencil or felt tip pens are not acceptable. Notations should be made in logbook fashion, noting the time and date of all entries. When filling out a log book, the pages should be numbered sequentially. The person responsible for completing the field log book must place his/her initials, the date and the

project number at the top of each page. The daily log should include, but not be limited to, the following information:

- Time of arrival and departure;
- Name and affiliation of persons on-site;
- Name and affiliation of persons contacted;
- Field instrument calibration time;
- Indicate if any quality assurance/quality control (QA/QC) samples were collected;
- Method of sample collection;
- Date and time of sample collection;
- Observed or known potential factors that may affect sample quality;
- All sample identification numbers;
- Description of samples;
- Discussion/explanation for any change to the approved scope of work; and,
- Description of any problems or issues that arose during the field event.

All notations in the field book shall be objective. Personal opinions and comments should not be recorded in the field book. Once the event is completed all project related field books are to be archived in the project file.

Field Information Forms

Field information forms may be used to collect sampling point data. Much of the information documented on a field form does not need to be repeated in the bound field book. However, sample point identification and sample time must be documented in the field book, even if supplemental field forms are used.

These forms should contain:

- Name of sample point;
- Site name, location and project number;

- Name of persons collecting the samples;
- Field instrument type, serial number and calibration time;
- Description of samples taken;
- Field measurements and units;
- List of analytical parameters;
- Method of sample collection; and,
- Date and time of sample collection; and,
- Any factors that may affect sample quality.

Field forms are to be signed and dated. Once the event is completed, the field forms are to be consolidated and archived in the project file.

Instrument Calibration Forms

Instrument calibration forms may be required. If sampling occurs in the New Jersey, the NJDEP calibration methods must be followed. Instructions on the proper calibration procedure are typically found in the manufacturer's manual and/or may be provided separately.

Follow the provided instructions and record the necessary information on the field form or in the field book. If used, the completed NJDEP calibration forms must be photo-copied. The original form shall be placed in the Calibration Record binder. A copy is to be archived in the project file.

Chain of Custody Forms

When samples are collected for laboratory analysis, additional documentation procedures are required. The chain-of-custody (COC) form is intended as a legal record indicating the chain of possession of the sample. The COC is initiated at the lab at sample container receipt and remains with the sample(s) at all times. The name of the person assuming responsibility for the samples shall be recorded on the COC. This person is tasked with

ensuring secure and appropriate handling of the bottles and samples. When the form is completed, it should indicate that there were no lapses in sample possession/accountability. In additional, the COC will include sender information, recipient information, identification of samples by number, sample location, time collected and requested analysis. All QA/QC samples shall be identified (e.g. trip blanks, rinsate blanks, field duplicates, MS/MSD, etc.). on the COC.

Updated June 2006

Written by J. Loureiro
Edited by S. Anderson
Revised by M. Morris (April 2009)

STANDARD OPERATING PROCEDURE

GFP-2 SAMPLING EQUIPMENT DECONTAMINATION

Standard Operating Procedure

GFP-2 Sampling Equipment Decontamination

This Standard Operating Procedure (SOP) provides general guidance for the cleaning procedures to be used by field personnel for cleaning manual sampling and related equipment (i.e. not heavy equipment such as drill rigs, backhoes, etc.) in the field. Any deviations from these procedures should be documented in the field notebook and investigative reports.

Definitions/specifications for standard decontamination materials are as follows:

- Soap shall be a phosphate-free laboratory detergent such as Liquinox® or Alconox® Use of other detergent must be justified and documented in the field logbooks and investigative reports.

- Solvent shall be pesticide-analysis grade isopropanol[1]. Use of a solvent other than pesticide-analysis grade isopropanol for equipment cleaning purposes must be justified and documented in field logbooks and investigation reports.

- Tap water may be used from any municipal water treatment system. Use of an untreated potable water supply is not an acceptable substitute for tap water.

- Analyte free water (deionized water) is tap water that has been treated with activated carbon and a standard deionizing resin column. At a minimum, the analyte free water should contain no detectable heavy metals or other organic or inorganic compounds (i.e., at or above analytical detection limits). This water is usually provided along with sample bottles by the analytical laboratory for the project.

- Nitric Acid shall be trace-metal analysis grade or better. Nitric acid used to decontaminate non-dedicated and soil sampling equipment, shall be a 1 percent solution.

- Other solvents may be substituted for a particular purpose if required. For example, removal of concentrated waste materials may require the use of either pesticide-grade hexane or petroleum ether. After the waste material is removed, the equipment must be subjected to the standard cleaning procedure. Because these solvents are not miscible with water, the equipment must be completely dry prior to use.

[1] NJDEP does not allow use of isopropanol as a decontamination solvent without specific approval – see the Field Sampling Procedure Manual dated 2005 section 2.4.1. They do allow use of acetone with no restrictions, because "it is an excellent solvent, miscible in water and is not a targeted analyte in Priority Pollutant Analysis." If acetone is known to be a contaminant at a given site or Target Compound List analysis is to be performed, methanol or another solvent may be substituted on a case by case basis with approval from NJDEP." Note that methanol cannot be used when sampling gasoline and its' by- products, and that hexane is not a necessary solvent for dioxin, PCB, or other chlorinated organic sampling. Both methanol and hexane are flammable solvents.

Solvents, laboratory detergent, rinse waters, etc. used for equipment decontamination must not be reused, and must be collected and stored in DOT-approved 55-gallon drums (or other approved container), properly labeled, and staged for subsequent proper disposal.

Soil Sampling Equipment

The procedures in this section are to be used for all non-dedicated sampling equipment used to collect and/or homogenize solid samples.

1. Clean with tap water and soap using a brush to remove obvious particulate matter and surface films;
2. Rinse thoroughly with tap water;
3. Rinse thoroughly with distilled and analyte free water;
4. if metal analysis will be performed - rinse with dilute (1 percent) trace-metal analysis nitric acid , and then rinse with analyte free water;
5. Allow to air dry; and
6. Equipment should be wrapped in aluminum foil until needed for sampling.

Electronic Water Quality Meters and Water Level Meters

All water quality meters (e.g. Horiba U-22) and depth to water meters must be decontaminated by thoroughly rinsing the probes with distilled or deionized water prior to each use.

Groundwater Sampling Equipment - Non-Dedicated Submersible Pump

Non-dedicated groundwater sampling equipment used for the low flow purging and sampling technique (such as the submersible pump) must be decontaminated prior to use and following sampling of each well. The submersible pump will not be removed from the well between purging and sampling operations. The pump and tubing (including support cable and electrical wires which are in contact with the sample) will be decontaminated by the procedure(s) described below[2].

[2] Note that the procedures described in this SOP are not pre-approved by the NJDEP. Section 2.4.5.1.2.1 of the August 2005 NJDEP *Field Sampling Procedures Manual* states that submersible pumps used for sampling (as opposed to just used for purging), need to be completely disassembled and cleaned. NJDEP states that specifically for the Grundfos® Redi Flo 2 pumps, the manufacturer's *Installation and Operating Instruction Manual* must be followed for cleaning the inside of the stator housing by completely removing the motor shaft in order to achieve a *complete* replacement of motor fluid (distilled/deionized water). However as with all field procedures, the proposed SOP can be approved on a case-by-case basis.

Supplies:

- scrub brush;
- potable water;
- distilled water;
- Alconox® (or similar detergent) and potable water solution (hereafter referred to as "soapy water");
- pesticide-grade isopropyl alcohol;
- two 2-inch diameter de-con PVC tubes (hereafter referred to as "tube A" and "tube B" each approximately two feet long with one end capped);
- Teflon®-lined tubing; and
- waste buckets for decontamination fluids.

Procedures:

1. Use scrub brush with soapy water on cable spool;
2. Rinse pump and spool with potable water;
3. Place short piece of Teflon®-lined tubing (~3 feet) on pump and place pump into tube A. Place the tubing discharge back into tube A so that the pump will re-circulate the water;
4. Fill the tube with potable water and a small amount of soapy water;
5. Activate pump for at least one minute; occasionally move the pump up and down within the tube;
6. While pumping, remove the discharge tubing and direct discharge to a waste bucket;
7. Turn-off pump after flow stops. Remove pump, dump out soapy water from tube A, then replace pump into tube A;
8. Turn-on potable water source so that it flows directly into tube A and the tubing discharge is into a waste bucket. Activate pump and equilibrate both pump speed and potable water flow. Occasionally move the pump up and down within the tube;
9. Flush with potable water for at least one minute and all soap appears to be rinsed;
10. Turn off water, running the pump until flow ceases, then stop pump. Remove pump and dump out water from tube A;
11. Replace pump in tube A and place tubing discharge back into the tube;
12. Fill tube A with pesticide grade isopropyl alcohol[3] (approximately 1 liter) and then start pump.
13. Re-circulate isopropyl for at least one minute; occasionally move the pump up and down within the tube;
14. While pumping, remove the discharge tubing and direct to a waste bucket;
15. Turn-off pump after flow stops. Remove pump and dump out isopropyl wash from tube A. Allow pump to air dry and make sure that most of the isopropyl has drained from both the tubing and tube A;
16. Rinse tube A with distilled water. Replace pump in tube A;
17. Fill tube A with distilled water and direct discharge tubing into waste bucket;
18. When flow ceases, stop pump. Remove pump and dump out water from tube A;

[3] NJDEP does not allow use of isopropanol as a decontamination solvent without specific approval – see the Field Sampling Procedure Manual dated 2005 section 2.4.1. They do allow use of acetone with no restrictions, because "it is an excellent solvent, miscible in water and is not a targeted analyte in Priority Pollutant Analysis." If acetone is known to be a contaminant at a given site or Target Compound List analysis is to be performed, methanol or another solvent may be substituted on a case by case basis with approval from NJDEP." Note that methanol cannot be used when sampling gasoline and its' by- products, and that hexane is not a necessary solvent for dioxin, PCB, or other chlorinated organic sampling. Both methanol and hexane are flammable solvents.

19. Place pump in tube B. Only a clean pump and distilled water are to be placed in tube B.
20. Fill tube B with distilled water and direct discharge tubing into waste bucket;
21. When flow ceases, stop pump. Remove pump and dump out water from tube B. Repeat this process until a minimum of one gallon of distilled water has been used, generally a series of three rinses; and
22. Remove pump and disconnect discharge tubing. Place pump and cable spool into a clean bag.

Groundwater Sampling Equipment – Non-Dedicated Bladder Pump

Most bladder pumps cannot be easily decontaminated in the field due to their construction, and therefore typically are not used for non-dedicated groundwater sampling. An exception are those constructed with easy to clean parts and disposable bladders (bladder pumps with non-disposable bladders are best suited for dedicated scenarios, such as dedicated Well Wizard pumps). If the pump is constructed with disposable bladders, proper decontamination includes exchanging the used bladder and the multiple-step decon procedure noted above for submersible pumps.

Groundwater Sampling Equipment – Bailers

Bailers CANNOT be field decontaminated. Bailers must be:

- New and dedicated to a well for multiple uses;
- New and disposable for a single use; or
- Laboratory cleaned and decontaminated prior to each use.

If new bailers are used, a certificate of cleanliness should be provided by the manufacturer.

If laboratory cleaned bailers are used, a certificate of decontamination should be provided by the laboratory.

STANDARD OPERATING PROCEDURE

GFP-3 FIELD MEASUREMENTS AND INSTRUMENTATION CALIBRATION PROCEDURES FOR ENVIRONMENTAL FIELD WORK

GFP-3 GOLDER FIELD PROCEDURE 3
FIELD MEASUREMENTS AND INSTRUMENTATION CALIBRATION PROCEDURES FOR ENVIRONMENTAL FIELD WORK

1.0 FIELD MEASUREMENTS

The following sections describe the procedures to be followed for environmental projects for the field measurement of:

- groundwater level depths and well depths using a typical electronic water level meter;
- groundwater field parameters of temperature, specific conductance, pH, oxidation-reduction potential (ORP), turbidity and dissolved oxygen (DO) using a typical photoionization detector (PID); and
- soil volatile organic compound (VOC) vapors from continuous soil samples using a typical PID.

1.1 Water Level Measurements

The depth to groundwater is typically measured prior to and during low flow groundwater sampling, and during groundwater level measurement events.

Equipment

The following equipment and materials are required to perform this procedure:

- An electronic water level meter (e.g., Solinst Model 101) or an oil-water interface probe (e.g., Solinst Model 122), or weighted tape measure (for well depth only);
- Distilled or de-ionized water (or other required decontamination supplies if free product or other types of contamination are an issue); and
- Field notebook.

Water Level Measurement Procedure

The water level measuring device type (hereinafter referred to as water level meter) and serial number must be recorded in the field notebook each day water level measurements are obtained. The water level meter must be decontaminated prior to each use in accordance with the procedures described in Standard Operating Procedure (SOP) GFP-1.

During groundwater sampling, depth to groundwater is typical measured before purging starts (to provide a baseline), and during purging (to monitor drawdown).

Depth to groundwater is also measured to prepare groundwater surface contour maps. For such groundwater level measurement events, all water levels should be measured using the same water level meter, and as close in time as practical (i.e. "synoptic"). The shorter the event, the more representative the data will be. However for large sites with many wells (e.g., 100 wells to 200+ wells), multiple staff using different water level meters are typically required for a long duration (e.g., 8 hours) to gather all the needed data. If multiple water level meters are used, they should be calibrated relative to one another at the beginning of the day in two different wells: the well with the shallowest expected water level and the well with the deepest expected water level, so that corrections can be made to the data for potential variances between the water level meters. If the event is more than several hours in duration, background measurements should be made at regular intervals in at least one well to check for possible variations in local water level (due to tides, weather changes in barometric pressure or precipitation, groundwater pumping, etc.) so that corrections can be made as needed.

The water level meter must first be turned on and the battery checked by pushing the battery test button prior to use. A beeping sound indicates the batteries are adequately charged. To measure the depth to water in a well, the meter probe should be slowly lowered into the well and stopped at the depth where the meter beeps, indicating a completed circuit and the top of the groundwater surface. It may be useful to slowly raise and lower the probe several times in and out of the groundwater to help establish the correct depth. The depth to groundwater water measurement is then made using the graduations inscribed on the probe line at the location of a previously established surveyed reference point on the well casing. The measurement should be made to the nearest 0.01 foot. Typically the reference point is on the top of the inner well casing, and consists of a simple mark/line or a notch cut into the casing. If no reference point is visible, the measurement should be made relative to the north side of the inner well casing. Once the measurement is made, the well identification number, measured depth to water, date and time must be recorded in the field notebook.

Total Well Depth Measurement Procedure

A water level meter or a weighted tape measure can be used to determine total well depth. The measuring device must be decontaminated prior to each use in accordance with the procedures outlined in SOP GFP-1.

The well depth is measured by lowering the water level meter probe or the end of the weighted tape measure slowly into the well until the probe or weighted end is felt resting on the bottom. Due to the buoyancy of the tape and/or the tendency for tapes to stick to the casing wall in those wells with long water columns, it may be difficult to determine the depth to the bottom of the well. It may be useful to slowly raise and lower the probe/tape several times when it is thought to be resting on the bottom to help establish the correct depth.

Total well depth measurements must be made relative to the established reference point on the well casing (see above) and recorded to the nearest 0.1 foot. Once the measurement is made, the well identification number, measured well depth, date and time must be recorded in the field notebook.

1.2 Groundwater Field Parameter Measurements

The following procedures will be used to obtain representative field measurements of groundwater temperature, specific conductance, pH, DO, turbidity and ORP (collectively referred to as "field parameters") during groundwater sampling events.

Note that for projects under the authority of the NJ Department of Environmental Protection (NJDEP), the firm measuring and reporting the field parameters of temperature, specific conductance, pH, DO, and turbidity must be part of the NJDEP Environmental Laboratory Certification Program and be certified annually. Golder Associates Inc. is currently certified for these parameters as NJDEP Laboratory No. 03027.

Equipment

The following equipment and materials are required:

- An in-line, flow through cell;
- Calibration Standards;
- A water quality instrument capable of measuring temperature, specific conductance, pH, ORP, turbidity, and DO (e.g. Horiba U-22);
- Groundwater Sample Field Information Form; and,
- Field notebook.

Procedure

Prior to measuring the field parameters, the following must be completed:

- water quality meter must be calibrated in accordance with the procedures described in Section 2.0;
- water quality meter must be decontaminated in accordance with the procedures described in SOP GFP-1;
- water quality samples cannot be filtered or preserved; and
- the location where the field parameters will be measured must be shielded from the wind and direct sunlight as much as reasonably possible, and must be shielded/moved away from electrical systems, motors, pumps, wires, etc. which might induce stray electrical currents in the instrument or its probe.

Before purging the groundwater well, place the flow through cell (used as the sampling chamber) in-line with the discharge tubing. Insert the water quality meter probe into the flow-through cell and position the probe so that it will measure the influent sample to the chamber. To measure the field parameters, record the field parameters using the water quality meter at regular intervals of approximately 5 minutes, as follows:

- Temperature - recorded to the nearest 0.1 degrees Celsius;
- Specific conductance - measured in micromohs per centimeter (µmohs/cm) or microsiemens (µS/cm) corrected for 25°C. Results will be reported to the nearest ten (10) units for readings below 1,000 µmohs/cm @ 25°C and to the nearest one hundred (100) units for reading above 1,000 µmohs/cm @ 25°C;
- pH - recorded to the nearest 0.1 standard pH units (SU);
- Turbidity -recorded to the nearest whole nephelometric turbidity units (NTUs);
- DO - recorded to the nearest 0.1 milligrams per liter (mg/l);
- ORP - recorded to the nearest 0.1 millivolts (mV); and

Once the measurements are made, the well identification number, field parameter values, date and times must be recorded on the Groundwater Sample Field Information Form and noted in the field notebook.

1.3 Soil Screening VOC Vapor Measurements

These procedures will be used to field screen VOC vapors from continuous soil samples, such as those collected during soil boring programs using hollow stem auger (HSA) split spoon sampling or direct push soil sampling (e.g., GeoProbe MacroCores).

Equipment

The following equipment and materials are required:

- PID (with moisture protection disc) (e.g., MiniRAE 3000);
- Stainless steel knife; and,
- Field notebook.

Procedure

A PID will be used for screening soil samples collected during the soil boring program. The PID typically operates with a 10.6 electron Volt (eV) lamp, however 8.4, 9.5, 10.2 and 11.7 eV lamps are also available and may be needed depending upon the specific VOCs of concern. The specific PID lamp to be used is typically identified in the approved project workplan, Field Sampling Plan (FSP), and/or Health and Safety Plan (HASP). It is important to note that some VOCs exhibit a low response on the PID in relation to their actual concentrations, while others will not respond at all to the detector's ionization energy. Wind, high humidity and rain likely will affect PID measurement. Humid/moist conditions can cause condensation on the lamp, affecting measurements.

Prior to use, the PID must be calibrated in accordance with the manufacturers' instructions. After the split spoon or Macro-Core continuous soil sample has been removed from the borehole and opened by the driller, the soil core will be scored lengthwise with a decontaminated stainless steel knife to a depth of approximately ¼ inch to ½ inch, in intervals of about 6 inches to 12 inches at a time. The tip of the PID probe will be slowly moved over the freshly exposed soil, as close to the surface as reasonably possible, taking care not to touch the soil with the tip. The PID will be held over the scored interval for at least 30 seconds to 60 seconds to allow sufficient time for the vapors to be pumped into the instrument. Try to shield the tip of the probe and the scored soil core from any wind, if possible (e.g. use a cupped hand). If the PID indicates the presence of target compounds, then the probe will be held in the same location until the readings reach a maximum and begin to decrease. The highest/peak measurement and depth result will be recorded in the field notebook. The process will be repeated by scoring an additional 6 inches to 12 inches, until the

entire continuous soil sample has been screened. Any odors or visual evidence of contamination (e.g. discoloration) must also be recorded in the field notebook.

2.0 FIELD INSTRUMENTATION CALIBRATION

All field instruments used for measurements must be calibrated in accordance with the manufacturer's specifications and/or the Golder SOPs, as appropriate. Documentation of calibration must be made in the field notebook, and must include the following at a minimum:

- Analysts' name;
- Date and time of calibration;
- Date and time and results of calibration checks;
- Instrument type, model number, and serial number (if present); and,
- Manufacturer, concentration, and lot number of calibration standards used.

Note that the calibration of the water quality meter used for measuring field parameters certified under the NJDEP Environmental Laboratory/Measurement Certification Program under the *Regulations Governing the Certification of Laboratories and Environmental Measurements,* N.J.A.C. 7:18 et seq must be calibrated in accordance with the following NJDEP approved Golder SOPs:

- SOP for Specific Conductance Calibration – Golder SOP 101;
- SOP for DO Calibration – Golder SOP 102a;
- SOP for Temperature Calibration – Golder SOP 103;
- SOP for pH Calibration – Golder SOP 104; and
- SOP for Turbidity Calibration – Golder SOP 105

STANDARD OPERATING PROCEDURE

GFP-4 GROUNDWATER SAMPLING

STANDARD OPERATING PROCEDURES

GROUNDWATER SAMPLING

PHILADELPHIA OPERATIONS

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1.0 DOCUMENTATION

Information pertinent to the field work will be recorded in bound and numbered project specific field notebooks. All field notes must be legible. Errors should be crossed out with a single line and initialed. Field records will be retained for a minimum of 10 years after the completion of the project and should at a minimum contain the following information for each day in the field:

- Date;
- Project or site name;
- Time of each data entry;
- Description of work being performed that day;
- Names and affiliations of personnel at location;
- Weather conditions on site;
- Location and type of activity;
- Pertinent visual observations;
- Pertinent field data (and any other measurements);
- Serial numbers, if any, on custody seals, and transportation cases, and equipment;
- Name of field custodian; and,
- Photographs taken, if any, including date, time, direction faced, description of subject or activity, sequential number of the photo and film roll number will be recorded in the field notebook.

Any deviations from the project scope of work, health and safety issues, or other information deemed necessary should be recorded in the fieldbook, and the project manager should be contacted immediately.

2.0 EQUIPMENT

Groundwater sampling equipment will be constructed of inert materials such as stainless steel or Teflon. Proper equipment decontamination procedures, described below, will be followed to minimize the potential for cross-contamination. Groundwater samples for Hydrogen gas will not be collected using a direct-current (DC) driven pump (see attached).

2.1 Equipment Requirements

Depending upon the type of groundwater sampling specified in the workplan, the required equipment includes that shown below in category A, B or C. The equipment shown in category D is necessary for all sampling events. All equipment must be ordered prior to the sampling event from the Field Equipment Manager. Equipment Request Forms as shown in Figure 1 are available in the equipment supply room or on the common computer drive at: *G:\Field Information\General Info\FEQBlank.xls.*

A. Low Flow Sampling with Submersible Pump
- Gundfos Redi-Flow II submersible pump (or equivalent);
- Gundfos Redi-Flow II control box
- Teflon-lined polyethylene tubing (recommended for low flow purge and sampling technique);
- In-line flow-through cell; and
- Generator.

B. Low Flow Sampling with Well Wizard Bladder Pump
- Dedicated Well Wizard Bladder Pumps or Portable Bladder Pump with Teflon Bladders and Teflon lined tubing;
- Well Wizard control box;
- Well Wizard air compressor; and
- In-line flow-through cell.

C. Conventional 3 to 5 Well Volume Sampling with Bailers
- Teflon-lined, bottom-filling bailer (1 or 2 inch, depending on the size of the casing); and
- New, polyethylene well rope.

D. General Equipment
- Latex and/or nitrile gloves;
- 55-gallon drums or similar container to hold purge water (if needed);
- Water quality meter(s) capable of in-line measurements for pH, specific conductance, dissolved oxygen (DO), temperature, turbidity, and oxidation-reduction potential (ORP);
- Groundwater Sample Field Information Form
- Chain of Custody (COC) form;
- Sample bottles and preservatives (provided by analytical laboratory) ;

- Sample cooler (provided by analytical laboratory);
- Ice (blue or wet);
- Water level meter;
- Workplan with sample location map;
- Well construction information;
- Sample collection forms from prior event (if available);
- Air monitoring equipment, such as a photoionization detector (PID) and,
- Site Specific Health and Safety Plan (HASP).

2.2 Equipment Set-up

2.2.1 Inspection and Measurements

Prior to sampling, all monitoring wells will be inspected for signs of damage, tampering, or un-authorized access.

Prior to purging the monitoring well, a field decontaminated electronic water level meter will be used to measure the depth from the top of the inner well casing (or equivalent measuring point) to the top of water surface to the nearest 0.01 feet.

Periodically (e.g. annually), the depth to the bottom of the well should be measured to confirm well construction details, however such measurements should not be made immediately prior to well purging or sample collection in order to minimize potential cross-contamination and disturbance to sediments which may have accumulated in the bottom of the well.

2.2.2 Portable Gundfos Redi-Flo 2 Submersible Pump

The submersible pump, with dedicated Teflon-lined polyethylene tubing, will be carefully lowered into the well to the midpoint of the well screen or open borehole interval. Be sure to remove the water level indicator before lowering the pump as they may tangle and cause the pump and tubing to get stuck in the well. In those instances where the screened or open interval is not completely saturated, the pump will be lowered to the midpoint of the saturated interval, which will help ensure representative samples are collected from the water-bearing zone. A bungee cord should be securely wrapped around the pump electrical line and tubing, and secured to the top of the well to help hold the pump at the desired depth.

Next, attach the pump discharge tubing to the in-line flow-through cell with water quality meter attached. Be sure the meter is calibrated to the manufacture specifications. Following installation of the pump, attach the electrical line to the control box; and the power cord to the generator. Before turning on the control box, place the pump speed control to the lowest setting. After the pump is turned on, slowly increase the pump speed until water is seen rising in the tubing. Adjust pump speed such that groundwater discharge does not exceed well recharge by monitoring the water level while increasing or decreasing the pump flow. Once the flow through cell is full, begin monitoring and recording field parameters as specified in Section 3.1.

2.2.3 Portable Well Wizard Bladder Pump

The pump, with dedicated Teflon-lined polyethylene tubing and air line attached, will be carefully lowered into the well to the midpoint of the well screen or open interval. The airline connection to the pump should be securely fastened to minimize or reduce introduction of air into the well. Be sure to remove the water level indicator before lowering the pump as they may tangle and cause the pump and tubing to get stuck in the well. In instances where the screened or open interval is not completely saturated, the pump will be lowered to the midpoint of the saturated interval, which will help ensure representative samples are collected from the water-bearing zone. A bungee cord should be securely wrapped around the pump electrical line and tubing and secured to the top of the well to help hold the pump at the desired depth.

Next, attach the pump discharge tubing to the in-line flow-through cell with the water quality meter attached. Be sure the meter is calibrated to the manufacture specifications. Following installation the pump, attach the air lines from the pump and compressor to the control box. Turn the control box power on and position the setting as follows: (1) The pressure setting should be set at the pounds per square inch (psi) corresponding to the pump depth plus 10 feet; and (2) the discharge and refill cycles should initially be set for 4 cycles per minute. Adjust discharge time such that groundwater discharge does not exceed the well recharge by monitoring the water level while increasing or decreasing the pump discharge rate and/or air pressure. Once the flow-through cell is full, begin monitoring and recording field parameters as specified in Section 3.1.

2.2.4 Dedicated Well Wizard Bladder Pump

Attach the compressor air line to the control box inflow connection, and the control box air discharge line to the well connection. Then, connect the water discharge tubing to the in-line flow-through cell with water quality meter attached. Be sure the meter is calibrated to the manufacturer's specifications. Turn the control box power on and position the setting as follows: (1) The pressure setting should be set at the psi corresponding to the pump depth plus 10 feet; and (2) the discharge and refill cycles should initially be set for 4 cycles per minute. Adjust discharge water flow such that groundwater discharge does not exceed well recharge by monitoring the water level while increasing or decreasing the pump discharge rate and/or air pressure. Once the flow through cell is full, begin monitoring and recording field parameters as specified in Section 3.1.

2.3 Equipment Decontamination

Prior to each use, the following procedures will be used for all non-dedicated sampling equipment used to collect groundwater samples[1]:

1. Clean with tap water and soap using a brush to remove obvious particulate matter and surface films;
2. Rinse thoroughly with tap water;
3. If sampling for metal constituents rinse equipment with a 10% nitric acid solution (nitric acid is not to be run through the Grundfos pump);
4. Rinse thoroughly with deionized or distilled water;
5. Rinse thoroughly with pesticide-grade isopropanol[2] unless made of PVC or plastic. These items are not to be solvent rinsed;
6. Rinse thoroughly with analyte free water. If analyte free water is not available, equipment should be allowed to completely dry;

[1] Note that NJDEP has specific decontamination procedures for submersible pumps that require complete disassembly, including removal of the motor shaft from the stator housing, and all components within the impeller housing. See Field Sampling Procedure Manual dated August 2005, section 2.4.5.11. Also note that NJDEP does NOT allow for the field decontamination of bailers - all bailers must be either be new/dedicated, new/disposable, or laboratory decontaminated.

[2] NJDEP does not allow use of isopropanol as a decontamination solvent without specific approval – see FSPM section 2.4.1. They do allow use of acetone with no restrictions, because "it is an excellent solvent, miscible in water and is not a targeted analyte in Priority Pollutant Analysis." If acetone is known to be a contaminant at a given site or Target Compound List analysis is to be performed, methanol or another solvent may be substituted on a case by case basis with approval from NJDEP." Note that methanol cannot be used when sampling gasoline and its' by- products, and that hexane is not a necessary solvent for dioxin, PCB, or other chlorinated organic sampling. Both methanol and hexane are flammable solvents.

7. Equipment should be allowed to air dry then wrapped in aluminum foil until needed for sampling.

Water level meters will be thoroughly rinsed with distilled or deionized water prior to each use. Decontamination water should be containerized and handled on a project specific basis.

3.0 WELL PURGING PROCEDURES

The following information will be recorded in the Groundwater Sample Field Information Form for each sample point:

- Before Purging:
  - Date, time;
  - Well ID;
  - PID readings taken from the well immediately after the cap is removed (if applicable);
  - Depth to water;
  - Well depth (if measured);
  - Construction well depth;
  - Meter calibration time; and
  - Site name, location, project number.

- Purging:
  - Start and end time for purging;
  - Purge device;
  - Purge rate;
  - Depth to water, pH, ORP, temperature, specific conductance, turbidity and dissolved oxygen (every 5 minutes);
  - Parameters to be analyzed; and,
  - Pump depth.

- Sampling:
  - Start and end time for sampling;
  - Weather conditions;
  - Sampling method;
  - Pertinent observations regarding sample characteristics (turbidity, color, etc.);
  - Results of field test kits, if any; and,
  - Post sampling field parameters (if required).

3.1 Low Flow Purging[3] using a Portable Submersible Pump or Bladder Pump

Purge each well at a rate of approximately 200 to 500 milliliters per minute. During purging, monitor the water level and adjust pumping rate such that the water level draw down is minimized (ideally no more than 0.3 feet drawdown during purge). If drawdown is excessive, the pump rate should be lowered to 200 ml/min (be sure to note lowered purge rates on the field form). There must be at least 2 feet of water maintained over the pump intake to prevent pump suction being

[3] The procedures to be used for sampling monitoring wells are based upon the USEPA Region II document entitled "Groundwater Sampling Procedure Low Stress Purging and Sampling" dated March 16, 1998.

broken, or entrainment of air in the sample. If there is risk of water level dropping to within 2 feet above the pump, the purge should be terminated, and procedures for bailer sampling should be followed (Section 3.2). Record the pumping rate adjustments and depth(s) to water on the sample collection form (Figure 2).

Attach a field decontaminated Horiba U-22 water quality meter (or equivalent) that has been calibrated to the manufacturer's specifications and in-line flow-through cell to the discharge tubing. Measurements will be taken with a flow-through cell so that they are recorded prior to the sample being exposed to the atmosphere. During purging, monitor the field parameters (temperature, pH, turbidity, specific conductance, ORP, and DO with the Horiba approximately every 5 minutes (or at a minimum of one flow cell volume exchange) until the parameters have stabilized over three (3) consecutive readings. Site Specific stabilization requirements should be followed. In general, stabilization is considered achieved if:

- pH is within +/- 0.1;
- conductivity is within +/- 3%;
- temperature is within +/- 3%;
- ORP is within +/- 10 mV;
- turbidity is within +/- 10% (or is less than 50 NTU); and
- DO is within +/- 10% (or within 0.1 mg/l when the DO is less than 1 mg/l).

All measurements will be recorded on the sample collection form or in field notebooks.

3.2 Conventional Purging Using Dedicated Bailers

Depending upon site specific conditions (e.g. the formation will not support the use of submersible pumps as groundwater recharge is too slow) or other project requirements, then conventional purging will be utilized. The well will be purged of 3 to 5 well volumes and sampled using a dedicated or disposable Teflon-lined bailer. If the bailer is dedicated to a well, the bailer does not need to be decontaminated.

The well will be purged and sampled with a new or dedicated, Teflon, bottom-filling bailer connected to new or dedicated, nylon well rope. Using bailers dedicated to each sample point, and new polyethylene well rope each time, reduces the likelihood of cross contamination.

Using the well construction information, the volume of standing water in each casing will be calculated using the following equation:

Standing Water Volume = ((Well depth) – (Water level))*(Casing Volume/foot))

Casing Volumes

2" casing	4" casing	6" casing	8" casing
0.163 gal/ft	0.653 gal/ft	1.47 gal/ft	2.61 gal/ft

The nylon well rope will be securely tied to a new or dedicated Teflon bailer. The bailer will be gently lowered into the water column in order to minimize disturbance. Once the bailer fills, it will be slowly pulled up and purge water discarded into the 55-gallon drum or similar container for later disposal (if not allowed to discharge directly to the ground surface). Field parameter readings (pH, DO, conductivity, temperature, ORP, and turbidity) will be collected from initial bailer of water, and following removal of each well volume and after the sample collection[4]. All measurements will be recorded on the sample collection form (Figure 3) and/or in field notebooks. This will be repeated until at least 3 (minimum if field parameters meet stabilization criteria), but no more than 5 standing water volumes have been evacuated.

If the well is pumped dry during purging[5], the samples will be collected as soon as there is a sufficient recharge volume to fill the sample bottles. VOCs will be collected within 2-hours, if possible and all other parameters will be collected within 24-hours.

[4] NJDEP does NOT require measurement of field parameters when during "volume averaged" sampling (i.e. using bailers to evacuate 3 to 5 casing volumes) – see 2005 FSPM section 6.9.2.4

[5] Wells to be sampled for VOCs cannot be pumped dry.

4.0 SAMPLE COLLECTION PROCEDURES

If using a bailer, collect samples directly from the bailer port. If using a pump, remove the flow-through cell from the discharge tubing and collect the samples directly from the end of the tubing. Samples for VOC and appropriate gas sensitive parameters, such as hydrogen gas, must be collected first. The pump flow rate must be reduced to approximately 100 milliliters per minute (ml/min) during collection of samples for VOCs and appropriate gas-sensitive parameters, should be between 100 and 350 ml/min (optimally 300 ml/min) for collection of samples for hydrogen gas, but may be as high as approximately 500 milliliters per minute for other parameters depending on the well yield and turbidity of the sample. All sample bottles will be filled by allowing the pump discharge to flow gently down the inside of the bottle with minimal turbulence. Cap each bottle as it is filled. For VOCs and appropriate gas-sensitive parameters, steps must be taken to eliminate headspace in the 40-milliliter (ml) vial. Such steps may include adding several drops of the sample to create a meniscus on the vial opening before screwing on and inverting the vial to check for air bubbles. The bottles will be preserved according to the specifications listed in the analytical methods. Hydrogen gas samples will be collected according to the laboratory instructions (attached). All samples must be labeled prior to sample collection, using indelible ink with the sample point identification, sampler's initials, sample date and time, preservative, and parameters for analysis.

Immediately after sample collection, sample bottles will be placed on ice and maintained at approximately 4° Celsius (C) and transported by overnight courier to the laboratory. Samples must be logged on a chain-of-custody form (Figure 4), which is kept with the samples. Strict chain-of-custody procedures must be maintained throughout the sampling and transportation process.

5.0 QA/QC SAMPLES

In addition to the primary samples described above, it is often necessary to collect quality assurance/quality control (QA/QC) samples. This section describes the various QA/QC samples typically collected in the field and analyzed in the laboratory, and the frequency at which they will be performed. QA/QC samples are used to monitor sampling and laboratory performance and include trip blanks, field rinsate blanks, field duplicates, and matrix spike/matrix spike duplicates (MS/MSD). Each of these is described in more detail below. Project specific requirements should be reviewed; this is an overview of standard practice.

5.1 Trip Blanks

Trip blanks are used to verify that the VOC bottles and samples or sample bottles are not contaminated in transit between the lab to the Site, while on Site, or from the Site back to the lab. The lab will either supply pre-prepared trip blanks or supplies to prepare trip blanks in the field. Trip blanks should accompany the VOC samples throughout the event from collection through shipment to the laboratory, and are recorded on the Chain-of-Custody along with the primary samples. Trip blanks are shipped in each cooler that contains aqueous VOC samples. To reduce the number of trip blanks, the sampling team should attempt to consolidate all VOC vials in one cooler.

5.2 Field Rinsate Blanks

Field rinsate blanks are used to verify the effectiveness of the decontamination of the field sampling equipment. Rinsate blanks are collected for all required analyses at a frequency of one per day per type of non-dedicated sampling equipment which comes in contact with the sample. Field rinsate blanks are prepared in the field using lab supplied demonstrated analyte free water. The water is poured over and/or through each type of sampling equipment, and the rinsate collected in labeled laboratory supplied bottles. Field rinsate blanks are recorded on the Chain-of-Custody along with the primary samples.

5.3 Field Duplicates

Field duplicates are collected to assess the laboratory equipment accuracy. Field duplicates are collected for all required analyses at a frequency of one per 20 primary samples per matrix. Field duplicates are collected by sampling the same location/depth twice, but the field duplicate is

assigned a unique sample identification number – and may or may not be blind (i.e, the laboratory may or may not know that the sample is a duplicate depending upon the scope of work). Field duplicates are recorded on the Chain-of-Custody along with the primary samples.

5.4 MS/MSD

Matrix spike/matrix spike duplicates are samples collected in the field that are spiked in the laboratory with the analyte list to check for matrix interferences. These samples verify the effectiveness of sample preparation procedures in measuring chemicals of interest from the matrix material. MS/MSDs are collected for all required analyses at a frequency of one per 20 primary samples per matrix. Additional sample volume (Same sample ID as the primary sample) is collected from a location and submitted to the laboratory for analysis. MS/MSD samples are recorded on the Chain-of-Custody along with the primary samples.

STANDARD OPERATING PROCEDURE

GFP-6 GROUNDWATER WELLS INSTALLATION AND DEVELOPMENT

GFP-6 GOLDER FIELD PROCEDURE 6
GROUNDWATER WELL INSTALLATION AND DEVELOPMENT

1.0 GROUNDWATER WELL INSTALLATION

1.1 Well Construction

Groundwater monitoring well construction will vary based upon investigation objectives and actual Site conditions.

1.1.1 Double Cased Groundwater Monitoring Wells

The double cased wells will be advanced in several stages. First, a borehole will be advanced a minimum of one foot below the confining unit specified in the Site-Specific Work Plan. An outer casing will then be installed in the borehole. The annulus between the borehole and the casing will be grouted using cement-bentonite grout placed using the tremie method. The grout will be allowed to set up for a minimum of twelve hours before drilling continues. Second, a borehole will be advanced through the outer casing into the underlying units to the desired depth. Upon drilling to the desired depth, the double cased well will be finished as a monitoring well. Soil samples will be collected during drilling for the purpose of logging the borehole and, if necessary, for environmental or geotechnical testing purposes.

1.1.2 Single Cased Groundwater Monitoring Wells

The single cased wells will be advanced in a single stage. Upon drilling to the desired depth, the single cased well will be finished as a monitoring well. Soil samples will be collected during drilling for the purpose of logging the borehole and, if necessary, for environmental or geotechnical testing purposes.

1.1.3 Well Screen and Casing Placement

Well plugs, well casing, and well screen should be secured to each other by flush-jointed threads. Before the well screen and casings are placed on the bottom of the borehole, at least 6 inches of filter pack or sand pack should be placed at the bottom of the borehole to serve as a firm footing for the well screen/casing. The string of well screen and casings should then be placed into the borehole, centered and plumbed.

No lubricating oils or grease should be used on casing threads. Teflon tape can be used to wrap the threads to insure a tight fit and minimize leakage. No glue of any type should be used to secure casing joints. Teflon "O" rings can also be used to insure a tight fit and minimize leakage; however, "O" rings made of other materials are not acceptable.

1.1.4 Sand/Filter Pack Placement

When placing the sand/filter pack into the borehole, a minimum of 6 inches of the sand/filter pack material should be placed below the bottom of the well screen to provide a firm footing. Silica sand will be used as the well sand filter pack material. A Sand Pack (sand size as appropriate for the slot size of the well screen installed) will be placed to a depth of 2-feet above the screen and a 1-foot Filter Pack (#0 or #00 Sand) will be placed on top of Sand Pack. The sand/filter pack should be placed by carefully pouring the sand in the annulus between the well and borehole wall and regularly measured during placement.

1.1.5 Grouting the Annular Space

The annular space between the casing and the borehole wall will be filled with a cement/bentonite grout. The grout should be placed into the borehole, by the tremie method (side discharge), from the top of the filter pack to within 2 feet of the ground surface or below the frostline, whichever is greater. The tremie tube should have a side discharge port to minimize damage to the filter pack during grout placement. The grout should be allowed to cure for a minimum of 12 hours before the concrete surface pad is installed and the well is developed.

Cement grouts should be mixed using 6.5 to 7 gallons of water per 94-lb bag of Type 1 Portland cement. The addition of bentonite (5 to 10 percent) to the cement grout is generally used to delay the "setting" time and may not be needed in all applications.

1.1.6 Protective Casing

The well will then be finished with a protective casing (e.g. stick-up casing or flush mount) as designated in the Site-Specific work plan.

<u>Above Ground Riser Pipe and Outer Protective Casing</u>

The well casing, when installed and grouted, should extend above the ground surface a minimum of 2 feet. A vent hole should be drilled into the top of the well casing cap to permit pressure

equalization, if applicable. An outer protective casing should be installed into the borehole after the annular grout has cured for at least 24 hours. The outer protective casing should be of steel construction with a locking cap. All protective casings should have sufficient clearance around the inner well casings, so that the outer protective casings will not come into contact with the inner well casings after installation. A protective casing is installed by pouring concrete into the borehole on top of the grout. The protective casing is then pushed into the wet concrete a minimum of 2 feet into the borehole. Extra concrete may be needed to fill the inside of the protective casing so that the level of the concrete inside of the protective casing is at or above the level of the surface pad. The protective casing should extend approximately 2.5 feet to 3 feet above the ground surface or to a height so that the cap of the inner well casing is exposed and accessible when the protective casing is opened.

1.1.7 Flush-Mount Well

Water-tight flush mount protective casings should be installed in lieu of above-ground protective casings in high traffic areas. At such locations, the well casing, when installed and grouted, should extend only to approximately 2 inches to 4 inches below ground surface. A watertight, monitoring well flush mount protective casing should be installed into the borehole after the annular grout has cured for at least 24 hours. The flush mount protective casing should be of one-piece steel construction and fitted with a bolted and gasketed cover. As the covers typically cannot be locked, a locking well cap should be used on the inner well casing. All flush mount protective casings should have sufficient clearance around the inner well casings so that the sides of the box will not come into contact with the casing after installation. A flush mount protective casing is installed by pouring concrete into the borehole on top of the grout. The flush mount protective casing is then pushed into the wet concrete until the top of the cover is level with the ground surface. In areas without vehicular traffic, it may be advantageous to raise the manhole cover approximately 1 inch above grade to reduce the possibility of water and sediment entering the casing.

1.1.8 Concrete Surface Pad

A concrete surface pad should be installed around each well at the same time as the outer protective casing is being installed. The surface pad should be formed around the well casing. Concrete should be placed into the formed pad and into the borehole (on top of the grout) in one operation making a contiguous unit. The protective casing is then installed into the concrete as described above. The finished pad should be sloped so that drainage will flow away from the protective

casing and off of the pad. In addition, a minimum of 3 inches of the finished pad should be below grade or ground elevation to prevent washing and undermining by soil erosion. All locks on the outer protective casings should be keyed alike.

1.1.9 Well Construction Materials

Well construction materials are chosen based on the goals and objectives of the proposed program and the geologic conditions at the site. Well construction materials (e.g. stainless steel or PVC) and screen slot size (e.g. 0.01-inch slot) and length will be designated in the Site-Specific work plan.

2.0 WELL DEVELOPMENT

Newly completed well should not be developed for at least 24 hours after the surface pad and outer protective casing are installed. This will allow sufficient time for the well materials to cure before development procedures are initiated. The main purpose of developing new wells is to remove the residual materials remaining in the wells after installation has been completed, and to attempt to re-establish the natural hydraulic flow condition of the formation which may have been disturbed by well construction around the immediate vicinity of each well. New wells will be developed until the column of water in the well is relatively turbid-free, and the pH, temperature, and specific conductivity have stabilized.

The following development procedures may be used to develop the wells:

1. Pumping;
2. Compressed air (with the appropriate organic filter system);
3. Bailing;
4. Surging;
5. Backwashing ("rawhiding"); and
6. Jetting.

Newly installed wells will not be sampled until at least 14 days after the completion of well development to allow for the formation to restabilize to pre-well construction conditions. The selected development method(s) will be approved by a field geologist/hydrogeologist before any well development activities are initiated and will be documented on well development forms and in the site-specific Field notebook.

STANDARD OPERATING PROCEDURE

GFP-7 ENVIRONMENTAL SAMPLE HANDLING, CUSTODY, AND SHIPMENT

GFP-7 GOLDER FIELD PROCEDURE 7
ENVIRONMENTAL SAMPLE HANDLING, CUSTODY, AND SHIPMENT

1.0 SAMPLE HANDLING

The laboratory must supply appropriately prepared sample containers, preservatives, sample labels, chain of custody forms, custody seals, and sample coolers/shuttles. Preservation procedures and analytical holding times must be in accordance with the published analytical methods and USEPA Region II (or other appropriate regulatory agency) guidelines as further detailed below.

1.1 Sample Preservation

Environmental sample containers must be kept closed until the time they are to be filled. After filling, the containers must be securely closed, residue (if any) wiped from the sides, and immediately placed in the sample cooler/shuttle. Samples must be cooled to approximately 4°C in the cooler/shuttle immediately after collection using wet ice, and that temperature maintained during storage and shipment to the laboratory. Samples will generally be shipped on the day of sample collection to the laboratory via overnight courier. Samples requiring chemical preservatives must either be collected in pre-preserved containers obtained from the laboratory (avoiding overfilling which would cause loss of preservative), or the appropriate laboratory provided preservatives carefully added per their instructions.

1.2 Sample Identification

All samples must be adequately marked for unique identification from the time of collection through analysis and storage. Marking must be on a sample label affixed directly to the sample container. Sample identification shall include, as a minimum:

- Project name and/or number;
- Unique sample identification number;
- Analysis requested;
- Chemical preservatives (if any);
- Sample date and time; and,
- Initials of the individual who collected the sample.

Each sample will be assigned a unique sample identification (ID) number to be recorded on the sample label. Each sample ID number must be recorded in the field notebook, a Sample Field Information Form and, as applicable, on chain-of-custody documentation. Sample naming protocols are described in Standard Operating Procedure (SOP) GFP-8.

Equipment

- Water proof marking pen;
- Sample bottle labels;
- Transparent tape; and,
- Site base map or list with designated sampling identification numbers.

Procedure

Sample labels must be marked with the sample ID number, requested laboratory analysis, initials of the sampler, and the date and time of sample collection. The labels must be affixed directly to the sample containers and, if necessary, secured with transparent tape. The corresponding sample ID number must be marked in the project field notebook for correlation during report preparation.

2.0 SAMPLE CUSTODY

Chain of Custody (COC) procedures are required to help ensure sample traceability from the time of collection through completion of analysis. The National Enforcement Investigations Center (NEIC) of USEPA considers a sample to be in custody under the following conditions:

1. It is in your possession; or
2. It is in your view after being in your possession; or
3. It was in your possession and you locked it up; or
4. It is in a designated secure area.

2.1 Field Sample Custody

All environmental samples must be handled under strict COC procedures beginning in the field. The following procedures must be used to maintain COC of environmental samples.

Equipment

The following equipment and materials are needed to perform COC procedures:

- Chain-of-custody forms;
- Chain-of-custody seals; and,
- A secure (locked) vehicle or building.

Procedures

Samples and sample containers must be kept under proper COC during field sampling. If custody of the samples is exchanged during field sampling, such transfer must be documented on the COC form. The departing field staff must sign indicating the custody has been relinquished, and the arriving field staff must sign indicating custody has been accepted.

The COC form and Field notebook (and/or field information form) should include:

- Sample identification number and matrix;
- Project or site name or number;
- Sampler's name or initials;
- Sample collection date and time (military time);
- Designation as a grab or composite sample;
- Requested laboratory analysis;
- Any appropriate comments/remarks; and,
- Identification of any preservatives added to the sample.

When shipping samples to the laboratory, all sample bottles and requested analyses must be noted on the COC form. Where multiple analytical methods are available for a particular analysis, the specific method number should be listed on the COC form.

Only one (1) member of the sampling team should sign the COC form relinquishing custody to the courier/laboratory. If using an overnight courier service, record the tracking number on the COC. The COC form must be sealed inside the shipping container with the samples. The paperwork should be sealed inside a plastic bag to prevent potential damage from water. Note that the courier does not need to sign the COC form if it is sealed within the shipping container using custody seals. If the samples are hand delivered to the laboratory by field staff, the COC form should be signed at the laboratory when the samples are delivered. Under such situations, the shipping container does not need to be sealed as long as it is kept under proper COC until delivered to the laboratory. When required, at least two (2) seals should be used on each shipping container. If possible, COC seals should be signed and dated, and the serial numbers listed on the COC form.

2.2 Laboratory Custody

Once samples are transported to the analytical laboratory, custodial responsibility is transferred to the Laboratory Sample Manager to assure that the procedures presented in the laboratory's Quality Assurance Plan (QAP) and the appropriate analytical methods are followed. The laboratory QAP will contain a detailed description of the laboratory chain-of-custody procedures, including receipt of samples, designation of a sample custodian, custody within the laboratory and laboratory storage, and disposal procedures.

3.0 SAMPLE PACKAGING AND SHIPMENT

The following procedure is to be used to help ensure successful shipping of samples to the laboratory.

Equipment

The following equipment and materials are required to perform this procedure:

- Overnight courier airbills and courier phone number (if applicable);
- Packing tape;
- Cushion material such as bubble wrap or vermiculite;
- Address labels; and,
- Laboratory address and phone number.

Procedures

Samples should be packed upright into the sample cooler in a manner that will minimize potential breakage of sample bottles. This may require use of laboratory-supplied bubble wrap designed to fit the particular bottle, polystyrene chips, or vermiculite. Wet ice (only) must be used for preservation. Blue ice is not acceptable, as it may not provide sufficient cooling. Make sure that wet ice is placed in zip locked/sealed bags that will not leak, as sample labels may be damaged, and sample integrity compromised, if subjected to standing water in the cooler. The sample containers must contain enough wet ice to maintain a temperature of 4°C during transport to the laboratory. Check the amount of ice in the cooler just prior to sealing and sending them to the laboratory. A temperature blank should be placed in each cooler as a check. In general, samples should be shipped to the laboratory within 24 hours of collection. Samples of different matrices (i.e., soil and water) must be shipped separately to minimize cross-contamination.

STANDARD OPERATING PROCEDURE

GFP-8 GRAVITY FLOW AND PRESSURIZED NUTRIENT INJECTIONS FOR ENHANCED BIOREMEDIATION

STANDARD OPERATING PROCEDURE (SOP) FOR GRAVITY FLOW AND PRESSURIZED NUTRIENT INJECTIONS FOR ENHANCED BIOREMEDIATION

This Standard Operating Procedure (SOP) provides guidance for the field-scale injection of nutrients for enhanced bioremediation using either gravity flow or pressurized injection.

Supplies

- 4-wheel-Drive Full-Size Pick-up Truck
- 275-gallon Polycarbonate Temporary Holding Tank
- 5-gallon Graduated Container
- Generator
- Injection Header
- Piping
- Circulation Hoses
- Fittings
- Teflon Tape
- Flow Meter
- Pressure Gauge
- Transfer Pump
- Drum Pump
- Sodium Bromide (1 kg bottle)
- Ion-Specific Electrode (bromide detection)
- Down-hole pressure transducers
- 55-gallon drum of Sodium Lactate stock (275 kg)

Procedures

1. **Lactate Mixing**:
    a. 1 gallon of Sodium Lactate stock solution contains 5 kg of Sodium Lactate
    b. 2.5 gallons of Sodium Lactate should be pumped from the 55-gallon drum of Sodium Lactate stock to a 5-Gallon Graduated Container using a Drum Pump
    c. 2.5 gallons of Sodium Lactate should then be poured into the top of the 275-gallon Polycarbonate Temporary Holding Tank on the back of the Field Truck
    d. 600 grams of Sodium Bromide should be pre-measured and supplied for the field using a digital scale
    e. 600 grams of Sodium Bromide should then be added to the 275-gallon Polycarbonate Temporary Holding Tank

f. The 275-gallon Polycarbonate Temporary Holding Tank should then be filled to the 100 gallon mark with potable water from an on-Site location to achieve a Sodium Lactate solution concentration of approximately 32 g/L and Sodium Bromide concentration of approximately 1 g/L
g. The 275-gallon Polycarbonate Temporary Holding Tank should then be transported to the injection Site

2. **Lactate Pressurized Injection**:
   a. Connections:
      i. Remove well cover
      ii. Remove well-cap
      iii. Thread the Injection Header onto the well casing using Teflon Tape on the exposed threads.
      iv. All Circulation Hose connections will be Quick-Connect fittings.
      v. Transfer Pump will be connected in-line between a Circulation Hose at the bottom valve of the 275-gallon Polycarbonate Temporary Holding Tank and connected via a Circulation Hose to the Injection Header.
      vi. A second Circulation Hose should be fitted to the bleed-off valve and the end of the Circulation Hose should be placed into the 275-gallon Polycarbonate Temporary Holding Tank.
   b. Priming the Injection Well:
      i. Open the bleed-off valve at the Injection Header.
      ii. Open the valve at the base of the 275-gallon Polycarbonate Temporary Holding Tank
      iii. Open the valve at the Injection Header.
      iv. Allow Sodium Lactate solution to flow into the injection well under gravity flow until fluid fills the bleed-off valve Circulation Hose.
      v. If Sodium Lactate solution flows out of the bleed-off Circulation Hose into the 275-gallon Polycarbonate Temporary Holding Tank, continue with step vi. and perform the injection using gravity flow.
      vi. If Sodium Lactate solution does not flow out of the bleed-off Circulation Hose into the 275-gallon Polycarbonate Temporary Holding Tank, start the Transfer Pump to increase the flow.
      vii. Once the Sodium Lactate solution begins pouring out of the end of the Circulation Hose, shut the bleed-off valve.
   c. Injection Start
      i. Once the injection well, Transfer Pump and all Circulation Hoses are primed, continue injecting Sodium Lactate solution, either via gravity flow or using the Transfer Pump, until the tank is completely drained.
      ii. Adjust the flow rate and backpressure using the valve at the Injection Header; never use the valve at the base of the 275-gallon Polycarbonate Temporary Holding Tank.
      iii. The injection flow rate will be monitored with a totalizing Flow Meter.
      iv. The target flow-rate is as high as the formation will accept without significant backpressure build-up
      v. The total volume to be injected is 100 gallons
      vi. The injection back-pressure will be monitored with a Pressure Gauge.
      vii. The target backpressure is less than 30 psi

d. Purging the Well-bore:
   i. Refill the injection tank with 20 gallons of clean water
   ii. Inject 20 gallons of water to clean the well-bore using gravity feed or pressurized injection.
   iii. The same flow-rate and backpressure targets apply
e. Injection Completion:
   i. At the completion of injections, turn off the Transfer Pump if using pressurized injection.
   ii. Close the valve at the Injection Header.
   iii. Close the valve at the base of the 275-gallon Polycarbonate Temporary Holding Tank.
   iv. Remove all Circulation Hoses and the Injection Header.
   v. Replace well-cap and well cover.

Written by: Michael J. Borda, Ph.D. (April, 2009)

Reviewed by: (DATE)

Revised by: (DATE)

STANDARD OPERATING PROCEDURE

GFP-9 SURFACE WATER SAMPLING

Standard Operating Procedure
GFP-9 Surface Water Sampling

This Standard Operating Procedure (SOP) provides general guidance for the collection of grab surface water samples; any site specific sampling plans may take precedence over this general SOP. This SOP addresses grab samples collected from water bodies and/or wetlands only, and does not address the collection of composite surface water samples collected from wastewater tanks or pipes using an automatic composite sampler.

Grab surface water samples may be quite easy to collect (e.g. a small, slow moving stream), whereas at other times these samples may be much more involved (e.g. a deep lake, or fast moving stream). For streams, channels, rivers, etc., the sample should generally be collected from the middle of the channel at mid-depth, which may require specialized sampling equipment (e.g., grab pole). At some locations, the collection of surface water samples necessitates entering the body of water, which could require the use of rubber boots, hip or chest waders, or even a boat. Health and safety concerns are always paramount. A site specific health and safety plan (HASP) must be prepared prior to the collection of any field samples. If field conditions are potentially hazardous, the risk to sampling personnel must be weighed against the need to collect the sample.

Suggested Equipment

- Personal protective equipment (PPE) as required in the site-specific HASP;
- Rubber boots, hip or chest waders, or a boat, if required;
- Sampling device(s), if required, such as a stainless steel cup attached to an extendable grab pole;
- Decontamination equipment and supplies;
- Field parameter meter for measuring specific conductance, pH, temperature, redox, dissolved oxygen, turbidity and salinity (required by NJDEP);
- Filters and filter vessel , as required, for filtered metals;
- Appropriate sample containers and labels;
- Bound field logbook;
- Sample shuttle or cooler with ice; and,
- Chain of Custody forms.

Procedures

1. Prior to sample collection, record the water body characteristics (e.g., size, depth, and flow rate) in the field logbook. Salinity and tides can significantly affect contaminant distribution in coastal or off-shore areas, and therefore should be addressed by the sampling plan. At a minimum, the stage of the tide at the time of sample collection should be recorded in the field logbook;

2. For health and safety purposes, field parameters should be measured and surface water samples should be collected from land (e.g., using an extendable pole) if reasonably possible. However if it is necessary to enter the water body by wading or boat, slowly approach the sample location from downstream, but do not enter the actual sample area. If possible, avoid disturbing the bottom sediments. If the sediments do become suspended, do not collect them with the sample. If necessary, wait until the suspended particles settle down or flow out of the sampling area before measuring field parameters or collecting the sample;

3. The probes of the field parameter meter should be submerged at the sample location slightly downstream from where the sample bottle(s) will be filled. Water quality measurements for surface water samples typically include temperature, pH, total hardness (as $CaCO_3$), alkalinity (as $CaCO_3$), salinity (parts per thousand, 0/00), conductivity (as *u*mhos/cm), and dissolved oxygen (mg/l);

4. Collecting surface water samples in pre-preserved sample containers require special procedures. If the sample can be collected near the surface, then tip the container to one side and slowly submerge the container into the water, taking care not to fully submerge or overfill the pre-preserved sample container (to eliminate the loss of preservative). If the sample needs to be collected from some depth, then additional non-preserved containers will be required. Submerge the capped container to the appropriate depth, then open the cap, fill the non-preserved container below the water surface, then close the cap and remove the container. Collect a sufficient volume of water to fill all sample necessary sample containers; several re-fillings of the vessel may be necessary. When transferring the sample from the non-preserved to the pre-preserved sample container, slowly pour the sample into the pre-preserved bottles taking care not to overflow the bottle resulting in the loss of preservative. Immediately cap the bottle after filling. For the vials for volatile organic compound (VOC) analysis, turn the vial upside down (after capping) and check for air bubbles. Tap the vial to dislodge any bubbles that may have formed around the cap or sides. If a bubble is present, open the vial and carefully add a small amount of water to the vial. If an air bubble is still present after several attempts, discard the vial and re-sample using a new vial;

5. If pre-preserved sample containers are not required, submerge the capped container to the appropriate depth, open the cap, fill the container, close the cap, then remove the container from the water;

6. Place labeled sample container(s) upright into a sample cooler with ice. The sample label should be completed and affixed to the bottle prior to filling the bottle. The cooler temperature should be approximately 4 degrees Celsius (°C) before the sample is placed within it, and kept at that temperature until received at the analytical laboratory; and

7. Record sample information (e.g., sample ID, location, method, etc.) in the field logbook and on the chain of custody (COC) form.

Quality Assurance/Quality Control (QA/QC) Samples

In addition to the primary samples described above, QA/QC samples are also typically collected to help achieve the data quality goals or objectives for the project. This description is a brief overview: procedures for QA/AC sample are discussed in more detail in other documents (site-specific sampling plans, regulatory guidance documents, Quality Assurance Project Plans (QAPP), etc). In general, the following QA/QC samples will be collected:.

- Temperature blank – used to determine shuttle or cooler temperature;
- Trip blank – prepared by the laboratory to accompany VOC samples;
- Rinsate blank – rinsate collected from an non-dedicated sampling equipment (e.g. stainless steel vessels, filter vessels, etc);
- Field duplicates – duplicate sample collected from sampling location; and,
- Matrix spike/matrix spike duplicate (MS/MSD) – triplicate sample collected for analyte spiking in the laboratory.

Updated: June 2009
Written by: J. Loureiro
Edited by: S. Anderson
Checked by: M. Morris (June 2009)

CompuChem
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SOP DOCUMENTATION FORM

This form must accompany all new and revised Standard Operating Procedures (SOPs) when you turn them in to Quality Assurance for review. Please fill out the entire block below (except effective date).

This is a new procedure _____ revised procedure ✓ outdated procedure (archive) _____

- Procedure Code: IP 1402 SOP Section #: 1.2.3.4 Revision #: 5

SOP Title: GC/MS Analysis of Aqueous and Medium-Level Solids for Volatile Organic Compounds using USEPA CLP SOW SOM01.2

Effective date: (QA fills in) 02-26-2009

- Procedure prepared by: [signature] Date: 02-23-2009
- Procedure approved by: (If the manager prepared the SOP, a qualified second party should sign) Bob McGann Date: 02-24-2009
- Reason for change: Corrections from EPA/DATS onsite audit and from annual review
- This procedure meets the requirements of the following approved method references: USEPA CLP SOW for Organic Analysis, Multi-Media, Multi-Concentration, SOM01.2 (8/2007)

Procedure approved by a QA Representative (unless QA Representative signed above):

_____ Date: _____

On an annual basis: Lab managers are required to review lab practices and revise the SOP if necessary. If no revision is necessary, indicate by your signature that the SOP has been reviewed.

Annual Review—Signature: _____ Date: _____

Annual Review—Signature: _____ Date: _____

Annual Review—Signature: _____ Date: _____

Annual Review—Signature: _____ Date: _____

R2-0001725

Instrument Procedure 1402: GC/MS Analysis of Aqueous and Medium Level Solids for Volatile Organic Compounds using USEPA **CLP** SOW SOM01.2

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R2-0001726

Instrument Procedure 1402: GC/MS Analysis of Aqueous and Medium Level Solids for Volatile Organic Compounds using USEPA SOW SOM01.2

1.0 Scope and Application

The method described is designed to analyze water and medium level soil/sediment samples from hazardous waste sites for the volatile organic compounds listed in Attachment 1. The actual analysis is based on a purge and trap gas chromatograph/mass spectrometer (GC/MS) method for aqueous and medium level soil samples.

Staff members performing the procedures described in this SOP are responsible for reading, understanding, and complying with the SOP requirements. Supervisors are responsible for directing the analyst to the controlled SOP, and providing adequate explanation of the material contained therein.

This procedure is restricted to use by or under the supervision of analysts experienced in the instrumentation or preparative methods and who have demonstrated the ability to generate acceptable results through QC samples and analyst capability studies.

2.0 Summary of Method

2.1 Aqueous

An inert gas (helium) is bubbled through 5 mL of sample spiked with internal standard and deuterated monitoring compounds (DMC). The sample is purged at ambient temperature, causing the purgeable volatile organic compounds to be transferred from the aqueous phase to the vapor phase. The vapor is swept onto a sorbent column where the purgeable volatile organic compounds are trapped.

2.2 Medium Level Soil/Sediment

Medium level soil samples are collected and preserved in methanol or extracted with methanol. An aliquot (generally 100 µL) of methanol extract is added to 5 mL of reagent water, spiked with internal standard and DMC solutions. The sample is purged at ambient temperature, causing the purgeable volatile organic compounds to be transferred from the aqueous phase to the vapor phase. The vapor is swept onto a sorbent column where the purgeable volatile organic compounds are trapped.

After purging is completed, the sorbent column is heated and back flushed with the inert gas to desorb the purgeable volatile organic compounds onto a gas chromatograph wide-bore capillary column. The gas chromatograph is temperature programmed to separate the purgeable volatile organic compounds that are then detected with a mass spectrometer.

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R2-0001727

3.0 Definitions

3.1 Method detection limit (MDL) – The minimum concentration of an analyte that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte (40 CFR, Part 136, Appendix B.)

3.2 Reporting Limit- The reporting limit for CLP is the Contract Required Quantitation Limit (CRQL)

3.3 Reporting Units – µg/L for water and µg/Kg for soils

3.4 A sample delivery group (SDG) is defined by the following, whichever is more frequent:

- each 20 field samples received within a case, or
- each 7 calendar day period (3 calendar day period for 7 day turnaround) during which field samples in a case are received beginning with the receipt of the first sample.

3.5 Analytical range – The range of concentrations that comprise the initial calibration (i.e., 5 to 200 µ/L for non-ketone compounds). Samples containing target analyte(s) above the analytical range must be diluted, or a lesser amount of sample analyzed, in order to bring the concentration to within the upper half of the analytical range. The upper half of the analytical range is defined as the concentration between the midpoint standard and the high standard.

3.6 BFB - Bromofluorobenzene

3.7 EICP - Extracted Ion Current Profile

3.8 VOA – Volatile Organic Analysis

3.9 VTSR – Validated Time of Sample Receipt

4.0 Interferences

4.1 Impurities in the purge gas or methanol, organic compounds out gassing from the plumbing ahead of the trap, and solvent vapors in the laboratory account for the majority of contamination problems. Gas lines from the gas tanks to the instrument must be either stainless steel or copper tubing. Non-

polytetrafluoroethylene (PTFE) thread sealants, or flow controllers with rubber components are not to be used. When potential interfering peaks are noted in laboratory method blanks, it may be necessary to reduce solvent contamination in the laboratory, purge the methanol used to prepare standard solutions, purge the reagent water with helium or nitrogen, change the purge gas source, or regenerate the molecular sieve purge gas filter.

4.2 Samples can be contaminated by diffusion of purgeable organics (particularly methylene chloride, fluorocarbons, and other common laboratory solvents) through the septum seal into the sample during storage and handling. Therefore, these samples are stored in GC/MS VOA laboratory refrigerator separate from laboratory standards, and analyzed in a room whose atmosphere is demonstrated to be free of all potential contaminants that will interfere with the analysis.

4.3 Laboratory clothing worn by analysts must be devoid of solvents because clothing previously exposed to methylene chloride and other laboratory solvent fumes during common liquid/liquid extraction procedures can contribute to sample contamination.

4.4 Contamination by carryover can occur whenever a sample is analyzed after a sample that contains high levels of organic compounds. Whenever an unusually concentrated sample is encountered, it must either be followed by analysis of an instrument blank or the next sample must be closely monitored to check for cross-contamination. For samples containing large amounts of water soluble materials, suspended solids, high boiling compounds, or high purgeable levels, it may be necessary to clean the purge and trap apparatus by purging a 10 - 20% methanol solution, followed by baking the purge and trap apparatus and the analysis of a reagent water blank to confirm that the system is free from contamination. The trap and other parts of the system are also subject to contamination; therefore, frequent bake out and purging of the entire system may be required.

4.5 Method interferences caused by contaminants in solvents, reagents, glassware, purge gas, sorbents, laboratory air, and other sample storage and processing hardware that lead to discrete artifacts and/or elevated baselines in gas chromatograms must be eliminated. The chromatographic system must be inspected for malfunctions and corrections must be made as required before more samples are analyzed.

4.6 Instrument problems/preventative maintenance

4.6.1 If a low response is observed for the early eluting compounds such as the gases, replacement of the trap or septum may be necessary. In addition, adjustments to the purge flow may be necessary to achieve a desired response for these compounds. If such adjustments do not help, it may be

necessary to check the fittings on the purge and trap device and on the column for leaks. This is done with a helium leak detector and certain software utility programs.

4.6.2 Column maintenance or replacement may be necessary if peak tailing or broad chromatographic peaks are observed.

5.0 Safety

5.1 Appropriate protective equipment and clothing must be used under the assumption that all samples are potentially hazardous. During sample preparation, glasses, gloves and lab coats are a minimum requirement. The persistent presence of noxious odors may be indicative of failure of the laboratory ventilation system and must be reported to a supervisor or manager.

5.2 Laboratory staff must review the Chemical Hygiene Plan for general safety policies, and Material Safety Data Sheets (MSDS) for solvents and reagents used in the laboratory. The MSDSs are located in the Quality Assurance department.

5.3 The toxicity and carcinogenicity of many chemicals used in this method have not been precisely determined. Each chemical should be treated as a potential health hazard. Exposure to these chemicals should be minimized. Preparation of calibration standards, blanks, and samples is performed in a fume hood to minimize risk.

5.4 The following method analytes have been tentatively classified as known or suspected human or mammalian carcinogens: benzene, carbon tetrachloride, chloroform, vinyl chloride, and 1,4-dioxane.

6.0 Equipment and Supplies

6.1 Syringes

6.1.1 5 mL – SGE International gastight syringe

6.1.2 1 mL – SGE International gastight syringe

6.1.3 10 µL – Hamilton microsyringe

6.1.4 25 µL – Hamilton microsyringe

6.1.5 100 µL – Hamilton microsyringe

6.2 Analytical column

6.2.**1** Supelco SPB-624, 60 M, 0.32 mm ID, 1.**8** µm film thickness

6.3 Gas Chromatograph (GC)

6.3.1 **Hewlett Packard 6890**

6.3.2 Hewlett Packard 5890

6.3.3 Agilent 6890N

6.4 Mass Spectrometer

6.4.1 Hewlett Packard 5972 Mass Selective Detector (MSD)

6.4.2 Hewlett Packard 5973 MSD

6.4.3 Hewlett Packard 6890 MSD

6.4.4 Agilent Technologies 5975 MSD

6.5 Interface (GC to mass spectrometer)

6.5.1 Direct capillary insertion

6.6 Data System

6.6.1 For data acquisition, the Hewlett Packard GC/MS systems utilize ChemServer software.

6.6.2 For data processing, the laboratory uses the Hewlett Packard HP 9000 series 735 Unix Workstation **employing HP ChemServer with Target3 and Promium's Element form generation software.**

6.6.3 The reference library used is the NIST Library **(NIST 2002, or newer)**

6.7 Data storage

6.7.1 Data are stored on the Target3 Unix Workstation, which is backed up incrementally on a daily basis.

6.8 Purge and trap **Autosampler System**

6.8.1 Tekmar LSC

6.8.1.1 Tekmar, LSC 3000, LCS 3100 and Velocity XPT with glass frit bottom liquid sample purging vessel and Luerlock valve, with a Supelco K trap or equivalent.

6.8.1.2 The absorption trap must be at least 25 cm long and have an internal diameter of at least 0.105 inches (0.2667 cm).

6.8.1.3 The K (VOCARB 3000) trap consists of the following:

- carbopack B, 10 cm
- carboxen - 1000, 6 cm
- carboxen – 1001, 1 cm

6.8.2 Archon ALS

6.8.2.1 The Archon Model 5100, 4552 Purge and trap autosampler, interfaces directly to Tekmar Purge and Trap Concentrators.

6.8.2.2 The autosampler is designed for soil samples and utilizes 40 ml VOA closed-system, purge and trap vials with low bleed Teflon septa.

6.8.2.3 The Archon ALS has the capacity of up to 51 vials.

6.9 pH paper

6.9.1 Wide range, capable of measuring pH 0-14.

6.10 Balance

6.10.1 The analytical balance (Sartorius Model B410) used must be capable of accurately weighing plus or minus 0.01 grams (for sample weighing).

6.10.2 Calibrate the balance must be with Class S or known reference weights each day of use.

6.10.3 Schedule the semiannual calibration of the balance by an outside agency. This is coordinated by the QA Department.

6.11 Disposable pasteur pipets

6.12 Volumetric flasks, Class A, 10 mL to 100 mL, with ground glass stoppers.

6.13 Vials and caps – assorted sizes

7.0 Reagents and standards

Note: All SOM01.2 and OLM04.3 standards information is entered into the LIMS. To obtain information on any standard, access Element, click on "Laboratory," and scroll down and access "Standards." Standards can be sorted by Department. Select the standard you would like to access. The view will show lot number, prepared dates, solvent, vendor, composition, and concentration.

7.1 Reagent water

7.1.1 Reagent water – Use reagent-grade Type I water, with regard to resistivity of > 10 megohm-cm (19th and 20th Editions of Standard Methods, Method 1080). It is subsequently purged with the inert gas, nitrogen, and demonstrated to meet the blank contamination acceptance criteria contained in this Standard Operating Procedure (SOP). It is referred to throughout the remainder of this SOP as reagent water.

7.2 Methanol, purge and trap grade

7.3 Tuning standard

7.3.1 Bromofluorobenzene (BFB), Restek, 99% purity

7.3.1.1 Standard ID# 7008, at 25 µg/mL in methanol.

7.3.1.2 Prepare fresh BFB solution every six months or sooner if degradation or evaporation occurs.

7.4 Calibration Standards

7.4.1 The initial calibration consists of five standards containing all target compounds and DMCs. Add a sufficient amount **of** calibration standard solution to 5 mL of reagent water to result in the following concentrations:

7.4.1.1 Prepare all non-ketone target compounds and their associated DMCs at 5.0, 10, 50, 100, and 200 µg/L; all ketones and their DMCs are at 10, 20, 100, 200, and 400 µg/L; 1, 4-dioxane and its DMC are at 100, 200, 1000, 2000, and 4000 µg/L. The concentrations of the m,p-xylene isomers must total 5.0, 10, 50, 100, and 200 µg/L.

7.4.2 The opening and closing continuing calibration standards are prepared at or near the mid-point of the calibration range, 50 µg/L for non-ketones and their associated DMCs, 100 µg/L for ketones and their associated DMCs, and 1000 µg/L for 1,4-dioxane and 1,4-dioxane-d_8.

7.4.3 Prepare standards in a volumetric flask or gastight syringe, depending on the volume needed.

7.4.4 The methanol contained in each aqueous calibration standard must not exceed 1.0 percent by volume.

7.4.5 Prepare a fresh calibration standard solution monthly, or sooner if the solution has degraded or evaporated.

7.5 Internal Standard Solution

7.5.1 Prepare the internal standard solution consisting of 1,4-difluorobenzene, chlorobenzene-d_5, and 1,4-dichlorobenzene-d_4.

7.5.2 Add sufficient amount of internal standard to each calibration standard, blank, and sample including duplicate matrix spikes to result in 0.25 µg of each internal standard.

7.5.3 Prepare a fresh internal standard solution monthly, or sooner if the solution has degraded or evaporated.

7.6 DMC Standard solution

7.6.1 Prepare a DMC standard solution consisting of vinyl chloride-d_3, chloroethane-d_5, 1,1-dichloroethene-d_2, 2-butanone-d_5, chloroform-d, 1,2-dichloroethane-d_4, benzene-d_6, 1,2-dichloropropane-d_6, toluene-d_8, trans-1,3-dichloropropene-d_4, 2-hexanone-d_5, 1,4-dioxane-d_8, 1,1,2,2-tetrachlorothane-d_2, and 1,2-dichlorobenzene-d_4.

7.6.2 Add a sufficient amount of DMC to each calibration standard, blank and sample including duplicate matrix spikes to result in the addition of 0.25 µg of each non-ketone DMC, 0.50 ug of each ketone DMC, and 6.25 ug of 1,4-dioxane-d8.

7.6.3 Prepare a fresh DMC standard solution monthly, or sooner if the solution has degraded or evaporated.

7.7 Matrix Spiking Solution

7.7.1 Prepare a matrix spiking solution consisting of 1,1-dichloroethene, trichloroethene, chlorobenzene, toluene, and benzene at 25 µg/mL.

7.7.2 Prepare a fresh matrix spiking solution monthly, or sooner if the solution has degraded or evaporated.

7.8 Storage of standards

7.8.1 Store the stock standards in Teflon®-sealed, screw-cap bottles with zero headspace at –10° C to –20° C. Protect the standards from light.

7.8.2 Store aqueous standards for up to 24 hours in Teflon®-sealed, screw-cap bottles with zero headspace at 4° C (± 2° C). Protect the standards from light.

7.8.3 Aqueous standards not stored as in 7.8.2, must be discarded after one hour unless they are set up to be purged on an autosampler. When an autosampler is used, the standards may be kept up to 12 hours in purge vessels connected via the autosampler to the purge and trap device.

7.8.4 Purgeable standards must be stored in the GC/MS Freezer, separate from other standards and samples.

7.9 Standard Storage Records

7.9.1 All temperature records must be recorded daily following the procedures in QC SOP 13.15, "Documenting Refrigerator and Freezer Temperatures".

7.9.2 Corrective actions SOPs are required to be posted on refrigerators/freezers.

8.0 Sample Preservation and Storage

8.1 Samples are preserved and stored according to the tables in Sample Control SOP 4.1, "Receiving Samples" and 4.6, "Storing Samples." Sample holding times are also listed.

8.2 Analysis of water and soil sediment samples must be must be completed within 10 days of validated time of sample receipt. Analysis of unpreserved, unfrozen soil sediment samples must be completed within 24 hours of VTSR. These holding time requirements do not apply to performance evaluation (PE) samples.

8.3 Aqueous samples and storage blanks must be protected from light and stored at 4° C (± 2° C) in a VOA only storage unit.

8.4 Unpreserved medium soil samples and inert sand storage blanks must be protected from light and stored at less than -7 ° C in a VOA only storage unit.

9.0 Quality Control

9.1 DMCs

9.1.1 All samples, blanks and standards are fortified with DMCs that are used to monitor performance of the entire purge and trap/GC/MS system.

9.1.2 The following table contains DMC recovery criteria.

DMC	Percent Recovery for Aqueous Samples	Percent Recovery for Soil Samples
Vinyl chloride-d_3	65-131	68-122
Chloroethane-d_5	71-131	61-130
1,1-Dichloroethene-d_2	55-104	45-132
2-Butanone-d_5	49-155	20-182
Chloroform-d	78-121	72-123
1,2-Dichloroethane-d_4	78-129	79-122

DMC	Percent Recovery for Aqueous Samples	Percent Recovery for Soil Samples
Benzene-d_6	77-124	80-121
1,2-Dichloropropane-d_6	79-124	74-124
Toluene-d_8	77-121	78-121
Trans –1,3-Dichloropropene-d_4	73-121	72-130
2-Hexanone-d_5	28-135	17-184
1,4-Dioxane-d_8	50-150	50-150
1,1,2,2-Tetrachloroethane-d_2	73-125	56-161
1,2-Dichlorobenzene-d_4	80-131	70-131

9.2 Internal Standards

9.2.1 Add internal standard compounds to every standard, blank and sample at the required concentration prior to analysis. Internal standards are used as the basis for quantitation of the DMC and target compounds.

9.2.1.1 The EICP area of each of the internal standards in the blanks and samples (including duplicate matrix spikes) must be in the range of 50% to 200% of its response in the most recent opening continuing calibration verification (CCV) standard.

9.2.1.2 If internal standard area response criteria are not met, corrective action must be taken. Start with actions such as checking calculations and checking solution for degradation. Samples analyses not meeting internal standard response criteria must be reanalyzed.

9.2.1.3 The retention time (RT) shift of each internal standard in the blanks and samples (including duplicate matrix spikes) must be within ± 0.50 minutes (30 seconds) of its RT in the most recent opening CCV standard.

9.2.1.4 If internal standard RTs are not within limits, check the instrument for malfunctions. Sample analyses not meeting internal standard RT criteria must be reanalyzed.

9.3 Blanks

9.3.1 Method blank (One per 12-hour period of operation)

9.3.1.1 Prepare the method blank using reagent water for water samples or a purified solid matrix (Ottawa sand) for soil/sediment

samples, and carry through the entire analytical process for the purpose of measuring reagent and system contamination.

9.3.1.2 Analyze immediately after the opening continuing calibration verification standard and before any field samples (including duplicate matrix spikes) are analyzed. Analyze the method blank after the initial calibration if samples are analyzed during that tune batch.

9.3.1.3 Before any samples are analyzed, demonstrate that a laboratory method blank is free from contamination that would prevent the determination of any analyte of concern. Background contamination must be reduced to an acceptable level before proceeding with the next analysis.

9.3.1.4 The percent recovery of each of the DMC in the blank must meet the criteria listed in 9.1.2. The recovery for 1,4-dioxane is advisory.

9.3.1.5 The method blank must meet the internal standard acceptance criteria listed in 9.2.1.1 and 9.2.1.3.

9.3.1.6 The concentration of each target compound found in the method blank must be less than the CRQL listed in Attachment 1, except methylene chloride, acetone, and 2-butanone which must be less than 2 times their respective CRQL.

9.3.2 Storage blanks (One per matrix type)

9.3.2.1 On receipt of the first samples in an SDG, store two vials of clean reference matrix (reagent water or inert sand) at 4° C $\pm$ 2° C for water and methanol preserved soil samples.

9.3.2.2 Analyze the storage blank after all samples in a SDG have been analyzed.

Note: The storage blank indicates whether contamination may have occurred during storage of samples. The storage blank is analyzed once per SDG.

9.3.2.3 The storage blank must meet all method blank acceptance criteria.

9.3.2.4 If the storage blank does not meet the blank contamination criteria, reanalyze the storage blank to determine whether contamination occurred during analysis or during storage. If the results of the reanalysis do not meet blank contamination acceptance criteria, contamination occurred during storage. These results must be noted so that they can be discussed in the SDG narrative, along with appropriate corrective actions.

9.3.3 Instrument blanks

9.3.3.1 Analyze instrument blanks (5 mL of reagent water, spiked with internal standards and DMCs) after a sample analysis containing target compounds at concentrations that exceed the instrument's analytical range.

Note: The results from the instrument blank analysis indicate whether there is contamination from a previous sample.

9.3.3.2 The concentration of each target analyte in the instrument blank must be less than CRQL.

9.3.3.3 Do not resume sample analysis until the instrument blank meets the criteria in 9.3.3.2, along with meeting the internal standard and DMC recovery criteria.

9.3.4 Analyze all blanks on a GC/MS system meeting the BFB, initial calibration, and continuing calibration acceptance criteria.

9.4 Duplicate Matrix Spikes

9.4.1 Analyze duplicate matrix spikes on a GC/MS system meeting the BFB, initial calibration, continuing calibration, and method blank acceptance criteria.

9.4.2 Duplicate matrix spikes are required (if requested by the client) for each group of 20 field samples in a SDG or for each SDG, which ever is most frequent.

9.4.3 Duplicate matrix spikes must meet the internal standard acceptance criteria in 9.2.1.1 and 9.2.1.3.

9.4.4 The table below contains the spike recovery and relative percent difference (RPD) criteria for duplicate matrix spikes. These limits are

advisory and no further action by the laboratory is required. However, frequent recovery and RPD failures should be addressed by the laboratory.

Spike Compounds	Percent Recovery Aqueous	RPD Aqueous	Percent Recovery Soil	RPD Soil
1,1-Dichloroethene	61-145	0-14	59-172	0-22
Trichloroethene	71-120	0-14	62-137	0-24
Benzene	76-127	0-11	66-142	0-21
Toluene	76-125	0-13	59-139	0-21
Chlorobenzene	75-130	0-13	60-133	0-21

9.5 Samples

9.5.1 Analyze all samples on a GC/MS system meeting the BFB, initial calibration, continuing calibration, and method blank acceptance criteria.

9.5.2 Analyze the samples within the contractual holding time.

9.5.3 Three DMCs may fail the criteria in 9.1.2, excluding 1,4-dioxane-d_8. The recovery for 1,4-dioxane-d_8 is advisory.

9.5.4 The area responses of the internal standards must be within 50 - 200% of their respective area responses in the opening CCV.

9.5.5 The RT shift of each of the internal standards in the sample must be less than 30 seconds from the corresponding internal standard in the most recent opening CCV.

9.5.6 If target compound concentrations exceed the concentration of the same analyte(s) in the high level initial calibration standard (or because excessive matrix interference prevents accurate quantitation), re-prepare at a dilution. The diluted analysis must bring the concentration of the compound(s) exceeding the concentration(s) in the high level initial calibration standard within the upper half of the analytical range.

9.6 Contingency

9.6.1 If due to a lab accident or to QC failures, a re-preparation and analysis are required for the sample and insufficient sample volume remains, the Project Manager must be alerted and will contact the client for direction on how to proceed.

9.6.2 If persistent contamination occurs in the laboratory, analysis must be halted until the source of the contamination can be identified and isolated. When the contamination issue is resolved, samples analysis may proceed.

9.6.3 Refer to the corresponding Data Review SOP (number will vary among sections) for information on how to handle reporting of data that are unacceptable or out-of-control.

9.6.4 Any other issues that potentially effect data quality should also be addressed with the Project Manager.

10.0 Calibration and Standardization

10.1 BFB

10.1.1 A calibrant, perfluoro-tri-n-butylamine (FC-43), is first used to tune the GC/MS system.

10.1.2 Analyze the instrument performance check solution by injecting 50 ηg of BFB (2 µL Std ID# 7008) into the GC using a 10 µL Hamilton syringe.

10.1.3 Acquire BFB by averaging three scans. The scan immediately prior to the apex, the apex scan, and the scan immediately following the apex are averaged. Background subtraction is also required and must be accomplished by subtraction of a single scan no more than 20 scans prior to the elution of BFB. Do not subtract part of the BFB peak.

10.1.4 The analysis of the instrument performance check solution must meet the ion abundance criteria given in the table below.

BFB Key Ions and Ion Abundance Criteria

Key Ions	Ion Abundance Criteria
50	15.0 – 40.0% of m/z 95
75	30.0 – 80.0% of m/z 95
95	Base Peak; 100% relative abundance
96	5.0 – 9.0% of m/z 95
173	< 2.0% of m/z 174
174	50.0 – 120.0% of m/z 95
175	5.0 – 9.0% of m/z 174
176	95.0 – 101.0% of m/z 174
177	5.0 – 9.0% of m/z 176

Note: All ion abundances must be normalized to m/z 95, even though ion m/z 174 may be up to 120% of m/z 95.

10.1.5 If BFB technical acceptance criteria are not met, retune the GC/MS system. If required, clean the ion source, clean the quadrapole rods, or take other corrective action to achieve the technical acceptance criteria.

10.1.6 BFB technical acceptance criteria must be met before any standards, samples, or required blanks are analyzed.

10.2 Initial calibration

10.2.1 Prior to the analysis of samples and required blanks, and after the instrument performance check solution (BFB) criteria have been met, calibrate the GC/MS system at five concentrations (see 7.4.1.1) to demonstrate instrument sensitivity and the linearity of the GC/MS response for the purgeable target compounds.

10.2.1.1 If time remains in the 12 hour time period after meeting the technical acceptance criteria for the initial calibration, samples may be analyzed. It is not necessary to analyze an opening CCV.

10.2.1.2 A method blank is required. Quantify all blank and sample internal standard area response changes and retention time shifts, against the med-level initial calibration standard.

10.2.2 Perform an initial calibration when the continuing calibration criteria cannot be met or whenever a column is changed or an ion source cleaned.

10.2.3 Excluding those ions in the solvent front, no ion may saturate the detector.

10.2.3.1 If a compound (s) in an initial calibration standard saturates the instrument's detector, terminate analysis. Tune the instrument, making adjustments such as lowering the electron multiplier, to reduce instrument sensitivity. After tuning, analyze the BFB. Resume calibration procedure, after BFB has met acceptance criteria.

10.2.4 Tabulate the area response of the characteristic ions in the extracted ion current profile (EICP) against the concentration for each compound and internal standard. Calculate relative response factors (RRF) for each compound. Calculate the mean RRF for all compounds.

10.2.5 The RRF at each calibration concentration for each DMC and target compound must be greater than of equal to the compounds minimum RRF listed in Attachment 2.

10.2.6 The percent relative standard deviation (%RSD) for each DMC and target compound must be less than or equal to that listed in Attachment 2.

10.2.7 Up to two compounds may fail to meet minimum RRF criteria and up to two compounds may fail the maximum %RSD criteria. However, none may fail with more than 40.0% RSD and none may have an RRF less than 0.010.

10.2.7.1 The exceptions are 1,4-dioxane and 1,4-dioxane-d_8, which must have a minimum RRF of $\geq$ 0.0050 and a maximum % RSD of $\leq$ 50.0%.

10.2.8 If the initial calibration technical acceptance criteria are not met, inspect the system for problems. If required, clean the ion source, perform column maintenance, change the column, service the purge and trap device, or take other corrective action to achieve the technical acceptance criteria

10.3 Opening and Closing Continuing Calibration Verification (CCV)

10.3.1 The CCV standards are at a concentration at or near the mid point of the initial calibration.

10.3.2 A check of the calibration of the GC/MC system must be performed once every 12 hours by the injection of BFB and the opening CCV standard.

10.3.2.1 The RRF percent difference (%D) for each DMC and target compound must be less than or equal to the maximum %D listed in Attachment 2.

10.3.2.2 The RRF for each DMC and target compound must be greater than or equal to the minimum RRF listed in Attachment 2.

10.3.2.3 Up to two compounds may fail the criteria in 10.3.2.1 and 10.3.2.2, however, these compounds must meet a minimum RRF of ≥ 0.01 and a maximum %D of ± 40. The exceptions are 1,4-dioxane and 1,4-dioxane-d_8, which must have a minimum RRF of ≥ 0.005 and a maximum %D of ± 50.

10.3.3 After all the samples are analyzed, and before the end of the twelve-hour time period, the closing CCV standard must be analyzed.

10.3.3.1 The RRF %D for each target compound must be ± 50.

10.3.3.2 The RRF for each DMC and target compound must be ≥ 0.01, except for 1,4 dioxane and its DMC, which must be at least 0.0050.

10.3.3.3 If the closing CCV meets the acceptance criteria for the opening CCV, sample analysis may continue without the analysis of BFB. The twelve-hour time period begins at the injection time of the closing CCV. However, a method blank must be analyzed.

10.3.4 Opening CCV acceptance criteria must be met before any samples, including duplicate matrix spikes, or blanks are analyzed. If the acceptance criteria are not met, recalibrate the GC/MS by performing another initial calibration. This may require some corrective action first.

10.3.5 Closing CCV acceptance criteria must be meet or all samples analyzed within the twelve-time period must be reanalyzed.

11.0 Procedure

Documentation must follow the requirements in Quality Control SOP 13.6, "Proper Documentation Procedures". Record all instrument information in the GC/MS VOA Run Log (Attachment 6). **Condition Codes, abbreviations defined in Attachment 7, are used to document failed and qualified injections.**

11.1 Instrument Performance Check

11.1.1 Perform an instrument performance check by analyzing 50 ηg of BFB. The BFB is directly injected onto the GC column.

11.1.2 If BFB acceptance criteria are met, print the BFB mass spectrum, mass listing, and reconstructed ion chromatograph (RIC).

11.2 Initial Calibration Analysis

11.2.1 Prepare the five aqueous initial calibration standards (See Section 7.4) by adding calibration standard, DMC and internal standard solutions to 5 mL of reagent water in a gastight syringe. Inject syringe contents into a 40 mL VOA vial and place vial on the purge-and-trap autosampler. Purge at ambient temperature.

11.2.1.1 Medium level soil analysis is performed using the aqueous initial calibration.

11.2.2 Analyze the initial calibration standards at the concentration listed in 7.4.1.1.

11.2.3 Process and review each standard analysis using the Target3 data system insuring that each DMC and target compound is present in each standard.

11.2.4 Check that the initial calibration met acceptance criteria by reviewing the initial calibration summary form on the Target3 data system.

11.2.5 If acceptance criteria are met, print the initial calibration summary form. Also print the RIC, quantitation report, and EICP for each calibration standard used.

11.2.6 If time remains in the twelve hour period after the initial calibration has been analyzed, samples may be analyzed without the analysis of an opening CCV.

11.2.7 If no samples are analyzed, complete the GC/MS run log. (Attachment 5) "Z" out any unused portion of the run log and have a supervisor or designee to review and sign it. Make a photocopy of the run log and attach it to the hard copy data for the BFB and initial calibration.

11.3 Opening CCV

11.3.1 After the BFB and the initial calibration have met acceptance criteria, the GC/MS must be routinely checked by analyzing the opening CCV standard.

11.3.2 Process and review the CCV using Target3 processing software insuring that each target compound is present in the analysis

11.3.3 Check that the CCV met acceptance criteria, by reviewing the continuing calibration summary form on the Target3 data system.

11.3.4 If opening CCV acceptance criteria are met print the continuing calibration summary form, RIC, quantitation report, and EICP.

11.4 Method Blank Analysis

11.4.1 Analyze a method blank after BFB, initial calibration, and opening CCV acceptance criteria are met and before any samples are analyzed.

11.4.2 Prepare an aqueous method blank by adding DMC and internal standard solutions to 5 mL of reagent water in a gastight syringe. The blank is injected into a 40 mL vial and placed in the autosampler for analysis.

11.4.3 Prepare the medium level blank by weighing 5 g of inert sand into a 40 mL vial. Add 5 mL of methanol to the vial and cap. Shake the vial for 2 minutes. Allow contents to settle. Transfer approximately 1 mL of the extract, with a disposable pipette, to a GC vial (2 mL vial). Store the extract at 4° C (± 2° C).

11.4.3.1 Prepare a medium level soil method blank by adding 100 µL of the blank extract to 5 mL of reagent water in a gastight syringe, then adding DMC and internal standard solutions. The blank is injected into a 40 mL vial and placed in the autosampler for analysis.

11.4.4 Process and review the method blank. After the method blank meets acceptance criteria, analyze samples.

11.5 Instrument Blank Analysis

11.5.1 Prepare an instrument blanks in the same manner as aqueous method blanks.

11.5.2 Analyze instrument blanks after samples containing target analytes that exceed the initial calibration range.

11.5.3 Process and review the instrument blank. Resume sample analysis when no target compound detected is greater than CRQL.

11.6 Storage Blank Analysis

11.6.1 Analyze storage blanks after all sample in the SDG have been analyzed.

11.6.2 Prepare storage blanks in the same manner as the aqueous method blank for aqueous samples and preserved soil samples stored at 4°C (± 2° C). For soil samples stored at less than -7° C, prepare a storage blank consisting of blank sand.

11.7 Sample Preparation and Analysis

11.7.1 Aqueous samples are provided with zero headspace to the laboratory in 40 mL screw-cap vials with Teflon®-lined, silicon septa. Store samples in a GC/MS laboratory refrigerator. Allow samples to equilibrate to ambient temperature before analysis.

11.7.1.1 Prepare an aqueous sample for analysis by pouring the sample into a 5 mL gastight syringe, replace the plunger, adjust the volume to 5.0 mL and add **an aliquot of the** DMC solution. **The internal standard solution is added by the Archon autosampler after the sample, containing DMCs is transferred to a closed-system, purge and trap vial.**

11.7.1.2 If there is only one VOA vial, fill a second syringe to preserve sample integrity should a reanalysis be required. The reanalysis must occur within 24 hours.

11.7.1.3 Take the pH of each water sample. After the sample aliquot is taken, add a couple of drops to pH paper. Do not add pH paper to sample vials. Record the pH of each sample on the batch sheet and GC/MS run log. No pH adjustment is to be performed.

11.7.2 Soil samples for medium-level analysis may be received in 1) closed-system purge and trap containers or 40 mL vials pre-preserved in methanol or 2) in core sampler/storage containers (Encore™ or equivalent).

11.7.2.1 Store samples, received pre-preserved in methanol, at 4° C until analysis. Prepare the sample for analysis by adding a 100 µL (undiluted extract volume) aliquot of the methanol extract to 5 mL of reagent water in a gas tight syringe. Add internal standard and DMC solutions to the syringe. Inject the sample into a 40 mL vial and place it on the autosampler.

11.7.2.2 Transfer samples received in Encore™ samplers, upon receipt, to 40 mL vials and store at ≤ -7° C until extraction. Just prior to extraction, allow the sample to equilibrate to ambient temperature. Remove cap, quickly add 5 mL of methanol and replace cap. Shake the sample vial for 2 minutes. Allow the contents to settle. Using a disposable pipette, transfer approximately 1 mL of the extract to a GC vial (2 mL vial) for storage. Discard the remainder. Store the extract at 4° C (± 2° C) until analysis. Prepare the sample for analysis as in 11.7.2.1.

11.7.2.3 To perform a diluted analysis of the sample, use a smaller aliquot of the extract. However, the total volume of methanol must equal 100 µL.

11.7.3 For duplicate matrix spikes, matrix spiking solution is added, along with the DMC and internal standard solutions, to each sample aliquot prior to analysis.

11.7.3.1 To prepare aqueous MS/MSD samples, add 10 uL of the Matrix Spiking Solution to separate 5-mL aliquots of the sample selected, or designated, for spiking.

11.7.3.2 To prepare medium-level soil MS/MSD samples, add 4.5 mL of methanol and 500 uL of Matrix Spiking Solution to separate aliquots of the sample selected, or designated, for spiking.

Note: In those situations where methanol has been added in the field as a preservative, no additional methanol should be added. If this occurs, 10 uL of the Matrix Spiking Solution stock (2500 ug/mL) should be added to the separate aliquots of the sample selected, or designated, for spiking.

11.8 Purge and Trap Analysis

Recommended purge and trap analysis conditions.

11.8.1 After sample preparation, the purge vessel is loaded onto the closed-system autosampler that is interfaced with the purge and trap apparatus.

11.8.2 Purge at ambient temperature for 11.0 (± 0.1) minutes.

11.8.3 After purging, heat to 180° C and back-flush contents onto the GC column with helium at 15 mL/min for 4.0 (± 0.1) minutes (desorb).

11.8.4 After desorbing, recondition the trap by baking at 180° C for at least 7 minutes. After the trap has finished baking and is cool, it is ready for the next sample to be purged.

11.9. GC/MS Analysis

11.9.1.1 HP/ Agilent GC conditions listed below:

- **Column:** **30m**
- **Carrier Gas:** **Helium**
- **GC mode:** **Capillary**
- **Injection Port Temperature:** **230°C**
- **Interface Temperature:** **230°C**
- **Initial Temperature:** **40° C**
- **Final Temperature:** **225° C**
- **Flow Rate:** **35ml/minute**

The listed column flow rate is approximate. The flow rate is adjusted to optimize the linear velocity of an un-retained compound (butane) through the column. The optimum linear velocity for a SPB-624 column is 30 - 45 cm/second.

11.9.1.2 Temperature Program

These temperature program conditions are provided as an example and may vary.

- **HP/Agilent:** **40° C for 4.50 minute**
- **Ramp:** **40° C - 100° C @ 20° C/minute**
- **Ramp:** **100° C - 150° C @ 25° C/minute**
- **Ramp:** **150° C - 225° C @ 33° C/minute**

11.9.1.3 Once an initial hold time has been chosen and the GC conditions optimized, those same GC condition must be used for analysis.

11.9.2 The following are the required MS analytical conditions:

Parameter	
Electron Energy	70 Volts (nominal)
Mass Range	35 - 300 amu
Ionization Mode	Electron Ionization (EI)
Scan Time	At least 5 scans per peak, not to exceed 2 seconds per scan for capillary column

11.10 Sample Dilutions

11.10.1 Perform a dilution if a sample concentration exceeds the concentration of the high level standard or because of excessive matrix interference. Determine a level of dilution that will result in a value within the upper half of the calibration range and/or to keep baseline height of the earliest eluting peak from exceeding one-half the relative height of the highest peak in the chromatogram.

11.10.2 Analyze the sample and dilutions within the required holding time.

11.10.3 Contact the client if more than one sample dilution (and the original analysis) is necessary to have all target analytes within the calibration range.

11.10.4 A 10x dilution is performed using 1 mL sample plus 9 mL diluent for a total volume of 10 mL. Record all dilutions on the run log.

11.11 Sample Quantitation

11.11.1 Process each sample.

11.11.2 Check that each sample meets internal standard response and RT criteria.

11.11.3 Check that each sample meets DMC recovery criteria.

11.11.4 Check that all target compound concentrations are within analytical range.

11.12. Closing CCV

11.12.1 Analyze the closing CCV after all samples have been analyzed and before the end of the twelve hour period.

11.12.3 Process and review the closing CCV using Target3 processing software insuring that each target compound is present.

11.12.4 Check that the CCV meets acceptance criteria, by reviewing the continuing calibration summary form on the Target3 data system.

11.12.5 If the closing CCV meets the opening CCV criteria, continue sample analyses for 12 hours, without performing another instrument performance check (BFB) analysis.

11.12.6 If the closing CCV acceptance criteria are met, print the continuing calibration summary form, RIC, quantitation report and EICP.

11.12.7 Complete the GC/MS run log. "Z" out any unused portion of the run log and have a supervisor or designee review and sign it. Make a photocopy of the run log and attach it to the hard copy data for the BFB and initial or continuing calibration.

11.13 Qualitative Identification of Target Compounds

11.13.1 Compare and identify the mass spectra of the compounds listed in Attachment 1 to those of the mass spectra of the standard. Verify the identifications with the following two criteria:

11.13.1.1 Elution of the compound in the sample at the same RRT as the compound in the standard.

11.13.1.1.1 The RRT of the compound in the sample must compare within ± 0.06 RRT units of the compound in the reference standard. Analyze the reference standard within the same twelve-hour time period as the sample.

11.13.1.2 Mass spectrum compound correspondence in the sample with the mass spectrum of the compound in the standard.

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11.13.1.2.1 Obtain the mass spectra used for comparison from the laboratory's GC/MS that has met the acceptance criteria for BFB.

11.13.2 The guidelines for qualitative verification by comparison of mass spectrum are as follows:

11.13.2.1 All ions in the standard mass spectrum at a relative intensity of greater than 10% must be in the sample spectrum.

11.13.2.2 All ions present in the standard mass spectrum at intensities greater than 10% must agree within ± 20% of the relative intensities of the corresponding ions in the sample mass spectrum.

11.13.2.3 Ions greater than 10% on the sample spectrum, but not present, in the standard spectrum must be considered and accounted for when making the comparison. The verification process should favor false positives.

11.13.3 Report all compounds meeting the identification criteria with their spectra.

11.13.4 If a compound cannot be verified by all of the spectral identification criteria listed in section 11.13.2, but in the technical judgment of the mass spectra interpretation specialist, the identification is correct, then report the compound.

11.14 Qualitative Identification of Non-Target Compounds

11.14.1 A library search of the sample using the NIST mass spectral library (see section 6.6.3) is performed to tentatively identify non-target compounds.

11.14.2 Tentatively identify all organic compounds that have not been identified as target, internal standard or DMC compounds are by performing a forward search of the mass spectral library.

11.14.3 Report up to 30 non-alkane Tentatively Identified Compounds (TICs) of greatest concentration on Form I VOA-TIC. Do not report or count carbon dioxide, compounds with response less than 10% (based on the height of the nearest internal standard), or semivolatile TCL analytes as part of the 30.

11.14.4 Report compounds tentatively identified as straight chain, branched, or cyclic alkanes, and are alone or part of an alkane series, as "total alkanes" on the Form I VOA-TIC. Sum the concentration of each alkane and report as a single result for the "total alkanes".

11.14.5 Rules for making tentative identification:

11.14.5.1 Report as presented those TICs whose library search match is 85% or greater. If the mass spectral interpretation specialist feels there is **just evidence** not to report the compound as identified, an alternate identification is reported. An explanation as to why an alternate identification was reported must be included in the SDG narrative.

11.14.5.2 Report the compound with the highest match (e.g., positional isomers), if the library search produces more than one match at 85% or higher. If more than one compound has the same percent match, report the first compound. If in either case, the mass spectral interpretation specialist feels there is just evidence not to report the match, an alternate identification may be reported.

11.14.5.3 If the library search produces no matches above 85%, the mass spectral interpretation specialist is encouraged to make a valid tentative identification of the compound. Report the compound as unknown if a valid, tentative identification cannot be made. Give additional classification of the unknown, if possible (e.g., unknown aromatic compound).

11.15 Sample Quantitation

11.15.1 The concentration of each target and non-target compound is calculated using the equations in Section 12.0. Concentrations are based on the dry weight of the sample, for medium level solids. Percent moisture is determined using SOP 2.8.1 "Undecanted Percent Moisture Determination in Soil/Sediment/Sludge by CLP and SW-846".

12.0 Data Analysis and Calculations

Calculations must be consistent with the Quality Control SOP 13.4, "Numerical Data Reduction".

12.1 Calculation of the mean or average of a set of values:

$$\overline{X} = \frac{\sum_{i=1}^{n} X_i}{n}$$

where:

n = total number of values
x_i = each individual value used to calculate the mean
x = the mean of n

12.2 Calculation of the standard deviation of a set of values:

$$\text{Standard deviation} = \sqrt{\frac{\sum_{i=1}^{n}\left(X_n - \overline{X}\right)^2}{n-1}}$$

12.3 Calculation of percent recovery:

12.3.1 Surrogates:

$$\%R = \frac{Amount\ found}{Amount\ spiked}\ x\ 100$$

12.3.2 Matrix spikes:

$$\%\,R = \frac{Amount\ in\ spiked\ sample - Amount\ in\ unspiked\ (native)\ sample}{Amount\ spiked}\ x\ 100$$

12.4 Calculation of % RSD

$$\%RSD = \left(\frac{\text{Standard deviation}}{\overline{X}}\right) \times 100$$

12.5 Calculation of RPD

$$RPD = \frac{|Value\ 1 - Value\ 2|}{(Value\ 1 + Value\ 2)/2} x100$$

12.6 Calculation of %Difference (%D)

$$\%Diff = \frac{Value - \overline{Reference\ \ value}}{\overline{Reference\ \ value}} x\ 100$$

12.7 Calculation of Relative Response Factor (RRF)

$$RRF = \frac{Ax}{Ais} x \frac{Cis}{Cx}$$

Where:

Ax = area of the characteristic ion from the EICP for the compound to be measured
Ais = area of the characteristic ion for the EICP for the internal standard
Cis = concentration of the internal standard
Cx = concentration of the compound to be measured

12.8 Concentration of aqueous samples by GC/MS analysis

$$\mu g / L = \frac{(Ax)(Is)(Df)}{(Ais)(\overline{RRF})(Vo)}$$

where:

Ax = area of the characteristic ion from the EICP for the compound to be measured
Ais = area of the characteristic ion for the EICP for the internal standard
Is = amount of internal standard injected (ηg)
$\overline{RRF}$ = mean relative response factor from the ambient temperature purge of the calibration standard
Vo = volume of water purged (mL)
Df = dilution factor. If no dilution, Df = 1.0

12.9 Concentration of medium level soil samples (dry weight basis) by GC/MS

$$\mu g / Kg = \frac{(Ax)(Is)(AVt)(1000)(Df)}{(Ais)(\overline{RRF})(Va)(Ws)(D)}$$

where:

Ax, Ais, and Is are the same as given for water
$\overline{RRF}$ = Mean relative response factor from the ambient temperature purge of the calibration standard
AVt = Adjusted total volume of the methanol extract plus soil water in mL, where methanol extract volume (Vt) is typically 10 mL although only one mL is transferred to the vial.

$$AVt = Vt + \{Ws - [Ws\ (D)\ ]\ \}$$

Va = Volume of the aliquot of the sample methanol extract, i.e., sample extract, not including the methanol added to equal 100 µL added to DI water.

Ws = Weight of soil/sediment sample extracted, in grams

D = Dry weight

$$\frac{100 - \%\ moisture}{100}$$

Df = Dilution factor. The dilution factor for analysis of soil/sediment samples for volatiles by medium level method is as follows.

$$Df = \frac{\mu L\ most\ conc.\ extract\ used\ to\ make\ dilution + \mu L\ clean\ solvent}{\mu L\ most\ conc.\ extract\ used\ to\ make\ dilution}$$

12.10 TICs are quantified by comparing the MS response from the RIC for the non-target compound peaks to the MS response for a peak produced by the nearest internal standard compound. A response factor of 1 is assumed.

12.10.1 Concentration of TICs in aqueous samples

$$TIC\ \ amount\ = \frac{A(tic)\ x\ Amt\ (std)(Df)}{A(IS)\ x\ (Vo)}$$

where:

Df and Vo are defined in 12.8

A(tic) = area response from RIC for non-target compound

Amt(std) = amount of internal standard added to the sample

A(I.S.) = area response of the nearest internal standard

12.10.2 Concentration of TICs in medium level soil samples

$$TIC\ \ amount\ = \frac{A(tic)\ x\ Amt\ (std)(Df)(Vt)\ \text{x}\ 1000}{A(IS)\ x\ 1\ \text{x}\ (Va)(Ws)\ \text{x}\ D}$$

where:

Df, Vt, Va, Ws and D are defined in 12.9

A(tic) = area response from RIC for non-target compound

Amt(std) = amount of internal standard added to the sample
A(I.S.) = area response of the nearest internal standard

13.0 Method Performance

This method was validated through in-house laboratory studies of method detection limits and precision and accuracy for single analyst. The data is retained by the QA department.

14.0 Pollution Prevention

The solvents used in this procedure pose little threat to the environment when recycled and managed properly. Pollution prevention encompasses any technique that reduces or eliminates the quantity or toxicity of waste at the point of generation. Numerous opportunities for pollution prevention exist in laboratory operation. The EPA has established a preferred hierarchy of environmental management techniques that places pollution prevention as the management option of first choice. Whenever feasible, laboratory personnel should use pollution prevention techniques to address their waste generation. When wastes cannot be feasibly reduced at the source, the Agency recommends recycling as the next best thing. See SOP 12.1, Hazardous Waste Disposal, regarding laboratory procedures for recycling solvent waste streams.

15.0 Waste Management

It is the laboratory's responsibility to comply with all federal, state, and local regulations governing waste management, particularly the hazardous waste identification rules and land disposal restrictions, and to protect the air, water, and land by minimizing and controlling all releases from fume hoods and bench operations. Compliance with all sewage discharge permits and regulations is also required.

Samples preserved with HCl are hazardous and must be handled as hazardous waste.

Refer to the Hazardous Waste Management and Safety SOPs located in the lab.

16.0 References

16.1 U.S. EPA CLP SOW for Organic Analysis, Multi-Media, Multi-Concentration, SOM01.2 (8/2007)

16.2 "Test Methods for Evaluating Solid Wastes: Physical/Chemical Methods", SW-846, 3rd Edition, Update III, 12/96

16.3 Methods for Chemical Analysis of Water and Wastes, March 1983

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16.4 Standard Methods for the Examination of Water and Wastewater, 20th (1998) Edition, Method 1080

16.5 Code of Federal Register, 40 CFR, Part 136, "Guidelines for Establishing Test Procedures for Priority Pollutants"

16.6 Quality Control SOP 13.6 "Proper Documentation Procedures"

16.7 Quality Control SOP 13.4 "Numerical Data Reduction"

16.8 NELAC Standards, **effective July 2003**, plus revisions

16.9 QA-G6: Guidance for Preparing Standard Operating Procedures (SOPs) EPA/600/B-07/001, April 2007.

16.10 CompuChem Quality Manual, **Revision 11, June 23, 2008**, plus revisions

17.0 Attachments as Tables, Diagrams and Flowcharts

17.1 Attachment 1 – Target Compound List (TCL) and CRQLs

17.2 Attachment 2 – Relative Response Factor Criteria for Initial and Continuing Calibration Verification of Volatile Organic Compounds

17.3 Attachment 3 – Characteristic Ions for Trace Volatile Target Compounds

17.4 Attachment 4 – Target Compounds and DMCs with Corresponding Internal Standards for Quantitation

17.5 Attachment 5 – DMCs and the Associated Target Compounds

17.6 Attachment 6 – GC/MS Volatile Run Log Example

17.7 Attachment 7 - Condition Codes

Attachment 1

Volatiles Target Compound List (TCL) and
Contract Required Quantitation Limits (CQRLs)

Target Compound	Low Water µg/L	Medium Soil µg/Kg
Dichlorodifluoromethane	5.0	250
Chloromethane	5.0	250
Vinyl chloride	5.0	250
Bromomethane	5.0	250
Chloroethane	5.0	250
Trichlorofluoromethane	5.0	250
1,1-Dichloroethene	5.0	250
1,1,2-Trichloro-1,2,2-trifluoroethane	5.0	250
Acetone	10	500
Carbon disulfide	5.0	250
Methyl acetate	5.0	250
Methylene chloride	5.0	250
trans-1,2-Dichloroethene	5.0	250
Methyl tert-butyl ether	5.0	250
1,1-Dichloroethane	5.0	250
cis-1,2-Dichloroethene	5.0	250
2-Butanone	10	500
Bromochloromethane	5.0	250
Chloroform	5.0	250
1,1,1-Trichloroethane	5.0	250
Cyclohexane	5.0	250
Carbon tetrachloride	5.0	250
Benzene	5.0	250
1,2-Dichloroethane	5.0	250
1,4-Dioxane	100	5000
Trichloroethene	5.0	250
Methylcyclohexane	5.0	250
1,2-Dichloropropane	5.0	250
Bromodichloromethane	5.0	250
cis-1,3-Dichloropropene	5.0	250
4-Methyl-2-pentanone	10	500
Toluene	5.0	250

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Attachment 1 (Continued)

Volatiles Target Compound List (TCL) and
Contract Required Quantitation Limits (CQRLs)

Target Compound	Low Water µg/L	Medium Soil µg/Kg
trans-1,3-Dichloropropene	5.0	250
1,1,2-Trichloroethane	5.0	250
Tetrachloroethene	5.0	250
2-Hexanone	10	500
Dibromochloromethane	5.0	500
1,2-Dibromoethane	5.0	250
Chlorobenzene	5.0	250
Ethylbenzene	5.0	250
o-Xylene	5.0	250
m-, p-Xylene	5.0	250
Styrene	5.0	250
Bromoform	5.0	250
Isopropylbenzene	5.0	250
1,1,2,2-Tetrachloroethane	5.0	250
1,3-Dichlorobenzene	5.0	250
1,4-Dichlorobenzene	5.0	250
1,2-Dichlorobenzene	5.0	250
1,2-Dibromo-3-chloropropane	5.0	250
1,2,4-Trichlorobenzene	5.0	250
1,2,3-Trichlorobenzene	5.0	250

Attachment 2

Technical Acceptance Criteria for Initial and Opening Continuing Calibration Verification for Trace Volatile Organic Compounds

Volatile Compounds	Minimum RRF	Maximum % RSD[1]	Maximum % Diff[1]
Dichlorodifluoromethane	0.010	40.0	± 40.0
Chloromethane	0.010	40.0	± 40.0
Vinyl chloride	0.100	20.0	± 25.0
Bromomethane	0.100	20.0	± 25.0
Chloroethane	0.010	40.0	± 40.0
Trichlorofluoromethane	0.010	40.0	± 40.0
1,1-Dichloroethene	0.100	20.0	± 25.0
1,1,2-Trichloro-1,2,2-trifluoroethane	0.010	40.0	± 40.0
Acetone	0.010	40.0	± 40.0
Carbon disulfide	0.010	40.0	± 40.0
Methyl acetate	0.010	40.0	± 40.0
Methylene chloride	0.010	40.0	± 40.0
trans-1,2-Dichloroethene	0.010	40.0	± 40.0
Methyl tert-butyl ether	0.010	40.0	± 40.0
1,1-Dichloroethane	0.200	20.0	± 25.0
cis-1,2-Dichloroethene	0.010	40.0	± 40.0
2-Butanone	0.010	40.0	± 40.0
Bromochloromethane	0.050	20.0	± 25.0
Chloroform	0.200	20.0	± 25.0
1,1,1-Trichloroethane	0.100	20.0	± 25.0
Cyclohexane	0.010	40.0	± 40.0
Carbon tetrachloride	0.100	20.0	± 25.0
Benzene	0.400	20.0	± 25.0
1,2-Dichloroethane	0.100	20.0	± 25.0
1,4-Dioxane	0.0050	50.0	± 50.0
Trichloroethene	0.300	20.0	± 25.0
Methylcyclohexane	0.010	40.0	± 40.0

[1]For a closing CCV, all target compounds and DMCs must meet a minimum RRF of 0.010 and a maximum percent difference of ± 50.0 , except for 1,4-dioxane and 1,4-dioxane-d_8, which must meet a minimum RRF of 0.0050 and a maximum percent difference of ± 50.0.

Attachment 2 (Continued)

Technical Acceptance Criteria for Initial and Opening Continuing Calibration Verification for Trace Volatile Organic Compounds

Volatile Compounds	Minimum RRF	Maximum % RSD[1]	Maximum % Diff[1]
1,2-Dichloropropane	0.010	40.0	± 40.0
Bromodichloromethane	0.200	20.0	± 25.0
cis-1,3-Dichloropropene	0.200	20.0	± 25.0
4-Methyl-2-pentanone	0.010	40.0	± 40.0
Toluene	0.400	20.0	± 25.0
trans-1,3-Dichloropropene	0.100	20.0	± 25.0
1,1,2-Trichloroethane	0.100	20.0	± 25.0
Tetrachloroethene	0.100	20.0	± 25.0
2-Hexanone	0.010	40.0	± 40.0
Dibromochloromethane	0.100	20.0	± 25.0
1,2-Dibromoethane	0.010	40.0	± 40.0
Chlorobenzene	0.500	20.0	± 25.0
Ethylbenzene	0.100	20.0	± 25.0
o-, m-, and p-xylene	0.300	20.0	± 25.0
Styrene	0.300	20.0	± 25.0
Bromoform	0.050	20.0	± 25.0
Isopropylbenzene	0.010	40.0	± 40.0
1,1,2,2-Tetrachloroethane	0.300	20.0	± 25.0
1,3-Dichlorobenzene	0.600	20.0	± 25.0
1,4-Dichlorobenzene	0.500	20.0	± 25.0
1,2-Dichlorobenzene	0.400	20.0	± 25.0
1,2-Dibromo-3-chloropropane	0.010	40.0	± 40.0
1,2,4-Trichlorobenzene	0.200	20.0	± 25.0
1,2,3-Trichlorobenzene	0.200	20.0	± 25.0

[1]For a closing CCV, all target compounds and DMCs must meet a minimum RRF of 0.010 and a maximum percent difference of ± 50.0 , except for 1,4-dioxane and 1,4-dioxane-d_8, which must meet a minimum RRF of 0.0050 and a maximum percent difference of ± 50.0.

Attachment 2 (Continued)

Technical Acceptance Criteria for Initial and Opening Continuing Calibration Verification for Trace Volatile Organic Compounds

Deuterated Monitoring Compounds	Minimum RRF	Maximum % RSD[1]	Maximum % Diff[1]
Vinyl chloride-d_3	0.010	20.0	± 25.0
Chloroethane-d_5	0.010	40.0	± 40.0
1,1-Dichloroethene-d_2	0.010	20.0	± 25.0
2-Butanone-d_5	0.010	40.0	± 40.0
Chloroform-d	0.010	20.0	± 25.0
1,2-Dichloroethane-d_4	0.010	20.0	± 25.0
Benzene-d_6	0.010	20.0	± 25.0
1,2-Dichloropropane-d_6	0.010	40.0	± 40.0
Toluene-d_8	0.010	20.0	± 25.0
trans-1,3-Dichloropropene-d_4	0.010	20.0	± 25.0
2-Hexanone-d_5	0.010	40.0	± 40.0
1,4-Dioxane-d_8	0.0050	50.0	± 50.0
1,1,2,2-Tetrachloroethane-d_2	0.010	20.0	± 25.0
1,2-Dichlorobenzene-d_4	0.010	20.0	± 25.0

[1]For a closing CCV, all target compounds and DMCs must meet a minimum RRF of 0.010 and a maximum percent difference of ± 50.0 , except for 1,4-dioxane and 1,4-dioxane-d_8, which must meet a minimum RRF of 0.0050 and a maximum percent difference of ± 50.0.

Attachment 3

Target Compounds and Deuterated Monitioring Compounds Quantitation and Secondary Ions

Target Compound	Quantitation Ion	Secondary Ion(s)
Dichlorodifluoromethane	85	87
Chloromethane	50	52
Vinyl chloride	62	64
Bromomethane	94	96
Chloroethane	64	66
Trichlorofluoromethane	101	103
1,1-Dichloroethene	96	61, 63
1,1,2-Trichloro-1,2,2-trifluoroethane	101	85, 151
Acetone	43	58
Carbon disulfide	76	78
Methyl acetate	43	74
Methylene chloride	84	49, 86
trans-1,2-Dichloroethene	96	61, 98
Methyl tert-butyl ether	73	43, 57
1,1-Dichloroethane	63	65, 83
cis-1,2-Dichloroethene	96	61, 98
2-Butanone	43*	72
Chloroform	83	85
Bromochloromethane	128	49, 130, 51
1,1,1-Trichloroethane	97	99, 61
Cyclohexane	56	69, 84
Carbon tetrachloride	117	119
Benzene	78	-
1,2-Dichloroethane	62	98
1,4-Dioxane	88	43, 58
Trichloroethene	95	97, 132, 130
Methylcyclohexane	83	55, 98
1,2-Dichloropropane	63	112
Bromodichloromethane	83	85, 127
cis-1,3-Dichloropropene	75	77
4-Methyl-2-pentanone	43	58, 100
Toluene	91	92
trans-1,3-Dichloropropene	75	77
1,1,2-Trichloroethane	97	83, 85, 99, 132, 134
Tetrachloroethene	164	129, 131, 166
2-Hexanone	43	58, 57, 100
Dibromochloromethane	129	127

* m/z 43 is used for quantitation of 2-Butanone, but m/z 72 must be present for positive identification

Attachment 3 (Continued)

Target Compounds and Deuterated Monitioring Compounds Quantitation and Secondary Ions

Target Compound	Quantitation Ion	Secondary Ion(s)
1,2-Dibromoethane	107	109, 188
Chlorobenzene	112	77, 114
Ethylbenzene	91	106
o-, m-, p-xylene	106	91
Styrene	104	78
Bromoform	173	175, 254
Isopropylbenzene	105	120, 77
1,1,2,2-Tetrachloroethane	83	85, 131
1,3-Dichlorobenzene	146	111, 148
1,4-Dichlorobenzene	146	111, 148
1,2-Dichlorobenzene	146	111, 148
1,2-Dibromo-3-chloropropane	75	157, 155
1,2,4-Trichlorobenzene	180	182, 145
1,2,3-Trichlorobenzene	180	182, 145
Deuterated Monitoring Compounds	**Quantitation Ion**	**Secondary Ion(s)**
Vinyl chloride-d_3	65	67
Chloroethane-d_5	69	71, 51
1,1-Dichloroethene-d_2	63	98, 65
2-Butanone-d_5	46	77
Chloroform-d	84	86, 47, 49
1,2-Dichloroethane-d_4	65	67, 51
Benzene-d_6	84	82, 54, 52
1,2-Dichloropropane-d_6	67	65, 46, 42
Toluene-d_8	98	100, 42
trans-1,3-Dichloropropene-d_4	79	81, 42
2-Hexanone-d_5	63	46
1,4-Dioxane-d_8	96	51, 66
1,1,2,2-Tetrachloroethane-d_2	84	86
1,2-Dichlorobenzene-d_5	152	150
Internal Standards	**Quantitation Ion**	**Secondary Ion(s)**
1,4-Dichlorobenzene-d_4	152	115, 150
1,4-Difluorobenzene	114	63, 88
Chlorobenzene-d_5	117	82, 119

Attachment 4

Target Compounds and Deuterated Monitioring Compounds (DMCs) with Corresponding Internal Standards for Quantitation

1,4-Difluorobenzene (IS)	**Chlorobenzene-d_5 (IS)**	**1,4-Dichlorobenzene-d_4 (IS)**
Dichlorodifluoromethane	1,1,1-Trichloroethane	Bromoform
Chloromethane	Cyclohexane	1,3-Dichlorobenzene
Vinyl Chloride	Carbon Tetrachloride	1,4-Dichlorobenzene
Bromomethane	Benzene	1,2-Dichlorobenzene
Chloroethane	Trichloroethene	1,2-Dibromo-3-chloropropane
Trichlorofluoromethane	Methylcyclohexane	1,2,4-Trichlorobenzene
1,1-Dichloroethene	1,2-Dichloropropane	1,2,3-Trichlorobenzene
1,1,2-Trichloro-1,2,2-trifluoroethane	Bromodichloromethane	1,2-Dichlorobenzene-d_4 (DMC)
Acetone	cis-1,3-Dichloropropene	
Carbon Disulfide	4-Methyl-2-pentanone	
Methyl Acetate	Toluene	
Bromochloromethane	trans-1,3-Dichloropropene	
Methylene Chloride	1,1,2-Trichloroethane	
trans-1,2-Dichloroethene	Tetrachloroethene	
Methyl tert-Butyl Ether	2-Hexanone	
1,1-Dichloroethane	Dibromochloromethane	
cis-1,2-Dichloroethene	1,2-Dibromoethane	
2-Butanone	Chlorobenzene	
Chloroform	Ethylbenzene	
1,2-Dichloroethane	m- and p- Xylenes	
1,4-Dioxane	o-Xylene	
Vinyl chloride-d_3 (DMC)	Styrene	
Chloroethane-d_2 (DMC)	Isopropylbenzene	
1,1-Dichloroethene-d_2 (DMC)	1,1,2,2-Tetrachloroethane	
2-Butanone-d_5 (DMC)	Benzene-d_6 (DMC)	
Chloroform-d	1,2-Dichloropropane-d_6 (DMC)	
1,2-Dichloroethane-d_4 (DMC)	trans-1,3-Dichloropropene-d_4 (DMC)	
1,4-Dioxane-d_8 (DMC)	Toluene-d_8 (DMC)	
	2-Hexanone-d_5 (DMC)	
	1,1,2,2-Tetrachloroethane-d_2 (DMC)	

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Attachment 5
Deuterated Monitoring Compounds and the Associated Target Compounds

Chloroethane-d_5 (DMC)	**1,2-Dichloropropane-d_6 (DMC)**	**1,2-Dichlorobenzene-d_4 (DMC)**
Dichlorodifluoromethane	Cyclohexane	Chlorobenzene
Chloromethane	Methylcyclohexane	1,3-Dichlorobenzene
Bromomethane	1,2-Dichloropropane	1,4-Dichlorobenzene
Chloroethane	Bromodichloromethane	1,2-Dichlorobenzene
Carbon disulfide		1,2,4-Trichlorobenzene
		1,2,3-Trichlorobenzene
1, 4-Dioxane-d_8 (DMC)	**trans-1, 3-Dichloropropene-d_4 (DMC)**	**Chloroform-d (DMC)**
1,4-Dioxane	cis-1,3-Dichloropropene	1,1-Dichloroethane
	trans-1,3-Dichloropropene	Bromochloromethane
	1,1,2-Trichloroethane	Chloroform
		Dibromochloromethane
		Bromoform
2-Butanone-d_8 (DMC)	**1, 1-Dichloroethene-d_2 (DMC)**	**2-Hexanone-d_5 (DMC)**
Acetone	trans-1,2-Dichloroethene	4-Methyl-2-pentanone
2-Butanone	cis-1,3-Dichloroethene	2-Hexanone
	1,1-Dichloroethene	
Vinyl Chloride-d_3 (DMC)	**Benzene-d_6 (DMC)**	**1,1,2,2-Tetrachloroethane-d_2**
Vinyl chloride	Benzene	1,1,2,2-Tetrachloroethane
		1,2-Dibromo-3-chloropropane
1,2-Dichloroethane-d_4 (DMC)		**Toluene-d_8 (DMC)**
		Trichloroethene
Trichlorofluoromethane		Toluene
1,1,2-Trichloro-1,2,2-trifluoroethane		Tetrachloroethene
Methyl acetate		Ethylbenzene
Methylene chloride		o-Xylene
Methyl-tert-butyl ether		m, p-Xylene
1,1,1-Trichloroethane		Styrene
Carbon tetrachloride		Isopropylbenzene
1,2-Dibromoethane		
1,2-Dichloroethane		

Attachment 6

COMPUCHEM a Division of Liberty Analytical Corp DATE ___/___/___ INITIAL TIME OF TUNE_____ SHIFT/S(A)_____(B)_____(C)_____
GC/MS VOLATILE RUN LOG TIME TUNE EXPIRES_____ LINKER /METHOD_____
COMPUCHEM LOGBOOK 11 WWW 2? (5972hp71)

PREVENTIVE MAINTENANCE

		FILE NAME		pH	Vial	DATE	TIME	Client ID	SDG#	INJ. VOL.*	DF+	CHEMIST	COMMENTS(ETC.)/ DISPOSITION
1						/ /							
2						/ /							
3						/ /							
4						/ /							
5						/ /							
6						/ /							
7						/ /							
8						/ /							
9						/ /							
10						/ /							
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22						/ /							
23						/ /							
24						/ /							

*On-column sample aliquot +Not applicable to soil matrix

The presence of the Chemist's/Analyst's employee ID number, or signature, on this run log attests that strict compliance with the method's SOP has occurred. Any SOP deviations require documentation by the responsible chemist/analyst together with the chemist's/analyst's initials and the initials of the lab supervisor and a QA department representative, signifying approval of the deviation.

Tune (ID #7008) Lot #: _____ Calibration Group Code / Lot #: _____

Reviewed by: _____ Date_____
10/17/08: jr

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Attachment 7

Condition Codes Used for Documentation in Logbooks

Condition Code	Definition
CS	Contamination Suspected
CT	Contamination Verified
DA	Dilution Acceptable
DI	Requires Dilution
DW	Dilution Wrong
ES	Extraction Same
EF2JS	Ending Standard Failed Second Tune Injection Same
JS	Injection Same
IH	Internals High
IL	Internals Low
IM	Internals Missing
LA	Lab Accident (Must Explain)
OT	Other (Must Explain)
OQ	Original Run Qualified
OW	Original Wrong for QC Sample
RP	Reportable Prior Run
RT	Retention Time Shift
RU	Run Unnecessarily
SF	Spike Recoveries Failed
SH	Surrogate Recoveries Failed High
SI	Spiked Inadvertently
SL	Surrogate Recoveries Failed Low
SM	Surrogate or Spike Missing
IF	Instrument Failure (Must Explain)
US	Unacceptable Standard (Must Explain)
VR	Verify Results (Must Explain)
NM	Did Not Match Prior Run or Duplicate
RN	Reanalyze Neat
PC	Poor Chromatography
WS	Wrong Standard

CompuChem
A Division Of
Liberty Analytical Corp.

501 Madison Avenue
Cary, NC 27513

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SOP DOCUMENTATION FORM

This form must accompany all new and revised Standard Operating Procedures (SOPs) when you turn them in to Quality Assurance for review. Please fill out the entire block below (except effective date).

This is a new procedure _____ revised procedure ✓ outdated procedure (archive) _____

- Procedure Code: IP 1401 SOP Section #: 1.2.4.2 Revision #: 4

SOP Title: GC/MS Analysis of Trace Level Volatiles in Water by Scan and Selected Ion Monitoring using EPA CLP SOW SOM01.2

Effective date: (QA fills in) 02-26-2009

- Procedure prepared by: _____ Date: 02-24-2009
- Procedure approved by: (If the manager prepared the SOP, a qualified second party should sign) Bob McGhee Date: 02-24-2009
- Reason for change: Corrections from EPA/QATS on-site audit and from annual review
- This procedure meets the requirements of the following approved method references: USEPA CLP SOW for Organic Analysis, Multi-Media, Multi-Concentration, SOM01.2 (8/2007)

Procedure approved by a QA Representative (unless QA Representative signed above):

_____ Date: _____

On an annual basis: Lab managers are required to review lab practices and revise the SOP if necessary. If no revision is necessary, indicate by your signature that the SOP has been reviewed.

Annual Review—Signature: _____ Date: _____

Annual Review—Signature: _____ Date: _____

Annual Review—Signature: _____ Date: _____

Annual Review—Signature: _____ Date: _____

Sopdocform2-1/19/07: vr

Instrument Procedure 1401: GC/MS Analysis of Trace Level Volatiles in Water **by** Scan and Selected Ion Monitoring using EPA CLP SOW SOM01.2

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Instrument Procedure 1401: GC/MS Analysis of Trace Level Volatiles in Water Scan and Selected Ion Monitoring using EPA CLP SOW SOM01.2.

1.0 Scope and Application

This method is used for the gas chromatograph mass spectrometer (GC/MS) analysis of water samples for trace concentrations of volatile organic compounds. When requested, an additional analysis by selected ion monitoring (SIM) is performed for 1,2-dibromoethane and 1,2-dibromo-3-chloropropane. The target compound list (TCL) for this method and the Contract Required Quantitation Limits (CRQL) are listed in Attachment 1.

Staff members performing the procedures described in this SOP are responsible for reading, understanding, and complying with the SOP requirements. Supervisors are responsible for directing the analyst to the controlled SOP, and providing adequate explanation of the material contained therein.

This procedure is restricted to use by or under the supervision of analysts experienced in the instrumentation or preparative methods and who have demonstrated the ability to generate acceptable results through QC samples and analyst capability studies.

2.0 Summary of Method

A 25 mL sample is sparged with an inert gas at 40 °C, transferring purgeable compounds from the aqueous phase to the vapor phase. The vapor is then swept onto a sorbent column where the purgeable compounds are trapped. The sorbent column is heated and back flushed with the inert gas to desorb the purgeables compounds onto a gas chromatograph (GC) wide-bore capillary column. The gas chromatograph is temperature programmed to separate the purgeable compounds, which are then detected with a mass spectrometer (MS).

3.0 Definitions

3.1 Method detection limit (MDL) – The minimum concentration of an analyte that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte (40 CFR, Part 136, Appendix B.)

3.2 Reporting Limit – The laboratory reporting limit is based on the lowest multipoint calibration standard concentration. Values detected below the reporting limit and above the MDL may be reported and qualified as an estimated concentration.

For CLP methods, the MDL is required to be lower than the reporting limit.

For CLP the reporting limit is the Contract Required Quantitation Limit (CRQL).

3.3 Reporting Units – µg/L

3.4 An SDG is defined by the following, whichever is more frequent:

- each Case of field samples received, or
- each 20 field samples (excluding PE samples) received within a case, or
- each 7 calendar day period (3 calendar day period for 7 day turn around) during which field samples in a case are received beginning with the receipt of the first sample.

3.5 Analytical range – The analytical range is defined by the concentrations of the standards in the initial calibration. Samples containing target analytes at concentrations above the level of the highest calibration standard must be diluted, or a lesser amount of sample analyzed, in order to bring the concentration to within the upper half of the calibration range. For CLP the upper half is defined as the concentration between the midpoint standard and the high standard. For non-CLP the limit is between one-half the concentration of the high standard and the low standard.

3.6 DMC – Deuterated Monitoring Compounds

3.7 IS – Internal Standard

3.8 BFB – Bromofluorobenzene

3.9 EICP – Extracted Ion Current Profile

3.10 VTSR – Validated Time of Receipt of Sample Receipt

4.0 Interferences

4.1 Impurities in the purge gas or methanol, organic compounds out-gassing from the plumbing ahead of the trap, and solvent vapors in the laboratory account for the majority of contamination problems. Gas lines from the gas tanks to the instrument are to be made of copper tubing. Non- polytetrafluoroethylene (PTFE) thread sealants, or flow controllers with rubber components are not used. When potential interfering peaks are noted in laboratory method blanks, it may be

necessary to reduce solvent contamination in the laboratory, purge the methanol used to prepare standard solutions, purge the reagent water with helium or nitrogen, change the purge gas source, or regenerate the molecular sieve purge gas filter.

4.2 Samples can be contaminated by diffusion of purgeable organics (particularly methylene chloride, fluorocarbons, and other common laboratory solvents) through the septum seal into the sample during storage and handling. Therefore, store samples in the GC/MS volatiles laboratory refrigerator separate from laboratory standards. Analyze samples in a room whose atmosphere is demonstrated to be free of all potential contaminants that will interfere with the analysis.

4.3 Laboratory clothing worn by analysts must be devoid of solvents because clothing previously exposed to methylene chloride and other laboratory solvent fumes during common liquid/liquid extraction procedures can contribute to sample contamination.

4.4 The method blank is analyzed to determine the level of contamination present in the lab environment, in the reagents used and in the GC/MS system. Contamination by carryover can occur whenever a sample is analyzed after a sample that contains high levels of organic compounds. When an unusually concentrated sample is analyzed, it is followed by the analysis of an instrument blank to confirm that the instrument is free of contamination. If the samples are set up on an autosampler, the next sample analyzed after the high concentration sample is checked for contamination.

4.5 Method interferences caused by contaminants in solvents, reagents, glassware, purge gas, sorbents, laboratory air, and other sample storage and processing hardware that lead to discrete artifacts and/or elevated baselines in gas chromatograms must be eliminated. Inspect the chromatographic system for malfunctions and make corrections as required before analyzing additional samples.

4.6 The following are problems associated with certain compounds analyzed by this method:

- Chloromethane , vinyl chloride, bromomethane, and chloroethane may display peak broading.
- Acetone, hexanone, 2-butanone, and 4-methyl-2-pentanone have poor purge efficiencies.

- 1,1,1-trichloroethane and all of the dichloroethanes maybe degraded by contaminated transfer lines in purge-and-trap systems and/or active sites in the trapping materials.

- Chloromethane may be lost if the purge flow is too fast.

- Bromoform is adversely effected by cold spots and/or active sites in the transferlines. Bromoform's quantitation (m/z 173) is directly effected by the tuning of the Bromofluorobenzene (BFB) at m/z 174/176.

4.7 Instrument problems/preventative maintenance

4.7.1 If a low response is observed for the early eluting compounds such as the gases, replacement of the trap or septum may be necessary. In addition, adjustments to the purge flow may be necessary to achieve a desired response for these compounds. If such adjustments do not help, it may be necessary to check the fittings on the purge and trap device and on the column for leaks. This is done with a helium leak detector and certain software utility programs.

4.7.2 Column maintenance or replacement may be necessary if peak tailing or broad chromatographic peaks are observed.

5.0 Safety

5.1 Appropriate protective equipment and clothing must be used under the assumption that all samples are potentially hazardous. During sample preparation, glasses, gloves and lab coats are a minimum requirement. The persistent presence of noxious odors may be indicative of failure of the laboratory ventilation system and must be reported to a supervisor or manager.

5.2 Laboratory staff must review the Chemical Hygiene Plan for general safety policies, and Material Safety Data Sheets (MSDS) for solvents and reagents used in the laboratory. The MSDS are located in the Quality Assurance department.

5.3 The toxicity and carcinogenicity of many chemicals used in this method have not been precisely determined: each chemical should be treated as a potential health hazard. Exposure to these chemicals should be minimized.

5.4 The following method analytes have been tentatively classified as known or suspected human or mammalian carcinogens: benzene, carbon tetrachloride, chloroform, and vinyl chloride.

6.0 Equipment and Supplies

6.1 Hamilton micro syringes

6.1.1 10 µL

6.1.2 25 µL

6.1.3 50 µL

6.1.4 100 µL

6.2 SGE International gastight syringes

6.2.1 1 mL

6.2.2 5 mL

6.2.3 10 mL

6.2.4 25 mL

6.3 pH paper-wide range, capable of measuring pH 0-14.

6.4 Analytical column

6.4.1 **Supelco SPB**-624, 60 M, 0.32 mm ID, 1.8 µm film thickness.

6.4.2 Descriptions of alternative capillary columns are presented in the SOW. Columns other than those listed may be used if equivalency is demonstrated. Specifications for equivalency are also presented in the SOW. The equivalency documentation must be maintained and made available during on-site audits

6.5 **Purge and trap Autosampler System**

6.5.1 Tekmar LSC

6.5.1.1 Tekmar, LSC 3000, LCS 3100 and Velocity XPT with glass frit bottom liquid sample purging vessel and Luerlock valve

6.5.1.2 The absorption trap must be at least 25 cm long and have an internal diameter of at least 0.105 inches (0.2667 cm).

6.5.2 Archon ALS

6.5.2.1 The Archon Model 5100, 4552 Purge and trap autosampler, interfaces directly to Tekmar Purge and Trap Concentrators.

6.5.2.2 The autosampler is designed for soil samples and utilizes 40 ml VOA vials with low bleed Teflon septa.

6.5.2.3 The Archon ALS has the capacity of up to 51 vials.

6.6 Gas Chromatograph

6.6.1 Hewlett Packard 5890 Series

6.6.2 Hewlett Packard 6890 Series

6.6.3 Agilent 6890N Series

6.7 Mass spectrometer

6.7.1 Hewlett Packard 5972 Mass Selective Detector (MSD)

6.7.2 Hewlett Packard 5973 MSD

6.7.3 Hewlett Packard 6890MSD

6.7.4 Agilent Technologies 5975 MSD

6.8 Interface (GC to mass spectrometer)

6.8.1 Direct capillary interface at 225° C is used for Hewlett Packard MSDs

6.9 Data system

6.9.1 The Hewlett Packard GC/MS systems utilize ChemServer software, for data acquisition.

6.9.2 For data processing, CompuChem uses the Hewlett Packard HP 9000 series 735 Unix Workstation employing **HP ChemServer with Target3 and Promium Element's form generation software.**

6.9.3 The reference library used is the NIST Library (**NIST 2002, or newer**),

6.10 Data storage

Data are stored on the Target3 Unix Workstation. The Workstation is backed up incrementally on a daily basis.

7.0 Reagents and standards

Note: All SOM01.2 and OLM04.3 standards information is entered into the LIMS. To obtain information on any standard, access Element, click on "Laboratory," and scroll down and access "Standards." Standards can be sorted by Department. Select the standard you would like to access. The view will show lot number, prepared dates, solvent, vendor, composition, and concentration.

Reference standards used in this procedure are prepared by analysts in the volatiles laboratory. Standards are stored separately from samples at -10° C to -20° C in the laboratory when not in use.

7.1 Reagent water – All water used in this procedure must be equivalent to ASTM Type I , with regard to resistivity of > 10 megohm-cm (19th and 20th Editions of Standard Methods, Method 1080), which is subsequently purged with the inert gas, nitrogen, and demonstrated to meet the blank contamination acceptance criteria contained in this Standard Operating Procedure (SOP). It is referred to throughout the remained of this SOP as reagent water.

7.2 Methanol – purge and trap grade

7.3 Tuning standard

7.3.1 Bromofluorobenzene (BFB), **Restek, 99% purity**

7.3.1.1 Standard ID# 7008, at a concentration of 25µg/mL in methanol.

7.3.1.2 Prepare fresh BFB solution every six months or sooner if degradation or evaporation occurs.

7.4 Internal Standards

7.4.1 Prepare the internal standard spiking solution containing 1,4-dichlorobenzene-d_4, chlorobenzend-d_5, and 1,4-difluorobenzene in methanol.

7.4.1 Add sufficient amount of internal standard to each calibration standard, blank, and sample including duplicate matrix spikes to result in a concentration of 5 µg/L. If SIM analysis is required, the resulting concentration is 0.50 ug/L.

7.4.3 Prepare monthly or as needed.

7.5 DMC

7.5.1 Prepare a DMC standard solution consisting of vinyl chloride-d_3, chloroethane-d_5, 1,1-dichloroethene-d_2, 2-butanone-d_5, chloroform-d, 1,2-dichloroethane-d_4, benzene-d_6, 1,2-dichloropropane-d_6, toluene-d_8, trans-1,3-dichloropropene-d_4, 2-hexanone-d_5, 1,1,2,2-tetrachlorothane-d_2, and 1,2-dichlorobenzene-d_4.

7.5.2 Add sufficient amount of DMC solution to each calibration standard, blank, and sample including duplicate matrix spikes to result in a concentration of 5.0 µg/L for each non-ketone DMC and 50 ug/L for each ketone DMC. If SIM analysis is required, the resulting concentrations is 0.50 ug/L for each non-ketone DMC.

7.5.2 Prepare monthly or as needed.

7.6 Initial Calibration Standards

7.6.1 Prepare all non-ketones and their associated deuterated monitoring compounds (DMC) (listed in Attachment 1), at 0.50 1.0, 5.0, 10, and 20 µg/L. Prepare all ketones and their associated DMC at 5.0, 10, 50, 100 and 200 µg/L. The concentration of m and p-xylene must total 0.50 1.0, 5.0, 10, and 20 µg/L.

7.6.2 Prepare the initial calibration standards for SIM analysis at 0.05, 0.10, 0.50, 1,0, and 2.0 µg/L for all compounds of interest and their associated DMC.

7.6.3 Perform initial calibrations whenever corrective actions are taken which may affect, the initial calibration criteria (i.e., ion source cleaning/repair, column replacement, etc.).

7.6.4 Calibration standards are prepared in volumetric flasks or gastight syringes.

7.7 Storage of Standards

7.7.1 Stock standards are purchased from a commercial provider and stored in the freezer until needed. After the ampule is opened, the solution is stored in a min-inert vial in the freezer at -10° C to -20° C.

7.7.2 Working standards are prepared monthly or sooner and are stored in a freezer.

7.8 Standard Storage Records

7.8.1 All temperature records must be recorded daily following the procedures in QC SOP 13.15, "Documenting Refrigerator and Freezer Temperatures".

7.8.2 Corrective action SOPs must be posted on the refrigerators.

8.0 Sample Preservation and Storage

8.1 Samples are preserved and stored according to the tables in Sample Control SOP 4.1, "Receiving Samples" and 4.6, "Storing Samples." Sample holding times are also listed.

8.2 Complete analysis of all water samples, except performance evaluation samples (PE), within 10 days of Validated Time of Sample Receipt (VTSR).

8.3 Prior to analysis, store all samples under refrigeration at 4° C (± 2° C) in a volatiles only storage unit. Store all samples in the same sample delivery group (SDG) together in the same refrigerator.

9.0 Quality Control

9.1 Deuterated Monitoring Compounds (DMC)

9.1.1 Add an amount of DMC solution to each blank and sample (including matrix spikes) to result in a concentration of 5 µg/L for each non-ketone DMC and 50 µg/L for each ketone DMC.

9.1.1.1 Add 2.5 µL of non-ketone DMC standard and 5µL of ketone DMC standard.

9.1.2 Add a sufficient amount of DMC solution to each blank and sample to result in a concentration of 0.50 µg/L for each non-ketone DMC for SIM analyses.

9.1.2.1 Add 2.5 µL of non-ketone DMC standard.

9.1.3 DMCs must meet the recovery criteria listed in the table below:

Deuterated Monitoring Compound Recovery Limits

Compound	Percent Recovery Limits
Vinyl Chloride-d_3	65-131
Chloroethane-d_5	71-131
1,1-Dichloroethene-d_2	55-104
2-Butanone-d_5	49-155
Chloroform-d	78-121
1,2-Dichloroethane-d_4	78-129
Benzene-d_6	77-124
1,2-Dichloropropane-d_6	79-124
Toluene-d_8	77-121
trans-1,3-Dichloropropene-d_4	73-121
2-Hexanone-d_5	28-135
1,1,2,2-Tetrachloroethane-d_2	73-125
1,2-Dichlorobenzene-d_4	80-131

9.2 Internal Standards

9.2.1 Add 5 µL of internal standard solution to every standard, blank, and sample prior to scan or SIM analysis. Use internal standards as the basis for quantitation of the target and DCM compounds. Attachment 2 summarizes target and DMC compounds with corresponding internal standards for quantitation.

9.2.2 Evaluate the EICP area response for each of the internal standard compounds during or immediately after data acquisition. Compare the EICP area response of each of the internal standards in the blanks, matrix spikes and field samples to the most recent opening continuing calibration verification (CCV) standard. The response must be within the range of 60% - 140%.

9.2.3 Compare the retention time shift for each internal standard in the blanks, matrix spikes and field samples, to the most recent opening CCV, during or immediately after data acquisition. If the retention time for any internal standard changes by more than ± 0.33 minutes (20 seconds), corrective action must be taken.

9.2.4 Take corrective action, if the acceptance criteria for any internal standard are not met. Corrective action may require instrument maintenance, replacement of internal standard solution, and/or recalibration. Once corrective action are completed, samples having internal standard retention time shifts outside the limits must be reanalyzed to verify whether the initial failure was due to the sample matrix or whether it was due to a laboratory problem.

9.2.5 The RRT of each of the DMCs must be within ± 0.06 RRT units of its relative retention time in the most recent continuing calibration standard analysis.

9.3 Blanks

9.3.1 Method blank

The method blank measures reagent and system contamination and consists of 25 mL reagent water.

9.3.1.1 Analyze a method blank immediately after the initial calibration sequence if samples are analyzed before the 12-hour time period

expires. Analyze a method blank immediately after the continuing calibration standard and before any samples are analyzed.

9.3.1.2 Method blanks must meet all internal standard and DMC acceptance criteria in 9.1.3. and 9.2. The concentration of all compounds listed in Attachment 1 (with the exception of methylene chloride, acetone, and 2-butanone) must be less than the CRQL, and all tentatively identified compounds (TICs) less than 2µg/L. For methylene chloride, acetone, and 2-butanone the concentration levels in the method blank must be less than 2 times the CRQL.

9.3.2 Storage blank

The storage blank indicates whether cross-contamination may have occurred during storage of samples. Acceptance criteria are the same as the method blank.

9.3.2.1 Upon receipt of the first samples from a SDG, fill two 40 mL screw cap vials with a PTFE-faced silicon septum with reagent water (80 mL total).

9.3.2.2 Store the vials with the SDG under the same conditions. Analyze a 25 mL aliquot of the storage blank after all samples in the SDG have been analyzed.

9.3.3 Instrument blank

The results from the instrument blank analysis indicate whether there is carryover from a previous sample. Instrument blank criteria are the same as those of the method blank.

9.3.3.1 Analyze an instrument blanks after a sample/dilution, containing a target compound at a concentration greater than the initial calibration range.

9.3.4 Corrective Action for Blank Analysis

9.3.4.1 Re-analyze any method blank or instrument blank that fails to meet the technical acceptance criteria. Re-analyze all samples processed within the same 12-hour time period with a method blank that does not meet the blank technical acceptance criteria.

9.3.4.2 Until an instrument blank meets the blank technical acceptance criteria or a sample meets the maximum carryover criteria, re-analyze any samples analyzed since the original contaminated sample.

9.3.4.3 If the storage blank does not meet technical acceptance criteria for blank analysis, correct any system problem and reanalyze the storage blank. If the storage blank does not meet contamination criteria, the problem should be addressed in the narrative along with the corrective action taken.

Note: The storage blank is a deliverable and it must also be made available for review during an on-site audit.

9.4 Duplicate Matrix Spikes

9.4.1 Analyze duplicate matrix spike analyses at the frequency of once per twenty samples in an SDG or once per SDG, if requested by the submitting client. SIM and PE sample analyses do not require duplicate matrix spike analyses.

9.4.2 Prepare the matrix spike solution at a concentration of 12.5 µg/mL, containing the compounds listed in the table in 9.4.4.

9.4.3 If the client designates a sample to be used for duplicate spike analyses, that sample must be used. If there is insufficient volume of the designated sample to perform duplicate matrix spike analyses, another sample is chosen. Notify the client that an alternate sample was chosen and the reason for the change. Note this information in the SDG narrative.

9.4.4 The duplicate matrix samples must meet the following criteria.

Spike Compounds	Percent Recovery	Relative Percent Difference
1,1-Dichloroethene	61-145	14
Benzene	76-127	11
Trichloroethene	71-120	14
Toluene	76-125	13
Chlorobenzene	75-130	13

9.4.5 Record the lot numbers of the matrix spike solution in the comment section of the log sheet.

9.4.6 Analyze duplicate matrix spikes on a GC/MS system meeting the BFB, initial calibration, continuing calibration, and blank technical acceptance criteria, and within the contract-required holding time.

9.4.7 Internal standard retention time shift must be within ± 0.33 minutes (20 seconds) compared to the most recent opening CCV standard. The internal standard area response must be within 60.0% to 140% of the corresponding internal standard response in the most recent opening CCV.

Note: The limits for the matrix spike recovery and RPD are advisory and no further action by the laboratory is required. However, frequent failures to meet the limits should be investigated by the laboratory and may warrant questions by the Agency.

9.5 Samples

9.5.1 Analyze all samples on a GC/MS system meeting the BFB, initial calibration, opening CCV, and method blank criteria.

9.5.2 Analyze the sample within the contractual holding time.

9.5.3 DMC recovery must meet the acceptance criteria presented in Section 9.1.**3**. Up to three DMCs per sample may fail to meet the recovery limits.

9.5.4 The area responses of the internal standards must be within 60.0% to 140% of their respective area responses in the opening CCV standard.

9.5.5 The internal standard retention time shift between the sample and the most recent opening CCV must be ± 0.33 minutes (20 seconds).

9.5.6 If target compound concentrations are outside the upper limit of the instrument's analytical range, re–prepare the sample and reanalyze at a dilution such that the compound concentrations in question will be within the upper half of the analytical range for this method.

9.6 Contingency

9.6.1 If due to a lab accident or to QC failures, a re-preparation and analysis are required for the sample and insufficient sample volume remains, the Project Manager must be alerted and will contact the client for direction on how to proceed.

9.6.2 If persistent contamination occurs in the laboratory, analysis must be halted until the source of the contamination can be identified and isolated. When the contamination issue is resolved, samples analysis may proceed.

9.6.3 Refer to the corresponding Data Review SOP (number will vary among sections) for information on how to handle reporting of data that are unacceptable or out-of-control.

9.6.4 Any other issues that potentially effect data quality should also be addressed with the Project Manager.

10.0 Calibration and Standardization

10.1 BFB

10.1.1 Tune the GC/MS with perfluoro-tri-n-butylamine (FC-43).

10.1.2 Analyze the instrument performance check solution by injecting 50 ηg of BFB (2 µL STD ID# 7008) into the GC using a 10 µL Hamilton syringe.

10.1.3 All performance criteria must be met. GC/MS tuning and Mass Calibration forms must be printed and attached to the instrument run log page for each tune. Report relative abundances to the number of significant figures presented in the table in Section 10.1.5.

10.1.4 Base the criteria for BFB analysis on averaging from one scan prior to the apex of the BFB peak to one scan after the apex, subtracting a single background scan prior to the peak, but no more than 20 scans prior to the elution of BFB. Do not subtract part of the BFB peak.

10.1.5 Analysis of the instrument performance check solution must meet the ion abundance criteria given in the following table.

BFB Key Ions and Ion Abundance Criteria

Mass	Ion Abundance Criteria
50	15.0 – 40.0 % of m/z 95
75	30.0 – 80.0 % of m/z 95
95	Base Peak; 100 % relative abundance
96	5.0 – 9.0 % of m/z 95
173	<2.0 % of m/z 174
174	50.0 – 120 % of m/z 95
175	5.0 – 9.0 % of m/z 174
176	95.0 – 101 % of m/z 174
177	5.0 – 9.0 % of m/z 176

Note: All ion abundances must be normalized to m/z 95, even though the ion abundance of m/z 174 may be up to 120% of m/z 95.

10.1.6 If BFB technical acceptance criteria are not met, retune the GC/MS system. If required, clean the ion source, clean the quadrapole rods, or take other corrective action to achieve the technical acceptance criteria.

10.1.7 BFB technical acceptance criteria must be met before the analysis of any standards, samples, or required blanks.

10.2 Initial calibration

10.2.1 Prior to the analysis of samples and required blanks, and after the instrument performance check solution (BFB) criteria have been met, perform a 5-point calibration of each GC/MS system (See 7.4.1 and 7.4.2) to demonstrate instrument sensitivity and the linearity of the GC/MS response for the purgeable target compounds and DMC.

10.2.2 Analyze all initial calibration standards at the concentration and at the frequency levels required on a GC/MS system meeting the BFB technical acceptance criteria.

10.2.2.1 If time remains in the 12-hour time period after meeting the technical acceptance criteria for the initial calibration, analyze samples. It is not necessary to analyze a CCV standard. A method blank is required.

10.2.2.2 Quantitate all samples and blank results using the mean relative response factor ($\overline{RRF}$) from the initial calibration. Compare quality control criteria, such as, internal standard area response change and retention time (RT) shift, against the initial calibration standard that is the same concentration as the continuing calibration standard.

10.2.3 Perform an initial calibration if the CCV acceptance criteria has not been met, or whenever a corrective action might effect the initial calibration (i.e., a column is changed or an ion source cleaned).

10.2.4 Excluding those ions in the solvent front, no quantitation ion may saturate the detector.

10.2.5 Tabulate the area response of the characteristic ions in the extracted ion current profile (EICP) against the concentration for each compound and internal standard. Calculate relative response factors (RRF) for each compound. Calculate the mean RRF for all compounds.

10.2.6 The RRF at each calibration concentration for each target and DMC must be greater than or equal to the compounds minimum RRF listed in Attachment 4

10.2.7 The percent relative standard deviation (%RSD) for each target and DMC must be less than or equal to that listed in Attachment 4.

10.2.7.1 Up to two compounds may fail to meet minimum RRF criteria or maximum %RSD criteria, however these compounds must have a minimum RRF of greater than or equal to 0.01 and a maximum %RSD of 40.

10.2.7.2 For SIM analysis, each target compound and DMC must meet a minimum RRF of 0.01 and a maximum %RSD of less than or equal to 50.

10.2.8 If the initial calibration technical acceptance criteria are not met, inspect the system for problems. If required, clean the ion source, perform column maintenance, change the column, service the purge and trap device, or take other corrective action to achieve the technical acceptance criteria

10.2.9 Initial calibration technical acceptance criteria must be met before any samples or required blanks are analyzed.

10.3 Opening and Closing Continuing Calibration Verification

10.3.1 Analyze an opening CCV before the analysis of samples and required blanks and after BFB and initial calibration acceptance criteria have been met, to ensure that the instrument meets the sensitivity and linearity requirements of the method. Analyze a closing CCV after all the blanks and samples, and before the end of the twelve-hour time period.

10.3.2 Perform the opening and closing CCV standards at the mid-level concentration of the initial calibration; 5.0 µg/L for non-ketones and 25 µg/L for ketones and 0.50 µg/L for all other compounds by SIM.

10.3.3 Perform a check of the calibration curve every 12 hours, beginning with the injection of BFB. Calculate **the** percent difference (%D) of the opening CCV relative response factor compared to the average relative response factor from the initial curve. The opening CCV must meet the minimum RRF and maximum %D acceptance criteria listed in Attachment 4.

10.3.3.1 For the opening CCV up to two compounds may fail to meet minimum RRF criteria and up to two compounds may fail maximum %RSD criteria in the opening CCV; however these compounds must have a minimum RRF of greater than or equal to 0.01 and a maximum %RSD of 40.

10.3.4 The closing CCV must meet a minimum RRF of 0.01 for all target and DMC. The closing CCV must meet a maximum %D of 50

10.3.5 If the closing CCV meets the acceptance criteria for the opening CCV, sample analysis may continue without the analysis of BFB. The twelve-hour period begins at the injection time of the closing CCV. However, a method blank has to be analyzed.

10.3.6 Opening CCV acceptance criteria must be met before any samples, spikes, or blanks are analyzed. If the acceptance criteria are not met, recalibrate the GC/MS by performing another initial calibration. This may require some corrective action first.

10.3.7 If closing CCV acceptance criteria are not met, all sample analyzed within the twelve hour time period must be reanalyzed.

11.0 Procedure

Documentation must follow the requirements in Quality Control SOP 13.6, "Proper Documentation Procedures". Record all instrument information in the GC/MS VOA Run Log (Attachment 6). **Condition Codes, abbreviations defined in Attachment 7, are used to document failed and qualified injections.**

11.1 Instrument Performance Check

Analyze an instrument performance check sample and ensure it meets acceptance criteria, before any calibration standards, blanks, or samples are analyzed.

11.1.1 Inject 2 µL, of 25 µL/mL BFB solution (50 ηg), into the GC column.

11.1.2 If BFB acceptance criteria are met, print the BFB mass spectrum, mass listing, and reconstructed ion chromatogram (RIC)

11.2 Initial Calibration

11.2.1 Perform an initial calibration after all BFB tuning criteria are met. The initial calibration consists of 5 standards at the concentrations listed in 7.4.1 and 7.4.2.

11.2.2 Prepare each standard in a 25 mL gastight syringe by adding calibration standard, DMC, and internal standard solutions to 25 mL of reagent water. Inject the contents of the syringe into a 40mL vial and place it on the autosampler. Purge the standards at ambient temperature.

11.2.3 Prepare each standard in a volumetric flask, by adding calibration standard, DMC, and internal standard solutions to reagent water and bringing the flask to the appropriate volume. Measure a 25 mL volume using a 25 mL gastight syringe. Inject the contents of the syringe into a 40mL vial and place it on the autosampler.

11.2.4 Process and review each calibration standard using the Target3 data system insuring that each DMC and target compound is present in each analysis.

11.2.5 Check that the initial calibration met acceptance criteria by reviewing the initial calibration summary form on the Target3 data system.

11.2.6 If acceptance criteria are met, print the initial calibration summary form. Also print the RIC, quantitation report, and EICP for each standard used.

11.2.7 Analyze samples if time remains in the twelve hour period after the initial calibration has been analyzed, without the analysis of an opening CCV.

11.2.8 If no samples are analyzed, complete the GC/MS run log (Attachment 5). "Z" out any unused portion of the run log and have a supervisor or designee to review and sign it. Make a photocopy of the run log an attach it to the hard copy data for BFB and the initial calibration.

11.3 Opening CCV

11.3.1 After the BFB and initial calibration have met acceptance criteria, check the GC/MS system by analyzing the opening CCV.

11.3.2 Process and review the opening CCV using Target 3 processing software insuring that each target compound is present in the analysis.

11.3.3 Check that the opening CCV met acceptance criteria, by reviewing the continuing calibration summary form on the Target3 data system.

11.3.4 If the opening CCV acceptance criteria are met, print the continuing calibration summary form, RIC, quantitation report, and EICP.

11.4 Method Blank

11.4.1 Analyze a method blank after all BFB and initial calibration or opening CCV criteria are met.

11.4.2 Prepare the method blank by adding internal standard and DMC solutions to 25 mL of reagent water in a gastight syringe. Add the contents of the syringe to a 40 mL vial and place on the autosampler for analysis.

11.4.3 Process and review the method blank. If the method blank meets acceptance criteria, samples may be analyzed. If the method blank fails, re-analyze.

11.5 Sample Preparation and Analysis

11.5.1 Permit sample to obtain ambient temperature.

11.5.2 Prepare liquid samples for analysis, by pouring the sample into a 25 mL Hamilton gastight syringe, replace the plunger, adjust the volume to 25 mL, and add internal standard and DMC solutions. Inject the contents of the syringe into a 40 mL vial and place on the autosampler for analysis.

11.5.2.1 Determine the pH of the water samples. Test the pH by placing one or two drips on the pH paper (do not add pH paper to the vial). Record the pH of each sample. Do not adjust the pH.

11.5.2.2 Prepare duplicate matrix spike samples cited in 11.5.2, with the addition of matrix spike solution.

11.6 Instrument Blank

11.6.1 Perform an instrument blank analysis after a sample analysis containing a target compound(s) exceeding the instrument's calibration range.

Note: The results of the instrument blank analysis indicate if there is contamination from a previous sample.

11.6.2 Prepare the instrument blank by adding internal standard and DMC solutions to 25 mL of reagent water.

11.6.3 Do not conduct sample analysis until the instrument blank meets method blank acceptance criteria.

11.7 Storage Blank

11.7.1 Analyze the storage blank after all samples in the SDG have been analyzed.

Note: The results of the storage blank indicate whether the samples were contaminated during storage.

11.7.2 Prepare the storage blank by adding internal standard and DMC solutions to a 25 mL aliquot.

11.7.3 Storage blank analysis must meet all method blank acceptance criteria. If these criteria are not met, analyze a second aliquot and document the results in the SDG narrative.

11.8 Purge and Trap Analysis

11.8.1 After preparation, load each standard, blank, and sample onto the closed-system autosampler interfaced with the purge-and-trap apparatus.

11.8.2 Purge for 11 minutes at 40 °C..

11.8.3 Heat the trap to 180° C and desorb the trapped contents onto the GC column by back flushing the trap with inert gas for 4.0 (± 0.1) minutes.

11.8.4 Bake the trap for 7.0 (± 0.1) minutes at 220 to 260°C.

11.9 HP/ Agilent GC conditions listed below:

- **Column:** **30m**
- **Carrier Gas:** **Helium**
- **GC mode:** **Capillary**
- **Injection Port Temperature:** **230°C**
- **Interface Temperature:** **230°C**
- **Initial Temperature:** **40° C**
- **Final Temperature:** **225° C**
- **Flow Rate:** **35ml/minute**

The listed column flow rate is approximate. The flow rate is adjusted to optimize the linear velocity of an un-retained compound (butane) through the column. The optimum linear velocity for a SPB-624 column is 30 - 45 cm/second.

11.9.1 Temperature Program

These temperature program conditions are provided as an example and may vary.

- **HP/Agilent:** **40° C for 4.50 minute**
- **Ramp:** **40° C - 100° C @ 20° C/minute**
- **Ramp:** **100° C - 150° C @ 25° C/minute**
- **Ramp:** **150° C - 225° C @ 33° C/minute**

11.9.2 The following are the required MS analytical conditions:

Parameter	
Electron Energy	70 Volts (nominal)
Mass Range	35 - 300 amu
Ionization Mode	Electron Ionization (EI)
Scan Time	At least 5 scans per peak, not to exceed 2 seconds per scan for capillary column

11.10 Sample Quantitation

11.10.1 Process each sample data file. Review file(s) to ensure that internal standards, DMC, and dilution acceptance criteria are met.

11.11 Closing CCV

11.11.1 Analyze a closing CCV after all samples and before the end of the twelve-hour period.

11.11.2 Process and review the closing CCV using the Target3 data system insuring that each DMC and target compound is present in the analysis.

11.11.3 Check that the closing CCV met acceptance criteria by reviewing the continuing calibration summary form on the Target3 data system.

11.11.4 If the closing CCV meets the acceptance criteria for the opening CCV, sample analysis may continue for another twelve hour period without analyzing BFB.

11.11.5 If the closing CCV acceptance criteria are met, print the continuing calibration summary form, RIC, quantitation report and EICP.

11.11.6 After the analysis and acceptance of the closing CCV, make all entries on the appropriate logbook page(s). Have the logbook page(s) reviewed and signed by the supervisor or designee and make a copy. This copy will accompany the data. Attach the BFB and calibration data to the logbook copy.

11.12 Sample Dilutions

11.12.1 Dilute samples if target compounds concentrations in the sample analyses are outside of the instrument's calibration range, as defined by the highest level to the initial calibration standard.

11.12.2 An acceptable dilution is one that brings the concentration of the diluted compound within the upper half of the instruments calibration range. Dilutions must be analyzed within the required holding time.

11.12.3 A dilution is prepared in a gastight syringe **or** volumetric flask.

11.12.3.1 To prepare a 25 times dilution, fill a 25 mL gastight syringe (Luer-Lok) with 24 mL of reagent water. Adjust plunger to 25 mL. Fill a 1 mL gastight syringe with 1 mL of sample and add it to the other 25 mL syringe.

11.12.3.2 To prepare a 100 times dilution, add an aliquot of reagent water to a 100 mL volumetric flask. Using a gastight syringe, aliquot 1 mL of sample and add to flask. Adjust to mark with reagent water and invert to mix.

11.12.4 If more than two sample analyses (i.e., the undiluted analysis and more than one dilution) are necessary to have all target analytes within the calibration range, contact client for guidance.

12.0 Data Analysis and Calculations

Calculations must be consistent with the Quality Control SOP 13.4, "Numerical Data Reduction".

12.1 Calculation of the mean or average of a set of values:

$$\overline{X} = \frac{\sum_{i=1}^{n} X_i}{n}$$

where:

n = total number of values
x = each individual value used to calculate the mean
$\overline{x}$ = the mean of n

12.2 Calculation of the standard deviation of a set of values:

$$\text{Standard deviation} = \sqrt{\frac{\sum_{i=1}^{n}\left(X_n - \overline{X}\right)^2}{n-1}}$$

12.3 Calculation of percent recovery:

12.3.1 DMCs:

$$\%R = \frac{Amount\ found}{Amount\ spiked}\ x\ 100$$

12.3.2 Matrix spikes:

$$\%\,\mathrm{R} = \frac{Amount\ in\ spiked\ sample - Amount\ in\ unspiked\ (native)\ sample}{Amount\ spiked}\ x\ 100$$

12.4 Calculation of % RSD

$$\%RSD = \left(\frac{\text{Standard deviation}}{\overline{X}}\right) \times 100$$

12.5 Calculation of RPD

$$RPD = \frac{|Value\ 1 - Value\ 2|}{(Value\ 1 + Value\ 2)/2} x100$$

12.6 Calculation of %Difference (%D)

$$\%Diff = \frac{Value - \overline{Reference\ \ value}}{\overline{Reference\ \ value}} x\ 100$$

12.7 Calculation of Relative Response Factor (RRF)

$$RRF = \frac{Ax}{Ais} x \frac{Cis}{Cx}$$

where:

Ax = area of the characteristic ion from the EICP for the compound to be measured
Ais = area of the characteristic ion for the EICP for the internal standard
Cis = concentration of the internal standard
Cx = concentration of the compound to be measured

12.8 Concentration of aqueous samples by GC/MS analysis

$$\mu g / L = \frac{(Ax)(Is)(Df)}{(Ais)(\overline{RRF})(Vo)}$$

where:

Ax = area of the characteristic ion from the EICP of the compound to be measured
Ais = area of the characteristic ion for the EICP of the internal standard
Is = amount of internal standard added (ng)
$\overline{RRF}$ = mean relative response factor from continuing calibration standard
Vo = volume of water purged (mL)
Df = dilution factor. If no dilution, Df = 1.0

12.9 Quantify non-target compounds by comparing the MS response from the reconstructed ion chromatogram (RIC) for the non-target compound peaks to the MS response for a peak produced by the nearest internal standard compound. Assume a response factor of 1.

$$TIC\ amount = \frac{A(tic)\ x\ Amt(std)xDf}{A(IS)\ x\ 1(RRF)xVo}$$

where:

Df, Vo are defined in 12.8
A(tic) = area response from RIC for non-target compound
Amt(std) = 50ug/L (amount of internal standard added to the sample
A(I.S.) = area response of the nearest internal standard
1(RRF) = assumed response factor of 1

12.11 Calculating Dilutions

If a sample concentration exceeds the high level standard, a dilution must be performed. Determine a level of dilution that will result in a value within the upper half of the initial calibration range. This is an acceptable dilution. Determine the sample volume needed for the diluted analysis to bring the analyte concentration within the upper half of the initial calibration range.

12.1.1 $(C_1)(V_1) = (C_2)(V_2)$

where: C_1 = desired concentration within upper half of calibration range
V_1 = total purge volume
C_2 = concentration of analyte to be diluted in the sample
V_2 = sample volume needed for diluted analysis

12.1.2 Calculate the dilution factor by dividing the total volume purged by the volume of sample purged.

13.0 Method Performance

This method was validated through in-house laboratory studies of method detection limits and precision and accuracy for single analyst. The data are retained by the QA department.

14.0 Pollution Prevention

The solvents used in this procedure pose little threat to the environment when recycled and managed properly. Pollution prevention encompasses any technique that reduces or eliminates the quantity or toxicity of waste at the point of generation. Numerous opportunities for pollution prevention exist in laboratory operation. The EPA has established a preferred hierarchy of environmental management techniques that places pollution prevention as the management option of first choice. Whenever feasible, laboratory personnel use pollution prevention techniques to address their waste generation. When wastes cannot be feasibly reduced at the source, the Agency

recommends recycling as the next best thing. See SOP 12.1, Hazardous Waste Disposal, regarding laboratory procedures for recycling solvent waste streams.

15.0 Waste Management

It is the laboratory's responsibility to comply with all federal, state, and local regulations governing waste management, particularly the hazardous waste identification rules and land disposal restrictions, and to protect the air, water, and land by minimizing and controlling all releases from fume hoods and bench operations. The laboratory also complies with all sewage discharge permits and regulations.

Samples preserved with HCl are hazardous and are handled as hazardous waste. Refer to the Hazardous Waste Management and Safety SOPs located in the lab.

16.0 References

16.1 U.S. EPA CLP SOW for Organic Analysis, Multi-Media, Multi-Concentration SOM01.2 (8/2007)

16.2 Standard Methods for the Examination of Water and Wastewater, 20th (1998) Edition, Method 1080

16.3 Code of Federal Register, 40 CFR, Part 136, "Guidelines for Establishing Test Procedures for Priority Pollutants"

16.4 Quality Control SOP 13.6"Proper Documentation Procedures"

16.5 Quality Control SOP 13.4"Numerical Data Reduction"

16.6 "Less is Better: Laboratory Chemical Management for Waste Reduction," American Chemical Society Department of Government Relations and Science Policy, 1155 16th Street, N.W., Washington DC, 20036, (202) 872-4477.

16.7 NELAC Standards, **effective July 2003**, plus revisions

16.8 QA-G6: Guidance for the Preparation of Standard Operating Procedures for Quality-Related Operations EPA/600/R-96/027, November 1995.

16.9 CompuChem Quality Manual, **Revision 11, June 23, 2008,** plus revisions

16.10 Sample Control SOP 4.1, "Receiving Samples"

16.11 Sample Control SOP 4.6, "Storing Samples"

16.12 QC SOP 13.15, "Documenting Refrigerator and Freezer Temperatures"

16.13 Sample Preparation Procedure –223, "Methanol Extraction of Soil/Sediment Samples for the Analysis of Medium Level Volatile Organics by EPA CLP and NYSASP".

16.14 Organic Standard Preparation Procedure, "Instrument Performance Check (Tuning) Solution, ID # 7008, VOA, Water & Soil"

17.0 Attachments as Tables, Diagrams, Flowcharts & Validation Data

17.1 Attachment 1 – Target Compound List (TCL) and CRQLs

17.2 Attachment 2 – TCL and DMC with corresponding IS for quantitation

17.3 Attachment 3 – TCL and DMC Quantitation and Secondary Ions

17.4 Attachment 4 – Technical Acceptance Criteria for Initial and Opening Continuing Calibration Verification for Trace Volatile Organic Compounds

17.5 Attachment 5 – DMCs and the Associated Target Compounds

17.6 Attachment 6 – GC/MS Volatile Run Log Example

17.7 Attachment 7 – Condition Codes

Attachment 1

Target Compound List (TCL) and Contract
Required Quantitation Limits (CRQL)

Target Compound	Trace	Trace by SIM
Dichlorodifluoromethane	0.50	
Chloromethane	0.50	
Vinyl chloride	0.50	
Bromomethane	0.50	
Chloroethane	0.50	
Trichlorofluoromethane	0.50	
1,1-Dichloroethene	0.50	
1,1,2-Trichloro-1,2,2-trifluoroethane	0.50	
Acetone	5.00	
Carbon disulfide	0.50	
Methyl acetate	0.50	
Methylene chloride	0.50	
trans-1,2-Dichloroethene	0.50	
Methyl tert-butyl ether	0.50	
1,1-Dichloroethane	0.50	
cis-1,2-Dichloroethene	0.50	
2-Butanone	5.00	
Bromochloromethane	0.50	
Chloroform	0.50	
1,1,1-Trichloroethane	0.50	
Cyclohexane	0.50	
Carbon tetrachloride	0.50	
Benzene	0.50	
1,2-Dichloroethane	0.50	
Trichloroethene	0.50	
Methylcyclohexane	0.50	
1,2-Dichloropropane	0.50	
Bromodichloromethane	0.50	
cis-1,3-Dichloropropene	0.50	
4-Methyl-2-pentanone	5.00	
Toluene	0.50	

Attachment 1 (Continued)

Target Compound List (TCL) and Contract
Required Quantitation Limits (CRQL)

Target Compound	Trace	Trace by SIM
trans-1,3-Dichloropropene	0.50	
1,1,2-Trichloroethane	0.50	
Toluene	0.50	
trans-1,3-Dichloropropene	0.50	
1,1,2-Trichloroethane	0.50	
tetrachloroethene	0.50	
2-Hexanone	5.00	
Dibromochloromethane	0.50	
1,2-Dibromoethane	0.50	0.05
Chlorobenzene	0.50	
Ethylbenzene	0.50	
Xylenes (total)	0.50	
Styrene	0.50	
Bromoform	0.50	
Isopropylbenzene	0.50	
1,1,2,2-Tetrachloroethane	0.50	
1,3-Dichlorobenzene	0.50	
1,4-Dichlorobenzene	0.50	
1,2-Dichlorobenzene	0.50	
1,2-Dibromo-3-chloropropane	0.50	0.05
1,2,4-Trichlorobenzene	0.50	
1,2,3-Trichlorobenzene	0.50	

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Attachment 2

Target Compounds and Deuterated Monitioring Compounds (DMCs) with Corresponding Internal Standards for Quantitation

1,4-Difluorobenzene	**Chlorobenzene-d_5**	**1,4-Dichlorobenzene-d_4**
Dichlorodifluoromethane	1,1,1-Trichloroethane	Bromoform
Chloromethane	Cyclohexane	1,3-Dichlorobenzene
Vinyl Chloride	Carbon Tetrachloride	1,4-Dichlorobenzene
Bromomethane	Benzene	1,2-Dichlorobenzene
Chloroethane	Trichloroethene	1,2-Dibromo-3-chloropropane
Trichlorofluoromethane	Methylcyclohexane	1,2,4-Trichlorobenzene
1,1-Dichloroethene	1,2-Dichloropropane	1,2,3-Trichlorobenzene
1,1,2-Trichloro-1,2,2-trifluoroethane	Bromodichloromethane	1,2-Dichlorobenzene-d_4 (DMC)
Acetone	cis-1,3-Dichloropropene	
Carbon Disulfide	4-Methyl-2-pentanone	
Methyl Acetate	Toluene	
Bromochloromethane	trans-1,3-Dichloropropene	
Methylene Chloride	1,1,2-Trichloroethane	
trans-1,2-Dichloroethene	Tetrachloroethene	
Methyl tert-Butyl Ether	2-Hexanone	
1,1-Dichloroethane	Dibromochloromethane	
cis-1,2-Dichloroethene	1,2-Dibromoethane	
2-Butanone	Chlorobenzene	
Chloroform	Ethylbenzene	
1,2-Dichloroethane	o-Xylene	
1,2-Dichloroethane-d_4 (DMC)	m- and p- Xylenes	
Vinyl Chloride-d_3 (DMC)	Trans-1,3-Dichloropropene-d_4 (DMC)	
Chloroethane-d_5 (DMC)	Toluene-d_8 (DMC)	
1,1-Dichloroethene-d_2 (DMC)	2-Hexanone-d_5 (DMC)	
2-Butanone-d_5 (DMC)	1,1,2,2-Tetrachloroethane-d_2 (DMC)	
Chloroform-d (DMC)	Styrene	
	Isopropylbenzene	
	1,1,2,2-Tetrachloroethane	
	Benzene-d_6 (DMC)	
	1,2-Dichloropropane-d_6 (DMC)	

Attachment 3

Target Compounds and Deuterated **Monitoring** Compounds Quantitation and Secondary Ions

Target Compound	Quantitation Ion	Secondary Ion(s)
Dichlorodifluoromethane	85	87
Chloromethane	50	52
Vinyl chloride	62	64
Bromomethane	94	96
Chloroethane	64	66
Trichlorofluoromethane	101	103
1,1-Dichloroethene	96	61, 63
1,1,2-Trichloro-1,2,2-trifluoroethane	101	85, 151
Acetone	43	58
Carbon disulfide	76	78
Methyl acetate	43	74
Methylene chloride	84	49, 86
trans-1,2-Dichloroethene	96	61, 98
Methyl tert-butyl ether	73	43, 57
1,1-Dichloroethane	63	65, 83
cis-1,2-Dichloroethene	96	61, 98
2-Butanone	43*	72
Chloroform	83	85
Bromochloromethane	128	49, 130, 51
1,1,1-Trichloroethane	97	99, 61
Cyclohexane	56	69, 84
Carbon tetrachloride	117	119
Benzene	78	None
1,2-Dichloroethane	62	98
Trichloroethene	95	97, 132, 130
Methylcyclohexane	83	55, 98
1,2-Dichloropropane	63	112
Bromodichloromethane	83	85, 127
cis-1,3-Dichloropropene	75	77
4-Methyl-2-pentanone	43	58, 100
Toluene	91	92
trans-1,3-Dichloropropene	75	77
1,1,2-Trichloroethane	97	83, 85, 99, 132, 134
Tetrachloroethene	164	129, 131, 166
2-Hexanone	43	58, 57, 100
Dibromochloromethane	129	127

*m/z 43 is used for quantitation of 2-Butanone, but m/z 72 must be present for positive identification

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Attachment 3 (Continued)

Target Compounds and Deuterated **Monitoring** Compounds Quantitation and Secondary Ions

Target Compound	Quantitation Ion	Secondary Ion(s)
1,2-Dibromoethane	107	109, 188
Chlorobenzene	112	77, 114
Ethylbenzene	91	106
o-, m-, p-xylene	106	91
Styrene	104	78
Bromoform	173	175, 254
Isopropylbenzene	105	120, 77
1,1,2,2-Tetrachloroethane	83	85, 131
1,3-Dichlorobenzene	146	111, 148
1,4-Dichlorobenzene	146	111, 148
1,2-Dichlorobenzene	146	111, 148
1,2-Dibromo-3-chloropropane	75	157, 155
1,2,4-Trichlorobenzene	180	182, 145
1,2,3-Trichlorobenzene	180	182, 145
Deuterated Monitoring Compounds	**Quantitation Ion**	**Secondary Ion(s)**
Vinyl chloride-d_3	65	67
Chloroethane-d_5	69	71, 51
1,1-Dichloroethene-d_2	63	98, 65
2-Butanone-d_5	46	77
Chloroform-d	84	86, 47, 49
1,2-Dichloroethane-d_4	65	67, 51
Benzene-d_6	84	82, 54, 52
1,2-Dichloropropane-d_6	67	65, 46, 42
Toluene-d_8	98	100, 42
trans-1,3-Dichloropropene-d_4	79	81, 42
2-Hexanone-d_5	63	46
1,1,2,2-Tetrachloroethane-d_2	84	86
Internal Standards	**Quantitation Ion**	**Secondary Ion(s)**
1,4-Dichlorobenzene-d_4	152	115, 150
1,4-Difluorobenzene	114	63, 88
Chlorobenzene-d_{11}	117	82, 119

Attachment 4

Technical Acceptance Criteria for Initial and Opening Continuing Calibration Verification for Trace Volatile Organic Compounds

Volatile Compounds	Minimum RRF	Maximum % RSD[1]	Maximum % Diff[1]
Dichlorodifluoromethane	0.010	40.0	± 40.0
Chloromethane	0.010	40.0	± 40.0
Vinyl chloride	0.100	30.0	± 30.0
Bromomethane	0.100	30.0	± 30.0
Chloroethane	0.010	40.0	± 40.0
Trichlorofluoromethane	0.010	40.0	± 40.0
1,1-Dichloroethene	0.100	30.0	± 30.0
1,1,2-Trichloro-1,2,2-trifluoroethane	0.010	40.0	± 40.0
Acetone	0.010	40.0	± 40.0
Carbon disulfide	0.010	40.0	± 40.0
Methyl acetate	0.010	40.0	± 40.0
Methylene chloride	0.010	40.0	± 40.0
trans-1,2-Dichloroethene	0.010	40.0	± 40.0
Methyl tert-butyl ether	0.010	40.0	± 40.0
1,1-Dichloroethane	0.200	30.0	± 30.0
cis-1,2-Dichloroethene	0.010	40.0	± 40.0
2-Butanone	0.010	40.0	± 40.0
Bromochloromethane	0.050	30.0	± 30.0
Chloroform	0.200	30.0	± 30.0
1,1,1-Trichloroethane	0.100	30.0	± 30.0
Cyclohexane	0.010	40.0	± 40.0
Carbon tetrachloride	0.100	30.0	± 30.0
Benzene	0.400	30.0	± 30.0
1,2-Dichloroethane	0.100	30.0	± 30.0
Trichloroethene	0.300	30.0	± 30.0
Methylcyclohexane	0.010	40.0	± 40.0

[1]For a closing CCV, all target compounds and DMCs must meet a minimum RRF of 0.010 and a maximum percent difference of ± 50.0..

Attachment 4 (Continued)

Technical Acceptance Criteria for Initial and Opening Continuing Calibration Verification for Trace Volatile Organic Compounds

Volatile Compounds	Minimum RRF	Maximum % RSD[1]	Maximum % Diff[1]
1,2-Dichloropropane	0.010	40.0	± 40.0
Bromodichloromethane	0.200	30.0	± 30.0
cis-1,3-Dichloropropene	0.200	30.0	± 30.0
4-Methyl-2-pentanone	0.010	40.0	± 40.0
Toluene	0.400	30.0	± 30.0
trans-1,3-Dichloropropene	0.100	30.0	± 30.0
1,1,2-Trichloroethane	0.100	30.0	± 30.0
Tetrachloroethene	0.100	30.0	± 30.0
2-Hexanone	0.010	40.0	± 40.0
Dibromochloromethane	0.100	30.0	± 30.0
1,2-Dibromoethane	0.010	40.0	± 40.0
Chlorobenzene	0.500	30.0	± 30.0
Ethylbenzene	0.100	30.0	± 30.0
o-, m-, and p-xylene	0.300	30.0	± 30.0
Styrene	0.300	30.0	± 30.0
Bromoform	0.050	30.0	± 30.0
Isopropylbenzene	0.010	40.0	± 40.0
1,1,2,2-Tetrachloroethane	0.100	30.0	± 30.0
1,3-Dichlorobenzene	0.400	30.0	± 30.0
1,4-Dichlorobenzene	0.400	30.0	± 30.0
1,2-Dichlorobenzene	0.400	30.0	± 30.0
1,2-Dibromo-3-chloropropane	0.010	40.0	± 40.0
1,2,4-Trichlorobenzene	0.200	30.0	± 30.0
1,2,3-Trichlorobenzene	0.200	30.0	± 30.0

[1]For a closing CCV, all target compounds and DMCs must meet a minimum RRF of 0.010 and a maximum percent difference of ±50.0.

Attachment 4 (Continued)

Technical Acceptance Criteria for Initial and Opening Continuing Calibration Verification for Trace Volatile Organic Compounds

Deuterated Monitoring Compounds	Minimum RRF	Maximum % RSD[1]	Maximum % Diff[1]
Vinyl chloride-d_3	0.010	30.0	± 30.0
Chloroethane-d_5	0.010	40.0	± 40.0
1,1-Dichloroethene-d_2	0.010	30.0	± 30.0
2-Butanone-d_5	0.010	40.0	± 40.0
Chloroform-d	0.010	30.0	± 30.0
1,2-Dichloroethane-d_4	0.010	30.0	± 30.0
Benzene-d_6	0.010	30.0	± 30.0
1,2-Dichloropropane-d_6	0.010	40.0	± 40.0
Toluene-d_8	0.010	30.0	± 30.0
trans-1,3-Dichloropropene-d_4	0.010	30.0	± 30.0
2-Hexanone-d_5	0.010	40.0	± 40.0
1,1,2,2-Tetrachloroethane-d_2	0.010	30.0	± 30.0
1,2-Dichlorobenzene-d_4	0.010	30.0	± 30.0

[1]For a closing CCV, all target compounds and DMCs must meet a minimum RRF of 0.010 and a maximum percent difference of ±50.0.

Attachment 5
Deuterated Monitoring Compounds and the Associated Target Compounds

Chloroethane-d_5 (DMC)	**1,2-Dichloropropane-d_6 (DMC)**	**1,2-Dichlorobenzene-d_4 (DMC)**
Dichlorodifluoromethane	Cyclohexane	Chlorobenzene
Chloromethane	Methylcyclohexane	1,3-Dichlorobenzene
Bromomethane	1,2-Dichloropropane	1,4-Dichlorobenzene
Chloroethane	Bromodichloromethane	1,2-Dichlorobenzene
Carbon disulfide		1,2,4-Trichlorobenzene
		1,2,3-Trichlorobenzene
	trans-1, 3-Dichloropropene-d_4 (DMC)	**Chloroform-d (DMC)**
	cis-1,3-Dichloropropene	1,1-Dichloroethane
	trans-1,3-Dichloropropene	Bromochloromethane
	1,1,2-Trichloroethane	Chloroform
		Dibromochloromethane
		Bromoform
2-Butanone-d_8 (DMC)	**1, 1-Dichloroethene-d_2 (DMC)**	**2-Hexanone-d_5 (DMC)**
Acetone	trans-1,2-Dichloroethene	4-Methyl-2-pentanone
2-Butanone	cis-1,3-Dichloroethene	2-Hexanone
	1,1-Dichloroethene	
Vinyl Chloride-d_3 (DMC)	**Benzene-d_6 (DMC)**	**1,1,2,2-Tetrachloroethane-d_2**
Vinyl chloride	Benzene	1,1,2,2-Tetrachloroethane
		1,2-Dibromo-3-chloropropane
1,2-Dichloroethane-d_4 (DMC)		**Toluene-d_8 (DMC)**
		Trichloroethene
Trichlorofluoromethane		Toluene
1,1,2-Trichloro-1,2,2-trifluoroethane		Tetrachloroethene
Methyl acetate		Ethylbenzene
Methylene chloride		o-Xylene
Methyl-tert-butyl ether		m, p-Xylene
1,1,1-Trichloroethane		Styrene
Carbon tetrachloride		Isopropylbenzene
1,2-Dibromoethane		
1,2-Dichloroethane		

Attachment 6

COMPUCHEM a Division of Liberty Analytical Corp DATE ___/___/___ INITIAL TIME OF TUNE_____ SHIFT/S(A)____(B)____(C)____
GC/MS VOLATILE RUN LOG TIME TUNE EXPIRES_____ LINKER /METHOD_____
COMPUCHEM LOGBOOK 11 WWW 27 (5972hp71)

PREVENTIVE MAINTENANCE

		FILE NAME				DATE	TIME	Client ID	SDG#	INJ VOL.*	DF+	CHEMIST	COMMENTS(ETC.) DISPOSITION
1						/ /							
2						/ /							
3						/ /							
4						/ /							
5						/ /							
6						/ /							
7						/ /							
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22						/ /							
23						/ /							
24						/ /							

*On-column sample aliquot +Not applicable to soil matrix

The presence of the Chemist's/Analyst's employee ID number, or signature, on this run log attests that strict compliance with the method's SOP has occurred. Any SOP deviations require documentation by the responsible chemist/analyst together with the chemist's/analyst's initials and the initials of the lab supervisor and a QA department representative, signifying approval of the deviation.

Tune (ID #7008) Lot #: _____ Calibration Group Code / Lot #: _____

Reviewed by: _____ Date_____

10/17/08: jr

Attachment 7

Condition Codes Used for Documentation in Logbooks

Condition Code	Definition
CS	Contamination Suspected
CT	Contamination Verified
DA	Dilution Acceptable
DI	Requires Dilution
DW	Dilution Wrong
ES	Extraction Same
EF2JS	Ending Standard Failed Second Tune Injection Same
JS	Injection Same
IH	Internals High
IL	Internals Low
IM	Internals Missing
LA	Lab Accident (Must Explain)
OT	Other (Must Explain)
OQ	Original Run Qualified
OW	Original Wrong for QC Sample
RP	Reportable Prior Run
RT	Retention Time Shift
RU	Run Unnecessarily
SF	Spike Recoveries Failed
SH	Surrogate Recoveries Failed High
SI	Spiked Inadvertently
SL	Surrogate Recoveries Failed Low
SM	Surrogate or Spike Missing
IF	Instrument Failure (Must Explain)
US	Unacceptable Standard (Must Explain)
VR	Verify Results (Must Explain)
NM	Did Not Match Prior Run or Duplicate
RN	Reanalyze Neat
PC	Poor Chromatography
WS	Wrong Standard

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SOP DOCUMENTATION FORM

This form must accompany all new and revised Standard Operating Procedures (SOPs) when you turn them in to Quality Assurance for review. Please fill out the entire block below (except effective date).

This is a new procedure _____ revised procedure ✓ outdated procedure (archive) _____

- Procedure Code: IP 19D SOP Section #: 7.1.2.3 Revision #: 4

SOP Title: GC/ECD Analysis of Pesticides in Aqueous and Solid Extracts by EPA CLP SOW SOM01.2

Effective date: (QA fills in) 2/24/09

- Procedure prepared by: Bob McElroy Date: 02-04-2009
- Procedure approved by: (If the manager prepared the SOP, a qualified second party should sign) Kathryn E Humphries Date: 2/13/09
- Reason for change: Corrections from EPA/QATS review plus minor changes from annual review
- This procedure meets the requirements of the following approved method references: USEPA CLP SOW SOM01.2

Procedure approved by a QA Representative (unless QA Representative signed above):

_____ Date: _____

On an annual basis: Lab managers are required to review lab practices and revise the SOP if necessary. If no revision is necessary, indicate by your signature that the SOP has been reviewed.

Annual Review—Signature: _____ Date: 2/21/09

Annual Review—Signature: _____ Date: _____

Annual Review—Signature: _____ Date: _____

Annual Review—Signature: _____ Date: _____

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Instrument Procedure 190: GC/ECD Analysis of Pesticides in Aqueous and Solid Sample Extracts by EPA CLP SOW SOM01.2

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Instrument Procedure 190: GC/ECD Analysis of Pesticides in Aqueous and Solid Sample Extracts by EPA CLP SOW SOM01.2

1.0 Scope and Application

This analytical method is designed to analyze water, sediment, and soil from hazardous waste sites to determine the presence and concentration of the chlorinated pesticides found in the Target Compound List (TCL) found in Attachment 1. The method can be used for determining analyte concentrations in the range from the contract required quantitation limits (CRQL) to one million times the CRQL in these matrices when appropriate dilutions are made. The extract is analyzed using the dual column, megabore capillary Gas Chromatography/Electron Capture Detector (GC/ECD) technique.

This procedure is restricted to use by or under the supervision of analysts experienced in the instrumentation or preparative methods and who have demonstrated the ability to generate acceptable results through QC samples and analyst capability studies.

Staff members performing the procedures described in this SOP are responsible for reading, understanding, and complying with the SOP requirements. Supervisors are responsible for directing the analyst to the controlled SOP, and providing adequate explanation of the material contained therein.

2.0 Summary of Method

Prior to analysis continuous liquid-liquid or separatory funnel extraction procedures are used for water samples following Sample Preparation Procedure -742 (-1090→-938), "Preparation of Water Samples for the Analysis of Pesticides/ PCBs by CLP and NYSASP". Sonication extraction is required for soil/sediment samples following Sample Preparation Procedure -743 (-251→-940→-938), "Preparation of Soil/Sediment/Sludge Samples for the Analysis of Pesticides/PCBs by EPA CLP SOW SOM01.2 and NYSASP". Florisil adsorption column cleanup is also specified for both water and soil extracts followed by GC/ECD analysis.

An instrument blank and a Performance Evaluation Mixture (PEM) or an instrument blank and the midpoint concentration of Individual Standard Mixture C are allowed to bracket the front-end of a 12-hour analytical sequence in order to monitor retention times, calibration factors, and column performance. If an instrument blank and PEM bracket the front-end of a 12-hour analytical sequence, an instrument blank and the midpoint concentration of the Individual Mixture C must close the 12-hour sequence and vice-versa. Data can be collected only as long as the results for these standards and instrument blanks fall within the acceptable limits. If two consecutive unacceptable standards are

run, all extracts run since the previous acceptable calibration verification must be re-analyzed. Therefore, it is desirable to run these standards and blanks more frequently.

3.0 Definitions

3.1 Contract-Required Quantitation Limits (CRQL)-Reporting limits defined in the contract. GC/MS and GC results may be reported below the CRQL with positive qualitative identification and flagged or qualified as estimated concentration. (See Attachment 1.)

3.2 Contract Laboratory Program (CLP) – An analytical services program which provides a contractual framework for laboratories to apply EPA analytical methods for the isolation, detection, and quantitative measurement of volatile, semivolatile, and pesticide/Aroclor target compounds in water and soil/sediment environmental samples.

3.3 Statement of Work (SOW) – part of the documentation for a contract between EPA and a commercial laboratory to perform analyses in support of EPA Superfund programs.

3.4 VTSR – Validated time of sample receipt

3.5 Method detection limit (MDL) – The minimum concentration of an analyte that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte (40 CFR, Part 136, Appendix B.)

3.6 Reporting Limit – The laboratory reporting limit is based on the lowest multipoint calibration standard concentration. For organic methods, values detected below the reporting limit and above the MDL may be reported and qualified as an estimated concentration.

If the low level standard concentration is not at least three times higher than the MDL value, the standard concentration is adjusted upward in order to achieve this minimal ratio. It may be adjusted higher than three times depending on the concentration range of the calibration curve and the ability to meet method linearity requirements. An exception to this is for CLP methods where the MDL is only required to be lower than the reporting limit.

For CLP the reporting limit is the Contract Required Quantitation Limit (CRQL) for organics.

3.7 Reporting Units – µg/L for water and µg/Kg for soil

3.8 An SDG is defined by the following, whichever is more frequent:

- each 20 field samples received within a case, or
- each 7 calendar day period (3 calendar day period for 7 day turn around) during which field samples in a case are received (14 calendar days if requested by the client) beginning with the receipt of the first sample.

3.9 RT – Retention time

3.10 INDC = Individual Standard Mixture C

4.0 Interferences

4.1 Contaminants may be present in solvents/reagents, glassware, and other materials used in processing samples. Discrete artifacts and/or elevated baselines may result from these interferences. Materials used in sample preparation and analysis are demonstrated to be free of interferences by processing method blanks. Interferences from phthalates can be minimized by not using plastics in the lab.

Depending on the source of the environmental samples, co-extracted contaminants may cause matrix interferences that may vary from sampling site to sampling site.

5.0 Safety

5.1 Each chemical used in the method should be treated as a potential health hazard since the toxicity or carcinogenicity of each chemical/reagent lab has not been thoroughly determined. Safe handling of chemicals used in this method must be practiced. Information concerning the chemicals is available in Material Safety Data Sheets (MSDS). When working with these chemicals/reagents use adequate safeguards (hoods, safety glasses, and lab coats) and if eye or skin contact occurs, flush with large volumes of water.

Appropriate protective equipment and clothing must be used under the assumption that all samples are potentially hazardous. During sample preparation glasses, gloves and lab coats are a minimum requirement. The persistent presence of noxious odors may be indicative of failure of the laboratory ventilation system and must be reported to a supervisor or manager.

5.2 The following analytes in this method have been tentatively classified as known or suspect carcinogens: 4,4'-DDT, 4,4'-DDE, and BHCs.

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5.3 Laboratory staff are required to review the Chemical Hygiene Plan for general safety policies, and Material Safety Data Sheets for reagents used in the laboratory.

6.0 Equipment and Supplies

6.1 Gas Chromatograph

6.1.1 ThermoQuest Trace 8000 GCs and **Agilent Technologies 6890N GCs,** equipped with CTC A2000S/CTC HS500 autosamplers and dual Electron Capture Detectors are used.

6.1.2 Glass tee adapters will be used in 0.25 inch injector ports with glass adapters, allowing simultaneous injections onto both columns.

6.1.3 Helium is used as the carrier gas; P-5 (argon/methane) is used as the make-up gas.

6.2 Columns

6.2.1 Restek Rtx® CLPesticide (0.32 mm ID x 30 m, 0.5 µm film thickness) fused silica

6.2.2 Restek Rtx® CLPesticide II (0.32 mm ID x 30 m, 0.25 µm film thickness) fused silica

6.2.3 Restek universal Y presstight connectors

6.3 Data system

6.3.1 EZ-Chrom data acquisition system

6.3.2 **Promium's Element form** generation software.

6.4 Pipets

6.4.1 Eppendorf adjustable pipet with disposable pipet tips: 10 – 100 **µL**; 100 – 1000 µL

7.0 Reagents and Standards

Note: All SOM01.2 standards information is entered into the LIMS. To obtain information on any standard, access Element, click on "Laboratory," and scroll down and access "Standards." Standards can be sorted by Department. Select the standard you would like to access. The view will show lot number, prepared dates, solvent, vendor, composition, and concentration.

All standards are prepared by a chemist from the GC laboratory.

7.1 Reagent water – Use reagent-grade Type I water with regard to resistivity of > 10 megohm-cm (19th and 20th Editions of Standard Methods, Method 1080). It is demonstrated to meet the blank criteria contained in this Standard Operating Procedure (SOP). It is referred throughout this SOP as DI water.

7.2 Hexane – pesticide quality or equivalent

7.3 Working Standards

7.3.1 Commercially available standards are purchased from Restek and are received with manufacturer's certificates of analysis. The certificate documentation is retained for reference purposes. Working standards are prepared from the commercial standards in the organic standards preparation lab.

Note: The concentration and composition of standards used during the sample preparation and cleanup are provided in the sample preparation SOPs. Standards must equilibrate to room temperature before use.

7.3.2 Resolution Check Mixture

7.3.2.1 Prepare in hexane every six months, or sooner, if the solution has degraded or concentrated.

Compounds	Concentration (ng/mL)
alpha-BHC	10.0
beta-BHC	10.0
delta-BHC	10.0
gamma-BHC	10.0
Aldrin	10.0
Heptachlor	10.0
Heptachlor epoxide	10.0
alpha-Chlordane	10.0

Compounds	Concentration (ηg/mL)
gamma-Chlordane	10.0
Endosulfan I	10.0
Endosulfan II	20.0
4,4′-DDD	20.0
4,4′-DDE	20.0
4,4′-DDT	20.0
Dieldrin	20.0
Endrin	20.0
Endosulfan sulfate	20.0
Endrin ketone	20.0
Endrin aldehyde	20.0
Methoxychlor	100.0
Tetrachloro-m-xylene	10.0
Decachlorobiphenyl	20.0

7.3.3 Performance Evaluation Mixture (PEM)

7.3.3.1 Prepare in hexane every six months, or sooner, if the solution has degraded or concentrated.

Compounds	Concentration (ηg/mL)
gamma-BHC	10.0
alpha-BHC	10.0
4,4′-DDT	100.0
beta-BHC	10.0
Endrin	50.0
Methoxychlor	250.0
Tetrachloro-m-xylene	20.0
Decachlorobiphenyl	20.0

7.3.4 Individual Standard Mixture C

7.3.4.1 Prepare in hexane every six months or sooner, if the solution has degraded or concentrated.

7.3.4.2 The low calibration standard concentration corresponds to the CRQL, the midpoint concentration must be 4x the low point concentration and the high point concentration must be at least 16x the low point concentration. The standard is prepared every six months, or sooner if the solutions have degraded or concentrated.

INDC (ng/mL)					
Compound	**CS1**	**CS2**	**CS3**	**CS4**	**CS5**
alpha-BHC	5.0	10	20	40	80
Heptachlor	5.0	10	20	40	80
gamma-BHC	5.0	10	20	40	80
Endosulfan I	5.0	10	20	40	80
Dieldrin	10	20	40	80	160
Endrin	10	20	40	80	160
4,4'-DDD	10	20	40	80	160
4,4'-DDT	10	20	40	80	160
Methoxychlor	50	100	200	400	800
beta-BHC	5.0	10	20	40	80
delta-BHC	5.0	10	20	40	80
Aldrin	5.0	10	20	40	80
Heptachlor Epoxide (exo-epoxy isomer)	5.0	10	20	40	80
alpha-Chlordane	5.0	10	20	40	80
gamma-Chlordane	5.0	10	20	40	80
4,4'-DDE	10	20	40	80	160
Endosulfan Sulfate	10	20	40	80	160
Endrin Aldehyde	10	20	40	80	160
Endrin ketone	10	20	40	80	160
Endosulfan II	10	20	40	80	160
Tetrachloro-m-xylene	5.0	10	20	40	80
Decachlorobiphenyl	10	20	40	80	160

NOTE: Only the exo-epoxy isomer (isomer B) of Heptachlor Epoxide is used as an analytical standard.

7.3.5 Toxaphene Standards

7.3.5.1 Prepare in hexane every six months or sooner, if the solution has degraded or concentrated.

7.3.5.2 The concentrations of the surrogates tetrachloro-m-xylene (TCX) and decachlorobiphenyl (DCB), in each of the five concentration levels is the same as the INDC standard.

7.3.5.3 The concentrations of Toxaphene in the five calibration standards are 500, 1000, 2000, 4000, and 8000 ηg/mL.

7.4 Standard Solution Storage

7.4.1 Stocks and secondary dilution standards are stored at 4°C (± 2°C) in Teflon®-lined, screw cap amber vials/bottles. Fresh standard should be prepared every six months or sooner if degradation/evaporation occurs.

7.4.2 All working standards are stored at 4°C (± 2°C) in amber glass bottles/vials with Teflon®-lined screw caps and replaced every six months or sooner if degradation/evaporation occurs.

7.4.3 Corrective action SOPs shall be posted on the refrigerators.

8.0 Sample Preservation and Storage

8.1 Water samples are received from clients collected in 1L (or 1 quart) amber glass containers, fitted with screw caps lined with Teflon. If amber containers are not available, the samples should be protected from light. Soil samples are received from clients collected in glass containers or closed-end tubes (e.g., brass sleeves) in sufficient quantity to perform the analysis.

8.2 All samples must be iced or refrigerated at 4°C (± 2°C) from the time of collection until extraction.

8.3 Samples must be protected from light and refrigerated at 4°C (± 2°C) from the time of receipt until 60 days after delivery of a complete reconciled SDG.

8.4 Extracts must be stored at 4°C (± 2°C) until analysis and for 365 days after delivery of a complete reconciled SDG.

8.5 Samples and extracts must be stored in an atmosphere demonstrated to be free of contaminants.

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8.6 Water samples must be extracted within 5 days of VTSR, and started within 5 days for continuous liquid/liquid extraction. Soil/sediment samples must be extracted within 10 days of VTSR.

8.7 Samples are preserved and stored according to the tables in Sample Control SOP 4.1, "Receiving Samples" and 4.6, "Storing Samples." Sample holding times are also listed.

8.8 All extracts must be analyzed within 40 days of extraction.

8.9 Prior to analysis, all extracts must be stored in the reach-in refrigerated storage units in the laboratory. After analysis, extracts are returned to Sample Control for long-term storage and disposal.

9.0 Quality Control

9.1 Instrument Failure for GC analysis

9.1.1 When linearity is difficult to achieve, verify that the appropriate length of column is inserted in the detector. Examine all column ends and determine if the ends of the columns need to be trimmed.

9.1.2 When the instrument blanks fail, examine the chromatography to determine if there is contamination in the column that is causing the failure. If so, bake the column for 1 hour or less to see if this can be corrected. If the contamination is such that baking for 1 hour does not improve the baseline, it may be necessary to change the liner.

9.1.3 When calibration verifications fail recovery low, verify that the correct peaks are being named. Also verify that the syringe is not plugged and change the septa. If the calibration verification fails again, examine the chromatography to determine if there is a problem with the baseline that is causing the failure. If so, bake the column for 1 hour or less to see if this can be corrected. Also, if the calibration verification is failing on only one column, the y-splitter may be plugged. If the calibration verification continues to fail, the instrument will need a new calibration curve.

9.1.4 When calibration verifications fail recovery high, verify that the correct peaks are being named. Examine the chromatography to determine if there is contamination on the column that is causing the failure. If so, bake the column for 1 hour or less to see if this can be corrected. If the

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calibration verification fails again, the instrument will need a new calibration curve.

9.1.5 When the calibration verification fails due to drift, change the septa and verify that all the column fittings are secure. Also, determine if there is contamination on the column that is causing the failure. If so, bake the column for 1 hour or less to see if this can be corrected. If it is not corrected, a new multipoint must be acquired.

9.1.6 All preventive and routine maintenance as mentioned above is recorded in the instrument run log. Major maintenance is recorded in the maintenance log.

9.2 Initial Calibration

9.2.1 Acceptance Criteria

9.2.1.1 The resolution between two adjacent peaks, when using the single Individual Standard Mixture (C) has to be $\geq$ 80.0 % for all analytes for the primary column. For the confirmation column, the resolution for all analytes has to be $\geq$ 50.0%.

9.2.1.2 All single component pesticide and surrogate peaks in both runs of the PEM must be $\geq$ 90.0 % resolved on each column.

9.2.1.3 The absolute retention times (RT) of each of the single component pesticides and surrogates in both the PEMs must be within the retention time windows determined from the five-point initial calibration.

9.2.1.4 The percent difference (%D) of the calculated amount and the true amount for each of the single component pesticides AND surrogates in both of the PEMs on both columns must be $\geq$ -25.0 %, and $\leq$ 25.0 %

9.2.1.5 The breakdown of DDT and Endrin in both of the PEMs (bottle #2 and #14) must be $\leq$ 20.0 percent, and the combined breakdown of DDT and Endrin must be $\leq$ 30.0%.

9.2.1.6 The %RSD of the calibration factors for each single component pesticide is $\leq$ 20.0 % except alpha-BHC and delta-BHC, both of which must be $\leq$ 25.0 %.

- The %RSD of the calibration factors for the two surrogates must be ≤ 30.0 %.

- Other than surrogates, the calibration factors of up to two single-component analytes per column may exceed 20.0 % (25% for alpha-BHC and delta-BHC), but must be ≤ 30.0 %.

- The % RSD of the calibration factors for Toxaphene must be ≤ 30.0 %.

If the linearity requirements listed above are met, the calibration factor from the mid-point concentration standard is used for quantitation of each single component pesticide.

9.2.1.7 The resolution between any two adjacent peaks in the midpoint concentrations of Individual Standard Mixture C (CS3) in the initial calibration must be at least ≥ 80.0 % for the primary column and 50.0% for the secondary column.

9.2.1.8 Instrument blanks must not contain any target analyte ≥ the CRQL.

9.3 Continuing Calibration Verification

9.3.1 See Section 10.2 for frequency of Continuing Calibration Verification.

9.3.2 Acceptance Criteria

9.3.2.1 All single component pesticides and surrogates in the PEM used to demonstrate continuing calibration must be ≥ 90.0 % resolved. The resolution between any two adjacent peaks in the midpoint concentration of INDC (CS3) must be ≥ 80.0 for the primary column and 50.0% for the secondary column.

9.3.2.2 All absolute RTs for single-component pesticides and surrogates in the PEMs and midpoint INDC must be within the RT windows determined from the five-point initial calibration.

9.3.2.3 The percent difference of the calculated amount and the amount added (nominal amount) for each of the single component pesticides and surrogates in the PEM, used to

demonstrate continuing calibration, must be ≥ -25.0 % and ≤ 25.0 %.

9.3.2.4 Breakdown for endrin and DDT separately must be ≤ 20.0 % on each column. The combined breakdown of both DDT and endrin must be ≤ 30.0 % on each column.

9.3.2.5 The percent difference between the CF of each single component pesticide and surrogate in the INDC (CS3), used to demonstrate calibration verification, and the mean CF from the initial calibration must be ≥ -20.0% and ≤ 20.0%.

9.3.2.6 Instrument blanks must not have any target analytes detected at ≥ the CRQL, and surrogates must be within the RT windows.

9.4 Acceptance Criteria for Chromatograms of Calibration Standards

9.4.1 Chromatograms for the Resolution Check Mixture, the Performance Evaluation Mixture, and Individual Standard Mixture C during the initial calibration sequence must display the single component analytes at greater than 10% of full scale but less than 100% of full scale.

9.4.2 The chromatograms, for at least one of the five analyses of Individual Standard Mixtures C from the initial calibration sequence, must display the single component analytes at greater than 50% and less than 100% of full scale.

9.4.3 The chromatogram for at least one of the five analyses of the Toxaphene standards analyzed during the initial calibration must display the peaks chosen for identification at greater than 25% and less than 100% of full scale.

9.4.4 For any standard containing alpha-BHC, the baseline of the chromatogram must return to below 50% of full scale before the elution time of alpha-BHC, and return to below 25% of full scale after the elution time of alpha-BHC and before the elution time of decachlorobiphenyl.

9.4.5 If a chromatogram is replotted electronically to meet requirements, the scaling factor used must be displayed on the chromatogram.

Note: While the Target software does not provide a scaling factor, it does indicate intensity values.

9.4.6 If a chromatogram is replotted electronically to meet these requirements, both the initial chromatogram and the replotted chromatogram must be submitted in the data package.

9.5 Blanks

There are three types of blanks required by this method: method blanks, sulfur cleanup blanks, and instrument blanks.

9.5.1 Method Blanks. Method blanks, extracted each time samples are extracted (up to 20 field samples excluding MS/MSDs, PE samples and LCSs), are spiked with the surrogate solution, extracted, cleaned up, and analyzed by the same procedure as the samples. Water method blanks are one liter of reagent water treated as a water sample, while soils are 30 g of sodium sulfate treated as a soil sample.

Note: The following acceptance criteria apply independently to each column.

9.5.1.1 Method blanks must be analyzed on each GC/EC system used to analyze samples.

9.5.1.2 Method blanks cannot contain any target analytes at levels equal to or greater than the CRQL.

9.5.1.3 Surrogate acceptance criteria MUST be met.

9.5.1.4 Surrogate RTs must be within the RT windows from the initial calibration as described in section 10.0.

9.5.1.5 All samples associated with an unacceptable method blank must be re-extracted and reanalyzed.

9.5.2 Sulfur Cleanup Blank. A modified form of the method blank, it is hexane spiked with the surrogates and passed through the sulfur cleanup procedure with samples. Refer to Sample Preparation Procedure –946, "Sulfur Cleanup of Pesticide and PCB Extracts by Copper or Tetrabutylammonium (TBA) Sulfite by CLP, SW-846 and NYSASP."

Note: The following acceptance criteria apply independently to each column.

9.5.2.1 The sulfur cleanup blank is prepared when only part of a set of samples extracted together requires sulfur cleanup, and is associated only with the part of the set that requires sulfur cleanup. If all samples in a given SDG require sulfur cleanup, then the method blank must be subjected to sulfur cleanup, and no sulfur cleanup blank is required.

9.5.2.2 The sulfur cleanup blank also cannot contain any target analytes equal to or above the CRQLs, and the RTs of both surrogates must be within the RT window calculated during the initial calibration.

9.5.2.3 All samples associated with an unacceptable sulfur cleanup blank must be re-extracted.

9.5.2.4 Surrogate acceptance criteria MUST be met.

9.5.3 Instrument Blank. An instrument blank, **the first analysis in a 12-hour long sequence,** is a hexane solution containing 20.0 ηg/mL of tetrachloro-m-xylene and 40.0 ηg/mL decachlorobiphenyl. All groups of acceptable analyses must be preceded and followed by acceptable instrument blanks.

Note: The following acceptance criteria apply independently to each column.

9.5.3.1 All acceptable sample analyses are to be bracketed by acceptable instrument blanks.

9.5.3.2 The instrument blank must demonstrate that no target analyte is detected at equal to or greater than the CRQL and that the surrogate RTs are within the established RT criteria.

9.5.3.3 If analytes are detected at greater than the CRQL or the surrogate RTs are outside the RT windows, all data collection must be stopped and an acceptable instrument blank run before samples can be analyzed. All samples run between the last acceptable instrument blank and one that fails must be re-analyzed.

9.6 Matrix Spikes/Matrix Spike Duplicate (MS/MSD)

R2-0001827

9.6.1 An MS/MSD must be performed at least once every SDG, extracted and analyzed within holding times, and analyzed on an instrument meeting initial calibration verification and blank technical acceptance criteria.

9.6.2 The surrogate RTs must be within the RT windows.

9.6.3 Recovery limits and RPD are advisory, and the EPA dictates no action.

Compound	%Rec. Water	RPD Water	%Rec. Soil	RPD Soil
gamma-BHC	56-123	0-15	46-127	0-50
Heptachlor	40-131	0-20	35-130	0-31
Aldrin	40-120	0-22	34-132	0-43
Dieldrin	52-126	0-18	31-134	0-38
Endrin	56-121	0-21	42-139	0-45
4, 4'-DDT	38-127	0-27	23-134	0-50

9.7 Laboratory Control Sample (LCS)

9.7.1 A Laboratory Control Sample (LCS) is prepared and analyzed with each extraction batch.

9.7.2 The technical acceptance requirements apply independently to each GC column.

9.7.3 The LCS must be analyzed on a GC/ECD system meeting initial calibration, calibration verification, and blank technical acceptance criteria.

9.7.4 The surrogate RTs must be within the RT windows.

9.7.5 The percent recovery for each of the compounds in the LCS (water and soil/sediment) must be within the recovery limits presented below.

9.7.6 Surrogate recoveries must fall within the limits of 30-150% and the limits are not advisory.

Compounds	% Recovery
gamma-BHC	50-120
Heptachlor epoxide	50-120
Dieldrin	30-130

4,4'-DDE	50-150
Endrin	50-120
Endosulfin sulfate	50-120
gamma-Chlordane	30-130

9.7.7 If the acceptance criteria for the surrogates or the LCS compounds are not met, check calculations, spiking solutions, and instrument performance.

9.7.7.1 LCS technical acceptance criteria must be met before reporting any data.

9.7.7.2 LCS contamination or any LCS not meeting the technical acceptance criteria will require re-extraction and reanalysis of the LCS, along with all samples and required blanks (including MS/MSD and PE samples).

9.8 Sample Data Acceptance Criteria.

9.8.1 Requirements apply to both columns, and quantitations must be reported from both GC columns.

9.8.2 Surrogate acceptance limits are 30-150% for both tetrachloro-m-xylene and decachlorobiphenyl. Up to one surrogate may fail per column and the limits don't apply to dilutions.

9.8.3 The RT for both of the surrogates must be within the RT windows for both columns.

9.8.4 All samples must be analyzed as part of a valid analysis sequence, and must be bracketed by acceptable instrument blanks, Performance Evaluation Mixtures, and Individual Standard Mixture C, that were analyzed at the required frequency.

9.8.5 Reportable data for a sample must include a chromatogram with a baseline returning to < 50% of full scale before the elution of alpha-BHC, and to <25% of full scale after alpha-BHC but before the elution of decachlorobiphenyl.

9.8.6 For specifics regarding acceptable sample dilutions, see Section 11.0 below. No target compound concentrations may exceed the concentrations of the high level **initial calibration** standard.

9.8.7 The LCS associated with the samples must meet the technical acceptance criteria.

9.9 Surrogates

9.9.1 Two surrogates are used, 2,4,5,6-Tetrachloro-m-xylene (TCX) and Decachlorobiphenyl (DCB), and must be added to all samples, blanks, blank spikes (BS), MS, and MSDs prior to extraction. The RT of both surrogates must fall within the RT windows for an analysis to be acceptable. Surrogate recoveries are mandatory for blanks.

9.10 If Toxaphene is detected in a sample, a corresponding standard must be run within 72 hours of sample analysis. This standard is used for identification only. Quantitation is based on the mean calibration factor from the initial calibration.

9.11 Contingency

9.11.1 If, due to a lab accident or to QC failure, a re-preparation is required for the sample and insufficient volume remains, the Project Manager must be alerted and will contact the client for direction on how to proceed. For the CLP, the Sample Management Office must be contacted.

9.11.2 If persistent contamination occurs in the laboratory, analyses must be halted until the source can be identified and isolated. When the contamination issue is resolved, sample analyses may proceed.

9.11.3 Any other issues that potentially affect data quality should be addressed with the Project Manager.

10.0 Calibration and Standardization

10.1 Initial Calibration

10.1.1 Analysis begins with an initial demonstration of instrument performance and the calibration of all pesticides and Toxaphene. Initial calibration must be repeated whenever calibration verification fails, or when major instrument maintenance is performed (replacing a column, baking out the detector, etc.)

10.1.2 Analytical Sequence

10.1.2.1 Before any samples can be analyzed, an acceptable initial calibration sequence must be run.

10.1.2.2 For single component analytes and Toxaphene the initial calibration consists of five points.

10.1.2.3 The initial calibration standards are analyzed in order in positions (or bottles) 1-14 on the autoanalyzer as follows:

1. Resolution Check
2. Performance Evaluation Mixture (PEM)
3. Toxaphene CS1
4. Toxaphene CS2
5. Toxaphene CS3
6. Toxaphene CS4
7. Toxaphene CS5
8. CS1 Individual Standard Mix C
9. CS2 Individual Standard Mix C
10. CS3 Individual Standard Mix C
11. CS4 Individual Standard Mix C
12. CS5 Individual Standard Mix C
13. Instrument Blank
14. Performance Evaluation Mixture

10.1.2.5 Calibration and analysis sequence specifications of the GC/ECD method apply independently to both GC columns.

10.1.2.6 After the initial calibration, the analytical sequence may continue as long as acceptable instrument blanks, Performance Evaluation Mixtures, and Individual Standard Mixture C are analyzed at the required frequency and meet acceptance criteria.

A full sequence is performed as follows:

Time	Bottle/Position	Standards/Samples
	1-12	Initial Calibration
0 hour	13	Instrument Blank at the end of ICal
	14	PEM at the end of ICal
	15	First Sample
		Subsequent Samples
12 hours		Last Sample
	1st inj. past 12 hours	Instrument Blank

12 hours	2nd injection samples	Mid INDC Samples Last Sample
12 hours	1st inj. past 12 hours 2nd injection	Instrument Blank PEM Samples Last Sample

10.1.2.7 The first 12 hours begin with injection #13 (the instrument blank at the end of the initial calibration), and NOT from injection #1. Samples may be INJECTED until 12 hours have elapsed.

10.1.2.8 An analytical sequence must include all required QC: blanks, blank spikes, matrix spikes, and matrix spike duplicates.

10.2 Continuing Calibration Verification

10.2.1 Three types of analyses are used to verify the calibration and evaluate instrument performance. Instrument Blanks, PEM's, and the mid-point concentration of INDC (CS3) constitute the continuing calibration.

10.2.2 Each 12-hour period during which sample data are collected must be bracketed on one end by an Instrument Blank (IB) plus a PEM and on the other end by an IB plus the mid point concentration of INDC.

10.2.3 For the 12-hour period immediately following the initial calibration sequence, the IB and PEM that are the last two steps in the initial calibration sequence are considered to bracket the front end of that 12-hour period. The injection of the IB starts the beginning of the 12-hour period. Samples may be INJECTED for 12 hours from the injection of the IB. The two injections immediately following that 12-hour period must be an IB and INDC. The IB must be analyzed first and then the INDC.

10.2.4 The analyses of the IB and INDC immediately following one 12-hour period may be used to begin the subsequent 12-hour period, provided they meet acceptance criteria. The subsequent 12-hour period must end with the acceptable analyses of an IB and a PEM, in that order. Those two analyses may in turn be used to bracket the front end of yet another 12-hour period. This progression may continue every 12 hours until such time as any of the IBs, PEMs, or INDC standards fail to meet acceptance criteria. Each 12-hour period begins with the injection of the IB.

10.2.5 If more than 12 hours have elapsed since the injection of an IB that bracketed a previous 12-hour period, an acceptable IB and PEM MUST be analyzed in order to start a new sequence. This applies even if no analyses were performed since that standard was injected.

10.2.6 After a break in sample analyses, sample analysis may proceed, using the current initial calibration for quantitation, by first analyzing an acceptable IB and PEM.

10.2.7 If sample analyses are completed and there is time remaining in the 12 hour tune, the shortened sequence MUST be ended with either the IB/PEM combination or the IB/INDC combination, whichever was due to be performed at the end of the 12-hour period.

10.2.8 If the PEM or Individual Standard Mixture C does not meet acceptance criteria it must be immediately re-injected and if it then meets acceptance criteria, analyses may continue. If the second injection doesn't meet criteria, all analyses must be stopped and corrective action taken. If the corrective action involves changing the septa, changing the liner, or baking, re-inject the standard. If any other corrective action is taken, then a new initial calibration performed.

10.2.9 Carryover of late eluting peaks into the next injection is not acceptable. Instrument blanks and standards may have to be run at a greater frequency to avoid discarding data.

10.2.10 No more than 14 hours are allowed to lapse from the injection beginning the opening CCV and the injection ending the closing CCV (PEM or Individual Standard Mixture C).

10.3 Linearity

10.3.1 The high point concentration defines the upper end of the concentration, or linear range.

10.3.2 The linearity of the instrument is determined by calculating a percent relative standard deviation (%RSD) of the calibration factors from a five-point calibration curve for each single component pesticide, Toxaphene and surrogates. Use peak area to calculate calibration factors used in the %RSD equation.

10.3.3 If the linearity requirements listed above are met, the mean calibration factors from the initial calibration standards are used for quantitation of each single-component pesticide and Toxaphene.

10.4 Determination of Absolute Retention Times

10.4.1 During the initial calibration sequence, absolute RTs are determined for all single response pesticides, Toxaphene, and the surrogates.

10.4.2 For single component pesticides an RT is measured in each of the five Individual Standard Mixture C calibration standards. The mean RT is calculated as the average of the five values. For surrogates, an RT is measured from each of the five analyses of Individual Mixture C, and the mean RT is calculated as the average of the five values.

10.4.3 For Toxaphene, an RT is measured in each of the five calibration standards for 3, 4, or 5 of the major peaks.

10.4.4 An RT window is calculated for each single component analyte and surrogate by using the following list. Windows are centered around the mean absolute retention time for the analyte established during the initial calibrations. Retention time windows are set as follows:

Compound	RT window(min)
alpha-BHC	± 0.05
beta-BHC	± 0.05
gamma-BHC	± 0.05
delta-BHC	± 0.05
Heptachlor	± 0.05
Aldrin	± 0.05
alpha-Chlordane	± 0.07
gamma-Chlordane	± 0.07
Heptachlor epoxide	± 0.07
Dieldrin	± 0.07
Endrin	± 0.07
Endrin Aldehyde	± 0.07
Endrin Ketone	± 0.07
DDD	± 0.07
DDE	± 0.07
DDT	± 0.07
Endosulfan I	± 0.07
Endosulfan II	± 0.07

Compound	RT window(min)
Endosulfan sulfate	± 0.07
Methoxychlor	± 0.07
Toxaphene	± 0.07
TCX	± 0.05
DCB	± 0.10

10.4.5 Analytes are identified when peaks are observed in the RT window for the compound on both GC columns.

11.0 Procedure

Documentation must follow the requirements in Quality Control SOP 13.6 "Proper Documentation Procedures". The analyst must complete all information fields in the run log (Attachment 2.) **Condition Codes, abbreviations defined in Attachment 3, are used to document failed and qualified injections.**

11.1 Analysis of a sample on BOTH GC columns is required for ALL samples, blanks, matrix spikes, matrix spike duplicates and LCSs, whether pesticides are detected on the primary column or not.

11.2 Sample analysis may not begin until a satisfactory calibration has been demonstrated.

11.3 GC Operating Conditions. The following are the GC analytical conditions:

11.3.1 Carrier gas

11.3.1.1 Helium

11.3.1.2 Flow rate: 10 mL/minute

11.3.2 Make-up gas

11.3.2.1 Argon/methane (P - 5)

11.3.2.2 Flow rate: 20 mL/minute

11.3.3 Injector temperature: 225° C

11.3.4 Detector (ECD) temperature: 330° C

11.3.5 Injection volume: 1 µL per column

11.3.6 Initial oven temperature: 150° C

11.3.7 Initial hold time: 1.0 minute

11.3.8 Temperature ramp: 6° C/minute

11.3.9 Final temperature: 275° C

11.3.10 Final hold time: 1.0 minute

Note: These are typical operating conditions that may vary with different instruments and/or instrument performance.

11.4 Sample Analysis and Acceptance Criteria

11.4.1 A single component pesticide is identified if a peak is detected within the target retention time window on each of two columns. Toxaphene is identified primarily by pattern recognition, but RTs of 3 to 5 major peaks must also be taken into consideration. The absolute RT window is calculated during initial calibration from the mean RT of the standards.

11.4.2 The concentration of all analytes must be ≤ the concentration in the high initial calibration standard. If not, the extracts must be diluted.

11.4.3 Quantitation must be performed and reported for both GC columns.

11.4.4 If sample chromatograms have interfering or off-scale peaks or a high baseline, then those samples must be diluted, subjected to sulfur cleanup, or re-extracted. Samples that still do not meet acceptance criteria after one re-extraction with the three-step cleanup (GPC, Florisil, and sulfur) can be reported without further analysis as long as they are discussed in the SDG narrative. Failures based on method blanks, however, must include additional extractions.

11.4.5 A standard for Toxaphene must be analyzed on the same instrument and column within 72 hours of its detection in a sample, with a valid 12-hour sequence.

11.4.6 Sample Dilutions

11.4.6.1 The sample must be analyzed at the most concentrated level while still achieving satisfactory chromatography.

11.4.6.2 If an acceptable chromatogram is achieved with the diluted extract, an additional analysis 10 times the concentration of the diluted sample must be performed and reported with the sample data.

11.4.6.3 If the dilution factor is less than or equal to 10, an undiluted sample extract must be injected and reported. If the most concentrated extract doesn't meet dilution requirements of having no target analytes exceeding the upper limit of the initial calibration, then the analysis is at no additional cost to the EPA.

11.4.6.4 If the concentration of any single component pesticide is greater than the concentration of the high standard (CS5) of the initial calibration on both columns, then the extract must be diluted and the concentration of the pesticide compounds(s) in the diluted extract must be between the initial calibration low and high point standards.

11.4.6.5 For Toxaphene, if the concentration of the largest peak is greater than the concentration of the corresponding Toxaphene peak in the high level standard from the initial calibration on both columns, then the sample must be diluted. The concentration of the largest peak in the dilution of the Toxaphene must be between the concentrations of the low and high level single component standards from the initial calibration.

11.4.6.6 Do not dilute the MS/MSD solely to get non-spike analytes within the calibration range.

11.4.6.7 If more than two analyses are required to get all target compounds within the calibration range, contact the client for guidance.

11.4.7 Sample Chromatograms

11.4.7.1 If no analytes are identified in a sample, the chromatogram of the sample must use the same scaling factor as the low point standard of the initial calibration.

11.4.7.2 Chromatograms must display single component pesticides detected in the sample at less than full scale.

11.4.7.3 Chromatograms must display the largest peak of any Toxaphene detected in the sample at less than full scale.

11.4.7.4 If an extract is diluted, chromatograms must display single component pesticides between 10 and 100 percent of full scale.

11.4.7.5 If an extract is diluted, chromatograms must display the peaks chosen for quantitation of Toxaphene between 25 and 100 percent of full scale.

11.4.7.6 For any sample, the baseline of the chromatogram must return to below 50% of full scale before the elution time of alpha-BHC, and return to below 25% of full scale after the elution time of alpha-BHC and before decachlorobiphenyl.

11.5 GC/MS Confirmation of Pesticides and Aroclors

11.5.1 Any pesticide or Aroclor analyte for which a concentration is reported from a GC/EC analysis must have the identification confirmed by GC/MS if the concentration is sufficient for that purpose.

GC/MS confirmation takes place if pesticide concentrations are $\geq$ 5 ηg/µL for both columns for single components and 125 ηg/µL for both columns for Toxaphene. A GC/MS confirmation analysis also takes place if a pesticide is detected as a TIC in the semivolatile analysis and is also detected by GC/ECD. The GC/MS confirmation may be accomplished by one of the following:

11.5.1.1 examination of the semivolatile GC/MS library search results (TICs),

11.5.1.2 a second analysis of the semivolatile extract, or

11.5.1.3 analysis of the pesticide/Aroclor extract following solvent exchange.

11.5.2 If an analyte cannot be confirmed by either of the first two procedures listed above, then the pesticide/Aroclor extract must be analyzed by GC/MS following solvent exchange.

11.5.2.1 In order to confirm the identification of the target pesticide/Toxaphene, the GC/MS laboratory must also analyze a reference standard for the analyte at a concentration no greater than 10 ηg / 2 µL for single component pesticides and 125 ηg/µL for Toxaphene. This reference standard for single component pesticides may be included in the semivolatile continuing calibration standard or analyzed separately.

11.5.3 Regardless of which of the three approaches above is used for GC/MS confirmation, the appropriate blank must also be analyzed by GC/MS.

11.5.3.1 If the confirmation is based on the analysis of the semivolatile extract, the semivolatile method blank must be injected.

11.5.3.2 If the confirmation is based on the analysis of the pesticide extract, the pesticide method blank must be injected on the GC/MS instrument.

11.5.4 If the identification of the analyte cannot be confirmed by GC/MS, the analyte is then reported as undetected and the sample quantitation limit is adjusted to an equivalent concentration of the GC/MS reference standard. Unconfirmed analytes are qualified with a laboratory-defined footnote on the Form 1, and this is explained in the SDG narrative.

11.5.5 Pesticide results that are confirmed by GC/MS are flagged with a "C" on Form 1.

11.5.6 For single component analytes, the required deliverables are copies of the library search results (three best TIC matches) or analyte spectrum and the spectrum of the reference standard. For Toxaphene, spectra of three characteristic peaks are required for both the sample component and the reference standard.

12.0 Data Analysis and Calculations

12.1 Quantitation of Analytes

Calculations must be consistent with the Quality Control SOP 13.4, "Numerical Data Reduction".

12.1.1 If analytes are detected below the CRQL, they are reported and flagged with a "J" to indicate the value is estimated.

12.1.2 If target analytes are detected at a level greater than the high calibration point, the sample must be diluted either to a maximum of 1:100,000 or until the response is within the upper half of the linear range. If response is still out of range after a 1:100,000 dilution, the client should be contacted.

12.1.3 If a dilution is done solely to bring a peak within the calibration range or to get the Toxaphene pattern on scale, the results for both the more and the less concentrated extract must be reported. The changes in quantitation limits and surrogate recovery are affected by sample dilutions.

12.1.4 The quantitation of Toxaphene is done by comparing areas of each of three to five major peaks of the sample with the mean calibration factor for the same peaks established in the initial calibration. The concentration of each peak is determined in this way, and then an average concentration for three to five major peaks is determined and reported on Form I.

12.2 Calculation of the mean or average of a set of values (also used for Mean Calibration Factor, $\overline{CF}$)

$$\overline{X} = \frac{\sum_{i=1}^{n} X_i}{n}$$

where: n = total number of values
x_i = each individual value used to calculate the mean
x = the mean of n

12.3 Calculation of the standard deviation of a set of values:

$$\text{Standard deviation} = \sqrt{\frac{\sum_{i=1}^{n}\left(X_n - \overline{X}\right)^2}{n-1}}$$

12.4 Calculation of percent recovery:
12.4.1 LCS and surrogates:

$$\%R = \frac{Amount\ found}{Amount\ spiked}\ x\ 100$$

12.4.2 Matrix spikes:

$$\%\,R = \frac{Amount\ in\ spiked\ sample - Amount\ in\ unspiked\ (native)\ sample}{Amount\ spiked} \times 100$$

12.5 Calculation of % RSD

$$\%RSD = \left(\frac{Standard\ deviation}{\overline{X}}\right) \times 100$$

12.6 Calculation of RPD

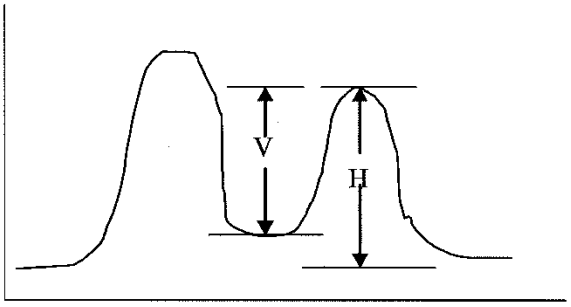
$$RPD = \frac{|Value\ 1 - Value\ 2|}{(Value\ 1 + Value\ 2)/2} x100$$

12.7 Calculation of %Difference (%D)

$$\%Diff = \frac{Value - \overline{Reference\ \ value}}{\overline{Reference\ \ value}} \times 100$$

12.8 Calculation of Resolution

The calculation of resolution between the analyte in the Resolution Check Mixture, the Performance Evaluation Mixture, and the midpoint concentration of Individual Standard Mixtures A and B is performed as follows:



where: x axis = time
y axis = peak area or height
V = depth of the valley between two adjacent peaks. The depth of the valley is measured along a vertical line from the level of the apex of the shorter peak to the floor of the valley between the two peaks.
H = height of the shorter of the two adjacent peaks

$$\%\ Resolution = \frac{V}{H} x 100$$

12.9 Breakdown in PEMs

$$\%\ breakdown\ DDT = \frac{Amount\ (\eta g)\ DDD + DDE\ found}{Amount\ (\eta g)\ DDT\ injected} x 100$$

$$\%\ breakdown\ endrin = \frac{Amount\ (\eta g)\ endrin\ aldehyde + endrin\ ketone\ found}{Amount\ endrin\ injected}$$

$$Combined\ \%\ breakdown = \%\ breakdown\ DDT + \%\ breakdown\ endrin$$

12.10 Calibration Factor (See 12.2 for calculation of Mean Calibration Factor $\overline{CF}$)

$$CF = \frac{peak\ area\ (or\ height)}{mass\ injected\ (ng)}$$

12.11 Concentration

12.11.1 Quantitative analysis of pesticides and Toxaphene must be accomplished by the external standard method. Five-point calibration curves for single component analytes, Toxaphene and the surrogates must be generated during the initial calibration. A linear response range must be demonstrated from the Contract Required Quantitation Limits (CRQL) to a high point at least 16 times greater than the CRQL.

12.11.2 Concentration in aqueous samples

$$\mu g/L = \frac{(Ax)(Vt)(DF)(CVout)}{(\overline{CF})(Vo)(Vi)(CVinXE)}$$

where:

Ax = area of the peak for the compound to be measured
$\overline{CF}$ = Mean calibration factor from the initial calibration
Vo = volume of water extracted (mL)
Vi = volume of extract injected (µL)
Vt = volume of the concentrated extract (µL)
Df = dilution factor. If no dilution, Df = 1.0
CVout = volume of extract produced by a cleanup process (cleanup and concentration), in µL
CVin = volume of extract subjected to a cleanup process, in µL
E = the efficiency of the cleanup process expressed as a fraction of material that passes through or is not mechanically lost during the cleanup step (e.g., 50% efficiency must be expressed as 0.50)

12.11.3 Concentration in soil samples (dry weight basis)

$$\mu g/kg = \frac{(Ax)(Vt)(Df)(CVout)}{(\overline{CF})(Vi)(Ws)(D)(CVinXE)}$$

where:

Ax and $\overline{CF}$ = same as for water

Vt = Volume of concentrated extract in µl (5000 µL)
Vi = Volume of extract injected in µl
Ws = weight of sample extracted, in grams
Df = Dilution factor

D = Dry weight factor (% moisture) = $\frac{100 - \%\ moisture}{100}$
CVout = volume of extract produced by a cleanup process (cleanup and concentration), in µL
CVin = volume of extract subjected to a cleanup process, in µL
E = the efficiency of the cleanup process expressed as a fraction of material that passes through or is not mechanically lost during the cleanup step (e.g., 50% efficiency must be expressed as 0.50)

12.12 Calculating Dilutions

If a sample concentration exceeds the high level standard a dilution must be performed. Determine a level of dilution that will result in a value within the calibration range. This is an acceptable dilution. A 10x dilution is performed using 1 mL sample plus 9 mL diluent for a total volume of 10 mL. It should be recorded on the run log as "10x (1 mL in 10 mL)."

12.12.1 Dilution factor

$$Dilution\ factor = \frac{\mu L\ most\ conc.\ extract\ used\ to\ make\ dilution + \mu L\ clean\ solvent}{\mu L\ most\ conc.\ extract\ used\ to\ make\ dilution}$$

13.0 Method Performance

This method was validated through in-house laboratory studies of method detection limits and precision and accuracy for single analyst. The data are retained by the QA department.

14.0 Pollution Prevention

The solvents used in this procedure pose little threat to the environment when recycled and managed properly. Pollution prevention encompasses any technique that reduces or eliminates the quantity or toxicity of waste at the point of generation. Numerous opportunities for pollution prevention exist in laboratory operation. The EPA has

established a preferred hierarchy of environmental management techniques that places pollution prevention as the management option of first choice. Whenever feasible, laboratory personnel should use pollution prevention techniques to address their waste generation. When wastes cannot be feasibly reduced at the source, the Agency recommends recycling as the next best thing. See SOP 12.1, Hazardous Waste Disposal, regarding laboratory procedures for recycling solvent waste streams.

15.0 Waste Management

It is the laboratory's responsibility to comply with all federal, state, and local regulations governing waste management, particularly the hazardous waste identification rules and land disposal restrictions, and to protect the air, water, and land by minimizing and controlling all releases from fume hoods and bench operations. Compliance with all sewage discharge permits and regulations is also required.

Samples preserved with HCl or H_2SO_4 to pH <2 are hazardous and must be handled as hazardous waste.

Refer to the Hazardous Waste Management and Safety SOPs located in the lab.

16.0 References

16.1 USEPA CLP SOW for Organic Analysis, Multi-media, Multi Concentration SOM01.2 (8/2007)

16.2 Standard Methods for the Examination of Water and Wastewater, 20th Edition (1998), Method 1080

16.3 Quality Control SOP 13.6 "Proper Documentation Procedures"

16.4 Quality Control SOP 13.4 "Numerical Data Reduction"

16.5 "Less is Better: Laboratory Chemical Management for Waste Reduction," American Chemical Society Department of Government Relations and Science Policy, 1155 16th Street, N.W., Washington DC, 20036, (202) 872-4477.

16.6 Hazardous Waste Management & Safety SOPs: "Hazardous Waste Disposal" and "Spill Control & Cleanup."

16.7 **NELAC Standards, effective July 2003**

16.8 QA-G6: Guidance for the Preparation of Standard Operating Procedures for Quality-Related Operations EPA/600/R-96/027, November 1995.

16.**9** CompuChem Quality Manual, Revision **11, June 23, 2008, plus revisions**

16.**10** Sample Control SOP 4.1, "Receiving Samples"

16.11 Sample Control SOP 4.6, "Storing Samples"

16.12 Sample Preparation Procedure –946, "Sulfur Cleanup of Pesticide and PCB Extracts by Copper or Tetrabutylammonium (TBA) Sulfite by CLP, SW-846 and NYSASP."

16.13 Sample Preparation Procedure -742 (-1090-->-938), "Preparation of Water Samples for the Analysis of Pesticides/ PCBs by CLP and NYSASP"

16.14 Sample Preparation Procedure -743 (-251→-940→-938), "Preparation of Soil/Sediment/Sludge Samples for the Analysis of Pesticides/PCBs by EPA CLP and NYSASP"

17.0 Attachments as Tables, Diagrams, Flowcharts & Validation Data

17.1 Attachment 1 - Target Compound List and CRQLs

17.2 Attachment 2 - GC Run Log

Attachment 1

The Target Compound List (TCL) of analytes, together with their Contract Required Quantitation Limits (CRQL), in the proper reporting units.

Target Compound	CAS No.	CRQLs	
		Water µg/L	Soil µg/Kg
alpha-BHC	319-84-6	0.050	1.7
beta-BHC	319-85-7	0.050	1.7
delta-BHC	319-86-8	0.050	1.7
gamma-BHC (Lindane)	58-89-9	0.050	1.7
Heptachlor	76-44-8	0.050	1.7
Aldrin	309-00-2	0.050	1.7
Heptachlor epoxide	1024-57-3	0.050	1.7
Endosulfan I	959-98-8	0.050	1.7
Dieldrin	60-57-1	0.10	3.3
4,4'-DDE	72-55-9	0.10	3.3
Endrin	72-20-8	0.10	3.3
Endosulfan II	33213-65-9	0.10	3.3
4,4'-DDD	72-54-8	0.10	3.3
Endosulfan sulfate	1031-07-8	0.10	3.3
4,4'-DDT	50-29-3	0.10	3.3
Methoxychlor	72-43-5	0.50	17
Endrin ketone	53494-70-5	0.10	3.3
Endrin aldehyde	7421-93-4	0.10	3.3
alpha-Chlordane	5103-71-9	0.050	1.7
gamma-Chlordane	5103-74-2	0.050	1.7
Toxaphene	8001-35-2	5.0	170

Attachment 2

COMPUCHEM a Division of Liberty Analytical Corp Instrument ID 8091 File Path: _____ DATE ___/___/___
GC EXTRACTABLES RUN LOG
COMPUCHEM LOGBOOK 4 Q (5) 11 Method: 8081A 8082 8151A OLM04.3 OLC03.2 SOM01.2 Other _____ Amt. Inj 2 µL (1 µL per column)

☐Changed septum ☐Changed liner ☐Baked column ☐Trimmed column

	FILE NUMBER	DATE	COMPUCHEM #	CASE/SDG#	STANDARD ID	CHEMIST	COMMENTS
1		/ /					
2		/ /					
3		/ /					
4		/ /					
5		/ /					
6		/ /					
7		/ /					
8		/ /					
9		/ /					
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15		/ /					
16		/ /					
17		/ /					
18		/ /					
19		/ /					
20		/ /					

The presence of the Chemist's/Analyst's employee ID number, or signature, on this run log attests that strict compliance with the method's SOP has occurred. Any SOP deviations require documentation by the responsible chemist/analyst together with the chemist's/analyst's initials and the initials of the lab supervisor and a QA department representative, signifying approval of the deviation.

Calibration ID: _____ Sequence ID: _____ Hexane Lot No_____

REVIEWED BY: _____ DATE _____

01/20/09: js

R2-0001848

Attachment 3

Condition Codes Used for Documentation in Logbooks

Code	Explaination
CS	Carry over Suspected from prior analysis
CT	Contamination verified
DI	Requires Dilution
DW	Dilution Wrong
JS	Reinjection same as prior run
LA	Lab Accident (explain in comments)
OT	Other (explain in comments)
OW	Original wrong for QC sample
RP	Reportable prior run
RT	Retention time shift
RU	Repeated Unnecessarily
SF	Spike recoveries failed (high or low)
SI	Spiked inadvertently
SH	Surrogate recoveries high
SL	Surrogate recoveries low
SM	Surrogate or spike missing
IF	Instrument failure
US	Unacceptable Standard (explain in comments)
VR	Verify results
NM	Did not match prior run or duplicate
RN	Reanalyze neat, was run at a dilution
PC	Poor chromatography
SC	Sulfur clean up required
WS	Wrong standard (SOM PCBs)
MI	Misinjection (bad injection)

Code	Explaination
%R	%RSD failed (lcal)
%B	Breakdown failed
%D	%D (CCV)
RT	Retention time shift
RU	Repeated Unnecessarily
IF	Instrument failure
US	Unacceptable Standard (explain in comments)
PC	Poor chromatography
SC	Sulfur clean up required
LA	Lab Accident (explain in comments)
OT	Other (explain in comments)

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SOP DOCUMENTATION FORM

This form must accompany all new and revised Standard Operating Procedures (SOPs) when you turn them in to Quality Assurance for review. Please fill out the entire block below (except effective date).

This is a new procedure _____ revised procedure ✓ outdated procedure (archive) _____

- Procedure Code: IP 1500 SOP Section #: 2.1.2.4 Revision #: 4

SOP Title: GC/ECD Analysis of Polychlorinated Biphenyls (PCBs) as Aroclors in Water and Soil Extracts by CLP SOW SOM01.2

Effective date: (QA fills in) 2/24/09

- Procedure prepared by: Bob Meixner Date: 02-04-2009
- Procedure approved by: (If the manager prepared the SOP, a qualified second party should sign) Kathryn E Humphries Date: 2/13/09
- Reason for change: Corrections from EPA/QATS review plus minor changes from annual review
- This procedure meets the requirements of the following approved method references: USEPA CLP SOW SOM01.2

Procedure approved by a QA Representative (unless QA Representative signed above):

_____ Date: _____

On an annual basis: Lab managers are required to review lab practices and revise the SOP if necessary. If no revision is necessary, indicate by your signature that the SOP has been reviewed.

Annual Review—Signature: _____ Date: 2/21/09

Annual Review—Signature: _____ Date: _____

Annual Review—Signature: _____ Date: _____

Annual Review—Signature: _____ Date: _____

R2-0001850

Instrument Procedure 1500: GC/ECD Analysis of Polychlorinated Biphenyls (PCBs) as Aroclors in Water and Soil Extracts by CLP SOW SOM01.2

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Instrument Procedure 1500: GC/ECD Analysis of Polychlorinated Biphenyls (PCBs) as Aroclors in Water and Soil Extracts by CLP SOW SOM01.2

1.0 Scope and Application

This procedure is used to determine the concentration of various polychlorinated biphenyls (PCBs) as Aroclors in extracts from solid and liquid matrices. Open-tubular, capillary columns are employed with electron capture detectors (ECD). The following are amenable to analysis using this method:

Compound Name	CAS Registry No.
Aroclor-1016	12674-11-2
Aroclor-1221	11104-28-2
Aroclor-1232	11141-16-5
Aroclor-1242	53469-21-9
Aroclor-1248	12672-29-6
Aroclor-1254	11097-69-1
Aroclor-1260	11096-82-5
Aroclor-1262	37324-23-5
Aroclor-1268	11100-14-4

Staff members performing the procedures described in this SOP are responsible for reading, understanding, and complying with the SOP requirements. Supervisors are responsible for directing the analyst to the controlled SOP, and providing adequate explanation of the material contained therein.

This procedure is restricted to use by or under the supervision of analysts experienced in the instrumentation or preparative methods and who have demonstrated the ability to generate acceptable results through QC samples and analyst capability studies.

2.0 Summary of Method

Aqueous and solid sample extracts are analyzed using a gas chromatograph equipped with an electron capture detector (GC/ECD).

The analysis is performed using the dual column option where a Y-splitter joins a single injection port with two dissimilar analytical columns. In this manner, confirmation may be performed simultaneously with the primary analysis. The extract is analyzed by

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injecting 2 µL (1 µL per column) into a GC with dual wide-bore, fused silica, capillary columns.

3.0 Definitions

3.1 Method detection limit (MDL) – The minimum concentration of an analyte that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte (40 CFR, Part 136, Appendix B.)

3.2 Reporting Limit – The laboratory reporting limit is based on the lowest multipoint calibration standard concentration. For organic methods, values detected below the reporting limit and above the MDL may be reported and qualified as an estimated concentration.

If the low level standard concentration is not at least three times higher than the MDL value, the standard concentration is adjusted upward in order to achieve this minimal ratio. It may be adjusted higher than three times depending on the concentration range of the calibration curve and the ability to meet method linearity requirements. An exception to this is for CLP methods where the MDL is only required to be lower than the reporting limit.

For CLP the reporting limit is the Contract Required Quantitation Limit (CRQL) for organics.

3.3 An SDG is defined by the following, whichever is more frequent:

- each 20 field samples received within a case, or
- each 7 calendar day period (3 calendar day period for 7 day turn around) during which field samples in a case are received (14 calendar days if requested by the client) beginning with the receipt of the first sample.

3.4 VTSR – Validated Time of Sample Receipt

3.5 Aroclor 1660 – A mixture of single component Aroclors 1016 and 1260

4.0 Interferences

4.1 Interferences in this method can be grouped into three broad categories: contaminated solvents, reagents, or glassware; contaminated GC carrier gas, parts, column surfaces, detector surfaces; and the presence of co-eluting

compounds in the sample matrix that also are detected by the ECD. Specific cleanups may be necessary for samples, depending on the compounds of interest.

4.2 Interferences by phthalate esters introduced during the sample preparation procedures can be a major problem. Common flexible plastics found in certain gloves and other objects contain varying amounts of phthalates which may be introduced during lab operations. Cross-contamination of clean glassware routinely occurs when plastics are handled during extraction steps, especially when solvent wetted surfaces are handled. These interferences can be minimized by cleanup of solvents, reagents, and glassware.

4.3 Glassware must be scrupulously cleaned as soon as possible after use by rinsing with the last solvent used. This should be followed by detergent washing with hot water, and rinses with tap water and organic-free reagent water. Drain the glassware and dry in an oven at 130° C for several hours or rinse with methanol and drain.

4.4 The presence of elemental sulfur will result in broad peaks that interfere with early eluting pesticides, and can be removed by cleaning the extract with tetrabutylammonium (TBA) sulfite reagent.

4.5 Waxes, lipids, and other high molecular weight compounds are also removed using GPC.

5.0 Safety

Appropriate protective equipment and clothing must be used under the assumption that all samples are potentially hazardous. During sample preparation glasses, gloves and lab coats are a minimum requirement. The persistent presence of noxious odors may be indicative of failure of the laboratory ventilation system and must be reported to a supervisor or manager.

Laboratory staff must review the Chemical Hygiene Plan for general safety policies, and Material Safety Data Sheets for reagents used in the laboratory.

6.0 Equipment and Supplies

6.1 GC/ECD – **ThermoQuest Trace 8000 GCs and Agilent Technologies 6890N GCs, equipped with dual Electron Capture Detectors are used.**

6.2 10 µL syringes – Hamilton

6.3 Autosampler – CTC A2000S

6.4 GC Columns

6.4.1 Restek, Rtx® - clpest, 30 m, 0.32 mm ID, 0.5 µm film thickness

6.4.2 Restek, Rtx® - clpest2, 30 m, 0.32 mm ID, 0.42 µm film thickness

6.4.3 Restek universal Y presstight connectors

6.5 Screw top amber vials – 2 mL, Microliter Analytical Supplies, Inc.

6.6 Data system

6.6.1 EZ-Chrom data acquisition system

6.6.2 **Promium's Element form** generation software.

6.7 Pipets

6.7.1 Eppendorf adjustable pipet with disposable pipet tips: 10 – 100 mL; 100 – 1000 µL

6.7.2 Drummond adjustable pipet with disposable capillary tubes to deliver between 20-100 µL volumes

7.0 Reagents and Standards

7.1 **Note: All SOM01.2 standards information is entered into the LIMS. To obtain information on any standard, access Element, click on "Laboratory," and scroll down and access "Standards." Standards can be sorted by Department. Select the standard you would like to access. The view will show lot number, prepared dates, solvent, vendor, composition, and concentration.**

7.2 Refer to the Standards Preparation Logbook 22 F for details on preparation of standards used in this procedure.

7.3 Reagent water – Use reagent-grade Type I with regard to resistivity of > 10 megohm-cm (19th and 20th Editions of Standard Methods, Method 1080), and is demonstrated to meet the blank criteria contained in this Standard Operating Procedure (SOP). It is referred throughout this SOP as DI water.

7.4 Hexane – pesticide grade

7.5 Tetrabutylammonium sulfite reagent

7.3.1 Tetrabutylammonium hydrogen sulfate – 97%, Sigma-Aldrich

7.3.2 Sodium sulfite – ACS grade, 98% EM Science

7.6 Stock standard solutions (1 mg/mL) are purchased from Restek Corporation, for example, as certified solutions.

7.7 Prepare calibration standards at 100, 200, 400, 800, and 1600 ng/mL by diluting the stock standards solutions with hexane.

7.8 Separate calibration standards are used for each multi-component analyte, with the exception of Aroclors 1016 and 1260, which can be run as a mixture. The mixture is referred to as Aroclor 1660.

7.9 Surrogate standard solution – Tetrachloro-m-xylene (TCX) at 0.6 µg/mL and Decachlorobiphenyl (DCB) at 1.2 µg/mL.

7.9.1 Decachlorobiphenyl (DCB) and tetrachloro-m-xylene (TCX) are the surrogates used. Corrective action is taken when the recoveries of both surrogates fall outside acceptance limits on both columns.

7.10 Store all reagents in a flammables cabinet or in a fume hood. Store all standard solutions at 4° C (± 2° C) in Teflon®-sealed amber containers. Replace all standard solutions (intermediate and working) after six months or sooner, if degradation occurs.

8.0 Sample Preservation and Storage

8.1 Samples are preserved and stored according to the tables in Sample Control SOP 4.1, "Receiving Samples" and 4.6, "Storing Samples."

8.2 Extraction of water samples by separatory funnel must be completed within 5 days of the VTSR. Extraction of water samples by continuous liquid-liquid extraction must be started within 5 days of VTSR. Extraction of soil/sediment samples must be completed within 10 days of VTSR.

8.3 All extracts must be analyzed within 40 days of extraction.

8.4 Prior to analysis, store all extracts under refrigeration at 4° C (± 2° C) in the reach-in storage unit in the laboratory. After analysis, extracts are returned to Sample Control for long-term storage and disposal.

9.0 Quality Control

9.1 Initial Calibration

9.1.1 Calibrate the GC/ECD instrument as described in section 10.1 before the analysis of any blanks, field, or QC samples.

9.1.2 If, during sample analysis, one of the single point Aroclors is detected in a sample, calibrate with five levels of the Aroclor standard. (See Section 10.1.1.2). The laboratory also has the option for all Aroclor target compounds to have five-point calibrations initially, prior to sample analysis.

9.1.3 Perform an initial calibration if the calibration verification criteria are not met or after major instrument maintenance (e.g., column replacement, cleaning or replacement of the ECD).

9.1.4 Initial calibration acceptance criteria

9.1.4.1 The peaks chosen to identify the Aroclors in the calibration standards must be between 25 and 100 % of full scale in the chromatogram. The scaling factor must be displayed on the chromatogram.

9.1.4.2 The instrument blank must meet the acceptance criteria in section 9.4.4.

9.1.4.3 The percent Relative Standard Deviation (%RSD) of the calibration factors for each selected Aroclor component and surrogate in the initial calibration must be less than or equal to 20%. The % RSD for Aroclors is calculated by determining the mean of the five selected peaks in each standard level. Acceptance criteria must be met for each of the Aroclor peaks and surrogate. See Section 10.1.2.

9.2 Continuing Calibration Verification (CCV)

9.2.1 Analyze an instrument blank and the CS3 Aroclor 1660 standard at the beginning (opening CCV) and at the end (closing CCV) of each 12-hour period during which field and QC samples are analyzed.

9.2.2 Analyze an instrument blank, CS3 Aroclor 1660 standard, and the CS3 of any single Aroclor standard at the beginning (opening CCV) and at the end (closing CCV) of each 12-hour analysis period, if an Aroclor other than 1016 or 1260 was detected in the samples. The analysis of the single Aroclor standard is not necessary, if the samples are analyzed in the same 12-hour period as the initial calibration of the single component Aroclor.

9.2.3 If the closing CCV meets the acceptance criteria for the opening CCV (see section 9.2.6), it may be used as the opening CCV for the next 12-hour sample analysis period. An Aroclor other than 1660 can also be used as a closing standard if it **meets** the opening CCV acceptance criteria.

9.2.4 If the entire 12-hour time period is not required for analyses of all samples and blanks to be reported and the data collection is to be stopped, end the sequence with the appropriate closing CCV combination, i.e., an instrument blank/CS3 Aroclor 1016/1260 and all detected Aroclor CS3 standard mixture(s).

9.2.5 No more that 14 hours may elapse between the injection of the instrument blank for the opening CCV and the injection of the CS3 Aroclor standard in the closing CCV. If more than 12 hours have elapsed between the injections of the two instrument blanks associated with the opening and closing CCV standards that bracket a 12-hour period during which samples and required blanks are analyzed, then the time between the injection of the instrument blank associated with the closing CCV and the preceding sample may not exceed the length of one chromatographic run.

9.2.6 CCV Acceptance Criteria

9.2.6.1 The calibration factors for each Aroclor and surrogate peak in the continuing calibration verification (CCV) standard must be within ± 15% difference (%D) when compared to the mean calibration factors from the initial calibration on both analytical columns. (The %Ds for the surrogates are calculated against the mean CF from the initial calibration of the Aroclor 1016/1260 standards.) The % D is calculated by determining the average %D of the five selected peaks for each Aroclor. Acceptance

criteria must be met by the average of the five peaks, as opposed to each individual peak.

9.2.6.2 If the %D exceeds ± 15%, then corrective action must be taken and the opening CCV re-injected. If the calibration still exceeds the criteria, a new initial calibration must be analyzed.

9.2.6.3 The calibration factors for each Aroclor and surrogate in the closing CCV must not exceed a %D of ± 50%, when compared to the calibration factors from the initial calibration. If the closing %D is within ± 15%, then it can be used for the opening CCV of the next 12-hour period.

9.2.6.4 If any of the continuing calibration Aroclor components fall outside their retention time windows as established during the initial calibration sequence, the system is out of control and corrective action must be taken to correct the problem. If, after re-injection of the standard following corrective action, the retention times are still outside the windows, a new initial calibration must be analyzed.

9.3 Surrogates

9.3.1 Surrogate recoveries must be met for all samples, blanks, laboratory control samples, matrix spikes, and matrix spike duplicates. The required surrogates, decachlorobiphenyl (DCB) and tetrachloro-m-xylene (TCX) must be in the recovery range of 30-150% and within the retention time windows. In samples, one surrogate may fail recovery criteria per column.

If both surrogates (tetrachloro-m-xylene and decachlorobiphenyl) are outside the control range on both columns, the sample must be re-extracted and re-analyzed. The surrogate recovery requirements do not apply to sample dilutions.

9.4 Instrument Blanks

9.4.1 Prepare an instrument blank by spiking hexane with TCX at 20 ηg/mL and DCB at 40 ηg/mL.

9.4.2 Analyze an instrument blank after the initial calibration before any samples are analyzed.

9.4.3 Analyze an instrument blank as the first injection of the opening and closing CCV. The analysis of the instrument blank begins the 12-hour sample analysis period.

9.4.4 Instrument Blank Acceptance Criteria

9.4.4.1 The concentration of any target compound detected must be < CRQL.

9.4.4.2 The surrogates must be within the retention time windows on both columns.

9.4.5 The instrument blank is used to assess instrument contamination from analyte carryover from calibration standards or high concentration samples.

9.5 Method blanks

9.5.1 Method blanks are extracted with each preparation batch of up to 20 samples, excluding the LCS, duplicate matrix spikes and PE samples. The method blank is analyzed on the same instrument used to analyze the associated samples.

9.5.2 The acceptance criteria for method blanks include the following:

9.5.2.1 Surrogate recoveries must be within 30-150% and each surrogate must be within the retention time windows.

9.5.2.2 No target analytes may be present at or above the CRQL.

9.5.3 If the method blank does not meet acceptance criteria, the source of the problem (s) must be investigated and appropriate corrective action taken. All samples processed with a method blank that does not meet acceptance criteria must be re-extracted and reanalyzed.

9.5.4 The method blank is used to assess contamination in the extraction process.

9.6 Sulfur Cleanup Blanks

9.6.1 Prepare a sulfur cleanup blank when one or more of the samples in an extraction batch require sulfur removal. No separate sulfur cleanup blank is necessary, if all of the samples in an extraction batch require sulfur cleanup.

9.6.2 Prepare a sulfur cleanup blank by adding surrogates to an aliquot of hexane and subjecting it to cleanup using TBA. See SOP 2.1.1.5 "Sulfur Cleanup of Pesticide/PCB Extracts by Copper or TBA Sulfite by CLP, SW-846, and NYASP".

9.6.3 Sulfur blank acceptance criteria are the same as the method blank.

9.6.4 The sulfur blank is used to assess any contamination from the sulfur cleanup process.

9.7 Laboratory Control Sample (LCS)

9.7.1 The LCS is prepared for each preparation batch of up to 20 field samples.

9.7.2 An LCS contains Aroclor 1016 and 1260. The recovery criterion for each Aroclor is 50-150%.

9.7.3 Surrogate recovery must be within 30-150%. The retention time for each surrogate must be within the RT window.

9.7.4 If the LCS fails to meet acceptance criteria, all samples in the associated batch must be re-extracted and reanalyzed.

9.8 Matrix Spikes

9.8.1 A matrix spike and matrix spike duplicate (MS/MSD) must be performed for each sample delivery group of up to 20 field samples, unless otherwise specified by the client.

9.8.2 The percent recovery and relative percent difference (RPD) criteria for the MS/MSD are shown in the following table.

Analyte	% Recovery	RPD
Aroclor 1016	29-135	0-15
Aroclor 1260	29-135	0-20

9.8.3 Duplicate matrix spikes must be analyzed within the contract required holding time. .

9.8.4 The retention time for each surrogate in the duplicate matrix spikes must be within the retention time windows.

9.8.5 The spike recovery limits for the duplicate matrix spikes are advisory and require no further action by the laboratory. However, frequent failures must be addressed.

9.9 Samples

9.9.1 Analyze samples after all initial and continuing calibration criteria are met.

9.9.2 Analyze samples within a 12-hour analysis period, beginning with the analysis of an instrument blank and ending with the analysis a CS3 Aroclor standard.

9.9.3 Analyze samples within the required holding time.

9.9.4 Sample Dilutions

9.9.4.1 If the highest concentrated peak for any Aroclor is greater than the concentration of the same peak in the high-level standard in the initial calibration for both columns, (the largest peak on the second column may be a different peak) the sample must be diluted. Dilute the sample such that the concentration of the largest peak (lower response of the two columns) is within the calibration range.

9.9.4.2 If the concentration of the analytes detected is greater than that of the high calibration standard, dilute the sample until the concentration is within the calibration range. The maximum dilution is 1: 100,000.

9.9.4.3 Dilute all sample extracts with hexane.

9.9.5 Sample Acceptance Criteria

9.9.5.1 The associated method blank must meet acceptance criteria.

9.9.5.2 The associated LCS must meet acceptance criteria.

9.9.5.3 The retention times of the surrogates must be within the retention window on both columns.

9.9.5.4 The surrogate percent recoveries must be between 30 and 150 %. One surrogate may fail this criterion per column. The surrogate recovery requirements don't pertain to samples that have been diluted.

9.9.5.5 Choose 5 peaks (minimum of 3 peaks) for the identification of each Aroclor. Choose peaks that are at least 25% of the height of the largest Aroclor peak and 1 peak that is unique to each Aroclor.

9.10 Corrective actions for GC/ECD analysis

9.10.1 When linearity is difficult to achieve, verify that the appropriate length of column is inserted in the detector. Examine all column ends and determine if the ends of the columns need to be trimmed. The removal of 0.5 meters of the detector end of the column may be indicated when linearity is difficult to achieve.

9.10.2 When the instrument blanks fail, examine the chromatography to determine if there is contamination in the column that is causing the failure. If so, bake the column for 1 hour or less to see if this can be corrected. If the contamination is such that baking for 1 hour does not improve the baseline, it may be necessary to change the liner.

9.10.3 When calibration verifications fail recovery low, verify that the correct peaks are being named. Also verify that the syringe is not plugged and change the septa. If the calibration verification fails again, examine the chromatography to determine if there is a problem with the baseline that is causing the failure. If so, bake the column for 1 hour or less to see if this can be corrected. Also, if the calibration verification is failing on only one

column, the y-splitter may be plugged. If the calibration verification continues to fail, the instrument will need a new calibration curve.

9.10.4 When calibration verifications fail recovery high, verify that the correct peaks are being named. Examine the chromatography to determine if there is contamination on the column that is causing the failure. If so, bake the column for 1 hour or less to see if this can be corrected. If the calibration verification fails again, the instrument will need a new calibration curve.

9.10.5 When the calibration verification fails due to drift, change the septa and verify that all the column fittings are secure. Also, determine if there is contamination on the column that is causing the failure. If so, bake the column for 1 hour or less to see if this can be corrected. If the calibration verification still fails, it is permissible to update retention times once per 24 hours period. Record in the instrument run log when the retention times are updated.

9.10.6 All preventive and routine maintenance as mentioned above is recorded in the instrument run log. Major maintenance is recorded in the maintenance log (Attachment 1).

9.11 Contingency

9.11.1 If, due to a lab accident or to QC failure, a re-preparation is required for the sample and insufficient volume remains, the Project Manager must be alerted and will contact the client for direction on how to proceed. For the CLP, the Sample Management Office must be contacted.

9.11.2 If persistent contamination occurs in the laboratory, analyses must be halted until the source can be identified and isolated. When the contamination issue is resolved, sample analyses may proceed.

9.11.3 Any other issues that potentially affect data quality should be addressed with the Project Manager.

10.0 Calibration and Standardization

10.1 Initial Calibration

10.1.1 For the initial calibration five concentration levels are prepared for Aroclors 1016/1260. Single standards for the remaining Aroclors are

prepared at the mid-concentration (CS3). The CS3 level for Aroclors 1221, 1232, 1242, 1248, 1254, 1262, and 1268 are used for pattern recognition and to generate calibration factors for them. The laboratory also has the option for all Aroclor target compounds to have five-point calibrations initially, prior to sample analysis.

10.1.1.1 Analyze a five-point initial calibration for Aroclors 1016 and 1260 at 100, 200, 400, 800, and 1600 ηg/mL; surrogate TCX at 5.0, 10, 20, 40, and 80 ηg/mL; surrogate DCB at 10, 20, 40, 80, and 160 ηg/mL. Analyze the single-points initial calibration containing Aroclors 1221, 1232, 1242, 1248, 1254, 1262, and 1268 at 400 ηg/mL and surrogates at 20 ηg/mL for TCX and 40 ηg/mL for DCB.

Note: The single-point calibration standards may be run before or after the five-point Aroclor 1016/1260 initial calibration standards.

10.1.1.2 If a sample is analyzed and any of the Aroclors analyzed as a single point are detected, a five-point calibration must be analyzed for that Aroclor, unless the five-point initial calibration was performed before sample analyses were initiated. The calibrations must be prepared at the following levels:

- Aroclors 1221, 1232, 1242, 1248, 1254, 1262, and 1268 at 100, 200, 400, 800, and 1600 ηg/mL

- Surrogates
  - TCX at 5.0, 10, 20, 40, and 80 ηg/mL
  - DCB at 10, 20, 40, 80, and 160 ηg/mL

10.1.2 Five sets of calibration factors are generated for the Aroclor 1016/1260 standards. Each set consists of the calibration factor for each of the five peaks chosen. The single standard of the remaining Aroclors will each produce a minimum of three calibration factors, one for each selected peak. See Section 9.1.4 for initial calibration acceptance criteria.

10.1.3 The initial calibration standard sequence is as follows.

ICAL Sequence Injection Number	Initial Calibration Standard Sequence
1	AR1221CS3
2	AR1232CS3
3	AR1242CS3
4	AR1248CS3
5	AR1254CS3
6	AR1262CS3
7	**AR1268CS3**
8	AR1660-CS1
9	AR1660-CS2
10	AR1660-CS3
11	AR1660-CS4
12	AR1660-CS5
13	Instrument blank

Note: The single-point Aroclor standards may be analyzed before the analyses of the five levels of the Aroclor 1660. The steps pertaining to the instrument blank are used as a part of the calibration verification as well.

10.2 Continuing Calibration Verification (CCV)

10.2.1 The continuing calibration verification standards are used to evaluate retention time stability. The injection of an instrument blank and Aroclor 1660 constitute the calibration verification. See section 9.2.6 for CCV criteria.

11.0 Procedure

Documentation must follow the requirements in Quality Control SOP 13.6, "Proper Documentation Procedures". **Condition Codes, abbreviations defined in Attachment 3, are used to document failed and qualified injections.**

11.1 Dual Column Analysis and Confirmation

11.1.1 The dual column/dual detector approach involves the use of two 30 m x 0.32 mm ID fused silica open-tubular columns of different polarities (clpest and clpest2). Each has different selectivities towards the target

compounds. The columns are connected to a "Y-splitter" and dual ECD detectors.

11.2 GC operating conditions are as follows:

11.2.1 Column 1

- Type: clpest
- Dimensions: 30 m x 0.32 mm ID
- Film Thickness: 0.50 µm

11.2.2 Column 2

- Type: clpest2
- Dimensions: 30 m x 0.32 mm ID
- Film Thickness: 0.42 µm

11.2.3 Carrier gas

- Helium
- Flow rate: 6 mL/minute

11.2.4 Makeup gas

- Argon/methane (P-5)
- Flow rate 20 mL/minute

11.2.5 Temperature program

- Hold at 150° C for 1.0 minute
- Ramp to 275° C at 5 degrees/minute
- Hold for 2.0 minutes

11.2.6 Injector temperature: 250° C

11.2.7 Detector temperature: 300° C

11.2.8 Injection volume: 2 or 4 µL (1 or 2 µL per column)

11.2.9 Solvent
- Hexane

11.2.10 Detector: Dual ECD's

Note: These are typical operating conditions that may vary with different instruments and/or instrument performance.

11.3 Analytical Sequence

11.3.1 Analytical Sequence

All acceptable samples must be analyzed within a valid analysis sequence as given in the following:

Time	Injection #	Material Injected
	1-12 (or 5-points of all Aroclors)	First 12 steps of the initial calibration
0 hr.	13	Instrument blank
	14	Aroclor 1016/1260 Standard Sample
	15	Additional Aroclor CS3 Standard (optional)
	16	Subsequent Samples
12 hr.		Last sample
	1st injection past 12 hr.	Instrument blank
	2nd injection past 12 hr.	Aroclor 1016/1260 standard subsequent samples Detected Aroclor CS3
	3rd injection past 12 hr.	Standard (as required) Detected Aroclor CS3
14 hr.	4th injection past 12 hr.	Standard (as required), Subsequent Samples

Time	Injection #	Material Injected
Another 12 hrs.		Last sample
	1st injection past 12 hr.	Instrument blank
	2nd injection past 12 hr.	Aroclor 1016/1260 standard
	3rd injection past 12 hr.	Sample

11.3.2 Injections #1 through 12 may be expanded to include all injections of initial calibration standards, in the normal initial calibration sequence. The first 12 hours are counted from injection #13, not from injection #1. Samples may be injected until 12:00 hours have elapsed. All subsequent 12-hour periods are timed from the injection of the instrument blank that brackets the front end of the samples. If more than 12 hours elapse between the injections of two instrument blanks that bracket a 12-hour period in which samples or required blanks are analyzed, then the time between the injection of the instrument blank and the preceding sample may not exceed the length of one chromatographic run. No more than 14 hours may elapse from the injection beginning the opening CCV (Aroclor Standard).

11.3.3 After the initial calibration, the analysis sequence may continue as long as acceptable calibration verifications(s) are analyzed at the required frequency.

11.4 Gas chromatographic analysis:

11.4.1 The GC is set up according to the operating conditions detailed above. A final temperature of 240 - 275° C is necessary to elute decachlorobiphenyl.

11.4.2 The initial calibration is performed according to the discussion in Section 10.0.

11.4.3 An opening/closing CCV standard brackets each 12-hour analysis period. Since an analytical sequence may continue as long as calibration verification criteria are met, the end of one 12-hour sequence is considered to be the beginning of the next 12-hour sequence. The calibration factor must meet acceptance criteria when compared to the initial calibration curve. See Section 9.2.6 for CCV criteria.

When this criteria is exceeded, corrective action is required as described in Section 7.0 and may include re-injection of the calibration verification

standard or analysis of a new initial calibration before more samples are analyzed.

11.5 Retention Time Windows

11.5.1 An RT window is calculated for the major peaks (a minimum of 3) of each Aroclor and for each surrogate using the RT window listed below. Analytes are identified when peaks are observed in the RT window for the compound on both GC columns.

Compounds	RT Windows (min.)
Aroclors	± 0.07
TMX	± 0.05
DCB	± 0.10

11.6 Identification and Quantitation

11.6.1 Compound identification is based on a second column confirmation, with the second column being of a dissimilar nature. Target analyte peaks must fall within the retention time windows on both columns.

11.6.2 Tentative identification of an analyte occurs when three to five of the chosen Aroclor component peaks from a sample extract fall within the retention time windows and the pattern matches that of the Aroclor standard.

11.6.3 Identification of Aroclors is based on the characteristic pattern and retention times of the indicator peaks.

11.6.4 Quantitation is based on comparing the area under the characteristic peaks (minimum 3) with the mean CF for the same peaks in the initial calibration. The external calibration method is used for quantitation.

11.6.5 When samples contain more than one multi-component analyte, a more experienced analyst may be required to process or assess the data. Similar conditions exist when multicomponent analytes have been subjected to environmental degradation, resulting in weathered Aroclors that may have significant differences in peak patterns than the standards.

11.6.6 Use the external calibration procedure to establish mean response factors for each chosen Aroclor component by dividing peak area in the standard by the mass injected. Peak areas from peaks within the chosen Aroclor component's retention time window are used to calculate the quantity of each target Aroclor while retention times are used to identify each component.

The concentration reported on the reporting form is the lower of the two values obtained from the dual column analysis. If the result is **>25%** different, the data reviewer should verify that there are not overlapping peaks causing this to occur. Also, the data reviewer will examine the baseline to verify that the baseline parameters are set properly.

11.6.7 The Aroclors are quantitated using responses of five major peaks (minimum of three) of the sample pattern compared to the calibration factors of the same peaks in the initial calibration for the Aroclor. Those concentrations are averaged for both columns. The lower value of the two columns is reported.

12.0 Data Analysis and Calculations

Calculations must be consistent with the Quality Control SOP 13.4, "Numerical Data Reduction".

12.1 Calculation of the mean or average of a set of values (also used for Mean Calibration Factor, $\overline{CF}$):

$$\overline{X} = \frac{\sum_{i=1}^{n} X_i}{n}$$

where: n = total number of values
x_i = each individual value used to calculate the mean
x = the mean of n

12.2 Calculation of the standard deviation of a set of values:

$$\text{Standard deviation} = \sqrt{\frac{\sum_{i=1}^{n}\left(X_n - \overline{X}\right)^2}{n-1}}$$

12.3 Calculation of percent recovery:

12.3.1 LCS and surrogates:

$$\%R = \frac{Amount\ found}{Amount\ spiked}\ x\ 100$$

12.3.2 Matrix spikes:

$$\%\,R = \frac{Amount\ in\ spiked\ sample\ -\ Amount\ in\ unspiked\ (native)\ sample}{Amount\ spiked}\ x\ 100$$

12.4 Calculation of % RSD

$$\%RSD = \left(\frac{Standard\ deviation}{\overline{X}}\right) \times 100$$

12.5 Calculation of RPD

$$RPD\ =\ \frac{|Value\ 1\ -\ Value\ 2|}{(Value\ 1\ +\ Value\ 2)/2} x100$$

12.6 Calculation of %Difference (%D)

$$\%Diff\ =\ \frac{Value\ -\ \overline{Reference\ \ value}}{\overline{Reference\ \ value}}\ x\ 100$$

12.7 Calibration factors are calculated by dividing the total peak area for each chosen Aroclor component in the standard by the total mass injected (in nanograms).

$$Calibration\ Factor\ (CF) = \frac{Peak\ area}{Total\ mass\ injected}$$

12.8 Concentration

12.8.1 Concentration in aqueous samples

$$\mu g / L = \frac{(Ax)(Vt)(DF)(CVout)}{(\overline{CF})(Vo)(Vi)(CVinXE)}$$

where:

Ax = area response for the analyte
$\overline{CF}$ = Mean calibration factor from the initial calibration
Vo = volume of water extracted (mL)
Vi = volume of extract injected (µL)
Vt = volume of the concentrated extract (µL)
Df = dilution factor. If no dilution, Df = 1.0
CVout = volume of extract produced by a cleanup process (cleanup and concentration), in µL
CVin = volume of extract subjected to a cleanup process, in µL
E = The efficiency of the cleanup process expressed as a fraction of material that passes through or is not mechanically lost during the cleanup step (e.g., 50% efficiency must be expressed as 0.50)

12.8.2 Concentration in soil samples (dry weight basis)

$$\mu g / kg = \frac{(Ax)(Vt)(Df)(CVout)}{(\overline{CF})(Vi)(Ws)(D)(CVinXE)}$$

where:

Ax and $\overline{CF}$ = same as for water
Vt = Volume of concentrated extract in µl (5000 µL)
Vi = Volume of extract injected in µl
Ws = weight of sample extracted, in grams
Df = Dilution factor

D = Dry weight factor (% moisture) = $\frac{100 - \%\ \text{moisture}}{100}$

CVout = volume of extract produced by a cleanup process (cleanup and concentration), in µL

CVin = volume of extract subjected to a cleanup process, in µL
E = The efficiency of the cleanup process expressed as a fraction of material that passes through or is not mechanically lost during the cleanup step (e.g., 50% efficiency must be expressed as 0.50)

12.9 Calculating Dilutions

12.9.1 If the highest concentrated peak for any Aroclor exceeds the concentration of the same peak in the high level Aroclor initial calibration standard for both columns, it must be diluted and re-analyzed. Comparing the on-column nanogram amount of the chosen Aroclor components with the nanogram amounts of the same chosen Aroclor components from the high level standard used in the initial calibration will allow you to determine an appropriate dilution.

12.9.2 If a sample concentration exceeds the high level standard a dilution must be performed. Determine a dilution factor that will result in a value within the calibration range by dividing the concentration of the high analyte in the sample by the desired concentration. Dilute the extract with hexane and note the DF and preparation in the run log. (Ex. 10X dil = 100 µL of sample into 900 µL of hexane.)

13.0 Method Performance

This method was validated through in-house laboratory studies of method detection limits and precision and accuracy for single analyst. The data are retained by the QA department.

14.0 Pollution Prevention

The solvents used in this procedure pose little threat to the environment when recycled and managed properly. Pollution prevention encompasses any technique that reduces or eliminates the quantity or toxicity of waste at the point of generation. Numerous opportunities for pollution prevention exist in laboratory operation. The EPA has established a preferred hierarchy of environmental management techniques that places pollution prevention as the management option of first choice. Whenever feasible, laboratory personnel should use pollution prevention techniques to address their waste generation. When wastes cannot be feasibly reduced at the source, the Agency

recommends recycling as the next best thing. See SOP 12.1, Hazardous Waste Disposal, regarding laboratory procedures for recycling solvent waste streams.

15.0 Waste Management

It is the laboratory's responsibility to comply with all federal, state, and local regulations governing waste management, particularly the hazardous waste identification rules and land disposal restrictions, and to protect the air, water, and land by minimizing and controlling all releases from fume hoods and bench operations. Compliance with all sewage discharge permits and regulations is also required.

Samples preserved with HCl, HNO_3, or H_2SO_4 to pH <2 are hazardous must be handled as hazardous waste.

Refer to the Hazardous Waste Management and Safety SOPs located in the lab.

16.0 References

16.1 U.S. EPA CLP SOW for Organic Analysis, Multi-Media, Multi-Concentration, SOM01.2 (8/2007)

16.2 "Test Methods for Evaluating Solid Wastes: Physical/Chemical Methods", SW-846, 3rd Edition, Update III, 12/96, Method 8082

16.3 Standard Methods for the Examination of Water and Wastewater, 20th (1998), Method 1080

16.4 Quality Control SOP 13.6 "Proper Documentation Procedures"

16.5 Quality Control SOP 13.4 "Numerical Data Reduction"

16.6 "Less is Better: Laboratory Chemical Management for Waste Reduction," American Chemical Society Department of Government Relations and Science Policy, 1155 16th Street, N.W., Washington DC, 20036, (202) 872-4477.

16.7 **NELAC Standards, effective July 2003**

16.8 QA-G6: Guidance for the Preparation of Standard Operating Procedures for Quality-Related Operations EPA/600/R-96/027, November 1995.

16.9 CompuChem Quality Manual, Revision **11, June 23, 2008, plus revisions**

16.10 Sample Control SOP 4.1, "Receiving Samples"

16.11 Sample Control SOP 4.6, "Storing Samples"

17.0 Attachments as Tables, Diagrams and Flowcharts

17.1 Attachment 1 – Instrument Maintenance Log

17.2 Attachment 2 – Instrument Run Log

17.3 Attachment 3 – Condition Codes

Attachment 1

CompuChem a division of Liberty Analytical Corp. Logbook 4 H(4) 1

GC Extractables Instrument Maintenance Log: 66/67

Date: _____ Time: _____

System: _____

Problem: _____

_____

_____

_____

_____

Action Taken: _____

_____

_____

_____

_____

_____

Parts used:

Part Number	Description	Quantity

File Name Indicating Instrument In Control: _____

Performed By: _____ Date: _____

Reviewed By: _____ Date: _____

2/11/08:mlj

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Attachment 2

COMPUCHEM a Division of Liberty Analytical Corp **Instrument ID** 80/81 **Sequence ID** _____ DATE ___/___/___
GC EXTRACTABLES RUN LOG
COMPUCHEM LOGBOOK 4 TTT 37 Method: 8081A 8082 8151A OLM/OLC SOM01.2 Other_____ Amt Inj. 2 µL (1 µL per column)

☐Changed septum ☐Changed liner ☐Baked column ☐Trimmed column

	FILE NUMBER	DATE	COMPUCHEM #	CASE/SDG#	STANDARD ID	CHEMIST	COMMENTS
1		/ /					
2		/ /					
3		/ /					
4		/ /					
5		/ /					
6		/ /					
7		/ /					
8		/ /					
9		/ /					
10		/ /					
11		/ /					
12		/ /					
13		/ /					
14		/ /					
15		/ /					
16		/ /					
17		/ /					
18		/ /					
19		/ /					
20		/ /					

The presence of the Chemist's/Analyst's employee ID number, or signature, on this run log attests that strict compliance with the method's SOP has occurred. Any SOP deviations require documentation by the responsible chemist/analyst together with the chemist's/analyst's initials and the initials of the lab supervisor and a QA department representative, signifying approval of the deviation.

Calibration ID: _____ Sequence ID: _____ Hexane Lot No_____

REVIEWED BY: _____ DATE: _____
1/22/09 jr

Attachment 3
Condition Codes Used for Documentation in Logbooks

Code	Explaination
CS	Carry over Suspected from prior analysis
CT	Contamination verified
DI	Requires Dilution
DW	Dilution Wrong
JS	Reinjection same as prior run
LA	Lab Accident (explain in comments)
OT	Other (explain in coments)
OW	Original wrong for QC sample
RP	Reportable prior run
RT	Retention time shift
RU	Repeated Unnecessarily
SF	Spike recoveries failed (high or low)
SI	Spiked inadvertently
SH	Surrogate recoveries high
SL	Surrogate recoveries low
SM	Surrogate or spike missing
IF	Instrument failure
US	Unacceptable Standard (explain in comments)
VR	Verify results
NM	Did not match prior run or duplicate
RN	Reanalyze neat, was run at a dilution
PC	Poor chromatography
SC	Sulfur clean up required
WS	Wrong standard (SOM PCBs)
MI	Misinjection (bad injection)

Code	Explaination
%R	%RSD failed (ical)
%B	Breakdown failed
%D	%D (CCV)
RT	Retention time shift
RU	Repeated Unnecessarily
IF	Instrument failure
US	Unacceptable Standard (explain in comments)
PC	Poor chromatography
SC	Sulfur clean up required
LA	Lab Accident (explain in comments)
OT	Other (explain in coments)

CompuChem
A Division Of
Liberty Analytical Corp.

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Cary, NC 27513

NELAP accredited

SOP DOCUMENTATION FORM

This form must accompany all new and revised Standard Operating Procedures (SOPs) when you turn them in to Quality Assurance for review. Please fill out the entire block below (except effective date).

This is a new procedure _____ revised procedure ✓ outdated procedure (archive) _____

- Procedure Code: IP 1400 SOP Section #: 2443 Revision #: 6

SOP Title: GC/MS Scan and SIM Analyses of Semivolatiles in Water and Soil Matrices by EPA CLP SOW SOM01.2

Effective date: (QA fills in) 2/24/09

- Procedure prepared by: Bob McEleven Date: 02-04-2009
- Procedure approved by: (If the manager prepared the SOP, a qualified second party should sign) Kathryn E Humphries Date: 2/13/09
- Reason for change: Corrections from EPA/DATS review plus minor changes from annual review
- This procedure meets the requirements of the following approved method references: USEPA CLP SOW SOM01.2

Procedure approved by a QA Representative (unless QA Representative signed above):

_____ Date: _____

On an annual basis: Lab managers are required to review lab practices and revise the SOP if necessary. If no revision is necessary, indicate by your signature that the SOP has been reviewed.

Annual Review—Signature: [signature] 02-23-09 Date: 2/23/9

Annual Review—Signature: _____ Date: _____

Annual Review—Signature: _____ Date: _____

Annual Review—Signature: _____ Date: _____

Sopdocform2-1/19/07: vr

R2-0001880

Instrument Procedure 1400: GC/MS Scan and SIM Analyses of Semivolatiles in Water and Soil Matrices by EPA CLP SOM01.2

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R2-0001881

Instrument Procedure 1400: GC/MS Scan and SIM Analyses of Semivolatiles in Water and Soil Matrices by EPA CLP SOM01.2

1.0 Scope and Application

This method is for the analysis of extractable, aqueous and solid samples for semivolatile compounds. The target compound list (TCL) for this method and the Contract Required Quantitation Limits (CRQL) are listed in Attachment 1. **Additional analytes may be assessed as part of Modified Analysis (MA) projects.**

Staff members performing the procedures described in this SOP are responsible for reading, understanding, and complying with the SOP requirements. Supervisors are responsible for directing the analyst to the controlled SOP, and providing adequate explanation of the material contained therein.

This procedure is restricted to use by or under the supervision of analysts experienced in the instrumentation or preparative methods and who have demonstrated the ability to generate acceptable results through QC samples and analyst capability studies.

2.0 Summary of Method

2.1 A two microliter aliquot of sample extract is injected onto the gas chromatograph (GC). The GC is temperature programmed to separate the semivolatile compounds that are then detected by the mass spectrometer (MS).

2.2 Target and deuterated monitoring compounds are identified in the samples by analyzing standards under the same conditions used for samples and comparing resultant mass spectra and GC retention times. Internal standards are added to all samples and standards. A response factor is established for each target and deuterated monitoring compound during the initial and continuing calibrations by comparing the MS response for the primary ion produced by the compound's extracted ion current profile (EICP) to the MS response for the primary ion produced by an internal standard. Each identified target and deuterated monitoring compound in a sample is quantified by comparing the response for the target compound and the internal standard, while taking into account the mean relative response factor from the most recent initial calibration, the sample volume for water samples (sample weight and percent moisture for solid samples), and any sample dilutions.

2.3 Non-target compounds are identified by comparing the resultant mass spectra from the non-target compounds, to mass spectra contained in the National Institute of Standards and Technology Mass Spectral Library. Non-target compounds are quantified by comparing the MS response from the reconstructed

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ion chromatogram (RIC) for the non-target compound peaks to the MS response produced by the nearest internal standard. A response factor of 1 is assumed. Non-target compounds are referred to as Tentatively Identified Compounds (TICs).

2.4 Selected Ion Monitoring (SIM) is performed on the Polynuclear Aromatic Hydrocarbons (PAHs) and pentachlorophenol, when requested.

3.0 Definitions

3.1 Method detection limit (MDL) – The minimum concentration of an analyte that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte (40 CFR, Part 136, Appendix B.)

3.2 Reporting Limit – The laboratory reporting limit is based on the lowest multipoint calibration standard concentration. Values detected below the reporting limit and above the MDL may be reported and qualified as an estimated concentration.

For CLP methods, the MDL is required to be lower than the reporting limit and must be verified annually.

For CLP, the reporting limit is the Contract Required Quantitation Limit (CRQL).

3.5 Reporting Units – µg/L or µg/Kg

3.4 An SDG is defined by the following, whichever is more frequent:

- each case of field samples received, or
- each 20 field samples (excluding PE samples) received within a case, or
- each 7 calendar day period (3 calendar day period for 7 day turnaround) during which field samples in a case are received beginning with the receipt of the first sample.

3.5 Analytical range for organics – The analytical range is defined by the concentration of the highest standard in the initial calibration. Samples containing target analytes above this limit must be diluted, or a lesser amount of sample analyzed, in order to bring the concentration to within the upper half of the initial calibration range. For CLP the upper half is defined as the concentration between the midpoint standard and the high standard.

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3.6 DMC – Deuterated Monitoring Compounds

3.7 I.S. – Internal Standard

3.8 SMO – Sample Management Office

4.0 Interferences

Contaminants in solvents, reagents, glassware, and other sample processing hardware may cause method interferences such as discrete artifacts and/or elevated baselines in the reconstructed ion current (RIC) profiles. All of these materials must be routinely demonstrated to be free from interferences under the conditions of the analysis by running laboratory method blanks. Matrix interference may be caused by contaminants that are co-extracted from the sample. The extent of matrix interferences will vary considerably from source to source.

5.0 Safety

5.1 Appropriate protective equipment and clothing must be used under the assumption that all samples are potentially hazardous. During sample preparation, glasses, gloves and lab coats are a minimum requirement. The persistent presence of noxious odors may be indicative of failure of the laboratory ventilation system and must be reported to a supervisor or manager.

5.2 Laboratory staff must review the Chemical Hygiene Plan for general safety policies, and Material Safety Data Sheets (MSDS) for solvents and reagents used in the laboratory. The MSDS are located in the Quality Assurance department.

6.0 Equipment and Supplies

6.1 Gas Chromatograph/Mass Spectrometer

6.1.1 Gas Chromatograph – The gas chromatograph (GC) system must be capable of temperature programming and have a flow controller that maintains a constant column flow rate throughout the temperature program. The system must be suitable for splitless injection and have all required accessories including syringes, analytical columns, and gases. All GC carrier gas lines must be constructed from stainless steel or copper tubing. Non-polytetrafluoroethylene (PTFE) thread sealants, or flow controllers with rubber components are not to be used.

GC conditions may vary based upon regular column maintenance and column manufacturer specifications.

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6.1.2 Gas Chromatography Columns

6.1.2.1 RTX-5MS (30m x 0.32 mm ID x 0.25 µm film thickness)

6.1.2.2 ZB-5MS (30m x 0.32 mm ID x 0.25 µm film thickness)

6.2 Mass Spectrometer

6.2.1 Hewlett Packard (HP) 5890GC, 5972 MSD

6.3 Interface

6.3.1 The GC interfaces with the MS through direct insertion of the GC column.

6.4 Data System

6.4.1 The standards and samples are processed using the Hewlett Packard HP 9000 735 Unix Workstation, employing HP Chemserver with **Promium's Element form generation software.** The mass spectral library used is the NIST Library **(NIST 2002, or newer).**

6.5 Data Storage Device

6.5.1 Data is collected on the instrument's ChemServer data system and is transferred via FTP to the Target3 data system for processing and review.

6.5.2 Data is stored on the Target3 data system on a short-term basis and is stored long-term on a data server.

6.6 Glassware

6.6.1 Sample preparation vials: amber, 12 x 32 mm with 350 µL or 400 µL inserts, with 11 mm crimp seals with Teflon® septum.

6.7 Syringes

6.7.1 Hamilton microliter syringes: 10 µL with low heat transfer from hand to sample.

7.0 Reagents and Standards

Note: All SOM01.2 standards information is entered into the LIMS. To obtain information on any standard, access Element, click on "Laboratory," and scroll down and access "Standards." Standards can be sorted by Department. Select the standard you would like to access. The view will show lot number, prepared dates, solvent, vendor, composition, and concentration.

Store all standards separately from samples at 2 - 6° C in the laboratory when not in use.

7.1 Reagent Water-Use reagent-grade Type I water with regard to resistivity of > 10 megohm-cm (19th and 20th Editions of Standard Methods, Method 1080). It is demonstrated to meet the blank criteria contained in this Standard Operating Procedure (SOP). It is referred throughout this SOP as reagent water.

7.2 Methylene chloride, pesticide residue analysis grade

7.3 Instrument Performance Check (Tuning) Solution

7.3.1 Prepare the instrument performance check solution, decafluorotriphenylphosphine (DFTPP), at a concentration of 25 ηg/µL. The DFTPP is used to verify the mass calibration and resolution of the MS.

7.3.2 Prepare the DFTPP solution fresh once every twelve months, or sooner, if the solution has degraded or concentrated.

7.4 Initial and Continuing Calibration Solutions

7.4.1 Prepare five initial calibration standards with each target analyte and deuterated monitoring compound (DMC) at concentrations of 5, 10, 20, 40, and 80 ηg/µL except the seven target compounds **and two DMCs** listed below. These seven compounds require a preparation of a four point calibration at 10, 20, 40, and 80 ηg/µL.

- 2,4-dinitrophenol
- pentachlorophenol
- 2-nitroaniline

- 3-nitroaniline
- 4-nitroaniline
- 4-nitrophenol **and 4-nitrophenol-d4**
- 4,6-dinitro-2-methylphenol **and 4,6-dinitro-2-methylphenol-d2**

7.4.1.1 Ampulated DMC standards for full-scan analyses are purchased from Cambridge Isotope Laboratories, Inc. (CIL) **or Absolute Standards, Inc.** The 16 full-scan DMCs are each at a concentration of 2000 µg/mL in methylene chloride. The two SIM DMCs are purchased from CIL **or Absolute Standards** in separate ampules, each at a concentration of 200 µg/mL in isooctane. These as-received ampules are used to prepare analytical standards and the DMC spiking solution.

7.4.2 Prepare five initial calibration standards for each SIM DMC and compound at concentrations of 0.10, 0.20, 0.40, 0.80, and 1.00 ηg/µL. A four point calibration is required for pentachlorophenol at 0.20, 0.40, 0.80, and 1.00 ηg/µL.

7.4.3 Add internal standard to each calibration standard for a concentration of 20 ηg/µL for each internal standard. (0.4 ηg/µL for SIM analysis)

7.4.4 Use the 20 ηg/µL initial calibration solution (0.4 ηg/µL for SIM analysis) as the opening and closing continuing calibration verification solution.

7.4.5 Prepare the initial and continuing calibration standards fresh once every twelve months or sooner if the solution has concentrated or compound degradation occurs.

7.5 Deuterated Monitoring Compounds (DMC) Spiking Solution

7.5.1 Prepare the DMC spiking solution in methanol. The solution consists of the following:

- Phenol-d_5
- bis-(2-Chloroethyl) ether-d_8
- 2-Chlorophenol-d_4
- 4-Methylphenol-d_8
- Nitrobenzene-d_5
- 2-Nitrophenol-d_4
- 2,4-Dichlorophenol-d_3
- 4-Chloroaniline-d_4

- Dimethylphthalate-d_6
- Acenaphthylene-d_8
- 4-Nitrophenol-d_4
- Fluorene-d_{10}
- 4,6-Dinitro-2-methylphenol-d_2
- Anthracene-d_{10}
- Pyrene-d_{10}
- Benzo (a) pyrene-d_{12}
- Fluoranthene-d_{10} (SIM)
- 2-Methylnapthalene-d_{10} (SIM)

7.5.2 Add an aliquot of DMC solution to each method blank, sample, and matrix spike to result in a 40 ηg (0.40 ηg for SIM) concentration before extracting.

7.5.3 Prepare the DMC spiking solution fresh once every twelve months, or sooner, if the solution has degraded or concentrated.

7.6 Internal Standard Spiking Solution

7.6.1 Prepare the internal standard spiking solution, containing the compounds listed below, at 20 ηg/µL. Add to each calibration standard and sample prior to analysis.

- 1,4-dichlorobenzene-d_4
- naphthalene-d_8
- acenaphthene-d_{10}
- phenanthrene-d_{10}
- chrysene-d_{12}
- perylene-d_{12}

7.6.2 Prepare the SIM internal standard at 0.4 ηg/µL. Add to each calibration standard and sample prior to analysis.

7.6.3 Prepare the internal standard spiking solution fresh once every twelve months, or sooner, if the solution has degraded or concentrated.

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7.7 Matrix Spike Spiking Solution

7.7.1 The matrix spiking solution consists of the compounds listed in the following Table.

Base/Neutrals Compounds	Acid Compounds
Acenaphthene	Pentachlorophenol
2,4-Dinitrotoluene	Phenol
Pyrene	2-Chlorophenol
N-nitroso-di-n-propylamine	4-Chloro-3-methylphenol
	4-Nitrophenol

7.7.2 Before extraction, add an aliquot of matrix spiking solution to the matrix spike and matrix spike duplicate samples. The compounds in the matrix spike are at a concentration of 40 ηg/µL (0.4 ηg/µL for SIM) in the sample aliquot being analyzed.

7.7.3 Prepare the matrix spiking solution every twelve months, or sooner, if the solution has degraded or concentrated.

8.0 Sample Preservation **and** Storage

8.1 Samples are preserved and stored according to the tables in Sample Control SOP 4.1, "Receiving Samples" and 4.6, "Storing Samples." Sample holding times are also listed.

8.2 Extract water samples within 5 days of Validated Time of Sample Receipt (VTSR). Extract soil/sediment samples within 10 days of VTSR. Analyze all extracts within 40 days of extraction.

8.3 Prior to analysis, protect all extracts from light and store under refrigeration at 2 - 6° C in the laboratory. After analysis, return extracts to Sample Control for long-term storage and disposal.

9.0 Quality Control

9.1 Method Blank

9.1.1 Analyze the method blank on each instrument used to analyze associated samples.

9.1.2 For the analysis of aqueous and low level soil samples, no target analyte in the method blank may be present at a concentration equal to or greater than the CRQL, except bis (2-ethylhexyl) phthalate. The concentration of bis (2-ethylhexyl) phthalate, in the method blank, must be less that 5x the CRQL.

9.1.3 For medium level soils, the concentration of all target compounds must be less than the CQRL.

9.1.4 The percent recovery for each of the DMCs in the blank must be within the acceptance windows listed in 9.2.1.

9.1.5 The area response of the internal standards must be within the range of 50.0% and 200.0% of their response from the most recent opening continuing calibration verification standard (CCV). The retention time shift of each internal standard must be within ± 0.50 minutes (30.0 seconds) of its retention time from the most recent opening continuing calibration verification standard.

9.1.6 Corrective action for method blanks.

9.1.6.1 If internal standards do not meet criteria:

- check calculations
- check standard solution for degradation or concentration
- check instrument for malfunction
- reanalyze method blank

9.1.6.2 If DMCs fail acceptance criteria:

- re-analyze the method blank
- if DMC criteria are not met after reanalysis, re-extract all associated samples

9.1.6.3 If the method blank is contaminated:

- contamination source must be determined and corrective action taken

- samples associated with a contaminated blank must be re-extracted and reanalyzed

9.2 DMCs

9.2.1 All DMC recoveries must fall within acceptance ranges shown in the table below. Up to four DMCs per sample may fail to meet the recovery limits, but their recoveries must be greater than zero. The DMC recovery requirements do not apply to a diluted sample.

Deuterated Monitoring Compound Recovery Limits

Compound	% Recovery for Water Samples	% Recovery for Soil Samples
Phenol-d_5	39-106	17-103
bis-(2-Chloroethyl) ether-d_8	40-105	12-98
2-Chlorophenol-d_4	41-106	13-101
4-Methylphenol-d_8	25-111	8-100
Nitrobenzene-d_5	43-108	16-103
2-Nitrophenol-d_4	40-108	16-104
2,4-Dichlorophenol-d_3	37-105	23-104
4-Chloroaniline-d_4	1-145	1-145
Dimethylphthalate-d_6	47-114	43-111
Acenaphthylene-d_8	41-107	20-97
4-Nitrophenol-d_4	33-116	16-166
Fluorene-d_{10}	42-111	40-108
4,6-Dinitro-2-methylphenol-d_2	22-104	1-121
Anthracene-d_{10}	44-110	22-98
Pyrene-d_{10}	52-119	51-120
Benzo (a) pyrene-d_{12}	32-121	43-111
Fluoranthene-d_{10} (SIM)	50-150	50-150
2-Methylnapthalene-d_{10} (SIM)	50-150	50-150

9.2.2 Both SIM DMCs must meet recovery limits.

9.3 Use internal standards as the basis for quantitation of the target and DMC compounds. Attachment 2 summarizes the target and DMC compounds with corresponding internal standards for quantitation.

9.4 Sample Analysis

9.4.1 The internal standard area response must be within the inclusive range of 50.0% and 200.0% of the respective response in the most recent opening continuing calibration verification standard.

9.4.2 The retention time shift for each of the internal standards must be within ± 30 seconds of the respective internal standard in the most recent continuing calibration verification standard.

9.4.3 No ion may saturate the detector and the concentration of no target compound may exceed the concentration of the same compound in the high initial calibration standard, unless a more dilute aliquot of the sample extract is analyzed.

9.5 Corrective action for sample analysis

9.5.1 If the sample fails to meet DMC acceptance criteria:

- Check calculations.
- Check if correct amount of DMC solution was added; if not, re-extract sample.
- Check if DMC solution was properly prepared; if not, re-extract sample.
- If DMC recoveries were low, check GPC injection volume; if wrong injection volume was used, re-prepare and reanalyze.
- Check for instrument malfunction; correct and reanalyze.

9.5.1.1 If none of the above is true, the problem may be with the sample matrix. Re-extract and reanalyze to confirm matrix effect. If the sample is the original for the duplicate matrix spikes and the DMC failure is observed in one or both of the duplicate matrix spikes, matrix effect is confirmed. If the DMC criteria are met in the duplicate matrix spikes, re-extract the original sample.

9.6 Duplicate Matrix Spikes (only needed when requested by the Client)

9.6.1 Duplicate matrix spike recovery criteria are listed in the table given in **9.6.4**. Since the limits are advisory, no further action is required; however, frequent failures should be investigated and may result in questions by the client.

9.6.2 Prepare duplicate matrix spikes for every 20 samples, or as designated.

9.6.3 Do not perform duplicate matrix spike analyses on any field QC samples (including PE samples).

9.6.4 If the submitting client designates a field sample to be used for the duplicate matrix spikes, that sample must be used. The lab is to contact the client if there is insufficient sample left to perform the tests and another sample is selected, or there is insufficient sample remaining in any of the samples.

Matrix Spike Recovery and Relative Percent Difference Limits

Compound	% Recovery Water	RPD Water	% Recovery Soil/Sediment	RPD Soil/Sediment
Phenol	12-110	0-42	26-90	0-35
2-Chlorophenol	27-123	0-40	25-102	0-50
N-nitroso-di-n-propylamine	41-116	0-38	41-126	0-38
4-Chloro-3-methylphenol	23-97	0-42	26-103	0-33
Acenaphthene	46-118	0-31	31-137	0-19
4-Nitrophenol	10-80	0-50	11-114	0-50
2,4-Dintrotoluene	24-96	0-38	28-89	0-47
Pentachlorophenol	9-103	0-50	17-109	0-47
Pyrene	26-127	0-31	35-142	0-36

9.6.5 Internal standard criteria in 9.4.1 and 9.4.2 must be met.

9.7 Method Detection Limit (MDL) Determination

9.7.1 Determine the MDL for each semivolatile target analyte on each of the instruments to be used for sample analyses.

Note: MDLs are matrix-specific and level-specific, that is, the MDL must be determined for water, low-level soils and medium-level soils.

9.7.2 Determine the MDLs following the procedures specified in 40 CFR Part 136.

9.7.3 The determined concentration of the MDL has to be less than the CRQL.

9.7.4 The MDLs must be verified annually thereafter, while the contract is in effect, and after major instrument maintenance, e.g., cleaning or replacing the source, mass filters, or electron multiplier, or replacement of the GC column.

9.7.4.1 Verify the MDL by spiking with each target analyte at two times the analytically determined MDL. The resulting mass spectra of each target analyte must meet the qualitative identification criteria, presented in the SOW.

9.7.4.2 Verify the MDL for low-level soil by spiking a single purified soil matrix blank with each target compound at a concentration 1-4 times the determined MDL.

9.7.4.3 Verify the MDL for medium-level soil by spiking a single purified soil matrix blank with each target compound at a concentration two times the determined MDL.

9.7.5 All MDL documentation must be maintained at the laboratory and submitted to the client upon written request.

9.8 Contingency

9.8.1 If, due to a lab accident or to QC failure, a re-preparation is required for the sample and insufficient volume remains, the Project Manager must be alerted and will contact the client for direction on how to proceed. For the CLP, the Sample Management Office must be contacted.

9.8.1 If persistent contamination occurs in the laboratory, analyses must be halted until the source can be identified and isolated. When the contamination issue is resolved, sample analyses may proceed.

9.8.1 Any other issues that potentially affect data quality should be addressed with the Project Manager.

10.0 Calibration and Standardization

10.1 GC/MS Instrument Performance Check

10.1.1 Tune the GC/MS to meet manufacturer's specifications using perfluoro-tri-n-butyl amine (FC-43).

10.1.2 Verify the instrument's mass calibration and resolution by analyzing the DFTPP instrument performance check solution every 12 hours. Inject 2 µL of the 25 ηg/µL DFTPP solution into the GC using the cold needle technique. (See Section 7.3.1.) The acceptance criteria for the ion abundances found in the DFTPP spectrum are as follows:

Mass	Ion Abundance Criteria
51	10 - 80 % of mass 198
68	< 2 % of mass 69
69	Present
70	< 2 % of mass 69
127	10 - 80 % of mass 198
197	< 2 % of mass 198
198	Base peak, 100 % relative abundance (see note)
199	5 - 9 % of mass 198
275	10 - 60 % of mass 198
365	Greater than 1 % of mass 198
441	Present but < mass 443
442	≥50.0 % - ≤100 % of mass 198
443	15 - 24 % of mass 442

Note: Normalize all ion abundances to m/z 198, the nominal base peak, even though the ion abundances of m/z 442 may be up to 100 % that of m/z 198.

10.1.3 These abundance criteria must be met for a 50 ηg injection of DFTPP. Acquire the mass spectrum of DFTPP in the following manner:

- Acquire three scans (the peak apex scan and the scans immediately preceding and following the apex) and average.

- Perform background subtraction using a single scan acquired no more than 20 scans prior to the beginning of the elution of DFTPP. Do not subtract part of the DFTPP peak.

Note: The DFTPP solution contains DFTPP, internal standards, benzidine, pentachlorophenol, and 4, 4′-DDT. While there is no criterion for the pentachlorophenol response, a very low response indicates that the column and/or the injector is degraded or dirty and needs to be cleaned.

10.1.4 The requirement to analyze the instrument performance check doesn't apply when performing SIM analyses. When performing SIM analysis, perform the following procedure:

10.1.4.1 From the instrument desktop, go to the "View" drop-down menu and select "Manual Tune".

10.1.4.2 Go to the "File" drop-down menu and select "Load Tune Values".

10.1.4.3 Select "SIM.u", from the list provided.

10.1.4.4 From the "File" drop-down menu, select "Generate Reports". A report containing tuning masses, mass abundances and mass ratios is automatically printed. Include this printout in the final report.

10.2 Initial Calibration Procedure

10.2.1 Perform an initial five-point calibration (multipoint), at the concentration levels listed in 7.4.1 (7.4.2 for SIM) before any method blanks, matrix spikes, or field samples are analyzed.

10.2.2 Perform a multipoint whenever the column is changed or an ion source is replaced.

10.2.3 Allow all standard solutions to equilibrate to ambient temperature.

10.2.4 Perform one injection of each of the five standard concentrations.

10.2.5 Acquire all standard analyses after acceptable DFTPP analysis.

10.2.6 All compounds must be present in all applicable standard levels

10.3 Initial Calibration Acceptance Criteria

10.3.1 All minimum response factor and maximum percent relative standard deviation (%RSD) criteria listed in Attachment 3 must be met for the multipoint to be acceptable.

10.3.1.1 Four of the compounds listed in Attachment 3 may fail acceptance criteria, however, the relative response factors (RRF) for these compounds must be greater than 0.01 and their % RSD less than or equal to 40%.

10.3.1.2 For SIM analysis of PAHs and pentachlorophenol, the multipoint must meet the criteria in 10.3.1. Two compounds may fail acceptance critieria, however, they must meet a minimum RRF of 0.01 and a % RSD of less than or equal to 40 %.

10.4 Opening Continuing Calibration Verification Procedure

10.4.1 Calibrate the GC/MS every twelve hours. This twelve hour period begins with the injection of the DFTPP for full scan analysis.

10.4.1.1 For the SIM analysis, the twelve hour time period begins with the injection of the first standard in the multipoint or the opening CCV.

10.4.2 Inject a 2 µL aliquot of standard into the GC/MS, resulting in a 20 ηg concentration (0.4 ηg for SIM). Calculate the RRFs for this opening continuing calibration verification (CCV) and compare with the mean RRFs from the multipoint.

10.4.3 Opening CCV Acceptance Criteria

10.4.3.1 As with the initial calibration, up to four (2 for SIM) semivolatile target compounds listed in Attachment 3 may fail to meet the minimum RRF or maximum percent difference criteria (% D), but the RRFs of those compounds must be greater than or equal to 0.01, and the% D must be less than or equal to 40 % for the continuing calibration to be acceptable.

10.5 Closing Continuing Calibration Verification Procedure

10.5.1 Analyze the closing CCV prior to the end of the twelve hour analysis period, and after the last sample is analyzed.

10.5.2 Inject a 2 µL aliquot of the 20 ηg/µL (0.4 ηg/µL for SIM) standard concentration into the GC/MS. Calculate the RRF for each compound in the closing CCV and compare to the mean RRFs from the multipoint calibration.

10.5.3 Closing CCV Acceptance Criteria

10.5.3.1 The RRF for each compound listed in Attachment 3 must be greater than or equal to 0.01 and the % D must be in the inclusive range of ± 50.0%.

10.5.3.2 For SIM analysis, pentachlorophenol and all PAH compounds must meet the criteria in 10.5.3.1.

Note: If SIM analysis is requested, a full-scan analysis must be performed first.

10.5.3.3 If a closing CCV meets the technical acceptance criteria for an opening CCV and samples are analyzed within the next 12-hour time period, then an additional DFTPP tune isn't required. In this case, the 12-hour time period begins with that calibration verification standard.

11.0 Procedure

Documentation must follow the requirements in Quality Control SOP 13.6, "Proper Documentation Procedures". Record all instrument information in the GC/MS SVOA Run Log (Attachment 4). **Condition Codes, abbreviations defined in Attachment 6, are used to document failed and qualified injections.**

11.1 The following instrument conditions are used for calibration and sample analyses for both scan and SIM. See section 10.0 for details on instrument calibration.

11.1.1 GC Conditions

	Scan	SIM
Injector	Split/Splitless	Split/Split less
Carrier Gas	Helium	Helium
Injection Port Temp	280 – 320°C	280 – 320°C
Sweep Flow (mL/min)	100	100
Column Flow (mL/min)	1.5 – 2.7	1.5 – 2.7
Initial Temp	40	45° C
Hold (min)	2	0.5
Ramp Rate	4° C/min to 60° C hold 1 min	10° C/min to 280° C hold 9 min
	10° C/min to 100° C hold 1 min	
	12° C/min to 300° C hold 6.5 min	
Final Temp	300 ° C	280° C

11.1.2 Mass Spectrometer Conditions

11.1.2.1 Solvent Delay: 3.00

11.1.2.2 EMV offset: -105.9 from tune file

11.1.2.3 Scan Parameters

- Low Mass: 35 amu
- High Mass: 500 amu
- Threshold: 150 amu
- Scan time: ≤ 1 second
- Electron energy: 70 volts (nominal)

11.2 Analysis

11.2.1 Aliquot an amount of DFTPP solution into an autosampler vial. Place vial in autosampler tray on the instrument. The autosampler injects 2 µL of the 25 ηg/µL DFTPP solution, resulting in 50 ηg on-column amount.

11.2.2 Aliquot calibration standard solution(s) into autosampler vials. Place vials in the autosampler tray on the instrument. The autosampler injects 2 µL of standard solution onto the instrument. The initial calibration consists of at least five injections, the continuing calibration, at least one injection.

11.2.3 Aliquot 100 µL of method blank or sample extracts (including duplicate matrix spikes) and add 2.5 µL of internal standard solution into autosampler vials. Place vials in the autosampler tray on the instrument. The autosampler injects 2 µL of the extract onto the instrument.

11.3 Quantitation

11.3.1 Acquire analytical data from each analysis (DFTPP, calibration standard, method blank, or sample) on the instrument's data system and transfer via the file transfer program (FTP) to data processing software.

11.3.2 Use the data processing software (Target) to quantitate the data files. Review the data files for compliance with SOW acceptance criteria.

11.3.3 Process the DFTPP data file. If the data meet acceptance criteria, print the Reconstructed Ion Chromatograph (RIC), mass listing and spectrum with listing of ion abundance criteria.

11.3.4 Process the calibration standard data.

11.3.4.1 For a multipoint calibration:

- Review each standard data file ensuring that each target compound is present. Manual integration may be needed.
- Check the Initial Calibration Data Summary Form on Target and print out if multipoint meets acceptance critiera.
- Print each standard file and arrange in the following order: RIC, quantitation report, and EICP.

11.3.4.2 For opening or closing CCV, follow the points outlined in Sections 10.4 and 10.5

11.3.5 Process each sample data file. Review file(s) to insure that internal standard, DMC and dilution acceptance criteria are met.

11.3.6 After the analysis and acceptance of the closing CCV, make all entries onto the appropriate logbook page(s). Have the logbook page(s) reviewed and signed by the supervisor or designee and make a copy. This copy will accompany the data. Attach the DFTPP and calibration data to the log book copy.

11.4 Qualitative Identification of Target Compounds

11.4.1 An analyst/data reviewer competent in the interpretation of mass spectra must identify the compounds listed in Attachment 1 by comparing the sample mass spectra to the standard mass spectra.

11.4.2 Identify each target compound by verifying that the compound in the sample eluted at the same GC Relative Retention Time (RRT) as the compound in the standard and that the compound's mass spectrum in the sample is comparable to the compound's mass spectrum in the standard.

11.4.2.1 The RRT of the compound in the sample must be within ±0.06 RRT units of the RRT of the compound in the corresponding opening CCV. For samples analyzed in the same 12-hour period as the initial calibration, the sample RRT is compared to that of the 20 ηg/μL standard (0.4 ηg/μL standard for SIM analysis).

11.4.2.1.1 If co-elution of interfering compounds prohibits accurate assignment of the RRT of a compound in the sample from the total ion chromatograph, assign the RRT using the EICP or ions unique to the compound of interest.

11.4.2.2 Compare the mass spectra of the target compounds in the sample to those in the standard.

11.4.2.2.1 All ions present in the standard mass spectrum at a relative intensity of >10% (most abundant ion in the spectrum equals 100%) must be present in the sample mass spectrum.

11.4.2.2.2 The relative intensities of the ions in the sample mass spectrum must agree within ±20% of the ions in the standard mass spectrum (e.g., for an ion with an abundance of 50% in the standard spectrum the corresponding abundance of the ion in the sample must be between 30 and 70 %.)

11.4.2.2.3 Ions with an abundance >10% in the sample spectrum but not present in the standard spectrum must be considered and accounted for by the analyst/data reviewer making the comparison. The verification process should favor false positives. All compounds

meeting the identification criteria must be reported with their spectra. Compounds meeting the identification criteria, but at concentration below the adjusted CRQL are reported with as estimated concentrations (flagged with a "J").

11.4.3 If a compound cannot be verified by all of the identification criteria in section **11.4.2.2**, but in the technical judgment of the analyst/data reviewer that the identification is correct, the compound is reported.

11.5 Qualitative Analysis of Non-Target Compounds

11.5.1 Tentatively identify all compounds in the sample that have not already been identified as target compounds, or that are not DMCs, internal standards or volatile compounds listed in **Exhibit C of the SOM01.2 SOW** (except 1,4-dioxane), by performing a computer-generated library search using the NIST mass spectral library (See section 6.4.1). The library search must not be normalized.

11.5.2 Up to 30 tentatively identified compounds (TICs), excluding alkanes, of the greatest concentration are reported for each sample. **The library search encompasses TICs eluting between the elution of the first and last TCL analyte.**

11.5.3 TICs identified as alkanes are not counted among the TICs in section **11.5.1** Their concentrations are summed as a single result and reported as "total alkanes".

11.5.4 Peaks identified as aldol-condensation reaction products, such as 4-methyl-4-hydroxy-2-pentanone and 4-methyl-3-pentene-2-one, must be reported and counted among the 30 most concentrated TICs. Flag these compounds with an "A" on the Form I SV-TIC.

11.5.5 Rules for making tentative identification:

11.5.5.1 TICs receiving a library search match of 85% or higher are considered a "probable match". Report the compound identified.

11.5.5.2 For TICs receiving more than one library search match of 85% or higher, report the compound with the highest percent match.

11.5.5.3 For TICs receiving two or more library search matches of 85% or higher with the same percent match, report the first compound.

11.5.5.4 For TICs that are isomers receiving library search matches of 85% or higher, report the compound with the highest percent match.

Note: If in the opinion **of** the experienced analyst/data reviewer there is sound technical evidence not to identify the compound as specified in sections 11.5.5.1 to 11.5.5.4 the justification must be documented in the narrative.

11.5.5.5 TICs receiving a library search match of < 85% are given a tentative identification by the analyst/data reviewer, if possible. If no identification can be made the TIC is reported as "unknown". If possible the unknown is further identified as part of a class of compounds (for example "unknown aromatic").

11.5.6 TIC identification does not apply to SIM analyses.

11.6 Sample Quantitation

11.6.1 The concentration of each target and non-target compound is calculated using the equations is section 12.0.

12.0 Data Analysis and Calculations

Calculations must be consistent with the Quality Control SOP 13.4, "Numerical Data Reduction".

12.1 Calculation of the mean or average of a set of values:

$$\overline{X} = \frac{\sum_{i=1}^{n} X_i}{n}$$

where: n = total number of values

x_i = each individual value used to calculate the mean

$\overline{x}$ = the mean of n

12.2 Calculation of the standard deviation of a set of values:

$$\text{Standard deviation} = \sqrt{\frac{\sum_{i=1}^{n}\left(X_n - \overline{X}\right)^2}{n-1}}$$

12.3 Calculation of percent recovery

12.3.1 Surrogates

$$\%R = \frac{Amount\ found}{Amount\ spiked} x\ 100$$

12.3.2 Matrix spikes

$$\%\,R = \frac{Amount\ in\ spiked\ sample - Amount\ in\ unspiked\ (native)\ sample}{Amount\ spiked} x\ 100$$

12.4 Calculation of % RSD

$$\%RSD = \left(\frac{Standard\ deviation}{\overline{X}}\right) \times 100$$

12.5 Calculation of RPD

$$RPD = \frac{|Value\ 1 - Value\ 2|}{(Value\ 1 + Value\ 2)/2} x100$$

12.6 Calculation of %Difference (%D)

$$\%Diff = \frac{Value - \overline{Reference\ value}}{\overline{Reference\ value}} x\ 100$$

12.7 Calculation of Relative Response Factor (RRF)

$$RRF = \frac{Ax}{Ais} x \frac{Cis}{Cx}$$

Where: Ax = area of the characteristic ion from the EICP for the compound to be measured
Ais = area of the characteristic ion for the EICP for the internal standard
Cis = concentration of the internal standard
Cx = concentration of the compound to be measured

12.8 Concentration of aqueous samples by GC/MS analysis

$$\mu g / L = \frac{(Ax)(Is)(Vt)(Df)(CVout)}{(Ais)(\overline{RRF})(Vo)(Vi)(CVinXE)}$$

where:

Ax = area of the characteristic ion from the EICP for the compound to be measured
Ais = area of the characteristic ion for the EICP for the internal standard
Is = amount of internal standard injected (ηg)
$\overline{RRF}$ = mean relative response factor from most multipoint
Vo = volume of water extracted (mL)
Vi = volume of extract injected (µL)
Vt = volume of the concentrated extract (µL)
Df = dilution factor. If no dilution, Df = 1.0
CVout = volume of extract produced by a cleanup process (cleanup and concentration), in µL
CVin = volume of extract subjected to a cleanup process, in µL
E = the efficiency of the cleanup process expressed as a fraction of material that passes through or is not mechanically lost during the cleanup step (e.g., 50% efficiency must be expressed as 0.50)

12.9 Concentration of soil samples (dry weight basis) by GC/MS

$$\mu g / kg = \frac{(Ax)(Is)(Vt)(Df)(2.0)}{(Ais)(\overline{RRF})(Vi)(Ws)(D)}$$

where:

Ax, Ais, Is, Vt, Vi, $\overline{RRF}$, Df, **CVout, CVin, and E** are the same as given for water
2.0 = GPC factor (if used)
Ws = weight of sample extracted, in grams
D (dry weight) = $\frac{100 - \%\ \text{moisture}}{100}$

12.10 Calculating Dilutions

If a sample concentration exceeds the concentration of the high level standard a dilution must be performed. Determine a level of dilution that will result in a value within the calibration range by dividing the concentration of the high analyte in the sample by the desired concentration. Dilute the extract with methylene chloride and note the dilution factor and preparation on the run log. (A 10x dilution = 100 µL sample plus 900 µL diluent for a total volume of 1000 µL.)

12.10.1 The maximum dilution factor permitted for low-level soils is 30.0. If a dilution greater than 30.0 is required, then the medium-level method shall be utilized.

13.0 Method Performance

This method was validated through in-house laboratory studies and precision and accuracy for single analyst. The data are retained by the QA department.

14.0 Pollution Prevention

The solvents used in this procedure pose little threat to the environment when recycled and managed properly. Pollution prevention encompasses any technique that reduces or eliminates the quantity or toxicity of waste at the point of generation. Numerous opportunities for pollution prevention exist in laboratory operation. The EPA has established a preferred hierarchy of environmental management techniques that places pollution prevention as the management option of first choice. Whenever feasible, laboratory personnel should use pollution prevention techniques to address their waste generation. When wastes cannot be feasibly reduced at the source, the Agency recommends recycling as the next best thing. See SOP 12.1, Hazardous Waste Disposal, regarding laboratory procedures for recycling solvent waste streams.

15.0 Waste Management

It is the laboratory's responsibility to comply with all federal, state, and local regulations governing waste management, particularly the hazardous waste identification rules and land disposal restrictions, and to protect the air, water, and land by minimizing and controlling all releases from fume hoods and bench operations. Compliance with all sewage discharge permits and regulations is also required.

Samples preserved with HCl, HNO_3, or H_2SO_4 to pH <2 must be handled as hazardous waste.

Refer to the Hazardous Waste Management and Safety SOPs located in the lab.

16.0 References

16.1 U.S. EPA CLP SOW for Organic Analysis, Multi-Media, Multi-Concentration SOM01.2 (8/2007)

16.2 Methods for Chemical Analysis of Water and Wastes, March 1983

16.3 Standard Methods for the Examination of Water and Wastewater, 20th (1998) Editions upon promulgation, Method 1080

16.4 Code of Federal Register, 40 CFR, Part 136, "Guidelines for Establishing Test Procedures for Priority Pollutants"

16.5 Quality Control SOP 13.6, "Proper Documentation Procedures"

16.6 Quality Control SOP 13.4, "Numerical Data Reduction"

16.7 "Less is Better: Laboratory Chemical Management for Waste Reduction," American Chemical Society Department of Government Relations and Science Policy, 1155 16th Street, N.W., Washington DC, 20036, (202) 872-4477.

16.8 **NELAC Standards, effective July 2003**

16.9 QA-G6: Guidance for the Preparation of Standard Operating Procedures for Quality-Related Operations EPA/600/R-96/027, November 1995

16.**10** CompuChem Quality Manual, Revision **11, June 23, 2008, plus revisions**

17.0 Attachments as Tables, Diagrams, Flowcharts & Validation Data

17.1 Attachment 1 – Target Compound List and CRQL

17.2 Attachment 2 – TCL and DMC with Corresponding IS for Quantitation

17.3 Attachment 3 - Relative Response Factor Criteria for Initial and Continuing Calibration Verifications of Semivolatile Target Compounds and Deuterated Monitoring Compounds

17.4 Attachment 4 – GC/MS Run Log Example

17.5 Attachment 5 – DMC Primary and Secondary Ions

17.6 Attachment 6 – Condition Codes

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Attachment 1

Target Compound List (TCL) and Contract Required Quantitation Limits (CRQLs)

Target Compounds	CRQLs µg/L	CRQLs µg/Kg Low	CRQLs µg/Kg Medium	SIM CRQLs µg/L	SIM CRQLs µg/Kg
Benzaldehyde	5.0	170	5000		
Phenol	5.0	170	5000		
Bis-(2-Chloroethyl) ether	5.0	170	5000		
2-Chlorophenol	5.0	170	5000		
2-Methylphenol	5.0	170	5000		
2,2'-oxybis (1-Chloropropane)	5.0	170	5000		
Acetophenone	5.0	170	5000		
4-Methylphenol	5.0	170	5000		
N-nitroso-di-n-propylamine	5.0	170	5000		
Hexachloroethane	5.0	170	5000		
Nitrobenzene	5.0	170	5000		
Isophone	5.0	170	5000		
2-Nitrophenol	5.0	170	5000		
2,4-Dimethylphenol	5.0	170	5000		
Bis (2-Chloroethoxy) methane	5.0	170	5000		
2,4-Dichlorophenol	5.0	170	5000		
Naphthalene	5.0	170	5000	0.10	3.3
4-Chloroaniline	5.0	170	5000		
Hexachlorobutadiene	5.0	170	5000		
Caprolactam	5.0	170	5000		
4-Chloro-3-methylphenol	5.0	170	5000		
2-Methylnaphthalene	5.0	170	5000	0.10	3.3
Hexachlorocyclopentadiene	5.0	170	5000		
2,4,6-Trichlorophenol	5.0	170	5000		
2,4,5-Trichlorophenol	5.0	170	5000		
1,1'-Biphenyl	5.0	170	5000		
2-Chloronaphthalene	5.0	170	5000		
2-Nitroaniline	10.0	330	10000		
Dimethylphthalate	5.0	170	5000		
2,6-Dinitrotoluene	5.0	170	5000		
Acenaphthylene	5.0	170	5000	0.10	3.3
3-Nitroaniline	10.0	330	10000		
Acenaphthene	5.0	170	5000	0.10	3.3

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Attachment 1 (Continued)

Target Compound List (TCL) and Contract Required Quantitation Limits (CRQLs)

Target Compounds	CRQLs			SIM CRQLs	
	µg/L	µg/Kg Low	µg/Kg Medium	µg/L	µg/Kg
2,4-Dinitrophenol	10.0	330	10000		
4-Nitrophenol	10.0	330	10000		
Dibenzofuran	5.0	170	5000		
2,4-Dinitrotoluene	5.0	170	5000		
Diethylphthalate	5.0	170	5000		
Fluorene	5.0	170	5000	0.10	3.3
4-Chlorophenyl-phenylether	5.0	170	5000		
4-Nitroaniline	10.0	330	10000		
4,6-Dinitro-2-methylphenol	10.0	330	10000		
N-Nitrosodiphenylamine	5.0	170	5000		
1,2,4,5 Tetrachlorobenzene	5.0	170	5000		
4-Bromophenyl-phenylether	5.0	170	5000		
Hexachlorobenzene	5.0	170	5000		
Atrazine	5.0	170	5000		
Pentachlorophenol	10.0	330	10000	0.20	6.7
Phenanthrene	5.0	170	5000	0.10	3.3
Anthracene	5.0	170	5000	**0.10**	**3.3**
Carbazole	5.0	170	5000		
Di-n-butylphthalate	5.0	170	5000		
Fluoranthene	5.0	170	5000	0.10	3.3
Pyrene	5.0	170	5000	0.10	3.3
Butylbenzylphthalate	5.0	170	5000		
3,3'-Dichlorobenzidine	5.0	170	5000		
Benzo (a) anthracene	5.0	170	5000	0.10	3.3
Chrysene	5.0	170	5000	0.10	3.3
Bis (2-ethylhexyl) phthalate	5.0	170	5000		
Di-n-octyl phthalate	5.0	170	5000		
Benzo (b) fluoranthene	5.0	170	5000	0.10	3.3
Benzo (k) fluoranthene	5.0	170	5000	0.10	3.3
Benzo (a) pyrene	5.0	170	5000	0.10	3.3
Indeno (1,2,3-cd) pyrene	5.0	170	5000	0.10	3.3
Dibenz (a,h) anthracene	5.0	170	5000	0.10	3.3
Benzo (g,h,i) perylene	5.0	170	5000	0.10	3.3
2,3,4,6-Tetracholophenol	5.0	170	5000		

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Attachment 2

Target Compounds and Deuterated Monitoring Compound (DMC)
with Corresponding Internal Standards For Quantitation

1,4-Dichlorobenzene-d_4	**Naphthalene-d_8**	**Acenaphthene-d_{10}**
Benzaldehyde	Nitrobenzene	Hexachlorocyclopentadiene
Phenol	Isophorone	2,4,6-Trichlorophenol
Bis(2-Chloroethyl)ether	2-Nitrophenol	2,4,5-Trichlorophenol
2-Chlorophenol	2,4-Dimethylphenol	2,3,4,6-Tetrachlorophenol
2-Methylphenol	Bis (2-Chloroethoxy) methane	1,1'-Biphenyl
2,2'-oxybis-(1-Chloro-propane)	2,4-Dichlorophenol	2-Chloronaphthalene
Acetophenone	4-Chloroaniline	2-Nitroaniline
4-Methylphenol	Hexachlorobutadiene	Dimethylphthalene
N-Nitroso-Di-n-propylamine	Caprolactam	Acenaphthylene
Hexachloroethane	4-Chloro-3-methylphenol	3-Nitroaniline
Phenol-d_5 (DMC)	2-Methylnaphthalene	Acenaphthene
Bis (2-chloroethyl) ether-d_8 (DMC)	Naphthalene	2,4-Dinitrophenol
2-Chlorophenol-d_4 (DMC)	Nitrobenzene-d_5 (DMC)	4-Nitrophenol
4-Methylphenol-d_8 (DMC)	2-Nitrophenol-d_4 (DMC)	Dibenzofuran
	2,4-Dichlorophenol-d_3 (DMC)	2,4-Dinitrotoluene
	4-Chloroaniline-d_4 (DMC)	2,6-Dinitrotoluene
	2-Methylnaphthalene-d_{10} (SIM DMC)	1,2,4,5-Tetrachlorobenzene
		Diethylphthalate
		4-Chlorophenyl-phenylether
		Fluorene
		4-Nitroaniline
		Acenaphthylene-d_8 (DMC)
		4-Nitrophenol-d_4 (DMC)
		Dimethylphthalate-d_6 (DMC)
		Fluorene-d_{10}

Attachment 2 (Continued)

Target Compounds and Deuterated Monitoring Compound (DMC)
with Corresponding Internal Standards For Quantitation

Phenanthrene-d_{10}	**Chrysene-d_{12}**	**Perylene-d_{12}**
4,6-Dinitro-2-methylphenol	Pyrene	Di-n-octylphthalate
N-nitrosodiphenylamine	Butylbenzylphthalate	Benzo (b) fluoranthene
4-Bromophenyl-phenylether	3,3'-Dichlorobenzidine	Benzo (k) fluoranthene
Hexachlorobenzene	Benzo (a) anthracene	Benzo (a) pyrene
Atrazine	Bis (2-Ethylhexyl) phthalate	Indeno (1,2,3-cd) pyrene
Pentachlorophenol	Chrysene	Dibenzo (a,h) anthracene
Phenanthrene	Pyrene-d_{10} (DMC)	Benzo (g,h,i) perylene
Anthracene		Benzo (a) pyrene-d_{12} (DMC)
Carbazole		
Di-n-butylphthalate		
Fluoranthene		
4,6-Dinitro-2-methylphenol-d_2 (DMC)		
Anthracene-d_{10} (DMC)		
Fluoranthene-d_{10} (SIM-DMC)		

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Attachment 3

Relative Response Factor Criteria for Initial and Continuing Calibration Verification of Semivolatile Target Compounds and Deuterated Monitoring Compounds

Semivolatile Compounds	Minimum RRF	Maximum % RSD[1]	Maximum % Diff[1]
Benzaldehyde	0.010	40.0	±40.0
Phenol	0.800	20.0	±25.0
Bis-(2-Chloroethyl) ether	0.700	20.0	±25.0
2-Chlorophenol	0.800	20.0	±25.0
2-Methylphenol	0.700	20.0	±25.0
2,2'-oxybis (1-Chloropropane)	0.010	40.0	±40.0
Acetophenone	0.010	40.0	±40.0
4-Methylphenol	0.600	20.0	±25.0
N-nitroso-di-n-propylamine	0.500	20.0	±25.0
Hexachloroethane	0.300	20.0	±25.0
Nitrobenzene	0.200	20.0	±25.0
Isophone	0.400	20.0	±25.0
2-Nitrophenol	0.100	20.0	±25.0
2,4-Dimethylphenol	0.200	20.0	±25.0
Bis (2-Chloroethoxy) methane	0.300	20.0	±25.0
2,4-Dichlorophenol	0.200	20.0	±25.0
Naphthalene	0.700	20.0	±25.0
4-Chloroaniline	0.010	40.0	±40.0
Hexachlorobutadiene	0.010	40.0	±40.0
Caprolactam	0.010	40.0	±40.0
4-Chloro-3-methylphenol	0.200	20.0	±25.0
2-Methylnaphthalene	0.400	20.0	±25.0
Hexachlorocyclopentadiene	0.010	40.0	±40.0
2,4,6-Trichlorophenol	0.200	20.0	±25.0
2,4,5-Trichlorophenol	0.200	20.0	±25.0
1,1'-Biphenyl	0.010	40.0	±40.0
2-Chloronaphthalene	0.800	20.0	±25.0
2-Nitroaniline	0.010	40.0	±40.0

[1]For a closing CCV, all target compounds and DMCs must meet a minimum RRF of 0.010 and a maximum % Difference of ± 50.0.

Attachment 3 (Continued)

Relative Response Factor Criteria for Initial and Continuing Calibration Verification of Semivolatile Target Compounds and Deuterated Monitoring Compounds

Semivolatile Compounds	Minimum RRF	Maximum % RSD[1]	Maximum % Diff[1]
Dimethylphthalate	0.010	40.0	±40.0
2,6-Dinitrotoluene	0.200	20.0	±25.0
Acenaphthylene	0.900	20.0	±25.0
3-Nitroaniline	0.010	40.0	±40.0
Acenaphthene	0.900	20.0	±25.0
2,4-Dinitrophenol	0.010	40.0	±40.0
4-Nitrophenol	0.010	40.0	±40.0
Dibenzofuran	0.800	20.0	±25.0
2,4-Dinitrotoluene	0.200	20.0	±25.0
Diethylphthalate	0.010	40.0	±40.0
1,2,4,5 Tetrachlorobenzene	0.010	40.0	±40.0
4-Chlorophenyl-phenylether	0.400	20.0	**±25.0**
Fluorene	0.900	20.0	±25.0
4-Nitroaniline	0.010	40.0	±40.0
4,6-Dinitro-2-methylphenol	0.010	40.0	±40.0
4-Bromophenyl-phenyl ether	0.100	20.0	±25.0
N-Nitrosodiphenylamine	0.010	40.0	±40.0
Hexachlorobenzene	0.100	20.0	**±25.0**
Atrazine	0.010	40.0	**±40.0**
Pentachlorophenol	0.050	20.0	±25.0
Phenanthrene	0.700	20.0	±25.0
Anthracene	0.700	20.0	±25.0
Carbazole	0.010	40.0	±40.0
Di-n-butylphthalate	0.010	40.0	±40.0
Fluoranthene	0.600	20.0	±25.0
Pyrene	0.600	20.0	±25.0
Butylbenzylphthalate	0.010	40.0	±40.0
3,3'-Dichlorobenzidine	0.010	40.0	±40.0
Benzo (a) anthracene	0.800	20.0	±25.0

[1]For a closing CCV, all target compounds and DMCs must meet a minimum RRF of 0.010 and a maximum % Difference of ± 50.0.

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Attachment 3 (Continued)

Relative Response Factor Criteria for Initial and Continuing Calibration Verification of Semivolatile Target Compounds and Deuterated Monitoring Compounds

Semivolatile Compounds	Minimum RRF	Maximum % RSD[1]	Maximum % Diff[1]
Chrysene	0.700	20.0	±25.0
Bis (2-ethylhexyl) phthalate	0.010	40.0	±40.0
Di-n-octyl phthalate	0.010	40.0	±40.0
Benzo (b) fluoranthene	0.700	20.0	±25.0
Benzo (k) fluoranthene	0.700	20.0	±25.0
Benzo (a) pyrene	0.700	20.0	±25.0
Indeno (1,2,3-cd) pyrene	0.500	20.0	±25.0
Dibenzo (a,h) anthracene	0.400	20.0	±25.0
Benzo (g,h,i) perylene	0.500	20.0	±25.0
2,3,4,6-Tetrachlorophenol	0.100	20.0	±25.0

Deuterated Monitoring Compounds	Minimum RRF	Maximum % RSD[1]	Maximum % Diff[1]
Phenol-d_5	0.010	20.0	±25.0
Bis-(2-Chloroethyl) ether-d_8	0.010	20.0	±25.0
2-Chlorophenol-d_4	0.010	20.0	±25.0
4-Methylphenol-d_8	0.010	20.0	±25.0
Nitrobenzene-d_5	0.010	20.0	±25.0
2-Nitrophenol-d_4	0.010	20.0	±25.0
2,4-Dichlorophenol-d_3	0.010	20.0	±25.0
4-Chloroaniline-d_4	0.010	40.0	±40.0
Dimethylphthalate-d_6	0.010	40.0	±40.0
Acenaphthylene-d_8	0.010	20.0	±25.0
4-Nitrophenol-d_4	0.010	40.0	±40.0
Fluorene-d_{10}	0.010	20.0	±25.0
4,6-Dinitro-2-methylphenol-d_2	0.010	40.0	±40.0
Anthracene -d_{10}	0.010	20.0	±25.0
Pyrene-d_{10}	0.010	20.0	±25.0
Benzo (a) pyrene-d_{12}	0.010	20.0	±25.0
Fluoranthene-d_{10} (SIM)	0.010	20.0	±25.0
2-Methylnaphthalene-d_{10} (SIM)	0.010	20.0	±25.0

[1]For a closing CCV, all target compounds and DMCs must meet a minimum RRF of 0.010 and a maximum % Difference of ± 50.0.

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Attachment 4

COMPUCHEM a division of Liberty Analytical Corp DATE___/___/___INITIAL TIME OF TUNE_____ SHIFT/S(A)_____(B)_____(C)_____
GC/MS SEMIVOLATILE RUN LOG TIME TUNE EXPIRES_____ LINKER/METHOD_____
COMPUCHEM LOGBOOK 4 YYY 11 (5972hp64)
PREVENTIVE MAINTENANCE_____

		FILE NAME		DATE	TIME	CLIENT ID#	CASE/SDG#	AMOUNT INJECTED	CHEMIST	COMMENTS(ETC)/DISPOSITION
1				/ /						
2				/ /						
3				/ /						
4				/ /						
5				/ /						
6				/ /						
7				/ /						
8				/ /						
9				/ /						
10				/ /						
11				/ /						
12				/ /						
13				/ /						
14				/ /						
15				/ /						
16				/ /						
17				/ /						
18				/ /						
19				/ /						
20				/ /						
21				/ /						
22				/ /						
23				/ /						
24				/ /						

STANDARDS

Tune	Analytical	Int. Std.	Column Type	SUPERVISOR APPROVAL_____
Std. ID#				DATE_____
Lot #				

The presence of the Chemist's employee ID number, or signature, on this run log attests that strict compliance with the method's SOP has occurred. Any SOP deviations require documentation by the responsible chemist together with the chemist's initials and the initials of the lab supervisor and a QA department representative, signifying approval of the deviation.

Solvent Lot #_____

12/16/04:jad

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Attachment 5

Target and Deuterated Monitoring Compounds Quantitation and Secondary Ions

Target Compound	Quantitation Ion	Secondary Ion(s)
Benzaldehyde	77	105, 106
Phenol	94	65, 66
Bis(2-Chloroethyl) ether	93	63, 95
2-Chlorophenol	128	64, 130
2-Methylphenol	108	107
2,2'-oxybis(1-Chloropropane)	45	77, 79
Acetophenone	105	77, 51
4-Methylphenol	108	107
N-nitroso-di-n-propylamine	70	42, 101, 130
Hexachloroethane	117	201, 199
Nitrobenzene	77	123, 65
Isophorone	82	95, 138
2-Nitrophenol	139	65, 109
2,4-Dimethylphenol	107	121, 122
Bis(2-chloroethoxy)methane	93	95, 123
2,4-Dichlorophenol	162	164, 98
Naphthalene	128	129, 127
4-Chloroaniline	127	129
Hexachlorobutadiene	225	223, 227
Caprolactam	113	55, 56
4-Chloro-3-methylphenol	107	144, 142
2-Methylnaphthalene	142	141
Hexachlorocyclopentadiene	237	235, 272
2,4,6-Trichlorophenol	196	198, 200
2,4,5-Trichlorophenol	196	198, 200
1,1'-Biphenyl	154	153, 76
2-Chloronaphthalene	162	164, 127
2-Nitroaniline	65	92, 138
Dimethyl phthalate	163	194, 164
Acenaphthylene	152	151, 153
3-Nitroaniline	138	108, 92
Acenaphthene	153	152, 154
2,4-Dinitrophenol	184	63, 154
4-Nitrophenol	109	139, 65

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Attachment 5 (Continued)

Target Compounds and Deuterated Monitoring Compounds Quantitation And Secondary Ions

Target Compound	Quantitation Ion	Secondary Ion(s)
Dibenzofuran	168	139
2,4-Dinitrotoluene	165	63, 182
2,6-Dinitrotoluene	165	89, 121
Diethylphthalate	149	177, 150
1,2,4,5-Tetrachlorobenzene	216	214, 179, 108, 143, 218
4-Chlorophenyl-phenylether	204	206, 141
Fluorene	166	165, 167
4-Nitroaniline	138	92, 108
4,6-Dintro-2-methylphenol	198	182, 77
N-Nitrosodiphenylamine	169	168, 167
4-Bromophenyl-phenylether	248	250, 141
Hexachlorobenzene	284	142, 249
Atrazine	200	173, 215
Pentachlorophenol	266	264, 268
Phenanthrene	178	179, 176
Anthracene	178	179, 176
Carbazole	167	166, 139
Di-n-butylphthalate	149	150, 104
Fluoranthene	202	101, 100
Pyrene	202	101, 100
Butylbenzylphthalate	149	91, 206
3,3'-Dichlrorbenzidine	252	254, 126
Benzo (a) anthracene	228	229, 226
Bis (2-Ethylhexyl) phthalate	149	167, 279
Chrysene	228	226, 229
Di-n-octyl phthalate	149	None
Benzo (b)fluoranthene	252	253, 125
Benzo (k) fluoranthene	252	253, 125
Benzo (a) pyrene	252	253, 125
Indeno (1,2,3-cd)pyrene	276	138, 227
Dibenz (a,h) anthracene	278	139, 279
Benzo (g,h,i) perylene	276	138, 277
2,3,4,6-Tetrachlorophenol	232	131, 230, 166, 234, 168

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Attachment 5 (Continued)

Target Compounds and Deuterated Monitoring Compounds Quantitation and Secondary Ions

Deuterated Monitoring Compound	Quantitation Ion	Secondary Ion(s)
Phenol-d_5	99	71, 42
Bis(2-Chloroethyl)ether-d_8	67	99, 69
2-Chlorophenol-d_4	132	134, 68, 66
4-Methylpheno-d_8	113	115, 54
Nitrobenzene-d_5	128	82, 54
2-Nitrophenol-d_4	143	69, 41, 42
2,4-Dichlorophenol-d_3	165	167, 101
4-Chloroaniline-d_4	131	133, 69
Dimethylphthalate-d_6	166	78
Acenaphthylene-d_8	160	80, 158
4-Nitrophenol-d_4	143	113, 41, 42
Fluorene-d_{10}	176	174, 87, 86
4,6-Dinitro-2-methylphenol-d_2	200	170, 52
Anthracene-d_{10}	188	94, 80
Pyrene-d_{10}	212	106, 104
Benzo(a)pyrene-d_{12}	264	132, 118
Fluoranthene-d_{10} (SIM)	212	106, 104
2-Methylnaphthalene-d_{10} (SIM)	152	151
Internal Standards		
1,4-Dichlorobenzene-d_4	152	115
Naphthalene-d_8	136	68
Acenapthene-d_{10}	164	162, 160
Phenanthrene-d_{10}	188	94, 80
Chrysene-d_{12}	240	120, 236
Perylene-d_{12}	264	260, 265

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Attachment 6

Condition Codes Used for Documentation in Logbooks

Condition Code	Definition
CS	Contamination Suspected
CT	Contamination Verified
DA	Dilution Acceptable
DI	Requires Dilution
DW	Dilution Wrong
ES	Extraction Same
EF2JS	Ending Standard Failed Second Tune Injection Same
JS	Injection Same
IH	Internals High
IL	Internals Low
IM	Internals Missing
LA	Lab Accident (Must Explain)
OT	Other (Must Explain)
OQ	Original Run Qualified
OW	Original Wrong for QC Sample
RP	Reportable Prior Run
RT	Retention Time Shift
RU	Run Unnecessarily
SF	Spike Recoveries Failed
SH	Surrogate Recoveries Failed High
SI	Spiked Inadvertently
SL	Surrogate Recoveries Failed Low
SM	Surrogate or Spike Missing
IF	Instrument Failure (Must Explain)
US	Unacceptable Standard (Must Explain)
VR	Verify Results (Must Explain)
NM	Did Not Match Prior Run or Duplicate
RN	Reanalyze Neat
PC	Poor Chromatography
WS	Wrong Standard

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SOP DOCUMENTATION FORM

This form must accompany all new and revised Standard Operating Procedures (SOPs) when you turn them in to Quality Assurance for review. Please fill out the entire block below (except effective date).

This is a new procedure _____ revised procedure ✓ outdated procedure (archive) _____

- Procedure Code: IP 308 SOP Section #: 3.1.1.4 Revision #: 18

SOP Title: Determination of Metals by Inductively Coupled Plasma (ICP) by EPA CLP and NYSASP (ILM04.1 and ILM05.4 SOW Documents)

Effective date: (QA fills in) 02-25-2009

- Procedure prepared by: _____ Date: 02-24-2009
- Procedure approved by: (If the manager prepared the SOP, a qualified second party should sign) Bob McGinn Date: 02-24-2009
- Reason for change: changes from annual review
- This procedure meets the requirements of the following approved method references: US EPA CLP SOW ILM04.1 and ILM05.4; NYSASP, June 2000

Procedure approved by a QA Representative (unless QA Representative signed above):

_____ Date: _____

On an annual basis: Lab managers are required to review lab practices and revise the SOP if necessary. If no revision is necessary, indicate by your signature that the SOP has been reviewed.

Annual Review—Signature: _____ Date: _____

Annual Review—Signature: _____ Date: _____

Annual Review—Signature: _____ Date: _____

Annual Review—Signature: _____ Date: _____

R2-0001921

Instrument Procedure 308: Determination of Metals by Inductively Coupled Plasma (ICP) by EPA CLP and NYSASP (ILM04.1, ILM05.4 SOW Documents)

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R2-0001922

Instrument Procedure 308: Determination of Metals by Inductively Coupled Plasma (ICP) by EPA CLP and NYSASP (ILM04.1, ILM05.4 SOW Documents)

1.0 Scope and Application

This method may be used for the determination of dissolved, suspended, total, and total recoverable metals in the digestates of liquid samples and solid samples such as sludge, sediments, and soil. This method is compliant with the requirements of the EPA CLP Statement of Work (SOW) ILM04.1 and ILM05.4 plus revisions, and with the New York State Analytical Services Protocol (NYSASP).

Staff members performing the procedures described in this SOP are responsible for reading, understanding, and complying with the SOP requirements. Supervisors are responsible for directing the analyst to the controlled SOP, and providing adequate explanation of the material contained therein.

This procedure is restricted to use by or under the supervision of analysts experienced in the instrumentation or preparative methods and who have demonstrated the ability to generate acceptable results through QC samples and analyst capability studies.

2.0 Summary

ICP is a technique that enables an analyst to simultaneously determine multi-elements in solid or liquid samples after digestion of the samples. The basis of this method is the measurement of atomic emission by an optical spectroscopic technique. Samples in liquid form are nebulized, and the aerosols produced are transported to the plasma torch where excitation occurs. Characteristic atomic-line emission spectra are produced by a radio-frequency ICP. The spectra are dispersed by a grating spectrophotometer, and the intensities of the lines are monitored by photomultiplier tubes.

The photocurrents from the photomultiplier tubes are controlled by a computer system. A background correction technique is necessary to compensate for variable background contribution to the determination of metals.

Conventional ICP does not allow for the determination of the four elements, arsenic, selenium, lead, and thallium, at the levels detected by the graphite furnace techniques. However, the Trace ICP is capable of attaining lower detection limits and, therefore, the ICP analysis includes the four graphite furnace elements.

3.0 Definitions

3.1 dissolved metals – metals that will pass through a 0.45 micron membrane filter.

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3.2 suspended metals – metals that are retained by a 0.45 micron membrane filter. The residue from the membrane filter is further digested with hot dilute mineral acid(s) and other oxidizing reagent(s).

3.3 total metals – the concentration of metals determined on an unfiltered liquid sample following vigorous digestion. Total metals in solid samples are determined by digesting a known weight aliquot.

3.4 total recoverable metals – the concentration of metals determined on an unfiltered sample following digestion with hot mineral acid

3.5 Instrument Detection Limit (IDL) – determined by multiplying by three the standard deviation obtained for the analysis of a standard solution (each analyte in reagent water) at a concentration of 3x - 5x IDL on three nonconsecutive days with seven consecutive measurements per day

3.6 Method detection limit (MDL) – The minimum concentration of an analyte that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte (40 CFR, Part 136, Appendix B.)

3.7 Reporting Limit – The laboratory reporting limit is based on the lowest multipoint calibration standard concentration. For some inorganic methods, the reporting limit is based on the MDL, and is usually 4 - 8 times higher than the MDL.

For CLP the reporting limit is the Contract Required Quantitation Limit (CRQL) for ILM05.4 and the Contract Required Detection Limit (CRDL) for ILM04.1.

3.8 Reporting Units – µg/L for water and mg/Kg for soil

3.9 An SDG is defined by the following, whichever is more frequent:

- each 20 field samples received within a case, or
- each 7 calendar day period during which field samples in a case are received (3 calendar day period for 7-day turnaround, 14 calendar days if requested by the client) beginning with the receipt of the first sample.

3.10 CLP – Contract Laboratory Program

3.11 SOW – Statement of Work

3.12 VTSR – **Validated** time of sample receipt

4.0 Interferences

4.1 Try to avoid or compensate for the following interferences in ICP measurements:

- Spectral Interferences
- Physical Interferences
- Chemical Interferences

Note: Refer to EPA Method 200.7-CLPM, SOW ILM04.1, **and ILM05.4,** Section D for details about how to minimize/compensate for each of the above-mentioned interference effects.

4.2 For the determination of metals, contamination and loss of metals of interest are of prime concern. Dust in the laboratory and impurities on laboratory apparatus and in the reagents are sources of potential contamination. Sample containers can introduce either positive or negative errors in the measurement of metals. Therefore, laboratory glassware, sample bottles, etc., should be thoroughly prepared. Chemical interferences are partially compensated for by the use of interelement correction factors (IECs). These are analytically determined and adjusted quarterly. See Section 9.2 for additional information.

5.0 Safety

5.1 Many metal salts are extremely toxic if inhaled or swallowed, so wash your hands after handling salts.

5.2 Appropriate protective equipment and clothing must be used under the assumption that all samples are potentially hazardous. During sample preparation, glasses, gloves and lab coats are a minimum requirement. The persistent presence of noxious odors may be indicative of failure of the laboratory ventilation system and must be reported to a supervisor or manager.

5.3 Laboratory staff must review the Chemical Hygiene Plan for general safety policies, and Material Safety Data Sheets (MSDS) for solvents and reagents used in the laboratory. The MSDS are located in the Quality Assurance department.

6.0 Equipment & Supplies

6.1 Inductively Coupled Plasma (ICP) spectrometers

6.1.1 TJA Trace Analyzer (P3)

6.1.2 TJA Trace Analyzer (P4)

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6.2 Computer-controlled ICP with background correction

6.3 Radio Frequency Generator

6.4 Argon gas supply

6.5 Nitrogen gas supply (for P4)

7.0 Reagents & Standards

Standard lot numbers are assigned by using the identification of the standard, the date of preparation, and the initials of the preparer each separated by a hyphen. Example: ICSA-031700-abc is the lot number of the ICSA solution prepared on March 17, 2000 by an analyst with the initials of A.B.C. This is recorded in the Daily QC/Standards Preparation for Trace ICP Log (Attachment 1). This logbook also contains instructions for preparation of each standard and QC sample as well as other required traceability documentation.

Standards prepared for quarterly and annual instrument verifications (IDL, IECs, LRS, and MDLs) are reported on the applicable Standards Preparation Logs for Trace ICP, (Attachments 2-5)

7.1 Reagent Water - All water used in this procedure must be equivalent to ASTM Type I water, with regard to resistivity of > 10 megohm-cm (19th and 20th Editions of Standard Methods, Method 1080), which is subsequently purged with the inert gas, nitrogen, and demonstrated to meet the blank contamination acceptance criteria contained in this Standard Operating Procedure (SOP). It is referred to throughout the remainder of this SOP as reagent water.

7.2 Concentrated acids - ultra-high purity grade acids

7.2.1 J.T. Baker Instra-analyzed

7.2.2 Hydrochloric acid (HCl)

7.2.3 Nitric acid (HNO3)

7.2.4 All acids must be used in the preparation lab under a hood.

7.3 Stock standard solutions - commercially available

7.3.1 Standard stock solutions may be purchased from High Purity **(RSTD 1, RSTD 2A + 2B, RSTD 3A + 3B, and RSTD 4)** or prepared from ultra-high purity grade chemicals or metals (99.99 -99.999% pure).

7.3.2 Refer to the QC/Standards Prep for Trace ICP and the Standards Preparation Logs for Trace ICP LRS, MDL, IDL, and IEC studies for details regarding solutions and standards used for preparation of these materials.

7.3.3 Label and refer to these solutions as Calibration Standards.

7.3.4 Prepare as needed.

7.3.5 Calibration standards must be verified using an independent source EPA Quality Control sample immediately after instrument calibration.

7.4 Prepare and analyze interference check samples to check for spectral interferences.

7.4.1 Refer to the QC/Standards Prep for Trace ICP and the Standards Preparation Logs for Trace ICP LRS, MDL, IDL, and IEC studies for details regarding solutions and standards used for preparation of these materials.

7.5 Prepare and analyze a CRI standard at the contract required quantitation limit (CRQL, Attachment 6) for ILM05.4. For ILM04.1, the CRI standard is prepared and analyzed at two times the CRDL.

7.5.1 Refer to the QC/Standards Prep for Trace ICP and the Standards Preparation Logs for Trace ICP LRS, MDL, IDL, and IEC studies for details regarding solutions and standards used for preparation of these materials.

7.6 Calculations for typical stock standard solutions are made based on the weight of pure metal added, or with the use of the mole fraction and the weight of the metal added.

$$Concentration\ (ppm) = \frac{weight\ (mg)}{volume\ (L)}$$

Metal salts:

$$Concentration\ (ppm) = \frac{weight\ (mg)\ x\ mole\ \ fraction}{volume\ (L)}$$

7.7 When required, a serial dilution is performed on the sample picked for QC at a five-fold dilution. An aliquot of the sample is combined with four parts acidified reagent water (1% nitric acid, 5% hydrochloric acid) before analysis.

8.0 Sample Preservation and Storage

8.1 Samples are preserved and stored according to the tables in Sample Control SOP 4.1, "Receiving Samples" and 4.6, "Storing Samples." Sample holding times are also listed.

8.2 Metals samples are collected in plastic or glass containers and preserved at the time of collection with HNO_3 to a pH <2. For ILM04.1, liquid samples may be stored at ambient temperature whereas solid samples must be stored in the cooler at 4 ± 2° C. For ILM05.4, all samples must be refrigerated at 4 ± 2° C from the time of receipt until 60 days after the delivery of a complete, reconciled data package.

8.3 Prior to analysis, all digestates are stored at ambient temperature in the ICP laboratory. After analysis, ILM04.1 digestates are maintained for a period of three months and then returned to the Sample Custodian for storage until disposal into the acid waste stream. Digestates for ILM05.4 are stored until 365 days after delivery of a complete, reconciled data package.

8.4 Samples must be analyzed within 180 days of **validated** time of sample receipt (VTSR) in order to meet the method holding time.

9.0 Quality Control

9.1 Method Detection Limits (MDLs) – for ILM05.4

9.1.1 MDLs are to be determined annually for non-prepared analyses (NP1), soil analyses (HS1), and digested water analyses (HW1) on both P3 and P4. After major maintenance or a change in instrument conditions, the MDLs must be rerun to verify instrument sensitivity.

9.1.1.1 Actual analyte concentrations and preparation procedures are reported on the Standards Preparation Log for Trace ICP (P3&P4) MDL Studies, Attachment 5.

9.1.1.2 Under standard analysis conditions (including full calibration, CCV/CCB, CRI, ICSA and ICSAB analyses), eight replicates of the MDL solution are run.

9.1.2 The determined concentration of the MDL must be less than half the concentration of the CRQL.

9.1.3 The test concentration must be ≤ ten times the calculated MDL. The MDL solution should be made up at a concentration of 3 to 5 times the expected MDL.

9.1.3.1 A spreadsheet to calculate the results is maintained by QA and shall be updated by the analyst upon completing each set of MDLs.

9.2 Interelement corrections (IECs)

9.2.1 Before the analysis of any samples, the ICP interelement correction factors (IEC) must be determined prior to the start of contract analyses and at least quarterly thereafter, annually for ILM04.1. Correction factors for spectral interference due to Al, Ca, Fe, and Mg must be determined at all wavelengths used for each analyte reported by ICP. Correction factors for spectral interference due to analytes other than Al, Ca, Fe, and Mg must be reported if applied. See Attachment 6 for wavelengths used.

9.2.2 The preparation of standards used for IECs is documented in the Standards Preparation Log for Trace ICP (P3&P4) IEC Studies, Attachment 2.

9.2.3 To determine the IECs, the existing IECs must first be turned off in the method. (Keeping a backup copy of the method is highly recommended.) The analysis of the IEC standards must be preceded by calibration. However, no calibration verification (CCV/CCB) is required.

9.2.4 Calculation of the IEC for a given element is done by dividing the deviation of that element from zero by the measured concentration of the interferent. If the deviation is very small (less than 40% of the ILM04.1 CRDL, see Attachment 6), it can be disregarded. Additional thresholds may be implemented to determine the validity of a correction factor, but it must be noted that the minimum corrections must be sufficient to allow the ICSA and ICSAB solutions to pass.

9.3 Linear Range Standard (LRS)

9.3.1 For all ICP analyses, a Linear Range Standard (LRS) must be analyzed and reported quarterly for each element on Form XII-IN. The standard must be analyzed during a routine analytical run.

9.3.2 The preparation of the standards used and the analyte concentration is documented in the Standards Preparation Log for Linear Range Standard (LRS) Determination, Attachment 3.

9.3.3 The concentration of this standard must be measured within 5% of the true value.

9.3.4 This concentration is the upper limit of the ICP linear range. Results beyond the range cannot be reported without dilution of the sample.

9.3.5 For certain elements (Al, Ba, Ca, K, Mg, and Na), a curve-fit is used. Multiple calibration standards are prepared and analyzed to develop a calibration curve. Once the curve is determined, the range is confirmed in the same manner as for the linear range elements.

9.4 Instrument Detection Limits (IDLs) – for ILM04.1

9.4.1 Before any field samples are analyzed and quarterly thereafter, the instrument detection limits (IDL) must be determined (in µg/L) for the ICP instrument. IDLs are determined and reported for each wavelength used in the analysis of the samples.

9.4.2 Instrument IDLs are to be used by that instrument for the quarter. If the instrument is adjusted in any way that may affect the IDL, the IDL for that instrument must be re-determined and the results submitted for use as the established IDL for the remainder of the quarter.

9.4.3 The IDLs are determined by multiplying by three, the average of the standard deviations obtained on three non-consecutive days (e.g., Monday, Wednesday, and Friday) from the analysis of a standard solution (each analyte in DI water at a concentration 3x - 5x the instrument manufacturer's suggested IDL or the most recently determined IDL), with seven consecutive measurements per day. Each measurement should be performed as though it were a separate analytical sample (i.e., each measurement shall be followed by a rinse and/or any other procedure normally performed between analysis of separate samples).

9.4.3.1 NYSASP requires its own set of IDLs to be reported for analytical data. NYSASP IDLs are derived from the same source as typical IDLs but are subjected to a different mathematical process described in the NYASP methods.

9.5 Initial Calibration Verification (ICV)

9.5.1 Use the following sample solutions to verify the calibration:

- ICV1 (Ag, Al, As, B, Ba, Be, Bi, Cd, Ca, Cr, Co, Cu, Fe, Mg, Mn, Mo, Ni, K, Na, Pb, Sb, Se, Sn, Ti, Tl, V, and Zn)
- Blank (ICB)

9.5.2 The results of the initial calibration verification must agree within 10% of the "true" values.

9.5.3 Follow the ICV with the Initial Calibration Blank (ICB).

9.5.3.1 Any analyte present in the blank must be less than the EPA CRQL for ILM05.4 or the CRDL for ILM04.1.

9.5.4 If criteria are not met, the run must be terminated and the instrument re-calibrated. If re-calibration does not fix the problem, shut down the instrument and request instrument service.

9.6 CRQL/CRDL Check Standard (CRI)

9.6.1 Analyze the CRI standard before the ICS solutions, at the end of the analytical run and at a frequency of no greater than 20 analytical samples.

9.6.2 The CRI standard concentration is equal to the CRQL for ILM05.4 and equal to 2x CRDL for ILM04.1.

9.6.3 There are no criteria for this solution in ILM04.1. The criteria for ILM05.4 are ± 30% (± 50% for Sb, Pb, and Tl). Under ILM05.4, the sample shall be reanalyzed once for failing analytes. However, due to the limitations of the autosampler software, the analyst shall terminate the run, recalibrate, and reanalyze any samples affected by the failing CRI standard.

9.7 Interference Check Sample

9.7.1 Follow the CRI analysis with the Interference Check Samples (ICSA and ICSAB, consecutively). The Interference Check Samples and the CRI are analyzed at the beginning and the end of the analytical run. Also, the ICS and CRI samples are analyzed and reported at a frequency of not less than once per 20 analytical samples. (CRI, ICSA and ICSAB samples are counted as analytical samples.) The Interference Check Samples should be followed, immediately, by the analysis of a CCV/CCB pair.

9.7.2 The Interference Check Samples consist of two solutions: Solution A (ICSA) and Solution AB (ICSAB). Solution A contains the interferents and Solution AB contains the analytes and interferents.

9.7.3 The analysis of the ICSA and ICSAB should agree with the true values. The results for analytes must be within ± 2 times the CRQL of the analyte's true value or ± 20% of the analyte's true value, whichever is greater (the true value shall be 0 µg/L unless otherwise stated). If these results do not fall within these control limits, check the system, correct the problem, and recalibrate.

9.7.4 ICS reference material shall be obtained from EPA, if available, or an independent source such as ERA. Certificates of analysis with true values for each lot are maintained in a three ring binder in the laboratory.

9.8 Continuing Calibration Verification (CCV)

9.8.1 Verify the calibration every 10 samples, or every 2 hours during the analytical run, whichever is more frequent, and at the end of **the** analytical run.

9.8.2 The results of the check standard must agree within ±10% of the true value. If not, terminate the analysis, correct the problem, and recalibrate the instrument.

9.9 Continuing Calibration Blank (CCB)

9.9.1 A calibration blank must be analyzed at each wavelength used for analysis immediately after every initial and continuing calibration verification and at a frequency of 10% or every 2 hours during the run, whichever is more frequent.

9.9.2 Calibration blanks are prepared using **the** same acid concentrations as calibration standards.

9.9.3 Any analyte present in the blank must be less than the CRQL for ILM05.4 or **the** CRDL for ILM04.1.

9.9.4 If criteria are not met, terminate the analysis and recalibrate. If re-calibration does not fix the problem, shut down the instrument and request instrument service.

9.10 Preparation Blank Analysis

9.10.1 A preparation blank is prepared with each digestion batch of up to 20 samples, contains all reagents in the same volumes used in processing samples, and is carried through the complete procedure used for samples.

9.10.2 The preparation blank is used to ascertain whether sample concentrations reflect contamination.

9.10.3 The blank must contain absolute values of analyte concentrations at less than or equal to the EPA CRQL for ILM05.4 or CRDL for ILM04.1.

9.10.4 If the blank exceeds the CRQL/CRDL, the entire sample batch associated with the blank must be re-prepared along with a new method blank. The only circumstance under which the method blank can be reported with analyte values greater than the **CRQL**/CRDL is when the concentration of the affected analyte in all associated samples exceeds the blank concentration by a factor of 10 or more.

9.11 Spiked Sample

9.11.1 One sample spike must be prepared with each SDG.

9.11.2 If the sample concentration is less than four times the amount spiked and the recovery of the spike is less than 75% or greater than 125%, the corresponding element is flagged with an "N" on Form 1 to indicate that the element did not recover in the matrix spike acceptably (See Attachment 8 for spiking levels.)

9.11.3 Prepare and analyze a Post Digestion Spike (PDS) for those elements flagged with an "N" (except Ag).

9.11.3.1 The PDS should be spiked at 2 times the CRQL/CRDL or 2 times the indigenous level of the analyte in the original sample, whichever is greater.

9.12 Duplicate Sample

9.12.1 A duplicate sample analysis should be performed once per SDG.

9.12.2 If the sample and duplicate do not agree within a 20% RPD when the concentration is either greater than or equal to 5 X CRQL/CRDL, or ± CRQL/CRDL when the concentration is < 5 X CRQL/CRDL, then the

affected element is flagged with an "*" to indicate poor duplication of results.

9.13 Laboratory Control Sample (LCS)

9.13.1 A matrix-specific Laboratory Control Sample is prepared with each digestion batch of up to 20 samples.

9.13.2 The LCS is received certified, with certificate of analysis showing true values and acceptance limits for each element. The results of the aqueous LCS must agree within ± 20% of the true values for all the elements. (Exeption: Ag and Sb)

9.13.3.1 If the aqueous LCS falls outside these control limits, the samples associated with that LCS must be re-digested and reanalyzed.

9.13.3 The solid LCS has special control limits that have been established by the vendor. Control limits vary with lot numbers. For the solid LCS control limits see the binder of certificates in the laboratory for the current lot number in use.

9.13.3.2 If the control limits for the solid LCS cannot be met, the samples associated with that LCS must be re-digested and reanalyzed.

9.14 Serial Dilution

9.14.1 One serial dilution must be performed for each SDG.

9.14.2 Perform a 5x serial dilution on the sample to determine if a chemical or physical interference exists.

9.14.3 If the analyte concentration is 50 times or more above the **IDL for ILM04.1 or MDL for ILM05.4** in the original sample, the serial dilution must then agree within 10% of the original sample, after correction for dilution. If not then flag the appropriate elements with an "E" to indicate that an interference exists.

9.15 Field Blanks

9.15.1 Samples identified as field blanks should not be used for sample spike, duplicate, or serial dilution analysis.

9.16 Sample Tracking Records

9.16.1 Each sample bottle must be labeled with a CompuChem sample identification number.

9.17 Instrument Printout

9.17.1 Because of the nature of the data being collected, all analytical data generated must be labeled so that it can be identified.

9.17.2 Note any dilutions, duplicate analysis, spike analysis, and blank and standard analyses.

9.18 Contingency

9.18.1 If, due to a lab accident or to QC failure, a re-preparation is required for the sample and insufficient volume remains, the Project Manager must be alerted and will contact the client for direction on how to proceed. For the CLP, the Sample Management Office must be contacted.

9.18.2 If persistent contamination occurs in the laboratory, analyses must be halted until the source can be identified and isolated. When the contamination issue is resolved, sample analyses may proceed.

9.18.3 Any other issues that potentially affect data quality should be addressed with the Project Manager.

10.0 Calibration & Standardization

The instrument calibration standards are analyzed at the beginning of the analytical sequence, in the order shown in the Trace ICP Run Log (Attachment 7) and must meet acceptance criteria before samples can be analyzed. Calibration is further discussed in the Procedure section that follows.

11.0 Procedure

Documentation must follow the requirements in Quality Control SOP 13.6, "Proper Documentation Procedures". The sequence information must be recorded in the Trace ICP Run Log.

11.1 TJA Trace Analyzer (P3 or P4) instrument setup

11.1.1 Set up the TJA Trace Analyzer:

- COOLING WATER: Turn on the re-circulation pump. Thirty psi is required at a flow rate of 700 mL/minute.

- ARGON SUPPLY: Open the argon supply to the instrument. A volume rate of 30 SCFH and delivery pressure of 60 psi is required.

- VENTING SYSTEM: A permanent vent has been installed to provide a proper draft in the torch compartment. A torch fan is permanently installed to force a 22 mph-draft across the end of the plasma torch.

- WATER IN DRAIN BARREL: A hose is connected to the drain outlet from the spray chamber to allow the flow of unused sample waste from the chamber. This drain line acts as a positive seal to the spray chamber; therefore, liquid must always be present in the waste container.

11.1.2 Power Up (TJA Trace Analyzer) (P3 or P4)

11.1.2.1 To start the ICP Trace Analyzer, turn on the video display, the printer, and the computer. At the "C" prompt, Type "P" and press "ENTER." This will start the Thermospec™ software and bring up the main menu. To start the RF generator and the plasma torch, select "SETUP" at the main menu. Then select "PLASMA CONTROL PANEL" and press "ENTER." Select "F1."

11.1.2.2 The default startup time, during which argon purges the spray chamber and the plasma torch, is 90 seconds. The purge time can be reduced to as little as 20 seconds by pressing "PURGE TIME" if the plasma has been off for less than 15 minutes. After the purge time and power have been set, the automated plasma startup sequence is initiated by pressing "CONTINUE." If the pump and gas have not been started, select "F2" and start the pump rate at 100 RPM and switch the nebulizer gas to "ON." Press "LEVELS" if you want to change any of the plasma operating conditions.

11.2 Analysis

Note: The plasma torch should be allowed to run for at least 30 minutes after ignition to reach optimum stability.

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11.2.1 Profile

11.2.1.1 Profiling the instrument assures that the optical pathway is clean and in alignment. Emission intensities are essential to accurate data.

At the THERMOSPEC main menu, select "Setup" and highlight "Profile" then "Enter."

11.2.2.2 Begin aspirating the 1 ppm As standard for analysis. Note the peak position. This number must be less than 0.10. A perfect reading would be 0.000000. If an adjustment is necessary, select the "F1" key. At the bottom of the screen, a box labeled "Enter Vernier Position" will appear. Check the dial on the face of the instrument labeled "Hg Profile." The digital number on this dial is the number that is entered in the box labeled "Enter Vernier Position." Press enter. At this point, a line reading "New Vernier Position at:" will appear within the graph. This number is the number that should be set on the instrument dial. Repeat the automatic profile procedure until the peak position is within acceptable limits. Record this information in the run log as described in Section 11.7.4.1.

11.3 Autosampler Table Setup

11.3.1 Obtain all data necessary from each case that will be set up on the run i.e., prep logs and login chain of custody report from the LIMS. The information contained on these sheets will be used to create the autosampler table.

11.3.2 From the main menu of Thermospec, select "OPERATION," and then "Autosampler Setup," then press enter. The software will prompt for an autosampler table name. An existing table can be edited from this point, or a new autosampler table name can be typed in at this point. Press enter. Press F3 "Add Set." Enter the appropriate run parameters to be used. Parameters that should always be entered here are Method Name, Rinse Time (90 seconds), # of Unknowns in this set, Default Limit Check Table Name (Sample). Press the F1 "EdSamples" key. This will allow for sample IDs to be entered.

11.3.3 Under the column titled "Sample Name," enter the CompuChem sample ID. Be certain the proper check table is selected for each analysis that is assigned. The "F" key allow for various modifications to the autosampler table. Use these keys as necessary. It is very important that the proper

QC samples be inserted into the table at the necessary frequencies. See section 9.0 for a description of necessary QC and frequencies.

11.3.4 Also, if the "Alt" key on the keyboard is pressed, additional options will appear. One of these options is "EdSampInfo." This option is selected by pressing the "Alt" key and the "F2" key simultaneously. From this screen, additional comments can be added that will appear on the raw data printout. Under the column titled "Comment," the SDG, client sample ID and dilution of the sample should be entered.

11.3.5 When all entries are finished, press the "F9," Done/Keep key to save the table. It is important to remember the name of the table created, as this will be used to start the analysis. Press F2 to print the table.

11.3.6 Create a configuration file to store all analytical data. From the main menu of THERMOSPEC select "SETUP" and highlight "CONFIGURATION." Press "Enter" twice then "F9" four times. This will provide the screen to enter the configuration file name. Configuration file names should identify the instrument used and the date of the analysis. Use the scheme, xxmmdd, to construct the file name. The letter "x" is used to identify the instrument, the letter "m" identifies the month, and the letter "d" is for the day. If there is more than one run in a day, a letter suffix should be used to identify the runs. In the example filename, P30922B, the instrument is identified as "P3", the run occurred on September 22, and the "B" suffix identifies this as the third run of the day.

11.3.7 Proceed to analysis. From the main menu of THERMOSPEC select "OPERATION." Highlight "ANALYSIS" then "Enter." Confirm that the correct method is being used and select the autosampler table to be used. Continue to follow on-screen instructions to initiate run.

IMPORTANT: If the run should fail at any time, remember to change the configuration file name before restarting the analytical run.

11.4 Standardization and Analysis

Start the autosampler table following these instructions.

11.4.1 Select "OPERATION" and highlight "Analysis." Enter the correct method for analysis and select the autosampler table for samples to be analyzed.

11.4.2 Fill all standards cups and QC cups with the appropriate solutions. The autosampler table provides the information for cup positions. With regard

to standards cups, their positions will change as the number of samples that will be analyzed. Improper cup position will seriously affect analysis to the point that there may not be any salvageable data.

11.4.3 Press "F1" to begin the analytical run. Sample racks should be loaded accurately following the rows and positions provided by the autosampler table. Samples in the wrong position can produce erroneous data that may not be detectable.

11.4.4 Although software drives the instrument operation, the instrument should not be left completely unattended. In the course of the run, matrix spike analyses must be evaluated to determine percent recoveries. Some samples will have concentrations of analytes that are beyond the established linear ranges and will need to be diluted and reanalyzed within those ranges. Serial dilution analyses particularly should be evaluated for proper dilution. Responding to the need for dilutions or a PDS analysis quickly within the same analytical run saves time by not requiring an additional run, hence higher productivity. Sheets to assist in assessing PDS determinations are available.

11.4.5 Attention should be given to periodic QC analyses. Analytes may be found to be outside of their established control limits. The loss of one or more analytes does not necessarily mean the run has ended. Early detection of failed analytes by the analyst will prevent lost time and productivity.

11.4.6 Standards cups have limited capacity and should be filled frequently and monitored at all times.

11.4.7 ILM04.1 and ILM05.4 require CRI, ICSA and ICSAB analyses performed every 20 analytical samples. The structure of the autosampler table must incorporate this requirement. CRI, ICSA and ICSAB are numbered with the analytical samples. If this maximum is exceeded, the run has ended and all data that does not comply is lost. CRI, ICSA and ICSAB must immediately be followed by a CCV/CCB.

11.4.8 The analytical run is not complete until all final paperwork is complete. A run log (Attachment 7) must be completed by the analyst, and the standards prep log (Attachment 1) must also be filled out for the day. See Section 11.7 for more information on required documentation.

11.5 Transferring Data

11.5.1 At the completion of the analytical run, exit analysis and return to the THERMOSPEC main menu. Change the configuration file name.

11.5.2 Exit THERMOSPEC and return to Desktop. Double-click on the Explorer icon. While in Explorer, open the STATION directory in the left column, and then open the BIN directory. In the right column, find the name of the file from the analytical run that was just finished. Next, find the MARRS directory in the left column and open that directory. Click on the file name in the right column and copy it to the appropriate directory in MARRS (P3 ICP Trace Files or P4 ICP Trace Files.) Explorer can then be closed.

11.5.3 Transfer the file to the computer used to run the SQUEEZE program. The squeeze function combines two pages of data onto one page. Type "SQZ61E" and follow the instructions to squeeze the data file, and then print the .SQZ file.

11.6 Instrument Shutdown

11.6.1 TJA Trace Analyzer (P3 or P4)

11.6.1.1 Aspirate DI water for approximately one minute.

11.6.1.2 From the MAIN MENU go to SETUP and PLASMA CONTROL PANEL and press enter.

11.6.1.3 Press F7 for PLASMA SHUT off.

11.6.1.4 Remove pump tubing from peristaltic pumps.

11.7 Proper documentation of the run is crucial to compliance with the ILM05.4 and ILM04.1 SOW documents. The primary parts of post-run documentation for regular analyses are the raw data, Run Log, and Daily Standards prep log. For quarterly and annual instrument studies (IECs, IDLs, LRS, MDLs), the relevant prep logs are also required.

11.7.1 Raw data

11.7.1.1 Calibration analyses: on the first page, where the "Blank" was analyzed, write "S0," initial and date. On the subsequent five calibration standard analyses, write "S," initial and date.

11.7.2 Daily Standards Prep Log

11.7.2.1 This should be updated with any new standards used on the first page, and the following pages should have the standard lot numbers updated for any new solutions made. The data file name must be recorded in the designated space on the upper right of the first page. Fill out completely, including required signatures. If no dissolved metal cases are on the run, make sure "N/A" is entered for those sections.

11.7.3 Other Prep Logs

11.7.3.1 If a run includes data for Method Detection Limits (MDLs), Inter-Element Corrections (IECs), Linear Range Standard (LRS), or Instrument Detection Limits (IDLs), the relevant prep logs must be completed (Attachments 2-5).

11.7.4 Run Log

11.7.4.1 Profiling information – on the top of the first page of the run log, fill out the section for instrument profile. If the Vernier position was adjusted, it is only necessary to record the final measurement. Make note of the Vernier position, the peak intensity, the peak position, and the nebulizer pressure.

11.7.4.2 Maintenance – routine maintenance (cleaning the torch, replacing or switching tubes, adjusting tension on the pump, cleaning the nebulizer, replacing internal standard or acid rinse) should be recorded here. For major maintenance (anything else), record an entry in the instrument's Maintenance Log Book and reference that page in the Run Log.

11.7.4.3 Method – circle the method(s) used on the run.

11.7.4.4 Operator – the name of the analyst running the instrument

11.7.4.5 File name – the name of the file where the raw data was recorded.

11.7.4.6 Date – the date of analysis (NOT the day the run is written up)

11.7.4.7 Time – the time of the analysis of the blank

11.7.4.8 Case information – fill out completely for each SDG on the run

11.7.4.8.1 SDG – the CompuChem-assigned number for non-EPA cases.

11.7.4.8.2 Matrix – specify S for solid, L for leachate, W for water, and B for biological tissue.

11.7.4.8.3 Analytes – indicate TAL, TCLP, RCRA, etc., or "custom" for a specific list.

11.7.4.8.4 Comments – fill out after the run, and will include any information about required re-analysis. If re-running a case, make sure to indicate the data file where the original run took place.

11.7.5 Fill out and number pages sequentially.

11.7.6 Record the run exactly as it happened, with one line per sample analysis. Unused lines must be Z'd out, initialed, and dated.

11.7.6.1 Make sure the proper codes are used for QC.

11.7.6.2 Record any instrument errors, QC failures, or other reason to re-analyze the samples using the symbols in the legend.

11.7.6.3 Make a copy of the run log after it has been reviewed and signed. This copy becomes the "original" for making additional copies for multiple folders on the run.

11.8 Before passing the data package on, make sure all the required components are present and completely filled out. This may also include relevant Chain of Custody documentation and sample preparation documentation (standards log and sample prep).

11.8.1 The original printout and copy of the run log (along with other required documentation) shall be assigned to the lowest alphanumeric EPA SDG. After copies are made, the first page of the original run log is stamped "ORIGINAL" and all other copies are stamped with the "Copy – original included in CSF-_____" stamp. Sign and date this stamp in the spaces provided.

12.0 Data Analysis & Calculations

Calculations must be consistent with the QC SOP: Numerical Data Reduction.

12.1 Calculation of the mean or average of a set of values:

$$\overline{X} = \frac{\sum_{i=1}^{n} X_i}{n}$$

where: n = total number of values
x_i = each individual value used to calculate the mean
x = the mean of n

12.2 Calculation of the standard deviation of a set of values:

$$\text{Standard deviation} = \sqrt{\frac{\sum_{i=1}^{n}\left(X_n - \overline{X}\right)^2}{n-1}}$$

12.3 Calculation of percent recovery:

12.3.1 LCS and surrogates:

$$\%R = \frac{Amount\ found}{Amount\ spiked}\ x\ 100$$

12.3.2 Matrix spikes:

$$\%\,R = \frac{Amount\ in\ spiked\ sample - Amount\ in\ unspiked\ (native)\ sample}{Amount\ spiked}\ x\ 100$$

12.4 Calculation of % RSD

$$\%RSD = \left(\frac{Standard\ deviation}{\overline{X}}\right) \times 100$$

12.5 Calculation of RPD

$$RPD = \frac{|Value\ 1 - Value\ 2|}{(Value\ 1 + Value\ 2)/2}\ x100$$

12.6 Calculation of %Difference (%D)

$$\%Diff = \frac{Value - \overline{Reference\ \ value}}{\overline{Reference\ \ value}} \times 100$$

12.7 Concentration

12.7.1 Concentration of aqueous samples

$$\mu g / L = \frac{(C)(V)(D)}{(W)}$$

where: C - Concentration (mg/L)
D- Dilution factor
V - Final volume of digestate (L)
W - Volume of sample (L)

12.7.2 Concentration of soil samples (dry weight basis)

$$\mu g / kg = \frac{(C)(V)(D)}{(W)(S)}$$

where: C - Concentration (mg/L)
D - Dilution factor
V - Final volume of digestate (L)
W - Weight in kg of wet sample
S - % Solids/100

12.7.2.1 The concentration of soil samples determined in the digestate are to be reported on the basis of the dry weight of the sample. A separate determination of percent solids must be performed for solid samples as described in Sample Preparation Procedure – 190: "% Solids Determination."

12.8 Calculating Dilutions

If a sample concentration exceeds the linear range of the instrument, a dilution must be performed. Determine a level of dilution that will result in a value within the upper 75% of the calibration range. This is an acceptable dilution. A 10x dilution is performed using 1 mL sample plus 9 mL diluent for a total volume of 10 mL. It should be recorded on the run log as "10x (1 mL in 10 mL)."

13.0 Method Performance

This method was validated through in-house laboratory studies of method detection limits (See Section 9.1) and precision and accuracy for single analyst. The data are retained by the QA department.

14.0 Pollution Prevention

The solvents used in this procedure pose little threat to the environment when recycled and managed properly. Pollution prevention encompasses any technique that reduces or eliminates the quantity or toxicity of waste at the point of generation. Numerous opportunities for pollution prevention exist in laboratory operation. The EPA has established a preferred hierarchy of environmental management techniques that places pollution prevention as the management option of first choice. Whenever feasible, laboratory personnel should use pollution prevention techniques to address their waste generation. When wastes cannot be feasibly reduced at the source, the Agency recommends recycling as the next best thing.

15.0 Waste Management

It is the laboratory's responsibility to comply with all federal, state, and local regulations governing waste management, particularly the hazardous waste identification rules and land disposal restrictions, and to protect the air, water, and land by minimizing and controlling all releases from fume hoods and bench operations. Compliance with all sewage discharge permits and regulations is also required. See SOP 12.1, Hazardous Waste Disposal, regarding laboratory procedures for recycling solvent waste streams.

Samples preserved with HCl, HNO_3, or H_2SO_4 to pH <2 are hazardous and must be handled as hazardous waste.

Refer to the Hazardous Waste Management and Safety SOPs located in the lab.

16.0 References

16.1 U.S. EPA CLP SOW for Inorganic Analysis ILM04.1 and ILM05.4 plus revisions

16.2 TJA ICAP Trace Analyzer Set-up and Operating Manual

16.3 Standard Methods for the Examination of Water and Wastewater, 20th (1998) Edition, Method 1080

16.4 Quality Control SOP 13.6, "Proper Documentation Procedures"

16.5 Quality Control SOP 13.4, "Numerical Data Reduction"

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16.6 "Less is Better: Laboratory Chemical Management for Waste Reduction," American Chemical Society Department of Government Relations and Science Policy, 1155 16th Street, N.W., Washington DC, 20036, (202) 872-4477.

16.7 Hazardous Waste Management & Safety SOPs: "Hazardous Waste Disposal" and "Spill Control & Cleanup."

16.8 NELAC Standards, **effective** July 2003, plus revisions

16.9 QA-G6: Guidance for the Preparation of Standard Operating Procedures for Quality-Related Operations EPA/600/R-96/027, November 1995.

16.10 New York State Environmental Laboratory Approval Program, Certification Manual, December 2005, plus revisions.

16.11 CompuChem Quality Manual, **Revision 11, June 23, 2008,** plus revisions

16.12 Sample Preparation Procedure –190: "% Solids Determination."

16.13 New York State Analytical Services Protocol (NYASP), June 2000, plus revisions

17.0 Attachments as Tables, Diagrams, Flowcharts & Validation Data

17.1 Attachment 1 – Daily Standard/QC Preparation for Trace ICP Logbook

17.2 Attachment 2 – Standards Preparation Log for Trace ICP IEC Studies

17.3 Attachment 3 – Standards Preparation Log for Trace ICP LRS Studies

17.4 Attachment 4 – Standards Preparation Log for Trace ICP IDL Studies

17.5 Attachment 5 – Standards Preparation Log for Trace ICP MDL Studies

17.6 Attachment 6 – Wavelengths and Reporting Limits for Analytes

17.7 Attachment 7 – Trace ICP Run Log

17.8 Attachment 8 – List of spiking levels for spike sample analysis

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Attachment 1

Daily Standards/QC Preparation Log for Trace ICP (P3 & P4) 1 of 3 CompuChem a division of Liberty Analytical Corp. Worksheet 1 P(6)

STANDARDS and REAGENTS TRACEABILITY

Seq. File Name:_____

	Ref #*	Manufacturer	Lot #	Expiration Date
HNO_3 [Baker Instra-analyzed Trace-Metals grade]	1M2-182-01	JT Baker	C47031	03/10
HCl [Baker Instra-analyzed Trace-Metals grade]	1M2-182-02	Caledon	60544	03/10
SM-770-027 multi-element standard mix (RSTD-1)	7M1-40-17	High Purity**	0819311	07/22/09
SM-770-028 part A multi-element standard mix (RSTD-2A)	7M1-41-10 / 8K07003	High Purity**	0830416	10/31/09
SM-770-028 part B multi-element standard mix (RSTD-2B)	7M1-41-11 / 8K07004	High Purity**	0830417	10/31/09
SM-770-029 part A multi-element standard mix (RSTD-3A)	7M1-41-8 / 8K07001	High Purity**	0805135	10/31/09
SM-770-029 part B multi-element standard mix (RSTD-3B)	7M1-41-9 / 8K07002	High Purity**	0824901	05/01/10
SM-770-030 multi-element standard mix (RSTD-4)	7M1-40-18	High Purity**	0819306	07/22/09
SPEX-R multi-element standard mix	7M1-40-16	High Purity**	0809826	04/09
ICP-AES-CRQL-R multi-element standard mix	7M1-41-12 / 8K07005	High Purity**	0830420	10/31/09
ICV1 multi-element standard mix	1M2-187-5	EPA	0307	01//10
ICSA multi-element standard mix	7M1-40-26	EPA	1206	09/09
ICSB multi-element standard mix	7M1-40-27	EPA	0203	04/09
SM-770-031 multi-element standard mix (PDS-R)	7M1-41-1	High Purity**	0826013	09/17/09
IRON (Fe) 10,000 PPM single-element standard	7M1-41-20	High Purity**	0826002	06/10
CHROMIUM (Cr) 1,000 PPM single-element standard	7M1-39-24	High Purity**	0733812	06/12/09
LEAD (Pb) 1,000 PPM single-element standard	7M1-39-22	High Purity**	0728504	06/12/09
ARSENIC (As) 1,000 PPM single-element standard	7M1-39-8	High Purity**	0723203	03/07/09
Internal Mix	7M1-41-02	High Purity**	0828021	10/06/09
XCL-LCS-10X R multi-element mix	8H31001	High Purity**	0823903	08/26/09
XCL-20 multi-element mix	1m2-186-12	High Purity**	0825902	09/17/09

Multi-Element Stock Standard Concentrations:

Stock Standard	Analyte Concentrations (µg/mL)
RSTD-1 multi-element standard mix	Cd:1,000 Cr:1,000 Cu:1,000 Pb:1,000 Ni:1,000 Se:1,000 Ag:100 Tl:1,000 Zn:1,000
RSTD-2A/2B multi-element standard mix	Part A: As:1,000 Ba:1,000 Be:1,000 Co:1,000 Mn:1,000 Mo:1,000 V:1,000 Part B: Fe:25,000
RSTD-3A/3B multi-element standard mix	Part A: Ca:10,000 Mg:10,000 K:10,000 Na:10,000 Part B: Al:10,000
RSTD-4 multi-element standard mix	Sb:1,000 Bi:1,000 B:1,000 Sn:1,000 Ti:1,000
SPEX-R multi-element standard mix	Mo:1,000 Sn:1,000 Bi:1,000 Ti:1,000 B:1,000
ICP-AES-CRQL-R multi-element standard mix	Ag:10 Be:5 Cd:5 Co:50 Cr:10 Cu:25 Mn:15 Ni:40 Tl:25 V:50 Zn:60 Pb:10 Se:35 As:10 Sb:60
PDS-R multi-element standard mix	Al:400 Ba:400 Ag:20 Be:10 Cd:10 Co:100 Cr:20 Cu:50 Fe:200 Mn:30 Ni:80 Tl:20 V:100 Zn:40 Pb:6 Se:10 As:20 Sb:120
Internal Mix	Li:50,000 Y:250

Entered By: Q FORRESTER

Reviewed By: _____ Date: _____

*Ref# = Logbook ID, Page number, and item number from Materials Receipt Log
**High Purity is abbreviated "HP" on reporting forms

05/23/07:jbb

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Attachment 1 (Continued)

Daily Standards/QC Preparation Log for Trace ICP (P3 & P4) 2 of 3 CompuChem a division of Liberty Analytical Corp. Worksheet 1 P(6)

Standard Lot Number*	Preparation Instructions	Resultant Analyte Conc. (µg/L)
S0/ICB/CCB- 02 19 09-QF	Place in a 500 mL volumetric flask: 100 mL deionized water, 20 mL concentrated HNO_3, and 100 mL concentrated HCl. Bring up to volume with deionized water. Transfer to a 2L Teflon bottle and add 1.5L deionized water. Final volume 2 L. Prepare as needed.	N/A
RSTD-1- 02 23 09-QF	In a 200 mL volumetric flask, combine 150 mL deionized water, 2 mL concentrated HNO_3, and 10 mL concentrated HCl. Pipet 0.4 mL RSTD-1 into flask. Bring up to 200 mL volume with deionized water. Prepare as needed.	Cd:2,000 Cr:2,000 Cu:2,000 Pb:2,000 Ni:2,000 Se:2,000 Ag:200 Tl:2,000 Zn:2,000
RSTD-2- 02 19 09-QF	In a 200 mL volumetric flask, combine 150 mL deionized water, 2 mL concentrated HNO_3, and 10 mL concentrated HCl. Pipet 0.4 mL each RSTD-2A and RSTD-2B into flask. Bring up to 200 mL volume with deionized water. Prepare as needed.	As:2,000 Ba:2,000 Be:2,000 Co:2,000 Fe:50,000 Mn:2,000 Mo:2,000 V:2,000
RSTD-3- 02 19 09-QF	In a 200 mL volumetric flask, combine 150 mL deionized water, 2 mL concentrated HNO_3, and 10 mL concentrated HCl. Pipet 2.0 mL each RSTD-3A and RSTD-3B into flask. Bring up to 200 mL volume with deionized water. Prepare as needed.	K:100,000 Na:100,000 Al:100,000 Mg:100,000 Ca:100,000
RSTD-4- 02 19 09-QF	In a 200 mL volumetric flask, combine 150 mL deionized water, 2 mL concentrated HNO_3, and 10 mL concentrated HCl. Pipet 0.4 mL RSTD-4 into flask. Bring up to 200 mL volume with deionized water. Prepare as needed.	Sn:2,000 Bi:2,000 Ti:2,000 Sb:2,000 B:2,000
ICV1- 01 29 09-QF	Place in a 500 mL volumetric flask: 300 mL deionized water, 5 mL concentrated HNO_3, and 25 mL concentrated HCl. Pipet 50.0 mL ICV1 into flask and 0.55 mL Compuchem SPEX-R. Bring up to volume with deionized water. Transfer to a 500mL Teflon bottle. Final volume 500 mL. Prepare as needed.	Al:2,521 Ba:497 K:10,021 Mg:6,074 Na:10,097 Ca:10,026 Ag:501 Be:495 Cd:496 Co:499 Cr:490 Cu:492 Fe:5,062 Mn:499 Ni:503 Tl:1,025 V:501 Zn:1,025 Pb:1002 Se:1,029 As:998 Sb:994 Mo:1,100 Sn:1,100 Bi:1,100 Ti:1,100 B:1,100
CCV/ICVS1- 01 14 09-QF	Place in a 500-mL volumetric flask: 300 mL deionized water, 20 mL concentrated HNO_3, and 100 mL concentrated HCl. Add 0.2 mL 1,000-ppm Zn, 2 mL each RSTD-1, RSTD-2A, and RSTD-2B, and RSTD-4; 10 mL each RSTD-3A and RSTD-3B. Bring to volume with deionized water. Transfer to a 2 L Teflon bottle. Add 1.5 L deionized water. Final volume 2 L. Prepare as needed.	Al:50,000 Ba:1,000 K:50,000 Mg:50,000 Na:50,000 Ca:50,000 Ag:100 Be:1,000 Cd:1,000 Co:1,000 Cr:1,000 Cu:1,000 Fe:25,000 Mn:1,000 Ni:1,000 Tl:1,000 V:1,000 Zn:1,100 Pb:1,000 Se:1,000 As:1,000 Mo:1,000 Sn:1,000 Bi:1,000 Ti:1,000 Sb:1,000 B:1,000
LRS- 01 16 09-QF	In a 500 mL volumetric flask, combine 200 mL deionized water, 5 mL concentrated HNO_3 and 25 mL concentrated HCl. Pipet 0.25 mL PDS-R, 0.1 mL RSTD-3A, and 10 µL Compuchem SPEX-R into flask. Bring up to volume with deionized water and transfer to a 500mL Teflon bottle. Final volume 500 mL. Prepare as needed.	Al:200 Ba:200 K:2,000 Mg:2,000 Na:2,000 Ca:2,000 Ag:10 Be:5 Cd:5 Co:50 Cr:10 Cu:25 Fe:100 Mn:15 Ni:40 Tl:10 V:50 Zn:20 Pb:3 Se:5 As:10 Mo:20 Sn:20 Bi:20 Ti:20 Sb:60 B:20
As- 02 11 09-QF	In a 100 mL volumetric flask, combine 50 mL deionized water, 1 mL concentrated HNO_3, 5 mL concentrated HCl, and 0.1 mL 1000-ppm As standard. Bring to final 100 mL volume with deionized water and transfer to Teflon bottle.	As:1,000
HICRFE- 12 15 08-QF	Place in a 100 mL volumetric flask: 50 mL deionized water, 1 mL concentrated HNO_3, and 5 mL concentrated HCl. Pipet 4.0 mL 1,000-ppm Cr and 1.0 mL 10,000-ppm Fe into flask. Bring up to volume with deionized water. Final volume 100 mL. Prepare as needed.	Cr:40,000 Fe:100,000

Standard Solutions Prepared By: _____

Entered By: Q FORRESTER

Reviewed By: _____ Date: _____

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Attachment 1 (Continued)

Daily Standards/QC Preparation Log for Trace ICP (P3 & P4) 3 of 3 CompuChem a division of Liberty Analytical Corp. Worksheet 1 P(6)

Standard Lot Number*	Preparation Instructions	Resultant Analyte Conc. (µg/L)
ICSA-02 18 09-QF	In a 500-mL volumetric flask, combine 350 mL deionized water, 5 mL concentrated HNO_3, and 25 mL concentrated HCl. Pipet 50.0 mL ICSA into flask. Bring up to volume with deionized water and transfer to a 500mL Teflon bottle. Final volume 500 mL.	Al:244,100 Ba:2 Ca:234,900 Co:4 Cr:43 Cu:23 Fe:95,600 Mg:247,500 Mn:19 Ni:21 Zn:28 Pb:10
ICSAB-02 18 09-QF	In a 500-mL volumetric flask, combine 350 mL deionized water, 5 mL concentrated HNO_3, and 25 mL concentrated HCl. Pipet 50.0 mL ICSA and 50.0 mL ICSB into flask. Add 0.5 mL Compuchem SPEX-R. Bring up to volume with deionized water and transfer to a 500mL Teflon bottle. Final volume 500 mL.	Ag:206 Al:241,100 Ba:495 Be:475 Ca:231,100 Cd:940 Co:461 Cr:511 Cu:548 Fe:94,800 Mg:251,100 Mn:502 Ni:964 Tl:103 V:494 Zn:1028 Pb:61 Se:53 Sb:588 As:101 Sn:1,000 B:1,000 Mo:1,000 Ti:1,000 B:1,000
EPA-CRI-02 18 09-QF	In a 500 mL volumetric flask, combine 300 mL deionized water, 5 mL concentrated HNO_3 and 25 mL concentrated HCl. Pipet 0.50 mL ICP-AES-CROL-R and 25 µL Compuchem SPEX-R into flask. Bring up to volume with deionized water and transfer to a 500mL Teflon bottle. Final volume 500 mL. Prepare as needed.	Ag:10 Be:5 Cd:5 Co:50 Cr:10 Cu:25 Mn:15 Ni:40 Tl:25 V:50 Zn:60 Pb:10 Se:35 As:10 Sb:60 Sn:50 B:50 Mo:50 Bi:50 Ti:50
EPA-ASPB-11 14 08-QF	In a 200 mL volumetric flask, combine 100 mL deionized water, 2 mL concentrated HNO_3 and 10 mL concentrated HCl. From 1,000-ppm standards, pipet 100 µL Pb and 20 µL As into flask. Bring up to volume with deionized water. Final volume 200 mL. Prepare as needed.	Pb:500 As:100 (CRI for FLEX 1341.1 and 1342.0)
COMM-CRI-01 16 09-QF	In a 500 mL volumetric flask, combine 300 mL deionized water, 5 mL concentrated HNO_3 and 25 mL concentrated HCl. Pipet 0.50 mL PDS-R and 25 µL Compuchem SPEX-R into flask. Bring up to volume with deionized water and transfer to a 500mL Teflon bottle. Final volume 500 mL. Prepare as needed.	Al:400 Ba:400 Ag:20 Be:10 Cd:10 Co:100 Cr:20 Cu:50 Fe:200 Mn:30 Ni:80 Tl:20 V:100 Zn:40 Pb:5 Se:10 As:20 Mo:50 Sn:50 B:50 Ti:50 Sb:120 B:50
P3INTSTD-02 23 09-QF	In a 10 L container, combine 8 L deionized water, 400 mL concentrated HNO_3, and 200 mL Internal Mix. Fill with deionized water. Final volume 10 L.	Li:1,000,000 Y:5,000
P4INTSTD-02 17 09-QF	In a 10 L container, combine 8 L deionized water, 400 mL concentrated HNO_3, and 200 mL Internal Mix. Fill with deionized water. Final volume 10 L.	Li:1,000,000 Y:5,000

Dissolved Metals only:	Prepared By	Date Prepared	Preparation Instructions
LCS	NA	NA	Add 5.0 mL of XCL-LCS-10XR solution to 45.0 mL acidified water (1% HNO_3 + 5% HCl).
Prep Blank	NA	NA	Use acidified water (SO/ICB/CCB).
Sample Spike	NA	NA	Add 0.1 mL of XCL-20 to 9.9 mL of sample.

Standard Solutions Prepared By: _____

Entered By: Q FORRESTER

Reviewed By: _____ Date: _____

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Attachment 2

Standards Preparation Log for Trace ICP (P3&P4) IEC Studies

1 of 3
Worksheet **1** P(A)

STANDARDS and REAGENTS TRACEABILITY

	Ref #*	Manufacturer	Lot #	Expiration Date
ALUMINUM (Al) 10,000 PPM	7M1-41-21 / 8L17002	High Purity	0824901	06/15/10
ANTIMONY (Sb) 1,000 PPM	7M1-40-21	High Purity	0809519	01/23/10
ARSENIC (As) 1,000 PPM	7M1-39-07	High Purity	0718613	03/07/09
BARIUM (Ba) 10,000 PPM	7M1-40-02	High Purity	0733813	06/12/09
BERYLLIUM (Be) 1,000 PPM	7M1-41-27 / 8L17008	High Purity	0827434	06/15/10
BISMUTH (Bi) 1,000 PPM	7M1-40-22	High Purity	0732309	01/23/10
BORON (B) 1,000 PPM	7M1-41-25 / 8L17006	High Purity	0808103	06/15/10
CALCIUM (Ca) 10,000 PPM	7M1-41-23 / 8L17004	High Purity	0802213	06/15/10
CADMIUM (Cd) 1,000 PPM	7M1-42-01 / 8L17010	High Purity	0825423	06/15/10
CHROMIUM (Cr) 1,000 PPM	7M1-39-24	High Purity	0733812	06/12/09
COBALT (Co) 1,000 PPM	7M1-39-23	High Purity	0726203	06/12/09
COPPER (Cu) 1,000 PPM	7M1-42-02 / 8L17011	High Purity	0812720	06/15/10
IRON (Fe) 10,000 PPM	7M1-41-20 / 8L17001	High Purity	0826002	06/15/10
LEAD (Pb) 1,000 PPM	7M1-39-08	High Purity	0723203	03/07/09
MAGNESIUM (Mg) 10,000 PPM	7M1-38-07	High Purity	0701815	02/10/09
MANGANESE (Mn) 10,000 PPM	7M1-40-02	High Purity	0731231	06/12/09
MOLYBDENUM (Mo) 1,000 PPM	7M1-42-04 / 8L17013	High Purity	0828502	06/15/10
NICKEL (Ni) 1,000 PPM	7M1-39-25	High Purity	0730921	06/12/09
POTASSIUM (K) 10,000 PPM	7M1-41-24 / 8L17005	High Purity	0816917	06/15/10
SELENIUM (Se) 1,000 PPM	7M1-42-05	High Purity	0810801	06/15/10
SILVER (Ag) 1,000 PPM	7M1-42-07 / 8L17016	High Purity	0815118	06/15/10
SODIUM (Na) 10,000 PPM	7M1-38-25	High Purity	0710716	01/16/09
THALLIUM (Tl) 1,000 PPM	7M1-39-26	High Purity	0722128	06/12/09
TIN (Sn) 1,000 PPM	7M1-40-24	High Purity	0802123	01/23/10
TITANIUM (Ti) 1,000 PPM	7M1-40-25	High Purity	0809812	01/23/10
VANADIUM (V) 1,000 PPM	7M1-39-27	High Purity	0731223	06/12/09
ZINC (Zn) 1,000 PPM	7M1-40-12	High Purity	0806419	01/03/10

Applies to Seq. File(s):_____

Entered By: Q. FORRESTER

Reviewed By:_____ Date:_____

*Ref# = Logbook ID, Page number, and item number from Materials Receipt Log

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Attachment 2 (Continued)

Standards Preparation Log for Trace ICP (P3&P4) IEC Studies

2 of 3
Worksheet 1 P(A)

Standard Lot Number**	Preparation instructions
Al-500 PPM-12 18 08-QF	In a 100-ml volumetric flask, combine 50 mL deionized water, 1 mL concentrated HNO_3, and 5 mL concentrated HCl. Pipet 5 mL 10,000-ppm Al. Bring up to volume with deionized water. Prepare as needed.
Ag-2 PPM-12 18 08-QF	In a 100-ml volumetric flask, combine 50 mL deionized water, 1 mL concentrated HNO_3, and 5 mL concentrated HCl. Pipet 0.2 mL 1,000-ppm Ag. Bring up to volume with deionized water. Prepare as needed.
As-10 PPM-12 18 08-QF	In a 100-ml volumetric flask, combine 50 mL deionized water, 1 mL concentrated HNO_3, and 5 mL concentrated HCl. Pipet 1 mL of 1,000-ppm As. Bring up to volume with deionized water. Prepare as needed.
B-20 PPM-12 18 08-QF	In a 100-ml volumetric flask, combine 50 mL deionized water, 1 mL concentrated HNO_3, and 5 mL concentrated HCl. Pipet 2 mL of 1,000-ppm B. Bring up to volume with deionized water. Prepare as needed.
Ba-50 PPM-12 18 08-QF	In a 100-ml volumetric flask, combine 50 mL deionized water, 1 mL concentrated HNO_3, and 5 mL concentrated HCl. Pipet 0.5 mL of 10,000-ppm Ba. Bring up to volume with deionized water. Prepare as needed.
Be-5 PPM-12 18 08-QF	In a 100-ml volumetric flask, combine 50 mL deionized water, 1 mL concentrated HNO_3, and 5 mL concentrated HCl. Pipet 0.5 mL of 1,000-ppm Be. Bring up to volume with deionized water. Prepare as needed.
Bi-5 PPM-12 18 08-QF	In a 100-ml volumetric flask, combine 50 mL deionized water, 1 mL concentrated HNO_3, and 5 mL concentrated HCl. Pipet 0.5 mL of 1,000-ppm Bi. Bring up to volume with deionized water. Prepare as needed.
Ca-500 PPM-12 18 08-QF	In a 100-ml volumetric flask, combine 50 mL deionized water, 1 mL concentrated HNO_3, and 5 mL concentrated HCl. Pipet 5 mL of 10,000-ppm Ca. Bring up to volume with deionized water. Prepare as needed.
Cd-15 PPM-12 18 08-QF	In a 100-ml volumetric flask, combine 50 mL deionized water, 1 mL concentrated HNO_3, and 5 mL concentrated HCl. Pipet 1.5 mL of 1,000-ppm Cd. Bring up to volume with deionized water. Prepare as needed.
Co-20 PPM-12 18 08-QF	In a 100-ml volumetric flask, combine 50 mL deionized water, 1 mL concentrated HNO_3, and 5 mL concentrated HCl. Pipet 2 mL of 1,000-ppm Co. Bring up to volume with deionized water. Prepare as needed.
Cr-20 PPM-12 18 08-QF	In a 100-ml volumetric flask, combine 50 mL deionized water, 1 mL concentrated HNO_3, and 5 mL concentrated HCl. Pipet 2 mL of 1,000-ppm Cr. Bring up to volume with deionized water. Prepare as needed.
Cu-20 PPM-12 18 08-QF	In a 100-ml volumetric flask, combine 50 mL deionized water, 1 mL concentrated HNO_3, and 5 mL concentrated HCl. Pipet 2 mL of 1,000-ppm Cu. Bring up to volume with deionized water. Prepare as needed.
Fe-300 PPM-12 18 08-QF	In a 100-ml volumetric flask, combine 50 mL deionized water, 1 mL concentrated HNO_3, and 5 mL concentrated HCl. Pipet 3 mL of 10,000-ppm Fe. Bring up to volume with deionized water. Prepare as needed.
K-200 PPM-12 18 08-QF	In a 100-ml volumetric flask, combine 50 mL deionized water, 1 mL concentrated HNO_3, and 5 mL concentrated HCl. Pipet 2 mL of 10,000-ppm K. Bring up to volume with deionized water. Prepare as needed.

**Standard Lot Number consists of standard ID, date prepared, and initials of preparer.

Standard Solutions Prepared By:_____

Entered By: Q. FORRESTER

Reviewed By:_____ Date:_____

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Attachment 2 (Continued)

Standards Preparation Log for Trace ICP (P3&P4) IEC Studies

3 of 3
Worksheet 1 P(A)

Standard Lot Number**	Preparation instructions
Mg-500 PPM-12 18 08-QF	In a 100-ml volumetric flask, combine 50 mL deionized water, 1 mL concentrated HNO_3, and 5 mL concentrated HCl. Pipet 5 mL of 10,000-ppm Mg. Bring up to volume with deionized water. Prepare as needed.
Mn-10 PPM-12 18 08-QF	In a 100-ml volumetric flask, combine 50 mL deionized water, 1 mL concentrated HNO_3, and 5 mL concentrated HCl. Pipet 0.1 mL of 10,000-ppm Mn. Bring up to volume with deionized water. Prepare as needed.
Mo-5 PPM-12 18 08-QF	In a 100-ml volumetric flask, combine 50 mL deionized water, 1 mL concentrated HNO_3, and 5 mL concentrated HCl. Pipet 0.5 mL of 1,000-ppm Mo. Bring up to volume with deionized water. Prepare as needed.
Na-500 PPM-12 18 08-QF	In a 100-ml volumetric flask, combine 50 mL deionized water, 1 mL concentrated HNO_3, and 5 mL concentrated HCl. Pipet 5 mL of 10,000-ppm Na. Bring up to volume with deionized water. Prepare as needed.
Ni-20 PPM-12 18 08-QF	In a 100-ml volumetric flask, combine 50 mL deionized water, 1 mL concentrated HNO_3, and 5 mL concentrated HCl. Pipet 2 mL of 1,000-ppm Ni. Bring up to volume with deionized water. Prepare as needed.
Pb-20 PPM-12 18 08-QF	In a 100-ml volumetric flask, combine 50 mL deionized water, 1 mL concentrated HNO_3, and 5 mL concentrated HCl. Pipet 2 mL of 1,000-ppm Pb. Bring up to volume with deionized water. Prepare as needed.
Sb-5 PPM-12 18 08-QF	In a 100-ml volumetric flask, combine 50 mL deionized water, 1 mL concentrated HNO_3, and 5 mL concentrated HCl. Pipet 0.5 mL of 1,000-ppm Sb. Bring up to volume with deionized water. Prepare as needed.
Se-20 PPM-12 18 08-QF	In a 100-ml volumetric flask, combine 50 mL deionized water, 1 mL concentrated HNO_3, and 5 mL concentrated HCl. Pipet 2 mL of 1,000-ppm Se. Bring up to volume with deionized water. Prepare as needed.
Sn-5 PPM-12 18 08-QF	In a 100-ml volumetric flask, combine 50 mL deionized water, 1 mL concentrated HNO_3, and 5 mL concentrated HCl. Pipet 0.5 mL of 1,000-ppm Sn. Bring up to volume with deionized water. Prepare as needed.
Ti-5 PPM-12 18 08-QF	In a 100-ml volumetric flask, combine 50 mL deionized water, 1 mL concentrated HNO_3, and 5 mL concentrated HCl. Pipet 0.5 mL 1,000-ppm Ti. Bring up to volume with deionized water. Prepare as needed.
Tl-20 PPM-12 18 08-QF	In a 100-ml volumetric flask, combine 50 mL deionized water, 1 mL concentrated HNO_3, and 5 mL concentrated HCl. Pipet 2 mL 1,000-ppm Tl. Bring up to volume with deionized water. Prepare as needed.
V-20 PPM-12 18 08-QF	In a 100-ml volumetric flask, combine 50 mL deionized water, 1 mL concentrated HNO_3, and 5 mL concentrated HCl. Pipet 2 mL of 1,000-ppm V. Bring up to volume with deionized water. Prepare as needed.
Zn-20 PPM-12 18 08-QF	In a 100-ml volumetric flask, combine 50 mL deionized water, 1 mL concentrated HNO_3, and 5 mL concentrated HCl. Pipet 2 mL of 1,000-ppm Zn. Bring up to volume with deionized water. Prepare as needed.

**Standard Lot Number consists of standard ID, date prepared, and initials of preparer.

Standard Solutions Prepared By:_____

Entered By: Q. FORRESTER

Reviewed By:_____ Date:_____

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Attachment 3

Standards Preparation Log for Trace ICP (P3&P4) Linear Range Standard (LRS) Studies
1 of 3

Worksheet 1 P(B)

STANDARDS and REAGENTS TRACEABILITY

	Ref #*	Manufacturer	Lot #	Expiration Date
SM-770-027 multi-element standard mix (RSTD-1)	7M1-40-17	High Purity	0819311	07/09
SM-770-028 part A multi-element standard mix (RSTD-2A)	7M1-41-10	High Purity	0830416	10/09
SM-770-028 part B multi-element standard mix (RSTD-2B)	7M1-41-11	High Purity	0830417	10/09
SM-770-029 part A multi-element standard mix (RSTD-3A)	7M1-41-8	High Purity	0805135	10/09
SM-770-029 part B multi-element standard mix (RSTD-3B)	7M1-41-9	High Purity	0824901	05/10
SM-770-030 multi-element standard mix (RSTD-4)	7M1-41-20	High Purity	0826002	06/10
IRON (Fe) 10,000 PPM	7M1-41-11	High Purity	0830417	10/09
POTASSIUM (K) 10,000 PPM	7M1-41-24	High Purity	0816917	06/10
MANGANESE (Mn) 1,000 PPM	7M1-42-3	High Purity	0805617	06/10
ZINC (Zn) 1,000 PPM	7M1-40-12	High Purity	0806419	01/10

Multi-Element Stock Standard Concentrations:

Stock Standard	Analyte Concentrations (µg/mL)
RSTD-1 multi-element standard mix	Cd:1,000 Cr:1,000 Cu:1,000 Pb:1,000 Ni:1,000 Se:1,000 Ag:100 Tl:1,000 Zn:1,000
RSTD-2A/2B multi-element standard mix	Part A: As:1,000 Ba:1,000 Be:1,000 Co:1,000 Mn:1,000 Mo:1,000 V:1,000 Part B: 25,000
RSTD-3A/3B multi-element standard mix	Part A: Ca:10,000 Mg:10,000 K:10,000 Na:10,000 Part B: Al:10,000
RSTD-4 multi-element standard mix	Sb:1,000 Bi:1,000 B:1,000 Sn:1,000 Ti:1,000

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Attachment 3 (Continued)

Standards Preparation Log for Trace ICP (P3&P4) Linear Range Standard (LRS) Studies

2 of 3

Worksheet 1 P(B)

Standard Lot Num.**	Preparation Instructions	True Values
LRS-1_10K-010609-QF	In a 15-ml beaker, dilute 0.1 mL of RSTD-1 to a final volume of 10 mL with acidified water.	Cd:10ppm Cr:10ppm Cu:10ppm Pb:10ppm Ni:10ppm Se:10ppm Ag:1.0ppm Tl:10ppm Zn:10ppm
LRS-1_20K-010609-QF	In a 15-ml beaker, dilute 0.2 mL of RSTD-1 to a final volume of 10 mL with acidified water.	Cd:20ppm Cr:20ppm Cu:20ppm Pb:20ppm Ni:20ppm Se:20ppm Ag:2ppm Tl:20ppm Zn:2 0ppm
LRS-1_30K-010609-QF	In a 15-ml beaker, dilute 0.3 mL of RSTD-1 to a final volume of 10 mL with acidified water.	Cd:30ppm Cr:30ppm Cu:30ppm Pb:30ppm Ni:30ppm Se:30ppm Ag:3ppm Tl:30ppm Zn:30ppm
LRS-1_40K-010609-QF	In a 15-ml beaker, dilute 0.4 mL of RSTD-1 to a final volume of 10 mL with acidified water.	Cd:40ppm Cr:40ppm Cu:40ppm Pb:40ppm Ni:40ppm Se:40ppm Ag:4ppm Tl:40ppm Zn:40ppm
LRS-1_50K-010609-QF	In a 15-ml beaker, dilute 0.5 mL of RSTD-1 to a final volume of 10 mL with acidified water.	Cd:50ppm Cr:50ppm Cu:50ppm Pb:50ppm Ni:50ppm Se:50ppm Ag:5ppm Tl:50ppm Zn:50ppm
LRS-1_60K-010609-QF	In a 15-ml beaker, dilute 0.6 mL of RSTD-1 to a final volume of 10 mL with acidified water.	Cd:60ppm Cr:60ppm Cu:60ppm Pb:60ppm Ni:60ppm Se:60ppm Ag:6ppm Tl:60ppm Zn:60ppm
LRS-2_5K-010609-QF	In a 15-ml beaker, dilute 0.05 mL of RSTD-2A to a final volume of 10 mL with acidified water.	As:5ppm Ba:5ppm Be:5ppm Co:5ppm Mn:5ppm Mo:5ppm V:5ppm
LRS-2_10K-010609-QF	In a 15-ml beaker, dilute 0.1 mL of RSTD-2A to a final volume of 10 mL with acidified water.	As:10ppm Ba:10ppm Be:10ppm Co:10ppm Mn:10ppm Mo:10ppm V:10ppm
LRS-2_20K-010609-QF	In a 15-ml beaker, dilute 0.2 mL of RSTD-2A to a final volume of 10 mL with acidified water.	As:20ppm Ba:20ppm Be:20ppm Co:20ppm Mn:20ppm Mo:20ppm V:20ppm
LRS-2_30K-010609-QF	In a 15-ml beaker, dilute 0.3 mL of RSTD-2A to a final volume of 10 mL with acidified water.	As:30ppm Ba:30ppm Be:30ppm Co:30ppm Mn:30ppm Mo:30ppm V:30ppm
LRS-2_40K-010609-QF	In a 15-ml beaker, dilute 0.4 mL of RSTD-2A to a final volume of 10 mL with acidified water.	As:40ppm Ba:40ppm Be:40ppm Co:40ppm Mn:40ppm Mo:40ppm V:40ppm
LRS-2_50K-010609-QF	In a 15-ml beaker, dilute 0.5 mL of RSTD-2A to a final volume of 10 mL with acidified water.	As:50ppm Ba:50ppm Be:50ppm Co:50ppm Mn:50ppm Mo:50ppm V:50ppm
LRS-3_300K-010609-QF	In a 15-mL beaker, dilute 0.3 mL each RSTD-3A and RSTD-3B to a final volume of 10 mL with acidified water.	Ca:300ppm K:300ppm Mg:300ppm Na:300ppm Al:300ppm
LRS-3_400K-010609-QF	In a 15-mL beaker, dilute 0.4 mL each RSTD-3A and RSTD-3B to a final volume of 10 mL with acidified water.	Ca:400ppm K:400ppm Mg:400ppm Na:400ppm Al:400ppm
LRS-3_500K-010609-QF	In a 15-mL beaker, dilute 0.5 mL each RSTD-3A and RSTD-3B to a final volume of 10 mL with acidified water.	Ca:500ppm K:500ppm Mg:500ppm Na:500ppm Al:500ppm
LRS-3_600K-010609-QF	In a 15-mL beaker, dilute 0.6 mL each RSTD-3A and RSTD-3B to a final volume of 10 mL with acidified water.	Ca:600ppm K:600ppm Mg:600ppm Na:600ppm Al:600ppm
LRS-4_20K-010609-QF	In a 15-ml beaker, dilute 0.2 mL of RSTD-4 to a final volume of 10 mL with acidified water.	Ti:20ppm Sb:20ppm Sn:20ppm Bi:20ppm B:20ppm
LRS-4_30K-010609-QF	In a 15-ml beaker, dilute 0.3 mL of RSTD-4 to a final volume of 10 mL with acidified water.	Ti:30ppm Sb:30ppm Sn:30ppm Bi:30ppm B:30ppm
LRS-4_40K-010609-QF	In a 15-ml beaker, dilute 0.4 mL of RSTD-4 to a final volume of 10 mL with acidified water.	Ti:40ppm Sb:40ppm Sn:40ppm Bi:40ppm B:40ppm

**Standard Lot Number consists of standard ID, date prepared, and initials of preparer.

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Standard Solutions Prepared By:_____

Entered By: Q. FORRESTER

Reviewed By:_____ Date:_____

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Attachment 3 (Continued)

Standards Preparation Log for Trace ICP (P3&P4) Linear Range Standard (LRS) Studies
3 of 3

Worksheet 1 P(B)

Standard Lot Num.**	Preparation Instructions	True Values
LRS_FE-500K-010609-QF	In a 15-ml beaker, dilute 0.5 mL of 10,000ppm Fe to a final volume of 10 mL with acidified water.	Fe:500ppm
LRS_FE-600K-010609-QF	In a 15-ml beaker, dilute 0.6 mL of 10,000ppm Fe to a final volume of 10 mL with acidified water.	Fe:600ppm
LRS_K-300K-010609-QF	In a 15-ml beaker, dilute 0.3 mL of 10,000ppm K to a final volume of 10 mL with acidified water.	K:300ppm
LRS_Mn-30K-010609-QF	In a 15-ml beaker, dilute 0.3 mL of 1,000ppm Mn to a final volume of 10 mL with acidified water.	Mn:30ppm
LRS_Mn-40K-010609-QF	In a 15-ml beaker, dilute 0.4 mL of 1,000ppm Mn to a final volume of 10 mL with acidified water.	Mn:40ppm
LRS_Mn-50K-010609-QF	In a 15-ml beaker, dilute 0.5 mL of 1,000ppm Mn to a final volume of 10 mL with acidified water.	Mn:50ppm
LRS_Zn-10K-010609-QF	In a 15-ml beaker, dilute 0.1 mL of 1,000ppm Zn to a final volume of 10 mL with acidified water.	Zn:10ppm
LRS_Zn-15K-010609-QF	In a 15-ml beaker, dilute 0.15 mL of 1,000ppm Zn to a final volume of 10 mL with acidified water.	Zn:15ppm
LRS_Zn-20K-010609-QF	In a 15-ml beaker, dilute 0.2 mL of 1,000ppm Zn to a final volume of 10 mL with acidified water.	Zn:20ppm

**Standard Lot Number consists of standard ID, date prepared, and initials of preparer.

Applies to Seq. File(s):_____

Standard Solutions Prepared By:_____

Entered By: Q. FORRESTER

Reviewed By:_____ Date:_____

07/06/06;jbb

Attachment 4

Standards Prep Log for Trace ICP (P3&P4)
Instrument Detection Limit (IDL) Studies

page 1 of 1
Worksheet 1 P(C)

STANDARDS and REAGENTS TRACEABILITY

	Ref #*	Manufacturer	Lot #	Expiration Date
ALUMINUM (Al) 10,000 PPM	7M1-41-21 / 8L17002	High Purity	0824901	06/15/10
ANTIMONY (Sb) 1,000 PPM	7M1-40-21	High Purity	0809519	01/23/10
ARSENIC (As) 1,000 PPM	7M1-39-07	High Purity	0718613	03/07/09
BARIUM (Ba) 1,000 PPM	7M1-40-02	High Purity	0733813	06/12/09
BERYLLIUM (Be) 1,000 PPM	7M1-41-27 / 8L17008	High Purity	0827434	06/15/10
BISMUTH (Bi) 1,000 PPM	7M1-40-22	High Purity	0732809	01/23/10
BORON (B) 1,000 PPM	7M1-41-25 / 8L17006	High Purity	0808103	06/15/10
CALCIUM (Ca) 10,000 PPM	7M1-41-23 / 8L17004	High Purity	0802213	06/15/10
CADMIUM (Cd) 1,000 PPM	7M1-42-01 / 8L17010	High Purity	0825423	06/15/10
CHROMIUM (Cr) 1,000 PPM	7M1-39-24	High Purity	0733812	06/12/09
COBALT (Co) 1,000 PPM	7M1-39-23	High Purity	0728203	06/12/09
COPPER (Cu) 1,000 PPM	7M1-42-02 / 8L17011	High Purity	0812720	06/15/10
IRON (Fe) 10,000 PPM	7M1-41-20 / 8L17001	High Purity	0826002	06/15/10
LEAD (Pb) 1,000 PPM	7M1-39-22	High Purity	0728504	06/12/09
MAGNESIUM (Mg) 10,000 PPM	7M1-38-07	High Purity	0701815	02/10/09
MANGANESE (Mn) 10,000 PPM	7M1-40-02	High Purity	0731231	06/12/09
MOLYBDENUM (Mo) 1,000 PPM	7M1-42-04 / 8L17013	High Purity	0828502	06/15/10
NICKEL (Ni) 1,000 PPM	7M1-39-25	High Purity	0730921	06/12/09
POTASSIUM (K) 10,000 PPM	7M1-41-24 / 8L17005	High Purity	0816917	06/15/10
SELENIUM (Se) 1,000 PPM	7M1-42-25	High Purity	0810801	05/15/10
SILVER (Ag) 1,000 PPM	7M1-42-07 / 8L17016	High Purity	0815118	06/15/10
SODIUM (Na) 10,000 PPM	7M1-38-25	High Purity	0710716	01/06/09
THALLIUM (Tl) 1,000 PPM	7M1-36-26	High Purity	0722128	06/12/09
TIN (Sn) 1,000 PPM	7M1-40-24	High Purity	0802123	01/23/10
TITANIUM (Ti) 1,000 PPM	7M1-40-25	High Purity	0809812	01/23/10
VANADIUM (V) 1,000 PPM	7M1-39-27	High Purity	0731223	06/12/09
ZINC (Zn) 1,000 PPM	7M1-40-12	High Purity	0808419	01/03/10

Standard Name	Preparation Instructions	Analyte Concentration (µg/L)
MDLA-01 05 09-QF	Place in a 1-L volumetric flask: 500 mL deionized water, 10 mL concentrated HNO_3, and 50 mL concentrated HCl. From 1,000-ppm standards, pipet 1 µL each Ba, Be, and Cd; 2 µL each of V; 3 µL each Ag, Ni, and Cr; 4 µL Co; 5 µL each Mo, and B; 6 µL Cu; 10 µL each Pb and Zn; 12 µL Sb; 15 µL each Se, As, and Bi; 20 µL each Sn and Ti; 25 µL Tl. From 10,000-ppm standards, pipet 0.1 µL Mn; 2.5 µL Mg; 3 µL K; 5 µL Ca; 6 µL Fe; 7.5 µL Al and 52.5 µL Na. Dilute to volume with DI water. Prepare quarterly.	Ag:3 Al:75 Ba:1 Be:1 Ca:50 Cd:1 Co:4 Cr:3 Cu:6 Fe:60 K:30 Mg:25 Mn:1 Na:525 Ni:3 Tl:25 V:2 Zn:8 Pb:10 Se:15 Sb:12 As:15 Sn:20 Bi:15 Mo:5 Ti:20 B:5
IDLA-01 05 09-QF	Place in a 500-mL volumetric flask: 300 mL deionized water, 5 mL concentrated HNO_3, and 25 mL concentrated HCl. From 10,000-ppm standards, pipet 7.5 µL each Ca and Mg. Dilute to volume with DI water. Prepare quarterly.	Ca:150 Mg:150

Applies to Seq. File(s):_____

Standard Solutions Prepared By:_____

Entered By: Q. FORRESTER

Reviewed By:_____ Date:_____

*Ref# = Logbook ID, Page number, and item number from Materials Receipt Log
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Attachment 5

Standards Prep Log for Trace ICP (P3&P4)
Method Detection Limit (MDL) Studies

page 1 of2
Worksheet 1 P(C)

STANDARDS and REAGENTS TRACEABILITY

	Ref #*	Manufacturer	Lot #	Expiration Date
ALUMINUM (Al) 10,000 PPM	7M1-41-21 / 8L17002	High Purity	0824901	06/15/10
ANTIMONY (Sb) 1,000 PPM	7M1-40-21	High Purity	0809519	01/23/10
ARSENIC (As) 1,000 PPM	7M1-39-07	High Purity	0718613	03/07/09
BARIUM (Ba) 1,000 PPM	7M1-40-02	High Purity	0733813	06/12/09
BERYLLIUM (Be) 1,000 PPM	7M1-41-27 / 8L17008	High Purity	0827434	06/15/10
BISMUTH (Bi) 1,000 PPM	7M1-40-22	High Purity	0732309	01/23/10
BORON (B) 1,000 PPM	7M1-41-25 / 8L17006	High Purity	0808103	06/15/10
CALCIUM (Ca) 10,000 PPM	7M1-41-23 / 8L17004	High Purity	0802213	06/15/10
CADMIUM (Cd) 1,000 PPM	7M1-42-01 / 8L17010	High Purity	0825423	06/15/10
CHROMIUM (Cr) 1,000 PPM	7M1-39-24	High Purity	0733812	06/12/09
COBALT (Co) 1,000 PPM	7M1-39-23	High Purity	0728203	06/12/09
COPPER (Cu) 1,000 PPM	7M1-42-02 / 8L17011	High Purity	0812720	06/15/10
IRON (Fe) 10,000 PPM	7M1-41-20 / 8L17001	High Purity	0826002	06/15/10
LEAD (Pb) 1,000 PPM	7M1-39-22	High Purity	0728504	06/12/09
MAGNESIUM (Mg) 10,000 PPM	7M1-38-07	High Purity	0701815	02/10/09
MANGANESE (Mn) 10,000 PPM	7M1-40-02	High Purity	0731231	06/12/09
MOLYBDENUM (Mo) 1,000 PPM	7M1-42-04 / 8L17013	High Purity	0828502	06/15/10
NICKEL (Ni) 1,000 PPM	7M1-39-25	High Purity	0730921	06/12/09
POTASSIUM (K) 10,000 PPM	7M1-41-24 / 8L17005	High Purity	0816917	06/15/10
SELENIUM (Se) 1,000 PPM	7M1-42-25	High Purity	0810801	05/15/10
SILVER (Ag) 1,000 PPM	7M1-42-07 / 8L17016	High Purity	0815118	06/15/10
SODIUM (Na) 10,000 PPM	7M1-38-25	High Purity	0710716	01/26/09
THALLIUM (Tl) 1,000 PPM	7M1-36-26	High Purity	0722128	06/12/09
TIN (Sn) 1,000 PPM	7M1-40-24	High Purity	0802123	01/23/10
TITANIUM (Ti) 1,000 PPM	7M1-40-25	High Purity	0809812	01/23/10
VANADIUM (V) 1,000 PPM	7M1-39-27	High Purity	0731223	06/12/09
ZINC (Zn) 1,000 PPM	7M1-40-12	High Purity	0806419	01/03/10
SM-770-031 multi-element standard mix (PDS-R)	7M1-41-1	High Purity**	0826013	06/17/09
SPEX-R multi-element standard mix	7M1-40-16	High Purity**	0809826	04/09
SM-770-029 part A multi-element standard mix (RSTD-3A)	7M1-41-8 / 8K07001	High Purity**	0805135	10/31/09

Multi-Element Stock Standard Concentrations:

Stock Standard	Analyte Concentrations (µg/mL)
RSTD-3A/3B multi-element standard mix	Part A: Ca:10,000 Mg:10,000 K:10,000 Na:10,000
SPEX-R multi-element standard mix	Mo:1,000 Sn:1,000 Bi:1,000 Ti:1,000 B:1,000
PDS-R multi-element standard mix	Al:400 Ba:400 Ag:20 Be:10 Cd:10 Co:100 Cr:20 Cu:50 Fe:200 Mn:30 Ni:80 Tl:20 V:100 Zn:40 Pb:6 Se:10 As:20 Sb:120

Reviewed By:_____ Date:_____
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Attachment 5 (Continued)

Standards Prep Log for Trace ICP (P3&P4) page 2 of2
Method Detection Limit (MDL) Studies Worksheet 1 P(C)

Standard Name	Preparation Instructions	Analyte Concentration (µg/L)
MDLA-NP1/HW1-010509-QF	*Place in a 1-L volumetric flask:* 500 mL deionized water, 10 mL concentrated HNO_3, and 50 mL concentrated HCl. From 1,000-ppm standards, pipet 1 µL each Ba, Be, and Cd; 2 µL each of V; 3 µL each Ag, Ni, and Cr; 4 µL Co; 5 µL each Mo, and B; 6 µL Cu; 10 µL each Pb and Zn; 12 µL Sb; 15 µL each Se, As, and Bi; 20 µL each Sn and Ti; 25 µL Tl. From 10,000-ppm standards, pipet 0.1 µL Mn; 2.5 µL Mg; 3 µL K; 5 µL Ca; 6 µL Fe; 7.5 µL Al and 52.5 µL Na. Dilute to volume with DI water.	Ag:3 Al:75 Ba:1 Be:1 Ca:50 Cd:1 Co:4 Cr:3 Cu:6 Fe:60 K:30 Mg:25 Mn:1 Na:525 Ni:3 Tl:25 V:2 Zn:8 Pb:10 Se:15 Sb:12 As:15 Sn:20 Bi:15 Mo:5 Ti:20 B:5
MDLB-NP1/HW1-010709-QF	*Place in to a 500 ml volumetric flask :* 100 mL of deionized water 2.5 mL concentrated HNO3 and 12.5 concentrated HCL. Pipet in 250 mL of MDLA-NP1-010509-QF. Dilute to volume with DI water.	Ag:1.5 Al:32.5 Ba:0.5 Be:0.5 Ca:25 Cd:0.5 Co:2 Cr:1.5 Cu:3 Fe:30 *K:15 Mg:12.5 Mn:0.5 Na:265.5* Ni:1.5 Tl:12.5 V:1 Zn:4 Pb:5 Se:7.5 Sb:6 As:7.5 Sn:10 Bi:7.5 Mo:2.5 Ti:10 B:2.5
MDLC-NP1-011209-QF	Place in to a 100 ml volumetric flask : 75 mL of deionized water 2 mL concentrated HNO3 and 5 concentrated HCL. Pipet in 0.8 uL of 1000 ppm Ni standard. Dilute to volume with DI water.	Ni 8
MDLD-NP1-011209-QF	Place in to a 100 ml volumetric flask : 75 mL of deionized water 2.5 mL concentrated HNO3 and 12.5 concentrated HCL. Pipet in 20 uL of 1000 ppm Al standard. Dilute to volume with DI water.	Al: 200
LRS-010909	In a 500 mL volumetric flask, combine 200 mL deionized water, 5 mL concentrated HNO_3 and 25 mL concentrated HCl. Pipet 0.25 mL PDS-R, 0.1 mL RSTD-3A, and 10 µL Compuchem SPEX-R into flask. Bring up to volume with deionized water and transfer to a 500mL Teflon bottle. Final volume 500 mL.	Al:200 Ba:200 K:2,000 Mg:2,000 Na:2,000 Ca:2,000 Ag:10 Be:5 Cd:5 Co:50 Cr:10 Cu:25 Fe:100 Mn:15 Ni:40 Tl:10 V:50 Zn:20 Pb:3 Se:5 As:10 Mo:20 Sn:20 Bi:20 Ti:20 Sb:60 B:20
MDLF-NP1-010709-QF	Place in to a 500 ml volumetric flask : 300 mL of deionized water 8 mL concentrated HNO3 and 40 mL concentrated HCL. Pipet in 100 mL of LRS-010909-QF. Dilute to volume with DI water.	Al:40 Ba:40 K:400 Mg:400 Na:400 Ca:400 Ag:2 Be:1 Cd:1 Co:10 Cr:2 Cu:5 Fe:20 Mn:3 Ni:8 Tl:2 V:10 Zn:4 Pb:0.6 Se:1 As:2 Mo:4 Sn:4 Bi:4 Ti:4 Sb:4 B:4
MDLA-HS1-011209-JCF	In a 100 mL volumetric flask, combine 75 mL deionized water, 1 mL concentrated HNO_3 and 5 mL concentrated HCl. Pipet 5.0 mL PDS-R, 2.0 mL RSTD-3A, and 200 µL Compuchem SPEX-R into flask. Bring up to volume with deionized water and transfer to a 500mL Teflon bottle. Final volume 500 mL.	Al:20000 Ba:20000 K:200000 Mg:200000 Na:200000 Ca:200000 Ag:1000 Be:500 Cd:500 Co:5000 Cr:1000 Cu:2500 Fe:10000 Mn:1500 Ni:4000 Tl:1000 V:5000 Zn:2000 Pb:300 Se:500 As:1000 Mo:2000 Sn:2000 Bi:2000 Ti:2000 Sb:6000 B:2000
MDLB-HS1-011209-JCF	Into a 10 mL volumetric flask: Place 2 mL of deionized water, 0.1 mL concentrated HNO_3 and 0.25 mL concentrated HCl. Pipet in 5 mL of MDLA-HS1-011209-JCF. Dilute to volume with DI water	Al:10000 Ba:10000 K:100000 Mg:100000 Na:100000 Ca:100000 Ag:500 Be:250 Cd:250 Co:250 Cr:500 Cu:1250 Fe:5000 Mn:750 Ni:2000 Tl:500 V:2500 Zn:1000 Pb:150 Se:250 As:500 Mo:1000 Sn:1000 Bi:1000 Ti:1000 Sb:1000 B:1000
MDLC-HS1-011309-JCF	Into a 10 mL volumetric flask: Place 2 mL of deionized water, 0.2 mL concentrated HNO_3 and .8 mL concentrated HCl. Pipet in 2 mL of MDLA-HS1-011209-JCF. Dilute to volume with DI water	Al:4000 Ba:4000 K:40000 Mg:40000 Na:40000 Ca:40000 Ag:200 Be:100 Cd:100 Co:1000 Cr:200 Cu:500 Fe:2000 Mn:300 Ni:800 Tl:200 V:1000 Zn:400 Pb:60 Se:100 As:200 Mo:400 Sn:400 Bi:400 Ti:400 Sb:400 B:400
MDLD-HS1-011409-JCF	Into a 10 mL volumetric flask: Place 2 mL of deionized water, 0. 2mL concentrated HNO_3 and .9 mL concentrated HCl. Pipet in 1 mL of MDLA-HS1-011209-JCF. Dilute to volume with DI water	Al:2000 Ba:2000 K:20000 Mg:20000 Na:20000 Ca:20000 Ag:100 Be:50 Cd:50 Co:500 Cr:100 Cu:250 Fe:1000 Mn:150 Ni:400 Tl:100 V:500 Zn:200 Pb:30 Se:50 As:100 Mo:2000 Sn:200 Bi:200 Ti:200 Sb:600 B:200

Reviewed By:_____ Date:_____
*Ref# = Logbook ID, Page number, and item number from Materials Receipt Log
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Attachment 6

Table 1: Wavelength and Contract Required Quantitation Limits on Trace ICP Instruments P3 and P4

Elements	P3 Wavelength* (nm)	P4 Wavelength* (nm)	CRDL (µg/L) ILM04.1	CRQL (µg/L) ILM05.4
Aluminum	308.215	308.215	200	200
Antimony	206.83	206.838	60	60
Arsenic	189.042	189.042	10	10
Barium	493.409	493.409	200	200
Beryllium	313.042	313.042	5	5
Cadmium	226.502	226.502	5	5
Calcium	317.933	317.933	5000	5000
Chromium	267.716	267.716	10	10
Cobalt	228.616	228.616	50	50
Copper	324.753	324.753	25	25
Iron	271.441	271.441	100	100
Lead	220.35	220.35	3	10
Magnesium	279.078	279.078	5000	5000
Manganese	257.610	257.610	15	15
Nickel	213.604	213.604	40	40
Potassium	766.491	766.491	5000	5000
Selenium	196.02	196.02	5	35
Silver	328.068	328.068	10	10
Sodium	330.232	330.232	5000	5000
Thallium	190.864	190.864	10	25
Vanadium	292.402	292.402	50	50
Zinc	213.856	206.200	20	60
Titanium	334.941	334.941	-	-
Molybdenum	202.030	202.030	-	-
Tin	189.989	189.989	-	-
Bismuth	223.061	223.061	-	-
Boron	249.678	-	-	-
Lithium	-	670.784	-	-

*Wavelengths listed in the SOW are recommended because of their sensitivity and overall acceptance. Other wavelengths may be substituted if they can provide the needed sensitivity and are treated with the same corrective techniques for spectral interference (see SOW).

R2-0001959

Attachment 7

COMPUCHEM a Division of Liberty Analytical Corp. LOGBOOK 1 O(4) 68

Trace ICP Run Log (P3) **Part (A) of a three-part form**

Daily Instrument Profile: **Maintenance:**
Nebulizer pressure:_____ _____
Peak position:_____ _____
Peak intensity:_____ _____
Vernier position:_____ _____

Page 1 of ___

Method(s) (circle one): ILM04.1 ILM05.4 6010B 200.7 _____

Operator:_____ **File name:** P3_____ **Date/Time:**_____ to _____

SDG	Matrix	Analytes	Comments

Legend		No.	Sample ID	Comments	Action needed
↑	Specified element(s) fail(s) high	1			
↓	Specified element(s) fail(s) low	2			
RR	Re-run sample(s) neat	3			
RR #x	Re-run at a #-fold dilution	4			
#x	Sample run at a #-fold dilution (aliquot of sample diluted with acidified water)	5			
		6			
L	Matrix = leachate	7			
W	Matrix = water	8			
S	Matrix = solid	9			
B	Matrix = biological Tissue	10			
			CCV		
			CCB		

No.	Sample ID	Comments	Action needed
	S0	Blank	
	S	RSTD-1	
	S	RSTD-3	
	S	RSTD-2	
	S	RSTD-4	
	ICV1		
	ICB		
	CRI/LRS		
	ICSA		
	ICSAB		
	CCV-1		
	CCB-1		

The presence of the Chemist's/Analyst's employee ID number, or signature, on this run log attests that strict compliance with the method's SOP has occurred. Any SOP deviations require documentation by the responsible chemist/analyst together with the chemist's/analyst's initials and the initials of the lab supervisor and a QA department representative, signifying approval of the deviation.

COMMENTS:

Reviewed By: _____ Date: _____

12/31/07: vr

Attachment 7 (Continued)

COMPUCHEM a Division of Liberty Analytical Corp. LOGBOOK 1 O(4) 68

Trace ICP Run Log (P3) **Part (B) of a three-part form** Page 2 of ___

File name: P3

No.	Sample ID	Comments	Action needed	No.	Sample ID	Comments	Action needed
1				1			
2				2			
3				3			
4				4			
5				5			
6				6			
7				7			
8				8			
9				9			
10				10			
	CCV				CCV		
	CCB				CCB		
1				1			
2				2			
3				3			
4				4			
5				5			
6				6			
7				7			
8				8			
9				9			
10				10			
	CCV				CCV		
	CCB				CCB		
1				1			
2				2			
3				3			
4				4			
5				5			
6				6			
7				7			
8				8			
9				9			
10				10			
	CCV				CCV		
	CCB				CCB		
1				1			
2				2			
3				3			
4				4			
5				5			
6				6			
7				7			
8				8			
9				9			
10				10			
	CCV				CCV		
	CCB				CCB		

The presence of the Chemist's/Analyst's employee ID number, or signature, on this run log attests that strict compliance with the method's SOP has occurred. Any SOP deviations require documentation by the responsible chemist/analyst together with the chemist's/analyst's initials and the initials of the lab supervisor and a QA department representative, signifying approval of the deviation.

COMMENTS

Reviewed By: _____ Date: _____

12/31/07: vr

Attachment 7 (Continued)

COMPUCHEM a Division of Liberty Analytical Corp. LOGBOOK 1 O(4) 68

Trace ICP Run Log (P3) **Part (C) of a three-part form** Page 3 of 3

File name: P3

No.	Sample ID	Comments	Action needed	No.	Sample ID	Comments	Action needed
1				1			
2				2			
3				3			
4				4			
5				5			
6				6			
7				7			
8				8			
9				9			
10				10			
	CCV				CCV		
	CCB				CCB		
1				1			
2				2			
3				3			
4				4			
5				5			
6				6			
7				7			
8				8			
9				9			
10				10			
	CCV				CCV		
	CCB				CCB		
1				1			
2				2			
3				3			
4				4			
5				5			
6				6			
7				7			
8				8			
9				9			
10				10			
	CCV				CCV		
	CCB				CCB		
1				1			
2				2			
3				3			
4				4			
5				5			
6				6			
7				7			
8				8			
9				9			
10				10			
	CCV				CCV		
	CCB				CCB		

The presence of the Chemist's/Analyst's employee ID number, or signature, on this run log attests that strict compliance with the method's SOP has occurred. Any SOP deviations require documentation by the responsible chemist/analyst together with the chemist's/analyst's initials and the initials of the lab supervisor and a QA department representative, signifying approval of the deviation.

COMMENTS:

Reviewed By: _____ Date: _____

12/31/07: vr

Attachment 8

Table 1. SPIKING LEVELS FOR SPIKE SAMPLE ANALYSIS

	For ICP-AES ILM05.4		For ICP-AES ILM04.1	
Element	Water µg/L	Soil mg/kg	Water µg/L	Soil mg/kg
Aluminum	2000	*	2000	20
Antimony	100	20	500	50
Arsenic	40	8	40	4
Barium	2000	400	2000	200
Beryllium	50	10	50	5
Cadmium	50	10	50	5
Calcium	*	*	*	*
Chromium	200	40	200	20
Cobalt	500	100	500	50
Copper	250	50	250	25
Iron	1000	*	1000	100
Lead	20	4	20	2
Magnesium	*	*	*	*
Manganese	500	100	500	50
Nickel	500	100	500	50
Potassium	*	*	*	*
Selenium	50	10	10	1
Silver	50	10	50	5
Sodium	*	*	*	*
Thallium	50	10	50	5
Vanadium	500	100	500	50
Zinc	500	100	500	50

*No spike required.

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R2-0001963

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Cary, NC 27513

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NELAP accredited

SOP DOCUMENTATION FORM

This form must accompany all new and revised Standard Operating Procedures (SOPs) when you turn them in to Quality Assurance for review. Please fill out the entire block below (except effective date).

This is a new procedure _____ revised procedure ✓ outdated procedure (archive) _____

- Procedure Code: IP 315 SOP Section #: 3.1.2.2 Revision #: 3

SOP Title: VR 3/19/07 ~~Determin~~ Determination of Inductively Coupled Plasma-Mass Spectrometry (ICP-MS) by EPA CLP

Effective date: (QA fills in) 04/03/07

- Procedure prepared by: Valgena Respass

Date: 3/19/07

- Procedure approved by: (If the manager prepared the SOP, a qualified second party should sign)

Date: 04-03-07

- Reason for change: Annual review; ILM05.4 update

- This procedure meets the requirements of the following approved method references:

USEPA CLP SOW for Inorganic Analysis, Multi-Media, Multi-Concentration ILM05.4

Procedure approved by a QA Representative (unless QA Representative signed above):

_____ Date: _____

On an annual basis: Lab managers are required to review lab practices and revise the SOP if necessary. If no revision is necessary, indicate by your signature that the SOP has been reviewed.

Annual Review—Signature: _____ Date: _____

Annual Review—Signature: _____ Date: _____

Annual Review—Signature: _____ Date: _____

Annual Review—Signature: _____ Date: _____

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Instrument Procedure 315: Determination of Metals by Inductively Coupled Plasma – Mass Spectrometry (ICP-MS) by EPA CLP

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Instrument Procedure 315: Determination of Metals by Inductively Coupled Plasma – Mass Spectrometry (ICP-MS) by EPA CLP

1.0 Scope and Application

This method provides procedures for the use of ICP-MS to determine the concentration of dissolved and total recoverable elements in water/aqueous samples taken from hazardous waste sites. This method is compliant with the requirements of the EPA CLP Statement of Work (SOW) ILM05.**4**.

Staff members performing the procedures described in this SOP are responsible for reading, understanding, and complying with the SOP requirements. Supervisors are responsible for directing the analyst to the controlled SOP, and providing adequate explanation of the material contained therein.

This procedure is restricted to use by or under the supervision of analysts experienced in the instrumentation or preparative methods and who have demonstrated the ability to generate acceptable results through QC samples and analyst capability studies.

2.0 Summary

This method describes the multi-element determination of trace elements by ICP-MS. Sample material in solution is introduced by nebulization into a radio frequency plasma where energy transfer processes cause desolvation, atomization, and ionization. The ions are extracted from the plasma through a differentially pumped vacuum interface and separated on the basis of their mass-to-charge ratio. The separated ions are detected and the ion information processed by a data handling system. Interferences related to the technique must be recognized and corrected. Such corrections may include compensation for isobaric elemental interferences and interferences from polyatomic ions derived from plasma gas, reagents, or sample matrix. Instrumental drift, as well as suppressions or enhancements of instrument response, must be corrected by the use of internal standards

3.0 Definitions

3.1 Dissolved metals – metals that will pass through a 0.45 micron membrane filter.

3.2 Total metals – the concentration of metals determined on an unfiltered liquid sample following vigorous digestion.

3.3 Method detection limit (MDL) – The minimum concentration of an analyte that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte (40 CFR, Part 136, Appendix B.)

3.4 Instrument Detection Limits (IDL) – determined by multiplying by three the standard deviation obtained for the analysis of a standard solution (each analyte in reagent water) at a concentration of 3x to 5x IDL on three nonconsecutive days with seven consecutive measurements per day.

3.5 Reporting Limit – The laboratory reporting limit is based on the lowest multipoint calibration standard concentration. For some inorganic methods, the reporting limit is based on the MDL, and is usually 4 - 8 times higher than the MDL.

For CLP the reporting limit is the Contract Required Quantitation Limit (CRQL). (Attachment 1)

3.6 Reporting Units – µg/L for water

3.7 An SDG is defined by the following, whichever is more frequent:

- each 20 field samples (excluding PE samples) received within a case, or
- each 7 calendar day period during which field samples in a case are received beginning with the receipt of the first sample.

3.8 CLP – Contract Laboratory Program

3.9 SOW – Statement of Work

3.10 VTSR – Validated time of sample receipt

4.0 Interferences

4.1 Isobaric elemental interferences result from isotopes of different elements forming singly or double charged ions of the same nominal mass-to-charge ratio that cannot be resolved by the mass spectrometer. All elements determined by this method have at least one isotope free of isobaric elemental interference. Only selenium-82, of the analytical isotopes recommended, has an isobaric elemental interference. If greater sensitivity is desired, alternative analytical isotopes with higher natural abundances can be selected, but an isobaric elemental interference may occur. When this happens, all data obtained must be corrected by measuring the signal from another isotope of the interfering element and subtracting the

appropriate signal ratio from the isotope of interest. Records need to be maintained of this correction process and should be included in the submitted data package.

4.2 Physical interferences are generally considered to be effects associated with the ICP analysis, especially with samples containing high dissolved solids concentrations. Deposits can form on the extraction and/or skimmer cones, reducing the effective diameter and, therefore, the ion transmission. Physical interferences may occur in the transfer of solution to the nebulizer, at the point of aerosol formation and transport to the plasma, or during the excitation and ionization processes within the plasma.

4.3 Abundance sensitivity relates to the degree the wings of a mass peak contribute to adjacent masses. It is affected by ion energy and mass filter operating pressure. The wing overlap interference may result when a small ion peak is being measured adjacent to a large peak. When this occurs, the resolution of the spectrometer should be adjusted to minimize the condition.

4.4 Isobaric polyatomic ion interferences are caused by ions comprised of more than one atom that have the same nominal mass-to-charge ratio as the isotope of interest and cannot be resolved by the spectrometer. The ions are generally formed in the plasma or interface system from support gases or sample components. These interferences must be recognized and appropriate correction made to the data unless they can be avoided by selecting alternative analytical isotopes.

4.5 Memory interferences occur when isotopes of elements in a previous sample contribute to the signals measured in a new sample. These memory effects (carryover) may develop from sample deposition on the sampler and skimmer cones or from the buildup of sample material in the plasma torch and spray chamber. Flushing the system with a rinse blank between samples can minimize the effect. This problem should be recognized during an analytical run and suitable rinse time used to eliminate it. By analyzing a standard containing the elements at 10X the upper end of the linear range and following that with the analysis of the rinse blank at designated intervals, the analyst should be able to estimate suitable rinse times. From the length of time necessary to reduce analyte signals to within a factor of 10 of the MDL, the analyst has the necessary rinse time. The assessment of memory interferences can also take place by using a minimum of three replicate integrations for data acquisition. If the integrated signal value drops consecutively, this may be a sign to the analyst of a memory effect and that should direct the analyst to evaluate the analyte concentration in

the previous sample to determine if it had a high value. If suspected, the sample should be reanalyzed after a long rinse period.

4.6 For the determination of metals, contamination and loss of metals of interest are of prime concern. Dust in the laboratory and impurities on laboratory apparatus and in the reagents are sources of potential contamination. Sample containers can introduce either positive or negative errors in the measurement of metals. Therefore, laboratory glassware, sample bottles, etc., should be thoroughly prepared.

4.7 Reagents may contain elemental impurities that might affect the integrity of analytical data. Owing to the high sensitivity of the ICP-MS, high-purity reagents should be used whenever possible. All acids used must be of ultra high-purity grade. Suitable acids are available from a number of manufacturers or may be prepared by sub-boiling distillation. Nitric acid is preferred for ICP-MS in order to minimize polyatomic ion interferences. Several polyatomic ion interferences result when hydrochloric acid (HCl) is used, however, it should be noted that HCl is required to maintain stability in solutions containing antimony and silver. When HCl is used, corrections for the chloride polyatomic ion interferences must be applied to all data.

5.0 Safety

5.1 Many metal salts are extremely toxic if inhaled or swallowed, so wash your hands after handling salts.

5.2 Appropriate protective equipment and clothing must be used under the assumption that all samples are potentially hazardous. During sample preparation, glasses, gloves and lab coats are a minimum requirement. The persistent presence of noxious odors may be indicative of failure of the laboratory ventilation system and must be reported to a supervisor or manager.

5.3 Laboratory staff **must** review the Chemical Hygiene Plan for general safety policies, and Material Safety Data Sheets (MSDS) for solvents and reagents used in the laboratory. The MSDS are located in the Quality Assurance department.

6.0 Equipment **and** Supplies

6.1 Graduated cylinders

6.2 Various volumetric flasks (Type A)

6.3 Analytical Balance - **OHAUS E-400**

6.4 ICP-MS

6.4.1 Thero Electron VG PQ Excell

6.4.2 A radio-frequency generator compliant with Federal Communications Commission (FCC) regulations.

6.4.3 A variable speed peristaltic pump **- Spectec Permax 12**

6.4.4 A mass-flow controller on the nebulizer gas supply is required.

6.4 A high purity (99.99%) argon gas supply.

7.0 Reagents **and** Standards

7.1 Reagents

7.1.1 Reagent Water - The purity of this water must be equivalent to ASTM Type II water (ASTM D1193-77). Use this preparation for all reagents, standards, and dilutions of solutions.

7.1.2 Nitric Acid - Concentrated (specific gravity 1.41).

7.1.2.1 Nitric acid (1+1) - Add 50 milliliters (mL) conc. HNO_3 to approximately 30 mL of reagent water and dilute to 100 mL.

7.1.3 Hydrochloric acid – Concentrated, distilled (specific gravity 1.19).

7.1.3.1 Hydrochloric acid (1+1) - Add 50 mL conc. HCl to approximately 30 mL of reagent water and dilute to 100 mL.

7.2 Stock Standards Solutions – commercially available

7.2.1 Stock standard solutions my be either purchased from a commercial source as High Purity or CPI or obtained from USEPA.

7.3 Working Standards

7.3.1 Multi-elemental Calibration Standard Solutions

Care must be taken in the preparation of multi-elemental calibration standard solutions to ensure that the elements are compatible and stable. **Prepare fresh** calibration standards weekly. (**Prepare calibration blanks** daily.)

Note: Reference to all working standards can be found in Attachment 5.

7.3.1.1 S0/ICB/CCB

Place into a 100 mL volumetric flask 1.0 mL of HNO3 and 1.0 mL of Internal Standard Solution. (see 7.3.2) Fill to volume with **reagent** water.

7.3.1.2 S2

Place into a 100 mL volumetric flask, 1.0 mL of HNO3 and 1.0 mL of Internal Standard Solution. Pipet 0.002 mL of Quality Control Standard, 26 multi-element solution and 0.020 mL of 10 µg/mL Tin into the flask. Fill to volume with **reagent** water.

Resultant Concentration: 2 ppb for all target analytes

7.3.1.3 S20

Place into a 100 mL volumetric flask, 1.0 mL of HNO3 and 1.0 mL of Internal Standard Solution. Pipet 0.020 mL of Quality Control Standard, 26 multi-element solution and 0.200 mL of 10 µg/mL Tin into the flask. Fill to volume with **reagent** water.

Resultant Concentration: 20 ppb for all target analytes

7.3.1.2 S200

Place into a 100 mL volumetric flask, place 1.0 mL of HNO3 and 1.0 mL of Internal Standard Solution. Pipet 0.200 mL of Quality Control Standard, 26 multi-element solution and 2.0 mL of 10 µg/mL Tin into the flask. Fill to volume with **reagent** water.

Resultant Concentration: 200 ppb for all target analytes

7.3.2 Internal Standard Solution

Place in a 100 mL volumetric flask, 50 mL of deionized water and 1 mL of HNO_3. Pipet 2.0 mL of Lithium6 single element standard, 0.2 mL of Scandium single element standard, 0.2 mL of Indium single element standard, 0.2 mL of Terbium single element standard, 0.2 mL of Homium single element standard and 0.2 mL of Bismuth single element standard. Dilute to volume with deionized water.

Resultant Concentrations: Lithium 200 ppb, Scandium 20 ppb, Indium 20 ppb, Terbium 20 ppb, Homium 20 ppb, and Bismuth 20 ppb

7.3.3 Tuning Solutions

These solutions are used for instrument optimization, tuning, stability, and resolution prior to analysis.

7.3.3.1 Instrument Tuning Solution

This solution is used during the optimization of the ICP-MS (autolen tuning, gas flow, detector voltages, torch box alignment, mass calibration, RF power, and pole bias)

Into a 500 mL volumetric flask, place 0.005 mL of Cerium (1000 ppm), 0.005 mL of Lithium 7 (1000 PPM), 0.005 mL of Uranium (1000 ppm), 0.5 mL of Tuning Standard, and 5.0 mL of distilled nitric acid. Dilute to volume with **reagent** water.

Resultant Concentration: 10 ppb of Li, Be, Mg, Co, In, Ce, Pb, and U.

7.3.3.2 Pre-Calibration Tune Solution

This solution is used to determine resolution and stability.
Place into a 100 mL volumetric flask, 1.0 mL of Tuning Standard, and 1.0 mL of distilled nitric acid. Dilute to volume with **reagent** water. This solution is used to check the resolution and stability of the ICP-MS.

Resultant Concentration: 100 ppb of Be, Mg, Co, In, and Pb

7.3.4 Initial Calibration Verification (ICV)

The ICV solution independently verifies the accuracy of the initial calibration for each target analyte. The ICV is obtained from the USEPA and is a second source standard. Refer to Attachment 2 for all resultant analyte concentrations.

Place into a 100 mL volumetric flask, 1 mL distilled nitric acid and 1 mL Internal Standard. Pipet 2 mL of ICV (1201) multi-element solution, 1mL of 10 µg/mL Molybdenum and 1 mL of 10 µg/mL Tin into flask. Dilute to volume with **reagent** water. (Note: Tin must be from a source different than that used for the calibration standards.)

7.3.5 Interference Check Sample (ICS)

This solution **is used to** verify that correction equations for elemental or polyatomic isobaric interferences are being properly applied. The coefficients in the correction equations were calculated using natural isotopic abundances, and assuming zero instrumental fractionation. However; the correction equation shall not be applied if the appropriate interference check sample measurement demonstrates absence of interferences above the CRQL. Refer to Attachment 3 for resultant analytes concentrations.

Interference Check Sample consists of two solutions: ICSA containing only the interferents; ICSAB contains both the interferents and target analytes.

7.3.5.1 ICSA Solution

Place into a 200 mL volumetric flask, 2 mL distilled nitric acid and 2 mL Internal Standard Solution. Pipet 20.0 mL of ICS Part A (0803) into flask. Dilute to volume with **reagent** water.

7.3.5.2 ICSAB Solution

Place in a 200 mL volumetric flask, 2 mL distilled nitric acid and 2 mL Internal Standard Solution. Pipet 20.0 mL of ICS Part A (0803) and 20.0 mL of ICS Part B (0803) into flask. Dilute to volume with **reagent** water.

7.3.6 Contract Required Quantitation Limit Check Standard (CRI)

The concentrations of the analytes in the CRI are at the CRQL.

Place into a 200-mL volumetric flask, 2 mL distilled nitric acid and 2 mL Internal Standard Solution. Pipet 0.2 mL of CP-MS-CRQL, 0.02 mL of 10 µg/mL Molybdenum**,** 0.02 mL of 10 µg/mL Tin**, and 0.04mL of 10 µg/mL Vanadium** into flask. Dilute to volume with **reagent** water.

7.3.7 Continuing Calibration Verification (CCV)

Place in a 200 mL volumetric flask, 2 mL distilled nitric acid and 2 mL Internal Standard Solution. Pipet **0.21** mL of Quality Control Standard 26 Solution and **2.1** mL of 10 µg/mL Tin into flask. Dilute to volume with **reagent** water.

Analyte concentration in the CCV is **105** ppb.

7.3.8 Method Detection Limit (MDL) Solution – for ILM05.**4**

The MDL Solution shall be a concentration of 3 to 5 times the expected MDL values.

Refer to Standards/QC Preparation LDR/MDL/IDL for ICP-MS for preparation procedures and actual analyte concentrations. (Attachment 6)

7.3.9 Instrument Detection Limit (IDL) Solution – for 6020

The IDL Solution shall be prepared at a concentration of 3 to 5 times the instrument manufacturer's suggested instrument detection limits.

Refer to Standards/QC Preparation LDR/MDL/IDL for ICP-MS for preparation procedures and actual analyte concentrations. (Attachment 6)

7.3.10 Linear Dynamic Range (LDR)

The LDR solution **is used to** determine the linearity of the instrument for each analyte. Due to the varying response signals of the analytes**,** the LDR varies for each analyte; several solutions are prepared in order to meet the criteria.

Refer to Standards/QC Preparation LDR/MDL/IDL for ICP-MS for preparation procedures and actual analyte concentrations. (Attachment 6)

8.0 Sample Preservation and Storage

8.1 All samples must be collected in glass or polyethylene containers. **A**queous samples must be preserved with nitric acid to pH less than 2 immediately after collection. For ILM05.**4**, samples must be iced or refrigerated at 4°C (± 2°C) from the time of collection until digestion.

8.2 For the determination of dissolved metals, the sample must be filtered through a 0.45 micrometer (μm) pore diameter membrane filter at the time of collection or as soon as possible. Use a portion of the sample to rinse the filter flask, discard this portion, and collect the required volume of filtrate. Preserve the filtrate with nitric acid to pH less than 2 immediately after filtration.

8.3 The samples must be protected from light and refrigerated at 4°C (± 2°C) from the time of receipt until 60 days after the delivery of a complete, reconciled data package to USEPA. After 60 days the samples may be disposed of in a manner that complies with all applicable regulations.

8.4 Sample digestates must be stored until 365 days after delivery of a complete, reconciled data package to USEPA.

8.5 The maximum holding time for metals is 180 days from Validated Time of Sample Receipt (VTSR).

9.0 Quality Control

9.1 Preparation Blank Analysis

9.1.1 **Prepare a** preparation blank with each digestion batch of up to 20 samples.

9.1.2 This blank is used to ascertain whether sample concentrations reflect contamination.

9.1.3 The blank must contain absolute values of analyte concentrations at less than or equal to the CRQL.

9.1.4 If the **preparation** blank exceeds the CRQL, the entire sample batch associated with the blank must be re-prepared along with a new preparation blank. The only circumstance under which the method blank can be reported with analyte values greater than the CRQL is when the concentration of the affected analyte in the sample exceeds the blank concentration by a factor of 10 or more. If all associated samples are less than the CRQL, no re-digestion is required.

9.2 Spiked Sample

9.2.1 **Prepare one** sample spike with each SDG.

9.2.2 If the sample concentration is less than four times the amount spiked and the recovery of the spike is less than 75% or greater than 125%, the corresponding element is flagged with an "N" on Form 1 to indicate that the element did not recover in the matrix spike acceptably (See Attachment 3 for spiking levels.)

9.2.3 Prepare and analyze a Post Digestion Spike (PDS) for those elements flagged with an "N" (except Ag).

The PDS should be spiked at 2 times the CRQL or 2 times the indigenous level of the analyte in the original sample, whichever is greater.

9.3 Duplicate Sample

9.3.1 **Analyze a** duplicate sample once per SDG.

9.3.2 If the sample and duplicate do not agree within a 20% RPD when the concentration is either greater than or equal to 5 X CRQL, or ± CRQL when the concentration is < 5 X CRQL, then the affected element is flagged with an "*" to indicate poor duplication of results.

9.4 Laboratory Control Sample (LCS)

9.4.1 **Prepare an** aqueous LCS with each digestion batch of up to 20 samples.

9.4.2 The results of the aqueous LCS must agree within ±20% of the true values for all the elements.

If the aqueous LCS falls outside these control limits, **Re-digest and re-analyze** the samples associated with that LCS**.**

9.5 Serial Dilution

9.5.1 **Perform one** serial dilution for each SDG.

9.5.2 Perform a 5x serial dilution on the sample to determine if a chemical or physical interference exists. Prepare the serial dilution by taking 1 part sample to 4 parts acidified water.

9.5.3 If the analyte concentration is 50 times or more above the method detection limit in the original sample, the serial dilution must then agree within 10% of the original sample. If not, then flag the appropriate elements with an "E" to indicate an interference exists.

9.6 Field Blanks

9.6.1 Samples identified as field blanks should not be used for sample spike, duplicate, or serial dilution analysis.

9.7 Internal Standards

9.7.1 The analyst shall monitor all responses from the internal standards through the analytical run. The absolute response of any ONE internal standard must not deviate more than 60 – 125% of the original response in the calibration blank. If deviations greater than these are observed in field samples, matrix spikes, or duplicate samples, the original sample shall be diluted by a factor of two, internal standard added, and the sample reanalyzed.

9.8 Contingency

9.8.1 If, due to a lab accident or to QC failure, a re-preparation is required for the sample and insufficient volume remains, the Project Manager must be alerted and will contact the client for direction on how to proceed. For the CLP, the Sample Management Office must be contacted.

9.8.2 If persistent contamination occurs in the laboratory, analyses must be halted until the source can be identified and isolated. When the contamination issue is resolved, sample analyses may proceed.

9.8.3 Any other issues that potentially affect data quality should be addressed with the Project Manager.

10.0 Calibration **and** Standardization

The instrument calibration standards are analyzed at the beginning of the analytical sequence, in the order shown in the ICP-MS Run Log (Attachment 4) and must meet acceptance criteria before samples can be analyzed. Calibration is further discussed in the Procedure section that follows.

10.1 Linear Dynamic Range (LDR)

10.1.1 Analyze LDR check standards including all ICP-MS analytes quarterly. Establish the upper limit of the linear calibration range for each analyte by determining the signal responses from a minimum of three different concentration standards, one of which is close to the upper limit of the linear range. The linear calibration range used for the analysis of samples shall be determined from the resulting data. The upper LDR limit shall be an observed signal no more than 10% below the level extrapolated from lower standards.

10.1.2 Determined sample analyte concentrations that are greater than 90% of the determined upper LDR limit must be diluted and re-analyzed.

10.1.3 The LDRs must be verified whenever a change in instrument hardware operating conditions indicates they should be re-determined, or verified quarterly.

10.1.4 Report the LDR for each element on Form XI-IN.

10.2 Initial Calibration Verification (ICV)

10.2.1 Analyze the ICV1 standard immediately following the initial calibration to verify the calibration:

10.2.2 The results of the ICV must agree within ± 10% of the solution "true" values.

10.2.3 Analyze the ICV solution at each mass used for reporting final results. Report the values for the ICV on Form IIA-IN.

10.3 Initial Calibration Blank (ICB)

10.3.1 Follow the ICV with the ICB.

10.3.2 Any analyte present in the blank must be less than the CRQL.

10.2.5 If criteria are not met, terminate the run and re-calibrate the instrument. If re-calibration does not fix the problem, shut down the instrument and request instrument service.

10.4 CRQL Standard (CRI)

10.4.1 Analyze the CRI standard to verify linearity near the CRQL at the beginning and end of each sample analysis run, but not before the ICV. Analyze the CRI at a frequency of not less than once per 20 analytical samples. Analyze the Interference Check Samples (ICS) immediately following the CRI.

10.4.2 Analyze the CRI for every required isotope used for the analysis of all ICP-MS analytes. Report the results of the CRI analysis on the Form IIB-IN.

10.4.3 If the percent recovery of the CRI falls outside the control limits of 70 -130% (50-150% for cobalt, manganese, and zinc) for one or more analytes, reanalyze the CRI immediately for those analytes only. If the results of the re-analysis for those analytes fall within the control limits, no further corrective action is required. If the results of the re-analysis for those analytes do not fall within the control limits, terminate the analysis. Correct the problem and recalibrate the instrument. Reanalyze the samples associated with the failing CRI.

10.5 Interference Check Samples

10.5.1 Analyze the ICS following the CRI analysis. Analyze the ICS and the CRI at the beginning of the analytical run.

10.5.2 The ICS samples consist of two solutions: Solution A (ICSA) and Solution AB (ICSAB). Solution A contains the interferents and Solution AB contains the analytes and interferents (Attachment 2).

10.5.3 The analytical results of ICS Solution A (ICSA) shall fall within the control limit of ± 3 times the CRQL of the analyte's true value or ±20% of the analyte's true value (the true value shall be zero unless

otherwise stated) in the ICSA, whichever is greater. If not, the analysis shall be terminated, the problem corrected, the instrument recalibrated, and re-analysis of the ICSA shall be performed. The ICSA results for these analytes shall be reported from an undiluted sample analysis

10.5.4 ICS reference material must be obtained from EPA. Because the values may vary with each lot obtained, the analyte concentrations shown in Attachment 2 are typical and provided as an example only. Certificates of analysis with true values for each lot are maintained in a three ring binder in the laboratory.

10.5.5 Results for the ICS Solution AB (ICSAB) during the analytical runs shall fall within the control limit of ± 3 times the CRQL of the true value or ± 20% of the true value, whichever is greater, for the analytes included in the ICSAB. If not, the analysis shall be terminated, the problem corrected, the instrument recalibrated, and re-analysis of the ICSAB shall be performed

10.6 Continuing Calibration Verification (CCV)

10.6.1 Analyze the CCV immediately following the ICS.

10.6.2 Analyze the CCV every 10 samples, or every 2 hours during the analytical run, whichever is more frequent, and at the end of analytical run.

10.6.3 The results of the check standard must agree within ± 10% of the true value. If not, terminate the analysis, correct the problem, and recalibrate the instrument.

10.7 Continuing Calibration Blank (CCB)

10.7.1 Analyze a CCB immediately after every CCV and at a frequency of 10% or every 2 hours during the run, whichever is more frequent.

10.7.2 Prepare the calibration blanks using the same acid volumes as calibration standards.

10.7.3 Any analyte present in the blank must be less than the CRQL.

10.7.4 If criteria are not met, terminate the analysis and recalibrate. If re-calibration does not fix the problem, shut down the instrument and request instrument service.

11.0 Procedure

Documentation must follow the requirements in Quality Control SOP 13.6, "Proper Documentation Procedures". The analytical sequence is documented in the ICP-MS Run Log (Attachment 4).

11.1 Tune the instrument by adjusting lense voltages and torch position while aspirating the 10 ppb Tune Solution to obtain a maximum signal response with a minimum %RPD for each analyte mass in the Tune Solution. Use of the instrument's "AutoTune" routine is recommended.

11.2 Perform a pre-calibration tune verification by analyzing five replicates of the 100 ppb Tune Solution. The %RPD for the five replicates must be < 5%. The mass calibration must be verified to be within 0.1 amu over the mass range of 6 – 210 amu and the peak width at 10% peak height must be between 0.60 – 0.85 amu.

11.3 Begin calibration and sample analysis by selecting an instrument template (typically ILM05.**4**) and adding samples to the "Sample List." Templates contain all instrument operating and acquisition parameters, configurations, timing parameters, and calibration and verification sequences.

11.4 Once sample information is entered, begin the analysis by queuing the sequence.

11.5 Once analysis is complete, data undergoes a peer review process to verify all data meet acceptance criteria. Samples associated with failing acceptance criteria **are** re-analyzed.

12.0 Data Analysis **and** Calculations

Calculations must be consistent with the Q**uality** C**ontrol** SOP **13.6, "**Numerical Data Reduction**"**.

12.1 Calculation of the mean or average of a set of values:

$$\overline{X} = \frac{\sum_{i=1}^{n} X_i}{n}$$

where: n = total number of values

x_i = each individual value used to calculate the mean
x = the mean of n

12.2 Calculation of the standard deviation of a set of values:

$$\text{Standard deviation} = \sqrt{\frac{\sum_{i=1}^{n}\left(X_n - \overline{X}\right)^2}{n-1}}$$

12.3 Calculation of percent recovery:

12.3.1 LCS:

$$\%R = \frac{Amount\ found}{Amount\ spiked}\ x\ 100$$

12.3.2 Matrix spikes:

$$\%\,R = \frac{Amount\ in\ spiked\ sample - Amount\ in\ unspiked\ (native)\ sample}{Amount\ spiked}\ x\ 100$$

12.4 Calculation of % RSD

$$\%RSD = \left(\frac{Standard\ deviation}{\overline{X}}\right) \times 100$$

12.5 Calculation of RPD

$$RPD = \frac{|Value\ 1 - Value\ 2|}{(Value\ 1 + Value\ 2)/2} x100$$

12.6 Calculation of %Difference (%D)

$$\%Diff = \frac{|\ Value - Reference\ value\ |}{Reference\ value}\ x\ 100$$

12.7 Concentration of aqueous samples

$$\mu g / L = \frac{(C)(V)(D)}{(W)}$$

where: C - Concentration (mg/l)
D- Dilution factor
V - Final volume of digestate (L)
W - Volume of sample (L)

12.8 Calculating Dilutions

If a sample concentration exceeds the linear range of the instrument, a dilution must be performed. Determine a level of dilution that will result in a value within the upper 75% of the calibration range. This is an acceptable dilution. A 10x dilution is performed using 1 mL sample plus 9 mL diluent for a total volume of 10 mL. It should be recorded on the run log as "10x (1 mL in 10 mL)."

12.9 Percent Relative Intensity

$$\%RI = \frac{I_n}{I_o} x\ 100$$

where: I_n = Intensity of the internal standard in the sample

I_o = Intensity of the internal standard in the calibration blank (S0)

13.0 Method Performance

This method was validated through in-house laboratory studies of method detection limits and precision and accuracy for single analyst. The data are retained by the QA department.

14.0 Pollution Prevention

The solvents used in this procedure pose little threat to the environment when recycled and managed properly. Pollution prevention encompasses any technique that reduces or eliminates the quantity or toxicity of waste at the point of generation. Numerous opportunities for pollution prevention exist in laboratory operation. The EPA has established a preferred hierarchy of environmental management techniques that places pollution prevention as the management option of first choice. Whenever feasible, laboratory personnel should use pollution prevention techniques to address their waste generation. When wastes cannot be feasibly reduced at the source, the Agency recommends recycling as the next best thing.

15.0 Waste Management

It is the laboratory's responsibility to comply with all federal, state, and local regulations governing waste management, particularly the hazardous waste identification rules and land disposal restrictions, and to protect the air, water, and land by minimizing and controlling all releases from fume hoods and bench operations. Compliance with all sewage discharge permits and regulations is also required. **See SOP 12.1, Hazardous Waste Disposal, regarding laboratory procedures for recycling solvent waste streams.**

Samples preserved with HCl or H_2SO_4 to pH <2 are hazardous and must be handled as hazardous waste.

Refer to the Hazardous Waste Management and Safety SOPs located in the lab.

16.0 References

16.1 U.S. EPA CLP SOW for Inorganic Analysis ILM05.**4**

16.2 ICP-MS Operating Manual for VG PQ Excell Thermo Elemental

16.3 Standard Methods, 20th Edition (1998), Method 1080

16.4 Q**uality** C**ontrol** SOP **13.6, "**Proper Documentation Procedures**"**

16.5 Q**uality** C**ontrol** SOP**13.4, "**Numerical Data Reduction**"**

16.6 "Less is Better: Laboratory Chemical Management for Waste Reduction," American Chemical Society Department of Government Relations and Science Policy, 1155 16th Street, N.W., Washington DC, 20036, (202) 872-4477.

16.7 NELAC Standards, approved June 2003, plus revisions

16.8 QA-G6: Guidance for the Preparation of Standard Operating Procedures for Quality-Related Operations EPA/600/R-96/027, November 1995.

16.9 CompuChem Quality Manual, Revision 7, Update 1, 12/13/05, plus revisions

17.0 Attachments as Tables, Diagrams **and** Flowcharts

Attachment 1 – Contract Required Quantitation Limits (CRQLs)

Attachment 2 – Interference Check Samples

Attachment 3 – List of spiking levels for spike sample analysis

Attachment 4 – ICP-MS Run Log

Attachment 5 – Standards/QC Preparation for ICP-MS

Attachment 6 – Standards/QC Preparation **LDR/MDL/IDL** for ICP-MS

Attachment 1

ICP-MS Target Analyte List and Contract Required Quantitation Limits

Analyte	CAS Number	ICP-MS CRQL for Water [1,2,3] µg/L
Antimony	**7440-33-0**	**2**
Arsenic	**7440-38-2**	**1**
Barium	**7440-39-3**	**10**
Beryllium	**7440-41-7**	**1**
Cadmium	**7440-43-9**	**1**
Chromium	**7440-47-3**	**2**
Cobalt	**7440-48-4**	**1**
Copper	**7440-50-8**	**2**
Lead	**7439-92-1**	**1**
Manganese	**7439-95-5**	**1**
Nickel	**7440-02-0**	**1**
Selenium	**7782.49-2**	**5**
Silver	**7440-22-4**	**1**
Thallium	**7440-28-0**	**1**
Vanadium	**7440-62-2**	**5**
Zinc	**7440-66-6**	**2**

[1]The CRQLs are the minimum levels of quantitation acceptable under the contract SOW.
[2]Subject to the restrictions specified in Exhibit D, any analytical method specified in the OLM05.4 Exhibit D may be utilized as long as the documented MDLs are <½ the CRQLs.
[4]Changes to the Inorganic TAL (e. g., adding an additional analyte) or CRQLs may be requested under the modified analysis clause in the contract.

Attachment 2

QATS INORGANIC REFERENCE MATERIAL
INTERFERENCE CHECK SAMPLE FOR ICP-MS
PART A (0803) WITH PART B (0803)

August 15, 2003

The interference check sample set is to be used to verify elemental isobaric correction factors of inductively coupled plasma-mass spectrometers (ICP-MS). This reference material consists of two concentrated solutions. The Part A (0803) solution contains several interferent elements and species; for a complete listing refer to the ILM05.2 SOW. The Part B (0803) solution contains the analytes: Ag, As, Sb, Ba, Be, Cd, Co, Cr, Cu, Mn, Ni, Pb, Tl, Se, V, and Zn. Store the solutions at room temperature and do not freeze. To insure the stability of silver, which is contained in the Part B solution, the solution-set should be stored in the dark.

The "Certified Value" concentrations of the elements are listed in Table 1. The values are certified in that all results used in calculating the certified values were derived from statistically pooled results from the following sources: ILM05.2 Pre-award, Quarterly Blind, CLP laboratory referee, and QATS analysis. Preparation and analysis must be performed according to the following instructions:

Part A (0803), Inferferents: Pipet 10 mL of the Part A solution into a 100-mL volumetric flask and dilute to volume with 1% v/v HNO_3. Analyze this solution, Soln. A, by ICP-MS.

Part B (0803), Analytes, mixed with Part A (0803), Interferents: Pipet 10 mL of the Part A solution and 10 mL of the Part B solution into a 100-mL volumetric flask and dilute to volume with 1% v/v HNO_3. Analyze this solution, Soln. AB, by ICP-MS.

Table 1. "CERTIFIED VALUES" FOR INTERFERENCE CHECK SAMPLE ICP-MS
PART A (0803) AND PART A (0803) MIXED WITH PART B (0803)

Element	Part A	Concentration (ug/L) Part A&B
Al	[100000]	[100000]
Sb	(1.5)	22
As	(0.1)	19
Ba	(1.2)	22
Be	(0)	19
Cd	(0.7)	20
Ca	[100000]	[100000]
C	[200000]	[200000]
Cl	[1000000]	[1000000]
Cr	21	40
Co	1	20
Cu	8	25
Fe	[100000]	[100000]
Pb	4	25
Mg	[100000]	[100000]
Mn	7	27
Mo	[2000]	[2000]
Ni	6	24
P	[100000]	[100000]
K	[100000]	[100000]
Se	(0.3)	19
Ag	(0)	18
Na	[100000]	[100000]
S	[100000]	[100000]
Tl	(0)	21
Ti	[2000]	[2000]
V	(0.5)	19
Zn	11	29

[ ] INDICATES ANALYTES THAT DO NOT REQUIRE ICP-MS DETERMINATION IN THE ICS.
( ) INDICATES ANALYTE VALUES THAT ARE LESS THAN THE CRQL AND THE VALUE IS TO BE USED AS A SET POINT FOR THE +/- 3 TIMES CRQL ACCEPTANCE CRITERIA CALCULATIONS.

Attachment 3

Spiking Levels for Spike Sample Analysis

Analyte	Spike (µg/L)
Sb	100
As	40
Ba	2000
Be	50
Cd	50
Cr	200
Co	500
Cu	250
Pb	20
Mn	500
Ni	500
Se	10
Ag	50
Tl	50
V	500
Zn	500

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If words above are not highlighted, this is an uncontrolled copy of this document.

Attachment 4

COMPUCHEM a division of Liberty Analytical Corp. LOGBOOK 1 X(6) 5

ICP-MS Run Log (MS1)

Instrument Profile:
Detector Cross Cal:_____
Analog Voltage:_____
Pulse Voltage:_____
Nebulizer pressure:_____

Maintenance
_____
_____
_____
_____

Method (circle one): CLP ILM05.3 SW-846 6020

Operator:_____ **File name**: MS1 **Date/Time**:_____ Page____of____

SDG	Matrix	Analytes	Comments

Legend		No.	Sample ID	Comments	Action needed
↑	Specified element(s) fail(s) high	1			
↓	Specified element(s) fail(s) low	2			
RR	Re-run sample(s) neat	3			
RR #x	Re-run at a #-fold dilution	4			
#x	Sample run at a #-fold dilution (aliquot of sample diluted with acidified water)	5			
		6			
L	Matrix = leachate	7			
W	Matrix = water	8			
S	Matrix = solid	9			
B	Matrix = biological tissue	10			
			CCV		

No.	Sample ID	Comments	Action needed		CCB		
	Tune			1			
	S0			2			
	S2			3			
	S20			4			
	S200			5			
	ICV			6			
	ICB			7			
	CRI			8			
	ICSA			9			
	ICSAB			10			
	CCV				CCV		
	CCB				CCB		
1				1			
2				2			
3				3			
4				4			
5				5			
6				6			
7				7			
8				8			
9				9			
10				10			
	CCV				CCV		
	CCB				CCB		

COMMENTS

0.100 mL of Internal Standard added to each sample prior to an analysis

Reviewed By:_____

Date: _____

The presence of the Chemist's/Analyst's employee ID number, or signature, on this run log attests that strict compliance with the method's SOP has occurred. Any SOP deviations require documentation by the responsible chemist/analyst together with the chemist's/analyst's initials and the initials of the lab supervisor and a QA department representative, signifying approval of the deviation.

10/27/05:jad

Attachment 5

Standards/QC Preparation for ICP-MS (MS1) 1 of 4 CompuChem a division of Liberty Analytical Corp. WORKSHEET 1 Y(6)

STANDARDS and REAGENTS TRACEABILITY Seq. File Name : _____

STANDARD / REAGENT	Ref # *	Manufacturer	Lot #	Expiration Date
Nitric Acid (HNO3)	NHO3-D-012307-JCF	Caledon	50445	01/08
Hydrochloric Acid (HCl)	HCL-D-020207-JCF	Caledon	61132	02/08
Tuning Solution	7M1-36-22	High Purity	613522	06/07
Quality Control Standard 26	7M1-36-24	High Purity	615001	08/07
ICV-1 (1201) multi-element solution	7M1-37-10	EPA	1201	10/07
CP-MS-CRQL-Rev multi-element solution	7M1-37-7	High Purity	626428	09/07
ICSA (0803) multi-element solution	7M1-37-12	EPA	0803	10/07
ICSAB (0803) multi-element solution	7M1-37-13	EPA	0803	10/07
LITHIUM^{6} (Li^{6}) 1000 mg/L single element standard	7M1-36-25	High Purity	610815	02/08
LITHIUM^{7} (Li^{7}) 1000 mg/L single element standard	7M1-37-14	High Purity	616414	05/06/08
SCANDIUM (Sc) 1,000 mg/L single element standard	7M1-35-10	High Purity	525506	06/07
URANIUM (U) 1000 mg/L single element standard	7M1-37-2	High Purity	623708	09/25/07
INDIUM (In) 1,000 mg/L single element standard	7M1-35-9	High Purity	507716	06/07
TERBIUM (Tb) 1,000 mg/L single element standard	7M1-35-11	High Purity	511721	06/07
HOLMIUM (Ho) 1,000 mg/L single element standard	7M1-35-03	High Purity	513906	05/07
BISMUTH (Bi) 1,000 mg/L single element standard	7M1-35-8	High Purity	518906	06/07
CERIUM (Ce) 1,000 mg/L single element standard	7M1-37-27	High Purity	635409	09/28/08
TIN (Sn) 1000 µg/ml single element standard	7m1-37-24	High Purity	0701844	07/08
TIN (Sn) 10 µg/ml single element standard	7M1-35-24	CPI	06C092	09/07
MOLYBDENUM (Mo) 10 µg/ml single element standard	7M1-37-4	CPI	05I053	02/08
VANADIUM (V) 10 µg/ml single element standard	7M1-38-4	High Purity	626806	03/15/08
Water Spike Sample D ICP-MS Matrix Spike multi-element solution	1M2-180-24	High Purity	629915	01/08

Entered By: J. Feldhaus

Reviewed By: _____ Date: _____

*Ref# = Logbook ID, Page number, and item number from Materials Receipt Log 07.06.06:jcf

Attachment 5 (continued)

Standards/QC Preparation for ICP-MS (MS1) 2 of 4 CompuChem a division of Liberty Analytical Corp. WORKSHEET 1 Y(6)

Multi-Element Stock Standard Concentrations:

Stock Standard	Analyte Concentrations (µg/mL)
Tuning Solution	Be: 10 Mg: 10 Co: 10 In: 10 Pb: 10
Quality Control Standard 26	Al: 100 Sb: 100 As: 100 Ba: 100 Be: 100 B: 100 Cd: 100 Ca: 100 Cr: 100 Co: 100 Cu: 100 Fe: 100 Pb: 100 Mg: 100 Mn: 100 Mo: 100 Ni: 100 K: 1000 Se: 100 Si: 50 Ag: 100 Na: 100 Tl: 100 Ti: 100 V: 100 Zn: 100
CP-MS-CRQL-Rev multi-element solution	Be: 1 V: 1 Cr: 2 Mn: 1 Co: 1 Ni: 1 Cu: 2 Zn: 2 As: 1 Se: 5 Ag: 1 Cd: 1 Sb: 2 Ba: 10 Tl: 1 Pb: 1 Al: 30

Entered By: J. Feldhaus

Reviewed By: _____ Date: _____

07.06.06:jcf

Attachment 5 (continued)

Standards/QC Preparation for ICP-MS (MS1) 3 of 4 CompuChem a division of Liberty Analytical Corp. WORKSHEET 1 Y(6)

Standard Lot Number *	Preparation Instructions	Resultant Analyte Conc. (µg/L)
Instrument Tune Solution– 0 4 0 2 0 7 – J F	Place in a 500-mLvolumetric flask: 0.005 mL of Cerium single element standard, 0.005 mL of Lithium[7], 0.005 mL of Uranium, 0.5 mL of Tuning solution and 5 mL distilled nitric acid. Dilute to volume with deionized water.	Li^{7}: 10 Be: 10 Mg: 10 Co: 10 In: 10 Ce: 10 Pb: 10 U: 10
Pre-Calibration Tune Solution – 0 3 0 5 0 7 – J F	Place in a 100-mLvolumetric flask: 1.0 mL of Tuning solution and 1.0 mL distilled nitric acid. Dilute to volume with deionized water.	Be: 100 Mg: 100 Co: 100 In: 100 Pb: 100
Internal Standard– 0 4 0 2 0 7 – J F	Place in a 100-mLvolumetric flask: 50 mL of deionized water and 1.0 mL of distilled nitric acid. Pipet: 2.0 ml of Lithium[6], 0.2 ml of Scandium, 0.2 ml of Indium, 0.2 ml of Terbium, 0.2 ml of Holmium and 0.2 ml of Bismuth. Dilute to volume with deionized water	Li^{6}: 20000 Sc: 2000 In: 2000 Tb: 2000 Ho: 2000 Bi: 2000
S0/ICB/CCB– 0 4 0 2 0 7 – J F	Place in a 100-mL volumetric flask: 1 mL distilled nitric acid and 1mL Internal Standard. Dilute to volume with deionized water. Prepare Daily.	Li^{6}: 200 Sc: 20 In: 20 Tb: 20 Ho: 20 Bi: 20
S1– 0 4 0 2 0 7 – J F SW-846	Place in a 100-mL volumetric flask: 1 mL distilled nitric acid and 1 mL Internal Standard. Pipet 0.001 ml of Quality Control Standard 26 and 0.010 ml of 10 µg/ml Tin into flask. Dilute to volume with deionized water	Li^{6}: 200 Be: 1 Al: 30 Sc: 20 V: 1 Cr: 1 Mn: 1 Co: 1 Ni: 1 Cu: 1 Zn: 1 As: 1 Se: 1 Mo: 1 Ag: 1 Cd: 1 In: 20 Sn: 1 Sb: 1 Ba: 1 Tb: 20 Ho: 20 Tl: 1 Pb: 1 Bi: 20
S2– 0 4 0 2 0 7 – J F	Place in a 100-mL volumetric flask: 1 mL distilled nitric acid and 1 mL Internal Standard. Pipet 0.002 ml of Quality Control Standard 26 and 0.020 ml of 10 µg/ml Tin into flask. Dilute to volume with deionized water	Li^{6}: 200 Be: 2 Sc: 20 V: 2 Cr: 2 Mn: 2 Co: 2 Ni: 2 Cu: 2 Zn: 2 As: 2 Se: 2 Mo: 2 Ag: 2 Cd: 2 In: 20 Sn: 2 Sb: 2 Ba: 2 Tb: 20 Ho: 20 Tl: 2 Pb: 2 Bi: 20
S20– 0 4 0 2 0 7 – J F	Place in a 100-mL volumetric flask: 1 mL distilled nitric acid and 1 mL Internal Standard. Pipet 0.020 ml of Quality Control Standard 26 and 0..200 ml of 10 µg/ml Tin into flask. Dilute to volume with deionized water	Li^{6}: 200 Be: 20 Al: 200 Sc: 20 V: 20 Cr: 20 Mn: 20 Co: 20 Ni: 20 Cu: 20 Zn: 20 As: 20 Se: 20 Mo: 20 Ag: 20 Cd: 20 In: 20 Sn: 20 Sb: 20 Ba: 20 Tb: 20 Ho: 20 Tl: 20 Pb: 20 Bi: 20
S200– 0 4 0 2 0 7 – J F	Place in a 100-mL volumetric flask: 1 mL distilled nitric acid and 1 mL Internal Standard. Pipet 0.200 ml of Quality Control Standard 26 and 2.0 ml of 10 µg/ml Tin into flask. Dilute to volume with deionized water	Li^{6}: 200 Be: 200 Al: 2000 Sc: 20 V: 200 Cr: 200 Mn: 200 Co: 200 Ni: 200 Cu: 200 Zn: 200 As: 200 Se: 200 Mo: 200 Ag: 200 Cd: 200 In: 20 Sn: 200 Sb: 200 Ba: 200 Tb: 20 Ho: 20 Tl: 200 Pb: 200 Bi: 20

Standard Solutions Prepared By: _____

Entered By: J Feldhaus Date: _____

Reviewed By: _____ Date: _____

*Standard Lot Number consists of standard ID, date prepared, and initials of preparer. 07.06.06:jcf

Attachment 5 (continued)

Standards/QC Preparation for ICP-MS (MS1) 4 of 4 CompuChem a division of Liberty Analytical Corp. WORKSHEET 1 Y(6)

Standard Lot Number *	Preparation Instructions	Resultant Analyte Conc. (µg/L)
ICV- 0 4 0 2 0 7 - J F	Place in a 200-mL volumetric flask: 2 mL distilled nitric acid and 2 mL Internal Standard Pipet 4.0 ml of ICV (1201) multi-element solution, 2.2 ml of 10 µg/ml Molybdenum and 0.022 ml of 1000 µg/ml Tin into flask. Dilute to volume with deionized water. (Note: Tin must be from a source different than that used for the calibration standards)	Al: 496 Sb: 198 As: 199 Ba: 100 Be: 99 Ca: 2036 Cr: 98 Co: 99 Cu: 98 Fe: 1021 Pb: 199 Mg: 1201 Mn: 99 Ni: 98 K: 2002 Se: 201 Ag: 99 Na: 2008 Tl: 205 V: 100 Zn: 200 Cd: 99 Li^{6}: 200 Sc: 20 In: 20 To: 20 Ho: 20 Bi: 20 Mo: 110 Sn: 110
CRI- 0 4 0 2 0 7 - J F	Place in a 200-mL volumetric flask: 2 mL distilled nitric acid and 2 mL Internal Standard Pipet 0.200 ml of CP-MS-CRQL, 0.020 ml of 10 µg/ml Molybdenum, 0.020 ml of 10 µg/ml Tin and 0.080 ml of 10 µg/ml Vanadium into flask. Dilute to volume with deionized water	Li^{6}: 200 Be: 1 Al: 30 Sc: 20 V: 5 Cr: 2 Mn: 1 Co: 1 Ni: 1 Cu: 2 Zn: 2 As: 1 Se: 5 Mo: 1 Ag: 1 Cd: 1 In: 20 Sn: 1 Sb: 2 Ba: 10 To: 20 Ho: 20 Tl: 1 Pb: 1 Bi: 20
ICSA- 0 4 0 2 0 7 - J F	Place in a 200-mL volumetric flask: 2 mL distilled nitric acid and 2 mL Internal Standard Pipet 20.0 ml of ICS Part A (0803) into flask. Dilute to volume with deionized water.	Al: 100000 Sb: 1.5 As 0.1 Ba: 1.2 Be: 0 Cd: 0.7 Ca: 100000 C: 200000 Cl: 1000000 Cr: 21 Co: 1 Cu: 8 Fe: 10000 Pb: 4 Mg: 100000 Mn: 7 Mo: 2000 Ni: 6 P: 100000 K: 10000 Se: 0.3 Ag: 0 Na: 100000 S: 100000 Tl: 0 Ti: 2000 V: 0.5 Zn: 11
ICSAB- 0 4 0 2 0 7 - J F	Place in a 200-mL volumetric flask: 2 mL distilled nitric acid and 2 mL Internal Standard Pipet 20.0 ml of ICS Part A (0803) and 20.0 ml of ICS Part B (0803) and 0.400 ml of 10 µg/ml Tin into flask. Dilute to volume with deionized water.	Al: 100000 Sb: 22 As 19 Ba: 22 Be: 19 Cd: 20 Ca: 100000 C: 200000 Cl: 1000000 Cr: 40 Co: 20 Cu: 25 Fe: 10000 Pb: 25 Mg: 100000 Mn: 27 Mo: 2000 Ni: 24 P: 100000 K: 10000 Se: 19 Ag: 18 Na: 100000 S: 100000 Tl: 21 Ti: 2000 V: 19 Zn: 29
CCV- 0 4 0 2 0 7 - J F	Place in a 200-mL volumetric flask: 2 mL distilled nitric acid and 2 mL Internal Standard Pipet 0.210 ml of Quality Control Standard 26 and 2.10 ml of 10 µg/ml Tin into flask. Dilute to volume with deionized water	Li^{6}: 200 Be: 105 Sc: 20 V: 105 Cr: 105 Mn: 105 Co: 105 Ni: 105 Cu: 105 Zn: 105 As: 105 Se: 105 Mo: 105 Ag: 105 Cd: 105 In: 20 Sn: 105 Sb: 105 Ba: 105 To: 20 Ho: 20 Tl: 105 Pb: 105 Bi: 20

Preparation Instructions for Dissolved Metals		Prepared By	Date
Preparation Blank	Use acidified deionized water (1% HNO_3).	NA	NA
Laboratory Control Sample	Add 0.200 ml of ICV multi-element solution and 0.100 ml Internal Standard to 9.7 ml of acidified deionized water.	NA	NA
Sample Spike	Add 0.100 ml Water Spike Sample D and 0.100 ml of Internal Standard to 9.8 ml of sample.	NA	NA

Standard Solutions Prepared By: _____

Entered By: J Feldhaus Date: _____

Reviewed By: _____ Date: _____

*Standard Lot Number consists of standard ID, date prepared, and initials of preparer.

07.06.06:jcf

The presence of the Chemist's/Analyst's employee ID number, or signature, on this run log attests that strict compliance with the method's SOP has occurred. Any SOP deviations require documentation by the responsible chemist/analyst together with the chemist's/analyst's initials and the initials of the lab supervisor and a QA department representative, signifying approval of the deviation.

Attachment 6

COMPUCHEM a division of Liberty Analytical Corp.

Worksheet 1 ZZZ

Standards/QC Preparation LDR/MDL/IDL for ICP-MS (MS1) Page 1 of 3

STANDARD / REAGENT	Ref # [1]	Manufacturer	Lot #	Expiration Date
Nitric Acid (HNO3) - DISTILLED	NHO3-D-112705-JF	J.T. Baker	53821	11/09
ICV-1 (1201) multi-element solution	7M1-22-20	EPA	1201	06/06
Quality Control Std 26 multi-element solution	7m1-33-27	High Purity	515426	08/06
Aluminum (Al) 1000 µg/ml single element standard	7m1-33-24	High Purity	518220	02/07
TIN (Sn) 10 µg/ml single element standard	7M1-33-21	High Purity	518605	09/06
MOLYBDENUM (Mo) 10 µg/ml single element standard	7M1-29-27	CPI	4HG010	02/06

Entered By: _____

Reviewed By: _____ Date: _____

*Ref# = Logbook ID, Page number, and item number from Materials Receipt Log

The presence of the Chemist's/Analyst's employee ID number, or signature, on this run log attests that strict compliance with the method's SOP has occurred. Any SOP deviations require documentation by the responsible chemist/analyst together with the chemist's/analyst's initials and the initials of the lab supervisor and a QA department representative, signifying approval of the deviation.

11/22/05:jad

Attachment 6 (continued)

COMPUCHEM a division of Liberty Analytical Corp.

Worksheet 1 ZZZ

Preparation of Standards for Linear Dynamic Range (LDR) Determination Page 2 of 3

Standard Name	Preparation instructions	True Values
LRS-1 0.3 PPM	Place in a 100-mL volumetric flask: 1mL HNO_3 and 1 mL Internal Standard Pipet 0.3 mL of 100 PPM Quality Control Std 26 and 0.03 mL of 1000 PPM Al standard Dilute to volume with deionized water.	Be: 0.3 ppm V: 0.3 ppm Cr: 0.3 ppm Mn: 0.3 ppm Co: 0.3 ppm Ni: 0.3 ppm Cu: 0.3 ppm Zn: 0.3 ppm As: 0.3 ppm Se: 0.3 ppm Mo: 0.3 ppm Ag: 0.3 ppm Cd: 0.3 ppm Al: 0.3 ppm Sb: 0.3 ppm Ba: 0.3 ppm Tl: 0.3 ppm Pb: 0.3 ppm
LRS-1 1.0 PPM	Place in a 100-mL volumetric flask: 1mL HNO_3 and 1 mL Internal Standard Pipet 1.0 mL of 100 PPM Quality Control Std 26 and 0.1 mL of 1000 PPM Al standard Dilute to volume with deionized water.	Be: 1.0 ppm V: 1.0 ppm Cr: 1.0 ppm Mn: 1.0 ppm Co: 1.0ppm Ni: 1.0 ppm Cu: 1.0 ppm Zn: 1.0 ppm As: 1.0 ppm Se: 1.0 ppm Mo: 1.0 ppm Ag: 1.0 ppm Cd: 1.0 ppm Al: 1.0 ppm Sb: 1.0 ppm Ba: 1.0 ppm Tl: 1.0 ppm Pb: 1.0 ppm
LRS-1 2.0 PPM	Place in a 100-mL volumetric flask: 1mL HNO_3 and 1 mL Internal Standard Pipet 2.0 mL of 100 PPM Quality Control Std 26 and 0.2 mL of 1000 PPM Al standard Dilute to volume with deionized water.	Be: 2.0 ppm V: 2.0 ppm Cr: 2.0 ppm Mn: 2.0 ppm Co: 2.0ppm Ni: 2.0 ppm Cu: 2.0 ppm Zn: 2.0 ppm As: 2.0 ppm Se: 2.0 ppm Mo: 2.0 ppm Ag: 2.0 ppm Cd: 2.0 ppm Al: 2.0 ppm Sb: 2.0 ppm Ba: 2.0 ppmTl: 2.0 ppm Pb: 2.0 ppm
LRS-1 6.0 PPM	Place in a 100-mL volumetric flask: 1mL HNO_3 and 1 mL Internal Standard Pipet 6.0 mL of 100 PPM Quality Control Std 26 and 0.6 mL of 1000 PPM Al standard Dilute to volume with deionized water.	Be: 6.0 ppm V: 6.0 ppm Cr: 6.0 ppm Mn: 6.0 ppm Co: 6.0ppm Ni: 6.0 ppm Cu: 6.0 ppm Zn: 6.0 ppm As: 6.0 ppm Se: 6.0 ppm Mo: 6.0 ppm Ag: 6.0 ppm Cd: 6.0 ppm AL: 6.0 ppm Sb: 6.0 ppm Ba: 6.0 ppmTl: 6.0 ppm Pb: 6.0 ppm

Standard Solutions Prepared By:_____ Date:_____

Entered By: J. Feldhaus

Reviewed By:_____ Date:_____

The presence of the Chemist's/Analyst's employee ID number, or signature, on this run log attests that strict compliance with the method's SOP has occurred. Any SOP deviations require documentation by the responsible chemist/analyst together with the chemist's/analyst's initials and the initials of the lab supervisor and a QA department representative, signifying approval of the deviation.

11/22/05:jad

Attachment 6 (continued)

COMPUCHEM a division of Liberty Analytical Corp.

Worksheet 1 ZZZ

Preparation of Standards for Method Detection Limit (MDL) Determination/Instrument Detection Limit (IDL) Determination Page 3 of 3

Standard Name	Preparation instructions	True Values
MDLNP1-120105-JCF	Place in a 1000-mL volumetric flask: 10mL HNO_3 and 10 mL Internal Standard Pipet 0.03 mL of Quality Control Std 26 and 0.0026 mL of 1000 PPM Al standard Dilute to volume with deionized water.	Be: 0.3 ppb V: 0.3 ppb Cr: 0.3 ppb Mn: 0.3 ppb Co: 0.3 ppb Ni: 0.3 ppb Cu: 0.3 ppb Zn: 0.3 ppb As: 0.3 ppb Se: 0.3 ppb Mo: 0.3 ppb Ag: 0.3 ppb Cd: 0.3 ppb Sn: 0.3 ppb Sb: 0.3 ppb Ba: 0.3 ppb Tl: 0.3 ppb Pb: 0.3 ppb Al: 3.0 ppb
MDLNP2-120205-JCF	Place in a 1000-mL volumetric flask: 10mL HNO_3 and 10 mL Internal Standard Pipet 0.02 mL of Quality Control Std 26 Dilute to volume with deionized water.	Be: 0.2 ppb V: 0.2 ppb Cr: 0.2 ppb Mn: 0.2 ppb Co: 0.2 ppb Ni: 0.2 ppb Cu: 0.2 ppb Zn: 0.2 ppb As: 0.2 ppb Se: 0.2 ppb Mo: 0.2 ppb Ag: 0.2 ppb Cd: 0.2 ppb Sn: 0.2 ppb Sb: 0.2 ppb Ba: 0.2 ppb Tl: 0.2 ppb Pb: 0.2 ppb Al: 0.2 ppb
MDLNP3-120605-JCF	Place in a 1000-mL volumetric flask: 10mL HNO_3 and 10 mL Internal Standard Pipet 0.01 mL of Quality Control Std 26 Dilute to volume with deionized water.	Be: 0.1 ppb V: 0.1 ppb Cr: 0.1 ppb Mn: 0.1 ppb Co: 0.1 ppb Ni: 0.1 ppb Cu: 0.1 ppb Zn: 0.1 ppb As: 0.1 ppb Se: 0.1 ppb Mo: 0.1 ppb Ag: 0.1 ppb Cd: 0.1 ppb Sn: 0.1 ppb Sb: 0.1 ppb Ba: 0.1 ppb Tl: 0.1 ppb Pb: 0.1 ppb Al: 0.1 ppb
MDLHW3-120505-JCF	Place in a 1000-mL volumetric flask: 10mL HNO_3 and 10 mL Internal Standard Pipet 0.04 mL of Quality Control Std 26 and 0.0246 mL of 1000 PPM Al standard Dilute to volume with deionized water.	Be: 0.4 ppb V: 0.4 ppb Cr: 0.4 ppb Mn: 0.4 ppb Co: 0.4 ppb Ni: 0.4 ppb Cu: 0.4 ppb Zn: 0.4 ppb As: 0.4 ppb Se: 0.4 ppb Mo: 0.4 ppb Ag: 0.4 ppb Cd: 0.4 ppb Sn: 0.4 ppb Sb: 0.4 ppb Ba: 0.4 ppb Tl: 0.4 ppb Pb: 0.4 ppb Al: 25 ppb
MDLHW32-120605-JCF	Place in a 1000-mL volumetric flask: 10mL HNO_3 and 10 mL Internal Standard Pipet 0.02 mL of Quality Control Std 26 Dilute to volume with deionized water.	Be: 0.2 ppb V: 0.2 ppb Cr: 0.2 ppb Mn: 0.2 ppb Co: 0.2 ppb Ni: 0.2 ppb Cu: 0.2 ppb Zn: 0.2 ppb As: 0.2 ppb Se: 0.2 ppb Mo: 0.2 ppb Ag: 0.2 ppb Cd: 0.2 ppb Sn: 0.2 ppb Sb: 0.2 ppb Ba: 0.2 ppb Tl: 0.2 ppb Pb: 0.2 ppb Al: 0.2 ppb
IDL-120105-JCF	Place in a 1000-mL volumetric flask: 10mL HNO_3 and 10 mL Internal Standard Pipet 0.02 mL of Quality Control Std 26 Dilute to volume with deionized water.	Be: 0.2 ppb V: 0.2 ppb Cr: 0.2 ppb Mn: 0.2 ppb Co: 0.2 ppb Ni: 0.2 ppb Cu: 0.2 ppb Zn: 0.2 ppb As: 0.2 ppb Se: 0.2 ppb Mo: 0.2 ppb Ag: 0.2 ppb Cd: 0.2 ppb Sn: 0.2 ppb Sb: 0.2 ppb Ba: 0.2 ppb Tl: 0.2 ppb Pb: 0.2 ppb Al: 0.2 ppb

Standard Solutions Prepared By:_____ Date:_____

Entered By: J. Feldhaus

Reviewed By:_____ Date:_____

The presence of the Chemist's/Analyst's employee ID number, or signature, on this run log attests that strict compliance with the method's SOP has occurred. Any SOP deviations require documentation by the responsible chemist/analyst together with the chemist's/analyst's initials and the initials of the lab supervisor and a QA department representative, signifying approval of the deviation.

11/22/05:jad

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SOP DOCUMENTATION FORM

This form must accompany all new and revised Standard Operating Procedures (SOPs) when you turn them in to Quality Assurance for review. Please fill out the entire block below (except effective date).

This is a new procedure _____ revised procedure ✓ outdated procedure (archive) _____

- Procedure Code: IP 005 SOP Section #: 3.3.4 Revision #: 21

SOP Title: Automated Cold Vapor Determination for Mercury by CLP, SW-846, MCAWW, and NYSASP

Effective date: (QA fills in) August 7, 2007

- Procedure prepared by: Bob Meiers Date: July 23, 2007
- Procedure approved by: (If the manager prepared the SOP, a qualified second party should sign) Date: 8-7-07
- Reason for change: Update SOP based on revised method reference
- This procedure meets the requirements of the following approved method references: US EPA CLP SOW ILM04.1 and ILM05.4; SW-846 3rd Edition, Update III, Method 7470A, Method 7471A; MCAWW, 1994, Method 245.1, Revision 3.0

Procedure approved by a QA Representative (unless QA Representative signed above):

_____ Date: _____

On an annual basis: Lab managers are required to review lab practices and revise the SOP if necessary. If no revision is necessary, indicate by your signature that the SOP has been reviewed.

Annual Review—Signature: _____ Date: _____

Annual Review—Signature: _____ Date: _____

Annual Review—Signature: _____ Date: _____

Annual Review—Signature: _____ Date: _____

Instrument Procedure 005: Automated Cold Vapor Determination for Mercury by CLP, SW-846, MCAWW, and NYSASP

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Instrument Procedure 005: Automated Cold Vapor Determination for Mercury by CLP, SW-846, MCAWW, and NYSASP

1.0 Scope and Application

1.1 This **Standard Operating Procedure (SOP) describes the determination mercury in** drinking and surface waters, as well as soil and sediment samples after appropriate preparation. It may be applicable also to saline waters, waste waters, effluents, and domestic sewages, providing potential interferences are not present.

1.2 The working range is 0.20 to 10.0 µg Hg/L

1.3 Staff members performing the procedures described in this SOP are responsible for reading, understanding, and complying with the SOP requirements. Supervisors are responsible for directing the analyst to the controlled SOP, and providing adequate explanation of the material contained therein.

1.4 This procedure is restricted to use by or under the supervision of analysts experienced in the instrumentation or preparative methods and who have demonstrated the ability to generate acceptable results through QC samples and analyst capability studies.

2.0 Summary of Method

2.1 The flameless AA procedure is a physical method based on the absorption of radiation at 253.7 ηm by mercury vapor. The mercury is reduced to the elemental state and aerated from solution. The mercury vapor passes through a cell positioned in the light path of an atomic absorption spectrophotometer. Absorbance (peak height) is measured as a function of mercury concentration.

2.2 In addition to inorganic forms of mercury, organic mercurials may also be present. These organo-mercury compounds will not respond to the flameless atomic absorption technique unless they are first broken down and converted to mercuric ions. Potassium permanganate oxidizes many of these compounds, but recent studies have shown that a number of organic mercurials, including phenyl mercuric acetate and methyl mercuric chloride, are only partially oxidized by the reagent. Potassium persulfate has been found to give approximately 100% recovery when used as the oxidant for these compounds.

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Therefore, a persulfate oxidation step following the addition of the permanganate was included during digestion to ensure that organo-mercury compound(s), if present, will be oxidized to the mercuric ion before measurement.

3.0 Definitions

3.1 Method detection limit (MDL) – The minimum concentration of an analyte that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte.

3.2 Reporting Limit – The laboratory reporting limit is based on the lowest multipoint calibration standard concentration. For some inorganic methods, the reporting limit is based on the MDL, and is usually 4-8 times higher than the MDL.

3.3 Reporting Units – µg/L for water and mg/Kg for soil

3.4 A **Sample Delivery Group (**SDG**)** is defined by the following, whichever is more frequent:

- each 20 field samples received within a case, or
- each 7 calendar day period during which field samples in a case are received (14 calendar days if requested by the client) beginning with the receipt of the first sample.

NOTE: The DoD-QSM and SC DHEC do not accept the SDG approach, unless the samples are prepared in a single batch. When a group of up to 20 field samples of a similar matrix are prepared as one batch, method-specified QC samples such as a method blank, laboratory control sample, matrix spike, matrix spike duplicate, and matrix duplicate must also be prepared together**.** If samples are batched together from different sites, project-specific QC must be processed.

3.5 SC DHEC – South Carolina Department of Health and Environmental Control

3.6 CRDL – Contract Required Detection Limit (for ILM04.1)

3.7 CRQL – Contract Required Quantitation Limit (for ILM05.**4**)

3.8 DOD-QSM – Department of Defense Quality Systems Manual

4.0 Interferences

4.1 Some sea waters, waste waters, and sediment samples which are high in chlorides have shown a positive interference, probably due to the formation of free chlorine which will absorb radiation at 253 ηm.

4.2 Interference from certain volatile organic materials that will absorb at this wavelength is also possible. A preliminary run under oxidizing conditions, without stannous chloride, would determine if this type of interference is present.

5.0 Safety

5.1 Appropriate protective equipment and clothing must be used under the assumption that all samples are potentially hazardous. During sample preparation, glasses, gloves and lab coats are a minimum requirement. The persistent presence of noxious odors may be indicative of failure of the laboratory ventilation system and must be reported to a supervisor or manager.

5.2 Laboratory staff **must** review the Chemical Hygiene Plan for general safety policies, and Material Safety Data Sheets for reagents used in the laboratory. The **Chemical Hygiene Play and the** MSDS are located in the Quality Assurance department.

6.0 **Equipment and Supplies**

6.1 Atomic Absorption Spectrophotometer: Leeman Labs PS200 Automated Mercury Analyzer

6.2 Volumetric flasks

7.0 Reagents and Standards

Record all reagent and standard preparations in the Standards/QC Preparation Log for Cold Vapor Mercury (Attachment **1**).

7.1 Reagent water- All water used during preparation should be reagent-grade Type I with regard to resistivity of >10 megohm-cm (20th Edition of standards Methods, Method 1080), and referred throughout this SOP as **reagent** water.

7.2 Stannous chloride **(**10%**) - D**issolve 100 g**rams into 500 mL of reagent water contained in a 1 L volumetric flask. Add** 250 mL of concentrated HCl **and dilute to volume** with **reagent** water. Pour this solution into the reductant bottle

and connect the reductant line from the pump. (Stannous sulfate may be substituted.)

7.3 NH_2OH-HCl **(**24%**) - D**issolve **240** g**rams of** hydroxylamine chloride and **240** g**rams** sodium chloride in **2000** mL **reagent** water. (Sodium chloride-hydroxylamine sulfate may be used instead.)

7.4 Hydrochloric Acid **(**Concentrated**) -** J. T. Baker, "Instra-Pure"

7.4.1 **Hydrochloric acid (10%) -** Add 200 mL concentrated HCl **to a 2 L volumetric flask containing 1 L of reagent water. Dilute to volume with reagent water.**

CAUTION: Always pour acid into water.

7.5 Stock Hg solution **(**20 ppm**) -** Custom standard from commercial standard vendors.

7.6 Intermediate Hg Standard **(**100 ppb**) -** Pipet 0.5 mL of 20 ppm stock standard into a 100 mL volumetric flask. Add 5.0 mL of concentrated HNO_3 and dilute to volume with **reagent** water. Label flask according to the naming procedure in the standard log.

7.7 Hg Calibration Standards:

7.8.1 0.2 ppb: Pipet 0.2 mL of intermediate Hg standard into a 100 mL volumetric flask and dilute to 100 mL with **reagent** water.

7.8.2 0.5 ppb: Pipet 0.5 mL of intermediate Hg standard into a 100 mL volumetric flask and dilute to 100 mL with **reagent** water.

7.8.3 1.0 ppb: Pipet 1.0 mL of intermediate Hg standard into a 100 mL volumetric flask and dilute to 100 mL with **reagent** water.

7.8.4 5.0 ppb: Pipet 5.0 mL of intermediate Hg standard into a 100 mL volumetric flask and dilute to 100 mL with **reagent** water.

7.8.5 10.0 ppb: Pipet 10.0 mL of intermediate Hg standard into a 100 mL volumetric flask and dilute to 100 mL with **reagent** water.

7.8.6 **0.0 ppb**: **Add 100 mL reagent water** to a 100 mL volumetric flask. **This is the calibration blank.**

7.8.7 **The calibration** standards are prepared by the inorganics sample preparation **technician** and **are** digested before use, following the appropriate sample preparation procedure (SPP). The soil SOP is SPP – 162, "Solid Sample Mercury Digestion by SW-846 and NYSASP." The water SOP is SPP –074, "Mercury in Water, Manual Digestion Procedure for EPA CLP, NYSASP, and SW-846, and MCAWW." Standard preparation and concentrations are included in this procedure for reference.

7.9 Initial Calibration Verification

7.9.1 The ICV is analyzed once after each initial calibration to verify the standards. The concentration of the ICV standard may vary with each vendor lot. Check certificate for true value of lot used. Certificates are kept in the certificate notebook and may be located by material receipt log number.

7.10 All purchased chemicals and reagents that do not arrive with an expiration date, must be assigned an expiration date three years from receipt date. All lab prepared regents must be assigned an expiration date one year from preparation date.

8.0 Sample Preservation and Storage

8.1 Samples preserved and stored according to the tables in Sample Control SOP 4.1, "Receiving Samples" and 4.6, "Storing Samples." Sample holding times are also listed.

8.2 Aqueous samples should be preserved by acidification with nitric acid to a pH of ≤ 2 at the time of collection. If only dissolved mercury is to be determined, the sample should be filtered before the acid is added. For total mercury, the filtration step is omitted. Aqueous samples for all methods except ILM05.**4** may be stored at room temperature **or** may be refrigerated.

8.3 Aqueous samples received for analysis using the ILM05.4 statement of work must be refrigerated at 2 - 4.°C.

8.4 For MCAWW, it is recommended that samples be sent to the lab as soon as possible after collection and acid preserved upon receipt. After acidification, the samples should be mixed, held for 16 hours, and then the pH verified to be ≤ 2. If the sample pH is > 2, repeat the process.

8.5 Soil samples are not preserved with acid. The soil samples are **stored** at 2 - 4°C until sample preparation.

9.0 Quality Control

9.1 Preparation Blank

9.1.1 For every 20 samples or for each digestion batch, whichever is more frequent, analyze a **preparation** blank. For SC DHEC, a blank is prepared every 10 water samples. This blank is used to ascertain whether sample concentrations reflect contamination.

9.1.1.1 **For CLP t**he blank must not contain mercury at **a** level above the CRDL/CRQL

9.1.1.2 **For SW-846 the blank must not contain mercury at a level above the** reporting limit (PQL).

9.1.1.3 **For the** DOD-QSM the preparation blank must **not contain mercury at a level above** one half the reporting limit (PQL).

9.1.1.4 **For MCAWW, the blank must not contain mercury at a level ≥ 10% of the analyte concentration determined in the sample or > 2.2 times the analyte MDL, whichever is greater.**

9.1.2 If the blank **does not meet the applicable criteria above**, the entire sample batch associated with the **preparation** blank must be re-prepared along with a new blank.

9.2.2.1 The only circumstance under which the **preparation** blank can be reported with values greater than the CRDL/CRQL for CLP is when the concentration of mercury in the sample exceeds the blank concentration by a factor of 10 or more.

9.1.3 Values between CRDL/CRQL **and the MDL** or PQL and IDL are reported with a "B" flag ("J" flag for ILM05.**4**).

9.2 Matrix Spike

9.2.1 A matrix spike shall be prepared with every 20 samples or each digestion, whichever is more frequent. For SC DHEC **and MCAWW**, the matrix spike is prepared every 10 water samples.

9.2.1.1 A matrix spike duplicate is also prepared with every 20 samples for SW-846. For SC DHEC a duplicate is prepared at a 10% frequency for water samples. The matrix spike duplicate fulfill this requirement.

9.2.2 The spike recovery of the matrix spike should be within 70-130% for MCAWW and within 75-125% for CLP and SW-846. The relative percent difference (RPD) between the duplicated matrix spikes should be ± 20.

9.2.2.1 If the sample concentration is less than four times the amount spiked and the recovery of the spike is less than 75% or greater than 125%, the corresponding element is flagged with an "N" on Form I to indicate that the element did not recover the matrix spike acceptably.

9.2.3 To meet the requirements of the DoD-QSM, the matrix spike recovery should meet the LCS control limits. The RPD between the matrix spikes should be ≤ 20%.

9.2.3.1 If the DOD-QSM acceptance limits are not met for the matrix spikes, contact the client for guidance.

92.3.2 If the results are reported that are associated with failing matrix spikes, indicate the specific analytes in the original sample in the narrative. Refer to the DoD-QSM "J" flag.

9.3 Sample Duplicate

9.3.1 A duplicate sample is prepared with every 20 samples or each digestion, whichever is more frequent. For SC DHEC, the duplicate is prepared every 10 water samples. **A duplicate sample is not required for MCAWW.**

9.3.2 If the sample and duplicate do not agree within 20% RPD, then the affected element is flagged with an "*" on Form I to indicate poor results duplication.

9.4 Laboratory Control Sample (LCS)

9.4.1 An LCS is prepared with every 20 samples or each digestion, whichever is more frequent. For SC DHEC, the LCS is prepared every 10 water samples. (An LCS is not required for CLP waters.)

9.4.2 The solid EPA LCS/ERA PPT has special control limits, which **have** been provided by EPA/ERA. The true value and acceptance range are subject to change without notice based upon the current lot purchased. See the certificate **of analysis or the standard preparation log** for the current lot in use.

9.4.3 For SW-846, in-house determined statistical limits are used. The statistical control limits are ± 20% for aqueous LCS. The solid LCS has special control limits, which have been provided by ERA. The true value is subject to change without notice based upon the current lot purchased. See the certificate **of analysis or the standard preparation log** for the current lot in use.

9.4.4 To meet the requirements for the DoD-QSM, the LCS must meet the recovery control limits of 80-120%.

9.4.5 **To meet the requirements of the MCAWW, the LCS must meet the recovery limits of 85-115%. In calculating the recovery results for the MCAWW, the analyte concentration from the preparation blank must be subtracted form the LCS.**

9.4.6 If the LCS fails acceptance criteria, re-analyze. If the LCS continues to fail and no instrument malfunctions or calibration failures are detected, the LCS and all associated samples and QC samples are re-digested.

9.5 CRQL/CRDL Check Standard (CRA/CRI**)**

9.5.1 Analyze the CRA (ILM04.1) and CRI (ILM05.**4**) at the CRDL/CRQL at the beginning of each sample analysis **sequence** to verify linearity near the CRDL/CRQL. The **CRA/**CRI is repeated as the 20th sample, 40th sample, etc.

9.5.2 The acceptance criterion is ± 50% for ILM04.1 and ± 30% for ILM05.**4**.

9.6 Serial Dilution

9.6.1 **For SW-846, p**erform a serial dilution (1:5) on one sample per analytical batch (or when a new or unusual matrix is encountered) when analyte concentrations are > than 25 times the MDL.

9.6.2 The recovery of the analyte in the diluted sample must be within ± 10% of that in the undiluted sample.

9.6.3 If the serial dilution fails, prepare and analyze a **spiked portion of the sample at 2.5 times the analyte level**.

9.6.4 If the recovery is not between 85-110%, analyze all samples in the batch by the method of standard additions.

9.7 Contingency

9.7.1 If, due to a lab accident or to QC failure, a re-preparation is required for the sample and insufficient volume remains, the Project Manager must be alerted and will contact the client for direction on how to proceed.

9.7.2 If persistent contamination occurs in the laboratory, analyses must be halted until the source can be identified and isolated. When the contamination issue is resolved, sample analyses may proceed.

9.7.3 Any other issues that potentially affect data quality should be addressed with the Project Manager.

10.0 Calibration and Standardization

10.1 Initial Calibration Verification/Initial Calibration Blank (ICV/ICB)

10.1.1 The ICV is digested with samples and prepared with each sample batch. The results of the ICV must agree within 10% for SW-846, 5% for MCAWW, and 20% for CLP, of the "true" values. If not, the run must be terminated and the instrument recalibrated. If recalibration does not fix the problem, shut down the instrument, label with an "OUT OF CALIBRATION" tag, and request instrument service.

10.1.2 Follow the ICV with the initial calibration blank (ICB). The mercury results for the blank must be less than the EPA CRDL/CRQL for CLP or less than the reporting limit (PQL) for SW-846. If not, terminate the analysis and recalibrate. A reanalysis of the ICB may be performed for SW-846 prior to recalibration. If recalibration does not fix the problem, shut down the instrument, label with an "OUT OF CALIBRATION" tag, and request instrument service.

10.1.2.1 The DOD-QSM requires that the results for the ICB must be less than the MDL.

10.2 Continuing Calibration Verification/Continuing Calibration Blank (CCV/CCB)

10.2.1 Verify the calibration every 10 samples and at the end of the analytical sequence using the 5.0 µg/L level calibration standard. The results of the check standard must agree within ± 20% of the true value. If not, terminate the analysis, correct the problem, and recalibrate the instrument.

10.7.1.1 For North Carolina regulatory work and for MCAWW, the check standard must agree within ± 10%.

10.2.2 Follow the CCV with the continuing calibration blank (CCB).The results for the CCB must be less than the CRDL/CRQL for CLP or less than the reporting limit (PQL) for SW-846. If not, terminate the analysis and recalibrate. A reanalysis of the ICB may be performed for SW-846 prior to recalibration. If recalibration does not fix the problem, shut down the instrument, label with an "OUT OF CALIBRATION" tag, and request instrument service.

10.2.3.1 The DOD-QSM and the MCAWW require that the results for the CCB must be less than the MDL.

10.3 The PS200 must be calibrated before you can run samples. The following procedure is performed after the start-up (11.4) and before running samples. Calibration standards are digested along with samples.

10.4 To perform a standard EPA (**Method** 245.1 or 7470A) calibration, press the macro (F2) key and a "Macro:" prompt will appear at the top of the screen. Type AUTOCRA and press Enter. The calibration routine will begin. It is assumed that the six standards have been loaded as standards 1-6 on the calibration standards screen.

10.5 To perform a calibration other than a standard EPA procedure, press the STD F6 action key. The standard screen appears, and a "Run standard: 1 2 3 4 5 6" message is displayed at the bottom of the screen. Enter the number of the standard to be run (1-6) and press Enter. A "from replicate: 1 to:" message will then appear at the bottom of the screen. Enter the first number in the "from replicate:" field and last number in the "to:" field. Press Enter. The system will run the standards.

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10.6 The results of the calibration are automatically stored. To review the results, select **"**Calibration**"** from the main menu and then select line calibration to generate a display. Below are some guidelines for determining whether the results are acceptable:

- Do the % RSDs look acceptable for various concentrations?
- Is the correlation coefficient larger than 0.995?
- For ILM05.**4**, standards must be within 5% of true value (except **the** CRQL standard)
- A forced intercept calibration model is not utilized.

10.7 If the calibration results are acceptable, begin running samples.

10.8 If the calibration results are unacceptable**,** rerun the standards to verify results. When an acceptable calibration is achieved, you can begin running the samples.

11.0 Procedure

Documentation must follow the requirements in Q**uality** C**ontrol** SOP **13.6, "**Proper Documentation Procedures**"**.

11.1 Powering up the system

11.1.1 Press the green button on the lower right front of the unit to turn on the PS200, and press the blue button to turn on the mercury lamp. This should only be done if system has been off. The system should remain on at all times.

11.1.2 Press the "Power On" buttons on the printer, monitor, and computer.

11.1.3 When the system prompt appears on the monitor, type "PS" and press "Enter." The system will move the autosampler tip into the rinse tank and the PS200 menu will appear on the monitor.

11.1.4 Press the "F2" macro key on the keyboard, type "COLDSTRT", and press "Enter." This begins the Coldstart procedure, which warms up the instrument in preparation for the initial system test. The Coldstart procedure takes about 2.5 hours. Do not attempt to use the PS200 before the Coldstart procedure is complete. Performance will be significantly impaired.

Note: This is only necessary if system has been turned off.

11.2 Setting the Optics

11.2.1 Select the following options in sequence from the PS200 main menu: "Utility", "Diagnostics", and "Aperture Test." Press "Enter." A display will appear on the monitor.

11.2.2 Look at the aperture reading. If the value is outside ± 100, adjust the aperture. To do this, follow these steps:

- Expose the aperture adjustment screws by removing the front panel of the PS200. The panel is easily detached by pushing it up and pulling out.

- Unscrew the aperture screw which is threaded in the furthest optical cell. Use the proper size allen wrench to adjust this screw. Perform the aperture test again, taking note that the number has changed from the original reading. Repeat this process until the value stops changing (this indicates that neither aperture is blocking the light).

- Turn the appropriate aperture screw (top aperture screw if the value is positive, bottom aperture screw if the value is negative) in or clockwise one-eighth revolution, and press "Enter." Check the aperture reading and repeat this process until the reading is within ± 100; an ideal reading is 0.

11.2.3 Select the "Zero Detector" option and press "Enter." A small screen will appear, divided into two sections. On the left side of the screen there should be a small, flat peak. On the right side, there should be a peak or peaks, the last of which should appear to tail off the screen. The size of these peaks is not important, only that they tail off above the bottom of the screen.

11.2.4 Select the "Test Optics" option and press "Enter." The values that appear for the sample and reference intensities should be between 400,000 and 1,200,000, and the difference between them should be no greater than 100,000. If these criteria are not met, then the optical cell should be cleaned.

11.2.5 Replace the front panel.

11.3 Preparing the System

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The following procedures must be performed each morning before warming up the system.

11.3.1 Press the Stop ("F10") key to stop any currently running macro.

11.3.2 Change the drying tube. Refer to the maintenance section of the Instrument Operator's Manual for instructions.

11.3.3 Release the clamps and check the pump tubing for wear. Under normal use, the tubes will need to be replaced about once per week. To replace tubing, refer to the maintenance section of the Instrument Operator's Manual.

11.3.4 Check the reductant volume and refresh it, if needed.

11.3.5 Clean the rinse tank using standard lab cleaning practices, and add fresh rinse.

11.3.6 If the lamp has been off, turn on lamp power and allow the lamp to warm up for at least 45 minutes.

11.3.7 If the PS200 has been shut off, power up all components and perform the Coldstart macro. You are now ready to start up the system.

11.4 Start-up Procedure

11.4.1 Warm Start

The warmstart macro is used to prepare the PS200 for operation if it is being started up from a short-term (overnight) shutdown.

To run the warmstart macro, press the macro ("F2") key on the keyboard. Type "WARMSTRT" and press "Enter." The system will wait for several minutes and then turn on the pump and gas flow to protocol speed. When the system is stable, a beep will sound and a "System ready" message will appear on screen. The PS200 is now ready for operation.

11.4.2 Cold Start

The coldstart macro procedure is used to prepare the PS200 for operation if the system has been shut down for an extended period of time. This procedure turns on the liquid and the gas flow, and then waits until the

system thermally equilibrates before beeping to indicate that it is ready to run. You should then perform an aperture test and make any necessary adjustments to the aperture before you run samples.

11.4.2.1 To run the coldstart macro, press the Macro ("F2") key on the keyboard, type "COLDSTRT", and press "Enter." The cold start procedure takes approximately 2.5 hours. Do not attempt to operate the PS200 before this procedure is complete, or performance will be significantly impaired.

11.4.2.2 When a beep has sounded and an "Operation complete" message is visible on the screen (indicating the completion of the cold start procedure), you must check the apertures on the optical cell and make any necessary adjustments. When the aperture adjustments are completed, the PS200 is ready for operation.

11.4.3 Software set-up

To run samples, you must enter all information regarding the protocol, sample identification, calibration values, and autosampler parameters into the software. This information is entered into a series of screens that are accessed from the main menu. (You can display the main menu at any time by pressing the menu ["F1"] key on your keyboard.)

Perform each of the steps in sequence to set up the software. When you have completed these steps, the PS200 will be able to run samples automatically.

First you must name the protocol, or set of operating parameters that instruct the system how to run a determination for a specific type of sample. You enter the name of the protocol to tell the PS200 how to run a batch of samples.

11.4.3.1 From the Main menu, select "Protocol: and then select "Get." The protocol screen will appear with a list of protocols currently on the disk. A "Get protocol name:" message will appear at the bottom of the screen.

11.4.3.2 Type "Hg2" and press "Enter."

11.4.3.3 Press the Menu ("F1") key to return to the main menu.

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Once you have named the protocol, you must open or create a folder to hold all data generated by running that protocol. A folder is a place to store data on disks. It is created to make reporting of batches of samples easier. A folder contains data for standards, samples, scans, updates, and batch markers for a single protocol. Whenever you copy or create a protocol, you must create a new folder.

11.4.3.4 From the main menu, select “Data Output” and then select “Open Folder.” The folder maintenance screen appears with a list of available folders. An "Enter folder name:" message will be displayed at the bottom of the screen.

11.4.3.5 Type a folder name (you can open an existing folder or create a name for a new folder) and press “Enter.” If you type a new name, the prompt box will say, "Folder does not exist. Create (Y or N)?" Answer “Y” and press “Enter” to create a new folder. The name of the selected folder appears in the status box at the top of the screen, and all data will be stored on disk under the folder name. If you do not open a folder, no data will be stored on the disk.

Note that data cannot be transferred from one folder to another. When you create summary reports from stored data, you report from one folder at a time. Keep this in mind when you set up your folders.

Each folder can store data for only one protocol, but you can create any number of folders for a protocol. When you create a new protocol, you will be asked to open a new folder for that protocol.

11.4.3.6 Press the Menu (“F1”) key to return to the main menu.

11.4.4 Autosampler Table Set-up

11.4.4.1 From the main menu, select AUTOSAMPLER and then Rack entry. The rack screen appears, and an "Enter rack name:" message is displayed at the bottom of the screen.

11.4.4.2 Type a rack name (either new or existing) and press enter. (If you enter a new name, you will be asked if you want to create a new rack; answer Y.)

11.4.4.3 Press the insert “insert” key on the keyboard. This will allow for individual entry into the autosampler table.

11.4.4.4 Type the CompuChem sample number under the column titled “Sample ID.” Then type the client’s sample number and the dilution of the sample in the column titled “Additional ID.”

11.4.4.5 When you have finished entering all the sample ID’s for your run, page up to first page, press the F3 key to print the current page. Page down and print each page until all pages have been printed. This will allow for analyst identification of sample positions for pouring up samples in autosampler rack.

11.4.4.6 To define another rack, type E (EXIT) to go back to the rack entry menu and repeat steps 1-3.

11.4.4.7 Press the menu (F1) key to return to the main menu.

Next you must define the start-to-finish sample sequence.

11.4.4.8 From the main menu, select AUTOSAMPLER and then Set-up. Type the rack number to be run (1 or 2). The prompt "Enter rack name" is displayed at the bottom of the screen.

11.4.4.9 Type the rack name and press Enter. The set-up screen for that rack will appear, and a "Begin cup:" prompt will appear at the bottom of the screen.

11.4.4.10 Enter the number (cup position) of the first cup to be sampled and press Enter. An "End cup:" prompt will now be displayed at the bottom of the screen.

11.4.4.11 Enter the number of the last cup to be sampled and press “Enter”.

11.4.4.12 If you are using a second rack, repeat the previous five steps.

11.4.4.13 Press the Menu (F1) key to return to the main menu.

11.4.4.14 Press N to name the standard cups. 1-ICB/CCB, 2-CCV, 3-ICV, 4-CRA, enter (x3). Press the menu (F1) key to return to the main menu.

11.5 Sample Analysis

Prior to analysis all samples and standards are digested following the appropriate method sample preparation procedure (SPP). The soil SOP is SPP –162, "Solid Sample Mercury Digestion by SW-846 and NYSASP." The water SOP is SPP – 074, "Mercury in Water, Manual Digestion Procedure for EPA CLP, NYSASP, and SW-846, and MCAWW."

Note: The PS200 must be calibrated before you can run samples. The calibration procedure is given in section 10.0. Autosample tables automatically gos through the calibration process and proceeds to run the samples.

Note: See section 9.0 for QC samples, acceptance criteria, and corrective actions for QC failures.

11.5.1 Just before analysis, add 50 mL of DI water to all soil samples. Next, add 6 mL of hydroxylamine hydrochloride solution to reduce excess permanganate, and mix until the sample is clear. The Leeman PS200 automatically adds the appropriate amount of stannous chloride during analysis. Pour standards and samples into cuvettes and load into autosampler racks based upon the set-up of the autotable.

11.5.2 Arrange standards in increasing concentrations and calibrate instrument.

11.5.3 Analyze a solution from a different source stock than the standards for initial calibration verification (ICV). Determine that the measured value is in agreement with the certified value. If not, recalibrate after determining the problem.

11.5.4 Analyze the calibration blank and preparation blank(s). If the calibration blank contains mercury at a value that is greater than the reporting limit terminate the analysis, correct the problem, and recalibrate.

11.5.5 Analyze the CRA/CRI standard at the beginning of each sample analysis to verify linearity near the CRDL/CRQL.

11.5.6 Analyze samples, sample spike(s), and duplicate(s) monitoring quality control requirements. A serial dilution must also be analyzed for **SW-846 methods**. This should be a dilution of one sample within each SDG, and/or of each sample matrix. This dilution is 1 in 5 (5x).

11.5.7 Verify the calibration every 10 samples and at the end of the analytical run with a CCV followed by the CCB. Samples must be bracketed by passing CCV/CCB samples. Samples associated with a failing CCV or CCB must be re-analyzed.

11.5.8 Complete the mercury run log (Attachment 4). When sample analysis is complete, the run log and original raw data is copied and placed in all associated SDG folders.

11.6 Transferring Data

11.6.1 Select <F4> to generate the report.

- Type K (disk) and it will prompt for filename.
- File name must be the same as the folder name at the top of the screen.
- Type L (PRN file).
- Type G (generate).
- Type K (disk) and type A:\filename.
- Type L (PRN file).
- Type G (generate).
- Copy file to a diskette. Load data from diskette into MARRS.

11.7 Shutdown Procedure

There are two methods for shutting down the PS200. In routine operation, where the system is likely to be used daily, the overnight routine is used to put the unit into a "sleep mode." If the system is to be completely turned off and not used for an extended period of time (one week or more), or if it is to be shipped or moved, you must use the long-term shutdown routine instead. These two methods are described below. For weekends or periods of "sleep" greater than 24 hours it is recommended that you turn off the mercury lamp by pressing the blue button.

NOTE**:** Before shutting down the instrument, the system must have beeped to indicate completion of the last procedure, and the word "Idle" should appear in the "State" field in the top left of the displayed screen. To

interrupt or stop an ongoing procedure, press the STOP (F10) key. You can then shut down the instrument.

11.7.1 Short-term (overnite macro)

Press the macro (F2) key, type overnite, and press Enter. Turn off power to the lamp if the instrument will not be used for longer than 24 hours. In Overnite mode, the pump and gas flow will turn on every few minutes, run for a few seconds, and then stop. This cycle exercises the tubes to avoid flat spots and fatigue, and the gas flow keeps the optical cell dry. IMPORTANT--if the drying tube is blocked, liquid may flow back into the optical cell; this will require disassembly and cleaning. Make certain the drying tube has been packed loosely.

11.7.2 Long-term (Shutdown Macro)

The shutdown macro procedure is designed to flush out all lines with deionized water to get rid of any residual chemicals.

- Lift the sample tip and remove the rinse tray. Rinse and fill it with deionized water and replace the tray. Lower the sample tip into the cleaned tray.

- Remove the reductant bottle cap and line and carefully place the tip of the line in the rinse tank (rest the cap on the corner of the rinse tray).

- Turn off the lamp.

- Press the Macro (F2) button. Type SHUTDOWN and press Enter. When you hear a beep and see the message "Disconnect optical cell" in the lower right corner of the screen (you will have to wait several minutes), release all pump clamps.

- Remove the front cover of the PS200 and remove the optical cell. Disconnect the two gas lines on the left side of the cell, and leave them hanging. Replace the optical cell and the front cover.

  NOTE**:** The next time that you start up the system, you must remember to reopen the front cover, remove the optical cell and reconnect the gas lines.

- Shut off power to the computer, monitor, printer, and PS200.

12.0 Data Analysis and Calculations

Calculations must be consistent with the QC SOP: Numerical Data Reduction.

12.1 Linear Calibration using Least Squares Regression

$$y = ax + b$$

where: y = Instrument response (peak area)
a = Slope of the line (coefficient of x)
x = Concentration of the calibration standard
b = The intercept

12.2 Calculations

12.2.1 Concentration of Mercury in aqueous samples =

$$\frac{\text{(digestion concentration (µg/L)) (digestate volume (L))(dilution factor)}}{\text{(sample volume (L))}}$$

12.2.2 Concentration of Mercury in soil samples =

$$\frac{\text{(digestion concentration (µg/L)) (digestate volume (L)) (dilution factor)}}{\text{(sample weight (g)) (\% solid)}}$$

12.3 Calculation of the mean or average of a set of values:

$$\overline{X} = \frac{\sum_{i=1}^{n} X_i}{n}$$

where: n = total number of values
x_i = each individual value used to calculate the mean
x = the mean of n

12.4 Calculation of the standard deviation of a set of values:

$$\text{Standard deviation} = \sqrt{\frac{\sum_{i=1}^{n}\left(X_n - \overline{X}\right)^2}{n-1}}$$

12.5 Calculation of percent recovery:

12.5.1 LCS and surrogates:

$$\%R = \frac{Amount\ found}{Amount\ spiked}\ x\ 100$$

12.5.2 Matrix spikes:

$$\%\,R = \frac{Amount\ in\ spiked\ sample - Amount\ in\ unspiked\ (native)\ sample}{Amount\ spiked}\ x\ 100$$

12.6 Calculation of % RSD

$$\%RSD = \left(\frac{Standard\ deviation}{\overline{X}}\right) \times 100$$

12.7 Calculation of RPD

$$RPD = \frac{|Value\ 1 - Value\ 2|}{(Value\ 1 + Value\ 2)/2} x100$$

12.8 Calculation of %Difference (%D)

$$\%Diff = \frac{Value - \overline{Reference\ \ value}}{\overline{Reference\ \ value}}\ x\ 100$$

12.9 Dilutions

12.9.1 Sample concentrations falling above the analytical range, i.e. highest calibration standard concentration, must be diluted.

12.9.2 A sample dilution must yield a value within the upper half of the analytical concentration range to be acceptable.

12.9.3 The level of dilution selected is determined by the detected concentration and the expertise of the analyst.

12.9.4 Samples are analyzed undiluted unless in the analyst's technical judgement a dilution is required based on the appearance of the sample,

prior knowledge of the client or site, instrument problems related to analysis of a particular sample set, etc.

13.0 Method Performance

This method was validated through in-house laboratory studies of method detection limits and precision and accuracy for single analyst. The data are retained by the QA department.

14.0 Pollution Prevention

The solvents used in this procedure pose little threat to the environment when recycled and managed properly. Pollution prevention encompasses any technique that reduces or eliminates the quantity or toxicity of waste at the point of generation. Numerous opportunities for pollution prevention exist in laboratory operation. The EPA has established a preferred hierarchy of environmental management techniques that places pollution prevention as the management option of first choice. Whenever feasible, laboratory personnel should use pollution prevention techniques to address their waste generation. When wastes cannot be feasibly reduced at the source, the Agency recommends recycling as the next best thing.

15.0 Waste Management

It is the laboratory's responsibility to comply with all federal, state, and local regulations governing waste management, particularly the hazardous waste identification rules and land disposal restrictions, and to protect the air, water, and land by minimizing and controlling all releases from fume hoods and bench operations. Compliance with all sewage discharge permits and regulations is also required. **See SOP 12.1, "Hazardous Waste Disposal", regarding laboratory procedures for recycling solvent waste streams.**

Samples preserved with HCl, HNO_3, or H_2SO_4 to pH <2 are hazardous and must be must be handled as hazardous waste.

Refer to the Hazardous Waste Management and Safety SOPs located in the lab.

16.0 References

16.1 "Leeman PS200 Set-up and Operation Manual"

16.2 U.S. EPA CLP SOW for Inorganic Analysis, ILM04.1, ILM05.**4**

16.3 Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846, Methods 7470A **and** 7471A

16.4 Chemical Analysis of Water and Wastes, Method 245.1 **, Revision 3.0, 1994**

16.5 Q**uality C**ontrol SOP**, 13.6, "**Proper Documentation Procedures**"**

16.6 Q**uality C**ontrol SOP **13.4, "**Numerical Data Reduction**"**

16.7 "Less is Better: Laboratory Chemical Management for Waste Reduction," American Chemical Society Department of Government Relations and Science Policy, 1155 16th Street, N.W., Washington DC, 20036, (202) 872-4477.

16.8 NELAC Standards, **June** 2003

16.9 QA-G6: Guidance for the Preparation of Standard Operating Procedures for Quality-Related Operations EPA/600/R-96/027, November 1995.

16.10 Standard Methods for the Examination of Water and Wastewater, 20th (1998) Edition, Method 1080

16.11 Code of Federal Register, 40 CFR, Part 136, "Guidelines for Establishing Test Procedures for Priority Pollutants"

16.12 CompuChem Quality Manual, Revision **9, June 5, 2007**

16.13 Sample Control SOP 4.6, "Storing Samples"

16.14 Department of Defense Quality Systems Manual of Environmental Laboratories, Version 3 Final, January 2006

16.15 New York State Analytical Services Protocol (NYSASP), 6/2000

17.0 Attachments as Tables, Diagrams **and** Flowcharts

17.1 Attachment 1 – Standards/QC Preparation Log for Cold Vapor Mercury

17.2 Attachment **2** – Mercury Run Log

Attachment 1

Standards/QC Preparation Log for Analysis of Cold Vapor Mercury

COMPUCHEM a division of Liberty Analytical Corp. WORKSHEET 1 NNN

Seq. File Name: _____

REAGENTS	REF # [1]	MANUFACTURER	LOT #	EXPIRATION DATE
Sodium Chloride (NaCL)	1u(6) 1-4-7	Merck	41208136	01/09
Hydrochloric Acid (HCL)	1m2-182-02	Caledon	60544	03/10
Hydroxylamine Hydrochloride (NH_2OH-HCL)	1m2-181-15	Caledon	60445	01/09
Stannous Chloride ($SnCL_2$-$2H_2O$)	1m2-180-17	Caledon	60456	09/09

STANDARD LOT NUMBER [2]	PREPARATION INSTRUCTIONS
$SnCL_2$– 0 7 23 0 7 – M L Stannous chloride	Place in a 1000 mL volumetric flask containing 500 mL of reagent water: 100 g of $SnCl_2$-$2H_2O$ Baker Instra-analyzed or equivalent 250 mL of HCL Baker Instra-analyzed or equivalent Dilute to 1000 mL with reagent water. Prepare as needed
HCL– 0 7 23 0 7 – M L Hydrochloric Acid	Place in a 2 L volumetric flask: 1000 mL of deionized water 200 mL of concentrated HCL Baker Instra-analyzed or equivalent Dilute to 2000 mL with reagent water. Prepare as needed
NH_2OH-HCL– 0 7 23 0 7 – M L Hydroxylamine hydrochloride	Place in a 2000 ml volumetric flask: 240.0 g of NH_2OH-HCl Baker Instra-analyzed or equivalent 240.0 g NaCl Baker Instra-analyzed or equivalent Dilute to 2000 mL with reagent water. Place solution in a repipetor bottle. Prepare as needed

Standard Solutions Prepared By: _____ Date: _____

Entered By: _____ Date: _____

Reviewed By: _____ Date: _____

[1]Ref# = Logbook ID, Page number, and item number from Materials Receipt Log

[2]Standard Lot Number consists of standard ID, date prepared, and initials of preparer.

The presence of the Chemist's/Analyst's employee ID number, or signature, on this run log attests that strict compliance with the method's SOP has occurred. Any SOP deviations require documentation by the responsible chemist/analyst together with the chemist's/analyst's initials and the initials of the lab supervisor and a QA department representative, signifying approval of the deviation.

7/24/07: VR

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Attachment **2**

COMPUCHEM a division of Liberty Analytical Corp. LOGBOOK 1 V(6) 25

Automated Mercury Run Log (V3)
Part (A) of a two-part form

Maintenance:_____

Method (circle one): CLP ILM04.1 CLP ILM05.4 SW-846 MCAWW _____ Page___of_____

Operator:_____ File name:__V3_____ Start Date/Time:_____

End Date/Time:_____

SDG	Matrix	Analytes	Comments

Legend		No.	Sample ID	Comments	Action needed
↑	Sample fails high	1			
↓	Sample fails low	2			
RR	Re-run sample neat	3			
RR #x	Re-run at a #-fold dilution	4			
#x	Sample run at a #-fold dilution (aliquot of sample diluted with acidified water)	5			
		6			
L	Matrix = leachate	7			
W	Matrix = water	8			
S	Matrix = solid	9			
B	Matrix = biological tissue	10			
			CCV		

No.	Sample ID	Comments	Action needed		CCB		
	S0			1			
	S0.2			2			
	S0.5			3			
	S1.0			4			
	S5.0			5			
	S10.0			6			
	ICV-5			7			
	ICB			8			
	CRI			9			
	CCV			10			
	CCB				CCV		
					CCB		

COMMENTS

Reviewed By: _____

Date: _____

The presence of the Chemist's/Analyst's employee ID number, or signature, on this run log attests that strict compliance with the method's SOP has occurred. Any SOP deviations require documentation by the responsible chemist/analyst together with the chemist's/analyst's initials and the initials of the lab supervisor and a QA department representative, signifying approval of the deviation.

6/8/07: VR

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Attachment **2** (continued)

COMPUCHEM a division of Liberty Analytical Corp. LOGBOOK 1 V(6) 25

Automated Mercury Run Log (V3)

Part (B) of a two-part form Page____of____

File name: V3_____

No.	Sample ID	Comments	Action needed	No.	Sample ID	Comments	Action needed
1				1			
2				2			
3				3			
4				4			
5				5			
6				6			
7				7			
8				8			
9				9			
10				10			
	CCV				CCV		
	CCB				CCB		
1				1			
2				2			
3				3			
4				4			
5				5			
6				6			
7				7			
8				8			
9				9			
10				10			
	CCV				CCV		
	CCB				CCB		
1				1			
2				2			
3				3			
4				4			
5				5			
6				6			
7				7			
8				8			
9				9			
10				10			
	CCV				CCV		
	CCB				CCB		
1				1			
2				2			
3				3			
4				4			
5				5			
6				6			
7				7			
8				8			
9				9			
10				10			
	CCV				CCV		
	CCB				CCB		

COMMENTS

Reviewed By: _____

Date: _____

The presence of the Chemist's/Analyst's employee ID number, or signature, on this run log attests that strict compliance with the method's SOP has occurred. Any SOP deviations require documentation by the responsible chemist/analyst together with the chemist's/analyst's initials and the initials of the lab supervisor and a QA department representative, signifying approval of the deviation.

6/8/07: VR

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Cary, NC 27513

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SOP DOCUMENTATION FORM

This form must accompany all new and revised Standard Operating Procedures (SOPs) when you turn them in to Quality Assurance for review. Please fill out the entire block below (except effective date).

This is a new procedure _____ revised procedure ✓ outdated procedure (archive) _____

- Procedure Code: IP 559 SOP Section #: 3.5.1.1 Revision #: 8

SOP Title: Alkalinty in Waters and Leachates by MCAWW and Lachat

Effective date: (QA fills in) 1/14/08

- Procedure prepared by: Valgena Lespass

Date: June 18, 2007

- Procedure approved by: (If the manager prepared the SOP, a qualified second party should sign) [signature]

Date: 01-11-08

- Reason for change: update method reference for MUR

- This procedure meets the requirements of the following approved method references:

Methods for Chemical Analysis of Water and Wastes, March 1983, Method 310.2, Editorial Revision 1971; Lachat Autoanalyzer QuikChem Method 10-303-31-1-A, January 2001

Procedure approved by a QA Representative (unless QA Representative signed above):

_____ Date: _____

On an annual basis: Lab managers are required to review lab practices and revise the SOP if necessary. If no revision is necessary, indicate by your signature that the SOP has been reviewed.

Annual Review—Signature: _____ Date: _____

Annual Review—Signature: _____ Date: _____

Annual Review—Signature: _____ Date: _____

Annual Review—Signature: _____ Date: _____

Sopdocform2-1/19/07: vr

Instrument Procedure 559: Alkalinity in Waters and Leachates by MCAWW and Lachat

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Instrument Procedure 559: Alkalinity in Waters and Leachates by MCAWW and Lachat

1.0 Scope and Application

This automated method is applicable to potable and surface waters and to domestic and industrial waste waters. The applicable range is 10-500 mg of calcium carbonate ($CaCO_3$).

Staff members performing the procedures described in this **Standard Operating Procedure (**SOP**)** are responsible for reading, understanding, and complying with the SOP requirements. Supervisors are responsible for directing the analyst to the controlled SOP, and providing adequate explanation of the material contained therein.

This procedure is restricted to use by or under the supervision of analysts experienced in the instrumentation or preparative methods and who have demonstrated the ability to generate acceptable results through QC samples and analyst capability studies.

2.0 Summary of Method

Methyl orange is used as a color reagent for this method because its pH range is the same as the pH of the equivalence point for a total alkalinity titration. The methyl orange indicator is in a weak buffer pH 3.1, which is just below its color change pH. When an alkaline sample is injected, the weakly buffered methyl orange changes color in proportion to the change in pH of the weak buffer, and thus in proportion to the alkalinity of the sample.

3.0 Definitions

3.1 Method detection limit (MDL) – The minimum concentration of an analyte that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte (40 CFR, Part 136, Appendix B.)

3.2 Reporting Limit – The laboratory reporting limit is based on the lowest multipoint calibration standard concentration.

For some inorganic methods, the reporting limit is based on the MDL, and is usually 4-8 times higher than the MDL. This is referred to as the Practical Quantitation Limit (PQL).

3.3 Reporting Units – mg/L

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3.4 A **Sample Delivery Group (**SDG**)** is defined by the following, whichever is more frequent:

- each 20 field samples received within a case, or
- each 7 calendar day period during which field samples in a case are received (14 calendar days if requested by the client) beginning with the receipt of the first sample.

NOTE: The **DOD-QSM** and SC DHEC do not accept the SDG approach, unless the samples are prepared in a single batch. When a group of up to 20 field samples of a similar matrix are prepared as one batch, method-specified QC samples such as a method blank, laboratory control sample, matrix spike, matrix spike duplicate, and matrix duplicate must also be prepared together at a rate of 5% for **DOD-QMS** and 10% for SC DHEC. If samples are batched together from different sites, project-specific QC must be processed.

3.5 SC DHEC – South Carolina Department of Health and Environmental Control

3.6 DOD-QSM – Department of Defense Quality Systems Manual

4.0 Interferences

4.1 Turbidity and color will interfere. Turbidity can be removed by filtration. If the sample is filtered, this method is not approved for NPDES monitoring.

4.2 Chlorine will interfere unless it is reduced by the addition of sodium thiosulfate. This may be added in-stream before the addition of the methyl orange reagent.

5.0 Safety

Appropriate protective equipment and clothing must be used under the assumption that all samples are potentially hazardous. During sample preparation, **safety** glasses, gloves and lab coats are a minimum requirement. The persistent presence of noxious odors may be indicative of failure of the laboratory ventilation system and must be reported to a supervisor or manager.

Laboratory staff are **must** review the Chemical Hygiene Plan for general safety policies, and Material Safety Data Sheets (MSDS) for solvents and reagents used in the laboratory.

The **Chemical Hygiene Plan and** MSDS are located in the Quality Assurance department.

6.0 Equipment **and** Supplies

6.1 A Lachat QuikChem Automatic Flow Injection Ion Analyzer which includes:

6.1.1 Automatic sampler

6.1.2 Proportioning pump

6.1.3 Injection module with a 45 cm sample loop

6.1.4 Colorimeter--interference filter wavelength: 550 **nm**; Flow cell: 10 mm, 80 **µL**

6.1.5 Alkalinity (methyl orange) reaction manifold 10-303-31-1-A

6.2 Injection Timing

- pump speed: 35
- cycle period: 45 sec
- load period: 15 sec
- inject period: 20 sec
- inject to start of peak period: 30 sec
- inject to end of peak period: 44 sec
- sample loop length: 10 cm
- gain: 275 x 1

7.0 Reagents **and** Standards

Record all standard preparation information in the Standards/QC Preparation Log for Alkalinity on Lachat (Attachment 1).

7.1 Reagent water – All water used during preparation must be reagent-grade Type I with regard to resistivity of > 10 megohm-cm (19th and 20th Editions of Standard Methods, Method 1080),which is demonstrated to meet the blank contamination acceptance criteria contained in this SOP. It is referred to throughout the remainder of this SOP as reagent water.

7.2 Carbon dioxide-free water

7.2.1 Bring 6 liters of water to a boil and boil for 5 min. Cool before using or the volumetric measurements will be wrong.

7.3 Hydrochloric acid (HCl), 0.1 M

7.3.1 In a 1 liter volumetric flask, dilute 8.3 mL of concentrated HCl to the mark with carbon dioxide-free reagent water. Invert three times **to mix**.

7.4 KHP Buffer, 25 mM, pH 3.1

7.4.1 In a 1 liter container, dissolve 5.00 g of potassium acid phthalate in 850 mL (± 10 mL) of carbon dioxide-free water. Add 85 mL of 0.1 M HCl, then add acid to bring the pH to 3.1 (± 0.05). **If you** overrun the endpoint**, re-prepare the solution**. Pour the solution into a glass storage bottle. Prepare weekly.

7.5 Methyl Orange Reagent

7.5.1 In a 1 liter volumetric flask, dissolve 131.3 mg of methyl orange (indicator grade or equivalent) in 700 mL of carbon dioxide-free water. Dilute to the mark and invert three times. **The ratio of methyl orange buffer is 1:5.** Store **the solution** in **a** glass **container**.

7.6 Stock Standard - 5000 mg of $CaCO_3$/L as sodium carbonate (Na_2CO_3).

7.6.1 In a 200 mL volumetric flask, dissolve 1.060 g of anhydrous primary standard grade sodium carbonate, dried at 250° C for 4 hr, in 900 mL of carbon dioxide-free water. Dilute to the mark and invert three times **to mix**. Prepare fresh monthly and protect it from the atmosphere because it will absorb carbon dioxide.

7.7 Working Standards

7.7.1 To six 100 mL flasks add, respectively, 10.0, 7.5, 5.0, 0.5, and 0.2 mL of the 5000 mg/l stock standard. A seventh should contain reagent water only for the blank (0 ppm) standard. Dilute each to the mark with carbon dioxide-free water and invert three times **to mix**. This makes working standards with the respective concentrations of 500, 375, 250, 25, and 10 mg of $CaCO_3$/L.

8.0 Sample Preservation and Storage

8.1 Samples are preserved and stored according to the tables in Sample Control SOPs 4.1, "Receiving Samples" and 4.6, "Storing Samples."

8.2 Samples must be refrigerated at 2-4 °C and analyzed as soon as practical. Do not open the sample bottles before analysis. The recommended holding time is 14 days. Sample bottles need to be filled completely for zero head space. If not, note this and include in report.

9.0 Quality Control

9.2 **Analyze a** calibration blank **following the initial calibration. The** absolute **value of** calibration blank must not be greater than one half the reporting limit. If **that criterion is not** met, then determine where the problem is occurring**. C**orrect the problem, recalibrate and reanalyze. Document any instrument maintenance in the maintenance log.

9.3 A continuing calibration blank (CCB) must be analyzed **after the CCV** at a 10% frequency throughout the analytical run. The CCB control limits and corrective actions are the same as those of the ICB described above. Reanalyze all affected samples.

9.4 For every preparation batch of up to 20 samples or for each SDG, whichever is more frequent, analyze a method blank. For SC DHEC, the method blank is prepared at a frequency of 10%. This blank is used to ascertain whether sample concentrations reflect contamination. This blank must be free from analyte impurities and must not contain an analytical result greater than the reporting limit. If the blank exceeds the reporting limit, stop the analysis, determine and correct the problem, recalibrate the instrument, and reanalyze any affected samples.

NOTE: Carbon dioxide-free water must be used for all blanks (including ICB and CCB).

9.5 A laboratory control sample (LCS) must be prepared with every 20 samples or with each SDG, whichever is more frequent. For SC DHEC, the LCS is **prepared** at a frequency of 10%. The LCS is prepared from the same solution as the ICV. The results of the LCS must fall within 90-110% of the true value. If, after **re-**analysis, the LCS still falls outside these control limits, determine **and correct** the problem; recalibrate and reanalyze the entire batch.

9.6 **A matrix spike and matrix spike duplicate (MS/MSD) may be prepared for** every 20 samples or for each **SDG**, **if requested by the client**. If the spike

recovery is not within the control limits of 75-125% and the sample result does not exceed 4x the spike added, matrix interference is suspected. Verify this by spiking another aliquot of the sample. If the control limits still cannot be met, then a quality assurance (QA) notice is required to indicate that matrix interference is present. If the relative percent difference (RPD) between the MS/MSD exceeds control limits of 20, a QA notice is required.

NOTE: Samples identified as field blanks should not be used for MS/MSD analysis.

9.7 A duplicate must be **prepared** once per batch. For SC DHEC a duplicate is required every 10 samples. The duplicate may be a matrix spike and matrix spike duplicate (MS/MSD) or a sample and sample duplicate. The RPD between the MS/MSD or sample and duplicate should be within 20%.

9.8 Contingency

9.8.1 If due to a lab accident or to QC failure a re-preparation is required for the sample and insufficient volume remains, the Project Manager must be alerted and will contact the client for direction on how to proceed.

9.8.2 If persistent contamination occurs in the laboratory, analyses must be halted until the source can be identified and isolated. When the contamination issue is resolved, sample analyses may proceed.

9.8.3 Any other issues that potentially affect data quality should be addressed with the Project Manager.

10.0 Calibration **and** Standardization

10.1 Set up the instrument as detailed in section 11.0.

10.2 Analyze the calibration standards prepared in section 7.7.7 in descending concentration order.

10.3 After the instrument has been calibrated and before any samples can be analyzed, the correlation coefficient must be determined to be 0.995 or greater. The lowest reporting level (RL) for this analysis is the concentration of the lowest point of calibration curve (10 mg/L).

10.4 A calibration verification solution (ICV) must be analyzed after the initial calibration before and samples are analyzed. This certified solution may be obtained for the EPA of other vender. The control limits for the ICV are 90-

110% of the true value. If the control limits for the ICV are not met, reanalyze the ICV. If the ICV continues to fail, recalibrate.

10.5 A continuing calibration verification (CCV) solution must be analyzed at a 10% frequency throughout the analytical run. The CCV is the mid-range standard (250 mg/L). The CCV control limits and corrective actions are the same as those of the ICV described above. Reanalyze all affected samples.

11.0 Procedure

Documentation must follow the requirements in Quality Control SOP 13.6, "Proper Documentation Procedures".

11.1 Using the manifold diagram table (Attachment 2) as a guide:

11.1.1 Inspect the modules for proper connections.

11.2 Turn on the power for all modules.

11.3 Place the reagent transmission lines in the proper reagents.

11.4 Pump the system until a stable baseline is attained.

11.5 Program the data system to initial parameters (or those empirically determined).

11.6 Place the calibration standards and the blank in the sample tray in descending order of concentration followed by check standards and samples. Print out the alkalinity run log (Attachment 3).

11.7 At the end of the run, place all feed-lines in **reagent** water, flush the system, and pump dry.

11.8 Turn off the pump and all modules, and release the tube cassettes.

Note: Thoroughly mix sample before aliquotting.

12.0 Data Analysis **and** Calculations

Calculations must be consistent with the Quality Control SOP 13.4, "Numerical Data Reduction."

12.1 Calculation of the mean or average of a set of values:

$$\overline{X} = \frac{\sum_{i=1}^{n} X_i}{n}$$

where: n = total number of values
x_i = each individual value used to calculate the mean
x = the mean of n

12.2 Calculation of the standard deviation of a set of values:

$$\text{Standard deviation} = \sqrt{\frac{\sum_{i=1}^{n}\left(X_n - \overline{X}\right)^2}{n-1}}$$

12.3 Calculation of percent recovery:

12.3.1 LCS:

$$\%R = \frac{Amount\ found}{Amount\ spiked}\ x\ 100$$

12.3.2 Matrix spikes:

$$\%\,R = \frac{Amount\ in\ spiked\ sample - Amount\ in\ unspiked\ (native)\ sample}{Amount\ spiked}\ x\ 100$$

12.4 Calculation of % RSD

$$\%RSD = \left(\frac{Standard\ deviation}{\overline{X}}\right) \times 100$$

12.5 Calculation of RPD

$$RPD = \frac{|Value\ 1 - Value\ 2|}{(Value\ 1 + Value\ 2)/2} x100$$

12.6 Calculation of %Difference (%D)

$$\%Diff = \frac{Value - \overline{Reference\ \ value}}{\overline{Reference\ \ value}} \times 100$$

12.7 Alkalinity (mg/L) concentration

Concentration = [sample concentration (mg/L)] x [dilution factor]

12.8 Calculating Dilutions

If a sample concentration exceeds the high level standard a dilution must be performed. Determine a level of dilution that will result in a value within the upper half of the calibration range.

12.8.1 Dilution factor

$$Dilution\ factor = \frac{\mu L\ most\ conc.\ extract\ used\ to\ make\ dilution + \mu L\ clean\ solvent}{\mu L\ most\ conc.\ extract\ used\ to\ make\ dilution}$$

13.0 Method Performance

This method was validated through in-house laboratory studies of method detection limits and precision and accuracy for single analyst. The data are retained by the QA department.

14.0 Pollution Prevention

The solvents used in this procedure pose little threat to the environment when recycled and managed properly. Pollution prevention encompasses any technique that reduces or eliminates the quantity or toxicity of waste at the point of generation. Numerous opportunities for pollution prevention exist in laboratory operation. The EPA has established a preferred hierarchy of environmental management techniques that places pollution prevention as the management option of first choice. Whenever feasible, laboratory personnel should use pollution prevention techniques to address their waste generation. When wastes cannot be feasibly reduced at the source, the Agency recommends recycling as the next best thing.

15.0 Waste Management

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It is the laboratory's responsibility to comply with all federal, state, and local regulations governing waste management, particularly the hazardous waste identification rules and land disposal restrictions, and to protect the air, water, and land by minimizing and controlling all releases from fume hoods and bench operations. Compliance with all sewage discharge permits and regulations is also required. See SOP 12.1, Hazardous Waste Disposal, regarding laboratory procedures for recycling solvent waste streams.

Samples preserved with HCl, HNO_3, H_2SO_4, NaOH, ZN acetate are hazardous and must be handled as hazardous waste.

Refer to the Hazardous Waste Management and Safety SOPs located in the lab.

16.0 References

16.1 Lachat Autoanalyzer QuikChem Method 10-303-31-1-A, January 2001

16.2 Methods for Chemical Analysis of Water and Wastes, March 1983, Method 310.2**, Editorial Revision 1971**

16.3 Standard Methods for the Examination of Water and Wastewater, 20th (1998) Edition, Method 1080

16.4 Code of Federal Register, 40 CFR, Part 136, "Guidelines for Establishing Test Procedures for Priority Pollutants"

16.5 Quality Control SOP 13.6, "Proper Documentation Procedures"

16.6 Quality Control SOP 13.4, "Numerical Data Reduction"

16.7 "Less is Better: Laboratory Chemical Management for Waste Reduction," American Chemical Society Department of Government Relations and Science Policy, 1155 16th Street, N.W., Washington DC, 20036, (202) 872-4477.

16.9 NELAC Standards, June 2003

16.10 QA-G6: Guidance for the Preparation of Standard Operating Procedures for Quality-Related Operations EPA/600/R-96/027, November 1995.

16.12 CompuChem Quality Manual, Revision **9**, **June 5, 2007**

17.0 Attachments as Tables, Diagrams, Flowcharts

17.1 Attachment 1 – Standards/QC Preparation Log

17.2 Attachment 2 – Alkalinity Manifold Diagram

17.3 Attachment 3 – Alkalinity Determination Run Log Example

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Attachment 1

Standards/QC Preparation for Alkalinity on Lachat File Seq. Number_____

COMPUCHEM a division of Liberty Analytical Corp. WORKSHEET 1 UUU

STANDARDS AND REAGENTS TRACEABILITY*	REF#
Hydrochloric Acid (HCl) 0.1 M	1M2-180-2
Potassium acid phthalate (KPH Buffer)	1U(6)1-6-28
Methyl Orange Reagent	7M2-207-5
Sodium Carbonate dried (anhydrous-primary standards grade)	1U(6)1-3-24
Alkalinity ICV / NSI (SECOND SOURCE) LCS Standard Solution	1U(6)1-10-11 ALK TV=300mg/L
STANDARD/REAGENT LOT NUMBER**	**PREPARATION INSTRUCTIONS**
KHP Buffer, 25 mM, pH 3.1 – 0 5 3 0 0 7 – J M	Place in a 1000-ml volumetric flask: 5.00g potassium acid phthalate. Dissolve in carbon dioxide free water. Add 85 ml of 0.1 M HCl, then add acid to pH of 3.1 (± 0.05). Dilute to volume with carbon dioxide free water. Prepare fresh weekly.
Na_2Co_3 (5000 ppm) – 0 5 1 6 0 7 – J M (Stock Solution)	Place in a 200-ml volumetric flask: 1.060g of dried sodium carbonate Dilute to the mark with carbon dioxide free water. Prepare fresh monthly or more often as needed.
Na_2Co_3 (500 ppm) – 0 5 1 6 0 7 – J M	Place 10 mL of stock solution in a 100 mL volumetric flask Dilute to mark with deionized water. Prepare fresh weekly or more often as needed.
Na_2Co_3 (375 ppm) – 0 5 1 6 0 7 – J M	Place 7.5 mL of stock solution in a 100 mL volumetric flask Dilute to mark with deionized water. Prepare fresh weekly or more often as needed.
Na_2Co_3 (250 ppm) – 0 5 1 6 0 7 – J M USE FOR CCV	Place 5 mL of stock solution in a 100 mL volumetric flask Dilute to mark with deionized water. Prepare fresh weekly or more often as needed.
Na_2Co_3 (25 ppm) – 0 5 1 6 0 7 – J M	Place 0.5 mL of stock solution in a 100 mL volumetric flask Dilute to mark with deionized water. Prepare fresh weekly or more often as needed.
Na_2Co_3 (10 ppm) – 0 5 1 6 0 7 – J M	Place 0.2 mL of stock solution in a 100 mL volumetric flask Dilute to mark with deionized water. Prepare fresh weekly or more often as needed.

Standard Solutions Prepared By: _____ Date: _____

Entered By: _____ Date: _____

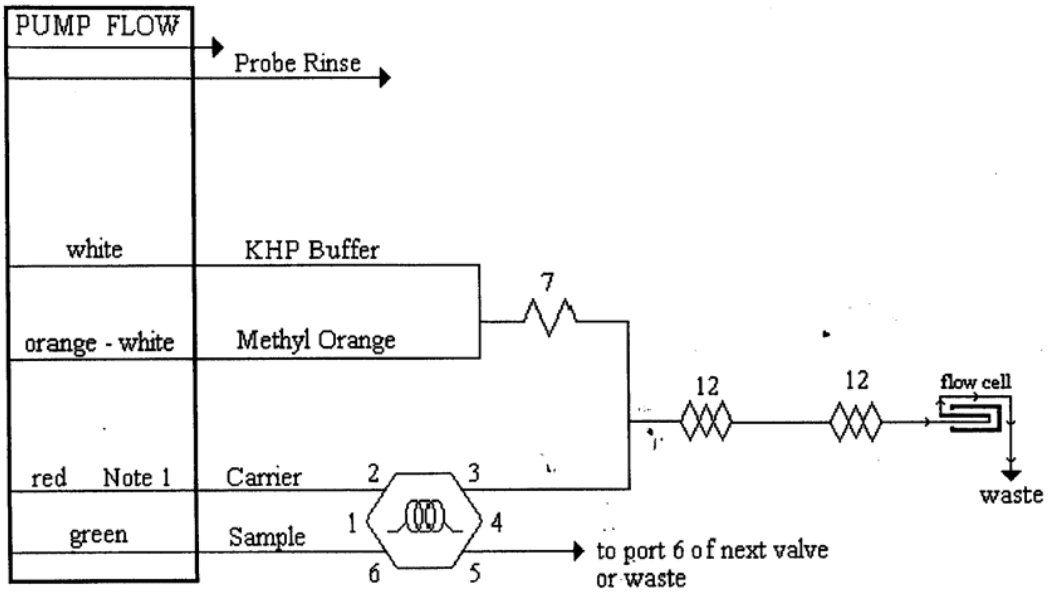
Reviewed By: _____ Date: _____

*Ref# = Logbook ID, Page number, and item number from Materials Receipt Log
**Standard Lot Number consists of standard ID, date prepared, and initials of preparer. 12/8/03:doe

The presence of the Chemist's employee ID number, or signature, on this run log attests that strict compliance with the method's SOP has occurred. Any SOP deviations require documentation by the responsible chemist together with the chemist's initials and the initials of the lab supervisor and a QA department representative, signifying approval of the deviation.

Attachment 2

17.3. ALKALINITY MANIFOLD DIAGRAM



Carrier: DI water (CO_2 free)
Manifold Tubing: 0.8 mm (0.032 in) i.d. This is 5.2 µL/cm.
AE Sample Loop: 100 cm of 0.8 mm (0.032 in) i.d. This is 5.2 µL/cm
QC8000 Sample Loop: 100 cm of 0.8 mm (0.032 in) i.d. This is 5.2 µL/cm
Interference Filter: 550 nm

Apparatus: An injection valve, a 10 mm path length flow cell, and a colorimetric detector module is required.

7: 135 cm of tubing on a 7 cm coil support
12: 255 cm of tubing on a 12 cm alternating coil support

Note 1: Remove the steel pins from the carrier reagent line.
Note 2: **PVC PUMP TUBES MUST BE USED FOR THIS METHOD.**

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Attachment 3

CompuChem
A Division of Liberty Analytical Corp.

Analyst:_____ File Name(s):_____

Date:_____ Case Name(s):_____

Instrument ID: C2 _____

Note: Manual Dilution Factor is not reflected in the sample results

Lachat Method 10-303-31-1-A
Method EPA 310.2

Cup Number	Sample ID	Sampling Date	Sampling Time	Manual Dil Factor	Result/Peak Area	Unit	Analyte Name
1	500	31-Dec-07	10:30:14	1	47394396	uv-s	Alkalinity
2	375	31-Dec-07	10:31:15	1	34631860	uv-s	Alkalinity
3	250	31-Dec-07	10:32:16	1	21375334	uv-s	Alkalinity
4	125	31-Dec-07	10:33:16	1	9030093	uv-s	Alkalinity
5	25	31-Dec-07	10:34:17	1	1499251	uv-s	Alkalinity
6	10	31-Dec-07	10:35:18	1	496960	uv-s	Alkalinity
7	0	31-Dec-07	10:36:19	1	2190	uv-s	Alkalinity
13	ICV	31-Dec-07	10:38:41	1	308.167847	mg/L	Alkalinity
14	ICB	31-Dec-07	10:39:42	1	7.030782	mg/L	Alkalinity
1	159699 MB	31-Dec-07	10:42:05	1	8.097047	mg/L	Alkalinity
2	159700 LCS	31-Dec-07	10:43:06	1	306.154144	mg/L	Alkalinity
3	159702 LCSD	31-Dec-07	10:44:07	1	311.32605	mg/L	Alkalinity
4	1447401	31-Dec-07	10:45:08	1	5.732183	mg/L	Alkalinity
5	1447402	31-Dec-07	10:46:09	1	5.845906	mg/L	Alkalinity
6	1447403	31-Dec-07	10:47:09	1	10.292072	mg/L	Alkalinity
7	1447404	31-Dec-07	10:48:10	1	6.610818	mg/L	Alkalinity
8	1447405	31-Dec-07	10:49:10	1	6.146561	mg/L	Alkalinity
9	1447406	31-Dec-07	10:50:10	1	7.73382	mg/L	Alkalinity
10	1447407	31-Dec-07	10:51:11	1	7.638853	mg/L	Alkalinity
3	CCV	31-Dec-07	10:52:12	1	256.792847	mg/L	Alkalinity
7	CCB	31-Dec-07	10:53:13	1	6.508664	mg/L	Alkalinity

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501 Madison Avenue
Cary, NC 27513

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NELAP accredited

SOP DOCUMENTATION FORM

This form must accompany all new and revised Standard Operating Procedures (SOPs) when you turn them in to Quality Assurance for review. Please fill out the entire block below (except effective date).

This is a new procedure _____ revised procedure ✓ outdated procedure (archive) _____

- Procedure Code: IP 608 SOP Section #: 3.5.14.1 Revision #: 6

SOP Title: pH Determination

Effective date: (QA fills in) 01/11/08

- Procedure prepared by: Bob Mercer Date: 08-21-2007
- Procedure approved by: (If the manager prepared the SOP, a qualified second party should sign) Date: 01-11-08
- Reason for change: Update SOP based on revised method reference
- This procedure meets the requirements of the following approved method references: Standard Methods for the Examination of Water and Wastewater, 20th Edition (1998), Method 4500-H+B

Procedure approved by a QA Representative (unless QA Representative signed above):

_____ Date: _____

On an annual basis: Lab managers are required to review lab practices and revise the SOP if necessary. If no revision is necessary, indicate by your signature that the SOP has been reviewed.

Annual Review—Signature: _____ Date: _____

Annual Review—Signature: _____ Date: _____

Annual Review—Signature: _____ Date: _____

Annual Review—Signature: _____ Date: _____

Instrument Procedure 608: pH Determination

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Instrument Procedure 608: pH Determination

1.0 Scope and Application

This method is applicable to drinking, surface, and saline waters, and to domestic and industrial wastes.

The terms "method detection limit" and "reporting limit" are not applicable to this method. Results are reported as "Standard pH units" at 25° C.

Staff members performing the procedures described in this **Standard Operating Procedure (**SOP**)** are responsible for reading, understanding, and complying with the SOP requirements. Supervisors are responsible for directing the analyst to the controlled SOP, and providing adequate explanation of the material contained therein.

This procedure is restricted to use by or under the supervision of analysts experienced in the instrumentation or preparative methods and who have demonstrated the ability to generate acceptable results through QC samples and analyst capability studies.

2.0 Summary of Method

The pH of a sample is determined electrometrically using a combination electrode.

3.0 Definitions

3.1 SC DHEC – South Carolina Department of Health and Environmental Control

3.2 Reporting Units – Standard pH units

3.3 A **Sample Delivery Group (**SDG**)** is defined by the following, whichever is more frequent:

- each 20 field samples received within a case, or
- each 7 calendar day period during which field samples in a case are received (14 calendar days if requested by the client) beginning with the receipt of the first sample.

NOTE: The **Department of Defense Quality Systems Manual DOD-QSM** and SC DHEC do not accept the SDG approach, unless the samples are prepared in a single batch. When a group of up to 20 field samples of similar matrices are prepared as one batch, method-specified QC samples such as a method blank, laboratory control sample, matrix

spike, matrix spike duplicate, and matrix duplicate must also be prepared together**.** If samples are batched together from different sites, project-specific QC must be processed.

3.4 Slope - Change in voltage output resulting from a decade change in the activity of the responding ion. Raw slope values do not provide a good measurement of the electrode's performance due to temperature dependence. The Model 50 reports slope values as temperature referenced to 25°C. This value reflects the condition of the ion selective electrode (ISE).

3.5 Efficiency Factor - Slope value for electrode divided by its theoretical value. Typical factors for properly functioning electrodes range from 0.90-1.05.

3.6 Efficiency - Efficiency factor of the electrode expressed as **percent.** Properly functioning electrode in the Model 50 exhibit efficiencies between 90-105%.

4.0 Interferences

4.1 The electrode may become coated with oil, grease, fine solids, or heavy particulate such as lime.

4.1.1 Remove oil, grease, and fine solids from the electrode surface by gentle wiping or wash with detergent.

4.1.2 Remove heavy particulate by carefully scrubbing or immersion of the electrode in a dilute solution of hydrochloric acid (10%)

5.0 Safety

5.1 Appropriate protective equipment and clothing must be used under the assumption that all samples are potentially hazardous. During sample preparation, safety glasses, gloves and lab coats are a minimum requirement. The persistent presence of noxious odors may be indicative of failure of the laboratory ventilation system and must be reported to a supervisor or manager

5.2 Laboratory staff **must** review the Chemical Hygiene Plan for general safety policies, and Material Safety Data Sheets **(MSDS)** for reagents used in the laboratory. **The Chemical Hygiene Plan and MSDS are located in the Quality Assurance department.**

6.0 Equipment **and** Supplies

6.1 Fisher Scientific Model 50 pH/ISE meter

6.2 Standard glass- body combination electrode

6.3 Ordinary laboratory glassware

6.4 50 **mL** plastic disposable beakers

6.5 magnetic stirrer and stir bars

7.0 Reagents **and** Standards

7.1 Reagent Water-All water used during preparation should be reagent-grade Type I with regard to resistivity of > 10 megohm-cm (20 Editions of Standard Methods, Method 1080), and referred throughout this SOP as **reagent** water.

7.2 Fisher certified buffer solutions at pH 2.0, 4.0, 7.0, and 10.0.

7.3 pH Electrode Storage Solution, Orion 810001 or 910001

8.0 Sample Preservation **and** Storage

8.1 Samples are preserved, and stored according to the tables in Sample Control SOP 4.1, "Receiving Samples" and 4.6, "Storing Samples." Sample holding times are also listed.

8.2 **Samples are** stored at **2 – 6°C and are analyzed as soon as possible after receipt.**

8.3 Because pH should be analyzed immediately after collection, within 15 minutes of collection, holding times cannot be met by the laboratory. A notice regarding this holding time compliance issue is included on the analysis worksheet.

9.0 Quality Control

9.1 Analyze an aqueous **Laboratory Control Sample (LCS)** for each batch of **not more that 20** samples. For SC DHEC analyze the **LCS** at a 10% frequency. Obtain prepared solution and acceptance criteria from ERA. Record **the** results and **standard** reference numbers **on the pH Determination Log**. If acceptance

criteria are not met, correct the problem, recalibrate and reanalyze the entire batch.

9.2 Contingency

9.2.1 If due to a lab accident or to QC failures, a re-preparation and analysis are required for the sample and insufficient sample volume remains, the Project Manager must be alerted and will contact the client for direction on how to proceed.

9.2.2 If persistent contamination occurs in the laboratory, analysis must be halted until the source of the contamination can be identified and isolated. When the contamination issue is resolved, samples analysis may proceed.

9.2.3 Any other issues that potentially effect data quality should also be addressed with the Project Manager.

10.0 Calibration **and** Standardization

10.1 The pH meter must be calibrated and recorded on the pH Determination Log (Attachment 1) before this analysis begins.

10.2 The value for each of the certified buffer solutions must be within +/- 0.05 pH units. Use fresh buffer solutions each time the pH meter is calibrated.

10.3 After calibration and at a frequency of at least every 10 samples, analyze the pH 7.0 buffer as a calibration verification standard. Deviations of more than ± 0.10 pH units from the true value require recalibration and reanalysis of samples analyzed between the failing buffer and the preceding acceptable buffer.

10.4 Calibrate the meter using the auto recognition standardization method described below and in the Fisher Scientific Model 50 pH Meter Operating Instructions Manual. With this method, the meter automatically corrects the buffer value for the variation of buffer pH with temperature and it eliminates the need to key and enter a buffer value each time standardization is performed. Temperature compensation at 25° C is provided, independent of whether automatic temperature compensation (ATC) probe is connected.

However, if temperature compensation with the ATC probe is not used, all buffers and samples should be at the same temperature.

Stir all buffers and samples with a magnetic stirrer while a measurement is being made.

10.4.1 From the main screen, press "setup".

10.4.2 Press "clear".

10.4.3 Press "1" to update and select "buffer recognition"

10.4.4 Place the electrode into pH 2.0 buffer and turn on the stirrer. Immerse the electrode in a sufficient volume of solution to cover the sensing elements and allow the electrode to remain in the solution until a stable reading is obtained.

10.4.5 Remove the pH electrode from the pH 2.0 buffer and rinse the electrode thoroughly with **reagent** water. Place the electrode into the pH 4.0 buffer repeating 10.**4**.4.

10.4.6 Repeat 10.**4**.5 for the pH 7.0 and 10.0 buffers.

10.5 Store the electrode in pH **Electrode Storage Solution when not in use.**

10.6 Check the slope and efficiency. Efficiency should be between 90-105%.

11.0 Procedure

Documentation must follow the requirements in Q**uality** C**ontrol** SOP **13.6, "**Proper Documentation Procedures**"**.

11.1 Standardize the meter and electrode system as outlined in Section 10.0 above.

11.2 Thoroughly mix sample before aliquotting. Place the sample (or buffer solution) in a 50 **mL** plastic disposable beaker using a sufficient volume to cover the sensing elements of the electrodes and to give adequate clearance for the stir bar. **Using the procedure in section 10.4.1 through 10.4.5 analyze each sample in the batch.**

11.3 Record sample pH and temperature in the pH Determination Log.

11.4 Rinse and wipe the electrode **between each reading**.

11.5 Store the electrode on pH Electrode Storage Solution when not in use.

12.0 Data Analysis **and** Calculations

N/A

13.0 Method Performance

This method was validated through in-house laboratory studies of precision and accuracy for **a** single analyst. The data are retained by the QA department.

14.0 Pollution Prevention

The solvents used in this procedure pose little threat to the environment when recycled and managed properly. Pollution prevention encompasses any technique that reduces or eliminates the quantity or toxicity of waste at the point of generation. Numerous opportunities for pollution prevention exist in laboratory operation. The EPA has established a preferred hierarchy of environmental management techniques that places pollution prevention as the management option of first choice. Whenever feasible, laboratory personnel should use pollution prevention techniques to address their waste generation. When wastes cannot be feasibly reduced at the source, the Agency recommends recycling as the next best thing.

15.0 Waste Management

It is the laboratory's responsibility to comply with all federal, state, and local regulations governing waste management, particularly the hazardous waste identification rules and land disposal restrictions, and to protect the air, water, and land by minimizing and controlling all releases from fume hoods and bench operations. Compliance with all sewage discharge permits and regulations is also required. **See SOP 12.1, "Hazardous Waste Disposal", regarding laboratory procedures for recycling solvent waste streams.**

Samples preserved with HCl, HNO_3, or H_2SO_4 to pH <2 are hazardous and must be handled as hazardous waste.

Refer to the Hazardous Waste Management and Safety SOPs located in the lab.

16.0 References

16.1 **Standard Methods for the Examination of Water and Wastewater, 20th (1998) Edition, Method 4500-H^+ B.**

16.2 Standard Methods for the Examination of Water and Wastewater, 20th (1998) Edition, Method 1080

16.3 Q**uality** C**ontrol** SOP **13.6, "**Proper Documentation Procedures**"**

16.4 "Less is Better: Laboratory Chemical Management for Waste Reduction," American Chemical Society Department of Government Relations and Science Policy, 1155 16th Street, N.W., Washington DC, 20036, (202) 872-4477.

16.5 NELAC Standards, July 2003

16.6 QA-G6: Guidance for the Preparation of Standard Operating Procedures for Quality-Related Operations EPA/600/R-96/027, November 1995.

16.7 CompuChem Quality Manual, Revision **9**, **June 5, 2007**

17.0 Attachments as Tables, Diagrams **and** Flowcharts

17.1 Attachment 1 - pH Determination Run Log

Attachment 1

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Worksheet 1 HH

pH Determination

Page 1 of 1

Batch No.: _____ SM4500-H B (water) or 9045C/D (soil):

Analyst No.: 2477 Date: 8/22/2007

Standards (pH Units)	pH	Temp (°C)	Slope	Reference Lot No.	Comments
2.00	2.00	20.0	57.42	1U(6)1-8-15	
4.00	4.00	20.0	59.88	1U(6)1-8-16	
7.00 & Check	7.00	20.0	56.10	1U(6)1-8-17	
10.00	10.00	NA	NA	1U(6)1-8-18	
Slop Efficiency =	99.5	Efficiency (90-105%)			

Cond	CompuChem No.	Sample Type	FOR SOILS ONLY Weight (g)	Water Added (mL)	pH Result	Temp (°C)	Comments

LCS Reference No.	1U(6)1-12-12	Acceptance Criteria ± 0.10 pH Units

Reveiewed by: _____ Date: _____

The presence of the Chemist's/Analyst's employee ID number, or signature, on this run log attests that strict compliance with the method's SOP has occurred. Any SOP deviations require documentation by the responsible chemist/analyst together with the chemist's/analyst's initials and the initials of the lab supervisor and a QA department representative, signifying approval of the deviation.

8/22/07: VR

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SOP DOCUMENTATION FORM

This form must accompany all new and revised Standard Operating Procedures (SOPs) when you turn them in to Quality Assurance for review. Please fill out the entire block below (except effective date).

This is a new procedure _____ revised procedure ✓ outdated procedure (archive) _____

- Procedure Code: IP600 SOP Section #: 3.5.17.1 Revision #: 4

SOP Title: Determination of Sulfide in Aqueous Samples

Effective date: (QA fills in) 9/22/07

- Procedure prepared by: Valgina Lopass Date: 7/9/07
- Procedure approved by: (If the manager prepared the SOP, a qualified second party should sign) Date: 9-21-07
- Reason for change: update method reference for EPA MUR
- This procedure meets the requirements of the following approved method references: Standard Methods 4500-S^{-2}-F, 20th Edition, 1998

Procedure approved by a QA Representative (unless QA Representative signed above):

_____ Date: _____

On an annual basis: Lab managers are required to review lab practices and revise the SOP if necessary. If no revision is necessary, indicate by your signature that the SOP has been reviewed.

Annual Review—Signature: _____ Date: _____

Annual Review—Signature: _____ Date: _____

Annual Review—Signature: _____ Date: _____

Annual Review—Signature: _____ Date: _____

Sopdocform2-1/19/07: vr

Instrument Procedure 600: **Determination of** Sulfide in Aqueous Samples

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1.0 Scope and Application

This **Standard Operating Procedure** (SOP) describes the procedure **used** to measure total and dissolved sulfides in aqueous un-precipitated samples including drinking, surface and saline waters, domestic and industrial wastes. This method measures sulfides in concentrations above 0.5 mg/L. If sample is not preserved with zinc acetate **and** NaOH or if dissolved SO_3 is being measured, then the analysis must be started immediately.

Staff members performing the procedures described in this SOP are responsible for reading, understanding, and complying with the SOP's requirements. Supervisors are responsible for directing the analyst to the controlled SOP, and providing adequate explanation of the material contained therein.

This procedure is restricted to use by or under the supervision of analysts experienced in the instrumentation or preparative methods and who have demonstrated the ability to generate acceptable results through QC samples and analyst capability studies.

2.0 Summary of Method

Excess iodine is added to a sample that may or may not have been treated with zinc acetate to produce zinc sulfide. The iodine oxidizes the sulfide to sulfur under acidic conditions. The excess iodine is back titrated with sodium thiosulfate.

3.0 Definitions

3.1 Method detection limit (MDL) – The minimum concentration of an analyte that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte (40 CFR, Part 136, Appendix B.)

3.2 Reporting Limit – The laboratory reporting limit is based on the lowest multipoint calibration standard concentration. For some inorganic methods, the reporting limit is based on the MDL, and is usually 4-8 times higher than the MDL.

3.3 Reporting Units – mg/L

3.4 A **Sample Delivery Group (**SDG**)** is defined by the following, whichever is more frequent:

- each 20 field samples received within a case, or
- each 7 calendar day period during which field samples in a case are received (14 calendar days if requested by the client) beginning with the receipt of the first sample.

NOTE: The **DOD-QSM** and SC DHEC do not accept the SDG approach, unless the samples are prepared in a single batch. When a group of up to 20 field samples of a similar matrix are prepared as one batch, method-specified QC samples such as a method blank, laboratory control sample, matrix spike, matrix spike duplicate, and matrix duplicate must also be prepared together at a rate of 5% for **DOD-QSM** and 10% for SC DHEC. If samples are batched together from different sites, project-specific QC must be processed.

3.5 SC DHEC – South Carolina Department of Health and Environmental Control

3.6 DOD-QSM – Department of Defense Quality Systems Manual

4.0 Interferences

4.1 Reduced sulfur compound**s**, such as sulfite, thiosulfate and hydrosulfite, which decompose in acid may yield erratic results.

4.2 Volatile iodine-consuming substances will give high results.

4.3 Samples must be taken with a minimum of aeration. Sulfide may be volatilized by aeration and any oxygen inadvertently added to the sample may convert the sulfide to an unmeasurable form.

5.0 Safety

5.1 Appropriate protective equipment and clothing must be used under the assumption that all samples are potentially hazardous. Safety glasses, gloves and lab coats are a minimum requirement. The persistent presence of noxious odors may be indicative of failure of the laboratory ventilation system and must be reported to a supervisor or manager.

5.2 Laboratory staff **must** review the Chemical Hygiene Plan for general safety policies, and Material Safety Data Sheets for reagents used in the laboratory. **The Chemical Hygiene Plan and MSDS are located in the quality assurance department.**

6.0 Equipment and Supplies

6.1 50 mL class "A" buret

6.2 Ordinary laboratory glassware:

6.2.1 500 mL wide mouth Erlenmeyer flask

6.2.2 200 mL volumetric flask

6.2.3 Magnetic stirrer, stir bar, **pipettes**

7.0 Reagents and Standards

7.1 Reagent Water-All water used during preparation should be reagent-grade Type I with regard to resistivity of > 10 megohm-cm (**20**th Edition of Standard Methods, Method 1080), and referred throughout this SOP as **reagent** water.

7.2 Hydrochloric acid (6N) HCl – Add 500 mL concentrated HCl to **reagent water** in a one liter volumetric flask, then dilute to **volume**.

7.3 Sulfide reference solution: Dissolve 0.750 g**rams** of $Na_2S•9H_2O$ in **reagent water** in a 100 mL volumetric flask, then dilute to **volume**. This solution contains 1000 ppm hydrogen sulfide. Prepare daily.

7.4 Standardized iodine solution (0.025N) I_2 **–** commercially prepared

7.5 Sodium thiosulfate (0.025N) $Na_2S_2O_3•5H_2O$ **–** commercially prepared and certified

7.6 Starch solution – commercially prepared

8.0 Sample Preservation and Storage

8.1 Samples are preserved, and stored according to the tables in Sample Control SOP 4.1, "Receiving Samples" and 4.6, "Storing Samples." Sample holding times are also listed.

8.2 The sample should be preserved with zinc acetate and NaOH and stored refrigerated at 2 - 4 °C. **A**nalyze as soon as possible but within 7 days of collection.

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8.3 If the sample is not preserved with zinc acetate and NaOH, the analysis must be started immediately. Similarly, the measurement of dissolved sulfides must also be commenced immediately.

8.4 After analysis, samples are returned to Sample Control for long-term storage and disposal.

9.0 Quality Control

9.1 Method Blank (Preparation or Reagent Blank): A reagent blank is used to establish that the reagents are free from contamination. One method blank must be analyzed with every preparation batch of up to 20 samples. For SC DHEC analyze the blank every 10 samples.

9.1.1 If any value present in the method blank exceeds the reporting limit, the entire batch must be reprocessed using clean glassware.

9.2 Laboratory Control Sample (LCS): The LCS is prepared by adding 1 mL sulfide reference solution (7.3) into **reagent water** in a 200 mL volumetric flask**. Dilute** to **volume with reagent water**. This solution contains 5.0 mg/L hydrogen sulfide. The LCS must be prepared with every batch of up to 20 samples. For SC DHEC analyze the LCS every 10 samples. Accuracy of the process is determined from the LCS recovery.

9.2.1 The result of the LCS must agree within 90-110% of the true value. When the LCS is outside this range, the system must be checked and any error corrected. The associated batch of samples must be reprocessed with new QC samples.

9.3 Matrix Spike and Matrix Spike Duplicate (MS/MSD): If sufficient sample bottles have been collected, then two additional 200 mL aliquots of native sample are spiked with 1 mL of the sulfide reference solution (7.3). This yields a spike concentration of 5 mg/L. The MS/MSD pair are prepared with every SDG**, if requested by the client**. Precision and accuracy are determined from the MS/MSD relative percent difference (RPD) and recovery. Failures must be documented on the run log. (Attachment 1)

9.3.1 The MS/MSD recovery must fall within 75 - 125% of the expected value and the RPD must be < 20%. If the MS/MSD fail criteria but the LCS passes, the results may be reported with the failure attributed to the sample matrix. If a spiking error can be identified, the MS/MSD may be re-prepared, or the amount of spike adjusted in the case of known double spiking.

9.4 For SC DHEC a duplicate is required at a 10% frequency. The MS/MSD **fulfills that** requirement.

9.5 Contingency

9.5.1 If, due to a lab accident or to QC failure, a re-preparation is required for the sample and insufficient volume remains, the Project Manager must be alerted and will contact the client for direction on how to proceed.

9.5.2 If persistent contamination occurs in the laboratory, analyses must be halted until the source can be identified and isolated. When the contamination issue is resolved, sample analyses may proceed.

9.5.4 Any other issues that potentially affect data quality should be addressed with the Project Manager.

10.0 Calibration and Standardization

10.1 The standardized iodine solution is purchased certified and traceable to NIST.

11.0 Procedure

Documentation must follow the requirements in Q**uality** C**ontrol** SOP **13.6, "**Proper Documentation Procedure**"**.

Record all data in the Sulfide Preparation and Run Log (Attachment **1**). Include all pertinent information such as sample size, dilution factors, date(s) of analysis, and sample ID. Discrepancies or deviations must be written in the logbook as they occur.

11.1 Titration; total sulfide

11.1.1 Using a calibrated pipet, add 1 mL of 0.025N iodine solution **to a 500 mL volumetric flask.**

11.1.2 Add distilled water to bring the volume to approximately 20 mL.

11.1.3 Add 2mL of 6N HCl.

11.1.4 Thoroughly mix the sample before aliquotting. Pipet 200 mL of sample, underneath the surface of the liquid, into the 500 mL Erlenmeyer flask.

11.1.5 If **the** amber color of the iodine solution fades to yellow, add more 0.025N iodine solution **until color remains**. Record this on run log. The additional amount must be included in total volume added in the calculation.

11.1.6 Titrate the solution in the flask with 0.025N sodium thiosulfate until the amber color fades to yellow. Add enough starch **solution** for the solution to turn dark blue and titrate until the blue disappears. Record the volume **of 0.025N sodium thiosulfate** in mL used on the run log.

11.2 Titration, insoluble sulfide

11.2.1 Filter the sample bottle contents and record the volume of sample on run log.

11.2.2 Place the filter **with precipitate** in**to the original sample bottle. Add 1**00 mL **reagent water**. Perform steps 11.1.2, 11.1.3, **11.1.5** and **11.1.6**.

12.0 Data Analysis and Calculations

Calculations must be consistent with the Q**uality** C**ontrol** SOP **13.4, "**Numerical Data Reduction**"**.

12.1 Calculation of the mean or average of a set of values:

$$\overline{X} = \frac{\sum_{i=1}^{n} X_i}{n}$$

where: n = total number of values
x_i = each individual value used to calculate the mean
x = the mean of n

12.2 Calculation of the standard deviation of a set of values:

$$Standard\ deviation = \sqrt{\frac{\sum_{i=1}^{n}\left(X_n - \overline{X}\right)^2}{n-1}}$$

12.3 Calculation of percent recovery:

12.3.1 LCS:

$$\%R = \frac{Amount\ found}{Amount\ spiked}\ x\,100$$

12.3.2 Matrix spikes:

$$\%\,R = \frac{Amount\ in\ spiked\ sample - Amount\ in\ unspiked\ (native)\ sample}{Amount\ spiked}\ x\,100$$

12.4 Calculation of RPD

$$RPD = \frac{|Value\ 1 - Value\ 2|}{(Value\ 1 + Value\ 2)/2}\ x100$$

12.5 Calculation of %Difference (%D)

$$\%Diff = \frac{Value - \overline{Reference\ \ value}}{\overline{Reference\ \ value}}\ x\ 100$$

12.6 Sulfide Concentration:

$$\text{mg/L Sulfide} = \frac{(A-B)\ 400}{\text{mL Sample}}$$

where: A = mL of 0.025N standard iodine solution
B = mL of 0.025N standard sodium thiosulfate

12.7 Data Review and Verification

12.7.1 Review and verification must follow the procedures in the Inorganic Wet Chemistry and Organic Characterization SOP for data review.

12.7.2 **An initial** review is performed by the analyst. A peer or supervisory review is performed prior to release of **the final report** to the client.

13.0 Method Performance

This method was validated through in-house laboratory studies of method detection limits and precision and accuracy for single analyst. The data are retained by the QA department.

14.0 Pollution Prevention

The solvents used in this procedure pose little threat to the environment when recycled and managed properly. Pollution prevention encompasses any technique that reduces or eliminates the quantity or toxicity of waste at the point of generation. Numerous opportunities for pollution prevention exist in laboratory operation. The EPA has established a preferred hierarchy of environmental management techniques that places pollution prevention as the management option of first choice. Whenever feasible, laboratory personnel should use pollution prevention techniques to address their waste generation. When wastes cannot be feasibly reduced at the source, the Agency recommends recycling as the next best thing.

15.0 Waste Management

15.1 It is the laboratory's responsibility to comply with all federal, state, and local regulations governing waste management, particularly the hazardous waste identification rules and land disposal restrictions, and to protect the air, water, and land by minimizing and controlling all releases from fume hoods and bench operations. Compliance with all sewage discharge permits and regulations is also required. **See SOP 12.1, "Hazardous Waste Disposal", regarding laboratory procedures for recycling solvent waste streams**

15.2 Samples preserved with HCl, HNO_3, or H_2SO_4 to pH <2 are hazardous and must be handled as hazardous waste.

15.3 Refer to the Hazardous Waste Management and Safety SOPs located in the lab.

16.0 References

16.1 Standard Methods for the Examination of Water and Wastewater, 20th (1998) Edition, Method 1080.

16.2 Standard Methods for the Examination of Water and Wastewater, 20th Edition, 1998, Method 4500-S^{2-} F

16.3 Code of Federal Register, 40 CFR, Part 136, "Guidelines for Establishing Test Procedures for Priority Pollutants"

16.4 Q**uality** C**ontrol** SOP **13.6, "**Proper Documentation Procedures**"**

16.5 Q**uality** C**ontrol** SOP **13.4, "**Numerical Data Reduction**"**

16.6 "Less is Better: Laboratory Chemical Management for Waste Reduction," American Chemical Society Department of Government Relations and Science Policy, 1155 16th Street, N.W., Washington DC, 20036, (202) 872-4477.

16.7 NELAC Standards, July 2003

16.8 QA-G6: Guidance for the Preparation of Standard Operating Procedures for Quality-Related Operations EPA/600/R-96/027, November 1995.

16.9 CompuChem Quality Manual, Revision **9**, **June 5, 2007**

16.10 Sample Control SOP 4.6, "Storing Samples"

17.0 Attachments as Tables, Diagrams **and** Flowcharts

17.1 Attachment 1 – **Sulfide Preparation and Run Log**

Attachment **1**

Worksheet 1 D(6) CompuChem, a division of Liberty Analytical C Page __1___ of __1___

Sulfide Preparation & Analysis

Analyst No.:_____ Date:_____

Method SM 4500S-2-F SDG:_____ Batch No.:_____

Cond	CompuChem No.	Sample Type	Total or Insoluable Sulfide?	Sample Vol. (mL)	Iodine Vol. (mL)	Sodium Thiosulfate Vol. (mL)	Sulfide Result (mg/L)	Comments
			Total	200			0.00	

Soluble Starch Ref #:	1U(6)1-8-25	Hydrocloric Acid Ref #:	1M2-168-18
Iodine Soln. Ref #:	1U(6)1-8-5	Sodium Sulfate Ref #:	1U(6)1-4-2
Conc = (Iodine vol - sodium thiosulfate vol)*400/Initial vol		Thiosulfate (0.025N) Ref #:	1U(6)1-7-17
HCl(6N) - 0 1 0 8 0 4 - J M	Add 500 ml concentrated HCl to DI H2O in a one liter volumetric flask, then dilute to the mark.		
Sulfide Ref Soln.- 0 1 0 8 0 4 - J M	Dissolve 0.750g of Na2S•9H2O in DI H2O in a 100 ml volumetric flask, then dilute to the mark. This solution contains 1000 ppm hydrogen sulfide. Prepare daily.		

Reviewed By: _____ Date:_____

The presence of the Chemist's employee ID number, or signature, on this run log attests that strict compliance with the method's SOP has occurred. Any SOP deviations require documentation by the responsible chemist together with the chemist's initials and the initials of the lab supervisor and a QA department representative, signifying approval of the deviation.

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SOP DOCUMENTATION FORM

This form must accompany all new and revised Standard Operating Procedures (SOPs) when you turn them in to Quality Assurance for review. Please fill out the entire block below (except effective date).

This is a new procedure _____ revised procedure ✓ outdated procedure (archive) _____

- Procedure Code: IP61Z SOP Section #: 3.5.22.1 Revision #: _____

SOP Title: Determination of Inorganic Anions by Ion Chromatography

Effective date: (QA fills in) 6/19/08

- Procedure prepared by: Bob Mercer Date: 06-17-2008
- Procedure approved by: (If the manager prepared the SOP, a qualified second party should sign) Date: 061808
- Reason for change: Navy assessment findings (2008) and minor format changes
- This procedure meets the requirements of the following approved method references: EPA/600/R-93-100, "Determination of Inorganic Anions by Ion Chromatography," Revision 2.1, August 1993; Method 300.0; SW-846, 3rd Edition, Update III, 12/96, Method 9056

Procedure approved by a QA Representative (unless QA Representative signed above):

_____ Date: _____

On an annual basis: Lab managers are required to review lab practices and revise the SOP if necessary. If no revision is necessary, indicate by your signature that the SOP has been reviewed.

Annual Review—Signature: _____ Date: _____

Annual Review—Signature: _____ Date: _____

Annual Review—Signature: _____ Date: _____

Annual Review—Signature: _____ Date: _____

Instrument Procedure 612: Determination of Inorganic Anions by Ion Chromatography

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Instrument Procedure 612: Determination of Inorganic Anions by Ion Chromatography

1.0 Scope and Application

This Standard Operating Procedure (SOP) describes the determination of the following anions: nitrate-N, nitrite-N, bromide, sulfate, chloride, fluoride, and orthophosphate-P in aqueous samples.

Staff members performing the procedures described in this SOP are responsible for reading, understanding, and complying with the SOP requirements. Supervisors are responsible for directing the analyst to the controlled SOP, and providing adequate explanation of the material contained therein.

This procedure is restricted to use by or under the supervision of analysts experienced in the instrumentation or preparative methods and who have demonstrated the ability to generate acceptable results through QC samples and analyst capability studies.

2.0 Summary of Method

A small volume of sample is introduced into an ion chromatograph. The anions of interest are separated and measured using a system comprised of ion chromatography instrument, autosampler, and Omion IC software.

3.0 Definitions

3.1 Method detection limit (MDL) – The minimum concentration of an analyte that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte (40 CFR, Part 136, Appendix B.)

3.2 Reporting Limit – The laboratory reporting limit is based on the lowest multipoint calibration standard concentration.

For some inorganic methods, the reporting limit is based on the MDL, and is usually 4-8 times higher than the MDL. This is referred to as the Practical Quantitation Limit (PQL). Values detected between the PQL and the instrument detection limit (IDL) are flagged and reported.

3.3 Reporting Units – mg/L

3.4 A Sample Delivery Group (SDG) is defined by the following, whichever is more frequent:

- each 20 field samples received within a case, or
- each 7 calendar day period during which field samples in a case are received (14 calendar days if requested by the client) beginning with the receipt of the first sample.

NOTE: The DOD QSM and SC DHEC do not accept the SDG approach, unless the samples are prepared in a single batch. When a group of up to 20 field samples of a similar matrix are prepared as one batch, method-specified QC samples such as a method blank, laboratory control sample, matrix spike, matrix spike duplicate, and matrix duplicate must also be prepared together.

3.5 SC DHEC – South Carolina Department of Health and Environmental Control

3.6 DOD-QSM – Department of Defense Quality Systems Manual

4.0 Interferences

4.1 Substances with retention times as the anion of interest can cause inferences. Large amounts of an anion can interfere with the resolution of an adjacent anion. Sample dilution and/or fortification may be used to remove the effects of these interferences.

4.2 Samples that contain particles larger than 0.45 microns and reagents that contain particles larger than 0.20 microns require filtration to prevent damage to instrument columns and flow systems.

4.3 Contaminants in the reagents, reagent water, glassware and other sample processing equipment may lead to discrete artifacts or elevated baseline in ion chromatographs.

4.4 Samples containing residual chlorine dioxide will form additional chlorite prior to analysis and must be purged with an inert gas (argon or nitrogen) to remove chlorine dioxide.

4.5 This procedure should not be used for leachates of solid samples in which acetic acid was used to adjust the pH as the acetate ion may effect the elution of anions of interest.

5.0 Safety

Appropriate protective equipment and clothing must be used under the assumption that all samples are potentially hazardous. During sample preparation, safety glasses, gloves and lab coats are a minimum requirement. The persistent presence of noxious odors may be indicative of failure of the laboratory ventilation system and must be reported to a supervisor or manager.

Laboratory staff must review the Chemical Hygiene Plan for general safety policies, and Material Safety Data Sheets (MSDS) for solvents and reagents used in the laboratory. The Chemical Hygiene Plan and MSDS are located in the Quality Assurance department.

6.0 Equipment and Supplies

6.1 Ion chromatograph – Omnion IC

6.2 Autosampler – ASX 500 series XYZ autosampler

6.3 Syringes equipped with 0.2 micron filters

6.4 Sample vials

6.5 Volumetric flasks – various sizes

6.6 Polypropylene bottles – 1-L

7.0 Reagents and Standards

Preparation of all reagents and standards is documented in the Reagent/Standard/QC Preparation Logbook (Attachment 1). The final volume of reagent or standard may vary from that listed in the SOP as long as the concentrations remain consistent.

7.1 Reagent Water-All water used during preparation should be reagent-grade Type I with regard to resistivity of > 10 megohm-cm (20th Edition of Standard Methods, Method 1080), and referred throughout this SOP as reagent water.

7.2 Regenerant solution (0.25 M)

7.2.1 In a 1 L volumetric flask partially filled with reagent water, add 14 mL of sulfuric acid and dilute to volume.

7.3 Eluent stock sodium bicarbonate solution (100 mM)

7.3.1 Dissolve 8.40 g of sodium bicarbonate into reagent water in a 1 L volumetric flask.

7.4 Eluent stock sodium carbonate solution (100 mM)

7.4.1 Dissolve 10.60 g of sodium carbonate into reagent water in a 1 L volumetric flask. Filter the solution through 0.45 micron filter and store in a 1 L polypropylene bottle.

7.5 Eluent working solution (2 mM sodium bicarbonate and 2.6 mM sodium carbonate)

7.5.1 Add to 20 mL of stock sodium bicarbonate solution and 26 mL of stock sodium carbonate solution and dilute in a 1 L volumetric flask with reagent water. Filter the solution through 0.45 micron filter and store in a 1 L polypropylene bottle.

7.6 Stock A Calibration Standard – commercially purchased

7.6.1 Nitrite at 50 ppm concentration

7.7 Stock B Calibration Standard – commercially purchased

7.7.1 Fluoride, Bromide, Nitrate, and orthophosphate at 50 ppm concentration

7.7.2 Chloride at 500 ppm concentration

7.7.3 Sulfate at 1000 ppm concentration

7.8 Initial Calibration Standards

7.8.1 For standard 1 in the table below, add 20 mL of stock A and B standards to a 200 mL flask and dilute to volume with reagent.

7.8.2 For standard 2 through 7 in the table below, add 3.0, 1.0, 0.4, 0.1, 0.05 and 0.01 mL, respectively, of stock standards A and B to individual 50 mL volumetric flasks. All standard concentrations are in ppm. These standards are prepared fresh weekly.

Calibration Standards Analyte Concentrations							
	Fluoride	**Chloride**	**Nitrite**	**Nitrate**	**Bromide**	**Phosp.**	**Sulfate**
1	5	50	5	5	5	5	100
2	3	30	3	3	3	3	60
3	1	10	1	1	1	1	20
4	0.4	4	0.4	0.4	0.4	0.4	8
5	0.1	1	0.1	0.1	0.1	0.1	2
6	0.05	0.5	0.05	0.05	0.05	0.05	1
7	0.01	0.1	0.01	0.01	0.01	0.01	0.2

7.9 Initial Calibration Verification (ICV) Stock Standards

7.9.1 Separate stock standard is purchased for the ICV. The ICV concentration for each parameter is listed on the table below. All standard concentrations are in ppm.

Fluoride	**Chloride**	**Nitrite**	**Nitrate**	**Bromide**	**Phosp.**	**Sulfate**
500	2000	500	500	500	500	2000

7.9.2 Prepare the ICV standard by adding 1 mL of ICV stock standard to reagent water in a 100 mL volumetric flask and dilute to volume with reagent water. The concentration for each parameter is listed in the table below.

Fluoride	**Chloride**	**Nitrite**	**Nitrate**	**Bromide**	**Phosp.**	**Sulfate**
2.5 ppm	20 ppm	2.5 ppm	2.5 ppm	2.5 ppm	2.5 ppm	20 ppm

7.10 Continuing Calibration Verification (CCV) and Laboratory Control Sample (LCS)

Prepare the CCV and LCS by adding 50 mL of the highest concentration calibration standard solution (section 7.8.1) to reagent water in a 100 mL volumetric flask. Dilute to volume with reagent water. The concentrations for each parameter are listed in the table below.

Fluoride	**Chloride**	**Nitrite**	**Nitrate**	**Bromide**	**Phosp.**	**Sulfate**
2.5 ppm	25 ppm	2.5 ppm	2.5 ppm	2.5 ppm	2.5 ppm	50 ppm

7.11 Matrix Spike (MS)/ Matrix Spike Duplicate (MSD) spiking solution.

7.11.1 The ICV stock solution is used as the MS/MSD spiking solution. Add 0.1 mL of ICV stock solution to the 10 mL sample aliquot. A 5x dilution is performed on the spiked sample resulting in the concentrations in the table below.

Fluoride	Chloride	Nitrite	Nitrate	Bromide	Phosphate	Sulfate
1ppm	4ppm	1ppm	1ppm	1ppm	1ppm	4ppm

8.0 Sample Preservation and Storage

8.1 Samples are obtained from the Custodian out of cold storage. Samples should be allowed to come to room temperature prior to sample preparation. After preparation, they are returned to the Custodian for long-term storage and disposal.

8.2 Samples are preserved and stored according to the tables in Sample Control SOP 4.1, "Receiving Samples" and 4.6, "Storing Samples." Samples should be received unpreserved and analyzed within the holding time requirements for the parameter of interest. A summary of the holding times are given below.

Parameter	Holding Times
Chloride	28 days
Fluoride	28 days
Nitrate-N	48 hours
Nitrite-N	48 hours
Orthophosphate-P	48 hours
Bromide	28 days
Sulfate	28 days

9.0 Quality Control

9.1 A method blank must be prepared and analyzed with every batch of not more than 20 samples. The method blank value **for any analyte** must not be greater than the reporting limit. If the blank exceeds the reporting limit, stop the run. Determine and correct the problem. Recalibrate. Re-prepare and reanalyze the batch.

9.1.1 To meet the requirements of the DOD-QSM, any analyte in the method blank must be at a concentration ≤ one-half the reporting limit.

9.2 A LCS must be prepared and analyzed with every batch of up to 20 samples. A dilution may be required to achieve a concentration near the calibration mid-point. The result of the LCS must fall within the control limits of 90-110% of the true value. If the LCS analysis results fall outside these control limits, stop the run. Determine and correct the problem. Recalibrate. Re-prepare and reanalyze the batch.

9.3 A matrix spike must be prepared and analyzed with each 10 samples. The recoveries of the matrix spike must be within 90 to 110% of the true value.

9.3.1 For samples prepared and analyzed according to the SW-846 (Method 9056), a matrix spike should be analyzed with each analytical batch or every 20 samples, whichever is more frequent.

9.3.2 If the matrix spike recoveries fall outside the control limits and the method blank and the LCS meet acceptance criteria, the recovery failure is considered to be due to the matrix and not further action is taken.

9.4 A matrix duplicate is required each 10 samples for the SW-846 method. The percent difference between the sample and duplicated should be 20. The preparation and analysis of duplicate matrix spikes in a batch of up to 20 samples may fulfill the duplicate requirement.

9.6 A method detection limit study should be performed every six months or when significant changes to the instrument occur. The MDL is performed for all analytes at approximately two to three times the instrument detection limit.

9.7 Contingency

9.7.1 If due to a lab accident or to QC failures, a re-preparation and analysis are required for the sample and insufficient sample volume remains, the Project Manager must be alerted and will contact the client for direction on how to proceed.

9.7.2 If persistent contamination occurs in the laboratory, analysis must be halted until the source of the contamination can be identified and isolated. When the contamination issue is resolved, samples analysis may proceed.

9.7.3 Any other issues that potentially effect data quality should also be addressed with the Project Manager.

10.0 Calibration and Standardization

10.1 After preparing reagents and standards and setting up and priming the instrument, load the working standards in the XYZ sampler tray in order from highest to lowest concentration. Follow steps given in section 11.0 to perform the calibration.

10.2 The Linear Calibration Range (LCR) must be determined initially and verified every 6 months or whenever a significant change in instrument response is observed or expected.

10.2.1 The initial LCR determination must include enough standards to insure that the resulting curve is linear.

10.2.2 The LCR verification must include a minimum of a blank and 3 standards. If the verification data exceeds ± 10%, the LCR must be reestablished.

10.3 After instrument calibration is complete, the correlation coefficient must be determined to be ≥ 0.995 before sample analysis can begin. An initial calibration verification (ICV) and initial calibration blank (ICB) must be analyzed. The ICV standard is a second source standard. It may be diluted to achieve a concentration near the calibration mid-point. The results ICV analysis must fall within 90-110% of the true value. The absolute ICB value must not be greater than the reporting limit. If these control limits cannot be met, determine and correct the problem, recalibrate and reanalyze until all control limits can be met. Document any instrument maintenance in the instrument maintenance log (Attachment 3).

10.4 A continuing calibration verification (CCV) and a continuing calibration blank (CCB) must be analyzed at a 10% frequency throughout the analytical run and analyzed at the end. The CCV is a mid-range calibration standard. The control limits the CCV are 90-110% of the true value. The CCB must not contain a value above the reporting limit. In the event of a CCV/CCB failure, determine and correct the problem, recalibrate the instrument, and reanalyze all affected samples.

11.0 Procedure

Documentation must follow the requirements in Quality Control SOP 13.6, “Proper Documentation Procedures”. All preventive and routine maintenance must be recorded in the instrument service log (Attachment 2).

11.1 Initializing IC

11.1.2 Place carrier, regenerant, and eluent lines in appropriate solutions.

11.1.3 Turn on computer and IC.

11.1.4 Push initialize button. Initialization will take approximately five minutes. The button light will change from red to orange to green once initialization is complete.

11.1.5 Mode button should be set to PSI. The PSI range is typically 900-1200.

11.1.6 The conductivity detector gain factor is set at 1.

11.1.7 Press Run button. This will start the pump.

11.1.8 Load calibration standards and samples onto the autosampler. Each standard and sample must be syringe filtered through a 0.2 micron filter before being added to the sampling vial.

11.2 Computer sequence

11.2.1 Double click on IC5000 icon.

11.2.2 Click ok on Omnion IC screen. This will initialize the auto sampler.

11.2.3 From the Data System screen, click on IC5000.

11.2.4 Click on File, then new batch. The system will ask "Save current batch file?" Answer yes. A new batch screen will appear.

11.2.5 On the new batch screen complete the following fields.

11.2.6 To choose method, click on blue folder to right. Choose 5_300a1.met file by double clicking.

11.2.7 Leave the data path field as is appears on the screen.

11.2.8 Leave the sample ID column empty.

11.2.9 The file name is the current date, for example, 111907. If multiple runs are performed on a given day follow the date will an alphabet sequence,

for example, 111907a, 111907b, etc. Follow the date with a decimal and then (001), for example, 111907b.(001).

11.2.10 Leave sample amount as 1, ISTD amount as 0, and dilution factor as 1. Enter the total number of standards, QC and samples in the number of runs field.

11.2.11 Click ok. This will make the batch table.

11.3 Completing batch table

11.3.1 Click on the run type cell and choose calibration. Follow this process for all standards associated with the instrument calibration

11.3.2 Scroll across to the Level 1 column. The calibration standards are entered from high to low. This column should start at 1 for the high standard and increase with each lower standard used. If standard concentrations deviate from those stated in this SOP, contact the laboratory supervisor.

11.3.3 After the calibration information, type the QC and CompuChem numbers down the run type column.

11.3.4 Enter the sample IDs associated with the QC and CompuChem numbers in the sample ID column.

11.3.5 All other column information will appear on the screen with appropriate information already entered.

11.3.6 Click on File, Save batch as, and save autosampler table as the file name assigned earlier, for example, 111907a. The file type is *.seq.

NOTE: This step is very important because the system will not analyze a batch that has not been saved.

11.3.7 Once the batch is saved, click on the green run batch arrow icon button on the top toolbar.

11.3.8 Click yes. The batch acquisition screen will appear. The current batch name will appear, if not click on folder to choose correct batch. Check confirm overwriting existing file option. Start run # will be first and end run # will be last. Then click start.

11.4 Instrument Run

11.4.1 The autosampler will start and the instrument calibration will begin. The run time is approximately 12 minutes per sample.

11.4.2 Once the calibration curve is completed, it can be reviewed. Click on Method, review peak calibration curve. Review the calibration for each parameter of interest. If the calibration is acceptable, continue analyzing the batch.

11.4.3 When analysis is complete, generate the instrument run log (Attachment 4) for inclusion in final report.

11.4.4 Place the eluent line in the reagent water and shut down the IC and computer.

11.5 Retention time windows

11.5.1 Retention time windows are established for each analyte after method set-up and after major maintenance, including column change. The width of the retention time windows should be based on actual retention times of standards, assessed over 24 hours. The windows are defined as ± 3X the standard deviation of the absolute retention times of each standard. Analyst experience is critical in the interpretations of chromatograms.

11.5.2 Absolute retention time windows are established for each analyte. For each analyte, the retention time window position establishment is performed once per multipoint calibration and the position is established at the midpoint of the initial calibration curve ± 3X the standard deviation as determined from above.

11.5.3 As indicated in Method 300.0 and in SW-846 Method 9056, ± 3X the standard deviation can be used to calculate a suggested window for each analyte. However, the experience of the analyst should weigh heavily in the interpretation of chromatograms.

12.0 Data Analysis and Calculations

Calculations must be consistent with the Quality Control SOP 13.4, "Numerical Data Reduction".

12.1 Calculation of the mean or average of a set of values:

$$\overline{X} = \frac{\sum_{i=1}^{n} X_i}{n}$$

where: n = total number of values
x_i = each individual value used to calculate the mean
x = the mean of n

12.2 Calculation of the standard deviation of a set of values:

$$\text{Standard deviation} = \sqrt{\frac{\sum_{i=1}^{n}\left(X_n - \overline{X}\right)^2}{n-1}}$$

12.3 Calculation of percent recovery:

12.3.1 LCS:

$$\%R = \frac{Amount\ found}{Amount\ spiked}\ x\ 100$$

12.3.2 Matrix spikes:

$$\%\,R = \frac{Amount\ in\ spiked\ sample - Amount\ in\ unspiked\ (native)\ sample}{Amount\ spiked}\ x\ 100$$

12.4 Calculation of % RSD

$$\%RSD = \left(\frac{Standard\ deviation}{\overline{X}}\right) \times 100$$

12.5 Calculation of RPD

$$RPD = \frac{|Value\ 1 - Value\ 2|}{(Value\ 1 + Value\ 2)/2} x100$$

12.6 Calculation of %Difference (%D)

$$\%Diff = \frac{Value - \overline{Reference\ \ value}}{\overline{Reference\ \ value}} \times 100$$

12.7 Calculating Dilutions

If a sample concentration exceeds the high **initial calibration** standard**,** a dilution must be performed. Determine a level of dilution that will result in a value within the upper half of the calibration range. This is an acceptable dilution. A 10x dilution is performed using 1 mL sample plus 9 mL diluent for a total volume of 10 mL. It should be recorded on the run log as "10x".

13.0 Method Performance

This method was validated through in-house laboratory studies of method and precision and accuracy for single analyst. The data are retained by the QA department.

14.0 Pollution Prevention

The solvents used in this procedure pose little threat to the environment when recycled and managed properly. Pollution prevention encompasses any technique that reduces or eliminates the quantity or toxicity of waste at the point of generation. Numerous opportunities for pollution prevention exist in laboratory operation. The EPA has established a preferred hierarchy of environmental management techniques that places pollution prevention as the management option of first choice. Whenever feasible, laboratory personnel should use pollution prevention techniques to address their waste generation. When wastes cannot be feasibly reduced at the source, the Agency recommends recycling as the next best thing.

15.0 Waste Management

It is the laboratory's responsibility to comply with all federal, state, and local regulations governing waste management, particularly the hazardous waste identification rules and land disposal restrictions, and to protect the air, water, and land by minimizing and controlling all releases from fume hoods and bench operations. Compliance with all sewage discharge permits and regulations is also required. See SOP 12.1, "Hazardous Waste Disposal", regarding laboratory procedures for recycling solvent waste streams.

Samples preserved with HCl, HNO_3, H_2SO_4, NaOH, Zn acetate are hazardous and must be handled as hazardous waste.

Refer to the Hazardous Waste Management and Safety SOPs located in the lab.

16.0 References

16.1 "Test Methods for Evaluating Solid Wastes: Physical/Chemical Methods", SW-846, 3rd Edition, Update III, 12/96, Method 9056.

16.2 EPA/600/R-93-100, "Determination of Inorganic Anions by Ion Chromatography", Revision 2.1, August 1993, Method 300.0

16.3 Standard Methods for the Examination of Water and Wastewater, 20th (1998) Edition, Method 1080

16.4 IC5000 User Manual, Doc#2129, Rev E, April, 1, 2000

16.5 Code of Federal Register, 40 CFR, Part 136, "Guidelines for Establishing Test Procedures for Priority Pollutants"

16.6 Quality Control SOP 13.6, "Proper Documentation Procedures"

16.7 Quality Control SOP 13.4, "Numerical Data Reduction"

16.**8** NELAC Standards, approved June 2003

16.**9** **EPA QA-G6: Guidance for the Preparation of Standard Operating Procedures (SOPs) EPA/600/B-07/001, April, 2007.**

16.**10** **CompuChem Quality Manual, Revision 10, February 19, 2008**

16.11 Department of Defense Quality Systems Manual for Environmental Laboratories, Final Version 3, January 2006

17.0 Attachments as Tables, Diagrams and Flowcharts

17.1 Attachment 1 – Reagent/Standard/QC Preparation Log

17.2 Attachment 2 – Instrument Maintenance Log

17.3 Attachment 3 – Example Instrument Run Log

Attachment 1

Reagent /Standards/QC Preparation for IC Page 1 of 2 File Seq. Number:_____
CompuChem a division of Liberty Analytical Corp. WORKSHEET 1 W(7)

STANDARDS AND REAGENTS TRACEABILITY*	REF#:
Stock A Calibration Standard - Nitrite (50 ppm)	
Stock B Calibration Standard - Fluoride (50 ppm), Bromide (50 ppm), Nitrate (50 ppm), Phosphate, (50 ppm), Chloride (500 ppm), Sulfate (1000 ppm)	
ICV/MS/MSD Stock Standard - Fluoride (500 ppm), Bromide (500 ppm), Nitrate (500 ppm), Nitrite (500 ppm), Phosphate, (500 ppm), Chloride (2000 ppm), Sulfate (2000 ppm)	
Sulfuric acid Sodium bicarbonate	
Sodium carbonate	
REAGENT LOT NUMBER**	**PREPARATION INSTRUCTIONS**
Regenerant solution – 0 1 0 8 0 4 – J M	In a 1L volumetric flask partially filled with reagent water, add 14 mL of sulfuric acid and dilute to volume.
Eluent stock sodium bicarbonate soln. (100mM) – 0 1 0 8 0 4 – J M	Dissolve 8.40 g of sodium bicarbonate into reagent water in a 1 L volumetric flask.
Eluent stock sodium carbonate soln. (100mM) – 0 1 0 8 0 4 – J M	Dissolve 10.60 g of sodium carbonate into reagent water in a 1 L volumetric flask.
Eluent working solution – 0 1 0 8 0 4 – J M	Add to 20 mL of stock sodium bicarbonate solution and 26 mL of stock sodium carbonate solution and dilute in a 1 L volumetric flask with reagent water.
STANDARD LOT NUMBER**	**PREPARATION INSTRUCTIONS**
ICV Working Standard - Fluoride (2.5 ppm), Bromide (2.5 ppm), Nitrate (2.5 ppm), Nitrite (2.5 ppm), Phosphate, (2.5 ppm), Chloride (20 ppm), Sulfate (20 ppm) – 0 1 0 8 0 4 – J M	Place in a 100-ml volumetric flask: 1 ml of ICV Stock Standard Dilute to the mark with reagent water.
Working Standard A - Fluoride (5 ppm), Bromide (5 ppm), Nitrate (5 ppm), Nitrite (5 ppm), Phosphate, (5 ppm), Chloride (50 ppm), Sulfate (100 ppm) – 0 1 0 8 0 4 – J M	Place in a 200-ml volumetric flask: 20 ml of Stock A & B Calibration Standard Dilute to the mark with reagent water.
CCV/LCS - Fluoride (2.5 ppm), Bromide (2.5 ppm), Nitrate (2.5 ppm), Nitrite (2.5 ppm), Phosphate, (2.5 ppm), Chloride (25 ppm), Sulfate (50 ppm) – 0 1 0 8 0 4 – J M	Place in a 100-ml volumetric flask: 50 ml of Working Standard A Dilute to the mark with reagent water.

Standard Solutions Prepared By: _____ Date: _____

Entered By: _____ Date: _____

Reviewed By: _____ Date: _____

*Ref# = Logbook ID, Page number, and item number from Materials Receipt Log
**Standard Lot Number consists of standard ID, date prepared, and initials of preparer.

1/19/06:jad

Attachment 1 (Continued)

Reagent /Standards/QC Preparation for IC Page 2 of 2

CompuChem a division of Liberty Analytical Corp. WORKSHEET 1 W(7)

STANDARD LOT NUMBER**	PREPARATION INSTRUCTIONS
Standard 1 - Fluoride (5 ppm), Bromide (5 ppm), Nitrate (5 ppm), Nitrite (2.5 ppm)m Phosphate, (5 ppm), Chloride (50 ppm), Sulfate (100 ppm) – 0 1 0 8 0 4 – J M	Use Working Standard A listed above.
Standard 2 - Fluoride (3 ppm), Bromide (3 ppm), Nitrate (3 ppm), Nitrite (3 ppm), Phosphate, (3 ppm), Chloride (30 ppm), Sulfate (60 ppm) – 0 1 0 8 0 4 – J M	Place in a 50-ml volumetric flask: 3 ml of Stock A & B Calibration Standard Dilute to the mark with reagent water.
Standard 3 - Fluoride (1 ppm), Bromide (1 ppm), Nitrate (1 ppm), Nitrite (1 ppm), Phosphate, (1 ppm), Chloride (10 ppm), Sulfate (20 ppm) – 0 1 0 8 0 4 – J M	Place in a 50-ml volumetric flask: 1 ml of Stock A & B Calibration Standard Dilute to the mark with reagent water.
Standard 4 - Fluoride (0.4 ppm), Bromide (0.4 ppm), Nitrate (0.4 ppm), Nitrite (0.4 ppm), Phosphate, (0.4 ppm), Chloride (4 ppm), Sulfate (8 ppm) – 0 1 0 8 0 4 – J M	Place in a 50-ml volumetric flask: 0.4 ml of Stock A & B Calibration Standard Dilute to the mark with reagent water.
Standard 5 - Fluoride (0.1 ppm), Bromide (0.1 ppm), Nitrate (0.1 ppm), Nitrite (0.1 ppm), Phosphate, (0.1 ppm), Chloride (1 ppm), Sulfate (2 ppm) – 0 1 0 8 0 4 – J M	Place in a 50-ml volumetric flask: 0.1 ml of Stock A & B Calibration Standard Dilute to the mark with reagent water.
Standard 6 - Fluoride (0.05 ppm), Bromide (0.05 ppm), Nitrate (0.05 ppm), Nitrite (0.05 ppm), Phosphate, (0.05 ppm), Chloride (0.5 ppm), Sulfate (1 ppm) – 0 1 0 8 0 4 – J M	Place in a 50-ml volumetric flask: 0.05 ml of Stock A & B Calibration Standard Dilute to the mark with reagent water.
Standard 7 - Fluoride (0.01 ppm), Bromide (0.01 ppm), Nitrate (0.01 ppm), Nitrite (0.01 ppm), Phosphate, (0.01 ppm), Chloride (0.1 ppm), Sulfate (0.2 ppm) – 0 1 0 8 0 4 – J M	Place in a 50-ml volumetric flask: 0.01 ml of Stock A & B Calibration Standard Dilute to the mark with reagent water.

Standard Solutions Prepared By: _____ Date: _____

Entered By: _____ Date: _____

Reviewed By: _____ Date: _____

*Ref# = Logbook ID, Page number, and item number from Materials Receipt Log
**Standard Lot Number consists of standard ID, date prepared, and initials of preparer. 1/19/06:jad

The presence of the Chemist's/Analyst's employee ID number, or signature, on this run log attests that strict compliance with the method's SOP has occurred. Any SOP deviations require by the documentation responsible chemist/analyst together with the chemist's/analyst's initials and the initials of the lab supervisor and a QA department representative, signifying approval of the deviation.

Attachment 2

CompuChem A division of Liberty Analytical Corp. Logbook 1 U (8) 1

Wet Chemistry Lab Instrument Service: IC1
(Lachat IC 5000, Serial# A50000-415 w/Autosampler ASX-500, Serial# 080137ASX)

Operator: _____ Page ____ of ____

Date: _____ Time: _____ □AM □PM

Explanation of Problem

Total time instrument down: _____ Job complete? □yes □no

Explanation of corrective action

Reviewed By:_____ Date: _____

8/25/05:jad

Attachment 3

Lachat IC 5000 RunLog

Case Name(s): P1810 QI1804

CompuChem
A Division of Liberty Analytical Corp.

Analyst: G. Pattison

Method: c:\omnionic\methods\ic5000\5_300a1.met

Date: 1-8-02

Date	Time	Sample Id	File Name	Fluoride	Chloride	Nitrite-N	Bromide	Nitrate-N	Phosphate-P	Sulfate
12/12/01	11:24:30	Standard 1	c:\omnionic\data\cal1212.001	5	50	5	5	5	5	100
12/12/01	11:39:29	Standard 2	c:\omnionic\data\cal1212.002	3	30	3	3	3	3	60
12/12/01	11:54:28	Standard 3	c:\omnionic\data\cal1212.003	1	10	1	1	1	1	20
12/12/01	12:09:26	Standard 4	c:\omnionic\data\cal1212.004	0.4	4	0.4	0.4	0.4	0.4	8
12/12/01	12:24:25	Standard 5	c:\omnionic\data\cal1212.005	0.1	1	0.1	0.1	0.1	0.1	2
12/12/01	12:39:23	Standard 6	c:\omnionic\data\cal1212.006	0.05	0.5	0.05	0.05	0.05	0.05	1
12/12/01	12:54:22	ICV (NO3 PO4)	c:\omnionic\data\cal1212.007	0	46.671	0	0	4.749	1.508	0.155
12/12/01	13:09:20	ICV (CL F SO4)	c:\omnionic\data\cal1212.008	0.861	44.129	0	0	0	0.078	11.667
12/12/01	13:24:18	ICV (NO2 BR)	c:\omnionic\data\cal1212.009	0	0.245	0.171	0.342	0	0	0.186
12/12/01	13:39:16	ICB	c:\omnionic\data\cal1212.010	0	0.255	0.022	0	0	0.026	0.151
12/12/01	13:54:13	CCV	c:\omnionic\data\cal1212.011	2.448	24.517	2.416	2.448	2.384	2.39	52.54
12/12/01	14:09:11	CCB	c:\omnionic\data\cal1212.012	0	0.195	0	0	0	0.043	0.149

Reviewed by: [signature]

Date: 1-09-02

CompuChem
A Division of
Liberty Analytical Corp.

501 Madison Avenue
Cary, NC 27513

ACCREDITED IN ACCORDANCE WITH

NELAP accredited

SOP DOCUMENTATION FORM

This form must accompany all new and revised Standard Operating Procedures (SOPs) when you turn them in to Quality Assurance for review. Please fill out the entire block below (except effective date).

This is a new procedure _____ revised procedure ✓ outdated procedure (archive) _____

- Procedure Code: IP 801 SOP Section #: 3.6.2.1 Revision #: 13

SOP Title: Total Organic Carbon (TOC) in Water by Standard Methods and SW-846

Effective date: (QA fills in) 6/23/08

- Procedure prepared by: Bob Maione Date: 06-20-2008
- Procedure approved by: (If the manager prepared the SOP, a qualified second party should sign) Date: 06-23-2008
- Reason for change: Update method reference and minor format changes
- This procedure meets the requirements of the following approved method references: SW-846, 3rd Edition, Update III, 12/96, method 9060; Standard Methods for the Examination of Water and Wastewater, 20th Edition, 1998, Method 5310B

Procedure approved by a QA Representative (unless QA Representative signed above):

_____ Date: _____

On an annual basis: Lab managers are required to review lab practices and revise the SOP if necessary. If no revision is necessary, indicate by your signature that the SOP has been reviewed.

Annual Review—Signature: _____ Date: _____

Annual Review—Signature: _____ Date: _____

Annual Review—Signature: _____ Date: _____

Annual Review—Signature: _____ Date: _____

R2-0002083

Instrument Procedure 801: Total Organic Carbon (TOC) in Water, by **Standard Methods** and SW-846

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If the words above are not highlighted, this is an uncontrolled copy of this document.

Instrument Procedure 801: Total Organic Carbon (TOC) in Water, by **Standard Methods** and SW-846

1.0 Scope and Application

This method includes the measurement of organic carbon in surface and saline waters, domestic and industrial wastes. The method is most applicable to measurement of organic carbon above 10 µg/L.

Staff members performing the procedures described in this SOP are responsible for reading, understanding, and complying with the SOP requirements. Supervisors are responsible for directing the analyst to the controlled SOP, and providing adequate explanation of the material contained therein.

This procedure is restricted to use by or under the supervision of analysts experienced in the instrumentation or preparative methods and who have demonstrated the ability to generate acceptable results through QC samples and analyst capability studies.

2.0 Summary of Method

Water samples are analyzed using the combustion catalytic oxidation non-dispersive infrared (NDIR) detector method. Carrier gas is passed through a total carbon combustion tube filled with oxidation catalyst. The water sample is injected into the combustion tube**, after addition of acid and sample purging, both performed automatically by the instrument to remove inorganic carbon.** The **remaining** carbon in the sample is oxidized or decomposes into carbon dioxide (CO_2). The CO_2 is cooled and dehumidified before it passes through the halogen scrubbers into the NDIR detector. The NDIR detector's analog signal forms a peak and the data processor **determines** the peak area **and calculates the TOC result.**

3.0 Definitions

3.1 Method detection limit (MDL) – The minimum concentration of an analyte that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte (40 CFR, Part 136, Appendix B.)

3.2 Reporting Limit – The laboratory reporting limit is based on the lowest multipoint calibration standard concentration. For some inorganic methods, the reporting limit is based on the MDL, and is usually 4 - 8 times higher than the MDL.

3.3 Reporting Units – mg/L

3.4 An SDG is defined by the following, whichever is more frequent:

- each 20 field samples received within a case, or
- each 7 calendar day period during which field samples in a case are received (14 calendar days if requested by client) beginning with the receipt of the first sample.

NOTE: The DOD-QSM and SC DHEC do not accept the SDG approach, unless the samples are prepared in a single batch. When a group of up to 20 field samples of a similar matrix are prepared as one batch, method-specified QC samples such as a method blank, laboratory control sample, matrix spike, matrix spike duplicate, and matrix duplicate must also be prepared together at a rate of 5% for **DOD-QSM.** If samples are batched together from different sites, project-specific QC must be processed.

3.6 CCV = Continuing Calibration Verification

3.7 ICV = Initial Calibration Verification

3.8 SC DHEC – South Carolina Department of Health and Environmental Control

3.9 DOD-QSM – Department of Defense Quality Systems Manual

3.10 Nonpurgeable Organic Carbon – This is commonly referred to as TOC and is the organic carbon remaining in an acidified sample after purging the sample with a gas.

4.0 Interferences

4.1 Carbonate and bicarbonate carbon represent interference under the terms of this test and must be removed or accounted for in the final calculation.

4.2 This procedure is applicable only to homogenous samples that can be injected into the apparatus reproducibly by means of a microliter type syringe or pipette. The openings of the syringe or pipette limit the maximum size of particles that may be included in the sample.

5.0 Safety

5.1 Appropriate protective equipment and clothing must be used under the assumption that all samples are potentially hazardous. During sample preparation safety glasses, gloves and lab coats are a minimum requirement. The persistent presence of noxious odors may be indicative of failure of the laboratory ventilation system and must be reported to a supervisor or manager.

5.2 Laboratory staff must review the Chemical Hygiene Plan for general safety policies, and Material Safety Data Sheets for reagents used in the laboratory.

6.0 Equipment **and** Supplies

6.1 TOC analyzer - Shimadzu, TOC-VCSH, model # H51104335168

6.1.1 Automatic sample injector - ASI-V, model # H52104301622

61.2 Solid sample analyzer – SMM-5000A, model # H525043

6.2 Glassware is prepared by hand washing with a non-phosphate biodegradable detergent, then rinsed 3 times with deionized water.

6.3 Automatic Pipeters – various

6.4 40 mL glass vials with Teflon®-lined screw caps, purchased pre-cleaned **from vendor**

7.0 Reagents **and** Standards

Standards and reagent traceability information must be documented on the Standards/QC Sample Preparation for TOC Waters log sheet.

7.1 Reagent water - All water used during preparation should be reagent-grade Type I with regard to resistivity of >10 megohm-cm (20th Edition of Standard Methods, Method 1080), and referred throughout this SOP as DI water.

7.2 Phosphoric acid - reagent grade, for all acidifications

7.3 Potassium hydrogen phthalate (KHP) - reagent grade, for standards. This standard can be used to prepare standards if a commercially prepared standard is not available.

7.4 Stock Standards

7.4.1 TOC Stock Standard

A 10,000 ppm stock standard **can be** prepared by dissolving 4.**251** g of KHP (potassium hydrogen phthalate) in 200 mL of DI water. Alternately, it may be purchased with **Certificate of Analysis (COA)** from **a** vendor**, which is the approach used by the laboratory. The laboratory purchases a 10,000 ppm stock standard from Science Stuff, Inc. (Part # 9578).**

7.4.2 TOC Check Stock Standard

A 2,000 ppm stock standard **can be** prepared by dissolving 0.**850** g of KHP in 200 mL of DI water. Alternately, it may be purchased with **a COA from a second source vendor, which is the approach used by the laboratory. The laboratory purchases a 2,000 ppm stock standard from Science Stuff, Inc. (Part # 9575).**

7.4.3 TOC Second Source Standard

A 1,000 ppm second source standard is purchase, with a COA from Alfa Aesar (Specpure Stock # 42562). This material is used to prepare the ICV and LCS.

7.5 Calibration Standard

7.5.1 A 100 ppm standard is prepared by diluting 0.5 mL of the 10,000 ppm standard to 50 mL of DI water and adding approximately 100 µL of concentrated sulfuric as a preservative. This standard is automatically diluted by the instrument**'**s autosampler to 0.0, 0.5, 25, 50, and 100 ppm and used to calibrate the instrument. Make fresh monthly.

7.6 Calibration Verification (ICV, CCV), Laboratory Control Sample (LCS), & Matrix Spikes (MS/MSD)

7.6.1 The second source standard is used to verify the integrity of the initial calibration curve. This **75** ppm standard is referred to as the ICV and also serves as the laboratory control sample (LCS). The **75** ppm standard is prepared by diluting **7.5 mL** of the **1,000** ppm **second source standard** to **100** mL of DI water and adding approximately 100 **µL** of concentrated sulfuric as a preservative. Make fresh monthly.

The 50 ppm CCV standard is prepared each calibration day by diluting 1.25 mL of the 2,000 ppm TOC Check Stock Standard to 50 mL of DI water and adding approximately 100 µL of concentrated sulfuric acid as a preservative.

7.7 Purge and Carrier Gas

7.7.1 Oxygen is used as both the purge and carrier gas for the procedure.

8.0 Sample Preservation and Storage

8.1 Samples are preserved and stored according to the tables in Sample Control SOP 4.1, "Receiving Samples" and 4.6, "Storing Samples." Sample holding times are also listed.

8.2 Sampling and storage of samples in glass bottles is preferable although plastic is permissible, provided if free of organic contaminants.

8.3 Samples should be kept cool at 4°C and protected from sunlight and atmospheric oxygen with no headspace due to the possibility of oxidation or bacterial decomposition.

8.4 The sample must be acidified to a pH <2 with H_2SO_4. **This invalidates any inorganic carbon determinations in the sample.**

8.5 Samples must be analyzed within 28 days of collection.

9.0 Quality Control

9.1 A **75** ppm initial calibration verification (ICV) standard, prepared from a second source**,** is run immediately after the instrument is calibrated.

9.1.1 The ICV also serves as the laboratory control sample (LCS). A laboratory control sample is prepared and analyzed **after every 10 samples to meet the requirements of Standard Methods 5310B and every 15 samples to meet the requirements of SW-846 Method 9060.**

9.1.2 The acceptance criteria for the LCS **tests are** recover**ies** between 90% and 110%. If the LCS recovery is not between 90% and 110%, re-analyze the LCS. If confirmed out of range, re-calibrate the instrument and re-analyze. All samples associated with that LCS must also be reanalyzed. An LCS is analyzed for each sample batch.

9.2 An initial calibration blank (ICB) consisting of reagent water is run after the ICV. This result must not be greater than the reporting limit or reanalysis is required.

9.2.1 The ICB also serves as the method blank. A method blank must be analyzed with every sample batch analyzed. The **analyte content** must be less than the reporting limit. If **the blank contains TOC** greater than the reporting limit, reanalyze the blank. If **the** result is confirmed high, recalibrate the instrument and re-analyze.

9.2.1.1 To meet the requirements of the DOD-QSM, the contents of the analyte in the blank has to be ≤ one-half the reporting limit.

9.3 A matrix spike (MS) and matrix spike duplicate (MSD) are prepared and analyzed with every batch of up to 20 samples. The MS/MSD **samples** are prepared by adding 500 µL of the **2,000 ppm** standard to a **20 mL** sample aliquot, yielding a spike amount of 50 ppm. Note: 500 µL should be entered into the analyzer to make the calculation correct.

The acceptance criteria for the MS/MSD **samples** are 75 - 125% spike recovery and ≤ 20% Relative Percent Difference (RPD). If the MS/MSD does not meet the acceptance criteria, the LCS must be evaluated to determine if the process is in control and to confirm a sample matrix effect. In cases of confirmed matrix effect the data will be reported.

9.**4** Contingency

9.**4.**1 If due to a lab accident or to QC failures, a re-preparation and analysis are required for the sample and insufficient sample volume remains, the Project Manager must be alerted and will contact the client for direction on how to proceed.

9.**4**.2 If persistent contamination occurs in the laboratory, analysis must be halted until the source of the contamination can be identified and isolated. When the contamination issue is resolved, samples analysis may proceed.

9.4.3 Any other issues that potentially effect data quality should also be addressed with the Project Manager.

10.0 Calibration **and** Standardization

10.1 Calibration

10.1.1 The TOC analyzer is calibrated using aqueous **TOC** standard solutions at concentrations **of 0.0** (calibration blank), 5, 25, 50 and 100 ppm.

10.1.2 Turn on the TOC-VCSH TOC analyzer. Adjust the oxygen flow rate to 40 psi. If necessary, verify a gas flow rate of 200 cc/minute, or 40 psi, coming out of the detector using a flow meter. Verify the baseline is stable and low (less than 20 ppm).

10.1.3 Load a 40 mL vial containing the 100ppm TOC stock standard solution onto the instrument's autosampler.

10.1.4 Set up the instrument's sample table to perform the proper dilutions of the TOC standard stock solution to complete the initial calibration. The total injection volume is 500 µL.

10.1.5 The calibration curve must have a correlation coefficient of ≥ 0.995.

10.2 Verifying the Calibration

10.2.1 The initial calibration is verified by analyzing the **75** ppm ICV standard and a blank or ICB. The ICV results must be within ± 10% of the true value and the ICB < the reporting limit. If the ICV fails, re-analyze. If the re-analysis, analyze a new initial calibration.

10.2.1.1 To meet the requirements of the DOD-QSM, the contents of the analyte in the blank has to be ≤ one-half the reporting limit.

10.2.2 A 50 ppm continuing calibration verification (CCV) standard and a continuing calibration blank (CCB) are analyzed, after every 10 samples, and at the end of the analytical sequence. The results of the CCV must be within ± 10% of the true value and the CCB < the reporting limit. If the CCV fails, reanalyze it once. If it still fails, the instrument must be recalibrated and the previous samples since the last passing CCV/CCB must be reanalyzed.

10.2.2.1 To meet the requirements of the DOD-QSM, the contents of the analyte in the blank has to be ≤ one-half the reporting limit.

11.0 Procedure

Documentation must follow the requirements in Quality Control SOP 13.6, "Proper Documentation Procedures".

11.1 Turn on the TOC-VCSH TOC analyzer.

11.2 Adjust the oxygen flow rate to 40 psi.

11.3 Verify that sample pH is < 2.

11.3.1 Samples that require dissolved organic carbon (DOC) analysis must be filtered through a 0.45 micron filter before analysis

11.4 Place the 40 mL vial containing the sample **into** the autosampler **after thoroughly shaking the vial.**

11.3 On the instruments computer, open a new file in the TOC-Control V sample table. Select run, then TOC system. Save the file name and create a sample table.

11.3.1 View the ASI/8port sampler vials and insert samples (in the order that they are loaded onto the autosampler) into the sample table.

12.0 Data Analysis **and** Calculations

Calculations must be consistent with the Q**uality** C**ontrol** SOP **13.6 "**Numerical Data Reduction**"**.

12.1 Calculation of the mean or average of a set of values:

$$\overline{X} = \frac{\sum_{i=1}^{n} X_i}{n}$$

where: n = total number of values
x_i = each individual value used to calculate the mean
x = the mean of n

12.2 Calculation of the standard deviation of a set of values:

$$\text{Standard deviation} = \sqrt{\frac{\sum_{i=1}^{n}\left(X_n - \overline{X}\right)^2}{n-1}}$$

12.3 Calculation of percent recovery:

12.3.1 LCS and surrogates:

$$\%R = \frac{Amount\ found}{Amount\ spiked}\ x\ 100$$

12.3.2 Matrix spikes:

$$\%\ \mathrm{R} = \frac{Amount\ in\ spiked\ sample\ -\ Amount\ in\ unspiked\ (native)\ sample}{Amount\ spiked}\ x\ 100$$

12.4 Calculation of % RSD

$$\%\mathrm{RSD} = \left(\frac{Standard\ deviation}{\overline{\mathrm{X}}}\right) \times 100$$

12.5 Calculation of RPD

$$RPD = \frac{|Value\ 1\ -\ Value\ 2|}{(Value\ 1\ +\ Value\ 2)/2} x100$$

12.6 Calculation of %Difference (%D)

$$\%Diff = \frac{Value - \overline{Reference\ \ value}}{\overline{Reference\ \ value}}\ x\ 100$$

12.7 Concentration

$$mg/L = \frac{peak\ area\ of\ sample}{peak\ area\ from\ standard}\ x\ concentration\ of\ standard$$

The TOC-VCSH TOC analyzer calculates the concentration of organic carbon automatically.

13.0 Method Performance

This method was validated through in-house laboratory studies of method detection limits and precision and accuracy for single analyst. The data are retained by the QA department.

14.0 Pollution Prevention

The solvents used in this procedure pose little threat to the environment when recycled and managed properly. Pollution prevention encompasses any technique that reduces or eliminates the quantity or toxicity of waste at the point of generation. Numerous opportunities for pollution prevention exist in laboratory operation. The EPA has established a preferred hierarchy of environmental management techniques that places pollution prevention as the management option of first choice. Whenever feasible, laboratory personnel should use pollution prevention techniques to address their waste generation. When wastes cannot be feasibly reduced at the source, the Agency recommends recycling as the next best thing.

15.0 Waste Management

It is the laboratory's responsibility to comply with all federal, state, and local regulations governing waste management, particularly the hazardous waste identification rules and land disposal restrictions, and to protect the air, water, and land by minimizing and controlling all releases from fume hoods and bench operations. Compliance with all sewage discharge permits and regulations is also required. See SOP 12.1, Hazardous Waste Disposal, regarding laboratory procedures for recycling solvent waste streams.

Samples preserved with H_2SO_4 to pH <2 are hazardous and must be handled as hazardous waste.

Refer to the Hazardous Waste Management and Safety SOPs located in the lab.

16.0 References

16.1 Standard Methods for the Examination of Water and Wastewater, 20th Edition (1998), Method 1080 **and Method 5310B.**

16.2 "Test Methods for Evaluating Solid Wastes: Physical/Chemical Methods", SW-846, 3rd Edition, Update III, 12/96, Method 9060

16.3 Quality Control SOP 13.6, "Proper Documentation Procedures"

16.4 Quality Control SOP 13.4, "Numerical Data Reduction"

16.5 NELAC Standards, June 2003

16.6 EPA QA/G6: Guidance for Preparing Standard Operating Procedures (SOPs) EPA/600/B-07/001, April, 2007

16.7 CompuChem Quality Manual, Revision 10, February 19, 2008

16.8 Department of Defense Quality Systems Manual for Environmental Laboratories, Final Version 3, January 2006

17.0 Attachments as Tables, Diagrams, **and** Flowcharts

17.1 Standards/QC Sample Preparation for TOC Waters log sheet

Attachment 1

Standards/QC Preparation for TOC Waters Case Name(s):_____

COMPUCHEM a division of Liberty Analytical Corp WORKSHEET 1 G(8)

STANDARDS AND REAGENTS TRACEABILITY*	REF #:
TOC Stock 10,000 ppm Standard	1U(6)1-11-3
TOC Check 2,000 ppm (Second Source) Standard	1U(6)1-11-2
Phosphoric Acid	1U(6)1-9-2
Conc. Sulfuric Acid	1M2-178-28
REAGENT/STANDARD LOT NUMBER**	**PREPARATION INSTRUCTIONS**
Calibration Standard – 0 8 2 6 0 6 – J M	A 100 ppm standard is prepared by diluting 0.5 ml of the 10,000 ppm standard to 50 ml of DI water and adding approximately 100 ul of concentrated sulfuric as a preservative. This standard is used to calibrate the instrument and constitutes the linear limit. Make fresh monthly.
Calibration Verification – 0 8 2 6 0 6 – J M (ICV, CCV, LCS, MS/MSD)	Diluting 1.25 ml of the 2,000 ppm stock standard to 50 ml of DI water and adding approximately 100 ul of concentrated sulfuric as a preservative. Make fresh monthly.

Standard Solutions Prepared By: _____ Date: _____

Entered By: _____ Date: _____

Reviewed By: _____ Date: _____

*Ref# = Logbook ID, Page number, and item number from Materials Receipt Log
**Standard Lot Number consists of standard ID, date prepared, and initials of preparer. 10/02/06:jad

The presence of the Chemist's/Analyst's employee ID number, or signature, on this run log attests that strict compliance with the method's SOP has occurred. Any SOP deviations require documentation by the responsible chemist/analyst together with the chemist's/analyst's initials and the initials of the lab supervisor and a QA department representative, signifying approval of the deviation.

Standard Operating Procedures for Specific Conductance (COND) Calibration
Golder SOP 101

Method: EPA 120.1
Date: May 27, 2005
Revision No.: 0
Signature of Golder's Quality Assurance Officer: _____

Purpose: Golder SOP 101 provides the procedures required for calibrating specific conductance (COND) measurements (in mS/m or S/m) of groundwater using the Horiba U-22 and/or U-10 to meet the current requirements of the NJ Department of Environmental Protection (NJDEP) Environmental Laboratory/Measurement Certification Program under the Regulations Governing the Certification of Laboratories and Environmental Measurements, N.J.A.C. 7:18 et seq.

Equipment & Supplies Needed:

Meter: Horiba U-22 or U-10
Meter Specifications: Four (4) AC electrode meter with temperature compensation; range 0 to 9.99 S/m; resolution 0.1% of full scale, repeatability +/- 1%; accuracy +/- 3%
Calibration Standards: 1.00 mS/m COND standard and distilled water.

Procedures:

1. Visually inspect specific conductivity electrode for cleanliness. If the probe is soiled, it may be cleaned by gently wiping with a paper towel, and/or using a diluted Alconox solution. Rinse the probe with distilled water, then completely dry the water from the electrode.
2. To begin the initial calibration in air, press the CAL key twice in the COND measurement mode. MAN, ZERO, and CAL will be indicated.
3. When the readout stabilizes, record COND value and the time.
4. Scroll with the UP/DOWN keys and adjust COND read-out to 0.0, then press the ENT key. Record the adjusted reading.
5. When DATA IN stops blinking, immerse the probe in the 1.00 mS/m standard, occasionally stirring the solution.
6. Press the CAL key once. MAN, SPAN, and CAL will be indicated.
7. When the readout stabilizes, record the COND value and the time.
8. Scroll with the UP/DOWN keys and adjust COND read-out to 1.00, then press the ENT key. (Note that if the readout value is less than 1.00, the meter can be adjusted to only 0.999.) Record the adjusted reading.
9. When DATA IN stops blinking, remove probe from standard and discard the solution.
10. Press the MEAS key to return to the measurement mode.
11. Rinse the probe with distilled water and dry before use.

Schedule: Meter must be calibrated daily prior to initial use, at a minimum.

Documentation: Written documentation must be provided in a bound Calibration Log Notebook, and must include: instrument identification and serial number; date and time of calibration; buffer lot number and expiration date; calibration values and results; adjustments made (if any); and name of person performing the calibration. In addition, any maintenance performed on the meter must be recorded in the notebook. All calibration data must be signed, initialed, and dated by the analyst. The Calibration Log Notebook must be retained for at least five (5) years after last entry.

References: Horiba U-20 Series Operation Manual, EPA method 120.1 and N.J.A.C. 7:18 et seq.

R2-0002097

Standard Operating Procedures for Dissolved Oxygen (DO) Calibration - Daily
Golder SOP 102a

Method: SM 4500-O G
Date: January 22, 2008
Revision No.: 2
Signature of Golder's Quality Assurance Officer: [Lab Manager]

Purpose: Golder SOP 102a provides the procedures required for daily calibration of dissolved oxygen (DO) measurements (in mg/l) of groundwater using the Horiba U-22 and/or U-10 to meet the current requirements of the NJ Department of Environmental Protection (NJDEP) Environmental Laboratory/Measurement Certification Program under the Regulations Governing the Certification of Laboratories and Environmental Measurements, N.J.A.C. 7:18 et seq.

Equipment & Supplies Needed:

Meter: Horiba U-22 or U-10
Meter Specifications: Diaphragm galvanic battery method with temperature compensation; range 0-19.99 mg/l; resolution 0.01 mg/l; repeatability ± 0.1 mg/l; accuracy ± 0.2 mg/l.
Calibration Standards: Zero percent DO (sodium sulfite) solution and air-saturated water

Procedures:

1. Visually inspect DO sensor for cleanliness (e.g. salt build-up) and membrane integrity (e.g. holes). Clean and/or repair as needed. Rinse sensor with distilled water.
2. Immerse sensor in Zero percent DO solution.
3. Press the CAL key twice in the DO mode. MAN, ZERO, and CAL will be indicated.
4. When the readout stabilizes, record the DO value and time.
5. Scroll with the UP/DOWN keys to adjust the DO read-out value to 0.0, then press the ENT key. Record the adjusted reading.
6. When DATA IN stops blinking, remove the sensor from the solution and rinse with distilled water.
7. Immerse sensor in air-saturated water.
8. Press the CAL key once. MAN, SPAN, and CAL will be displayed.
9. When the readout stabilizes, record the DO and time.
10. Compare the readout to Table 1 (attached). Scroll with the UP/DOWN keys to adjust the DO readout to match the appropriate Table 1 values according to sample temperature (on read-out screen).
11. Press the ENT key and record the adjusted value.
12. When DATA IN stops blinking, press MEAS key to return to the measurement mode.

Schedule: Meter must be calibrated using this method on a daily basis, at a minimum. In addition, meter must be calibrated weekly using the Winkler method - see Golder SOP 102b.

Documentation: Written documentation must be provided in a bound Calibration Log Notebook, and must include: instrument identification and serial number; date and time of calibration; buffer lot number and expiration date; calibration values and results; adjustments made (if any); and name of person performing the calibration. In addition, any maintenance performed on the meter must be recorded in the notebook. All calibration data must be signed and dated by the analyst. The Calibration Log Notebook must be retained for at least five (5) years after last entry.

References: Horiba U-20 Series Operation Manual, Standard Method 4500-O G and N.J.A.C. 7:18 et seq.

R2-0002098

Table 1
Amounts of saturated dissolved oxygen in water at various temperatures (salinity =0.0%).

Temp.(°C)	DO (mg/L)
0	14.16
1	13.77
2	13.40
3	13.04
4	12.70
5	12.37
6	12.06
7	11.75
8	11.47
9	11.19
10	10.92
11	10.67
12	10.43
13	10.20
14	9.97
15	9.76
16	9.56
17	9.37
18	9.18
19	9.01
20	8.84
21	8.68
22	8.53
23	8.39
24	8.25
25	8.11
26	7.99
27	7.87
28	7.75
29	7.64
30	7.53

Source: JIS KO101 Horiba U-20 Series Operation Manual, 2001

R2-0002099

Standard Operating Procedures for Dissolved Oxygen (DO) Calibration - Weekly
Golder SOP 102b

Method: SM 4500-O C.
Date: January 23, 2008
Revision No.: 3
Signature of Golder's Quality Assurance Officer: _____ [Lab Manager]

Purpose: Golder SOP 102b provides the procedures required for weekly calibration of dissolved oxygen (DO) measurements (in mg/l) of groundwater using the Horiba U-22 and/or U-10 to meet the current requirements of the NJ Department of Environmental Protection (NJDEP) Environmental Laboratory/Measurement Certification Program under the Regulations Governing the Certification of Laboratories and Environmental Measurements, N.J.A.C. 7:18 et seq.

Equipment & Supplies Needed:

Meter: Horiba U-22 or U-10
Meter Specifications: Diaphragm galvanic battery method with temperature compensation; range 0-19.99 mg/L; resolution 0.01 mg/L; repeatability ± 0.1 mg/L; accuracy ± 0.2 mg/L.
Test Kit: Hach Dissolved Oxygen Test Kit Model No. OX-DT
Calibration Standards: Sodium Thiosulfate Titration Cartridge (0.200 N), Sodium Thiosulfate Titration Cartridge (2.0 N), and Starch Indicator Solution.

Procedures:

1. Follow the attached procedures (pages 2-5 of this SOP) to calculate the DO of a distilled water solution.
2. On the same sample, follow SOP 202 for Collection of Dissolved Oxygen to collect a reading using the field DO meter.
3. Compare the results of the Winkler method and the field meter. The results must be within +/- 0.2 mg/L.
4. If the results are greater than 0.2 mg/L, recalibrate the field meter, then reanalyze the sample.
5. If the results are still greater than 0.2 mg/L, perform cleaning or replacement of the DO membrane and/or probe.
6. The field meter cannot be used if the results are not within 0.2 mg/L.

Schedule: Meter must be calibrated using this method ("Winkler Method") on a weekly basis, at a minimum. In addition, meter must be calibrated daily using Golder SOP 102a.

The Winkler Method procedures must be completed within 8 hours of adding the reagents due to instability of the solution once reagents are added. The strength of the Sodium Thiosulfate Standard solution must be checked quarterly in accordance with the attached procedure.

Documentation: Written documentation must be provided in a bound Calibration Log Notebook, and must include: instrument identification and serial number; date and time of calibration; buffer lot number and expiration date; calibration values and results; adjustments made (if any); and name of person performing the calibration. In addition, any maintenance performed on the meter must be recorded in the notebook. All calibration data must be signed and dated by the analyst. The Calibration Log Notebook must be retained for at least five (5) years after last entry.

References: Hach DO Test Kit Model OX-2P Instructions Manual, Standard Method 4500-O C and N.J.A.C. 7:18 et seq.

R2-0002100

Manufacturer's Procedures to Calculate & Check Dissolved Oxygen

Methods 8215 and 8332

OXYGEN, DISSOLVED (1 to greater than 10 mg/L as DO)

Azide Modification of Winkler Method

Using a 300-mL BOD Bottle **Method 8215**

1. Collect a water sample in a clean 300-mL BOD Bottle.

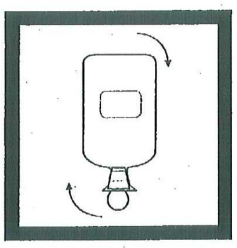
Note: *Allow the sample to overflow the bottle for 2-3 minutes to ensure air bubbles are not trapped.*

Note: *If samples cannot be analyzed immediately, see Sampling and Storage on page 152.*

2. Add the contents of one Manganous Sulfate Powder Pillow and one Alkaline Iodide-Azide Reagent Powder Pillow.

3. Immediately insert the stopper so air is not trapped in the bottle. Invert several times to mix.

Note: *A flocculent precipitate will form. It will be orange-brown if oxygen is present or white if oxygen is absent. The floc settles slowly in salt water and normally requires 5 additional minutes before proceeding to step 5.*

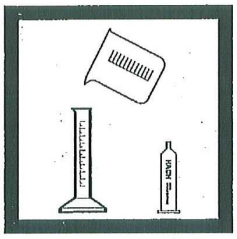


4. Wait until the floc in the solution has settled. Again invert the bottle several times and wait until the floc has settled.

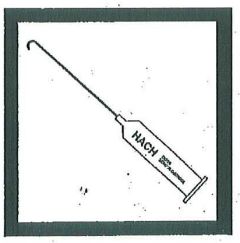
Note: *Waiting until floc has settled twice assures complete reaction of the sample and reagents.*

5. Remove the stopper and add the contents of one Sulfamic Acid Powder Pillow. Replace the stopper without trapping air in the bottle and invert several times.

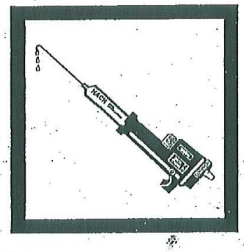
Note: *The floc will dissolve and leave a yellow color if oxygen is present.*



6. Select a sample volume and Sodium Thiosulfate Titration Cartridge corresponding to the expected dissolved oxygen (D.O.) concentration from *Table 1*.



7. Insert a clean delivery tube into the titration cartridge. Attach the cartridge to the titrator body. See *General Description, Step-by-Step* for assembly instructions, if necessary.



8. Turn the delivery knob to eject a few drops of titrant. Reset the counter to zero and wipe the tip.

Note: *For added convenience use the TitraStir® Stir Plate. See General Description, Step 3 in Step-by-Step.*

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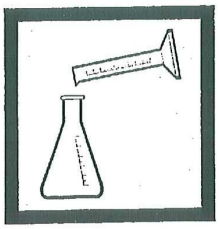
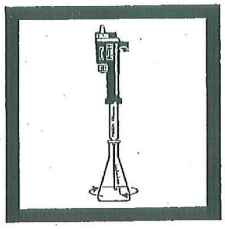
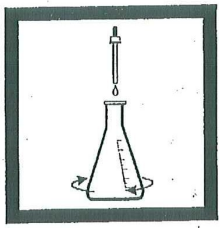
OXYGEN, DISSOLVED, continued



9. Use a graduated cylinder to measure the sample volume from *Table 1*. Transfer the sample into a 250-mL Erlenmeyer flask.

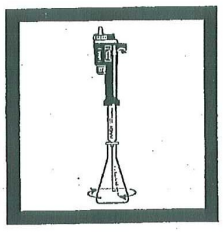


10. Place the delivery tube tip into the solution and swirl the flask while titrating with sodium thiosulfate to a pale yellow color.



11. Add two 1-mL droppers of Starch Indicator Solution and swirl to mix.

Note: *A dark blue color will develop.*



12. Continue the titration to a colorless end point. Record the number of digits required.

13. Calculate:

Digits Required x Digit Multiplier = mg/L Dissolved Oxygen

Table 1

Range (mg/L D.O.)	Sample Volume (mL)	Titration Cartridge (N $Na_2S_2O_3$)	Catalog Number	Digit Multiplier
1-5	200	0.200	22675-01	0.01
2-10	100	0.200	22675-01	0.02
>10	200	2.000	14401-01	0.1

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Sampling and Storage

Sampling and sample handling are important in obtaining meaningful results. The dissolved oxygen content of the sample changes with depth, turbulence, temperature, sludge deposits, light, microbial action, mixing, travel time, and other factors. A single dissolved oxygen test rarely reflects the over-all condition of a body of water. Several samples taken at different times, locations and depths are recommended for most reliable results.

Collect samples in clean BOD Bottles (see *step 1*). If storage is necessary, run steps 1-5 of the procedure and store in the dark at 10-20 ° C. Seal the bottle with water by pouring a small volume of water into the flared lip area of a stopper bottle. Snap a BOD Bottle Cap over the flared lip. Samples preserved like this can be held 4-8 hours. Begin with *step 6* when analyzing.

Accuracy Check

Check the strength of the Sodium Thiosulfate Solution by using an Iodate-Iodide Standard Solution which is equivalent to 10 mg/L dissolved oxygen. For the 300-mL procedure, begin at *step 5* adding the Sulfamic Acid Powder Pillow. For the 60-mg/L procedure, begin the analysis at *step 5* adding the Dissolved Oxygen 3 Powder Pillow. The titration should take 10 mL. If

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OXYGEN, DISSOLVED, continued

more than 10.5 mL is required to reach the end point, replace the Sodium Thiosulfate Solution.

Interferences

Nitrite interference is eliminated by the azide in the reagents. Other reducing or oxidizing substances may interfere. If these are present, use an alternate method, such as the High Range Dissolved Oxygen Method (colorimetric) in this manual, or a dissolved oxygen electrode.

Summary of Method

Samples are treated with manganous sulfate and alkaline iodide-azide reagent to form an orange-brown precipitate. Upon acidification of the sample, this floc reacts with iodide to produce free iodine as triiodide in proportion to the oxygen concentration. The iodine is titrated with sodium thiosulfate to a colorless end point.

R2-0002104

Standard Operating Procedures for Temperature (TEMP) Calibration
Golder SOP 103

Method: SM 2550 B.
Date: January 22, 2008
Revision No.: 2
Signature of Golder's Quality Assurance Officer: [Lab Manager]

Purpose: Golder SOP 103 provides the procedures required for calibration of temperature measurements (in °C) of groundwater using the Horiba U-22 and/or U-10 to meet the current requirements of the NJ Department of Environmental Protection (NJDEP) Environmental Laboratory/Measurement Certification Program under the Regulations Governing the Certification of Laboratories and Environmental Measurements, N.J.A.C. 7:18 et seq.

Equipment & Supplies Needed:

Meter: Horiba U-22 or U-10
Meter Specifications: Thermistor sensor; range 0 to 55 °C; resolution 0.01 °C; repeatability ± 0.3 °C; accuracy ± 1.0 °C.
Calibration Standard: National Institute of Standards and Technology (NIST) certified thermometer graduated in 0.1 °C increments.

Procedures:

1. Place the temperature probe and certified NIST thermometer in a room temperature container of water.
2. Allow temperature read-out to stabilize. Record meter and NIST thermometer readings and time.
3. Press the CAL once in the temperature measurement mode. MAN, SPAN, and CAL will be indicated.
4. Scroll using the UP/DOWN keys to adjust the temperature read-out to the value indicated by the certified NIST thermometer. Press the ENT key and record the adjusted reading.
5. When DATA IN stops blinking, the calibration is complete. Press the MEAS key to return to the measurement mode.

Schedule: Meter must be calibrated quarterly, at a minimum, to a certified NIST thermometer.

Documentation: Written documentation must be provided in a bound Calibration Log Notebook, and must include: instrument identification and serial number; date and time of calibration; NIST ID number; correction factors (if applicable); calibration values and results; adjustments made (if applicable); and name of person performing the calibration. In addition, any maintenance performed on the meter must be recorded in the notebook. All calibration data must be signed and dated by the analyst. The Calibration Log Notebook must be retained for at least five (5) years after last entry.

Note: Alternatively, the meter can sent to a facility with a NIST certified thermometer to perform the quarterly calibration. If the meter is sent off-site for calibration, all associated certification forms must be retained for at least five (5) years after final use of meter.

References: Horiba U-20 Series Operation Manual, Standard Method 2550 B and N.J.A.C. 7:18 et seq.

R2-0002105

Standard Operating Procedures for pH Calibration
Golder SOP 104

Method: SM 4500-H^+ B.
Date: January 23, 2008
Revision No.: 2
Signature of Golder's Quality Assurance Officer: [Lab Manager]

Purpose: Golder SOP 104 provides the procedures required for calibration of pH measurements (in standard units S.U.) of groundwater using the Horiba U-22 and/or U-10 to meet the current requirements of the NJ Department of Environmental Protection (NJDEP) Environmental Laboratory/Measurement Certification Program under the Regulations Governing the Certification of Laboratories and Environmental Measurements, N.J.A.C. 7:18 et seq.

Equipment & Supplies Needed:

Meter: Horiba U-22 or U-10

Meter Specifications: Glass sensor with temperature compensation; range 0 to 14 S.U.; resolution 0.01 S.U.; scale readability ±0.1 S.U.; repeatability ±0.05 S.U.; accuracy ±0.1 S.U.

Calibrations Standards: Per manufacturer specifications for manual calibration, pH 7 buffer must be used for "zero" calibration. The span calibration standard can be either pH 4 or pH 9 buffer. Calibration buffers must bracket sample pH. For example if the assumed pH of a sample is 5.6, then the pH 4 and pH 7 buffers should be used. Conversely, if a pH value of 8.3 is expected, calibrate with pH 7 and pH 9 buffers.

Procedures:

1. Visually inspect pH sensor for cleanliness (e.g. salt build-up) and integrity (e.g. cracks). Clean with dilute Alconox solution and/or repair as needed. Rinse sensor with distilled water.
2. Immerse the sensor in pH 7.00 buffer, occasionally stirring the solution.
3. Press the CAL key twice in the pH measurement mode. MAN, ZERO, and CAL will be indicated.
4. When the readout stabilizes, record pH and time.
5. Scroll using the UP/DOWN keys to input 7.00, then press the ENT key. Record the adjusted reading.
6. When DATA IN stops blinking, remove the sensor from the 7.00 buffer and rinse sensor with distilled water.
7. Immerse the sensor in pH 4.00 (or pH 9.00) buffer, occasionally stirring the solution.
8. Press the CAL key once. MAN, SPAN, and CAL will be indicated.
9. When the readout stabilizes, record the pH and time.
10. Scroll using the UP/DOWN keys to input 4.00 (or 9.00), then press the ENT key. Record the adjusted reading.
11. When DATA IN stops blinking, remove the sensor from the 4.00 (or 9.00) buffer and rinse the sensor with distilled water.
12. Press the MEAS key to return to the measurement mode.
13. Immerse the sensor in pH 9.00 (or pH 4.00) buffer, occasionally stirring the solution.
14. When the readout stabilizes, record the pH and time. This value must be ±0.05 S.U. of the true value. If this value is out of range, the meter must be recalibrated.
15. Remove the sensor from the pH 9.00 (or pH 4.00) buffer and rinse sensor with distilled water.
16. Three hours after calibration, perform an instrument calibration check.
17. Immerse the sensor in pH 7.00 buffer, occasionally stirring the solution.

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18. When the readout stabilizes, record the pH and time. This value must be between 6.8 and 7.2 S.U. If the readout is outside of this range, the meter must be recalibrated.

Schedule: Meter must be calibrated daily prior to use. During use, meter must be checked against a standard buffer every three hours. If the pH differs by more than ± 0.21 S.U. from the standard buffer value, the meter must be recalibrated. The pH buffer calibration aliquots must be appropriately disposed of after use.

Documentation: Written documentation must be provided in a bound Calibration Log Notebook, and must include: instrument identification and serial number; date and time of calibration; buffer lot number and expiration date; calibration values and results; adjustments made (if any); and name of person performing the calibration. In addition, any maintenance performed on the meter must be recorded in the notebook. All calibration data must be signed and dated by the analyst. The Calibration Log Notebook must be retained for at least five (5) years after last entry.

References: Horiba U-20 Series Operation Manual, Standard Method 4500-H^+ B and N.J.A.C. 7:18 et seq.

R2-0002107

Standard Operating Procedures for Turbidity (TURB) Calibration
Golder SOP 105

Method: EPA 180.1
Date: May 27, 2005
Revision No.: 0
Signature of Golder's Quality Assurance Officer: _____

Purpose: Golder SOP 105 provides the procedures required for calibration of turbidity measurements (in Nephelometric turbidity units NTU) of groundwater using the Horiba U-22 and/or U-10 to meet the current requirements of the NJ Department of Environmental Protection (NJDEP) Environmental Laboratory/Measurement Certification Program under the Regulations Governing the Certification of Laboratories and Environmental Measurements, N.J.A.C. 7:18 et seq.

Equipment & Supplies Needed:

Meter: Horiba U-22 or U-10
Meter Specifications: Penetration and scattering method; range 0 to 800 NTU; resolution 0.1 NTU, repeatability ±3%; accuracy ±5%.
Calibration Standards: 100 NTU standard and distilled water

Procedures:

1. Visually inspect turbidity sensor for cleanliness. Clean with dilute Alconox solution as needed. Rinse sensor with distilled water.
2. Immerse the sensor into distilled water, occasionally stirring the solution.
3. Press the CAL key twice in the TURB measurement mode. MAN, ZERO, and CAL will be indicated.
4. When the TURB readout stabilizes, record turbidity and time.
5. Scroll using the UP/DOWN keys adjust read-out to 0.0, then press the ENT key. Record the adjusted reading.
6. When DATA IN stops blinking, remove the sensor from the distilled water and discard.
7. Immerse the sensor in 100 NTU standard, occasionally stirring the solution.
8. Press the CAL key once. MAN, SPAN, and CAL will be indicated.
9. When the readout stabilizes, record the turbidity and time.
10. Scroll using the UP/DOWN keys to adjust read-out to 100.0, then press the ENT key. Record the adjusted reading.
11. When DATA IN stops blinking, remove the sensor from the standard and discard.
12. Rinse the sensor with distilled water.
13. Press the MEAS key to return to the measurement mode.

Schedule: Meter must be calibrated daily prior to use, at a minumum.

Documentation: Written documentation must be provided in a bound Calibration Log Notebook, and must include: instrument identification and serial number; date and time of calibration; buffer lot number and expiration date; calibration values and results; adjustments made (if any); and name of person performing the calibration. In addition, any maintenance performed on the meter must be recorded in the notebook. All calibration data must be signed, initialed, and dated by the analyst. The Calibration Log Notebook must be retained for at least five (5) years after last entry.

References: Horiba U-20 Series Operation Manual, EPA method 180.1 and N.J.A.C. 7:18 et seq.

R2-0002108

Standard Operating Procedures for Specific Conductance (COND) Analysis
Golder SOP 201

Method: EPA 120.1
Date: May 27, 2005
Revision No.: 0
Signature of Golder's Quality Assurance Officer: _____

Purpose: Golder SOP 201 provides the specific procedures required for measuring specific conductance (COND) (in mS/m or S/m) in groundwater samples using the Horiba U-22 and/or U-10 to meet the current requirements of the NJ Department of Environmental Protection (NJDEP) Environmental Laboratory/Measurement Certification Program under the Regulations Governing the Certification of Laboratories and Environmental Measurements, N.J.A.C. 7:18 et seq.

Equipment & Supplies Needed:

Meter: Horiba U-22 or U-10
Meter Specifications: Four (4) AC electrode meter with temperature compensation; range 0 to 9.99 S/m; resolution 0.1% of full scale, repeatability ±1%; accuracy ± 3%

Equipment Calibration: Refer to Golder SOP 101

Analytical Procedures:

COND Analysis - Using Flow-Through Cell:

1. Visually inspect conductivity electrode for cleanliness, clean with dilute Alconox solution if necessary, and rinse probe with distilled water.
2. Place probe into flow cell.
3. Attach flow cell inlet to the discharge tubing of the sample source and activate flow.
4. When the flow cell has filled and started to discharge, record COND value and time according to project specific Sampling and Analysis Plan, generally every five minutes.
5. When finished collecting all COND readings, stop sample flow and drain flow cell.
6. Remove the probe and rinse with distilled water.

COND Analysis - Using Disposable Sample Container:

1. Visually inspect conductivity electrode for cleanliness, clean with dilute Alconox solution if necessary, and rinse probe with distilled water.
2. Place the sample to be analyzed in an appropriately cleaned disposable container having sufficient volume and then completely immerse the probe in the sample. Occasionally stir the sample.
3. Record the time and COND when the readout stabilizes.
4. Remove the probe and rinse with distilled water.

COND Analysis – Using Direct Immersion:

1. Visually inspect conductivity electrode for cleanliness, clean with dilute Alconox solution if necessary, and rinse probe with distilled water.
2. Immerse the probe into the sample source (i.e. surface water).
3. Record the time and COND when the readout stabilizes.
4. Remove the probe and rinse with distilled water.

Reporting Requirements: Reporting of results must include:

1. Certified environmental lab name and ID.
2. Sample ID, and date and time of sample collection and analysis.
3. COND analysis results and units (mS/m or S/m).
4. Printed name and signature of environmental lab manager or designee.

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Documentation Requirements: Written documentation must be provided on a field sample information form and/or in a project specific field book, and must include: sample identification; date and time of sample collection and analysis; instrument ID and calibration time; analysis results and units (mS/m or S/m). This information must be retained in the project files for at least five (5) years.

References: Horiba U-20 Series Operation Manual, EPA method 120.1 and N.J.A.C. 7:18 et seq.

R2-0002110

Standard Operating Procedures for Dissolved Oxygen (DO) Analysis
Golder SOP 202

Method: SM 4500-O G.
Date: January 23, 2008
Revision No.: 1
Signature of Golder's Quality Assurance Officer: [Lab Manager]

Purpose: Golder SOP 202 provides the specific procedures required for measuring dissolved oxygen (DO) (in mg/l) in groundwater samples using the Horiba U-22 and/or U-10 to meet the current requirements of the NJ Department of Environmental Protection (NJDEP) Environmental Laboratory/Measurement Certification Program under the Regulations Governing the Certification of Laboratories and Environmental Measurements, N.J.A.C. 7:18 et seq.

Equipment & Supplies Needed:

Meter: Horiba U-22 or U-10

Meter Specifications: Diaphragm galvanic battery method with temperature compensation; range 0-19.99 mg/l; resolution 0.01 mg/l; repeatability ± 0.1 mg/l; accuracy ± 0.2 mg/l.

Calibration: Refer to Golder SOP 102a and 102b

Procedures:

DO Analysis - Using Flow-Through Cell:

1. Visually inspect DO sensor for cleanliness (e.g. salt build-up) and membrane integrity (e.g. holes). Clean with dilute Alconox solution and/or repair as needed. Rinse sensor with distilled water.
2. Place sensor into flow cell.
3. Attach flow cell inlet to the discharge tubing of the sample source and activate flow.
4. When the flow cell has filled and started to discharge, record DO value and time according to project specific Sampling and Analysis Plan, generally every five minutes.
5. When finished collecting all DO readings, stop sample flow and drain flow cell.
6. Remove the sensor and rinse with distilled water.

DO Analysis - Using Disposable Sample Container:

1. Visually inspect DO sensor for cleanliness (e.g. salt build-up) and membrane integrity (e.g. holes). Clean with dilute Alconox solution and/or repair as needed. Rinse sensor with distilled water.
2. Place the sample to be analyzed in an appropriately cleaned disposable container having sufficient volume and then completely immerse the sensor in the sample. Occasionally stir the sample.
3. Record the time and DO when the readout stabilizes. This reading must be recorded within fifteen minutes of sample collection.
4. Remove the sensor and rinse with distilled water.

DO Analysis – Using Direct Immersion:

1. Visually inspect DO sensor for cleanliness (e.g. salt build-up) and membrane integrity (e.g. holes). Clean with dilute Alconox solution and/or repair as needed. Rinse sensor with distilled water.
2. Immerse the sensor into the sample source (i.e. surface water).
3. Record the time and DO when the readout stabilizes.
4. Remove the sensor and rinse with distilled water.

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Reporting Requirements: Reporting of results must include:

1. Certified environmental lab name and ID.
2. Sample ID, and date and time of sample collection and analysis.
3. DO analysis results and units (mg/l).
4. Printed name and signature of environmental lab manager or designee.

Documentation Requirements: Written documentation must be provided on a field sample information form and/or in a project specific field book, and must include: sample identification; date and time of sample collection and analysis; instrument ID and calibration time; analysis results and units (mg/l). This information must be retained in the project files for at least five (5) years.

References: Horiba U-20 Series Operation Manual, Standard Method 4500-O G and N.J.A.C. 7:18 et seq..

R2-0002112

Standard Operating Procedures for Temperature (TEMP) Analysis
Golder SOP 203

Method: SM 2550 B.
Date: January 23, 2008
Revision No.: 1
Signature of Golder's Quality Assurance Officer: [Lab Manager]

Purpose: Golder SOP 203 provides the specific procedures required for measuring temperature (°C) in groundwater samples using the Horiba U-22 and/or U-10 to meet the current requirements of the NJ Department of Environmental Protection (NJDEP) Environmental Laboratory /Measurement Certification Program under the Regulations Governing the Certification of Laboratories and Environmental Measurements, N.J.A.C. 7:18 et seq.

Equipment & Supplies Needed:

Meter: Horiba U-22 or U-10
Meter Specifications: Thermistor sensor; range 0 to 55 °C; resolution 0.01 °C; repeatability ±0.3 °C; accuracy ±1.0 °C.

Calibration: Refer to Golder SOP 103

Procedures:

Temperature Analysis - Using Flow-Through Cell:

1. Visually inspect temperature probe for cleanliness. Clean with dilute Alconox solution as needed. Rinse probe with distilled water.
2. Place probe into flow cell.
3. Attach flow cell inlet to the discharge tubing of the sample source and activate flow.
4. When the flow cell has filled and started to discharge, record temperature value and time according to project specific Sampling and Analysis Plan, generally every five minutes.
5. When finished collecting all temperature readings, stop sample flow and drain flow cell.
6. Remove the probe and rinse with distilled water.

Temperature Analysis - Using Disposable Sample Container:

1. Visually inspect temperature probe for cleanliness. Clean with dilute Alconox solution as needed. Rinse probe with distilled water.
2. Place the sample to be analyzed in an appropriately cleaned disposable container having sufficient volume and then completely immerse the probe in the sample. Occasionally stir the sample.
3. Record the time and temperature when the readout stabilizes. This reading must be recorded within fifteen minutes of sample collection.
4. Remove the probe and rinse with distilled water.

Temperature Analysis – Using Direct Immersion:

1. Visually inspect temperature probe for cleanliness. Clean with dilute Alconox solution as needed. Rinse probe with distilled water.
2. Immerse the probe into the sample source (i.e. surface water).
3. Record the time and temperature when the readout stabilizes.
4. Remove the probe and rinse with distilled water.

Reporting Requirements: Reporting of results must include:

1. Certified environmental lab name and ID.
2. Sample ID, and date and time of sample collection and analysis.
3. Temperature analysis results and units (°C).
4. Printed name and signature of environmental lab manager or designee.

R2-0002113

Documentation Requirements: Written documentation must be provided on a field sample information form and/or in a project specific field book, and must include: sample identification; date and time of sample collection and analysis; instrument ID and calibration time; analysis results and units (^{o}C). This information must be retained in the project files for at least five (5) years.

References: Horiba U-20 Series Operation Manual, Standard Methods 2550B and N.J.A.C. 7:18 et seq.

R2-0002114

Standard Operating Procedures for pH Analysis
Golder SOP 204

Method: SM 4500-H^+ B.
Date: January 23, 2008
Revision No.: 1
Signature of Golder's Quality Assurance Officer: [Lab Manager]

Purpose: Golder SOP 204 provides the specific procedures required for measuring pH (in standard units S.U.) in groundwater samples using the Horiba U-22 and/or U-10 to meet the current requirements of the NJ Department of Environmental Protection (NJDEP) Environmental Laboratory/Measurement Certification Program under the Regulations Governing the Certification of Laboratories and Environmental Measurements, N.J.A.C. 7:18 et seq.

Equipment & Supplies Needed:

Meter: Horiba U-22 or U-10
Meter Specifications: Glass sensor with temperature compensation; range 0 to 14 S.U.; resolution 0.01 S.U.; scale readability ±0.05 S.U.; repeatability ±0.05 S.U.; accuracy ±0.1 S.U.

Calibration: Refer to Golder SOP 104

Procedures:

pH Analysis - Using Flow-Through Cell:

1. Visually inspect pH sensor for cleanliness (e.g. salt build-up) and integrity (e.g. cracks). Clean with dilute Alconox solution and/or repair as needed. Rinse sensor with distilled water.
2. Place sensor into flow cell.
3. Attach flow cell inlet to the discharge tubing of the sample source and activate flow.
4. When the flow cell has filled and started to discharge, record pH value and time according to project specific Sampling and Analysis Plan, generally every five minutes.
5. When finished collecting all pH readings, stop sample flow and drain flow cell.
6. Remove the sensor and rinse with distilled water.

pH Analysis - Using Disposable Sample Container:

1. Visually inspect pH sensor for cleanliness (e.g. salt build-up) and integrity (e.g. cracks). Clean with dilute Alconox solution and/or repair as needed. Rinse sensor with distilled water.
2. Place the sample to be analyzed in an appropriately cleaned disposable container having sufficient volume and then completely immerse the sensor in the sample. Occasionally stir the sample.
3. Record the time and pH when the readout stabilizes. This reading must be recorded within fifteen minutes of sample collection.
4. Remove the sensor and rinse with distilled water.

pH Analysis – Using Direct Immersion:

1. Visually inspect pH sensor for cleanliness (e.g. salt build-up) and integrity (e.g. cracks). Clean with dilute Alconox solution and/or repair as needed. Rinse sensor with distilled water.
2. Immerse the sensor into the sample source (i.e. surface water).
3. Record the time and pH when the readout stabilizes.
4. Remove the sensor and rinse with distilled water.

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Reporting Requirements: Reporting of results must include:

1. Certified environmental lab name and ID.
2. Sample ID, and date and time of sample collection and analysis.
3. pH analysis results and units (S.U.).
4. Printed name and signature of environmental lab manager or designee.

Documentation Requirements: Written documentation must be provided on a field sample information form and/or in a project specific field book, and must include: sample identification; date and time of sample collection and analysis; instrument ID and calibration time; analysis results and units (S.U.). This information must be retained in the project files for at least five (5) years.

Notes: pH sensors must be stored in accordance with manufacturer's recommendations.

References: Horiba U-20 Series Operation Manual, Standard Methods 4500-H^+ B and N.J.A.C. 7:18 et seq.

R2-0002116

Standard Operating Procedures for Turbidity (TURB) Analysis
Golder SOP 205

Method: EPA 180.1
Date: May 27, 2005
Revision No.: 0
Signature of Golder's Quality Assurance Officer: _____

Purpose: Golder SOP 205 provides the specific procedures required for measuring turbidity (in Nephelometric turbidity units NTU) in groundwater samples using the Horiba U-22 and/or U-10 to meet the current requirements of the NJ Department of Environmental Protection (NJDEP) Environmental Laboratory/Measurement Certification Program under the Regulations Governing the Certification of Laboratories and Environmental Measurements, N.J.A.C. 7:18 et seq.

Equipment & Supplies Needed:

Meter: Horiba U-22 or U-10
Meter Specifications: Penetration and scattering method; range 0 to 800 NTU; resolution 0.1 NTU, repeatability ±3%; accuracy ± 5%.

Calibration: Refer to Golder SOP 105

Procedures:

Turbidity Analysis - Using Flow-Through Cell:

1. Visually inspect turbidity sensor for cleanliness (e.g. salt build-up) and integrity (e.g. cracks). Clean with dilute Alconox solution and/or repair as needed. Rinse sensor with distilled water.
2. Place sensor into flow cell.
3. Attach flow cell inlet to the discharge tubing of the sample source and activate flow.
4. When the flow cell has filled and started to discharge, record turbidity value and time according to project specific Sampling and Analysis Plan, generally every five minutes.
5. When finished collecting all turbidity readings, stop sample flow and drain flow cell.
6. Remove the sensor and rinse with distilled water.

Turbidity Analysis - Using Disposable Sample Container:

1. Visually inspect turbidity sensor for cleanliness (e.g. salt build-up) and integrity (e.g. cracks). Clean with dilute Alconox solution and/or repair as needed. Rinse sensor with distilled water.
2. Place the sample to be analyzed in an appropriately cleaned disposable container having sufficient volume and then completely immerse the sensor in the sample. Occasionally stir the sample.
3. Record the time and turbidity when the readout stabilizes. This reading must be recorded within fifteen minutes of sample collection.
4. Remove the sensor and rinse with distilled water.

Turbidity Analysis – Using Direct Immersion:

1. Visually inspect turbidity sensor for cleanliness (e.g. salt build-up) and integrity (e.g. cracks). Clean with dilute Alconox solution and/or repair as needed. Rinse sensor with distilled water.
2. Immerse the sensor into the sample source (i.e. surface water).
3. Record the time and Turbidity when the readout stabilizes.
4. Remove the sensor and rinse with distilled water.

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Reporting Requirements: Reporting of results must include:

1. Certified environmental lab name and ID.
2. Sample ID, and date and time of sample collection and analysis.
3. TURB analysis results and units (NTU).
4. Printed name and signature of environmental lab manager or designee.

Documentation Requirements: Written documentation must be provided on a field sample information form and/or in a project specific field book, and must include: sample identification; date and time of sample collection and analysis; instrument ID and calibration time; analysis results and units (NTU). This information must be retained in the project files for at least five (5) years.

References: Horiba U-20 Series Operation Manual, EPA method 180.1 and N.J.A.C. 7:18 et seq.

R2-0002118

Microseeps, Incorporated

Analytical Method AM20GAx
Standard Operating Procedure for the Analysis of Biodegradation Indicator Gases

Controlled Copy No. _____

Ruth Welsh
Ruth Welsh
Laboratory Manager

Signature of Final Approval:

Patrick McLoughlin
Patrick McLoughlin, Ph.D.
Technical Director

11-21-08
Date

1.0 Scope and Application

Method AM20GAx is used to determine the concentration of biodegradation indicator gases in vapor samples. Specifically, Method AM20GAx is used to determine the dissolved concentration of the following gases:

Gases	CAS Number
Acetylene	74-86-2
Carbon dioxide	124-38-9
Oxygen	7782-44-7
Nitrogen	7727-37-9
Hydrogen	1333-74-0
Methane	74-82-8
Ethane	74-84-0
Ethene	74-85-1
Propane	74-98-6
Propene	115-07-1
n-Butane	106-97-8
i-Butane	75-28-5
Carbon Monoxide	630-08-0
Total Inorganic Carbon*	

*Total inorganic carbon (TIC) is converted to carbon dioxide using the steps outlined in SOP-PM01. The sample is then analyzed for carbon dioxide according to this SOP. Any differences in method are specified in the appropriate section.

This method is recommended for use by, or under the supervision of, analysts experienced in sample preparation, the operation of gas chromatographs and in the interpretation of chromatograms.

2.0 Method Summary

The sample gas is analyzed with a gas chromatograph capable of simultaneous analysis of all of the target analytes from a single gas sample. A single injection of gas from integral, simultaneously filled sample loops is used to assure consistent injection volume. The permanent gases are analyzed using a thermal conductivity detector (TCD). The light hydrocarbons are analyzed using a flame ionization detector (FID). Hydrogen is analyzed using a reduction gas detector (RGD). The data are transferred to a microcomputer, converted to digital format, stored, and processed using a chromatography data system.

2.1 Definitions

Batch: A batch consists of twenty or fewer samples.

Instrument Flush: The front end of the sample loop is flushed with ultra high purity helium injected into the loop directly from the cylinder to remove possible interference by ambient air and to avoid cross contamination between samples.

Method Blank: An injection analyzed by all three detectors that consists of ultra high purity helium. The method blank is free from the analytes of interest

Laboratory Control Sample: A sample of laboratory grade deionized water spiked with verified known amounts of analytes. A LCS is used to assess the performance of the measurement system.

Matrix Spike and Matrix Spike Duplicate: A sample prepared by adding a known concentration of target analyte to a specific amount of sample. Matrix spikes are used to determine the effect of sample matrix on a method's recovery efficiency.

3.0 Apparatus and Materials and Operating Conditions

3.1 Apparatus

Gas Chromatograph: The chromatographs designed and built by Microseeps are equipped with multiple packed columns and multi-port valves, a TCD, a FID, a RGD, and multiple sample loops. The FIDs, which were also built by Microseeps, are of a special design that allows considerably more sensitivity than commercially available models. This instrument provides rapid turn-around for consecutive analyses and a clean baseline for accurate, reproducible results.

3.2 Materials

- Sample vials (Supelco, Inc, Bellefonte, PA or equivalent)
- Syringe: locking gas tight (Hamilton/Alltech, 3, 5, 10, 30 and 60 ml or equivalent)

3.3.1 Interferences

The most likely source of "interference" is ambient air. Due to the relatively high concentrations of oxygen and nitrogen, a very small amount of air as a contaminant will dramatically affect the results. The analyst must take great care to ensure that air is flushed from the gas tight syringe before sample preparation and that no air has entered the syringe or needle prior to injection of the sample into the gas chromatograph.

Contamination by carryover can occur whenever high-level and low-level samples are sequentially analyzed. An unrestricted flow (Instrument flush) of pure carrier gas from a 10 psig source should be allowed to flow through each sample loop for 30 seconds prior to each analysis.

As required, the analyst should demonstrate the absence of carryover contamination by analysis of the contents of the sample loop when purged with carrier gas. This demonstration should be performed when carryover contamination is suspected (after high samples). In the event that 'ghost peaks' (peaks similar to previous sample) appear when a pure carrier gas sample is analyzed (method blank), measures should be taken to eliminate the carryover contamination.

4.0 Reagents

- Helium (UHP Gas)
- Nitrogen (UHP Gas)
- Certified Commercial Gas Standards
- Benzalkonium chloride (BAK) solution – Prepared by dissolving 12.08 g into 1L DI water.
- Tri-sodium phosphate (TSP) – purchased as the dodecahydrate

4.1 Standard Preparation Procedures

Calibration standards are prepared by using the procedures below:

4.1. Vial Preparation

Headspace vials used for instrument calibration standards for this method are prepared as follows:

- Crimp and cap each vial, with stopper septa.
- Evacuate each vial to vacuum.
- Flush each vial to atmospheric pressure with the vial balance gas appropriate for the detector being calibrated. (See Table 4.1)

Table 4.1

Detector	Vial Balance Gas
FID	Nitrogen
TCD	Helium
RGD	Nitrogen

4.1.1 Preparing Calibration Standards

The instrument is initially calibrated (ICAL) using dilutions of custom certified gas mixes. Refer to Table 4.1.1 for the correct amounts of standard mix and vial preparation gas to inject into prepared vials.

- Prepare the correct number of vials for the detector being calibrated.
- Each of the three detectors is calibrated with a gas mix from a commercial source.
- Remove the specified amount of standard by extracting it from the standard mix gas cylinder using a gas-tight syringe and injecting it into a prepared vial.
- Add the specified amount of vial balance gas to the same vial.

The dilution factor of one is achieved by directly injecting the standard gas mix from the cylinder into the GC.

Table 4.1.1
Standard Gas and Balance Gas Injection Volumes in ml

Dilution Levels	Standard Gas Mix	Balance Gas	Final Gas Volume
1	N/A	N/A	N/A
2	21	21	42
5	10	40	50
10	5	45	50
25	2	48	50
100	2	198	200
250	1	249	250
2500	20 (of 250x)	180	200
12500	40 (of 2500x)	160	200

4.1.2 Calibration Standard Concentrations

Calibration standards are made up in the following concentrations as specified in Tables 4.1.2 A, B, and C. The true values of the calibration standards vary slightly from cylinder to cylinder. The values below are very close approximations. All standards are prepared using 22 cc headspace vials with stopper septum or 160cc serum bottles.

Table 4.1.2 A
FID Calibration (In PPMV)

Compound	1X	5X	25X	250X	2500X	12,500X
Methane	500	100	20	2	0.2	0.04
Ethane	500	100	20	2	0.2	0.04
Ethene	500	100	20	2	0.2	0.04
Propane	500	100	20	2	0.2	0.04
Propene	500	100	20	2	0.2	0.04
n-Butane	500	100	20	2	0.2	0.04
i-Butane	500	100	20	2	0.2	0.04
Compound	**1X**	**4X**	**20X**	**100X**	**500X**	
Acetylene	100	25	5	1	0.2	

Table 4.1.2 B
TCD Calibration (In PPMV)

Compound	1X	2X	10X	50X	100X	250X
Carbon Dioxide	150,000	75,000	15,000	3,000	1,500	600
Oxygen	70,000	35,000	7,000	1,400	700	280
Nitrogen	665,000	332,500	66,500	13,300	6650	2,660
Methane	45,000	22,500	4,500	900	450	180
Carbon Monoxide	70,000	35,000	7,000	1,400	700	280

Table 4.1.2 C
RGD Calibration (In PPMV)

Compound	10X	15X	25X	250X	2500X
Hydrogen	50	33.3	20	2	0.2

4.2 Quality Control Sample Preparation

Quality control samples are prepared as indicated below.

4.2.1 Initial Calibration Verification (ICV) and Continuing Calibration Verification (CCV)

The ICV and CCV are prepared from a source different from the source used to prepare the ICAL standards. The concentration of the ICV and CCV is in the middle of the calibration range and is close to that of the ICAL midpoint, but because of the nature of gas standard it is not at exactly that concentration.

4.2.2 Laboratory Control Sample (LCS) and LCS Duplicate (LCSD)

The LCS and LCSD are prepared at a mid-range concentration. The type of LCS/LCSD depends upon the original matrix of the sample. For samples that arrive as vapors, the LCS/LCSD is injected as a gas. For samples that arrive as waters, DI water is spiked with a gas mixture of target analytes and prepared the same as the samples. Water that is free of the principle atmospheric components of nitrogen and oxygen is very difficult to make and similarly difficult to store. Toward that end, LCS/LCSD results for nitrogen or oxygen will not be reported with client data. Table 4.2.2 below gives the true values of the LCS/LCSDs.

4.2.2.1 Total Inorganic Carbon LCS

Mix approximately 0.20g $NaHCO_3$ into 200ml laboratory grade DI water, prepare according to the TIC procedures outlined in PM01 and analyze in duplicate as a sample. The true value of the spike is calculated as follows:

$$\text{mg/L } CaCO_3 = \frac{Mass(g)NaHCO_3}{H_2O(L)} X \frac{100.09}{84.01} X (1{,}000{,}000)$$

4.2.3 Matrix Spike (MS) and Matrix Spike Duplicate (MSD)

- For water samples, MS and MSDs are prepared, analyzed, and reported when clients' request and send sufficient numbers of aliquots to prepare them (e.g. one 40 ml vial each for the MS and another for the MSD).

Table 4.2.2

Compound	Vapor LCS/LCSD (ppmv)	Water LCS/LCSD & MS/MSD
Methane	300.0	822.8 µg/L
Ethane	100.0	41.70 µg/L
Ethene	100.0	38.54 µg/L
Propane	100.0	60.56 µg/L
Propene	100.0	57.81 µg/L
iso-Butane	100.0	79.83 µg/L

Compound	Vapor LCS/LCSD (ppmv)	Water LCS/LCSD & MS/MSD
n-Butane	100.0	79.83 µg/L
Acetylene	-------	36.10 µg/L
Carbon dioxide	50,000	129.3 mg/L
Oxygen	20,000	***
Nitrogen	balance gas	balance gas
Hydrogen	25.00	1376 nM
Carbon Monoxide	-------	2.17 mg/L

Notes on Table 4.2.2

- Since oxygen is an ubiquitous "contaminant", it is not monitored in either the LCS or MS.
- Actual values vary slightly from lot to lot of cylinders of calibration gases.
- MS/MSD prepared by using a standard gas mix instead of He in the headspace prep. procedure.

4.2.3.1 Total Inorganic Carbon MS and MSD

Mix approximately 0.04g $NaHCO_3$ directly into client samples (when provided and requested), prepare according to the TIC procedures outlined in PM01 and analyze in duplicate as a sample. The true value of the spike is calculated as follows:

$$\text{mg/L } CaCO_3 = \frac{Mass(g)NaHCO_3}{H_2O(L)} X \frac{100.09}{84.01} X (1{,}000{,}000)$$

4.2.4 Method Blank

Method blanks are made up of ultra high purity helium injected into a vial and then into the instrument.

4.2.4.1 Total Inorganic Carbon Method Blank

The method blank for TIC is made up of deionized water in a 40 ml vial, prepared according to the TIC procedures outlined in PM01, and analyzed as a sample.

4.3 Glassware and Storage Requirements for Reagents and Standards

Reagents are stored at room temperature (70°F ±5°) and all standards are prepared fresh for each use immediately prior to each analysis. Standards are made up from compressed gas cylinders. Those standards expire after 2 years.

5.0 Procedure

Water samples should be cooled upon collection and stored at a temperature of ≤ 6°C.

Gas samples are shipped and received at a positive pressure, which eliminates a cross-contamination issue during sample shipment. It is preferable that gas samples be shipped without cooling. However, it is not a sample receipt non-conformance if received vapor samples are packed in ice (sample may experience slight loss in pressure.) Gas samples are stored in the laboratory at room temperature (70°F ±5°). The pressure in gas vials is not checked upon receipt in the laboratory because of the inherent risk of losing sample, or inadvertently introducing atmospheric gases, when the septum is pierced. The number of times the septum is pierced should be as few as absolutely possible. See Section 5.2.2 for a discussion on how the laboratory checks and documents vial pressure. Holding time for both gas and water samples is fourteen days.

Water samples for light hydrocarbon analyses only (methane, ethane, ethane, propane, propene, n-butane, i-butane, acetylene) are collected in 40ml VOA vials with zero headspace and preserved with tri-sodium phosphate (TSP). TSP is added as the dodecahydrate at 200 mg/40 ml vial. This results in a sample pH > 10. Water samples collected for either permanent gases only or permanent gases and light hydrocarbon analyses are collected in 40ml amber VOA vials with zero headspace and preserved with four drops of BAK solution.

Analysts who use this method have been certified for the method by running Initial Demonstration of Proficiency (IDOP) Samples in accordance with Microseeps Standard Operating Procedure for Administering and Documenting Training in Laboratory Procedures and Instrumentation (SOP ADM 02). IDOPs are run any time there is significant change to an instrument, method, or in the training procedure for training a new analyst.

Because the results from this method frequently require the analyst to use manual integration, manual integration is included as part of the training. Because of the nature of the instrument, the range of interrogated concentrations and the low specificity of the detectors, it is often necessary to perform manual integration even on the laboratory control samples. As part of the annual training, the analysts must:

- Retain an electronic copy of the original chromatogram that was integrated by the automated settings of the instrument software. (This is done automatically by the chromeleon software.)
- Document on the hard copy Case Narrative a justification for the manual integration and circle “YES” in the box in the lower right corner of the narrative sheet.
- The analyst shall present all the data to the Lead Analyst (if not applicable, then the Laboratory Manager) for review.

- The Lead Analyst or Laboratory Manager shall thoroughly examine the data and when satisfied, check the appropriate box on the case narrative form and place their initials where designated.
- If there are questions about the manual integration, the data reviewer shall review the original chromatogram from the data system.
- If agreement is obtained from the Lead Analyst or Laboratory Manager that the manual integration was indeed necessary, the Lead Analyst or Laboratory Manager shall document on the same hard copy Case Narrative (lower left corner) that the manual integration was reviewed and the justification stands. If the other criteria of the training are met, the training is deemed successful.
- If the reviewer disagrees with either the necessity of the integration or the specific manipulations done in the integration, the specifics objections should be discussed with the trainee and the training should be repeated (4 new samples must be analyzed).

5.1 Sample Preparation

Samples that are collected using the Bubble Strip Sampling Technique, Microseeps Sampling Method SM9, do not require additional preparation prior to analysis.

Samples that are collected as waters and are to be analyzed for dissolved gases (methane, ethane, ethene, acetylene, CO_2, N_2, O_2, propane, propene, iso-butane, n-butane, TIC), must be prepared using Microseeps Standard Operating Procedure PM01G.

Samples that are collected as gases, for example from a soil gas survey or from the headspace of a microcosm sample, need not be collected by a Microseeps sampling method, nor do they require additional preparation.

5.2 Analysis

5.2.1 If the sample is prepared via SOP-PM 01, it can be injected from the gastight syringe in which it is prepared by inserting the needle of the syringe through the septum on the "sample in" port. If the sample is a calibration standard, a bubble strip sample (SM9), or a gas, the septum inlet to the "sample in" port of the GC must be removed and a luer-lock needle receptacle is plumbed to the "sample in" port in place of the needle. A needle is attached to the luer-lock receptacle and inserted through the septa of the calibration standard, bubble stripped sample, or gas sample.

5.2.2 In order to initiate analysis and introduce the sample into the GC sample loop, a needle is attached to the entry port on the GC and inserted through the sample septum. The flow through the sample loop is monitored by a flow meter connected to the sample-loop vent-port on the gas chromatograph.

When a vial is sufficiently filled, the ball in the flow meter will shoot to the top of the column. This indicates that there is sufficient pressure in the vial to fill the sample loop. If the loop is not properly pressurized, this is reflected on the flow meter immediately. The ball in the flow meter will go up the column part way and drop back to the bottom. This indicates there is not sufficient pressure in the sample vial. If this happens, the analyst will remove the vial from the inlet port as quickly as possible and withdraw 10 – 12ccs of sample from the sample vial using a locking syringe. This is then injected into the instrument. The lack of sufficient pressure in the vial and the means of sample injection are then documented on the case narrative.

5.2.3 Once the flow out of the sample loop ceases (3 seconds if SOP-PM 01 is used) the sample loop valves are activated.

5.2.4 Once the sample loop valves are activated, the ports to and from the sample loop are flushed with ultra high purity helium injected into the loop directly from the cylinder to remove any interference from ambient air and to avoid cross contamination between samples.

5.3 Calibration and Results

5.3.1 The standard calibration gas should be introduced in the same manner as described in section 5.2.1 above. Measured peak areas are converted to concentrations using certified commercial gas standards. Dilutions are made to achieve multi-point calibration curves for each detector.

Methane can be detected on both the FID and the TCD. If the methane concentration causes an FID signal output level of 8000 millivolts, then any output exceeding that is quantified on the TCD.

5.3.2 Initial calibration is accomplished by analyzing multiple standards of appropriate calibration ranges.

Note: Due to the nature of preparing custom gas standards, the component concentration can fluctuate between purchased lots. This is accounted for during method/calibration development. These results will be used to establish a multi-point calibration curve.

Acceptance Criteria: A linear fit to an area response versus concentration plot is formed with the origin forced to zero, and the calibration is accepted for use if r^2, the coefficient of determination is ≥ 0.995. If this criterion can not be met using a linear fit, a quadratic can be used. For the quadratic fit, the acceptance criteria is also $r^2 \geq 0.995$.

Corrective Action: If the acceptance criteria specified above is not met, the reason is determined and a new set of calibration standards are analyzed.

5.3.3 An Initial Calibration Verification (ICV) standard immediately follows the initial calibration. Acceptance criterion for the ICV is an instrument response within ± 20% drift.

Since the instrumentation used at Microseeps routinely monitors the percent recoveries and in this instance percent drift is equal to percent recovery less 100%, the control limits are 80%-120% recovery for the ICV.

$$Percent\ \mathrm{Recovery} = \frac{MeasuredValue}{TrueValue} \times 100\%$$

Acceptance Criteria and Corrective Action: If the instrument response for the ICV standard is outside the acceptance window of 80-120%, the analyst will not analyze samples until either the reason is determined and the problem is corrected, or a new multi-point calibration is analyzed and an acceptable ICV is run using that calibration.

5.3.4 An initial calibration blank follows the ICV. The blank is made up of the carrier gas. Compounds must not be detected above the reporting limits. For DoD projects the results of the ICB must be < ½ RL.

Corrective Action: If the blank does not meet the acceptance criterion, another blank is injected until the results are within the acceptance criterion.

5.3.5 The analytes of this method are indicators. Every attempt to achieve and deliver precise results is made. However, it is realized that for indicator parameters measuring the range of the analyte concentration (*i.e.* is the concentration of methane gas >1 mg/l or < 0.1 mg/l) is the primary goal of employing these analyses. The calibration range is chosen to extend over most of the bio-indicator concentration range. If the concentration of an analyte exceeds that of the highest calibration standard, but does not saturate the instrument response, the concentration is calculated by assuming detector response linearity and using an extrapolation of the calibration plot. If the instrument response is saturated the sample is diluted to bring the analyte concentration into the calibration range.

5.4 Quality Control

The following quality control samples shall be analyzed with each analytical batch of twenty or fewer samples.

5.4.1 A Continuing Calibration Verification: The CCV is made up from a source other than what was used to make up the initial calibration. The acceptance criterion for the CCV is a percent recovery of 80-120%.

Corrective Action: If the CCV fails, a new CCV is prepared and analyzed. If the new CCV falls within the acceptance criterion, analysis continues. If the new CCV fails, the instrument shall be recalibrated, and all samples since the last acceptable calibration verification shall be reanalyzed, provided sufficient sample volume is present and the samples have not been compromised by exposure to air.

5.4.2 A Continuing Calibration Blank: A CCB follows each CCV. The blanks are made up of the carrier gas. The acceptance criterion for the blank is the result must be less than the reporting limits for all compounds. For DoD projects the results for the CCB must be < ½ RL.

Corrective Action: If the blank does not meet the acceptance criterion, another blank is injected until the results are within the acceptance criterion.

5.4.3 Laboratory Control Sample and Laboratory Control Sample Duplicate: The LCS and LCSD are prepared and analyzed at a mid-calibration range. Both an LCS and an LCSD are to be run with each batch.

Acceptance Criteria: Percent recovery is required to be between 75% and 125%, inclusive. An acceptance criterion is based upon the percent recovery and the RPD as calculated by:

$$Percent\,\mathrm{Recovery} = \frac{MeasuredValue}{TrueValue} \times 100\%$$

$$RPD = \frac{|C1 - C2|}{\frac{C1 + C2}{2}} \times 100\%$$

Where: C1=LCS
C2=LCSD

RPD (Relative Percent Difference) is required to be less than or equal to 20%.

Corrective Action: If the LCS fails, a new LCS is prepared and analyzed. If the new LCS falls within the acceptance criterion, analysis continues. If the new LCS fails, analysis is stopped and the instrument is checked with a series of standards to determine the cause. Once the cause is determined and the instrument repaired, calibration is conducted and analysis continues.

5.4.4 Matrix Spike and Matrix Spike Duplicate: Matrix spikes and spike duplicates are analyzed for water samples only when requested by a client and sufficient sample aliquots are provided. Acceptance criterion is a percent recovery between 70% and 130%, and a relative percent difference (RPD) of less than or equal to 20%.

Corrective Action: If the matrix spike and spike duplicate fail but all the other quality control samples are within the acceptance criteria, matrix interference is noted in the Case Narrative.

5.4.5 Method Blank: A method blank is analyzed with each sample batch. The blanks are made up of UHP helium for all of the gases except for blanks for TIC. TIC blanks are made up of deionized water. The acceptance criterion for the blank is the result must be less than the reporting limits for all compounds. For DoD projects the results for the method blank must be < ½ RL.

Corrective Action: If the blank does not meet the acceptance criterion, another blank is injected until the results are within the acceptance criterion.

5.4.6 Contingency for Handling Out of Control or Unacceptable Data

If the requirements set forth in section 5.4 are not met, the analytical program will be terminated until the cause is determined and a solution is affected. All samples associated with out of control quality control samples (with the exception of matrix interference) must be reanalyzed provided another vial of sample has been provided by the client. If quality control acceptance criteria cannot be met using the corrective action above, a detailed check of the analytical system is made. Reagents, standards, and other quality control samples are re-prepared and analyzed. If problems persist, sample analysis will be halted and the Laboratory Manager shall be contacted immediately to determine the cause and implement corrective action.

Any data submitted with unacceptable quality control sample results shall be qualified in a case narrative. The narrative should indicate the out of control event that occurred, the corrective action that was taken, and any other pertinent information to inform the client of exactly what occurred.

5.4.7 An experienced analyst shall examine all chromatograms.

5.4.8 Through out analysis the gas samples are injected mechanically into the GC flow path utilizing a sample loop to achieve a uniform sample size from a flow directly from the sample preparation syringe. The uniform sample size achieved using the sample loop assures consistent and accurate results. Table 5.4.8 (see next page) gives example data from a study performed via this analysis. That data can also be used for accuracy and precision estimates.

Table 5.4.8
Example Data for Precision and Accuracy Studies

	Carbon Dioxide	Oxygen	Nitrogen	Methane	Hydrogen	Methane	Ethane	Ethylene	Propane	Propylene	Iso-Butane	N-Butane
REP. #	(%v)	(%v)	(%v)	(%v)	(PPMV)	(PPMV)	(PPMV)	(PPMV)	(PPMV)	(PPMV)	(PPMV)	(PPMV)
1	0.1221	0.0670	0.5744	0.0410	0.1118	0.2512	0.0525	0.0453	0.0461	0.0581	0.0473	0.0358
2	0.1267	0.0690	0.6020	0.0428	0.1122	0.2608	0.0518	0.0468	0.0521	0.0465	0.0439	0.0407
3	0.1207	0.0657	0.5838	0.0446	0.1247	0.2812	0.0509	0.0485	0.0529	0.0588	0.0436	0.0405
4	0.1193	0.0667	0.6036	0.0444	0.1244	0.2779	0.0549	0.0460	0.0461	0.0536	0.0549	0.0476
5	0.1261	0.0703	0.5860	0.0439	0.1120	0.2894	0.0551	0.0497	0.0520	0.0549	0.0417	0.0460
6	0.1193	0.0665	0.5861	0.0478	0.0943	0.2970	0.0515	0.0467	0.0458	0.0542	0.0435	0.0514
7	0.1227	0.0732	0.5748	0.0353	0.1296	0.3053	0.0532	0.0473	0.0485	0.0584	0.0483	0.0535
AVERAGE	0.1224	0.0683	0.5872	0.0428	0.1156	0.2804	0.0528	0.0472	0.0491	0.0549	0.0462	0.0451
KNOWN	0.1500	0.0700	0.6649	0.0450	0.0999	0.1500	0.0500	0.0500	0.0500	0.0500	0.0500	0.0500
STD. DEV.	0.003	0.003	0.012	0.004	0.012	0.019	0.002	0.001	0.003	0.004	0.004	0.006

5.4.9 The gas matrix for this analysis minimizes the opportunity for matrix effects. If the gas is prepared from a matrix other than that which is injected into the GC (*e.g.* prepared through headspace extraction via Microseeps SOP-PM01), the client should request that matrix spike (MS) and matrix spike duplicate (MSD) analyses be conducted and should supply sufficient sample volume. Since matrix effects are extremely site dependent, the MS and MSD are not part of the regular analytical quality assurance program.

5.4.10 All of the target analytes are gases at room temperature so the opportunity for carry over is small. This is further reduced by the flushing of the sample loop, by the "backflush" configuration of the GC plumbing, and by the nightly bake-out procedure. These combine to keep carry-over concentrations to less than half of the reporting limits.

5.5 Capturing and Submitting Data

The output of the chromatograph is directed to a microcomputer where the signal is converted to digital format, stored, and processed using a chromatography data system.

Automated valve control: Digital control is provided by the microcomputer though the chromatography data-system software. This control provides constant start and stop times for directing carrier gas flow. The event times are programmed and saved using the method editor module of the software.

5.5.1 Total Inorganic Carbon Result Calculation

The total inorganic carbon result is calculated as follows:

TIC as mg/L $CaCO_3$= (%CO_2)((Volume headspace)(2.08)+43.3)

This analysis produces concentration of the analyzed gas in % V.

5.5.2 Retention Time Windows

Retention time studies have been conducted for this analysis. These studies are kept on file in the Quality Systems Office. The retention times in Table 5.5.2 below are examples. The exact retention times will vary as a function of column type, column age, and column history. For the instruments that use this method, true retention times and retention time windows are taken from the most recent retention time window study conducted.

Table 5.5.2
Retention Time Windows

Compound	RT Window (Min.)	RT Window (Min.)	RT Window (Min.)	RT Window (Min.)

Compound	RT Window (Min.)	RT Window (Min.)	RT Window (Min.)	RT Window (Min.)
	BioRem I Unit		BioRem II Unit	
Carbon Dioxide	5.171	5.340	4.058	4.635
Oxygen	6.537	7.015	5.686	5.721
Nitrogen	7.200	7.626	6.510	6.570
Methane	9.523	9.933	8.874	8.999
Carbon Monoxide	10.475	10.841	10.938	11.302
Methane	0.586	0.609	0.420	0.420
Ethane	0.809	0.835	0.730	0.730
Ethene	1.027	1.050	1.029	1.064
Propane	1.545	1.570	1.871	1.962
Propene	2.822	2.850	3.942	4.225
iso-Butane	3.763	3.807	5.804	6.230
n-Butane	4.351	4.399	6.855	7.379
Hydrogen	4.404	4.480	NA	NA

5.6 Bake-out Procedure

Either overnight, through the weekend or whenever the instrument is not going to be used for several hours, the instrument is put in "bake-out". With carrier gas continuous flushing through the GC, the temperature on the oven is manually turned up to 210 degrees or as high as the instrument column oven can maintain.

6.0 Secondary Data Review

All analytical data must undergo a minimum of a two-tiered review. The analyst first reviews the data for completeness and accuracy. The data is then submitted to the Group Lead Analyst for final review and the data is entered into the LIMS. Once approved at this level, the data is uploaded into the LIMS.

7.0 Reporting Limits

The reporting limits for this analysis are listed in Table 7.0 below. Method detection limit studies are run annually in accordance with Microseeps Standard Operating Procedure for the Determination of Method Detection Limits and PQLs (SOP-ADM 18).

Those MDLs must be less than the reporting limits specified below. MDL studies are also performed when there is reason to suspect that method sensitivity has changed. The MDL studies are kept on file in the Quality Systems Office.

Reporting Limits
Table 7.0

Parameter	Reporting Limit	Units
Carbon Dioxide	0.2	%V
Oxygen	0.1	%V
Nitrogen	0.1	%V
Hydrogen	0.5	ppmv
Acetylene	0.1	ppmv
Methane	0.2	ppmv
Ethane	0.02	ppmv
Ethene	0.03	ppmv
Propane	0.05	ppmv
Propene	0.1	ppmv
n-butane	0.07	ppmv
i-butane	0.05	ppmv

7.1 Conversion Factors

This procedure is used to measure the volume concentration of the analytes in a gas. Two methods are used to extract that gas from the groundwater. The conversion factors that are used to convert the concentration of the analytes in the water from the concentration of the analytes as they are measured using this method, are specific to the collection or preparation method and can be found in either SOP-SM9 or SOP-PM 01.

8.0 Safety

Gloves, proper eye protection, and a laboratory coat shall be worn when handling samples and standards. The major hazard in this laboratory area is stick from needles. All needles must be capped when not in use and when moving about the laboratory. The proper way of capping a needle is to place the cap on the laboratory bench and direct the needle into the cap. A needle is never to be directed into a cap while the cap is being held.

All compressed gases are to be moved using a dolly made for transporting gases and shall be chained in place when in the laboratory. The chain shall be tightened sufficiently to keep the cylinder upright if jostled.

9.0 Laboratory Waste

Samples are kept for 30 days following analysis. Samples are disposed according to Microseeps Standard Operation Procedure for Waste Disposal (SOP-ADM 14).

9.1 Waste Minimization

Where possible, Microseeps takes steps to minimize the amount of waste generated in the laboratory by using substitution, where possible, and good chemical handling procedures. For specific information on waste minimization consult SOP-ADM 14.

10.0 References

Citing a reference does not imply that all of the recommendations and/or requirements in those cited methods is required in this Standard Operating Procedure. This section simply refers to sources that were consulted to gather information or knowledge in order to write an informed technical procedure.

U.S. Environmental Protection Agency, Test Methods for Evaluating Solid Waste. SW-846, 3rd ed., Office of Solid Waste and Emergency Response, Washington, DC. 1986.

Newel, B.S., RSKSOP-175, Sample Preparation and Calculations for Dissolved Gas Analysis in Water Samples using a GC Headspace Equilibration Technique. Revision No. 0, August 1994.

Newel, B.S., RSK-SOP-147, Gas Chromatographic Analysis of Gaseous Samples for Part-Per-Million Levels of Nitrous Oxide, Methane, Ethylene, and Ethane. Revision No. 0, August 1993.

American Society for Testing and Materials, Standard Practice for Analysis of Reformed Gas by Gas Chromatography. Annual Book of ASTM Standards. Vol. 14.02, 1994.

Kampbell, D.H. and Vandegrift, S.A., Analysis of Dissolved Methane, Ethane, and Ethylene in Ground Water by a Standard Gas Chromatographic Technique. Journal of Chromatographic Science. Vol. 36, May 1998.

SOP Review Date: November 21, 2008

Microseeps, Incorporated

Standard Operating Procedure For the Analyses of Low Level Volatile Fatty Acids by Ion Chromatography

Controlled Copy No. _____

Signatures of Final Approval:

Ruth Welsh
Laboratory Manager

Patrick McLoughlin, Ph.D.
Technical Director

11-20-08
Date

1.0 Purpose and Application

This Standard Operating Procedure addresses the determination of low level VFAs in groundwater. VFAs are not a contaminant but a metabolic by-product and measurement of their concentration can aid remedial effort.

The method used for this procedure is a modification of SW846-9056 in that this method uses an ion chromatograph (IC), a hydroxide eluent, an anion-exchange separation column, a hydronium based suppressor column and an electrical conductivity detector. However, due to the data quality objectives (DQOs) presented by the clients use of the data, and the inherent presence of matrix interference even in laboratory prepared samples, the quality control requirements of SW846-9056 are inappropriate for this method. Rather, the DQOs are met and quality is assured by the use of the quality control requirements of SW846-8000.

While SW846-8000 requires confirmation by either a second column or second detector, none is available for ICs that would provide either separation or sensitivity similar to that provided by the system here-in described. The current method is not used to monitor environmental contaminants, so confirmation is not part of the client DQOs. However, if the client requires confirmation we can achieve it by analysis of VFAs by gas chromatograph as per Microseeps AM21.

1.1 Analyte List

Table 1.1
Analyte List

Low Level VFA	CAS Number
Lactic acid *	50-21-5
Hydroxy-isobutyric acid (HIBA) *	594-61-6
Acetic acid	64-19-7
Propionic acid	79-09-4
Butyric acid	107-92-6
Pyruvic acid	127-17-3
i-Pentanoic	503-74-2
n-Pentanoic acid	109-52-4
i-Hexanoic	646-07-1
n-Hexanoic acid	142-62-1

* Compounds co-elute and are reported together.

1.2 Matrix

This method is applicable to groundwater.

2.0 Method Summary

Samples are pretreated to remove potential interference. The pretreated samples are then spiked with a mix of compounds that serve as preservatives and internal retention time markers. Samples are then analyzed by ion exchange in an ion chromatograph (IC). In the alkaline solutions of the IC, the acids ionize to their conjugate anions. The anions are separated on an ion chromatograph and chemically converted to their acid form in an anion self-regenerating suppressor (ARSR). The volatile fatty acids pass through an electrical conductivity detector. The instrument responds by producing peaks that correspond to the individual VFA concentration.

2.1 Definitions

Analytical Batch: a group of ten samples or fewer that are prepared and analyzed together.

Laboratory Control Sample: sample matrix free from analytes of interest, spiked with verified known amounts of analytes. A LCS is used to assess the performance of the measurement system.

Matrix Spike/Matrix Spike Duplicate: samples prepared by adding a known concentration of target analyte to a specific amount of sample. Matrix spikes are used to determine the effect of sample matrix on a method's recovery efficiency.

Method Blank: a sample of similar matrix that is free from the analytes of interest that is processed through all the steps of the analysis with other samples.

Internal Retention Time Marker: a spike of non-target compounds that is placed in a sample and used to determine the relative retention times. Internal Retention time markers are used to compensate for the inevitable retention time shift that occurs in this chromatography. The internal retention time marker is not to be used quantitatively, as a surrogate would be used.

2.2 Method Limitations

Lactic acid (2-hydroxy propionic acid) co-elutes with hydroxy-iso-butyric acid (HIBA, 2 hydrxy-2 methyl propionic acid). Either of these may be a target analyte, but it is unlikely that they would both be found at detectable levels in the same well. Studies have shown that the two compounds respond equally, and the Laboratory Information Management System (LIMS) is set so that the client report reflects that any observed peak may be lactic acid, HIBA, or both.

The anion exchange chromatography used in this procedure produces considerable retention time shifts. The use of internal retention time markers can help eliminate any uncertainty in peak identification that these shifts introduce. Further confidence can be provided by the use of an analytical spike.

Retention time shifts are due to variations in the pH and the ionic strength of the treated sample. Any increase in ionic strength will shift retention times and may degrade the chromatography. For this reason, surrogates are not used in this method because they would increase the ionic strength of the sample.

Dichloroacetic acid, nitrate and bromide co-elute. Inadvertent introduction of carbonate or carbon dioxide can adversely affect the samples. Additionally, latex gloves must be worn throughout the preparation procedure to minimize the introduction of sulfate and chloride.

3.0 Apparatus, Materials, and Operating Conditions

3.1 Apparatus

- Sample pre-treatment rack

3.2 Materials

- Type II deionized degassed water

4.0 Reagents

All reagents are prepared from water with a resistivity of 18-mega ohm/cm (Mohm); obtained from an Ultra-pure water system. Reagent grade chemicals are used in preparing all reagents. All standards are labeled and documented in accordance with Microseeps Standard Operating Procedure for Standards and Reference Materials SOP-ADM 15. The following reagents are used:

- Potassium Hydroxide KOH (Eluent Generator Cartridge)
- Benzalkonium chloride (BAK)
- Degassed deionized water
- UHP Helium
- HIBA
- Lactic acid
- Pyruvic acid
- Quinic acid

4.1 Standard Preparation Procedures

Standards are purchased as a custom mix from Restek or another vendor, for the simple alkanoic acids and spiked with a mixture of Lactic acid, Pyruvic acid and HIBA. Initial calibration standards are prepared at eight concentrations: 0.05, 0.1, 0.2, 0.5, 1.0, 2.0, 5.0, and 10.0 ppm. This is listed in Table 4.1.

Table 4.1
Calibration Mix Concentrations

Acid	Conc. (ppm)	ICAL1 20,000x	ICAL2 10,000x	ICAL3 5000x	ICAL4 2000x	ICAL5 1000x	ICAL6 500x	ICAL7 200x	ICAL8 100x
Quinic	-	-	-	-	-	-	-	-	-
Lactic	1000	0.05	0.1	0.2	0.5	1.0	2.0	5.0	10.0
Acetic	1000	0.05	0.1	0.2	0.5	1.0	2.0	5.0	10.0
Propionic	1000	0.05	0.1	0.2	0.5	1.0	2.0	5.0	10.0
Butyric	1000	0.05	0.1	0.2	0.5	1.0	2.0	5.0	10.0
Pyruvic	1000	0.05	0.1	0.2	0.5	1.0	2.0	5.0	10.0
i-Pentanoic	1000	0.05	0.1	0.2	0.5	1.0	2.0	5.0	10.0
Pentanoic	1000	0.05	0.1	0.2	0.5	1.0	2.0	5.0	10.0
Chloride	-	-	-	-	-	-	-	-	-
i-Hexanoic	1000	0.05	0.1	0.2	0.5	1.0	2.0	5.0	10.0
Hexanoic	1000	0.05	0.1	0.2	0.5	1.0	2.0	5.0	10.0

Table 4.1 Note: Compounds are listed in order of elution. Quinic acid, formic acid, and chloride are used as internal retention time markers only.

4.2 Preservative Solution Preparation

There are two preservative solutions. One is a solution of BAK in DI that is used as a field preservative. Some or all of that preservative is removed during the preparation described in section 5.1. That preservative is replenished by the spiking of the prepared solutions. The internal retention time markers are placed into that spiking solution as well.

4.2.1 BAK field Preservative

BAK is an extremely viscous liquid that is completely water soluble (it is soap). Dissolve 12 grams of BAK into 1 liter of DI water.

4.2.2 Preservative and Internal Retention Time Marker Spiking Solution

Place 250 ml DI water in a 400 ml beaker and add 3 g of BAK and let the BAK dissolve. Place 20 ml of that solution into a 40 ml VOA vial. Dissolve 5 mg quinic acid into that solution. Use DI to fill the rest of the vial and mix.

4.3 Quality Control Sample Preparation

A working stock standard (100x dilution) is made up using the same standard as for the initial calibration.

4.3.1 Laboratory Control Sample

The laboratory control sample (LCS) is a portion of reagent grade water that has been prepared in the same manner as a field sample, but has been spiked with a known amount of the contaminants being monitored. The laboratory control sample (LCS) is prepared at a 2 ppm concentration from a 10 ppm standard by adding 1.4 ml of the standard solution to 5.6 ml of deionized water. The LCS shall be from a second source independent of the initial calibration standards.

4.3.2 Matrix Spike/Matrix Spike Duplicate

The matrix spike and spike duplicates are prepared using a 5x dilution of the working stock used for initial calibration by adding 1.4 ml of the standard solution to 5.6 ml of deionized water. True values of the MS/MSD are 2 ppm.

4.3.3 Initial and Continuing Calibration Verification

The ICV and CCV are prepared at a concentration of 2 ppm from a source other than that used for the initial calibration.

4.4 Glassware and Storage Requirements for Reagents and Standards

All standards are stored in tightly sealed glass containers and cooled to between $\leq 6^{o}$C when not in use.

5.0 Procedure

Samples are collected in 40 ml glass VOA vial and preserved with the BAK solution described in section 4.2.1. Samples may be stored for up to 14 days at $\leq 6^{o}$ C.

Analysts who use this method have been certified for the method by running Initial Demonstration of Proficiency (IDOP) Samples in accordance with Microseeps Standard Operating Procedure for Administering and Documenting Training in Laboratory Procedures and Instrumentation (SOP ADM 02). IDOP's are run any time there is significant change to an instrument, method, or in the training procedure for training a new analyst.

5.1 Sample Preparation

Prepare the sample bottles by adding 4 drops of prepared BAK solution to a clear glass 40 ml vial. Be sure that the full preservative name of benzalkonium chloride is written on the bottle labels.

All samples, including quality control samples (LCS, MS/MSD), must be field or lab preserved and pre-treated. The purpose of the pretreatment is to remove sulfate, chloride, and heavy metals, and to minimize carbonate interference. Pretreatment is accomplished through the use of pretreatment cartridges.

Inadvertent introduction of carbonate or carbon dioxide can adversely affect the samples. Additionally, spurious introduction of sulfate and chloride should be minimized, though some is inevitable. To minimize that introduction, latex gloves should be worn throughout the preparation procedure.

5.1.1 Sample Preparation Procedure:

- The eluent from these flushes should be discarded in accordance with Microseeps Standard Operating Procedure for Waste Disposal (SOP-ADM 14).
- 7 ml of sample should then be placed into the syringe, and then forced through the prepared cartridges. The first 1.5 ml of the eluent should be discarded, and the rest should be collected in 20 ml VOA vials containing 1 drop of the preservation and internal time marker solution. A portion of each is transferred into the 0.5 ml autosampler vials.
- Cap the vials, being sure to completely insert the filter-cap into the vials (the cap depression tool may be used to facilitate this).
- Once the sample is treated with the pre-treatment cartridges and the post-preparation spike is added the sample is considered prepared and is ready for loading into the IC.
- If sulfate breakthrough is observed during analysis, this procedure can be repeated with multiple sulfate removing cartridges.

5.2 Calibration

The calibration proceeds via three steps: standard sample preparation, peak identification and calibration calculation.

5.2.1 Standard Sample Preparation

The standards are prepared according to the following procedure:

- Insure that the instrument setup is correct.
- Prepare calibration standards and a blank by labeling nine vials with the concentrations specified in section 4.1.
- Cap the vials, being sure to completely insert the filter-cap into the vials (the cap depression tool may be used to facilitate this).

- Add one drop of the 'post-prep." spike
- Load the calibration standards into an autosampler rack and begin a sequence file that identifies each bottle and its contents.

5.2.2 Peak Identification

Initially, the order of elution must be measured from the analysis of single component standards. That order has been found to be the same order in which the acids are listed in Table 4.1, with HIBA exactly co-eluting with lactic acid.

With that information, the position and width of the retention time window used to make identifications should be based on measurements of actual retention time variations of standards over the course of a day. Three times the standard deviation of a retention time can be used to calculate a suggested window size for a compound. However, the experience of the analyst should weigh heavily in the interpretation of chromatograms. The internal retention time markers quinate (from quinic acid), formate (from formic acid), and chloride (from the BAK) are added to each sample. Quinate is an extremely early eluting compound, it even elutes before fluoride. The elution of formate is specified in Table 4.1. In standards containing i-butyric acid, formate is the first component of the partially merged peaks eluting after propionate. Chloride elutes between pentanoic acid and i-hexanoic acid.

5.2.3 Calibration Calculations

The standards are analyzed as samples and then the Chromeleon software is used to combine the calibration and the method file. Because the conductivity of a weak acid is not directly proportional to the concentration, the calibration is done with a quadratic equation with an offset. Because this introduces two extra degrees of freedom, the large number of calibration levels indicated in Table 4.1 is required. The calibration points (concentration vs. instrument response) are fit via a least-squared-error type regression routine in the software. For further procedural details, please see the Chromeleon software documentation. The correlation of determination (which has the same meaning for a quadratic calibration as for a linear calibration) must be at least 0.99. If this criterion is failed, the system should be inspected and the calibration repeated.

Formula:

The formula used for calculating concentrations is as follows:

$c = c_{1i} A$

Where: c = concentration.
c_{1i} = first coefficient for compound i, determined from the calibration.
A = area count or instrument response**.**

5.2.4 Initial Calibration Verification

After initial calibration, the calibration curve must be verified by use of an ICV standard at or near the mid-range of the calibration curve as specified in Section 4.3.3. The ICV standard is prepared from a source independent of the calibration standards.

5.2.4.1 ICV Acceptance Criteria

The acceptance criteria for the ICV standard must not vary more than ± 15% of its true value.

5.2.4.2 Corrective Action

If the calibration curve cannot be verified within the specified limits, the cause must be determined and the instrument recalibrated before samples are analyzed.

5.3 Sample Analysis

Instrument runs employing the autosampler should always start off with two blanks. The purpose of the first is to establish the baseline conditions discussed above and to clean the entire instrument. The data produced from this first analysis is of no use. This run is typically called the "blank XX." To insure that no analytes or samples are left in the analytical path, the last analysis should also be a blank. A method called "shutdown.met" was written to turn off the pump and the ASRS. It should always be in a schedule, and should always be last.

5.3.1 Automatic System Cleaning

During every sample analysis two cleaning procedures are executed. Those procedures, and the provisions that must be made for them, are described below.

5.3.1.1 Rinses

There is an automatic rinse programmed into the method. This rinse occurs five minutes after the start of analysis.

5.3.1.2 Column "Clean out"

Once the retention time of all analytes of interest has passed, the gradient program passes a high concentration of hydroxide onto the column.

5.3.2 Instrument Run Procedure

For a new calibration, a new sequence file should be set up per 5.3.2.1. For a run that is using a pre-existing calibration, the current sequence should simply be appended to the existing sequence file, per 5.3.2.2.

5.3.2.1 Setting Up and Using a New Sequence

- With Chromeleon running, make sure the program is available and note the name of the program.
- On the IC computer, using Chromeleon and the timebase Semivol13, choose File>New>Sequence
- Use the Wizard to set up the sequence, responding to the prompts.

5.3.2.2 Using an Existing Sequence

- Select a sequence on the IC computer.
- Scroll to the last sample and append another below that by selecting the sample, right clicking on it, and choosing "Append".
- In the appended sample, change the sample type (standard or unknown, the last being for QC samples and client samples), the sample name and check the method and program.
- You can always add to a sequence after it has started.
- From the VFA panel choose "Batch" and "Start"

The method is already set up to synchronize the autosampler, IC injection valve, and the data acquisition system.

For aqueous samples with volatile compound concentrations that exceed the range of the initial calibration the sample is to be diluted and reanalyzed until the concentration is within the initial calibration range.

5.4 Quality Control Requirements

The following quality control samples must be run with each analytical batch or more frequently, if noted.

5.4.1 Continuing Calibration Verification

In order to verify the working calibration curve a CCV is run at the beginning of each day and at the beginning and end of each analytical batch. If the instrument response has changed more than ±15%, the instrument should be recalibrated.

Corrective Action: If the calibration cannot be verified within the specified limits, discontinue sample analysis, determine the cause, and recalibrate the instrument. All samples analyzed after the last acceptable CCV/CCB must be reanalyzed.

5.4.2 Continuing Calibration Blank

The CCV must be followed by a continuing calibration blank (CCB). The calibration blank must not contain target analytes above the reporting limits.

Corrective Action: If this criterion is not met, inspect all glassware, etc. and then prepare and analyze another blank. Blanks shall be run until this criterion is met. If three blanks are analyzed in succession and this criterion is still not met, the laboratory director shall be notified.

5.4.3 Performance/Method Blank

A performance (PBW) or method blank (18 Mohm water) shall be analyzed for each analytical batch. Any analytes detected in this blank must not be present in concentrations greater than the reporting limit.

Note for DOD projects: The concentrations of any analytes present in the blank must be below ½ RL.

Corrective Action: If this criterion is not met, inspect all glassware, etc. and then prepare and analyze another blank. Blanks shall be run until this criterion is met. If three blanks are analyzed in succession and this criterion is still not met, the laboratory director shall be notified.

5.4.4 Laboratory Control Sample (LCS)

A Laboratory Control Sample (LCS) shall be analyzed every twenty samples. The LCS should be spiked with each analyte of interest between the low and mid-level standards and must be carried throughout the entire sample preparation and analytical process. Acceptance criterion is a percent recovery between 70% and 130%.

$$Percent\,\mathrm{Recovery} = \frac{Measured\ Value}{True\ Value} X 100$$

Corrective Action: If the percent recovery for this sample is not between 70% and 130%, a fresh LCS solution should be made, and the LCS should be run again. If it fails again, all samples analyzed after the last acceptable LCS must be prepared again and reanalyzed.

5.4.5 Matrix Spike and Matrix Spike Duplicate

Matrix spike and matrix spike duplicate (MS) samples shall be run for each analytical batch. The percent recovery must be between 70% and 130% and the relative percent difference (RPD) must be ≤ 30%.

$$\%RPD = \frac{\left|MS\ result - MSD\ result\right|}{\frac{\left(MS\ result + MSD\ result\right)}{2}} X 100\%$$

Corrective Action: If this criterion fails, but all other instrument run criteria are passed, then it is simply noted in the case narrative for the instrument run and the analysis proceeds. Acceptance criteria shall be modified as in-house data is compiled.

5.4.6 Contingency for Handling Out of Control or Unacceptable Data

All samples associated with out of control quality control samples must be reanalyzed. If quality control acceptance criteria cannot be met using the corrective action above, a detailed check of the de-ionized water and chemical purity is made. Reagents, standards, and other quality control samples are re-prepared and analyzed. If problems persist, sample analysis will be halted and the Technical Director shall be contacted immediately to determine the cause and implement corrective action.

Any data submitted with unacceptable quality control sample results shall be qualified in a case narrative. The narrative should indicate the out of control event that occurred, the corrective action that was taken, and any other pertinent information to inform the client of exactly what occurred.

5.5 Capturing and Submitting Data

After the anions are separated on the IC column, they are chemically converted to their acid form. The anion most prevalent in the column eluent is hydroxide (OH^-). The acid form of hydroxide is water. Water has no measurable conductivity. The other acids all have measurable conductivity, so they produce peaks in the conductivity cell as they pass through it.

The peaks are maximized and the noise is minimized if the conversion is perfectly efficient. The conversion occurs in the suppressor (ASRS, or anion self regenerating suppressor).

Acquisition of data for all standards, samples, blanks, and laboratory control samples is done using a Windows based personal computer outfitted with Dionex Chromeleon software. The software collects data, plots the peaks, integrates the peaks, calculates the calibration curve associated with the target analytes, and calculates the concentrations of the analytes in mg/L. After review from the analyst, a standard report containing a chromatogram is printed.

The raw data from all analyses, including initial calibration, calibration verification, and method blanks are stored by the analyst in the laboratory where the analyses are performed.

5.5.1 Retention Time Windows

Retention time studies have been conducted for this analysis. These studies are kept on file in the Quality Systems Office. The retention times in Table 5.5.1 below are examples. The exact retention times will vary as a function of sample composition, column type, column age, and column history. For the instruments that use this method, true retention times and retention time windows are taken from the most recent standard analyzed.

Table 5.5.1
Retention Time Windows

Low Level VFA	RT Window (Min.)	RT Window (Min.)
Lactic acid and HIBA	6.683	12.590
Acetic acid	7.259	13.408
Propionic acid	8.840	15.627
Butyric acid	12.318	18.368
Pyruvic acid	13.821	19.539
i-Pentanoic	15.489	20.864
n-Pentanoic acid	19.832	25.355
i-Hexanoic	27.659	30.008
n-Hexanoic acid	29.721	31.539

6.0 Secondary Data Review

The analyst is responsible for insuring that all calibrations, calibration checks, and quality control samples are within the specifications outlined in this SOP.

All data are validated by the analyst and the Lead Analyst. Both signatures are required on the case narrative sheets that are turned in for each analytical batch.

The analyst checks all raw data and calculations for reasonableness and accuracy, making sure that sample dilutions are taken into account. Quality control results are rechecked for compliance with acceptance criteria. If any acceptance criteria cannot be met or if any atypical conditions are encountered, a Case Narrative detailing the conditions is written and handed in with the results.

6.1 Peer Review

All data derived from this method undergoes peer data review prior to being turned into the Laboratory Director. This review served to catch potential errors prior to the data's entry into the Laboratory Information Management System. This review may only be done by another analyst who is certified in this method or the Group Lead Analyst.

6.2 Laboratory Director Review

The Laboratory Director reviews 10% of all laboratory data and calculations. This review includes sample results, quality control acceptance limits, and a review of the level of quality control required for the project.

6.3 Performance Evaluation Studies

Performance evaluation samples are currently not available. When they become available, they will be analyzed twice annually using this method.

7.0 Reporting Limits

Method detection limit studies are run annually in accordance with Microseeps Standard Operating Procedure for the Determination of Method Detection Limits and PQLs (SOP-ADM 18). Reporting limits for the VFAs are shown in table 7.0 below:

Table 7.0
Volatile Fatty Acid PQLs

VFA	PQL in mg/L
Lactic Acid	0.10
Hydroxy-isobutyric acid (HIBA)	0.07
Acetic acid	0.07
Propionic acid	0.07
Formic acid	0.07
i-Butyric acid	0.07
Butyric acid	0.07
Pyruvic acid	0.07
i-Pentanoic	0.07
Pentanoic acid	0.10
i-Hexanoic	0.10
Hexanoic acid	0.10

8.0 Safety

Safety glasses are required in all laboratory areas. Samples and reagents should always be handled with caution. For other safety concerns, consult Microseeps' Chemical Hygiene Plan. Material Safety Data Sheets (MSDS) for all compounds used in this procedure are available in the laboratory.

9.0 Waste

Unused portions of samples are kept for thirty days following analysis. The samples are then removed from the laboratory and stored until disposal according to Microseeps Standard Operation Procedure for Waste Disposal (SOP-ADM 14).

9.1 Waste Minimization

Where possible, Microseeps takes steps to minimize the amount of waste generated by substitution and good chemical handling procedures. For specific information on waste minimization consult SOP-ADM 14.

10.0 References

Citing a reference does not imply that all of the recommendations and/or requirements in those cited methods are required in this Standard Operating Procedure. This section simply refers to sources that were consulted to gather information or knowledge in order to write an informed technical procedure.

U.S. Environmental Protection Agency, Test Methods for Evaluating Solid Waste. SW-846, 3rd ed. Method 8000., Office of Solid Waste and Emergency Response, Washington, DC. 1986.

U.S. Environmental Protection Agency, Test Methods for Evaluating Solid Waste. SW-846, 3rd ed. Method 9056., Office of Solid Waste and Emergency Response, Washington, DC. 1986.

Procedure for Degassing Water

To degas the water use the following procedure:

- Place the water to be degassed into a 4L side-arm vacuum Erlenmeyer flask with a clean, 18 Mohm water rinsed stir bar. Stopper the top of the flask.
- Set the flask atop a stir plate. With the rotation initially at zero, gradually increase it so that the water throughout the entire flask is well stirred.
- Attach the side arm to mechanical vacuum pump inlet and turn on the pump. Make sure that there is a liquid trap between the flask and the pump.
- Pump-on and mix the solution for ~ 10 minutes. Bubbles will continue to come out of the water as the water boils under vacuum, but the rate of bubbling should slow dramatically by the time pumping is ceased.
- Clamp the line from the sidearm to the trap closed and break the connection after the clamp. Turn off the stir plate. Be sure to handle the water with a minimum of agitation and atmospheric exposure.

Procedure for Regeneration and cleaning of the ASRS

Equipment:

- 20 cm. piece of line with a male 1/16" fitting and a ferrule on one end. This will be the waste line for the ATC.
- 50 cm. piece of line with a male 1/16" fitting and a ferrule on one end. This will be the waste line for the ASRS.
- 20 cm piece of line with a male 1/16" fitting and a ferrule on one end and a male luer-lock fitting on the other. This will be the delivery line into the ASRS.
- 5 ml disposable syringe.

Procedure

- Place a waste receptacle close to the pump.
- Put the pump in Local, direct Control mode. Set the eluent to 100% a channel, and begin flow.
- Locate the "eluent in" port of the ASRS. Remove that line from that port of the ASRS and plumb the fitted end of the ASRS waste line into the "eluent in" port in its place.
- Locate the "eluent out" port on the ASRS. Remove that line from that port of the ASRS and plumb the fitted end of the ASRS delivery line into the "eluent in" port in its place.
- Fill the 5 ml syringe with 3-5 ml 0.25 N H_2SO_4. Attach the syringe to the ASRS delivery line.
- Use the syringe to force the H_2SO_4 solution through the ASRS. It should take 2-3 minutes to flush 5 ml of the solution through the ASRS.
- Remove the syringe, rinse it out with deionized water, and fill it with deionized water.

- Attach the syringe to the ASRS delivery line and flush DI through the ASRS. Again, it should flow at about 2-min/5 ml. Repeat the flush 2 more times.
- Turn the pump off.
- Remove the waste line from the "Eluent in" port of the ASRS and replace the line from the top of the analytical separation column (AS-11HC).
- Remove the delivery line from the "Eluent out" port of the ASRS and replace the line from the conductivity cell.
- Turn the pump back on. Check all connections for leaks, and check that, with the suppressor off, there is a baseline of less than 1 uS total conductance (as read in the top-right-hand corner of the main screen of the CD20 module).
- While checking the baseline current, also monitor the column pressure. It should be greater than 1500 psi and should not vary by more than 5%. If it does, it is most likely that the pump needs to be primed.

Instructions for priming the pump

Priming the GP40 pump is a two-step process: priming the eluent manifold and priming the pump heads. Both steps should always be done so the operator is satisfied that the priming is complete.

Priming the eluent manifold:

- Open the Main screen of the GP40 and, using the arrow keys to maneuver the cursor, the select keys to scroll through the choices, and the enter key to finalize the choices, Select LOCAL and then DIRECT CNTRL.
- Verify that the Off/On LED is in the on position.
- Move the cursor to the desired eluent. Enter 100%. This automatically sets the other eluents to 0%.
- Set the flow rate to 0.
- The priming block is below the two pump heads and has a metal lever on its top. Connect a plastic luer-lock syringe to the luer adapter on the priming block.
- Find the metal lever on top of the priming block and open it completely by turning it to your left. If the eluent reservoir is properly pressurized to 8 psi, the eluent should start flowing into the syringe immediately.
- Draw eluent into the syringe, remove the syringe, discard the eluent, reattach the syringe, and repeat until the air bubble formed in the syringe is very small and reproducible.
- Return to step 3, select another eluent, and repeat the priming procedure. It must be done for channels A, B and D.
- When the manifold has been primed with each eluent, move the lever on the priming lock back to the right, fully closed position.
- Reset the flow rate to 1.5 ml/min.

Priming the pump heads:

- Insure that the pump is in LOCAL, DIRECT CNTRL.
- Above the priming block and both pump heads is the pressure transducer. On the front and angled down, is the pressure transducer waste valve. The top of the valve is a plastic knob. Turn that knob counter-clockwise approximately two turns. Opening this valve allows the eluent to travel from the pump heads to waste, rather than from the pump heads to the column.
- Press PRIME on the GP40. The pump will begin pumping at its maximum flow rate of 2.5 ml/min for this micro-bore pump.
- Watch the waste line out of the pump for bubbles. Allow the pump to prime until no bubbles can be seen exiting the pump.
- Press PRIME again to return to the normal, screen specified, flow-rate.
- Close the pressure transducer waste valve by turning it completely clockwise. Once closed, the column pressure on the pump should rapidly rise above 1500 and should be stable. If this is achieved, the eluent system, pump included, is ready for regular operation.

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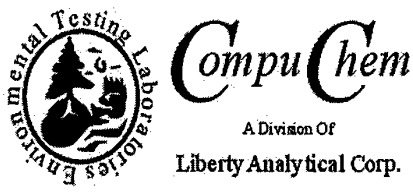

Revision 11
June 23, 2008

501 Madison Ave.
Cary, North Carolina 27513
www.compuchemlabs.com

CompuChem's mission is to work towards a cleaner environment, providing quality analytical services economically and efficiently. Our highly trained staff members work as partners to our clients to support and facilitate environmental solutions.

CompuChem
A Division Of
Liberty Analytical Corp.

Quality Manual for
CompuChem, a Division of Liberty Analytical Corporation

501 Madison Avenue
Cary, NC 27513

Revision **11**

Prepared by:

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Effective Date: **June 23, 2008**

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1.0 Statement of Policy

This Quality Manual summarizes the policies and operational procedures associated with CompuChem, a **Division** of Liberty Analytical Corporation, in Cary, North Carolina. Specific protocols for sample handling and storage, chain-of-custody, and laboratory analyses, data reduction, corrective action, and reporting are described. All policies and procedures have been structured in accordance with the National Environmental Laboratory Accreditation Conference (NELAC) and applicable EPA requirements, regulations, guidance, and technical standards. This manual has been prepared in accordance with the guidance documents listed further in Section 14. Further details on these policies and procedures are contained in SOPs and related documents. This Quality Manual, SOPs, and related documentation describe the quality system for CompuChem.

CompuChem performs chemical analyses for inorganic and organic constituents in water and soil. CompuChem's goal, and primary QA objective, is to produce data that are scientifically valid, defensible, and of known and documented quality in accordance with standards adopted by NELAC and any applicable state or EPA regulations or requirements.

CompuChem analyzes Proficiency Test (PT) samples at a minimum of two times per year for each field of proficiency testing following the requirements for PT providers and laboratories in Chapter 2.0 of the NELAC standards. Samples are obtained from a A2LA accredited PT provider. The specific analytes and matrices analyzed are based on the current scope of the laboratory services and accreditations and are documented in a laboratory SOP on PT sample analyses and in QA PT study files.

CompuChem has been a participant in the Contract Laboratory Program (CLP) since its inception and has established a long-standing rapport with the U.S. Environmental Protection Agency (USEPA) Program Office in Washington, DC, through our CLP Project Officer, and with the Region IV support division office. The EPA administers organic and inorganic Quarterly Blind PT studies for CLP analytes.

The technical and service requirements of all requests to provide analytical services are thoroughly evaluated and summarized by the Vice President of Quality Assurance and Technology. Marketing, Customer Services, Project Management, and Laboratory Operations review the summary before commitments are made to accept the work and before the project begins. This includes a review of facilities and instrumentation, current sample load, staffing, and any special method, QC or reporting requirements. All measurements are made using published reference methods or methods developed by CompuChem. Competence with all methods is demonstrated according to the procedure described in Appendix B of this Quality Manual prior to use.

The management of CompuChem is fully and firmly committed to the quality assurance program described in this Quality Manual. **The company's policies on ethical practices and its organizational hierarchy ensures that all if its employees are free from undue pressures that may adversely affect the quality of their work.** Each director, manager and supervisor, as well as their staff, is assigned, in accordance with this plan, responsibilities and objectives. Key aspects of procedures for sample receiving, chain-of-custody, sample preparation, laboratory analysis, data verification, and reporting are described in this Quality Manual and detailed the laboratory's SOPs. This manual and the SOP's document the elements of CompuChem's QA program.

The QA program is maintained and expanded or modified as necessary, to ensure all reported data are of uncompromising quality. In order to determine whether QA objectives are met,

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sufficient quality control will be generated. To meet the objectives of the QA program, senior management supports a program designed to:

- assess the capabilities of analytical methods for meeting users' needs in terms of accuracy, precision, completeness, representativeness, and comparability.
- establish and monitor the routine operational performance of the laboratory through appropriate systems checks to ensure that all aspects of the QA program are operative.
- assure that corrective actions are taken and that system control has been restored before resuming sample analysis whenever QC acceptance criteria are not met.

CompuChem has developed a proactive program for prevention of improper, unethical or illegal actions. Components of this program include the following:

- proficiency testing (single blinds).
- electronic data audits and post-analysis data audits by the QA staff.
- QA audit of the data management software audit trail for organics analyses.
- a signed Code of Ethics statement (Figure 1-1) issued and signed at employee orientation **and reaffirmed annually by each employee with their signature.**
- reaffirmation through an annual review and sign-off by all technical and support staff of the laboratory policies pertaining to manual integrations, instrument data system time, and SOP compliance.
- periodic supplemental company-wide training such as the Laboratory Fraud Detection and Deterrence presentation provided by EPA Region X.
- written SOPs addressing issues such as performing manual peak integrations and proper ethical conduct.

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1.1 CODE OF ETHICS

CompuChem, a **Division** of Liberty Analytical Corporation, provides analytical services to a variety of clients involved in the assessment of toxicants in environment samples. Our commitment to meeting client expectations and providing data of the highest quality has been, and will continue to be, a distinguishing feature of our service. Consistent with the commitment to quality data is the underlying, assumed attribute of integrity as it relates to all aspects of our service business. Because clients put their trust in the testing laboratory's ability to provide impeccable results, CompuChem's policies and philosophy will be never to put that trust in jeopardy.

CompuChem's Standard Operating Procedures (SOPs) provide appropriate instructions for completing the required tasks in the laboratory and support areas. Additional guidance is provided by Good Laboratory Practice (glp) standards, the Quality Manual and appropriate laboratory policy memos. Training programs within each area also supply added assistance that supplements the direction provided by the SOPs. Within the contents of the aforementioned documentation, and in any training programs, provisions are included which govern the situations that allow for changes to written data (including chain-of-custody documentation) or instrument output. Situations requiring change must be appropriately documented and the requirements for this are set forth in the Quality Manual or appropriate SOPs.

In absolutely no circumstances do CompuChem's policies, philosophy, SOPs, or training programs allow for inappropriate manipulation (falsification) within the analytical testing process that would compromise the validity of that process. This practice constitutes fraud and is grounds for termination. CompuChem's management feels very strongly about this position since we value the trust that clients place in the quality and integrity of the data we produce for them.

_____
Vice President & General Manager

I, _____, have read and understand this Code of Ethics, and will act appropriately.

_____ _____
Employee Signature Date

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1.2 Scope of the Quality Assurance Program Outlined in this Manual

The quality assurance plan described in this document applies specifically to CompuChem, a **Division** of Liberty Analytical Corporation, at 501 Madison Avenue in Cary, North Carolina. The plan pertains to the following major topics:

Policy
Organization and Responsibilities
Quality Assurance Objectives
Sample Handling
Test Methods and Standard Operating Procedures
Reference Standard Preparation and Instrument Calibration
Data Quality
Data Reduction, Review, and Reporting
Performance and System Audits and Frequency
Corrective Action
Facilities, Equipment, Security and Waste Management
Subcontracting and Support Services and Supplies

1.3 Concurrence with Quality Assurance program

The management of CompuChem is committed to the laboratory's quality system and to its continued improvement. **The management of** CompuChem understands and acknowledges that the laboratory is required to be continually in compliance with the National Environmental Laboratory Accreditation Program (NELAP) Standards. **All** of CompuChem's responsible parties document their concurrence with the policies and procedures detailed in this document **by their signatures on its Title Page.**

1.4 Procedures for Review of Requests, Tenders, and Contracts

Prior to **CompuChem entering into a contract to provide analytical testing services, the Vice President of Sales and Marketing reviews the request for bid (tender) and the Request for Proposal (RFP) or Scope of Work (SOW) presented by the client. The RFP or SOW detail the technical and service requirements associated with requests to provide analytical services. During or prior to the bidding process the Vice President of Sales and Marketing forwards the RFP or SOW to** the Vice President **and General Manager** or the Manager of Quality Assurance **who thoroughly review the technical aspects of the request.** After the review has been completed, a written summary is prepared and distributed to Laboratory Operations, Marketing, and Project Management for review. **This summary documents the review of the following:**

- Verification that the sample container and preservation requirements and the extraction and analyses holding times are consistent with method requirements.
- Verification that the laboratory has the requisite laboratory instrumentation, equipment, and personnel to perform the analytical services.
- Verification that the laboratory performs the analytical methods required for the project.

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- Verification that the QC requirements presented are consistent with the method and that the laboratory has the ability to achieve them.
- Verification that the laboratory meets any identified accreditation/certification requirements.
- Verification that the laboratory can achieve all method detection limit (MDL) and practical quantitation limit (PQL) requirements.
- Verification that the laboratory is able to meet the hard copy and electronic data deliverable (EDD) requirements.

The review also identifies any items that need to be resolved with the client. **These** may include errors identified during the review of the client-supplied documentation or suggestions on alternative analytical approaches that would meet the project objectives. **These observations and suggestions are also documented in the summary. All information pertaining to requests, tenders and contracts are maintained by the laboratory in the applicable project file, the Laboratory Information Management System (LIMS), the intranet server, and the quality assurance department.**

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2.0 Organization and Responsibility

2.1 Introduction

CompuChem offers the scientific and technical expertise needed to service the chemical laboratory needs of our customers. In addition to experienced analytical laboratory personnel who have skills in organic and inorganic methodologies, CompuChem utilizes a computer systems staff that manages software systems for data reporting and sample scheduling and control. To ensure that all the needs of our clients are met, a project manager is assigned to each account, providing a liaison between the customer and the laboratory.

A laboratory organizational chart of key personnel is shown as Figures 2-1. This chart includes all individuals discussed further in this section. The Human Resources department maintains job descriptions for all employees. Job descriptions for positions shown on the organizational chart are found in Figure 2-3. Resumes of key management staff are found as Figure 2-4.

This section describes the operational and functional responsibilities of key lab personnel, including the duties and services performed for product quality. The roles and responsibilities of the Quality Assurance Department and its organizational relationship to lab management are identified.

The Quality Assurance staff monitors and reviews all laboratory units and operates independently of production. All quality control criteria are documented, and compliance is verified at each level of laboratory data review. Standard Operating Procedures (SOPs) for in-lab data evaluation and independent QA auditing describe the details of these quality control functions. The QA Department is responsible for verifying the integrity of these functions and documenting performance for lab management review.

2.2 Assignment of Responsibilities

The following is a brief summary of the responsibilities and authorities assigned to each of the QA staff, laboratory management staff, and laboratory technical staff:

2.2.1 Vice President and General Manager

Assuring the laboratory achieves all QA Program objectives, the Vice President and General Manager monitors and directs quality activities of QA Department and lab personnel. The Vice President and General Manager acts in strict adherence to the procedures and requirements stated in the Quality Manual. He works closely with laboratory supervisors and staff to address data quality issues. The Vice President and General Manager reports directly to the President and Chief Executive Officer (CEO). The Vice President and General Manager and QA have oversight responsibilities for all lab operations as depicted in the organization chart. The Vice President and General Manager and QA Manager have the authority to terminate non-conforming work.

The Vice President and General Manager and the QA manager conduct annual assessments of the total QA program. Based on the assessments, a written status report of QA activities and progress is forwarded to management. Additional monthly reports include information regarding the effectiveness of the quality management systems and are reported to executive management staff. Included are:

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- status of or changes to the QA program and Quality Manual
- measures of data quality
- significant QA problems, accomplishments and recommendations
- results of performance audits
- results of system audits
- status of QA requirements for contracts and QA Project Plans
- summary of QA training (internal and external QA/QC seminars and courses)
- overall effectiveness of the QA program

2.2.2 Manager of Quality Assurance (*QA Officer*)

The Manager of Quality Assurance reports to the Vice President and General Manager and is organizationally and functionally independent of direct job involvement and day-to-day laboratory operations. The QA Officer serves as the focal point for QA/QC and is responsible for the oversight and/or review of quality control data. She is primarily responsible for auditing the implementation of the quality system and carrying out the directives of the Vice President and General Manager.

2.2.3 Director of Laboratory Operations

The Director of Laboratory Operations reports directly to the President and Chief Executive Officer and is responsible for all aspects of laboratory operations. All laboratory section managers report directly to the Director of Laboratory Operations. She is responsible for ensuring that all laboratory technical staff are qualified and properly trained to perform their job functions. She is also responsible for the timely delivery of client data reports that meet all quality control and project requirements.

2.2.4 Laboratory Management

The laboratory section managers and supervisors report directly to the Director of Laboratory Operations and are responsible for sample receipt, sample preparation, sample analysis, reference standard preparation, instrument calibration, instrument maintenance, corrective action, data report preparation, and waste disposal.

2.2.5 Laboratory Technical Staff

Laboratory technical staff report directly to section managers and supervisors and are responsible for performing their various job functions utilizing current, approved laboratory standard operating procedures, EPA methods and EPA CLP statements of work. Laboratory technical staff are also responsible for the preparation and analysis of quality control samples and adherence to quality control and safety procedures.

2.2.6 Project Management and Customer Support Services

Project Management representatives are responsible for communicating client and project-specific requirements to the laboratory in order to ensure that data quality objectives are met. The Project Manager is the internal customer representative and the primary contact for the client. Details of the project requirements are reviewed and discussed prior to the receipt of samples. The Laboratory Information Management System (LIMS) allows the Project Manager (PM) to list detailed requirements for a given project. In addition, a Project Profile Sheet (PPS) can be

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completed to supply additional details or explain project specific requirements. Electronic PPS files are maintained in a network database available to all PCs. The LIMS is also available to all appropriate personnel.

2.5 Training of Technical Staff

CompuChem's training program is administered by the Human Resources (HR) department and laboratory supervisors and applies to all full-time, temporary and part-time employees. To be hired or promoted, an employee must meet all job description requirements. Checklists are used to document that requirements are met. All hiring and subsequent changes in personnel status are documented through the use of the Personnel Action Form (PAF).

Various types of training are provided for employees new to a position, and the training records are maintained in the individual's permanent training files. Initial and on-going performance is measured through indicators such as precision and accuracy in replicate spiked quality system matrices, performance evaluation or single blind proficiency test samples, and surrogate recoveries. If an employee fails to maintain acceptable performance standards, retraining must be documented before the employee may work independently. Training proficiency records are maintained for each employee.

Trainees are not allowed to process samples independently before they have demonstrated capability. See Appendix B of this manual for policy on performing Demonstration of Capability. During the training period, any work performed by a trainee is directly supervised by a senior qualified analyst, and any worksheets, forms, or other analytical data are reviewed and co-signed by the senior qualified analyst. The training period varies in length of time depending on the position and on the prior experience and knowledge level of the individual. On an as needed basis the QA staff provide training in certain quality aspects of the operation such as correct chain of custody documentation, proper error correction protocols, etc. Continuing training occurs annually with a signatory review of the Quality Manual by all staff.

In order to provide adequate staff to perform all of the laboratory's job functions, analysts are cross trained typically within their departments to perform other job functions. These cross trained analysts serve as backup in the absence of the primary analyst or as additional help if the work load is heavy in a particular area. Crossed trained analysts are required to demonstrate capability as described in Appendix B in all job functions in which they perform.

Each employee is required to read and understand the SOPs relative to their job responsibilities. They must agree to follow the most current version of the controlled SOP. Evidence of this agreement is maintained in each employee's training file or within the QA Department.

All job functions are fully described in formalized job descriptions. The employee job descriptions include minimum acceptable levels of formal education, training, prior experience, and special requirements for certifications or licenses. Some contracts or client agreements specify minimum qualifications for technical, administrative, computer, and management positions. Certain positions require auxiliary training, including viewing of training videotapes, on-site training classes, or off-site attendance of specialized training or certification courses.

Formal training at CompuChem also involves safety and chemical hygiene training. The Vice President and General Manager has the ultimate responsibility for chemical hygiene in the laboratory and provides continuing support of the program. The Safety Officer, Safety

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Committee, and the Chemical Hygiene Officer (CHO) have the responsibility of coordinating and enforcing the laboratory safety program at CompuChem. Each employee in the laboratory is responsible for ensuring an effective chemical hygiene plan. The safety program involves the following key elements:

- safety training programs for all personnel
- the Chemical Hygiene Plan (CHP), approved by the Vice President and General Manager
- the Emergency Action Plan, approved by the Vice President and General Manager
- monthly inspections of the facilities for compliance with safety regulations
- verification that all safety equipment is operable and in good working condition (including inspection and recharging of all fire extinguishers, and monthly inspection of fume hoods and eye washes)
- initial testing of all new safety equipment
- annual fire/evacuation drills
- the safety committee, which is comprised of safety facilitators representing key sections of the operation
- right-to-know seminars held for all laboratory personnel to discuss chemical hazards, safety precautions, medical treatment, and spill procedures

The CHO and the safety committee have the responsibility of conducting internal safety inspections, covering all aspects of laboratory safety including fire, hazardous materials, personal dress, electrical safety, posted evacuation routes, and condition of all safety equipment. Corrective actions identified in the inspection or during safety drills are the responsibility of the each laboratory section manager.

Safety briefings for all employees are the responsibility of the department managers. Employees receive technical assistance from the CHO in complying with the CHP. Training includes safety for fire, electricity, compressed gases, chemical hazards, safety equipment, and hazardous sample and waste handling, depending on the responsibilities of the department or laboratory. New employees must be trained in all aspects of safety concerned with their job responsibilities and the laboratory in which they work. Human Resources, along with department managers and the CHO must maintain documentation of safety training. The documentation must include a completed training form, a list of the attendees, the training subject(s), the time spent in training, and the date.

A variety of local seminars, workshops, and lectures are also made available to employees. Workshop and seminar attendees usually relate their experiences in the form of trip reports or in-house presentations to appropriate staff members.

2.6 Laboratory Capabilities

CompuChem analyzes waste water, soil, and solid and liquid waste samples. Table 2.1 lists the parameters, analytes, and method references. Unless otherwise indicated in the SOP, the laboratory performs the published method as written.

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Figure 2-1:

CompuChem, a Division of Liberty Analytical Corporation
Key Personnel Organizational Chart

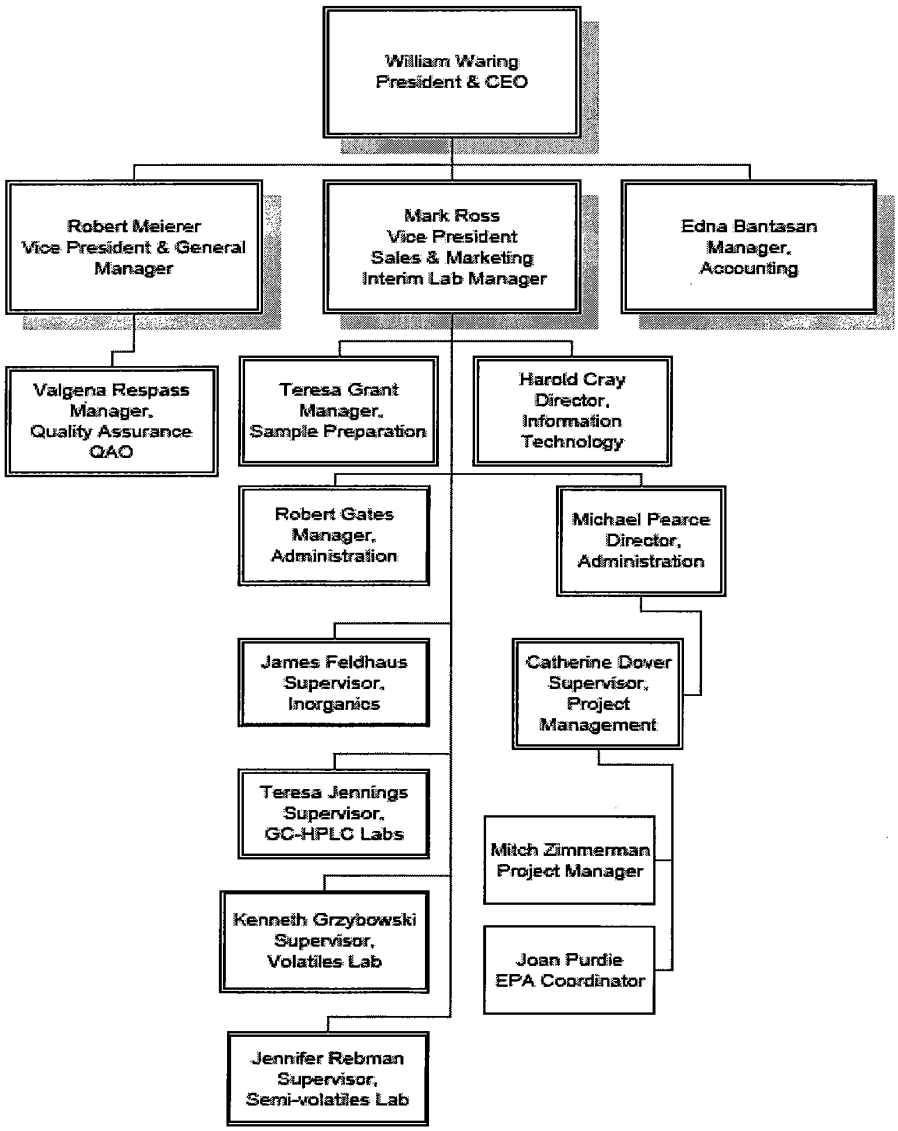

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Figure 2-3: ***Job Descriptions of Key Positions listed on Organization Chart***

COMPUCHEM, a division of Liberty Analytical Corporation
DESCRIPTIVE TITLE: ***Vice President & General Manager*** **JOB NO.**:370008
DEPARTMENT: 3700 – Quality Assurance & Technology **F.L.S.A.** Exempt
IMMEDIATE SUPERVISOR: President & Chief Executive Officer **LOCATION**: Cary, NC

I. BASIC FUNCTION:

Develop and implement strategic processes and practices within the company. Manage and guide the overall organization. Provide guidance in analyzing and appraising the effectiveness of overall operations. Assure all EPA CLP contractual requirements and federal and state agency certification requirements are met by the company. Assure that the company consistently produces data of known and documented quality.

II. SCOPE OF THE POSITION:

A. Organizational Relationships

This position reports to and receives direction from the President and Chief Executive Officer (CEO). This position works closely with laboratory managers and the Marketing/Sales personnel concerning the nature and quality of work performed.

Outside of CompuChem, this position works closely with personnel from government agencies on analytical methodologies, customers and potential customers on the technical aspects of projects, and vendors on project information.

B. Major Functions Reporting to this Position

Director of Laboratory Operations

Quality Assurance Officer

C. Know How, Training and Experience

This position requires an advanced degree in analytical chemistry or equivalent, and a minimum of five (5) years experience in Quality Control/Quality Assurance functions. Extensive management experience and strong management capabilities are required. Experience in EPA and other agency requirements and regulations are required, as is an understanding of government agency interactions. Experience in GC, GC/MS and inorganic analyses are also required.

- Plan, develop and manage the Quality Assurance program assuring that all laboratory operations and standards meet the necessary requirements for continuing compliance with accreditation agencies.
- Monitor the effectiveness of the Quality Assurance program, assuring that appropriate QC standards are established and met, implementing changes or new programs as conditions require.
- Resolve quality control problems, explaining or directing the explanation of abnormal sample data, and recommending sample rework or corrective action when necessary.

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Vice President & General Manager ***JOB No.: 370008 (continued)***

- Establish the conditions and programs necessary to meet certification and licensing standards on new products/analyses as they are developed.
- Work with laboratories to develop appropriate methodologies and standards for new products or special projects.
- Provide evaluation and approval for all method validation study programs and SOPs.
- Direct in-house systems and performance audits of laboratories and data audits
- Oversee and direct the efforts of the Quality Assurance staff activities to ensure that SOPs and the Quality Manual are current and documented.
- Conduct meeting of the Senior Managers.
- Assess findings in EPA CLP Contract Compliance Screening (CCS) Reports.
- Oversee responses to CCS Reports.
- Assess the feasibility of CLP modified analysis projects requested by the EPA
- Oversee and/of respond to EPA inquiries, data/tape audit reports, and on-site audit reports
- Review available RFP, RFQ and SOW documents for commercial clients and the EPA to understand the analytical and QC requirements

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COMPUCHEM, a division of Liberty Analytical Corporation
DESCRIPTIVE TITLE: ***Director, Laboratory Operations*** **JOB NO.:** 500001
DEPARTMENT: 5000 Lab Support **F.L.S.A.** Exempt
IMMEDIATE SUPERVISOR: President & Chief Operating Officer **LOCATION:** Cary, NC

I. BASIC FUNCTION:

Direct the activities of the GC/MS, GC, Inorganics/Wet Chem & Extractions Laboratories which are comprised of various technical departments which function in a multi-shift production environment. The major responsibility of Laboratory Operations is to produce accurate and timely data packages based on the analyses of environmental samples. Additionally, to develop new methods and/or techniques which enhance CompuChem's product line and/or improves its process techniques and production throughput.

II. SCOPE OF THE POSITION:

A. Organizational Relationships

This position reports to and receives direction from President and COO. This position works closely with the Laboratory Managers as well as Managers from other CompuChem departments such as Sales & Marketing, Accounting, and Quality Assurance & Technology.

Outside of CompuChem, contact is with CompuChem's customers concerning laboratory practices, status of analyses, explanation of analytical results, etc. This position also has contact with equipment manufacturers, vendors, and consultants utilized by CompuChem.

B. Major Functions Reporting to this Position

Volatile and Semi-Volatile GC/MS Laboratories – Responsible for the preparation and analysis of environmental samples and for the generation of complete data packages.

Extractions Laboratory – Responsible for the preparation of sample extracts for analysis by other laboratories.

GC/HPLC Laboratories – Responsible for the preparation of sample environmental samples and for the generation of complete data packages.

Inorganics/Wet Chemistry Laboratory – Responsible for the preparation and analysis of inorganics samples, preparation of samples for metals, mercury, cyanide, phenols, fluoride, sulfate and chloride for the generation of complete data packages.

C. Know How, Training and Experience

The position requires a B.S. degree in Chemistry plus a minimum of five (5) years of experience in an analytical laboratory preferably performing organic environmental analyses. This position also requires a minimum of eight (8) years of managerial experience. The managerial experience should have been in a high growth, high technology production environment managing individuals with technical and/or scientific backgrounds. Knowledge of the environmental industry/analytical requirements is also required. A broad base knowledge of business plus excellent verbal and written communication skills is also required.

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Director, Laboratory Operations ***JOB NO.: 500001 (continued)***

III. ACCOUNTABILITIES:

- Responsible for directing the Extractions, GC, HPLC, GC/MS, and Inorganics/Wet Chem Laboratories in the preparation, analysis, and generation of technical data packages of environmental samples within prescribed quality limits and specified timeframes in order to meet production requirements for shipments.
- Direct the development and implementation of new methods/processing improvements in order to allow CompuChem to expand its product line and/or to maximize instrument/processing capability and efficiency. The new methods/processing improvements may deal with analytical procedures, software enhancements or process flow improvements.
- Responsible for the preparation of the annual budget in order to accurately anticipate the cost associated with producing our products and to provide a framework for managing and controlling departmental resources and expenses.
- Develop annual goals and objectives within Laboratory Operations in order to provide a methodical systematic approach to planning and achieving business plan objectives.
- The position will have Profit & Loss (P&L) responsibility for the operation of the laboratory and will be charged with exercising control over various laboratory cost centers in order to accentuate efficiency and the use of purchased materials, reduce expenses to the extent possible, and maximize company profit.
- Responsibility for managing direct reports in the area of P&L responsibility and for assisting in the development of individual supervisors for accepting accountability for controlling costs in their respective lab areas.
- Responsible for ensuring that all pertinent information gleaned in executive staff meetings is disseminated to direct reports in order that communication may be provided on a real-time basis, openly and accurately.
- Participate in special assignments/projects as required.

IV. MAJOR CHALLENGES OF THIS POSITION:

- The most difficult and/or complex part of this position is to integrate a production orientation into a scientific environment, which is highly dynamic due to the growth of the business. In combination with the previous statement, the blending of multiple technologies, i.e., analytical chemistry, computers, production, and management expertise to increase the quality of the total organic data package (i.e., reduce reworks of all types) and simultaneously increase productivity is also extremely complex.
- The position will be directly responsible for meeting monthly production quotas, i.e. planned shipments of data that allow the company to meet monthly revenue and profit goals.

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COMPUCHEM, a division of Liberty Analytical Corporation
DESCRIPTIVE TITLE: ***Manager, Purchasing, Admin., Facilities & Safety Officer*** **JOB NO.:** 600005
DEPARTMENT: 6000 Gen. Management **F.L.S.A.** Exempt
IMMEDIATE SUPERVISOR: *President & CEO* **LOCATION**: Cary, NC

I. *BASIC FUNCTION*

Responsible for the purchase of materials, supplies, etc. for all the departments.

Manage facility related activities, including building systems maintenance, telephone system installation and maintenance, and installation of CRT wiring; develop and implement facility renovation plans to provide proper work areas for both office, laboratories, manage hazardous waste collection and disposal program and company wide safety program; design, build and coordinate laboratory support equipment; coordinate cafeteria and vending machine service with contractor.

II. SCOPE OF THE POSITION

A. Organizational Relationships

This position reports to and receives direction from the President & COO. This position works closely with managers/supervisors and all other employees across the Company concerning purchasing, facility and safety issues. The position also serves as contact for CompuChem with vendors for facilities-related projects, telecommunications and Government Regulatory Agencies.

B. Major Functions Reporting to This Position

Building Maintenance

C. Know How, Training and Experience

This position requires a minimum of five (5) years experience in facilities and instrumentation management, including the design and construction of new and existing office and laboratory facilities as well as coordinating and scheduling work with outside contractors and the installation and service of laboratory instruments. Must have knowledge of plumbing system, electrical systems, HVAC systems, telecommunications systems and services, CRT systems, security and fire alarm systems and Halon systems equipment repair practices. The ability to read and develop blueprints is required. An understanding of safety practices and regulations is required. Knowledge of hazardous waste disposal requirements is also required.

III. ACCOUNTABILITIES

- Operate and maintain laboratory and office heating, ventilating, air conditioning systems and fume hoods. Also responsible for installation and renovation of new and existing systems to meet facility requirements.
- Operate and maintain laboratory and office electrical systems. Also responsible for installation and renovation of new and existing systems to meet facility requirements.
- Operate and maintain of plumbing and water systems and the installation and renovation of new and existing systems to meet facilities requirements.

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Manager, Purchasing, Admin., Facilities & Safety Officer ***JOB NO.: 600005 (continued)***

- Operate and maintain telecommunications equipment. Audit monthly telecommunications invoices for accuracy and approve for payment. Maintain state-of-the-art telecommunications equipment and services.
- Maintain of laboratory appliances.
- Responsible for hiring, training and development of maintenance staff.
- Operate and maintain facility fire suppression systems and fire alarm equipment.
- Manage the facilities shop, assuring that parts and supplies are ordered in a cost-effective manner and making changes in suppliers and/or equipment as required.
- Responsible for the design and construction of new and existing space as required to meet facility needs.
- Work with the laboratory operations management on the adaptations and/or development of special equipment or projects as needed.
- Responsible for Operation and maintenance of building security systems and personnel.
- Operation and maintenance of building security systems and personnel.
- Design, fabricate and/or coordinate laboratory support apparatus and equipment.
- Coordinate operations of cafeteria and food vending services.
- Install laboratory gas supply systems.
- Interacting with the landlord to negotiate new leases and other requirements needed to provide adequate facilities.
- Responsible for accounts payable inquiries and remittances.
- Assist in accounts receivable inquiries.
- Responsible for the purchase of all materials & supplies.
- Provide recommendation for promotion and lateral transfers. Conduct performance appraisals, recommend and review merit increases.
- Develop and maintain CompuChem's Affirmative Action Program to provide an environment which is free of discrimination.
- Maintain an awareness of all Federal, State, & local rules and regulations that pertain to employment practices, i.e., wage & hour laws, EEO, and OSHA regulations.
- Responsible for communicating and ensuring that all employees understand and adhere to Company's Work Rules, and Policies and Procedures.
- Participate in special development projects as required.
- Insurance purchase and claims interface.

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COMPUCHEM, a division of Liberty Analytical Corporation
DESCRIPTIVE TITLE: ***Manager of Quality Assurance*** **JOB NO.:** 370002
DEPARTMENT: 3700- Quality Assurance & Technology **F.L.S.A.** Exempt
IMMEDIATE SUPERVISOR: Vice President & General Manager **LOCATION:** Cary, NC

I. BASIC FUNCTION:

Manage and improve the laboratory's quality assurance program by conducting internal systems audits and coordinating corrective actions with laboratory management and staff.

II. SCOPE OF THE POSITION:

A. Organizational Relationships

This position reports to and receives direction from the Vice President and General Manager in matters relating to data quality.

Outside of CompuChem, contact is with State and Federal Regulatory agencies and clients.

B. Major Functions Reporting to this Position

None

C. Know How, Training and Experience

This position requires an undergraduate degree in Chemistry or related science or equivalent and a minimum of five (5) years laboratory experience, preferably in organic/analytical/clinical chemistry and five (5) years involvement in QA/QC.

III. ACCOUNTABILITIES:

- Develop and evaluate methods for evaluating the quality of data being generated to ensure method and contract compliance.
- Ensure that all employees have a current job description in their training file. The job descriptions must have complete signatures including employee, immediate supervisor and next managerial level.
- Represent the laboratory and the Quality Assurance Department, when required, during on-site audits and laboratory evaluations.
- Perform data and system audit functions and report findings to laboratory management.
- Oversee and participate in the requirements for State Certification programs and PE sample programs.
- Coordinate/perform subcontractor lab audits and provide recommendations for approval of such labs, if required.
- Maintain QA/QC databases, including control limits, MDL and reporting limits, and Corrective Action Reports (CARs).
- Review client QA Project Plans, contracts and statement-of-work, and provide other supplemental Marketing Department support as needed.
- Review and approve Standard Operating Procedures and Method Validation Study data.
- Perform special project functions at the direction of the Vice President and General Manager

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COMPUCHEM, a division of Liberty Analytical Corporation
DESCRIPTIVE TITLE: ***Supervisor, Inorganics/Wet Chemistry Lab*** **JOB NO.:** 430001
DEPARTMENT: 4300 Inorganics **F.L.S.A.** Exempt
IMMEDIATE SUPERVISOR: Director, Lab Operations **LOCATION:** Cary, NC

I. BASIC FUNCTION:

Responsible for the analysis of various types of environmental samples and digestates utilizing various instrumental and wet-chemistry procedures for the generation of complete data packages ensuring that timely and accurate production is achieved. Responsible for analysis of environmental inorganic samples utilizing Inductively Coupled Plasma emission spectroscopy, ICP/MS, Cold Vapor/Hydride Atomic Absorption spectroscopy, Colorimetric Automated Analyzers and the generation and transfer of complete data in an accurate and timely manner.

II. SCOPE OF THE POSITION:

A. Organizational Relationships:

This position reports to and receives direction from the Director, Laboratory Operations. This position works closely with other managers for the purpose of coordinating production and special projects.

Outside of CompuChem, contact is with vendors, equipment manufacturers, and consultants utilized by CompuChem. This position also provides technical guidance to customers concerning analyses performed and/or participates in on-site audits.

B. Major Functions Reporting to this Position:

Inorganics/Wet Chemistry Laboratory - analysis of environmental samples and extracts with different matrices and the generation of complete and accurate data packages.

C. Know How, Training and Experience

This position requires an undergraduate degree in chemistry or equivalent. A minimum of three (3) years of experience in applied analytical techniques (including ICP) for Inorganic Environmental analysis is required. Must have three years of supervisory experience with a strong production orientation.

III. ACCOUNTABILITIES:

- Responsible for ensuring the analytical quality of all data generated by the Inorganics/Wet Chemistry Laboratory.
- Evaluate and develop methods for improving the quality and quantity of the data produced.
- Develop and monitor all training programs utilized in the Inorganics/Wet Chemistry Laboratory for effectiveness and compliance with existing analytical quality standards.
- Plan and schedule work assignments according to analysis requirements. Assign individual work schedules based on analysis requirements and capabilities of the department staff.
- Responsible for interviewing, selecting, orienting, and training new employees.
- Determine training needs of current employees and define a plan of action to address the training requirements.

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Supervisor, Inorganics/Wet Chemistry Lab ***JOB NO.: 430001 (continued)***

- Provide recommendations for promotions and lateral transfers. Conduct performance appraisals, recommend merit increases and review merit increases with employees.
- Responsible for communicating and ensuring that all departmental employees understand and adhere to all company policies and procedures.
- Responsible for safety attitudes and practices; and for the overall housekeeping of the Inorganics/Wet Chemistry Laboratory.
- Maintain an accurate inventory of laboratory supplies and equipment. Reorder supplies when required and maintain appropriate records of purchase. Keep expenses to a minimum.
- Responsible for maintaining up-to-date Standard Operating Procedures for the Inorganics/Wet Chemistry Laboratory.
- Assist other areas of the lab by providing personnel and cross-training whenever possible.
- Provide technical guidance and input as requested for new contract requirements, special, and/or new products.
- Ensure overtime is evenly distributed between staff and kept to a minimum.
- Maintain an awareness of all Federal, State, & local rules and regulations that pertain to employment practices, i.e., wage & hour laws, EEO and OSHA regulations
- Responsible for monitoring the absence and vacation utilization by departmental staff.
- Responsible for communicating & ensuring that all departmental employees understand & adhere to all Company's Work Rules; and Policies & Procedures.
- Participate in special assignments/projects as required.

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COMPUCHEM, a division of Liberty Analytical Corporation
DESCRIPTIVE TITLE: ***Supervisor, Sample Preparation Lab*** **JOB NO.:** 360001
DEPARTMENT: 3600 Sample Preparation Lab **F.L.S.A.** Exempt
IMMEDIATE SUPERVISOR: Manager, Sample Preparation Lab **LOCATION:** Cary, NC

I. BASIC FUNCTION:

Preparation of various environmental matrices using liquid-liquid and liquid-solid chemical extraction techniques for analysis using SW-846 and CLP methodologies. Supervising and training of sample preparation technicians and ensuring that timely and accurate production is achieved. Handling and coordinating the disposal of hazardous waste generated by the facility.

II. SCOPE OF THE POSITION:

A. Organizational Relationships

This position reports to and receives direction from the Sample Preparation Lab Manager. This position works closely with the other supervisors and managers to coordinate sample processing throughout the laboratory.

B. Major Functions Reporting to this Position

Glassware Preparation – preparation and inventory of all glassware utilized by the various laboratory functions.

Organic Sample Preparation Technicians/analysts – preparation of samples for organic analyses.

C. Know How, Training and Experience

This position requires an undergraduate degree in chemistry or equivalent. A minimum of three (3) years in preparation of environmental samples, one (1) year supervisory experience and annual training in hazardous waste regulations are required

III. ACCOUNTABILITIES:

- Ensuring that the production of the organic sample preparation laboratory is conducted in a timely and accurate manner.
- Plan and schedule work assignments according to sample load.
- Assign individual work schedules based on sample load and capabilities of the department staff.
- Interview, select, and train new employees. Determine training needs of employees and define a plan of action to address the training requirements.
- Provide recommendation for promotions and lateral transfers. Conduct performance appraisals, recommend merit increases and review merit increases with employees.
- Practice overall good housekeeping of the sample and glassware preparation areas.
- Maintain an accurate inventory of laboratory supplies and equipment. Reorder supplies when required and maintain appropriate records of purchase.
- Maintain up-to-date Standard Operating Procedures for the preparation lab
- Monitoring absence and vacation utilization by departmental staff.
- Participate in special development projects as required.

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Supervisor, Sample Preparation Lab ***JOB NO.: 360001(continued)***

- Collect, identify, label, package, store and coordinate the shipment of the facility's hazardous waste for disposal in compliance with all federal, state, and local regulations.
- Maintain records of all waste shipped
- Perform spill control and cleanup as described in the CompuChem Contingency Plan – Emergency Response Procedures, Section B Chemical Release.
- Perform and document compliance inspections of the waste storage areas

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COMPUCHEM, a division of Liberty Analytical Corporation
DESCRIPTIVE TITLE: ***Supervisor Semi-VOA Lab*** **JOB NO.:** 412002
DEPARTMENT: 4120 - GC/MS Semi-VOA Laboratory **F.L.S.A.** Exempt
IMMEDIATE SUPERVISOR: Director, Lab Operations **LOCATION:** CARY,NC

I. BASIC FUNCTION:

Responsible for the in-depth review of all environmental GC/MS generated sample data ensuring that all data reviewed are turned-in in an accurate and timely manner. The Supervisor is also responsible for managing the multi-shift Semi-VOA Lab ensuring that timely and accurate production is achieved.

II. SCOPE OF THE POSITION:

A. Organizational Relationships

This position reports to and receives direction from the Sr. Manager, Organics Laboratory. This position works closely with other Managers & Supervisors of the Company for the purpose of coordinating production and special projects.

Outside of CompuChem , this position also provides technical guidance to customers concerning analyses performed and/or participates in on-side audits.

B. Major Functions Reporting to this Position

GC/MS Data Review & Case Review – In depth technical and clerical review of data packages generated by GC/MS Laboratories.

GC/MS Semi-Volatile Lab – analysis of environmental extracts with different matrices and the generation of complete and accurate data packages.

C. Know How, Training and Experience

This position requires an undergraduate degree in chemistry or equivalent. A minimum of three (3) of experience in applied gas chromatography/mass spectrometry is required as is the ability to interpret mass spectra. Must have demonstrated knowledge of basic analytical techniques and methods. Supervisory/managerial experience with a strong production orientation is also required. Excellent verbal, written communication skills, and a strong production orientation are required of this position.

III. ACCOUNTABILITIES:

- Responsible for ensuring that the production of the GC/MS Semi-VOA Lab in a timely and accurate manner. This includes coordinating the production effort with the Supervisors and other shifts/
- Responsible for developing methods for improving the quality and quantity of the data produced.
- Provide technical guidance and input of new contract requirements and/or new products.

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Supervisor Semi-VOA Lab ***JOB NO.: 412002(continued)***

- Determine training needs of current employees and define a plan of action to address the training requirements.
- Responsible for ensuring the analytical quality of all data generated by the Environmental GC/MS Laboratory.
- Monitor and evaluate the statistical validity of the computerized databases identifying laboratory trends.
- Develop and monitor all training programs utilized in the GC/MS Laboratory for effectiveness and compliance with existing analytical quality standards.
- Develop and maintain database of all "go-backs" from the Final Technical Review Department. This includes monitoring the "go-backs" which are appropriate and also, those that are not. Provide the Final Technical Review Department with feedback concerning inappropriate "go-backs."
- Provide technical guidance and input as requested for new contract requirements, special projects, and/or new products.
- Respond to client directly when technical issues are involved.
- Responsible for interviewing, selecting, orienting, and training new employees.
- Responsible for the preparation of job descriptions for each position or job title within the department. Ensure that all employees have a current job description in their training file. The job descriptions must have complete signatures including employee, immediate supervisor and next managerial level.
- Provide recommendations for promotions and lateral transfer. Conduct performance appraisals and recommend merit increases.
- Responsible for safety attitudes and practices; and for the overall housekeeping of the Laboratories
- Responsible for ensuring that up-to-date Standard Operating Procedures are maintained.
- Maintain an accurate inventory of laboratory supplies and equipments. Reorder supplies when required and maintain appropriate records of purchase. Keep expenses to a minimum.
- Assist other areas of the lab by providing personnel and cross-training whenever possible.
- Ensure overtime is evenly distributed between staff and kept to a minimum.
- Responsible for monitoring the absence and vacation utilization by departmental staff.
- Maintain an awareness of all Federal, State, & local rules and regulations that pertain to employment practices, i.e., wage & hour laws, EEO and OSHA regulations.
- Responsible for communicating and ensuring that all departmental employees understand and adhere to all company work rules and policies & procedures.
- Participate in special assignment/projects as required.

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COMPUCHEM, a division of Liberty Analytical Corporation
DESCRIPTIVE TITLE: ***Supervisor, Volatile Laboratory*** **JOB NO.**: 421002
DEPARTMENT: 4210 - GC/MS Laboratory **F.L.S.A.** Exempt
IMMEDIATE SUPERVISOR: Director, Lab Operations **LOCATION**: CARY, NC

IV. BASIC FUNCTION:

Responsible for the preparation and analysis of environmental volatile samples utilizing GC/MS and for the generation of complete data packages. The Supervisor is also responsible for managing the multi-shift Volatile Laboratory ensuring that timely and accurate production is achieved.

V. SCOPE OF THE POSITION:

A. Organizational Relationships

This position reports to and receives direction from the Director, Lab Operations. This position works closely with the other Managers & Supervisors of the Company for the purpose of coordinating production and special projects.

Outside of CompuChem, this position also provides technical guidance to customers concerning analyses performed and/or participates in on-side audits.

B. Major Functions Reporting to this Position

GC/MS Data Review & Case Review – In depth technical and clerical review of data packages generated by GC/MS Laboratories.

Volatile GC/MS Volatile Laboratory – analysis of environmental volatile samples utilizing GC/MS and the generation of complete data packages.

C. Know How, Training and Experience

This position requires an undergraduate degree in chemistry or equivalent. A minimum of three (3) years of experience in applied analytical gas chromatography/mass spectrometry is required as is the ability to interpret mass spectra. Must have a demonstrated knowledge of basic analytical techniques and methods. Supervisory/managerial experience with a strong production orientation is also required. Excellent verbal, written communication skills, and a strong production orientation are required of this position.

VI. ACCOUNTABILITIES:

- Responsible for ensuring that the production of the GC/MS Volatile Laboratory in a timely and accurate manner. This includes coordinating the production effort with the Supervisors and other shifts.
- Responsible for developing methods for improving the quality and quantity of the data produced.
- Provide technical guidance and input for new contract requirements and/or new products.

R2-0002190

Supervisor, Volatile Laboratory ***JOB NO.: 421002(continued)***

- Responsible for planning and scheduling work assignments according to analysis requirements. Assign individual work schedules based on analysis requirements and capabilities of the department staff.
- Responsible for interviewing, selecting, orienting, and training new employees.
- Determine training needs of current employees and define a plan of action to address the training requirements.
- Monitor and evaluate the statistical validity of the computerized databases identifying laboratory trends.
- Develop and monitor all training programs utilized in the GC/MS Laboratory for effectiveness and compliance with existing analytical quality standards.
- Develop and maintain database of all "go-backs" from the Final Technical Review Department. This includes monitoring the "go-backs" which are appropriate and also, those that are not. Provide the Final Technical Review Department with feedback concerning inappropriate "go-backs."
- Provide technical guidance and input as requested for new contract requirements, specials, and/or new products.
- Respond to client directly when technical issues are involved.
- Responsible for communicating and ensuring that all departmental employees understand and adhere to all company policies and procedures.
- Responsible for interviewing, selecting, orienting, and training new employees.
- Provide recommendations for promotions and lateral transfer. Conduct performance appraisals and recommend merit increases.
- Responsible for the preparation of job descriptions for each position or job title within the department. Ensure that all employees have a current job description in their training file. The job descriptions must have complete signatures including employee, immediate supervisor and next managerial level.
- Responsible for ensuring that up-to-date Standard Operating Procedures are maintained.
- Responsible for safety attitudes and practices; and for the overall housekeeping of the Laboratories.
- Maintain an accurate inventory of laboratory supplies and equipments. Reorder supplies when required and maintain appropriate records of purchase. Keep expenses to a minimum.
- Assist other areas of the lab by providing personnel and cross-training whenever possible.
- Ensure overtime is evenly distributed between staff and kept to a minimum.
- Maintain an awareness of all Federal, State, & local rules and regulations that pertain to employment practices, i.e., wage & hour laws, EEO and OSHA regulations.
- Responsible for monitoring the absence and vacation utilization by departmental staff.
- Participate in special assignment/projects as required.

R2-0002191

COMPUCHEM, a division of Liberty Analytical Corporation
DESCRIPTIVE TITLE: ***Supervisor, GC/HPLC Labs*** **JOB NO.**: 410001
DEPARTMENT: 4100 - GC Laboratory **F.L.S.A.** Exempt
IMMEDIATE SUPERVISOR: Director, Laboratory Operations **LOCATION**: Cary, NC

I. BASIC FUNCTION:

Responsible for the analysis of various types of environmental samples and extracts utilizing GC and HPLC for the generation of complete data packages. The GC/HPLC Lab Supervisor is responsible for managing the GC/HPLC Laboratories ensuring that timely and accurate production is achieved.

II. SCOPE OF THE POSITION:

A. Organizational Relationships

This position reports to and receives direction from the Director of Laboratory Operations. This position works closely with the other Managers and Supervisors of the company for the purpose of coordinating production and special projects.

Outside CompuChem, contact is with CompuChem's customers concerning laboratory practices, status of analyses, explanation of analytical results, etc. This position also has contact with equipment manufacturers, vendors, and consultants utilized by CompuChem.

B. Major Functions Reporting to this Position

GC and HPLC analysts and data reviewers

C. Know How, Training and Experience

This position requires an undergraduate degree in chemistry or equivalent. Minimum of (3) three years of experience in applied analytical gas chromatography in pesticide and volatile GC analysis is required. Must have a demonstrated knowledge of basic analytical techniques and methods. Supervisory experience with a strong production orientation is also required.

III. ACCOUNTABILITIES:

- Responsible for ensuring that the production of the GC/HPLC Laboratory is conducted in a timely and accurate manner. This includes coordinating the production effort with other Departmental Supervisors.
- Ensure that quality control procedures and good laboratory practices are being followed.
- Evaluate and develop methods for improving the quality and quantity of the data produced.
- Provide technical guidance and input for new contract requirements and/or new products.
- Plan and schedule work assignments according to analysis requirements. Assign individual work schedules based on analysis requirements and capabilities of the department staff.
- Responsible for interviewing, selecting, orienting, and training new employees.
- Provide recommendations for promotions and lateral transfers. Conduct performance appraisals and recommend merit increases.

R2-0002192

Supervisor, GC/HPLC Labs **JOB NO.: 410001 (continued)**

- Responsible for communicating and ensuring that all departmental employees understand and adhere to all company policies and procedures.
- Responsible for safety attitudes and practices; and for the overall housekeeping of the GC and HPLC Laboratory.
- Maintain an accurate inventory of laboratory supplies and equipment. Reorder supplies when required and maintain appropriate records of purchase.
- Responsible for maintaining up-to-date Standard Operating Procedures for the GC/HPLC Laboratory.
- Responsible for communicating and ensuring that all departmental employees understand and adhere to all company work rules and policies and procedures.
- Assist other areas of the lab by providing personnel and cross-training whenever possible.
- Maintain awareness of all Federal, State, and local rules and regulations that pertain to employment practices, i.e., wage and hour laws, EEO, and OSHA regulations.
- Responsible for monitoring the absence and vacation utilization by departmental staff.
- Participate in special assignments/projects as required.

R2-0002193

COMPUCHEM, a division of Liberty Analytical Corporation
DESCRIPTIVE TITLE: ***Supervisor, Project Management/Shipping & Receiving*** **JOB NO.**: 500005
DEPARTMENT: 5000 Lab Support **F.L.S.A.** Exempt
IMMEDIATE SUPERVISOR: Director, Laboratory Operations **LOCATION**: Cary, NC

I. BASIC FUNCTION:

Supervise the daily activities in the Sample Receiving/Storage and Shipping Areas. Supervise and perform sample receipt, sample-login and order entry. Manage client projects and provide customer service.

II. SCOPE OF THE POSITION:

A. Organizational Relationships

This position reports to and receives direction from the Director of Laboratory Operations. The position will work closely with members of the Project Management personnel in order to facilitate timely log-in of customer sample receipts. The position will interface daily with all laboratory areas and personnel relative to the distribution of samples for analysis. The position will work closely with Subcontract Coordinator to insure that subcontracted work is documented on a real-time basis and to insure performance of vendor network.

Outside CompuChem, the position will communicate with shipping vendors to coordinate pick-ups, glassware shipment logistics, etc. This position will also communicate directly with clients as required to resolve issues related to sample receipt, log-in and/or order-entry.

B. Major Functions Reporting to this Position

Sample Custodian, Project Managers

C. Know How, Training and Experience

The position requires a Bachelor's Degree or a minimum of 5-7 years experience involving the processing and scheduling of receipts in a production environment. Prior supervisory experience is also required as is a working knowledge of LIMS. An understanding of extractions and/or analytical instrumentation processes would be useful.

III. ACCOUNTABILITIES:

- Supervise and train personnel in the areas of responsibility, establish daily workload priorities on a six day schedule and assist in and direct the completion of the activities. Responsible for scheduling personnel and their work time to address and meet workload requirements.
- Responsible for the completeness and correctness of all Chain of Custody documentation, including; ensuring proper COC procedures are followed for samples being received and internal COC guidelines are maintained.
- Responsible for identification of discrepancies between sample receipts and client COC documentation and for insuring that appropriate feedback is given clients in order to effect and facilitate timely corrections prior to entering client receipts into the LIMS. Responsible for ensuring those clients receive acknowledgment of sample receipt within 24 hours of order-entry.

R2-0002194

Supervisor, Project Management/Shipping & Receiving ***JOB NO.:*** ***500005 (continued)***

- Responsible for interaction with subcontract coordinator as required in order to schedule shipments for all subcontracted parameters.
- Responsible for updating (as needed) and maintaining as current, all Standard Operating Procedures (SOPs) pertaining to the operation of the area. Responsible for having all personnel familiar with and adhering to them at all times.
- Responsible for preparation of glassware shipments via cooler or bulk distribution to clients as required by client. The position will ensure that clients receive appropriate bottleware, preservatives (if required), COCs, labels, etc. to ensure success of field sampling events.
- Responsible for maintaining the organization of walk-in and extract coolers daily and for ensuring that all sample request sheets received from each laboratory area are responded to completely, accurately, and in a timely manner with all signature requirements. Ensure sample security at all times by maintaining internal COC.
- Responsible for maintaining a safe, healthy, clean and presentable work environment at all times.
- Responsible for the hiring, training and development, and performance evaluations of employees in the department. Responsible for documenting sub-par work related performance with employees as may be necessary and for dealing with work related disciplinary problems on an as needed basis. Provide recommendation for promotions, lateral transfer, and merit increases.
- Responsible for maintaining temperature checks of thermometers for short and long-term storage areas and rotate sample stock to effect the SOP required purging process on a timely basis.
- Oversight of the purging process after samples have exceeded their retention times.
- Monitor inventory levels of warehouse stock items, glassware, coolers, components (COCs, labels, etc.) to ensure that appropriate levels are maintained on an ongoing basis.
- Maintain awareness of all Federal, State, and local rules and regulations that pertain to employment practices, i.e., wage and hour laws, EEO, and OSHA regulations.
- Responsible for communicating and ensuring that all departmental employees understand and adhere to all Company's Work Rules, and Policies and Procedures.
- Assist other areas of the lab by providing personnel and cross-training whenever possible.
- Manager or other company officers (e.g., Lab Manager, President) may assign responsibility for other duties as may be required from time to time.

- The position requires weekend work and overtime as may be required.

R2-0002195

COMPUCHEM, a division of Liberty Analytical Corporation
DESCRIPTIVE TITLE: ***Project Manager*** **JOB NO.**: 750007
DEPARTMENT: 7500 - Project Management/Customer Service **F.L.S.A.**: Exempt
IMMEDIATE SUPERVISOR: Supervisor, Customer Service/Shipping/Rec **LOCATION**: Cary, NC

I. BASIC FUNCTION:

Provide technical and administrative management for client specific project.

II. SCOPE OF THE POSITION:

A. Organizational Relationships

Reports directly to Supervisor, Customer Service/Shipping and Receiving.

B. Major Functions Reporting to this Position

None

C. Know How, Training and Experience

- BA/BS in Chemistry or related discipline.
- Minimum of three years environmental knowledge required.
- Excellent verbal and written communication skills required.
- Knowledge of Word and Excel required.

III. ACCOUNTABILITIES:

- Ensure compliance with client Scope of Work (SOW).
- Answer any technical inquiries from client.
- Sign outgoing reports.
- Prepare and distribute internal project profile sheet (PPS) for each client.
- Gather information from client on project specific requirements.
- Communicate all issues and concerns with lab.
- Review project status and compliance.
- Prepare status reports and inquiry responses as required by client.
- Monitor financial compliance with client agreement.
- Ensure client is satisfied with lab.
- Assist in training of Senior Account Administrator.
- Perform other related duties as assigned.

R2-0002196

COMPUCHEM, a Division of Liberty Analytical Corporation
DESCRIPTIVE TITLE: Director, Information Technology JOB NO.: 430007
DEPARTMENT: 4070 Computer Operations F.L.S.A. Exempt
IMMEDIATE SUPERVISOR: President & Chief Executive Officer LOCATION: CARY, NC

I. BASIC FUNCTION:

Manage the computer operations function in support of Company's production, administration, and system management.

II. SCOPE OF THE POSITION:

A. Organizational Relationships:

This position reports to and receives direction from the President, Chief Executive Officer. The position also interacts with any other user within the Company that relies on computerized production systems. This position works closely with the managers and supervisors throughout CompuChem and WearCheck USA.

Outside of CompuChem the position has contact with hardware vendors and consultants as well as hardware and software maintenance personnel.

B. Major Functions Reporting to this Position

Computer Operations - Provide technical expertise (hardware configurations, software revisions, user profiles, backup, and recovery) for system use and program development.

Computer Support Specialist

Electronic Deliverable System (EDS) Coordinator

C. Know How, Training and Experience

This position requires a minimum of B.S. degree in Computer Science or equivalent and 6 years of experience in computer operations management, a thorough understanding of integrated computer systems (preferably Hewlett-Packard) including computer maintenance. Also, effective human relation skills are also extremely important in managing and developing department personnel as well as interacting with the various users of the computer systems.

III. ACCOUNTABILITIES:

- Manage the Company's Computer Operations functions, assuring a fully functioning computer system adequate to support the Company's needs.
- Evaluate and select computer hardware and related products.
- Propose hardware configuration including migration/growth strategies.
- Participate in the selection of computer software and related products.
- Manage and control software installations, revisions, configuration and documentation.
- Manage system account structure setup.

- Ensure that system backup procedures are being followed and that a disaster plan exists.
- Oversee the installation, maintenance and monitoring of computer hardware including mainframes, printers, disk, modems, plotters, and personal computers, as well as the software and programs run on the hardware.
- Interview, select, and train new employees; provide recommendations for promotions and lateral transfers; conduct appraisals and recommend merit increases.
- Provide planned needs of all projects within the computer operations area.
- Maintain up-to-date Standard Operating Procedures for the department.
- Prepare job descriptions for each position or job title within the department. Ensure that all employees have a current job description in their training file. Ensure the written job descriptions have complete signatures including employee, immediate supervisor and next managerial level.
- Ensure that all departmental employees understand and adhere to all Company Policies and Procedures.
- Participate in special development projects are required.

R2-0002198

Figure 2-4 Resumes of Key Laboratory Personnel and Technical Directors

Dover, Cathy
Supervisor, Project Management/Receiving

Responsibilities: Ms. Dover is responsible for representing the laboratory as the primary contact with commercial clients, account setup and maintenance, sample receipt into the Laboratory Information Management System (LIMS), tracking the status of projects within the production laboratory and providing technical evaluation and support. Ms. Dover must ensure that client requirements are met and that proper customer service and technical support are provided during the course of projects.

Education: Ms. Dover earned diploma from Charles E. Jordan High School in Durham County in June 1980. She continued her studies at North Carolina State University where she focused on the curriculum in the schools of Chemical Engineering, Chemistry and Science Education.

Experience: Ms. Dover joined CompuChem in August 1983 as a Senior Laboratory Assistant. She earned her first promotion in February 1985 to Quality Control and Report Integration Clerk.

In January 1986, Ms. Dover became Laboratory Production Coordinator, and in August1989 she worked in the position of Production Scheduler/Planner.

In January 1994, as Account Administration Representative, she worked closely with clients on a service level. In April 1997, Ms. Dover was promoted to Special Project Coordinator (CELDM) and dedicated her efforts providing customer service to one of our most significant clients.

In September 1998 Ms. Dover was promoted to the position of Supervisor of Sample Control. In that capacity Ms. Dover was responsible for sample management, including receipt of samples, sample custody, storage and control, and shipping collection materials to the field.

Seniority Date: August 15, 1983

R2-0002199

Feldhaus, James C.
Supervisor, Inorganics

Responsibilities: Mr. Feldhaus is responsible for the daily operations of inorganics department. This includes sample preparation, sample analysis, verifying that quality control criteria are met, and the generation of client reports.

Education: Mr. Feldhaus received his Bachelor of Science degree in Chemistry from North Carolina State University in 2000.

Experience: Mr. Feldhaus joined CompuChem in May of 2005 as an Analyst III. In that position his responsibilities were the analyses of environmental matrices using ICP-AES and ICP-MS instrumentation and review of the data produced from those analyses.

Prior to joining CompuChem, Mr. Feldhaus was employed as a Chemist by Chemical and Environmental Technology, Inc in Cary, North Carolina from 2000 to 2005. His responsibilities included environmental sample collection, analysis of environmental matrices using GC, Cold Vapor, ICP-MS, and classical chemistry techniques.

Seniority Date: May 2, 2005

R2-0002200

Gates, Robert (Rob) J.
Administrative Manager

Responsibilities:	Mr. Gates is Administrative Manager for CompuChem. This position manages all purchasing functions. Mr. Gates also manages all facility related activities, including building systems maintenance. Mr. Gates also serves as the Safety Officer.
Education:	Mr. Gates received a B.S. degree in Public Recreation from Georgia Southern University in 1975.
Experience:	Before joining CompuChem, Mr. Gates was the Health Physics Supervisor for Alara Engineer. Mr. Gates started this position in June 1992 where he tracked, scheduled, and audited health physics monitoring. From 1986 to 1992 Mr. Gates held the same position for Site Services at the Savannah River site.
Seniority Date:	July 8, 1996

R2-0002201

Grant, Teresa M.
Manager, Sample Preparation

Responsibilities:

Ms. Grant is responsible for the daily planning and scheduling of sample preparation activities to meet production demands, the training of staff in standard operating and safety procedures.

Education:

Ms. Grant earned a B.S. degree in Biology with minors in Chemistry and Psychology from the University of Alabama in Birmingham in May 1980. She also earned a B.A. degree in Chemistry from Huntingdon College in June 1991.

Ms. Grant earned 38 credit hours in chemistry and 4 credit hours in microbiology toward her degree.

Experience:

Prior to resuming her current responsibilities, Ms. Grant was responsible for the operations of the GC, HPLC, GC/MS, Inorganic/Wet Chemistry, and Sample Preparation laboratories which function is a multi-shift production environment. Her primary responsibility is ensuring that the data produced from these laboratories is accurate, meets all quality control requirements and is provided to the client in a timely manner.

Before being promoted to Laboratory Director, Ms. Grant was Sample Preparation Laboratory Manager where her responsibilities included the daily planning and scheduling of sample preparation activities to meet production demands, the training of staff in standard operating and safety procedures, and oversight of the laboratory's data shipping and data archival activities. At CompuChem Ms. Grant has also held the positions of Hazardous Waste Coordinator, Manager of Sample Receiving and LIMS Administrator.

Prior to joining CompuChem, Ms. Grant was employed by CH2M Hill Quality Analytical Laboratory from December 1988 to August 1996 in the following capacities: Resource Chemist, Laboratory Health and Safety Officer, Organic Extraction Supervisor, Environmental Scientist I, and Technician.

From September 1980 to June 1981, Ms Grant was employed as the General Chemistry Lab Coordinator with Midwestern State University. Her responsibilities included supervision and teaching.

R2-0002202

Grant, Teresa M.
Manager, Sample Preparation

Publications:	**P.J. Schrynemeekers, Michael S. Clark, C.H. Kelly, Ward Dickens, and Teresa Priest, "The Analysis of Part Per Trillion Levels of Polynuclear Aromatic Compounds in Drinking Water Using GC/MS Selected Ion Monitoring", Pittsburgh Conference, Atlanta, GA, 1989.**
	P.J. Schrynemeekers, Mickael S. Clark, C.H. Kelly, Ward Dickens, and Teresa Priest, "GC/MS SIM for Drinking Water Analysis", Environmental Lab. April/May 1990.
Seniority Date:	**April 14, 1997**

R2-0002203

Grzybowski, Kenneth
Supervisor, Volatiles Lab

Responsibilities: Mr. Grzybowski is responsible for the analysis of environmental samples for volatile constituents utilizing GC and GC/MS instrumentation and the generation of complete and accurate data reports associated with these analyses. He also ensures that the data reported meets quality control and client requirements.

Education: Mr. Grzybowski earned a Bachelor of Science degree in Environmental Earth Science from Buffalo State College in Buffalo, New York.

Experience: Prior to rejoining CompuChem, Mr. Grzybowski was employed by Laboratory Corporation of America, Durham, North Carolina as a Senior Technician. His responsibilities included analysis of biological samples for drugs of abuse utilizing GC/MS instrumentation and the troubleshooting and maintenance of that instrumentation.

From April 2002 to September 2005, Mr. Grzybowski was employed by CompuChem as an Analyst II. His responsibilities included the analysis of environmental samples for volatile organic compounds using GCMS instrumentation. He ensured the instrument met all calibration and quality control requirements.

From December 1998 to April 2002, Mr. Grzybowski was employed at Severn Trent Laboratories in Amherst, New York were he held the positions of Volatile Organic Chemist and Laboratory Waste Disposal Manager.

Seniority Date: April 15, 2002

R2-0002204

Jennings, Teresa A.
Supervisor, GC/HPLC

Responsibilities: Ms. Jennings is responsible for the analysis of environmental sample extracts utilizing GC and HPLC instrumentation, and for the review and reporting of the data associated with these analyses ensuring client requirements and quality criteria are met.

Education: Ms. Jennings received her B.S. degree in Textile Chemistry from North Carolina State University in May 2001.

Experience: Prior to joining CompuChem, Ms. Jennings was employed as a Laboratory Assistant at EnviroGuard and Sensors, Cary, North Carolina from March 2003 to June 2004. Her responsibilities included troubleshooting and routine maintenance of GC and HPLC instrumentation and customer service support.

From September 2001 to June 2002, Ms. Jennings was employed as Product and Process Improvement personnel for Milliken and Company, Alma, Georgia. Her responsibilities included overseeing and scheduling maintenance of the carpet and yarn machines as well as improving machine efficiency.

From July 2000 to September 2001, Ms. Jennings was employed as a Preventive Maintenance Dispatcher for Gregory Poole Equipment Company, Raleigh, NC.

Seniority Date: August 9, 2004

R2-0002205

Meierer, Robert (Bob) E.
Vice President & General Manager

Responsibilities: Develop and implement strategic processes and practices within the company. Manage and guide the overall organization. Provide guidance in analyzing and appraising the effectiveness of overall operations. Assure all EPA CLP contractual requirements and federal and state agency certification requirements are met by the company. Assure that the company consistently produces data of known and documented quality.

Education: Mr. Meierer received an Associate degree in Industrial Chemistry from the Erie County Technical Institute in 1963, and an undergraduate B.A. degree in Chemistry from the State University of New York at Buffalo in 1971. He has taken advanced studies in Analytical Chemistry and Business Administration from the State University at Buffalo.

During his studies Mr. Meierer earned 76 credit hours in chemistry toward his degree. No credit hours in microbiology were required for his degree program.

Experience: As Vice President of Quality Assurance and Technology at CompuChem Mr. Meierer was responsible for assuring that the laboratory consistently produced high quality and reliable data, and that all necessary certification and licensing requirements were met by the laboratory. Additional responsibilities included the implementation of change, defined by new technology or operational improvement needs.

Prior to joining CompuChem, Mr. Meierer held positions as Laboratory Manager with Radian Corporation and as Department Head, Analytical Laboratory; Special Contamination Monitoring, The Carborundum Company from 1969-1980.

In his previous position with CompuChem Corporation as Vice President of Quality, Mr. Meierer was responsible for overseeing the QA efforts for both the environmental analytical and forensic drug testing aspects of the company.

Through the variety of laboratory positions Mr. Meierer has held, he has gained fifteen (15) years of experience in the interpretation of GC/MS volatile and semivolatile data. In addition, Mr. Meierer has six (6) years of experience in the preparation of extracts from environmental or hazardous waste samples.

Further, he has gained ten (10) years of experience in organochlorine pesticide residue and PCB analysis, including clean-up procedures (such as column chromatography) for a variety of environmental sample matrices.

R2-0002206

Meierer, Robert (Bob) E.
Vice President & General Manager

Publications:

Meierer, R. E., "Non-Traditional Analyses on CLP Contracts." paper presented at the 19th Annual National Environmental Monitoring Conference, Crystal City Hilton, Arlington, VA, on July 23, 2003.

Meierer, R. E., "The Analytical Testing Laboratory: Its Role and Responsibility in Environmental Legislation." paper presented at the Environmental Science for Lawyers Seminar, NC Bar Center, Cary, NC, on February 10, 1995.

Meierer, R.E., "How to Maintain a High Level of Quality Assurance--and Still Make a Profit," paper presented at the Third Annual Conference of the International Association of Environmental Testing Laboratories, Virginia Beach, VA, on October 23, 1990.

Meierer, R.E., Whitehead, R.J. "Making an On-Site Evaluation of an Analytical Services Laboratory," Environmental Claims Journal, Vol. 1, 4 (Summer 1989)

L.R. Flynn, S.W. Bass, R.E. Meierer, "Headspace Screening/Capillary Column GC/MS Analysis for Volatile Organics: Validation Studies and Applications." paper presented at the Fifth Annual Waste Testing and Quality Assurance Symposium, Washington, DC, on July 24-28, 1989.

Meierer, R.E., Whitehead, R.J. "Quality Assurance: In Search of Excellence," Environmental Lab, November 1989.

Meierer, R.E., "Selecting and Evaluating An Analytical Service Laboratory: What the Client Should Do and What the Responsibilities of the Laboratory Are." paper presented at the Environmental-Analytical Teleconference on Quality, on November 10, 1988.

Meierer, R.E., Ragsdale, P.L. "Validation of Toxicity Characteristic Leaching Procedure (TCLP) and Application to Industrial Wastes," paper presented in Washington, DC at the USEPA Symposium on Solid Waste Testing and Quality Assurance, July 13, 1987.

Meierer, R.E., Myers R.L., Whitehead, R.J., "Quality Assurance Studies Based On Analytical Condition Codes," paper presented to the Fifth Annual EPA Contract Laboratory Program Conference, U.S. EPA, August 1, 1985.

Meierer, R.E., "GC/MS: Applications For The Determination of Organic Constituents In Hazardous Waste," paper presented at the Twelfth Annual Conference on Waste Technology, NSWMA, October 18, 1983.

R2-0002207

Meierer, Robert (Bob) E.
Vice President & General Manager

Publications:

Meierer, R.E., Ragsdale P.L., and Mills, P.E., "Quality Assurance of Support Functions In A Large Hazardous Wastes Analytical Laboratory," paper presented before the division of Environmental Chemistry, American Chemical Society, March 29, 1982.

Meierer, R.E., "Laboratory Data Credibility and Reliability," paper presented in Milwaukee, Wisconsin on March 8, 1980, at the Federation of Environmental Technologists Conference.

Shaffer, P.T.B., Meierer, R.E., McGee, C.D., "Virus Recovery From Natural Water" JAWWA., 69 (10), 528-531 (1977).

Cook, G.A., Meierer, R.E., and Shields, B.M. "Combustibility Tests on Several Flame-Resistant Fabrics in Compressed Air, Oxygen Enriched Air, and Pure Oxygen." Textile Research, 37:591 (1967).

Seniority Date: October 2, 1980

R2-0002208

Rebman, Jennifer B.
Supervisor, GC/MS Semivolatiles

Responsibilities: Ms. Rebman is responsible for the analysis environmental samples for semi-volatile constituents utilizing GC/MS instrumentation along with the generation of complete and accurate data reports associated with these analyses. She also ensures that the data meets quality control and client requirements.

Education: Ms. Rebman received her B.A. degree in Chemistry from the University of North Carolina at Chapel Hill, in 1991.

Experience: Prior to being promoted to supervisor, Ms. Rebman was a Senior Scientist responsible for the analysis of organic sample extracts utilizing GC/MS instrumentation and for the review of the data associated with these analyses insuring its compliance with quality control criteria and client requirements.

Prior to joining CompuChem, Ms. Rebman was employed by Chemical and Environmental Technologies, Inc., in Cary, North Carolina from 1991 to 2005. While there Ms. Rebman held various positions including Organic Chemist, GC/MS Chemist, Organic Preparation Supervisor, and Organic Department Supervisor. Her responsibilities included chemical extraction of environmental matrices for GC analyses. She analyzed sample extracts using GC instrumentation equipped with FID, PID, ECD, HALL and MS detectors. She insured that client reports met quality control and client requirements. She developed new preparation and analytical methods. She hired and trained new employees.

Seniority Date: July 13, 2005

R2-0002209

Respass, Valgena
Quality Assurance Manager
QA Officer

Responsibilities: Ms. Respass is responsible for developing and maintaining the laboratory's quality system through the performance of internal systems and data audits and oversight of Proficiency Test sample analysis. She maintains the laboratory's certifications with state agencies and the National Environmental Laboratory Accreditation Program (NELAP).

Education: Ms. Respass earned a BS in Chemistry from Elizabeth City State University in Elizabeth City, North Carolina in 1985.

Ms. Respass earned 43 credit hours in chemistry toward her degree; no credit hours were required in microbiology.

Experience: Prior to joining CompuChem Ms. Respass was employed as a chemist at Triangle Laboratories, Inc. in Research Triangle Park, NC from March 1998 through March 1999 where she was responsible for overseeing data generated from the organic chemistry laboratory.

Ms. Respass was employed as a chemist at RCRA Environmental Inc. in Lionville, PA from June 1997 through February 1998 where she performed GCMS analyses and data review.

From October 1992 to June 1997 Ms. Respass was employed as a chemist at Roy F. Weston in Lionville, PA performing GC and GCMS analyses of samples for pesticide, PCB, and volatile target compounds.

From August 1985 to October 1992 CompuChem Laboratories, Inc. employed Ms. Respass where she performed GCMS analysis and data review. She also performed solvent extractions of samples for pesticides, PCBs, dioxins, herbicides, and semivolatiles.

Seniority Date: June 18, 1992

R2-0002210

Zimmerman, Mitchell S.
Project Manager/Alternate Emergency Coordinator

Responsibilities: Mr. Zimmerman is responsible project oversight from order entry to data delivery. He ensures that the client requirements are met and that proper customer service and technical support are provided during the course of the project. He is responsible for updating the client on sample status, receipt issues, and any lab issues that may arise. As Alternate Emergency Coordinator, Mr. Zimmerman has the authority to implement the emergency response procedures in the lab's Contingency Plan.

Education: Mr. Zimmerman earned BS degree in Biology from Montana State University, Bozeman Montana, in May 1999. He received an AAS degree in Resource Management from Sterling College, Craftsbury Commons, Vermont, in June 1991.

Mr Zimmerman received a Masters Certificate in Disaster Relief Management and Community Preparedness from the University of North Carolina in 2006.

Experience: Mr. Zimmerman joined CompuChem in December of 1999 as Chemist I in the Volatile Organics lab. He was promoted to Analyst II in 2003. In these positions his duties included the GC/MS purge and trap analyses of various environmental matrices for volatile organic compounds. He was promoted to Data Reviewer I/Waste Handler in 2004. In this position his duties included and the review of the data produced by GC/MS analysis for volatile constituents to ensure compliance with quality control criteria and client requirements as well as the handling and removal of hazardous waste form laboratory areas.

Prior to joining CompuChem, Mr. Zimmerman served in the Peace Corps as Rural Community Developer in Paramaribo, Suriname from August 1996 to September 1998. While there, he successfully introduced a community development program in an area new to the Peace Corps.

Seniority Date: December 6, 1999

R2-0002211

Table 2.1 - Analytical Methods Performed by CompuChem

Method ID	Type of Analysis	Analyte	Method References
Clean Water Act Methods			
120.1	Conductivity	specific conductance	EPA, 1982
130.1	Colorimetric, flow Injection analyzer, Lachat	total hardness as CaCO3	EPA, 1971 Lachat, January 1993
4500-H^+B	Electrometric	pH	Standard Method, 20th Ed. 1998
2540C	Gravimetric	filterable residue, total dissolved solids (TDS)	Standard Methods 20th Ed. 1998
2540D	Gravimetric	non-filterable residue, total suspended solids(TSS)	Standard Methods 20th Ed. 1998
2540B	Gravimetric	total solids	Standard Methods 20th Ed. 1998
200.7	Inductively Coupled Plasma-Atomic Emmision Spectroscopy (ICP-AES)	Metals	40 CFR, Appendix C Rev. 4.4 , 1994
245.1 245.5	manual cold vapor AA(CVAA) automated Leeman analysis	Mercury	EPA, Rev 3.0, 1994 EPA, March 1983
300.0	Ion Chromatography	Bromide	EPA/6006R-93/100 EPA, Rev. 1.0, 1993
300.0	Ion Chromatography	Chloride	EPA/6006R-93/100 EPA, Rev. 1.0, 1993
300.0	Ion Chromatography Distillation	Fluoride	EPA/6006R-93/100 Std.Meth. 20th Ed. EPA, Rev. 1.0, 1993
300.0 353.2	Ion Chromatography Colorimetric, flow Injection analyzer, Lachat	nitrate N	EPA/6006R-93/100 EPA, Rev. 1.0, 1993
300.0 353.2	Ion Chromatography Colorimetric, flow injection analyzer, Lachat	nitrite N	EPA/6006R-93/100 EPA, Rev. 1.0, 1993 EPA, Rev. 2.0, 1993
300.0	Ion Chromatography	orthophosphate P	EPA/6006R-93/100 EPA, Rev. 1.0, 1993
300.0	Ion Chromatography	Sulfate	EPA/6006R-93/100 EPA, Rev. 1.0, 1993
310.2	Colorimetric, flow Injection analyzer, Lachat	Alkalinity	EPA, 1974 Lachat, January 1996
335.4 4500 Cn-F 10-204-00-1-A	Off-line manual distillation, colorimetric, flow injection analyzer, Lachat	Cyanide, total and free Cyanide, amenable	EPA, Rev. 1.0, 1993 Standards Methods 20th Ed. 1998 Lachat, February 1992

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Table 2.1 - (cont.) Analytical Methods Performed by CompuChem

Clean Water Act Methods (cont.)

350.1	Colorimetric	Ammonia N	EPA, Rev.2, 1993
10-107-06-1-A	flow injection analyzer, Lachat distillation		Lachat, November 1995
351.2 10-107-06-2-E	Colorimetric, flow injection analyzer, Lachat	Kjeldahl N, total	EPA, Rev. 2.1, 1993 Lachat, June1996
3500-Fe D/B	Phenanthroline method	Ferrous/ferric iron	Std.Meth. 19th/20th Ed.
365.4 10-115-01-1-D	colorimetric, flow injection analyzer, Lachat	total phosphorus P	EPA, 1974 Lachat, May 1995
4500-S^2-F	titrimetric	Sulfide	Standard Methods 20th Ed. 1998
1664A	gravimetric	Hexane-extractable material, HEM	EPA-821-R-98-002
1664A	gravimetric	Silica-gel treated (SGT)-HEM	EPA-821-R-98-002
3510B	DC-180 total organic carbon analyzer	TOC	Standard Methods 20th Ed. 1998
420.4 10-210-00-1-A	manual distillation, automated colorimetric, 4-AAP, Lachat	Phenols	EPA, Rev. 1.0, 1993 Lachat, April 1987
3030C	aqueous filtration/acid digestion	Metals	Std.Meth. 20th Ed.
10-124-13-1-A 3500-CrD/B	automated colorimetric, flow injection analyzer, Lachat	Hexavalent chromium (Cr+) (Aqueous)	Lachat, October 1993 Std.Meth. 19th/20th Ed.
608/608.2	solvent extraction, GC/ECD	Organochlorine pesticides & PCBs	40 CFR 136, Appendix A
610	solvent extraction, HPLC/UV/fluorescence	polynuclear aromatic hydrocarbons (PAH)	40 CFR 136, Appendix A
615	Solvent extraction GC/ECD	Herbicides	40 CFR 136, Appendix A
624	GC/MS P&T, megabore column	purgeable volatile Organics	40 CFR 136, Appendix A
625	Solvent extraction, GC/MS capillary column	BNA extractables	40 CFR 136, Appendix A
D3987-85	Leachate generation from soil	Wet chemistry Parameter	ASTM 1999
RSK-175	GC/FID, gas in water (headspace) analysis	Methane, ethane, ethene, propane	RSK-175

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Table 2.1 - (cont.) Analytical Methods Performed by CompuChem

Method ID	Type of Analysis	Analytes	Method References
Resource Conservation & Recovery Act Methods			
1010 ASTM-D93-00	Pensky-Martens closed cup	ignitability	EPA SW846, 3rd Ed., 9/86
1311	toxicity characteristic leaching procedure (TCLP)	semivolatiles, metals, herbicides, pesticides	EPA SW846, 3rd Ed., Up.I, 7/92
1311	TCLP w/ zero headspace extraction (ZHE)	volatile organics	EPA SW846, 3rd Ed., Up.I, 7/92
D3987-85	leachate generation from soil	Wet chemistry (S)	ASTM
1312	synthetic precipitation leaching procedure (SPLP)	semivolatiles, metals, herbicides, pesticides dissolved metals	EPA SW846, 3rd Ed., Up.II, 9/94 3rd Ed., Up.I, 7/92
3010A	aqueous acid block-digestion ICP	total metals (Aqueous)	EPA SW846, 3rd Ed., Up.I, 7/92
3050B	soil/sediment/sludge acid block-digestion	total metals (Solids)	EPA SW846, 3rd Ed., Up.III, 12/96
3510C	separatory funnel liquid/liquid extraction	organic extractables (Aqueous)	EPA SW846, 3rd Ed., Up.III, 12/96
3520C	continuous liquid/liquid extraction	organic extractables (Aqueous)	EPA SW846, 3rd Ed., Up.III, 12/96
3535	solid phase extraction (SPE)	Explosives (Aqueous)	EPA SW846 3rd Ed., Up.III, 12/96
3540C	soxhlet extraction	extractable organics (Solids)	EPA SW846, 3rd Ed., Up.III, 12/96
3541	Automated Soxhlet Extraction (SoxTherm)	Semivolatiles & PCBs (Solids)	EPA SW846, 3rd Ed., Up.III,12/96
3550B	sonication extraction	non-volatile & extractable organics (Solids)	EPA SW846, 3rd Ed., Up.III, 12/96
3580A	waste dilution, dilute & shoot	non-aqueous waste	EPA SW846, 3rd Ed., Up.I, 7/92
3620B	florisil column cleanup	Organochlorine pesticides & PCBs	EPA SW846, 3rd Ed., Up.III, 12/96
3640A	gel permeation cleanup (GPC)	extractable organics	EPA SW846, 3rd Ed., Up.II, 9/94
3660B	sulfur cleanup	organochlorine pesticides & PCBs	EPA SW846, 3rd Ed., Up.III, 12/96
3665A	sulfuric acid cleanup	PCBs	EPA SW846, 3rd Ed., Up.III, 12/96

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Table 2.1- (cont.) Analytical Methods Performed by CompuChem

Method ID	Type of Analysis	Analytes	Method References
Resource Conservation & Recovery Act Methods (cont.)			
3005A	Aqueous acid block digestion	Total recoverable or dissolved metals	EPA SW846, 3rd Ed., Up.I, 7/92
5030B	P&T	volatile organics	EPA SW846, 3rd Ed., Up.III, 12/96
5035	Closed system P&T for soil	volatile organics	EPA SW846, 3rd Ed., Up.III, 12/96
6010B	ICP	metals	EPA SW846, 3rd Ed., Up.III, 12/96
6020	ICP-MS	metals	EPA SW846, 3rd Ed.,Up.III, 12/96
7196A 3500CrB	automated colorimetric, flow injection analyzer, Lachat	Hexavalent chromium (Cr+) (Aqueous)	EPA SW846, 3rd Ed.,Up.III, 12/96 Std.Meth.20th Ed.
7470A, 7471A	CVAA automated Leeman	Mercury	EPA SW846, 3rd Ed., Up.II, 9/94
8015B	GC/FID	Gasoline range organics, including TN-DEC Diesel range organics, including JP4, JP8,TN EPH (Aqueous & Solids)	EPA SW846, 3rd Ed., Up.III, 12/96
8081A	solvent extraction, GC/ECD	Organochlorine Pesticides	EPA SW846, 3rd Ed., Up.III, 12/96
8082	solvent extraction, GC/ECD	PCBs	EPA SW846, 3rd Ed., Up.III, 12/96-
8151A	solvent extraction, GC/ECD	chlorinated herbicides	EPA SW846, 3rd Ed., Up.III, 12/96
8260B	GC/MS P&T Selected ion monitoring (SIM)	purgeable volatile Organics	EPA SW846, 3rd Ed., Up.III, 12/96
8270C	solvent extraction, GC/MS capillary column Selected ion monitoring (SIM)	semivolatile organic Extractables	EPA SW846, 3rd Ed., Up.III, 12/96
8310	solvent extraction, HPLC/UV/fluorescence	polynuclear aromatic hydrocarbons (PAHs)	EPA SW846, 3rd Ed., 9/86
8330	solvent extraction, HPLC,UV detector	Explosives	EPA SW846, 3rd Ed., Up.II, 9/94
8332	solvent extraction, HPLC,UV detector	Nitroglycerin/PETN	EPA SW846, 3rd Ed., Up. III, 12/96
9010B	manual midi-distillation (followed by 9012A, flow injection analysis,Lachat)	total and free cyanide	EPA SW846, 3rd Ed., Up. III, 12/96

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Table 2.1 - (cont.) Analytical Methods Performed by CompuChem

Method ID	Type of Analysis	Analytes	Method References
Resource Conservation & Recovery Act Methods (cont.)			
9012A	off-line midi-distillation, flow injection analyzer, Lachat	total and free cyanide	EPA SW846, 3rd Ed., Up.III, 12/96
Chapter (7.3.3) 9014	HCN formation and release, titration	reactive (total releasable) cyanide	EPA SW846, 3rd Ed., Up.III, 12/96
Chapter (7.3.4) 9034	H2S formation and release, titration	reactive (total releasable) sulfide	EPA SW846, 3rd Ed., 9/86
9040B	electrometric	aqueous pH	EPA SW846, 3rd Ed., 1/95
9045C	electrometric	soil & waste pH (corrosivity)	EPA SW846, 3rd Ed., Up.IIB, 1/95
9050A	conductivity	specific conductance	EPA SW846, 3rd Ed., Up.III, 12/96
9060, modified for soil/water Lloyd Kahn	DC-180 TOC analyzer	TOC (Aqueous & Solids) (Aqueous)	EPA SW846, 3rd Ed., 9/86
9066	manual off-line distillation, automated colorimetric, flow injection analyzer, Lachat	Phenol (Solids)	EPA SW846, 3rd Ed., 9/86, CE-81-1, 5/81
9070A (see Method 1664)	gravimetric	Oil and Grease (Aqueous)	EPA SW846, 3rd Ed.,Up.III, 12/96
9071B	soxhlet extraction, gravimetric Hexane-Extractable Material (HEM)	Oil and Grease (Solids)	EPA SW846, 3rd Ed., Up.III, 12/96 Rev.2, April 1998
9095A	filtration	paint filter liquids	EPA SW846, 3rd Ed., Up.III, 12/96

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Table 2.1 - (cont.) Analytical Methods Performed by CompuChem

Superfund / Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), EPA Contract Laboratory Program (CLP)

Method ID	Type of Analysis	Analytes	Method References
EPA CLP	GC/MS P&T megabore column	purgeable volatile Organics	CLP SOW OLM04.3
EPA CLP	solvent extraction, GC/MS capillary column	semivolatile organic Extractables Pesticide confirmation	CLP SOW OLM04.3
EPA CLP	solvent extraction, GC/ECD capillary column TBA/sulfur cleanup	organochlorine pesticides & PCBs	CLP SOW OLM04.3
EPA CLP	ICP/AES	inorganic metals, total & dissolved	CLP SOW ILM04.1 ILM05.4
EPA CLP	ICP/MS	Inorganic metals, total & dissolved	CLP SOW ILM05.4
EPA CLP	CVAA	Mercury	CLP SOW ILM04.1 ILM05.4
EPA CLP	manual distillation, flow injection analyzer, Lachat	Cyanide total and amenable	CLP SOW ILM04.1 ILM05.4
EPA CLP	GC/MS P&T megabore column	Low concentration Purgeable volatile Organics (Aqueous)	CLP SOW OLC03.2
EPA CLP	Solvent extraction, GC/MS capillary column	Low concentration Semivolatile organics (Aqueous)	CLP SOW OLC03.2
EPA CLP	Solvent extraction, GC/ECD capillary column	Low concentration Organochlorine Pesticides & PCBs (Aqueous)	CLP SOW OLC03.2
EPA CLP	GC/MS P&T megabore column	trace & low-medium aqueous volatiles low solid volatiles	CLP SOW SOM01.2
EPA CLP	solvent extraction, GC/MS capillary column	semivolatile organic aqueous low solid	CLP SOW SOM01.2
EPA CLP	solvent extraction, GC/ECD capillary column	organochlorine pesticides	CLP SOW SOM01.2
EPA CLP	solvent extraction, GC/ECD capillary column	Aroclors	CLP SOW SOM01.2

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Table 2.2: Method References

Method Key	Reference
ASTM	American Society for Testing and Materials, D3987-85 (1999), Standard Test Method for Shake Extraction of Solid Waste with Water; D93-00, Standard Test Method for Flash-Point by Pensky-Martens Closed Cup Tester
40 CFR 136	Code of Federal Regulations 40, Part 122, 136 (March 12, 2007) "Guidelines Establishing Test Procedures for Analysis of Pollutants Under the Clean Water Act."
40 CFR 136, Appendix A	Appendix A. (since October 26, 1984, with subsequent updates.) "Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater."
40 CFR 135, Appendix C	Appendix C. (since October 26, 1984, with subsequent updates.) "Inductively Coupled Plasma – Atomic Emission Spectrometric Method for Trace Element Analysis of Water and Wastes, Method 200.7"
EPA CLP SOW	U.S. EPA. Contract Laboratory Program Statement of Work for Organic and Inorganic Analysis, Multi-Media, Multi-Concentration. Documents number OLM04.3, ILM04.1, and ILM05.4, SOM01.2.
EPA CLP SOW	U.S. EPA. Contract Laboratory Program Statement of Work for Organic Analysis, Low Concentration Water, OLC03.2
EPA MCAWW March 1983	U.S. EPA. (March 1983.) "Methods for Chemical Analysis of Water and Wastes". EPA-600/4-79-020.
Standard Methods, 19th,20th Ed	APHA, AWWA, WEF. (Standard Methods for the Examination of Water and Wastewater", 19th, 20th Editions 1995, 1998.
Lachat	Lachat Instruments. "Method Manual for the QuikChem Automated Ion Analyzer". Milwaukee, WI, (periodic updates by method).
SW-846 3rd Edition	U.S. EPA (September, 1986) "Test Methods for Evaluating Solid Waste Physical/Chemical Methods", SW846, Third Edition (9/86), Update I (7/92), Update II (9/94), Update III (12/96).
EPA/6006R-93/100	U.S. EPA "Methods for the Determination of Inorganic Substances in Environmental Samples", Method 300.0, Revision 2.1, August 1993
EPA-821-R-98-002	"Method 1664, Revision A: n-Hexane Extractable Material (HEM; Oil and Grease) and Silica Gel Treated n-Hexane Extractable Material (SGT-HEM; Non-polar Material) by Extraction and Gravimetry", EPA-821-R-98-002, February 1999
RSK-175	Dissolved Oxygen and Methane in Water by a GC Headspace Equilibration Technique", R.S. Kerr Environmental Research Laboratory, Ada, OK, RSK-175, March 15, 1989
EPA/4-81-054, page 115	U.S. EPA EMSL Cincinnati, Ohio, September 1978, "Methods for Benzidine, Chlorinated Organic Compounds, Pentachlorophenol and Pesticides in Water and Wastewater, page 115, "Method for Chlorophenoxy Acid Pesticides in Water and Wastewaters."
Lloyd Kahn Method	"Determination of Total Organic Carbon in Sediment," July 1

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3.0 Quality Assurance Objectives

The overall QA objective for CompuChem is to develop and implement procedures for laboratory analysis, chain-of-custody, and reporting that will provide results that are of known and documented quality. Data Quality Indicators (DQIs) are used as qualitative and quantitative descriptors in interpreting the degree of acceptability or utility of data. The principal DQIs are precision, bias (accuracy), representativeness, comparability, completeness and detection limits. DQIs are used as quantitative goals for the quality of data generated in the analytical measurement process. This section summarizes how specific QA objectives are achieved. The specific application of these various activities are contained in the method SOPs.

3.1 Precision and Accuracy

Statistically derived control limits, determined from laboratory-acquired historical data, are reviewed annually and updated if needed. These limits are used for the evaluation of the laboratory control sample (LCS) in the control chart program and at the bench for some procedures. For other procedures, control limits are established in the method, Statement of Work (SOW), or laboratory Standard Operating Procedures (SOPs).

Statistical control limits for matrix spikes and matrix spike duplicates (MS/MSD) have been generated for SW-846 and wet chemistry methods. Default limits have been established internally when statistical limits are broad. For matrix spikes and for laboratory control samples the default limits are 20-150%, with allowances for marginal exceedances.

While the statistical limits presented are goals to be achieved, a specific client or project may dictate the use of other limits. In these cases the laboratory exercises flexibility in applying these in order to meet client-specific requirements.

For Clean Water Act 600 series, matrix spike recovery limits are taken from the tables of "QC Acceptance Criteria" in the "Range for Percent Recovery Measured" columns in the methods. For the Contract Laboratory Program (CLP), matrix spike recoveries are specified in the SOW.

An initial precision and accuracy demonstration is performed for each method. Four replicate control samples are spiked at concentrations near the calibration midpoint and processed through the entire analytical method. The mean percent recovery and percent relative standard deviation are calculated from the replicate results. Precision and accuracy studies are used to document analyst proficiency in performing methods. Data from these studies are maintained in the QA department and HR training files. The standard used in the preparation of the precision and accuracy determinations generally has a concentration within 20% to 80% of the linear calibration range.

The accuracy limits for surrogates are specified by the method or determined statistically for SW-846 and are applicable to laboratory QC samples as well as field samples.

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3.1.1 Precision

Precision is a measure of the degree to which two or more measurements are in agreement. Precision is assessed through the calculation of relative percent differences (RPDs) and relative standard deviations (RSDs) for replicate samples. For inorganic analyses, laboratory precision is assessed through the analysis of a sample/sample duplicate pair, a matrix spike/matrix spike duplicate (MS/MSD) pair, and/or field duplicate pairs. For organic analyses, precision is assessed through the analysis of MS/MSD and field duplicate samples.

When acceptance criteria for precision are not met, depending on the type of problem and sample holding time, corrective action may involve reporting data with a laboratory qualifying notice. An example is the poor precision between matrix spike duplicates when one of the extracts is not concentrated accurately or when matrix interference is evident. When an analyte does not meet criteria for RPD in inorganic duplicates, a data qualifying flag accompanies the result in associated samples in accordance with the U.S. EPA CLP reporting convention.

Formulas used to calculate precision of test measurements and the associated acceptance ranges are as follows.

3.1.1.1 Percent relative standard deviation (%RSD)

$$\%\,RSD = \frac{s}{x} \times 100$$

where: x = average of the data points,
s = is the standard deviation

3.1.1.3 Relative Percent Difference (RPD)

$$RPD = \frac{|A-B|}{1/2\,(A+B)} \times 100$$

where: A = conc. in sample A
B = conc. in Sample B

3.1.2 Accuracy

Accuracy is the degree of agreement between an observed value and an accepted reference or true value.

Accuracy is assessed by the analysis of quality control samples and through the adherence to all sample handling and holding times. Accuracy is demonstrated through the recovery of spiked compounds in the analysis of the MS/MSD and laboratory control samples (LCS), through surrogate recoveries in organic samples and QC, and through quality control check samples with known concentrations of target analytes.

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3.1.2.1 Surrogate, Deuterated Monitoring Compounds and Spike Standard Recoveries

Evaluating the recoveries of spike, Deuterated Monitoring Compounds (DMC) and surrogate standards is a means to assess method accuracy in a specific sample matrix when subjected to specific method conditions. Samples are fortified before extraction, purging, and digestion or distillation.

The recovery of these standards is quantitatively measured during analysis. Records of the percent recovery for laboratory control samples are maintained in control chart databases. The statistical warning and control limits are updated annually, if needed. Surrogate, DMC, and spike compound recoveries must meet acceptance criteria before the analytical data are reported. In some instances the sample matrix may produce interferences that adversely affect recoveries of surrogates, DMC or spike compounds. Re-preparation and/or reanalysis of the sample must confirm the results. When a matrix spike test fails spike recovery criteria, the LCS must be evaluated. If the LCS test fails, the entire batch must be reprocessed. If the LCS passes, the sample matrix effect is confirmed. The data is qualified in the narrative or with a flag.

The formulas used to calculate accuracy of test measurements follow:

3.1.2.2 Accuracy = Percent Recovery (%R)

$$\%R = \frac{SSR - SR}{SA} \times 100$$

where: SSR = conc.of spiked sample
SR= conc.in unspiked sample
SA = expected conc.of spike

3.1.2.2 Control limits are calculated using the following formulas:

LCL = x – 3sd
UCL = x + 3sd

where: LCL = lower control limit
UCL = upper control limit
x = mean percent recovery
sd = standard deviation using n-1 degrees of freedom

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3.2 Table of Concentration Levels for QC Samples

Type	*Purpose*	*Conc. Level*	*Method Reference*
MS/MSD	**Precision/Accuracy**	**Mid Level**	**CWA 600 series** **CLP organics** **SW-846 organics** **Wet Chemistry**
MS	**Accuracy**	**Mid Level**	**CWA 600 series** **Inorganics**
BS/LCS	**Accuracy**	**Mid Level**	**All analyses**
Duplicate	**Precision**	**Sample-dependent**	**Inorganics** **Wet Chemistry**

Mid level = Mean level between the minimum detection level and the upper end of the linear range

3.3 Representativeness

Representativeness expresses the degree to which the analytical results of one sample accurately and precisely represent results characteristic of a population, parameter variations at a sampling point, a process or an environmental condition within a defined spatial and/or temporal boundary. Representativeness is a qualitative characteristic, and is considered a goal to be achieved rather than a quantitative measurement. Representativeness is dependent upon both the sampling program design and proper laboratory protocol.

For many sample types, careful collection planning, sample compositing, and/or sample splitting can accomplish true representativeness. Soil samples and samples of complex or heterogeneous matrix usually present the greatest difficulties for samplers and analysts. The sampler should make every effort to homogenize the sample during collection. Laboratory chemists must, whenever practical, homogenize or thoroughly mix the sample before removing aliquots for analysis. CompuChem's sample preparation SOPs include specific procedures for homogenizing as-received samples. Volatile soil samples may not be composited or mixed due to the potential loss of analytes.

Representativeness is ensured by using the proper analytical procedures, appropriate methods, meeting sample holding times, and analyzing field duplicate samples.

The manner in which the data are correlated to the particular sampling episode and sample site are major considerations when evaluating representativeness. When the laboratory is aware of conditions adversely affecting data representativeness, a QA Notice or Laboratory Notice is included in data packages to qualify results or discussion is made in the Sample Delivery Group (SDG) narrative to provide guidance in interpreting data usability.

3.4 Completeness

Completeness is a measure of the amount of valid data obtained from a measurement system compared to the amount that was expected under normal conditions.

Laboratory completeness is a measure of the amount of valid measurements obtained

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from all the measurements taken in the project. CompuChem's objective for completeness is to provide unqualified data of the highest quality for 100% of samples.

Factors beyond the laboratory's control that adversely affect attainment of completeness objectives include:

- receipt of samples in broken containers
- receipt of samples whose chain of custody (COC) or integrity is compromised in some way
- receipt of samples with insufficient volume to perform initial analyses or repeat analyses should initial efforts not meet QC acceptance criteria
- receipt of improperly preserved samples
- receipt of samples held in the field for longer than expected so that holding times are jeopardized
- receipt of incomplete or inaccurate information resulting in the application of incorrect methods
- assessment of sample data by end-users using criteria other than those stated in applicable method references or applicable data validation guidelines (Data validation guidelines may reject data although method criteria are met.)

When requested, the completeness of an analysis can be documented by including in the test report sufficient information to allow the data user to assess the quality of the results. This information may include such items as chromatograms, mass spectra, a summary of QC sample results, and the tabulated analytical results.

Additional results, up to and including all data sufficient to recreate the entire analytical process, are optional deliverable items. These may include laboratory worksheets, calibration data, all QC sample data, and internal COC documents. The highest level document emulates that required under the U.S. EPA CLP and is intended as a legally defensible document in itself. The raw data are archived and stored electronically by scanning using Adobe Acrobat. Scanning allows for the accurate duplication of documents including signatures, affidavits, and all other information. The electronic data is then indexed for tracking on a computer that is backed up daily. The images of the data are stored on duplicate CDs. One CD is kept with the computer system for easy retrieval of data and the duplicate CD is kept in a secure location in a fireproof safe. The original hardcopy report is shipped to the client, but a hardcopy can be retained if requested or required.

Archived data are stored for a minimum of five years. Additional storage time may also be requested by the client for certain projects or required under certain programs such as the Ohio Voluntary Action Program (VAP). It is the responsibility of the laboratory project manager to oversee the extended retention of data reports. The auxiliary data field in the LIMS is able to record data retention time requirements for each client and to assist in tracking extended retention times. For the Ohio VAP, the laboratory must notify the agency by certified mail when the 10-year retention period has expired and retain the data until directed in writing by the agency whether they will or will not retain the data.

3.5 Comparability

Comparability is an expression of the confidence with which one data set can be compared with another. The analytical results can be compared to results of other laboratories because CompuChem's objectives for comparability are to:

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- Demonstrate traceability of analytical/calibration standards to NIST, EPA, or other certified sources
- Use routine and approved analytical methodology
- Achieve sample holding time
- Adhere to instrument tuning and calibration procedures and frequency requirements
- Determine detection limits using Federal Register methodology consistently
- Apply appropriate levels of QC within the context of the QA program
- Report results in common units and use consistent rules in reporting data
- Participate in interlaboratory studies and independent proficiency testing programs to document laboratory performance

By using traceable standards and standard methods, the analytical results can be compared to other laboratories operating similarly. The internal QA program documents laboratory QC performance, and the inter-laboratory studies document performance compared to other laboratories.

3.5.1 QC Reference Standards Traceability

Calibration standards are traceable to the National Institute of Standards and Technology (NIST) or the EPA. EPA standards are purchased with certificates of purity and traceability.

Standards are received as neat materials and concentrated solutions with certificates of analysis (COA) for dilution into intermediate and working standard solutions.

Neat materials are logged into a receipt log and are assigned a sequential number. That number is placed on the COA and bottle label. Intermediate and working standards prepared from these materials are entered into a standard preparation logbook using the appropriate receipt log numbers to identify the components.

Concentrated standards are identified using the names and/or lot numbers which appear on the COA. Intermediate and working standards prepared from these solutions are entered into the standard preparation logbook using the name and/or lot number to identify the components.

In the standard preparation logbook intermediate and working standard solutions are given unique identification numbers (lot numbers). These lot numbers are used to reference these solutions on all subsequent data such as instrument logs and sample preparation sheets.

COA for all standards are retained for traceability to NIST sources. All standard containers (neat materials, concentrated solutions, intermediate and working standards) are labeled with a lot number, preparation/receipt date, expiration date, and analyst's initials.

3.5.2 Proficiency Tests

Interlaboratory studies in the form of proficiency tests are performed on at least a semiannual basis (NELAC) or quarterly (EPA).

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3.6 Limits of Detection and Reporting Limits

Method Detection Limits (MDLs) are determined for all analytes as specified in the NELAC standards.

3.6.1 Method Detection Limits

A statistical method detection limit (MDL) study is performed yearly for all approved methods in use. The studies are performed following the design specified in the Federal Register, 40 CFR Part 136 (October 26, 1984).

The MDL is the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero. The MDL is determined from the analysis of a sample in a lab pure matrix containing the analyte.

At least seven replicate samples are prepared containing the analyte(s) to be tested at a concentration that is 3 to 5 times the estimated MDL for each analyte. The samples are processed through the entire analytical method.

The MDL is calculated using the standard deviation of the replicate measurements and the Student's T value at the 99% confidence level (n-1 degrees of freedom.) The mean analyte value is also calculated. The Dixon outlier test or a similar one is used to eliminate any anomalous data point, but a minimum of seven replicate values are required for calculating the MDL.

Detailed MDL criteria are presented in the specific SOP.

3.6.1.1 MDL Calculation

- $MDL = t(n-1, 1-\alpha = .99)(\sigma n-1)$

  where: $t(n-1, 1-\alpha = .99)$ = the student's value for a 99% confidence level and a standard deviation with n-1 degrees of freedom

  $\sigma n-1$ = standard deviation of the replicate analysis

- Standard Deviation

$$\sigma n-1 = \sqrt{\frac{\sum (x_i - x)2}{n-1}}$$

where: x_i = the data point
x = the mean
$\sigma n-1$ = standard deviation
n=number of samples

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3.6.2 Instrument Detection Limits

To fulfill the requirements of the EPA Contract Laboratory Program (CLP) Statement of Work (SOW) ILM04.1, instrument detection limit (IDL) determinations are performed quarterly. This is accomplished by the analysis of seven replicate standards prepared in reagent water containing all target analytes at a concentration of 3 to 5 times the estimated IDL. These analyses must be performed over three non-consecutive days and the standard deviations of the replicates calculated. The IDL is calculated by multiplying the average of these standard deviations by three.

For SW-846 ICP analysis, the calculated IDL value must be less than or equal to MDL for the analyte.

3.6.3 Method Detection Limit Default Cut-off Values

For organic methods, when the concentration of a detected target analyte is between the MDL and the reporting limit, it is reported with a "J" flag to indicate the result is estimated.

For projects that do not require the results to be reported down to the MDL, a cut off value has been defined by the laboratory and may be used. The definition states that any analyte with an MDL <1/5 the RL will have a default cut-off value equal to 1/5 the RL. Any analyte with an MDL >1/5 the RL will have its actual MDL as the cut-off value. For the latter the MDL has to be less than the RL.

Clients would receive prior notification from the project manager for analytes falling into the latter scenario and may require an elevation in the reporting limit.

The use of the MDL cutoff option is not utilized for the EPA Contract Laboratory Program Statement of Work or clients requiring the actual MDL value.

3.6.4 Reporting Limits

For CLP methods, the reporting limit is the Contract Required Quantitation Limit (CRQL) or the Contract Required Detection Limit (CRDL) for ILM04.1. Results are reported down to the IDL for ILM04.1 or down to the MDL for **ILM05.4** and organic parameters. Results reported between CRDL and IDL or the CRQL and the MDL are flagged to indicate the quantitated results are estimated.

For non-CLP methods using a multipoint calibration, the reporting limit is equivalent to or higher than the lowest calibration standard concentration. For ICP metals, the laboratory determines a practical quantitation limit (PQL) for each analyte. The PQL is defined as four times the MDL rounded to a value four to eight times the MDL. However, the PQL may be adjusted, based on the judgment of the ICP analyst, for problematic or poor-performing elements. Experienced inorganic analysts team with senior Quality Assurance staff to establish a reporting limit for each element based on these PQLs. This level is either at or above the statistically determined PQL for most analytes, with few exceptions.

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3.7 Method Validation Studies

Prior to analysis of any samples for approved methods not previously offered for sale by the laboratory, a method validation study must first be performed. A chemist familiar with the extraction/preparation procedures and the instrumental detection systems reviews the as-written method. The chemist looks for safety hazards, applicability of available instrument systems, new equipment requirements, any discrepancies in the written method, and the QA/QC requirements. A plan of testing approach is discussed with the laboratory director, technical directors, and executive management. Analysis of laboratory spiked matrices is performed to determine overall method recoverability. A draft SOP is written after the method validation study has been performed.

Documentation includes an MDL study, a precision and accuracy determination, and a draft SOP. This and any other pertinent information is then forwarded to the QA department for final approval. Any deviations from the published method must be noted in the SOP. Once approval by QA and SOP document control is completed, product codes can be developed and the new method can be offered to clients.

3.8 Data Quality Objectives

Data quality objectives (DQOs) are used in planning environmental data collection activities. They establish the level of data that is needed to support decisions regarding the site. They establish the level of uncertainty in results that a decision-maker is willing to accept. They can be used to define QA/QC programs specific to a project or data collection activity. DQOs have been established for programs under which the laboratory provides analytical services. Internal project support staff work closely with the client and regulatory agencies to ensure that DQOs will be met by the analytical results provided. The project management team at CompuChem convey project and client-specific requirements to the laboratory by using the Laboratory Information Management System (LIMS) and distributing a unique Project Profile Sheet (PPS) and meeting on a regular basis.

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4.0 Sampling Procedures

CompuChem does not perform field sampling services. We do provide pre-preserved glassware with guidance on collection procedures, if requested, in compliance with program-specific and regulatory shipping requirements. Preservation and holding time requirements are listed in Tables 4.1 through 4.7. We offer shipping supplies that include a shipping container and requested glassware. Glassware supplied by CompuChem for sample collection is purchased pre-cleaned and certified from the vendor. Cleaning procedures are performed according to the U.S. EPA Office of Solid Waste Emergency Response (OSWER) directive published in the document *Specifications and Guidance for Obtaining Contaminant-Free Glassware* (current approved version). The vendor also provides results of analyses using low detection limit EPA methods to certify the glassware is free of contaminants. Certificates of analysis accompany the glassware, are kept on file in the Receiving department, and made available upon request.

4.1 Quality Control Procedures

4.1.1 Quality Control of Bottles

Pre-cleaned and certified glassware **lots including all of the bottles, jars, and vials sent to clients for the purpose of sample collection** are purchased and stored at CompuChem. **This glassware arrives at the laboratory with certificates of analysis documenting its level of contamination. The level of contamination should be less than the reporting limit (less that one half the reporting limit for DOD projects).** The vendor provides glassware with certificates of analysis for each lot. Preservative is added to sample collection bottles prior to shipment to the client with the exception of volatile vials. Volatiles are received from the vender containing preservative. Individually packaged EnCore™ sampling devices are provided for collection of 5 gram volatile soil samples for use with Method 5035 and certain methanol preserved TPH analyses.

4.1.2 Quality Control of the Pure Water System and Vendor Pre-Cleaned and Certified Bottles

A U.S. Filter pure water system is used to generate ASTM Type II reagent grade water. This laboratory pure water is used in sample and method blank preparations.

In addition, we supply water to our clients for use as a source of field QC samples (trip blanks, rinsate blanks, etc.) This water is stored in the volatile instrumentation laboratory in a series of 45 liter glass carboys. Water used for this purpose and for the volatile analytical procedures is generated by a Millipore system located in the volatile sample preparation room.

For many years, the water collected in each carboy has been analyzed for volatile, semivolatile, pesticide/PCB and inorganic (metal and cyanide) analytes. An assessment of the results from these tests has demonstrated that, with the exception of common laboratory solvents, the water had not contained target analytes above any blank acceptance criteria. For that reason, the analytical testing of the carboy water was discontinued, unless requested by a client.

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Water used to prepare laboratory QC samples, such as method blanks and LCS, must meet method requirements for acceptability.

4.1.3 Volatile Storage Blank Tests

Storage blank tests associated with CLP analyses and certain commercial clients analyses are performed on a routine basis. The storage blank is now used to demonstrate that the refrigerated storage environments, for samples submitted for volatile organic analyses, are free from contamination. Cooler tests are not required for any refrigerators being used strictly for long-term storage of volatiles samples.

4.2 Shipping Coolers

4.2.1 Preparation

An Igloo-style sample collection container is provided as a service to customers who request that CompuChem supply bottles to the field. A Customer Service representative determines with the client the required number and types of bottles and fills out a cooler request form (Figure 4-1) that includes the following information:

- address of the client
- special instructions: use of chain-of-custody, etc.
- method of shipment
- account number
- latest shipping date
- test codes for samples

The cooler is sent with instructional and necessary information such as chain of custody record (Figure 5-1), sample collection and preservation guidelines (Figure 4-2), bottle labels, custody seals (Figure 4-3), etc. When soil samples are to be imported into the USA, the US Department of Agriculture requires that the sample containers be labeled with "Restricted Entry" labels (Figure 4-6). CompuChem encloses these labels and instructions when sent outside the continental U.S.

For regulatory work done in the States of Florida and New Jersey and for some other clients, formal COC starts when the pre-cleaned sample containers are dispatched to the field from the laboratory. The required COC record is sent with these containers. It must be signed and dated by the individual who packs the cleaned and certified sample containers into the cooler and relinquishes custody of them. This initiates the COC process.

Protocol for sample collection is left to the discretion of the field sampling crew. In general, the use of "blue" ice for sample preservation is discouraged and is adequate only if the samples have been pre-cooled with wet ice.

Please note that Tables 4.1 to 4.7 lists all Preservation, Holding Times, and Recommended Sample Volumes published in a variety of federal documents. CompuChem does not perform all these methods in-house but supplies this

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information for the benefit of our clients. See section 2 of the Quality Manual for details on analyses performed at CompuChem.

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Table 4.1

Requirements for Containers, Preservation, Holding Times, and Recommended Sample Volumes Published in the Clean Water Act, 40 CFR 136, *Federal Register*

Parameter	Preservation	Holding[a] Time (days)	Containers[b]	Volume (mL)
Acidity	Cool, 4°C	14	P or G	200
Alkalinity	Cool, 4°C	14	P or G	100
Ammonia	Cool, 4°C, H_2SO_4 to pH<2	28	P or G	500
Biochemical Oxygen Demand	Cool, 4°C	48 hours	P or G	1000
Bromide	NR[c]	28	P or G	200
Chemical Oxygen Demand	Cool, 4°C, H_2SO_4 to pH<2	28	P or G	100
Chloride	NR	28	P or G	100
Chlorine, Total Residual	NR	0[d]	P or G	500
Chromium VI	Cool, 4°C	24 hours	P or G	500
Coliform, fecal and total	Cool, 4°C; 0.008% $Na_2S_2O_3$	6 hours	P or G	200
Color	Cool, 4°C	48 hours	P or G	500
Cyanide, total	Cool, 4°C; NaOH to pH>12 0.6 g ascorbic acid[f]	14[e]	P or G	1000
Cyanide, amenable to chlorination (free)	Cool, 4°C; NaOH to pH>12 0.6 g ascorbic acid[f]	14[e]	P or G	500
Fluoride	NR	28	P	500
Hardness	HNO_3 to pH<2 H_2SO_4 to pH <2	180	P or G	250
Hydrogen Ion (pH)	NR[c]	0[d]	P or G	40
Kjeldahl Nitrogen	Cool, 4°C; H_2SO_4 to pH <2	28	P or G	1000
Mercury	HNO_3 to pH<2	28	P or G	500
Metals (except Cr VI and Hg)	HNO_3 to pH<2	180	P or G	500
Nitrate (as N)	Cool, 4°C	48 hours	P or G	100
Nitrite (as N)	Cool, 4°C	48 hours	P or G	50
Nitrate-Nitrite (as N)	Cool, 4°C; H_2SO_4 to pH <2	28	P or G	500
Oil and Grease	Cool, 4°C; H_2SO_4 to pH <2	28	G	1000
Organic Carbon, Total (TOC)	Cool, 4°C HCl or H_2SO_4 to pH <2	28	P or G	100
Organic Nitrogen, Total	Cool, 4°C; H_2SO_4 to pH <2	28	P or G	500
Orthosphosphate (as P)	Filter immediately, Cool, 4°C	48 hours	P or G	50
Phenols (Total)	Cool, 4°C; H_2SO_4 to pH <2	28	G	1000
Phosphorus (Elemental)	Cool, 4°C	48 hours	G	500
Phosphorus (Total)	Cool, 4°C H_2SO_4 to pH <2	28	P or G	200
TRPH	5 ml HCl; Cool, 4°C	**28 days**	G	1000

[a] From time of sample collection
[b] Polyethylene (P) or glass (G)
[c] None required
[d] 0 days indicates that the sample must be analyzed immediately.
[e] Reduced to 24 hours if sulfide is present, unless sulfide is removed before preservation.
[f] Added if residual chlorine is present

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Table 4.1 (Continued)

Requirements for Containers, Preservation, Holding Times, and Recommended Sample Volumes Published in the Clean Water Act, 40 CFR 136, *Federal Register*

Parameter	Preservation	Holding Time[a] (days)	Containers[b]	Volume (mL)
Solids (Total and Filterable)	Cool, 4°C	7	P or G	100
Solids (Non-filterable)	Cool, 4°C	7	P or G	300
Solids (Settleable)	Cool, 4°C	7 days	P or G	1000
Silica	Cool, 4°C	28	P	100
Specific Conductance	Cool, 4°C	28	P or G	250
Sulfate	Cool, 4°C	28	P or G	250
Sulfide	Cool, 4°C Add zinc acetate and NaOH to pH>9.	7	P or G	
Sulfite	NR[c]	0[d]	P or G	250
Surfactants	Cool, 4°C	48 hours	P or G	250
Turbidity	Cool, 4°C	48 hours	P or G	250
Purgeable Halocarbons	Cool, 4°C 0.008% $Na_2S_2O_3$[e]	14	G	80
Purgeable Aromatic Hydrocarbons	Cool, 4°C 0.008% $Na_2S_2O_3$[e] HCl to pH<2	14	G	80
Phenols	Cool, 4°C 0.008% $Na_2S_2O_3$[e]	7/40[f]	P or G	2000
Benzidines	Cool, 4°C 0.008% $Na_2S_2O_3$[e]	7/7[g]	P or G	2000
Phthalate Esters	Cool, 4°C	7/40[f]	G	2000
Nitrosamines	Cool, 4°C, dark 0.008% $Na_2S_2O_3$[e]	7/40[f]	P or G	2000
PCBs	Cool, 4°C	7/40[f]	P or G	2000
Nitroaromatics and isophorone	Cool, 4°C, dark 0.008% $Na_2S_2O_3$[e]	7/40[f]	P or G	2000
Polynuclear Aromatic Hydrocarbons	Cool, 4°C, dark 0.008% $Na_2S_2O_3$[e]	7/40[f]	G	2000
Haloethers	Cool, 4°C 0.008% $Na_2S_2O_3$[e]	7/40[f]	P or G	2000
Chlorinated Hydrocarbons	Cool, 4°C	7/40[f]	P or G	2000
TCDD	Cool, 4°C 0.008% $Na_2S_2O_3$[e]	7/40[f]	P or G	2000
Pesticides	Cool, 4°C; pH 5-9	7/40[f]	P or G	2000

[a] From time of sample collection
[b] Polyethylene (P) or glass (G)
[c] None required
[d] 0 days indicates that the sample must be analyzed immediately.
[e] $Na_2S_2O_3$ added if residual chlorine is present; approx. equal to 1 ml of 10% thiosulfate / liter of sample.
[f] To complete extraction (or initiate extraction if continuous liquid-liquid extraction is performed)/ to complete analysis following extraction
[g] Extracts may be stored up to 7 days before analysis if stored under an inert (oxidant-free) atmosphere.

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Table 4.2

Requirements for Containers, Preservation, Holding Times, and Recommended Sample Volumes Published in the U.S. EPA CLP SOW for Inorganics Analysis, ILM04.1/ILM05.4

Parameter	Preservation[a]	Holding Time[b] (days)	Containers[c]	Volume (mL)
Cyanide, total	Cool, 4°C NaOH to pH>12 0.6 g of ascorbic acid[d]	12	P or G	1000
Metals (except Hg)	HNO_3 to pH<2, 4°± 2°C	180	P or G	500[e]
Mercury	HNO_3 to pH<2, 4°± 2°C	26	P or G	500[e]

a Water sample only; preservation performed by sampler immediately upon sample collection. Soil/sediment samples are maintained at 4°C until analysis. Dissolved metals are filtered onsite by sampler before addition of preservative. Water samples received under the ILM04.1 SOW are stored at ambient temperature
b From validated time of sample receipt
c Polyethylene (P) or glass (G)
d Only used in the presence of residual chlorine
e Can be combined into a one-liter bottle.

Table 4.3

Requirements for Containers, Preservation, Holding Times, and Recommended Sample Volumes Published in the U.S. EPA CLP SOW for Organics Analysis OLM04.3, and OLC03.2 (aqueous only), and SOM01.1

Parameter	Preservation	Holding Time (days)[a]	Containers[b]	Volume (mL)
Aqueous Volatiles	Cool, 4°± 2°C[c] HCl to pH≤2	10[d]	G-TLSSL	80
Soil/Sediment Volatiles	4°± 2°C[c], sodium bisulfate <-7°C	10[d] 10	G-TLC, CET, EnCore™ samplers	4 oz 60 mL
Aqueous Semivolatiles	4°± 2°C[c]	5/40[e]	AG	2000
Soil/Sediment Semivolatiles	4°± 2°C[c]	10/40[e]	G	8 oz
Aqueous Pesticides/PCBs	4°± 2°C[c]	5/40[e]	AG	2000
Soil/Sediment Pesticides/PCBs	4°± 2°C[c]	10/40[e]	G	8 oz

a From validated time of sample receipt
b All containers are 1-liter amber glass (AG) bottles with Teflon-lined cap except aqueous volatiles (G-TLSSL = 40-ml glass bottle with Teflon-lined septum sealed lid), and soil/sediment volatiles (G-TLC = 4-oz glass jar with Teflon-lined cap or CET = closed-end tubes such as brass sleeves). Soil samples may also be collected under OLM04.3 and SOM01.1 for low level analysis in Encore™ samplers or as 5 gm sample in sodium bisulfate or medium level analysis in pre-weighed vials containing 10ml methanol. When this occurs, the sample vial, with 10 ml methanol and all labeling, is weighed to the nearest 0.1g prior to the addition of sample. Approximately 5g of sample is added to the vial. The sample vial with sample is weighed to the nearest 0.1g. The initial weight, final weight and sample weight are recorded and provided to the laboratory.
c Preserve samples at time of collection; samples should be stored in the dark until extraction/analysis.
d Until analysis
e To complete extraction/to complete analysis following extraction

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Table 4.4

Requirements for Containers, Preservation, Holding Times, and Recommended Sample Volumes for Aqueous and Solid Matrices[a] Published in SW-846 Test Methods for Evaluating Solid Waste, Third Edition, Update 3, December 1996.

Parameter	Methods	References	Container	Preservation	Maximum Holding Times[b]
Volatile Organics in water	Purge and trap GC and GC/MS	8015A modified/ 8015B, 8260B	Glass, 40-ml vial with zero headspace	4°C, HCl to pH <2, 0.008% $Na_2S_2O_3$	14 days (A) (see below for soil)
Semivolatile Organics	GC, HPLC, and GC/MS	8081A,8082, 8151A, 8310, 8270C, 8330, 8332	Glass, amber (A) (1 liter sample); 8-oz wide mouth with PTFE-lined cap (S) (50-g min. ea. test)	Cool to 4°C, 0.008% $Na_2S_2O_3$	7 days to extract (A); 14 days to extract (S); 40 days to analyze (A/S)
Total Metals – except Mercury and Chromium VI	ICP	6010B	Glass or plastic 500ml (A), 8-oz wide mouth (S) (200-g sample)	HNO_3 to pH<2 (A); filter dissolved on-site first; filter suspended-no acid	6 months (A/S)
Chromium VI	Colorimetric, automated	7196A	Glass or plastic, 500ml (A), 8-oz wide mouth (S) (200-g sample)	Cool to, 4°C	24 hours (A); one mo. to extraction, 4 days after (S).
Mercury	Manual cold vapor AA	7470 7471A	Glass or plastic, 500ml (A), 8-oz wide mouth (200-g sample)	pH<2 HNO_3 (A); Cool to 4°C (S)	28 days (A/S)
Cyanide	Colorimetric automated	9012A	Glass or plastic	Cool to 4°C; pH >12 NaOH (A)	14days (A)
Phenols	Colorimetric, automated	420.2	Glass or plastic	Cool to 4°C; pH <4 H_2SO_4 (A)	28 days (A)
Specific conductance	conductivity	9050A	Glass or plastic	Cool to 4°C (A)	28 days (A)
Sulfide	distillation, titration	9034	Glass or plastic	Cool to 4°C; Zinc acetate (A/S)	7 days (A/S)
Oil & grease	Gravimetric	9070 9071A	Glass	Cool to 4°C (A/S); 5 ml diluted HCl(A)	28 days (A) 14 days (S)
TOC	Combustion analyzer	9060	Glass or plastic	Cool to 4°C; pH<2 HCl or H_2SO_4; Store in dark (A)	28 days
TOX	DX 208 analyzer	9020B	Glass, PTFE-lined cap	Cool to 4°C; pH<2 H_2SO_4	28 days

[a] Table originally excerpted, in part, from Table II, 49 FR 28, October 26, 1984, and revised.
b Holding time begins at time of sample collection.
[c] $Na_2S_2O_3$ added if residual chlorine is present; approx. equal to 1 ml of 10% thiosulfate / liter of sample.
(A) aqueous, (S) solid

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Table 4.5

Sample Handling, Preservation and Holding Time Table for SW-846 Method 5035, Volatile Organics in Soil

Conc. Level	Sampling Device	Collection Procedure	Container Type	Container Preparation	Preservation	Maximum Holding Time[a]
≤ 200 ug/kg	Coring Device	5035-Section 6.2.1	Glass vial w/ PTFE-silicon septum	5035-6.1.1	4°C, $NaHSO_4$	14 days
	Coring Device	5035-Section 6.2.1	Glass vial w/ PTFE-silicon septum	5035-6.1.1[b]	4°C	48 hours
	Coring Device	5035-Section 6.2.1	Glass vial w/ PTFE-silicon septum	5035-6.1.1	4°C/-10°C[d]	48 hours/ 14 days[e]
	Encore™ or equivalent	5035-Section 6.2.1	Encore™ or equivalent	5035-6.1.1[b,f,g]	4°C	48 hours
	Encore™ or equivalent	5035-Section 6.2.1	Encore™ or equivalent	5035-6.1.1[f,g]	$NaHSO_4$, 4°C	48 hours, 14 days
	Encore™ or equivalent	5035-Section 6.2.1	Encore™ or equivalent	5035-6.1.1 [b,f,g]	4°C/-10°C [c,d]	48 hours/ 14 days
> 200 ug/kg[h]	Encore™ or equivalent	5035-Section 6.2.2.3[f]	Encore™ or equivalent	5035-6.1.1 [f,g]	4°C	48 hours 14 days
	Coring Device	5035-Section 6.2.2.3[I]	Glass vial w/ PTFE-silicon septum	5035-6.1.1 [I]	Methanol/PEG 4°C	14 days
	Conventional Devices	FLDEP SOP –Section 4.3	Glass vial w/ PTFE-silicon septum	5035-6.1.1	4°C	14 days
Dry weight	Conventional Devices		Glass w/ teflon liner		4°C	

a Maximum time allowed from time/date of collection to sample analysis.
b Eliminate 6.1.1.2; use only organic-free water.
c Contents of sampling device must be transported to the laboratory at 4°C and stored at –10°C; this option upon client request.
d In order to ensure that vials do not break during freezing, they should be stored on their side or at a slanted angle.
e Maximum allowed time at 4°C is 48 hours; maximum allowed time to sample analysis is 14 days from collection.
f Conducted in the laboratory.
g Entire contents of sampling device is extruded into the sample analysis vial containing the appropriate solvent.
h Procedures are limited only to those situations or programs in which the maximum contamination level does not exceed 200ug/kg.
I Methanolic preservation in the field is not recommended.

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Table 4.6

Requirements for Holding Times for Hazardous Characteristics Indicators Published in SW-846 Test Methods for Evaluating Solid Waste, Third Edition, Update 3, December 1996.

Parameter	**Methods**	**References**	**Container**	**Preservation**	**Maximum Holding Times**
Reactivity-Total releasable cyanide	Reflux distillation, colorimetry	Chapter 7, 7.3.3, 9012A	Glass, with zero headspace	4°C in dark, pH>12 NaOH	ASAP
Reactivity-Total releasable Sulfide	Acid distillation, titration	Chapter 7, 7.3.4, 9034	Glass, with zero headspace	4°C in dark, pH>12 NaOH; zinc acetate	ASAP
Ignitability	Flash point	1010	Glass or plastic	NA	ASAP
Corrosivity	Electrometric	9040B	Glass or plastic	NA	ASAP
Paint filter liquids	filtration	9095A	Glass or plastic	NA	ASAP

Table 4.7

Requirements for Containers, Preservation, Holding Times, and Recommended Sample Volumes for Toxicity Characteristics Leaching Procedure, TCLP, Method 1311, and Synthetic Precipitation Leaching Procedure, SPLP, Method 1312, Published in SW-846 Test Methods for Evaluating Solid Waste, Third Edition, Update 3, December 1996.

Sample Maximum Holding Times				
Parameter	**From: Field collection** **To: TCLP Extraction**	**From: TCLP Extraction** **To: Preparative Extraction**	**From: Preparative extraction** **To: Determinative Analysis**	**Total elapsed time in days**
Volatiles	14	NA	14	28
Semivolatiles	14	7	40	61
Mercury	28	NA	28	56
Metals, no Hg	180	NA	180	360

Exceeding the holding time is not acceptable in establishing that a waste does not exceed the regulatory level. Exceeding the holding time will not invalidate characterization if the waste exceeds the regulatory level.

Holding time associated with the ASTM leachate generation method (D3987-85) is 14 days from collection to leachate generation, i.e. filtration, then the method holding time to preparation and/or analysis.

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Figure 4-1

GLASSWARE/COOLER ORDER FORM

DATE:_____ DATE NEEDED BY CLIENT:_____ (circle one) AM PM

REQUESTED BY:_____ **SHIP VIA:_____ (circle one) NDA NDAS 2nd DAY AM 2nd DAY AIR 3 DAY GROUND

CLIENT:_____ PROJECT ID:_____

ADDRESS:_____ COOLER #s_____

_____

_____

_____

PHONE #:_____

BOTTLES PER ANALYSIS

Number of Samples*	Parameters Needed	Container	Bottle Lot Number	Spikes	Preservative Lot Number	Total Bottles

* includes QC

Circle items needed: Coc's Labels Seals ____TB's / carboy#____ ____Liters DIH2O / carboy#____

Additional items:_____

Prepared by/date:_____

** NDA = NEXT DAY AIR (by 10:30AM); NDAS = NEXT DAY AIR SAVER (by 3:00PM); 2nd DAY AM = 2nd DAY AIR AM (by 10:30AM); 2nd DAY AIR = 2nd DAY AIR (by 3:00PM); 3 DAY = 3 DAY SELECT (by 3rd DAY PM); GROUND = GROUND 3-5 DAYS (SLOW BOAT)

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Figure 4-2

Sample Collection and Preservation Guidelines

Preservatives must be added in the field at the time of sample collection unless glassware are already pre-preserved. Preservatives should be recorded on the Chain-of-Custody form in the "Remarks" column on a per sample basis. For certain methods and parameters, the laboratory verifies upon receipt that the sample pH falls within an acceptable range. Improperly preserved samples or samples with pH values outside of the specified range are noted in the sample receiving documentation. The client is contacted and given the option of resampling, directing the laboratory to preserve the sample in-house, or processing the sample as it was received. To document the action taken, a Quality Assurance Notice is included in the data report for any occurrence.

When obtaining aqueous samples for the determination of volatile organics, the collector should ensure the absence of headspace by filling the 40-ml bottle to the top. This procedure should produce a positive meniscus across the surface of the vial. The Teflon-lined septum should be placed gently over the sample surface, with the Teflon side down, and the top screwed firmly on over the septum. A proper seal should be verified by inverting the sealed bottle and gently tapping on the sides with your finger, ensuring that no air bubbles appear.

The collector should designate which samples are to be used for Quality Control. For these designated samples, the recommended sample weight or volume should be doubled. If sufficient sample is not available to the laboratory, QC requirements may not be achievable. Excess sample will unnecessarily increase shipping costs.

Guidance on the EPA SW8-46 Method 5035 for the Closed System Purge and Trap and Extraction for Volatile Organics in Soil and Waste Samples.

CompuChem has the capabilities and supplies to provide any of the Method 5035 options. Because of some disadvantages, we favor the use of disposable EnCore™ samplers, with zero headspace design, for the collection of soil samples for volatile analysis. The EnCore™ sampler is available in 5g and 25g sizes. Some regulatory agencies may mandate using the 5g size. Three 5g EnCore™ samplers, with a 2 ounce jar for percent moisture, would be required per sampling site to include:

- a 5g aliquot for the sample analysis
- a 5g aliquot as a back-up for the sample analysis
- a 5g aliquot for a methanol extraction used for screening and/or a high concentration analysis
- a 2 oz. aliquot for a % moisture determination

In most cases, the methanol aliquot (containing surrogates) will be used for screening purposes. Based on those results, other tests will be performed. Once aliquots of the soil sample, taken from the EnCore™ sampler, are added to vials containing preservative, the remainder of the 14 day holding time is available.

During the initial transfer of sample aliquots to the vials containing the sodium bisulfate preservative solution, the presence of carbonates will be identified due to the observed effervescence. If this occurs, a 5g aliquot of sample will be transferred to a vial containing only water. The sample will be immediately sealed and analyzed as soon as possible but no later than 48 hours from preparation. Alternatively, the analysis will be conducted on the methanol-preserved aliquot. For effervescence, with the client's approval, another option is to freeze the contents of the EnCore.™ Freezing the contents of

R2-0002238

Encore™ samplers in closed system purge and trap vials with or without the addition of water is also allowed by some EPA Regions and other regulatory agencies. The laboratory project manager conveys this type of information directly to the laboratory upon sample receipt. Advantages of use of the EnCore™ include:

- No need to take or use a balance in the field
- No exposure of field personnel to corrosive sodium bisulfate or flammable/toxic methanol
- No additional shipping paperwork or cooler labeling
- No need to use the costly closed system purge and trap vials in the field
- No chance of volatile sample container breakage during shipment
- Significant decrease in man-hour requirements to complete the field sampling efforts

R2-0002239

Figure 4-3

Cooler Label

CompuChem
a division of Liberty Analytical Corporation

501 Madison Avenue
Cary, North Carolina 27513

Phone #(919) 379-4100

Please return cooler to the above address.

Custody Seal

CompuChem
a division of Liberty Analytical Corporation

CUSTODY SEAL

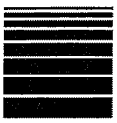
Person Collecting Sample_____Sample No._____
(signature)

Date Collected_____Time Collected_____

R2-0002240

Figure 4-4

Instructions for Bottles, Refrigerant, and Sample Collection Records



CompuChem
a division of Liberty Analytical Corporation

Bottles:

- Do not open any bottles until you actually put your sample in them—this prevents contamination.
- Do not substitute your own bottles or interchange any lids or labels on our bottles.
- Repack all bottles we provided, especially the plastic bottles in the center. Otherwise, bottle breakage may occur.
- Do not rinse our bottles prior to sample collection. Rinsing will contaminate them and remove preservative. Some states may require that non-preserved containers be rinsed with sample water before collection.

Blue Ice Substitute

- A wet ice slurry is ideal for sample collection and the use of blue ice is discouraged and not allowed by some state certifying bodies. Florida requires samples be cooled on wet ice to 4° C before packing.
- If you must use blue ice, freeze in a standard freezer for at least 12 hours and no more than 18 hours prior to sampling. *Do not freeze the blue ice using dry ice. This freezes your sample and breaks bottles.*
- Do not freeze the sample itself.
- Please repack the blue ice (with red caps upward). Otherwise, your sample results will not be accurate or bottle breakage may occur during shipment.

Sample Records

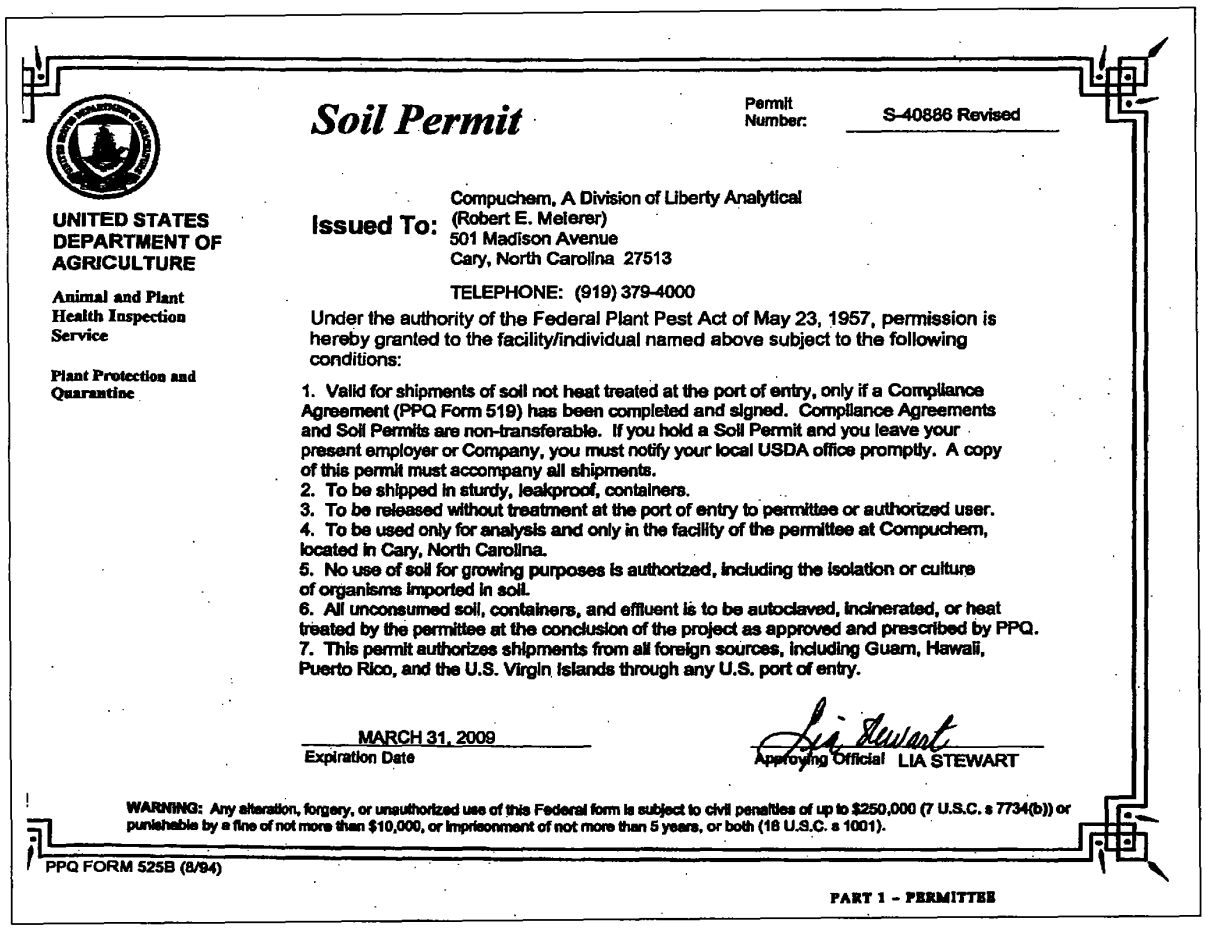
- Three types of labels will be supplied. Included will be: a return label, Custody seals, and a sufficient number of sample identification labels. On the sample identification labels, please indicate the analysis code you have ordered and your sample identification. If the sample ID is more than nine characters it will be truncated, due to computer software limitations, and explained in the SDG narrative. Affix these labels to the appropriate sample containers.
- A Chain-of-Custody record and client information sheet are also provided. The analysis code ordered as well as the volume requirements will be stated on the client information sheet.
- Provide as much identifying information about your company and your sample identity as possible. CompuChem processes thousands of samples a year—often from several plants within several divisions of the same company, all at the same time!

If you have any other questions, please call your customer service representative at 1-800-833-5097.

R2-0002241

Figure 4-5

Permit to Receive Soil



UNITED STATES DEPARTMENT OF AGRICULTURE

Animal and Plant Health Inspection Service

Plant Protection and Quarantine

Soil Permit

Permit Number: S-40886 Revised

Issued To: Compuchem, A Division of Liberty Analytical
(Robert E. Meierer)
501 Madison Avenue
Cary, North Carolina 27513

TELEPHONE: (919) 379-4000

Under the authority of the Federal Plant Pest Act of May 23, 1957, permission is hereby granted to the facility/individual named above subject to the following conditions:

1. Valid for shipments of soil not heat treated at the port of entry, only if a Compliance Agreement (PPQ Form 519) has been completed and signed. Compliance Agreements and Soil Permits are non-transferable. If you hold a Soil Permit and you leave your present employer or Company, you must notify your local USDA office promptly. A copy of this permit must accompany all shipments.
2. To be shipped in sturdy, leakproof, containers.
3. To be released without treatment at the port of entry to permittee or authorized user.
4. To be used only for analysis and only in the facility of the permittee at Compuchem, located in Cary, North Carolina.
5. No use of soil for growing purposes is authorized, including the isolation or culture of organisms imported in soil.
6. All unconsumed soil, containers, and effluent is to be autoclaved, incinerated, or heat treated by the permittee at the conclusion of the project as approved and prescribed by PPQ.
7. This permit authorizes shipments from all foreign sources, including Guam, Hawaii, Puerto Rico, and the U.S. Virgin Islands through any U.S. port of entry.

MARCH 31, 2009
Expiration Date

Approving Official LIA STEWART

WARNING: Any alteration, forgery, or unauthorized use of this Federal form is subject to civil penalties of up to $250,000 (7 U.S.C. s 7734(b)) or punishable by a fine of not more than $10,000, or imprisonment of not more than 5 years, or both (18 U.S.C. s 1001).

PPQ FORM 525B (8/94)

PART 1 - PERMITTEE

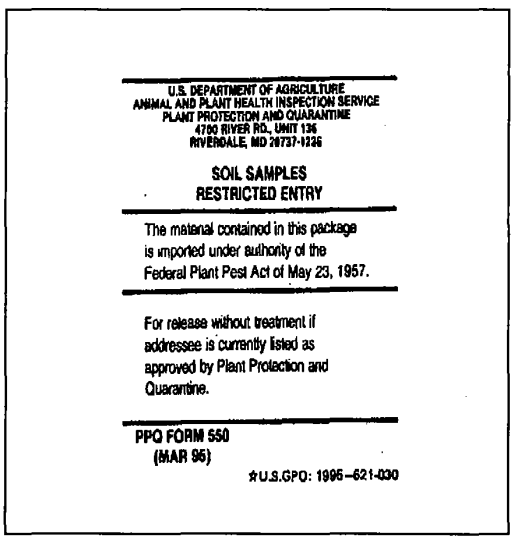
R2-0002242

Figure 4-6

Soil Sample Cooler Restricted Entry Label

CompuChem
a division of Liberty Analytical Corporation

In order to remain in compliance with current United States Department of Agriculture regulations regarding the importation of soil samples of foreign origin into the Unites States for subsequent analysis, it is necessary to affix the attached USDA labels to every soil sample that is expected to enter the U.S.A. Each label should be placed in a highly visible position on the exterior surface of every cooler being sent. Failure to comply with this regulation can result in transportation delays and denials.



U.S. DEPARTMENT OF AGRICULTURE
ANIMAL AND PLANT HEALTH INSPECTION SERVICE
PLANT PROTECTION AND QUARANTINE
4700 RIVER RD., UNIT 136
RIVERDALE, MD 20737-1236

SOIL SAMPLES
RESTRICTED ENTRY

The material contained in this package is imported under authority of the Federal Plant Pest Act of May 23, 1957.

For release without treatment if addressee is currently listed as approved by Plant Protection and Quarantine.

PPQ FORM 550
(MAR 95)

☆U.S.GPO: 1995–621-030

R2-0002243

5.0 Sample Handling

This section summarizes policies and practices for sample handling. Further details are contained in SOPs. If any discrepancy is noted at sample receipt or if there is any question about the sample's suitability for testing, the Project Manager or Customer Service Representative contacts the client for instructions on how to proceed. The condition of the samples is recorded on the Chain of Custody (COC) record, on the sample log-in form, and in the final report.

5.1 Sample Acceptance Policy

CompuChem's sample acceptance policy outlines the circumstances under which samples will be accepted by the laboratory. Data that do not meet the policy are noted in the laboratory report defining the nature and substance of the variation. Samples received by the laboratory for analysis require the following:

- Proper, full, and complete documentation, including:
  - unique sample identification,
  - location, date and time of collection,
  - collector's name,
  - preservation type,
  - matrix
  - analytical method
  - special remarks concerning the sample

- Sample identified using durable label completed in indelible ink
- Proper preservation
- Intact, undamaged sample container
- Adequate sample volume
- Appropriate receipt temperature
- Receipt within holding time

It is the laboratory's policy to accept all samples including those that do not meet the requirements listed above. However, in cases where these requirements are not met, the project manager contacts the SMO (who contacts the EPA Region) or the client via telephone or e-mail indicating any receiving issues. The laboratory will proceed with analysis or reject the sample as advised by the client or EPA Region.

5.2 Sample Tracking

CompuChem uniquely identifies each sample to be tested, to ensure that there can be no confusion regarding identity. The sample identification system includes identification for all samples, sub-samples and subsequent extracts and/or digestates. A unique identification (ID) code is automatically assigned by the LIMS. A label is printed and affixed to the sample container.

Internal COC records accompany raw samples from the cooler to the laboratories and back, extracts and digestates to the instrument labs from preparation, and are part of the data deliverables depending on the report style requested by the client.

R2-0002244

5.2.1 Bench Log-In Procedure

The following steps are completed by the Receiving Clerk and Sample Custodian for all samples when received by CompuChem. If for any reason a sample requires special handling, the Project Manager is consulted for instructions for processing and documentation. Completed COC forms are part of the data deliverables.

Each employee is required to wear protective clothing (lab coat, safety glasses, and gloves) at all times when working in the hood with samples. Upon receipt, the condition of the sample, including any abnormalities or departures from standard condition is observed and recorded. Each container is opened carefully under the fume hood and inspected for damage and integrity. For those clients using padlocks, sealing tape, or custody seals, these items are inspected to make sure that they are intact and this observation is recorded on the COC form (Figure 5-1). If the custody seals, tapes, or padlocks are broken, a project manager contacts the client for instructions as to how to proceed.

The condition of the refrigerant (whether any ice remains or whether the cooling packs, if present, are solid) is checked. The temperature of a representative sample, taken from the middle of the cooler, or of the temperature blank, when present, is obtained by means of an infrared (IR) gun. The temperature is taken while the sample is still inside the cooler. The temperature is recorded on the log-in sheet and on the COC. All samples requiring thermal preservation are considered acceptable if the arrival temperature is either within +/- 2 degrees C of the required temperature (4 degrees C) or the method-specified range. The acceptable range for the State of North Carolina DENR is 2°-4.4°C. Samples that are hand delivered to the laboratory immediately after collection may not meet criteria. In these cases, the samples will be considered acceptable if there is evidence that the chilling process has begun, such as arrival on ice. A Quality Assurance notice is completed and clients contacted for samples that exceed temperature requirements.

Samples are checked for breakage and removed from the shipping container. The sample identification information on the sample bottles is compared to the sample information on the traffic report, packing slip, and Chain-of-Custody form included in the container. If discrepancies exist, the problem is noted on the COC form; the receiving clerk notifies the Project Manager.

Each 40 mL vial for volatile analysis is checked for air bubbles and headspace. Findings are noted on the Chain-of-Custody and on the log-in-sheet. A bubble up to the size of a pea is permitted.

R2-0002245

Incoming EPA samples are checked against SMO scheduled receipts. Samples are logged in on the log-in-sheet using either an organic or inorganic EPA Receiving Log sheet (Figures 5-2 and 5-3) for EPA samples and the following items are noted:

- Case number/SDG
- CompuChem ID number (CC#)
- client name or order number
- temperature
- field ID (Sample ID)
- receiving date (RD)
- sampling date (SD)
- test codes
- matrix
- volume received
- pH of inorganic samples
- residual chlorine and sulfide check for cyanides and phenols
- residual chlorine check for all organic parameters, TKN, and ammonia, when required

Additional preservation checks include a residual chlorine check performed for cyanide and phenol samples and samples requiring Method 625 analysis. A sulfide check is performed for cyanide and phenol samples. The pH is verified for inorganic samples and samples requiring analysis by Method 608 using test strips and a small aliquot of sample dripped onto the strip with a disposable pipette. If a sample has not been properly preserved, the client is notified and a standard QA notice (Figures 5-4 through 5-9) is completed and placed in the sample file. The results are documented on the log-in sheet and on the COC.

On each complete EPA COC, Traffic Report, and commercial client COC a statement as to the condition of samples upon receipt is documented. "Good Condition" indicates that the sample cooler was received with the custody seal intact and the sample or samples were received intact with all associated documentation. If there are any discrepancies in the documentation or other problems, the exceptions are noted on the appropriate documents, initialed and dated.

The statement `Received in Good Condition' does not include sample temperature since EPA samples may be received at temperatures above the recommended 4°C. The temperature is noted on the sample log-in sheet and COC. Each log-in sheet and COC is reviewed by the Receiving department supervisor or designee, who ensures that all information is properly documented. Each is signed as having been reviewed, initialed, and dated.

All COC and log-in sheets are forwarded to the Project Manager for the completion of the LIMS log-in procedures. Samples that must be preserved by refrigeration do not remain un-refrigerated for more than two hours. If the completion of order entry is delayed, the samples are wheeled into the cooler until labels are generated and the process can be completed.

R2-0002246

5.2.2 Computer Log-in Procedure

For EPA and commercial samples, the Project Manager or designee enters the account data into the client setup section of the LIMS to generate the client's profile. This profile contains a listing of all requested analysis codes and project specific information.

The sample information is entered into the sample receipt portion of the LIMS in order to generate a CompuChem number (CCN) for each sample. A CCN is a unique laboratory identifier that consists of the work order number and a numerical suffix. EPA case and SDG numbers are associated with a specific work order number. The CCN is added to the log-in sheet and the original COC form next to the client ID if possible. QC samples associated with an SDG are also assigned a unique laboratory identifier.

Sample labels print in numerical sequence based on the number of bottles received for each sample ID. The labels contain the CCN, client ID, receipt date, container ID, container type, preservation, and any special lab instructions. Samples are labeled by wrapping each sample bottle with its unique computer-generated label (Figure 5-10), leaving the field label exposed if possible.

The labeled samples are transferred to the appropriate cooler. Samples to be analyzed for extractable organics and soil inorganics are stored in cold storage units separate from samples to be analyzed for purgeable organics. For ILM05.3, aqueous inorganic samples need to be refrigerated. Standards are always stored in separate refrigerated storage units in the analytical laboratories. Aqueous inorganic samples, except for hexavalent chromium and ILM05.3 aqueous inorganics, are stored separately at room temperature.

File envelopes are used to assemble field and QC sample information for report preparation. EPA envelopes contain all information for the case including: the yellow copy of the Organic Traffic Report (OTR), a copy of the COC, an original air bill, a copy of the log-in sheet, a copy of the EPA scheduling log, sample custody tags (if received), telephone logs, and "pull sheets" (internal chain of custody forms.) The envelope is stamped with the information in Figure 5-11. The white copy of the OTR is returned with the cover sheet to the EPA SMO. Commercial sample file folders contain the customer sample order information sheet and a copy of the COC record.

CompuChem sometimes receives raw samples from the EPA that should not have been sent to this location. These samples require a transfer. When this occurs, a new COC form is filled out using the information on the sample tags. Custody is relinquished to the courier by signing and dating the "Relinquished by" section of the COC form. A copy of the COC is kept and the original COC and paperwork are sent with samples. Notations are made on Traffic Reports that samples are being sent to another laboratory.

A work-order number is assigned to a group of samples according to client and matrix not to exceed 20 samples received together or over a period of 7 days. (A 14 day receipt may be used, per client request.)

R2-0002247

In the event that client samples are received by the laboratory unexpectedly, a Project Manager or salesperson contacts the client documented on the sample chain-of–custody by phone. During that call the Project Manager or salesperson verifies the information documented on the COC such as the project name, parameters to be tested, test methods to be used, client contact person, date the data report is due, and the data reporting requirements. The Project Manager documents the client information and project requirements in the LIMS and proceeds with sample login.

For samples hand-delivered after business hours, the actual date of sample receipt is recorded on the COC. The date and time of sample receipt and sample condition are recorded on the OTR. "Hand-Delivered" is recorded on the COC and OTRs.

5.3 Storage Conditions

The sample custodians and the supervisor of the Receiving department are responsible for the security of the sample storage units. Sample preparation and off-shift personnel also have access to the sample storage units. A roster is posted on each sample cold storage unit in the receiving department identifying personnel authorized to access samples. Samples are requested from the receiving department by lab staff by completing an internal COC form (Figure 5-12).

Under the NELAC standards, samples requiring thermal preservation are stored under refrigeration at ± 2 °C of the specified preservation temperature. For samples with a specified storage temperature of 4°C, storage at a temperature above the freezing point of water to 6°C is considered acceptable. Samples are segregated and stored in a manner that prevents cross contamination.

5.4 Chain of Custody

5.4.1 Sample Custody

Chain of custody records are used to document the collection of field samples and the transfer of the samples to the laboratory. The COC forms remain with the samples during transport or shipment. If shipping containers and/or individual sample containers are submitted with sample custody seals, and any seals are not intact, it is noted on the original COC. Internal COC records are used to document the storage, possession, transfer and disposal of samples, sub-samples, sample extracts and digestates with the laboratory. The COC documents the identity of all individuals who physically handle samples and the time periods associated with the sample handling. Initials of individuals may be used since a cross-reference is maintained by QA that includes the initials and full names of all individuals signing COCs (except for work performed for the State of Florida, and other work when specified, where full signatures are required.) Any corrections to COC information must be made with black indelible ink by using a single horizontal line to strike through the incorrect entry, and dating and initialing the correct entry written adjacent to it. Access to all samples is controlled. The laboratory area is maintained securely and is restricted to authorized personnel only. The sample custodian relinquishes possession to the lab staff.

R2-0002248

Depending on client and regulatory requirements, COC may originate at the time pre-cleaned sample containers are sent from the lab to the field, or when the sample containers are filled in the field and loaded into the coolers. New Jersey and Florida are two states that require COC initiation in the laboratory with the loading of pre-cleaned empty containers into the cooler and before shipment to the field. A representative of the Receiving department is responsible for initiating a glassware release COC in such cases.

An internal COC form is generated to accompany the physical transfer of the sample (including its extract or digestate) through the lab. Internal COCs, sample preparation and analytical worksheets, and instrument run logs are used to document the individuals handling the samples at all times. When the analysis is complete, the sample is returned to the sample custodian for log-term storage and disposal.

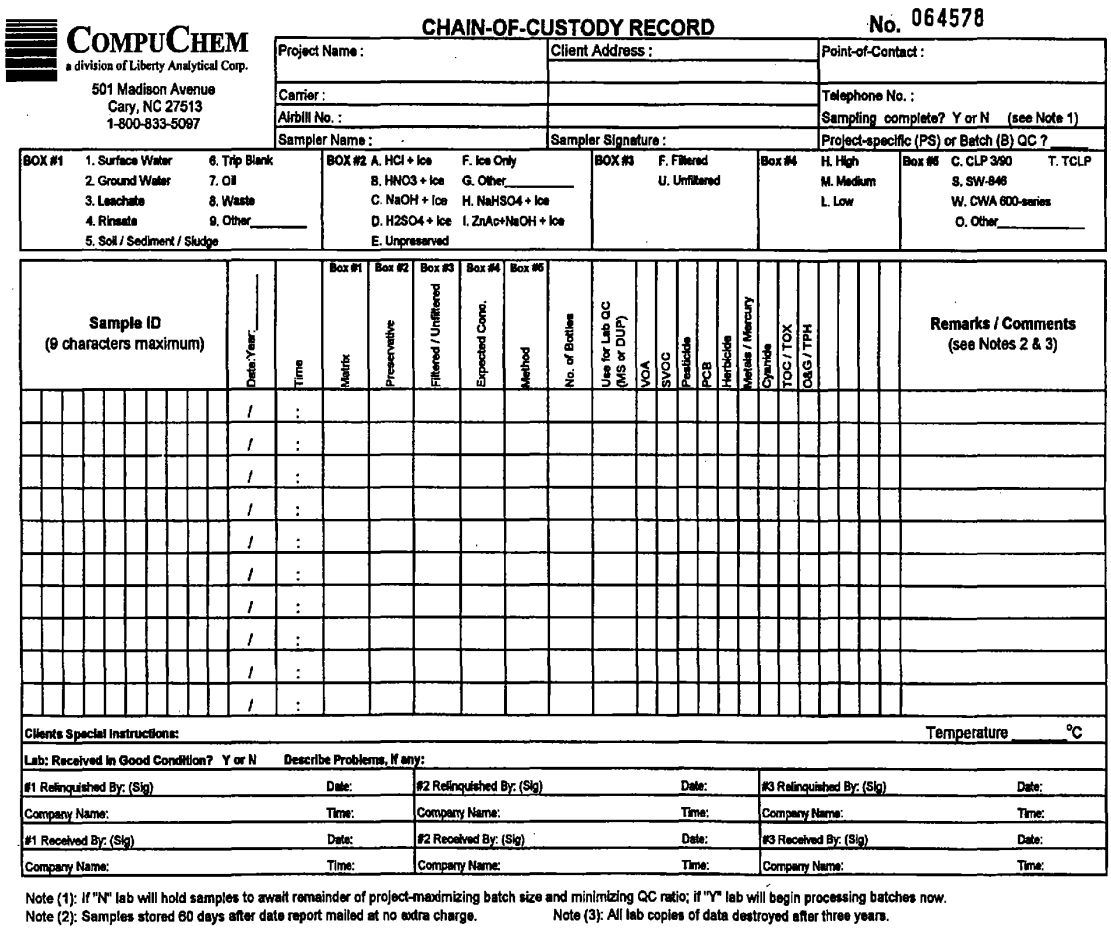
5.5 Sample Retention and Disposal

Unused raw samples are retained in a controlled temperature environment for 60 days after data submission to the client, or approximately 90 days after sample receipt. Extracts are stored refrigerated for one year after data submission. ILM05.3 requires a one year retention of metals digestates. Sample receipt and report dates are documented in the LIMS.

The sample custodian is responsible for purging raw samples from cold storage at the prescribed time. All samples, digestates, leachates, and extracts and other sample preparation products are disposed of in accordance with Federal and State laws and regulations. Sample identifications are recorded in designated Sample Disposal Logbooks at the time of purging (Figure 5-13.) Once segregated by the custodian, samples are processed for disposal by the hazardous waste technician. Client names are removed from bottles at the time of purging. If a sample is part of litigation, disposal of the physical sample occurs only with the concurrence of the client.

R2-0002249

Figure 5-1



COMPUCHEM
a division of Liberty Analytical Corp.
501 Madison Avenue
Cary, NC 27513
1-800-833-5097

CHAIN-OF-CUSTODY RECORD No. 064578

Project Name :	Client Address :	Point-of-Contact :
Carrier :		Telephone No. :
Airbill No. :		Sampling complete? Y or N (see Note 1)
Sampler Name :	Sampler Signature :	Project-specific (PS) or Batch (B) QC ? ____

BOX #1	1. Surface Water 2. Ground Water 3. Leachate 4. Rinsate 5. Soil / Sediment / Sludge	6. Trip Blank 7. Oil 8. Waste 9. Other_____	BOX #2	A. HCl + Ice B. HNO3 + Ice C. NaOH + Ice D. H2SO4 + Ice E. Unpreserved	F. Ice Only G. Other_____ H. NaHSO4 + Ice I. ZnAc+NaOH + Ice
BOX #3	F. Filtered U. Unfiltered		Box #4	H. High M. Medium L. Low	
Box #5	C. CLP 3/90 S. SW-846 W. CWA 600-series O. Other_____	T. TCLP			

Sample ID (9 characters maximum)	Date:Year_____	Time	Box #1 Matrix	Box #2 Preservative	Box #3 Filtered / Unfiltered	Box #4 Expected Conc.	Box #5 Method	No. of Bottles	Use for Lab QC (MS or DUP)	VOA	SVOC	Pesticide	PCB	Herbicide	Metals / Mercury	Cyanide	TOC / TOX	O&G / TPH					Remarks / Comments (see Notes 2 & 3)
	/	:																					
	/	:																					
	/	:																					
	/	:																					
	/	:																					
	/	:																					
	/	:																					
	/	:																					
	/	:																					
	/	:																					

Clients Special Instructions: Temperature _____ °C

Lab: Received in Good Condition? Y or N Describe Problems, if any:

#1 Relinquished By: (Sig) Date:	#2 Relinquished By: (Sig) Date:	#3 Relinquished By: (Sig) Date:
Company Name: Time:	Company Name: Time:	Company Name: Time:
#1 Received By: (Sig) Date:	#2 Received By: (Sig) Date:	#3 Received By: (Sig) Date:
Company Name: Time:	Company Name: Time:	Company Name: Time:

Note (1): If "N" lab will hold samples to await remainder of project-maximizing batch size and minimizing QC ratio; if "Y" lab will begin processing batches now.
Note (2): Samples stored 60 days after date report mailed at no extra charge. Note (3): All lab copies of data destroyed after three years.

R2-0002250

Figure 5-2

Page ____of____

CompuChem, a Division of Liberty Analytical Corp.- EPA ORGANIC RECEIVING LOG

Client / Account EPA	Rec'd Date	Comments:
Case No:	Courier	
Temp Blk in cooler? Yes / No	Airbill No.	
Temperature:		
Tags? Yes / No		
Custody Seals? Yes / No Intact? Yes / No		

COOLER REC'D BY:	REVIEWED BY:
Samples Logged in by:	SDG #:
Number of TR's?	Work Order No.:
Return Airbill in cooler? Yes / No	

No.	Sample No.	Client ID	QC	Matrix	Sample Date	Sample Time	T. VOC	VOC	VOC SIM	SVOC	SIM	PEST	AR	Amount/Containers
1														
2														
3														
4														
5														
6														
7														
8														
9														
10														
11														
12														
13														
14														
15														
16														
17														
18														
19														
20														

CrgRec.log.doc-02/24/06

R2-0002251

Figure 5-3

Page ___of

CompuChem, a Division of Liberty Analytical Corp.- EPA INORGANIC RECEIVING LOG

Client / Account EPA	Rec'd Date	Comments:
Case No:	Courier	
Temp. Blk in cooler? Yes / No	Airbill No.	
Temperature:		
Tags? Yes / No		
Custody Seals? Yes / No Intact? Yes / No		

COOLER REC'D BY:	REVIEWED BY:
SAMPLE LOGIN:	SDG #:
Number of TR's?	Work Order No:
Return Airbill in Cooler? Yes / No	
Cyanide Samples checked for sulfide & chlorine? YES / NA	

No.	Sample No.	Client ID	QC	Matrix	Sample Date	Sample Time	Total Metals	Cyanide	Dissolved Metals	pH	Amount/Containers
1											
2											
3											
4											
5											
6											
7											
8											
9											
10											
11											
12											
13											
14											
15											
16											
17											
18											
19											
20											

InorgReclog.doc-03/01/06

R2-0002252

Figure 5-4

CompuChem
a division of Liberty Analytical Corporation

QUALITY ASSURANCE NOTICE

CompuChem ID # _____
Client ID # _____
Case # _____
Type of Analysis _____
Receipt Date _____

A chlorine and sulfide check was performed on the above cyanide sample

The results are checked below.

Chlorine was detected _____
Sulfide was detected _____

A CompuChem customer service representative contacted the client. The client instructed the Receiving department to:

Analyze - qualify with notice _____

Dispose - client will resample _____

Supervisor Signature/ID _____/_____

Date _____

QAN-R-1
971022

Qanr1 – 10/22/97:llc

R2-0002253

Figure 5-5

CompuChem
a division of Liberty Analytical Corporation

QUALITY ASSURANCE NOTICE

CompuChem ID # _____
Client ID # _____
Case # _____
Type of Analysis _____
Receipt Date _____

The pH reading for the sample above was _____: the required pH level is _____.

A CompuChem Project Manager contacted the client who instructed the laboratory to:

Preserve in-house _____

Note: For samples preserved in house, certain clients require that the maximum amount of preservative added to a sample in an SDG also be added to the associated field or equipment blank. If neither blank is present, the appropriate laboratory must be notified so the proper amount of preservation can be added to the method blank.

Analyze - qualify with notice _____

Dispose - client will resample _____

Subcontract lab to preserve _____

Project Manager_____ Date _____

Preservation Type_____ Preservative Lot Number_____

Preserved By_____ Date_____

QAN-R-2
020529

QAN-R-2:052902:llc

R2-0002254

Figure 5-6

CompuChem
a division of Liberty Analytical Corporation

QUALITY ASSURANCE NOTICE

Client _____
Case # _____
Type of Analysis _____
Receipt Date _____

For some organic and/or inorganic determinations temperature preservation at 4 degrees Celsius is required for environmental samples during shipment to the laboratory and prior to analysis. A temperature tolerance range is generally allowed. Temperature of a representative sample from the shipping container is taken and recorded by the receiving clerk at the time of sample receipt. This temperature is representative of all samples contained in the cooler. The EPA CLP program requires the laboratory make notification when the temperature exceeds 10 degrees Celsius. The State of North Carolina allows a range of 2-4.4° Celsius. Notification to other clients is either client or project dependent.

Samples that are hand delivered to the laboratory immediately after collection may not meet this criteria. In these cases, the samples shall be considered acceptable if there is evidence that the chilling process has begun, such as arrival on ice.

The temperature of this sample at the time of receipt was determined to be _____.

A CompuChem customer service representative contacted the client. The client instructed the Receiving department to:

Hand Delivery/Received on ice _____

Analyze - qualify with notice _____

Dispose - client will resample _____

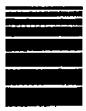
Supervisor Signature/ID _____/_____ Date _____

QAN-R-3
020205

qanr3 – 2/5/02:dce

R2-0002255

Figure 5-7



CompuChem
a division of Liberty Analytical Corporation

Quality Assurance Notice

CompuChem ID#_____
Client ID#_____
Case #_____
SDG#_____
Receipt Date_____
Method_____

A chlorine check was performed on the above phenol sample and was determined to be present. A member of CompuChem's Customer Service Department contacted the client. The Receiving Department was instructed as follows:

Analyze – Qualify with notice and address in narrative: _____
Dispose – Client will resample: _____

Supervisor Signature/ID _____/_____

Date _____

QAN-R-4
010702

Qanr4 – 07/2/01.dcc

R2-0002256

Figure 5-8

CompuChem
a division of Liberty Analytical Corporation

Quality Assurance Notice

Case # _____ SDG# _____
Receipt Date _____ Matrix _____

In the USEPA Contract Laboratory Program (CLP) "Statement of Work for Organic Analysis, Multi-Media, Multi-Concentration (Document Number OLM04.3, OLC03.2 and SOM01.1),"directions are provided dealing with a temperature blank, termed the USEPA Cooler Temperature Indicator.

If a cooler temperature indicator bottle is not present in the cooler, the laboratory is required to contact the Sample Management Office (SMO), inform them of that fact and use an alternative means of determining the cooler temperature.

The following is a list of options employed by CompuChem to determine the cooler temperature. For the Case/ SDG presented above, the option(s) used have been indicated by a check mark.

Note: Any of the options performed are done so immediately after the cooler has been opened and the determination made that the cooler temperature indicator bottle is absent.

Water Samples
___An aliquot from a sample bottle designated for extractable organics is poured into a disposable container, a thermometer is inserted into the disposable container, and the temperature is taken and recorded after a 3-minute equilibration period. The contents of the disposable container are then properly discarded.

___A calibrated IR temperature gun is focused onto a sample container, contained in the cooler, and after a minimum of 5 seconds, a temperature reading is taken and recorded.

Soil Samples
___A calibrated IR gun is used, as indicated for water samples.
___A temperature strip is affixed to the outside of a sample container and, after one minute, the temperature is read and recorded.

As required by the organic SOW, the alternative technique used to determine the cooler temperature must be documented in the SDG Narrative.

Signature_____
Date_____

QAN-R-5
011324

Qanr5 – 11/15/05:vr

R2-0002257

Figure 5-9

CompuChem
a division of Liberty Analytical Corporation

Quality Assurance Notice

Case # _____ SDG# _____
Receipt Date _____ Matrix _____

In the USEPA Contract Laboratory Program (CLP) "Statement of Work for Inorganics Analysis, Multi-Media, Multi-Concentration (Document Number ILM04.1 and ILM05.3),"directions are provided dealing with a temperature blank, termed the USEPA Cooler Temperature Indicator.

If a cooler temperature indicator bottle is not present in the cooler, the laboratory is required to contact the Sample Management Office (SMO), inform them of that fact and use an alternative means of determining the cooler temperature.

The following is a list of options employed by CompuChem to determine the cooler temperature. For the Case/ SDG presented above, the option(s) used have been indicated by a check mark.

Note: Any of the options performed are done so immediately after the cooler has been opened and the determination made that the cooler temperature indicator bottle is absent.

Water Samples
___An aliquot from a sample bottle is poured into a disposable container, a thermometer is inserted into the disposable container, and the temperature is taken and recorded after a 3-minute equilibration period. The contents of the disposable container are then properly discarded.

___A calibrated IR temperature gun is focused onto a sample container, contained in the cooler, and after a minimum of 5 seconds, a temperature reading is taken and recorded.

Soil Samples
___A calibrated IR gun is used, as indicated for water samples.
___A temperature strip is affixed to the outside of a sample container and, after one minute, the temperature is read and recorded.

As required by the inorganic SOW, the alternative technique used to determine the cooler temperature must be documented in the SDG Narrative.

Signature_____
Date_____

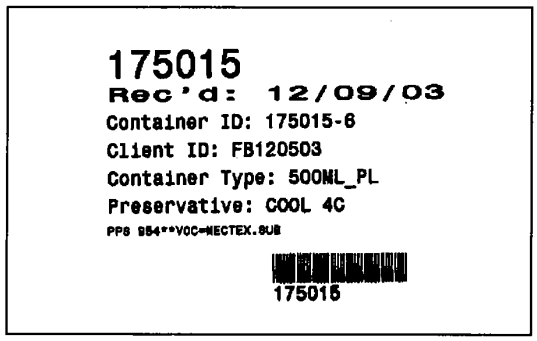
QAN-R-6
011023

Qanr6 – 11/15/05:vr

R2-0002258

Figure 5-10

Bottle Label



R2-0002259

Figure 5-11

Gray Folder Label

EPA CASE #s

EPA SAMPLE #s

C/C SAMPLE #s

DATE RECEIVED

AIRBILL INCLUDED: ( )

SAMPLES DELIVERED BY CUSTOMER: ( )

CHAIN OF CUSTODY: ( )

TAGS RECEIVED: ( )

COOLER RECEIVED SEALED: ( )

SAMPLES RECEIVED BELOW 4 C: ( )

R2-0002260

Figure 5-12

CompuChem a Division of Liberty Analytical
INTERNAL CHAIN OF CUSTODY

Laboratory: _____ Requested By: _____

Water _____ Soil _____ P.E. _____ Date: _____ Shift: 1 2 Sat
circle one

EPA _____ Commercial _____ Time: _____

	SAMPLE NUMBER	RECEIPT DATE	PRES.	PARAMETER	RECEIVING USE ONLY BOTTLE NUMBER
1					of
2					of
3					of
4					of
5					of
6					of
7					of
8					of
9					of
10					of
11					of
12					of
13					of
14					of
15					of
16					of
17					of
18					of
19					of
20					of

Relinquished By: _____ Date: _____ Received By: _____ Date: _____ Reason: _____

Relinquished By: _____ Date: _____ Received By: _____ Date: _____ Reason: _____

Relinquished By: _____ Date: _____ Received By: _____ Date: _____ Reason: _____

Comments: _____

_____

lc1 - 6/25/01:doe

R2-0002261

Figure 5-13

CompuChem, a Division of Liberty Analytical

SAMPLENUM	CONTAINERTYPE	BOTTLES	MATNUM	RECEIVEDATE
A0243-14	8oz jar	1	SO	7/21/01 0:00
A0243-15	8oz jar	1	SO	7/21/01 0:00
A0243-16	8oz jar	1	SO	7/21/01 0:00
A0243-17	8oz jar	1	SO	7/21/01 0:00
A0243-18	8oz jar	1	SO	7/21/01 0:00
A0243-19	8oz jar	1	SO	7/21/01 0:00
A0243-20	8oz jar	1	SO	7/21/01 0:00
A0251-3	amber liter	1	WA	7/21/01 0:00
A0251-4	amber liter	1	WA	7/21/01 0:00
A0265-1	8oz jar	1	SO	7/21/01 0:00
A0265-2	8oz jar	1	SO	7/21/01 0:00
A0265-3	8oz jar	1	SO	7/21/01 0:00
A0265-4	8oz jar	1	SO	7/21/01 0:00
A0265-5	8oz jar	1	SO	7/21/01 0:00
A0265-6	8oz jar	1	SO	7/21/01 0:00
A0265-7	8oz jar	1	SO	7/21/01 0:00
A0265-8	8oz jar	1	SO	7/21/01 0:00
A0265-9	8oz jar	1	SO	7/21/01 0:00
B09P8-1	amber liter	1	WA	7/21/01 0:00
B09P8-2	amber liter	1	WA	7/21/01 0:00
B09P8-3	amber liter	1	WA	7/21/01 0:00
C0098-10	40ml vial	1	WA	7/21/01 0:00
C0098-11	40ml vial	1	WA	7/21/01 0:00
C0098-12	40ml vial	1	WA	7/21/01 0:00
C0098-13	40ml vial	1	WA	7/21/01 0:00
C0098-14	40ml vial	1	WA	7/21/01 0:00
C0098-15	40ml vial	1	WA	7/21/01 0:00
C0098-16	40ml vial	1	WA	7/21/01 0:00
C0098-17	40ml vial	1	WA	7/21/01 0:00
C0098-4	40ml vial	1	WA	7/21/01 0:00
C0098-5	40ml vial	1	WA	7/21/01 0:00
C0098-6	40ml vial	1	WA	7/21/01 0:00
C0098-7	40ml vial	1	WA	7/21/01 0:00
C0098-8	40ml vial	1	WA	7/21/01 0:00
C0098-9	40ml vial	1	WA	7/21/01 0:00
MC0GK7-1	8oz jar	1	WA	7/21/01 0:00
MC0GK7-1	plastic liter	1	WA	7/21/01 0:00
MF0DY2-3	8oz jar	1	WA	7/21/01 0:00
MF0DY2-3	plastic liter	1	WA	7/21/01 0:00
MF0DZ5-14	4oz jar		SO	7/21/01 0:00
MF0DZ5-14	8oz jar	1	SO	7/21/01 0:00
MF0DZ5-14	plastic liter	1	SO	7/21/01 0:00
MF0DZ5-15	4oz jar		SO	7/21/01 0:00
MF0DZ5-15	8oz jar	1	SO	7/21/01 0:00
MF0DZ5-15	plastic liter	1	SO	7/21/01 0:00
MF0DZ5-16	4oz jar		SO	7/21/01 0:00
MF0DZ5-16	8oz jar	1	SO	7/21/01 0:00
MF0DZ5-16	plastic liter	1	SO	7/21/01 0:00

Relinquished by coolers 1, 2A, 2B, 3, 4, 5 and ambient storage

Received by _____ Date 10/22 for disposal

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6.0 Reference Standard Preparation and Instrument Calibration

6.1 Standard Preparation and Storage

Reference standard solutions including those used for both sample preparation and instrument calibration are prepared by individuals within the various laboratory sections.

Standards are purchased as neat materials and concentrated solutions and are diluted to intermediate and working standards. The frequency of standard preparation varies with method requirements, stability and rate of consumption.

With the exception of organic CLP standards, standard preparations are verified with the analysis of initial calibration verification standards prepared using a different source or standard lot than that used to prepare the initial calibration.

Standard storage conditions vary depending on the method requirements and vender recommendations. Most of the standards used for organic analyses are stored at 2 to 4 °C to meet the state of North Carolina regulatory requirements. All standards used for volatile organic analyses are stored at –10 to –20°C. Standards used for inorganic analyses are stored at room temperature.

6.2 Analytical Support Equipment

Analytical support equipment includes balances, ovens, refrigerators, freezers, water baths, thermometers, and volumetric dispensing devices (such as Eppendorf®, or dilutor/dispensing devices, if quantitative results are dependent on their accuracy). All support equipment is maintained in proper working order. The records of all activities, including service calls, are retained.

Prior to use on each working day balances and ovens are checked with NIST traceable references in the expected range of use and documented. Acceptance criteria are documented in the applicable logbook.

The temperatures of cold storage units containing samples (including sample extracts and digestates) are monitored daily. Cold storage units containing reference standards are monitored on the lab's normal days of operation. Monitoring is documented in the applicable logbook.

Balances are calibrated semiannually by a qualified outside service organization over the entire range of use. Balance calibrations are verified each day of use with certified Class-S (NBS circular 547 or ASTM E617 Class 1 and 2) weights.

All thermometers are calibrated annually against a NIST-certified thermometer. The NIST-certified thermometer is calibrated annually at both the ice point and boiling point. The infrared (IR) gun is used to measure sample temperatures upon receipt and is calibrated quarterly.

Automatic pipettes are calibrated monthly by weighing three aliquots of water dispensed into a container and calculating the accuracy of the pipettes.

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If calibration criteria are not met, the equipment is removed from service until repaired or replaced.

6.3 Instrument Calibration

Instruments used in the analysis of samples must be calibrated at regular intervals as specified by the analytical test method and manufacturer's recommendations. The calibration procedures, frequency, acceptance criteria, corrective actions and reference standards are specified in the applicable analytical SOPs.

For mass spectral analysis, tuning is required prior to calibration. Instrument calibration procedures for organic analysis consist of an initial calibration, initial calibration verification, and continuing calibration verification.

Instrument calibration procedures for inorganic analysis consist of (a minimum of) an initial calibration, initial calibration verification, initial calibration verification blank, continuing calibration verification, and continuing calibration verification blank. Continuing calibration verification is performed at a minimum of every ten sample analyses.

Initial calibration verification standard solutions are prepared using reference materials from a source other than that used to prepare the initial calibration.

Information relative to instrument calibration is documented in instrument run logs. This information includes instrument identification, data file names, standard lot numbers, analysis dates, analysis times, analyst identification, and calibration status. (Analysis times are not included in all instrument run logs.)

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7.0 Test Methods and Standard Operating Procedures

CompuChem maintains Standard Operating Procedures (SOPs) that accurately reflect laboratory activities such as assessing data integrity, corrective actions, handling customer complaints, and all test methods. Procedures for test methods describing how the analyses are performed are specified in analytical SOPs and include sample preparation, cleanup and analysis. These are based on referenced methods published primarily by the EPA. Internally developed methods will be validated according to the EPA Performance-Based Measurement System, although none have been developed at this time. Method validation is discussed in Section 3.0. Controlled copies of SOPs are accessible to all personnel in each laboratory area as well as electronically on the company's intranet site. Each SOP indicates the effective date, revision number, and signatures of the person who initiates the revision and those who approve the revision.

SOPs are useful in training staff, in ensuring consistency among staff in performing procedures, and in saving time and effort. Any deviation from an established procedure is documented. The SOP collection is outlined in Table 7.1. A listing of methods performed at CompuChem and the corresponding SOPs is located in Section 2.0 of this manual.

7.1 SOPs for Test Methods

CompuChem's analytical procedures are divided into two categories, sample preparation procedures (SPPs) and instrument procedures (IPs). The Quality Assurance department controls SOP revision and distribution ensuring that only the most current approved procedures are documented and distributed for laboratory use. Documentation of procedures is critical to the assurance of data quality. These SOPs contain or reference to the following information:

- identification of the test method
- applicable matrix or matrices
- detection limit
- scope and application, including components to be analyzed
- summary of the method
- definitions
- interferences
- safety
- equipment and supplies
- reagents and standards
- sample preservation and storage
- quality control
- calibration and standardization
- procedure
- calculations
- method performance
- pollution prevention
- data assessment and acceptance criteria for quality control measures
- corrective actions for out-of-control data
- contingencies for handling out-of-control or unacceptable data
- waste management
- references
- tables, diagrams, and flowcharts,

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7.2 Distribution Control of Standard Operating Procedures

SOPs are distributed by location and each lab area receives its own set of SOPs applicable to the procedures performed in the area. The complete set of original SOPs is maintained in the Quality Assurance department. A master copy of the complete set resides on the intranet and is available to all personnel in a read-only electronic format.

7.3 Document Control of Standard Operating Procedures

The Quality Assurance department is responsible for formalizing (editing, assigning document control information), distributing, and tracking all SOPs.

7.3.1 Creating and Revising SOPs

When laboratory staff draft a new SOP or a revision to an existing SOP, the individual must sign a SOP Documentation Form (Figure 7-1) and obtain approval and the signature of the supervisor or a qualified second party. This form, along with a copy of the SOP, is submitted to the QA department. After the SOP has been word processed by QA and has had document control information added, it is then distributed to the area in which it is used. All appropriate lab personnel read the SOP and sign the SOP Confirmation Form (Figure 7-2). The date that the SOP is distributed for use becomes the effective date of the SOP. The original, master, and controlled copies are generated and distributed to the appropriate locations. The SOP Confirmation Form is archived by QA.

7.3.2 Archiving SOPs

When a procedure becomes obsolete, the request is made to remove it from the SOP collection. The SOP is removed from the active SOP table of contents to the Archival SOP table. The SOP is then removed from each collection. Archived SOPs are maintained indefinitely on hardcopy record.

7.3.3 SOPs as Training Tool

New analysts are required to read SOPs pertinent to their job functions as part of their training. A SOP Signature Form is completed and signed by the employee and his/her immediate supervisor/manager to document that the employee has read the SOPs pertinent to his/her job function. Supervisors document various training aspects using checklists and most include a list of the required SOPs.

7.4 Document Control of the Quality Manual

The Quality Manual is revised and edited solely by the QA department. Revision numbers are provided with each update, and each section may be updated independently of others. There are controlled copies of the Quality Manual available to all laboratory staff. Quality Manuals that are sent off-site are for informational purposes only and are not controlled documents unless requested by the client. In that event, the issue is assigned a tracking number and a copy of the Quality Manual is sent to the recipient with each revision. On an annual basis, the Quality Manual is distributed laboratory-wide for all staff to read. Signature sheets are maintained to document this review.

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7.5 Document Control of Laboratory Logbooks and Sample Preparation Worksheets

The QA department has primary responsibility for document and distribution control of over 100 logbooks used in the laboratory. To ensure document uniformity and compliance with NELAC standards, the U.S. EPA, good laboratory practices, and other certifying agency protocol, specific document control procedures are used for all laboratory logbooks and run logs.

Document control header information appears along the top of each logbook page and identifies the laboratory or administrative area, the logbook, and the issue number. Each logbook issue is consecutively paginated and permanently bound.

A logbook is developed cooperatively by the area manager and the QA department. The requestor submits a completed Logbook Request Form to the QA department. They confer to design a prototype logbook page that meets the needs of the laboratory and contains the key elements required by the QA department. These elements are:

- The identity of the task
- The name CompuChem, a Division of Liberty Analytical Corporation
- A "Reviewed by" signature field
- A date of review field
- Any applicable measurement acceptance ranges with instructions for reporting out-of-range readings
- A corrective action statement
- Model specifications for equipment
- Standard lot number fields

An alphanumeric identifier is assigned to each logbook. The laboratory notifies QA when the logbook is ready for archival. Before turning over the logbook issue to QA, the manager of the area in which the logbook is used or a designee must review the contents of the logbook and sign the Logbook Authorization form, which is the last bound page.

The laboratory staff must complete the logbooks with the proper quality details. Any changes made must not obliterate or overwrite the original entry. Personnel make a single strike through the entry and initial and date the correct entry that is made adjacent to the original. Correction tapes and fluids are not allowed when completing laboratory logbooks or other records.

When completed, the laboratory returns the logbook to QA for archival. The issue is then logged into the Logbook Archival Log and assigned to a unique box number. The logbook is then placed into the appropriate box for archival.

The QA department also maintains laboratory sample preparation worksheets which include the same elements as logbooks. Logbook pages are included as attachments in SOPs. These are not bound nor paginated for ease in photocopying for data reports. When completed the sample preparation staff return the worksheets to QA for archival.

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The worksheets are then paginated and logged into the Worksheet Archival Log. The worksheets are assigned to a unique box number. The worksheets are then placed into the appropriate box for archival.

7.6 Records Retention and Purging

Archived laboratory records are stored on site for a period of five years, or longer per client request. (Data retention is 10 years for the Ohio Voluntary Action Program.)

7.7 Method Modifications

7.7.1 Total Organic Carbon in Soil -- Method 9060

The water method is adapted for soil matrices. Soil samples are analyzed using a boat sampler attachment in which the samples are introduced into an 800°C combustion zone, where all carbonaceous matter is oxidized to carbon dioxide. The carbon dioxide level is then determined using the non-dispersive infrared analyzer.

7.7.2 Aqueous Metals Digestion – Method 3010A

The block digestion technique utilizing an aqueous 50 ml sample aliquot, adjusted to a final volume of 50 ml, is used in the preparation procedure.

7.7.3 pH – Method 150.1

The method states that samples "should be analyzed as soon as possible preferably in the field at the time of sampling." Since the sample pH is measured in the laboratory, the method holding time cannot be met.

7.7.4 Oil and Grease—Method 9071A

The solvent evaporation step has been eliminated for analyses by the partition-infrared method.

7.7.5 Total Petroleum Hydrocarbons—Method 9071A

The solvent evaporation step has been eliminated for analysis by the partition-infrared method. Silica gel adsorbent is added to remove interferences.

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Figure 7-1

501 Madison Avenue
Cary, NC 27513

NELAP accredited

SOP DOCUMENTATION FORM

This form must accompany all new and revised Standard Operating Procedures (SOPs) when you turn them in to Quality Assurance for review. Please fill out the entire block below (except effective date).

This is a new procedure _____ revised procedure _____ outdated procedure (archive) _____

- Procedure Code:_____ SOP Section #: _____ Revision #:_____

SOP Title: Effective date: (QA fills in)

_____ _____

_____

_____

- Procedure prepared by: Date:

_____ _____

- Procedure approved by: (If the manager prepared the SOP, a qualified second party should sign) Date:

_____ _____

- Reason for change:_____

_____

- This procedure meets the requirements of the following approved method references:

_____

_____

_____

Procedure approved by a QA Representative (unless QA Representative signed above):

_____ Date:_____

On an annual basis: Lab managers are required to review lab practices and revise the SOP if necessary. If no revision is necessary, indicate by your signature that the SOP has been reviewed.

Annual Review—Signature: _____ Date: _____

Annual Review—Signature: _____ Date: _____

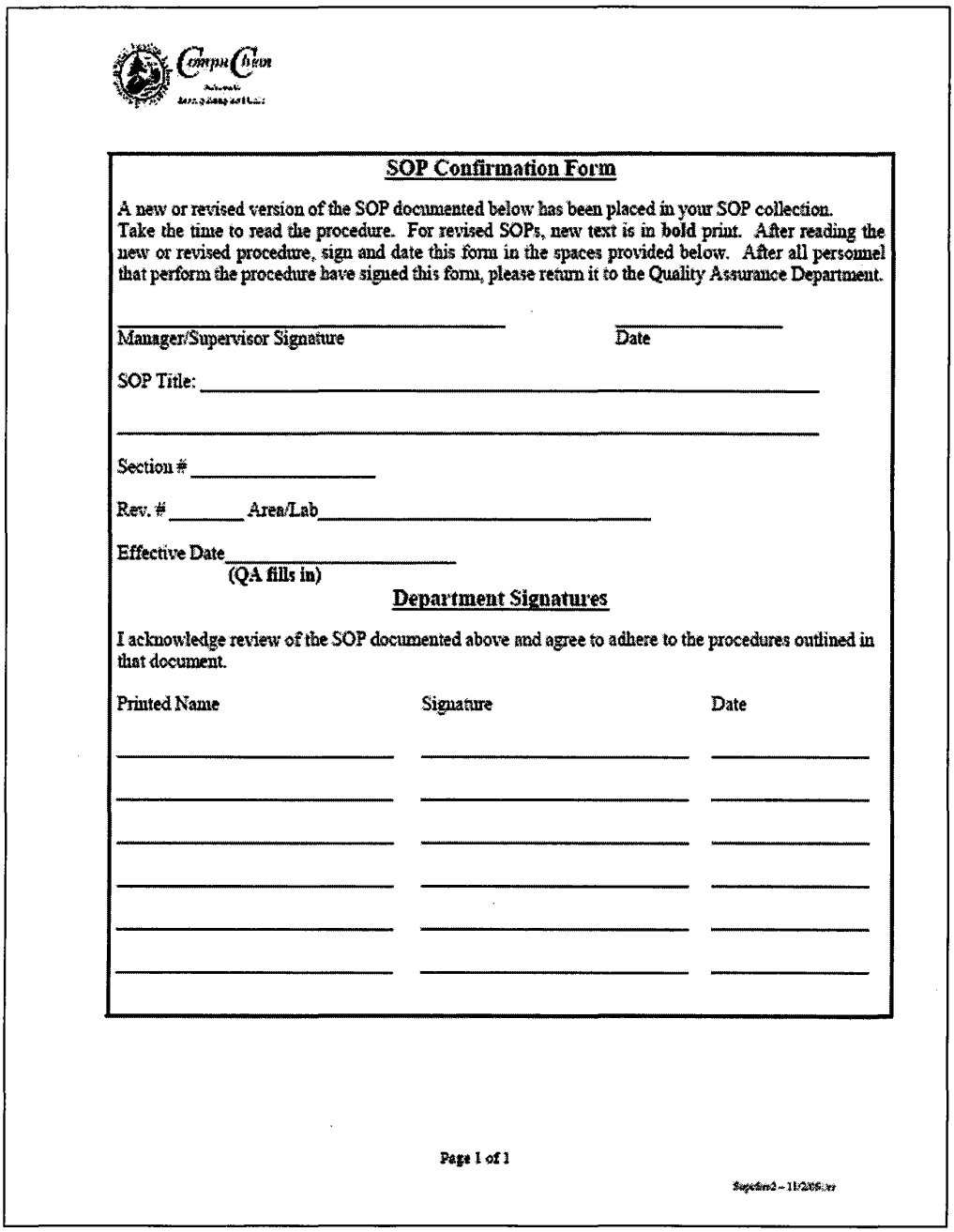
Annual Review—Signature: _____ Date: _____

Annual Review—Signature: _____ Date: _____

Sopdocform2-1/19/07: vr

R2-0002269

Figure 7-2



SOP Confirmation Form

A new or revised version of the SOP documented below has been placed in your SOP collection. Take the time to read the procedure. For revised SOPs, new text is in **bold** print. After reading the new or revised procedure, sign and date this form in the spaces provided below. After all personnel that perform the procedure have signed this form, please return it to the Quality Assurance Department.

_____ _____
Manager/Supervisor Signature Date

SOP Title: _____

_____

Section # _____

Rev. # _____ Area/Lab _____

Effective Date _____
(QA fills in)

Department Signatures

I acknowledge review of the SOP documented above and agree to adhere to the procedures outlined in that document.

Printed Name	Signature	Date

Page 1 of 1

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Table 7.1

SOP OUTLINE

ANALYTICAL STANDARD OPERATING PROCEDURES

1.0 Purgeable Organics
- 1.1 VOA GC
- 1.2 VOA GCMS CLP
- 1.3 VOA GCMS Non-CLP
- 1.4 VOA GCMS Miscellaneous

2.0 Extractable Organics
- 2.1 GC CLP
- 2.2 GC Non-CLP
- 2.3 HPLC
- 2.4 SV GCMS CLP
- 2.5 SV GCMS Non-CLP
- 2.6 Clean-up Procedures
- 2.7 Leachate Generation Procedures
- 2.8 Miscellaneous Preparation Procedures

3.0 Inorganics
- 3.1 Metals CLP
- 3.2 Metals Non-CLP
- 3.3 Mercury
- 3.4 Cyanide
- 3.5 Wet Chemistry
- 3.6 Organic Characterization

NON-ANALYTICAL STANDARD OPERATING PROCEDURES

4.0 Sample Control
5.0 Customer Services
6.0 Sample Scheduling
8.0 Organic Sample Preparation Laboratory
9.0 Inorganic Sample Preparation Laboratory
10.0 Glassware Preparation Room

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Table 7.1 (continued)

OUTLINE OF NON-ANALYTICAL STANDARD OPERATING PROCEDURES

11.0 Instrument Laboratories
- 11.1 Purgeable Organics
- 11.2 Extractable Organics
  - 11.2.1 GC
  - 11.2.2 SV GC/MS
- 11.3 Inorganics
  - 11.3.1 Metals
  - 11.3.2 Wet Chemistry & Organic Characterization

12.0 Hazardous Waste Management & Safety
13.0 Quality Control
14.0 Data Review
- 14.1 Purgeables
  - 14.1.1 VOA GC and GC/MS

14.2 Extractable Organics
- 14.2.1 GC
- 14.2.2 SV GCMS

14.3 Inorganics
- 14.3.1 Metals
- 14.3.2 Wet Chemistry & Organic Characterization

14.4 Data Release, Storage &Archival

15.0 Computer Operations
16.0 Human Resources
17.0 Quality Assurance

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8.0 Data Quality Indicators

The data acquired from quality control (QC) procedures are used to estimate the quality of the analytical data, determine the need for corrective action in response to identified deficiencies, and to assess the effectiveness of the corrective actions implemented. Each analytical SOP includes a QC section that documents the specific QC requirements for that procedure.

8.1 Quality Control Samples

8.1.1 Blanks

8.1.1.1 Method Blanks

Method blanks are prepared and analyzed at a rate of one per sample batch not to exceed 20 field samples, of the same matrix and test method. Method blanks are used to access the batch for possible contamination during sample processing. Samples associated with a blank that does not meet quality control acceptance criteria are re-prepared and analyzed.

8.1.1.2 Storage Blanks

Storage blanks are generated each day CLP SDGs are received for volatile analysis. These blanks are stored with each SDG and are analyzed after all samples in the SDG have been analyzed. The results of the storage blank indicate whether contamination occurred during sample storage. While storage blanks are required for CLP SDGs, they may also be associated with non-EPA client samples stored in the sample cold storage unit.

8.1.1.3 Trip Blanks

For volatile analyses, a blank is placed in each cooler that is delivered to the client for sample collection. The blank remains with the samples during transport to the lab for analysis. The results of the trip blank indicate whether contamination occurred during sample transport.

8.1.2 Laboratory Control Samples

A Laboratory Control Sample (LCS) is prepared and analyzed with each sample batch not to exceed 20 field samples. An LCS is not required for those analytes for which spiking solutions are not available such as pH. The LCS is used to assess whether the total analytical system is in control. The results of the LCS determine batch acceptance. Samples associated with an out of control LCS are re-prepared and analyzed.

8.1.3 Matrix Spikes

Matrix spikes are prepared and analyzed at the frequency required by the client, QAPP, or EPA region. **The compounds spiked should be specified in the**

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client QAPP or EPA CLP SOW. Matrix spikes are used to assess the effect the sample matrix has on the precision and accuracy of the test method. The results of the matrix spikes are expressed in percent recovery and relative percent difference between duplicate matrix spikes. The results of the matrix spikes do not determine the acceptance of the sample batch.

8.1.4 Sample Duplicates

Sample duplicates are prepared and analyzed at the frequency required by the client, QAPP, or EPA region. The sample duplicate is used to assess the precision of the test method. The results of the sample duplicate do not determine acceptance of the batch. Matrix spike duplicates may be used as sample duplicates.

8.2 Surrogates and DMCs

Surrogates and DMCs are added to all samples, standards, and blanks for all organic analyses. The surrogate recoveries are used to assess preparation/extraction efficiency. Surrogate percent recovery acceptance criteria used by the laboratory are presented in the test method or are derived statistically by the laboratory. Surrogate failures may indicate poor extraction efficiency or matrix interferences. Field and QC samples that do not meet surrogate acceptance criteria are reanalyzed or re-prepared and analyzed.

8.3 Internal Standards

Internal standard solutions are added to all calibration standards and field and QC samples for mass spectral analyses. Internal standards are used to quantitate results. The laboratory's acceptance criteria for internal standard responses are those specified in the applicable analytical method.

8.4 Spiking Solutions

The compositions of spiking solutions used vary according to method and client requirements. Typically the solutions will contain all compounds of interest in a project and that are commercially available. For some clients (EPA Region) a representative subset of compounds may be used. Spike percent recovery criteria are presented in the test method or are derived statistically by the laboratory.

8.5 Calibration Verification

Initial instrument calibration verification is performed using a reference standard solution acquired from a second manufacturer or lot than the solution used for the initial calibration. Initial calibration verification is required for inorganic methods and organic non-CLP methods. The initial calibration verification (ICV) standard is analyzed after the initial calibration and generally before any samples are analyzed.

When an initial calibration is not performed on the day of sample analysis, the initial calibration is verified by the analysis of the continuing calibration verification (CCV)

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standard. If the solution used for the CCV standard is from a second manufacturer or lot, analysis of an ICV is not required.

8.6 Selectivity

Selectivity is evaluated by using the checks established within the analytical methods.

GC/MS and ICP-MS instrumentation is tuned to meet method requirements and these acceptance criteria are documented in SOPs.

Retention time window are established for GC analyses and second column confirmation is performed. Acceptance criteria for retention time windows are documented in SOPs.

Inter-element interference checks are analyzed for ICP and ICP-MS methods. Acceptance criteria are documented in SOP.

8.7 Quality Control Sample Management

The analytical and quality control requirements for each sample are documented in the LIMS. The LIMS uses a system of test codes to schedule the appropriate analytical procedures and the QC samples required for each work-order or sample delivery group (SDG). The test codes have the analytical methods associated with them and are assigned to each sample upon receipt. Product codes may be defined to allow for specific requirements of a client or Quality Assurance Project Plan (QAPP). Unique project requirements may also be documented in a project profile sheet.

8.7.1 Batching

8.7.1.1 Preparation Batch

A preparation batch is a group of no more than 20 field samples prepared (extracted or digested) together with a method blank. A Laboratory Control Sample (LCS) is also required for non-CLP samples.

8.7.1.2 Analytical Batch

An analytical batch is a group of no more to 20 samples, sample extracts, or sample digestates (including QC samples) that are analyzed together on the same instrument. For analyses that have no preparation step (volatiles), the method blank, LCS, matrix spike and matrix spike duplicate are included in the 20 samples.

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9.0 Data Reduction, Review and Reporting

Computer software used for data reduction is validated before use. A test set of data, with manually calculated or previously validated results, is used to validate the new or revised software routine. Procedures for software validation are documented in SOPs. All data used in producing the final report are retained either as a hard copy or electronic file to insure that all results can be reproduced. These data include all instrument tune files, calibration files, sample files, QC sample files, standard preparation records, and sample preparation records. The following is a summary of the data review process. The analyst review responsibilities may vary slightly between the individual laboratory groups.

9.1 Data Review for Organic Analyses

Data collected by GC, GC/MS, and HPLC instrumentation software are transferred to Hewlett Packard UNIX servers for processing and review. The data is accessed by analysts and data reviewers through their personal intranet log-on.

All data are subjected to a three-tier review before being reported to the client.

The analyst documents all analyses on the instrument run log. The analyst insures that all tune, calibration, method blank, QC sample and field sample data met acceptance criteria. The analyst prints hard copies of the tune and calibration data generated by the instrument. The analyst signs (initials) and dates any manual integration he or she performed.

The data reviewer insures that all weights, volumes, and percent moistures are transcribed accurately into the raw data for calculation purposes. The data reviewer insures that the proper preparation and analysis methods have been used and that all the compounds of interest have been included in the analysis. The data reviewer insures that all tune, calibration, method blank, QC sample and field sample data met acceptance criteria. The data reviewer assesses the spectra of target and tentatively identified compounds. The data reviewer prints hard copies for all method blanks, QC samples and field samples included in the work-order/SDG. The data reviewer signs (initials) and dates the hard copy reports as well as any manual integration he or she performed.

Manual integrations are performed according to the procedures outlined in SOP 13.18 "Manual Chromatographic Peak Integration Procedures".

A senior level staff member or a supervisor performs the final review. The final reviewer insures that all weights, volumes, and percent moistures are transcribed accurately into the raw data for calculation purposes. The final reviewer prints hard copies of all report forms and generates any electronic data deliverable (EDD). The final reviewer summarizes the data in the work-order/SDG narrative documenting any anomalies in sample collection, receipt and analysis.

To meet the requirements of the Ohio VAP, the final reviewer must review all data files containing manual integrations.

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9.2 Data Review for Inorganic Analyses

Metals data collected on the ICP and ICP-MS instrumentation software are transferred to the Metals Analytical Review and Reporting System (MARRS) for review and reporting. Wet Chemistry data collected on the Lachat instruments are transferred to LIMS for review and reporting. Wet Chemistry data not collected on the Lachat are manually entered into Excel spreadsheets by the analyst. The information entered into these spreadsheets is transferred to LIMS for reporting.

Data for inorganic parameters is subjected to a two-tier review before being reported to the client.

The analyst documents all analyses on the instrument run log. The analyst insures that all weights, volumes, and percent solids are transcribed accurately into the raw data for calculation purposes. The analyst insures that all calibration, method blank, QC sample and field sample acceptance criteria are met. The analyst insures that all raw data transcribed into spreadsheet is accurate.

A senior level staff member or a supervisor performs the final review. The final reviewer insures that all weights, volumes, and percent solids are transcribed accurately into the raw data for calculation purposes. The final reviewer insures that all calibration, method blank, QC sample and field sample acceptance criteria are met. The final reviewer prints all reporting forms and generates the EDD. The final reviewer summarizes the data in the work-order/SDG narrative documenting any anomalies in sample collection, receipt and analysis.

9.3 Data Reporting

It is CompuChem's policy to report data that meet all quality control criteria, to the extent possible. If deficiencies are identified at any point in the review process, corrective action is taken. Documentation of any corrective action or data qualification is done by the final reviewer in the narrative.

Each fraction is reviewed separately and the individual reports that make up the final report are produced. The final report is scanned, paginated, saved in a portable document format (pdf), printed and the pdf archived. The printed final report is sent to the client.

The final report format and detail are tailored to the specific client needs.

Figure 9-1 shows how data flows through the laboratory from sample receipt to final report.

9.4 Confidentiality

Results of sample analyses and associated raw data are reported to the customer who requested the analyses. Confidentiality is preserved to the extent possible when clients require transmission of test results via telephone, fax, and electronic mail.

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A version of the following statement accompanies out-going fax and electronic mail correspondence:

> "This e-mail and any information contained or attached to this e-mail are privileged, confidential and proprietary information intended only/solely for the individual or entity to which it is addressed. It is a PRIVATE e-mail message and the sender does not waive any related rights and obligations. Kindly notify the sender immediately by e-mail if you have received this e-mail in error. You are notified that disclosing, copying, distributing or taking any action in reliance on contents of the information is strictly prohibited."

Access to data reports and other laboratory records is available to external auditors (representatives of accrediting bodies and agencies) during on-site assessment. Data reports and other laboratory records are provided upon request to auditors off-site to support the laboratory's certifications.

9.5 Data Security

The Computer Operations department assures the security of the computer systems by assigning log-on accounts and individual passwords for individuals to access data. The user is restricted to certain menu options through the log-on account, and only authorized staff has access to editing capabilities. A software product controls menus and uses local attributes consisting of specific options available to authorized users. These attributes are created and maintained by the computer operations staff. Access levels vary and depend on the user job functions. Log-on passwords are required to be changed every six months. Workstations are set up to lock after 10 minutes of inactivity.

The data servers located in the Computer Operations department are linked to an Uninterruptible Power Supply (UPS). All data saved on the data servers and personal computers are backed up at varying frequencies. The HP UNIX servers are backed up incrementally on a nightly basis and fully once each week. Personal computers are backed up on weekends. Archiving procedures are performed in compliance with Computer Operations SOPs. The archive storage media are stored in a restricted area within the facility, secured by locked doors, with limited access. Access is allowed only by means of an electronic security access key. The storage area is air-conditioned and kept free of debris. An additional copy of the archive storage media is maintained off-site.

9.6 Hard Copy Data Retention

The laboratory scans the hard copy data, paginates it, and sends it to the client. Only the scanned copy is retained on database at the laboratory, unless the client requires otherwise. If the client requires that a hard copy of the final report and associated data be retained by the laboratory, the data are boxed and placed in a secure room within the facility. The laboratory retains the data for 5 years or as specified by the client.

9.7 Electronic Data Retention

Archived data are stored for a minimum of five years, except for EPA who requires one year. Additional storage time may also be requested by the client for certain projects or required under certain programs such as the Ohio Voluntary Action Program (VAP) which requires a data retention time of at least 10 years. It is the responsibility of the

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laboratory project manager to oversee the extended retention of project files. The auxiliary data field in the LIMS is able to record data retention time requirements for each client and to assist in tracking extended retention times. For the Ohio VAP, the laboratory must notify the agency by certified mail when the 10-year retention period has expired and retain the data until directed in writing by the agency whether they will or will not retain the data.

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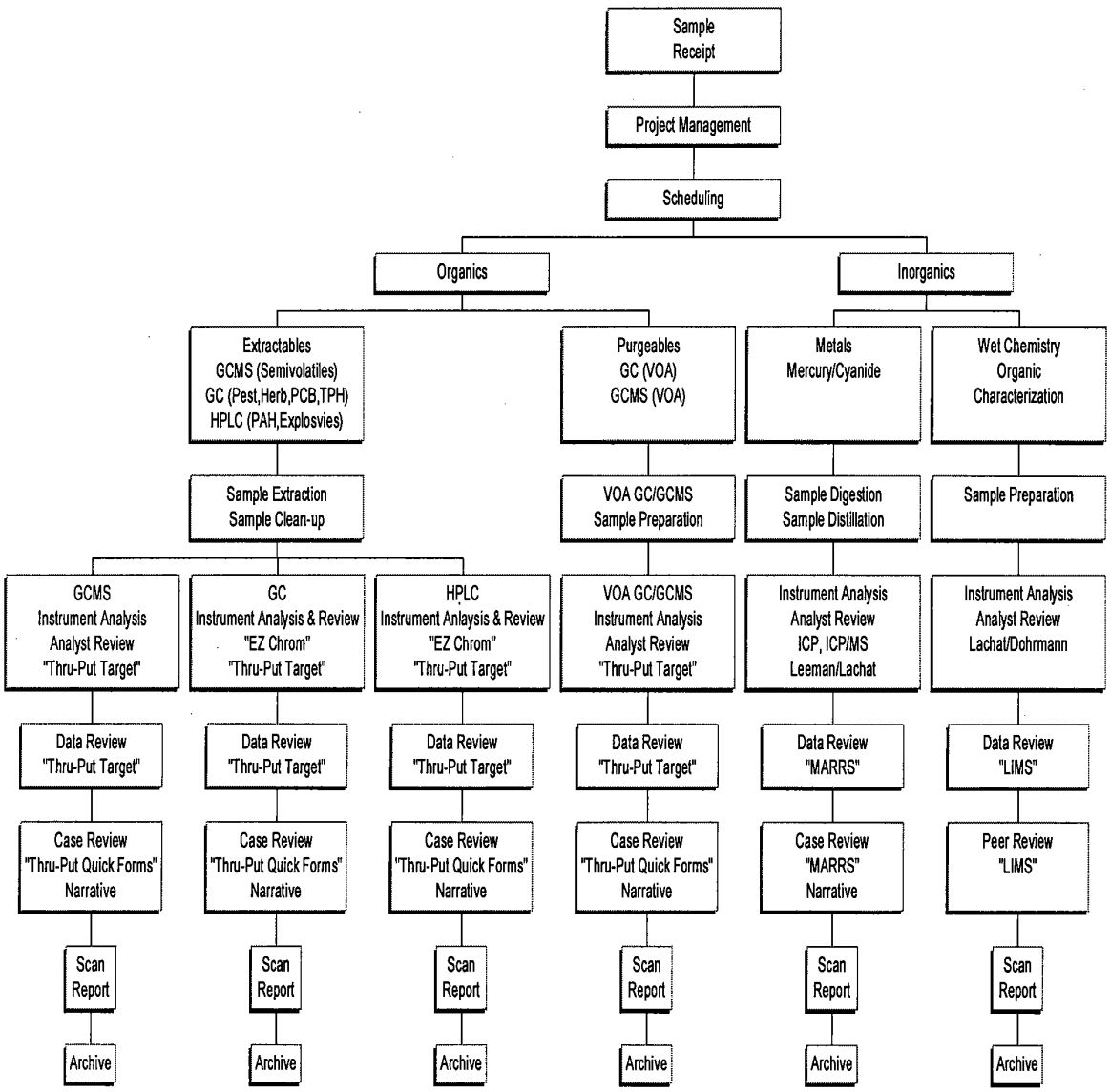
Figure 9-1 Sample Data Flow Chart



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10.0 Performance and System Audits and Frequency

10.1 Quality Assurance Audit Unit

The QA department staff consists of senior scientists with Bachelor of Science or Bachelor of Arts degrees in chemistry, ten or more years of environmental analytical laboratory experience, and at least five years of experience using laboratory QA/QC techniques.

The QA Manager, and Vice President **and General Manager** conduct internal system audits. The auditor applies specific audit methods, evaluates audit findings, and reports these findings to laboratory management.

10.2 Systems Audits

A systems audit is an on-site inspection or self-assessment of the laboratory's control systems. System audits are performed both by internal and external auditors. Clients and federal and state certifying agencies perform external system audits. A system audit is performed to qualitatively assess the laboratory's control systems and is intended to provide evidence of the laboratory's competence.

The objectives of a systems audit include ensuring that:

- management is committed to creating a work environment dedicated to quality and that a structured management system is in place to support an effective QA program,
- the QA program is documented and implemented to assess work to ensure technical, administrative, and quality objectives **are met**,
- personnel are adequately trained and qualified to do their jobs,
- procured items and services meet established requirements and perform adequately,
- procedures are established and maintained for the preparation, **review, revision, and** issuance of **laboratory documents**, including **SOPs, logbooks, and data reports**
- **records are retained** for evidentiary purposes,
- computer hardware **is maintained to support data processing and reporting software**
- **computer software is developed, documented, validated and** any changes are controlled **and documented**
- work performed complies with established **documented procedures** as well as safety policies, and
- procedures are established for detecting and preventing quality problems and for ensuring quality improvement.

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10.2.1 Internal Systems Audits

Internal systems audits are used to verify that laboratory operations continue to comply with the requirements of the quality system. Systems audits include a review of laboratory documentation on sample receiving, sample log-in, sample storage, chain-of-custody procedures, sample preparation, sample analysis, instrument operating records, etc. While performance audits are a quantitative appraisal, system audits are more qualitative in nature, intended to provide evidence of the laboratory's competence.

Upon completion of an internal system audit, the auditor discusses his or her findings with the responsible manager or supervisor. The auditor summarizes his or her findings in an audit report that is distributed to laboratory management. A Corrective Action Report (CAR) is issued for each finding. The responsible manager corrects the deficiency, documents the correction in the CAR, and returns the completed CAR to the auditor. Completed CARs are retained in the QA department. Implementation of the documented corrective actions is verified by subsequent follow-up audits. If an audit finding were to cast doubt on the correctness or validity of the laboratory's results, an immediate corrective action would be initiated and any client whose work may have been affected would be notified.

A full **internal** systems audit **is** performed annually. The following components comprise a complete system audit. **Below is a summary of the** audit activities performed by QA staff. **Figures 10-1 through 10-5 are example checklists used to document these activities.**

10.2.1.1 **Documentation and Record Keeping** -- **Review** logbooks **that document refrigerator temperature, instrument analysis, balance calibration, and standard preparation. Verify that records are complete, that documented observations are current, that any errors are corrected properly,** and **that** completed **pages and logbooks were peer reviewed as evidenced by a** review **signature.**

10.2.1.2 **Sample storage/Chain of Custody – Review temperature logs for refrigerators that store samples and sample extracts** Verify that samples are stored and controlled properly **and**, that COC procedures are followed through documented transfers.

10.2.1.3 **SOP compliance – Observe a procedure being performed by an analyst to** verify that **the** procedure **being performed** follows **the** written SOP. Also verify that **the** written SOP **is** compliant with the referenced methods.

10.2.1.4 **Reagent (solvent and chemical) storage and control – Observe and verify the proper storage conditions of reagents and solvents. Verify that proper control documentation is written on the container label such as the receipt date and expiration date.**

10 2.1.5 **Standard storage and control -- Observe and verify the proper storage conditions of reference standards. Verify that**

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proper control documentation is written on the container label such as the standard lot number and expiration date. Review standard logbooks to verify that standard preparations are properly documented and traceable to primary standards. Also verifies that standards are traceable to NIST sources.

10.2.2 QC test sample analyses – Review of data associated with the analysis of new solvent lots.

10.2.3 Data audits – QA staff routinely audit all data associated with the analyses of proficiency test samples. EPA CLP data are reviewed routinely by the Vice President and General Manager as a result of EPA CCS reports. During these audits, QA staff verify **the data for** accuracy, completeness, **and test method** and **program compliance**. Software data reduction routines are verified during data audits by performing manual calculations **or by reviewing the calculation verification provided with the data report**. Hardcopy to diskette results may be compared in the course of a data audit **but are typically verified by automated software routines**.

10.2.4 ThruPut systems Audit Trail —The audit trail in ThruPut systems is checked **annually** to verify changes to the processed files are **correct,** documented, allowed, and performed by authorized individuals.

10.2.5 Corrective Action Report (CAR) follow-up -- Verifies that corrective actions have taken place, are still in effect, and that recurrence is controlled.

10.2.6 Facilities maintenance -- Verifies that facilities and equipment are adequate and properly maintained and that laboratory areas are free from interference or contaminants.

10.2.7 Subcontract laboratory audits -- In lieu of on-site audits, a paper audit may be performed involving a review of the quality assurance plan, SOPs, data reports, and PE study results. On-site audits can be performed upon client request, but no routine audit is performed by our lab.

10.2.8 Employee training file audit-- Verifies that training records are current and that personnel meet the requirements stated in the current USEPA CLP SOW as well as those specified by individual states.

10.2.9 External Systems Audits

CompuChem's systems are also inspected extensively by external agencies, contractors, and third parties. The laboratory's primary NELAC accrediting authority conducts an assessment of the laboratory every two years. Most of the state certification programs specify that on-site inspections are to be conducted annually. As a laboratory in the USEPA CLP, CompuChem is audited annually by representatives of the EPA. Many clients conduct inspections or hire third party QA auditors to inspect the laboratory before start-up and during the course of larger, more critical, or sensitive projects.

CompuChem prefers a two-week notification before a scheduled audit to ensure that management and QA staff are available. However, an external audit may be conducted (announced or unannounced) at any time during normal business

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hours. To protect client confidentiality, some documents (particularly those identifying clients, sites, or projects) will not be made available for inspection except to those directly involved in such projects or authorized state or federal officials or authorized third parties.

Any deficiencies or non-conformances observed by the auditors are included in an audit report. Corrective action reports are initiated as needed in response to the audit findings. Once the corrective action responses are completed, a formal response is compiled by a QA staff member and submitted to the external agency by the required due date. Copies of the response are circulated to laboratory management. Follow-ups are performed to ensure implementation of stated corrective actions.

10.3 Performance Evaluation Samples

Laboratory performance is evaluated using proficiency test (performance evaluation) samples.

CompuChem analyzes water pollution (WP) and solid matrix (SM) proficiency test (PT) samples semiannually in support of its NELAC accreditation. The laboratory analyzes WP samples semiannually in support of its accreditation with the Ohio Voluntary Action Program. The laboratory analyzes single blind performance evaluation (PE) samples quarterly in support of its participation **in** the **EPA's** contract laboratory program.

As part of its data audit function, the QA department audits all PT sample data before results are submitted. PT and PE sample results are summarized in memoranda that are distributed to laboratory management.

10.4 Management Review

The results of the annual internal systems audit performed by the QA staff are reported to the laboratory management. Corrective action reports are distributed to the managers documenting any deficiencies. Corrective actions for these deficiencies are documented on the reports and returned to the QA department.

The QA Manager reports on activities done in support and development of the laboratory's quality system in writing on a monthly basis to the **Vice President and General Manager**.

The **Vice President and General Manager also writes a report on activities done in support of the laboratory's quality system and** discusses quality system **issues with senior management during** staff meetings.

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Figure 10-1

SYSTEM AUDIT CHECKLIST

Sample Storage/Chain of Custody

Auditor_____Date_____Department_____

1. Are refrigerators well organized?	Yes	No
2. Is ID Label on door?		
3. Is there a corrective action SOP posted on the door? (OLC03.2 and SOM01.1)	Yes	No
4. Is temperature range posted?	Yes	No
5. Is corrective action stated in logbook?	Yes	No
6. Are temperatures within range?	Yes	No
7. Are standards and samples separated?	Yes	No
8. Are logbook errors corrected properly?	Yes	No
9. Has the supervisor reviewed and signed off?	Yes	No
10. Are logbooks completed to the point of inspection?	Yes	No
11. Are samples under proper chain of custody?	Yes	No
12. Is chain of custody record completed?	Yes	No
13. Are samples left out of refrigeration more than 2 hrs since receipt?	Yes	No

Comments:

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____
12. _____

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Figure 10-2

DOCUMENTATION AND RECORD KEEPING AUDIT FORM

Auditor_____ Date_____ Laboratory_____

Logbook Title	Logbook ID No.	Documentation complete?	Cross-outs/ Overwrites Initialed & Dated Yes/No	Page z'd-out? Yes/No	Supervisor sign-off? Yes/No	Comments

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Figure 10-3

SYSTEM AUDIT CHECKLIST

SOP Compliance

Auditor_____Date_____Department_____
SOP Title:_____
Instrument Procedure No._____ or Sample Preparation Procedure No. _____

1. Is the procedure performed according to the SOP?	Yes	No
2. Is the SOP compliant with referenced methods?	Yes	No
3. Does the SOP require revision?	Yes	No
4. Is corrective action necessary?	Yes	No
5. Is there documentation of training for this chemist and procedure?	Yes	No

Comments

1. _____
2. _____
3. _____
4. _____
5. _____

Corrective Action Follow-up

1. _____
2. _____
3. _____
4. _____
5. _____

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Figure 10-4

SYSTEM AUDIT CHECKLIST

Standard Storage and Control

Auditor_____Date_____Department_____

1. Is the standards refrigerator/freezer well organized?	Yes	No
2. Is ID Label on door?	Yes	No
3. Is there a corrective action SOP posted on the door? (OLC03.2 and SOM01.1)	Yes	No
4. Is temperature range posted?	Yes	No
5. Is corrective action stated in logbook?	Yes	No
6. Are temperatures within range?	Yes	No
7. Are standards and samples separated?	Yes	No
8. Are logbook errors corrected properly?	Yes	No
9. Has the supervisor reviewed and signed off?	Yes	No
10. Are logbooks completed to the point of inspection?	Yes	No
11.Are shelves or racks clearly labeled and are active standards segregated from expired/unapproved/special standards?	Yes	No
12. Are standards left out of refrigeration more than 2 hrs?	Yes	No

List below standard lot numbers currently in use for traceability to the standards preparation logbooks.

Standard ID _____ Lot Number _____ Expiration date _____
Standard ID _____ Lot Number _____ Expiration date _____
Standard ID _____ Lot Number _____ Expiration date _____
Standard ID _____ Lot Number _____ Expiration date _____
Standard ID _____ Lot Number _____ Expiration date _____

List below any standard Ids and lot numbers of expired standards, is any, stored with current standards.

Standard ID _____ Lot Number _____ Expiration date _____
Standard ID _____ Lot Number _____ Expiration date _____
Standard ID _____ Lot Number _____ Expiration date _____
Standard ID _____ Lot Number _____ Expiration date _____
Standard ID _____ Lot Number _____ Expiration date _____

Comments

1. _____
2. _____

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Figure 10-5

SYSTEM AUDIT CHECKLIST

Reagent (Solvent and Chemical) Storage and Control

Auditor_____Date_____Department_____

1. Are chemicals stored properly (ether in flammables cabinet, etc.)?	Yes	No
2. Are bottles labeled with date received, opened, and initials?	Yes	No
3. Are expiration dates determined (i.e. 3 yr. from receipt or manufacturer recommendation)?	Yes	No
4. Are any beyond the expiration period?	Yes	No
5. Are materials logged into the materials receipt log (inorganics)?	Yes	No
6. Are materials traceable to the receipt log (inorganics)?	Yes	No
7. Are all bottles labeled with the identity of the contents?	Yes	No
8. Are reagents being made at the required frequency?	Yes	No
9. Is proper safety equipment worn when handling reagents?	Yes	No
10. Is the area clean of debris or spills?	Yes	No

List below reagent lot numbers currently found to be in use.

Reagent ID _____ Lot Number _____ Expiration date _____
Reagent ID _____ Lot Number _____ Expiration date _____
Reagent ID _____ Lot Number _____ Expiration date _____
Reagent ID _____ Lot Number _____ Expiration date _____
Reagent ID _____ Lot Number _____ Expiration date _____

List below any expired reagents, or those stored or labeled improperly.

Reagent ID _____
Reagent ID _____
Reagent ID _____
Reagent ID _____
Reagent ID _____

Comments

1. _____
2. _____
3. _____

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11.0 Facilities, Equipment, Security, Safety and Waste Management

11.1 Facilities, Security, and Safety

CompuChem is located in Cary, North Carolina on an eleven-acre site. The laboratory facility has over 30,000 square feet of office and laboratory space (Figure 11.1). An adjacent 1000 square foot concrete block storage building is used for waste containment. This building is vented and has a four-inch concrete berm designed to contain at least a 10% capacity spill.

Laboratory areas are separated as outlined below. A comprehensive instrument and support equipment list is found in Tables 11.1 to 11.7.

11.1.1 Sample Receiving Area

Located in the sample receiving area is a large walk-in refrigerator and several reach-in refrigerators for sample storage, an ambient storage unit for sample storage, and fume hooded bench space is used to unpack and inventory samples received for analysis.

11.1.2 Sample Preparation Laboratory

The sample preparation laboratory houses both organic and inorganic sample preparation areas. Fume hoods separate the two areas. A Liebert air handling system conditions the air by heating, cooling, filtering, humidifying and de-humidifying as needed. The room is maintained under a negative pressure to isolate any solvent vapors from the analytical laboratories.

11.1.3 Semivolatile Analytical Laboratory

The semivolatile analytical laboratory houses the GC and GC/MS instrumentation used to analyze sample extracts for semivolatile, pesticide, herbicide, polychlorinated biphenyl, and diesel range organic compounds. A Liebert air handling system conditions the air by heating, cooling, filtering, humidifying and de-humidifying as needed.

11.1.4 High Performance Liquid Chromatography Laboratory (HPLC)

The HPLC laboratory houses the HPLC instrumentation used to analyze sample extracts for polycyclic aromatic hydrocarbons and explosives. A Comfort Maker air conditioning unit cools the space.

11.1.5 Volatile Analytical Laboratory

The volatile analytical laboratory houses the GC and GC/MS instrumentation used to analyze samples for volatile organics and gasoline range organics. A Liebert air handling system conditions the air by heating, cooling, filtering, humidifying and de-humidifying as needed. In an effort to eliminate cross-contamination, the Liebert is equipped with carbon filters and the laboratory is under positive air pressure.

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11.1.6 Organic Standards Laboratory

Located in the organic standards laboratory are reach-in refrigerators and freezers used for standard storage. A Mettler analytical balance is used to weigh neat materials. A NIST-traceable thermometer is used for laboratory thermometer and IR gun calibrations.

11.1.7 Inorganic Analytical Laboratories

The inorganic analytical laboratories house ICP, ICP-MS, cold vapor, ion chromatograph and spectrophotometric instrumentation used to analyze sample digestates for trace metals, cyanide, minerals, nutrients, and anions. A Lennox air handling system conditions the air in the ICP lab by heating, cooling, filtering, humidifying and de-humidifying as needed.

11.1.8 Preventive and Routine Maintenance of Analytical Instrumentation and Support Equipment

The laboratory has an analytical instrument specialist on-site. He performs **preventive and/or** major maintenance (e.g. **replacement of turbo pump oil or** replacement of circuit boards) on the laboratory's analytical instrumentation except the ICPs and ICP-MS. The ICP and ICP-MS instruments have outside service contracts. Routine instrument maintenance (e.g. replacement of injector liners and septa) is preformed by the analyst. **Procedures for routine instrument maintenance are detailed in the SOPs for the particular analytical method and in the manufacturers instrument mauals.**

Analytical support equipment such as balances, ovens, and refrigerators are monitored by the analysts using NIST-traceable reference **materials**. Qualified outside servicepersons calibrate each balance on-site semiannually. **The NIST-traceable reference thermometer and weights are calibrated annually by the North Carolina Department of Agriculture and Consumer Services Standards Division.**

Any analytical instrument that cannot be successfully calibrated before the next work shift must be identified as out of service. The failed calibration is documented in the instrument run log. If the instrument cannot be returned to service after maintenance by the analyst, instrument specialist, or outside service person, a sign indicating the instrument is out of service is affixed to the instrument.

If analytical support equipment cannot be calibrated or is not operating within the required temperature range, a sign indicating it is out of service is affixed to it until it is repaired or replaced.

11.1.9 Documentation

The QA department issues bound and paginated log books to the laboratory areas. These log books include run logs, maintenance logs, temperature logs, standard preparation logs, and balance calibration logs. The analysts make

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entries in to these logs and return the completed logs to the QA department for archival.

11.2 Facilities Maintenance and Security

The facility is maintained under the direction of the Manager, Purchasing, Administration, and Facilities. Preventive maintenance, repair and/or replacement of facility environmental systems such as heating and cooling units are accomplished by maintenance personnel and outside contractors under his supervision. Plans for facility renovations and improvements developed by laboratory management and staff are coordinated and implemented under his supervision.

The facility is secured by locked doors accessed by electronic and manual keys. An electronic security system monitors access. A chain link fence surrounds the entire acreage. The fence is equipped with two gates secured by pad locks during non-business hours. Only authorized personnel have unsupervised access to the facility.

11.3 Safety

Laboratory personnel wear protective eyewear, lab coats, and gloves while handling samples. Emergency showers are located in the sample preparation laboratory. Eye wash stations and fire extinguishers are located throughout the facility. The safety committee performs monthly safety inspections and reports observations to management. A list of safety equipment is presented in table 11.8.

11.4 Contingency

Carolina Power and Light (CP&L) supplies electrical service to CompuChem. The laboratory also maintains an uninterruptible power supply (UPS), that powers computers, instruments, and hoods for approximately two hours in case of a temporary power outage. The laboratory has at its disposal a refrigerated tractor trailer for maintaining samples at the required storage temperature. Dry ice would be used to maintain freezer temperatures.

Qualified subcontracting laboratories are available to perform analyses on short notice in emergencies. In such a case, CompuChem notifies clients and gains approval before allowing a subcontractor laboratory to perform analyses.

11.5 Reagent Storage Control, Documentation and Labeling

The receipt date, open date, expiration date, and the initials of the person recording the information are placed on reagent bottle labels after receipt by the laboratory. If the vendor does not supply an expiration date, a period of three years from date of receipt is used. Table 11-9 summarizes the reagents present at the laboratory and under what conditions they are stored. Before a solvent lot is purchased, it is analyzed and approved by the laboratory. Once the lot is approved, the **vendor** supplies the laboratory with reagents until that lot is depleted.

In methods where the purity of reagents is not specified, analytical grade is used. Reagents of lesser purity than those specified by the method are not used. Reagent container labels are checked to verify that the purity meets the requirements of the

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particular method. Reagent lot numbers are documented on preparation sheets and instrument run logs.

11.6 Hazardous Waste

Waste handling and disposal procedures are carried out in compliance with CompuChem's waste disposal SOP. This SOP includes procedures for training of personnel, identification, segregation, storage, and details of disposal procedures. Disposal of samples, sample digestates, and sample extracts is detailed in sample control SOPs. Waste disposal is performed in compliance with all applicable local, state, and federal regulations. A licensed hazardous waste contractor handles all recycling and arrangements for final disposal. (See Table 11-10.)

CompuChem is subject to yearly RCRA inspections by the State of North Carolina Hazardous Waste Section. CompuChem is a large quantity waste generator (in excess of 1000 kg per month) and must comply with all applicable parts of the following regulations:

- Resource Conservation and Recovery Act (RCRA)(40 CFR 261-271)
- Occupational Safety and Health Administration (OSHA)(29 CFR 1910.120 and 1910.1200)
- Hazardous Material Transportation Act (HMTA)(49 CFR 171-180: HM-181 and HM126F)
- Clean Water Act (CWA)(40 CFR 403.5)
- Superfund Amendments Reauthorization Act (SARA)(40 CFR 355, 370)
- NC Hazardous Waste Rules(15A NCAC 13A)

CompuChem pursues waste minimization efforts and makes every effort to recycle the materials and chemicals that are well suited for this purpose. After analysis and following a 90 day holding period, all residual solid and aqueous samples are disposed of as hazardous waste. Wastes are segregated into various waste streams which fall under RCRA codes F001, F002, F003, F005, D001, and D018. Table 11.10 represents general waste disposal procedures.

Any additional wastes not listed above are evaluated by the hazardous waste technician, safety officer, and/or contracted disposal company to determine the appropriate means of disposal.

Each satellite accumulation container must have a hazardous waste label. Shipment containers must be labeled according to HM-181 and must include the generator's name and address, EPA ID number, manifest document number, accumulation start date, and EPA waste number. All hazardous waste shipments are accompanied by a North Carolina Hazardous Waste Manifest. One copy of the manifest is kept on file at CompuChem at the time of shipment by the hazardous waste technician. Additional copies accompany the waste to the hazardous waste contractor. After disposing of the waste, the contractor returns a signed copy of the manifest to CompuChem verifying disposal. These final copies of the manifests are kept on file by the hazardous waste technician. Logbooks are maintained for daily inspections of the outside 90-day waste storage building and manifest tracking and are located inside the waste storage area. To prevent any improper disposal, the licensed hazardous waste contractors perform additional testing on the contents of the shipment containers before disposal.

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Figure 11-1 Laboratory Floor Plan

CompuChem
a division of Liberty Analytical Corporation

Fire and Emergency Evacuation Routes

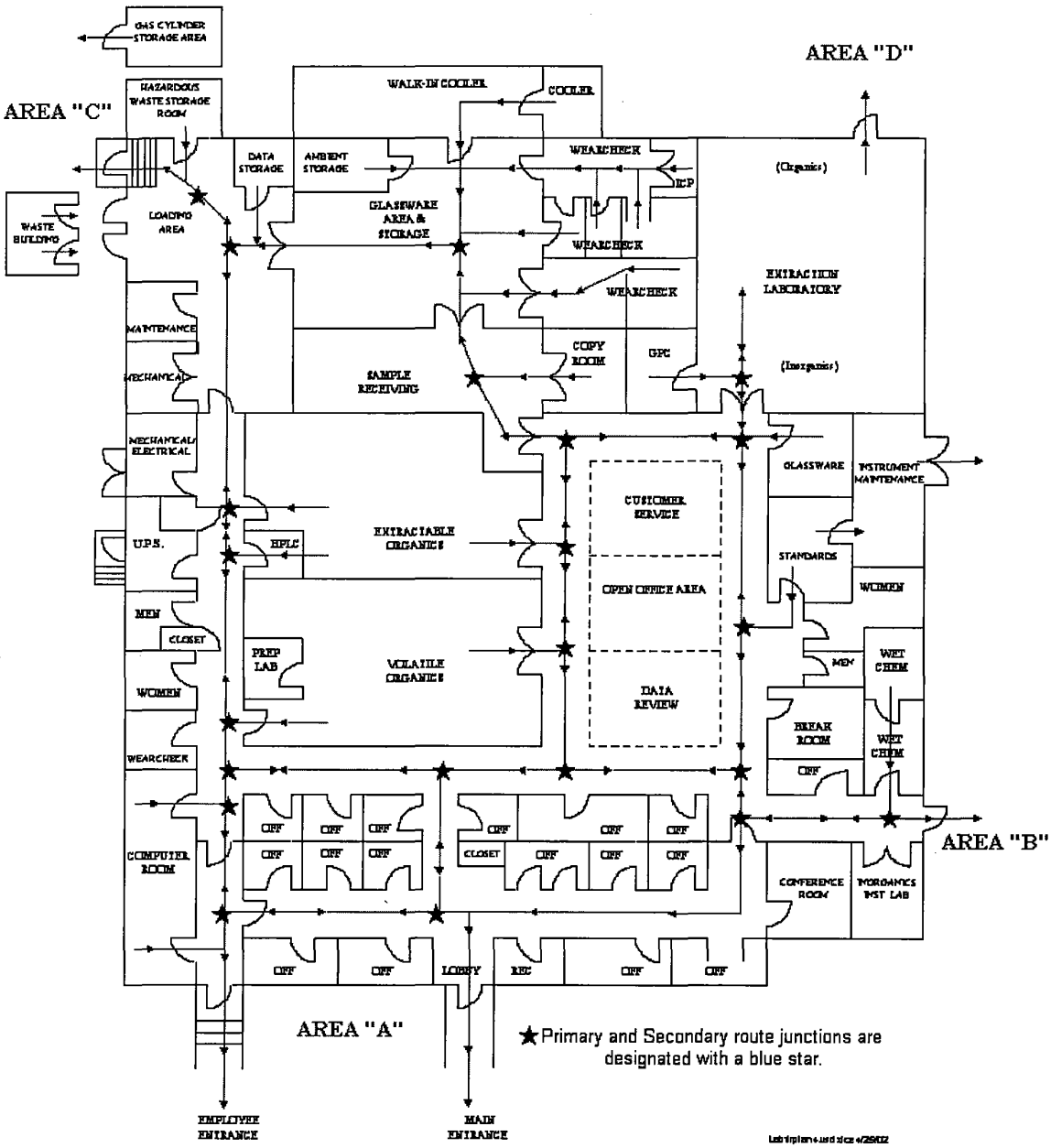

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Table 11.1 GC Laboratory Equipment

	Model No.	Serial No./Channel No.	Type	Installation Date
GC				
Varian 3400		#54	NPD	
Varian 3400		6949 #37/42	Dual ECD	1989
Varian 3400		3623 #39/41	Dual ECD	1987
Varian 3400		17403 #44	FID	
Varian 3400		3356 #59	FID	
Trace GC	20011612	#86/87	Dual ECD	2000
Trace GC		TR101370/#80/81	Dual ECD	2000
Trace GC		TR101369/#82/83	Dual ECD	2000
Trace GC		TR101375/#84/85	Dual ECD	2000
Hewlett Packard	P5890	Series II GC LR47359C #67	FID	2002
Hewlett Packard	5890	Series II GC #32/33	Dual ECD	
Agilent Technologies	6890N	CN10552045 #90/91	Dual ECD	2006
Agilent Technologies	6890N	CN10522046 #92/93	Dual ECD	2006
Autosampler				
CTC A2000S		1304/89(#37/42)	Autosampler	1991
CTC A2000S		13013(#39/41)	Autosampler	1991
CTC A2000S		1301/89(#44)	Autosampler	1991
CTC A2000S		12371(#54)	Autosampler	1989
CTC A2000S		1792/90(#59)	Autosampler	
CTC A2000S		1915/90(#86/87)	Autosampler	1991
CTC A2000S		12369(#80/81)	Autosampler	2000
CTC A2000S		1804/90(#82/83)	Autosampler	1990
CTC A2000S		12387(#84/85)	Autosampler	2000
CTC HS500		30135(#67)	Autosampler	2002
CTC A2000S		12371 (#32/33)	Autosampler	
Agilent Technologies	7683B	CN54637426 #90/91	Autosampler	2006
Agilent Technologies	7683B	CN62940489 #92/93	Autosampler	2006
Refrigerators				
Refrigerator #2		GC Lab Refrigerator #2	8 ft^3	
Refrigerator #7		GC Lab Refrigerator #7	8 ft^3	
Refrigerator #8		GC Lab Refrigerator #8	22,7 ft^3	
Refrigerator #3		GC Lab Refrigerator #3	8 ft^3	
Refrigerator #4		GC Lab Refrigerator #4	22 ft^3	
Refrigerator #9		GC Lab Refrigerator #9	22 ft^3	

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Table 11.2 HPLC Laboratory Equipment

Model No.	Serial No./Channel No.	Type	Installation Date
Agilent 1100 Series HPLC Micro Vacuum Degasser Quaternary Pump ALS Sampling System Thermo Column Compartment Multiple Wavelength Detector	a11001 JP40714429 DE40926792 DE33224733 DE405384472 JP43826437	HPLC	2004
Agilent 1100 Series HPLC Micro Vacuum Degasser Quaternary Pump ALS Sampling System Thermo Column Compartment Multiple Wavelength Detector	a11002 JP40721307 DE43631227 DE43627396 DE43644464 JP43826438	HPLC	2005
Refrigerators			
Baxter Explosion-Proof		Precision 814, 8 ft^3	
Marvel #1		8 ft^3	

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Table 11.3 SV GC/MS Laboratory Equipment

Model No.	Serial No./ID No.	Type	Installation Date
Hewlett Packard HP5972 GCMS 5890 Series II GC HP 7673 autosampler	#60 3244A32866	SV	1994
Hewlett Packard HP5972 GCMS 5890 Series II GC HP 7673 autosampler	#64 3415A38536	SV	1996
Hewlett Packard HP5972 GCMS 5890 Series II GC HP 7673 autosampler	#66 3442A40444	SV	1996
Hewlett Packard HP5972 GCMS 5890 Series II GC HP 6890 autosampler	#70 3529A43269	SV	1998
Hewlett Packard HP5972 MSD 5890 Series II GC 6890 Series injector	#62 3404A37674	SV	2005
Refrigerators			
Refrigerator #1	GC/MS SVOA Lab Ref. #1	8 ft^3	
Refrigerator #3	GC/MS SVOA Lab Ref. #3	22 ft^3	

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Table 11.4 VOA GC/MS Laboratory Equipment

Model No.	Serial No./ID No.	Type	Installation Date
Finnigan INCOS 500 GCMS Tekmar 3000 concentrator Archon autosampler	#55 IN001125 95107004	VOA	1991
Hewlett Packard HP6890 MSD 6890 Series GC Tekmar 3000 P&T concentrator Varian Archon autosampler	#71 US00004710 95097006 610701	VOA	2000
Hewlett Packard HP5972 MSD 5890 Series II GC Varian Archon autosampler, closed system P&T Tekmar LCS 3000	#59	VOA	2000
Hewlett Packard HP5973 MSD Varian Archon autosampler Tekmar/Dohrmann 3100 sample concentrator	#90	VOA	2005
Hewlett Packard HP5972 MSD 5890 Series II Plus GC Tekmar 3000 P&T concentrator Varian Archon autosampler	#73 700758 94293001 507204	VOA	1/2001
Agilent Technologies Dual P&T GC/MS 6890N Network GC System (G1530N) Agilent 5973 Network Mass Selective Detector (G1530N) Tekman Dohrmann Solartek 72™ Multi-Matrix Dual vial Autosamplers w/Emerson Process Management Tekmar Dohrmann 3100 Dual Sample Concentrators	61/62 US10143053 US0208006 US02056032 US02115002 US02109007	VOA	5/2002
Agilent Technologies Inert 5975 MSD 6890N Network GC System	#91 US54431647 CN10604034	63172A G1530N	2006
Varian 3400 Tekmar LCS2000 Tekmar ALS2016	6952(#68) 90163020	FID Purge & Trap	1989
Varian 3400 Tekmar LCS2000 Tekmar ALS2016	6954(#58) 90038029 91158005	FID Purge & Trap	1990

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Table 11.4 VOA GC/MS Laboratory Equipment (continued)

Model No.	Serial No./ID No.	Type	Installation Date
Refrigerators			
Refrigerator #2B			
Refrigerator #4/Freezer #3		22 ft^3	
Refrigerator #5	880101750		
Refrigerator #6	9910245654	5 ft^3	
Freezer #6		22 ft^3	
Water System			
Millipore Milli Q	06731-C		
Oven			
Blue M			
Weights			
Troemner	45823	Class 1	
Balance			
Sartorius B410	40010010	Electronic	

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Table 11.5 Inorganics Laboratory Equipment

Model No.	Serial No./ID No.	Type	Installation Date
TJA Trace ICAP P3			
Trace ICAP	303490	Simultaneous	1994
RF Generator	2361	12510801	
Chiller	K95805204	414003030003	
Autosampler	D2574		
Printer	None	Epson LG-570+	
PC CD	None	Sys/386	
ThermoSPEC software	Revision 6.20		
TJA Trace ICAP P4			
36161 System	10670/13685200	61E Trace purge, simultaneous	4/2000
Power unit	4118		
Grating	H801C7		
Compaq computer	6004CKT3A284	DeskPro	
OptiQuest Monitor	UZ94807900	Q71	
HP Deskjet printer	MX9CK1V0F2	Deskjet 810C	
Thermo Elemental ICP/MS	**MS1**		8/14/2001
37184 System			
VG PQ ExCell	ExCell-226	ICP/MS	
Plasma Lab Software	v. 1.06.02		
Merlin Series water chiller		M75	
CETAC Technologies autosampler			
PeriMax12 SPECTEC		Peristaltic pump	
Mercury Analyzer	**V3**	Automated Mercury	1992
Leeman Labs	1056A	Analyzer PS200	
PC-Standard	3017A88174	Vectra ES/12	
Printer	11OC0607422	Okidata Microline 320	
Mercury Analyzer **Leeman Labs** **Hydra AA**	**V4** **7031**	**CVAA Automated Mercury Analysis System**	**2007**
Buck Scientific Oil in Water IR Analyzer	506	HC-404	
Dionex	U503481/IC2		2005
Ion Chromatograph			
AS40 Automated Sampler			
TOC Analyzer			2006
Shimadzu TOC-V	H51104335168	VCSH	
Shimadzu Solid Sample Module	H52504300074	SM-5000A	
Shimadzu Autosampler	H52104301662	ASI-V	
Client Pro PC	4169020-001		

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Table 11.5 Inorganics Laboratory Equipment (continued)

Model No.	Serial No./ID No.	Type	Installation Date
Lachat Instruments	A5000-415	Ion Chromatograph	
IC A5000			
XYZ Sampler	2000-62	2100-000	
Auto Diluter	2000-021	2900-000	1990
Quickchem	2000-0076	2300-000	
Proportioning Pump	2000/12	2200-00	
PC Hewlett Packard	3024A01573	Vectra 286/12	
Printer Hewlett Packard	2935A70310	LaserJet Series II	
Zellweger Analytics, Inc.			
QuickChem FIA+ 8000 series	A83000-1605		2000
Spectrophotometer			
Spectronic 21D Milton Roy	3152073028	Spectrophometer	
Balances			
Sartorius	10505094	LC2200P/Electronic	1993
American Scientific	2904542	S/P 180/Electronic	1993
O'Haus E400	2061	Electronic	1993
O'Haus E400I	6371	Electronic	1993
Demoer		Electronic 4 place	
Mettler	H50747	PJ300	
Denver Instruments	B034903	300	
Weights			
Troemner	NCSN050	Class 1	
Fisher	NCSN054	Class 1	
Wet Chemistry Lab Refrigerator #1		8 ft^3	
Ovens			
Fisher ISO Temp200 Series	00143		
Fisher ISO Temp200 Series	00179		
Miscellaneous			
Electrothermal Midivap system (2)		10 place midi distillation	
Distillation apparatus (6 units)			
Hot Plates (seven units)			
Fisher pH Meter	50/PH1	Accumet	
Block Digestors			
Lachat	BD46		
Environmental Express SC100 w/SC200 racks		36 well block digestor	10/97

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Table 11.5 Inorganics Laboratory Equipment (continued)

Model No.	Serial No./ ID No.	Type	Installation Date
Miscellaneous (continued)			
Baths			
Digestion (2) turkey roasters Fisher Versa Bath, Precision Stainless		183	
Pyrex Burets		10, 25, 50 mL	1999
Fisher Isotemp Oven	00700173	Mode 500 Series	
Fisher Isotemp Oven	472	Mode 200 Series	
Flash Point Instrument Koehler Instruments, Inc.	R02291814	K16200	2006
Electrothermal Electromantles (4 units, 15 place)		ME	
Fisher Centrifuge	00200499	Centrific 228	
Corrosivity testing apparatus		Glass vessel	
Refrigerators			
American Scientific Products	NY 79522-2	SPR 24 A-O-A	
Gerald	6081295V	GR 17A	
Microwave Digestion			
Acid Distillation Unit			

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Table 11.6 Organic Sample Preparation Laboratory

Model No.	Serial No./ ID No.	Type	Installation Date
Balances			
O'Haus E400	3156	Electronic	
Sartorius BL310	13008591	Electronic	3/2000
Weights			
Troemner	45824	Class 1	
pH Meters			
pH Meter - Beckman	2721	Hand held	
pH Meter – WTW	3204	Hand held	
Baths			
Branson ultrasonic bath	B-22-4		
Branson ultrasonic bath 8510	RPA 9806516E		
Hot water baths (2 units/cp. 24)			
Ovens			
Fisher Econotemp	477	55G	
Wilt Furnace	90870	210	
Refrigerators			
Whirlpool	EE02722440	Compact	
Centrifuges			
IEC	24760668	Centra 8	
IEC	24760672	Centra 8	
Fisher Centrifuge	1041	225	
Water Purification System			
US Filter DI Water System (250 gal)			
Other			
Fisher Dessicator			
YSI Conductivity Meter	1422	Model 35	
Sonifiers			
Branson Sonifier	NH10245B	350 Four Tips	
Branson Sonifier	NH20102B	350 Four Tips	
Tekmar	11896E2	Model TM 600-2	
Tekmar	10500	Model VC 600-2	
Tekmar	13771B	Model TM375	
Nitrogen Evaporators			
Organomation	8373	115	

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Table 11.6 Organic Sample Preparation Laboratory (continued)

Model No.	Serial No./ ID No.	Type	Installation Date
Accelerated Solvent Extractor w/33 cells	9B050385	Dionex 200	3/1999
Environmental Express Extraction Vessels and rotation units			
ZHE			
3 rotation units/8 vessels each			
TCLP/EP Toxicity			
3 rotation units/8 vessels each			
Gel Permeation Chromatograph			
ABC GPC	833B-233	1002B	1997
ABC GPC	834B-234	1002B	1990
ABC GPC	879B-279	1002B	1991
ABC GPC	**887B-287**	**1002B**	**1997**
	GPC-6	**J2 Scientific**	**2007**
Autosampler Model # J2AIM3310	**4738A12420**		
AccuPrep MPS GPC Unit	**07J-1273-4.1DI**		
	GPC-5		
Autosampler Model # J2AIM3310	**4738A12422**	**J2 Scientific**	**2007**
AccuPrep MPS GPC Unit	**07K-1275-4.1DI**		
Recirculating Chillers			
Neslab	8005036	Cool flow 75	
Neslab		Cool flow CFT-75	
Neslab		HX-75	
Automated Soxhlet			
Gerhardt Soxtherm	4032297/4032044	SE-416	
Gerhardt Soxtherm	4022028/4022069	SE-3A/S306A	2003

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Table 11.7 Organic Standards Laboratory Equipment

Model No.	Serial No./ ID No.	Type	Installation Date
Weights			
Permas	A302	Class 1	
Balance			
Mettler H31AR	794794	Electronic Analytical	

Table 11.8 Safety Equipment

Model No.	Serial No./ ID No.	Type	Availability
Fire Extinguishers	Various	General Fire Ext., Inc.	In all lab and support areas
Eye Protection			
Safety glasses		Safety glasses	One per person plus surplus
Eye-wash stations		Model 3729	Four portable; two permanent
Protective Clothing		Lab coats North Safety Equipment	One per person plus surplus
Respirators			Two
Safety Showers		Water	Two in the sample prep lab

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Table 11.9 Reagent Storage

Reagent	Storage	Location	Conditions
Halogenated solvents	Vented storage cabinets	Inorganics Extractions Extractable GC/GCMS Standards Electronics	Air conditioning
Non-halogenated solvents	Vented storage cabinets	Inorganics Extractions Extractable GC/GCMS Standards Lab Electronics	Air conditioning
Alcohols	Vented storage cabinets	Inorganics Extractions Volatile Preparations Extractable GC/GCMS Standards Electronics	Air conditioning
Inorganic chemicals	Shelving cabinets	Inorganics Extractable GC/GCMS Standards Electronics	Air conditioning
Trace metals	Shelving cabinets	Inorganics	Air conditioning
Peroxides (H_2O_2)	Vented storage cabinets	Inorganics	Air conditioning
Acids (Inorganic)	Vented storage cabinets	Inorganics	Air conditioning
Acids (Organic)	Vented storage cabinets	Extractions Inorganics	Air conditioning
Organic standards	Explosion-proof refrigerators	Volatile GC/GCMS Extractable GC/GCMS Standards	Air conditioning
Stock organic solvents	Vented storage cabinet	Extractions	Air conditioned
Stock inorganic chemicals (NaOH)	Vented storage room	Solvent storage building	Vented ambient outside storage
Stock acids	Vented storage room	Solvent storage building	Vented ambient outside storage

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Table 11.10 Waste Disposal

Waste Stream	Storage	Disposal
Dichloromethane	55-gallon steel drums	Reclaimed
Freon 113	55-gallon steel drums	Reclaimed
Used oil	55-gallon steel drums	Reclaimed
Mixed flammable solvents	55-gallon steel drums	Disposed by HW contractor
Vials with flammable solvents	55-gallon steel drums	Disposed by HW contractor
Plant scraps with solvents	55-gallon steel drums	Disposed by HW contractor
019 waste water	55-gallon polyethylene drums	Disposed by HW contractor
Purged soil	55-gallon polyethylene drums	Disposed by HW contractor
Acid water and vials	55-gallon polyethylene drums	Disposed by HW contractor
Mixed acids	55-gallon polyethylene drums	Disposed by HW contractor
NaOH waste	55-gallon polyethylene drums	Disposed by HW contractor
Oil and acid	55-gallon polyethylene drums	Disposed by HW contractor
Cyanide standards	55-gallon polyethylene drums	Disposed by HW contractor
Pyridine and barbituric acid	55-gallon polyethylene drums	Disposed by HW contractor
Metal standards	55-gallon polyethylene drums	Disposed by HW contractor

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12.0 Corrective Action

Corrective action is the process of identifying the cause and implementing the procedures to correct nonconforming work and departures from the policies and procedures of the laboratory's quality system. The need for corrective action may arise from the identification of any of the following:

- Nonconformance issues identified during sample processing and analysis
- Deficiencies in the laboratory's quality system as identified as a result of internal and external audits
- Client inquires and complaints

Corrective actions are documented in Corrective Action Reports (CARs) (Figure 12-1), memoranda, management reports (including responses to external audit reports), instruments logs, and work-order/SDG narratives.

12.1 Nonconformance Issues Identified During Sample Processing and Analysis

12.1.1 Sample Receipt

Nonconformance issues identified during sample receipt may include but are not limited to the following:

- Samples received at temperatures outside of acceptable range
- Samples received improperly preserved
- Samples received in damaged or broken containers

In cases such as those listed above, receiving personnel document the nonconformance on the client chain-of-custody (COC) and advise the project manager of the problem. The project manager then immediately contacts the client. The project manager documents the client's instructions in writing on the client COC or separate document.

When the lab receives a sample from a site in North Carolina, which does not meet the requirements for shipping temperature, preservation, volume, or holding time, the lab will inform the client. If the client chooses not to resample but will accept the qualified results from the laboratory, the North Carolina Department of Environment and Natural Resources Division of Water Quality must be notified. This written notification must include the sampling site, client name, client address, and the non-compliance issue.

12.1.2 Sample Preparation

Nonconformance issues identified during sample preparation may include but are not limited to the following:

- Insufficient sample volume for the desired test method
- Sample matrix not amenable to the desired test method
- Laboratory accident during sample handling resulting in loss of sample extract/digestate
- Improper addition of QC reference standards during sample preparation

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In cases such as those listed above, the sample preparation technician advises the project manager of the problem and the procedure continues as stated above.

The technician documents instances such as an alternate sample volume used for preparation, a laboratory accident, or the addition of the incorrect volume of QC reference standard on the preparation worksheet.

12.1.3 Sample analysis

Nonconformance issues identified during sample analysis may include but are not limited to the following:

- Initial or continuing calibration fails acceptance criteria
- Field samples fail QC acceptance criteria
- QC samples fail acceptance criteria
- Sample preparation or analysis holding time exceeded

In the case of the failing initial or continuing calibration the analyst evaluates the results and may perform instrument maintenance before recalibration. This is documented in the appropriate instrument log book. Failed QC acceptance criteria for field and QC samples are documented in the instrument run log. Corrective actions for QC sample failure are detailed in the appropriate analytical SOP.

All corrective actions performed during the processing and analyses of samples are documented in the final report to the client. The work-order/SDG narrative summarizes the nonconformance issues and corrective actions taken.

12.2 Deficiencies in the Laboratory's Quality System Identified as a Result of Internal and External Audits

The laboratory's quality system is monitored through the periodic performance of internal and external audits. Deficiencies in the laboratory's quality system that can affect its ability to produce data of known and documented quality may be identified as a result these audits.

Deficiencies identified as a result of internal and external audits may include but are limited to the following:

- Deviations from established laboratory policies and procedures
- Deviations from the requirements of the NELAC standards or other external agency requirements
- Deviations from the requirements of the appropriate CLP statement of work

Deficiencies identified during internal audits are documented in internal CARs, interoffice memoranda, internal audit reports, and monthly management reports. Deficiencies identified during external audits, both on-site and through data and electronic media audits, are documented in external audit reports prepared by the auditing body and internal CARs.

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For both internal and external audits, the **Vice President and General Manager** or QA Manager issues an internal CAR to the responsible manager/supervisor. The responsible manager/supervisor then identifies the cause of the deficiency and devises a plan of correction. The plan of correction is documented on the CAR that is returned to the QA department for approval. Additionally, for an external audit, the laboratory's plan of correction for deficiencies is documented in a written response to the auditing body for its acceptance. All records are retained.

12.3 Client Inquiries or Complaints

CompuChem's clients are represented at the laboratory by Project Managers. The Project Manager is the client's point of contact for any questions and/or complaints.

For issues that arise between the time that the client samples are received by the laboratory and the time the final report is completed, the client contacts the Project Manager with any questions or changes. The Project Manager relays the information to the responsible manager/supervisor. This client correspondence is documented in the Project Manager's phone logs.

For issues that arise after the final report has been delivered, the client again contacts the Project Manager. The issue is documented on a Client Inquiry form that is forwarded to the responsible supervisor/manager for resolution.

Issues cited by the client may include but are not limited to the following:

- Missing or illegible page(s) in the final report
- Errors in sample processing and analysis
- Request for further analysis on sample previously analyzed
- Request for further information such as a more detailed report style than originally requested and electronic disk deliverable (EDD)
- Request an additional copy of the report

Once the issue has been resolved and the resolution documented on the Client Inquiry form, the form and any supporting documents are returned to the Project Manager. The Project Manager forwards the information to the client. If an amendment of the final report is required, it is identified as such before being submitted to the client.

12.4 Permitting Departures from Laboratory Policies and Procedures

The Vice President **and General Manager** and the Manager of QA write laboratory policies as the need arises. There are instances, during the course of normal operations, when the laboratory may be allowed to deviate from routine standard operating procedures, internal laboratory policies, or client specifications. An example of this would be if an analyte fails to meet QC limits in the LCS and is not of interest to the client for the project. In these instances, the laboratory staff must speak directly with and obtain permission from the **Vice President and General Manager** or the Manager of QA and the client, if there is questionable impact on the data. Laboratory staff frequent the QA offices to seek clarification and direction on situations that occur outside normal procedures. Project Managers maintain regular communication with clients regarding status of projects and sample analysis.

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A laboratory supervisor or analyst who has a question or doubt about whether a deviation is appropriate will contact QA to discuss resolution of the matter. The QA staff member will evaluate the situation relative to documented policies and procedures to determine if the data may be reported or corrective action must occur. A recommendation is made regarding the course of action including contacting the client. In general, any allowed deviation is discussed in the SDG narrative.

The following statement has been added to all logbooks, "The presence of the Chemist's/Analyst's employee ID number, or signature, on this run log attests that strict compliance with the method's SOP has occurred. Any SOP deviations require documentation by the responsible chemist/analyst together with the chemist's/analyst's initials and the initials of the lab supervisor and a QA department representative, signifying approval of the deviation."

This section does not apply to samples analyzed for the Ohio Voluntary Action Program (Ohio VAP). Deviations from Ohio VAP approved laboratory SOPs are not permitted. The Ohio VAP must approve any proposed revisions to previously approved SOPs prior to implementing any changes in the laboratory.

Figure 12-1

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CORRECTIVE ACTION REPORT

INITIATION

Project:	Date Initiated:
Client Name:	Required Response Date:
Initiator:	CAR#
Deficiency Type: (circle one) CERT – GLP – MDL – NARR – PT – RPT – REV – SOP – SOW – QC	
Recipient:	Lab Area:

NON-CONFORMANCE

Description of Non-Conformance:

CORRECTIVE ACTION

Signature of Responsible Supervisor/Manager:
Plan of Correction:
Target Implementation Date:

IMPLEMENTATION OF CORRECTIVE ACTION

Auditor:
Does SOP need revision? If so, target date of draft revision?
CAR Response Date:
CAR Closure Date:

FOLLOW-UP (completed by QA)

Auditor:	Audit Date:
Follow-up findings:	

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13.0 Subcontracting and Support Services and Supplies

CompuChem only uses those outside support services and supplies that are of adequate quality to sustain confidence in the laboratory's tests. Records of all suppliers for support services or supplies required for tests are maintained.

13.1 Control of Subcontracted Analytical Services

CompuChem performs a wide array of analytical methodologies, and on an exception basis, the laboratory must locate a suitable alternate laboratory to perform methods not performed in house. Only NELAC accredited laboratories are used to perform subcontracted analyses. **In addition to NELAP accreditation, subcontract laboratories utilized by the lab must be assessed and approved by the Department of Defense (DOD) component for which the analytical services will be provided.** CompuChem's client agrees to the use of a qualified laboratory for subcontracted analytical services before the samples are sent off-site. The Project Management team coordinates subcontract laboratories on a project-by-project basis through agreement and approval of our client. An evaluation of the laboratory may include a review of standard operating procedures, Quality Manual, Statement of Qualifications, and recent PT study scores. The lab's performance may be monitored through data evaluation.

13.2 Material Procurement and Control

The two prime objectives of CompuChem's purchasing are to maintain sufficient supplies of all required items, and to encourage all forms of competition to aggressively seek the best total value in a combination of supply, price, required quality, and service. Records of all suppliers for support services or supplies required for tests are maintained. Department and laboratory supervisors have primary responsibility for maintaining adequate inventory of supplies and ensuring that all supplies/equipment meet or exceed quality requirements. Supervisors work through the purchasing agent to meet these objectives.

CompuChem uses competitive inquiries or requests for bids, along with appropriate negotiation, to provide equal opportunities for potential and current suppliers to earn CompuChem's business and to allow the laboratory to seek the best overall value. Long-term considerations include reliability, price, required quality, and service. Suppliers must maintain the confidentiality of competitively sensitive information that is obtained from the Accounting department or other CompuChem personnel. Prices and related information, whether accepted or not, are not disclosed.

The laboratory evaluates solvents prior to purchase. If solvent/chemical quality is equivalent, then price and service are considered. Prices are kept low because of the highly competitive market and the high volume used by the laboratory.

13.3 Material Quality Inspection, Outside Support Services and Supplies

Managers interact with the QA department when purchasing supplies/equipment that could potentially affect data quality, and therefore results of sample analyses, before use in production. The Vice President and General Manager or Manager of QA determines the appropriate test procedures and evaluates the resulting test data. A similar validation process is used in testing new instrumentation. When variability is exhibited in the

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quality of vendor-supplied materials or services, the laboratory department supervisor is responsible for working with Purchasing to find a suitable alternative source.

Information on new chemicals must be supplied to the chemical hygiene officer, safety officer, or the waste management officer. Items and services have been identified that are known to affect quality. Documentation of material quality inspections for solvent lot tests, is maintained in the QA department. Laboratory supervisors maintain other documentation.

14.0 References

14.1 2003 NELAC Standards
14.2 Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans, QAMS-005/80, December 29, 1980, Office of Monitoring Systems and Quality Assurance, ORD, U.S. EPA, Washington, DC 20460.
14.3 RCRA QAPP Instructions, U.S. EPA Region 5, Revision: April 1998
14.4 ASTM D-5283-92. Generation of Environmental Data Related to Waste Management Activities: Quality assurance and Quality Control Planning and Implementation
14.5 "American National Standards Specification and Guidelines for Quality Systems for Environmental Data Collection and Environmental Technology Programs (ANSI/ASQC E-4)", 1994
14.6 EPA 2185 – Good Automated Laboratory Practices, 1995
14.7 ISO/IEC Guide 25: 1990. General requirements for the competence of calibration and testing laboratories
14.8 Guidance for Developing Quality Systems for Environmental Programs (QA/G-1), EPA/240/R-02/008, November 2002
14.9 Guidance on Assessing Quality Systems (QA/G-3), EPA/240/R-03/002, March 2003
14.10 QA/G-4: Guidance for the Data Quality Objectives Process EPA/600/R-96/055, August 2000
14.11 QA/R-5: EPA Requirements for Quality Assurance Project Plans EPA/240/B-01/003, March 2001
14.12 QA/G-5: Guidance for Quality Assurance Project Plans EPA/240/R-02/009, December 2002
14.13 QA/G-6: Guidance for the Preparation of Standard Operating Procedures for Quality-Related Operations EPA/240/B-01/004, March 2001
14.14 QA/G-9: Guidance for the Data Quality Assessment: Practical Methods for Data Analysis EPA/600/R-96/084, July 2000
14.15 Manual for the Certification of Laboratories Analyzing Drinking Water EPA/570/9-90/008
14.16 State of New York Environmental Laboratory Accreditation Program Certification Manual, revised May 2000
14.17 U.S. EPA Contract Laboratory Program Statements of Work OLC03.2, OLM04.3, SOM01.**2**, ILM04.1, and ILM05.**4**
14.18 Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846, Update III, 12/96
14.19 U.S. Army Corps of Engineers, Shell for Analytical Chemistry Requirements, May 2000
14.20 Department of Defense Quality Systems Manual for Environmental Laboratories, Version 3, January 2006
14.21 Air Force Center for Environmental Excellence (AFCEE) Guidance for Contract Deliverables Appendix C: Quality Assurance Project Plan (QAPP), version 3.1, August 2001

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Appendix A

Demonstration of Capability

A demonstration of capability is made prior to using any test method, and at any time there is a significant change in instrument type, personnel or test method.

All demonstrations are documented through the use of the Demonstration of Capability Certification Statement in this Appendix.

The following steps are performed.

a) A quality control sample is obtained from an outside source. If not available, the QC sample is prepared by the laboratory using stock standards that are prepared independently from those used in instrument calibration.

b) The analyte(s) are diluted in a volume of clean matrix sufficient to prepare four aliquots at the concentration specified, or if unspecified, to a concentration approximately 1-4 times the limit of quantitation.

c) Four aliquots are prepared and analyzed according to the test method either concurrently or over a period of days.

d) Using all of the results, the mean recovery and standard deviation are compared to the corresponding acceptance criteria for precision and accuracy in the test method (if applicable) or in laboratory-generated acceptance criteria (if there are not established mandatory criteria). If all parameters meet the acceptance criteria, the analysis of actual samples may begin. If any one of the parameters do not meet the acceptance criteria, the performance is unacceptable for that parameter.

f) When one or more of the tested parameters fail at least one of the acceptance criteria, the laboratory repeats the test for all parameters that failed to meet criteria. If repeated failure occurs, the laboratory will locate and correct the source of the problem and repeat the test for all compounds of interest beginning with c).

Certification Statement:

The following certification statement is used to document the completion of each demonstration of capability. A copy of the certification statement is retained in the training files of each affected employee.

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CompuChem
A Division Of
Liberty Analytical Corp.

Demonstration of Capability
Certification Statement

Study Date:
Laboratory Name: CompuChem, a division of Liberty Analytical Corporation
Laboratory Address: 501 Madison Avenue, Cary, NC 27513
Analyst Name/Employee ID#:

Matrix:
Method Number:
SOP No./Rev#:
Analyte/Class of Analytes/Measured Parameters:

We, the undersigned, CERTIFY that:

1. The analyst identified above, using the cited test method, which is in use at this facility for the analyses of samples under the National Environmental Laboratory Accreditation Program, have met the Demonstration of Capability.

2. The test method was performed by the analyst identified on this certification.

3. A copy of the test method and the laboratory-specific SOPs are available for all personnel on-site.

4. The data associated with the demonstration capability are true, accurate, complete and self-explanatory (1).

5. All raw data (including a copy of this certification form) necessary to reconstruct and validate these analyses have been retained at the facility, and that the associated information is well organized and available for review by authorized assessors.

Technical Director's Name and Title	Signature	Date
Quality Assurance Officer's Name	Signature	Date

This certification form must be completed each time a demonstration of capability study is completed.

(1) True: Consistent with supporting data.
Accurate: Based on good laboratory practices consistent with sound scientific principles and practices.
Complete: Includes the results of all supporting performance testing.
Self-Explanatory: Data properly labeled and stored so that the results are clear and require no additional explanation.

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14.0 References

14.1 2003 NELAC Standards
14.2 Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans, QAMS-005/80, December 29, 1980, Office of Monitoring Systems and Quality Assurance, ORD, U.S. EPA, Washington, DC 20460.
14.3 RCRA QAPP Instructions, U.S. EPA Region 5, Revision: April 1998
14.4 ASTM D-5283-92. Generation of Environmental Data Related to Waste Management Activities: Quality assurance and Quality Control Planning and Implementation
14.5 "American National Standards Specification and Guidelines for Quality Systems for Environmental Data Collection and Environmental Technology Programs (ANSI/ASQC E-4)", 1994
14.6 EPA 2185 – Good Automated Laboratory Practices, 1995
14.7 ISO/IEC Guide 25: 1990. General requirements for the competence of calibration and testing laboratories
14.8 Guidance for Developing Quality Systems for Environmental Programs (QA/G-1), EPA/240/R-02/008, November 2002
14.9 Guidance on Assessing Quality Systems (QA/G-3), EPA/240/R-03/002, March 2003
14.10 QA/G-4: Guidance for the Data Quality Objectives Process EPA/600/R-96/055, August 2000
14.11 QA/R-5: EPA Requirements for Quality Assurance Project Plans EPA/240/B-01/003, March 2001
14.12 QA/G-5: Guidance for Quality Assurance Project Plans EPA/240/R-02/009, December 2002
14.13 QA/G-6: Guidance for the Preparation of Standard Operating Procedures for Quality-Related Operations EPA/240/B-01/004, March 2001
14.14 QA/G-9: Guidance for the Data Quality Assessment: Practical Methods for Data Analysis EPA/600/R-96/084, July 2000
14.15 Manual for the Certification of Laboratories Analyzing Drinking Water EPA/570/9-90/008
14.16 State of New York Environmental Laboratory Accreditation Program Certification Manual, revised May 2000
14.17 U.S. EPA Contract Laboratory Program Statements of Work OLC03.2, OLM04.3, SOM01.**2**, ILM04.1, and ILM05.**4**
14.18 Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846, Update III, 12/96
14.19 U.S. Army Corps of Engineers, Shell for Analytical Chemistry Requirements, May 2000
14.20 Department of Defense Quality Systems Manual for Environmental Laboratories, Version 3, January 2006
14.21 Air Force Center for Environmental Excellence (AFCEE) Guidance for Contract Deliverables Appendix C: Quality Assurance Project Plan (QAPP), version 3.1, August 2001

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Appendix B

Procedure for Demonstration of Capability

CompuChem's Initial and On-going Demonstrations of Capability (Analyst Qualification) Policy

This policy details procedures for documenting the initial demonstration of capability (IDOC) and the on-going demonstration of capability (ODOC) for analysts in the laboratory following the rules listed below.

Initial Demonstration of Capability

General

1) Trainees are not allowed to process samples independently before they have demonstrated capability to perform the method through acceptable precision and accuracy testing with adequate documentation.

2) During the on-the-job training period no trainee is allowed to sign for his or her work without the signature of a manager/supervisor or an approved analyst, i.e. one who has documented capability for the method and has received approval to process samples independently. The approved analyst must cosign with the trainee on the instrument run logs or extraction worksheets.

3) The manager/supervisor, or designee, will provide the IDOC documentation to the QA department. Documentation includes all associated raw data, log sheets, and precision and accuracy statistics.

4) The precision and accuracy statistics must include the replicate values as concentration, the true value, a mean percent recovery from the true or expected value, and a standard deviation as % relative standard deviation (RSD).

5) The acceptance criteria for precision and accuracy are those stated in the methods or in CompuChem's Standard Operating Procedures (SOP) and Quality Manual. Percent recovery criteria for the LCS and RSD values for the initial calibration standards will be applied to these studies. Exceptions may be made for recovery criteria applied to dilutions of calibration standards for instrument analysts where the extracted LCS recovery may be inappropriate. The Initial Calibration Verification (ICV) criteria are appropriate in this application.

   If any failure occurs, the error must be corrected and the study repeated for the failed analyte(s). This may involve only a reanalysis or a re-preparation followed by analysis. Approval is based on an individual analyte basis.

6) Approval must be made by the QA Department and documented through the NELAC Demonstration of Capability Certification Statement. This form must be signed by both the supervisor and QA Department and is maintained in the employee's training files.

7) Failure to have an IDOC on file for an employee who processes AFCEE samples will result in rejected data under the AFCEE contract.

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GC/MS and GC Volatiles

1) For GC and GC/MS volatiles, some methods allow for the continuing calibration standard to serve as the laboratory control sample (LCS). Four consecutive continuing standards may be used to compile the IDOC. The working level of the continuing calibration standard is prepared in the laboratory on each day of analysis.

2) For GC/MS volatile, analysis of an IDOC by any current method will give the analyst credit for all water and soil methods based upon similarities in technologies, methods, and procedures.

Organic Extractions

1) For sample preparation staff, four LCSs will be prepared, following the 40 CFR Part 136 Appendix A guidelines, either concurrently or over a period of days.

2) Precision and accuracy must be demonstrated for all steps of an extraction procedure by the same analyst. The five critical steps are extraction (separatory funnel shake, etc.), KD, nitrogen evaporation or derivatization, bottle up to final volume, and spike standard additions.

3) For semivolatile waters, IDOC credit will be given for both methods 625 and 8270C. IDOC credit will be given for methods OLM04.3, OLC03.2, and **SOM01.2**.

4) For semivolatile soils, IDOC credit will be given for 8270C if OLM04.2/4.3/**SOM01.2** is performed. This credit will not work in reverse. In addition, 8270C soxhlet extractions require a separate IDOC.

5) For pesticides/PCB waters, IDOC credit will be given for methods 8081A/8082, 608, OLM04.3, OLC03.2, and **SOM01.2**.

6) For pesticides/PCB soils, IDOC credit will be given for methods 8081A/8082, OLM04.3, and **SOM01.2**.

7) For herbicide waters, IDOC credit will be given for methods 8151A and 615.

8) For PAH waters, IDOC credit will be given for both methods 610 and 8310.

9) For DRO waters, IDOC credit will be given for both 8015B and CA LUFT methods. TN DRO, JP4, and JP8 each require a unique IDOC. The same is true for soils.

GC/MS Semivolatile and GC/HPLC

1) For GC/HPLC and GC/MS semivolatiles (extractables), each analyst must make four separate dilutions of the high-level calibration standard. Statistics can be calculated for precision and accuracy from the injections of these dilution replicates. The performance of an IDOC using the diluted standard can count for both water and soil methods.

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Criteria used to evaluate replicates prepared from a calibration standard are those used to evaluate the initial calibration verification (ICV). For methods with no requirement for an ICV, such as CLP, the criteria are 70-130%. Sporadic marginal failures may be allowed in some instances and on a case-by-case basis. For these compounds, criteria of 50-150% are used.

2) Analysis of four extracted LCSs can also be used to demonstrate capability. The analysis of an extractor's IDOC will also count as an analyst's IDOC, but only for the method(s) and matrix approved under the extraction rules.

Inorganic Preparation

1) For mercury waters, analysis of an IDOC by any current method will give the analyst credit for all remaining water methods based upon similarities in technologies, methods, and procedures. The is true for soil samples.

2) For cyanide waters, analysis of an IDOC by any current method will give the analyst credit for all remaining water methods based upon similarities in technologies, methods, and procedures. The same is true for soil samples.

3) For metal waters, IDOC credit will be given for both methods ILM04.1 and **ILM05.4**. The same is true for soil samples. In addition, for metal waters, IDOC credit will be given for both methods 6010B and 200.7 and 6020 and 200.8.

Inorganic Instrumentation

1) For inorganic analyses, a precision and accuracy study can be generated from the analysis of four consecutive dilution analyses of the initial calibration verification (ICV) standards. These may be collected over a period of days.

2) The performance of an IDOC using the diluted standard can count for both water and soils for mercury and cyanide if the data is quantitated as both.

3) For metal waters using the four diluted standards, credit will be given for methods ILM04.1, **ILM05.4**, 6010B, and 6020, separately for ICP-AES and ICP-MS.

4) For metal soils using the four diluted standards, credit will be given for methods ILM04.1, **ILM05.4**, 6010B, and 6020, separately for ICP-AES and ICP-MS.

5) Analysis of four digested LCSs can also be used to demonstrate capability. The analysis of an extractor's IDOC will also count as an analyst's IDOC, but only for the method(s) and matrix approved under the inorganic preparation rules.

Wet Chemistry

1) For wet chemistry analysts, precision and accuracy studies can be generated using the LCS for all methods. Preliminary preparative steps required by a method should be followed for the LCS.

2) Information regarding cyanide IDOCs is given in the inorganics section of this memo.

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3) Whenever possible, IDOC credit will be given to multiple methods based upon similar technologies.

On-going Demonstration of Capabilities (ODOC)

1) Annually, an analyst must demonstrate continued proficiency for a procedure. This proficiency must be documented and approved following the same approach as the IDOC. The ODOC must be in the analyst's training file to allow continued performance of a test.

2) ODOC credit can be given for the successful completion of a PT sample or QC reference. The sample must be a single blind to count in this category. This credit can be given for all similar technologies for the specific matrix.

3) ODOC credit can be given for the acceptable performance of four consecutive LCSs. ODOC credit can be given for multiple methods using the rules defined for an IDOC.

4) ODOC credit can also be given for the completion of a new IDOC. ODOC credit can be given for multiple methods using the rules defined for an IDOC.

5) For extractions, ODOC credit is needed for each step of an extraction procedure. The five critical steps are the same as those stated in the IDOC procedure.

The QA department maintains summary tables of IDOC and ODOC information. Copies are currently available upon request. This table will soon be available on-line for review. The supervisors and analysts are responsible for satisfying these requirements, performing these tests in a timely manner, and providing the data to the QA department.

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Appendix C

Table of Contents for Standard Operating Procedures

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SOP#	Title
1.1.3.1	**Preparation and GC Analysis of Gasoline Range Organics (GRO) in Aqueous Samples by Purge and Trap Following SW-846, CA LUFT, and TN GRO**
1.1.3.2	**Preparation and Analysis of Gasoline Range Organics (GRO) in Soil/Sediment Samples by Purge and Trap Following SW-846, CA LUFT, and TN GRO**
1.1.4.1	**Preparation of Soil/Sediment/Sludge Samples for the Analysis of Volatile Organic Compounds by Closed-System Purge and Trap using SW-846 Method 5035 (Also Applicable to EPA CLP SOW Document OLM04.3)**
1.2.1.3	**Methanol Extraction of Soil/Sediment Samples for the Analysis of Medium Level Volatile Organics by EPA CLP & NYSASP**
1.2.3.1	**Preparation of Low Concentration Soil Samples for the Analysis of Volatile Compounds by EPA CLP**
1.2.3.2	**GC/MS Analysis of Low-Level Volatiles in Solid Samples by EPA CLP and NYSASP**
1.2.3.3	**GC/MS Analysis of Volatile Organic Compounds in Aqueous Samples and Medium-Level Volatiles in Solid Samples by EPA CLP and NYSASP**
1.2.3.4	**GC/MS Analysis of Aqueous and Medium Level Solids for Volatile Organic Compounds using USEPA SOW SOM01.2**
1.2.3.5	**GC/MS Analysis of Low Level Solids for Volatile Organic Compounds using USEPA SOW SOM01.2**
1.2.4.1	**GC/MS Volatiles in Low Concentration Water by EPA CLP SOW**
1.2.4.2	**GC/MS Analysis of Trace Level Volatiles in Water Scan and SIM using EPA CLP SOW SOM01.2**
1.3.2.2	**Analysis of Volatile Organic Compounds in Aqueous and Medium/High Concentration Soil Samples by SW-846**
1.3.2.4	**GC/MS Analysis of Low Concentration Volatiles in Soil/Sediment/Sludge Samples by SW-846**
1.3.2.5	**GC/MS Aqueous Direct Injection for Volatile Organics by SIM**

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SOP#	Title
1.3.3.1	Analysis of Low-Level Liquid Volatile Organics Using the Federal Register Method 624
2.1.1.1	Preparation of Water Samples for the Analysis of Pesticide/PCB by CLP & NYSASP
2.1.1.2	Preparation of Soil/Sediment/Sludge Samples for the Analysis of Pesticides/PCBs by EPA CLP plus NYSASP
2.1.1.5	Sulfur Clean-up of Pesticide and PCB Extracts by Copper or Tetrabutylammonium (TBA) Sulfite by CLP, SW846 and NYSASP
2.1.1.6	GC/ECD Analysis of Pesticides/PCBs in Aqueous and Solid Sample Extracts by EPA CLP and NYSASP
2.1.2.2	GC/ECD Analysis of Pesticides/PCBs in Low Concentration Water Samples by CLP
2.1.2.3	GC/ECD Analysis of Pesticides in Aqueous and Solid Sample Extracts by EPA CLP SOW SOM01.2
2.1.2.4	GC/ECD Analysis of Polychlorinated Biphenyls (PCBs) as Aroclors in Water and Soil Extracts by EPA CLP SOW SOM01.2
2.1.3.1	Aqueous Sample Preparation for Pesticides/ PCBs by Low Concentration (OLC03.2 and NYSASP)
2.1.3.2	Preparation of Water Samples for the Analysis of Pesticides by CLP SOW SOM01.2
2.1.3.3	Preparation of Water Samples for the Analysis of Arochlors by CLP SOW SOM01.2
2.1.3.4	Preparation of Soil/Sediment/Sludge Samples for the Analysis of Pesticides by EPA CLP SOM01.2
2.1.3.5	Preparation of Soil/Sediment/Sludge Samples for the Analysis of Aroclors by EPA CLP SOM01.2
2.2.2.1	Extraction of Water Samples for Analysis of Pesticides/PCBs Using the Federal Register Method 608 and 608.2 (Methoxychlor)
2.2.2.2	Analysis of Organochlorine Pesticides and PCBs in Water Samples by the Federal Register Method 608 and Method 608.2 (Methoxychlor)

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SOP#	Title
2.2.3.1	Preparation of Water Samples for Diesel Range Organics (DRO) by SW-846 and TN DEC
2.2.3.7	Analysis of Diesel Range Organics (DRO), JP4, JP8, and Total Jet Fuel in Aqueous and Solid Samples by SW846, CA LUFT, and TN DRO
2.2.3.8	Preparation of Soil/Sediment/Sludge Samples for Diesel Range Organics (DRO) by SW-846, CA LUFT, and TN DEC
2.2.4.1	Sample Preparation for Pesticides/PCBs in Water SW-846 and NYSASP
2.2.4.2	Low Level Preparation for Analysis of Pesticides/PCBs Soil/Sediment/Sludge by SW-846 and NYSASP
2.2.4.3	Extraction of TCLP Leachate for Determination of Pesticides/PCBs by SW-846 and NYSASP
2.2.4.5	Soxhlet Extraction of Fish Samples for Pesticides/PCBs with Provisions for % Lipid Determination by SW-846
2.2.4.7	Diluting and Processing of Oil Samples for Analysis of PCBs by SW-846
2.2.4.8	Diluting and Processing Non-Aqueous Waste Samples for Analysis of Pest/PCBS
2.2.4.10	GC/ECD Analysis of Organochlorine Pesticides in Water and Soil Extracts by SW-846
2.2.5.1	PCBs in Water Preparation Procedure (SW-846 and NYSASP)
2.2.5.2	Low Level Preparation for the Analysis of PCBs only in Soil/Sediment/Sludge by SW-846 and NYSASP
2.2.5.3	GC/ECD Analysis of Polychlorinated Biphenyls (PCBs) as Aroclors in Water and Soil by SW-846 and NYSASP
2.2.6.1	Preparation of Aqueous Samples for Analysis of Organophosphorus Pesticides by SW-846 and NYSASP
2.2.6.2	GC/FPD Analysis of Organophosphorus Pesticides in Water and Soil Extracts by SW-846
2.2.7.1	Extraction and Methylation of Chlorinated Herbicides in Water by Method 8151A & 615
2.2.7.2	Extraction and Methylation of Chlorinated Herbicides in Soil by SW-846 and NYSASP
2.2.7.3	Extraction of TCLP Leachates for the Determination of Herbicides by SW-846 and NYSASP

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SOP#	Title
2.2.7.4	GC/ECD Analysis of Chlorinated Herbicides in Soil and Water by Methods 8151A & 615
2.2.9.1	Methane, Ethane, Ethene, Propane in Water by RSK-175
2.3.1.1	Preparation of Water Samples for HPLC Analysis of Polynuclear Aromatic Hydrocarbons by Methods 8310 and 610
2.3.1.2	Preparation of Solid Samples for Polynuclear Aromatic Hydrocarbons (PAH) Analysis by SW-846 Method 8310
2.3.1.3	Analysis of Polynuclear Aromatic Hydrocarbons in Soil and Water Using High Performance Liquid Chromatography by Methods 8310 and 610
2.3.2.1	Preparation of Water Samples for the Analysis of Nitroaromatics and Nitramines by High Performance Liquid Chromatography (HPLC) by SW-846 and NYSASP
2.3.2.2	Preparation of Solid Samples for the Analysis of Nitroaromatics and Nitramines by SW-846 Method 8330
2.3.2.4	Analysis of Nitroaromatics and Nitramines in Water and Soil Samples by HPLC in SW-846 and NYSASP
2.3.2.5	Analysis of Explosives by High Performance Liquid Chromatography (HPLC) using SW-846 Method 8332
2.3.2.6	Solid Phase Extraction of Water Samples for the Analysis of Nitroaromatics and Nitramines by High Performance Liquid Chromatography (HPLC) by SW-846
2.4.1.5	Concentration of GC Pesticide/PCB Extract for GC/MS Confirmation by EPA CLP and SW846
2.4.1.6	GC/MS Confirmation of Extractable Pesticides/PCBs by EPA CLP and SW846
2.4.3.1	Preparation of Water Samples for the Analysis of Semivolatiles by EPA CLP and NYSASP
2.4.3.2	Preparation of S/S/S Samples for Analysis of Low Level Semivolatiles (EPA CLP SOW plus NYSASP)
2.4.3.3	Preparation of S/S/S Samples for Analysis of Medium Level Semivolatiles (EPA CLP SOW plus NYSASP)

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SOP#	Title
2.4.3.4	Analysis of Semivolatile Organic Compounds in Aqueous and Solid Sample Extracts by EPA CLP and NYSASP
2.4.3.5	Preparation of S/S/S Samples for Analysis of Low Level Semivolatiles (EPA CLP SOW SOM01.2)
2.4.3.6	Preparation of S/S/S Samples for Analysis of Medium Level Semivolatiles (EPA CLP SOW SOM01.2)
2.4.4.1	Water Preparation For Low Concentration Semivolatiles (OLC03.2 + NYSASP)
2.4.4.2	GC/MS Semivolatiles in Low Concentration Water Samples by EPA CLP SOW OLC03.2 and NYSASP
2.4.4.3	GC/MS Scan and SIM Analyses of Semivolatiles in Water and Soil Matrices by EPA CLP SOM01.2
2.4.4.4	Preparation of Aqueous Samples For Semivolatile GC/MS Analysis According to SOW SOM01.2
2.4.4.5	GC/MS Selected Ion Monitoring (SIM) Semivolatile Analyses of Aqueous and Soil Samples using SW-846 and EPA CLP Methodologies (OLC03.2 and OLM04.3)
2.5.1.1	Preparation of Commercial Base Neutral and Acid Water Samples by Federal Register Method 625
2.5.1.2	Analysis of Aqueous Acid and Base-Neutral Extractables by the Federal Register Method 625 with Library Searches
2.5.2.1	Preparation of Water Samples for the Analysis of Semivolatiles by SW-846 Method 3510C and EPA 625
2.5.2.2	Extraction of TCLP Leachate for Semivolatiles by SW-846 and NYSASP
2.5.2.3	Preparation of Soil/Sediment/Sludge Samples for the Analysis of Low-Level Semivolatiles by SW-846
2.5.2.4	Medium Level Preparation Procedure for Semivolatile Organics in Soil Samples by SW-846 and NYSASP
2.5.2.6	Diluting and Processing Non-Aqueous Waste Samples for Analysis of Semivolatiles
2.5.2.7	GC/MS Analysis of Extractable Semivolatiles in Aqueous and Solid Samples by SW-846

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SOP#	Title
2.5.2.8	Analysis of Bis(2-chloroethyl)ether using Selected Ion Monitoring (SIM) in Aqueous and Soil Samples by SW-846
2.5.2.12	Preparation of Wipe Samples for CS
2.6.1	Gel Permeation Chromatography (GPC) Cleanup of Soil and Water Extracts for GC/ECD Analysis of Pesticides/PCBs by EPA CLP SOW OLM04.3
2.6.1-NJ	Gel Permeation Chromatography (GPC) Cleanup of Soil and Water Extracts for GC/ECD Analysis of Pesticides/PCBs by EPA CLP SOW SOM01.2
2.6.3	Gel Permeation Chromatography (GPC) Cleanup of Semivolatile Soil Sample Extracts by CLP, SW-846 and NYSASP
2.6.3-NJ	Gel Permeation Chromatography (GPC) Cleanup of Semivolatile (SV) Soil Sample Extracts by CLP SOW SOM01.2
2.6.4	Sulfuric Acid Wash of PCB-Only Hexane Extract (SW846)
2.6.5	Manual Florisil Cartridge Cleanup of Water and Soil Extracts for the Analysis of Pesticide/PCB by CLP and SW-846
2.6.5-NJ	Manual Florisil Cartridge Cleanup of Water and Soil Extracts for the Analysis of Pesticides by CLP SOW SOM01.2
2.7.2	Toxicity Characteristic Leaching Procedure (TCLP) by SW846
2.7.3	Zero Headspace Extraction (ZHE) / Toxicity Characteristic Leaching Procedure (TCLP) by SW846
2.7.5	Leachate Generation with Water from Solid Waste Samples
2.7.6	Synthetic Precipitation Leaching Procedure by SW-846
2.8.1	Undecanted Percent Moisture Determination in Soil/Sediment/Sludge by CLP, SW-846, and NYSASP
2.8.2	Decanted Percent Moisture in Soil/Sediment/ Sludge by EPA CLP, NYSASP, and SW-846

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SOP#	Title
2.8.3	Percent Solids Determination in Inorganic Samples by CLP & NYSASP
2.8.4	pH Measurement for Solid Samples by EPA CLP and NYSASP
2.8.7	Soxhlet Extraction of Soil/Sediment/Sludge and Wipe Samples by SW-846 plus NYSASP
2.8.8	Conductivity in Water
2.8.10	Automated Soxhlet Extraction of Solid Samples (encluding Wipes) by SW-846
2.8.11	Homogenization of Biota and Soil Samples
3.1.1.2	Digestion Block Preparation of Aqueous Samples for Total or Dissolved Metals by CLP SOW ILM04.1 and NYSASP
3.1.1.3	Digestion Block Preparation of Soil Samples for Total Metals for ICP Analysis by CLP and NYSASP
3.1.1.4	Determination of Metals by Inductively Coupled Plasma (ICP) by EPA CLP and NYSASP(ILM04.1, ILM05.4 SOW Documents)
3.1.1.5	Digestion Block Preparation of Aqueous Samples for Total Metals or dissolved Metals by CLP ILM05.4 (ICP-AES) and NYSASP
3.1.1.6	Digestion Block Preparation of Soil Samples for Total Metals for ICP-AES Analysis by CLP SOW ILM05.4 and NYSASP
3.1.2.1	Preparation of Aqueous Samples for Total or Dissolved Metals Analysis by ICP-MS using CLP SOW ILM05.4 and NYSASP
3.1.2.2	Determination of Metals by Inductively Coupled Plasma -Mass Spectometry (ICP-MS) by EPA CLP
3.2.1.4	Digestion Block Preparation of Aqueous Samples for ICP Analysis of Total or Dissolved Metals by SW-846, MCAWW, Standard Methods, and NYSASP
3.2.1.5	Digestion Block Preparation of Soil Samples for ICP Determination of Total Metals by SW-846 and NYSASP
3.2.1.6	Inductively Coupled Plasma Atomic Emission Spectroscopy by SW-846 Method 6010B

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SOP#	Title
3.2.1.7	**Digestion Block Preparation of Solid Samples for ICP-MS Determination of Total Metals by SW-846**
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Appendix D

Certification Summary Table

Accrediting Body	ID Number	Type
Connecticut Department of Public Health	PH-0522	State
Florida Department of Health	E87047	Primary NELAP accreditation
State of Illinois Environmental Protection Agency	200034	Secondary NELAP accreditation
State of Kansas Department of Health and Environment	E-10312	Secondary NELAP accreditation
State of Louisiana Department of Environmental Quality	AI 8366 03071	Secondary NELAP accreditation
Massachusetts Department of Environmental Protection and Energy	M-NC028	State
New Hampshire Department of Environmental Services	201606	Secondary NELAP accreditation
New Jersey Department of Environmental Protection	NC249	Secondary NELAP accreditation
New York Department of Health	10065	Secondary NELAP accreditation
North Carolina Department of Environment, and Natural Resources	79	Home state certification
Ohio EPA Voluntary Action Program (VAP)	CL0060	State
Oklahoma Division of Environmental Quality	9410	State
Pennsylvania Department of Environmental Protection	68-00672	Secondary NELAP accreditation
South Carolina Department of Health and Environmental Control	99055002	State
Wisconsin Department of Natural Resources	999314910	State
Department of the Navy Naval Facilities Engineering Service Center	NFESC 413	Agency
U.S. EPA Contract Laboratory Program (CLP)	LIBRTY	Agency

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Accrediting Body	ID Number	Type
National Environmental Laboratory Accreditation Program (NELAP)	E87047	NELAP accreditation based upon FLDOH primary accreditation. Accepted by states marked on this chart and OR, and UT and the non-NELAC states: GA, ME, VT, and WA
U.S. Department of Agriculture	RAL-99-04	Permit to receive soil from foreign sources

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Golder Associates Inc.

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NEW JERSEY
QUALITY ASSURANCE/QUALITY CONTROL MANUAL

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DISTRIBUTION:

3 Copies Golder Associates Inc.

June 2005

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1.0 Introduction and Purpose

This Quality Assurance/Quality Control Manual (Manual) has been prepared by Golder Associates Inc. (Golder) in accordance with the New Jersey Department of Environmental Protection (Department) Regulations Governing the Certification of Laboratories and Environmental Measurements (N.J.A.C. 7:18). The requirements of this Manual will be reviewed and complied with by all Golder laboratory and field technical personnel.

The information contained herein establishes Golder's compliance with the Department's Environmental Laboratory Certification Program (ECLP) to maintain status as a New Jersey certified environmental laboratory. In order to maintain our status, Golder will participate in one of the Department's annual Proficiency Testing events and will submit the results in accordance with the Department's instructions. Additionally, Golder will submit the certification renewal application and applicable fee to the Department by March 31 of every year for which it requests to maintain its status as a New Jersey certified environmental laboratory.

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2.0 Environmental Laboratory Personnel

Golder employs qualified personnel, who possess the education, training, and experience required by the Department. The categories for which Golder is certified include the following Water Pollution Program Categories:

- WPP02 Inorganic Parameters, Nutrients and Demand (Turbidity and Specific Conductance)
- WPP03 Analyze-Immediately Inorganic Parameters (pH, Temperature, and Dissolved Oxygen).

These will be referred to herein as Categories. Golder's Supervisor meets all of the Department's education and experience requirements for the Categories for which Golder is certified.

The Laboratory Manager (Manager) and Lead Technical Director is Peter T. Guy. The Manager meets the Department education and experience requirements for sampling of all parameters for which Golder is certified. Mr. Guy has a Bachelor of Arts in Chemistry and has over 8 years experience performing sampling for the Categories for which Golder is certified. The duties of the Laboratory Manager include the following:

1. The Manager will administer the operations of the environmental laboratory including the reporting of tests and analyses. The Manager will be available for personal or telephone consultation with the environmental laboratory staff and the Department. If the Manager is to be absent, the Manager will arrange for a substitute;

2. The manager will assure that all relevant laboratory personnel meet the applicable education and experience requirements of the Department for their classification;

3. The manager or designee thereof will sign reports of analytical data; and

4. The manager or designee will obtain a Personal Identification Number from the Department for the electronic submittal of data. Submission of data using that PIN certifies that the manager or assigned designee believes that the submitted information is true, accurate, complete and generated according to Department-approved procedures.

The Supervisor for all Categories for which Golder is certified is R. Stephen Anderson. R. Stephen Anderson is the Quality Assurance (QA) officer as well. Golder's Supervisor meets all of the Department's education and experience requirements for the Categories for which Golder is certified. Mr. Anderson has a Bachelor of Science in Biology and has over 8 years experience performing sampling for the Categories for which Golder is certified. The duties of the Supervisor and QA officer include the following:

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1. The Supervisor will monitor the performance of technical personnel performing the analysis of a parameter. The Supervisor will report results within all of the Categories for which the supervisor is qualified;

2. The Supervisor, as the Manager's designee, may sign reports of analytical data;

3. The Supervisor will only perform tests or analyses within the Categories for which the supervisor is qualified;

4. The Supervisor will oversee the performance of all laboratory procedures, tests, analyses, and quality assurance within the Categories for which Golder is certified;

5. The QA officer will ensure Golder's collection of field parameters follows the quality control (QC) procedures of the appropriate analytical methods, listed on the individual Standard Operating Procedure (SOP); and,

6. The QA officer will implement the procedures of this Manual.

All SOPs are provided in the Standard Operating Procedures Manual in Appendix A. The resumes and transcripts for the Manager and Supervisor/QA officer are provided in Appendix B.

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3.0 Requirements for Equipment and Safety

Certified testing and analysis of regulatory samples will be performed only if or when the necessary equipment, supplies, materials, and instruments are on-hand. Equipment, supply, material, and instrument custody will be maintained by the Golder Supervisor/QA officer. All such items used to perform the certified tests will meet both the requirements of N.J.A.C. 7:18-4 through 8 and the following:

1. pH meters will be operated in accordance with the manufacturer's instructions, the SOP for pH Calibration, and the SOP for Collection of pH;
2. Temperature monitoring devices will be operated in accordance with the manufacturer's instructions, the SOP for Temperature Calibration, and the SOP of Collection of Temperature;
3. Conductivity meters will be operated in accordance with the manufacturer's instructions, the SOP for Specific Conductance Calibration, and the SOP of Collection of Specific Conductance;
4. Dissolved Oxygen (DO) meters will be operated in accordance with the manufacturer's instructions, the SOP for DO Calibration, and the SOP of Collection of DO;
5. Turbidity meters will be operated in accordance with the manufacturer's instructions, the SOP for Turbidity Calibration, and the SOP of Collection of Turbidity;
6. Polyethylene bottles will be used where appropriate for storage of reagents and standard solutions;
7. Distilled water will be available for use in the preparation of reagents, standards, and for cleaning equipment; and,
8. A permanent maintenance record for each instrument will be maintained by the owner of the equipment. The record will contain the date and description of repairs, modifications, and preventative maintenance and the signature of the person performing the maintenance.

In accordance with N.J.A.C. 7:18 and Golder's Standard Operating Procedures Manual, provided in Appendix A, equipment will be calibrated as follows:

1. The DO meter will be calibrated daily prior to use;
2. The Winkler Method of DO analysis will be run once a week for every week in which the membrane method of DO is utilized;

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3. The pH meter will be calibrated daily prior to use. During use, the meter must be checked against a standard buffer every three (3) hours;

4. The Specific Conductance meter will be calibrated daily prior to use;

5. The Temperature meter will be calibrated against a certified NIST thermometer quarterly; and,

6. The Turbidity meter will be calibrated daily prior to use.

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4.0 General Laboratory Practices

In accordance with N.J.A.C. 7:18-5.4, the Golder QA officer will ensure compliance with the following requirements for laboratory chemicals, reagents, and standards used in chemical testing:

1. The laboratory will use certified standards;

2. The laboratory will examine stock and working standard solutions weekly and before each use for signs of decomposition; including, but not limited to, discoloration, formation of precipitates and concentration change due to obvious evaporation. If the laboratory finds that a solution shows any such conditions, the laboratory will discard the solution immediately;

3. The laboratory will label all standards to indicate identity, manufacturer's name, preparation date, expiration date, batch/lot number, all associated hazards, and any other pertinent information;

4. The laboratory will immediately discard any standard that is past its expiration date;

5. The laboratory will mark all purchased chemicals, solutions, and standards with the date received by the laboratory and the date first opened by the laboratory;

6. The laboratory will not use purchased standards unless they have a lot-specific certificate of analysis; and,

7. The laboratory will obtain or prepare calibration or QC check samples for pH, DO, Turbidity, and Conductivity from lots of materials different from those used to prepare calibration standards.

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5.0 Requirements for Records and Data Reporting

Golder will retain records concerning all regulatory analyses. The records to be retained include raw data records, quality control and calibration data records, chain-of-custody forms, laboratory reports, and the information required herein. Golder will retain each record for at least five years after the date of the analysis. Golder will file and maintain data and other records in an accessible location on its premises for one year after the date of analysis so that reviews can be conducted during on-site audits. The Golder QA officer or designee will check all results reported on final report forms against original data to make sure there are no transcription errors.

The following information will be retained as part of the records of analysis:

1. The sample location name or other unique form of identification;
2. The date and time of sample analysis;
3. The name and signature of the person or persons who collected and analyzed the sample;
4. The type of analysis performed; and,
5. The results of the analysis.

The following information will be retained as part of the QC checks and calibration records:

1. The Site name and project number;
2. The date and time of the QC check or calibration;
3. The name and signature of the person or persons who performed the QC check or calibration;
4. The type of QC check or calibration performed; and,
5. The results of the QC check or calibration.

The following information will be included in reporting results to the client:

1. Golder's name and New Jersey laboratory identification number;
2. The date, time, and location of sample collection and sample analysis;
3. The type of analysis performed and the analytical method employed;
4. The results generated by the analysis; and,
5. The name and signature of the environmental laboratory manager or designee.

Results of analyses will not be reported to the Department or to any other person unless the original or true duplicate of the results is sent to the client.

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6.0 Sample Requirements

Regulatory samples will be handled and preserved as follows:

1. Drinking water samples to be analyzed for one or more chemical parameters will be handled and preserved in accordance with the applicable requirements of Table 9.1 in N.J.A.C. 7:18-9.4(b), as follows; and,

2. Wastewater samples to be analyzed for one or more chemical parameters will be handled and preserved in accordance with the applicable requirements in Table 9.2 in N.J.A.C. 7:18-9.4(c), as follows.

TABLE 9.1 REQUIRED CONTAINERS, PRESERVATION TECHNIQUES, AND HOLDING TIMES FOR DRINKING WATER SAMPLES

Parameter	Container	Preservation	Maximum Holding Time
pH	P or G	None	Analyze Immediately
Temperature	P or G	None	Analyze Immediately
Turbidity	P or G	Cool 4°C	48 hours

TABLE 9.2 REQUIRED CONTAINERS, PRESERVATION TECHNIQUES, AND HOLDING TIMES FOR WASTEWATER SAMPLES

Parameter	Container	Preservation	Maximum Holding Time
Hydrogen ion (pH)	P, G	None required	Analyze Immediately
Oxygen dissolved (probe)	Glass bottle and top	None Required	Analyze Immediately
Oxygen dissolved (Winkler)	Glass bottle and top	Fix on site and store in dark	8 hours
Specific conductance	P, G	Cool 4°C	28 days
Temperature	P, G	None required	Analyze Immediately
Turbidity	P, G	Cool 4°C	48 hours

Note: P, G : "P" means plastic, hard or soft; "G" means glass, hard or soft.

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Information regarding QC checks and calibration checks will be recorded in a field calibration log form or a calibration log field book in accordance with the individual calibration SOPs, provided in Appendix A. A blank field calibration log form is provided in Appendix C. Forms will be segregated by project and retained in a bound cover. Information regarding weekly DO QC checks using the Winkler Method will be recorded in a Winkler Weekly DO Calibration Log in accordance with Golder SOP 102b, provided in Appendix A. A blank DO calibration log is provided in Appendix D. In general, the following information will be recorded when performing a calibration or QC check:

1. The name of the personnel performing the calibration or QC check;
2. Site name and location;
3. Project number'
4. The date and time of calibration;
5. Instrument model or type;
6. Instrument serial number;
7. Calibration results and units; and,
8. The signature of the personnel performing the calibration or QC check.

Information regarding parameter sample collection will be recorded in a sample field information form or a project field book in accordance with the individual sample collection SOPs, provided in Appendix A. A blank sample field information form is provided in Appendix E. Forms will be retained in the project files. In general, the following information will be recorded when collecting and handling regulatory samples:

1. The collector's and analyzer's name;
2. Sample identification;
3. The date and time of collection;
4. Instrument ID;
5. Instrument serial number;
6. Calibration time;
7. Analysis results and units; and,
8. The signature of the collector and analyzer.

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The results will be provided to the client and/or Department on a project-specific Report of Analysis form. All forms must include Golder's NJDEP laboratory certification number.

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APPENDIX A

STANDARD OPERATING PROCEDURES MANUAL

The Golder Associates Standard Operating Procedures are provided in Attachment 2 – Analytical Standard Operating Procedures.

APPENDIX B

PERSONNEL RESUMES AND TRANSCRIPTS

LABORATORY MANAGER/LEAD TECHNICAL DIRECTOR RESUME AND TRANSCRIPT

Peter T. Guy

Education B.A., Chemistry and Biology, University of Kansas, 1985-1989
M.A., Systematic and Ecology, University of Kansas, 1993-1995

Certifications 40-Hour Hazardous Waste Operations Training, 1995
8-Hour Hazardous Waste Operations Supervisor Training, 1998

Experience

2005 - present **Golder Associates Inc.** **Cherry Hill, New Jersey**

Senior Environmental Scientist.

Organize, develop and manage a Data Validation/Database Group; understand various analytical methodologies which would be used for various projects and keep informed of updates and changes in the methods; perform validation and other data quality evaluations of data generated by the analytical laboratories in support of environmental projects; oversee the management of subcontract analytical laboratories in support of various projects including solicitation of bids, preparation of subcontract documents, coordination of sample bottle delivery, quality-control review of laboratory work products, and review of invoices; manage remedial investigation projects, routine Operation and Maintenance sampling programs, and preparation of reports and Quality Assurance Project Plans; and, in cooperation with other regional Golder offices, develop an integrated database management system between data validation groups and GIS to present interactive product to clients.

2000 - 2005 **URS Corporation** **Omaha, Nebraska**

Senior Environmental Scientist.

Site manager for RCRA Facility Investigations (RFI) at the Indiana Army Ammuntion Plant (USACE, Louisville District). Managed field tasks and budgets, using a multi-disciplinary team across several site assessments, with scopes ranging from 100K to 1.2M. Field tasks included on-site explosives and mercury analysis, well installations, direct push sampling, trenching, site survey, groundwater sampling, and subcontractor contracting and oversight. Additional responsibilities included:

- Technical proposal writing, including budgeting for site assessments.
- Providing oversight and aiding in research involving phytoremedial alternatives for treatment of mercury, nitroaromatics and polynuclear aromatic hydrocarbons in waste settling basins.
- Writing work plans, field sampling plans, technical memorandums, QAPPs, health and safety plans, waste analysis plans, and RI/FS and RFI reports (e.g. for RCRA and CERCLA programs).
- Phase I and Phase II environmental site assessments (ESAs) and performing pollution prevention (P2) assessments.
- Developing a Quality Assurance Program Plan (QAPP) with Arizona Department of Environmental Quality (ADEQ) for Superfund Programs Section.
- Developing QAPPs for senior project managers to support projects involving AFCEE, USACE, USEPA, and USFWS.
- Validating environmental data following USEPA, USACE, CLP and NELAC/DOD QSM guidelines, including report generation of data usability for USACE, USFWS, EPA and industry clients.

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Peter T. Guy

1995 - 1999 **Hydro-Logic, Inc.** **Eudora, Kansas**

Laboratory Manager.

Successfully doubled laboratory capabilities and annual net income. Managed laboratory budget and led staff in new method development to increase capabilities and revenue. Additional responsibilities included: writing company QAPP, standard operating procedures (SOPs), and company newsletters; managing laboratory projects and QA/QC program; performing Phase I and Phase II site investigations following state LUST guidelines.

1993 - 1995 **University of Kansas** **Lawrence, Kansas**

Graduate Research Assistant

Measured and statistically analyzed carbon and nitrogen levels of soil, leaf litter, and trees from Hubbard Brooke Long Term Ecological Research (LTER) site. Used multi-variate statistical analysis to determine an optimal balance of organic matter decay by soil microbes for a graduate research project. Studied and inventoried epiphytic plants by genus-species-s. species for a graduate research assistantship at the University of Kansas.

1992 - 1993 **INTERx** **Lawrence, Kansas**

Research Technician

Performed time-release research study of encapsulated Avermectin, a potent derivative of the bovine parasite drug Ivermectin. Results were used to assess the effectiveness of Avermecitn as a control of parasites, as used in flea and tick collars. Performed the analysis and quantification of drug levels in aqueous solutions for various other time release-studies. Studies were a part of a 5 and 10 year data gathering program to fulfill FDA requirements.

1990 - 1992 **VA Medical Center** **Kansas City, Missouri**

Research Technician (GS-7)

Studied the effects of alcohol induced lipid interdigitation on extruded, sub-micron sized, lipid vesicles. Published abstracts and journal articles related to ethanol induced lipid interdigitation using fluorescence and tritration calorimetry methods.

PUBLICATIONS

Komatsu, H., Guy, P.T. and Rowe, E.S. Fluorescence Studies of Lipid Interdigitation in Extruded Vesicles. Biophysical Journal. 59:502a, 1991.

Komatsu, H., Guy, P.T., and Rowe, E.S. Effect of Unilamellar Vesicle Size on Ethanol Induced Interdigitation in Dipalmitoylphosphatidycholine. Chemistry and Physics of Lipids. 65:11-21, 1993.

Rowe, E.S., Zhang, F., Leung, T.W., Parr, J.S., and Guy, P.T. Thermodynamics of Membrane Partitioning for a Series of n-Alcohols Determined by Titration Calorimetry: Role of Hydrophobic Effects. Biochemistry. 37:2430-2440, 1998.

R2-0002357

SUPERVISOR/QUALITY ASSURANCE OFFICER
RESUME AND TRANSCRIPT

R. Stephen Anderson

Education B.S., Biology, Wheaton College, Illinois, December 1990

Certifications OSHA 1910.120 – 40 Hour Health and Safety Certification
First Aid and CPR

Experience

2001 - present **Golder Associates Inc.** **New Jersey**
Staff Environmental Scientist
Responsible for leading sample events and O&M activities at various sites. Field activities include groundwater, surface water, wastewater and soil sampling; air monitoring and gas sampling; injection of nutrients in an enhanced in-situ biological treatment system; O&M for remedial systems and closed landfill sites; and auditing of field sampling teams. Responsibilities include coordination of sampling events, assisting in the preparation of reports and proposals, and training.

1997 - 2001 **Waste Management of Pennsylvania, Inc.** **Pennsylvania**
Environmental Field Technician.
Responsible for environmental sampling and compliance at regional Waste Management facilities. Activities included sampling groundwater, surface water, leachate and waste water; monitoring gas migration; tuning gas wells; collecting field parameters; and split sampling with state and local authorities. Responsibilities included coordinating sampling with contract lab and site personnel; preparing monitoring reports; ordering supplies; maintaining equipment; developing budget; and scheduling of work. Duties required extensive field work and frequent travel (1-2 weeks per month).

1992-1997 **Waste Management of Pennsylvania, Inc.** **G.R.O.W.S. Landfill**
Environmental Laboratory Technician.
Responsible for special waste receiving and monitoring on-site wastewater treatment plant. Activities included fingerprint sampling; treatment plant sampling, wet chemical analysis; monitoring asbestos disposal; and conducting working-face inspections. Responsibilities included tracking special waste approvals, following quality assurance and control procedures, and insuring compliance with state and local regulations. Organized system for receiving and shipping samples. Member of site safety committee.

1991 **Miles Wildlife Sanctuary, National Audubon Society** **Connecticut**
Wildlife Management Intern.
Assistant to the sanctuary manager. Activities included general site maintenance; constructing wood duck nesting boxes, instituting nesting box programs, capture and release of birds for identification and banding. Intern project entailed mapping woody vegetation distribution in the wetlands. Position required living at the sanctuary.

R2-0002359

R. Stephen Anderson

SELECTED PROJECT RELATED EXPERIENCE: ENVIRONMENTAL SAMPLING

BASF –Fairlawn Facility — **Fairlawn, NJ**
Groundwater sampling utilizing non-dedicated Grundfos submersible pumps for purging and dedicated bailers for sampling.

BFI-South Brunswick Landfill — **South Brunswick, NJ**
Groundwater sampling utilizing peristaltic pumps and bailers.

Big Bethel Landfill — **Hampton, VA**
O&M on landfill gas recovery system

Borne Chemical Facility — **Elizabeth, NJ**
Soil sampling (hand-bored) and surface water sampling.

Caldwell Trucking Company Superfund Site — **Caldwell, NJ**
Groundwater sampling utilizing non-dedicated Grundfos submersible pumps, implementing low-flow sampling techniques, including gas stripped samples. Nutrient injection into wells for insitu biological treatment.

Carlstadt Superfund Site — **Carlstadt, NJ**
Groundwater sampling using both low-flow sampling techniques (non-dedicated Grundfos submersible pumps) and dedicated bailers. Collection of surface water samples. Leachate system O&M.

Chester County Solid Waste Authority, Lanchester Landfill — **Honeybrook, PA**
Field audit of CCSWA subcontracted sampling team.

Delaware Sand and Gravel Superfund Site — **New Castle, DE**
Low-flow groundwater sampling utilizing non-dedicated Grundfos submersible pumps.

Elizabethtown Landfill — **Elizabethtown, PA**
Low-flow groundwater sampling utilizing dedicated Well Wizard bladder pumps. Residential and surface water sampling.

Ford-Teterboro — **Teterboro, NJ**
Groundwater sampling utilizing non-dedicated Grundfos submersible pumps.

GlaxoSmithKline Facility — **Research Triangle Park, NC**
Groundwater sampling utilizing non-dedicated Grundfos submersible pumps, implementing low-flow sampling techniques.

Larrymar Site — **Springfield Township, NJ**
Groundwater sampling utilizing non-dedicated Grundfos submersible pumps and dedicated bailers.

Keystone Sanitation Landfill — **Union Township, PA**
Landfill gas sampling with Air Con purge pumps and Summa Canisters.

Kodak-Former Sterling Winthrop Facility — **Trenton, NJ**
Groundwater sampling utilizing non-dedicated Grundfos submersible pumps and dedicated bailers.

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R. Stephen Anderson

Mayflower Cleaners **Princeton, NJ**
Groundwater sampling utilizing non-dedicated Grundfos submersible pumps and dedicated bailers. Surface water sampling.

Military Ocean Terminal Bayonne **Bayonne, NJ**
Groundwater sampling utilizing non-dedicated Grundfos submersible pumps, implementing low-flow sampling techniques.

PJP Landfill **Jersey City, NJ**
Groundwater sampling utilizing both dedicated Well Wizard bladder pumps and non-dedicated Grundfos submersible pumps.

PSE&G Former Bordentown Gas Works **Bordentown, NJ**
Groundwater sampling utilizing both non-dedicated portable Well Wizard bladder pumps.

Woodlands Superfund Sites **Woodland Township, NJ**
Groundwater sampling utilizing dedicated Well Wizard bladder pumps, implementing low-flow sampling techniques. Surface water sampling.

R2-0002361

Name: R. Stephen Anderson Jr.
Student No: 38110
Soc Sec No: 219-72-2625
Birth Date: 12/15/68
Degree(s) Earned: BS 12/20/90

WHEATON COLLEGE
Wheaton, Illinois 60187

ACADEMIC TRANSCRIPT

Date printed: 01/04/91

Dept	No	Type	Title	Hrs	Grade	Grade Pts	Sem GPA	Cum GPA	Grad Sem	Grad Cum
			FALL 1987							
			Achievement Exam equivalent to							
			College Algebra (2hrs M2630)							
			Biology non lab (2hrs BY630)							
ART	101		ART SURVEY	2	A-	7.4				
BIOL	231		COLLEGE BIOLOGY I	4	B+	13.2				
BITH	111		THEOLOGY OF CULTURE	2	A	8.0				
CHEM	231		GENERAL CHEMISTRY I	4	B	12.0				
CSCI	235		INTRO COMPUTER SCI	2	A-	7.4				
ENGW	104		WRITING EFFECT PROSE	2	B	6.0				
P E	000		SWIM TEST	0	P	0.0				
P E	101		FOUNDATIONS	1	A-	3.7				
			Hours Earned = 17 GPA Hours = 17				*3.39*	*3.39*		
			SPRING 1988							
BIOL	232		COLLEGE BIOLOGY II	4	B-	12.0				
CHEM	233		INORG/ANALTYCL CHEM	4	B-	10.8				
ENGL	101		LIT OF WESTERN WORLD	4	B+	13.2				
SOC	215		INTRO TO SOCIOLOGY	4	C+	9.2				
			Hours Earned = 16 GPA Hours = 16				*2.83*	*3.12*		
			FALL 1988							
BITH	213		NT LIT & INTERP	4	A	16.0				
CHEM	341		ORGANIC CHEMISTRY I	4	A	14.8				
HIST	102		HIST OF CIVIL CHINA	6	A	22.2				
P E	105		WEIGHT TRAINING	1	A	4.0				
			Hours Earned = 15 GPA Hours = 15				*3.80*	*3.33*		
			SPRING 1989							
BIOL	284		INTRO TO RESEARCH	2	A-	7.4				
BIOL	356		GENETICS	4	B+	13.2				
CHEM	342		ORGANIC CHEMISTRY II	4	B	10.8				
COMM	101		PUBLIC SPEAKING	2	B	5.4				
P E	232		CROSS COUNTRY SKIING	1	A	4.0				
P E	242		WILDERNESS SKILL	1	A	4.0				
PSCI	205		INTRO POLITICAL SCI	4	B+	12.0				
			Hours Earned = 18 GPA Hours = 18				*3.16*	*3.28*		
			SUMMER 1989							
BIOL	351		GENERAL ECOLOGY	4	A	14.8				
BIOL	385		SYS BIOL/BLACK HILLS	4	A	16.0				
BIOL	385		SYS BIOL/BLACK HILLS	2	A	8.0				
			Hours Earned = 10 GPA Hours = 10				*3.88*	*3.36*		
			FALL 1989							
ARCH	211		INT ARCHAEOLOGY	4	A	16.0				
BIOL	331		ANIMAL PHYSIOLOGY I	4	B+	13.2				
GERM	103		ACCEL ELEM GERMAN	4	B	10.8				
MUIS	101		INTRO TO MUSIC	2	B	6.0				
P E	136		BIKING/CLIMBING	1	A	4.0				
			Hours Earned = 15 GPA Hours = 15				*3.33*	*3.36*		
			SPRING 1990							
BIOL	314		ENVIRONMENTL SCIENCE	2	A	8.0				
BIOL	482		POPULATIONS/EVOLUTN	2	A-	7.4				
BITH	315		CHRISTIAN THOUGHT	4	A	16.0				
GERM	201		INTERM THEOL GERMAN	4	A	14.8				

Continued on top of next page

R2-0002362

Name: R. Stephen Anderson Jr.
Student No: 38110
Soc Sec No: 219-72-2625
Birth Date: 12/15/68
Degree(s) Earned: BS 12/20/90

WHEATON COLLEGE
Wheaton, Illinois 60187

ACADEMIC TRANSCRIPT

Date printed: 01/04/91

Dept No	Type	Title	Sem Hrs	Grade	Grade Pts	Sem GPA	Cum GPA	Grad Sem	Grad Cum
		(Continued From page 1)							
PHIL 101		ISSUES/WORLD VIEWS	4	B	12.0				
		Hours Earned = 16 GPA Hours = 16				3.64	3.40		
		FALL 1990							
ARCH 314		INTRO NT ARCHAEOLOGY	2	A	8.0				
ASTR 301		PLANETARY ASTRONOMY	2	A	8.0				
B/EC 321		STATISTICS	4	B+	13.2				
BIOL 361		CELL/MOLEC BIOLOGY	4	B	10.8				
ENGL 102		LIT OF WESTERN WORLD	2	B+	6.6				
GEOL 312		ENVIRONMENTL GEOLOGY	2	A	8.0				
P.E. 361		FIRST AID & CPR	1	A	4.0				
		Degree Date: December 20, 1990							
		B.S., Degree GPA 3.41							
		Major: Biology							
		Hours Earned = 17 GPA Hours = 17				3.45	3.41		

CUMULATIVE SUMMARY

Undergraduate GPA: 3.41
GPA Hours: 124
Wheaton Earned Hours: 124
Transfer/Exam Hours: 0
Total Earned Hours: 124

END OF TRANSCRIPT - 01/04/91

R2-0002363

APPENDIX C

FIELD CALIBRATION LOG FORM

FIELD CALIBRATION LOG

Site _____
Location: _____
Project #: _____
Personnel: _____

Meter Model: _____
Meter Serial # _____
Date: _____
Start Time: _____

Parameter	Standard	Lot #	Exp. Date	Reading	Time	Adjusted To	Units	Comments
pH	pH 7.00						S.U.	
	pH 4.01						S.U.	
	pH 9.00						S.U.	
Conductivity	Air	NA	NA				mS/cm	
	1 mS/m						mS/cm	
Turbidity	D.I.	NA	NA				NTU	
	100 NTU						NTU	
Dissolved Oxygen	Zero %						mg/L	
	D.I.	NA	NA				mg/L	Temp.:

pH Check*	Standard	Lot #	Exp. Date	Reading	Time	Adjusted To	Units	Comments
1	pH 7.00						S.U.	
2	pH 7.00						S.U.	
3	pH 7.00						S.U.	
4	pH 7.00						S.U.	

Meter must be calibrated daily prior to initial use, at a minimum.

Signature: _____

* During use, meter must be checked against a standard pH 7.00 buffer every three hours. If the pH differs by more than ± 0.2 S.U. from the standard buffer value, the meter must be recalibrated.

R2-0002365

APPENDIX D

WINKLER WEEKLY DO CALIBRATION LOG

Golder Associates

WINKLER WEEKLY DO CALIBRATION LOG

Date	Start Time	End Time	Personnel	Sample Volume (mL)	Titration Cartridge ($N\ Na_2S_2O_3$)	Cartridge Expiration Date	Digit Multiplier	Digits Required	Winkler Do (mg/L)	Meter Model	Meter Serial #	Meter DO (mg/L)	Signature	Comments

APPENDIX E

SAMPLE FIELD INFORMATION FORM

LOW FLOW GROUNDWATER PURGE/SAMPLE FIELD INFORMATION FORM

Golder Associates

Site _____

Location: _____

Project Number: _____ Meter/Type/Serial #: _____

MONITORING WELL ID: _____ Meter Calibrated @: _____

Depth to Water Prior to Purging [ft-bmp]: _____ Sampling Date/Time: _____

Well Casing Diameter [in]: _____ Sampler(s): _____

Start Time (purging): _____ Sampling Device: _____

Purging Device: _____ Sample Characteristics: _____

Pump intake setting: _____ PID Measurement of Well Headspace (ppm): _____

As-Built Construction Well Depth [ft-bmp]: _____ Analytical Parameters: _____

Sounded Well Depth [ft-bmp]: _____

Weather Conditions: _____ Fe+2 result (field measurement): _____ PPM

Time [hh:mm]	Temperature [°C]	pH [std]	Specific Conductance Circle One [S/m] or [mS/cm]	Turbidity [ntu]	Dissolved Oxygen [mg/l]	Redox Potential Note - Indicate if (+) or (-) [mV]	Depth To Water [ft-bmp]	Volume Purged [liters]	Approximate Purge Rate [ml/min]	Observations (PID readings, sample characteristics, equipment problems, etc.)

Comments:

R2-0002369

MICROSEEPS, INC.

QUALITY SYSTEMS MANUAL

Controlled Copy No. _____

Signatures of Final Approval:

Ruth Welsh
Laboratory Manager

2/27/08
Date

Patrick McLoughlin Ph.D.
Quality Systems Manager

2-27-08
Date

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5.0	Facilities, Instrumentation, and Materials Procurement	7.0	1/15/08
6.0	Data Quality	5.0	2/15/08
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1.0 Introduction, Purpose, and Scope

1.1 Introduction

Microseeps, Inc. (Microseeps) recognizes its crucial role in providing reliability and excellence in the environmental analytical industry. The laboratory provides information necessary for engineering, industrial, and regulatory clients to make informed judgments and applicable policy decisions. The laboratory's analytical services also assist clients in complying with major environmental regulations. Microseeps' management acknowledges that uncompromising dedication to quality is fundamental to remaining a competitive force in the analytical services market.

1.2 Purpose

The purpose of this Quality Systems Manual is to outline a program of policies, procedures, and documentation, which assures that our analytical services meet a defined standard of quality on an ongoing basis. This document defines the standards under which all laboratory operations will be performed. As supplemented by Standard Operating Procedures (SOPs), the Quality Systems Manual describes the laboratory's organization, objectives, and operating philosophy.

Microseeps Quality Systems Manual contains references to the laboratory's policies and operational procedures that have been established in order to meet the quality requirements of the NELAC Standards and the following Quality Policy Statement.

1.2.1 Microseeps' Quality Policy Statement

Microseeps is an organization that provides information and environmental services to a very diverse client base. In all processes from initial customer contact to project completion, Microseeps aim is to offer clients a reliable product of the best quality that is delivered in a timely manner at a reasonable price. This Policy Statement represents a top level management commitment and shall be achieved using the following goals:

1. Production of accurate information.
2. Adherence to an ethical standard that demands continuous honesty and integrity.
3. Achievement of customer satisfaction.
4. Establishment of a documented trail to support the results.
5. Maintenance of a pleasant working environment where employees are treated equitably and fairly.

These goals are fundamental to all of Microseeps' actions.

The Standard Operating Procedures and Microseeps Quality Systems Manual detail the procedures for achieving these goals. Management personnel are charged with ensuring all applicable procedures are completed in the spirit of the Quality Policy. They are available to all employees to assist in applying these principles and to advise appropriate action. It is the responsibility of each Microseeps employee to consistently act as directed by the five goals of quality. Further, it is their responsibility to consult their immediate superior for direction if an issue arises for which the response is unclear.

If Microseeps' Director Level Management realizes that these goals are not achievable but the validity and appropriateness of client results is not jeopardized, we will inform affected clients of the situation and allow them to alter their employ of Microseeps' services accordingly. If the client's data are to be negatively impacted where the validity of the results is in question, or a clients' project is operationally or legally jeopardized, the following procedures shall be followed:

1. Concerned operations will be suspended.

2. Affected clients will be notified.

3. Alternative procedures for securing the requested services will be employed until the corrective actions are completed to a level that is consistent with Microseeps' documented procedures and is satisfactory to management.

To achieve these quality goals, all laboratory data must be properly documented, legally defensible, and supported by statistically defined and verifiable confidence limits. Falsification of data under any circumstance is unacceptable and is grounds for termination. Microseeps has an Employee Handbook which provides policies and procedures to help employees avoid involvement in any activities that would diminish confidence in Microseeps competence, impartiality, judgment and/or operational integrity.

Microseeps uses EPA-approved methodologies such as those found in Standard Methods and SW-846, whenever methods are available. If an EPA-approved method has not been specified, Microseeps will select an industry recognized and validated method for use or will develop an internal method based upon thorough research and good scientific methods. In all instances of scientific innovation, Microseeps recognizes the value of a firm commitment to quality and integrity.

1.3 Scope of Quality Systems Manual

This document serves as both the Microseeps, Inc. Quality Systems Manual and the Microseeps Laboratory Quality Assurance Plan. It contains both quality assurance policies and quality control procedures that are followed to ensure and document the quality of analytical data. This manual provides detail concerning quality management requirements employed at Microseeps

for the documented acquisition of samples, analysis of those samples via specific tests, the reporting of that data to the client, and the ultimate disposal of samples.

1.4 Scope of Services

Microseeps offers a comprehensive scope of laboratory analytical services to environmental consultants, industries, governmental agencies, and municipalities. The scope of services include:

Wastewater, storm water, solid waste, and hazardous waste analyses

- Metals analyses via ICP or Cold Vapor Atomic Absorption
- Semivolatile analysis via:

  GC/MS

- Volatile analyses via:

  GC/MS

- Ion analysis via Ion Chromatography
- Wet Chemistry analyses of 32 different analytes via a range of wet chemistry techniques.

Intrinsic Bioremediation Analysis

Training Seminars

Soil Vapor Extraction Analysis

1.5 Certifications

Microseeps holds the following certifications:

- National Environmental Laboratory Accreditation Program (NELAP): Pennsylvania
- Florida
- Connecticut
- West Virginia
- South Carolina

- Louisiana
- New York
- New Jersey
- Kentucky

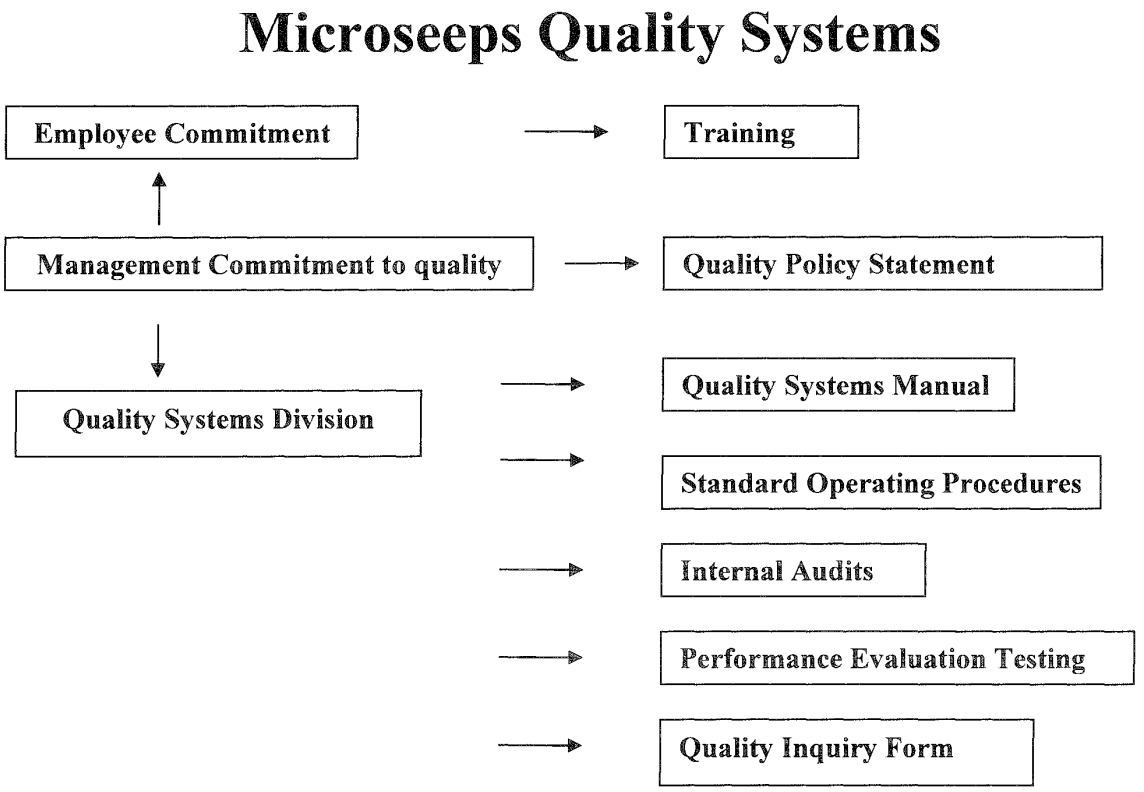
Specific parameter lists for the various certifications are available from the Customer Service Department upon request.

2.0 Quality Systems – Establishment and Audits

2.1 Establishment of a Quality System

Microseeps has established a quality system based upon the fundamentals of good laboratory practices and the requirements outlined in Chapter Five of the National Environmental Laboratory Accreditation Program. Although Microseeps provides a variety of environmental services, Microseeps' Quality System has been designed according to the type, range, and volume of analytical testing activities undertaken in the laboratories. This section describes Microseeps' Quality System and outlines the policy and procedures for implementing corrective action when non-conforming work or departures from policies and procedures occur.

2.2 Elements of Microseeps Quality System



This flowchart shows the general elements of Microseeps Quality Systems. Each area of this flowchart is addressed or referenced in this Quality Systems Manual.

2.2.1 Quality Manual Review

The Microseeps Quality Systems Manual is reviewed annually for accuracy and applicability. These records are maintained in the Quality Systems Coordinator's Office. All revisions will be conducted in accordance with Microseeps Standard Operating Procedure for Document Control.

2.2.1.1 Document Control

Document control procedures are specified in Microseeps Standard Operating Procedure for Document Control SOP-ADM 5. The Standard Operating Procedure outlines document control procedures for generating, formatting, revising, approving, tracking, distributing, indexing, archiving, and destroying controlled documents, including the Quality Systems Manual.

2.2.2 Internal Audits

Technical audits serve to verify compliance with method-specific procedures including operations related to test methods. Any audit that is conducted on an operation that is involved with data generation and the assurance of its quality is a technical audit. System audits function to verify compliance with the laboratory's quality system. Types of procedures that would be reviewed as a part of a systems audit could include: (1) response to complaints; (2) sample tracking methodologies; and (3) sample acceptance policies.

The Quality Systems Department will conduct all technical and system audits. Audits will be conducted under the direction of the Technical Director and shall be conducted by individuals who are independent of the activity to be audited. All internal auditors shall be trained and qualified in the areas in which they will be conducting the audit.

2.2.2.1 Audit Frequency

Internal Audits are scheduled and conducted by the Quality Systems Division and may either be scheduled or unannounced. Microseeps conducts internal technical audits and internal system audits at least monthly. The audits are conducted to insure that Microseeps' operations continue to comply with the Quality Systems requirements specified in the Quality Systems Manual and Standard Operating Procedures. The Quality Systems Coordinator maintains an audit schedule to ensure that all laboratory groups and programs are audited.

2.2.2.2 Procedures for Internal Audits

Audits will be conducted on analytical groups or systems according to the annual audit schedule posted in the Quality Systems Coordinator's Office. Immediately prior to starting the audit the Laboratory Director will be notified. Microseeps' Standard Operating Procedure ADM-4 for Internal Laboratory Audits outlines the specific procedures for conducting an internal audit.

According to the SOP, the audit is performed using the appropriate audit check sheet as a guide. The audit check sheet will be selected and used as the auditing guide for the area that is to be audited. The audit check sheets delineate the activities and records that will be reviewed. The sheet is completed and additional notes are made by the auditor based upon observations, interviews, and record reviews.

2.2.2.3 Internal Audit Findings and Corrective Action

Using the audit check sheets and supplementary notes, an Internal Audit Report (Figure 2-1) is prepared by the Quality Systems Coordinator. The Internal Audit Report contains an overall summary of the audit, including both items of a positive nature, as well as deficiencies. The cause of each deficiency is determined using Root Cause Analysis. Root Cause Analysis is the foundation upon which all Corrective Action is based. This process and an example are outlined in Figure 2-2 in this Quality Systems Manual.

Corrective Action based upon the root cause analysis is indicated on a Corrective Action Report (see Figure 2-3). A Corrective Action Report is prepared for each deficiency listed on the Internal Audit Report. The Internal Audit Report and Corrective Action Report are forwarded to the appropriate Department Head for corrective action. A follow-up audit is conducted.

If the audit was of a technical nature, the Audit Report will be forwarded to the Laboratory Director. The Laboratory Director will meet with the Analytical Division the first business day following the audit. The audit will be discussed along with the recommendations for corrective action. Corrective action is expected to take place immediately or as soon as possible following the audit. A follow-up audit of any deficient area(s) will be conducted within one week of audit completion, or as soon as corrective action is completed in order to monitor the effectiveness of corrective action.

Where any audit findings or defective measuring or test equipment may cast doubt on the correctness or validity of the laboratory's calibrations or test results, Microseeps shall take immediate corrective action as specified in Microseeps' Quality Policy Statement. If the subsequent investigation shows that laboratory results have been affected, the affected client shall be notified in writing by the Customer Service Office.

2.2.2.4 Work Stoppage

The Technical Director has the authority to stop any work that is found to be unsatisfactory or to prevent reporting of unjustifiable results. The work will not be ordered to commence until corrective action is taken that insures satisfactory work and reliable results according to the Technical Director's discretion.

2.2.3 Performance Evaluation Audits

Performance evaluation audits enable Microseeps to measure the precision, accuracy, and comparability of laboratory-generated data through the use of blind reference materials. Microseeps participates in performance evaluation studies required by the EPA and several state agencies. Performance evaluation studies are completed as required to maintain necessary certifications, and as required as an integral part of an internal audit at the Technical Director's discretion.

Performance evaluation studies for all accredited parameters are planned for testing twice each year. The Quality Systems office maintains EXCEL spreadsheets of results so that trends are easily noticeable.

In situations where the analyst is to know that a performance evaluation is being conducted, the analyst prepares the samples according to the instructions provided. If the PE is to be a blind audit, the Quality Systems Department prepares the samples. The samples are analyzed as soon as possible after opening the vials to avoid sample deterioration. Prior to reporting the results to the appropriate agency, the Laboratory Director and the Quality Systems Manager evaluate results of the performance evaluation samples.

2.2.3.1 Performance Evaluation Findings and Corrective Action

Once the evaluation report from the Performance Evaluation Provider or appropriate agency is received, the Quality Systems Coordinator forwards the findings to the Technical Director. The Laboratory Director is informed of the report and unacceptable results are investigated to determine the root cause of the failures. The following points are addressed during the investigation:

- Potential for reporting/calculation errors
- Preparation of calibration standards
- Evaluation of quality control data associated with the analysis
- Evaluation of analytical technique and instrument performance

Additional Performance Evaluation samples may be submitted for analysis if the Technical Director and Quality Systems Manager determine it is necessary to ensure that an analytical method, technique, or instrument performance problem is corrected.

2.2.4 External Audits

External Audits are conducted as necessary to retain laboratory certifications or at a client's request. The Technical Director is the liaison between Microseeps and an external auditor. The Technical Director is responsible for notifying the laboratory staff of upcoming audits. This notification will include the agency that will perform the audit, the reason for the audit, the dates involved, and the areas of concern.

During the audit, laboratory personnel will be available to the auditor as requested, as will any documentation necessary for the auditor to obtain sufficient information to effectively evaluate the laboratory. If laboratory information of a proprietary nature is necessary to complete an audit, the auditor will be required to complete and sign Microseeps Confidentiality Agreement.

2.2.4.1 External Audit Findings and Corrective Action

The Technical Director will prepare a report summarizing the findings of the post audit meeting. Following review of this report, any deficiencies noted by the auditor that affect the validity of data in any area will be addressed immediately. Corrective action will be taken to eliminate the cause of a deficiency and to prevent recurrence. The Corrective Action process shall identify and implement corrective actions to eliminate the root cause of the deficiency. The development and implementation of a corrective action plan shall not be contingent upon the receipt of the external auditor's report.

When the External Audit Report is received at Microseeps, deficiencies will be addressed in the order of their priority as determined by the auditor. The Technical Director will prepare a response plan for correcting the reported deficiencies and will submit a Corrective Action Plan to the auditing agency. Corrective action will be taken according to the timetable outlined by the Technical Director.

2.2.5 Managerial Review

Laboratory Management shall conduct a review of the Quality System and its testing and calibration activities. This review shall be conducted to ensure the Quality System's suitability and effectiveness and to introduce any necessary changes or improvements in the quality system and laboratory operations. This review shall be conducted annually by department level management or higher.

The review will be conducted in the same manner as an Internal Systems Audit, but the auditors will be made up of department level management. Microseeps' Standard Operating Procedure ADM-4 includes an Audit Check Sheet for the Managerial Review Process, which outlines the review procedure.

2.2.5.1 Managerial Review Findings and Corrective Action

The review findings shall be documented on an Audit Report Form and submitted to the Technical Director for review. The Technical Director shall review the Audit Report with the Quality Systems Department. Corrective Action Reports will be generated for the audit deficiencies and will be resolved as necessary. A timeline for resolution is specified on the Corrective Action Report and the review findings become an item for discussion at the Board of Directors meeting where management ensures the corrective actions are completed.

2.2.5.2 Board of Directors Meetings

Regular discussions of quality assurance issues are necessary to provide a forum in which upper management are informed of problems and changes that affect the laboratory operations. The Technical Director regularly provides a report to the President, Senior Vice President, Director of Operations, and Director of Sales to discuss quality issues. These meetings serve as a general review of factors affecting quality and will include the following topics at a minimum:

- Personnel changes
- Instrument changes
- Internal and External Audit findings
- Certification changes
- Testing and calibration activities
- Quality System implementation activities and progress

2.2.5.3 Documentation

At the end of the meeting, the Technical Director will document the results of the meeting, prepare a summary of the discussion, and set an agenda for additional follow-up, if required. This report shall serve as documentation of management commitment to the Quality System. A report of each meeting will be kept on file in the Quality System Coordinator's Office.

2.3 Additional Quality Control Checks

In addition to periodic audits, Microseeps ensures the quality of results provided to clients by implementing additional checks to monitor the quality of the laboratory's analytical activities. Some of these checks are as follows:

- Use of certified standards in many of our quality control samples
- Replicate testing using the same and different test methods
- Correlation of results for different but related analysis of a sample
- Participation in Proficiency Testing

2.4 Audit and Review Documentation

All audit records shall be kept on file in the Quality Systems Coordinator's Office. These records shall be available for external auditors, as well as, individuals involved in a Managerial Review of the Microseeps Quality System. This documentation will include:

- Audit Check Sheets
- Audit Report Forms
- Corrective Action Reports

2.5 Quality Inquiry Forms

Microseeps has instituted a procedure for reporting when departures from documented policies, procedures, and quality control have occurred. The Quality Inquiry Form QIF (see Figure 2-4) is a means for anyone in the company to communicate quality concerns to the Technical Department. These forms are a unique part of Microseeps' Quality System, which provide an avenue for all employees to reflect a genuine concern for quality throughout the company. The QIF is also used to document Customer Complaints and initiate the process of resolving those complaints. All items pertaining to the Customer complaint shall be recorded on the QIF including investigation results and resolution to the satisfaction of the client. All QIFs that deal with Customer Complaints shall be kept on file in the Customer Service Office.

Note: If the quality concern can be corrected by the person who discovered the quality problem, a CAR should be completed in lieu of a QIF.

2.6 Corrective Action

An integral part of Microseeps' Quality Systems Program is the system for identifying, reporting, and correcting deficiencies in the laboratory operation. There are several areas in the laboratory that may require corrective action. It is the responsibility of every employee to be aware of potential problems and to notify the appropriate personnel of situations requiring corrective action.

2.6.1 Problem Isolation and Identification

Identification and isolation of problems in the laboratory are not always easy tasks. The need to perform corrective action may become apparent at any point of the analytical process. Corrective action should be initiated and documented as soon as a problem becomes evident. The analyst at the bench detects some situations such as malfunctioning equipment. Corrective action for these situations takes the form of repairing the instrument, either internally or through the use of a service call. The corrective action is documented in the instrument maintenance log and the data obtained just prior to the failure is closely scrutinized for acceptability.

Other situations may not be easily identifiable. For example, systematic drift or sensitivity fluctuations may not be identified until the time that data is validated. Other occurrences that may trigger the need for corrective action include the following:

- Recoveries for surrogates, matrix spike, matrix spike duplicates, and laboratory control standards outside of acceptance limits.
- Percent differences for duplicate analyses outside acceptance limits.
- Trends noted in quality control data.

Out of control events that concern sample analysis and data generation must be documented in a Case Narrative, which becomes a permanent part of the client's project file and final data report.

2.6.2 Sample Handling Problems

Problems involving sample handling may include missing or broken containers, discrepancies between the chain of custody and actual shipment, improperly preserved bottles, insufficient volume, and missed holding times. When one of these problems is identified, a Non-Conformance Form is completed and acted upon in accordance with the Standard Operating Procedure for Sample Receiving (SOP-S2). If necessary, the client is contacted to discuss possible resolutions to the problem. The Non-Conformance Form becomes a part of the client's permanent file.

2.6.3 Sample Analysis Problems

Problems incurred during sample analysis may bring procedures and data into question. These problems may include the following:

- Unacceptable calibration
- Improper procedures
- Unacceptable blank, LCS, and/or surrogate recovery
- Quantitation error
- Required QC not performed
- Retention time shifts

Resolving these problems may include preparing and analyzing the samples a second time, re-calibrating the instrument, or making new standard solutions and reagents. Standard Operating procedures detail corrective action steps that are specific to an analytical procedure. The documentation becomes part of the client's permanent file.

The person identifying the problem documents the situation and identifies possible sources of the problem. If this individual can immediately correct the situation, for example, by re-calibrating the instrument, they will do so and document the action that was taken in the case narrative. If the problem cannot be corrected immediately, the person documents the situation and notifies the Laboratory Director. The Laboratory Director is responsible for ensuring that the appropriate corrective actions are followed.

2.6.4 Corrective Action Reports

A Corrective Action Report (CAR) will be completed for each audit deficiency, legitimate issue reported on a Quality Inquiry Form, and any systemic out of control event that occurs. The Quality Systems Coordinator is responsible for maintaining a supply of forms. To track the corrective action, each CAR will be given a unique identifier in the form of YY-XXXX where:

- YY = the year in which the CAR was initiated and
- XXXX = is the sequential number of the record starting with 0001

2.6.4.1 Corrective Action Report Initiation and Procedures

A Corrective Action Report may be generated by anyone in the company who discovers and can correct a systemic out of control event. There are two types of situations in which an employee will generate a CAR. First, when the root cause is obvious to the person who discovered the out of control event, and secondly when the root cause is not obvious.

In the first situation, the person who discovers an out of control event shall institute and document corrective action by completing the top portion of the CAR (above the dotted line). They will enter their name, the current date, a description of the event that needs corrective action, and the specific corrective action that was taken. The Lead Analyst or Department supervisor shall be notified of the event and the corrective action necessary to solve the non-conformance. The person who completes the corrective action shall sign the form and forward it to their immediate supervisor for a signature. The form will then be forwarded to the Quality Systems Department for cataloging. If additional action is required, the form shall be returned to the department concerned and returned to the Quality Department when corrective action is complete.

If the root cause is not immediately obvious, the Quality Systems Department shall be notified immediately to assist in Root Cause Analysis and determining the appropriate corrective action.

The Quality Systems Department will forward a copy of the CAR to the Laboratory Director. If it is determined that the client needs to be notified of the incident, the Quality Systems Department shall forward a copy of the CAR to the Customer Service Department for further action.

2.6.4.2 External Audits and Performance Evaluation Studies

The Technical Department will initiate CAR(s) in response to third party audits and deficiencies on performance evaluation studies. In the case of third party audits, if the resolution to the finding is easily identifiable, the Technical Director will discuss the situation with the Laboratory Director and the corrective action will be implemented. If the finding concerns a procedural change or is interdisciplinary, the Technical Director will form a task team to investigate the problem and develop an appropriate course of action. The task team's findings will be presented to the Technical Director for discussion and possible implementation. Once a corrective action plan is implemented, the situation will be monitored for a reasonable period of time to ensure that the action has been effective.

The Technical Director will prepare a report for management that summarizes all corrective actions (See Figure 2-5). The report will provide a brief description of the problem, the steps that are being taken to correct the situation, and the status of the item.

2.7 Preventive Actions

The preferred course of laboratory quality and improvement is to identify opportunities for improvement rather than react to the occurrence of problems or complaints. Microseeps is continually seeking ways to improve its performance and product. When these areas are identified,

a plan is developed by the staff, usually the Technical Director, Laboratory Manager, or Manager of Technical Systems. Preventative actions are implemented according to the time table specified in the plan and monitored at weekly Operations Meetings. Preventive action procedures include follow-up actions and applications of controls in order to ensure effectiveness.

2.8 Management Arrangements for Permitting Departures from Documented Procedures or Standard Specifications

It is Microseeps management's intent to ensure that documented procedures are followed. Rarely, a situation may occur that requires a departure from documented quality procedures. When this type of situation occurs, the Technical Director and Laboratory Director, and any other manager whose department may be affected, will discuss and unanimously agree upon the action to be taken. The departure will be documented in memo form and kept on file in the Quality System Coordinator's Office. Corrective action will be taken as soon as possible to prevent the necessity of the departure from reoccurring.

Figure 2-1

Internal Audit Report

Audit Date: _____ **Department:** _____

Division: _____ **Auditors:** _____

Lead Analyst/Supervisor: _____

Employees Present: _____

_____

Audit Summary:

Overall Rating (circle one): **Excellent** **Good** **Fair** **Poor**

Areas of Excellence:

Deficiencies:

(Listed by sequential numbers)

Technical Director Signature: _____ **Date:** _____

Figure 2-2

Root Cause Analysis

Deficiencies are always analyzed from the non-conformance back to the root cause as follows:

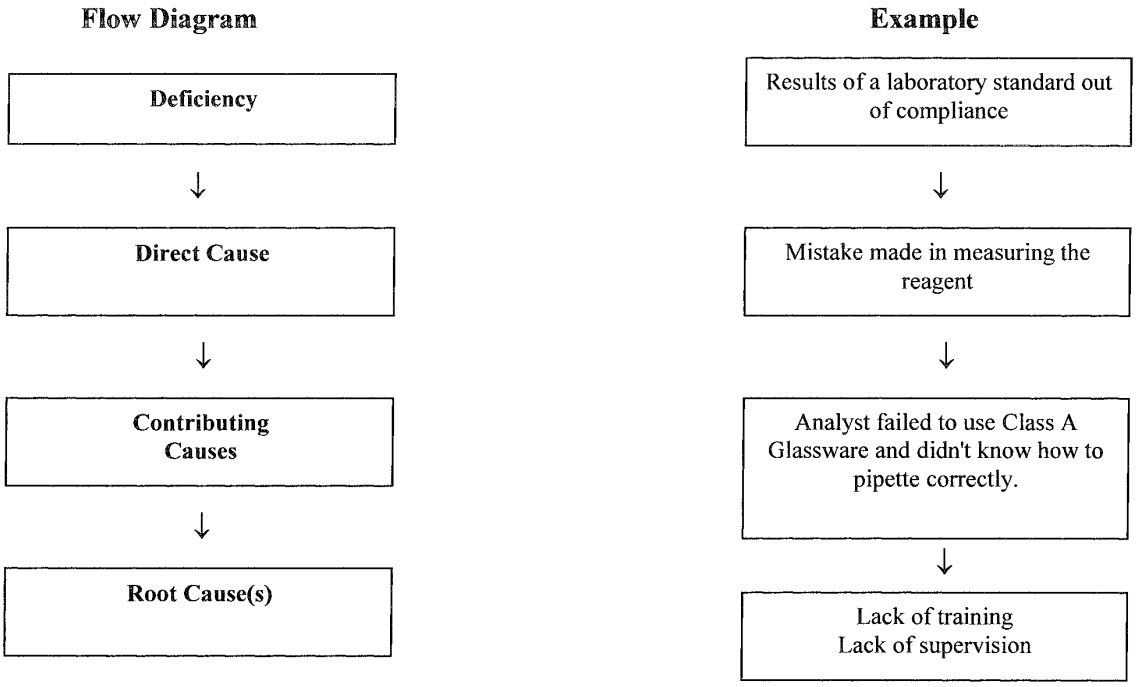


Figure 2-3

Corrective Action Report

This form is to be initiated by the person who discovers an event that needs corrective action. Please complete only the portion of the form above the dotted line. When complete, forward to the Quality Systems Department.

Initiated by: _____ **Date:** _____
Print Name

Description of the event needing corrective action and corrective action required.

Root Cause: _____

This Corrective Action must be acted upon in the time frame indicated below:

Immediately ___ **One Week** ___ **Two Weeks** ___ **Other** _____
Est. Date

Corrective Action Taken: **Due Date:**

Action Completed by: _____ **Date:** _____

Supervisor Review: _____ **Date:** _____

Project #: _____ **Sample Numbers:** _____

Additional Action: is___ is not ___ necessary. Customer Contact: is___ is not ___ necessary.

Action Closed: _____ **Date:** _____

cc: Laboratory Director, Technical Director **CAR #** _____

Figure 2-4

Quality Inquiry Form

This form is to be used as a means to communicate quality issues within the company and as a means of documenting customer complaints. The first resource to resolving any internal concern is direct communication. This form is provided as a means to pass inquiries to the Technical Department when direct communication is inappropriate or ineffective. Please fill out as completely as possible and forward to the Technical Director.

Date of inquiry _____

Concerned Department:	Customer Service	Organics	Bottle Preparation	Risk Vapors
	Metals	Extractions	Wet Chemistry	Risk Waters
	General	Management	Quality Systems	Receiving

Please categorize the issue (Please circle one of the following numbered items):

Procedure related

1) Failure to follow SOP
2) Improper SOP
3) No SOP known

Record keeping related

4) Items not or improperly recorded
5) Records improperly stored
6) Records improperly handled (lost, insecure, removed from building)

Client Communication related

7) Client was knowingly promised the unachievable
8) Client's request was disregarded
9) Information was inappropriately kept from client
10) Report was incomplete or inaccurate
11) Other client complaint (describe below)

Internal Communication related

12) Internal chain of command (as per organizational chart) not followed
13) Client's request not passed to appropriate personnel
14) Supervisor was unresponsive
15) Redundant efforts were caused by poor communication among analysts

Please describe the issue and means taken to resolve (use other side if necessary):

_____

_____

_____

_____

Figure 2-5

Quality Systems Update and
Corrective Action Summary Report
To Management

1. **Brief Description of audit deficiencies and quality inquiry forms:**

CAR #	Date	Deficiency	Resolution	Update

2. **Steps being taken to remedy the deficiency:** (Obtain information from other Management Team members who have unresolved CAR's and update them on status of Technical Directors'.)

3. **Other items for discussion as they pertain to quality:**

- **Personnel changes**
- **Instrument changes**
- **Upcoming Audits**
- **Certifications**
- **Quality System implementation activities and progress**

file:C\My Documents\Forms\Corrective Action Summary Report

3.0 Organization and Management

Microseeps is a small business as defined by Standard Industrial Classification 8734. Since Microseeps is a business that must compete in a marketplace characterized by merger and consolidation, it is even more important to have an efficient organization with well-defined responsibilities. The purpose of this section is to describe the organization and management structure of Microseeps, interdepartmental and intradepartmental relationships, and to detail employee responsibilities and qualifications.

3.1 Microseeps Organization

Organizations must have a framework within which to achieve their objectives. Organizational structure determines the configuration of positions, duties, and channels through which performance is controlled and authority is delegated. It is crucial that a company use a structure that enables it to realize competitive advantages.

In order for Microseeps to achieve its stated objectives for the quality of its analytical services, all employees must be able to function within a structure that provides an emphasis on quality from a technical standpoint. A functional organizational structure is specifically suited to this purpose.

3.1.1 Organizational Structure

Microseeps' organizational structure is functional. This type of structure is centralized, which restricts decision-making authority to higher levels of management. Company organization is departmental and is specialized and arranged according to function. Because of the nature of the individual departments, some authority is delegated to individuals who lead smaller groups within the larger departments.

The Quality Systems Department Manager reports directly to the President and CEO. Sales, Finance, and other administrative departments are overseen by the Board of Directors. Microseeps' Organizational Chart is depicted in Figure 3-1.

3.1.2 Interdepartmental Relationships

Responsibility and dedication to quality laboratory practices and procedures begin at the highest level of management. It is the duty of the President to assure that the framework is in place to provide quality systems guidelines. It is the duty of Microseeps managers to implement the policies and procedures and to see that they drive the activities of the laboratory.

3.1.2.1 Operations Department

The Vice President of Operations oversees the following departments: 1) Operations; 2) Technical Services; 3) Customer Service; and 4) Information Technology. The Laboratory Manager oversees the analytical work groups in the laboratory. The Manager of Customer Service oversees all of the

Customer Service functions. The Manager of Technical Services is responsible for equipment maintenance and regulatory method development.

3.1.2.2 Quality Systems Department

The Quality Systems Department operates outside of the scope of the Operations Department in lines of authority. Responsibility for the Quality Systems Department falls upon the Quality Systems Manager who reports directly to the President. The Quality Systems Manager is responsible for the following work:

1) Quality Systems
2) Research and Development

The Quality Systems Coordinator is administratively responsible for quality assurance and quality control, and may serve as the Quality Systems Manager's representative in his absence.

3.1.3 Intradepartmental Relationships

The Quality Systems department has a quality assurance and quality control role to fulfill within each department at Microseeps. Discrepancies in quality in any department will be relayed from the Quality Systems Manager to the appropriate Department Head using a format that is appropriate for the type of discrepancy and recommending an appropriate corrective action. This may take the form of using an electronic "Help Desk" forum or using a Corrective Action Form.

3.2 Personnel Qualifications

All of Microseeps employees are responsible for complying with the applicable job specific quality assurance and quality control requirements. All staff are to familiarize themselves with the quality documentation and implement the policies and procedures contained in this Manual in their work. Each staff member, including contracted and additional technical and key support personnel should they be required, must demonstrate a combination of formal education and experience to satisfactorily perform their particular function, as well as, a general knowledge of laboratory operation, quality assurance, quality control, test methods, and records management. All personnel are placed in a work group or department with adequate supervision that ensures the employee works in accordance with the laboratory's Quality System. Documentation of employee proficiency for specific job functions and test methods is maintained in the Quality Systems Coordinator's Office.

The Laboratory Manager, based upon specific educational and experience requirements, makes laboratory job assignments. Laboratory analysts are assigned a job classification according to the level of formal education and related laboratory experience they possess.

Basic duties of key staff (those included in Figure 3-1) are discussed below. Complete job descriptions for key staff are contained in Appendix A of this Quality Systems Manual. Complete

documentation of all employee job descriptions is kept on file in Employee Personnel Files in the Senior Vice President's Office.

3.2.1 President and Chief Executive Officer

The President and Chief Executive Officer is responsible for overall company performance. He is responsible for new business development and the financial integrity of the company. The President and Chief Executive Officer represents Microseeps at trade shows and environmental conferences.

3.2.2 Senior Vice President

The Senior Vice President works closely with the President to provide overall direction for the laboratory operation. He is responsible for identifying potential new markets and shares the responsibility for the financial integrity of the laboratory with the President. Additionally, he approves capital expenditures and evaluates current market conditions to maintain the laboratory's competitiveness.

3.2.3 Vice President of Sales and Marketing

The Vice President of Sales and Marketing is responsible for meeting target sales goals, overseeing sales staff, and assists the President and Senior Vice President in developing sales and marketing strategies.

3.2.4 Vice President of Operations

The Vice President of Operations is responsible for implementing and enforcing laboratory policies and procedures. The Vice President of Operations delegates responsibility to the Department Heads, is responsible for the daily operation of each department of the laboratory, except Quality Systems, and is responsible for overseeing the routine expenditures and for maintaining the laboratory's budget.

3.2.5 Laboratory Manager

The Laboratory Manager is responsible for ensuring that Microseeps' goals of providing accurate and verifiable analyses are met. It is the Laboratory Manager's responsibility to ensure that all Operation's Department personnel have the required qualifications and training for their positions. Once qualified personnel are in place, the Laboratory Manager, in conjunction with the Quality Department, will be responsible for assuring that all employees are thoroughly familiar with the Quality Systems Manual and accepted laboratory practices. The Laboratory Manager oversees the daily management of the laboratory staff. A major component of this particular responsibility is the integrity of laboratory reports. The Laboratory Manager's qualified designee will review and approve all outgoing reports. The Laboratory Manager reports to the Vice President of Operations.

In the absence of the Laboratory Manager, the Vice President of Operations will assume these responsibilities.

3.2.6 Quality Systems Manager

In laboratory documents, the title Technical Director is used synonymously with Quality Systems Manager. The Quality Systems Manager is ultimately responsible for ensuring that the data produced by the laboratory are technically sound and of the highest quality possible. The Quality Systems Manager serves as the focal point for quality assurance and quality control and is responsible for the oversight and/or review of quality control data. This position notifies laboratory management of deficiencies in the quality system and monitors corrective action. The Quality Systems Manager reports directly to the President.

3.2.7 Manager of Technical Systems

The Manager of Technical Systems ensures that technical problems within the laboratory are resolved. This position is also responsible for ensuring instrument repairs are conducted in a timely and cost effective manner. The Manager of Technical Systems implements plans for method development and assists clients in data interpretation. The Manager of Technical Systems reports to the Vice President of Operations.

3.2.8 Manager of Customer Service

The Manager of Customer Service provides direction and supervision to ensure that clients receive the best service possible. This position reviews proposal submittals and proposes pricing strategies for potential projects. This position reports to the Vice President of Operations.

3.2.9 Quality Systems Coordinator

The Quality Systems Coordinator assists the Quality Systems Manager to ensure that Microseeps Quality Systems Policies and Procedures are being followed. This is accomplished by: (1) Reviewing data validation procedures; (2) Alerting the analysts should the need for corrective action exist; (3) Performing internal audits; (4) Establishing a periodic schedule for analyzing performance evaluation samples; and (5) Maintaining Quality Control records. The Quality Systems Coordinator reports to the Quality Systems Manager.

3.2.10 Sample Custodian

The Sample Custodian is responsible for properly receiving and logging-in all samples received at Microseeps and ensuring that storage and documentation requirements are met. This position also unpacks and marks the samples with the correct internal laboratory identification number so that the client's samples can be tracked through the laboratory. The Sample Custodian is responsible for documenting all discrepancies between samples received and accompanying chains of custody

and for notifying customer service so that the client may be contacted. The Sample Custodian reports to the Laboratory Manager.

3.2.11 Lead Analyst

The Lead Analyst assists in the daily supervision and training of staff analysts and technicians. Lead Analysts ensure that safety policies are followed and that any unsafe conditions are reported to the Company Health and Safety Supervisor. The Lead Analyst performs a broad variety of duties within a specific group or division. The Lead Analyst ensures that analysts strictly adhere to procedures outlined in the Quality Systems Manual and Microseeps Standard Operating Procedures. The Lead Analysts report directly to the Laboratory Manager.

3.2.12 Laboratory Analyst

Laboratory Analysts are responsible for retrieving samples from Sample Receiving at the direction of the Lead Analyst and observing all internal custody requirements. The analysts shall ensure that aliquots analyzed are representative of the entire sample. All analyses shall be conducted according to Microseeps Standard Operating Procedures. Responsibilities also include following good laboratory practices in carrying out duties assigned, and complying with all safety regulations applicable to their respective laboratories. Analysts report directly to their Lead Analyst.

3.2.13 Project Manager/Customer Service Representative

The Project Manager (Customer Service Representative) is responsible for overseeing in-house analytical projects. It is the Project Manager's responsibility to accurately communicate project requirements to the Laboratory Manager so that projects are logged-in, analyzed, and reported in the format, timeframe, and within the project-specific protocols required by the client. This position reports to the Manager of Customer Service.

3.2.14 Bottle Preparation

The Bottle Preparation Technician is responsible for accurately preparing sample containers in a timely and safe manner according to client specification. The Bottle Preparation person also maintains records of standing orders and ensures they are prepared for the courier and for shipment when appropriate. This position also prepares purchase orders for ordering supplies as needed. The Bottle Preparation person also maintains the Bottle Preparation room and storage area in a neat and orderly manner. This position reports to the Manager of Customer Service.

3.3 Contract Review, Design Control, and Quality Planning

The Customer Service Department shall use the flow diagram shown in Figure 3-2 as an initial review of all new work that comes in to the laboratory. A project manager shall be assigned to the project if so designated by the flow diagram. When the contract or scope of work specifies two or

more of the requests on the left side of the flow diagram, the assigned project manager shall initiate a Contract Review Checklist (see Figure 3-3) and forward it to the departments concerned.

The contract and/or scope of work shall be reviewed by each department concerned to determine if Microseeps has adequate facilities and resources to complete the work in the contract appointed time frame. Each department is to indicate on the form whether their department can or cannot meet the contract requirements, initial and date the form, and return it to the Project Manager within 24 hours of receipt of the checklist. If a department cannot meet the requirements of the contract or scope of work, the department head is to indicate the reason(s) for that decision on the back of the Checklist prior to returning it to the Project Manager.

The client shall be informed and a resolution discussed if the laboratory review of capability indicates any potential conflict, deficiency, lack of accreditation status, or inability on the laboratory's part to complete the clients work. Any differences shall be resolved to the satisfaction of the laboratory and the client prior to commencement of work.

All records of Contract Reviews, including any significant changes, are maintained in the Customer Service Contract files. Customer service also maintains records of discussions with the client relating to the client's requirements and the results of the work during the period of the execution of the contract. Correspondence with the client pertaining to laboratory activities for a project are maintained in the Client Project File. The client shall be notified of any deviation from the contract, including accreditation changes that affect the contract.

In the event that the contract needs amended after work has commenced, the same contract review procedures shall be repeated and any changes shall be communicated to all affected personnel.

Figure 3-1
Microseeps' Organizational Chart

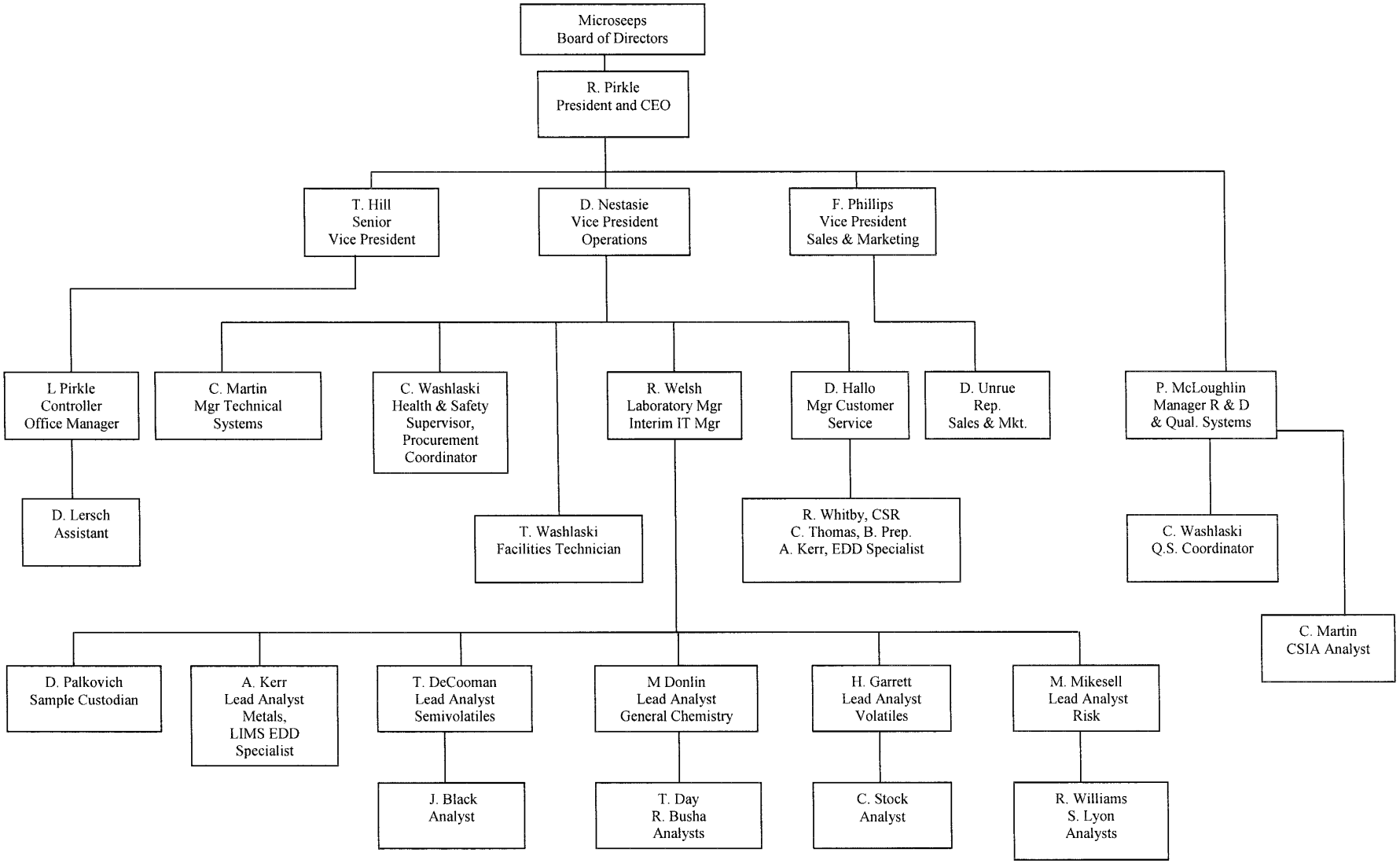


Figure 3-2

Flow Diagram for Contract Review, Design Control, and Quality Planning

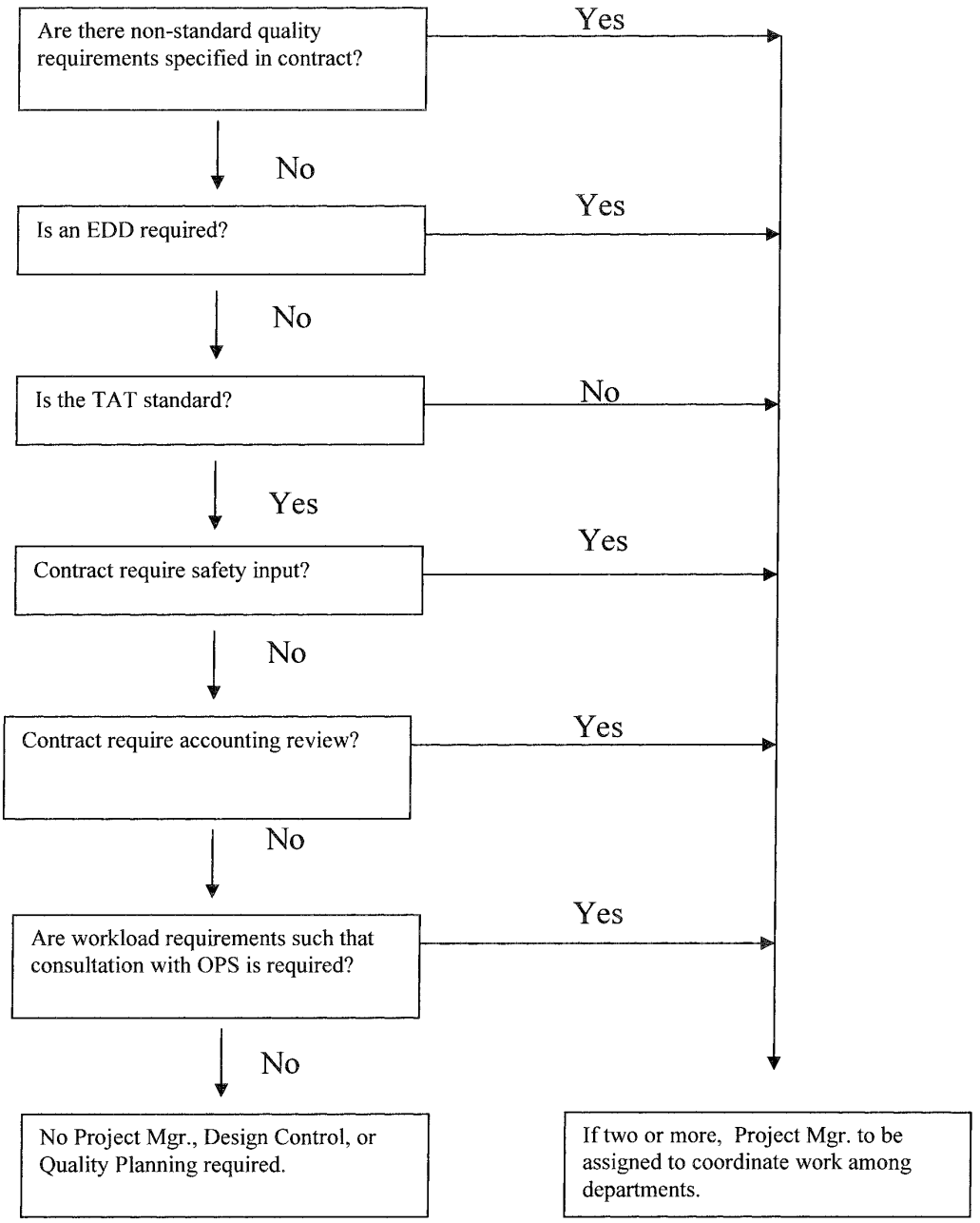


Figure 3-3

Contract Review Checklist

Please review the designated portion of the attached contract/scope of work and determine if your department/work group can or cannot meet all of the requirements of the contract.

Place an X in either the Can or Cannot column, date, and initial where indicated and return this form to the Project Manager within 24 hours of receipt.

Client Company: _____

Contact: _____

Microseeps PM: _____

Date Submitted	Department	Can	*Cannot	Date	Initials
	Operations: • Methods • Personnel • Detection Limits				
	Information Systems • EDD Format				
	Quality Systems • Certifications				
	Accounting • Payment terms				
	Safety • H & S Worksheet				
	Waste • Special requirements				

***Please note on the back of this page the specific reasons why your department may not be able to meet the requirements of the contract.**

4.0 Sample Management

The purpose of this section is to outline and reference procedures for the type and use of sample containers, the preservation of the samples, sample shipping, sample receipt, sample custody, sample log in, sample disposal, and analytical subcontracting. A list of analytical procedures conducted by Microseeps is found in Tables 4-1 through 4-3 at the end of this section. Certifications are found in Tables 4-4 and 4-5.

4.1 Sample Containers and Preservation

In order to provide the best possible service for the client and to obtain the required sample volume, Microseeps prefers to provide the sampling containers. Sample containers are constructed of either polyethylene or glass. Containers are purchased that are pre-cleaned and ready for use. Certified clean containers can be provided if project specifications require. Preservatives are added to most sample containers prior to shipping to the client, either by the bottle preparation technician, or the by the vendor. Clients are encouraged to completely fill each container in order to provide adequate sample volume.

4.2 Sample Packing and Shipping

Samples are either hand carried to the laboratory or shipped using commercial carriers. Samples should always be shipped to the laboratory daily using a reliable overnight shipping service.

The chain of custody is used to establish the identity of samples and to provide proof of possession of the samples by Microseeps. Chains of custody are supplied to the client with the sample bottle order. The following information should be recorded, by the client, on the chain of custody.

- Client Name, Address, and Phone Number
- Project Name
- Project Number
- Sample identification, Collection Time, Number of Containers
- Specific Analytical Requirements
- Sample Matrix
- To whom the analytical data shall be submitted
- Relinquish signature

Ice should be added so that a temperature of $\leq 6^{o}C$ is maintained during shipment. Samples should be packed inside a large bag and the bag should be sealed. Bags of ice should be placed on top of the bag and should not be in direct contact with the sample containers. Cooler temperatures are taken electronically and recorded upon receipt by the laboratory.

The chain of custody should be enclosed in the zip lock bag provided by Microseeps, and taped to the inside lid of the cooler.

A copy of Microseeps' Sample Acceptance Policy is included with each client bottle order (see below). In order to expedite the sample log in process, please be sure to include and accurately complete all paperwork that should accompany samples to the laboratory.

Sample Acceptance Policy

1. Samples that are shipped to Microseeps must be accompanied by proper, full, and complete documentation. This documentation shall be marked on a chain of custody and shall include: sample identification, the location, date and time of collection, sampler's name, preservation type, sample type, specific parameters to be analyzed, and any special remarks concerning the sample.

2. Sample labels shall be supplied by Microseeps or the client. Those labels must be water resistant and completed using indelible ink. Each sample label must include a unique identification number that links it to the chain of custody documentation.

3. Samples shall be in the proper containers with the preservatives that are specific to the type of analysis required.

4. All samples must be received within specified holding times. Clients are requested to notify a Microseeps' Customer Service Representative if samples with short holding times are being shipped.

5. Samples must arrive at Microseeps with sufficient volume to conduct the requested analyses. All bottles should be filled completely.

6. When problems with samples or documentation are found during the sample receiving process, a Non-Conformance Form is completed by the Sample Custodian and forwarded to the Customer Service Office. A Customer Service Representative will make every attempt to contact the client as soon as possible to make decisions concerning those discrepancies. The Non-Conformance Form is kept as a permanent part of the project file.

7. If the client cannot be reached, a message will be left either on voice mail, or with a receptionist, or via email for the client to return the phone call. The samples will be placed in a storage refrigerator and held until a Microseeps' Customer Service Representative gets a response from the client. (Exceptions will be made when samples are received that have short holding times and the samples are from a client with whom Microseeps has regular and frequent dealings. Or when the samples have short holding times and the samples are from a client with whom Microseeps has a signed contract, work order, or purchase order.)

4.3 Sample Custody

Microseeps takes custody of the samples when they are received at the laboratory or picked up at a client site by a Microseeps' employee. All samples are maintained in access-controlled areas until

work is started. The person responsible for either the sample preparation or analysis will retrieve the sample(s) from the storage area and return them when the function is complete.

4.3.1 Samples Requiring Secure Storage

For samples requiring locked storage and strict custody protocols (e.g. samples as evidence), the samples are locked in a temperature controlled sample storage cooler. When evidentiary samples are to be analyzed, the Sample Custodian initiates a sample tracking record (Figure 4-2), and the analyst signs them out using the complete sample number as generated by the LIMS to identify the samples taken.

After analysis, all remaining sample, sample extracts, or the empty sample container are returned to secure storage, signed back in on the sample tracking record, and placed back in the secure storage area until the client authorizes their disposal. Entries are made to the form each time a sample is removed and returned to the storage areas. Whenever sample preparations are completed, i.e. organic extractions and metals digestions, the sample preparation group adds them to the tracking record. All records of evidentiary samples are maintained until the client authorizes destruction.

4.3.2 Sample Receipt Protocols

The Sample Custodian or designee signs for each shipment and a copy of the shipping documents is retained. Specific sample receipt procedures are addressed in Microseeps Standard Operating Procedure for Sample Receipt (SOP-S2). A brief outline follows:

- Shipment containers are inspected, opened, and monitored for temperature, if applicable.
- Temperature is recorded on the Chain of Custody.
- Shipment containers are unpacked and samples reconciled with the chain of custody.
- Chain of Custody is signed.
- Non-conformances are resolved with the client.
- Samples are logged in to Microseeps LIMS system.

Specific sample log in procedures are outlined in Microseeps Standard Operating Procedure for Sample Log-In using the Laboratory Information Management System (LIMS). Microseeps LIMS assigns a unique internal project number and sequential sample numbers. These numbers are used to track the project through the laboratory. The sample numbers are transferred to each sample container using a computer-generated label. These numbers are documented on the chain of custody form and verified by the sample custodian. The computer generates a cooler receipt form, which is printed and placed in the project file along with the chain of custody and other related documentation.

All documentation relating to the project is maintained in the project file and retained in the laboratory for five years.

4.3.3 Resolution of Non-conformances

Sample receipt non-conformances are resolved according to Microseeps Standard Operation Procedure for Sample Receipt (SOP-S2). In nearly all cases, the client is contacted for the resolution decision and documentation.

Several possibilities may exist for resolving sample receipt problems. All decisions are the client's responsibility. Once a resolution is determined, the solution is noted on the non-conformance form and one or more of the following actions will occur:

- The log-in process will continue
- Written documentation will be requested from the client
- The sample(s) will be returned
- The sample(s) will be disposed

Throughout the problem resolution process, the sample will either be kept in a secure area or will be in view of the sample receipt personnel. All records generated during this process become a part of the client's permanent file.

When a client decides to proceed with analyses of samples that do not meet acceptance criteria, that decision shall be fully documented on the non-conformance form and the analysis data shall be "qualified" using a narrative on the final data report.

4.4 Sample Storage and Recovery

Samples requiring refrigeration are placed into temperature-controlled coolers that are maintained at $\leq 6°C$. The cooler temperature is recorded each morning and afternoon. Temperature logs are maintained for each cooler.

All samples for volatile analysis are segregated in a cooler away from other samples. All samples are stored separately from standards, reagents, food, and other potentially contaminating sources.

4.5 Sample Disposal

Once samples are analyzed, they are moved from a primary to a secondary storage area. Samples are stored in secondary storage areas for thirty days following the date an analytical report is generated. Samples are disposed or returned according to the procedures outlined in SOP-ADM 14, Microseeps Standard Operating Procedure for Waste Disposal.

4.6 Subcontracting Analytical Samples

Microseeps' Laboratory Manager or designee will notify the Project Manager when samples or extracts need to be sent to a subcontract laboratory, the number of samples to be sent, and the

duration of the need for subcontract services. The Project Manager or Customer Service Representative will notify the client in writing of the intent to subcontract samples. The Laboratory Manager will schedule the work with the subcontract laboratory and notify Sample Receiving about the specifics of shipping the samples.

The Laboratory Manager shall monitor the progress of the analytical work and receive the analytical data from the subcontract laboratory.

In the event of expedited turnaround that cannot be met by Microseeps, the Laboratory Manager shall initiate the subcontract laboratory procedure in order to meet the client's need.

4.6.1 Subcontract Laboratory Approval

The following procedures are in place to ensure that laboratories that are to be used for subcontracting analytical samples meet minimum requirements for quality as specified by the Quality Systems Department. Prior to approval of a subcontract laboratory, the Quality Systems department shall request the following information from the laboratory:

- List of current certifications and expiration dates of each.
- Copy of the Quality Assurance Plan for the subcontract facility.

Once this material has been received, it shall be reviewed by the Quality Systems Department and a decision will be made concerning the approval of the subcontract laboratory.

4.6.2 Client Notification of Subcontract Laboratory

There are various reasons why a subcontract laboratory may be used including, but not limited to, an expedited turnaround time, laboratory capacity, and special analysis. All clients shall be notified in writing when any samples are to be sent to a subcontract laboratory.

Where the laboratory subcontracts any part of the testing that is covered under NELAC, this work shall be subcontracted to a NELAC accredited laboratory. The laboratory performing the subcontracted work is indicated on the final report and non-NELAC accredited work is clearly identified.

TABLE 4-1

Container, Preservation, and Holding Time Requirements
(EPA Methods for Chemical Analysis of Water and Wastes Table I and SW-846 3rd ed. Revision 1, Table 2-21)

Parameter	Method	Container (1)	Preservative (2)(3)	Maximum Holding Time (4)
Acidity	SM2310B	P	Cool to ≤6°C	14 days
Alkalinity	SM2320B	P	Cool to ≤6°C	14 days
Anions by IC	SW846-9056	G, VOA with TLS	Cool to ≤6°C	48 hours for NO_2, NO_3 28 days for other anions
BOD CBOD	SM5210B	P	Cool to ≤6°C	48 hours
Chloride	SM 4500	P	Cool to ≤6°C	28 days
Chromium, Hexavalent	SM 3500	P	Cool to ≤6°C	24 hours
COD	HACH 8000	P	Cool ≤6°C ;H_2SO_4 to pH <2	28 days
Color	SM2120C	P	Cool to ≤6°C	48 hours
Cyanide, Total and Amenable to Chlorination	EPA 4500CN SW846-9010 SW846-9014	P	Cool to ≤6°C ; NaOH to pH >12(5)	14 days
Hardness	SM2340C	P	Cool to ≤6°C,HNO_3 to pH <2	6 months
MBAS (Surfactants)	SM5540C	P	Cool to ≤6°C	48 hours
Mercury	SW846-7470 EPA 245.2	P	Cool to ≤6°C , HNO_3 to pH <2	28 days
Metals, except Cr^{+6} and Mercury	SW846-6010 EPA 200.7	P	Cool to ≤6°C , HNO_3 to pH <2	6 months
Total Organic Nitrogen Ammonia Kjeldahl	SM 4500-N-C SM 4500 NH_3 SM 4500N3	P	Cool ≤6°C , H_2SO_4 to pH< 2	28 days
Nitrite	SM4500 NO_2-B	P	Cool to ≤6°C	48 hours
Nitrate/Nitrite	HACH 8192	P	Cool ≤6°C , H_2SO_4 to pH< 2	28 days
Oil and Grease	EPA 1664	AG	Cool ≤6°C , HCl to pH< 2	28 days
TOC/DOC	SW846-9060 SM 5310 C	G	Cool ≤6°C , H_2SO_4 to pH< 2	28 days
pH	SM 4500 H+ SW846-9040	P	Cool to ≤6°C	Immediate
Phenols	EPA 420.1 SW846-9065	AG	Cool ≤6°C ; H_2SO_4 to pH <2	28 days

TABLE 4-1, Continued

Parameter	Method	Container[1]	Preservative[2][3]	Maximum Holding Time[4]
Phosphorus: o-phosphate	EPA 365.3 EPA 365.1	P P	Filter immediately; H_2SO_4 to pH <2 Cool to ≤6°C	28 days 48 hours
TDS TSS TS Percent Solids TVS	SM 2540	P, G	Cool to ≤6°C	7 days
Conductivity	EPA 120.1 SW846-9050A	P	Cool to ≤6°C	28 days
Flashpoint	SW846-1010	P	Cool to ≤6°C	None specified
Sulfate	ASTM D516-2	P	Cool to ≤6°C	28 days
Sulfide	SM4500 S-F	P	Cool, ≤6°C; Zinc Acetate & NaOH to pH>9	7 days
Sulfite	SM4500 SO_3	P	Cool to ≤6°C	Immediate
Turbidity	EPA 180.1	P	Cool to ≤6°C	48 hours
Purgeable Halocarbons	SW846-5030 8260B EPA 624	G with TLS	HCl to pH<2, Cool ≤6°C	14 days
Purgeable Aromatics	SW846-5030 8260B EPA 624	G with TLS	HCl to pH<2, Cool ≤6°C	14 days
BNAs	SW846-3510 SW846-8270C EPA 625	AG with TLC	Cool to ≤6°C	7 days to extract then 40 days.

1. AG - amber glass, G - glass, P - polyethylene, TLC - Teflon-lined cap, TLS - Teflon-lined septum
2. Sample preservation should be performed immediately upon sample collection. Composite samples may be preserved by maintaining at ≤6°C until sample splitting and collection is completed.
3. If the dissolved content is to be measured, samples should be filtered on site immediately before adding preservatives.
4. The holding times listed are the maximum times that samples may be held before analysis and still be considered valid under EPA regulations. Holding times are measured from sampling.
5. For CN analysis, add 0.6 g ascorbic acid/liter sample if residual chlorine is present.
6. pH should be 6-9.
7. Add $Na_2S_2O_3$ if residual chlorine is present (0.008 percent).

TABLE 4-2

Container, Preservation and Holding Time Requirements for Soil, Sediment, Sludge

Parameter	Method	Container[1]	Preservative	Maximum Holding Time
Volatiles	SW846-5035 8260B	G with TLC Encore	Cool ≤6°C MeOH & $Na(SO_4)_2$	14 days
Semi-volatiles	SW846-3550B 8270C	G with TLC	Cool ≤6°C	14 days until extraction. 40 days after extraction.
Ammonia	Mod. 4500B	G with TLC	Cool ≤6°C	28 days
Flashpoint	SW-846-1010	G with TLC	Cool ≤6°C	Not specified
Mercury	SW846-7471	G with TLC	Cool ≤6°C	28 days
Oil and Grease	SW846-1664	G with TLC	Cool ≤6°C	28 days
Paint Filter	SW846-9095	P	Cool ≤6°C	Not specified
Percent Solids	SM2540F	G with TLC	Cool ≤6°C	7 days
pH 1:1	SW846-9045C	G with TLC	Cool ≤6°C	Immediate
Phenol	SW846-9065	G with TLC	Cool ≤6°C	28 days
Cyanide Reactive	Definition	G with TLC	Cool ≤6°C	14 days
Cyanide Total	SW846-9010B/ 9014	G with TLC	Cool ≤6°C	14 days
Sulfide Reactive	Definition	G with TLC	Cool ≤6°C	7 days
Mercury TCLP	SW846-1311/ 7470	G with TLC	Cool ≤6°C	28 days from collect. to extract. 28 days from extract. to analysis
Metals TCLP	SW846-3010/ 6010B	G with TLC	Cool ≤6°C	180 days from collect to extract. 180 days from extract. to analysis
Metals Total	SW846-3050/ 6010B	G with TLC	Cool ≤6°C	6 months
Semi-volatiles TCLP	SW846-8270C	G with TLC	Cool ≤6°C	14 days from collect. to extract. 7 days from extract. to prep. 40 days from prep. to analysis
Volatiles TCLP	SW846-5030B/ 8260B	G with TLC	Cool ≤6°C	14 days from collect. to extract. 14 days from extract. to analysis
Total Kjeldahl Nitrogen	$SM4500N_{org}C$	G with TLC	Cool ≤6°C	28 days
Total Organic Nitrogen	SM4500-N-C	G with TLC	Cool ≤6°C	28 days
Total Volatile Solids	EPA 160.4	G with TLC	Cool ≤6°C	7 days
Semivolatile, Methods	EPA 3510C/ 3550B/3580A	NA	NA	7 days

1. TLC = Teflon-lined cap, G = Glass

Table 4-3

Bioremediation Indicator Parameters and Risk Analysis Test Methods
These parameters are analyzed using Microseeps' Methods.

Parameter	Method	Container	Preservative	Maximum Holding Time
Hydrogen by Bubble Strip	SM9/AM20Gax	22 cc vapor vial with stopper septum	None	14 days
Light hydrocarbons by Bubble Strip	SM9/AM20Gax	22 cc vapor vial with stopper septum	None	14 days
Permanent gases by Bubble Strip	SM9/AM20Gax	22 cc vapor vial with stopper septum	None	14 days
Light hydrocarbons in water: Methane, Ethane Ethene	PM01/AM20Gax	40 ml Amber VOA vial with mylar septum	Trisodium Phosphate or Benzalkonium Chloride & Cool to ≤6°C	14 days
Permanent gases in water: Oxygen, Nitrogen, Carbon Dioxide	PM01/AM20Gax	40 ml Amber VOA vial with mylar septum	Benzalkonium Chloride & Cool to ≤6°C	14 days
Light hydrocarbons in vapor	AM20Gax	22 cc vapor vial with flat septum	None	14 days
Permanent gases in vapor	AM20Gax	22 cc vapor vial with flat septum	None	14 days
Hydrocarbons in vapor	AM4.02	22 cc vapor vial with flat septum	None	Unspecified
Chlorinated hydrocarbons in vapor	AM4.02	22 cc vapor vial with flat septum	None	Unspecified
Total inorganic carbon in water	PM01/AM20Gax	40 ml Clear VOA vial with mylar septum	Cool to ≤6°C	14 days
Volatile Fatty Acids	AM21G	40 ml Clear	Cool to ≤6°C	21 days
Low Level VFA	AM23G	40 ml Amber with teflon septum	Cool to ≤6°C Benzalkonium chloride	14 days
AMIBA	WC-43	BAFeIII: 8oz plast. All by direct push: 2 oz glass soil jar All by drill. rig: 2 – 40 ml amber 2 oz glass soil jar	Freeze	3 months

Table 4-4
STATE CERTIFICATIONS

Parameter	Method	State Certification
Alkalinity	SM2320	WV, SC, CT
Chloride	SM4500 Cl B; SW846-9056	WV, SC, CT
Hexavalent Chromium	SM3500 Cr D, SW846-7196A	WV, CT
Cyanide	SW846-9010B & 9014	WV, CT
Hexane Extractable Material	EPA 1664 A	WV
Specific Conductance	SW846-9050	WV, CT
Sulfate	SW846-9056, ASTM D516	WV, SC, CT
Sulfide	SM 4500S	WV, SC, CT
Orthophosphate & total Phosphorus	EPA 365.3	WV, CT
BOD	SM 5210B	WV, CT
CBOD	SM5210B	WV, CT
COD	HACH 8000	WV, CT
TOC	SW846-9060, SM 5310C	WV, SC, CT
Ammonia	SM4500 NH_3 B & E	WV, CT
Nitrate	SW846-9056	WV, SC, CT
Nitrite	SM 4500 NO_2, SW846-9056	WV, SC, CT
TDS	SM2540C	WV, CT
TSS	SM2540D	WV, CT
Total Solids	SM2540B	WV, CT
Mercury	EPA 245.2, SW846-7470 & 7471A	WV, CT, SC
Metals (TAL)	EPA 200.7, SW846-6010C	WV, CT, SC
Volatiles (TCL)	SW846-8260B; EPA 624	WV, CT, SC
BNAs	SW846-8270C; EPA 625	WV, CT, SC
Extractions	SW846-3510C, 3550B, 5030B, 5035	WV, CT, SC
Digestions	SW846-3010, 3050	WV, CT, SC

Check with Microseeps Customer Service Office for state specific parameter lists.

Table 4-5

NELAC Accredited Parameters/Methods

Primary NELAC: Pennsylvania
Secondary NELAC: FL, NY, NJ, LA
(Not all states accredit all parameters.)

Parameter	Method
Alkalinity	SM2320B
Chloride	SW846-9056; SM4500 Cl-B
Nitrate	SW846-9056
Hardness	SM 2340C
Nitrite	SW846-9056, SM 4500 NO_2
Oil and Grease, Non-Polar material	EPA 1664A
Orthophosphate, Phosphorus	EPA 365.3
Sulfate	SW846-9056, ASTM D516
Sulfide	SM 4500S
BOD	SM 5210B
CBOD	SM 5210B
TOC	SW846-9060, SM 5310C
Metals	SW846-6010B & EPA 200.7
Mercury	SW846-7470, SW846-7471, EPA 245.2
Volatile Organics	SW846-8260B, EPA 624
Specific Conductance	EPA 120.1, SW 9050
pH	SW 9040, SM 4500H+
Residue	SM 2540
Turbidity	EPA 180.1
Acidity	SM 2310
Cyanide	AW 9014, SM 4500CN
Ammonia	SM 4500NH_3
TKN	SM 4500N
Sulfite	SM 4500 SO_3B
COD	HACH 8000
Phenolics	EPA 420.2, EPA 420.2, SW9065

Parameter	Method
Surfactants	SM 5540C
Semi-volatile organics	EPA625, SW8270
Hexavalent chromium	SW 7196, SM 3500-CrB,CrD
Dissolve gases & Light Hydrocarbons	Microseeps SOP-AM20GAX
Hydrogen	Microseeps SOP-AM20GAX
Total Inorganic Carbon	Microseeps SOP-AM20GAX
Volatile organics in Vapor	Microseeps SOP-AM 4.02
Volatile Fatty Acids	Microseeps SOP-AM23G
Residual Chlorine	SM 4500-Cl G
Paint Filter Liquids Test	SW 9095
Fuel Oxygenates	SW846-8260, Mod. 524.2

Call Customer Service Office for state-specific analyte list.

Figure 4-1
Chain of Custody Form

CHAIN - OF - CUSTODY RECORD

Company : _____
Co. Address : _____
Proj. Manager : _____
Proj. Location : _____
Proj. Number : _____
Phone # : _____ Fax # : _____

Sampler's signature : _____

Parameters Requested

Results to : _____

Invoice to : _____

Cooler ID	Cooler Temp.

Sample ID	Sample Description	Date	Time	Comp.	Grab	# Cont.	Remarks

Relinquished by :	Company :	Date :	Time :	Recived by :	Company :	Date :	Time :
Relinquished by :	Company :	Date :	Time :	Recived by :	Company :	Date :	Time :
Relinquished by :	Company :	Date :	Time :	Recived by :	Company :	Date :	Time :

WHITE COPY : Accompany Samples YELLOW COPY : Laboratory File PINK COPY : Submitter

Figure 4-2
Sample Tracking Record

Sample Storage Location: _____

Samples placed in storage by: _____

Circle Bottle Type:		T-Metals	Sulfide	Cyanide	D-Gas	Hydrogen
IC-VOA	Nutrient	D-Metals	BNA	Bacteria	Vapor	G. Chemistry
HEM	Phenol	TOC/TOX	VOA	Soil	VFA	Fuel-Oxygenate
TIC	D-Gases	GRO	DRO	Pesticide	PCB	LLVFA

LIMS generated Sample Numbers	Removed from Storage			Returned to Storage		
	Initials	Date	Time	Initials	Date	Time

5.0 Facilities, Instrumentation, and Materials Procurement

5.1 Facility Description

Microseeps is located in the University of Pittsburgh's Applied Research Center (UPARC). The complex consists of 58 separate buildings, which house approximately 130 companies. The Oxford Development Company provides management for the UPARC facility including building maintenance and safety support. Oxford Development's maintenance personnel are on-site and respond quickly and efficiently to all internal environmental or air quality issues. Specialized maintenance staff is on-call to respond to ventilation, heating, cooling, lighting, or other problems that may occur.

Laboratory temperatures are controlled by the permanent heating and air-conditioning systems in the UPARC complex. Where the cooling systems have not been efficient enough to maintain correct temperature and humidity requirements for proper instrument function, Microseeps has installed additional units as needed.

When environmental conditions jeopardize the results of environmental tests, the Lead Analyst shall notify the Laboratory Manager immediately of the problem. If the problem cannot be resolved immediately the Laboratory Manager shall order a stoppage of all work until either the problem is resolved, or another area of the laboratory can be utilized to continue testing.

Microseeps is located in Building B-1 and has offices and laboratories on the first, second, and fourth floors.

5.1.2 Laboratory Areas

The following table specifies the locations of the individual laboratories and workspaces in the building in which Microseeps is housed.

First Floor

- Bottle Preparation — Room 108
- Sample Receiving — Room 115/117
- Volatiles Laboratory — Room 126/128

Second Floor

- Dissolved Gas Laboratory — Room 220/222
- Semi-volatiles Laboratory — Room 223
- Vapor Laboratory — Room 221
- Metals Laboratory — Room 213
- LIMS Center — Room 218

Fourth Floor

- Wet Chemistry Laboratory Room 415
- Metals Preparation Room 423
- Semi-Volatiles Preparation Room 425
- Instrument Laboratory Room 431
- CSIA Laboratory Room 424

5.1.3 Building and Laboratory Security

Employee access into the UPARC complex is controlled through key-card turn-styles where each individual that works in the complex has a unique code for entry. UPARC Security is aware of who is on-site or off-site at any given time. Microseeps' laboratory areas are controlled through keyed entry to prevent employees from other firms housed in the complex from gaining access to Microseeps' laboratories. Each employee is issued a key that will open doors to rooms occupied by Microseeps. Those keys do not access accounting or CEO offices. During normal working hours, the laboratory areas are kept unlocked. After normal business hours the rooms are locked to prevent unauthorized personnel entry.

A UPARC Security Force monitors the facility twenty-four hours a day with a series of video cameras. The guards also make rounds by foot and vehicle during afternoon and night shifts. Visitors cannot gain access to the complex except through the Main Security Gate. All visitors are required to register at the main gate and obtain a visitor's pass before entering the complex. UPARC Security notifies Microseeps upon the visitor's arrival to verify admittance. Visitors are directed to Microseeps Reception Office. The visitor is then escorted, by a Microseeps' employee to the Microseeps' front office to sign the visitors log, and is then directed to the employee or laboratory they intend to visit.

5.2 Instrumentation

Instrumentation must be properly calibrated and maintained to produce reliable and reproducible results. This section of the Quality Systems manual defines minimally acceptable standards for installation, calibration, and maintenance of analytical instruments used in the laboratory. Fully detailed procedures are instrument specific and are available in the individual instruments' Operator Manuals.

A list of Microseeps' Instrumentation is included in Exhibit 5-1. This list is updated whenever equipment is placed in service or removed from service.

5.2.1 Installation and Set-up

All new instrumentation must be included in the Quality Systems program prior to being used for sample analysis. When new equipment is ordered, the Laboratory Manager and the Manager of Technical Services determine the preparations that the laboratory must make to accommodate the

equipment. This plan includes descriptions of facility modifications that may be required, personnel responsible for installation (manufacturer or Microseeps employee), performance criteria that need to be met, and training procedures that will be followed.

Data generated during installation and set-up will be included in the maintenance log for the instrument. This data may become important later for troubleshooting and diagnostic checks. Operator manuals supplied by the manufacturer are maintained in the laboratory for reference.

5.2.2 Calibration

Calibration procedures for instrumentation are thoroughly documented and routinely followed to provide assurance that the data produced are reliable and accurate. Specific calibration procedures and frequency are detailed in the individual Standard Operating Procedures.

Initial calibration involves comparing instrumental response to various concentration levels of the analytes of interest. The calibration curve will contain a minimum of three points, excluding a blank. The lowest point of the curve should be approximately 2 - 5 times the instrument detection limit. The most concentrated standard should be below but near the upper concentration limit of the linear range. All standards are prepared from solutions of certified concentrations. All calibrations are checked against a "second source" obtained from, preferably a different vendor, but at least a different lot. All calibrations are followed by an initial calibration blank to verify that system contaminants and carry-over are not present. For organic analyses, surrogates are added to each blank and standard. In addition, internal standards are also added for some organic analyses.

If the initial instrument calibration results are outside established acceptance criteria, corrective actions are performed. These criteria and the corrective action are specified in individual Standard Operating Procedures. Data associated with unacceptable initial instrument calibration is not reported.

5.2.2.1 Calibration Verification

If an initial instrument calibration is not performed on the day of analysis, the validity of the initial calibration is verified prior to sample analysis by running continuing instrument calibration verification standards with each analytical batch. Continuing instrument calibration verifications must be run at the beginning and end of each analytical batch.

5.2.3 Instrument Maintenance

Maintenance of analytical instruments is carried out under the direction of the Manager of Technical Services and may include regularly scheduled preventive maintenance, or maintenance on an as-needed basis due to instrument malfunction. Maintenance activities for instrumentation are documented in Instrument Maintenance Logs. This documentation becomes a part of the laboratory's permanent records.

Regular maintenance of support equipment, such as balances, thermometers, and fume hoods is conducted annually and more often if required. Maintenance on other support equipment, such as ovens and refrigerators is conducted on an as needed basis. The Lead Analysts are responsible for ensuring that temperatures of ovens and refrigerators are checked and recorded twice daily. The Laboratory Manager is notified if the temperature is outside of the range of use of the specific piece of support equipment, and the equipment is scheduled for maintenance.

Records of maintenance to support equipment are also documented in Maintenance Logbooks. Each piece of support equipment does not necessarily have it's own logbook. Maintenance logbooks may be shared with equipment that is housed in the same laboratory area.

5.2.3.1 Out of Service Instruments

In the event that an instrument cannot be calibrated or is determined to be out of order, an out of service or out of calibration tag is placed on it. The Lead Analyst is responsible for ensuring the equipment is tagged. This tag shall be removed when the instrument is repaired and ready for use.

5.2.3.2 Instrument Repair

Unexpected repairs resulting from instrument failure are scheduled immediately after the malfunction is observed. Instrument failures are detected through direct observations and by evaluation of the response of verification standards throughout the analytical run. The Manager of Technical Services is responsible for deciding if laboratory personnel can make the repair or if an outside contractor is required.

Data obtained during instrument failure are not entered into the LIMS for reporting to the client. Complete records of the repairs are maintained in the Instrument Maintenance Logbooks. These records may include notes taken by laboratory personnel during repair and a copy of the service call record. Acceptable instrument performance must be verified before samples can be analyzed.

5.3 Materials Procurement

The purpose of this section is to define requirements for the procurement of materials needed to support laboratory operations.

5.3.1 Purchase and Control of Standards, Reagents, and Materials

The Lead Analysts, or in the case of Customer Service, the Department manager, review and approve all material orders for their departments. The quality of purchased standards and reagents is determined as specified in approved analytical methods and further specified in Microseeps' Standard Operating Procedures. All standards and reagents are to be handled and treated in accordance with the Standard Operating Procedure for Analytical Standards and Reference Materials (SOP-ADM 15).

5.3.2 Placing Orders

The employee specifies the materials that need to be ordered on a Purchase Order Form that can be obtained from the Procurement Coordinator. The Purchase Order form is completed by filling in a suggested vendor's name and catalogue number, a description of the item, the quantity requested, the date of the request, their name, and the accounting category. The form is forwarded through the Lead Analyst or Department Manager for approval. It is the Lead Analyst's or manager's responsibility to choose an acceptable vendor. Once the order is approved, the Procurement Coordinator places the order. One exception to this procedure is when an order needs placed with ThermoFisher on-line. Each Lead Analyst has a user name and password to order routine supplies on-line. If any supplies need a special quote or pricing, orders must then be placed by the Procurement Coordinator.

5.3.3 Receipt of Materials

Supplies or materials are received by the Sample Custodian, who in turn, calls the employee who the items are for to come pick them up. The employee compares the materials received to the packing list. Any discrepancies are noted on the packing list and is given to the Procurement Coordinator. A call is placed to the vendor to resolve any problems.

Once the order is reconciled with the purchase order, the packing list(s) is attached to the purchase order and is kept on file by the Procurement Coordinator. The materials and associated documentation (i.e. Certificates of Analysis or Purity) are forwarded to the Department that placed the order for storage until use.

All Material Safety Data Sheets are kept in the lab area where the supplies are being used.

Figure 5-1
Microseeps' Instrument and Equipment List

Volatiles

Hewlett Packard Chemstation Data System with NIST Chemical Structures; Hewlett Packard 6850Series II GC with EPC and 5973 Mass Spectrometer; Varion Archon Autosampler (Serial 14288) and Tekmar Velocity XPT Concentrator (Serial US04159007)

Thermo-Electron Focus GC (Serial 10603036) with DSQ II Mass Spetrometer (Serial MS1100132); Teledyne Aquatek 70 Autosampler (Serial US07003004) and Tekmar Velocity Concentrator (Serial US06335001)

Thermo-Electron GC (Serial 10603008) with DSQ II Mass Spectrometer (Serial 100442); Varian Archon Autosampler (Serial 14655) and Tekmar Velocity Concentrator (Serial US6047001)

Semi-volatiles

Hewlett Packard 5890 Series II GC (Serial 3501A02409) with Hewlett Packard 5972 Mass Spectrometer (Serial 2950A45623) with Hewlett Packard 7673 Autosampler (Serial 3323A35213)

Dionex Ion Chromatograph Model LC25 (Serial #97040068) Autosampler Model AS40-1 (Serial 97050241), Eluent Generator Model EG50 (Serial 94050039): Conductivity Generator Model CD20-1 (Serial 97050142); Gradient Pump Model GP40-1 (Serial 97030784)

Varian 3400 Gas Chromatograph (Serial 10272) with Varian 8100 Autosampler (Serial 1371)

Risk Analysis

Hewlett Packard 5890 Series A Gas Chromatograph (Serial 2536A05842) with Tekmar 7000 Autosampler (Serial 91099014/91135007).

Agilent 6890 Gas Chromatograph (Serial US10347026) with Agilent G1888 Headspace Autosampler (serial IT40220036).

Hewlett Packard 5890 Series A Gas Chromatograph (Serial 2536A05842) with Tekmar 7000 Autosampler (Serial 91099014/91135007)

Hewlett Packard 5890 Series II Plus (Serial 3336A53505)

Hewlett Packard 5890 Series II (Serial 3336A51836) with Tekmar 7000/7050 Autosampler (Serial 91346008/91346016)

Three Proprietary GCs

Metals

Varian Vista AX CCD Simultaneous ICP-AES (SPSS) (Serial EL99063568) with Auto Sampler (Serial EL99063365)

Perkin Elmer Flow Injection Mercury System (FIMS100) (Serial 509550-1410) with AS 90 Auto Sampler (Serial 508540-3767)

CPI Mod Block centrifuge type Digestion Unit

Fisher Versa-Bath

Mettler PE-4000 Balance (Serial C39640)

Accumet Model 50 pH Meter

Organic Extraction

Horizon Speed-Vap II 9000 Solvent Evaporation System (Serial 02-1801)

Zymark Turbo VapII concentrator

Horizon SPE-DEX 3000 Controller (Serial 07-1404)

Horizon 3000XL Oil and Grease Extractor (Serial 07-1413/07-2103)

Denver Instruments Model SI-4002 Top Loading Balance

Ohaus Discovery Analytical Balance Model # DV215CD (Serial 1128122704)

Wet Chemistry

Dionex 500 Ion Chromatograph with dual Autosamplers, columns and ovens, with electrochemical and UV-Vis Detectors.

Thermo Electron Hipertoc Model TOC Analyzer

Spectronic 20G Colorimeter

Spectronic 20D Colorimeter

Orion 601A pH Meter

Fisher Scientific Flash Point Tester

HF Scientific Instruments DRT-15C Turbidity Meter

Thermo-Electron Low-temperature Incubator Model 815

Yellow Springs Instruments Model 54A Dissolved Oxygen Meter

Sartorius Model 1612 Analytical Balance

Westco Scientific Instruments Digestions Block

Westco Scientific Instruments Easy Distillation Unit

Labconco Rapid Distillation Unit

Hach Chemical and BioScience COD reactors

Miscellaneous

Buchi EL131 Rotovapor

CSIA

Tekmar Aqua Tek 70 Autosampler (Serial US 06151001)

Tekmar Velocity XPT Purge and Trap (Serial US 06191003)

Entech 7100A Pre-concentrator (Serial 1304)

Thermo Trace GC Ultra Gas Chromatograph (Serial 200510408)

Thermo GC-Combustion III Interface (Serial 111201-175)

Thermo GC /TC Reactor OD (Serial 108520-349)

Thermo Delta V Plus Isotope Ratio Mass Spectrometer (Serial 8018)

6.0 Data Quality

6.1 Data Quality Objectives

Microseeps conducts analysis on environmental samples for clients who rely on the data in order to make decisions concerning environmental problems, environmental monitoring, and in many cases to investigate the feasibility of cutting edge remedial technologies. The necessity of high quality data is essential so that the best decisions can be made in the interest of both the environment and the client. Microseeps believes data quality objectives are applied to a project from the initial sampling to the final data validation process. On a laboratory scale, Microseeps' data quality objectives are reflected in individual Technical Standard Operating Procedures as quality control acceptance criteria.

Quality control sample acceptance criteria is generated using one of following three methods:

- A minimum of twenty data points are manually collected and entered into an EXCEL spreadsheet. The average percent recovery and/or relative percent difference (RPD) is calculated, whichever is applicable. Acceptance criteria are generated using the standard deviation of the average percent recovery and RPD. Three standard deviations comprise the acceptance range around the average percent recovery and above the RPD.
- Calculated electronically by the LIMS database and expressed in the Control Chart Program.
- Taken from EPA method-specific recommendations in the absence of laboratory-generated criteria.

Acceptance criteria generated from the implementation of control charts, either manually or LIMS generated are evaluated annually or more often. If it is determined that the acceptance criteria has changed to a broader set of limits, the reason for the change is evaluated for error to ensure the analytical method is still in control. When warranted, corrective action shall be instituted by the Quality Systems office or the Operations Department.

All analytical data including quality control results are checked in accordance with SOP-ADM 16 Standard Operating Procedure for Data Integrity, Review and Validation. Performance Evaluation studies are conducted twice a year and the results are reviewed by management. All failed PE samples are followed up with Corrective Actions.

To maintain the quality of laboratory data and to ensure that laboratory procedures are under control, a variety of internal batch quality control samples are analyzed. The data from those samples are used to calculate statistics that help determine precision, accuracy, and to track potential bias. In addition, performance evaluation studies are conducted regularly as well as random submission of blind quality control samples. Certified reference standards are used, as well, to ensure that quality is maintained.

6.2 Internal Batch Quality Control

Batch quality control sample types and frequencies are recommended in published methods and specified in Microseeps Technical Standard Operating Procedures. In general, a batch of samples consists of twenty samples or fewer (as recommended by analytical methods) that are analyzed at the same time. Typically, a set of internal quality control samples is analyzed once for each batch of clients' samples. The types of internal batch quality control samples are discussed below.

6.2.1 Initial and Continuing Calibration Verification Standards

Initial and continuing calibration standards verify the ratio of instrument response to the analyte amount. Typically, initial calibration verification and continuing calibration standards are made from stock solutions, which are different from the stock used to prepare the initial calibration standards.

6.2.2 Calibration Blank

A calibration blank is a 'clean' sample made from an appropriate matrix and/or solvent. The calibration blank is analyzed to insure that there is no contamination in any part of the analytical system, or to establish a baseline if that "contamination" is expected and known to be of consistent concentration. Calibration blanks are analyzed after each initial, continuing, and calibration verification standard. The analytical result of the blank must be below the laboratory's quantitation limit in order for analysis to proceed. If the result of the analysis is above the quantitation limit, the source of contamination must be identified and eliminated. The one exception involves the presence of common laboratory solvents as defined by the EPA.

6.2.3 Method (Preparation) Blanks

Method blanks are reagent water or, for solid/waste matrices, sand, or other appropriate material, or an appropriate solvent carried through the entire analytical process to monitor potential contamination that may or may not be introduced during sample preparation and processing. For organic analyses, surrogates and internal standards are added to the method blank.

Method blanks are analyzed at the beginning of the batch and prior to sample analysis. If the analytes of interest are below the laboratory's quantitation limit, sample analysis can proceed. If analyte concentrations are found above the quantitation limits, the source of the contamination must be identified and corrected. The reagents used for sample preparation must be checked for contamination and the samples associated with the method blank must be prepared again and reanalyzed if necessary.

6.2.4 Duplicates

Duplicates are analyzed to assess precision of the analytical procedure. Samples for batch duplicate analyses are selected at random, ensuring that the selection is rotated among client samples so that various matrix problems may be noted and/or addressed. If the sample requires

that an aliquot be removed and placed in another container in order to conduct the duplicate analysis, a representative aliquot is collected using one of the following options discussed below in Subsection 6.3.4.

Precision of the analyses may vary due to the matrix effects of the sample. If the precision is outside established control limits, the duplicate analysis is repeated. If the precision is still outside established control limits and all other quality control checks are within control, a matrix effect is assumed.

6.2.5 Matrix Spike/Matrix Spike Duplicates

Matrix spike and spike duplicate samples are analyzed to determine the extent of matrix bias or matrix interference on analyte recovery and to determine sample-to-sample precision. Analytes stipulated by the method, by regulations, or by other requirements must be spiked into the sample. If not supplied by the client, the analyst may choose these samples at random. Percent recoveries are calculated for each of the analytes detected. The relative percent difference between the samples is calculated and used to assess analytical precision.

Recovery data is highly dependent upon matrix effects. If acceptable recoveries are observed, it is determined that matrix is having no significant affect on the analytical procedure and that sample preparation and analysis have been performed correctly. Whenever precision, calibration, and system quality control checks are acceptable, large or small matrix spike recoveries are attributed to matrix effects. Because samples are spiked prior to analysis, the concentration of the analyte of interest in the sample may be so high that the spike amount is insignificant. In these cases, spike recovery is meaningless and is not calculated.

6.2.6 Laboratory Control Samples

Laboratory control samples are samples that are spiked with a specific concentration of known reference materials, independent of the calibration standards that are carried through the entire analytical process. These standards are used to assess the accuracy of the analytical process. Where possible, acceptance limits are statistically based upon actual laboratory data. If results are outside acceptance limits, corrective action must be performed before sample analyses can proceed.

6.2.7 Surrogate Standards

Surrogates are organic compounds which are similar to analytes of interest in chemical composition, extraction, and chromatography, but which are not normally found in environmental samples. These compounds are spiked into all blanks, standards, samples and spiked samples prior to organic analysis.

If surrogate recovery is not within acceptance limits, corrective action is instituted and reanalysis of those samples occurs.

6.2.8 Insufficient Sample Volume

When there is insufficient client sample volume in a batch to conduct quality control samples for precision, then a laboratory control sample and laboratory control sample duplicate are analyzed.

6.3 Measurements of Data Quality

Data quality measurements vary from parameter to parameter, are represented as warning and control limits, and are displayed along with associated data on control charts. The following types of measurements are utilized by Microseeps to insure the highest quality data is being provided.

6.3.1 Precision

Precision is a measure of the degree of mutual agreement among individual measurements made under prescribed conditions. Precision of laboratory data is determined through duplicate analyses of samples or matrix spikes and spike duplicates, and is calculated for Microseeps purposes, as either the range or relative percent difference (RPD) of the measurements.

6.3.1.1 Range

Range is defined as the difference between the highest and the lowest value reported for a sample. Range is used in the laboratory as recommended in published regulatory methods. The formula for calculating range is as follows:

$$Range = HighestValue - LowestValue$$

6.3.1.2 Relative Percent Difference

Relative percent difference (RPD) is used for all of the analytical methods at the laboratory where sample duplicates are analyzed and where both matrix spikes and matrix spike duplicates are analyzed. If one or both measurements are less than the reporting limit, precision is not calculated. The formula for calculating relative percent difference is as follows:

$$RPD = \frac{|A - B|}{\frac{A + B}{2}} \times 100\%$$

6.3.2 Accuracy

Accuracy is the measurement of agreement between a measurement and the true value. It is calculated as the percent recovery of standards and spikes. Accuracy is calculated as the percent recovery of laboratory control samples, matrix spikes, and in organic chemistry surrogate recoveries.

6.3.2.1 Percent Recovery

Percent recovery is used for all of the analytical methods at the laboratory where laboratory control samples, matrix spikes, and/or surrogates are analyzed. The formula for calculating percent recovery is as follows:

$$\%\,Recovery = \frac{Measurement}{True\,Value} \times 100\%$$

6.3.3 Bias

Bias is defined as a systematic error due to the experimental method that causes the measured values to deviate from the true value. Bias is determined by plotting the average percent recovery and the average relative percent difference on a control chart. A bias is suspected when seven successive data points are plotted on the same side of the average. This is considered an out of control event.

6.3.4 Representativeness

Representativeness is defined as data that accurately and precisely reflect the sampling points or environmental conditions. Numerous items throughout sampling and sample handling must be controlled to maximize representativeness. These include sample collection, preservation, and holding times. Since Microseeps does not perform sample collection, Microseeps cannot accept responsibility for representativeness of sample collection.

When an aliquot must be removed from the sample container for analysis or for making batch quality control samples, one of the following two options are used in order to obtain a representative aliquot:

1) If the analysis won't be compromised by agitation, then the sample is stirred, mixed, crushed, blended, as needed, and the aliquot is removed from sample container and placed in another container.

2) If the analysis may be compromised by shaking or mixing the sample, then portions of the aliquot are taken from different places within the original sample container ensuring that the aliquot is as representative as possible of the original sample.

In some cases where a sample cannot be homogenized, the client will be contacted and a course of action will be decided upon according to a mutually agreed upon decision.

6.3.5 Comparability

Comparability is the confidence level with which one set of data can be compared to a related set of data. Microseeps uses EPA recommended methodology, whenever feasible, participates in internal and external performance evaluation programs, and uses standard reference materials for sample analysis as means of enhancing comparability.

6.4 Validation of Methods

Validation is the confirmation by examination and the provision of objective evidence that the particular requirements for a specific intended use are fulfilled.

Microseeps validates non standard and laboratory-designed/developed methods, standard methods used outside their intended scope, and amplifications and modifications of standard methods to confirm that the methods are fit for the intended use. The laboratory keep records of results obtained, the procedures used, and a statement that the method is fit for the intended use.

Records of method development are kept in the Technical Director's Office.

6.5 Uncertainty

There are so many sources of uncertainty in a concentration measurement. Certainly, the collection of the sample is a very large source of uncertainty. The particular technique of collection is another, and the location of the points chosen for sampling is a third. Of course, there is uncertainty in analytical measurements as well, and all laboratory analytical procedures are specifically designed to minimize or otherwise control that uncertainty. As such, analytical uncertainty is very likely a minor contribution to the overall uncertainty of any measurement. However, analytical uncertainty is important. There are many potential causes. Some of the most common are enumerated below, along with a brief discussion on how Microseeps minimizes the effect of each:

- Human factors- by maintaining SOPs which are analysis-not analyst-dependant, and by engaging in training and yearly CDOP's, Microseeps tries to minimize the analyst-to-analyst variable.
- Accommodations and environmental conditions-Perhaps the biggest variable here is ambient temperature. In our wet chemistry, semi-volatiles prep., metals prep. and one of our non-traditional laboratories, there is manually controlled heating and cooling. (Since BOD is very temperature sensitive, there is an incubator for the BOD samples.) In our metals analyses room, one of our non-traditional analyses rooms, and our semi-volatile analysis room, there is additional, automated cooling. Since volatiles are extremely temperature sensitive, both our volatiles analysis laboratory and our CSIA laboratory are furnished with large capacity air condition systems.
- Environmental test calibration and method validation-The vast majority of our analytical activities are specifically designed to address these issues. Specifically,

it should be pointed out that all of our tests are calibrated with externally certified standards, and then double-checked with a "second source" standard when possible. Additionally, since we utilize many of our own analytical tests, we have strong emphasis on method validation. For a method to be validated here, it must either pass a successful calibration and then be verified against an external source. The method must be successfully brought through an IDOP and then regularly produce valid matrix spike, matrix spike duplicate and sample duplicate analyses, if applicable.

- Equipment-Before a new piece of equipment is routinely used, an IDOP must be successfully completed using that equipment. This minimizes the potential for un-controlled equipment fluctuations.
- Measurement traceability-I an analytical system is internally calibrated, we maintain records of that calibration, including the certificate of analysis of the standards used in that calibration. If the system was externally calibrated, the records of that external calibration are also supplied.

Finally, to measure the total analytical uncertainty we routinely perform LCS's. (LCS's are chosen because they are submitted to the entire analytical procedure.) The typical acceptance range for an LCS recovery is 80-120%, but the LCS performed with a batch and the SOP for the particular measurement technique should be consulted for specifics.

7.0 Data Handling

Microseeps maintains records that enable the re-creation of the specific conditions under which data are produced, and method specific Standard Operating Procedures outline procedures for data collection, reduction, validation, and reporting. This section discusses, in general, Microseeps data handling procedures.

On occasion when a client requests analyses that Microseeps is not equipped to perform, capacity issues prevent the laboratory from meeting requested turnarounds, or in the event of an instrument failure, a subcontract laboratory may be used. A list of routinely utilized subcontract laboratories is presented in Exhibit 1 at the end of this section.

For cases when the client requests analyses that Microseeps is unable to perform, the Project Manager notifies the Operations department of the need to locate a subcontract lab. The Laboratory Manager is responsible for contacting potential subcontract laboratories to determine where the samples will be sent. For routinely requested analyses, standard agreements are in place with the subcontractor. Whenever applicable, subcontract laboratories will be NELAC-approved. Other factors that affect the decision include turnaround, cost, and ability to provide the required data deliverables. Once the decision is made, the Laboratory Manager notifies the Project Manager so that the client can be informed. For cases when the internal problems require the use of a subcontractor, the Laboratory Manager will notify the Project Managers of the situation, what samples are affected, and the proposed resolution. The Project Managers will then contact each affected client to obtain approval prior to samples being shipped to the subcontractor.

All samples that require subcontracted analyses are prepared for shipment by the Sample Receiving Clerk. A chain of custody is prepared detailing the sample identification, collection date and time, as available, requested analyses, requested due date, and any other special instructions pertinent to the sample shipment. The samples are packed in a cooler with sufficient ice to maintain the appropriate temperature during shipment. All samples for subcontracted analyses are shipped so that the samples arrive the next business day.

All data received from the subcontract laboratory follow the same guidelines detailed in this section, with the Laboratory Manager filling the analyst's role and review performed by the Vice President of Operations.

7.1 Data Collection

All laboratory employees are responsible for maintaining laboratory records and documenting them in sufficient detail to recreate analyses. Manually entered data are made using permanent ink. Corrections are indicated by drawing a single line through the incorrect entry, dating and initialing the correction, and coding the reason for the correction. The use of correction fluid or tape, erasure, or other means of making corrections is prohibited. The following information is recorded at the bench either manually or printed out via the data system interfaced with the analytical instrument.

- Method performed.
- Analysis date.
- Analysis time.
- Analyst signature or initials on computer printouts.
- Instrument Identification and settings.
- Analytical sequence consisting of a chronological listing of the processing for each standard, quality control check, and sample recorded in an analytical sequence, run log, or data sheet.
- The laboratory sample number.
- Quality control sample type.
- Standard identification and volume used for all calibration standards.
- True value and lot number of all spiked quality control samples.
- Dilutions including actual initial and final volumes.
- Sample aliquot and final volume.
- Instrument reading.
- Final results with units.
- Calculations for all quality control checks.
- Narrative describing any unusual observances.

If an analysis extends over more than one shift or day, each person responsible for part of the analysis records the date and time their portion of the analysis was initiated.

7.2 Data Reduction

Reducing raw data into a presentable form is the responsibility of the analyst performing the determination. The actual equations used to calculate final results are found in the analytical methods. The following general rounding rules are used for the calculations:

- Data is not rounded until the final answer is obtained.
- To round a figure, the number of significant figures is determined. If the figure to the right of the immediate right-most significant figure is greater than 5, round up. If this figure is less than 5, truncate the result after the last reportable figure. If this figure is equal to 5 and there are non-zero digits to the right, round up. If the figure is equal to 5 and there are no non-zero digits to the right, round up when the preceding figure is odd, and truncate when the preceding figure is even.

7.3 Data Validation

Each analyst initials and dates the data that is generated in the laboratory. All data generated by the laboratory undergoes either an independent peer review or a review by a lead analyst or other designated individual to ensure compliance with accepted quality control standards prior to data entry. The purpose of this review is to check for precision, accuracy, and completeness. The following items are verified during this review. Not all items are applicable to each test.

- Holding times.

- Proper measurement units.
- Instrument tune and initial calibration criteria.
- Proper number of calibration standards and blanks.
- Surrogate and spike percent recoveries.
- Comparison of quality control sample results to acceptance criteria.
- Corrective action for out of control conditions.

After this review, all data that is not instrument-interfaced directly with the Laboratory Information Management System (LIMS), is manually entered into the database. All manually entered data undergoes a review upon entry. The Laboratory Director attempts to review approximately 10% of all laboratory data. Project Managers complete the data validation process by reviewing final reports for completeness prior to submission to the client.

7.4 Laboratory Information Management System

The LIMS is the point of collection for all of the laboratory data. The integrity of laboratory data is of the utmost importance. The LIMS system has built-in security levels that keep individual access on an "as needed" basis and does not allow for access beyond what is necessary for the completion of individual duties. Specific operation and management of the LIMS system is outlined in LIMS Standard Operating Procedures that are maintained by the Laboratory.

7.5 Report Preparation

After all of the data has been entered into the LIMS, a draft copy of the final report is generated and the following items are reviewed by the Laboratory Manager or designee:

- Client name and address.
- Analytical results, units, and reportable figures.
- Appropriate data qualifiers are applied as required according to the following table.
- Inter-parametric relationships.
- Data reasonableness in respect to sample information.

Table A

Data Qualifiers

Qualifier	Description
J	Estimated value-result is >MDL but <PQL
U	Component was analyzed for but not detected
R	Surrogate recoveries are outside control limits

Qualifier	Description
M	Percent recoveries or RPD outside of control limits for MS/MSD, sample/dup analyses
B	Component was detected in blank
L	Analyses were performed by a subcontract lab
N	NELAC certified anayses

Following the review, if results are acceptable the Laboratory Manager, or designee makes the determination to generate a final report. The report is forwarded to a Project Manager who conducts a general review for completeness, signs the report, and releases it to the client. The draft copy of the report is placed in the client file for storage.

Final Reports are sent to clients through the U.S. Postal Service unless the client requests an electronic copy. Electronic copies are placed into Portable Document Format (pdf) or EXCEL spreadsheets and password protected prior to transmission.

7.5.1 Final Report Modifications

Once a laboratory final report is generated and sent to the client, it can only be modified under the following circumstances:

- A copy of the original unedited report is kept on file in the laboratory. In the case of electronic records and/or files, either a pdf is generated of the original report prior to editing, or a paper copy of the original report is placed in the project file.
- The reissued report must have a statement in the comments section that specifies the modification(s) and indicates the date of report reissue.
- A copy of the reissued report must be filed with the original report.

Data review of report modifications is conducted in accordance with Microseeps Standard Operating Procedure for Data Review and Validation (SOP-ADM 16).

7.6 Record Retention

A signature record of all employees is maintained in the Training Records Manual kept in the Quality Systems Coordinator's Office.

All raw data and reports for analytical projects are kept for a full five (5) years. After this time the records are destroyed. Records are kept onsite in a locked storage area and maintained in accordance with Microseeps Standard Operating Procedure for Document Control (SOP-ADM 05). The area is inspected monthly.

The LIMS database, which retains all electronic records that have been entered from the date of the LIMS inception, is backed up each day. The tape on which this backup is stored is maintained in a secure location off-site.

All critical data on personal computers is backed up on the internal network S drive. The network is backed up on tape and stored at a secure location off-site.

7.7 Service to the Client and Confidentiality

Clients are welcome to an on-site visit to Microseeps Laboratories in order to discuss client needs or requests, and also to monitor the laboratory's performance in relation to ongoing client projects. All efforts are made to maintain client confidentiality while providing service to other clients.

All client data, whether from privately owned or government organizations, and all correspondence is considered confidential information and shall not be released to anyone other than the client without the expressed written permission of the client. These transactions shall be handled by the Customer Service Office.

7.8 Records Dispensation

In the unlikely event that the laboratory transfers ownership or goes out of business, all clients will be notified in writing and requested to notify Microseeps concerning the dispensation of their records.

Exhibit 1

Subcontractor Laboratories

Name	Requested Analyses
Pace Analytical Services	Pesticides, PCB's, Herbicides, EDB by 8011, Gasoline and Diesel Range Organics, TO-14, Volatiles by 8260.
Analytical Laboratory Services	TOX, EOX, PAH's by 525
Alternative Testing Laboratory	Silicon, Carbon, Percent Chloride on Ash
Teaco Laboratories	Total and Fecal Coliform
Microbial Insights	Dehalococcoides, Phospholipid Acids

8.0 Measurement Traceability

Traceability of measurements and standards is insured in the laboratory by using balance calibration weights that are traceable to national standards, calibrating thermometers using an NIST calibrated thermometer, and by the use of certified standard solutions.

8.1 Reagents and Standards

The purity of the materials required in analytical chemistry varies with the type of analysis, the parameter being measured, and the sensitivity of the detection system. In general analytical reagent grade is satisfactory for most inorganic analyses. Other analyses, such as trace organic, may require special ultra-pure reagents. In cases were the method does not specify the purity of the reagent, it is intended that analytical reagent grade be used. The labels on the container are checked and the contents examined to verify that the purity of the reagents meets the needs of the particular method involved.

8.1.1 Reagent and Standard Preparation

Reagents are prepared and standardized with the utmost of care against reliable primary standards. They are re-standardized or prepared fresh as often as required by their stability as specified by method and other reference sources. Stock and working standard solutions are checked regularly for signs of deterioration.

Standard preparation procedures are specific to the analytical determination being made and are defined in detail in specific technical Standard Operating Procedures, regulatory methods, and in the laboratory's Standards Logbooks.

8.1.2 Reagent and Standard Labeling and Storage

Standard solutions are labeled with the compound name, lot number, preparation date, and expiration date. The analysts store reagents and solvents in a manner that prevents contamination and deterioration prior to their use. Standard solutions are stored in compatible containers.

Microseeps Standard Operating Procedure for Analytical Standards and Reference Materials (SOP-ADM 15) gives detailed instructions for handling, storing, labeling, and documenting standards and reference materials.

8.1.3 Standards Preparation Logbook

Standard Preparation Logbooks are issued as controlled documents to every analyst or laboratory in which they will be used. These logbooks are used to document standard preparation procedures, dates, lot numbers, concentrations, manufacturer, expiration date, and any other information that

may be necessary in order to re-create or track a particular standard. The compound or element name and/or formula are documented along with the final concentration or normality. The description of how reagents and standards are prepared may be referenced from a previous description if the exact procedure is used.

8.1.4 Traceability of Standards

The traceability of each purchased stock standard is easily accessible. Certificates of analysis of each standard are maintained in a binder in the laboratory until the standard is depleted or disposed. The certificate is then given to the quality assurance manager for archiving. The traceability of each laboratory prepared standard is entered into standard logbooks.

8.2 Thermometers

All of the laboratory thermometers in use are calibrated annually using a thermometer that is traceable to NIST. Thermometer calibration is outlined in Microseeps Standard Operating Procedure for Calibration of Thermometers (SOP-ADM 12).

8.3 Weights and Balances

All balances are calibrated before use with Class I NIST traceable weights that are calibrated annually. Balances are serviced and calibrated by an outside contractor annually. Additional information is outlined in Microseeps Standard Operating Procedures for Calibration of Weights and Balances (SOP-ADM 11).

9.0 Training Program

Training for laboratory personnel is accomplished at several levels. Areas for which training is conducted include new employee orientation, laboratory safety, specific task training, analytical procedure training, laboratory ethics, and other technical training courses as the need arises.

Analytical training, while addressed in general in this manual, is addressed specifically in the Standard Operating Procedure for Administering and Documenting Training in Laboratory Procedures and Instrumentation (SOP-ADM 02).

9.1 New Employee Orientation

Orientation is conducted to familiarize new employees with company policies, quality system procedures, facilities, coworkers, laboratory ethics, and laboratory safety. The Department Managers are responsible for notifying the various departments of the start date of all new employees.

9.2 Laboratory Safety

Upon hire, each employee is required to read the laboratory's Chemical Hygiene Plan (safety manual), is issued a pair of safety glasses, and is instructed in basic laboratory safety requirements. Safety Meetings are mandatory for all employees and are held on a monthly basis by the Safety Coordinator. Documentation of safety training is updated and maintained by Microseeps' Safety Coordinator.

9.3 Task Training

Task training must be successfully completed for employees to perform the following tasks without direct supervision:

- Sample Receiving
- Bottle Preparation
- Customer Service
- Data Entry

Task training is conducted by the Department Manager of the department concerned. During this training, the trainer works closely with the trainee to ensure that all pertinent points of procedures are addressed. If the procedure is outlined in a Standard Operating Procedure (SOP), the trainee is charged with reading the SOP and the trainer will ensure that the training covers all aspects of the SOP. For training to be considered complete, proficiency in the task must be demonstrated to the trainer.

9.4 Analytical Method Training

Prior to conducting analysis on client samples, all analysts must demonstrate their proficiency through initial technical training. Analytical proficiency must be demonstrated annually thereafter. All analytical method training must be conducted by an analyst who is certified in the method for which training is required.

For individual analyst training in sample preparation and analysis, initial training and proficiency is demonstrated through the analysis of a set of 4 consecutively run mid-range standards or an Initial Demonstration of Proficiency (IDOP). When an analysis involves a work group (i.e. semivolatile preparation and analysis), a team approach to the IDOP applies. When each individual completes their part in the successful analysis of the IDOP, the analytical team is considered competent to conduct the analysis on client samples.

For continued demonstrations of capability for individuals and work groups, one of the following procedures may be used:

1) Another IDOP
2) Four consecutively run laboratory control samples that fall within laboratory/method acceptance criteria.
3) Acceptable analysis of Performance Evaluation samples.
4) Acceptable analysis of blind quality control sample.

Training documentation is maintained in the Quality Systems Office. See Exhibit 9-1 for a flow diagram of analytical method training. A Demonstration of Capability Certification Statement (Exhibit 9-2) shall be maintained for each method in which an employee is certified. This documentation is kept in the Employee Training Records in the Quality Systems Office.

9.5 Laboratory Ethics Training

All employees shall receive initial and annual ethics training. The training shall be conducted by Microseeps' management personnel. The training shall include the contents of the Ethics Program (see Appendix C) in its entirety, including employee and supervisory responsibilities, examples of unethical behavior, disciplinary action for unethical actions, and a means to report unethical actions.

Documentation of Ethics Program Training is kept in the Quality Systems Office. All employees are required to sign and date the Ethics and Data Integrity Agreement (see Exhibit 9-3). This form shall be placed in the employees personnel file.

9.6 Other Technical Training

Other types of technical training are conducted on an as-needed basis and may include training on new instruments, new procedures, or new equipment. Training may be conducted by Microseeps' employees

9.7 External Training

Employees are encouraged to continue their education through the use of symposia and seminars conducted by professional societies, regulatory agencies, and equipment manufacturers. These courses serve as one way for laboratory personnel to remain current on regulatory trends, analytical procedures, and advances in instrumentation. Documentation of external training will be added to the analysts' training records.

Exhibit 9-1

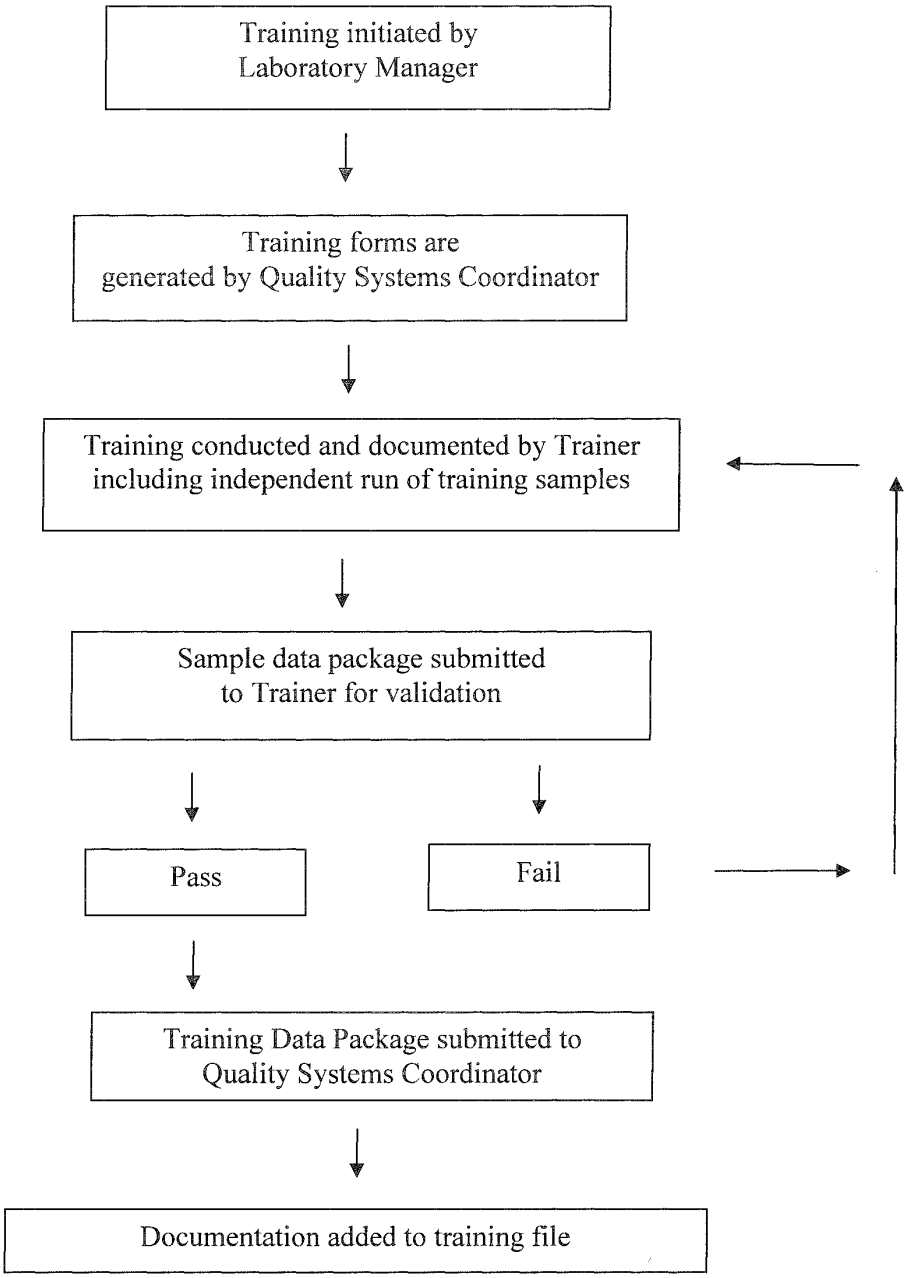

Training initiated by Laboratory Manager
Training forms are generated by Quality Systems Coordinator
Training conducted and documented by Trainer including independent run of training samples
Sample data package submitted to Trainer for validation
Pass
Fail
Training Data Package submitted to Quality Systems Coordinator
Documentation added to training file

Exhibit 9-2

Demonstration of Capability Certification Statement

Date: _____

Microseeps, Incorporated
220 William Pitt Way
Pittsburgh, PA 15238

Analyst Name: _____

Matrix: (laboratory pure water, soil, air, matrix spike)

Analyte (or group)	**Method Number**	**SOP #**	**Revision #**

I, the undersigned, CERTIFY that:

1. The analyst(s) identified above, using the cited test method (s), which is in use at this facility for the analyses of samples under the National Environmental Laboratory Accreditation Program, have met the Demonstration of Capability.

2. The test method was performed by the analyst(s) identified on this certification.

3. A copy of the test method and the laboratory-specific SOPs are available for all personnel on-site.

4. The data associated with the demonstration of capability are true, accurate, complete, and self-explanatory.

5. All raw data (including a copy of this certification form) necessary to reconstruct and validate these analyses have been retained at the facility, and that the associated information is well-organized and available for review by authorized assessors.

_____ _____
Patrick McLoughlin, Ph.D. Date
Technical Director

Exhibit 9-3

Microseeps, Incorporated

ETHICS AND DATA INTEGRITY AGREEMENT

I, _____, state that I understand the high standards of integrity required of me with regard to the duties I perform and the data I report in connection with my employment at **Microseeps, Incorporated.**

I agree that in the performance of my duties at Microseeps:

I. I shall not intentionally report data values that are not the actual values obtained;

II. I shall not intentionally report the dates and times of data analyses that are not the actual dates and times of data analyses; and

III. I shall not intentionally represent another individual's work as my own.

I agree to inform Microseeps of any accidental reporting of non-authentic data by myself in a timely manner.

I agree to inform Microseeps of any accidental or intentional reporting of non-authentic data by other employees.

I have read, acknowledge, and understand my personal ethical and legal responsibilities including potential punishments and penalties for improper, unethical, or illegal actions.

_____ _____

Signature Date

Appendix A

Key Personnel Job Descriptions

President and Chief Executive Officer

General Description: This exempt position is responsible for the overall administrative, technical, and financial direction of the corporation.

Educational Requirements: This position requires a graduate degree and/or fifteen or more years of experience in business management.

Functional Job Description

1. Performs the duties of the Chief Operational Officer as required.
2. Assumes financial responsibility and financial liability for the corporation.
3. Approves company policies and procedures.
4. Represents the company at trade shows.
5. Writes and presents research papers at environmental conferences.
6. Represents the corporation in negotiating major contracts.
7. Researches and considers the growth potential for future markets.
8. Keeping the company's focus on the technical edge of the environmental laboratory market.
9. Serves on the Board of Directors.
10. Committed to insure a framework is in place for the company to provide quality systems guidelines of the highest standard.
11. Other responsibilities as assigned by the Board of Directors.

Senior Vice President

General Description: This exempt managerial position is responsible for providing corporate management of the organization.

Educational Requirements: This position requires a graduate degree and/or ten or more years of experience in business management.

Functional Job Description

1. Administers and enforces company policies and procedures.
2. Produces plans and administrative procedures to maximize the efficiency of the corporation within established guidelines.
3. Oversees outsourced Human Resource, Information Technology, and Health and Insurance Benefits contracts.
4. Oversees Finance Department.
5. Maintains budgetary restraints for corporate profitability.
6. Supports the role of Quality Systems within the corporation.
7. Coordinates the administration of the Corporate Ethics Program and Policy.
8. Serves on the Board of Directors.
9. This position has contractual liability for the corporation.
10. Other duties and responsibilities as assigned by the President.

Vice President of Sales and Marketing

General Description: This exempt managerial position is responsible for directing the activities of the Sales and Marketing Staff. This position is ultimately responsible for meeting sales goals and reports directly to the President.

Educational Requirements: This position requires a Bachelor's Degree in Business or a related discipline and a minimum of ten years of business management experience.

Functional Job Description

1. Provide leadership and direction for the Sales and Marketing Staff.
2. Propose the yearly Sales and Marketing Budget to the Board of Directors.
3. Set and communicate reasonable target sales goals for sales staff.
4. Hold sales staff accountable for meeting target sales.
5. Assist the President and Senior Vice-President in developing short and long term sales and marketing strategies.
6. Communicate staffing needs for all related positions so that the sales division can efficiently handle workloads.
7. Responsible for sales staff's code of conduct and disciplinary action.
8. Act as liaison with other departments to ensure interdepartmental communication.
9. Serves on the Board of Directors.
10. Other duties and responsibilities as assigned by the President.

Vice President of Operations

General Description: This exempt managerial position is responsible for providing overall administration of the Operations Department.

Educational Requirements: This position requires a bachelor's degree and/or ten or more years of experience in operations management.

Functional Job Description

1. Oversee the duties and responsibilities of the department managers as required.
2. Administer and enforce company policies and procedures.
3. Develop administrative procedures to maximize the efficiency of operations within established company guidelines.
4. Oversee implementation of procedures to maximize the quality and efficiency of work performed.
5. Oversee effective subordinate development including but not limited to, training and career path development.
6. Maintains budgetary restraints for operational profitability and turnaround schedules.
7. Ensures that all technical assignments are carried out consistently within applicable professional and company quality standards.
8. Maximizes business opportunities within the current client base.
9. Supports the role of Quality Systems within the corporation.
10. Serves on the Board of Directors.
11. Other duties and responsibilities as assigned by the President.

Laboratory Manager

General Description: This exempt managerial position is responsible for overseeing the daily management of the laboratory operations and operations' staff. This position reports to the Vice President of Operations.

Educational Requirements: This position requires a Bachelor's Degree in Chemistry or a related field with a minimum of ten years of experience.

Functional Job Description

1. Provide supervision and direction to all Operations Department personnel.
2. Manage the size of the Operations Department efficiently in accordance with available workload and communicate staffing requirements to the Vice President Operations.
3. Responsible for laboratory code of conduct and staff disciplinary action.
4. Responsible for scheduling work and laboratory personnel to ensure efficient use of time and resources.
5. Assist the Vice President of Operations in developing short and long-range plans for laboratory improvement and growth.
6. Responsible for ensuring that the highest degree of technical quality possible is represented in outgoing final analytical data reports.
7. Ensure that laboratory work assignments are coordinated with work assignments of other groups in the company.
8. Represent the Operations Department in weekly meetings with other managers.
9. Work in conjunction with the Manager of Technical Services to provide input and support for instrumentation needs.
10. Coordinate with the Quality Systems Manager to develop and implement Standard Operating Procedures.
11. Support and enforce the specific methods, policies, and procedures outlined in Microseeps' Standard Operating Procedures and Quality Systems Manual.
12. Assist in the writing and review of laboratory Standard Operating Procedures.

13. Ensure MDLs, and PQLs are updated in the LIMS as required.

14. Responsible for the administration of the Chemical Hygiene Plan within the laboratory.

15. Perform other duties and responsibilities as assigned by the Vice President of Operations.

Quality Systems Manager

General Description: This exempt managerial position carries the responsibility for providing leadership and direction to ensure that the laboratory function at the highest level of quality possible in accordance with regulatory and certification requirements. The term Technical Director is use synonymously with the Quality Systems Officer.

Educational Requirements: This position requires a Bachelor's degree in chemistry or a related discipline and a minimum of ten years of laboratory experience.

Functional Job Description

1. Provide leadership and direction for the laboratory's Quality Systems Program.

2. Provide supervision and delegate tasks to the Quality Systems Coordinator.

3. Keep current on regulatory requirements to ensure that Standard Operating Procedures for analyses are in compliance with applicable regulations.

4. Conduct laboratory quality audits according to the annual schedule.

5. Serve as liaison between Microseeps and Regulatory Agencies.

6. Provide leadership and direction for developing and maintaining all Laboratory Standard Operating Procedures and the Quality Systems Manual.

7. Work with the Quality Systems Coordinator and the Laboratory Manager to discern and correct issues leading to poor quality and, if deemed necessary stop unsatisfactory work or prevent reporting of unjustifiable results.

8. Serve as client contact for questions that cannot be answered by the Customer Service Department or the Manager of Technical Services.

9. Other duties as assigned by the President and Chief Operating Officer.

Manager of Research and Development

General Description: The Manager of Research and Development is responsible for directing and managing an ongoing research and development program that insures the laboratory is ready to respond to leading edge technology needs.

Educational Requirements: This position requires a graduate degree in chemistry or a related discipline and a minimum of ten years of laboratory experience.

Functional Job Description

1. Provide assistance with interpretation of client data needs and data reports in cooperation with the Customer Service Department.

2. Assist clients in defining data needs, constructing sampling plans and interpreting data reports via non-binding suggestions and selected references to published documents.

3. Prepare and present at least two presentations per year at seminars, workshops, or conferences.

4. Develop written material for the use of Customer Service personnel to provide client assistance and education.

5. Identify emerging analytical needs and upon agreement with the Board of Directors, develop conceptual models for analytical methods to support those emerging client needs.

6. Develop conceptual analytical methods into routine procedures for bench chemists to implement.

7. Ensure that new method development is fully documented by compiling a complete package of experimental data in a form that is organized, summarized, and that can be validated.

8. When new analytical methods have become routine procedures, transfer responsibility to the Laboratory Manager.

9. Establish and maintain an awareness of the literature and the community of scientists and engineers that drive the market identified by the President and Chief Executive Officer.

10. Other duties as assigned by the President and Chief Executive Officer.

Manager Customer Service

General Description: This exempt managerial position is responsible for directing the activities of the Customer Service Staff, Bottle Preparation, and Sample Courier. This position is ultimately responsible for ensuring customer service satisfaction. This position reports directly to the Vice President of Operations.

Educational Requirements: This position requires a Bachelor's Degree and a minimum of four years of Customer Service experience.

Functional Job Description

1. Provide leadership and direction for the Customer Service Office, Bottle Preparation, Sample Courier, and EDD Specialist.
2. Assist the Vice President Sales and Marketing in developing short and long-term sales and marketing strategies.
3. Communicate staffing needs for all related positions so that the divisions can efficiently handle workloads to better ensure customer satisfaction.
4. Responsible for customer service code of conduct and disciplinary action.
5. Perform all of the functions of a Project Manager/Customer Service Representative.
6. Provide review of contracts.
7. Oversee purchasing for Bottle Preparation.
8. Act as liaison with other departments to ensure interdepartmental communication.
9. Ensure customer complaints are resolved to the customer's satisfaction.
10. Represent Customer Service at weekly Operations Meetings.
11. Communicate the importance of Customer Service within the company.
12. Review client projects and Lab Project Summary Sheets after projects are logged in, on a daily basis.
13. Other duties and responsibilities as assigned by the Vice President of Operations.

Manager of Technical Services

General Description: This exempt managerial position is responsible for overseeing the use of the laboratory facilities and instrumentation, and implementing new method development. This position reports to the Vice President of Operations.

Educational Requirements: This position requires a Bachelor's Degree in Chemistry or a related field with a minimum of ten years of experience.

Functional Job Description

1. Provide assistance for the technical review of client requests for chemical analysis as needed.

2. Respond to daily technical problems and questions on unusual samples at the request of the Laboratory Manager.

3. Evaluate the technical aspects and justify the cost of newly proposed instrumentation or existing instrument upgrades.

4. Maintain and repair of equipment and apparatus being used at Microseeps.

5. Provide support for equipment and data interfacing to the LIMS.

6. Recommend upgrades to laboratory apparatus to meet method requirements and to maintain Microseeps position as a leading-edge technology provider.

7. Reviews and participates in new hardware and software purchases for technical instrumentation.

8. Provide ongoing facility (plant) recommendations.

9. Any other duties as assigned by the Vice President of Operations.

Quality Systems Coordinator

General Description: This exempt position is responsible for assisting the Quality Systems Manager to ensure that the Quality Systems Policies and Procedures are implemented in accordance with the Quality Systems Manual and Microseeps Standard Operating Procedures. This position reports to the Quality Systems Manager.

Educational Requirements: This position requires a Bachelor's Degree and 2 years of laboratory experience.

Functional Job Description

1. Administratively responsible for the Quality Systems Program as directed by the Quality Systems Manager.
2. Prepare an annual schedule of laboratory audits.
3. Prepare audit reports and necessary corrective action to the Laboratory Manager.
4. Follow up on all corrective action reports until appropriate action has been taken.
5. Establish a schedule, order supplies, coordinate, and submit final analytical data for performance evaluation studies.
6. Maintain, control, and update the Quality Systems Manual and all of Microseeps' Standard Operating Procedures.
7. Ensure new Operation's Department employees receive required training and orientation and maintain the documentation of the training.
8. Ensure appropriate studies are conducted when necessary i.e. Initial Demonstrations of Proficiency and MDL's.
9. Calibrate all laboratory thermometers once a year.
10. Annually send out scale weights, radiation screening instrument, and NIST thermometer for calibration.
11. Coordinate annual inspections for certifications of balances and fume hoods.
12. Other duties as assigned by the Quality Systems Manager.

Procurement Coordinator

General Description: This exempt position is responsible for all aspects of purchasing and supply receipt and reconciliation. This position reports to the Vice President of Operations.

Education Requirements: This position requires a high school diploma and two years of laboratory experience. A basic knowledge of chemistry and laboratory analytical procedures is required.

Functional Job Description

1. Purchase, track, receive, and distribute supplies for the Operations Department.

2. Performs other duties and responsibilities as assigned by the Vice President of Operations.

Sample Custodian

General Description: This exempt position is responsible for all aspects of sample custody from sample receipt to storage until final disposal. This position reports directly to the Laboratory Manager.

Education Requirements: This position requires a high school diploma and two years of laboratory experience. A basic knowledge of chemistry and laboratory analytical procedures is required.

Functional Job Description

1. Receive and inspect samples and sample containers and sign appropriate documents according the Standard Operating Procedure for Sample Receiving and the Quality Systems Manual.

2. Record all necessary information on chain of custody.

3. In the event of any discrepancies or non-conformance issues with the above procedures, immediately complete a non-conformance form and submit it to customer service.

4. Notify Project Manager upon receipt of client samples when requested.

5. Accurately log samples into LIMS ensuring that all required fields are completed for the level of analysis required.

6. Label all sample containers.

7. Initiate transfer of samples as soon after receipt as possible to appropriate storage areas, ensuring that all samples are maintained at the appropriate temperature at all times.

8. Notify Lead Analysts immediately upon receipt of samples with short holding times. Complete non-conformance form for all samples that do not get picked up by analysts within the specified holding time.

9. Control and monitors access to and storage of samples in secure storage.

10. Performs other duties and responsibilities as assigned by the Laboratory Manager.

Lead Analyst

General Description: This exempt supervisory position assists in the daily supervision and training of staff analysts and technicians. This position reports directly to the Laboratory Manager.

Educational Requirements: This position requires a Bachelor of Science Degree in Chemistry or a related field and five years of related work experience, or a combination of college coursework in chemistry with a minimum of eight years of related work experience.

Functional Job Description

1. Conduct routine day to day technical training and supervision of analysts including proper Quality Assurance and Quality Control implementation and training.

2. Ensure that samples arriving with short holding times are analyzed within the applicable time frame.

3. Schedule analysis to efficiently meet holding times, and expedited and priority project schedules. Follow up with analysts to ensure turnaround times are met.

4. Review analytical data for completeness and accuracy. Institute corrective action when quality is found to be below the standards specified in the Standard Operating Procedures.

5. Properly collect, label, and store hazardous waste streams that are generated from the laboratory under the position's direct supervision. Coordinate with the Waste Coordinator for waste pick-up.

6. Ensure that the following logbooks are completed as required by Standard Operating Procedures: Temperature Logs, Balance Logs, Standards Preparation Logs, Run Logs, Sample Preparation Logs and Instrument Maintenance Logs.

7. Work with the Manager of Technical Systems to ensure preventative maintenance is conducted according to the maintenance schedule. Conduct daily preventative maintenance and minor repairs if able.

8. Keep laboratory stocked with supplies by submitting purchase orders to Procurement Coordinator in a timely manner.

9. Assure that all personnel under direct supervision practice quality control procedures in accordance with the Laboratory Quality Systems Manual and specific Standard Operating Procedures.

10. Enforce Health and Safety Procedures in the laboratory in accordance with the Chemical Hygiene Plan.

11. Work with the Health and Safety Officer to help correct suspected unsafe practices, situations, or working spaces.

12. Responsible for ensuring that all workspaces are maintained in a clean and well-organized fashion.

13. Performs other duties and responsibilities as assigned by the Laboratory Manager.

Staff or Laboratory Analyst

General Description: This exempt position is responsible for the timely analysis and custody of client samples. Job responsibilities cover a broad range of duties and responsibilities depending on employee education and experience. This position reports directly to the Lead Analyst.

Educational Requirements: This position covers a range of educational levels from a high-school education with on-the-job training to a Ph.D. in Chemistry or a related field. Analysts must pass Initial Demonstrations of Proficiency for every analytical method before independent analysis can be conducted.

Physical Requirements: This position requires the ability to lift 20 pounds and the ability to stand for extended periods of time.

Functional Job Description

1. In matters concerning order and priority of analysis, this position is accountable to, and will take direction from the Lead Analyst.
2. Keep all workspaces neat, clean, and organized.
3. Obtain samples from Sample Receiving as directed by the Lead Analyst.
4. Observe internal chain of custody requirements for all samples taken from Sample Receiving.
5. Ensure all aliquots analyzed are representative of the entire sample.
6. Analyze samples according to Microseeps Standard Operating Procedures (SOP) and or the applicable Standard or EPA Methods.
7. Observe and practice applicable quality control procedures in accordance with the Laboratory Quality Systems Manual and specific SOPs. This includes analyzing required quality control samples, ensuring results are within specified acceptance limits, and initiating corrective action when results are outside of acceptable parameters.
8. Analyze samples arriving with short holding times within the applicable time frame.
9. Review peer analytical data for completeness and accuracy where possible.
10. Responsible for making accurate entries into logbooks.

11. Conduct equipment preventative maintenance according to the Equipment Maintenance SOP.

12. Maintain supply inventory and notify lead analyst when laboratory supplies are needed.

13. Comply with all Health and Safety Procedures outlined in the Chemical Hygiene Plan.

14. Work with the Health and Safety Officer to help correct suspected unsafe practices, situations, or working spaces.

15. Identify any problems with samples, equipment, or procedures that will affect the integrity of analysis and report them to the Lead Analyst.

16. Performs other duties and responsibilities as assigned by the Lead Analyst or the Laboratory Manager.

Project Manager/Customer Service Representative

General Description: This exempt position is responsible for marketing, inside sales, and project management. This position reports to the Manager of Customer Service.

Educational Requirements: This position requires a minimum of five years of customer service experience in the laboratory, environmental, or chemistry field.

Functional Job Description

1. Generates quotations utilizing the LIMS.
2. Serves as the liaison between clients and the technical departments.
3. Provides supervision and direction to Bottle Preparation and Courier.
4. Takes bottle orders from clients.
5. Enter projects into the LIMS.
6. Manage projects as required according to client contracts.
7. Signs final data reports acknowledging that the reports are being sent.
8. Contact clients as required by Non-Conformance Forms.
9. Arrange rush and special analytical projects with Laboratory Manager.
10. Participate in conferences, trade shows, and other marketing activities.
11. Responsible for updating client databases with current information.
12. Provide initial review of contracts.
13. Serve as Microseeps representative to the client and as such, conduct themselves with the highest standard of ethics, is responsive to clients' needs, and portrays a level of professionalism for which Microseeps is known.
14. Create, generate, and disseminate company information to clients as requested.
15. Review invoices for accuracy.
16. Other duties as assigned by the Manager of Customer Service.

EDD Analyst/Customer Service Assistant

General Description: The EDD analyst position is responsible for the overall development, testing, maintenance, documentation, and support of all Electronic Data Deliverable (EDD) related processes, code and transactions. The Customer Service Assistant aspect of the position is responsible for specific customer service activities as they relate to the coordination of project work and consistently provides work on a timely basis.

Educational Requirements: This position requires High School education plus an Associate degree in Information Technology. Two years experience working with Electronic Data Interchange processes. Must also possess strong skills with SQL scripting and SQL Stored Procedures, as well as abilities with Microsoft SQL Server, Enterprise Manager, and Query Analyzer.

Functional Job Description

1. Provide technical support for all EDD related implementations.
2. Analyze client requirements, specify design, and develop new EDD solutions.
3. Modify and enhance existing EDD related code or procedures.
4. Provide customer support and correct reported problems with EDDs.
5. Utilize and develop procedures for EDD checking utilities, formatting applications and other tools as necessary.
6. Develop and publish documentation and procedures regarding proper uses and operations of the EDD environment as well as individual EDD requirements, structure, code, and results.
7. Perform training for responsible parties on the use of EDD related processes.
8. Work with customers, staff, external IT consultants and managers for both new development and problem determination/resolution.
9. Assure the highest levels of stability, integrity, reliability, performance, security, and availability of EDDs consistent with the resources available and the established change control policies, and prescribed procedures.

10. Use established user request and problem management tool to track requests and follow up to resolution and closure.

11. Perform special projects or other duties as required.

12. Review and check project files when received from login for correctness and completeness.

13. Review and prepare data packages by paginating data, scanning reports, and burning CDs.

14. Prepare and send Excel reports and invoices to clients electronically.

15. Receive and fill out bottle orders for clients when taking client calls.

16. Answering the telephone when required for customer satisfaction.

Bottle Preparation Technician

General Description: This non-exempt position consists of up to forty hours of work per week in completing bottle preparation activities. This position reports to the Customer Service Office.

Educational Requirements: High School Diploma with knowledge in basic chemistry. Computer skills are required, as well as, competencies in basic math, reading, and writing.

Physical Requirements: The position requires a maximum lifting capacity of 40 pounds with the ability to lift and carry large and bulky objects. The job skills also require a full range of motion for bending over and straightening.

Functional Job Description

1. Properly assemble, prepare, preserve, package and ship orders following Company Standard Operating Procedures in a cost effective and timely manner.
2. Inventory, order, track, and stock all necessary bottle preparation supplies.
3. Track, maintain, and fill all standing bottle orders for pick-up, delivery, and shipment.
4. Keep accurate records and files of standing orders, supply orders, and end of month inventories.
5. Track client packages that were lost or late via the telephone or by using the available software. (When given a computer/telephone)
6. Practice open communication in all instances with the Customer Service department in order to assure clients get the best possible service.
7. Maintain a neat, clean, and organized work and storage area.
8. Wear safety glasses while in bottle preparation room, and other protective clothing such as gloves and smocks when using chemicals, handling samples, and cleaning coolers.
9. Assist courier in sample collection, pick-up, or delivery when necessary.
10. Clean and dry all coolers that arrive prior to placing them in storage.
11. Obtain stock preservatives.
12. Other duties as designated by the Manager of Customer Service.

Appendix B

References

REFERENCES

U.S. Environmental Protection Agency, 1986, Test Methods for Evaluating Solid Waste, SW-846. , 3rd. ed., Office of Solid Waste and Emergency Response, Washington, DC.

U.S. Environmental Protection Agency, 1983, Methods for Chemical Analysis of Water and Wastes, EPA-600/4-79-020, Environmental Monitoring and Support Laboratory, Cincinnati, Ohio.

Standard Methods for the Examination of Water and Wastewater, 20th ed., 1998.

National Environmental Laboratory Accreditation Conference, Quality Systems National Environmental Laboratory Accreditation Program, Rev. 16, July 12, 2002, Chapter 5.

Appendix C

Microseeps Ethics Program

Microseeps, Incorporated

Ethics Program

Approved by: Thomas W. Hill Date: 2-27-08

Thomas W. Hill

Reviewed by: Date: 2-27-08

1.0 Introduction

At Microseeps, we are committed to operating with integrity. We value the integrity of the individual and the institution. We value honesty and trust in the way we treat one another and in the way we meet our commitments. Consistent with our commitment to integrity, our Ethics Program is based on values. For the program to succeed, each employee must use his or her own values to make decisions that reflect well on the employee and on the company.

This Program will encompass defining improper, unethical, and illegal actions, outline responsibilities, and ways in which the laboratory can prevent and/or detect these types of actions. This Program shall identify specific examples of improper, unethical, or illegal actions and establish potential punishments and penalties for the same. This Program shall include initial and annual ethics training.

The Statement of Ethical Responsibility (see Exhibit 1) shall be read and signed by every Microseeps' employee. This Program shall designate one individual to whom company personnel can report improper, unethical, or illegal practices.

2.0 Definitions

Improper Actions: Deviations from contract-specified or method-specified analytical practices and may be intentional or unintentional.

Unethical or Illegal Actions: The deliberate falsification of analytical or quality assurance results, where failed method or contractual requirements are made to appear acceptable (also known as laboratory fraud).

3.0 Responsibility

3.1 Laboratory Managers and Supervisors

The Laboratory management and supervisors at all levels are responsible for:

- Implementing the Ethics Program
- Providing clear guidelines on matters of everyday conduct to all employees.
- Stressing to all employees the need for a commitment in word and deed to the ethics policy and practices.
- Demonstrating their own commitment to the ethics policy and practices in the management of their area of responsibility and the activities of all employees under their supervision.

- Maintaining a workplace environment that encourages frank and open communication, free from the fear of reprisal, concerning the upholding of the ethics policy and practices.
- Distributing the Ethics Program to all employees.
- Developing and presenting training to ensure that all employees understand the laboratory's ethics principles and practices.
- Provide continuing counsel on laboratory practices, policies, rules, and regulations to any employee who seeks assistance.
- Maintaining working conditions supportive of employee responsibilities.
- Enforcing compliance with the ethics policy and practices.
- Recognizing employees who make exemplary efforts to implement and uphold the ethics policy and practices.
- Reviewing and investigating all allegations of wrongdoing.
- Ensuring that all current and new employees under their supervision have received a copy of the Ethics Policy and are trained in its meaning and applications.
- Reviewing the level of Ethics Policy knowledge and understanding of the employees under their supervision.

3.2 Employees

All employees are responsible for:

- Reviewing regularly their knowledge and understanding of the ethics policy and practices.
- Upholding the ethics policy and practices as demonstrated in their daily conduct.
- Contributing to a workplace environment that is conducive to the maintenance of the ethics policy and practices in daily activities.
- Seeking help when the proper course of action is unclear or unknown to them.
- Remaining alert and sensitive to situations that could result in actions by any employee that are improper, illegal, unethical, or otherwise in violation of the ethics policy and practices.
- Counseling fellow employees when it appears that they are in danger of violating the ethics policy and practices.
- Reporting violations of the ethics policy and practices to their supervisor, or higher-level management.
- Writing thorough case narratives explaining why analytical data may or may not be useful due to anything in the analytical process that may have been wholly or partially deficient.

4.0 Prevention and Detection

A key element in preventing fraud is the adoption of an ethics policy that is strictly enforced. Having employees that understand the difference between a mistake and improper behavior and

that are trained to make ethical decisions is one of the best prevention strategies. A strongly reinforced ethics-training program is one of the key cornerstones to an effective total ethical process.

4.1 Examples of Unethical Actions

There are a number of laboratory practices, which may constitute fraud. The following are some examples:

- Falsification of results to meet method requirements.
- Reporting of results without analyses to support (i.e. dry-labbing).
- Selective exclusion of data to meet QC criteria (initial calibration points dropped without technical or statistical justification).
- Misrepresentation of laboratory performance by presenting calibration data or QC limits within data reports that are not linked to the data set reported.
- Notation of matrix interference as a basis for exceeding acceptance limits (typically without implementing corrective actions) in interference-free matrices (e.g. method blanks or laboratory control samples).
- Unwarranted manipulation of computer software (e.g. improper background subtraction to meet ion abundance criteria for GC/MS tuning, chromatographic baseline manipulations).
- Improper alteration of analytical conditions (e.g. modifying EM voltage, changing GC temperature program to shorter analytical run time) from standard analysis to sample analysis.
- Misrepresentation of QC samples (e.g. adding surrogates after sample extraction, omitting sample preparation steps for QC samples, over-spiking or under-spiking).
- Reporting results from the analysis on one sample for those of another.

4.2 Prevention and Detection

The Quality Inquiry Form (QIF) can be used as a means to report improper, unethical, or illegal actions. The QIF should be completed and submitted anonymously (if desired) to the Technical Director. An immediate investigation shall be conducted by a member of Microseeps' management to ascertain if a violation did occur.

Other means of prevention and detection include an Internal Audit Program, an ethics-training program, and a requirement for analyst notation and sign-off on manual integration changes to data.

4.3 Disciplinary Action for Unethical Actions

Because the implications of unethical actions are substantial, swift and decisive disciplinary action shall be carried out for violations of the Ethics Policy. If an investigation reveals knowing and willful violation of laboratory ethics by an employee, that employee shall be terminated. Other violations can result in disciplinary actions that range from verbal warnings to written warnings with time off. The severity of the discipline shall match the severity of the offense. All ethics violations shall be documented in employee's personnel files.

5.0 Training

All employees shall receive initial and annual ethics training. The training shall be conducted by Microseeps' management personnel. The training shall include the contents of this policy in its entirety, employee and supervisory responsibilities, examples of unethical behavior, disciplinary action for unethical actions, and a means to report unethical actions.

5.1 Ethics Training Documentation

Training documentation shall be maintained in the Quality Systems Office. All employees are required to sign and date Exhibit 1, the Ethics, and Data Integrity Agreement. This form shall be placed in the employees personnel file.

5.2 Training Frequency

Initial training shall be conducted within two weeks of all initial hires and annually thereafter.

Microseeps, Incorporated

ETHICS AND DATA INTEGRITY AGREEMENT

I, _____, state that I understand the high standards of integrity required of me with regard to the duties I perform and the data I report in connection with my employment at **Microseeps, Incorporated.**

I agree that in the performance of my duties at Microseeps:

I. I shall not intentionally report data values that are not the actual values obtained;

II. I shall not intentionally report the dates and times of data analyses that are not the actual dates and times of data analyses; and

III. I shall not intentionally represent another individual's work as my own.

I agree to inform Microseeps of any accidental reporting of non-authentic data by myself in a timely manner.

I agree to inform Microseeps of any accidental or intentional reporting of non-authentic data by other employees.

I have read, acknowledge, and understand my personal ethical and legal responsibilities including potential punishments and penalties for improper, unethical, or illegal actions.

_____ _____

Signature Date

APPENDIX G

DOSAGE CALCULATION FOR SODIUM LACTATE AND SODIUM BROMIDE

Dosage Calculation for Sodium Lactate and Sodium Bromide
216 Paterson Plank Road Site
Carlstadt, NJ

Radius (ft)	Area (ft^2)	Thickness (ft)	Volume (ft^3)	Porosity	Saturated Volume (ft^3)	Saturated Volume (L)	Goal Lactate Concentration (mg/L)	Mass of Lactate (kg)
5.0	**78.5**	10.0	**785.4**	0.2	**157.1**	**4,448.0**	200.0	**0.9**
10.0	**314.2**	10.0	**3,141.6**	0.2	**628.3**	**17,792.0**	200.0	**3.6**
15.0	**706.9**	10.0	**7,068.6**	0.2	**1,413.7**	**40,032.0**	200.0	**8.0**

Goal Bromide Concentration (mg/L)	Mass of Bromide (kg)	Mass of NaBr (kg)	Injected Lactate concentration (g/L)	Volume Lactate Solution (L)	Volume Lactate Solution (gal)
50.0	**0.2**	**0.3**	32	**27.8**	**7.3**
50.0	**0.9**	**1.1**	32	**111.2**	**29.4**
50.0	**2.0**	**2.6**	32	**250.2**	**66.1**

Calculated Parameters

Made by: MJB
Checked by: HAL

Golder Associates
R2-0002477