INTERIM SITE MANAGEMENT PLAN
OU02 & OU03 SARANAC LAKE GAS COMPANY, INC.
SITE # 516008

(T) VILLAGE OF SARANAC LAKE, NEW YORK (C) ESSEX
WORK ASSIGNMENT NO. D007619-46

Prepared for:

New York State Department of Environmental Conservation
Albany, New York

Prepared by:

MACTEC Engineering and Consulting, P.C. Portland, Maine

MACTEC Project No. 3611181219

SEPTEMBER 2019

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SEPTEMBER 2019

Submitted by:

Jean Firth, P.G
Senior Geologist

Approved by:

Jamie Welch
Senior Project Manager

CERTIFICATION STATEMENT

I Jamie Welch certify that I am currently Qualified Environmental Professional as in defined in 6 NYCRR Part 375 and that this Interim Site Management Plan was prepared in accordance with all applicable statutes and regulations and in substantial conformance with the DER Technical Guidance for Site Investigation and Remediation (DER-10).

J. Welch QEP

Sept 19, 2019 DATE

TABLE OF CONTENTS

LIST OF FIGURES

Figure

LIST OF TABLES

Table

GLOSSARY OF ACRONYMS AND ABBREVIATIONS

ACOE	Army Corps of Engineers
BTEX compounds	benzene, toluene, ethyl benzene and xylene
cy	cubic yard(s)
DER	Division of Environmental Remediation
EC	Engineering Control
EWP	Excavation Work Plan
bgs	below ground surface
HASP	Health and Safety Plan
IC	Institutional Control
ISS	in-situ stabilization
ISMP	Interim Site Management Plan
MACTEC	MACTEC Engineering and Consulting, P.C.
MGP	manufactured gas plant
NAPL	non-aqueous phase liquid
NYCRR	New York Codes, Rules and Regulations
NYS	New York State
NYSDEC	New York State Department of Environmental Conservation
OU	Operable Unit
PAH	polycyclic aromatic hydrocarbons
PRR	Periodic Review Report

GLOSSARY OF ACRONYMS AND ABBREVIATIONS (CONTINUED)

RAO	Remedial Action Objective
RCM	reactive core mat
RI	Remedial Investigation
ROD	Record of Decision
RSO	Remedial System Optimization
SC	Site characterization
SCG	Standards, Criteria and Guidelines
SCO	Soil Cleanup Objective
SGV	Sediment Guidance Values
Site	the Saranac Lake Gas Company, Inc. site
SVOC	semi-volatile organic compounds
VOC	volatile organic compounds

EXECUTIVE SUMMARY

The following provides a brief summary of the controls implemented for the Site, as well as the inspections, monitoring, maintenance and reporting activities required by this Interim Site Management Plan (ISMP):

Site Identification:	NYSDEC Site No. 516008 Saranac Lake Gas Co., OU02 & OU03 24 Payeville Road Village of Saranac Lake, NY

Institutional Controls:	1. The property may be used for recreational use;
	2. Institutional Controls are in place per this ISMP.
	3. All engineering controls (ECs) must be inspected at a frequency and in a manner defined in the ISMP. Annual inspection of ECs will include visual and olfactory inspection of OU02 and OU03.
Engineering Controls:	1. Barrier/Cover Systems - Reactive Core Mat (RCM) at OU02 and AquaBlok® at OU03.

Inspections:	Frequency
1. Barrier/Cover Systems at OU03 and (OU02)	Year 1: Quarterly Year 2: Biannually Year 3+: Annually
Monitoring:	
1. Sediment OU02	Year 1: Quarterly Year 2: Biannually Year 3+: Annually
2. Surface Water at OU02 and OU03	Year 1: Quarterly Year 2: Biannually Year 3+: Annually
3. Groundwater at OU02	Year 1: Quarterly Year 2: Biannually Year 3+: Annually
Maintenance:	
1. Barrier / Cover systems at OU02 and OU03	As needed

Site Identification:	NYSDEC Site No. 516008 Saranac Lake Gas Co., OU02 & OU03 24 Payeville Road Village of Saranac Lake, NY

Reporting:	
1. Inspection Reports	Within 30 days of an inspection
2. Periodic Review Report	Annually

Further descriptions of the above requirements are provided in detail in the latter sections of this ISMP and associated appendices. In addition to the periodic inspections and reporting required for this ISMP, additional restoration inspections are required by the Army Corps of Engineers (ACOE) related to Permit Application No. NAN-2017-00440-UDE (ACOE Permit). The associated restoration plan, permit applications, follow-up correspondences, and inspection forms are included discussed in Section 4.0.

1.0 INTRODUCTION

1.1 GENERAL

This Interim Site Management Plan (ISMP) is a required element of the remedial program for the Saranac Lake Gas Company, Inc. site (Site) located in the Village of Saranac Lake, New York (hereinafter referred to as the “Site”). The Site is currently in the New York State (NYS) Inactive Hazardous Waste Disposal Site Remedial Program Site No. 516008 which is administered by New York State Department of Environmental Conservation (NYSDEC). The Site is comprised of three operable units (OUs): OU01 the former manufactured gas plant (MGP) property, which is where the release of contaminants occurred; OU02 a 0.75 mile stretch of Brandy Brook which is situated adjacent to the northern boundary of OU01 and flows generally northwestward to Pontiac Bay of Lake Flower; and OU03 the Pontiac Bay portion of Lake Flower. OU02 and OU03 were remediated in accordance with the Records of Decision (RODs) dated March 2016 and March 2015 respectively (NYSDEC, 2016; NYSDEC 2015b). Only OU02 and OU03 are covered by this ISMP. Once remedial activities at OU01 are complete this ISMP will be revised and finalized as a Site-Wide Site Management Plan for the entire site encompassing OU01, OU02 and OU03.

After completion of the remedial work at OU02 and OU03, some contamination was left at this Site, which is hereafter referred to as “remaining contamination.”

This ISMP was prepared to manage remaining contamination at the Site. This plan has been approved by the NYSDEC, and compliance with this plan is required. This ISMP may only be revised with the approval of the NYSDEC.

It is important to note that:

- This ISMP details the site-specific implementation procedures that are required by the NYSDEC.
- Failure to comply with this ISMP is also a violation of Environmental Conservation Law, 6 New York Codes, Rules and Regulations (NYCRR) Part 375 and thereby subject to applicable penalties.

Reports associated with the Site can be viewed by contacting the NYSDEC or its successor agency managing environmental issues in New York State. A list of contacts for persons involved with the Site is provided in Appendix A of this ISMP.

This ISMP was prepared by MACTEC Engineering and Consulting, P.C. (MACTEC), on behalf of the NYSDEC, in accordance with the requirements of the NYSDEC's Division of Environmental Remediation (DER)-10 ("Technical Guidance for Site Investigation and Remediation"), dated May 2010 (NYSDEC, 2010), and the guidelines provided by the NYSDEC. This ISMP addresses the means for implementing the required Engineering Controls (ECs).

1.2 REVISIONS

Revisions to this plan will be proposed in writing to the NYSDEC's project manager. Revisions will be necessary upon, but not limited to, the following occurring: a change in media monitoring requirements, post-remedial removal of contaminated sediment or soil, or other significant change to the Site conditions. The NYSDEC will provide a notice of any approved changes to the ISMP, and append these notices to the ISMP that is retained in its files.

1.3 NOTIFICATIONS

Notifications will be submitted to the NYSDEC, as needed, in accordance with NYSDEC's DER – 10 for the following reasons:

- 60-day advance notice of any proposed changes in Site use that are required by 6NYCRR Part 375 and/or Environmental Conservation Law.
- 7-day advance notice of any field activity associated with the remedial program.
- 15-day advance notice of any proposed ground-intrusive activity pursuant to the Excavation Work Plan (EWP).
- Notice within 48-hours of any damage or defect to the foundation, structures or EC that reduces or has the potential to reduce the effectiveness of an EC, and likewise, any action to be taken to mitigate the damage or defect.
- Verbal notice by noon of the following day of any emergency, such as a fire; flood; or earthquake that reduces or has the potential to reduce the effectiveness of ECs in place at the Site, with written confirmation within 7 days that includes a summary of actions taken, or to be taken, and the potential impact to the environment and the public.
- Follow-up status reports on actions taken to respond to any emergency event requiring ongoing responsive action submitted to the NYSDEC within 45 days describing and documenting actions taken to restore the effectiveness of the ECs.

Any change in the ownership of the Site or the responsibility for implementing this ISMP will include the following notifications:

- At least 60 days prior to the change, the NYSDEC will be notified in writing of the proposed change. This will include a certification that the prospective purchaser/Remedial Party has been provided with a copy of the ROD, and all approved work plans and reports, including this ISMP.
- Within 15 days after the transfer of all or part of the Site, the new owner's name, contact representative, and contact information will be confirmed in writing to the NYSDEC.

Table 1.1 below includes contact information for the above notification. The information on this table will be updated as necessary to provide accurate contact information. A full listing of Site-related contact information is provided in Appendix A.

Table 1.1: Notifications

Name	**Contact Information**
Sarah Saucier , NYSDEC Project Manager	(518) 402-9675, sarah.saucier@dec.ny.gov
Jamie Welch, MACTEC Project Manager	(208) 828-3479, jamie.welch@woodplc.com

* Note: Notifications are subject to change and will be updated as necessary.

2.0 SUMMARY OF PREVIOUS INVESTIGATIONS AND REMEDIAL ACTIONS

The following narrative provides an investigation and remedial history timeline for the Site. Full titles for each of the reports referenced below are provided in Section 8.0 - References.

Previous investigations:

- NYSDEC, 1989 Spill Report. indicated stratified layers and pockets of coal tar-like material were observed at depths of 6 to 8 feet during the excavation of a residential sewer line located adjacent to Brandy Brook.
- MACTEC, 2007 – Site Characterization Report
- MACTEC, 2015c - Remedial Investigation Report
- MACTEC, 2015b,a -Feasibility Study Reports (OU03-January, OU02-August)
- MACTEC 2017a- Pre-design Investigation Field Activities Report
- MACTEC 2017b - Remedial Design Basis Report

2.1 SITE INVESTIGATIONS

2.1.1 Site History

The Site is comprised of three OUs: OU01 the former manufactured gas plant (MGP) property, which is where the release of contaminants occurred; OU02 a 0.75 mile stretch of Brandy Brook which is situated adjacent to the northern boundary of OU01 and flows generally northwestward to Pontiac Bay of Lake Flower; and OU03 the Pontiac Bay portion of Lake Flower (Figure 2.1).

The Saranac Lake Gas Company manufactured lighting gas (coal gasification) for the Village of Saranac Lake from the late 1800s to approximately the 1940s (NYSDEC, 2013). Based on the operational age of this MGP site, the most likely method of gas manufacturing was via the Carbureted Water Gas process. In general, this method involved:

- Coal heated in closed retorts in which the coal was prevented from combusting by limiting the oxygen.
- During the heating process steam was injected into the retort and a chemical reaction occurred that produced a flammable gas mixture.
- Liquid petroleum hydrocarbons were sprayed into the hot gas mixture creating additional methane.
- The gas was collected, cooled, and purified before being used.

- Condensed tar (coal-tar) was produced as a by-product.

While the former MGP-plant was operating, releases of MGP-waste to the environment occurred within OU01. It appears direct surface discharge of waste occurred to Brandy Brook (OU02) and migrated to Pontiac Bay of Lake Flower (OU03). Non-aqueous phase liquids (NAPL) and residual product are present within OU01 and impacting groundwater migrating from the Site.

The remedial investigation (RI) evaluated the nature and extent of contamination present in the environment related to historical activities at the former MGP. An RI report was completed in January 2015, which summarized the findings of the RI (MACTEC, 2015a).

The by-product coal tar does not readily dissolve in water. Although most coal tars are slightly denser than water, the difference in density is slight. Consequently, they can either float or sink when in contact with water. Coal tar is a reddish brown oily liquid by-product resulting from manufacturing of coal gas and contains a number of different chemical constituents that are a cause for concern when left untreated in the environment. The contaminants of concern resulting from the by-products in the MGP process include:

- Two predominant contaminant classifications are present in coal-tar: volatile organic compounds (VOCs) and semi-volatile organic compounds (SVOCs). MGP-related VOCs are specifically characterized by four compounds; benzene, toluene, ethyl benzene and xylene (BTEX compounds). BTEX compounds often represent a small percentage of the mass of MGP-related waste, but are the most soluble and therefore are the most likely to migrate in groundwater. BTEX compounds are also the most volatile and are thus the most likely to migrate through subsurface soils as vapors or soil gas. SVOCs found in coal-tar are known as polycyclic aromatic hydrocarbons (PAHs). Naphthalene, a PAH, is present in coal-tar in relatively high concentrations and was used as an indicator compound for detecting MGP-related waste in media.
- Light oil, a secondary by-product of the gasification process, contains VOCs including: benzene, toluene, ethyl benzene, and xylenes, naphthalene and trimethylbenzenes, collectively referred to as petroleum-related VOCs.
- Phenols in coal-tar acids form during the cooling of the manufactured gas.
- Purifier box waste (typically wood chips with tar residuals) contains complex-cyanide compounds as well as sulfur (which may cause changes in pH).
- Coal ash and purifier waste contain metals which may include: aluminum, antimony, arsenic, barium, cadmium, chromium, copper, iron, lead, manganese, mercury, nickel, selenium, silver, vanadium, and zinc.

2.1.2 Site Characterization

Site Characterization (SC) field activities were conducted at the former Saranac Lake Gas Co. Inc. Site between 30 April and 4 May 2007.The purpose of this investigation was to determine whether a consequential amount of hazardous waste had been disposed at the Site as a result of past site activities related to the former MGP. Results of the SC investigation are described below, and can be found in the Site Characterization report (MACTEC, 2007):

- Field observations from test pits and direct push soil boring indicate the presence of MGP-related waste on-site, including wood debris and fibers (purifier waste), tar-like and oily residues, elevated photoionization detector readings, strong MGP-related odors, and “Prussian blue” sheens.
- VOCs, including benzene, toluene, naphthalene, ethylbenzene, and xylene, were detected in nearly all soil samples within the perimeter fence and two offsite locations in concentrations exceeding the NYSDEC Soil Cleanup Objectives (SCOs). MGP related SVOCs were detected in 13 of 21 soil samples.
- VOC contaminants likely related to MGP wastes were detected above NYS Class GA groundwater standards at 8 of 12 locations tested. MGP related SVOC compounds were detected above groundwater standards at 7 of 11 locations analyzed.
- MGP-related VOCs and SVOCs were detected at concentrations in excess of sediment screening criteria in all locations adjacent to and downstream of OU01, with the highest concentration observed within Brandy Brook, roughly 300 feet north of OU01.

Several data gaps were identified during the SC, which were later investigated during the RI. For a description of SC investigative findings, see the MACTEC Site Characterization Report dated October 2007.

2.1.3 Remedial Investigation

RI field investigations were completed at the Site between August 2013 and October 2014 to evaluate the nature and extent of contamination present in the environment related to historical activities at the former MGP (MACTEC, 2015c). This investigation included an evaluation of visual impacts to soil, groundwater, surface water, and sediment, and a comparison to applicable NYS Standards, Criteria, and Guidance values (SCGs). The RI was implemented predominately based on visual observations to identify MGP-impacted soils and sediment. RI field observations (visual, olfactory and photoionization detector field scan) were supported by a sub-set of analytical sampling results. As discussed in detail in the RI report, where MGP-like product or staining was observed, analytical results exceeded SCGs; where no observable impacts of MGP-like wastes were noted, analytical concentrations were generally below applicable SCGs.

The RI concluded:

- OU01 - Soil and groundwater are impacted with MGP waste. Volatile organic compounds and Semi-volatile organic compounds were detected in soils at concentrations exceeding the New York State Part 375 SCOs for residential, commercial and industrial use scenarios. Groundwater concentrations within and downgradient from OU01 exceed the NYS Part 703 GA Standards. The extent of groundwater contamination downgradient of OU01 has not been fully delineated. The volume of MGP-impacted soil is estimated to be approximately 38,500 cubic yards (cy).
- OU02 - Sediment in Brandy Brook is impacted with MGP waste at concentrations exceeding both Class A and B Sediment Guidance Values (SGVs) and therefore meets the definition of a Class C sediment which has a high potential to be toxic to aquatic life. Contaminants were not detected in surface water at concentrations exceeding SCGs. The volume of MGP-impacted sediment exceeding Class A SGVs within the stretch of OU02 is estimated to be approximately 4,800 cy.
- OU03 - Sediment in Pontiac Bay of Lake Flower was found to be visually impacted with MGP waste at concentrations exceeding both Class A and B SGVs and therefore meets the definition of a Class C sediment which has a high potential to be toxic to aquatic life. Contaminants were not detected in surface water at concentrations exceeding SCGs. The volume of MGP-impacted sediment exceeding Class A SGVs is estimated to be approximately 16,900 cy.

The former Saranac Lake Gas Company manufactured lighting gas through the coal gasification process for the Village of Saranac Lake. According to Sanborn insurance maps and photos obtained from the Saranac Lake Free Library, the gas company likely operated until the 1930s or 1940s and included two above-ground gas holders, a building housing the purifier and retort (heating) operations, as well as additional areas for coal storage and offices.

2.2 FEASIBILITY STUDIES

Following the issuance of the RI report, feasibility studies were developed for OU02 and OU03 in August 2015 and January 2015, respectively (MACTEC 2015a; MACTEC 2015b). Following the feasibility studies, the NYSDEC issued RODs for OU02 and OU03 dated March 2016 and March 2015, respectively (NYSDEC 2016; NYSDEC 2015b), which outlined the selected remedial alternatives for each OU.

2.3 REMEDIAL ACTIVITIES

Between May and December 2018, OUs 02 and 03 were remediated in accordance with the RODs dated March 2016 and March 2015 (NYSDEC 2016; NYSDEC 2015b), respectively. Remediation of the Site commenced with OU03, Pontiac Bay, which included the removal of contaminated sediments via dredging, solidification/stabilization of contaminated sediments in on-site staging areas, and offsite disposal of contaminated sediment at an approved disposal facility. Approximately 13,500 cy of material was removed from the bay over an approximately 76,000 square foot area. Turbidity curtains and constant turbidity monitoring were used during the remedial process to prevent migration of turbidity to the unaffected areas of Pontiac Bay and Lake Flower. Confirmatory sediment samples were collected after the estimated depth of contamination was dredged. Dredging continued until sample results were below the SGVs. In areas where the extent of contamination could not be dredged along the shoreline, Aquablok® was placed over contamination prior to backfilling. AquaBlok is an impermeable, patented, composite-aggregate technology typically comprised of a dense aggregate core, clay or clay-sized materials, and polymers. After installation of Aquablok®, backfill and/or riprap was placed to restore the excavated area.

In additional to the removal of impacted sediments from the Pontiac Bay, in-situ stabilization (ISS) was conducted in an area adjacent to the bay, over approximately 2,800 square feet, along the south and southeast bank to render impacted soils immobile. First, the top 5 feet of soil was excavated prior to conducted ISS from 5 to 15 feet below ground surface. ISS included mixing Portland cement into the soil using an excavator with a skeleton bucket and systematically conducting ISS one cell at a time. Soil cores of stabilized soil were collected from each cell and tested for strength at day 4 , 7, 14 and 28 after mixing to ensure that a minimum of 40-PSI was achieved after 28-days. Once complete, and strength was achieved, the area was backfilled to pre-existing elevations.

Remediation of OU02 was conducted by isolating and dewatering Brandy Brook, excavating contaminated sediment via a long reach excavator, and backfilling with certified clean material. Contaminated sediment was solidified and stabilized as needed and disposed of at an approved offsite disposal facility. Approximately 6,400 cy of material was removed from the brook over an approximately 30,000 square foot area. In areas where contaminated sediment could not be reached, reactive core mat (RCM) was installed. RCM is a permeable material that absorbs NAPL but allows water to pass through. RCM was also used in Brandy Brook near OU01 where seeps with visual contamination were identified flowing into the brook. Multiple layers of RCM were installed in this area, with clean backfill and monitoring points installed between them. These monitoring points allow for visual/olfactory inspection of mid-RCM layer water in order to identify RCM breakthrough.

2.4 SITE LOCATION AND DESCRIPTION

The former Saranac Lake Gas Company (OU01), Inc. Site, located at 24 Payeville Road in the Village of Saranac Lake, Essex County, New York and is identified on the Essex county tax map as #32.215-3-1.000. OU02, Brandy Brook is located adjacent to and north of OU01. The brook follows the Adirondack Scenic Railroad for approximately 950 feet. It then turns westward, is culverted under the railroad right of way, and extends roughly 700 feet along Brandy Brook Road and into Pontiac Bay of Lake Flower.

OU02 is located immediately north of OU01 and is bordered by the Adirondack Scenic Railroad to the west and residential properties to the east. After turning westward at the corner of Pine Street, OU02 is bordered by Brandy Brook Road to the north and residential properties to the south. OU03, Pontiac Bay, is bordered by public recreation/greenspace areas the north and commercial business property to the east; Lake Flower extends to the south and west from the bay. Figure 2.2 shows the extent of OU02 and OU03 and the adjacent parcels, some of which are also depicted in site surveys included in Appendix B. Table 2.1 lists the property owners within or abutting the extent of the Site.

The owners of the OU01 parcels at the time of issuance of this ISMP are:

AmeriGas Propane, LP
460 North Gulph Road
King of Prussia, PA 19406

NiSource, Inc.
801 E. 86th Avenue
Merrillville, IN 46410

2.5 PHYSICAL SETTING

2.5.1 Land Use

OU02 and OU03 are both water bodies which are used for recreational purposes. Properties abutting OU02 an OU03 are residential, commercial and public recreation areas, as shown on Figure 2.2.

OU02 consists of an approximately 0.75 mile stretch of Brandy Brook, which flows westerly along the northern boundary of OU01, where it then turns to the north and continues in a northerly direction parallel to the railroad tracks on the west and residential, village owned and commercial properties to the right for approximately 1,000 feet before turning to the west and flowing parallel to Brandy Brook Road for approximately 700 feet, where it discharges to Pontiac Bay (OU03) in Lake Flower. The brook is culverted under the railroad tracks bordering the Site, under four separate residential driveway crossings along Brandy Brook Road and under Slater Avenue and Lake Flower Avenue. The driveway crossings range from eight to 20 feet long and the culverted section below Slater Avenue and Lake Flower Avenue is approximately 250 feet long. The brook channel is approximately three to five feet wide.

OU03 includes Pontiac Bay and an adjacent area within Lake Flower. Pontiac Bay (approximately 4 acres) is located within the northeast portion of Lake Flower adjacent to the intersection of Lake Flower Avenue and River Street. Lake Flower is a Class AA designated water body (MACTEC 2015c). OU03 surrounding properties include the Saranac Lake Resort (under development), village owned property and NYSDEC property.

2.5.2 Hydrogeology

The depth to groundwater in OU02 ranges from 6.28 feet below ground surface (bgs) on the western edge of the brook to 8.65 feet bgs on the northern side of the brook adjacent to OU01. The bed of Brandy Brook along the northern edge of OU01 is approximately four feet above the water elevation in nearby wells indicating that the brook is a perched stream that recharges the groundwater table. The potential discharge point for groundwater beneath the impacted reach of Brandy Brook (OU02) is likely Pontiac Bay in Lake Flower (OU03). Seasonal variation in precipitation may affect surface water features (i.e., Brandy Brook to the north and drainage ditches located south of OU01) and influence shallow groundwater flow migrating from the Site.

Groundwater elevations were evaluated during the RI and a groundwater contour map is shown in Figure 2.3. Groundwater elevation data from the RI is provided in Table 2.2. A summary of groundwater monitoring well construction for wells installed during the RI is provided in Table 2.3. Additional wells installed for the purpose of pre-design remediation at OU02 and OU03, but were not used for groundwater contours and are not anticipated to be monitored as part of this ISMP are not included in Table 2.3 as they are likely to be abandoned.

2.6 REMEDIAL ACTION OBJECTIVES

The following remedial action objectives (RAOs) were identified in the associated RODs for OU02 and OU03.

2.6.1 OU02 Remedial Action Objectives

The RAOs for OU02 as listed in the ROD dated March 2016 (NYSDEC, 2016) include:

Groundwater RAOs for Environmental Protection:

- Prevent the discharge of contaminants to surface water.
- Remove the source of ground or surface water contamination.

Soil RAOs for Public Health Protection:

- Prevent ingestion/direct contact with contaminated soil.
- Prevent inhalation of or exposure from contaminants volatilizing from contaminants in soil.

Soil RAOs for Environmental Protection:

- Prevent migration of contaminants that would result in groundwater or surface water contamination.
- Prevent impacts to biota from ingestion/direct contact with soil causing toxicity or impacts from bioaccumulation through the terrestrial food chain.

Sediment RAOs for Public Health Protection:

- Prevent direct contact with contaminated sediments.
- Prevent surface water contamination which may result in fish advisories.

Sediment RAOs for Environmental Protection:

- Prevent releases of contaminant(s) from sediments that would result in surface water levels in excess of (ambient water quality criteria).
- Prevent impacts to biota from ingestion/direct contact with sediments causing toxicity or impacts from bioaccumulation through the marine or aquatic food chain.

- Restore sediments to pre-release/background conditions to the extent feasible.

2.6.2 OU03 Remedial Action Objectives

The RAOs for OU03 as listed in the ROD dated March 2015 (NYSDEC, 2015b) include:

Sediment RAOs for Public Health Protection:

- Prevent direct contact with contaminated sediments.
- Prevent surface water contamination which may result in fish advisories.

Sediment RAOs for Environmental Protection:

- Prevent releases of contaminant(s) from sediments that would result in surface water levels in excess of (ambient water quality criteria).
- Prevent impacts to biota from ingestion/direct contact with sediments causing toxicity or impacts from bioaccumulation through the marine or aquatic food chain.
- Restore sediments to pre-release/background conditions to the extent feasible.

2.7 REMAINING CONTAMINATION

There are areas of residual sediment/soil contamination (i.e. "remaining contamination") in OU02 and OU03 (Figures 2.4 and 2.5 respectively). Tables 2.4 and 2.5 present the sediment and soil sample results that exceed the SCGs and/or had visual MGP impacts after completion of the remedial action for OU02. Table 2.6 presents the sediment results that exceed the SCGs after completion of the remedial action for OU03.

2.7.1 Sediment and Soil

OU02, Brandy Brook, was remediated by excavating sediments contaminated with coal tar related PAHs to class A SGVs with the exception of areas shown on Figure 2.4. In locations where visually impacted sediment remained or laboratory results indicated that SGVs were not achieved, but additional sediment could not be reached or remediation was logistically impractical, RCM was installed to prevent migration of remaining NAPL from soils/groundwater to the sediment/surface water. In some instances, the extent of contamination could not be remediated because the impacts extended too close to structures (e.g. beneath the railroad tracks) or too deep to maintain an open excavation. Additionally, as shown on Table 2.4, there are three locations where pesticide

Endosulfan 1 was detected slightly above the sediment cleanup criteria and is not located under RCM.

In an area adjacent to OU01, seeps were identified within the brook bank with visual contamination flowing into Brandy Brook. Extending the excavation towards OU01 did not occur as OU01 will be remediated at a later date. Therefore, RCM was placed over the seep area to prevent migration of NAPL from the seeps to the brook.

OU03, Pontiac Bay of Lake Flower, was also remediated by excavating sediments contaminated with coal tar related PAHs to Class A SGVs with the exception of an area approximately 200 feet long along the southern sidewall of the Bay to avoid cave-in of adjacent land. Based on confirmation soil results of this triangular wedge of contaminated sediment, Aquablok®, an impermeable barrier, was installed over approximately 150 feet of the area to prevent migration of coal tar from contaminated sediment.

Clean backfill and riprap was used to restore the bay as shown in the "As Built" drawings provided in Appendix C.

2.7.2 Groundwater

No remediation for groundwater was conducted at OU02 or OU03. The source of potential groundwater contamination has been removed, and the conceptual site model does not suggest that groundwater is discharging to surface water. However, groundwater will be monitored at one location, MW-201, located adjacent to Brandy Brook to evaluate concentrations over time.

2.7.3 Surface Water

There were no RAOs for surface water within OU02 or OU03.

2.7.4 Soil Vapor

There is no concern for soil vapor intrusion from OU02 or OU03 related sources.

3.0 INSTITUTIONAL AND ENGINEERING CONTROL PLAN

3.1 GENERAL

Since remaining contamination exists at the Site, Institutional Controls (ICs) and ECs are required to protect human health and the environment. This IC/EC Plan describes the procedures for the implementation and management of IC/ECs at the Site. The IC/EC Plan is one component of the ISMP and is subject to revision by the NYSDEC.

This plan provides:

- A description of IC/ECs on the Site;
- The basic implementation and intended role of each IC/EC;
- A description of the key components of the ICs set forth in this ISMP;
- A description of the controls to be evaluated during each required inspection and periodic review;
- A description of plans and procedures to be followed for implementation of IC/ECs, such as the implementation of the EWP (as provided in Appendix D) for the proper handling of remaining contamination that may be disturbed during maintenance or redevelopment work on the Site; and
- Any other provisions necessary to identify or establish methods for implementing the IC/ECs required by the Site remedy, as determined by the NYSDEC.

3.2 INSTITUTIONAL CONTROLS

Institutional controls are required to: (1) implement, maintain and monitor EC systems; (2) prevent future exposure to remaining contamination; and, (3) limit the use and development of the Site to recreational uses only. Adherence to these ICs on the Site is required by this ISMP and will be implemented under this ISMP. ICs identified in this ISMP may not be discontinued without an amendment to this ISMP delisting of the Site.

These ICs will be implemented to prevent any future, non-recreational use of the Site which includes on-site excavation and building.

- OU02 and OU03 may be used for recreational use;
- All ECs must be maintained as specified in this ISMP;
- All ECs must be inspected at a frequency and in a manner defined in the ISMP.

- The use of groundwater underlying the property is prohibited without necessary water quality treatment as determined by the New York State Department of Health or the Essex County Department of Health to render it safe for use as drinking water or for industrial purposes, and the user must first notify and obtain written approval to do so from the Department.
- Environmental monitoring must be performed as defined in this ISMP;
- Data and information pertinent to site management must be reported at the frequency and in a manner as defined in this ISMP;
- All future activities that will disturb remaining contaminated material must be conducted in accordance with this ISMP;
- Monitoring to assess the performance and effectiveness of the remedy must be performed as defined in this ISMP;
- Maintenance, monitoring, inspection, and reporting of any physical component of the remedy shall be performed as defined in this ISMP;
- Access to the Site must be provided to agents, employees or other representatives of the State of New York with reasonable prior notice to the property owner to assure compliance with the restrictions identified in this ISMP.

3.3 ENGINEERING CONTROLS

Engineering controls utilized on-site include Aquablok®, installed over remaining contamination within OU03, and RCM, installed over remaining contamination in OU02. Areas where RCM and Aquablok® were placed are depicted on Figures 2.4 and 2.5. Backfill was placed over these barrier layers to protect them from environmental factors and anthropogenic disturbances. Inspection of these areas will be required quarterly for the first year following remediation, biannually the second year, and annually in all subsequent years; inspection reports will be distributed within 30 days of a Site inspection.

3.3.1 Cover (or Cap)

Exposure to remaining contamination at the Site is prevented by a barrier cover system (cap) which is comprised of Aquablok® and RCM covered with a minimum of 12 inches of clean soil. Figures 2.4 and 2.5 presents the locations of the cover systems and applicable barrier layers (RCM and Aquablok®). The EWP provided in Appendix D outlines the procedures required to be implemented in the event the cover system is breached, penetrated or temporarily removed, and any underlying remaining contamination is disturbed. Procedures for the inspection of this cover are provided in the Monitoring and Sampling Plan included in Section 4.0 of this ISMP. Work conducted pursuant to the EWP must also be conducted in accordance with a submitted Health and Safety Plan (HASP).

The HASP in Appendix E includes investigative and monitoring activities conducted by and anticipated to be conducted by MACTEC. Information within the HASP may be used to develop a HASP specific to excavation activities.

3.3.2 Criteria for Completion of Remediation/Termination of Remedial Systems

Generally, remedial processes are considered completed when monitoring indicates that the remedy has achieved the remedial action objectives identified by the decision document. The framework for determining when remedial processes are complete is provided in Section 6.4 of NYSDEC DER-10.

3.3.2.1 - COVER (OR CAP)

The composite cover systems, composed of Aquablok® or RCM and a protective backfill layer, are permanent controls and the quality and integrity of these systems will be inspected at defined, regular intervals in accordance with this ISMP in perpetuity.

4.0 MONITORING AND SAMPLING PLAN

4.1 GENERAL

This Monitoring and Sampling Plan describes the measures for evaluating the overall performance and effectiveness of the remedy. This Monitoring and Sampling Plan may only be revised with the approval of the NYSDEC. Details regarding the sampling procedures, data quality usability objectives, analytical methods, etc. for samples collected as part of Site management for the Site are included in the Quality Assurance Project Plan provided in Appendix F.

This Monitoring and Sampling Plan describes the methods to be used for:

- Sampling and analysis of surface water and sediment;
- Assessing compliance with applicable NYSDEC SCGs, particularly surface water standards and SGVs for sediment;
- Evaluating Site information periodically to confirm that the remedy continues to be effective in protecting public health and the environment; and
- Water levels in and near Brandy Brook.

To adequately address these issues, this Monitoring and Sampling Plan provides information on:

- Sampling locations, protocol and frequency;
- Analytical sampling program requirements; and
- Annual inspection and periodic certification.

Reporting requirements are provided in Section 7.0 of this ISMP.

4.2 SITE – WIDE INSPECTION

Inspections of OU02 and OU03 will be performed quarterly during the first year following the remedial action, biannually the second year, and annually in all subsequent years. Due to the potential for OU02 and OU03 to be frozen during winter months inspections will take place following the spring thaw in April. Early spring inspection will not only identify any disturbances caused by winter weather or ice, but will also provide time for any issues to be resolved before the summer tourist season. An annual site inspection form (Appendix G) will be completed during the inspection, and an annual Site Inspection Report will be issued within 30 days of the completion of the Site inspection.

Modification to the frequency or duration of the inspections will require approval from the NYSDEC. Site-wide inspections will also be performed after severe weather conditions that may affect ECs or monitoring devices. During these inspections, an inspection form will be completed as provided in Appendix G. The form will compile sufficient information to assess the following:

- Compliance with all ICs, including Site usage;
- An evaluation of the condition and continued effectiveness of ECs;
- General Site conditions at the time of the inspection;
- The Site management activities being conducted including, where appropriate, confirmation sampling and a health and safety inspection; and
- Confirm that Site records are up to date.

Inspections of all remedial components installed at the Site will be conducted. A comprehensive inspection of OU02 and OU03 will be conducted and documented according to the ISMP schedule, regardless of the frequency of the Periodic Review Report (PRR). The inspections will determine and document the following:

- Whether ECs continue to perform as designed;
- If these controls continue to be protective of human health and the environment;
- Compliance with requirements of this ISMP;
- Achievement of remedial performance criteria; and
- If Site records are complete and up to date; and
- Reporting requirements are outlined in Section 7.0 of this plan.

Inspections will also be performed in the event of an emergency. If an emergency, such as a natural disaster or an unforeseen failure of any of the ECs occurs that reduces or has the potential to reduce the effectiveness of ECs in place at the Site, verbal notice to the NYSDEC must be given by noon of the following day. In addition, an inspection of the Site will be conducted within 5 days of the event to verify the effectiveness of the IC/ECs implemented at the Site by a qualified environmental professional, as determined by the NYSDEC. Written confirmation must be provided to the NYSDEC within 7 days of the event that includes a summary of actions taken, or to be taken, and the potential impact to the environment and the public.

In addition to the Site-wide inspections detailed above to evaluate ICs, ECs, etc., during the first five years of Site-wide inspections, additional monitoring of Pontiac Bay and associated shore lines, and Brandy Brook and associated wetlands will be conducted to meet the requirements of the Army Corps of Engineers (ACOE) permit. A copy of the permit, associated correspondences including special conditions, and an associated monitoring form is included in Appendix H. Where applicable, monitoring activities to access shorelines and/or locations and conditions of structures placed as part of restoration, will be conducted in general accordance of the Hudson River Sustainable Shorelines Rapid Assessment Protocol Manual.

4.3 TREATMENT SYSTEM MONITORING AND SAMPLING

4.3.1 Remedial System Monitoring

Monitoring of the barrier layer and location of ISS, shown on Figures 2.4 and 2.5, will be performed on a routine basis, as identified in Table 4.1 Inspection and Monitoring Requirements and Schedule (see below). Modification to the frequency or sampling requirements will require approval from the NYSDEC. A visual inspection of the complete system will be conducted during each monitoring event. Unscheduled inspections and/or sampling may take place when a suspected failure of the RCM system or penetration of the ISS or Aquablok® system has been reported or an emergency occurs that is deemed likely to affect the operation of the system.

A complete list of items to be inspected and monitored is provided in the Inspection Checklist, provided in Appendix G. These inspections are also summarize in Table 4.1 below.

Table 4.1 – Inspection and Monitoring Requirements and Schedule

Remedial System Component	**Monitoring Parameter**	**Operating Range**	**Monitoring Schedule**
Barrier / Cover (Aquablok® / RCM)	Integrity Backfill Monitoring Points (Good/Bad)	Aquablok® and/or RCM is not visible. No visible sheen. No coal tar odor. Monitoring points (if present) are in proper, upright position.	Year 1: Quarterly Year 2: Biannually Year 3+: Annually
ISS Location	Has the location of ISS has been impacted?	Is there construction in the area. Is there subsurface impacts.	Year 1: Quarterly Year 2: Biannually Year 3+: Annually

4.3.2 Remedial System Evaluation

In order to inspect the integrity of the RCM within OU02 downgradient of OU01, monitoring points were installed between multiple RCM layers. These measuring points will be evaluated with an oil/water interface probe. If an oil/water interface is observed in the RCM monitoring points, the NYSDEC will be notified and a plan for further evaluation will be presented.

A visual inspection will be conducted in the areas where Aqublok® was placed and where ISS was implemented. If suspected subsurface impacts, including placement of structures or current construction activities, are noted, NYSDEC will be notified and may contact the property owner to ensure that proper procedures were followed to manage any soil generated from these areas and that the system was repaired accordingly.

4.4 POST-REMEDIATION MEDIA MONITORING AND SAMPLING

Sediment, surface water and groundwater samples will be collected to evaluate the effectiveness of the remedy within OU02 and OU03 as outlined below. Sampling locations, required analytical parameters, and schedule are provided in Table 4.2 – Remedial System Sampling Requirements and Schedule. Modification to the frequency or sampling requirements will require approval from the NYSDEC.

Detailed sample collection and analytical procedures and protocols are provided in Appendix F – Quality Assurance Project Plan.

4.4.1 Soil Sampling

No soil sampling will occur as soil at OU02 and OU03 was not the focus of the OU02 or OU03 remedial action.

4.4.2 Sediment Sampling

Sediment sampling will be performed annually to assess the quality of the sediment following completion of the remedial actions. Modification to the frequency or sampling requirements will require approval from the NYSDEC.

The network of on-site sediment sample locations has been designed based on the following criteria:

OU02

- Sediment samples within Brandy Brook will be collected at locations shown on Figure 2.4 which represent depositional areas downstream of the barrier/cover areas.

OU03

- Due to the depth of Pontiac Bay, a sediment sample from Brandy Brook, just prior to the culvert that conveys flow to the bay will be collected as a representative sample given that new sediments in the Bay would be as a result of discharge from Brandy Brook. This sampling location is also shown on Figure 2.4.

If areas are identified during Site inspections that may indicate contamination has become exposed, the NYSDEC project manager will be contacted and additional samples may be collected. Sampling location, description, and rationale will be recorded on field data records. If samples are collected in addition to the long term monitoring locations, coordinates of each location will be collected and recorded.

The sampling frequency may only be modified with the approval of the NYSDEC. This ISMP will be modified to reflect changes in sampling plans approved by the NYSDEC.

Deliverables for the sediment sampling program are specified in Section 7.0 – Reporting Requirements.

4.4.3 Groundwater Sampling

Groundwater sampling will be conducted at MW-104 and PZ-301 located adjacent to Brandy Brook. These monitoring wells are located upstream and downstream of the first co-located sediment/surface sampling location. In addition, MW-106 located at OU01, just upgradient of the OU02/OU03 remedial activities, will be sampled as a comparison to PZ-301 and MW-104. Note that PZ-301was installed during pre-design investigations for the purpose of evaluating dewatering during excavation activities and has not been tested for site contaminants. The groundwater results at PZ-301 will therefore be compared to previous groundwater results for monitoring well MW-201, which was located in the same vicinity but destroyed during remedial activities. In addition, MW-106 will only be available for monitoring until remedial activities are initiated at OU01.

4.4.4 Surface Water Sampling

Surface water sampling will be performed during regularly scheduled Site inspections to assess the performance of the remedy. Modification to the frequency or sampling requirements will require approval from the NYSDEC.

The on-site surface water sample locations have been designed based on the following criteria:

<u>OU02</u>
Brandy Brook surface water sampling will be co-located with sediment samples and will be collected from a depth equal to half the water column. Surface water samples should be collected prior to sediment samples, as sediment sampling will disturb the stream bed and form a slug of turbidity.

<u>OU03</u>
One Pontiac Bay surface water sample is proposed approximately 50 feet southwest from the culverted entrance of Brandy Brook. The surface water sample will be collected approximately one foot off the bottom of the bay adjacent to an area where Aquablok® was placed.

The sampling frequency may only be modified with the approval of the NYSDEC. This ISMP will be modified to reflect changes in sampling plans approved by the NYSDEC.

Deliverables for the surface water sampling program are specified in Section 7.0 – Reporting Requirements.

4.4.5 Soil Vapor Sampling

Soil vapor sampling will not be performed on Site as soil vapor is not a concern with OU02 and OU03 related contamination.

4.4.6 Soil Vapor Intrusion Sampling

Soil vapor intrusion sampling will not be performed on Site as soil vapor intrusion is not a concern with OU02 and OU03 related contamination.

4.4.7 Monitoring and Sampling Protocol

Sampling activities and observations will be recorded in a field book and associated field data record as provided in Appendix G. Observations will include weather conditions, rain events in the past 24 hours, and field parameters. Additional detail regarding monitoring and sampling protocols are provided in Appendix G.

5.0 OPERATION AND MAINTENANCE PLAN

5.1 GENERAL

The Site remedy does not rely on any mechanical systems, such as groundwater treatment systems, sub-slab depressurization systems or air sparge/soil vapor extraction systems to protect public health and the environment. Therefore, the operation and maintenance of such components is not included in this ISMP. The only ECs in place, Aquablok® and RCM, do not require any operation or regular maintenance, so only inspection of these systems is required.

6.0 PERIODIC ASSESSMENTS/EVALUATIONS

6.1 CLIMATE CHANGE VULNERABILITY ASSESSMENT

Increases in both the severity and frequency of storms/weather events, an increase in sea level elevations along with accompanying flooding impacts, shifting precipitation patterns and wide temperature fluctuation, resulting from global climactic change and instability, have the potential to significantly impact the performance, effectiveness and protectiveness of a given site and associated remedial systems. Vulnerability assessments provide information so that the Site and associated remedial systems are prepared for the impacts of the increasing frequency and intensity of severe storms/weather events and associated flooding.

A vulnerability assessment was included in the remedial design. The remedies implemented were intended to be protective in submerged conditions, which includes, but is not limited to, planting of trees and shrubs along Brandy Brook with the intent to provide shade along the brook to the extent possible.

No further vulnerability assessments are required, however, growth of planted trees and shrubs will be monitored in according with the ACOE permit.

6.2 GREEN REMEDIATION EVALUATION

NYSDEC's DER-31 Green Remediation (NYSDEC, 2011) requires that green remediation concepts and techniques be considered during all stages of the remedial program including Site management, with the goal of improving the sustainability of the cleanup and summarizing the net environmental benefit of any implemented green technology. This section of the ISMP provides a summary of any green remediation evaluations to be completed for the Site during Site management, and as reported in the PRR.

- Land and/or ecosystems
  - No land or ecosystems will be disturbed during routine Site management activities.
- Water Usage
  - No water will be used as all engineering controls are passive.
- Waste Generation
  - Remaining contamination is covered by a barrier cap system which does not require operation or schedule maintenance and, therefore, no waste will be generated.

- Energy usage
  - No electricity is needed to operate or regularly maintain the remedy.
- Emissions
  - Trips to the Site for inspections will be combined with other activities when possible to limit the emissions produced.

6.2.1 Timing of Green Remediation Evaluations

For major remedial system components, green remediation evaluations and corresponding modifications will be undertaken as part of a formal Remedial System Optimization (RSO), or at any time that the Project Manager feels appropriate, e.g. during significant maintenance events or in conjunction with storm recovery activities.

Modifications resulting from green remediation evaluations will be routinely implemented and scheduled to occur during planned/routine operation and maintenance activities. Reporting of these modifications will be presented in the PRR.

6.2.2 Remedial Systems

There are no remedial systems currently present on-site.

6.2.3 Building Operations

There are no Site-related operational buildings present at OU02 or OU03, so no operations are required.

6.2.4 Frequency of System Checks, Sampling and Other Periodic Activities

Transportation to and from the Site and use of consumables in relation to visiting the Site in order to conduct system checks and or collect samples and shipping samples to a laboratory for analyses have direct and/or inherent energy costs. The schedule and/or means of these periodic activities have been prepared so that these tasks can be accomplished in a manner that does not impact remedy protectiveness but reduces expenditure of energy or resources.

Green remediation has been evaluated for the activities in this ISMP and the following actions will be implemented:

- Sampling frequency will be reduced gradually within the first two years of evaluating the remedy.
- Travel to the Site will be coordinated to accomplish multiple tasks when possible.
- Staff will mobilize from the closest office to the Site when possible.

6.2.5 Metrics and Reporting

Green remediation efforts will be reported in the PRR.

6.3 REMEDIAL SYSTEM OPTIMIZATION

A remedial Site optimization is not anticipated as there are no operating remedial system that would require inspections, upgrades or replacements.

7.0. REPORTING REQUIREMENTS

7.1 SITE MANAGEMENT REPORTS

Site management inspection, maintenance and monitoring events will be recorded on the appropriate site management forms provided in Appendix G. These forms are subject to NYSDEC revision.

Applicable inspection forms and other records, including media sampling data and system maintenance reports, generated for the Site during the reporting period will be provided in electronic format to the NYSDEC in accordance with the requirements of Table 7.1 and summarized in the PRR.

Table 7.1: Schedule of Interim Monitoring/Inspection Reports

* The frequency of events will be conducted as specified until otherwise approved by the NYSDEC.

Task/Report	Reporting Frequency*
Inspection Report	Year 1: Quarterly Year 2: Biannually Year 3+: Annually
PRR	Annually, or as otherwise determined by the Department

Interim monitoring/inspections reports will include, at a minimum:

- Date of event or reporting period;
- Name, company, and position of person(s) conducting monitoring/inspection activities;
- Description of the activities performed;
- Where appropriate, color photographs or sketches showing the approximate location of any problems or incidents noted (included either on the checklist/form or on an attached sheet);
- Type of samples collected (e.g., sediment, surface water, etc.);
- Copies of all field forms completed (e.g., sampling logs, chain-of-custody documentation, etc.);
- Sampling results in comparison to appropriate standards/criteria;
- A figure illustrating sample type and sampling locations;
- Copies of all laboratory data sheets and the required laboratory data deliverables required for all points sampled (to be submitted electronically in the NYSDEC-identified format);
- Any observations, conclusions, or recommendations; and

- A determination as to whether contaminant conditions have changed since the last reporting event.

Non-routine maintenance event reporting forms will include, at a minimum:

- Date of event;
- Name, company, and position of person(s) conducting non-routine maintenance/repair activities;
- Description of non-routine activities performed;
- Where appropriate, color photographs or sketches showing the approximate location of any problems or incidents (included either on the form or on an attached sheet); and
- Other documentation such as copies of invoices for repair work, receipts for replacement equipment, etc. (attached to the checklist/form).

Data will be reported in digital format as determined by the NYSDEC. Currently, data is to be supplied electronically and submitted to the NYSDEC EQuIS™ database in accordance with the requirements found at this link http://www.dec.ny.gov/chemical/62440.html.

7.2 PERIODIC REVIEW REPORT

A PRR will be submitted to the Department beginning sixteen (16) months after the approval of the Construction Completion Report for OU02 and OU03 is issued. After submittal of the initial PRR, the next PRR shall be submitted annually to the Department or at another frequency as may be required by the Department. In the event that the Site is subdivided into separate parcels with different ownership, a single PRR will be prepared that addresses them together. The report will be prepared in accordance with NYSDEC's DER-10 and submitted within 30 days of the end of each certification period. Media sampling results will also be incorporated into the PRR. The report will include:

- Identification, assessment and certification of all ECs/ICs required by the remedy for the Site.
- Results of the required annual Site inspections and severe condition inspections, if applicable.
- Applicable site management forms and other records generated for the Site during the reporting period in the NYSDEC-approved electronic format, if not previously submitted.
- A summary of any discharge monitoring data and/or information generated during the reporting period, with comments and conclusions.

- Data summary tables and graphical representations of contaminants of concern by media (groundwater, soil vapor, etc.), which include a listing of all compounds analyzed, along with the applicable standards, with all exceedances highlighted. These will include a presentation of past data as part of an evaluation of contaminant concentration trends.
- Results of all analyses, copies of all laboratory data sheets, and the required laboratory data deliverables for all samples collected during the reporting period will be submitted in digital format as determined by the NYSDEC. Currently, data is supplied electronically and submitted to the NYSDEC EQuIS^{TM} database in accordance with the requirements found at this link: http://www.dec.ny.gov/chemical/62440.html.
- A Site evaluation, which includes the following:
  - The compliance of the remedy with the requirements of the Site-specific Remedial Action Work Plan, ROD or Decision Document;
  - Any new conclusions or observations regarding Site contamination based on inspections or data generated by the Monitoring and Sampling Plan for the media being monitored;
  - Recommendations regarding any necessary changes to the remedy and/or Monitoring and Sampling Plan; and
  - Trends in contaminant levels in the affected media will be evaluated to determine if the remedy continues to be effective in achieving remedial goals as specified by the Decision Document.
  - The overall performance and effectiveness of the remedy.

7.2.1 Certification of Institutional and Engineering Controls

Following the last inspection of the reporting period, a qualified environmental professional or Professional Engineer licensed to practice in New York State will prepare, and include in the PRR, the following certification as per the requirements of NYSDEC DER-10:

"*For each institutional or engineering control identified for the Site, I certify that all of the following statements are true:*

- *The inspection of the Site to confirm the effectiveness of the institutional and engineering controls required by the remedial program was performed under my direction;*
- *The institutional control and/or engineering control employed at this Site is unchanged from the date the control was put in place, or last approved by the Department;*
- *Nothing has occurred that would impair the ability of the control to protect the public health and environment;*
- *Nothing has occurred that would constitute a violation or failure to comply with any Site management plan for this control;*

- *Access to the Site will continue to be provided to the Department to evaluate the remedy, including access to evaluate the continued maintenance of this control;*
- *If a financial assurance mechanism is required under the oversight document for the Site, the mechanism remains valid and sufficient for the intended purpose under the document;*
- *The engineering control systems are performing as designed and are effective;*
- *To the best of my knowledge and belief, the work and conclusions described in this certification are in accordance with the requirements of the Site remedial program [and generally accepted engineering practices]; and*
- *The information presented in this report is accurate and complete.*

I certify that all information and statements in this certification form are true. I understand that a false statement made herein is punishable as a Class "A" misdemeanor, pursuant to Section 210.45 of the Penal Law. I, [name], of [business address], am certifying as [Owner/Remedial Party or Owner's/Remedial Party's Designated Site Representative] (and if the Site consists of multiple properties): *[I have been authorized and designated by all Site owners/remedial parties to sign this certification] for the Site."*

The signed certification will be included in the PRR.

The PRR will be submitted, in electronic format, to the NYSDEC Central Office and the Region 5 office. The Periodic Review Report may also be submitted in hard-copy format, if requested by the NYSDEC project manager.

7.3 CORRECTIVE MEASURES WORK PLAN

If any component of the remedy is found to have failed, or if the periodic certification cannot be provided due to the failure of an institutional or engineering control, a Corrective Measures Work Plan will be submitted to the NYSDEC for approval. This plan will explain the failure and provide the details and schedule for performing work necessary to correct the failure. Unless an emergency condition exists, no work will be performed pursuant to the Corrective Measures Work Plan until it has been approved by the NYSDEC.

7.4 REMEDIAL SITE OPTIMIZATION REPORT

There is no RSO planned for the Site at this time.

7.5 RESTORATION MONITORING AND REPORTING

As previously noted, restoration that took place at and adjacent to Brandy Brook and Pontiac Bay will require annual monitoring and reporting for five years following completion of restoration activities. Additional information related to these activities including the ACOE permit, restoration plan, associated correspondences, and monitoring forms are included in Appendix H. To the extent possible, inspections related to restoration will take place concurrent to ISMP inspections in order to reduce travel to the Site. Upon completion of the ACOE monitoring requirements, the ISMP will be revised to remove them.

8.0 REFERENCES

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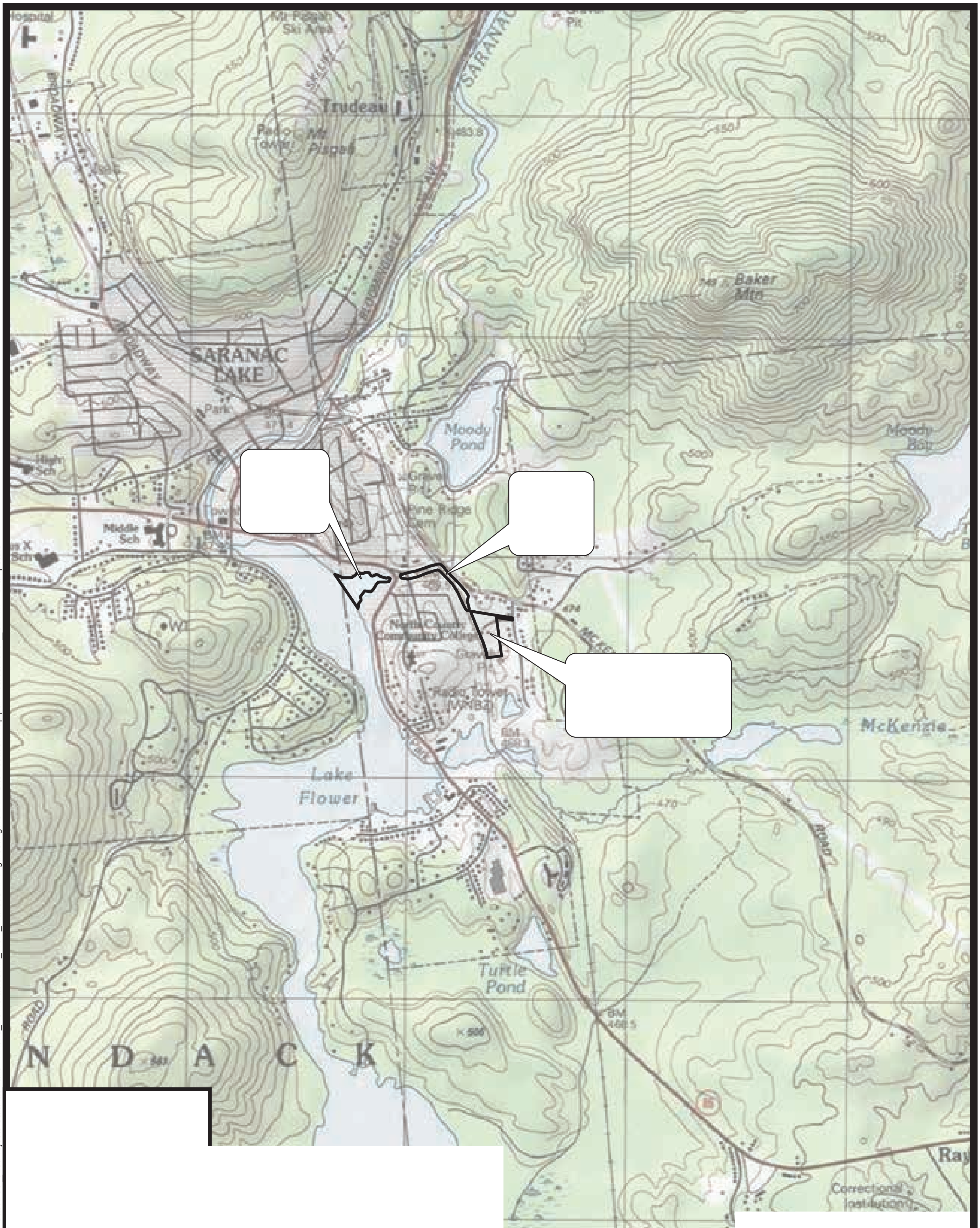
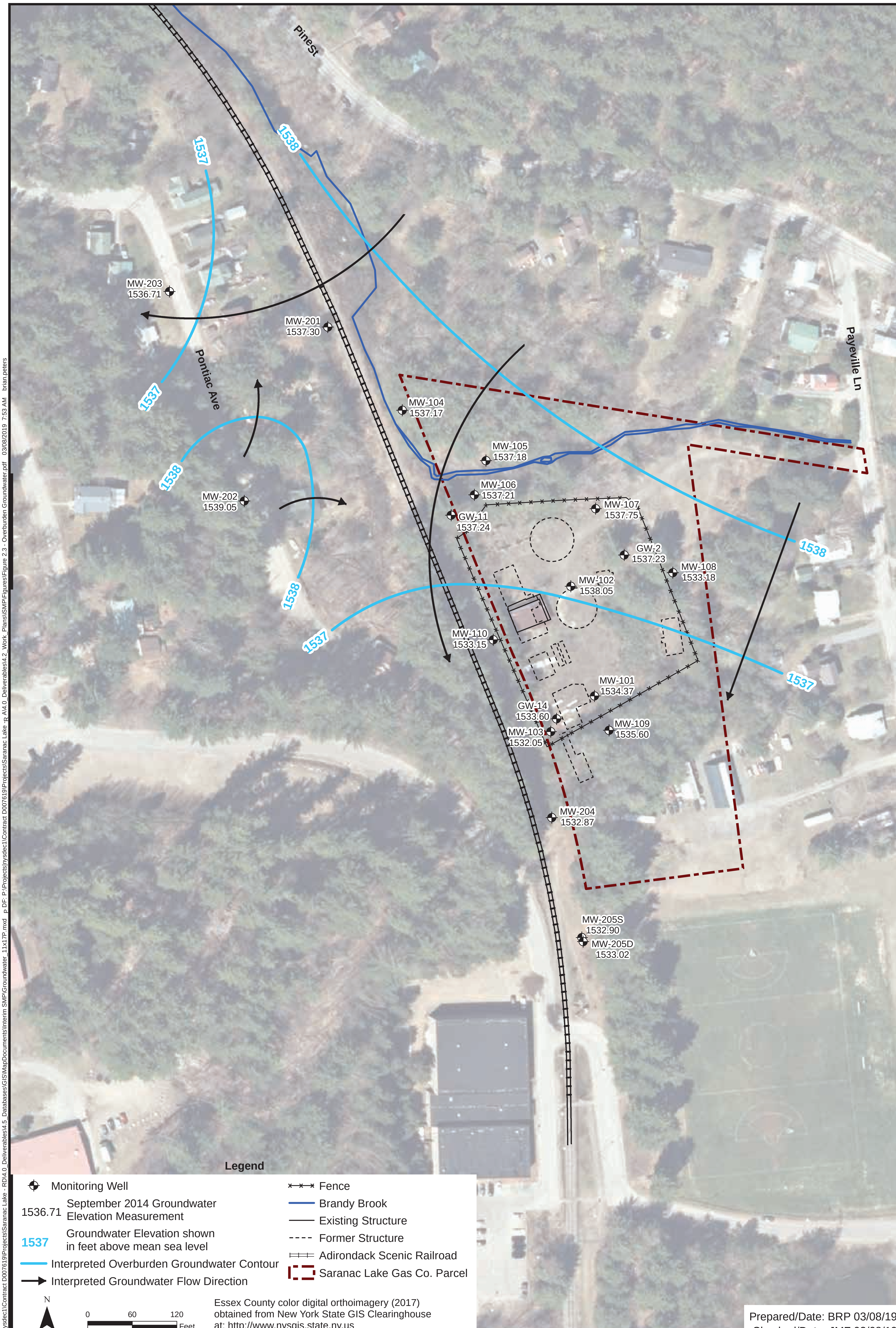
6NYCRR Part 375, Environmental Remediation Programs. December 14, 2006.

FIGURES



Mt Pisgah Ski Area
Trudeau
Mt Pisgah
SARANAC LAKE
Park
High Sch
Middle Sch
Moody Pond
Moody Bay
Baker Mtn
Gravel Pit
Pine Ridge Cem
North Country Community College
Radio Tower (WNBZ)
McKenzie
Lake Flower
Turtle Pond
Correctional Institution
N D A C K

River St (Rt 86)
Brandy Brook Rd
Slater Ave
Lake Flower Ave
Pontiac St
Winona Ave
Pontiac Ave
Pine St
Payeville Ln
OU01
OU02
OU03
Legend
Fence
Brandy Brook
Adirondack Scenic Railroad
OU01 - Saranac Lake Gas Co. Parcel
OU02 - Brandy Brook
Approximate Parcel Boundaries (from Tax Assessor)
N
0 40 80
Feet
Essex County color digital orthoimagery (2013) obtained from
New York State GIS Clearinghouse at: http://www.nysgis.state.ny.us
NYSDEC Site # 516008
Saranac Lake Gas Co., Inc.
Saranac Lake, New York
MACTEC
OU01, OU02 and OU03
and Approximate Parcel Boundaries
Project 3611181219
Figure 2.2
Prepared/Date: BRP 06/27/19
Checked/Date: JMF 06/27/19



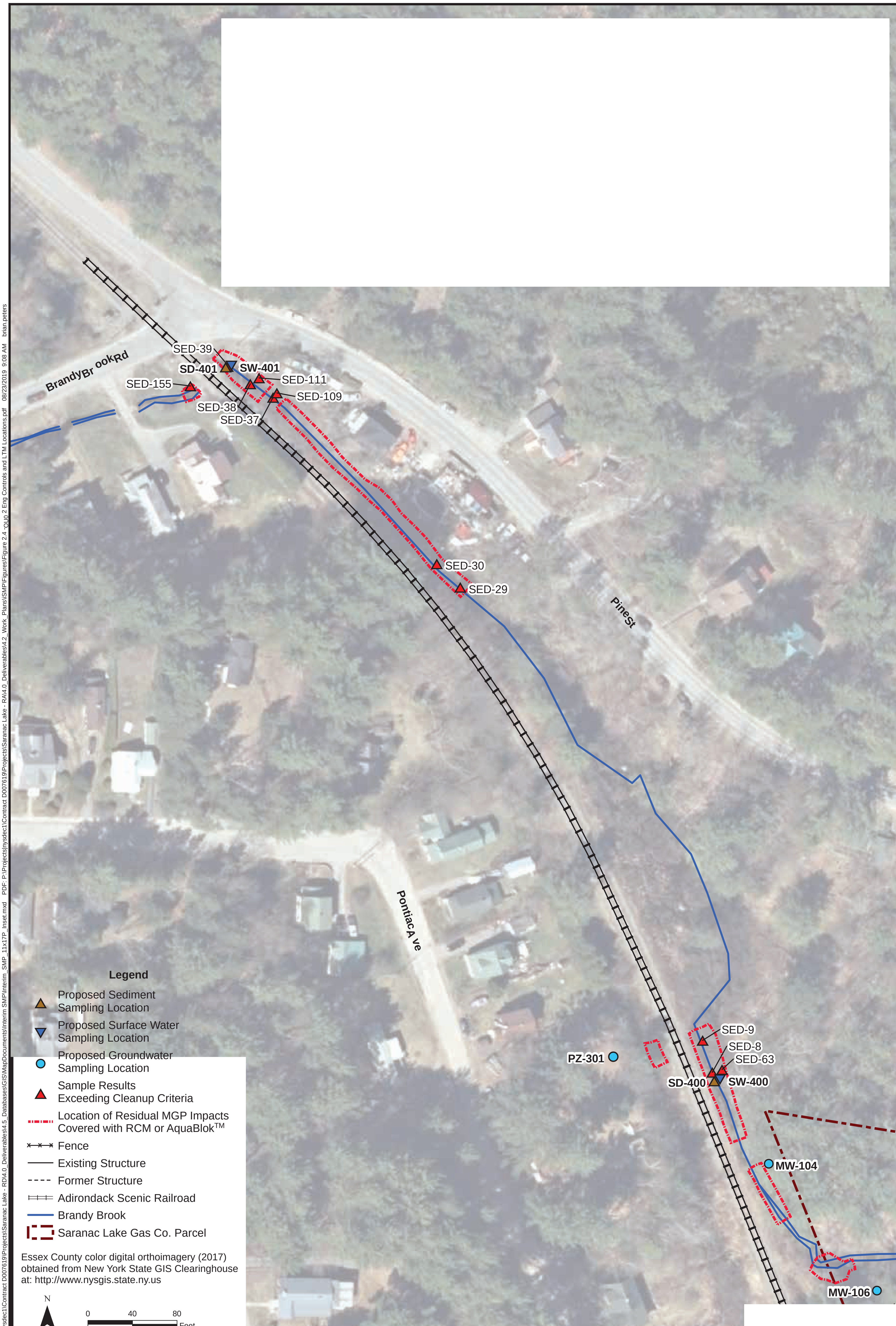
NYSDEC Site # 516008
Saranac Lake Gas Co., Inc.
Saranac Lake, New York

MACTEC

Interpreted Overburden
Groundwater Flow
Project 3611181219

Figure 2.3

Document: P:\Projects\nysdec1\Contract D007619\Projects\Saranac Lake - RD\4.0_Deliverables\4.5_Databases\GIS\MapDocuments\Interim SMP\Groundwater_11x17P.mxd p DF: P:\Projects\nysdec1\Contract D007619\Projects\Saranac Lake -p A\4.0_Deliverables\4.2_Work_Plans\SMP\Figures\Figure 2.3 - Overburden Groundwater.pdf 03/08/2019 7:53 AM brian.peters



MACTEC

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Legend

- Proposed Surface Water Sampling Location
- Sample Results Exceeding Cleanup Criteria
- Approximate Location of AquaBlok™
- Approximate location of In-Situ Stabilization

N

0 45 90 Feet

Essex County color digital orthoimagery (2017) obtained from New York State GIS Clearinghouse at: gis.ny.gov

Prepared/Date: BRP 08/23/19
Checked/Date: JDW 08/23/19

NYSDEC Site # 516008
Saranac Lake Gas Co., Inc.
Saranac Lake, New York

MACTEC

OU03 Engineering Controls and Long Term Monitoring Locations
Project 3611181219 Figure 2.5

TABLES

Table 2.1
Property Owners within Site Boundaries

Current Owner	Tax Map Parcel Number	Property Location	Owner Address	Site Description
Saranac Lake Gas Co. Inc c/o Amerigas Propane Lp and NiSource Inc.	32.231-1-11	24 Payeville Ln Saranac Lake, NY 12983	PO Box 798 Valley Forge, PA 19482 and 801 E. 86th Avenue Merrillville, IN 46410	OU1 Property
Dormitory Authority Attn: Comptroller	32.231-1-19.000	Pontiac Street	23 Santanoni Ave PO Bost 89 Saranac Lake, NY 12983	OU01 and OU02 extend on to portions of the railroad property.
Village of Saranac Lake Trustees	32.215-6-1	Pine Street Saranac Lake, NY 12983	3 Main Street Saranac Lake, NY 12983	OU02 - Brandy Brook runs along and adjacent to the southeast end of the Property.
Mark Nason	32.215-6-5	1071 Pine Street Saranac Lake, NY 12983	1071 Pine Street Saranac Lake, NY 12983	OU02 - Brandy Brook runs adjacent to the southeast end of the Property. Excavation and RCM likely extends beyond property line.
Barbara Kent	32.215-4-6	42 Brandy Brook Ave Saranac Lake, NY 12983	42 Brandy Brook Ave Saranac Lake, NY 12983	OU02 - Brandy Brook runs along the north/northwest end of the Property.
George Tolhurst	32.215-4-5	38 Brandy Brook Ave Saranac Lake, NY 12983	38 Brandy Brook Ave Saranac Lake, NY 12983	OU02 - Brandy Brook runs along the north/northwest end of the Property.
Karl Cameron	32.215-4-4	34 Brandy Brook Ave Saranac Lake, NY 12983	34 Brandy Brook Ave Saranac Lake, NY 12983	OU02 - Brandy Brook runs along the north/northwest end of the Property.
NYSARC Inc.	32.215-4-3	26 Brandy Brook Ave Saranac Lake, NY 12983	12 Mohawk Street Tupper Lake, NY 12986	OU02 - Brandy Brook runs along the north/northwest end of the Property.
Stephanie Reynolds	32.215-4-2	20 Brandy Brook Ave Saranac Lake, NY 12983	20 Brandy Brook Ave Saranac Lake, NY 12983	OU02 - Brandy Brook runs along the north/northwest end of the Property.
Carlene Cloud	32.215-4-1	70 Slater Ave Saranac Lake, NY 12983	207 W Channing Ave Fergus Falls, MN 56537	OU02 - Brandy Brook runs along the north/northwest end of the Property.
Saranac Lake Resort Owner LLC	32.214-5-4.000	234 Lake Flower Ave, Saranc Lake, NY 12983	1936 Saranac Ave Lake Placid, NY	OU03 - Section of Pontiac Bay that includes Aquablok® and the location of In-Situ Solidification

Table 2.2: Groundwater Elevation Measurements from Previous Site Visits

Monitoring Well Location ID	Riser Elevation	Bottom of Well (BTOR)	Depth to Water 08/19/2013 (BTOR)	Groundwater Table Elevation (08/19/2013)	Depth to Water 09/29/2014 (BTOR)	Groundwater Table Elevation (09/29/2014)
MW-101	1542.93	13.0	9.93	1533.00	8.56	1534.37
MW-102	1543.22	14.9	4.84	1538.38	5.17	1538.05
MW-103	1542.07	19.7	9.23	1532.84	10.02	1532.05
MW-104	1544.85	19.4	8.10	1536.75	7.68	1537.17
MW-105	1545.83	18.3	9.17	1536.66	8.65	1537.18
MW-106	1543.17	16.9	5.51	1537.66	5.96	1537.21
MW-107	1541.91	14.6	3.86	1538.05	4.16	1537.75
MW-108	1546.69	22.1	13.7	1532.99	13.51	1533.18
MW-109	1545.85	18.8	9.44	1536.41	10.25	1535.60
MW-110	1543.08	19.6	10.00	1533.08	9.93	1533.15
MW-201	1543.58	18.6	NM	NM	6.28	1537.30
MW-202	1553.97	22.4	NM	NM	14.92	1539.05
MW-203	1547.83	17.3	NM	NM	11.12	1536.71
MW-204	1546.29	28.3	NM	NM	13.42	1532.87
MW-205S	1545.24	19.6	NM	NM	12.34	1532.90
MW-205D	1545.37	33.5	NM	NM	12.35	1533.02
GW-02	1543.65	9.8	4.53	1539.12	6.42	1537.23
GW-11	1541.95	10.5	3.88	1538.07	4.71	1537.24
GW-14	1542.97	10.4	8.51	1534.46	9.37	1533.60
BB-1	1548.42	NA	NM	NM	5.98	1542.44
BB-2	1535.86	NA	NM	NM	6.06	1529.80
LF-1	1529.52	NA	NM	NM	1.97	1527.55

Notes:
TOC = top of casing
gs = ground surface
bgs = below ground surface
TOR = top of riser
BTOR = below top of riser
Wells Surveyed by Prudent Engineering
Northing/Easting = North American Datum 83/96 - NYSPCS EAST (US survey ft); Elevations = North American Vertical Datum 88 (US survey ft)
Water levels collected by MACTEC Engineering and Consulting

Created by: BAS 09/23/2013
Checked by: JDW 05/02/2019

Table 2.3: Monitoring Well Construction Details

Monitoring Well Location ID	Northing	Easting	Casing Elevation	Riser Elevation	Ground Surface Elevation	TOC - gs	TOC - TOR	Bottom of Well (BTOR)	Screening Interval (bgs)
MW-101	1999449.36	592312.95	1543.18	1542.93	1543.2	0	0.25	13.0	3 - 13
MW-102	1999596.97	592281.02	1543.51	1543.22	1543.5	0	0.29	14.9	4.9 - 14.9
MW-103	1999401.39	592254.05	1542.45	1542.07	1542.4	0	0.38	19.7	9.7 - 19.7
MW-104	1999833.87	592054.19	1545.27	1544.85	1542.3	3.0	0.42	19.4	6.4 - 16.4
MW-105	1999766.01	592166.86	1545.98	1545.83	1543.0	3.0	0.15	18.3	5.3 - 15.3
MW-106	1999720.04	592151.21	1543.23	1543.17	1540.4	2.8	0.06	16.9	4.1 - 14.1
MW-107	1999701.42	592314.39	1542.21	1541.91	1542.2	0	0.30	14.6	4.6 - 14.6
MW-108	1999615.19	592418.34	1546.75	1546.69	1543.6	3.1	0.06	22.1	9.0 - 19.0
MW-109	1999403.28	592332.38	1546.10	1545.85	1543.0	3.1	0.25	18.8	5.7 - 15.7
MW-110	1999524.97	592176.70	1543.33	1543.08	1543.3	0	0.25	19.6	9.6 - 19.6
MW-201 (Destroyed / Abandoned)	1999945.73	591954.15	1543.81	1543.58	1540.6	3.2	0.23	18.6	5.4 - 15.4
MW-202	1999711.88	591841.61	1554.19	1553.97	1554.2	0	0.22	22.4	12.4 - 22.4
MW-203	1999993.61	591740.99	1548.05	1547.83	1548.1	0	0.22	17.3	7.3 - 17.3
MW-204	1999285.76	592255.49	1546.53	1546.29	1543.5	3.0	0.24	28.3	10.3 - 25.3
MW-205S	1999119.02	592297.69	1545.44	1545.24	1542.5	2.9	0.20	19.6	9.6 - 19.6
MW-205D	1999124.30	592295.88	1545.52	1545.37	1542.4	3.1	0.15	33.5	20.4 - 30.4
GW-02	1999638.97	592352.87	1543.65	1543.65	1543.7	0	0.00	9.8	0.8 - 9.8
GW-11	1999692.50	592120.08	1542.15	1541.95	1542.1	0	0.20	10.5	1.5 - 10.5

Created by: BAS 09/23/2013
Revised by / Checked by: JDW 05/02/2019

Table 2.3: Monitoring Well Construction Details

Monitoring Well Location ID	Northing	Easting	Casing Elevation	Riser Elevation	Ground Surface Elevation	TOC - gs	TOC - TOR	Bottom of Well (BTOR)	Screening Interval (bgs)
GW-14	1999418.55	592261.79	1543.17	1542.97	1543.2	0	0.20	10.4	1.4 - 10.4
PZ-301*	19999930.60	1542.15	NA	1544.19	NM				

Notes:
TOC = top of casing
gs = ground surface bgs = below ground surface
TOR = top of riser
BTOR = below top of riser
Wells Surveyed by Prudent Engineering
Northing/Easting = North American Datum 83/96 - NYSPCS EAST (US survey ft); Elevations = North American Vertical Datum 88 (US survey ft)
*PZ-301 was installed during OU02/OU03 pre-design investigations and will be monitored during the SMP in lieu of MW-201. Other piezometers installed during that time were either destroyed during remedial activities or well be abandoned.

Table 2.4: Remaining Sediment Sample Exceedances at OU02

	Media:	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment
	Location:	OU2-SED-008	OU2-SED-009	OU2-SED-029	OU2-SED-030	OU2-SED-037	OU2-SED-038	OU2-SED-039	OU2-SED-040	OU2-SED-046
	Bottom or Sidewall:	Bottom	Bottom	Bottom	Bottom	Bottom	Bottom	Bottom	Bottom	Bottom
	Sample Date:	16-Aug-18	16-Aug-18	01-Oct-18	01-Oct-18	18-Oct-18	23-Oct-18	15-Oct-18	29-Oct-18	07-Nov-18
	Lab ID:	18H0885-03	18H0885-04	18J0087-01	18J0087-02	18J1036-01	18J1182-01	18J0816-01	18J1483-01	18K0426-01
	Description:	Located under RCM	Located under RCM	Located under RCM	Excavate an additional foot, no resample.	Based on Visual, backfilled prior to receiving sample result.	Located under RCM	Located under RCM	Located under RCM	Located under RCM
Parameter	**Class A Sediment Criteria (mg/kg)**									
Volatile Organic Compounds (mg/kg)										
Benzene	0.53	<5.0	<0.049	<0.00049	<0.00046	<0.00047	<0.00047	<0.00047	<0.00045	<0.00099
Ethyl Benzene	0.43	**6.3**	0.065	<0.00056	<0.00053	<0.00054	0.00059 J	<0.00053	<0.00052	<0.0011
Isopropylbenzene	0.21	<5.0	<0.049	<0.00049	<0.00046	<0.00047	0.0012 J	<0.00047	<0.00045	<0.00099
Toluene	0.93	**8**	<0.049	<0.00056	<0.00053	<0.00054	<0.00053	<0.00053	<0.00052	<0.0011
1,2,4-Trimethylbenzene	3.4	**11**	0.11	<0.00056	<0.00053	<0.00054	0.0072	0.00073 J	<0.00052	<0.0011
Xylenes, m&p	0.59	**12**	<0.097	<0.0012	<0.0011	<0.0011	<0.0011	<0.0011	<0.0011	<0.0024
Xylenes, o	0.82	**5.4**	<0.049	<0.00049	<0.00046	<0.00047	<0.00047	<0.00047	<0.00045	<0.00099
Semivolatile Organic Compounds (mg/kg)										
Acenaphthene		5.4	1	<0.062	<0.059	<0.060	2.1	0.48	0.21	
Acenaphthylene		49	0.49	<0.070	<0.066	<0.067	0.23	0.08 J	0.085 J	<0.092
Anthracene		23	0.85	<0.060	<0.056	<0.058	1.8	0.61	0.25	3
Benzo(a)anthracene		8	0.51	<0.055	<0.052	<0.053	0.87	0.4	0.59	<0.073
Benzo(a)pyrene		8.1	0.57	<0.065	<0.061	<0.062	0.73	0.42	0.78	<0.086
Benzo(b)fluoranthene		6.1	0.48	<0.059	<0.055	<0.057	0.47	0.29	0.67	<0.078
Benzo(g,h,i)perylene		3.5	0.32 J	<0.092	<0.086	<0.088	0.3	0.21 J	0.48	<0.12
Benzo(k)fluoranthene		2.1	0.15 J	<0.065	<0.061	<0.062	0.15 J	0.091 J	0.24	<0.086
Chrysene		6.8	0.46	<0.065	<0.061	<0.062	0.74	0.36	0.55	<0.086
Dibenz(a,h)anthracene		0.61	<0.25	<0.13	<0.12	<0.12	<0.12	<0.13	<0.12	<0.17
Fluoranthene		25	1.2	<0.069	<0.064	<0.066	1.7	0.82	0.98	1.9
Fluorene		27	0.79	<0.067	<0.063	<0.065	1.4	0.34	0.12 J	4.7
Indeno(1,2,3-cd)pyrene		2.9	<0.30	<0.15	<0.14	<0.14	0.25	0.18 J	0.44	<0.20
2-Methylnaphthalene		120	2.1	<0.072	<0.068	<0.070	3.5	0.52	<0.070	<0.095
Naphthalene		140	1.1	<0.11	<0.10	<0.10	1.2	0.22	<0.10	0.19 J
Phenanthrene		88	2.6	<0.11	<0.10	<0.10	6.9	1.8	0.72	16
Pyrene		45	2	<0.069	<0.064	<0.066	2.9	1.3	1.4	1.8
Total PAHs	4	**560.51**	**14.15**	0	0	0	**25.09**	**7.56**	**7.31**	**27.4**
Pesticides (mg/kg)										
4,4'-DDE	0.044	<0.0037	<0.00036	<0.00037	<0.00035	<0.00034	<0.00034	<0.00036	<0.00033	<0.0045
4,4'-DDT	0.044	<0.0050	<0.00048	<0.00049	<0.00046	<0.00045	<0.00046	<0.00048	<0.00044	<0.0060
Endosulfan I	0.001	<0.0050	<0.00048	**0.0017 J**	**0.0012 J**	**0.0051 J**	<0.00046	<0.00048	<0.00044	<0.0060
Endosulfan II	0.001	<0.0037	<0.00036	<0.00037	<0.00035	<0.00034	<0.00034	<0.00036	<0.00033	<0.0045

Results are reported in milligrams per kilogram (mg/kg)
Highlighted values exceed the the Sediment Cleanup Objective
NT = Not tested
< = Not detected above the laboratory reporting limit

Prepared by: JDW 5/17/19
Checked by: KMS 9/17/19

Table 2.4: Remaining Sediment Sample Exceedances at OU02

	Media:	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment
	Location:	OU2-SED-063	OU2-SED-109	OU2-SED-111	OU2-SED-126	OU2-SED-127	OU2-SED-128	OU2-SED-129	OU2-SED-155
	Bottom or Sidewall:	Sidewall	Sidewall	Sidewall	Sidewall	Sidewall	Sidewall	Sidewall	Sidewall
	Sample Date:	16-Aug-18	18-Oct-18	23-Oct-18	07-Nov-18	07-Nov-18	07-Nov-18	07-Nov-18	30-Oct-18
	Lab ID:	18H0885-02	18J1036-02	18J1182-02	18K0426-03	18K0426-04	18K0426-05	18K0426-06	18J1483-06
	Description:	Located behind RCM	Based on Visual, backfilled prior to receiving sample result.	Located behind RCM	Located behind RCM	Located behind RCM	Located behind RCM	Located behind RCM	Located behind RCM
Parameter	**Class A Sediment Criteria (mg/kg)**								
Volatile Organic Compounds (mg/kg)									
Benzene	0.53	<0.96	<0.00046	<0.00047	<0.00086	<0.00052	<0.00056	<0.00066	NT
Ethyl Benzene	0.43	**1.6**	<0.00053	0.00057 J	<0.00098	<0.00059	<0.00064	<0.00075	NT
Isopropylbenzene	0.21	<0.96	<0.00046	0.0009 J	<0.00086	<0.00052	<0.00056	<0.00066	NT
Toluene	0.93	**2**	<0.00053	<0.00054	<0.00098	<0.00059	<0.00064	<0.00075	NT
1,2,4-Trimethylbenzene	3.4	2.6	<0.00053	0.0047	0.0019 J	<0.00059	<0.00064	<0.00075	NT
Xylenes, m&p	0.59	**2.8**	<0.0011	<0.0011	<0.0021	<0.0013	<0.0014	<0.0016	<0.0014
Xylenes, o	0.82	**1.2**	<0.00046	<0.00047	<0.00086	<0.00052	<0.00056	<0.00066	<0.00057
Semivolatile Organic Compounds (mg/kg)									
Acenaphthene		2	<0.060	0.9	7.7	0.14 J	1.9	0.19 J	4.6
Acenaphthylene		15	<0.067	0.12 J	<0.10	<0.062	<0.067	<0.084	0.12 J
Anthracene		7.5	<0.057	0.75	<0.088	0.23	4.1	0.9	1.7
Benzo(a)anthracene		3.3	<0.053	0.38	<0.081	0.18 J	0.22	<0.067	0.84
Benzo(a)pyrene		3.3	<0.062	0.33	<0.095	0.077 J	<0.062	<0.078	1
Benzo(b)fluoranthene		2.4	<0.056	0.2	<0.086	0.062 J	<0.057	<0.071	0.7
Benzo(g,h,i)perylene		1.1	<0.088	0.14 J	<0.14	<0.082	<0.088	<0.11	0.55
Benzo(k)fluoranthene		0.77	<0.062	0.066 J	<0.095	<0.058	<0.062	<0.078	0.26
Chrysene		2.9	<0.062	0.32	<0.095	0.14 J	0.16 J	<0.078	0.73
Dibenz(a,h)anthracene		<0.26	<0.12	<0.12	<0.19	<0.11	<0.12	<0.15	<0.14
Fluoranthene		8.7	<0.065	0.69	<0.10	0.72	3.3	<0.083	1.8
Fluorene		7.6	<0.064	0.61	0.43	0.15 J	2	0.25 J	2
Indeno(1,2,3-cd)pyrene		1	<0.14	<0.14	<0.22	<0.13	<0.14	<0.18	0.47
2-Methylnaphthalene		35	<0.069	1.4	6.7	<0.065	<0.069	<0.087	1.7
Naphthalene		36	<0.10	0.41	2.7	<0.095	<0.10	<0.13	0.83
Phenanthrene		28	<0.10	2.6	<0.16	1.4	17	4.5	6.4
Pyrene		14	<0.065	1.2	<0.10	1.1	5	0.22 J	3
Total PAHs	4	**168.57**	0	**9.79**	**17.53**	3.45	**33.52**	**5.4**	**26.58**
Pesticides (mg/kg)									
4,4'-DDE	0.044	<0.0037	<0.00034	<0.00032	<0.00054	<0.00031	<0.00035	<0.0045	<0.00040
4,4'-DDT	0.044	<0.0049	<0.00046	<0.00043	<0.00071	<0.00041	<0.00047	<0.0060	<0.00053
Endosulfan I	0.001	<0.0049	**0.0021 J**	<0.00043	<0.00071	<0.00041	<0.00047	<0.0060	<0.00053
Endosulfan II	0.001	<0.0037	<0.00034	<0.00032	<0.00054	<0.00031	<0.00035	<0.0045	<0.00040

Results are reported in milligrams per kilogram (mg/kg)
Highlighted values exceed the the Sediment Cleanup Object
NT = Not tested
< = Not detected above the laboratory reporting limit

Prepared by: JDW 5/17/19
Checked by: KMS 9/17/19

Table 2.5: Remaining Soil Sample Exceedances at OU02

	Media:	Soil
	Location:	OU2-Soil-162
	Bottom or Sidewall:	Sidewall
	Sample Date:	07-Nov-18
	Lab ID:	18K0427-02
	Description:	Located behind RCM
Parameter	**Residential Use SCO[a] (mg/kg)**	
Volatile Organic Compounds (mg/kg)		
m+p Xylene	-	<0.0015
o-Xylene	-	<0.00063
Xylene (mixed)	100	<0.0015
Semivolatile Organic Compounds (mg/kg)		
Benzo(a)anthracene	1	**8.6**
Benzo (a) Pyrene	1	**8.2**
Benzo(b)fluoranthene	1	**5.2**
Benzo(k)fluoranthene	1	**2**
Chrysene	1.0	**6.8**
Dibenzo(a,h)anthracene	1	**0.7**
Indeno(1,2,3-cd)pyrene	0.5	**3.5**
Metals (mg/kg)		
Chromium (Total)	22	2.2
Pesticides (mg/kg)		
Alpha-BHC	0.097	<0.0053

Results are reported in milligrams per kilogram (mg/kg)
Highlighted values exceed the the Residential Use Soil Cleanup Objective (SCO)
"-" no SCO specified

Prepared by: JDW 5/17/19
Checked by: KMS 9/17/19

Table 2.6: Remaining Sediment Sample Exceedances at OU03

	Media:	Sediment	Sediment	Sediment
	Location:	OU3-SED-13-GRB1	OU3-SED-16-GRB1	OU3-SED-14-GRB2
	Bottom or Sidewall	Sidewall	Sidewall	Sidewall
	Sample Date:	23-Aug-18	23-Aug-18	23-Aug-18
	Lab ID:	18H1229-04	18H1229-08	18H1229-06
	Description:	No Napthalene, not associated with Site COCs	Located Under Aquablok	Does not exceed sediment criteria for individual PAHs
Contaminant	**Class A Sediment Criteria (ppm[b])**			
Volatile Organic Compounds (mg/kg)				
Ethyl Benzene	0.43	<0.051	<0.29	<0.0012
Isopropylbenzene	0.21	<0.051	<0.29	<0.0010
Naphthalene	4	1.1	**18**	0.0048
1,2,4-Trimethylbenzene	3.4	0.27	0.78	0.0014
m+p Xylene		<0.10	<0.57	<0.0025
o-Xylene		<0.051	<0.29	<0.0010
Xylenes, Total	0.59			
SVOCs				
Acenaphthene	4	2.5	**15**	0.43
Acenaphthylene	4	0.46	0.83	<0.11
Anthracene	4	**4.2**	**9.9**	0.77
Benzo(a)anthracene	4	**4.8**	**6.7**	0.8
Benzo(a)pyrene	4	**5**	**5.5**	0.87
Benzo(b)fluoranthene	4	4	**4.1**	0.63
Benzo(ghi)perylene	4	3.1	3.1	0.51
Benzo(k)fluoranthene	4	1.3	1.4	0.24
Chrysene	4	**4.2**	**5.1**	0.75
Fluoranthene	4	**12**	**15**	1.5
Fluorene	4	2.3	**7.6**	0.44
Indeno(1,2,3-cd)pyrene	4	2.6	2.8	0.41
Naphthalene	4	0.71	**13**	<0.17
Phenanthrene	4	**14**	**36**	2.3
Pyrene	4	**17**	**23**	2.9
Total PAHs	4	**78.17**	**149.03**	**12.55**
Pesticides/PCBs				
4,4'-DDD	0.044	<0.051	<0.056	<0.0080
Heptachlor Epoxide	0.015	<0.063	<0.070	<0.010
Inorganics				
Lead	47	**72**	43	8.8
Zinc	150	93	68	23

Results are reported in milligrams per kilogram (mg/kg)
Highlighted values exceed the the Sediment Cleanup Objective
NT = Not tested
< = Not detected above the laboratory reporting limit

Prepared by: JDW 5/17/19
Checked by: KMS 9/17/19

Table 4.2
Remedial System Sampling Requirements and Schedule

Operable Unit	Media	Location ID	Analysis	Sample Description	Location Description	Sampling Frequency
OU02	Sediment	SD-400	PAHs	Sediment sample taken from top 0.5' of sediment using either ponar sampler or hand auger.	Just upstream of final Brandy Brook culvert (under Slater Ave) before discharging to Pontiac Bay	Year 1: Quarterly Year 2: Biannually Year 3+: Annually
		SD-401	PAHs		Northeast corner of Brandy Brook at intersection of Pine Street and River Street, just upstream of railroad culvert	
		SD-402	PAHs		Southern portion of impacted brook, adjacent to OU01, just north of RCM monitoring points	
	Surface Water	SW-400	PAHs	Surface water sample drawn from a depth equal to half the water column using a peristaltic pump	Just upstream of final Brandy Brook culvert (under Slater Ave)	
		SW-401	PAHs		Northeast corner of Brandy Brook at intersection of Pine Street and River Street, just upstream of railroad culvert	
		SW-402	PAHs		Southern portion of impacted brook, adjacent to OU01, just north of RCM monitoring points	
	Groundwater	PZ-301	PAHs	LowFlow Sample Method from Mid-Screen.	West of railroad track downstream from SD/SW-400.	
	Groundwater	MW-104	PAHs	LowFlow Sample Method from Mid-Screen.	Upstream of SD/SW-400 adjacent to the second section of RCM placed in Brandy Brook.	
OU03	Surface Water	SD-403	PAHs	Surface water sample drawn from a depth equal to half the water column using a peristaltic pump	At corner of River Street and Lake Flower Avenue, southwest of Brandy Brook discharge culvert into Pontiac Bay.	Year 1: Quarterly Year 2: Biannually Year 3+: Annually
OU01	Groundwater	MW-106	PAHs	LowFlow Sample Method from Mid-Screen.	Just upgradient of OU02 remedial activities, for the purpose of comparing to OU02 groundwater. Note that this sampling location will only be available until remedial activities are initiated at OU01.	Year 1: Quarterly Year 2: Biannually Year 3+: Annually

APPENDIX A

LIST OF SITE CONTACTS

<table>
<tr><th colspan="5">Appendix A
List of Site Contacts</th></tr>
<tr><th>Name</th><th>Position</th><th>Mailing Address</th><th>Phone Number</th><th>E-mail Address</th></tr>
<tr><td>Saranac Lake Gas Company</td><td>Property Owner (OU01)</td><td>PO Box 798
Valley Forge PA 19482</td><td>-</td><td>-</td></tr>
<tr><td>Sarah Saucier</td><td>NYSDEC DER Project Manager</td><td rowspan="2">625 Broadway
Albany, NY 12233</td><td>(518) 402-9675</td><td>sarah.saucier@dec.ny.gov</td></tr>
<tr><td>Mike Cruden</td><td>NYSDEC Remedial Bureau E Director</td><td>(518) 402-9814</td><td>michael.cruden@dec.ny.gov</td></tr>
<tr><td>Russ Huyck</td><td>NYSDEC Region 5 HW Engineer</td><td rowspan="2">1115 Route 86 PO Box 296
Ray Brook, NY 12977</td><td>(518) 897-1242</td><td>russel.huyck@dec.ny.gov</td></tr>
<tr><td>Mike McLean</td><td>NYSDEC Region 5 HW Engineer</td><td>(518) 897-1243</td><td>mike.mclean@dec.ny.gov</td></tr>
<tr><td>Wendy Kuehner</td><td>NYSDOH Public Health Engineer</td><td>Empire State Plaza
Corning Tower Room 1787
Albany, NY 12237</td><td>(518) 402-7860</td><td>beei@health.ny.gov</td></tr>
<tr><td>Jamie Welch</td><td>MACTEC Project Manager</td><td>511 Congress Street,
Suite 200
Portland, ME 04101</td><td>(207) 828-3479</td><td>jamie.welch@woodplc.com</td></tr>
</table>

APPENDIX B

SITE SURVEYS

THE UNDERSIGNED SURVEYOR HEREBY CERTIFIES TO THE PEOPLE OF THE STATE OF NEW YORK ACTING THROUGH THE COMMISSIONER OF THE DEPARTMENT OF ENVIRONMENTAL CONSERVATION THAT THIS IS AN ACCURATE MAP OF AN ACTUAL SURVEY COMPLETED AND REVISED AS DATED. SUBJECT TO ANY STATE OF FACTS AN ACCURATE ABSTRACT DATED AFTER 5/5/2017 MAY SHOW.

NOTES:

1. HORIZONTAL COORDINATES REFERENCED TO THE NEW YORK STATE PLANE COORDINATE SYSTEM (NYSNET), EAST ZONE (3101) BASED ON NAD 83 (2011).

2. VERTICAL DATUM BASED ON NAVD 88 (NYSNET). CONTOURS ARE SHOWN AT 1/2 FOOT INTERVALS.

3. IT SHALL BE THE CONTRACTOR'S RESPONSIBILITY TO NOTIFY DIG SAFELY – NEW YORK FOR ALL UNDERGROUND UTILITY LOCATIONS PRIOR TO ANY EXCAVATION.

4. ALL SUBSURFACE LOCATIONS SHOWN ARE APPROXIMATE AND SHALL BE USED FOR PRELIMINARY ENGINEERING ONLY.

5. UTILITY INFORMATION HAS BEEN PLOTTED FROM AVAILABLE SOURCES AND THEIR LOCATIONS AND SIZE SHOULD BE CONSIDERED APPROXIMATE ONLY.

6. THE CONTRACTOR IS RESPONSIBLE FOR DETERMINING EXACT UTILITY LOCATIONS, SIZES, AND ELEVATIONS PRIOR TO COMMENCING CONSTRUCTION. IF UNCHARTED OR MISPLOTTED UTILITIES ARE ENCOUNTERED, THE CONTRACTOR IS REQUIRED TO NOTIFY THE OWNER IMMEDIATELY.

7. PRIOR TO BEGINNING ANY WORK: THE CONTRACTOR IS RESPONSIBLE FOR THE VERIFICATION OF SURVEY CONTROL POINTS USED IN THE VERTICAL AND HORIZONTAL POSITIONING OF DESIGNED IMPROVEMENTS AND FOR IMMEDIATELY NOTIFYING THE E.I.C. OF ANY DISCREPANCIES FOUND.

LEGEND

T.M. TAX MAP & PARCEL NO.
BENCHMARK
MANHOLE (UNKNOWN)
VALVE (UNKNOWN)
COMMUNICATIONS MANHOLE
SURVEY CONTROL POINT
ELECTRIC MANHOLE
GAS VALVE
GAS LINE
CATCH BASIN SQUARE
UTILITY POLE
SANITARY MANHOLE
WATER VALVE
TEST HOLE
UNDERGROUND CABLE
SANITARY SEWER
WATER LINE
MONITORING WELL
STREET RIGHT-OF-WAY
PROPERTY LINE
ELECTRIC LINE
CHAINLINK FENCE
FIRE HYDRANT
RAILROAD TRACKS
STORM SEWER
EP PAVEMENT EDGE
IPF/IRF IRON PIPE/ROD FOUND
STORM MANHOLE
APL APPROXIMATE PROPERTY LINE
AHB APPROXIMATE ROW LINE
EDGE OF WATER/STREAM

Saranac Gas Plant
Saranac Lake, NY

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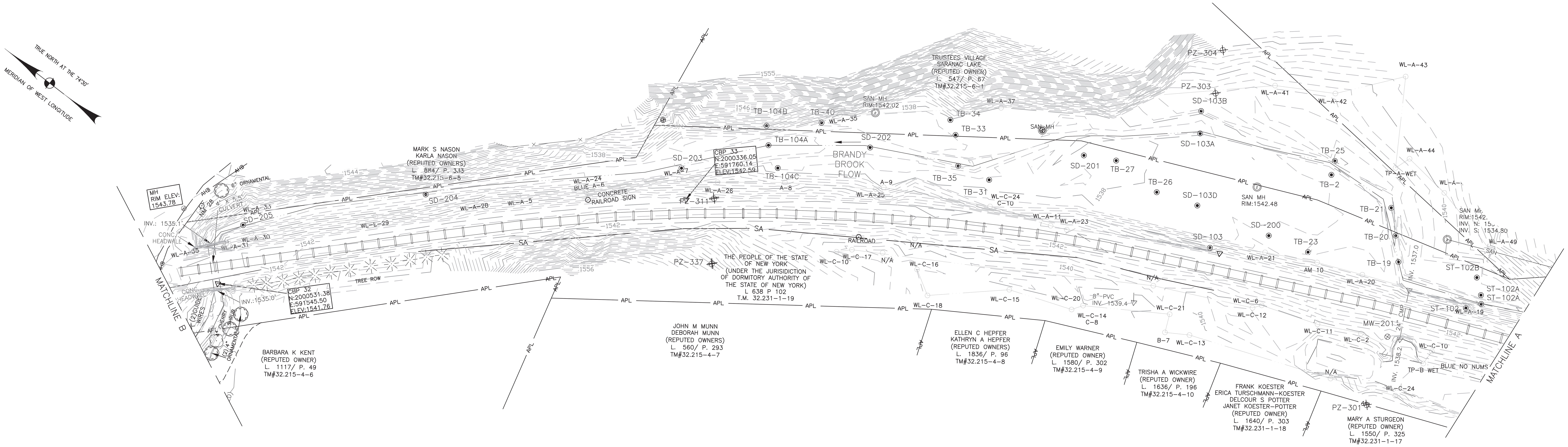
Part of LOT 13 TOWN North Elba County of Essex
State of New York
Scale of 1 inch = 30'
Date 1/7/14 - 12/08/14 (Revised) 1/6/17 (Revised) - 5/25/17 (Revised)

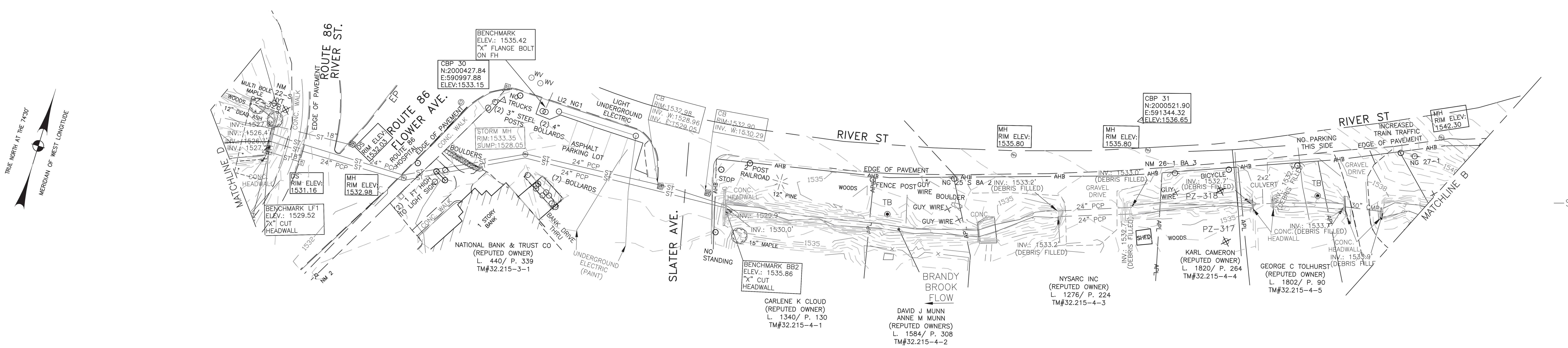
PHONE: (315) 748-7000
FAX: (315) 748-7780
6390 FLY ROAD
EAST SYRACUSE, N.Y. 13057
www.PrudentEng.com

Project No. 109.005-4

PRUDENT ENGINEERING

CADD File Name: M:\Drawings\109\005\Phase 04 – SARANAC GAS PLANT.DWG





LEGEND

T.M.	TAX MAP & PARCEL NO.
BM	BENCHMARK
MH	MANHOLE (UNKNOWN)
VA	VALVE (UNKNOWN)
C	COMMUNICATIONS MANHOLE
	SURVEY CONTROL POINT
E	ELECTRIC MANHOLE
GV	GAS VALVE
G	GAS LINE
CB	CATCH BASIN SQUARE
	UTILITY POLE
S	SANITARY MANHOLE
WV	WATER VALVE
	TEST HOLE
CU	UNDERGROUND CABLE
SA—/—SAN	SANITARY SEWER
W	WATER LINE
	MONITORING WELL
	STREET RIGHT-OF-WAY
PL	PROPERTY LINE
O/E	ELECTRIC LINE
	CHAINLINK FENCE
	FIRE HYDRANT
	RAILROAD TRACKS
ST	STORM SEWER
EP	PAVEMENT EDGE
IPF/IRF	IRON PIPE/ROD FOUND
D	STORM MANHOLE
APL	APPROXIMATE PROPERTY LINE
AHB	APPROXIMATE ROW LINE
	EDGE OF WATER/STREAM

NOTES:

1. HORIZONTAL COORDINATES REFERENCED TO THE NEW YORK STATE PLANE COORDINATE SYSTEM (NYSNET), EAST ZONE (3101) BASED ON NAD 83 (2011).

2. VERTICAL DATUM BASED ON NAVD 88 (NYSNET). CONTOURS ARE AT 1/2 FOOT INTERVALS.

GRAPHIC SCALE

30 0 15 30 60 120

(IN FEET)
1 inch = 30 ft.

Saranac Gas Plant
Saranac Lake, NY

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FAX: (315) 748-7780
6390 FLY ROAD
EAST SYRACUSE, N.Y. 13057
www.PrudentEng.com

Project No. 109.005-4

PRUDENT ENGINEERING

IN CHARGE OF — M.A.V. DESIGNED BY — CHECKED BY — ESTIMATED BY — CHECKED BY — DRAFTED BY — B.G.P. CHECKED BY — M.A.V.

CADD File Name: M:\Drawings\109\005\Phase 04 – SARANAC GAS PLANT.DWG

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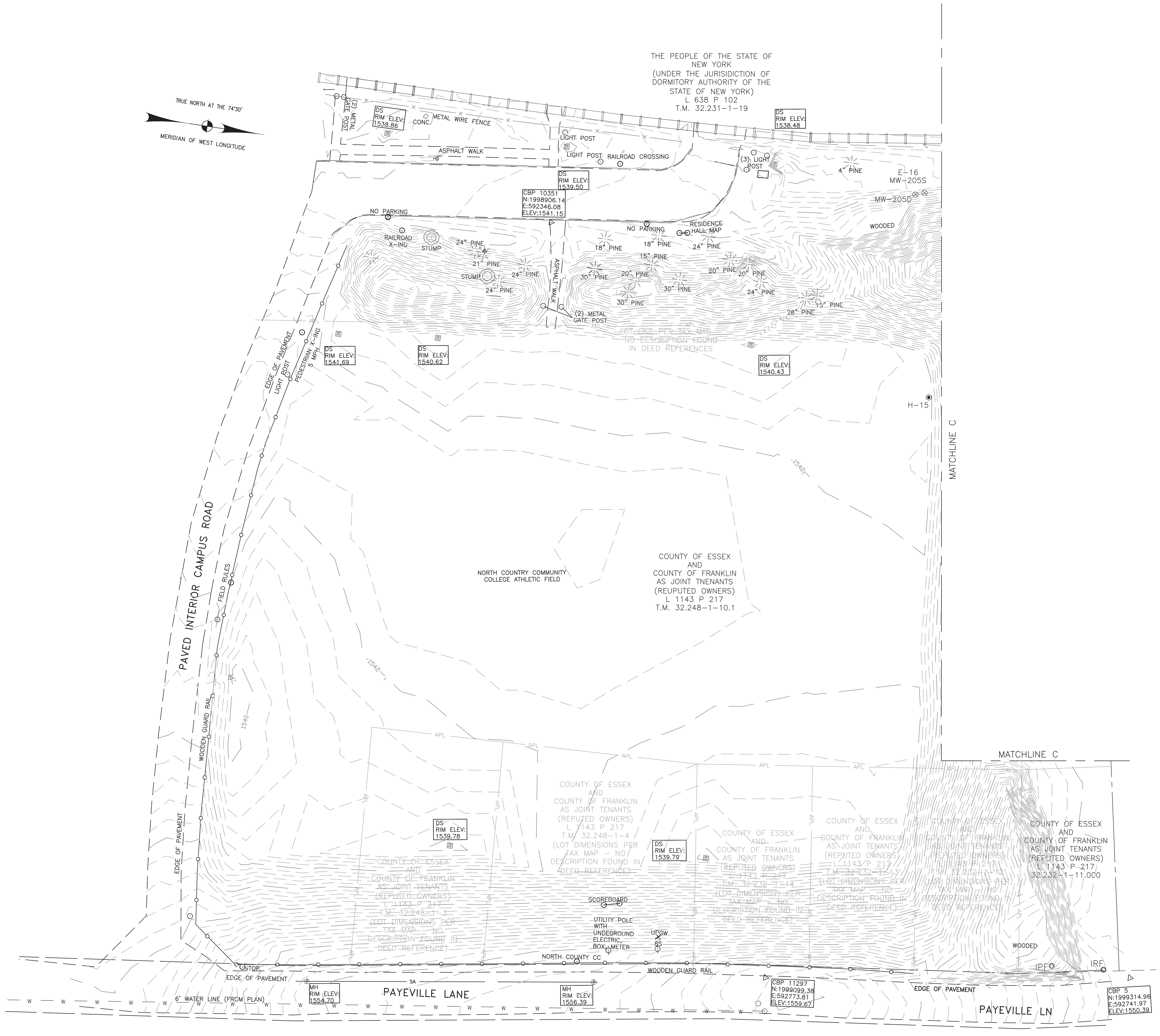

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	GAS VALVE
G	GAS LINE
	CATCH BASIN SQUARE
	UTILITY POLE
	SANITARY MANHOLE
	WATER VALVE
	TEST HOLE
CU	UNDERGROUND CABLE
SA—/—SAN	SANITARY SEWER
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	MONITORING WELL
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PL	PROPERTY LINE
O/E	ELECTRIC LINE
	CHAINLINK FENCE
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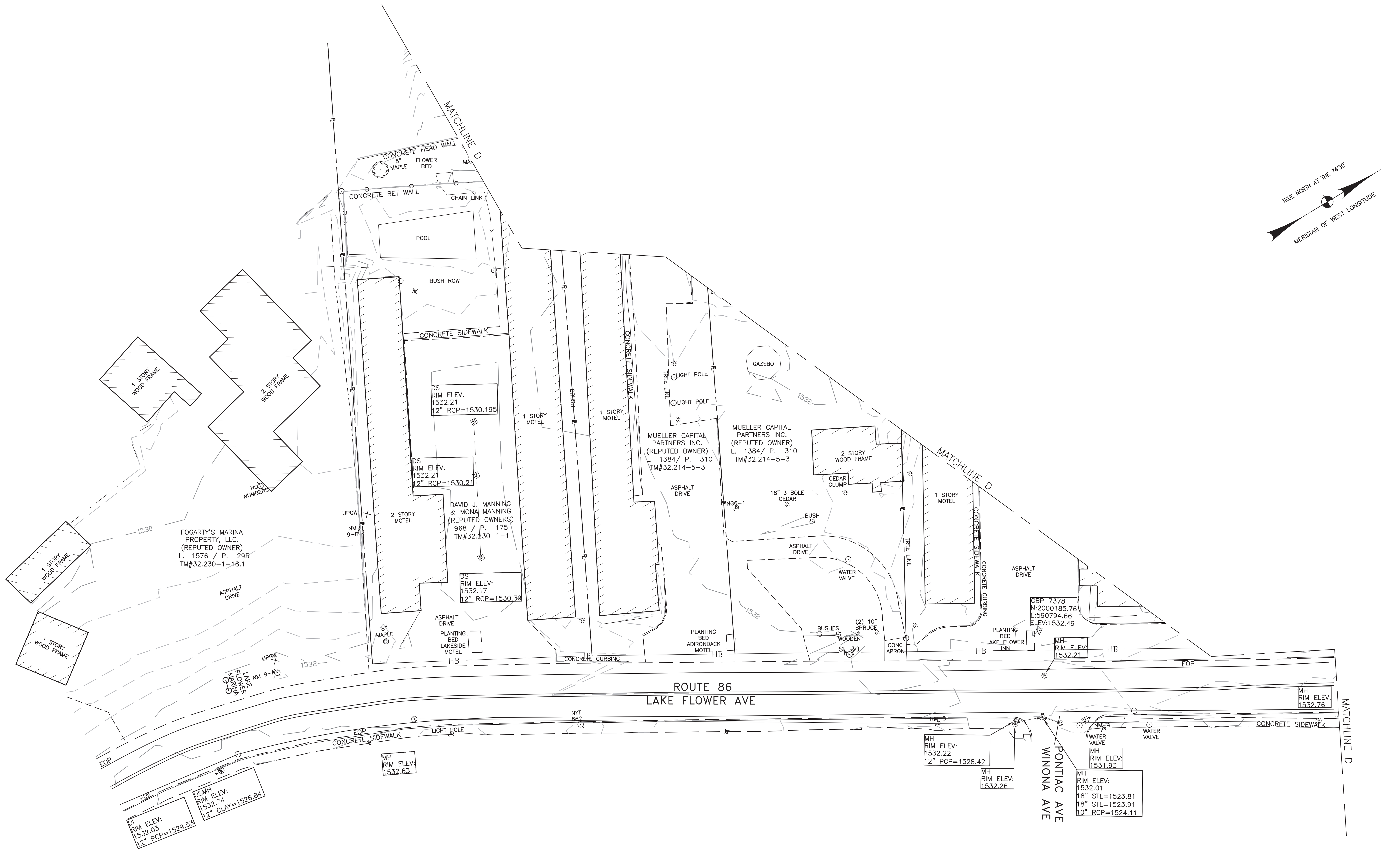

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—G—	GAS LINE
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S	SANITARY MANHOLE
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GRAPHIC SCALE

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(IN FEET)
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PRUDENT ENGINEERING

DRAFTED BY B.G.P. CHECKED BY M.A.V. DESIGNED BY IN CHARGE OF M.A.V. ESTIMATED BY CHECKED BY

NEW DESCRIPTION OF THE SURVEYED PROPERTY

A NEW DESCRIPTION WAS PREPARED WITH BEARINGS REFERENCE TO TRUE NORTH AT THE 74°30' MERIDIAN OF WEST LONGITUDE.

ALL THAT TRACT OR PARCEL OF LAND, SITUATE IN THE TOWN OF NORTH ELBA, COUNTY OF ESSEX AND STATE OF NEW YORK, BEING PART OF LOT NUMBER 13, TOWNSHIP 11, OLD MILITARY TRACT, BEING A PORTION OF TAX PARCEL NUMBER 32KC-1-11, AND BEING MORE PARTICULARLY BOUNDED AND DESCRIBED AS FOLLOWS:

PARCEL 1 - ADIRONDACK BOTTLED GAS CORPORATION OF NEW YORK

BEGINNING AT A POINT IN THE CENTER OF PAYEVILLE LANE, SAID POINT BEING DISTANT S 7°00' E, AS MEASURE ALONG THE CENTERLINE OF PAYEVILLE LANE, 280 FEET FROM THE CENTERLINE INTERSECTION OF PINE ST, SAID POINT ALSO BEING THE SOUTHEASTERLY CORNER OF A PARCEL OF LAND CONVEYED TO MARK S. NASON & KARLA NASON BY DEED AS RECORDED IN THE ESSEX'S COUNTY CLERK'S OFFICE IN LIEBER OF DEEDS 884 AT PAGE 333;

THENCE NORTHWESTERLY ALONG SAID SOUTHERLY BOUNDARY OF SAID MARK S. NASON & KARLA NASON, SHANE S. FOX BY DEED AS RECORDED IN THE ESSEX'S COUNTY CLERK'S OFFICE IN LIEBER OF DEEDS 1134 AT PAGE 75, GREGORY L. PEACOCK BY DEED AS RECORDED IN THE ESSEX'S COUNTY CLERK'S OFFICE IN LIEBER OF DEEDS 1190 AT PAGE 135, AND PARTIALLY ALONG GREGORY L. PEACOCK BY DEED AS RECORDED IN THE ESSEX'S COUNTY CLERK'S OFFICE IN LIEBER OF DEEDS 1028 AT PAGE 127 N80°54'57” W A DISTANCE OF 409.08 FEET TO NORTHEASTERLY CORNER OF A PARCEL OF LAND CONVEYED TO NATIONAL PROPANE, L.P. (PARCEL 2) BY DEED AS RECORDED IN THE ESSEX'S COUNTY CLERK'S OFFICE IN LIEBER OF DEEDS 1116 AT PAGE 32;

THENCE ALONG SAID EASTERLY AND SOUTHERLY LINE OF SAID PARCEL 2 THE FOLLOWING (2) COURSES AND DISTANCES: 1) SOUTHEASTERLY S 22°02'57” E, A DISTANCE OF 208.00 FEET; 2) SOUTHWESTERLY S 67°57'03” W, A DISTANCE OF 190.41FEET TO A POINT ON THE EASTERLY BOUNDS OF THE PEOPLE OF THE STATE OF NEW YORK (UNDER THE JURISDICTION OF THE DORMITORY AUTHORITY OF THE STATE OF NEW YORK) BY DEED AS RECORDED IN THE ESSEX'S COUNTY CLERK'S OFFICE IN LIEBER OF DEEDS 638 AT PAGE 102;

THENCE SOUTHEASTERLY ALONG THE EASTERLY LINE OF THE PEOPLE OF THE STATE OF NEW YORK (UNDER THE JURISDICTION OF THE DORMITORY AUTHORITY OF THE STATE OF NEW YORK) THE FOLLOWING (2) COURSES AND DISTANCES: 1) S 22°02'57” E A DISTANCE OF 80.99 FEET TO A POINT; 2) ALONG A NON TANGENT CURVE TO THE RIGHT WITH A RADIUS OF 1287.95 FEET A LENGTH OF 333.11 FEET (CHORD S 17°24'03” E, 332.18 FEET) TO A POINT BEING THE NORTHWEST CORNER OF A PARCEL OF LAND CONVEYED TO ESSEX & FRANKLIN COUNTY NEW YORK BY DEED AS RECORDED IN THE ESSEX'S COUNTY CLERK'S OFFICE IN LIEBER OF DEEDS 1143 AT PAGE 9273;

THENCE NORTHEASTERLY ALONG SAID NORTHERLY LINE OF ESSEX & FRANKLIN COUNTY NEW YORK N 82°34'03” E A DISTANCE OF 213.00 FEET TO A POINT, BEING THE SOUTHWEST CORNER OF A PARCEL OF LAND CONVEYED TO GEORGE PAYE JR. DEED AS RECORDED IN THE ESSEX'S COUNTY CLERK'S OFFICE IN LIEBER OF DEEDS 258 AT PAGE 575;

THENCE NORTHERLY ALONG THE WESTERLY LINE OF SAID GEORGE PAYE JR., MARGARET LOUISE PAYE & GEORGE E. PAYE JR. BY DEED AS RECORDED IN THE ESSEX'S COUNTY CLERK'S OFFICE IN LIEBER OF DEEDS 286 AT PAGE 373, MELISSA A. MARMORALE & ROSS X. BELSITO BY DEED AS RECORDED IN THE ESSEX'S COUNTY CLERK'S OFFICE IN LIEBER OF DEEDS 1694 AT PAGE 181, ROBERT & MARY L. OHMANN BY DEED AS RECORDED IN THE ESSEX'S COUNTY CLERK'S OFFICE IN LIEBER OF DEEDS 656 AT PAGE 120, JANICE M. GAUTHIER BY DEED AS RECORDED IN THE ESSEX'S COUNTY CLERK'S OFFICE IN LIEBER OF DEEDS 844 AT PAGE 112, AND ESSEX COUNTY BY DEED AS RECORDED IN THE ESSEX'S COUNTY CLERK'S OFFICE IN LIEBER OF DEEDS 1413 AT PAGE 194 N 07°25'57” E A DISTANCE OF 575.02 FEET TO A POINT BEING THE NORTHWEST CORNER OF A PARCEL OF LAND CONVEYED TO SAID ESSEX COUNTY;

THENCE EASTERLY ALONG SAID NORTHERLY LINE OF ESSEX COUNTY NEW YORK N 80°54'57” E A DISTANCE OF 244.32 FEET TO A POINT IN THE CENTER OF SAID PAYEVILLE LANE;

THENCE NORTHERLY ALONG THE SAID CENTERLINE OF PAYEVILLE LANE N 09°32'57” E A DISTANCE OF 33.01 FEET TO THE POINT AND PLACE OF BEGINNING.

CONTAINING 3.188 ACRES OF LAND, MORE OR LESS.

SUBJECT TO ANY EASEMENTS, RIGHT-OF-WAYS, AND/OR RESTRICTIONS OF RECORD, WHICH MAY AFFECT THIS PROPERTY.

PARCEL 2 - NATIONAL PROPANE, L.P.

COMMENCING AT A POINT IN THE CENTERLINE OF PAYEVILLE ROAD, SAID POINT BEING THE NORTHEASTERLY CORNER OF A PARCEL OF LAND CONVEYED TO ADIRONDACK BOTTLED GAS CORPORATION OF NEW YORK BY DEED AS RECORDED IN THE ESSEX'S COUNTY CLERK'S OFFICE IN LIEBER OF DEEDS 1116 AT PAGE 32 (PARCEL 1) AND THE SOUTHEASTERLY CORNER OF LANDS CONVEYED TO MARK S. NASON & KARLA NASON BY DEED AS RECORDED IN THE ESSEX'S COUNTY CLERK'S OFFICE IN LIEBER OF DEEDS 884 AT PAGE 333;

THENCE NORTHWESTERLY ALONG SAID NORTHERLY LINE OF PARCEL 1 N 80°54'57” W, A DISTANCE OF 409.08 FEET TO THE **POINT OF BEGINNING**, SAID POINT BEING THE NORTHWESTERLY CORNER OF PARCEL 1;

THENCE FROM SAID POINT OF BEGINNING N 80°54'57” W PARTIALLY ALONG THE SOUTHERLY LINE OF A PARCEL OF LAND CONVEYED TO GREGORY PEACOCK. BY DEED AS RECORDED IN THE ESSEX'S COUNTY CLERK'S OFFICE IN LIEBER OF DEEDS 1028 AT PAGE 127 AND ALONG OTHER LANDS OF GREGORY PEACOCK BY DEED AS RECORDED IN THE ESSEX'S COUNTY CLERK'S OFFICE IN LIEBER OF DEEDS 1366 AT PAGE 74 A DISTANCE OF 222.45 FEET TO AN IRON PIPE IN THE EASTERLY BOUNDS OF THE PEOPLE OF THE STATE OF NEW YORK (UNDER THE JURISDICTION OF THE DORMITORY AUTHORITY OF THE STATE OF NEW YORK) BY DEED AS RECORDED IN THE ESSEX'S COUNTY CLERK'S OFFICE IN LIEBER OF DEEDS 638 AT PAGE 102;

THENCE SOUTHEASTERLY ALONG THE EASTERLY LINE OF SAID THE PEOPLE OF THE STATE OF NEW YORK (UNDER THE JURISDICTION OF THE DORMITORY AUTHORITY OF THE STATE OF NEW YORK) S 22°02'57” E A DISTANCE OF 323.01 FEET TO A POINT BEING THE NORTHWEST CORNER OF SAID PARCEL 1;

THENCE SOUTHERLY AND EASTERLY LINE OF PARCEL 1 THE FOLLOWING (2) COURSES AND DISTANCES: 1) NORTHEASTERLY N 67°57'03” E, A DISTANCE OF 190.41 FEET; 2) NORTHWESTERLY N 22°02'57” W, A DISTANCE OF 208.00 FEET TO THE POINT AND PLACE OF BEGINNING.

CONTAINING 1.160 ACRES OF LAND, MORE OR LESS.

SUBJECT TO ANY EASEMENTS, RIGHT-OF-WAYS, AND/OR RESTRICTIONS OF RECORD, WHICH MAY AFFECT THIS PROPERTY.

SAMPLE LOCATIONS

Pnt.	Northing	Easting	Ground Elev.	PVC Riser Pipe Elev.	Desc.
1197	1999701.4	592314.4	1542.21	-	MW-107/F-4
1198	1999700.1	592263.7	1541.62	-	E-4
1199	1999694.1	592216.1	1541.37	-	D-4
1200	1999692.3	592175.3	1541.58	-	C-4
1201	1999659.8	592131.4	1542.32	-	B-4
1205	1999627.4	592176.5	1542.43	-	C-5
1206	1999639.0	592218.4	1542.27	-	D-5
1207	1999650.2	592262.1	1542.67	-	E-5
1209	1999639.0	592352.9	1543.65	-	GW-2
1210	1999619.0	592337.5	1544.14	-	F-5
1211	1999597.0	592281.0	1543.51	1543.22	MW-102/E-6
1212	1999588.1	592242.3	1543.28	-	D-6
1263	1999595.0	592319.9	1543.25	-	F-6
1264	1999563.3	592331.1	1543.85	-	F-7
1266	1999566.6	592382.1	1543.62	-	G-7
1279	1999497.1	592270.3	1543.57	-	E-8
1280	1999549.6	592256.4	1543.51	-	D-7
1282	1999487.1	592226.6	1543.19	-	D-8
1283	1999508.7	592319.0	1543.27	-	F-8
1284	1999514.2	592380.7	1543.39	-	G-8
1285	1999573.2	592418.0	1543.65	-	H-7
1286	1999517.3	592440.5	1544.79	-	H-8
1287	1999478.2	592397.3	1543.65	-	G-9
1323	1999401.4	592254.1	1542.45	1542.07	MW-103/E-10
1324	1999445.3	592264.2	1543.14	-	E-9
1325	1999418.5	592261.8	1543.17	1542.97	GW-14
1326	1999449.4	592312.9	1543.18	1542.93	MW-101/F-9
1382	1999529.3	592469.7	1542.28	-	I-7
1484	1999365.4	592377.8	1542.27	-	F-11
1489	1999423.6	592400.6	1543.56	-	G-10
1499	1999403.3	592332.4	1546.10	1545.85	MW-109/F-10
1501	1999365.3	592299.6	1542.85	-	E-11
1519	1999304.6	592350.3	1548.51	-	F-12
1531	1999256.3	592411.4	1547.19	-	H-13
1550	1999214.6	592537.4	1548.29	-	J-14
1699	1999615.2	592418.3	1546.75	1546.69	MW-108/H-6

SAMPLE LOCATIONS

Pnt.	Northing	Easting	Ground Elev.	PVC Riser Pipe Elev.	Desc.
1749	1999786.6	592297.3	1541.46	-	F-2
1767	1999747.5	592263.3	1541.36	-	E-3
1831	1999779.6	592249.6	1540.61	-	E-2
1882	1999766.0	592166.9	1545.98	-	MW-105/C-2
1892	1999720.0	592151.2	1543.23	-	MW-106/C-3
1931	1999833.9	592054.2	1545.27	1545.12	MW-104/A-1
1944	1999776.3	592087.3	1539.82	1539.76	A-2
1947	1999769.4	592115.3	1540.89	1540.47	B-2
2019	1999711.5	592085.6	1538.75	-	TB-13
2023	1999692.5	592120.1	1542.15	-	GW-11
2024	1999711.9	592117.5	1541.27	-	B-3
2034	1999525.0	592176.7	1543.33	-	MW-110 /C-7
2205	2000429.5	591223.3	1533.56	-	TEST BORING
2332	2000510.4	591451.8	1535.11	1534.86	TEST BORING
3842	1999912.6	592004.8	1537.04	-	ST-102A
3843	1999916.0	592009.0	1538.85	-	ST-102A
3844	1999924.5	592016.0	1538.59	-	ST-102B
3845	1999918.4	591997.1	1539.73	-	ST-102
3854	1999968.2	591994.3	1537.84	-	TB-19
3856	1999979.3	592006.1	1537.51	-	TB-20
3857	1999991.8	592017.9	1537.50	-	TB-21
3868	2000032.9	592011.6	1538.09	-	TB-2
3869	2000036.4	592019.6	1537.26	-	TB-25
3870	2000015.6	591965.5	1537.87	-	TB-23
3882	2000119.7	591994.0	1537.55	-	SD-103B
3883	2000111.8	591982.9	1537.11	-	SD-103A
3884	2000086.4	591946.9	1537.53	-	SD-103D
3885	2000111.0	591938.3	1537.56	-	TB-26
3886	2000142.3	591938.6	1537.36	-	TB-27
3908	2000196.6	591882.1	1537.17	-	TB-31
3909	2000216.8	591877.3	1536.05	-	TB-35
3910	2000229.5	591891.3	1537.05	-	TB-33
3911	2000237.6	591896.6	1537.24	-	TB-34
3912	2000064.6	591931.2	1541.23	-	SD-103
3921	2000298.9	591847.4	1536.40	-	TB-40
3922	2000324.4	591825.6	1537.36	-	SD-104B
3924	2000316.2	591816.8	1535.73	-	SD-104C
3926	2000303.2	591809.3	1536.76	-	SD-104C
	1999549.4	592288.0	-	-	E-7
	1999747.3	592307.1	-	-	F-3
	1999458.9	592239.3	-	-	D-9

**Horizontal Coordinates reference to the New York State Plane Coordinate System, East Zone (3101) based on NAD 83 (2011). Vertical Datum is NAVD88. Horizontal and Vertical control were established by NYSNET RTK.*

SAMPLE LOCATIONS 9-26-14

Pnt.	Northing	Easting	Ground Elev.	Top of Well Elev.	PVC Riser Pipe Elev.	Desc.
10032	1999370.5	592338.7	1543.08	-	-	F-11A
10034	1999285.8	592255.5	1543.44	1546.53	1546.29	MW-204
11003	1999528.6	592285.2	1543.02	-	-	E-7A
11004	1999426.2	592314.4	1543.02	-	-	F-9A
11005	1999945.7	591954.2	1540.77	1543.81	1543.58	MW-201
11007	2000040.7	591958.9	1537.72	-	-	SD-200
11008	2000159.9	591929.1	1537.35	-	-	SD-201
11009	2000266.2	591853.5	1536.29	-	-	SD-202
11010	2000349.7	591773.5	1536.14	-	-	SD-203
11011	2000463.7	591665.8	1535.66	-	-	SD-204
11012	2000540.6	591583.1	1535.11	-	-	SD-205
11014	1999993.6	591741.0	1547.99	1548.05	1547.83	MW-203*
11017	1999711.9	591841.6	1554.26	1554.19	1553.97	MW-202*
11020	1999119.0	592297.7	1542.44	1545.52	1545.37	MW-205D*
11021	1999124.3	592295.9	1542.65	1545.44	1545.24	MW-205S*
11026	1999303.8	592387.3	1547.16	-	-	G-12
11027	1999144.7	592416.4	1542.10	-	-	H-15*
11028	1999792.2	592658.4	1548.42	-	-	BB1
11029	2000366.8	590878.9	1529.52	-	-	LF1
11030	2000406.2	591134.9	1535.86	-	-	BB2

Note: Horizontal Coordinates reference to the New York State Plane Coordinate System, East Zone (3101) based on NAD 83 (2011). Vertical Datum is NAVD88. Horizontal and Vertical control were established by NYSNET RTK.

**Test areas located off site.*

SAMPLE LOCATIONS 5-4-17

Pnt.	Northing	Easting	Ground Elev	Top of Well Elev	PVC Riser Pipe Elev	Desc.
80055	1999930.6	591913.4	1541.15	-	1544.19	PZ-301
80035	1999841.6	592086.2	1548.34	-	1552.14	PZ-302
80062	2000119.2	592008.0	1538.40	-	1540.13	PZ-303
80063	2000131.7	592031.5	1542.25	-	1545.06	PZ-304
80021	2000322.7	591770.8	1542.29	-	1545.28	PZ-311
80015	2000470.5	591409.9	1535.49	1535.91	1535.84	PZ-317
80017	2000497.2	591398.6	1535.01	1535.41	1535.29	PZ-318
80010	2000386.6	590882.4	1531.63	1531.85	1531.67	PZ-328
80000	2000302.6	590671.3	1532.89	1533.12	1532.97	PZ-331
80003	2000171.7	590555.8	1528.98	1529.08	1528.95	PZ-332
80012	2000412.0	590854.7	1531.18	1531.33	1531.08	PZ-333
80007	2000457.7	590671.7	1531.56	1531.81	1531.59	PZ-335
80005	2000492.3	590420.6	1532.43	1532.28	1531.96	PZ-336
80023	2000299.5	591739.0	1547.72	-	1550.87	PZ-337

Note: Horizontal Coordinates reference to the New York State Plane Coordinate System, East Zone (3101) based on NAD 83 (2011). Vertical Datum is NAVD88. Horizontal and Vertical control were established by NYSNET RTK.

Saranac Gas Plant
Saranac Lake, NY

Part of LOT 13 TOWN North Elba
State of New York
Scale of 1 inch = 30'
Date 1/7/14 - 12/08/14 (Revised)
1/6/17 (Revised) - 5/25/17 (Revised)

PHONE: (315)748-7000
FAX: (315) 748-7780
6390 FLY ROAD
EAST SYRACUSE, N.Y. 13057
www.PrudentEng.com

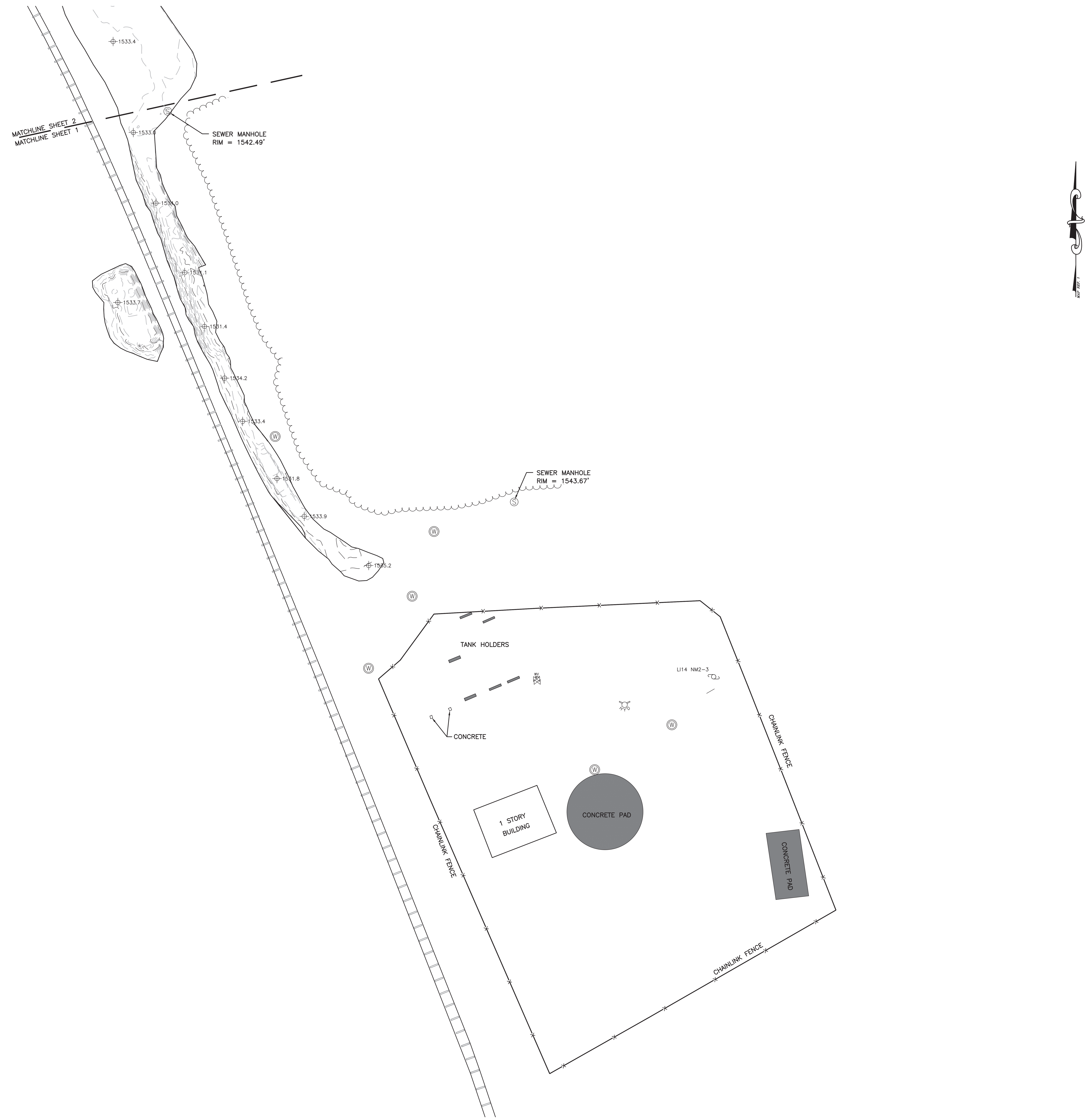
Project No. 109.005-4

PRUDENT ENGINEERING

IN CHARGE OF M.A.V. DESIGNED BY CHECKED BY ESTIMATED BY CHECKED BY DRAFTED BY B.G.P. CHECKED BY M.A.V.

APPENDIX C

DRAFT AS-BUILT DRAWINGS



SITE LOCATION MAP

N.T.S.

LEGEND:

- UTILITY POLE
- TREE LINE
- WATER VALVE
- FIRE HYDRANT
- MONITORING WELL
- BOLLARD
- SIGN (1 POST)
- SIGN (2 POST)
- CHAINLINK FENCE
- LIGHT POST
- 1529 MINOR CONTOUR
- 1530 MAJOR CONTOUR
- 1538.1 GROUND SPOT ELEVATIONS
- W WATER LINE
- G GAS LINE
- E UNDERGROUND ELECTRIC LINE
- SEWER MANHOLE
- DRAINAGE MANHOLE
- OH OVERHEAD UTILITY LINE
- GAS VALVE
- ASPHALT
- GRAVEL AREA
- CONCRETE

0 40 80 Feet

NOTES:

1. SURVEY SHOWN WAS PREPARED FROM A APRIL THROUGH MAY 2018 FIELD SURVEY.
2. SURVEY SUBJECT TO ANY SUBSURFACE CONDITIONS THAT MAY EXIST, IF ANY.
3. NO UNDERGROUND UTILITY INVESTIGATION WAS PERFORMED.
4. THE DATUM USED FOR THIS SURVEY IS BASED ON MAP REFERENCE 1.
5. SURVEY WAS PERFORMED UNDER ICE AND SNOW CONDITIONS, OTHER SITE FEATURES MAY EXIST.

MAP REFERENCES

MAP ENTITLED "REMEDIAL ACTION NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION SARANAC LAKE GAS CO., INC., SITE NO. 516008 OU02: BRANDY BROOK AND OU03 PONTIAC BAY ON LAKE FLOWER", DATED NOVEMBER 29, 2017 AND PREPARED BY MACTEC ENGINEERING AND CONSULTING, P.C..

NMB LAND SURVEYING PLLC
20 TROY AVE. WYNANTSKILL NY, 12198
518-376-4630

		REVISIONS	
NO.	DATE	DESCRIPTION	BY

NATHAN M. BURROWS L.S.
NEW YORK LIC. No. 50,724

BOTTOM OF EXCAVATION TOPOGRAPHIC SURVEY

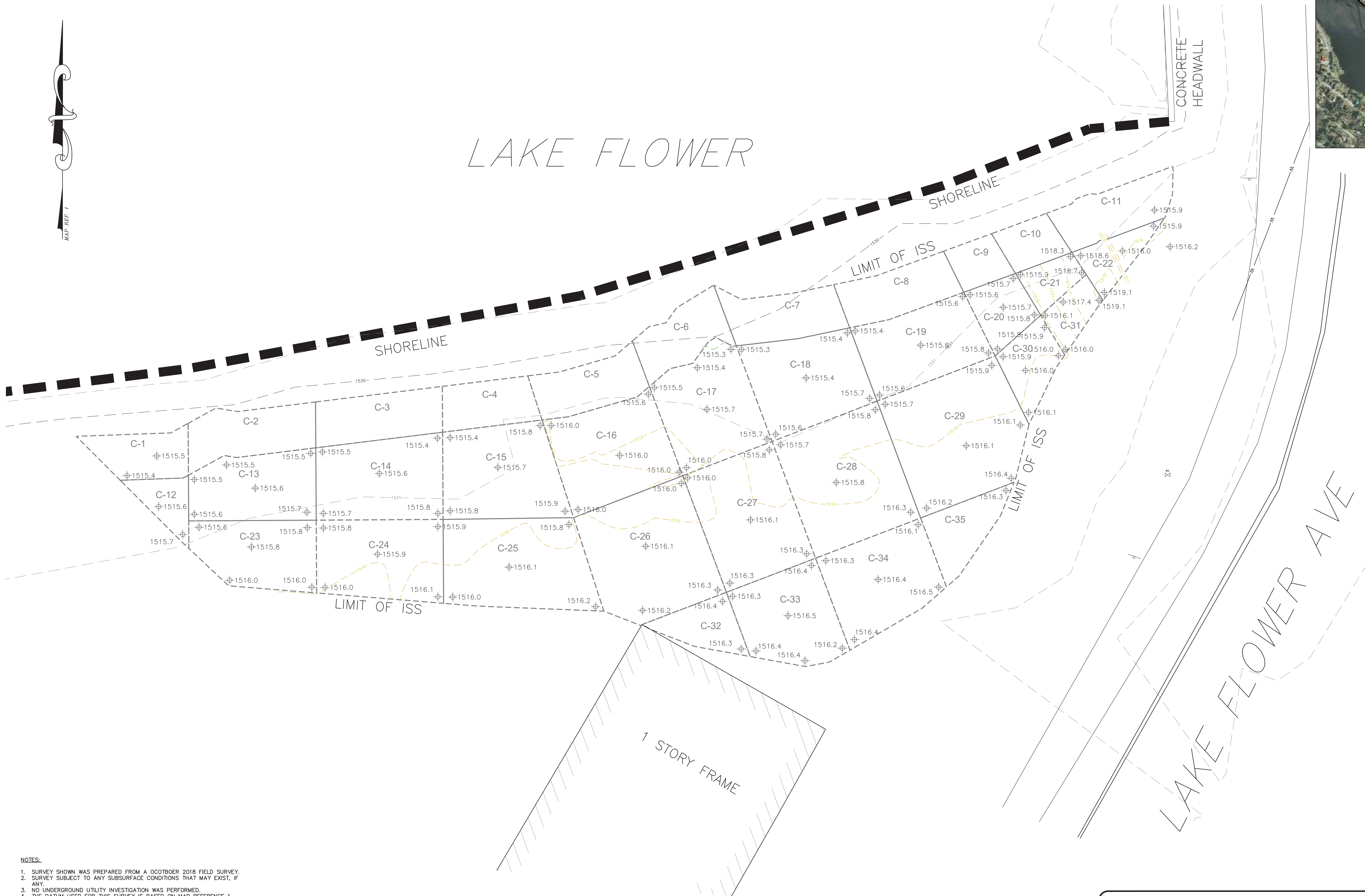
REMEDIAL ACTION NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION SARANAC LAKE GAS CO., INC., SITE 516008 OU02: BRANDY BROOK AND OU03 PONTIAC BAY ON LAKE FLOWER

VILLAGE OF SARANAC LAKE

COUNTY OF ESSEX — STATE OF NEW YORK

SURVEYED BY: LRI	CHECKED BY: NMB	DATE: 1-15-2018
DRAWN BY: AJK	JOB No. 6530	DWG No. EXCAVATION

SCALE: 1"=40' — SHEET 1 OF 3



SITE LOCATION MAP
N.T.S.

LEGEND:

- WATER VALVE
- SIGN (1 POST)
- 1531 — MINOR CONTOUR
- 1530 — MAJOR CONTOUR
- 1514 — BOTTOM OF ISS MINOR CONTOUR
- 1515 — BOTTOM OF ISS MAJOR CONTOUR
- 1515.6 — BOTTOM OF ISS SPOT ELEVATIONS
- W — WATER LINE
- LIMIT OF ISS

0 5 10 Feet

NOTES:

1. SURVEY SHOWN WAS PREPARED FROM A OCOTBOER 2018 FIELD SURVEY.
2. SURVEY SUBJECT TO ANY SUBSURFACE CONDITIONS THAT MAY EXIST, IF ANY.
3. NO UNDERGROUND UTILITY INVESTIGATION WAS PERFORMED.
4. THE DATUM USED FOR THIS SURVEY IS BASED ON MAP REFERENCE 1.
5. SURVEY WAS PERFORMED UNDER ICE AND SNOW CONDITIONS, OTHER SITE FEATURES MAY EXIST.

MAP REFERENCES

MAP ENTITLED "REMEDIAL ACTION NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION SARANAC LAKE GAS CO., INC., SITE NO. 516008 OUO2: BRANDY BROOK AND OUO3 PONTIAC BAY ON LAKE FLOWER", DATED NOVEMBER 29, 2017 AND PREPARED BY MACTEC ENGINEERING AND CONSULTING, P.C..

		REVISIONS	
NO.	DATE	DESCRIPTION	BY

STATE OF NEW YORK · NATHAN M. BURROWS · 050724 · LICENSED LAND SURVEYOR

NATHAN M. BURROWS L.S.
NEW YORK LIC. No. 50,724

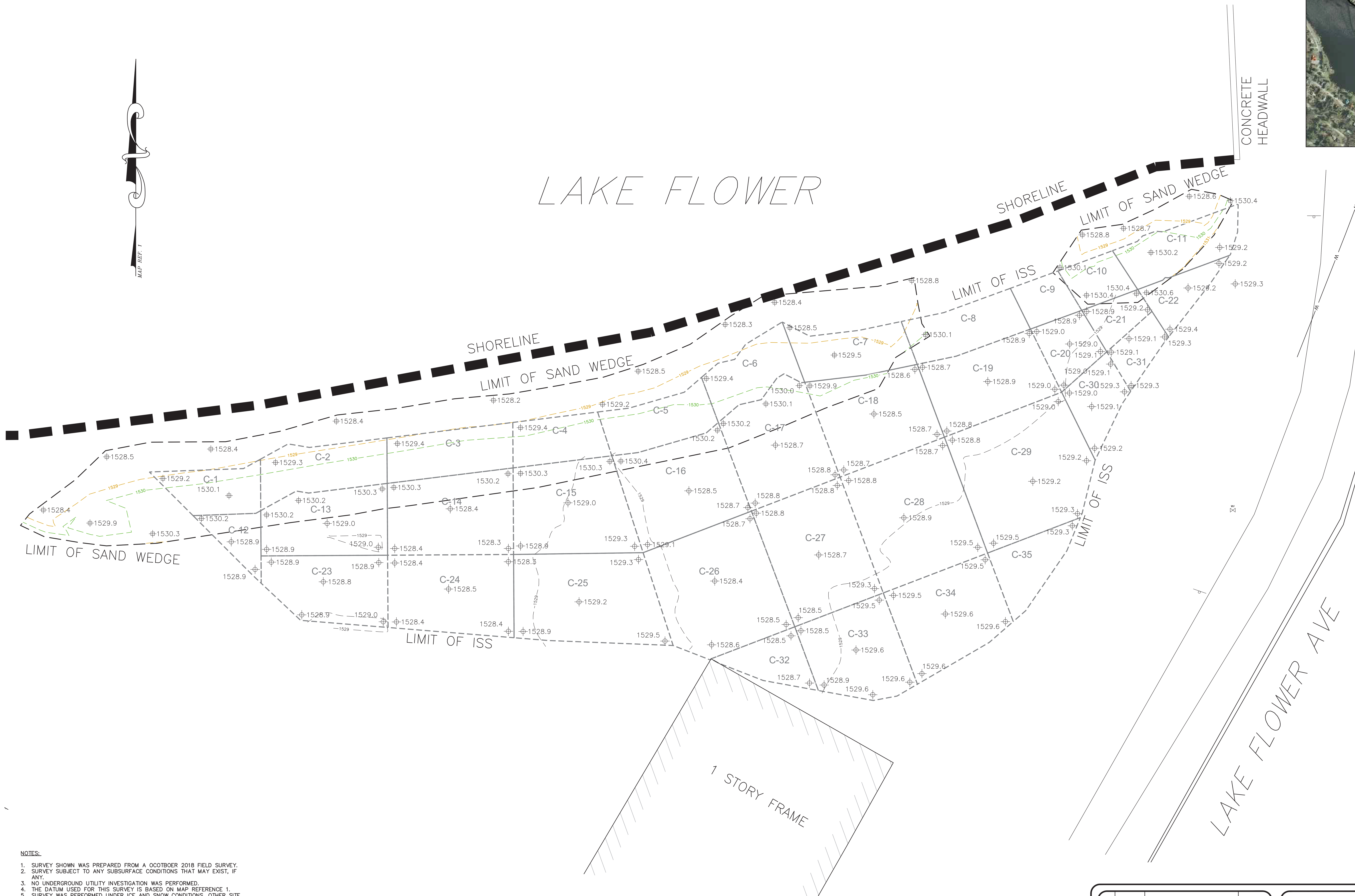
NMB
LAND SURVEYING
PLLC
20 TROY AVE. WYNANTSKILL NY, 12198
518-376-4630

BOTTOM OF ISS SURVEY

REMEDIAL ACTION NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
SARANAC LAKE GAS CO., INC., SITE 516008
OU3 – ISS AREA

VILLAGE OF SARANAC LAKE
COUNTY OF ESSEX — STATE OF NEW YORK

SURVEYED BY: LRI	CHECKED BY: NMB	DATE: 5-29-2019
DRAWN BY: AJK	JOB No. 6530	DWG No. ISS
SCALE: 1"=5'	SHEET 1 OF 1	



SITE LOCATION MAP
N.T.S.

LEGEND:

WV	WATER VALVE
	SIGN (1 POST)
1529	MINOR CONTOUR(TOP OF MONOLITH)
1530	MAJOR CONTOUR(TOP OF MONOLITH)
1528.5	GROUND SPOT ELEVATIONS(TOP OF MONOLITH)
1514	MINOR CONTOUR(SAND WEDGE)
1515	MAJOR CONTOUR(SAND WEDGE)
1529.5	GROUND SPOT ELEVATIONS(SAND WEDGE)
	LIMIT OF SAND WEDGE
W	WATER LINE
	LIMIT OF ISS

0 5 10 Feet

NOTES:

1. SURVEY SHOWN WAS PREPARED FROM A OCOTBOER 2018 FIELD SURVEY.
2. SURVEY SUBJECT TO ANY SUBSURFACE CONDITIONS THAT MAY EXIST, IF ANY.
3. NO UNDERGROUND UTILITY INVESTIGATION WAS PERFORMED.
4. THE DATUM USED FOR THIS SURVEY IS BASED ON MAP REFERENCE 1.
5. SURVEY WAS PERFORMED UNDER ICE AND SNOW CONDITIONS, OTHER SITE FEATURES MAY EXIST.

MAP REFERENCES

MAP ENTITLED "REMEDIAL ACTION NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION SARANAC LAKE GAS CO., INC., SITE NO. 516008 OU02: BRANDY BROOK AND OU03 PONTIAC BAY ON LAKE FLOWER", DATED NOVEMBER 29, 2017 AND PREPARED BY MACTEC ENGINEERING AND CONSULTING, P.C..

REVISIONS			
NO.	DATE	DESCRIPTION	BY

NATHAN M. BURROWS L.S.
NEW YORK LIC. No. 50,724

NMB
LAND SURVEYING
PLLC
20 TROY AVE. WYNANTSKILL NY, 12198
518-376-4630

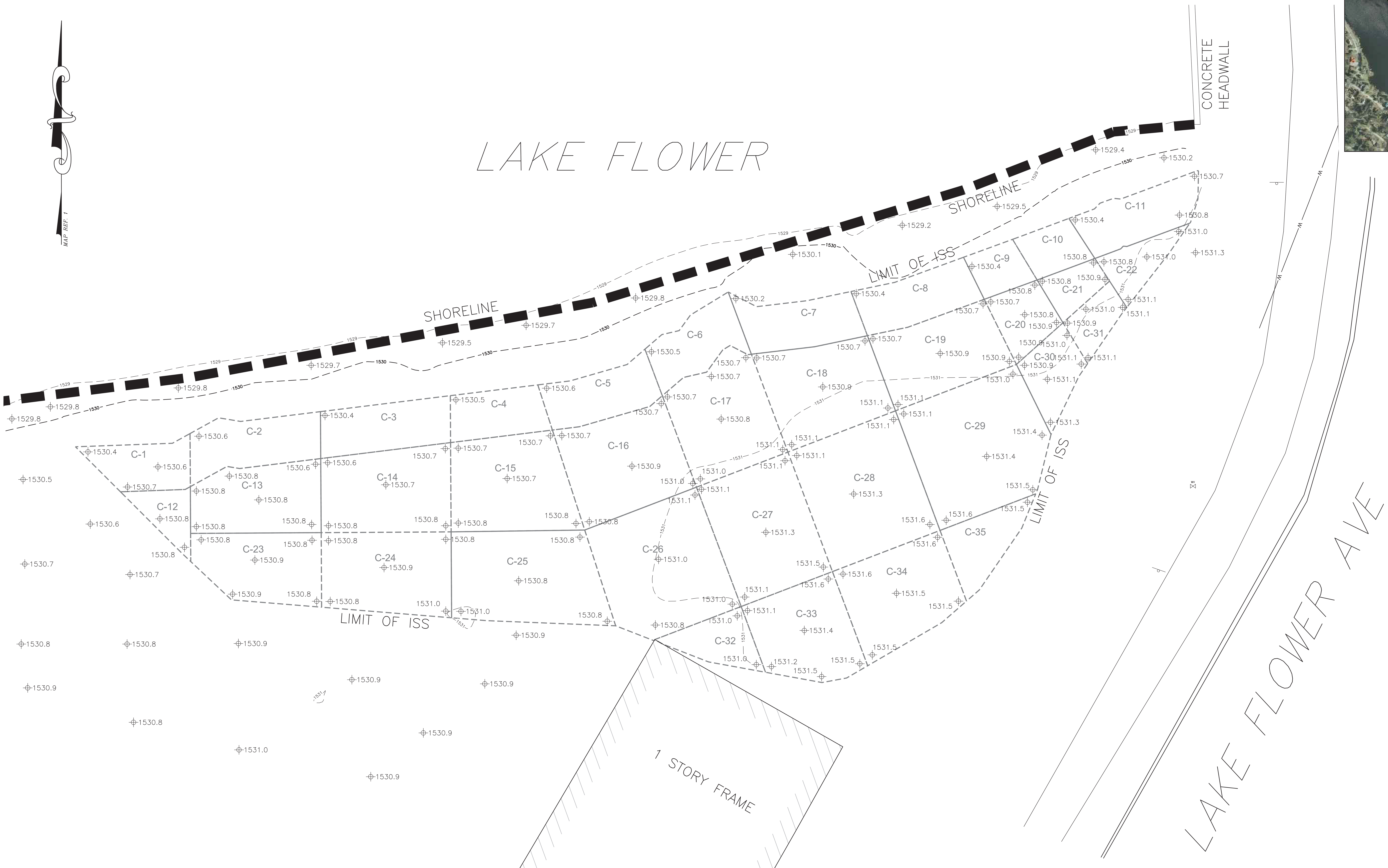
TOP OF MONOLITH/SAND WEDGE SURVEY

REMEDIAL ACTION NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
SARANAC LAKE GAS CO., INC., SITE 516008
OU3 – ISS AREA

VILLAGE OF SARANAC LAKE
COUNTY OF ESSEX STATE OF NEW YORK

SURVEYED BY: LRI	CHECKED BY: NMB	DATE: 6-3-2019
DRAWN BY: AJK	JOB No. 6530	DWG No. MONOLITH

SCALE: 1"=5' SHEET 1 OF 1



SITE LOCATION MAP
N.T.S.

LEGEND:

- WATER VALVE
- SIGN (1 POST)
- 1531 MINOR CONTOUR
- 1530 MAJOR CONTOUR
- 1531.1 BOTTOM OF ISS SPOT ELEVATIONS
- W WATER LINE
- LIMIT OF ISS

0 5 10 Feet

NOTES:

1. SURVEY SHOWN WAS PREPARED FROM A OCOTBOER 2018 FIELD SURVEY.
2. SURVEY SUBJECT TO ANY SUBSURFACE CONDITIONS THAT MAY EXIST, IF ANY.
3. NO UNDERGROUND UTILITY INVESTIGATION WAS PERFORMED.
4. THE DATUM USED FOR THIS SURVEY IS BASED ON MAP REFERENCE 1.
5. SURVEY WAS PERFORMED UNDER ICE AND SNOW CONDITIONS, OTHER SITE FEATURES MAY EXIST.

MAP REFERENCES

MAP ENTITLED "REMEDIAL ACTION NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION SARANAC LAKE GAS CO., INC., SITE NO. 516008 OUO2: BRANDY BROOK AND OUO3 PONTIAC BAY ON LAKE FLOWER", DATED NOVEMBER 29, 2017 AND PREPARED BY MACTEC ENGINEERING AND CONSULTING, P.C..

NMB LAND SURVEYING PLLC
20 TROY AVE. WYNANTSKILL NY, 12198
518-376-4630

NO.	DATE	REVISIONS DESCRIPTION	BY

STATE OF NEW YORK · LICENSED LAND SURVEYOR · 050724

NATHAN M. BURROWS L.S.
NEW YORK LIC. No. 50,724

POST CONSTRUCTION SURVEY

REMEDIAL ACTION NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
SARANAC LAKE GAS CO., INC., SITE 516008
OU3 – ISS AREA

VILLAGE OF SARANAC LAKE
COUNTY OF ESSEX — STATE OF NEW YORK

SURVEYED BY: LRI — CHECKED BY: NMB — DATE: 6-3-2019
DRAWN BY: AJK — JOB No. 6530 — DWG No. POST CONSTRUCTION

SCALE: 1"=5' — SHEET 1 OF 1

APPENDIX D

EXCAVATION WORK PLAN

APPENDIX D – EXCAVATION WORK PLAN (EWP)

Any future intrusive work that will penetrate barriers shown in Figures 2.4 and 2.5 of this ISMP or otherwise potentially encounter or disturb remaining contamination, including stabilized soil, will be performed in compliance with the Excavation Work Plan (EWP). Intrusive construction or utility work must be conducted in accordance with this Plan, an approved Health and Safety Plan (HASP), and a Community Air Monitoring Plan (CAMP). A CAMP will be submitted to the DEC for Approval prior to conducting invasive activities at the site.

D-1 NOTIFICATION

At least 15 days prior to the start of any activity that is anticipated to encounter remaining contamination, the site owner or their representative will notify the NYSDEC. Notifications will be made to:

Sarah Saucier, Project Manager
NYSDEC
625 Broadway, Albany, NY 12233-5060
Albany, NY
(518) 402-9675

This notification will include:

- A detailed description of the work to be performed, including the location and areal extent of excavation, plans/drawings for site re-grading, intrusive elements or utilities to be installed below or near a barrier system or in a location of remaining contaminated soil to be excavated and any work that may impact an engineering control;

- A summary of environmental conditions anticipated to be encountered in the work areas, including the nature and concentration levels of contaminants of concern, potential presence of grossly contaminated media, and plans for any pre-construction sampling;

- A schedule for the work, detailing the start and completion of all intrusive work;

- A summary of the applicable components of this EWP;

- A statement that the work will be performed in compliance with this EWP and 29 CFR 1910.120;

- A copy of the contractor's health and safety plan (HASP) and CAMP, in electronic format;

- Identification of disposal facilities for potential waste streams;

- Identification of sources of any anticipated backfill, along with all required chemical testing results.

D-2 SOIL SCREENING METHODS

Visual, olfactory and instrument-based (e.g. photoionization detector) soil screening will be performed by a qualified environmental professional during all excavations into known or potentially contaminated material (remaining contamination). Soil screening will be performed when invasive work is done and will include all excavation and invasive work performed, such as excavations for foundations and utility work.

Soils will be segregated based on screening results into material that requires off-site disposal and material that is deemed adequate for reuse as part of the proposed work. Further discussion of off-site disposal of materials and on-site reuse is provided below.

D-3 SOIL STAGING METHODS

Soil stockpiles will be continuously encircled with a berm and/or silt fence. Hay bales will be used as needed near catch basins, surface waters and other discharge points.

Stockpiles will be kept covered at all times with appropriately anchored tarps. Stockpiles will be routinely inspected, and damaged tarp covers will be promptly replaced.

Stockpiles will be inspected at a minimum once each week and after every storm event. Results of inspections will be recorded in a logbook and maintained at the site and available for inspection by the NYSDEC.

D-4 MATERIALS EXCAVATION AND LOAD-OUT

A qualified environmental professional or person under their supervision will oversee all invasive work and the excavation and load-out of all excavated material.

Contractors are solely responsible for safe execution of invasive and other work performed under this Plan.

The presence of utilities and easements on the site will be investigated by the qualified environmental professional. It will be determined whether a risk or impediment to the planned work under this SMP is posed by utilities or easements on the site.

Loaded vehicles leaving the site will be appropriately lined, tarped, securely covered, manifested, and placarded in accordance with appropriate Federal, State, local, and NYSDOT requirements (and all other applicable transportation requirements).

Locations where vehicles enter or exit the site shall be inspected daily for evidence of off-site soil tracking.

The qualified environmental professional will be responsible for ensuring that egress points for truck and equipment transport from the site are clean of dirt and other materials derived from the site during intrusive excavation activities. Cleaning of the adjacent streets will be performed as needed to maintain a clean condition with respect to site-derived materials.

D-5 MATERIALS TRANSPORT OFF-SITE

Transport of materials will be performed by licensed haulers in accordance with appropriate local, State, and Federal regulations, including 6 NYCRR Part 364. Haulers will be appropriately licensed and trucks properly placarded.

Material transported by trucks exiting the site will be secured with tight-fitting covers. Loose-fitting canvas-type truck covers will be prohibited. If loads contain wet material capable of producing free liquid, truck liners will be used.

Truck transport routes are to be determined by the contractor as appropriate and submitted with the excavation work plan and are to include both primary and secondary routes and maps. All trucks loaded with site materials will exit the vicinity of the site using only these approved truck routes. This is the most appropriate route and takes into account: (a) limiting transport through residential areas and past sensitive sites; (b) use of city mapped truck routes; (c) prohibiting off-site queuing of trucks entering the facility; (d) limiting total distance to major highways; (e) promoting safety in access to highways; and (f) overall safety in transport; (g) community input where necessary. A figure showing the trucking routes will be included with activity specific work plans submitted to the DEC.

Trucks will be prohibited from stopping and idling in the neighborhood outside the project site.

Egress points for truck and equipment transport from the site will be kept clean of dirt and other materials during site remediation and development.

Queuing of trucks will be performed on-site in order to minimize off-site disturbance. Off-site queuing will be prohibited.

D-6 MATERIALS DISPOSAL OFF-SITE

Materials excavated and removed from the site will be treated as contaminated and regulated material and will be transported and disposed in accordance with all local, State (including 6NYCRR Part 360) and Federal regulations. If disposal of material from this site is proposed for unregulated off-site disposal (i.e. clean soil removed for development purposes), a formal request with an associated plan will be made to the NYSDEC. Unregulated off-site management of materials from this site will not occur without formal NYSDEC approval.

Off-site disposal locations for excavated soils will be identified in the pre-excavation notification. This will include estimated quantities and a breakdown by class of disposal facility if appropriate, i.e. hazardous waste disposal facility, solid waste landfill, petroleum treatment facility, C/D recycling facility, etc. Actual disposal quantities and associated documentation will be reported to the NYSDEC in the Periodic Review Report. This documentation will include: waste profiles, test results, facility acceptance letters, manifests, bills of lading and facility receipts.

Non-hazardous historic fill and contaminated soils taken off-site will be handled, at minimum, as a Municipal Solid Waste per 6NYCRR Part 360-1.2. Material that does not meet Unrestricted SCOs is prohibited from being taken to a New York State recycling facility (6NYCRR Part 360-16 Registration Facility).

D-7 MATERIALS REUSE ON-SITE

Contaminated on-site material, including historic fill and contaminated soil, that is acceptable for reuse on-site, based on screening will not be reused on-site for landscaping or as backfill for subsurface utility lines. The qualified environmental professional will ensure that only non-impacted soil be re-used in the vicinity that it was generated.

D-8 FLUIDS MANAGEMENT

Liquids to be removed from the site, including but not limited to, excavation dewatering, decontamination waters and groundwater monitoring well purge and development waters, will be handled, transported and disposed in accordance with applicable local, State, and Federal regulations. Dewatering, purge and development fluids will not be recharged back to the land surface or subsurface of the site, and will be managed off-site, unless prior approval is obtained from NYSDEC.

Discharge of water generated during large-scale construction activities to surface waters (i.e. a local pond, stream or river) will be performed under a SPDES permit.

D-9 COVER/DEMARCATION BARRIER SYSTEM RESTORATION

If the cover system/demarcation barrier is compromised during soil removal and any other invasive activities the cover system will be restored in a manner that complies with the Remedial Action Work Plan. The existing cover system includes reactive core mat (RCM) along sections of Brandy Brook, and Aquablok® in a section of Pontiac Pay.

The RCM layer along identified locations of OU02 as shown in Figure 2.4 of this ISMP, is generally covered with a minimum of 12 inches of clean fill. If impacted, the compromised section of RCM shall be replaced and should overlap existing RCM by at least 2 feet on all sides and covered with 12 inches of clean fill

The Aquabok® layer along a section of OU03 as shown in Figure 2.5 of this ISMP, generally runs from the bottom of the bay up the side slope to the shoreline. The Aquablok® is approximately 3-4 inches thick and portions of it is are covered with either clean soil or riprap. If impacted the compromised section of Aquablok® shall be replaced with 3-4 inches of Aquablok®.

D-10 BACKFILL FROM OFF-SITE SOURCES

Materials proposed for import onto the site will be approved by the qualified environmental professional and will be in compliance with provisions in this ISMP prior to receipt at the site. A Request to Import/Reuse Fill or Soil form, which can be found at http://www.dec.ny.gov/regulations/67386.html, will be prepared and submitted to the NYSDEC project manager allowing a minimum of 5 business days for review.

Material from industrial sites, spill sites, or other environmental remediation sites or potentially contaminated sites will not be imported to the site.

Imported soils will meet the backfill and cover soil quality standards established in 6NYCRR 375-6.7(d). Soils that meet ‘exempt’ fill requirements under 6 NYCRR Part 360, but do not meet backfill or cover soil objectives for this site, will not be imported onto the site without prior approval by NYSDEC. Solid waste will not be imported onto the site.

Trucks entering the site with imported soils will be securely covered with tight fitting covers. Imported soils will be stockpiled separately from excavated materials and covered to prevent dust releases.

D-11 STORMWATER POLLUTION PREVENTION

Barriers and hay bale checks will be installed and inspected once a week and after every storm event. Results of inspections will be recorded in a logbook and maintained at the site and available for inspection by the NYSDEC. All necessary repairs shall be made immediately.

Accumulated sediments will be removed as required to keep the barrier and hay bale check functional.

Undercutting or erosion of the silt fence toe anchor shall be repaired immediately with appropriate backfill materials.

Manufacturer's recommendations will be followed for replacing silt fencing damaged due to weathering.

Erosion and sediment control measures identified in the SMP shall be observed to ensure that they are operating correctly. Where discharge locations or points are accessible, they shall be inspected to ascertain whether erosion control measures are effective in preventing significant impacts to receiving waters.

Silt fencing or hay bales will be installed around the entire perimeter of the construction area.

D-12 EXCAVATION CONTINGENCY PLAN

If underground tanks or other previously unidentified contaminant sources are found during post-remedial subsurface excavations or development related construction, excavation activities will be suspended until sufficient equipment is mobilized to address the condition.

Sampling will be performed on product, sediment and surrounding soils, etc. as necessary to determine the nature of the material and proper disposal method. Chemical analysis will be performed for a full list of analytes (TAL metals; TCL volatiles and semi-volatiles, TCL pesticides and PCBs), unless the site history and previous sampling results provide a sufficient justification to limit the list of analytes. In this case, a reduced list of analytes will be proposed to the NYSDEC for approval prior to sampling.

Identification of unknown or unexpected contaminated media identified by screening during invasive site work will be promptly communicated by phone to NYSDEC’s Project Manager. Reportable quantities of petroleum product will also be reported to the NYSDEC spills hotline. These findings will be also included in the Periodic Review Report.

D-13 OTHER NUISANCES

A plan for rodent control will be developed and utilized by the contractor prior to and during site clearing and site grubbing, and during all remedial work.

A plan will be developed and utilized by the contractor for all remedial work to ensure compliance with local noise control ordinances.

CAMP: A map showing the location of air sampling stations based on generally prevailing wind conditions shall be prepared and submitted to NYSDEC for approval. These locations will be adjusted on a daily or more frequent basis based on actual wind directions to provide an upwind and at least two downwind monitoring stations. Exceedances of action levels listed in the CAMP will be reported to NYSDEC and NYSDOH Project Managers.

Odor Control Plan: This odor control plan is capable of controlling emissions of nuisance odors off-site. If nuisance odors are identified at the Site boundary, or if odor complaints are received, work will be halted and the source of odors will be identified and corrected. Work will not resume until nuisance odors have been abated.

Dust Control Plan: A dust suppression plan that addresses dust management during invasive on-site work will include, at a minimum, the items listed below:

- Dust suppression will be achieved through the use of a dedicated on-site water truck for road wetting. The truck will be equipped with a water cannon capable of spraying water directly onto off-road areas including excavations and stockpiles.
- Clearing and grubbing of large areas will be done in stages to limit the area of exposed, unvegetated soils vulnerable to dust production.
- Gravel will be used on roadways to provide a clean and dust-free road surface.
- On-site roads will be limited in total area to minimize the area required for water truck sprinkling.

APPENDIX E

HEALTH AND SAFETY PLAN

MACTEC, Inc.

MACTEC Short Form HASP

Site: Saranac Lake Gas Company Site Job Number: 3612132271
Street Address: 24 Payeville Road, Village of Saranac Lake, New York
Proposed Date(s) of Investigation: August 2013
Prepared by: Rebecca Gabryszewski Date: 7/03/2013
*Approved by: Kendra Bavor, CSP Date: 8-1-13
Site Description: Closed propane distribution company. Previously the site of the Saranac Lake Gas Company former manufactured gas plant used for manufacture of lighting gas.
(See attached Site Location Map)

*Approval also serves as certification of a Hazard Assessment as required by 29 CFR 1910.132

MACTEC	Other contractor	Task Description
☒	☐	Mobilization/demobilizing
☒	☐	Overall inspection of the site
☒	☐	General Field Work/Oversight
☐	☒	Direct Push Boring Installation (on and off site)
☐	☒	Micro-Well Installation
☒	☐	Sediment sampling
☒	☐	Groundwater Sampling
☒	☐	Surface Water Sampling
☒	☐	Hand Borings
☒	☒	Sediment Coring in Lake Flowers
☐	☒	Survey
☐	☐	
☐	☐	

Dates of Required Training and Medical Surveillance:

		Names of Field Team*			
		Brandon Shaw	Charles Lyman	Charles Lyman	
	Req?	Dates	Dates	Dates	Dates
Medical Surveillance	YES	12/06/2012	5/16/2013		
Site Specific Medical Testing:___					
40-Hour Initial	YES	5/13/2005	8/1993		
8-Hour Supervisor [1,3]			6/12/2001		
8-Hour Refresher	YES	8/17/2012	4/30/2013		
First Aid/CPR [1,2]			3/20/2012		
Respirator Fit Test [1]					
Respirator Brand [1]					
Hazard Communication [1]	YES	6/9/2013	6/9/2013		
Fall Protection [1]					
Confined Space Entry [1]					
Lead Awareness					

[1] If Applicable
[2] At least one worker must be trained in First Aid/CPR and should received Bloodborne Pathogen Training
[3] Required for Field Lead and Site Health and Safety Officer
*Field Team to be determined at time field work is assigned.

Known or Suspected Contaminants (include PELs/TLVs :

Contaminants of Concern	Historical Highest Sample Data (pre-cleanup)	PEL/TLV	Fact Sheet Included
Benzene	67 ppm soil	0.5 ppm	X
Toluene	160 ppm (soil)	20 ppm	X
Ethyl Benzene	100 ppm (soil)	100 ppm	X
Xylene	140 ppm (soil)	100 ppm	X
PAHs Naphthalene	3300 ppm (soil)		X
Cyanide	423 ppm (soil)	5 mg/m3	X

Air Monitoring Action Levels:

PID/FID Reading [1]	Detector Tube [1]	Dust Meter [1]	LEL[2]/O_2 [1]	Action	Level of PPE
Above Background				Stop work, back away from work area, evaluate potential source of contamination	

[1] Sustained readings measured in the breathing zone
[2] Readings at measured at the source borehole, well, etc.

AHAs: Check and attach all that apply add applicable AHAs not already listed :
Activity and Hazard Specific AHAs:

☒	Mobilization/Demobilization and Site Preparation
☒	Field Work – General
☒	Decontamination
☒	Groundwater Sampling
☒	Sampling with a hand auger
☒	Field Oversight
☒	Geoprobe (MACTEC oversight
☒	Stream/Wetlands Work
☒	Insect Stings and Bites
☒	Working with Preservatives (Acids)
☒	Boating - Surface Water and Sediment Collection

☒	Soil Sampling
☒	Working near water
☐	
☐	
☐	
☐	
☐	
☐	
☐	
☐	
☐	

Chemicals Brought to the Site:
List all chemicals brought to the site e.g., preservatives, decontamination solutions, gasoline, etc.). Attach MSDS

Chemicals	MSDS Attached?
HYDROGEN CHLORIDE (HCL) (RESERVATIVE	☒
NITRIC ACID (PRESERVATIVE)	☒
LIQUINOX/ ALCONOX	☒
ISOBUTYLENE	☒
CALIBRATION SOLUTIONS (YSI)-PH4, PH7, DO, ORP, 1413 SPECIFIC COND.	☒
METHANOL	☒
SULFURIC ACID	☒

Chemicals will be kept in their original containers. If transferred to another container, aside from days use by one individual, the new container will be labeled with the name of the chemical and the hazard warnings.

HAZARD IDENTIFICATION SUMMARY

Complete the checklist for summarizing the hazards identified in the AHAs

Standard Hazards			
☒ Falling Objects	☒ Slips and trips	☒ Pinch points	☒ Rotating equipment
☒ Falls	☒ Power equipment/tools	☐ Elevated work surfaces	☐ ___________________

Eye Hazards			
☒ Particulates	☒ Liquid splashes	☐ Welding Arc	☐ ___________________

Hearing Hazards			
☐ None	☒ Impact noise	☐ High frequency noise	☒ High ambient noise

Respiratory Hazards						
☐ None	☒ Dust/aerosols/particulates	☐ Organic Vapors	☐ Acid Gases	☐ O_2 deficient	☐ Metals	☐ Asbestos

Chemical Hazards			
☐ None	☒ Organic solvents	☐ Reactive metals	☐ PCBs
☒ Acids / bases	☐ Oxidizers	☒ Volatiles/Semi-volatiles	☐ ____________________

Environmental Hazards				
☐ None	☒ Temperature extremes:	☒ Cold ☒ Heat	☒ Wet location	☒ Bio hazards (snakes, insects, spiders, poisonous plants, etc.)
☐ Explosive vapors	☐ Confined space		☐ Engulfment Hazard	☐ ____________________

Electrical Hazards				
☐ None	☒ Energized equipment or circuits	☒ Overhead utilities	☒ Underground utilities	☐ Wet location

Fire Hazards			
☒ None	☐ Cutting, welding, or grinding generated sparks or heat sources	☐ Flammable materials present	☐ Oxygen enriched location

Ergonomic Hazards					
☒ Lifting	☒ Bending	☐ Twisting	☒ Pulling/tugging	☐ Repetitive motion	☒ Carrying
Computer Use in the: ☐ Office ☐ Field				☐ ___________________	

Radiological Hazards						
☒ None	☐ Alpha	☐ Beta	☐ Gamma/X-rays	☐ Neutron	☐ Radon	☐ Non-Ionizing

Other Hazards
☐

PPE and Monitoring Instruments

Initial Level of PPE			
☒ Level D	☐ Modified Level D	☐ Level C	Cannot use Short Form HASP for Level B or A work

Standard PPE					
☒ Hard Hat	☒ Safety boots	☒ Safety glasses	☐ Chem. Resistant Boots	☒ High visibility vest	☐ Other:_____

Eye and Face Protection			
☐ Face shield	☐ Vented goggles	☐ Unvented goggles	☐ Indirect vented goggles

Hearing Protection			
☒ Ear plugs	☐ Ear Muffs	☐ Ear plugs and muffs	☐ Other _______________

Respiratory Protection					
☒ None	☐ Dust mask	☐ Full Face APR	☐☐ Half Face APR	Cartridge Type: _____	Change Cartridges: _____

Protective Clothing			
☒ Work uniform	☐ White uncoated Tyvek®	☐ Poly-coated Tyvek®	☐ Saranex®
☐ Boot covers	☒ Reflective vest	☐ Chaps or Snake Legs	☒ Other Optional Coveralls

Hand Protection					
☐ None	☐ Cotton gloves	☐ Leather gloves	☐ Glove liners	☐ Cut-resistant gloves	☒ Other –Nitrile Gloves
☐ Outer Gloves: List Type __________________			☐ Inner Gloves: List Type_______________		

Monitoring Instruments Required

Periodic monitoring shall be conducted when the possibility of an IDLH condition or flammable atmosphere has developed or when there is indication that exposures may have risen over permissible exposure limits or published exposure levels since prior monitoring. Situations where it shall be considered whether the possibility that exposures have risen are as follows:

- When work begins on a different portion of the site.
- When contaminants other than those previously identified are being handled.
- When a different type of operation is initiated (e.g., drum opening as opposed to exploratory well drilling.)
- When employees are handling leaking drums or containers or working in areas with obvious liquid contamination (e.g., a spill or lagoon.)

☐ LEL/O2 Meter	☐ PID: 10.0-10.6 eV Lamp ☐ 11.7 eV Lamp	☐ FID	☐ Hydrogen Sulfide/Carbon Monoxide

☐ Dräger Pump (or equivalent) List Tubes___________________	☐ Dust Meter: ☐ Respirable dust ☐ Total dust	☐ Other _______________

*Monitoring instruments will be calibrated daily in accordance with manufacturer's instructions.

PPE Selection Guidelines

When selecting the appropriate PPE for the job, consider the following:

- **Safety glasses** – general eye protection – source of hazard, typically coming from straight on, required at most sites
- **Tinted Safety Glasses** – same as above, but when working in direct sunlight. May need two both tinted and untinted if working in both sunlight and shade/overcast skys.
- **Safety goggles** – needed for splash hazard, more severe eye exposures coming from all directions. Non-vented or indirect venting for chemical splash, non-vented for hazardous gases or very fine dust, vented for larger particulates coming from all directions.
- **Face shield** – needed to protect face from cuts, burns, chemicals (corrosives or chemicals with skin notation), etc.
- **Safety boots** – needed if danger of items being dropped on foot that could injure foot
- **Hard hat** – danger from items falling on head – any overhead work, tools, equipment, etc that is above the head and could fall on head of item fails, or falls off work platform. Typically required at most sites as a general PPE
- **Thin, chemical protective inner gloves** (e.g., thin Nitrile, PVC – do not use latex – many people are allergic to latex –needed to protect hands from incidental contact with low risk contamination at very low concentrations (ppb or low ppm concentrations in groundwater or soil) or used in combination with outer gloves as a last defense against contamination. Need to specify type
- **Outer gloves** – thicker gloves (e.g., Nitrile, Butyl, Viton, etc.) – used when potential for high concentrations of contaminants e.g., floating product, percent ranges of contaminant, opening drums, handling pure undiluted chemicals, etc.). Need to specify type.
- **Leather gloves, leather palm, cotton** – good in protecting hands against cuts – no protection from chemicals. May be used in combination with chemical protective gloves.
- **Boot Covers –** when there is contamination in surface soils or waking surface in general. When safety boots need protection from contact with contaminants.
- **White (uncoated) Tyveks** – protect clothing from getting dirty, good for protection against solid, non-volatile chemicals e.g., asbestos, metals – no chemical protection.
- **Polycoated Tyveks** – least protective of chemical protective clothing. Used when some risk of contamination getting on skin or clothing. Usually, lower ppm ranges of contaminants.
- **Saranex** – Greater protection against contamination than Polycoated Tyveks. Used to protect against PCBs or higher concentrations of contaminants in the soil or groundwater.
- **Other Chemical protective clothing** – if significant risk of dermal exposure, contact H&S to determine best kind.
- **Long sleeved shirts, long pants** – if working in areas with poison ivy/oak/sumac, poisonous insects, etc. and no chemicals exposure. May want to use uncoated Tyveks for work in areas where poisonous plants are known to occur to protect clothing.
- **Cartridge Respirator (Level C PPE** – Need to calculate change schedule (contact Division EH S Manager for this to determine length of use. To be able to use cartridge respirators, need to know contaminants, estimate levels to be encountered in the breathing zone, need to ensure that cartridge will be effective against COCs, and need to be able to monitor for COCs using PID, FID, Dräger tubes, etc.. If can't do any of these, then Level B PPE is probably going to be needed.
- **High Visibility Vest** – needed for any road work with in 15 feet of a road) or when working on a site with vehicular traffic or working around heavy equipment. Needed if work tasks would take employee concentration away from movement of vehicles and workers would have to rely on the other driver's ability to see the employee in order not to hit them. This includes heavy equipment as well as cars and trucks, on public roads or the jobsite. Not needed if wearing Polycoated Tyveks – as they are already high visibility.
- **Reflective Vest** – see above, but for use at night.
- **Hearing Protection** – needed if working at noise levels above 85 dBA on a time weighted average. If noise measurements are not available, use around noisy equipment, or in general, if you have to raise your voice to be heard when talking to someone standing two feet away.
- **Protective Chaps –** required when using a machete or chain saw or any other cut hazard to legs.

Work Zones:
The work zones will be defined relative to the location of the work activity. The Exclusion Zone is considered the area within a 10-foot diameter of the sampling location. The Contamination Reduction Zone is considered to be the area with in a 20-foot diameter of the sampling location. The decontamination zone being located upwind of the work area. Work zones will be maintained through the use of:

☐ Warning Tape
☒ Visual Observations
☒ Cones and Barriers

Decontamination Procedures and Equipment:
Note: See Decontamination JHA for further information

Level D Decontamination Procedures

Decontamination Solution:	Detergent and Water
Station 1: Equipment Drop	Deposit equipment used on-site (tools, sampling devices and containers, monitoring instruments, radios, 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.
Station 2: Outer Boots, and Gloves Wash and Rinse (if worn)	Scrub outer boots, and outer gloves decon solution or detergent water. Rinse off using copious amounts of water.
Station 3: Outer Boot and Glove Removal (if worn)	Remove outer boots and gloves. Deposit in plastic bag.
Station 4: Inner glove removal	Remove inner gloves and place in plastic bag.
Station 5: Field Wash	Hands and face are thoroughly washed. Shower as soon as possible.

Modified Level D and Level C PPE Decontamination Procedures

Decontamination Solution:	Detergent and Water
Station 1: Equipment Drop	Deposit equipment used on-site (tools, sampling devices and containers, monitoring instruments, radios, 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.
Station 2: Outer Garment, Boots, and Gloves Wash and Rinse	Scrub outer boots, outer gloves, and splash suit with decon solution or detergent water. Rinse off using copious amounts of water.
Station 3: Outer Boot and Glove Removal	Remove outer boots and gloves. Deposit in container with plastic liner.
Station 4: Canister or Mask Level C only Change	If worker leaves exclusion zone to change canister (or mask , this is the last step in the decontamination procedure. Worker's canister is exchanged, new outer gloves and boot covers are donned, joints are taped, and worker returns to duty.
Station 5: Boot, Gloves and Outer Garment Removal	Boots, chemical resistant splash suit, and inner gloves are removed and deposited in separate containers lined with plastic.
Station 6: Face Piece Removal Level C only	Facepiece is removed. Avoid touching face with fingers. Facepiece is deposited on plastic sheet.
Station 7: Field Wash	Hands and face are thoroughly washed. Shower as soon as possible.

Site Communication:

☒ Verbal
☒ Two-way radio
☒ Cellular telephone
☒ Hand signals

- Hand gripping throat ---------- Out of air, can't breathe
- Grip partner's wrist or both hands around waist ---------- Leave area immediately
- Hands on top of head ---------- Need assistance
- Thumbs up ---------- OK, I am all right, I understand
- Thumbs down ---------- No, negative

☐ Horn
☐ Siren
☐ Other:

EMERGENCY CONTACTS

NAME	TELEPHONE NUMBERS		DATE OF PRE-EMERGENCY NOTIFICATION if applicable)
Fire Department:	911		
Hospital:			
Police Department:	911		
Site Health And Safety Officer: Charles Lyman	Office: 207 828-3280	Cell: 207 461-0001	
MACTEC Project Manager: Jayme Connolly	Office: 207 775-5401	Cell: 207 205-3155	
Division EH&S Manager: Cindy Sundquist	Office: 207 828-3309 Cell: (207 650-7593	Home: 207) 892-4402	
NYSDEC Project Manager: Mike McLean	Office: 518 897-1254		
OTHER: Ambulance	911		

Emergency Equipment:
The following emergency response equipment is required for this project and shall be readily available:

☒ Field First Aid Kit
☐ Fire Extinguisher ABC type)
☐ Eyewash (Note: 15 minutes of free-flowing fresh water
☐ Other: ____________________

EMERGENCY PROCEDURES

- The HSO or alternate) should be immediately notified via the on-site communication system. The HSO assumes control of the emergency response.
- The HSO notifies the Project Manager and client contact of the emergency. The HSO shall then contact the Division ES&H Manager who will then contact the Corporate EH&S Manager.
- If applicable, the HSO shall notify off-site emergency responders e.g. fire department, hospital, police department, etc.) and shall inform the response team as to the nature and location of the emergency on-site.
- If applicable, the HSO evacuates the site. Site workers should move to the predetermined evacuation point See Site Map).
- For small fires, flames should be extinguished using the fire extinguisher. Large fires should be handled by the local fire department.
- In an unknown situation or if responding to toxic gas emergencies, appropriate PPE, including SCBAs if available), should be donned. If appropriate PPE is unavailable, site workers should evacuate and call in emergency personnel.
- For chemical spills, follow the job specific JHA for spill containment
- If chemicals are accidentally spilled or splashed into eyes or on skin, use eyewash and wash affected area. Site worker should shower as soon as possible after incident.
- If a worker is injured, first aid shall be administered by certified first aid provider.
- If the emergency involves toxic gases, workers will back off and reassess. Prior to re-entering the work zone, the area must be determined to be safe. Entry will be using Level B PPE and utilize appropriate monitoring equipment to verify that the site is safe.
- An injured worker shall be decontaminated appropriately.
- After the response, the SHSO shall follow-up with the required company reporting procedures, including the completing the MACTEC Incident Analysis Report.

AMEC Early Injury Case Management Program

<table>
<tr><th>NON-EMERGENCY INCIDENT</th><th>EMERGENCY INCIDENT</th></tr>
<tr><td>Steps 1 & 2 must be completed before seeking medical attention other than local first aid.
1. Provide first-aid as necessary. Report the situation to your immediate supervisor AND HSE coordinator (all incidents with the apparent starting event should be reported within 1 hour of occurrence .
2. Injured employee:</td><td>1. Provide emergency first aid. Supervisor on duty must immediately call 911 or local emergency number; no employee may respond to outside queries without prior authorization. Any outside media calls concerning this incident must be referred immediately to Lauren Gallagher at 602-757-3211.
2. Once medical attention is sought and provided, the supervisor must:</td></tr>
<tr><th colspan="2">Call WorkCare 24/7 Hotline
888) II-XPRTS or (888 449-7787</th></tr>
<tr><td>WorkCare will assess the situation and determine whether the incident requires further medical attention. During this process, WorkCare will perform the following:
• Explain the process to the caller.
• Determine the nature of the concern.
• Provide appropriate medical advice to the caller.
• Determine appropriate path forward with the caller.
• Maintain appropriate medical confidentiality.
• Help caller to execute path forward, including referral to the appropriate local medical facility.
• Send an email notification to the Corporate HSE Department.</td><td>WorkCare will be responsible for performing the following:
• Contact the treating physician.
• Request copies of all medical records from clinic.
• Send an email update to the Corporate HSE Department.</td></tr>
<tr><td colspan="2">3. IMMEDIATELY after contacting WorkCare send a brief email notification AND inform verbally direct contact is required ONE of HSE corporate representatives See Figure 11.3.
4. Make all other local notifications and client notifications.
5. Local Supervisor, HSE Coordinator, SSHO and any applicable safety committees to complete preliminary investigation, along with the initial Incident Report within 24 hours.
6. Corporate Loss Prevention Manager to complete Worker's Compensation Insurance notifications as needed.
7. Corporate HSE to conduct further incident notifications, investigation, include in statistics, classify, and develop lessons learned materials.
- NOTE: Step 2 is only applicable to the North-American operations and to incidents involving AMEC personnel. High potential near misses, subcontractors' incidents, regulatory inspections, spills and property damages above $1,000 should be reported immediately, following directions from Step 3.</td></tr>
</table>

Site Specific Procedures are as follows:

FOLLOW THE "CAMP" in the FAP for dust and perimeter volatile monitoring.

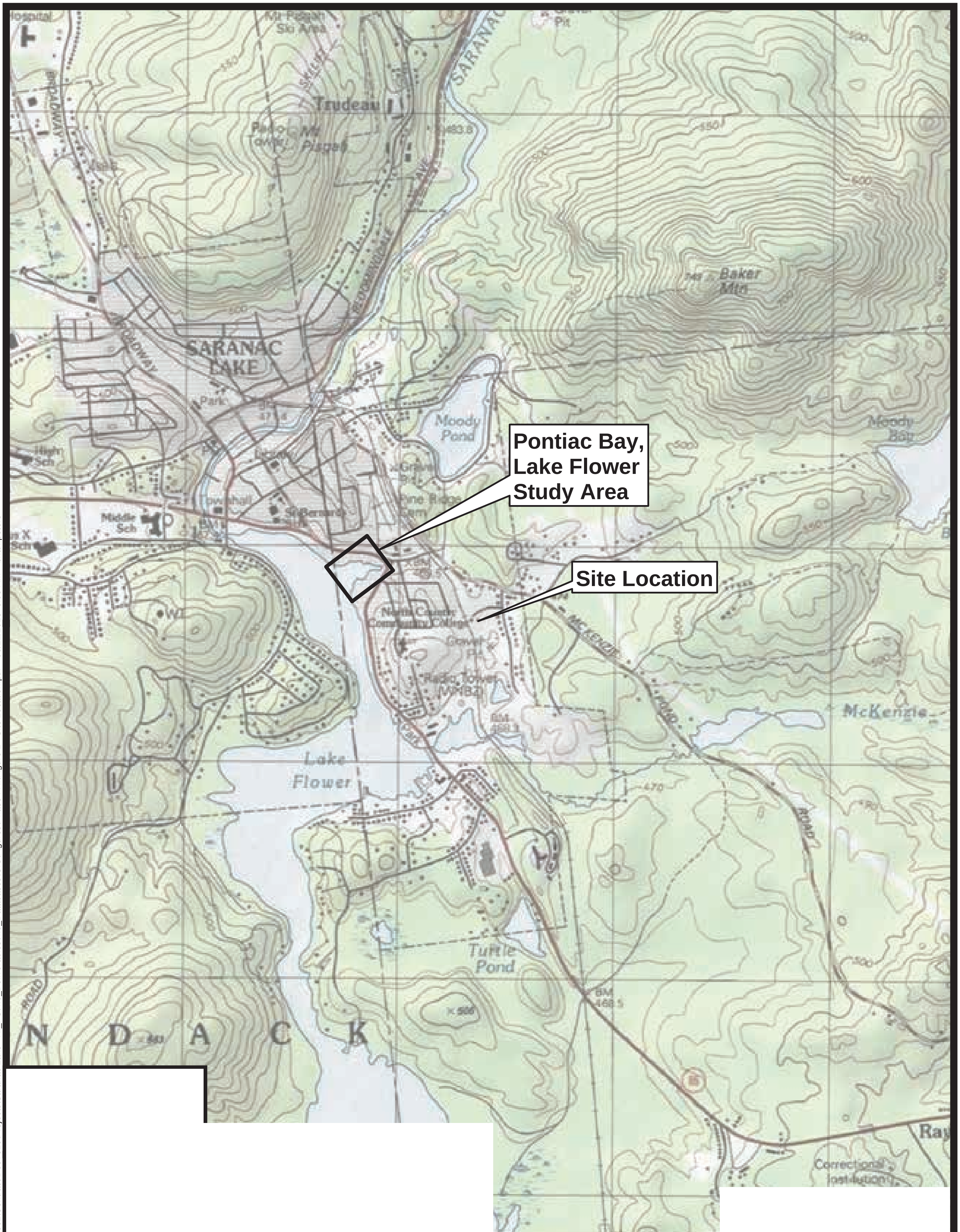
FIELD TEAM REVIEW: I acknowledge that I understand the requirements of this HASP, and agree to abide by the procedures and limitations specified herein. I also acknowledge that I have been given an opportunity to have my questions regarding the HASP and its requirements answered prior to performing field activities. Health and safety training and medical surveillance requirements applicable to my field activities at this site are current and will not expire during on-site activities.

Name: ____________________ Date: ________________

Name: ____________________ Date: ________________

Name: ____________________ Date: ________________

Name: ____________________ Date: ________________



Document: P:\Projects|nysdec1\Contract D007619\Projects\Saranac Lake - RI_FS\4.0_Deliverables\4.5_Databases\GIS\MapDocuments\SiteLocationMap.mxd
PDF: P:\Projects|nysdec1\Contract D007619\Projects\Saranac Lake - RI_FS\4.0_Deliverables\4.5_Databases\GIS\Figures\Phase I RI\Figure 1 - Site Location.pdf 06/11/2013 9:05 AM brian.peters

Routes to Emergency Medical Facilities

PRIMARY HOSPITAL:

Facility Name: Mountain Medical Urgent Care
Address: 345 Broadway, Saranac Lake New York 12983
Telephone Number: (518) 897-1000

DIRECTIONS TO PRIMARY HOSPITAL attach map : SEE ATTACHED

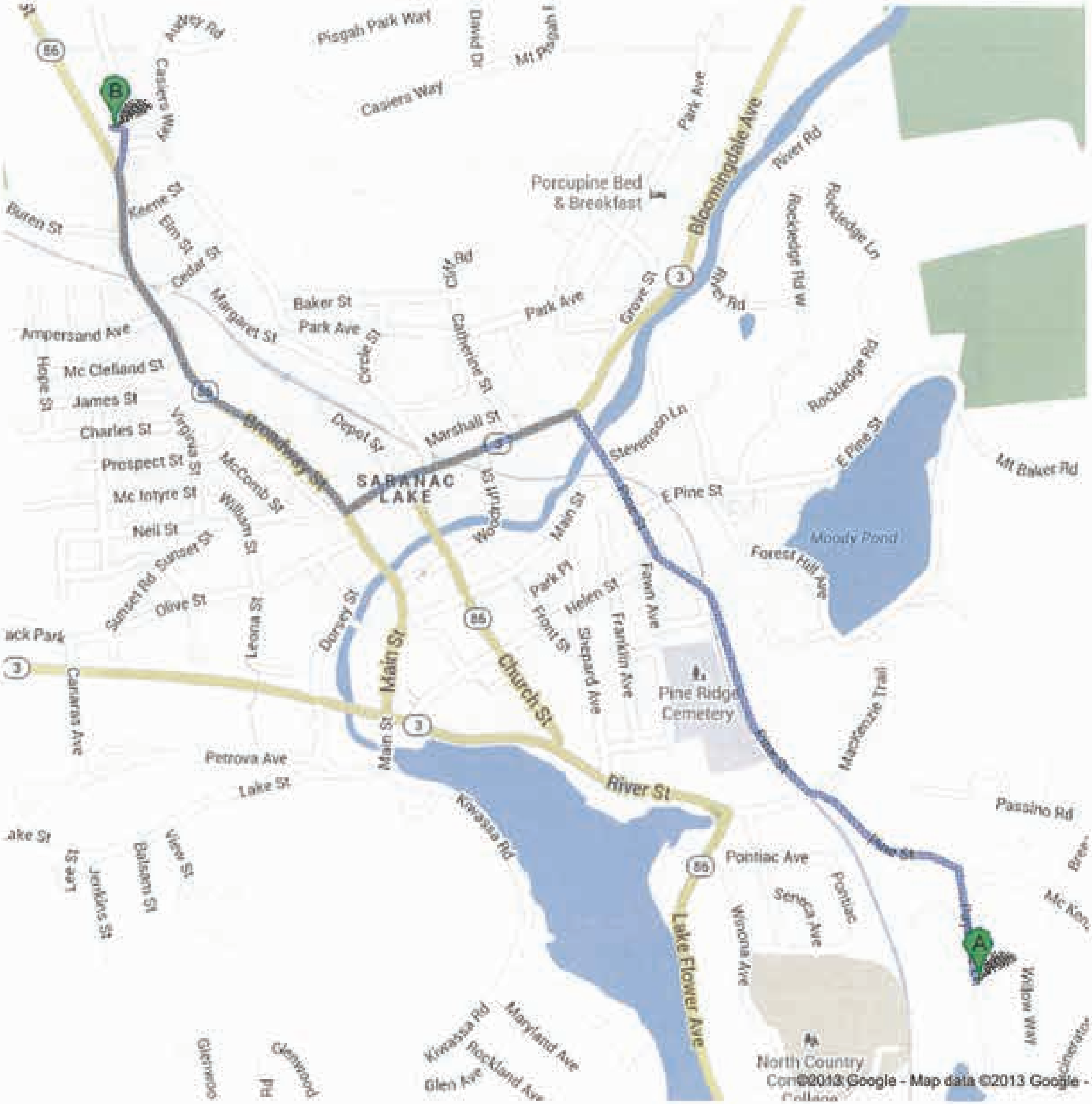
ALTERNATE HOSPITAL:

Facility Name: Adirondack Medical Center
Address: 2233 New York 86, Saranac Lake, New York 12983
Telephone Number: (518) 891-4141

DIRECTIONS TO ALTERNATE HOSPITAL (attach map): SEE ATTACHED

Google

Directions to 354 Broadway, Saranac Lake, NY 12983
2.0 mi – about 7 mins



Mountain Medical
Urgent Care
354 Broadway
Tel (518)-897-1000

Open M-F 8am-8pm
Sat/Sun 10am-6pm

24 Payeville Ln, Saranac Lake, NY 12983

1. Head **north** on **Payville Ln** toward **Adirondack Park Preserve**

go 0.2 mi
total 0.2 mi

2. Turn left onto **Pine St**
About 2 mins

go 0.9 mi
total 1.0 mi

3. Turn left onto **Bloomingdale Ave**
About 2 mins

go 0.3 mi
total 1.4 mi

4. Turn right onto **Broadway St**
About 1 min

go 0.6 mi
total 1.9 mi

5. Slight right onto **Old Lake Colby Rd**

go 305 ft
total 2.0 mi

6. Turn left
Destination will be on the right

go 92 ft
total 2.0 mi

354 Broadway, Saranac Lake, NY 12983

Google

Directions to Adirondack Medical Center
2233 New York 86, Saranac Lake, NY 12983
2.7 mi – about **8 mins**

Payeville Ln, Saranac Lake, NY 12983

1.	Head **north** on **Payeville Ln** toward **Adirondack Park Preserve**	go 0.2 mi total 0.2 mi
2.	Turn left onto **Pine St** About 2 mins	go 0.9 mi total 1.0 mi
3.	Turn left onto **Bloomingdale Ave** About 2 mins	go 0.3 mi total 1.4 mi
4.	Turn right onto **Broadway St** About 2 mins	go 1.0 mi total 2.4 mi
5.	Continue onto **NY-86 W/Lake Colby Dr** Continue to follow NY-86 W	go 0.2 mi total 2.6 mi
6.	Turn right onto **Adirondack Park** Destination will be on the right	go 0.1 mi total 2.7 mi

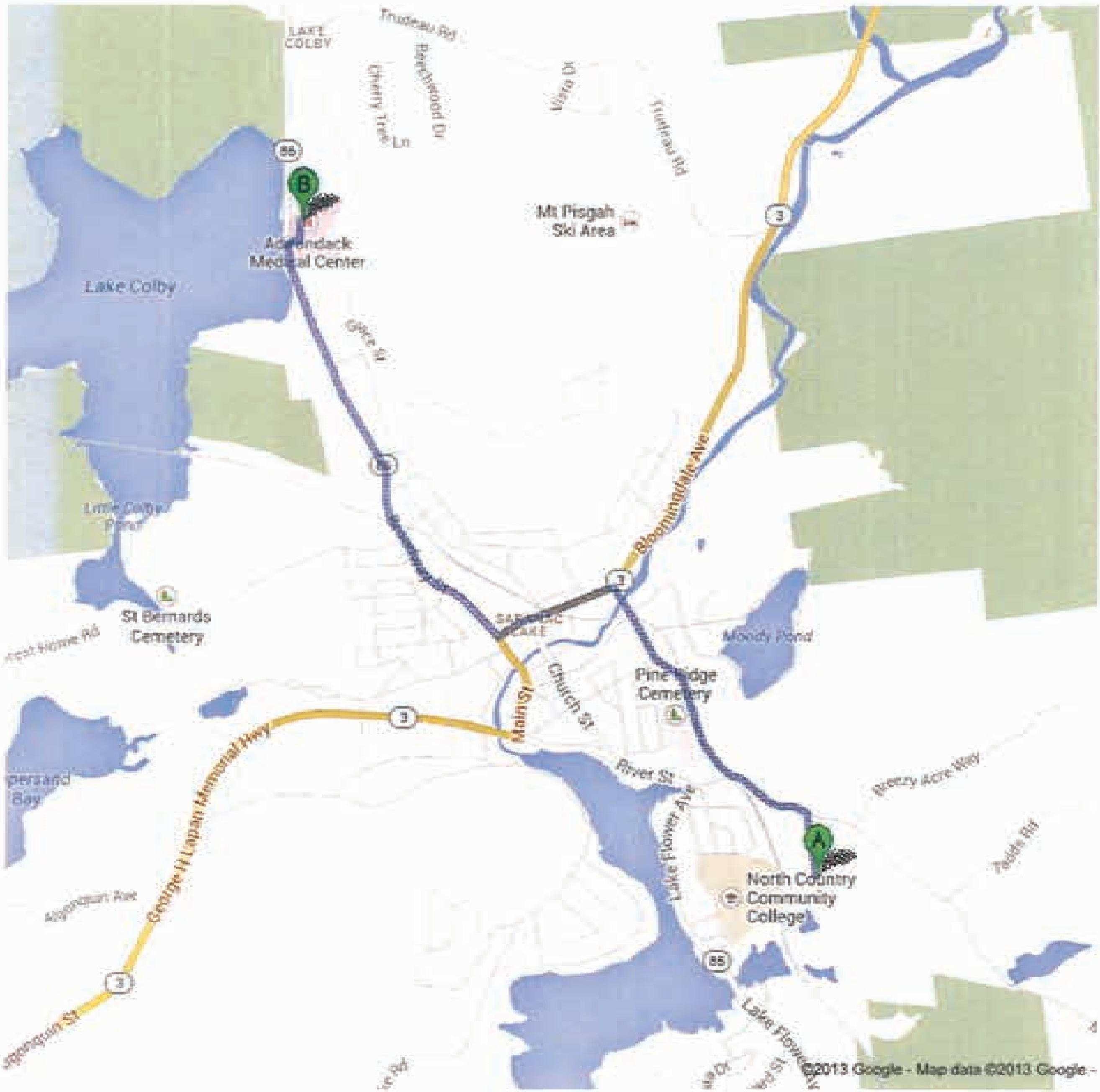
Adirondack Medical Center
2233 New York 86, Saranac Lake, NY 12983

These directions are for planning purposes only. You may find that construction projects, traffic, weather, or other events may cause conditions to differ from the map results, and you should plan your route accordingly. You must obey all signs or notices regarding your route.

Directions weren't right? Please find your route on maps.google.com and click "Report a problem" at the bottom left.

Google

Directions to Adirondack Medical Center
2233 New York 86, Saranac Lake, NY 12983
2.7 mi – about **8 mins**


Lake Colby
Adirondack Medical Center
Mt Pisgah Ski Area
Bloomingdale Ave
Little Colby Pond
St Bernards Cemetery
Moody Pond
Pine Ridge Cemetery
Main St
Church St
River St
Lake Flower Ave
George H Lapan Memorial Hwy
North Country Community College
Breezy Acre Way
Trudeau Rd
©2013 Google - Map data ©2013 Google -

Payeville Ln, Saranac Lake, NY 12983

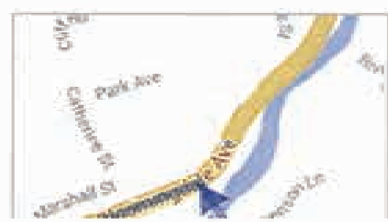
1. Head **north** on **Payeville Ln** toward **Adirondack Park Preserve**

go 0.2 mi
total 0.2 mi

2. Turn left onto **Pine St**
About 2 mins

go 0.9 mi
total 1.0 mi

3. Turn left onto **Bloomingdale Ave**
About 2 mins



go 0.3 mi
total 1.4 mi

4. Turn right onto **Broadway St**
About 2 mins

go 1.0 mi
total 2.4 mi

5. Continue onto **NY-86 W/Lake Colby Dr**
Continue to follow NY-86 W

go 0.2 mi
total 2.6 mi

6. Turn right onto **Adirondack Park**
Destination will be on the right

go 0.1 mi
total 2.7 mi

Adirondack Medical Center
2233 New York 86, Saranac Lake, NY 12983

These directions are for planning purposes only. You may find that construction projects, traffic, weather, or other events may

p results, and you should plan your route accordingly. You must obey all signs or notices regarding your route.

Directions weren't right? Please find your route on maps.google.com and click "Report a problem" at the bottom left.

DAILY TAILGATE SAFETY MEETING CHECKLIST

Project: ______________________ Site: ______________________

Date: Location:

To be reviewed on the first day of site activities and when new workers arrive on site:

Check-off:
Date

Agenda:

During the project, one or more of the agenda items could be selected for the required daily site training.

___ ___ ___ ___ ___

1. Planned work for this day (discuss ☐ ☐ ☐ ☐ ☐
2. Physical hazards and controls (discuss/review ☐ ☐ ☐ ☐ ☐
3. Chemical hazards and controls (discuss/review ☐ ☐ ☐ ☐ ☐
4. Biological hazards and controls (discuss/review ☐ ☐ ☐ ☐ ☐
5. Level of personal protective equipment: ____________ ☐ ☐ ☐ ☐ ☐
6. Personal protective equipment required per the hazard assessment: ☐ ☐ ☐ ☐ ☐

SPECIFY TYPE	
Protective coveralls	
Safety glasses/goggles	ANSI approved
Hard hat	ANSI approved
Foot protection	Safety toe boots
Work gloves	
Chemical gloves	Nitrile outer/vinyl inner
Hearing protection	
Other	

7. Review inspection and maintenance procedures and the limitations of the PPE to be used. ☐ ☐ ☐ ☐ ☐
8. Decontamination procedure (discuss/review ☐ ☐ ☐ ☐ ☐
9. Exclusion zone maintained ☐ ☐ ☐ ☐ ☐
10. Site emergency response plan (discuss/review ☐ ☐ ☐ ☐ ☐
11. Signs and symptoms of overexposure to chemicals anticipated on site ☐ ☐ ☐ ☐ ☐
12. General health and safety rules ☐ ☐ ☐ ☐ ☐
13. Specific health and safety requirements relating to site activities including: discuss/review ☐ ☐ ☐ ☐ ☐
14. Drilling/boring ☐ ☐ ☐ ☐ ☐
15. UST ☐ ☐ ☐ ☐ ☐
16. Excavations including UG utility locations) ☐ ☐ ☐ ☐ ☐
17. Heavy equipment ☐ ☐ ☐ ☐ ☐
18. Slips, trips, and falls ☐ ☐ ☐ ☐ ☐
19. Lockout/tagout ☐ ☐ ☐ ☐ ☐
20. Working in temperature extremes ☐ ☐ ☐ ☐ ☐
21. Rain or other weather advisories ☐ ☐ ☐ ☐ ☐
22. Other health safety issues discuss/note ☐ ☐ ☐ ☐ ☐

I have participated in the daily safety meeting discussing the topics indicated and fully understand my responsibility for complying with all health and safety requirements. I have had the opportunity to have my questions on site health and safety issues and procedures answered.

Employee Name	Employee Signature	Date

Incident Flow Chart

Call Immediatley

Emergency → Incident Occurs → Non-Emergency

Emergency ↓

CALL 911 Emergency → Supervisor Immediately Calls After Medical Attention is Sought and Provided → Contact Supervisor HSE Coordinator and WorkCare (24/7) Hotline (888)1-XPRTS or (888) 449-7787

Non-Emergency ↓ Contact Supervisor HSE Coordinator and WorkCare (24/7) Hotline (888)1-XPRTS or (888) 449-7787

Verbally Contact One HSE Representative Below Within 2 Hours ↓

E&I Corporate HSE Department Contact List

Name/Email	Office Location	Contact Information
Bruce Voss bruce.voss@amec.com	Catherdral City, CA	760.202.3737 (office) 951.897.6381 (cell)
Chad Barnes chad.barnes@amec.com	Phoenix, AZ	602.733.6000 (office) 480.495.9846 (cell)
Cindy Sundquist cynthia.sundquist@amec.com	Portland, ME	207.828.3309 (office) 207.650.7593 (cell) 207.892.4402 (home)
Don Kubik don.kubik@amec.com	Oakland, CA	510.663.4100 (office) 510.368.6433 (cell)
Gabe Sandholm gabe.sandholm@amec.com	Minneapolis, MN	612.252.3785 (office) 206.683.9190 (cell)
John Mazur john.mazur@amec.com	Wilmington, NC	910.452.1185 (office) 910.431.2330 (cell) 910.681.0538 (home)
Lori Dowling lori.dowling@amec.com	Prince George, BC	250.564.3243 (office)
Philip Neville philip.neville@amec.com	Thorold, ON	905.687.6616 (office) 905.380.4465 (cell)
Tim Kihn tim.kihn@amec.com	Edmonton, AB	780.944.6363 (office) 780.717.5058 (cell)
Vlad Ivensky (can call 24/7) vlad.ivesky@amec.com	Plymouth Meeting, PA	610.877.6144 (office) 484.919.5175 (cell) 215.947.0393 (home)

**High potential near misses, subcontractor incidents, regulatory inspections, spills, and property damage greater than $1000, should be reported within 60 minutes to one of the above HSE Representatives.*

Revised 17 July 2012-hb

Check one
Initial Report: ☐
Update: ☐
Final Report: ☐ ___

INCIDENT ANALYSIS REPORT

AMEC Environment & Infrastructure
Confidential - Privileged

Incident Potential
Letter: Select One
Number: Select One
Investigation Level: Select One

Group: Select One HSE Manager: ____ Incident Review Panel Team if applicable): ____

Incident Date: _____ Report Date: _____

Section 1 – General Information

Employee Name: ____ Sex: ☐ M ☐ F Date of Birth: ____ Age Range: Select One Time of incident: ____ ☐ am | ☐ pm

Job Position: Select One Hire Date: ____ Time employee began work: _____

Business Line: Select One Department Number: ____ Project Manager: ____

Project Name: ____ Project Number: ____ Client: ____

Office where employee works from: ____ Immediate Supervisor: ____ Hours employee worked during last 7 days: ____ hrs

Location: Select One Is this a Company controlled work site: ☐ Yes ☐ Incident Assigned to: Select One

Location description: ____

Section 2 – Incident Type - Process **mark at least ONE BOLD TYPE** and all that apply)

☐ **Fatality** ☐ **Environmental** ☐ **Injury/Illness Incident** If Injury/illness: Select One

☐ **Security** ☐ **Near Miss / Hazard ID** ☐ **Property Damage** If Damage: Select One ☐ 3rd Party?

☐ Hospitalization ☐ Regulatory Inspection ☐ Notice of Violation or Citation ☐ Agency Reportable?

☐ Motor Vehicle Incident Involving Injury ☐ Other (describe : ____

Outcome/Result: Select One Source of Hazard: Select One If “other”, specify: ___ Immediate Cause: Select One

A. If **injury/illness**: Indicate the part of the body: Select One If “other”, specify: ___
Indicate body part location: Select One If “other”, specify: ___
Injury Type: Select One If “other”, specify: ___ Illness Type: Select One If “other”, specify: ___

B. If **property damage**: describe what happened and estimate $ of damage to all objects involved? ___

C. If **environmental**: Type of Environmental incident?: Select One Name, CAS#, physical state and quantity? ___
Receiving Environment?: Select One Mechanism of Incident?: Select One If “other”, specify: ___
Nature of Breach?: Select One Duration of Breach?: Select One

D. If **security**: Security Incident Type: Select One If Physical: Select One If Criminal: Select One If Intellectual: Select One

E. If an **inspection by a regulatory agency**, what agency, who were the inspectors, inspector contact information? ___

Section 3 – Incident Description

Attach and number additional pages, as needed, to ensure all details related to the incident are captured.

A. List the names of all persons involved in the incident, and employer information: ____

B. List the names of any witnesses, their employer, and a local/company telephone number or address: ____

C. Name of Employee’s supervisor: ____ Contact phone number for supervisor: ____

D. What specific job/task or action was the employee(s) doing just prior to the incident: ____

E. Was a tool or equipment involved? ☐ Yes ☐ No What was it: ____ Last Inspection Date: ____Defects: ____

F. Explain in **detail** what happened: ____

G. Explain in **detail** what object or substance directly harmed the employee: ____

H. What were the weather conditions at time of incident?: ____

I. What was the lighting like at time of incident? Bright ☐ Shadows ☐ Dark ☐ Other: ____

J. List any damaged equipment or property (other than motor vehicles). Provide model and serial number **and** estimated costs to repair/replace damaged equipment or property, if applicable: ____

Section 4 - Incident Analysis

A. Was a Health and Safety Plan (HASP) or Activity Hazard Analysis (AHA) completed for the work being performed? ☐ Yes ☐ No
If "yes", Who prepared the document?: ____

B. Who and when was the last manager (Project, Unit, etc. at the site of the incident?: ____

C. When and what safety training **directly related** to the incident has the person(s) involved had?: ____

D. List attached documentation (HASP acknowledgement forms, kickoff/daily/weekly meetings, inspections, photographs): ____

Section 5 - Incident Investigation Results and Corrective Actions

This section to be completed by the Group HSE Manager/IRP with support from location where incident occurred.

Causal Factors (Acts or Omissions / Conditions)

(Attach and number any additional pages as needed to completely address this section)

	IMMEDIATE CAUSE	IMMEDIATE CAUSE SUB-TYPE	DESCRIPTION
1	Select One	_____	_____
2	Select One	_____	_____
3	Select One	_____	_____
4	Select One	_____	_____

Root Cause(s) Analysis - The below items represents major root cause categories which have been determined to be Less Than Adequate (LTA). A more detailed determination of the root cause will be facilitated, if needed, by the applicable Group HSE Manager / IRP.

	ROOT CAUSE TYPE	ROOT CAUSE SUB-TYPE	DESCRIPTION
1	Select One	_____	_____
2	Select One	_____	_____
3	Select One	_____	_____
4	Select One	_____	_____

Corrective Actions

Root Cause #	Corrective Actions Taken (Attach additional pages as needed to completely address this section)	Responsible Person	Proposed Completion Date	Closed on Date	Verified by and Date Verified
_____	____	____	____	____	____
_____	____	____	____	____	____
_____	____	____	____	____	____
_____	____	____	____	____	____
_____	____	____	____	____	____

Section 6 - Notifications, Certification & Approvals

Check the appropriate boxes indicating the applicable reports have been made to the following applicable organizations:

Auto Insurance Carrier was called ☐ **Group HSE Manager Notified** ☐

WorkCare was called ☐ **Post-incident Drug/Alcohol Testing Performed** ☐

Incident Report prepared by: ___

Employee s): ___	Date: ___	Employee’s Supervisor: ___	Date: ___
HSE Coordinator/Project/Unit Manager: ___	Date: ___	Group HSE Manager:___	Date: ___

ATTACHMENT 2

VEHICLE INCIDENT REPORT

Confidential - Privileged

Section 1 - General Information   Date of Incident: _____

Time incident occurred: _____ ☐ am | ☐ pm | Illumination: ☐ Dark ☐ Dusk ☐ Light | Road Condition: ☐ Dry ☐ Wet ☐ Icy/snow

Were police summoned to scene? ☐ Yes ☐ No   Police Department and Location: _____

Report #; _____ Officer's Name: _____ Officer's Badge Number: _____

Section 2 - Company Driver and Vehicle

Driver's name: _____ D/L #: _____ State: _____

Driver's home office address: _____ Driver's Phone #: _____

Company Vehicle #: _____ Year: _____ Model: _____ License #: _____ State: _____

Company car?: ☐ Yes ☐ No   Personal Vehicle?: ☐ Yes ☐ No   Rental Vehicle?: ☐ Yes ☐ No

If rental, rented from: _____

Passenger/Witness Name(s): _____ Address: _____ Telephone: _____

Passenger/Witness Name(s): _____ Address: _____ Telephone: _____

Damage to vehicle: _____

Was an employee injured?: ☐ Yes ☐ No   If yes, please describe: _____

Injuries to others?: ☐ Yes ☐ No   If yes, please describe: _____

Vehicle was being used for: Company business ☐ Yes ☐ No   Personal business ☐ Yes ☐ No

Towed?: ☐ Yes ☐ No   If yes, by whom?: _____ To Where?: _____

Section 3 - Other Driver and Vehicle Information

Driver's Name: _____ D/L # : _____ State: _____

Current address: _____ City: _____ State: _____

Telephone: _____ Work: _____ Cell: _____

Registered Owner's Name: _____ Address: _____ City: _____ State: _____

(verify registration document)

The Other Vehicle: Make: _____ Model: _____ Year: _____ License #: _____ State: _____

Insurance company name: _____ Address: _____ Phone #: _____

Policy No.: _____ Contact Person: _____ Phone #: _____

Passenger/Witness Name(s): _____ Address: _____ Telephone: _____

Passenger/Witness Name(s): _____ Address: _____ Telephone: _____

Damage: (*Make note of pre-existing damage and take pictures if possible – you may attach additional pages if necessary):* _____

Injuries to other driver/passengers: _____

Section 4 – Approvals (signatures required)

Form completed by (please print): _____ Date: _____

Signature: ____

Office/Project Manager (please print : _____ Date: _____

Signature: ____

Things to Do First In The Event Of a Motor Vehicle Incident

GENERAL INFORMATION

1. Do not decide on your own whether a particular incident is "covered" by insurance. Should there be any doubt, it is always preferable to report an occurrence, as this allows underwriters, the Risk Management Department and insurance adjusters to determine if a covered loss has taken place.

2. Policy Conditions do require that all losses and occurrences, which may result in a claim be promptly reported.

3. Do not admit liability or offer your opinion of liability to anyone.

4. Complete this IAR/VIR form promptly and forward with all applicable supporting documentation. It is essential both division and location information be provided.

5. For automobile collisions within the **United States**, please indicate on the IAR form that you have contacted Zurich at:

Zurich Insurance Company
1-800-987-3373 or
1-877-928-4531
24 hours a day, 7 days a week

6. For automobile collisions within **Canada**, please indicate on the IAR form that you have contacted Zurich at:

Crawford Adjusters Canada
Claims Alert
1-888-218-2346
24 hours a day, 7 days a week

The more details you have the better but, don't delay reporting if you don't have all of the information - that may be obtained later. A Zurich trained operator will answer your call and ask for all relevant information regarding the incident. The initial information required includes:

- Your division,
- Office location and division contact name – advise that you are an AMEC Company
- Name, drivers license and phone number of the driver involved in the loss
- Description of the vehicle which he/she was driving (i.e., year, make, model, license plate number, serial number
- Date, time and location of incident
- Passenger information (if applicable)
- Third party information (i.e., name, phone number, address, vehicle information, insurance information)
- If any injuries occurred (if applicable)
- Police information
- Witness information (if applicable)

Call 911 if there are serious injuries!

If you are injured or think you were injured, **contact your supervisor and call WorkCare at 888-449-7787**. Your supervisor will notify your HSE Coordinator and your Group HSE Manager. For additional instructions on what to do, go to AMEC's HSE website at:

http://ee.amecnet.com/she/sheweb/incident_reporting.htm

1. **Call for an officer if the incident occurred on public property** streets, highways or roads . Disputes often arise between the parties involved as to who was at fault; therefore, a police report is important. If an officer is unable to attend the scene of the collision, a counter police report may be filed at most stations. Insurance companies rely on police reports to determine liability.
2. **Complete the Incident Investigation Report and the Vehicle Incident Report forms**. It is important that both these forms are completed in detail. Include a diagram of the incident on the provided sheet. Incomplete information may lead to delays in processing associated claims and in helping to prevent this type of incident from occurring again.
3. **Give only information that is required by the authorities or as directed by AMEC** contractual requirements.
4. **Sign only those statements required by the authorities or as directed by AMEC** contractual requirements. Do not sign away your or the company s rights.

Vehicle Incident Diagram

This or a similar diagram must be completed with all VIRs

MACTEC, Inc.

Vehicle Crash Diagram

Instructions:

1. Number each vehicle and show directions → 1 2 ←
2. Use a solid line to show path before incident and use a dotted line to show path after inciert
   1 (before) 1 (after)
3. Show pedestrian/non-motorist by:
4. Show railroad by:
5. Indicate north by arrow as:
6. Show street or highway names or numbers
7. Show signs, signals, warning and traffic controls.

Indicate North by Arrow

Prepared by: ____________________ Date: ____________________

GROUND DISTURBANCE INCIDENT REPORT

AMEC Environment & Infrastructure

Section 1 – General Information

Employee Name: _____ Time of incident: _____ ☐ am | ☐ pm Time Reported:______☐ am | ☐ pm Report Date: _____

Project Name: _____ Project Number: _____ Client: _____

List of All Parties Present

Name	Company	Telephone No.	Role
____	____	____	____
____	____	____	____
____	____	____	____
____	____	____	____
____	____	____	____

Describe the chronological description of Incident and response:____

Section 2 – Date and Location of Event

A. *Date of Event: (MM/DD/YYYY

B. **Country** **State** **County** **City**

C. **Street address** **Nearest Intersection**

D. *Right of Way where event occurred

E. Public: ☐ City Street ☐ State Highway ☐ County Road ☐ Interstate Highway ☐ Public-Other

F. Private: ☐ Private Business ☐ Private Land Owner ☐ Private Easement

G. ☐ Pipeline ☐ Power /Transmission Line ☐ Dedicated Public Utility Easement

☐ Federal Land ☐ Railroad ☐ Data not collected ☐ Unknown/Other

List attached documentation (Public Utility Locates, Private Utility Locates, Copy of notifications submitted to Owner or other utility Owners, photographs): _____

Section 3 – Affected Facility Information

***What type of facility operation was affected?**

☐ Cable Television ☐ Electric ☐ Natural Gas ☐ Liquid Pipeline ☐ Sewer (Sanitary Sewer)

☐ Steam ☐ Telecommunications ☐ Water ☐ Unknown/Other

What type of facility was affected?

☐ Distribution ☐ Gathering ☐ Service/Drop ☐ Transmission ☐ Unknown/Other

Was the facility part of a joint trench?

☐ Unknown ☐ Yes ☐ No

Was the facility owner a member of One-Call Center?

☐ Unknown ☐ Yes ☐ No

Section 4 – Excavation Information

***Type of Excavator**

☐ Contractor ☐ County ☐ Developer ☐ Farmer ☐ Municipality ☐ Occupant
☐ Railroad ☐ State ☐ Utility ☐ Data not collected ☐ Unknown/Other

Type of Excavation Equipment

☐ Auger ☐ Backhoe/Trackhoe ☐ Boring ☐ Drilling ☐ Directional Drilling
☐ Explosives ☐ Farm Equipment ☐ Grader/Scraper ☐ Hand Tools ☐ Milling Equipment
☐ Probing Device ☐ Trencher ☐ Vacuum Equipment ☐ Data Not Collected ☐ Unknown/Other

Type of Work Performed

☐ Agriculture ☐ Cable Television ☐ Curb/Sidewalk ☐ Bldg. Construction ☐ Bldg. Demolition
☐ Drainage ☐ Driveway ☐ Electric ☐ Engineering/Survey ☐ Fencing
☐ Grading ☐ Irrigation ☐ Landscaping ☐ Liquid Pipeline ☐ Milling
☐ Natural Gas ☐ Pole ☐ Public Transit Auth. ☐ Railroad Maint. ☐ Road Work
☐ Sewer (San/Storm ☐ Site Development ☐ Steam ☐ Storm Drain/Culvert ☐ Street Light
☐ Telecommunication ☐ Traffic Signal ☐ Traffic Sign ☐ Water ☐ Waterway Improvement
☐ Data Not Collected ☐ Unknown/Other

Section 5 – Pre-Excavation Notification

***Was the One-Call Center notified?**

☐ Yes ☐ No If Yes, which One-Call Center? Ticket number:

Was Private Contract Locator used?

☐ Yes ☐ No

Section 6 – Locating and Marking

***Type of Locator**

☐ Utility Owner ☐ Contract Locator ☐ Data Not Collected

***Were facility marks visible in the area of excavation?**

☐ Yes ☐ No ☐ Data Not Collected

***Were facilities marked correctly?**

☐ Yes ☐ No ☐ Data Not Collected

What technology was used to locate utilities?

☐ Maps ☐ Active(transmitter+receiver ☐ Passive (receiver only ☐ GPR
☐ Acoustic ☐ Magnetic ☐ Infrared ☐ Unknown/Other

What Factors affected the ability to locate services?

☐ Soil Type:___________ ☐ Non-Grounded ☐ Common Bonded ☐ Depth
☐ Electromagnetic interference ☐ Parallel facilities ☐ Congested facilities ☐ Unknown/Other

Section 7 – Excavator Downtime

Did Excavator incur down time?

☐ Yes ☐ No

If yes, how much time?

☐ Unknown ☐ Less than 1 hour ☐ 1 hour ☐ 2 hours ☐ 3 or more hours Exact Value ______If

Estimated cost of down time?

☐ Unknown ☐ $0 ☐ $1 to 500 ☐ $501 to 1,000 ☐ $1,001 to 2,500 ☐ $2,501 to 5,000
☐ $5,001 to 25,000 ☐ $25,001 to 50,000 ☐ $50,001 and over Exact Value ______

Section 8 – Description of Damage

***Was there damage to a facility?**
☐ Yes ☐ No (i.e. near miss

***Did the damage cause an interruption in service?**
☐ Yes ☐ No ☐ Data Not Collected ☐ Unknown/Other

If yes, duration of interruption
☐ Unknown ☐ Less than 1 hour ☐ 1 to 2 hrs ☐ 2 to 4 hrs ☐ 4 to 8 hrs ☐ 8 to 12 hrs ☐12 to 24 hrs
☐ 1 to 2 days ☐ 2 to 3 days ☐ 3 or more days ☐ Data Not Collected Exact Value ________

Approximately how many customers were affected?
☐Unknown ☐ 0 ☐ 1 ☐ 2 to 10 ☐ 11 to 50 ☐51 or more Exact Value ________

Estimated cost of damage / repair/restoration
☐Unknown ☐ $0 ☐ $1 to 500 ☐ $501 to 1,000 ☐ $1,001 to 2,500 ☐ $2,501 to 5,000
☐ $5,001 to 25,000 ☐ $25,001 to 50,000 ☐ $50,001 and over Exact Value ______

Number of people injured
☐ Unknown ☐0 ☐ 1 ☐ 2 to 9 ☐ 10 to 19 ☐ 20 to 49 ☐ 50 to 99
☐ 100 or more Exact Value ________

Number of fatalities
☐ Unknown ☐ 0 ☐ 1 ☐ 2 to 9 ☐ 10 to 19 ☐ 20 to 49 ☐ 50 to 99
☐ 100 or more Exact Value ________

Was there a Product Release?
Product Release: ☐ No ☐ Yes ☐ N/A Type: ____ **If Yes, Incident Type is Environmental Report.**
Volume: ____ Spill Controls: ____
Repair Process: ____

Section 9 – Description of the Root Cause

Please choose one

One-Call Notification Practices Not Sufficient
☐ No notification made to the One-Call Center
☐ Notification to one-call center made, but not sufficient
☐ Wrong information provided to One Call Center

Locating Practices Not Sufficient
☐ Facility could not be found or located
☐ Facility marking or location not sufficient
☐ Facility was not located or marked
☐ Incorrect facility records/maps

Excavation Practices Not Sufficient
☐ Failure to maintain marks
☐ Failure to support exposed facilities
☐ Failure to use hand tools where required
☐ Failure to test-hole pot-hole)
☐ Improper backfilling practices
☐ Failure to maintain clearance
☐ Other insufficient excavation practices

Miscellaneous Root Causes
☐ One-Call Center error
☐ Abandoned facility
☐ Deteriorated facility
☐ Previous damage
☐ Data Not Collected
☐ Other

Section 10 - Notifications, Certification & Approvals

Check the appropriate boxes indicating the applicable reports have been made to the following applicable organizations:

One Call was called ☐ **Spills Reporting Agency Notified** ☐

Emergency Responders Fire) was called ☐ **Post-incident Drug/Alcohol Testing Performed**

List of All Agencies Contacted

Name/Agency	**Phone #**	**Date**	**Time**

Incident Report prepared by: ____

Employee s): ____	Date: ____	Employee's Supervisor: ____	Date: ____
HSE Coordinator/Project/Unit Manager: ____	Date: ____	Group HSE Manager:____	Date: ____

APPENDIX A

CONTAMINANT FACT SHEET

CONTAMINANT FACT SHEET

Chemical Name: Benzene

CAS Number: 71-43-2

Synonyms: Phenyl hydride Benzol

HEALTH HAZARD DATA

Color: Colorless

Physical State: Solid ___ Liquid X Gas ___

Odor: Aromatic

Odor Threshold 4.68 ppm

Vapor Density: 2.7 g/L

Ionization Potential IP : 9.24 eV

IDLH: 500 ppm

Carcinogen: OSHA X

IARC X

NTP ___

ACGIH X

NIOSH X

Skin absorbable: YES

Skin corrosive: No

Signs/Symptoms of Acute Exposure:

Eye, skin and nose irritation; headache, nausea, staggered gait, drowsiness, dizziness, headaches, vomiting, convulsions and unconsciousness

Source	TWA units)	STEL units)	C units)
OSHA PELs	1 ppm	5 ppm	
ACGIH TLVs	0.5 ppm	2.5 ppm	
NIOSH RELs	0.1 ppm	1 ppm	

AIR MONITORING

Type	Brand/Model No.	Calibrations Method/Media	Relative Response or Conversion Factor	Meter Specific Action Level
PID	Micro tip 10.6 eV	Isobutylene 100 ppm	1.80	0.4

Checked by: Joanne Bacchus Date: 06/04/08

PERSONAL PROTECTIVE EQUIPMENT

Recommended Protective Clothing Materials:

Suits Viton, Teflon, Barricade, CPF3, Responder Tychem

Gloves Viton, Teflon, Polyvinyl Alcohol (PVA) - do not use in water

Boots Teflon

Service Limit Concentration ppm: 1000

MUC 1/2 Mask APR = TWA x 10 = 4 ppm

MUC Full-Face APR = TWA x 50 = 20 ppm

FIRE/REACTIVITY DATA

Flash Point: 12 °F

LEL/UEL: 1.2/ 7.8%

Fire Extinguishing Media:

Dry Chemical X Foam X

Water Spray X CO_2 X

Incompatibilities:

Reacts violently with oxidizers, halogens, sulfuric acid, nitric acid

Attacks plastic and rubber.

ATTACHMENT A

CONTAMINANT FACT SHEET

CONTAMINANT FACT SHEET

Chemical Name: Toluene
CAS Number: 108-88-3
Synonyms: Methylbenzene, Methyl Benzol, Phenyl Methane Toluol

HEALTH HAZARD DATA

Color: Colorless

Physical State: Solid ___ Liquid X Gas ___

Odor: Sweet Pungent

Odor Threshold: 0.16 - 37 ppm

Vapor Density: 3.7 g/L
Vapor Pressure 21 mmHg
Ionization Potential (IP : 8.82 eV

IDLH: 500 ppm

Carcinogen: OSHA X
IARC ___
NTP ___
ACGIH ___
NIOSH X

Skin absorbable: yes X no ___
Skin corrosive: yes ___ no X

Signs/Symptoms of Acute Exposure:
Irritant to eyes and nose, dizziness, fatigue, confusion, weakness, headache dilated pupils, dermatitis, lacrimation nervousness

Source	TWA (units	STEL units	C units
OSHA PELs	200 ppm		300 ppm
ACGIH TLVs	20 ppm		
NIOSH RELs	100 ppm	150 ppm	

AIR MONITORING

Type	Brand/Model No.	Calibrations Method/Media	Relative Response or Conversion Factor	Meter Specific Action Level
PID	10.6	Isobutylene 100 ppm	1.81	18 ppm
PID	HNU 11.7 eV	Isobutylene 100 ppm	1.14	57 ppm

PERSONAL PROTECTIVE EQUIPMENT

Recommended Protective Clothing Materials:

Suits: Teflon, Viton, CPF3, PE/EVAL, Barricade, Responder, Tychem Trellchem

Gloves: Viton, Teflon Polyvinyl alcohol do not use in water

Boots: Teflon, Viton

Service Limit Concentration ppm : 1000

MUC 1/2 Mask APR = TWA x 10 181 ppm
*MUC Full-Face APR = TWA x 50 = 900 ppm

FIRE/REACTIVITY DATA

Flash Point: 40° F

LEL/UEL: 1.1% / 7.1%

Fire Extinguishing Media:
Dry Chemical X Foam X
Water Spray X CO_2 X

Incompatibilities:
Strong oxidizers

Checked by: Cindy Sundquist Date: 4/27/10

Use if conducted quantitative fit testing Portacount), otherwise use MUC for 1/2 respirator if did qualitative fit testing Irritant smoke

Note: The recommended protective clothing materials assumes that potential for direct contact (by splashing, dust inhalation, or other means) with the contaminants exists. Professional judgment and knowledge of on-site hazards should be used in selecting PPE appropriate to the concentration of the contaminant (trace vs percentage) to which the individual is likely to be exposed.

ATTACHMENT A

CONTAINMENT FACT SHEET

CONTAMINANT FACT SHEET

Chemical Name:
Ethylbenzene
CAS Number: 100-41-4
Synonyms:
Ethylbenzol,
Phenylethane

HEALTH HAZARD DATA

Color: Colorless

Physical State: Solid ___ Liquid X Gas ___

Odor: Aromatic

Odor Threshold: 0.092 - 0.6 PPM

Vapor Density: 3.66 g/L

Ionization Potential IP : 8.76 eV

IDLH: 800 ppm

Carcinogen: OSHA ___ IARC ___ NTP ___ ACGIH ___ NIOSH ___

Skin absorbable: yes ___ no X

Skin corrosive: yes ___ no ___

Signs/Symptoms of Acute Exposure:
Irritant to eyes, skin, and mucous membranes; dermatitis, and headache

Source	TWA (units	STEL units	C units
OSHA PELs	100 ppm		
ACGIH TLVs	100 ppm	125 ppm	
NIOSH RELs	100 ppm	125 ppm	

AIR MONITORING

Type	Brand/Model No.	Calibrations Method/Media	Relative Response or Conversion Factor	Meter Specific Action Level
PID	Microtip 10.6 eV	Isobutylene 100 ppm	1.63	163
PID	HNu 10.2 eV	Isobutylene 100 ppm		
FID	Foxboro TVA 1000 (10.6 eV	Methane	3.7	370

Checked by: Emmet F. Curtis Date: 12/5/03

PERSONAL PROTECTIVE EQUIPMENT

Recommended Protective Clothing Materials:

Suits: Viton, Barricade, Tychem Responder, Teflon

Gloves: Viton, teflon

Boots: Teflon

Service Limit Concentration ppm : 1000

MUC 1/2 Mask APR TWA x 10 = 500 ppm

MUC Full-Face APR TWA x 10 = 500 ppm

FIRE/REACTIVITY DATA

Flash Point: 55° F

LEL/UEL: 0.8% / 6.7%

Fire Extinguishing Media:

Dry Chemical X
Water Spray ___
Alcohol Resistant Foam X
CO_2 X

Incompatibilities:
Strong oxidizers

Note: The recommended protective clothing materials assumes that potential for direct contact (by splashing, dust inhalation, or other means) with the contaminants exists. Professional judgment and knowledge of on-site hazards should be used in selecting PPE appropriate to the concentration of the contaminant (trace vs percentage) to which the individual is likely to be exposed.

APPENDIX A

CONTAMINANT FACT SHEET

CONTAMINANT FACT SHEET

Chemical Name:
Xylene 108-38-3,
CAS Number: 95-47-6, 106-42-3
Synonyms:
Dimethylbenzene, Xylol

HEALTH HAZARD DATA

Color: Colorless

Physical State: Solid X below 56°F
Liquid X
Gas

Odor: Aromatic

Odor Threshold: 20 ppm

Vapor Density: 4.3 g/L

Ionization Potential (IP : 8.56 eV

IDLH: 900 ppm

Carcinogen: OSHA
IARC
NTP
ACGIH
NIOSH

Skin absorbable: yes ___ no X
Skin corrosive: yes ___ no X

Signs/Symptoms of Acute Exposure:
Irritant to eyes, skin, nose, throat,
dizziness, drowsiness, excitement

Source	TWA (units	STEL units	C units
OSHA PELs	100 ppm		
ACGIH TLVs	100 ppm	150 ppm	
NIOSH RELs	100 ppm	150 ppm	

AIR MONITORING

Type	Brand/Model No.	Calibrations Method/Media	Relative Response or Conversion Factor	Meter Specific Action Level
PID	Microtip 10.6 eV	Isobutylene 100 ppm	1.2	120 ppm
PID	HNu w/ 10.2 eV	Benzene 100 ppm	1.04	104 ppm

Checked by: Emmet F. Curtis Date: 12/5/03

PERSONAL PROTECTIVE EQUIPMENT

Recommended Protective Clothing Materials:

Suits: Teflon, Viton, PE/EVAL

Gloves: Teflon, Viton
Polyvinyl Alcohol (Do not use in water

Boots: Teflon, Viton

Service Limit Concentration ppm : 1000

MUC 1/2 Mask APR TWA x 10 500 ppm
MUC Full-Face APR TWA x 10 = 500 ppm

FIRE/REACTIVITY DATA

Flash Point: 81° F

LEL/UEL: 0.9% / 6.7%

Fire Extinguishing Media:
Dry Chemical X Foam X
Water Spray X CO_2 X

Incompatibilities:
Strong oxidizers
Strong Acids

Note: The recommended protective clothing materials assumes that potential for direct contact (by splashing, dust inhalation, or other means) with the contaminants exists. Professional judgment and knowledge of on-site hazards should be used in selecting PPE appropriate to the concentration of the contaminant (trace vs percentage) to which the individual is likely to be exposed.

APPENDIX A

CONTAMINANT FACT SHEET

CONTAMINANT FACT SHEET

Chemical Name: Polycyclic Aromatic Hydrocarbons

CAS Number: 12-90-00

Synonyms: Coal Tar Pitch Volatiles

CAS 65996-93-2

HEALTH HAZARD DATA

Color: Colorless

Physical State: Solid Residue ____ Liquid ____ Gas ____

Odor: NA

Odor Threshold NA

Vapor Density: >1.0 g/L

Ionization Potential IP): NA

IDLH: 80 mg/m3

Carcinogen: OSHA ____

IARC X

NTP X

ACGIH X

NIOSH X

Skin absorbable: YES

Skin corrosive: YES

Signs/Symptoms of Acute Exposure:

Dermatitis, bronchitis.

Source	TWA units)	STEL units)	C units)
OSHA PELs	0.2 mg/m3		
ACGIH TLVs	0.2 mg/m3		
NIOSH RELs	0.1 mg/m3		

AIR MONITORING

Type	Brand/Model No.	Calibrations Method/Media	Relative Resonse or Conversion Factor	Meter Specific Action Level
Dust meter **Action limit will be based on soil concentrations. Contact C. Sundquist for action limits	Any		N/A	

Checked by: Date:

PERSONAL PROTECTIVE EQUIPMENT

Recommended Protective Clothing Materials:

Suits Tyvek

Gloves Nitrile or neoprene

Boots Neoprene

Service Limit Concentration ppm): NA

MUC 1/2 Mask APR = TWA x 10 = **2 mg/m3

MUC Full-Face APR = TWA x *50 = **10 mg/m3

*If quantitative fit testing is conducted, otherwise, use protection factor of 10

**Action limit will be based on soil concentrations. Contact C. Sundquist for action limits

FIRE/REACTIVITY DATA

Flash Point: NA

LEL/UEL: NA

Fire Extinguishing Media:

Dry Chemical X Foam X

Water Spray ____ CO_2 X

Incompatibilities:

Strong Oxidizers

ATTACHMENT A

CONTAMINANT FACT SHEET

CONTAMINANT FACT SHEET

Chemical Name
Cyanide
CAS Number: 151-50-8
Synonyms:
Potassium cyanide, sodium cyanide
calcium cyanide

HEALTH HAZARD DATA

Color: white, granular, crystalline solid
Physical State: Solid X; Liquid ___; Gas ___
Odor: Almond-like odor
Odor Threshold: ___
Vapor Density: ___
Ionization Potential (IP): NA
IDLH: 25 mg/m³

Carcinogen: OSHA ___; IARC ___; NTP ___; ACGIH ___; NIOSH ___
Skin absorbable: yes X no
Skin corrosive: yes __ no ___

Signs/Symptoms of Acute Exposure
Headache; confusion; nausea; skin & eye irritation; weakness; slow gasping respiration; thyroid and blood change

Source	TWA units)	STEL units)	C units)
OSHA PEL	5 mg/m³	---	---
ACGIH TLVs	---	---	4.7 ppm 5 mg/m³
NIOSH RELs	---	---	4.7 ppm 5 mg/m³

AIR MONITORING

Type	Brand/Model No.	Calibrations Method/Media	Relative Response or Conversion Factor	Meter Specific Action Level

Checked by: Emmet F. Curtis   Date: 2/28/00

PERSONAL PROTECTIVE EQUIPMENT

Recommended Protective Clothing Materials
Suits ___
Gloves ___
Boots ___

Service Limit Concentration (ppm): NA

MUC 1/2 Mask APR=TWA x 10= 25 mg/m³
MUC Full-Face APR TWA x 10 25 mg/m³

FIRE/REACTIVITY DATA

Flash Point: NA
LEL/UEL: NA / NA

Fire Extinguishing Media
Dry Chemical X   Foam X
Water Spray X CO_2 X

Incompatibilities
Strong oxidizers, such as acids, acid salts, chlorates, and nitrates

Note: The recommended protective clothing materials assumes that potential for direct contact (by splashing, dust inhalation, or other means) with the contaminants exists. Professional judgment and knowledge of on-site hazards should be used in selecting PPE appropriate to the concentration of the contaminant (trace vs percentage) to which the individual is likely to be exposed.

* Listed here as a non-specific cyanide salt. Synonyms list possible cyanide compounds.

MACTEC

Job Hazard Analysis – HASP Format

Job Title: Mobilization/Demobilization and Site Preparation **Date of Analysis:** 8/15/06

Minimum Recommended PPE : High visibility vest, hard hat, steel-toed boots, safety glasses, hearing protection
*See HASP for all required PPE

Key Work Steps	Hazards/Potential Hazards	Safe Practices
1. Prepare for Site Visit	1A N/A	1A Prior to leaving for site ▪ Obtain and review HASP prior to site visit, if possible ▪ Determine PPE needs – bring required PPE to the site, if not otherwise being provided at the site (e.g., steel toed boots ▪ Determine training and medical monitoring needs and ensure all required Health and Safety training and medical monitoring has been received and is current ▪ Ensure all workers are fit for duty (alert, well rested, and mentally and physically fit to perform work assignment ▪ If respiratory protection is required/potentially required, ensure that training and fit-testing has occurred within the past year. ▪ Familiarize yourself with route to the site
	1B Vehicle defects	1B Inspect company owned/leased vehicle for defects such as: ▪ Flat tires ▪ Windshield wipers worn or torn ▪ Oil puddles under vehicle ▪ Headlights, brake lights, turn signals not working
	1C) Insufficient emergency equipment, unsecured loads	1C) Insufficient emergency equipment, unsecured loads ▪ Ensure vehicle has first aid kit and that all medications are current if first aid kits are not provided at the site ▪ Ensure vehicle is equpped with warning flashers and/or flares and that the warning flashers work ▪ Cell phones are recommended to call for help in the event of an emergency ▪ Vehicles carrying tools must have a safety cage in place. All tools must be properly secured ▪ Vehicles must be equipped with chocks if the vehicle is to be left running, unattended. ▪ Ensure sufficient gasoline is in the tank
2. Operating vehicles – general	2A Collisions, unsafe driving conditions	2A Drive Defensively! ▪ Seat belts must be used at all times when operating any vehicle on company business. ▪ Drive at safe speed for road conditions ▪ Maintain adequate following distance ▪ Pull over and stop if you have to look at a map ▪ Try to park so that you don't have to back up to leave. ▪ If backing in required, walk around vehicle to identify any hazards (especially low level hazards that may be difficult to see when in the vehicle) that might be present. Use a spotter if necessary
3. Driving to the jobsite	3A Dusty, winding, narrow roads	3A Dusty, winding, narrow roads ▪ Drive confidently and defensively at all times. ▪ Go slow around corners, occasionally clearing the windshield.
	3B Rocky or one-lane roads	3B Rocky or one-lane roads ▪ Stay clear of gullies and trenches, drive slowly over rocks. ▪ Yield right-of-way to oncoming vehicles---find a safe place to pull over.
	3C) Stormy weather, near confused tourists	3C) Stormy weather, near confused tourists ▪ Inquire about conditions before leaving the office. ▪ Be aware of oncoming storms. ▪ Drive to avoid accident situations created by the mistakes of others.

MACTEC

Job Hazard Analysis – HASP Format

Job Title: Mobilization/Demobilization and Site Preparation **Date of Analysis:** 8/15/06

Key Work Steps	Hazards/Potential Hazards	Safe Practices
	3D) When angry or irritated	3D) When angry or irritated ▪ Attitude adjustment; change the subject or work out the problem before driving the vehicle. Let someone else drive.
	3E Turning around on narrow roads	3E Turning around on narrow roads ▪ Safely turn out with as much room as possible. ▪ Know what is ahead and behind the vehicle. ▪ Use a backer if available.
	3F Sick or medicated	3F Sick or medicated ▪ Let others on the crew know you do not feel well. ▪ Let someone else drive.
	3G) On wet or slimy roads	3G) On wet or slimy roads ▪ Drive slow and safe, wear seatbelts.
	3H) Animals on road	3H) Animals on road ▪ Drive slowly, watch for other animals nearby. ▪ Be alert for animals darting out of wooded areas
4. Gain permission to enter site	4A Hostile landowner, livestock, pets	4A Hostile landowner, livestock, pets ▪ Talk to land owner, be courteous and diplomatic ▪ Ensure all animals have been secured away from work area
5. Mobilization/ Demobilization of Equipment and Supplies	5A Struck by Heavy Equipment/Vehicles	5A Struck by heavy equipment ▪ Be aware of heavy equipment operations. ▪ Keep out of the swing radius of heavy equipment. ▪ Ground personnel in the vicinity of heavy equipment operations will be within the view of the operator at all times ▪ Employees shall wear a high visibility vest or T-shirt (reflective vest required if working at night . ▪ Ground personnel will be aware of the counterweight swing and maintain an adequate buffer zone. ▪ Ground personnel will not stand directly behind heavy equipment when it is in operation.
	5B Struck by Equipment/Supplies	5B) Struck by Equipment/Supplies ▪ Workers will maintain proper space around their work area, if someone enters it, stop work. ▪ When entering another worker's work space, give a verbal warning so they know you are there.
	5C) Overexertion Unloading/Loading Supplies	5C) Overexertion Unloading/Loading Supplies ▪ Train workers on proper body mechanics, do not bend or twist at the waist while exerting force or lifting. ▪ Tightly secure all loads to the truck bed to avoid load shifting while in transit.
	5D) Caught in/on/between	5D) Caught in/on/between ▪ Do not place yourself between two vehicles or between a vehicle and a fixed object.
	5E Slip/Trip/Fall	5E 1E). Slip/Trip/Fall ▪ Mark all holes and low spots in area with banner tape. Instruct personnel to avoid these areas. ▪ Drivers will maintain 3 point contact when mounting/dismounting vehicles/equipment. ▪ Drivers will check surface before stepping, not jumping down.

MACTEC

Job Hazard Analysis – HASP Format

Job Title: Mobilization/Demobilization and Site Preparation **Date of Analysis:** 8/15/06

Key Work Steps	Hazards/Potential Hazards	Safe Practices
	5F Vehicle accident	5F Vehicle accident ▪ Employees should follow MACTEC vehicle operation policy and be aware of all stationary and mobile vehicles.
6. Site Preparation	6A Slip/Trip/Fall	6A Slip/Trip/Fall ▪ Mark all holes and low spots in area with banner tape. Instruct personnel to avoid these areas
7. Installation of soil erosion and sediment controls	7A Overexertion	7A Overexertion ▪ Workers will be trained in the proper method of placing erosion controls. ▪ Do not bend and twist at the waist while lifting or exerting force.
	7B Struck by Equipment/Supplies	7C) Struck by Equipment/Supplies ▪ Workers will maintain proper space around their work area, if someone enters it, stop work. ▪ When entering another worker's work space, give a verbal warning so they know you are there.
8. Driving back from the jobsite	8A See hazards listed under item #3	8A See safe work practices under item #3

Job Hazard Analysis – HASP Format

Job Title: Field Work - General **Date of Analysis:** 8/15/06

Minimum Recommended PPE : hard hat, steel-toed boots, safety glasses
*See HASP for all required PPE

Key Work Steps	Hazards/Potential Hazards	Safe Practices
1. Mobilization/ Demobilization and Site Preparation	1A See Mobilization/Demobilization and Site Preparation JHA	1A See Mobilization/Demobilization and Site Preparation JHA
2. Communication	2A Safety, crew unity	2A Talk to each other. ▪ Log all workers and visitor on and off the site. ▪ Let other crewmembers know when you see a hazard. ▪ Avoid working near known hazards. ▪ Always know the wherabouts of fellow crewmembers. ▪ Carry a radio and spare batteries or cell phone ▪ Review Emergency Evacuation Procedures see below .
3. Walking and working in the field	3A Falling down, twisted ankles and knees, poor footing	3A Always watch your footing. ▪ Horseplay is strictly prohibited ▪ Slow down and use extra caution around logs, rocks, and animal holes. ▪ Extremely steep slopes (>50%) can be hazardous under wet or dry conditions; consider an alternate route. ▪ Wear laced boots with a minimum 8" high upper and non-skid Vibram-type soles for ankle support and traction.
	3B Falling objects	3B Protect head agains falling objects. ▪ Wear your hardhat for protection from falling limbs and pinecones, and from tools and equipment carried by other crewmembers. ▪ Stay out of the woods during extremely high winds.
	3C) Chemical/Toxicological Hazards	3C) Chemical/Toxicological Hazards ▪ See HASP for appropriate level of PPE ▪ Use monitoring equipment, as outlined in HASP, to monitor breathing zone ▪ Read MSDSs for all chemicals brought to the site ▪ Be familiar with hazards associated with site contaminants. ▪ Ensure that all containers are properly labelled ▪ Decon thoroughly prior to consumption of food, beverage or tobacco.
	3D) Damage to eyes	3D) Protect eyes: ▪ Watch where you walk, ecpecially around trees and brush with limbs sticking out. ▪ Exercise caution when clearing limbs from tree trunks. Advise wearing eye protection. ▪ Ultraviolet light from the sun can be damaging to the eyes; look for sunglasses that specify significant protection from UV-A and UV-B radiation. If safety glasses require, use one's with tinted lenses
	3E Bee and wasp stings	3E See JHA for Insect Stings and Bites
	3F Ticks and infected mosquitos	3F See JHA for Insect Stings and Bites
	3G Wild Animals	3G Wild Animals ▪ Avoid phyisical contact with wild animals ▪ Do not threaten and/or conrner animals ▪ Make noise to get the animal to retreat. ▪ Stay in or return to vehicle/equipment if in danger

MACTEC

Job Hazard Analysis – HASP Format

Job Title: Field Work - General **Date of Analysis:** 8/15/06

Key Work Steps	Hazards/Potential Hazards	Safe Practices
	3H) Contact with poisonous plants or the oil from those plants:	3H) Contact with poisonous plants or the oil from those plants: ▪ Look for signs of poisonous plants and avoid. ▪ Ensure all field workers can identify the plants. Mark identified poisonous plants with spray paint if working at a fixed location. ▪ Do not allow plant to touch any part of your body/clothing. ▪ Wear PPE as described in the HASP and wear Tyveks, gloves and boot covers if contact with plant is likely ▪ Always wash gloves before removing them. ▪ Discard PPE in accordance with the HASP. ▪ Use commercially available products such as Ivy Block or Ivy Wash as appropriate.
		 POISON IVY (Rhus toxicondendron L.) POISON OAK (Rhus diversiloba) POISON SUMAC (Rhus toxicondendron vernix)
	3I Back Injuries	3I Back Injuries ▪ Site personnel will be instructed on proper lifting techniques. ▪ Mechanical devices should be used to reduce manual handling of materials. ▪ Split heavy loads in to smaller loads ▪ Team lifting should be utilized if mechanical devices are not available. ▪ Make sure that path is clear prior to lift.
	3J Shoveling	3J Shoveling ▪ Select the proper shovel for the task. A long handled, flat bladed shovel is recommend for loose material ▪ Inspect the handle for splinters and/or cracks ▪ Ensure that the blade is securely attached to the handle ▪ Never be more than 15 inches from the material you are shoveling ▪ Stand with your feet about hip width for balance and keep the shovel close to your body. ▪ Bend from the knees (not the back) and tighten your stomach muscles as you lift. ▪ Avoid twisting movements. If you need to move the snow to one side reposition your feet to face the direction the snow will be going. ▪ Avoid lifting large shoveling too much at once. When lifting heavy material, pick up less to reduce the weight lifted. ▪ Pace yourself to avoid getting out of breath and becoming fatigued too soon. ▪ Be alert for signs of stress such as pain, numbness, burning and tingling. Stop immediately if you feel any of these symptoms.
	3K Slips/Trips/Falls	3K) Slips/Trips/Falls ▪ Maintain work areas safe and orderly; unloading areas should be on even terrain; mark or repair possible tripping hazards. ▪ Site SHSO inspect the entire work area to identify and mark hazards. ▪ Maintain three points of contact when climbing ladders or onto/off of equipment

Job Hazard Analysis – HASP Format

Job Title: Field Work - General **Date of Analysis:** 8/15/06

Key Work Steps	Hazards/Potential Hazards	Safe Practices
	3L) Overhead Hazards	3L) Overhead Hazards ▪ Personnel will be required to wear hard hats that meet ANSI Standard Z89.1. ▪ All ground personnel will stay clear of suspended loads. ▪ All equipment will be provided with guards, canopies or grills to protect the operator from falling or flying objects. ▪ All overhead hazards will be identified prior to commencing work operations.
	3M Dropped Objects	3M Dropped Objects ▪ Steel toe boots meeting ANSI Standard Z41 will be worn.
	3N) Noise	3N) Noise ▪ Hearing protection will be worn with a noise reduction rating capable of maintaining personal exposure below 85 dBA (ear muffs or plugs ; all equipment will be equipped with manufacturer's required mufflers. Hearing protection shall be worn by all personnel working in or near heavy equipment.
	3O Eye Injuries	3O Eye Injuries ▪ Safety glasses meeting ANSI Standard Z87 will be worn.
	3P Heavy Equipment overhead hazards, spills, struck by or against	3P Heavy Equipment ▪ All operators will be trained and qualified to operate equipment ▪ Equipment will have seat belts. ▪ Operators will wear seat belts when operating equipment. ▪ Do not operate equipment on grades that exceed manufacturer's recommendations. ▪ Equipment will have guards, canopies or grills to protect from flying objects. ▪ Ground personnel will stay clear of all suspended loads. ▪ Personel are prohibited from riding on the buckets, or elsewhere on the equipment except for designated seats with proper seat belts or lifts specifically designed to carry workers. ▪ Ground personnel will wear high visibility vests ▪ Spill and absorbent materials will be readily available. ▪ Drip pans, polyethylene sheeting or other means will be used for secondary containment. ▪ Ground personnel will stay out of the swing radius of excavators. ▪ Eye contact with operators will be made before approaching equipment. ▪ Operator will acknowledge eye contact by removing his hands from the controls. ▪ Equipment will not be approached on blind sides. ▪ All equipment will be equipped with backup alarms and use spotters when significant physical movement of equipment occurs on-site, (i.e., other than in place excavation or truck loading). ▪ Inspect rigging prior to each use.

MACTEC

Job Hazard Analysis – HASP Format

Job Title: Field Work - General **Date of Analysis:** 8/15/06

Key Work Steps	Hazards/Potential Hazards	Safe Practices
	3Q) Struck by vehicle/equipment	3Q) Struck by vehicle/equipment ▪ Be aware of heavy equipment operations. ▪ Keep out of the swing radius of heavy equipment. ▪ Ground personnel in the vicinity of vehicles or heavy equipment operations will be within the view of the operator at all times. ▪ Ground personnel will be aware of the counterweight swing and maintain an adequate buffer zone. ▪ Ground personnel will not stand directly behind heavy equipment when it is in operation. ▪ Drivers will keep workers on foot in their vision at all times, if you lose sight of someone, Stop! ▪ Spotters will be used when backing up trucks and heavy equipment and when moving equipment. ▪ High visibility vests will be worn when workers are exposed to vehicular traffic at the site or on public roads.
	3R) Struck/cut by tools	3R) Struck/cut by tools ▪ Cut resistant work gloves will be worn when dealing with sharp objects. ▪ All hand and power tools will be maintained in safe condition. ▪ Do not drop or throw tools. Tools shall be placed on the ground or worksurface or handed to another employee in a safe manner. ▪ Guards will be kept in place while using hand and power tools.
	3S Caught in/on/between	3S Caught in/on/between ▪ Workers will not position themselves between equipment and a stationary object. ▪ Workers will not wear long hair down (place in pony-tail and tuck into shirt or jewelry if working with tools/machinery.
	3T Contact with Electricity/Lightning	3T Contact with Electricity/Lighting ▪ All electrical tools and equipment will be equipped with GFCI. ▪ Electrical extension cords will be of the “Hard” or “Extra Hard” service type. ▪ All extension cords shall have a three-blade grounding plug. ▪ Personnel shall not use extension cords with damaged outer covers, exposed inner wires, or splices. ▪ Electrical cords shall not be laid across roads where vehicular traffic may damage the cord without appropriate guarding. ▪ All electrical work will be conducted by a licensed electrician. ▪ All equipment will be locked out and tagged out and rendered in a zero energy state prior to commencing any operation that may exposed workers to electrical, mechanical, hydraulic, etc. hazards. ▪ All utilities will be marked prior to excavation activities. ▪ All equipment will stay a minimum of 10 feet from overhead energized electrical lines (50 kV). This distance will increase by 4 inches for each 10 kV above 50 kV. Rule of Thumb: Stay 10 feet away from all overhead powerlines known to be 50 kV or less and 35 feet from all others. ▪ The SHSO shall halt outdoor site operations whenever lightning is visible, outdoor work will not resume until 30 minutes after the last sighting of lightning.
	3U) Equipment failure	3U) Equipment failure ▪ All equipment will be inspected before use. If any safety problems are noted, the equipment should be tagged and removed from service until repaired or replaced.

MACTEC

Job Hazard Analysis – HASP Format

Job Title: Field Work - General **Date of Analysis:** 8/15/06

Key Work Steps	Hazards/Potential Hazards	Safe Practices
	3V Hand power tool usage.	3V Hand power tool usage ▪ Daily inspections will be performed. ▪ Ensure guards are in place and are in good condition. ▪ Remove broken or damaged tools from service. ▪ Use the tool for its intended purpose. ▪ Use in accordance with manufacturers instructions. ▪ No tampering with electrical equipment is allowed (e.g., splicing cords, cutting the grounding prong off plug, etc. ▪ See JHA for Power Tool Use - Electrical and Power Tool Use - Gasoline
	3W Fire Protection	3W Fire Protection ▪ Ensure that adequate number and type of fire extinguishers are present at the site ▪ Inspect fire extinguishers on a monthly basis – document ▪ All employees who are expected to use fire exinguishers will have received training on an annual basis. ▪ Obey no-smoking policy ▪ Open fires are prohibited ▪ Maintain good housekeeping. Keep rubbish and combustibles to a minimum. ▪ Keep flammable liquids in small containers with lids closed or a safety can. ▪ When dispensing flammable liquids, do in well vented area and bond and ground containers.
	3X Confined Space Entry	3X Confined Space Entry ▪ See JHA for Confined Space Entry

4. Environmental health considerations	4A Heat Stress	4A Take precautions to prevent heat stress
		▪ Remain constantly aware of the four basic factors that determine the degree of heat stress (air temperature, humidity, air movement, and heat radiation) relative to the surrounding work environmental heat load.
		▪ Know the signs and symptoms of heat exhaustion, heat cramps, and heat stroke. Heat stroke is a true medical emergency requiring immediate emergency response action.
		NOTE: The severity of the effects of a given environmental heat stress is decreased by reducing the work load, increasing the frequency and/or duration of rest periods, and by introducing measures which will protect employees from hot environments.
		▪ Maintain adequate water intake by drinking water periodically in small amounts throughout the day flavoring water with citrus flavors or extracts enhances palatability).
		▪ Allow approximately 2 weeks with progressive degrees of heat exposure and physical exertion for substantial acclimatization.
		▪ Acclimatization is necessary regardless of an employee's physical condition (the better one's physical condition, the quicker the acclimatization). Tailor the work schedule to fit the climate, the physical condition of employees, and mission requirements.
		  ▪ A reduction of work load markedly decreases total heat stress.
		  ▪ Lessen work load and/or duration of physical exertion the first days of heat exposure to allow gradual acclimatization.
		▪ Alternate work and rest periods. More severe conditions may require longer rest periods and electrolyte fluid replacement.

MACTEC

Job Hazard Analysis – HASP Format

Job Title: Field Work - General **Date of Analysis:** 8/15/06

Key Work Steps	Hazards/Potential Hazards	Safe Practices
	4B Wet Bulb Globe Temperature WBGT Index	4B WBGT ▪ Curtail or suspend physical work when conditions are extremely severe (see attached Heat Stress Index . ▪ Compute a Wet Bulb Globe Temperature Index to determine the level of physical activity take WBGT index measurements in a location that is similar or closely approximates the environment to which employees will be exposed). WBGT THRESHOLD VALUES FOR INSTITUTING PREVENTIVE MEASURES 80-90 degrees F: Fatigue possible with prolonged exposure and physical activity. 90-105 degrees F: Heat exhaustion and heat stroke possible with prolonged exposure and physical activity. 105-130 degrees F: Heat exhaustion and heat stroke are likely with prolonged heat exposure and physical activity.
	4C) Cold Extremes	4C) Take precautions to prevent cold stress injuries ▪ Cover all exposed skin and be aware of frostbite. While cold air will not freeze the tissues of the lungs, slow down and use a mask or scarf to minimize the effect of cold air on air passages. ▪ Dress in layers with wicking garments those that carry moisture away from the body – e.g., cotton) and a weatherproof slicker. A wool outer garment is recommended. ▪ Take layers off as you heat up; put them on as you cool down. ▪ Wear head protection that provides adequate insulation and protects the ears. ▪ Maintain your energy level. Avoid exhaustion and over-exertion which causes sweating, dampens clothing, and accelerates loss of body heat and increases the potential for hypothermia. ▪ Acclimate to the cold climate to minimize discomfort. ▪ Maintain adequate water/fluid intake to avoid dehydration.
	4D) Wind	4D) Effects of the wind ▪ Wind chill greatly affects heat loss (see attached Wind Chill Index . ▪ Avoid marking in old, defective timber, especially hardwoods, during periods of high winds due to snag hazards.
	4E Thunderstorms	4E Thunderstorms ▪ Monitor weather channels to determine if electrical storms are forcased. ▪ Plan ahead and identify safe locations to be in the event of a storm. e.g., sturdy building, vehicle, etc.) ▪ Suspend all field work at the first sound of thurnder. You should be in a safe place when the time between the lightning and thunder is less than 30 seconds. ▪ Only return to work 30 minutes after the after the last strike or sound of thunder

furnished by National Weather Service Gray, ME

Heat Index (Apparent Temperature)

Relative Humidity (%) across; Air Temperature (°F) down

°F	40	45	50	55	60	65	70	75	80	85	90	95	100
110	136												
108	130	137											
106	124	130	137										
104	119	124	131	137									
102	114	119	124	130	137								
100	109	114	118	124	129	136							
98	105	109	113	117	123	128	134						
96	101	104	108	112	116	121	126	132					
94	97	100	103	106	110	114	119	124	129	135			
92	94	96	99	101	105	108	112	116	121	126	131		
90	91	93	95	97	100	103	106	109	113	117	122	127	132
88	88	89	91	93	95	98	100	103	106	110	113	117	121
86	85	87	88	89	91	93	95	97	100	102	105	108	112
84	83	84	85	86	88	89	90	92	94	96	98	100	103
82	81	82	83	84	84	85	86	88	89	90	91	93	95
80	80	80	81	81	82	82	83	84	84	85	86	86	87

With Prolonged Exposure and/or Physical Activity

Extreme Danger
Heat stroke or sunstroke highly likely
Danger
Sunstroke, muscle cramps, and/or heat exhaustion likely
Extreme Caution
Sunstroke, muscle cramps, and/or heat exhaustion possible
Caution
Fatigue possible

Wind Chill Chart

Temperature (°F)

Wind (mph)	40	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45
Calm																		
5	36	31	25	19	13	7	1	-5	-11	-16	-22	-28	-34	-40	-46	-52	-57	-63
10	34	27	21	15	9	3	-4	-10	-16	-22	-28	-35	-41	-47	-53	-59	-66	-72
15	32	25	19	13	6	0	-7	-13	-19	-26	-32	-39	-45	-51	-58	-64	-71	-77
20	30	24	17	11	4	-2	-9	-15	-22	-29	-35	-42	-48	-55	-61	-68	-74	-81
25	29	23	16	9	3	-4	-11	-17	-24	-31	-37	-44	-51	-58	-64	-71	-78	-84
30	28	22	15	8	1	-5	-12	-19	-26	-33	-39	-46	-53	-60	-67	-73	-80	-87
35	28	21	14	7	0	-7	-14	-21	-27	-34	-41	-48	-55	-62	-69	-76	-82	-89
40	27	20	13	6	-1	-8	-15	-22	-29	-36	-43	-50	-57	-64	-71	-78	-84	-91
45	26	19	12	5	-2	-9	-16	-23	-30	-37	-44	-51	-58	-65	-72	-79	-86	-93
50	26	19	12	4	-3	-10	-17	-24	-31	-38	-45	-52	-60	-67	-74	-81	-88	-95
55	25	18	11	4	-3	-11	-18	-25	-32	-39	-46	-54	-61	-68	-75	-82	-89	-97
60	25	17	10	3	-4	-11	-19	-26	-33	-40	-48	-55	-62	-69	-76	-84	-91	-98

Frostbite Times 30 minutes 10 minutes 5 minutes

$$\text{Wind Chill (°F)} = 35.74 + 0.6215T - 35.75(V^{0.16}) + 0.4275T(V^{0.16})$$

Where, T= Air Temperature (°F) V= Wind Speed (mph)

Effective 11/01/01

Job Hazard Analysis - Short Form HASP

Job Title: Decontamination **Date of Analysis:** 5/30/06

Minimum Recommended PPE : High visibility vest, hard hat, steel-toed boots, safety glasses, hearing protection
*See HASP for all required PPE

Key Work Steps	Hazards/Potential Hazards	Safe Practices
1. Establish Decontamination Station	1A Materials Handling	1A Materials Handling ▪ Use proper lifting techniques ▪ Use mechanical aids, if available, to move heavy items.
2. Decontamination / Steam cleaning.	2A Struck by steam/hot water/pressure washing	2A Struck by steam/hot water ▪ Workers not directly engaged in steam cleaning operations must stay clear. ▪ Workers using steam cleaning equipment must be trained on operation and safety devices/procedures using the owners/operators manual. ▪ Use face shield **and** safety glasses or goggles, if steam cleaning. ▪ Stay out of the splash/steam radius. ▪ Pressure washer must have dead man switch. ▪ Do not direct steam at anyone. ▪ Do not hold objects with your feet or hands. ▪ Ensure that direction of spray minimizes spread of contaminants of concern. ▪ Use shielding as necessary.
	2B Exposure to contaminants	2B Exposure to contaminants ▪ Conduct air monitoring see HASP). ▪ Wear proper PPE (see HASP . ▪ See MSDSs for hazards associated with the decon solutions used (if other than water alone us used).
	2C Slips/Trips/Falls	2C Slips/Trips/Falls ▪ Be cautious as ground/plastic can become slippery ▪ Use boots or boot covers with good traction
3. Vehicle Decontamination	3A Vehicle traffic in and out of the CRZ	3A Large Vehicle Traffic ▪ Always wear a hard hat, steel toe boots, and a high visibility vest (unless Tyveks are used and are high visibility). ▪ Vehicle drivers are not to exit the vehicle in the CRZ. ▪ Identify an individual to communicate with vehicle drivers and maintain order ▪ Trucks will be lined with plastic and kept out of direct contact with any contaminated materials during loading. Wear PPE when removing plastic lining from truck beds. ▪ If not in the vehicle, obtain eye contact with the driver, so he is aware of your presence and location in the CRZ. ▪ If you are driving the vehicle, be aware of personnel in the CRZ and maintain communication with the identified personnel.
	3B Exposure to contaminants	3B Exposure to contaminants ▪ Use safety glasses or goggles, Polycoated Tyvek if level of contamination poses dermal hazard or to keep work clothes dry), high visibility vest (if high visibility Tyveks are not used) hard hats, steel toe boots, and gloves while cleaning contaminated materials. ▪ Do not doff PPE until decontamination of the vehicle is complete and a decontamination certificate has been issued by the HSO. ▪ Conduct air monitoring see HASP). ▪ See MSDSs for hazards associated with the decon solutions (if other than water alone is used).

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Job Hazard Analysis - Short Form HASP

Job Title: Decontamination **Date of Analysis:** 5/30/06

Key Work Steps	Hazards/Potential Hazards	Safe Practices
	3C Slips/Trips/Falls	3C Slips/Trips/Falls ▪ Be cautious as ground/plastic can become slippery ▪ Use boots or boot covers with good traction
4. Equipment and Sample Decontamination	4A Chemical exposure when handling contaminated sample jars and equipment	4A Chemical exposure ▪ Wear PPE as outlined in the HASP. ▪ Refer to MSDS for specific hazards associated with decon solutions ▪ Monitor breathing zone for contaminants ▪ Monitor breathing zone for decon solutions (e.g., methanol, hexane, etc.) if appropriate see HASP
	4B Materials Handling related injuries	4B Materials Handling related injuries ▪ Use proper lifting techniques when lifting heavy equipment ▪ Use two person lift for heavy coolers

5. Personal Decontamination	4C) Exposure to contaminants	4C) Exposure to contaminants
		▪ Avoid bringing contaminated materials via shoes and clothing into the CRZ by examining such prior to exiting the EZ.
		▪ Removal of PPE will be performed by the following tasks in the listed order:
		  ▪ Gross boot wash and rinse and removal
		  ▪ Outer glove removal
		  ▪ Suit removal
		  ▪ Respirator removal (if worn).
		  ▪ Inner glove removal
		▪ Contaminated PPE is to be placed in the appropriate, provided receptacles.
		▪ Respirators will be removed and decontaminated at a specified location within the CRZ by a designated technician, then placed in storage bag.
		▪ Employees will wash hands, face, and any other exposed areas with soap and water.
		▪ Portable eyewash stations and showers will be available should employees come into direct contact with contaminated materials.
		▪ See MSDSs for hazards associated with the decontamination solutions used.
		▪ Decon solutions will be disposed of according to the work plan.

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Job Hazard Analysis - HASP Format

Job Title: Groundwater Sampling **Date of Analysis:** 9/21/06

Minimum Recommended PPE : steel-toed boots, safety glasses, chemical resistant gloves
*See HASP for all required PPE

Key Work Steps	Hazards/Potential Hazards	Safe Practices
1. Mobilization	1A) See JHA Mobilization/Demobilization/Site Preparation	1A See JHA Mobilization/Demobilization/Site Preparation
2. General Site Hazards	2A See JHA Field Work - General	2A See JHA Field Work - General
	2B Chemical exposure	2B Chemical Exposure ▪ Read HASP and determine air monitoring and PPE needs.
3. Calibrate monitoring equipment	3A Exposure to calibration gases	3A Exposure to calibration gases ▪ Review equipment manuals ▪ Calibrate in a clean, well ventilated area
4. Opening the well cap, taking water level readings	4A Contact with poisonous plants or the oil from poisonous plants	4A Contact with poisonous plants or the oil from those plants: ▪ Look for signs of poisonous plants and avoid. ▪ Ensure all field workers can identify the plants. Mark identified poisonous plants with spray paint if working at a fixed location. ▪ Wear PPE as described in the HASP. ▪ Do not touch any part of your body/clothing. ▪ Always wash gloves before removing them. ▪ Discard PPE in accordance with the HASP. ▪ Use commercially available products such as Ivy Block or Ivy Wash as appropriate.
	4B Contact with biting insects (i.e., spiders, bees, etc.) which may have constructed a nest in the well cap/well.	4B Contact with stinging/biting insects ▪ Discuss the types of insects expected at the Site and be able to identify them. ▪ Look for signs of insects in and around the well. ▪ Wear Level of PPE as described in the HASP. At a minimum, follow guidelines in the JHA "Insects Stings and Bites." ▪ If necessary, wear protective netting over your head/face. ▪ Avoid contact with the insects if possible. ▪ Inform your supervisor and the Site Health and Safety Supervisor if you have any allergies to insects and insect bites. Make sure you have identification of your allergies with you at all times and appropriate response kits if applicable. ▪ Get medical help immediately if you are bitten by a black widow or brown recluse, or if you have a severe reaction to any spider bite or bee sting.
	4C) Exposure to hazardous Inhalation and contact with hazardous substances VOC contaminated groundwater/ soil ; liquid splash; flammable atmospheres.	4C) Exposure to hazardous substances ▪ Wear PPE as identified in HASP. ▪ Review hazardous properties of site contaminants with workers before sampling operations begin ▪ Immediately monitor breathing zone after opening well to determine exposure and verify that level of PPE is adequate – see Action Levels in HASP ▪ Monitor headspace in well. After the initial headspace reading (if required by the Work Plan), allow the well to vent for several minutes before obtaining water level and before sampling. ▪ When decontaminating equipment wear additional eye/face protection over the safety glasses such as a face shield.
	4D Back strain due to lifting bailers or pumps and from moving equipment to well locations	4D Back strain ▪ Use mechanical aids when possible, if mechanical aids are not available, use two person lifts for heavy items. ▪ Use proper lifting techniques

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Job Hazard Analysis - HASP Format

Job Title: Groundwater Sampling **Date of Analysis:** 9/21/06

Key Work Steps	Hazards/Potential Hazards	Safe Practices
	4E Foot injuries from dropped equipment	4E Foot Injuries ▪ Be aware when moving objects, ensure you have a good grip when lifting and carrying objects. ▪ Do not carry more than you can handle safely ▪ Wear Steel toed boots
5. Collecting water samples	5A Fire/Explosion/Contamination hazard from refueling generators	5A Fire/Explosion/Contamination hazard from refueling generators ▪ Turn the generator off and let it cool down before refueling ▪ Segregate fuel and other hydrocarbons from samples to minimize contamination potential ▪ Transport fuels in approved safety containers. The use of containers other than those specifically designed to carry fuel is prohibited ▪ See JHA for Gasoline use
	5B Electrocution	5B Electrocution ▪ A ground fault circuit interrupter GFCI) device must protect all AC electrical circuits. ▪ Use only correctly grounded equipment. Never use three-pronged cords which have had the third prong broken off. ▪ Make sure that the electrical cords from generators and power tools are not allowed to be in contact with water ▪ Do not stand in wet areas while operating power equipment ▪ Always make sure all electrically-powered sampling equipment is in good repair. Report any problems so the equipment can be repaired or replaced. ▪ When unplugging a cord, pull on the plug rather than the cord. ▪ Never do repairs on electrical equipment unless you are both authorized and qualified to do so.
	5C) Exposure to contaminants	5C) Exposure to Contaminants ▪ Stand up wind when sampling ▪ Monitor breathing zone with appropriate monitoring equipment see HASP) ▪ Wear chemical resistant PPE as identified in HASP ▪ See section 4C) under Safe Practices above
	5D) Infectious water born diseases	5D) Infectious water born diseases ▪ Wear chemical resistant gloves and other PPE – as identified in HASP ▪ Prevent water from contacting skin ▪ Wash exposed skin with soap and water ASAP after sampling event ▪ Ensure that all equipment is adequately decontaminated using a 10% bleach solution
	5E Exposure to water preservatives	5E Exposure to water preservatives ▪ Work in a well ventilated area, upwind of samples ▪ Wear chemical resistant PPE as identified in HASP ▪ When preserving samples always add acid to water, avoid the opposite. ▪ See JHA Working with Preservatives
	5F Slips/trips/falls	5F) Slips/trips/falls ▪ Ground can become wet/muddy, created by spilled water ▪ Place all purged water in drums for removal ▪ Wear good slip resistant footwear
	5G) Repetitive Motion and other Ergonomic Issues	5G) Ergonomic Issues ▪ Use mechanical means where possible to raise and lower equipment into well. ▪ Alternate raising and lowering equipment between field sampling team members, and alternate bailing the well. ▪ Use safe lifting techniques.

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Job Hazard Analysis - HASP Format

Job Title: Groundwater Sampling **Date of Analysis:** 9/21/06

Key Work Steps	Hazards/Potential Hazards	Safe Practices
6. Sample Processing	6A Contaminated water	6A Contaminated water ▪ Wear appropriate PPE as identified in HASP ▪ Decontaminate outside of bottles ▪ Prevent water from contacting skin ▪ Work in well ventilated area – upwind of samples ▪ Waste will be returned to the operation office for storage and disposal
7. Shipping Samples	7A Freeze burns, back strain, hazardous chemical exposure, sample leakage	7A Freeze burns, back strain, hazardous chemical exposure, sample leakage ▪ Wear appropriate chemical resistant gloves as identified in HASP. ▪ Wear leather or insulated gloves when handling dry ice. ▪ Follow safe lifting techniques – get help lifting heavy coolers. ▪ Samples that contain hazardous materials under the DOT definition, must be packaged, manifested and shipped by personnel that have the appropriate DOT HAZMAT training.

AHA – Soil Sampling w/ Hand Auger/Hand Tools

Activity/Work Task:	Soil Sampling w/ Hand Auger/Hand Tools			Overall Risk Assessment Code (RAC) (Use highest code)				M
Project Location:	**Portland, Maine**			**Risk Assessment Code (RAC) Matrix**				
Contract Number:				**Severity**	**Probability**			
Date Prepared:	**12/07/2012**	**Date Accepted:**			Frequent	Likely	Occasional	Seldom	Unlikely
Prepared by (Name/Title):	Ryan Mankowski/Env.Prof. Tech 1			Catastrophic	E	E	H	H	M
				Critical	E	H	H	M	L
Reviewed by (Name/Title):				Marginal	H	M	M	L	L
				Negligible	M	L	L	L	L

Notes: Field Notes, Review Comments, etc.

This AHA involves the following:

- Establishing site specific measures
-

This AHA is not an exhaustive summary of all hazards associated with the Site. Refer to the site HASP for additional requirements. Contractor to follow general site safety controls for Slips Trips and Falls, Biological hazards, cuts lacerations and pinch points, and emergency procedures.

Step 1: Review each **"Hazard"** with identified safety **"Controls"** and determine RAC See above)

"Probability" is the likelihood to cause an incident, near miss, or accident and identified as: Frequent, Likely, Occasional, Seldom or Unlikely.	**RAC Chart**
"Severity" is the outcome/degree if an incident, near miss, or accident did occur and identified as: Catastrophic, Critical, Marginal, or Negligible	**E = Extremely High Risk**
	H = High Risk
Step 2: Identify the RAC Probability/Severity) as E, H, M, or L for each "Hazard" on AHA. Annotate the overall highest RAC at the top of AHA.	**M = Moderate Risk**
	L = Low Risk

Job Steps	Hazards	Controls	RAC
1. Going to site, work preparation	1A Mobilization / Demobilization and Site Preparation	1A See JHA for Mobilization Demobilization and Site Preparation	H
2. Working at the site	2A General Field Work – Walking and working in the field, Environmental conditions, communication	2A See JHA for General Field Work	L

	2B Working Near Utilities	2B Working Near Utilities • See JHA for Utility Clearance Activities • See JHA for Field Work - Oversight • On private property/active facility, walk all planned locations with a appropriate representative prior to start of exploration to identify the location of marked/unmarked utilities (underground/overhead) and note any uncertainties. Field Lead should call PM and relay any issues. Document this inspection in the field book and note subcontractor's responses to any MACTEC concerns. • Coordinate with facility representatives to gain access to restricted areas. • For areas where utility locations cannot be verified, workers must hand dig for the first 3 feet • Wear appropriate PPE • If working in close proximity to live utilities (i.e. transformers), do not tamper with the units in any way and maintain safe working distance based on voltage. • If working alone, always notify other crewmembers/project team members/facility personnel of your whereabouts. • Carry a radio and spare batteries or cell phone. • Let other crewmembers know when you see a hazard.	M
3. Preparing sample location	3A Contact with poisonous plants or the oil from poisonous plants	3A Contact with Poisonous plants or oil from poisonous plants ▪ Look for signs of poisonous plants and avoid. ▪ Wear PPE as described in the HASP. ▪ Do not touch anything part of your body/clothing. ▪ Always wash gloves before removing them ▪ Discard PPE in accordance with the HASP	M

	3B Contact with biting insects (i.e., spiders, bees, etc.)	3B Contact with biting insects ▪ Discuss the types of insects expected at the Site and be able to identify them. ▪ Look for signs of insects in and around the well. ▪ Wear Level of PPE as described in the HASP. At a minimum, follow guidelines in the JHA "Insects Stings and Bites." ▪ If necessary, wear protective netting over your head/face. ▪ Avoid contact with the insects if possible. ▪ Inform your supervisor and the Site Health and Safety Supervisor if you have any allergies to insects and insect bites. Make sure you have identification of your allergies with you at all times and appropriate response kits if applicable. ▪ Get medical help immediately if you are bitten by a black widow or brown recluse, or if you have a severe reaction to any spider bite or bee sting.	M
	3C) Encounter wild/ dangerous animal	3C) Encounter wild/ dangerous animal • See JHA "Dog and Wildlife Safety"	L
	3D) Back strain due to lifting or moving equipment to sampling locations	3D) Back strain due to lifting or moving equipment to sampling locations ▪ Use mechanical aids when possible, if mechanical aids are not available, use two person lifts for heavy items. ▪ Use proper lifting techniques ▪ Split up heavy loads into smaller loads	M
	3E Foot injuries	3E Foot injuries ▪ Be aware when moving objects, ensure you have a good grip when lifting and carrying objects. ▪ Do not carry more than you can handle safely ▪ Wear steel toed boots with high tops ▪ Be observant of surroundings. Be mindful of holes and uneven terrain. Surfaces may be wet and muddy. Avoid puddles.	L
4. Hand Auguring/ Shoveling Test Holes	4A Back injury from lifting and twisting equipment	4A Back injury from lifting and twisting equipment • Use proper lifting and bending techniques. • Us 2 persons for lifting of heavy, bulky items over 50 lbs. • Use Mechanical means if available (e.g. auger jacks etc.) • Wobble auger or shovel to break suction of wet soils.	M

AHA – Soil Sampling w/ Hand Auger/Hand Tools

	4B Injuries from transporting equipment to site i.e. stumbling or falling	4B Injuries from transporting equipment to site i.e. stumbling or falling • Ensure surround are is clear of personnel and obstacles as you approach the test site. • Transport equipment in sections, beginning with equipment nearest tailgate of truck. • Use 2 person lift for heavy items • Assure pathway is clear	**M**
	4C) Injuries while adding extensions	4C) Injuries while adding extensions • Ensure that PPE is used. • Lift and connect extension with care. • Use proper lifting procedures.	**L**
	4D) Hit utilities or geo-textile membrane and contamination	4D) Hit utilities or geo-textile membrane and contamination • Locate utilities and mark. Sample in cleared area. • Use of hand tools. Be observant. Do not use excessive force. • Follow sampling work plan for location and depth.	**L**
	4E) Injury to others as equipment is removed	4E Injury to others as equipment is removed • Assure that other are standing at a safety distance before removing equipment	**L**
	4F Fingers injuries	4F Fingers injuries • Assure fingers are clear as equipment is extracted - Wear PPE (gloves, eye protection, etc). • Be aware of the type of material being removed from test hole and handle appropriately	**M**
	4G) Electrocution	4G) Electrocution • A ground fault circuit interrupter (GFCI) device must protect all AC electrical circuits. • Use only correctly grounded equipment. Never use three-pronged cords which have had the third prong broken off. • Make sure that the electrical cords from generators and power tools are not allowed to be in contact with water • Do not stand in wet areas while operating power equipment • Always make sure all electrically-powered sampling equipment is in good repair. Report any problems so the equipment can be repaired or replaced. • When unplugging a cord, pull on the plug rather than the cord. • Never do repairs on electrical equipment unless you are both authorized and qualified to do so.	**M**

AHA – Soil Sampling w/ Hand Auger/Hand Tools

5. Sample Collection	5A Exposure to contaminants	5A Exposure to Contaminants ▪ Stand up wind when sampling and do not breathe dust (if conditions are dusty ▪ Monitor breathing zone with appropriate monitoring equipment (see HASP ▪ Continually monitor soil samples for low level radiation. ▪ Wear chemical resistant PPE as identified in HASP / JHA ▪ Minimize sample contact ▪ Label sample in accordance with procedures	H
	5B Exposure to preservatives	5B Exposure to preservatives ▪ Work in a well ventilated area, upwind of samples ▪ Wear chemical resistant PPE as identified in HASP / JHA. ▪ Review MSDSs	H
	5C) Slips/trips/falls	5C) Slips/trips/falls ▪ Ground can become wet/muddy ▪ Wear good slip resistant footwear	H
	5D) Vapors and Airborne Particulates	5D) Vapors and Airborne Particulates ▪ Monitor air concentrations using direct-reading, real-time instruments (See HASP for required monitoring instruments and action limits ▪ If hazardous conditions are identified, stop work until precautions are taken ▪ Wear appropriate PPE including safety glasses with side shields, dust masks and respirators (See HASP	M
	5E Lifting Injury	5E Lifting injury ▪ Use proper lifting techniques when carrying quantities of samples ▪ Use proper ergonomics when hand digging for samples	M
	5F Eye injury	5F Eye Injury ▪ Wear eye protection during operation of Geoprobe or if misc. debris may harm your eyes.	L
	5G) Fire	5G) Have an A-B-C rated fire extinguisher on hand in case of small equipment fires. Only individuals trained in fire extinguisher use should use a fire extinguisher.	L

	5H) Sharp Sampling Tools	5H) Sharp Sampling Tools • Use correct tools for opening sleeves • When opening sleeve, cut away from body • Place soil core on sturdy surface prior to cutting	**L**
	5I Sample Cross Contamination	5I Sample Cross Contamination ▪ Decontaminate or dispose of sampling equipment between sampling locations ▪ Double-check sample labels to ensure accuracy and adhesion to containers	**M**
6. Disposal of leftover soil	6A Contamination from impacted soil	6A Properly dispose of any leftover soil sample ▪ Consult the Project Manager for proper disposal of soil. ▪ Don proper PPE when handling sample cores and disposing of soils. ▪ If soils are placed in a container (i.e. drum) properly label the drum.	**L**
7. Backfill Borehole.	7A Contamination from impacted soil and/or groundwater	7A) Minimize contact with potentially impacted soil and/or groundwater ▪ Don proper PPE when backfilling the borehole. ▪ If the borehole is located in a paved area (i.e. asphalt/concrete), carefully patch the borehole using proper patching materials.	**L**
8. Solid/Liquid Waste Management/ Disposal	8A) Contaminated Materials and Container Pinch Points	8A Contaminated Materials and Container Pinch Points ▪ Wear appropriate PPE including Nitrile and leather gloves (See HASP ▪ Position hands/fingers to avoid pinching/smashing/crushing when closing drum rings	**L**
	8B) Heavy Materials and Containers Lifting/ Moving	8B) Contaminated Materials and Container Pinch Points ▪ Do not lift or move heavy containers without assistance ▪ Use proper bending/lifting techniques by lifting with arms and legs and not with back ▪ If possible, use powered lift truck, drum cart, or other mechanical means Take breaks if feeling faint or overexerted ▪ Spot drums in storage area prior to filling ▪ Wear appropriate PPE including leather gloves and steel-toed boots	**M**
9. Demobilize	9A) See Mobilization/ Demobilization and Site Preparation JHA	9A) See Mobilization/ Demobilization and Site Preparation JHA	**H**

AHA – Soil Sampling w/ Hand Auger/Hand Tools

Equipment to be Used	Training Requirements/Competent or Qualified Personnel name(s)	Inspection Requirements
PPE Hard Hat, safety glasses, gloves, steel toe work boots, high visibility safety vest, hearing protection	**Competent / Qualified Personnel:** Name – Position/Employer **Training requirements:** List specific certification (as applicable) Site Specific HASP Orientation Toolbox safety meeting Task kick-off meeting	Daily inspection of equipment per manufacturer's instructions. Tag tools that are defective and remove from service. Inspect power cord sets prior to use. Inspect all PPE prior to use

APPENDIX F

QUALITY ASSURANCE PROJECT PLAN

FIELD ACTIVITIES PLAN
&
QUALITY ASSURANCE PROGRAM PLAN

NYSDEC ENGINEERING SERVICES CONTRACT
NUMBER D007619

Submitted to:

New York State Department of Environmental Conservation
Albany, New York

Submitted by:

MACTEC Engineering and Consulting, P.C.
Portland, Maine

June 2011
Version 1

FIELD ACTIVITIES PLAN
&
QUALITY ASSURANCE PROGRAM PLAN

NYSDEC ENGINEERING SERVICES CONTRACT
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June 2011
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William J. Weber, P.E.
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Quality Assurance Manager

TABLE OF CONTENTS

TABLE OF CONTENTS (CONTINUED)

TABLE OF CONTENTS (CONTINUED)

TABLE OF CONTENTS (CONTINUED)

LIST OF FIGURES

Figure

LIST OF FIGURES (CONTINUED)

LIST OF TABLES

Table

GLOSSARY OF ACRONYMS AND ABBREVIATIONS

ARF	Analysis Request Form
ASP	Analytical Services Protocol
ASTM	American Society for Testing and Materials
AVS	Acid Volatile Sulfide
CADD	Computer Aided Design
cc	cubic centimeter
CLP	contract laboratory program
COC	chain of custody
CS	Contract Specialist
DI	deionized
DO	dissolved oxygen
DQOs	Data Quality Objectives
DUSR	data usability summary report
EDD	electronic data deliverable
EDS	Electronic Document Standards
ELAP	Environmental Laboratory Approval Program
EM	electromagnetic
FAP	Field Activities Plan
FDR	Field Data Record
FOL	Field Operations Leader
ft	foot/feet
GIS	Geographic Information System
GPR	ground penetrating radar
GPS	Global Positioning System

GLOSSARY OF ACRONYMS AND ABBREVIATIONS (CONTINUED)

GSSI	Geophysical Survey Systems, Inc.
HASP	Health and Safety Plan
HDPE	high density polyethylene
Hg	mercury
HSA	hollow stem auger
I.D.	inside diameter
ID	identification
K	hydraulic conductivity
L	liter
LCS	laboratory control samples
LNAPL	light nonaqueous phase liquid
MACTEC	MACTEC Engineering and Consulting, P.C.
mg	milligram(s)
MGP	maximum allowable gauge pressure
ml	milliliter
MS	matrix spike
MSD	matrix spike duplicate
NAPL	nonaqueous phase liquid
NTU	nephelometric turbidity unit
NYS	New York State
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
O.D.	outside diameter

GLOSSARY OF ACRONYMS AND ABBREVIATIONS (CONTINUED)

ORP	oxidation reduction potential
oz.	ounce
PAH	polynuclear aromatic hydrocarbons
PCBs	polychlorinated biphenyls
PID	photoionization detector
PM	project manager
PPE	personal protective equipment
PS	Procurement Specialist
psi	pounds per square inch
PVC	polyvinyl chloride
QA	quality assurance
QAO	Quality Assurance Officer
QAPP	Quality Assurance Program Plan
QC	quality control
RCRA	Resource Conservation and Recovery Act
RPD	relative percent difference
RQD	rock quality data
SDG	sample delivery group
SEM	Simultaneously Extracted Metals
SOP	standard operating procedure
SOW	statement of work
SVOC	semivolatile organic compound
TAL	target analyte list
TC	terrain conductivity
TCL	Target Compound List

GLOSSARY OF ACRONYMS AND ABBREVIATIONS (CONTINUED)

TED	Technical Environmental Database
TICs	tentatively identified compounds
µg	microgram
USCS	Unified Soil Classification System
USEPA	United States Environmental Protection Agency
VOA	volatile organic analysis
VOC	volatile organic compound
WA	work assignment

1.0 PROGRAM OBJECTIVES AND DESCRIPTION

1.1 PURPOSE

The purpose of this Field Activities Plan (FAP) / Quality Assurance Program Plan (QAPP) is to define responsibilities and authorities for data quality, and to prescribe requirements for assuring that the field exploration activities undertaken by MACTEC Engineering and Consulting, P.C. (MACTEC) for the New York State Department of Environmental Conservation (NYSDEC) are planned and executed in a manner consistent with established program-wide quality assurance (QA) objectives and the Engineering Services Contract D007619.

The FAP/QAPP provides guidance and specifications to ensure that:

- samples are obtained under controlled conditions using appropriate and documented procedures;
- samples are identified uniquely and controlled through sample tracking systems and chain-of-custody (COC) protocols;
- field determinations and laboratory analytical results are of known quality and are valid and consistent through using approved methods, preventive maintenance, calibrations, analytical protocols, quality control (QC) measurements, reviews, audits, and correcting out-of-control situations;
- calculations and evaluations are accurate, appropriate, and consistent throughout the project;
- data are validated and their use in calculations is documented; and
- records are retained as documentary evidence of the quality of samples, applied processes, equipment, and results.

1.2 SCOPE

This document has been prepared in support of all work assignments issued under MACTEC's Engineering Services Contract No. D007619. The requirements of this FAP/QAPP apply to all MACTEC and subcontractor activities undertaken, unless otherwise stipulated in the project-specific FAP associated with a given Work Assignment (WA).

The organizational responsibilities and interactions outlined in Section 2 of this document extend to quality-related controls and activities. The content and format of the FAP/QAPP is based on:

- Engineering Services Contract No. D007619
- DER-10: Technical Guidance for Site Investigation and Remediation - Issued 05/03/2010, and
- *Guidance for Quality Assurance Project Plans* - *EPA QA/G-5 (EPA/240/R-02/009)* prepared by the United States Environmental Protection Agency (USEPA) (USEPA, 2002).

The FAP/QAPP consists of 15 sections, as follows:

Section 2	Program Organization and roles of the MACTEC project team
Section 3	QA objectives
Section 4	Sampling procedures
Section 5	Sample custody
Section 6	Calibration procedures
Section 7	Analytical procedures
Section 8	Data reduction, validation, and reporting
Section 9	Internal QC
Section 10	Audits
Section 11	Preventative maintenance
Section 12	Data assessment
Section 13	Corrective action
Section 14	Reports to management

Section 15 Sustainability and green remediation

1.3 CONTRACT SUMMARY

MACTEC has been retained by the NYSDEC to conduct field investigation and remedial activities at various inactive hazardous waste sites in New York State (NYS). Under the contract, work assignments are issued that may require the performance of some, or all, of the following services:

- Site Characterization
- Phased Remedial Investigation/Feasibility Study
- Remedial Design
- Engineering Services During Construction
- Analytical QA/QC Activities
- Site Response Activities / Interim Remedial Measures
- Site Management
- Citizen Participation Activities
- Health and Safety Plan (HASP) Review
- Potentially Responsible Party and Third Party Oversight
- Soil Vapor Intrusion

Particular sections of the FAP/QAPP will apply to the above work elements. Specific FAP/QAPP requirements that apply to a given work assignment will be identified in the project-specific FAP to be developed for each unique site.

2.0 PROGRAM ORGANIZATION AND RESPONSIBILITIES

2.1 ORGANIZATION

MACTEC operates using a multi-disciplinary team-based system. Under this system, personnel representing both engineering and scientific disciplines are assigned to teams and groups organized by similar client focus. The administrative personnel for the NYSDEC contract are the MACTEC Program Manager and Project Managers (PM). A Principal Professional who is responsible for project technical quality and acceptability is associated with each project and technical task. Task Leaders, Site Managers, and key technical staff are assigned to NYSDEC work assignments based on project scope and technical disciplinary needs. Resources are available from throughout the entire MACTEC organization and include engineers, QA specialists, geologists, hydrogeologists, physicists, chemists, risk assessors, and data managers. Individuals with specialized skills assigned to other teams, groups, or offices within MACTEC may join a NYSDEC project team as needed.

This portion of the FAP/QAPP addresses MACTEC's NYSDEC Program organization and specifically outlines QC coordination and responsibilities. Those individuals assigned to a project or task are responsible for conducting project work by using the resources assigned to the project management organization. In this way, resources through MACTEC are available to each project, but responsibility for initiating services and for ensuring acceptable results remains within the project organization. This responsibility carries with it the authority to initiate, modify, and stop activities, as appropriate. It is the Program Manger and Principal Professionals role to assist the PM, Task Leaders, and Site Managers in meeting project goals while providing an independent evaluation of product quality.

Figure 2.1 illustrates the overall program organization and principal lines of communication and authority.

2.2 SPECIFIC RESPONSIBILITIES

The responsibilities of the MACTEC project positions and support organizations are summarized below.

Corporate Officer. The Corporate Officer is William J. Weber, P.E. Mr. Weber is responsible for establishing a contract for the services to be performed, for committing the corporate resources necessary to conduct the program work activities, and for supplying corporate-level input for problem resolution.

Program Manager. The NYS Engineering Services Contract Program Manager is William J. Weber, P.E. The Program Manager has overall responsibility to organize and set operating procedures with NYSDEC.

Project Manager. The PM, named in the project-specific FAP, is responsible for day-to-day technical administration of the project and will be the primary contact for the NYSDEC on each Work Assignment. The PM will be responsible for:

- initiating project activities;
- identifying project staff, equipment, and other resource requirements;
- interfacing with the NYSDEC PM on all cost, contractual, personnel, and other administrative matters;
- provide program FAP/QAPP to individuals assigned to the project and ensure program procedures are followed;
- provide program generic HASP and project-specific safety documents to individuals assigned to the project and ensure program procedures are followed;
- monitoring task activities, and adjusting efforts on resources, as required, to help assure that existing budgets, schedules, and work programs are maintained;
- distributing copies of standard procedures and the project-specific planning documents (FAP) to all appropriate personnel involved in the project;
- providing regular briefings on the status of the project and preparation of monthly reports showing both technical progress and cost status;

- providing assurance that project technical and financial records are kept according to the requirements of the NYSDEC and MACTEC; and
- implementing subcontracting as required

Task Leaders and Site Managers. The Task Leaders and Site Managers are responsible for:

- the appropriateness, adequacy, and timeliness of the technical and engineering services provided;
- obtaining copies of the project-specific FAP and program FAP/QAPP, and any other applicable project planning documents, and ensuring implementation of procedures described in these documents;
- obtaining copies of the project-specific HASP and project-specific safety documents and ensuring implementation of procedures described in these document
- developing the technical approach and level of effort required to address each of task/subtask;
- the day-to-day conduct of the work, including the integration of the input of supporting disciplines and subcontractors (i.e., drilling or laboratory subcontractors);
- ongoing QC during performance of the work; and
- the technical integrity as well as the clarity and usefulness of all project work products.

Task Leaders and Site Managers will be identified in the project-specific FAP.

Principal Professional. A key component in the review process is the designation of a Principal Professional that will serve as technical leader for each project. The Principal Professional will provide guidance on the technical aspects of the project. This is accomplished through periodic reviews of the services designed to incorporate the accumulated experience and corporate policy of the firm and to meet the objectives of the program as established by NYSDEC. The Principal Professional provides input to project deliverables by conducting technical reviews while work is in progress. The Principal Professional along with the Quality Assurance Officer (QAO) serves as a resource for the PM in evaluating the magnitude of identified QC problems and supporting the development of appropriate corrective action.

Quality Assurance Officer. The QAO, Christian Ricardi, has responsibility for establishing, overseeing, and auditing specific procedures for documenting and controlling analytical and field data quality. Many of the procedures will be implemented by other individuals. The QAO works with the PM, Task Leaders, and Site Managers to verify that established MACTEC and NYSDEC protocols are followed.

Responsibilities of the QAO include:

- overseeing and coordinating analytical work;
- monitoring the QA and QC activities of the laboratory for conformance with approved policies, procedures, and sound practices, and authorize improvements as necessary;
- supervising/mentoring project staff on the preparation of data usability summary report and data validation report;
- informing the PM, Task Leaders, Site Managers, and/or subcontract laboratory management of nonconformance to the approved QC program;
- completing system audits when included in the scope of project activities;
- Reviewing project records, logs, standard procedures, project plans, and analytical results to verify records are complete and maintained in a retrievable fashion;
- distributing copies of standard procedures and the FAP/QAPP to all appropriate personnel involved in the project; and
- assuring that sampling and analysis is conducted in a manner consistent with the FAP/QAPP.

Procurement Specialist. The Procurement Specialist (PS), Peggy Franklin, aids and assists the PM, Task Leaders, and Site Managers with procuring subcontractors and subcontract terms and conditions issues.

Contract Specialist. The Contract Specialist (CS), Theresa Casavant, aids and assists the PM, Task Leaders, and Site Managers with compliance with contract terms and conditions, including cost allowability, invoicing, monitoring budgets, maintaining employee NSPE-grade lists, administering subcontracts, and meeting minority/women-owned business enterprise goals.

2.3 PERSONNEL QUALIFICATIONS AND TRAINING

Assignment of technical staff is completed by MACTEC with regard to appropriate qualifications in the technical areas relevant to the project and any associated QC techniques. This involves an assessment of individual qualifications and a resolution of training needs prior to the commencement of data generation/manipulation activities. Training typically consists of one or more of the following activities:

- general briefings covering all aspects of QA program and project plans;
- specific briefings on Program and project-specific FAPs;
- specific briefings on individual QA and QC procedures or activities;
- required reading of pertinent QA-related documents; and
- participation in USEPA-approved and other training courses.

MACTEC personnel involved with hazardous waste site investigations are required to attend an approved 40-hour health and safety course prior to working on hazardous waste sites. In addition, personnel are required to attend annual 8-hour, refresher health and safety training courses designed to review: (1) health and safety requirements and principles; (2) sampling procedures; (3) documentation procedures; (4) operational procedures; and (5) safety equipment use and function.

MACTEC will staff projects with capable, trained personnel. MACTEC typically uses a cross-section of junior-, middle-, and senior-level personnel to implement field sampling and investigation programs. By using this cross-section, personnel are placed in a position of responsibility to which they can respond.

2.4 SUPPORT SERVICES

To conduct certain WAs, MACTEC will retain subcontractors (selected considering price and technical qualifications) to perform specialized services, including sample analysis, drilling, surveying, and engineering consulting services. Before MACTEC enters into a subcontract relationship, MACTEC evaluates the potential subcontractor. Such evaluations may include visiting the subcontractors' business unit and conducting facility audits. MACTEC may conduct pre-bid meetings to explain potential tasks, site conditions that may be encountered, and the importance of each task to the project. MACTEC evaluates proposals both technically and financially, and then recommends selection to the NYSDEC.

Contract documents are thoroughly discussed with the subcontractor, and are complete and detailed, including scopes of work, payment terms and conditions, penalties for poor performance, and applicable prime contract flow down clauses. Before awarding any work, MACTEC will confirm the subcontractors' ability to accomplish the work on the required schedule. As work is to be awarded, and as it continues, MACTEC will confirm schedules and commitments. MACTEC requires periodic subcontractor progress reports (e.g., drillers' daily quantity sheets and documentation of internal technical reviews). Subcontractors must contact MACTEC if they anticipate difficulty in adhering to scope, schedule, or budget. For technical issues, the subcontractor's primary point of contact within MACTEC is the PM; for subcontract terms and conditions issues, it is the PS; and for payment issues, it is the CS. The procedural steps MACTEC follows to effect subcontractor corrective action are listed in Table 2.1.

3.0 QUALITY ASSURANCE OBJECTIVES

3.1 PROGRAM DATA QUALITY OBJECTIVES

This FAP/QAPP covers all work completed by MACTEC under the Engineering Services Contract and is applicable to site investigation activities that are completed in the State of New York. Site investigation activities will be completed in accordance with NYSDEC regulations and guidelines. Regulations and guidelines provided by the USEPA may also be applied. When planning and implementing project-specific investigations the MACTEC project team will incorporate requirements and procedures described in the following documents into their planning documents and technical evaluations of site conditions:

- DER-10 "Technical Guidance for Site Investigation and Remediation"; New York Department of Environmental Conservation; Division of Environmental Remediation; May 2010.
- 6 NYCRR PART 375 "Environmental Remediation Program"; New York Department of Environmental Conservation; Division of Environmental Remediation; October 2006.
- Title 6, Part 371 "Identification and Listing of Hazardous Wastes"; New York Codes, Rules, and Regulations; September 2006.
- Title 6, Part 700-705 "Water Quality Regulations Surface Water and Groundwater Classifications and Standards"; New York Codes, Rules, and Regulations; August 1999.
- Technical and Operational Guidance Series (TOGs) 1.1.1. "Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations"; New York Department of Environmental Conservation; Division of Water; June 1998.
- USEPA 542-S-02-001 "Ground-Water Sampling Guidelines for Superfund and Resource Conservation and Recovery Act (RCRA) project Managers"; United State Environmental Protection Agency (USEPA); Office of Solid Waste and Emergency Response; May 2002.
- "Analytical Services Protocols (ASP)"; New York Department of Environmental Conservation; June 2000; revised July 2005.
- "Guidance for Evaluating Soil Vapor Intrusion in the State of New York"; New York State Department of Health (NYSDOH); October 2006.
- "Draft Procedures for Collection and Preparation of Aquatic Biota for Contaminant Analysis"; New York State Department of Environmental Protection; Division of Fish, Wildlife, and Marine Resources; Bureau of Habitat; October 2002.

3.2 IDENTIFICATION OF PROJECT DATA QUALITY OBJECTIVES

Project Data Quality Objectives (DQOs) will be established during the development of project-specific FAPs to specify the quality of data and project specific goals for each particular data collection activity. The DQO will be established to ensure that data collected can support project-specific decisions. The DQOs are the starting point in the design of the investigation. DQOs are based on the concept that the intended use of the data determines the quality and type of the data required. DQOs are established based on site conditions, project objectives, and available measurement systems. The DQO process matches sampling and analytical capabilities to the data targeted for specific uses and ensures that the quality of the data does not underestimate project requirements.

During the development of project-specific FAPs, the guidance documents identified in Section 3.1 will be used to establish sampling and analytical testing goals. The MACTEC project team will evaluated site historical information and data, and recommend a plan for each site. Each project-specific FAP will include detailed descriptions of the following information:

- Project site description, history, and previous investigations/reports
- Site investigation objectives/goals
- Planned explorations and sampling procedures
- Summaries of proposed samples for all media at the site, as well as sample locations
- Summary of analytical methods, target analytes, and detection limits, as well as number and type of QA/QC samples
- Data quality goals for each sampling task
- Applicable standards, criteria and guidance values for groundwater, surface water, sediment, soils, and soil vapor/indoor air

3.3 ANALYTICAL DATA QUALITY LEVELS

During the development of project-specific FAPs the analytical program for field samples will be established. The plan will specify analytical methods, analyte detection limits, data reporting requirements, and data review and reporting procedures.

For the purposes of this FAP/QAPP, the data quality levels described below will be used for the NYSDEC program:

Level I - Field Screening. This level is characterized by the use of portable instrumentation that can provide real time data to assist in the optimization of sampling point locations and for health and safety monitoring. Data can be generated indicating the presence or absence of certain contaminants, especially volatiles, at sampling locations. These measurements may include hand held photoionization detector (PID) for volatile organic compounds (VOC) monitoring, and instruments used for measuring temperature, pH, specific conductance, dissolved oxygen (DO), and turbidity during water sampling. Calibration and data recording procedures for the field testing instruments are described in Section 6.

Level II - Field Analysis. This level is characterized by the use of portable analytical instruments of field test kits that can be used on-site or in mobile laboratories stationed near a site. A detailed description of field analytical procedures will be included in each project-specific FAP. Depending on the project field analysis objectives, types of contaminants, sample matrix, and analytical procedure either qualitative or quantitative data will be obtained. The data quality goal will be specified. For sampling tasks requiring quantitative results, split samples for off-site laboratory analysis will be collected to evaluate the accuracy of the field analytical data. The split sample process and data comparison goals will be identified in the FAPs.

Level III - Laboratory Analysis. Subcontract laboratory-generated data obtained using USEPA or NYSDEC-approved procedures. Laboratory services will be completed in accordance with the NYSDEC ASP. Analytical methods may include a MACTEC subcontracted lab using USEPA Contract laboratory Program (CLP) Statement of Work (SOW) methods, USEPA SW-846 (USEPA, 1996), USEPA drinking water (500 series) methods and waste water methods (600 series) [40 CFR Part 136], Methods for the Chemical Analysis of Waters and Wastes (USEPA, 1993b), Standard Method (APHA, 1998), American Society for Testing and Materials (ASTM) procedures, or other approved testing procedures. Analyses will be completed by a with the NYSDOH Environmental Laboratory Approval Program (ELAP) certification. For Level III work, a NYSDEC Data Usability Summary Report is generated as described in Section 8.

Level IV – Laboratory Analysis using CLP Routine Analytical Services. These data represent laboratory analytical results developed using a CLP contract and supported by a rigorous QA program, supporting documentation, and data validation procedures. These data are typically used to support enforcement/litigation activities. Level IV data would include CLP Target Compound List (TCL) VOCs, semivolatile organic compounds (SVOCs), pesticides/polychlorinated biphenyls (PCBs), and Target Analyte List (TAL) inorganics.

Level V - Non-standard Methods. This level is used for the analysis of non-standard sample matrices (i.e., biota, waste, etc.). The level also applies when non-conventional parameters, method-specific detection limits, or modification of existing methods are required. None standard methods will be identified and described in the project FAPs.

3.4 PRECISION, ACCURACY, REPRESENTATIVENESS, COMPLETENESS, COMPARABILITY

To establish the quality goals for analytical data, data quality refers to a degree of uncertainty with respect to precision, accuracy, representativeness, completeness, and comparability. Specific objectives for each of these characteristics are established to develop sampling protocols, and to identify applicable documentation, sample handling procedures and measurement system procedures.

3.4.1 Precision

Precision is defined as the agreement among individual measurements of the same chemical constituent in a sample, obtained under similar conditions. Field precision will be expressed as relative percent difference (RPD) of field duplicates:

$$\frac{(X_1\text{-}X_2)}{X_1 + X_2/2} \text{ x } 100 = \text{RPD}$$

where,

RPD	=	relative percent difference between duplicate results
X1 and X2	=	results of duplicate analyses
$\lvert X1 - X2 \rvert$	=	absolute difference between duplicates X1 and X2

Field duplicates take into account the level of error introduced by field sampling techniques, field conditions, and analytical variability. The RPD of field duplicates will be calculated by MACTEC in order to evaluate the sample precision.

3.4.2 Accuracy

Accuracy is defined as the degree to which the analytical measurement reflects the true concentration level present. Accuracy will be measured as percent recovery for spiked analyses including laboratory control samples (LCS), surrogates spikes, and matrix spikes.

A spike is a sample to which predetermined quantities of standard solutions of certain target analytes are added prior to sample extraction/digestion and analysis.

Accuracy can also be evaluated using the recovery of surrogate spikes in the organic analyses. These spikes consist of organic compounds which are similar to the 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, and samples prior to analysis.

Percent recoveries of the LCS, surrogate, and matrix spikes will be reported by the laboratory for all analytes associated with the samples. Variations from 100 percent recovery may be due to method extraction and analysis efficiency, matrix interferences, laboratory spike handling procedures, or sample heterogeneities between replicates. The percent recovery of the spikes can be calculated from the following equation:

$$\frac{X - B}{T} \times 100 = REC$$

where,

X	=	measured amount in sample after spiking
B	=	background amount in sample
T	=	amount of spike added

Accuracy is difficult to evaluate for the entire data collection activity, especially the sampling component. Field and trip blanks will be used in addition to the matrix and surrogate spiked samples to evaluate data accuracy in the investigations.

3.4.3 Representativeness

Representativeness expresses the degree to which sample data depict existing site conditions. Measurements will be made so that analytical results are representative of the media (e.g., soil, water, and sediments) and conditions being measured, to the extent possible. Representative data are collected by establishing standardized procedures for identification of sample locations and sampling techniques, and the collection of a sufficient number of samples. Sampling protocols are designed to collect representative samples of the media. Sample handling protocols (e.g., storage, transportation, holding time, sample preservation) are selected to protect the representativeness of the collected sample during shipment to the laboratory. Proper documentation will establish that protocols have been followed and sample identification and integrity are assured. Sample collection and handling will be in accordance with the standard procedures contained in Section 4 and Section 5.

QC blanks including laboratory method blanks and field QC blanks are also collected to determine if samples have been contaminated during sample collection or lab analysis. If evidence of sample contamination is found during data review, results for detected of contaminants may be removed from the final data set.

3.4.4 Completeness

The characteristic of completeness is a measure of the amount of valid data obtained compared to the amount that was expected. The completeness of data generated during each sampling task will be evaluated by the MACTEC project team when data review is completed and sample data are considered final. It may be impossible to collect samples that were proposed in the project FAPs due to problems encountered during the field sampling event. For example, multiple depth soil sample collection from a boring may be specified, but the boring may be terminated for technical reasons prior to reaching the specified depth. Samples may be lost or destroyed during sample handling or shipment to the laboratory. Data may be qualified during the completion of data usability summary reports (DUSR) or data validation reports described in Section 8. In some cases results may be qualified estimated (J) or rejected (R). Interpretations on missed sample location results, lost samples, and qualified data will be evaluated by the MACTEC project team after each site investigation sampling event. If data are missing from critical locations, or if qualification of data has an unacceptable impact on the usability of results relative to the project DQOs, then a decision may be made with the NYSDEC PMs to recollect samples.

3.4.5 Comparability

The characteristic of comparability reflects: (1) the internal consistency of measurements made at the site, (2) the expression of results in units consistent with other organizations reporting similar data, and (3) the confidence with which one data set can be compared to other similar measurements. The use of subcontract laboratories that have NYSDOH ELAP certification is a QA step designed to ensure that laboratories will produce chemical data that meet standards for testing for work within New York. Use of USEPA and other standard analytical methods used in the environmental testing industry provides another level of QA that results will be comparable to industry standards.

4.0 SAMPLING PROCEDURES

This section of the FAP/QAPP outlines typical field activities and sampling procedures completed at individual project sites. Specific procedures to be followed for a particular project will be referenced in the project-specific FAP. If additional sampling procedures are to be used that are not listed in this section, they will be described in detail in the project-specific FAP.

4.1 SAMPLE LABELS AND RECORDS

Sample labels will be prepared, to the extent feasible prior to initiation of work, using a computerized labeling system. Each sample may require several labels for the different containers, depending on the analysis to be performed.

Identification of samples collected during the field investigation will be accomplished with a code indicating sample type, sample identification, depth of sample (if applicable), and designation of duplicate samples. Soil, groundwater, and sediment samples will be labeled using the sample ID, as follows:

Digits 1 to 6 — Site Code - six number NYSDEC code to identify the site (http://www.dec.ny.gov/cfmx/extapps/derexternal/index.cfm?pageid=3)

Digits 7, 8 — Sample Type - two letter code to identify sample media
AA - Ambient Air Sample
BA - Basement Air Sample
BS - Test Boring Soil Sample
BW - Screened-auger Groundwater Sample
CD - Septic System/Sump Catch Basin Sludge Sample
CL - Septic System/Sump Catch Basin Liquid Sample
DL - Drum Liquid

DS - Drum Solids or Sludge

FA - First Floor Air Sample

GS - GeoProbe® Soil Sample

GV - GeoProbe® Soil Vapor Sample

GW - GeoProbe® Water Sample

IA - Indoor Air Sample

MW - Monitoring Well Groundwater Sample

PS – Pore Water Sample

PW – Private Well Sample

QD - Source Water Blank

QS - Sampler Blank (i.e., Rinsate Blank)

QT - Trip Blank

RC – Rock Chip

SD - Sediment Sample

SS - Surface Soil Sample and/or Subslab Soil Vapor Sample

SW - Surface Water

TP - Test Pit Soil Sample

TW - Test Pit Water Sample

WT - Waste Sample

Digits 9,10,11 — Horizontal Sample Locator - three numbers to identify sample location. Example: 202

Digits 12,13,14 — Depth of Sample Below Reference Surface – Example (1): 001 equals 1 foot (ft) in depth; Example (2): 025 equals 25 ft in depth.

For BS samples, the depth indicated is assumed to be the top of a 2-ft, split-spoon sample. The designation 000 will be used for BS samples collected from 0 to 2 ft below ground surface.

All samples obtained from the ground surface will be designated 000 and from drums will be designated XXX.

Digits 15/16(optional)	D - duplicate sample
	F - sample collected for field laboratory analysis or a filtered groundwater sample collected for analytical laboratory analysis
	MS - Matrix Spike
	MD - Matrix Spike Duplicate

Acceptable sample codes include 828072MW101025 (a groundwater sample collected from Erdle Perforating Site (Site Code 828072 from MW-101 at 25 ft in depth), 828072QT001 (a trip blank), and 828072BS101029 (a sample collected from soil boring BS-101 at 29 ft in depth).

At the time the sample is obtained a field data record (FDR) sheet and field logbook entries will be completed. The FDRs for specific types of sampling are discussed and illustrated in Subsections 4.4 and 4.5. The sample record documentation will include:

- a plan of the site with the sample location;
- sample label numbers;
- a description of the sample site;
- other physical descriptors of the sample site, if appropriate (e.g., stream width, groundwater depth, etc.);
- photographs of the sample site may be taken showing the sampling equipment and/or unusual conditions (orientation of photograph must be shown on sketch map, and photo number recorded in field notebook); and
- COC documentation (see Section 5).

4.2 SAMPLE CONTAINER AND PRESERVATION REQUIREMENTS

Sample integrity is maintained by using containers and preservation methods that are specific to the media sampled and analytical parameters. Sample containers and preservation methods specified in NYSDEC ASP protocols are summarized in Table 4.1. Any project-specific variation or addition to the sample containers and preservation methods outlined in this table will be specified in the project-specific FAP.

4.2.1 Preparation of Sample Containers

Sample containers will be provided by the laboratory and are pre-prepared according to USEPA protocols. QC records for the bottles used will be maintained by the laboratory.

4.2.2 Sample Preservation

Sample preservation for water samples will be completed in accordance with requirements described in the ASP Exhibit I (NYSDEC, 2005). Steps to maintain the in situ characteristics required for analysis may include storage of samples at 4 degrees Celsius, pH adjustment, and chemical fixation. Specific sample and container preservation requirements are summarized in Table 4.1 for the most commonly used methods. Holding times specified in the ASP Exhibit I are based on time of sample receipt at the laboratory. Holding times specified on Table 4.1 have been modified to begin at the time of sample collection. If pre-preserved sample containers are provided by the laboratory, extra preservation material should be available in the field in cases where additional material is needed to achieve the necessary pH.

Sample preservation and holding times for soils are based on guidelines provided in the ASP, referenced USEPA methods, or USEPA guidance documents.

Soil samples collected for VOC analysis will be preserved in the field in accordance with USEPA Method 5035 (USEPA, 1996) unless otherwise directed by the NYSDEC PMs.

4.3 DECONTAMINATION PROCEDURES

Equipment to be decontaminated during the project may include: (1) drill rig, direct push (GeoProbe®), backhoe, truck, or trailer; (2) tools; (3) monitoring equipment; and (4) sample collection equipment.

All decontamination will be done by personnel in protective gear appropriate for the level of decontamination as determined in the project-specific HASP. The project-specific FAP will designate where equipment decontamination will be performed on site (e.g., at a central decontamination station at an established site or at individual exploration locations).

4.3.1 Large Equipment

MACTEC anticipates that large equipment such as drill rigs, direct push (GeoProbe®), backhoes, trucks, and trailers may potentially be contaminated during field activities. Large equipment requiring decontamination will be cleaned with a portable, high-pressure steam cleaner. Personnel performing this activity will use the same level of health and safety personal protection required for invasive exploration activities plus splash protection.

4.3.2 Tools and Sampling Equipment

Contaminated tools and sampling equipment will be dropped into a plastic pail, tub or other container. The tools will be brushed off, rinsed, and transferred into a second pail to be carried to further decontamination stations where they will be washed with a Liquinox ®, or equivalent soap and water solution, rinsed with clean potable water, and finally rinsed with deionized water. Tools such as wrenches, split-spoons, etc., may be decontaminated between exploration locations with a high-pressure steam cleaner instead of washing. Sampling equipment, such as bailers, will be wrapped in aluminum foil after cleaning to prevent contamination before next use.

4.3.3 Monitoring Equipment

When monitoring equipment is being used under conditions where it may become contaminated, the equipment will be protected as much as possible from contamination by draping, masking or otherwise covering as much of the instrument as possible with plastic without hindering the operation of the unit. For example, the PID can be placed in a clear plastic bag which allows reading of the scale and operation of the knobs. The sensor on the PID can be partially wrapped, keeping the sensor tip and discharge port clear.

Any contaminated equipment will be taken from the drop area and the protective coverings removed and disposed of in the appropriate containers. Any direct or obvious contamination will be brushed or wiped with a disposable paper wipe. The units will then be wiped off with damp disposable wipes and dried. The units will be checked, standardized, and recharged, as necessary, for the next day's operation. They will then be prepared with new protective coverings.

4.3.4 Sample Handling/Shipping Areas

Sample containers will be wiped clean at the sample site, taken to the decontamination area to be further cleaned, as necessary, and transferred to a clean carrier. The samples will be checked off against the COC record. The samples will then be stored on ice in a secure area prior to shipment.

Sample handling areas will be cleaned/wiped down daily using disposable wipes. Disposable wipes will not be used on any equipment that comes in contact with samples. For final cleanup, all equipment will be disassembled and decontaminated. Any equipment which cannot be satisfactorily decontaminated will be disposed (e.g., glassware, covers for surfaces).

The management of disposal of liquid and solid wastes generated during decontamination is presented in Subsection 4.9.

4.4 FIELD INVESTIGATION TECHNIQUES AND PROCEDURES

Prior to any investigation activities, MACTEC and the contracted subcontractor, if applicable, will work closely with the NYSDEC, the Site property owner, the neighboring property owners, and utility companies to obtain access to the exploration locations and clear utility lines.

4.4.1 Utility Clearance

Subsurface sampling will require the clearing of underground utilities. Once boring locations have been identified, they will be marked in the field with white paint, flags, or stakes and One Call (Dig-Safely New York) will be notified by the subcontractor performing the work (at least three days prior to the field work). The list of utilities that are members of the One Call System should be identified, and the municipality of the project site called to determine if there are any other utilities in the area that are not covered. Any additional utilities identified should be contacted directly to request clearance. A list of contacted utilities and their responses will be maintained in the field and responses for each utility contacted should be documented.

Prior to starting intrusive work, locations will be visited and reviewed for proper markings. If a utility did not respond saying they have no utilities in the area and the locations are not marked, then the utility will be contacted directly for clearance prior to performing any intrusive work.

The chart below shows the color system used by the utilities for marking and identifying the various types of utilities potentially present.

	WHITE - Proposed Excavation
	PINK - Temporary Survey Markings
	RED - Electric Power Lines, Cables, Conduit and Lighting Cables
	YELLOW - Gas, Oil, Steam, Petroleum or Gaseous Materials
	ORANGE - Communication, Alarm or Signal Lines, Cables or

	Conduit
	BLUE - Potable Water
	PURPLE - Reclaimed Water, Irrigation and Slurry Lines
	GREEN - Sewers and Drain Lines

All discussions with utilities and subcontractors with respect to utility clearance will be documented in the field log book. If the excavation will cause the removal or disturbance of markings, offset marks will be establish in order to maintain reference points for the underground utilities. The field leader will make sure all workers are aware of established offsets.

For work conducted on private property, MACTEC and its subcontractor will check as-built drawings and interview key personnel (e.g., maintenance) at the project site to help locate underground utilities at proposed locations. Personnel must also be aware that drawings may be in error or may not be representative of actual locations. If the utility companies will not come onto the private property, MACTEC or its subcontractor will arrange for a private utility clearance company to visit the site prior to intrusive work.

If live utilities are known to be present in the area of the intrusive work, MACTEC will move the location to the extent possible. If it is not possible to move locations, MACTEC or its subcontractor will use non-destructive means to drill/excavate (e.g., hand dig, soil vacuum, water jet, and/or air knife) until it is safe to proceed with equipment. If electric power lines could be present, hand digging/auguring will not proceed unless the workers are wearing electrically, insulated gloves.
In addition to the above items, the following items in the area of intrusive work should also be noted:

- Overhead power -where does it come from? Does it go down a utility pole and underground?
- Are there trench patches in the pavement?
- Is there trench settlement in grassy ground?
- Look for utility manholes in the street, opening covers will provide directional assessment of utilities as well as size, depth, and use
- Look for valve risers in the pavement (water, gas)

Field personnel will evaluate the various information and confidence level in the data obtained on utility locations. If the field personnel are not confident that all utilities have been located, intrusive work will not proceed without discussing with the MACTEC and NYSDEC PM.

4.4.1 Geophysical Methods

Geophysical methods are remote-sensing techniques that provide information about subsurface conditions. Geophysical surveys can be used to identify buried objects or features such as utility lines/pipes, former disposal trenches or pits, buried debris and/or waste material. This information is used to plan locations of explorations including test pits, borings, and monitoring wells. Geophysical techniques commonly used as part of field investigations include (but not limited to) ground penetrating radar (GPR), magnetometry, and terrain conductivity (TC). Using more than one individual survey technique in a given area provides for correlation of anomalous features and lends for a more comprehensive interpretation. The principles, instrumentation, methodology, and techniques of data evaluation of GPR, magnetometry, and TC are presented in the following subsections.

4.4.1.1 Ground Penetrating Radar

GPR uses high frequency radio waves to investigate the presence of subsurface objects and structures by measuring reflections from any interface where there is a significant change in the dielectric constant. Typical applications for GPR include delineating the boundaries of buried waste materials and perimeters of abandoned landfills; finding steel reinforcement bars and voids in concrete structures; recording the depth of geological interfaces, bedrock, and coal seams; locating and mapping buried utilities; profiling lake bottoms; and determining glacial ice stratification and thickness.

Principles. Energy is radiated downward into the subsurface from an antenna that is pulled slowly across the ground at speeds varying from about 0.25 to 5 miles per hour, depending on the amount of detail desired and the nature of the target. The radio wave energy is reflected from surfaces where there is a contrast in the electrical properties of subsurface materials. These surfaces may be naturally occurring geologic horizons (e.g., soil layers, changes in moisture content, voids and fractures in bedrock) or manmade (e.g., buried utilities, tanks, drums). The reflected energy is processed and displayed on a continuous strip chart recording of distance versus time (i.e., where time can be thought of as proportional to depth).

The time required for the electromagnetic (EM) pulse to traverse the path down to and back from the reflecting medium is measured in nanoseconds (one nanosecond = $1x10^{-9}$ seconds). The two-way travel time is proportional to the depth of burial of the reflecting medium and is dependent on the dielectric properties of the medium through which the EM pulse travels. The dielectric properties of a medium are related to the moisture content and composition of a material. Figure 4.1 depicts the relationship between a single EM pulse generated by the controller and the resulting strip chart recording that would result from many such EM pulses.

The depth of penetration of a GPR system is highly site specific, and depends on (1) the soil types at the site, (2) moisture conditions, and (3) the frequency of the antenna (i.e., lower frequencies penetrate deeper resulting in less resolution).

Instrumentation. The radar system consists of a control unit, an antenna assembly (i.e., transmitter/receiver), and a recording device for analog field recordings. A digital recording unit may also be present for further data processing after field activities are completed. The antenna transmits EM pulses of short duration into the ground. The pulses are reflected from geologic or manmade surfaces and are picked up by the receiver, which transmits the signals to the control unit for processing and display. Shallow objects appear near the top of the strip chart recording (i.e., less time elapsed between the outgoing pulse and the return of reflected energy), whereas deeper objects appear farther down the recording (i.e., more time elapsed). MACTEC generally uses a GSSI (Geophysical Survey Systems, Inc., North Salem, N.H.) SIR 3000 utility locator.

Methodology. GPR surveys are usually performed by establishing a grid of parallel lines across a site and towing the radar antenna along each of these survey lines, usually in the same direction. The spacing and orientation of the grid lines depends on the orientation, if any, of the target features and the required resolution, factors that will be specified in the project-specific FAP. For determination of geologic features or to detect large targets, surveys are typically performed with line spacing ranging from 5 to 20 ft, or greater.

The position of the antenna along the survey lines is annotated by vertical marks (i.e., "tick marks") placed on the instrument output by a device controlled by the operator. The tick marks correspond with distance along a cloth measuring tape, pin flags, or other physical markers at the site.

Data Evaluation. The propagation velocity of the EM pulse depends upon the relative dielectric permittivity of the material through which the pulse travels. The relative dielectric permittivity is a measure of the degree to which a medium can resist the flow of the EM pulse -- the higher the relative permittivity, the lower the resistance to flow, and vice versa. For most earth materials and rocks, the relative dielectric permittivity does not exceed 10 and is always greater than unity, the value for a vacuum. Table 4.2 gives typical permittivity values for commonly encountered materials. The dielectric permittivity is related to the propagation velocity by the formula:

$$e_r = (c/V_m)^2$$

where,

c	=	propagation velocity in free space ($3x10^8$ meters per second or approximately 1 ft per nanosecond)
V_m	=	the propagation velocity through a material.

It follows that

$$(e_r)^{½} = c/V_m \text{ or } 1/V_m = (e_r)^2/c$$

Since c is approximately equal to 1 ft/ns, then $1/V_m$ is approximately equal to $(e_r)^{½}$.

Final results are values of nanoseconds per ft (one-way travel time). These formulas give a method for estimating the propagation velocity for a medium; therefore, the depth to a reflecting horizon if the soil conditions are known. If soil conditions are unknown or their properties cannot be estimated accurately enough, a reflector of known depth can often be used to calibrate the GPR recordings to site conditions.

4.4.1.2 Magnetometry

Magnetometry uses local variations in the earth's magnetic field to locate buried ferromagnetic objects such as drums, tanks, pipes, and cables. Typically a single 55-gallon drum can be detected at depths of up to 15 ft and large drum deposits or large tanks can be detected at depths of 65 ft or more assuming minimal magnetic interference in the vicinity of the target(s). Calculations of the mass or size of detected objects generally yield only approximate results.

Magnetic surveys are impractical in areas where metal pipes, fences, railroad tracks, metal buildings, and other ferrous metal artifacts are abundant. Proper selection of equipment and survey techniques can alleviate some of these problems.

Principles. All materials subjected to a magnetic field, including the magnetic field of the earth, will develop an induced magnetization, the intensity of which is proportional to the applied magnetic field and the magnetic susceptibility of the material. Ferromagnetic materials, such as iron or steel, have high magnetic susceptibilities.

Induced magnetization in an object produces a local magnetic field which either reinforces (i.e., positive magnetic susceptibility) or reduces (i.e., negative magnetic susceptibility) the external applied field. The variations in an otherwise uniform magnetic field caused by the presence of an object are called magnetic anomalies. Observations of such anomalies can be used to infer the presence of such objects.

In magnetometry, one measures local variations in the earth's magnetic field along a traverse or across an area on the surface. Because the intensity of the earth's magnetic field depends in part on the magnetic susceptibility of subsurface materials, a knowledge of variations in field intensity provides an indication of variations in the distribution of materials with different magnetic susceptibilities. In particular, magnetometry can detect the anomalies caused by buried ferromagnetic objects and other natural features which may be of interest in hydrogeologic site investigations.

Instrumentation. Magnetometer surveys will be conducted using a proton precession magnetometer with vertical gradiometer capability. A vertical gradiometer has a dual sensor mounted on a vertically oriented staff which simultaneously measures the total field at each sensor. The gradient is the difference between the values recorded at the upper and lower sensors divided by the distance between them, typically one-half of one meter. In a proton precession magnetometer, a strong magnetic field is applied to a proton-rich fluid (e.g., kerosene) which realigns the protons. The field is then turned off and the frequency of the signal generated by the protons as they realign themselves with the earth's magnetic field is dependent upon, and thus a measure of, the strength of the field at that point.

Methodology. Magnetic measurements are generally made along a grid pattern or in a series of parallel lines across the survey area. The spacing of the grid or lines depends on the size and depth of the objects sought and will be specified in the project-specific FAP. Because of the phenomena of temporal magnetic drift, a magnetic survey usually includes establishing a base station at which magnetic measurements are made at regular intervals. These measurements may later be used to correct all total field survey data for temporal differences due to drift and also act as a QA/QC check on the function of the instrument. Theoretically, it is not necessary to correct vertical gradient measurements for temporal drift because any variation affects the two sensors equally.

In the field, the operator should avoid any sources of high magnetic gradients such as power lines, buildings, and any large iron or steel objects. The operator should also avoid carrying any unnecessary metal articles.

Data evaluation. Field data are recorded in the instrument as a series of data blocks which can be transferred to a computer for processing and evaluation. Each data block contains the total field values for each sensor, the "X" and "Y" coordinates for the measurement are input by the user, the date and time, and several parameters that permit an evaluation of data quality. The total field values are recorded in gammas. The intensity of the earth's magnetic field is approximately 60,000 gammas at the poles and 30,000 gammas at the equator.

For typical manmade iron or steel objects, one may quantify the approximate depth of burial and the amount of metal that produces an observed magnetic anomaly. The intensity or size of the anomaly (I) can be expressed as:

$$\boldsymbol{I = M/r^n}$$

where,

M = magnetic moment of the source

r = depth to the source and,

n = is a measure of the rate of decay with distance, n = 3 for a dipole source and 2 for a monopole source.

Assuming a dipole source, the weight of a metal object in pounds, can be expressed as:

$$\boldsymbol{(Ir^3)/M}$$

where,

M = magnetic moment per pound of iron, varying from approximately 175 to 1,750

r = depth in ft below the sensor

I = anomaly amplitude in gammas.

4.4.1.3 Terrain Conductivity

TC surveys use measurements of the electrical conductivity of a hydrogeologic section to (1) characterize the conductivity of subsurface materials, (2) delineate the extent of contaminant plumes with high concentrations of dissolved electrolytes, and (3) map large concentrations of buried wastes with a degree of saturation, containerization, or inherent electrical properties distinct from the surrounding soil matrix.

Principles. The instrumentation consists of a transmitter and receiver. When a measurement is made, the transmitter is energized by an alternating current that produces a magnetic field, designated as the primary field, H_p. This artificial magnetic field induces small electric currents to flow in the earth which, in turn, produce a secondary magnetic field, H_s, which is made up of two components, quadrature and in-phase components.

The secondary magnetic field is related to the transmitter/receiver separation and to the operating frequency of the transmitter, both of which are selected by the operator. The ratio of the quadrature phase of the secondary field to the primary field (H_s/H_p) is linearly proportional to the TC under most conditions. This ratio is measured by the receiver and converted into conductivity values in units of milliohms per meter.

Field measurements may be recorded on a digital data logger, which is capable of recording simultaneously both the quadrature phase and in-phase components of the induced magnetic field. The quadrature phase component gives the ground conductivity value in milliohms per meter. The in-phase component is more sensitive to metallic objects and hence is useful for looking for buried tanks and drums. Data from the in-phase component may be thought of as being equivalent to a metal detector survey.

Instrumentation. Three instruments manufactured by Geonics, Ltd., of Mississauga, Ontario are commonly used for EM surveying: an EM-31 or EM 34-3, and EM-61. The GSSI Profiler EMP-400 is another common EM surveying instrument. These instruments are rapid-reconnaissance exploration tools used to assess the conductivity values for soil, rock, and waste materials.

The most commonly used instrument, the Geonics EM-31, is a single-piece model operable by one person, with a fixed coil spacing of 12 ft. This provides an effective sampling depth of up to 18 ft. The Geonics EM 34-3 is a dual coil model, operable by two people, with variable coil spacings of 33, 66, and 321 ft. This provides for an effective sampling depth of up to nearly 200 ft. Each instrument can be used in either the horizontal dipole or vertical dipole mode. Selection of the operational dipole mode depends on the depth of sampling desired and the desired sensitivity of the instrument to materials at various depths, relative to the transmitter-receiver coil separation. The EM-61 is a time domain metal detector which detects both ferrous and non-ferrous materials. The Profiler EMP-400 is build on many of the same principles as the EM-31 and EM-61

Methodology. TC surveys are generally conducted on a grid system of parallel lines across the site area. Measurements are taken at grid points. The spacing of the lines depends on the resolution required and will be specified in the project-specific FAP. At each grid point the meter reading is recorded and the apparatus is moved to the next site grid location.

For the dual coil method (Model EM-34), the selected inter-coil spacing must be achieved prior to recording the data. In addition, the two coils must be coplanar. In the horizontal dipole mode, the coils are oriented vertically, where as in the vertical dipole mode, the coils are oriented horizontally.

Data Evaluation. Although it is difficult to define the thickness and "true" conductivity of individual subsurface layers, the instrument measures very precisely the "apparent" conductivity of a volume of underlying earth materials. The apparent conductivity value is made up of the sum of the contributions from each layer that is "sampled" by the transmitter-receiver array. The volume, therefore the depth, of earth materials sampled increases with increasing separation between the transmitter and receiver.

A comparison of the relative responses for vertical and horizontal dipoles is illustrated in Figure 4.2. The vertical axis describes the relative contribution to the secondary magnetic field, arising from a thin layer at a given depth, z. The horizontal axis shows how this response varies as a function of the ratio (z/s), where "z" is the depth of the thin layer described previously and "s" is the transmitter/receiver separation.

As illustrated in Figure 4.2, in the vertical dipole mode, the contribution to the secondary magnetic field from near-surface materials is very small but reaches a maximum at a depth "z" of approximately 0.4. The contribution is significant, although diminished, at a depth of 1.5. This depth represents the effective depth of exploration in the vertical dipole mode.

In the horizontal dipole mode, the contribution to the secondary magnetic field arising from near-surface materials is a maximum and decreases with increased depth. The contribution is also significant at a depth of about 0.75s. This depth represents the effective depth of exploration in the horizontal dipole mode.

4.4.2 Test Pits

Test pits or trenches are designed to allow exploration of subsurface contamination and the nature of near-surface soils. The locations of test pits will be planned in advance and rationale presented in the project-specific FAP, with provisions for the field scientist to modify plans in response to unanticipated site conditions. Test pitting will be conducted at the levels of personal protection specified in the project-specific HASP.

Test pits will be excavated using a backhoe. The field scientist will record the following information on the Test Pit Record (see Figure 4.3) and in the field logbook:

- site name and location;
- names of contractor, backhoe operator, and sampler;
- date and time of excavation;

- depth, width, length, and orientation of trench;
- sample number, depth, and type for all samples;
- approximate water level, after stabilization;
- soil description;
- results of any field screening;
- list of any photographs taken;
- date and type of backfill; and
- any other pertinent observations (staining, odor, etc.).

Test pit samples will be collected from the middle of the backhoe bucket, without requiring the field scientist to enter the excavation. Samples will be collected using the following procedures:

1. Excavate to the dimensions required by the field scientist.
2. Test pit excavation may be terminated due to groundwater seepage into the excavation or encountering obstructions, utility lines, or waste containers. Depending on the conditions encountered, it may be possible to continue excavating more slowly and carefully, rather than to terminate the exploration.
3. The backhoe operator will remove the material from the test pit, under the direction of the field scientist, and deposit excavated soil on plastic sheets in order to minimize contamination of surface soils.
4. When the bucket is brought to the surface, the contents will be screened for VOCs with a PID and examined for visible signs of contamination.
5. Samples will be obtained from the middle of the bucket and placed in the appropriate jars using a clean stainless steel trowel or spatula. Samples may also be collected from the test pit walls by using an extendable hand tool.
6. Excavated soils will be back-filled into the excavation and tapped down into place with the backhoe bucket.

Sample containers will be checked for complete and accurate labeling and COC procedures will be initiated.

The test-pitting subcontractor will decontaminate his backhoe bucket between excavations following the procedures described in Subsection 4.3.1.

4.4.3 Exploratory Drilling

A MACTEC representative will be present during the drilling of borings and installation of monitoring wells. The field scientist will maintain drilling logs and collect appropriate samples. Soil borings will be described on the soil boring log (Figure 4.4) and bedrock coring will be described on the Rock Coring Log form (Figure 4.5). Soils will be described using the Unified Soil Classification System (USCS) (Figure 4.6). A qualified drilling subcontractor will supply the necessary type and number of drilling rigs capable of performing drilling techniques appropriate for the existing subsurface conditions. The boring methods employed at a given site are selected based on known subsurface conditions. MACTEC has prepared detailed drilling specifications that govern the drilling subcontractor's effort. These specifications are modified and issued on a project-specific basis to reflect the needs of each project.

4.4.3.1 Auger Borings

One of the most commonly used drilling methods use of hollow-stem augers (HSA), utilizing coupled lengths of continuous flight augers to bring cuttings upward as the auger string is rotated and advanced into the ground. MACTEC routinely specifies 4.25-inch inside diameter (ID) HSA drilling at sites where overburden is composed of sand or silt, and cobbles, boulders, or rubble are not expected to be encountered. The hollow-stem allows for collection ahead of the augers using a split-spoon sampler or other device, and is large enough for installation of 2-inch ID monitoring wells inside the annular space of the casing. Auger sections are usually 5 ft in length and are attached directly to each other with bolts or with bolted collars. During drilling, the open end of the auger can be blocked as it advances to prevent soil from entering the hollow stem. No drilling fluids are used under normal circumstances. More commonly, the soil is allowed to pack into the open end a few inches. After the auger is advanced to the desired sampling level, the sampling tool is inserted through the hollow stem and driven. Techniques for subsurface soil sampling are presented in Subsection 4.5.1.1.

The advantages of the HSA technique include:

- simplicity of procedure;
- low risk of personnel exposure;
- can be used to obtain soil samples from a wide range of subsurface conditions;
- drilling fluids are generally not required; and
- availability of equipment.

The disadvantages of the HSA technique are:

- difficulty in penetrating excessively cobbled or bouldered soils; and
- difficulty in sampling granular soil below the water table since, without drill fluids, there is no practical means to maintain hydrostatic equilibrium in the borehole. When the plug is withdrawn, water and sediment from outside the augers may enter the borehole, potentially causing contamination and difficulty in sampling undisturbed soil below the bottom of the augers.

4.4.3.2 Drive and Wash Drilling Method.

This method, which will be approved prior to use by the NYSDEC PM, involves advancing casing, as required, and washing-out the soil to the bottom of the casing with a chopping bit to the desired sampling depth. The casing can be advanced by either spinning or hammering (pounding) the casing with a 300-pound hammer. The borehole may be stabilized with the casing, water, or drilling mud, and open samplers, such as the split-or solid-spoon type are driven into the undisturbed soil at the bottom of the borehole.

Drive and wash is most commonly used in soils which do not contain large cobbles and boulders, or cemented horizons. The wash boring method involves the introduction of drilling water and/or drilling mud to the borehole. The use of these materials and this method is not preferred in environmental investigations since the introduction of drilling fluids can alter the chemical composition of the groundwater adjacent to the borehole, and may have an adverse effect on groundwater quality analyses on groundwater samples from monitoring wells installed in the completed borehole. If it is necessary to use this technique to advance a borehole, the field scientist should determine the source and quality of the drilling water to be used in the boring process. The field scientist should not authorize the use of on-site or nearby groundwater or surface water bodies as the source of the drilling water, unless the proposed source has been sampled and analyzed for the full suite of contaminants considered likely to be present in the groundwater beneath the site. In all cases where drilling water or drilling mud are used to advance a borehole, the field scientist should consider obtaining a sample of the drilling fluid for potential analysis, at the discretion of the PM and QAO.

Records of each exploration shall be made on the Test Boring Log (Figure 4.4) and in a field logbook.

4.4.3.3 Cased Borings

In washed casing methods (driven or spun), the boring is advanced by first driving or spinning the casing (i.e., smooth sided, threaded, flush joint pipe) into the soil to the desired depth and then clearing out to a maximum depth of three inches below the bottom of the casing using a rollerbit and rod through which water is pumped as the bit is advanced. Where driven casing is used, the lead casing is equipped with a bit called the drive shoe. Spun casing uses a spin shoe. MACTEC commonly specifies 4-inch ID washed casing in tight, heavy soils such as clay, soil containing cobbles, boulders, or rubble through which augers could not be advanced, or in borings that are planned to be advanced through the overburden into bedrock.

Driven casing is advanced using the blows of a 300-pound hammer falling 24-inches. Hammer blows are recorded for each 12 inches of penetration. In cohesive soils, the inner bit may be advanced further than 3-inches ahead of the casing, and then the casing advanced. During washing of the casing and advance of the roller bit and rod, water will not be recirculated, to prevent cross-contamination unless specified in the project-specific FAP. Management and disposal of the wash water and soil cuttings will be in accordance with Subsection 4.9 or specified in the project-specific FAP. As washed borings are advanced, special care shall be taken to note and record the depth where drilling fluid is lost if this occurs, the depth of an apparent change in soil type, consistency, or color, as can be detected practically while advancing the boring, or other details about the progress of the boring.

The advantages of this drilling technique are:

- simplicity of procedure;
- low risk of personnel exposure;
- can be used to obtain soil samples from a wide range of subsurface conditions;
- can be used to obtain samples from depths greater than 100 ft; and
- availability of equipment.

The disadvantages of cased borings arise from the need to use a drilling fluid. When sampling pervious soils, drilling fluids can permeate ahead of the casing. This can result in contamination of the underlying pervious soils if drilling fluids are recirculated.

4.4.3.4 Rotary Technique

This method is a variation of the wash boring technique, utilizing a rotary drill bit, rather than a chopping bit. It is employed primarily in advancing and cleaning the borehole to the required sampling depth, and is used in conjunction with air, water, or mud to bring the cuttings to the ground surface. This is the method generally preferred for exploratory test borings in the geo-technical consulting industry. This method is commonly used in environmental investigations when test borings are expected to encounter dense tills and coarse granular deposits (such as gravels), or are expected to terminate at depths exceeding thirty ft below the ground surface.

The primary disadvantage of this technique for environmental investigations is the introduction of drilling water or drilling mud. The use of air rotary drilling rigs is usually not appropriate for environmental investigations unless filters are used because the cuttings brought to the ground surface are ejected into the air adjacent to the drilling rig.

4.4.3.5 Rock Coring

Some rock core drilling may be required to complete monitoring well installations at specific sites. Bedrock drilling will be conducted with 4.0-inch ID flush joint casing. Continuous rock core will be collected using H rock coring equipment. The H rock coring device consists of a diamond drilling bit and core tube with inner core barrel. After a length of core drilling is complete, the core barrel is retrieved from the borehole. The core is extruded directly into wooden core boxes for description and storage.

The field scientist will take custody of the rock core after it is extruded from the core barrel. The length of rock core will be described using the procedures outlined below and recorded on the Rock Coring Log (Figure 4.5) and in the field logbook.

1. Scan the core with a PID and record any measurements.
2. Determine the percent recovery from measurement of length of core retrieved versus the length of drill bit advancement (i.e., the core run).
3. Visually examine the core and record its characteristics (including: lithology, petrography, color (wet), layering, fracture spacing, joints, presence of fossils, and visual evidence of possible contamination.
4. Determine rock quality data (RQD). RQD is determined as the total length of rock core segments greater than four inches in length versus the total length of drill bit advancement. RQD is calculated in percent.

4.4.3.6 GeoProbe®/Direct Push Sampling

A direct push sampling system may be used to conduct soil, groundwater, and/or soil vapor sampling and to assess contamination in the vadose zone and saturated overburden. This technology can be used to collect either final data for reports or screening data that can be used to optimize the future location of soil borings and monitoring well installations. The most common vendor of direct push technology is GeoProbe® Systems, and for the purposes of this document, direct push systems and geoprobe may be used interchangeably. The direct-push explorations shall be completed by a qualified direct-push subcontractor, and directed by a qualified field person. Collection of associated samples is outlined in following Sections.

Direct push drilling technique consist of a hydraulic ram unit, usually mounted on a small vehicle (ATV, cargo van, or pick-up truck) that advances small diameter drill rods to obtain overburden soil or groundwater samples or install piezometers. Advantages in environmental investigations include low cost, maneuverability and access to irregular terrain, minimization of investigation derived wastes. Disadvantages include depth limitations and small sample volumes.

The direct push device may employ either dual tube methodology which allows the collection of subsurface soil samples through an outer casing that is set to maintain the integrity of the boring or single-rod method that collects soil into a sleeve liner (e.g., macrocore) within the lead rod.

In the dual-tube method borings are advanced by simultaneously driving an outer stainless steel casing and inner Lexan® tube into the ground. Upon reaching the desired penetration depth, the inner Lexan® tube is extracted to collect the discrete subsurface soil samples, leaving the outer casing in place. To sample the next interval of soil, a new length of Lexan® tubing is then inserted into the outer casing (already in the ground) attached to a length of drive pipe, and another length of outer casing is attached to the top of the outer casing that is already in the ground.

In the single-rod method, ¾-inch diameter rods are advanced in 4-ft sections. The lead section is fitted with an inner polyethylene sleeve. When the top of the desired sampling interval is reached, a tool is used to unlock the drive point and the rod is driven ahead to obtain the soil sample. The entire drill rod is retrieved and the liner removed for characterization. The process is then repeated to collect the next desired sample.

The following materials will be available, as required, during the subsurface soil sampling:

- Health and safety equipment;
- Direct push sampling equipment;
- decontamination equipment as specified in the FAP/QAPP;
- Stainless steel trowels or spatulas;
- Aluminum Foil;
- Paper Towels;
- Measuring device;
- Appropriate sample containers and forms, and personal protective equipment (PPE);
- PID;
- Acetate field knife (if liner sleeves are used to collect the soil samples);
- Field notebook.

The following procedures will be employed to collect subsurface soil samples:

1. Identify sample locations from the project-specific FAP and note the locations in field notebook by obtaining ties to physical features.
2. Don the appropriate PPE.
3. Set up an equipment cleaning station, and decontaminate equipment as described in the FAP/QAPP. Use new, clean materials when decontamination is not appropriate (e.g., disposable gloves and dedicated drive points). Document the decontamination procedure in the field notebook.
4. Assemble the appropriate direct-push sampling apparatus or other direct push tool.
5. Drive the sampling tools to the appropriate sampling zone and collect a sample base on the type of direct-push method being used.
6. Retrieve the sample.

7. Screen for VOCs using the PID. Collect the needed soils for laboratory analysis per requirements of the project-specific FAP. Measure and describe the sample lithology on the boring log (Figure 4.4) using the USCS (Figure 4.6).
8. Evaluate the sample for the presence of visible non-aqueous phase liquid (NAPL). Document samples interpreted to contain visible NAPL with photograph, and record observations in field notebook.
9. Decontaminate non-disposable equipment or tools that may have come into contact with subsurface soil in accordance with the FAP/QAPP.
10. Discard all disposable equipment used during sampling activities in a designated location.
11. Record all other appropriate information in the field notebook.
12. Identify the next sequential boring location, move to that location and return to step 2.

Records of each exploration shall be made on a Soil Boring Log (Figure 4.4) and in the field logbook.

4.4.4 Monitoring Well/Piezometer Installation.

The objectives for each monitoring well and/or piezometer may vary from site to site and from well to well. The objectives will be clearly defined in the project-specific FAP before the monitoring system is designed. Monitoring wells serving different purposes require different types of construction. The objectives for installing monitoring wells may include:

- determining groundwater flow direction and velocity;
- sampling or monitoring for contaminants;
- determining aquifer characteristics (e.g., hydraulic conductivity (K) testing); and
- performing site remediation (e.g., injection or recovery wells).

In cases where only groundwater flow or velocities are to be determined, piezometers, cluster wells, or well points may be used.

Well Materials. Well riser pipe materials are specified by diameter, type of materials, and thickness of pipe. Well screens require an additional specification of slot size. Well specifications will be presented in the project-specific FAP.

The selection of well material depends on the method of drilling, the type of contamination expected, natural water quality, and anticipated depth. Cost may also be a consideration. The two most-commonly used materials are polyvinyl chloride (PVC) and stainless steel. PVC is generally preferred to stainless steel because it is light-weight, less expensive, non-corrosive, and generally easier to work with. However, PVC may deteriorate in the presence of ketones, aromatics, alkyl sulfides, and some chlorinated hydrocarbons. In such cases stainless steel may be preferred.

When the aquifer is bedrock, a well screen may not be necessary; the well is simply an open hole in bedrock. Unconsolidated materials such as sands, clay, and silts, require a well screen. The screen slot size should be selected to retain 90 percent of the filter pack material or in-situ aquifer material, after development (Driscoll, 1989). The gradation of the filter pack material will be selected based on the gradation of the native soils within the screened interval. A screen slot size of 0.010-inches is generally used when a screen is necessary and site conditions are not known.

The thickness of pipe depends on the strength required for the well. In general, larger diameter pipe requires greater thickness to maintain adequate strength. Similarly, driven well points require greater strength, and therefore greater thickness, than wells installed inside drilled borings.

Well Design. The well depth and diameter are tailored to the specific monitoring needs of each site and generally depends on the purpose of the monitoring system and the geologic setting. The decision concerning the depth of placement and length of the well screen is based on the following information:

- aquifer depth, thickness, and characteristics (e.g., permeability and specific yield);
- anticipated depth, thickness, and characteristics (e.g., density relative to water) of the contaminant plume;
- head distribution and estimated flow in the aquifer; and

- fluctuation in groundwater levels.

In most situations, screen lengths are 5 to 10 ft.

Standard well IDs are 2, 4, 6, or 8 inches. For most groundwater monitoring and sampling programs, a 2-inch ID well is preferred. Pumping tests for determining aquifer characteristics may require larger diameter wells; however, in situ K testing can be performed during drilling or after well installation in small diameter wells. Other considerations in selecting well diameters include the types and size of the sampling equipment, and any in situ instrumentation that may be used in the well. In general, the borehole diameter should be at least 4 inches larger than the well riser pipe diameter to provide an annular space of at least 2 inches for placement of filter pack, seal, and grout or backfill.

Well Installation. Monitoring well installation details will be recorded in the field logbook and on a Monitoring Well Construction Diagram (Figures 4.7 and 4.8).

Materials placed in the annular space between the borehole and the riser includes filter pack, bentonite seal, and grout. In general, all of these materials may be installed using a tremie pipe placed in the annular space. In shallow wells, these materials may be emplaced from the ground surface, but the rationale and procedures must be described in the project-specific FAP.

The filter pack is usually a fine to medium uniform sand. The exact filter pack gradation should be chosen to retain approximately 60 percent of the aquifer material after well development (Driscoll, 1989). The filter pack is installed around the well screen and extending 2 to 3 ft above the top of the screen. At least 2 ft of bentonite pellets will be placed above the filter pack.

The bentonite expands by absorbing water and serves to isolate the screened interval from the rest of the annular space and the formation. If the bentonite seal is above the water table, care must be taken to adequately hydrate the pellets before proceeding with well construction. If the seal is below the water table the bentonite slurry may be tremied into place.

Grout is placed from the top of the bentonite to the ground surface. Grout generally consists of a cement-bentonite mixture or Portland cement. The grout minimize the possibility of surface run-off reaching the screened interval and replaces material removed from the boring during drilling thereby minimizing hole collapse and subsidence around the well.

In certain cases, the borehole may be drilled to a depth greater than the well installation depth. For these cases, the well is backfilled to the desired depth with bentonite and sand is placed between the bottom of the well and the bentonite.

Well sections and all materials coming in contact with the well must be cleaned before installation. The screen and well-riser pipe can be placed in the boring either manually or using the rig to hold the pipe, depending on the weight of the well. The pipe is lowered and sections added until desired screen depth is reached. No glues or solvent-cement will be used in well construction monitoring wells. When the screen and riser are in place, the filter pack, bentonite seal, and grout are installed using tremie pipes. The well is completed with a vented PVC cap.

When the well is completed and grouted to the surface, a protective steel casing is often placed over the top of the well. This casing generally has a hinged cap and must be able to be locked to prevent vandalism. The protective casing is larger in diameter than the well and is set over the well into the wet grout or is concreted in place. Protective casings can be above ground or flush-mounted. Above ground protective casings will have weep holes to allow drainage. Special care must be taken with flush-mounted installations to ensure that surface drainage does not enter the well. The protective casing and surface cement should extend below the frost line to prevent heaving.

Well Development. Well development is a process of pumping or purging a new monitoring well, designed to stabilize and increase the permeability of the filter pack around the well screen and to restore the permeability of the formation which may have been reduced by drilling operations. The selection of the well development method will be made by the site hydrogeologist based on the drilling methods, well construction and installation details, and the site geology. Monitoring wells should be allowed to set for a minimum of 24 hours before well development to allow for the seal and grout to set. Any equipment introduced into the well will be decontaminated in accordance with the procedures presented in the FAP/QAPP. Water levels will be taken from each well before and after development. To avoid aeration of the filter pack, the water level will not be allowed, to the extent feasible, to fall below the top of the filter pack during development.

Well development may be accomplished using one of several methods including:

- Overpumping, which uses a pump (e.g., submersible or peristaltic) or compressed air (i.e., air lift) to remove water from the well.
- Surge block which uses a plunger, the approximate diameter of the well, to agitate water in and out of the screen. No water is removed from the well.
- Compressed air which develops a well by either backwashing (i.e., forcing water out of the well and reducing pressure to let water flow back in) or surging (i.e., releasing a large volume of air suddenly into an open well below the water table producing a strong surge due to resistance of water head, friction, and inertia). Water is pumped from the well using airlift.

Well development will continue until the turbidity of the discharge water is 50 nephelometric turbidity units (NTUs) or less. Field measurements of turbidity, temperature, pH, and specific conductivity will be recorded for each well volume removed. If the turbidity of the development water is not less than 50 NTUs within a reasonable amount of time, 2 to 3 hours or as specified in the project-specific FAP, field personnel will provide the field data to the Field Operations Leader (FOL) or PM who will contact the NYSDEC PM for guidance on how to proceed. An average of two weeks should be allowed between development and subsequent sampling or water level measurements to allow the aquifer to re-equilibrate.

Well development will be documented in the field notebook and on the Well Development Record (Figure 4.9).

4.5 SAMPLING TECHNIQUES

The rationale for each sampling site location will be identified in the project-specific FAP. For meaningful evaluation of the sample analytical results, it is important that the actual location of the samples be properly documented. If possible, sampling sites will be marked in the field with stakes or flagging. All sampling site locations will be referenced on a base map and on sampling records.

The location and distribution of contaminants at a given site are a function of many factors, including but not limited to:

- site operation or waste disposal practices;
- site design;
- site closure;
- waste characteristics;
- site topography and surface drainage;
- climate; and
- site hydrogeology.

The development of a sampling program requires consideration of the factors listed above and the scope and objectives of the project. Development of a sampling plan to evaluate the distribution and magnitude of contamination at a specific site requires at a minimum:

- an assessment of the site conditions;
- evaluation of the methodology and results of any previous sampling and analysis programs which may have been completed at the site; and
- definition of the scope and objectives of the project.

The techniques described herein are those normally employed by MACTEC. They have been selected to provide a practical and efficient means of obtaining samples in a manner consistent with safety protocols and QA/QC requirements. Additionally, they employ equipment that is normally available for use.

All samples collected will be logged in the field at the time of sampling by the field scientist.

At the time samples are obtained, the following must be recorded by the sampler in the field logbook and/or on sample data sheets:

- sample site location (e.g., grid coordinates baseline station and offset, or the location plotted on a map or aerial photograph);
- sample type;
- date and time of sampling;
- project and sample designations;
- sample identification; and
- analyses requested.

For laboratory samples, the sampler must initiate COC procedures and describe the sample site in adequate detail to allow the analytical results to be properly interpreted and, if necessary, to allow collection of additional samples from the same sample location. MACTEC uses labels and standardized record forms to expedite this process and ensure uniformity of records. The sampling protocols and recordkeeping requirements for the types of samples described in the following pages vary according to the sampling techniques. Additional requirements may also be established on a project-specific basis.

4.5.1 GeoProbe® Sampling

A GeoProbe® sampling rig may be used at the site to collect soil, groundwater, or soil vapor samples. The project objectives and DQOs for the GeoProbe® sampling will be described in the project-specific FAPs.

4.5.1.1 GeoProbe® Subsurface Soil Sampling.

The qualified field person shall collect soil samples for physical and analytical testing and geologic classification during completion of soil borings and direct push explorations. The soil samples shall be collected from pre-determined sampling intervals or, whenever subsurface conditions warrant. The latter condition shall be determined by the qualified field person.

The samples for laboratory analysis shall be collected using a split-spoon (soil borings) or sampling probe with disposable acrylic liner (direct push). The collection of the samples shall be in accordance with the following procedures:

1. Remove the rods and sampler from the borehole/exploration. Open the sampler by unscrewing the cutting shoe and retrieve the liner containing the soil sample. In the case of direct push explorations cut open the acetate liner. Recovered soils contained in the sampler shall be characterized using the USCS, as described previously.
2. Scan the soil sample with a PID and record measurements.
3. Collect sample for chemical analysis as described for Surface Soil Sampling.
4. Decontaminate the sampling device.
5. Record the boring lithology on a Soil Boring Log (Figure 4.4).

Information regarding sample location, depth, and character shall be recorded on the Soil Boring Log (Figure 4.4).

4.5.1.2 GeoProbe® Groundwater Sampling.

A direct-push sampling system (e.g., GeoProbe® or equivalent) may be used to obtain discrete groundwater grab samples.

A direct-push system advances a steel probe assembly to the desired depth. Groundwater samples are collected by allowing formation water to flow into a slotted probe tip or wire rapped stainless steel screen. Water within the probe is purged and sampled from inside the rod assembly using small-diameter tubing and a low-flow rate sampling pump, or a small-diameter bailer. The collection of groundwater grab samples via the direct-push method is dependent on sufficient saturated thickness of overburden soils and an adequate rate of inflow through the probe tip.

Sequential (vertical profile) sampling may be performed by driving the probe assembly to a predetermined depth and collecting a sample. Following sample collection, an additional section of riser is connected, and the sampling device is driven to the next sampling interval, where another sample is collected. Non-dedicated pumps and tubing shall be decontaminated and dedicated tubing shall be discarded between sample collection intervals.

A groundwater grab sample also may be collected from a small-diameter well that has been installed in a direct-push boring.

Groundwater sample collection data shall be recorded on the Groundwater Grab Sample Field Record log sheet (Figure 4.10) and in the field logbook.

4.5.1.3 GeoProbe® Soil Vapor Sampling.

Soil vapor samples will be collected using a GeoProbe® sampling device to evaluate the potential vapor migration of contaminants from the groundwater. Field data and observations will be recorded on the GeoProbe® Soil Vapor Sampling Record (Figure 4.11) and, if appropriate, the Soil Vapor Probe Construction Diagram (Figure 4.12).

The GeoProbe® rods will be pushed to the desired sampling depth (expected to be below the rain infiltration line, but above the water table fringe zone). Soil vapor collected just above the water table will give an indication of the possible vapor migration from potentially contaminated groundwater.

Procedure for GeoProbe® Soil Vapor Sample Collection

Soil vapor samples will be collected from the GeoProbe® points using either the GeoProbe® PRT system, or through open GeoProbe® rods. To sample through the open rods, the rods are pushed down to the target depth and then pulled back slightly, allowing a disposable point to drop off the bottom and expose the bottom of the open (hollow) rods to the soil. The rods will be sealed with O-rings at the joints and have a 1/4-inch tubing attached to the top for vapor purging and sample collection. To sample with the GeoProbe® PRT system, a specialized point is attached to the end of the GeoProbe® rods. The PRT point is also exposed to the soil by allowing a disposable tip to drop off the bottom of the rods when the rods are backed out slightly. This PRT point allows a ¼-inch tubing to be threaded directly to the bottom of the rods, for a small discrete sample point. The tubing is run to the surface and connected directly to the sample collection device. In addition, for both techniques the outside of the rods will be sealed at the ground surface with pre-hydrated bentonite. Approximately 1 liter of soil vapor, plus the volume of the tubing or rods, will be purged using a personal air monitoring pump before collecting samples. During the soil vapor purge, vapors will be screened with a PID. In addition, helium leak tests will be conducted on a subset of samples to ensure samples are representative of sub-surface conditions and not outdoor ambient air. Helium leak tests will be conducted by encapsulating the sample point (such as with a bucket sealed to the ground surface with bentonite), while allowing the tubing to be purged from outside the encapsulated area. The encapsulated area will be filled with helium, but care will be taken not to pressurize the enclosure. The soil vapor sample port will be tested for helium breakthrough with a portable monitoring device (such as the Radiodetection MGD-2002 Multi-Gas Locator) both before and after collection of the soil vapor sample. If greater than 10 percent of the tracer gas is detected in the screening sample, the sample point seal will be enhanced and the procedure repeated. Soil vapor samples will be collected with either 1.4-liter SUMMA®-type canisters with flow valves (set to approximately 20 minutes per sample), or with Tedlar bags (Tedlar bags may be filled using either a Vac-U-Chamber®, or with a syringe with a three way valve).

SUMMA® canister sample collection

- Place SUMMA® canister adjacent to the temporary sampling port.
- Record SUMMA® canister serial number on sampling summary form and COC.
- Record sample identification on canister identification tag, and record on sampling summary form and COC.
- Remove plastic cap canister fitting.
- Open and close canister valve.
- Record gauge pressure on sample summary form and COC. Gauge pressure must read >25 inches Mercury (Hg). Replace SUMMA® canister if gauge pressure reads <25 inches Hg.
- Connect canister to silastic tubing already connected to the subsurface probe.
- Open canister valve and in-line stainless steel valve to initiate sample collection.
- Record date and local time (20-minute basis) of valve opening on sampling summary form and COC.
- Take digital photograph of SUMMA® canister and surrounding area.
- Upon completion of 20 minute sample collection, record gauge pressure on sampling form and COC.
- Record date and local time (20 minute basis) of valve closing on sampling form and COC.
- Close canister valve.
- Disconnect silastic tubing and recap pressure gauge.
- Remove SUMMA® canister from sample collection area.
- Remove temporary probe from hole. Fill hole with a quick drying hydraulic cement.

Tedlar bag sample collection using Vac-U-Chamber®

The sampling line will be connected to a Vac-U-Chamber® Tedlar bag sampling box containing a one liter Tedlar sample bag. The external pump is then connected to the purge port and the soil vapor sampling probe will be purged for two minutes prior to sample collection. After purging the system, the external pump is connected to the vacuum port and the Tedlar bag is allowed to inflate. Upon complete inflation of the Tedlar bag, as observed through the Vac-U-Chamber® viewing window, the Tedlar bag valve is closed and the sample is labeled with the unique sampling location identification code. Upon completion of sampling, the rods and slotted screen are removed from the vapor point and decontaminated. For QC purposes, one duplicate sample will be collected for every twenty sample locations. If QC samples are collected, the duplicate sample will be collected by inserting a tee connector in the sampling line and filling two Tedlar bags from one probe at the same time.

Tedlar bag sample collection using syringe with a three way valve

The sampling line will be connected to the bottom port of a three way valve system. A 60 to 100 milliliter (ml) syringe is then connected to the top purge port. The sampling line valve and the purge port are opened and the syringe is filled. The sampling line valve is then closed and the side port is opened. The syringe is this emptied and the side port is closed. A one liter Tedlar sample bag is connected to the three way valve side port. The sampling line valve and the purge port are opened and the syringe is filled again. The sampling line valve is then closed and the side port is opened. The contents of the syringe are then purged into the Tedlar bag. This process is continued until the Tedlar bag has been filled.

4.5.2 General Soil Sampling Methodology

Development of a soil/sediment sampling plan to evaluate the distribution and magnitude of contamination at a specific site requires at a minimum:

- an assessment of the site conditions;
- evaluation of the methodology and results of any previous sampling and analysis programs which may have been completed at the site; and
- definition of the scope and objectives of the project.

A number of techniques have been developed to obtain samples from various depths below the ground surface. The techniques described herein are those normally employed by MACTEC. They have been selected to provide a practical and efficient means of obtaining samples in a manner consistent with safety protocols and QA/QC requirements. Additionally, they employ equipment that is normally available for use.

The selection of sampling techniques to be employed at a given site is based upon the depth from which samples must be obtained, the types of exploration, and/or the nature of the soils to be sampled. The sampling techniques are categorized by the depths or the types of explorations from which they are obtained:

- surface soil samples, from depths of less than 6 inches (or at depths designated in the project FAP;
- subsurface soil samples from test borings and GeoProbe® explorations at variable depths; and
- sediment samples from depths of less than 6 inches (see Subsection 4.5.4).

All soil samples collected will be logged in the field at the time of sampling by the field scientist. Soils shall be classified in accordance with the USCS, Figure 4.6. Soil samples will be described fully on the appropriate sampling logs (Figures 4.3, 4.4, 4.13 and 4.14).

At the time samples are obtained, the following must be recorded by the sampler in the field logbook and/or on sample data sheets:

- sample site location (e.g., grid coordinates baseline station and offset, or the location plotted on a map, site plan or aerial photograph determined using appropriate measurement methods);
- sample type and depth;
- date and time of sampling;
- project and sample designations;
- sample identification; and
- analyses requested.

For laboratory samples, the sampler must initiate COC procedures and describe the sample site in adequate detail to allow the analytical results to be properly interpreted and, if necessary, to allow collection of additional samples from the same sample location. MACTEC uses labels and standardized record forms to expedite this process and ensure uniformity of records. The sampling protocols and recordkeeping requirements for the types of samples described in the following pages vary according to the sampling techniques. Additional requirements may also be established on a project-specific basis.

4.5.2.1 Collection of Soil Samples for VOC Analysis

The purpose of this section is to outline the steps associated with field preservation of soil samples for volatile organic analysis (VOA) in accordance with USEPA Method 5035A (USEPA, 1996). Specific steps and details are described for the primary tasks of sample container preparation, soil sample collection, sample container management and documentation, sample analysis, and target compound quantitation.

Soil and sediment samples will be preserved in water or sodium bisulfate solution (low concentration) and methanol (high concentration) at the time of sample collection. Soils will be obtained from sampling devises (i.e., hand augers, split spoons or other auger sample collection apparatus, GeoProbe® cores) using plastic syringe samplers used to reduce exposure of samples to air. Approximately 5 grams of soil for low concentration VOC and 10 grams of soil for high concentration VOC vials will be immediately transferred to a vial containing a pre-measured amount of preservation fluid. Vials will be transported to the laboratory for analysis using procedures specified in the FAP/QAPP.

- For low concentration VOCs, two vials will be collected at each location. Vials are preserved with a sodium bisulfate solution or frozen within 48 hrs of collection. When freezing water preserved samples, vials should rest on their side to prevent glass from cracking during freezing.
- For VOCs, one high concentration methanol vial will be collected at each location.
- For locations selected for matrix spike analysis, the number of vials will be tripled (6 low and 3 high concentration vials).

Equipment and Supplies

- 40 ml glass VOA vial Teflon lined silicone septa lids filled with preservatives by the laboratory and pre-weighed.
- 20 ml plastic sampling syringe
- analytical balance capable of weighing to 0.1 gram
- utility knife
- stainless steel spatula
- vial storage cooler
- water resistant sample labels
- water proof marker
- Field Data Record

Sample Container Preparation

Sample containers used for the collection of off-site VOA samples will be prepared in advance at the off-site laboratory. Container preparation by the off-site laboratory will include attaching labels, adding preservation fluid, weighing sample containers, and recording all information necessary to document container preparation and to calculate sample weight and target analyte concentrations during subsequent sample analyses. Developing and implementing the exact procedures for container preparation will be the responsibility of the contract laboratory. The following requirements are provided to the contract laboratory for incorporation into the off-site laboratory procedures:

1. Containers will be prepared for each VOA sample.
2. The sample container will consist of a wide mouth glass vial appropriate for VOA soil samples. The container must contain a Teflon lined cap with an air tight silicone or phenolic septa.
3. A water resistant sample label will be attached to each container. Each sample container will be assigned a unique sample container tracking number that is marked on the container label with permanent waterproof ink. The label will have room for field samplers to record sample identification (ID), date sampled, time sampled, and initials.

4. Low concentration VOA vials will contain a stirring bar and 5 mL of water. High concentration VOA sample containers will be filled with 10 ml of purge and trap grade methanol. The lot number of the methanol must be recorded. If possible, the laboratory will use a single methanol lot for the preparation of all VOA containers, or the laboratory should use as few lots as necessary for the program.
5. Sample container caps will be firmly capped to create an air-tight seal. Containers will be weighed and container weights will be recorded to the nearest 0.1 gram. No other tape or packaging material will be added to the containers. The laboratory will mark the approximate level of the methanol on the vial with a permanent marker. Containers will be stored in a designated location that does not contain other environmental samples or standards until shipment to the field. Containers will be shipped to the field office.
6. The laboratory will maintain container preparation records. Record keeping can be done using a bound notebook or preprinted forms. Records must contain all information necessary to document container preparation steps and calculate soil weights for each sample. These records will be submitted as laboratory notebook records with the analytical data deliverable packages. At a minimum the following information must be recorded:
   - preparation dates
   - container tracking number for each container
   - manufacturer and lot number of the containers
   - methanol supplier and lot number
   - pre-sampling weight of container and methanol (with cap and label on) recorded to the nearest 0.1 gram
   - signature or initials of the individual preparing the containers
   - additional fields for entering the post-sampling weight of container and the calculated weight of soil added to the container during sampling
   - signature or initials of individual recording and calculating final weights
7. Containers will be stored at the field office in a dedicated area away from samples of sources of contamination. After sample collection and shipment to the laboratory, containers will be re-weighed by the off-site laboratory sample manager and the weights will be recorded into the container preparation records for use in calculating the actual soil weights for each sample.
8. **A separate sample vial filled with soil will be submitted for percent moisture determination in association with each soil sample that is collected from any location where only a VOC sample is collected.** The moisture sample will be collected using the same technique as the preserved sample. The laboratory will homogenize the sample (without decanting standing water) prior to collecting an aliquot for moisture determination.

9. Samples will be analyzed in accordance with purge and trap procedures specified in the analytical method specified in the project-specific FAP. **The laboratory will shake VOC high concentration samples as described in the referenced analytical methods prior to taking a methanol aliquot for analysis.**

Sample Collection

Sample collection will be performed with a disposable plastic syringe. The appropriate volume of soil collected in the syringe will be estimated prior to sampling to collect the appropriate weight of soil specified in Section 2.0. Field personnel will make note of preservation fluid levels on the sample containers to ensure no significant loss had occurred. Field personnel are responsible for ensuring that sample containers remain on ice at all times. The specific steps and details for soil sample collection are outlined below:

1. Using a clean utility knife or other sharp knife carefully cut of the tapered end of the 20 ml plastic sampling syringes. Take care to remove the tapered portion without removing significant portions of the body or tube of the syringe. Sampling syringes are disposable and are not to be reused after collecting a sample.
2. Transport sample containers in cooler with bagged ice. Keep sample containers in individual zip lock bags.
3. Obtain PID readings from the sample surface.
4. Samples are collected by capturing a representative sample within the sampling syringe and transferring the soil to the VOA vial. **For low concentration VOCs, two vials will be collected at each location. One high concentration methanol vial will be collected at each location (see method summary).** If samples are collected using split spoons or a GeoProbe ® sampler, samples will be collected from the soil core immediately upon opening the sampling devise. If samples are collected from hand augers samples will be collected from within the auger core. For surficial sediments or test pits, samples will be collected directly from the sampling location substrate. Push/advance the sampling syringe into the center of the sample core/location filling the soil sampling syringe to the target level volume. Pull the syringe plunger back further to apply suction on the soil sample which will help it to remain in the syringe during removal. Separate the syringe sample from the remaining soil. Remove the syringe. If the proper volume of soil is not present, repeat the procedure until the proper volume of soil has been collected. If necessary, use a stainless steel spatula to fill the syringe with the needed soil volume. If rocks are present in the sample it may be necessary to extrude the sample from the sleeve, select a portion of the core sample that is void of large rocks, and then advance the sampling syringe. If

possible, the sample volume should consist of sand, silt or clay and contain very few rocks or pebbles.

> **Note: If matrix spike/matrix spike duplicate (MS/MSD) samples are required, additional sample volume is necessary. Low Level Concentrations require 2 vials of deionized (DI) water and 1 vial of Methanol. Methanol is used to screen the sample. These screening results are interpreted and the appropriate analysis is performed.**

5. Remove a sample container from the cooler. Carefully extrude the soil sample from the syringe into the sample container. This task should be done slowly and carefully to insure that the preservation fluid does not splash from the sample container. A second vial used for moisture determination will be collected for all soils collected below standing water or at any location where only VOC samples are collected. The samples will be collected using the same sample syringe and coring technique used for the actual field sample. The sample jars will be labeled "percent moisture determination for VOA" with the sample label also containing all other sample information including sample ID, date and time sampled, and sampler initials. The laboratories will be instructed to homogenize the VOA percent moisture sample in the jar prior to removing an aliquot for moisture determination to simulate actual sample moisture added to the methanol vials.
6. Syringes should be discarded immediately after extruding sample from syringe; do not reuse. If split samples are collected, care must be taken to make the samples equally representative (i.e., collected from the same part of the soil core).
7. Replace container cap as soon as possible.
8. With permanent waterproof ink fill out the sample container label with the following information: date, time, location, depth of sample, sample ID code, sample type (i.e., regular, duplicate, matrix spike, matrix spike duplicate), and sampler initials. The approximate level of the methanol will be marked on the sample vial. <u>Do not tape over the sample container label.</u>
9. Make sure the sample container lid is screwed down tightly. <u>If necessary wipe excess soil from the mouth of the container to get an air-tight seal.</u> Place the sample container back into the zip lock bag. Place the container and bag into the cooler taking care that the sample container remains upright. Keep samples on ice until they are submitted to the sample manager.
10. Complete the appropriate FDR and release the samples to the sample manager.

<u>4.5.2.2 Surface Soil Sampling</u>

Shallow soil sampling provides samples of surface and near surface soils suitable for chemical analysis. Shallow soil samples are usually obtained by using one of the following devices:

- split-spoon sampler
- hand auger or corer
- trowel or spoon
- spade
- GeoProbe®

The split-spoon sampler is described in detail in Subsection 4.5.1.1. Two distinct types of hand augers are available: a cup-type auger and a screw-type auger. Use of either device is generally limited to the upper portion of the soil profile (i.e., less than 5 ft). These augers are best suited for obtaining composite samples from relatively shallow depths and in relatively loose soils. Use of trowels or spades is straightforward but usually limited to sampling very shallow depths (i.e., less than 18 inches).

Soil samples can be either grab or composite, depending on the objective of the sampling program described in the project-specific FAP. In grab sampling, the soil jar is filled directly. In composite sampling, several methods are available:

- Samples can be composited over depth at a single location.
- Samples can be composited laterally, in which one sample comprises several, usually three or four, soil specimens from the same depth in the vicinity of the sampling site.

During composite sampling, several depths or locations are selected and a stainless steel bucket is filled with samples from all locations. The material is then mixed and put into appropriate containers. Samples for VOCs are not mixed. A specific location is chosen and the sample is placed immediately in the appropriate containers with as little agitation or disturbance as possible.

Immediately after taking a sample, COC procedures are initiated and the Surface Soil Sample Data Record (Figure 4.13) is completed. Information recorded on the FDR will include the sample type, depth, date, time and sample identification. Any special observations (staining, odor, etc.) will also be recorded in the "Notes" portion of the FDR.

4.5.2.3 Subsurface Soil Sampling

Sampling during soil boring allows collection of soil samples from depths greater than 5 ft below ground surface. Borings are advanced using a variety of methods including HSA, drive-and-wash casing, or spun-and-wash casing methods. The boring method chosen is based on subsurface conditions and the method will be specified in the project-specific FAP.

Split-spoon Soil Sampling. Soil boring samples are taken from undisturbed soil at the bottom of the boring with a split-spoon sampler. This sampler consists of a split steel tube or sample barrel threaded at both ends. A sharpened drive shoe secures the bottom of the barrel and an adaptor secures the top. The adaptor is threaded to connect directly to the drill rods and contains a check valve (Figure 4.15). The split-spoon is driven into undisturbed soil below the casing using the standard penetration test (ASTM-D-1586-99) (ASTM, 1999) (Figure 4.15 and Figure 4.16). The standard penetration test consists of driving a 2-inch outside diameter (OD), 2-ft split spoon 24 inches into the soil at the end of the drilling rods using a 140-pound hammer dropped 30-inches. Blows per ft are recorded as a SPT-N value defined as total blows for the penetration from 6 to 18 inches. If the split-spoon is to be driven greater than 24 inches, or will be larger than 2-inch OD, this will be specified in the project-specific FAP.

After the sampler has been driven, it is withdrawn from the borehole and the sampler is opened by removing the drive shoe and adaptor. The field scientist will take custody of the sampling device as soon as it is withdrawn from the borehole. The sample will be collected and documented in the field logbook and on the Soil Boring Log (Figure 4.4) in accordance with the following procedures:

1. Scan the soil with a PID and record field measurements.
2. Visually examine the sample and record its characteristics (e.g., texture, color, consistency, moisture content, layering and other pertinent data) and classify using the USCS (ASTM-D-2488-09a, ASTM-D2487-10) (ASTM, 2009, 2010), Figure 4.6.
3. Remove the portion(s) of the sample selected for chemical analysis and place into appropriate containers using a clean spatula. Soil intended for VOC analysis should be placed in the

appropriate wide-mouth glass jar and capped as quickly as possible. The containers should be filled as near to capacity as possible to minimize volatilization of the sample into the container headspace. Soil intended for other types of analyses should be placed in appropriate containers and capped.

4. Place the remainder of the sample in an 8- or 16-ounce (oz) reference jar if specified in the project-specific FAP. This sample portion will be used for headspace PID measurement and for any physical materials testing that is required.
5. Discard excessively disturbed or loose material found in the sampler that may not be representative of the interval sampled. This material will be discarded in the same manner as the drill cutting at each boring location.
6. Decontaminate the sampling device in accordance with the procedures specified in Subsection 4.3.2.

In some instances, there may be no analytical samples collected from a given boring. In these instances, steps 2 and 3 of the procedure listed above are omitted and the sample is placed in one or more reference jars.

Immediately after the samples are collected, the boring log is also updated by the field scientist. Boring logs may be completed by the driller but for purposes of completeness and documentation a separate boring log is also compiled by the MACTEC field scientist. The boring log includes interpretations of subsurface materials and conditions encountered, sample locations, PID readings, and other notes pertinent to how the boring was conducted or conditions encountered during sampling, such as staining, odor, etc. The boring log will be completed in a site field logbook and/or on a Soil Boring Log (Figure 4.4).

The sampler must exercise considerable care while collecting samples for analysis. Some methods for sample collection are described below.

1. Obtain samples from undisturbed soil below the casing or auger. This is accomplished by monitoring or checking the drill crew's measurements, observing the sampling process and examining the sample once it is retrieved.
2. Carefully remove and discard portions of the sample that are suspected to be contaminated by contact with the casing, auger, or drilling fluids.

3. Conserve sample volume since under certain soil conditions it may be difficult or impossible to achieve good sample recovery with split-spoons.

Procedures employed to minimize cross-contamination during test boring sampling operations include the following:

- Samples are taken immediately after the boring is advanced to the desired sampling depth.
- The sampling tools are decontaminated prior to taking each sample.
- The drilling contractor is not permitted to use oil, grease or other petroleum-based lubricants on the drill rods, casing or sampling tools. Use of any other lubricants will be documented.
- The drilling technique and procedures to be used, particularly the use of drilling fluids, are carefully evaluated for each site.

4.5.3 Methanol Extracted Rock Chip Sampling

The analysis of rock chip samples collected from fracture zones within rock core samples provides data that may be used to evaluate the distribution of VOCs in rock matrix and potential presence of product in the fracture zones. This method of sampling is used in conjunction with rock core drilling techniques. Rock chip samples are usually obtained by using the following devices:

- Drill equipment – rig, core barrel, etc.
- Clean tested water supply
- Pre-weighed 8 or 12 oz clear wide mouth jars (or appropriate size to accommodate core)
- 40 ml amber vials/sample labels/tape
- Purge and trap grade methanol
- Syringes and pipettes
- Balance
- Notebook/field book/rock core logs
- 6 foot folding rule
- Rock hammer and coal chisel
- Core boxes

- Indelible markers
- Stainless steel bowl
- Cooler, ice, zip lock bags, paper towels
- Chain of custody forms/seals

Rock core samples retrieved from a borehole are examined for the presence of natural hydraulically active fractures. The face of a selected fracture is chipped away using a rock hammer, chisel, or rock saw, depending on the nature of the cored bedrock fracture material. Following extraction of the fractured rock interval from the drilling core barrel (depending on the nature of the fracture use of a rock saw may or may not be required), selected fracture face material (i.e. natural fracture rock chips) will be chipped away from the fracture face, pulverized into smaller flakes, and placed in a 8 oz clear wide mouth sample jar or collected in a stainless steel bowl and immediately transferred to a sample jar. The same method is appropriate for sampling rock matrix in proximity to fracture surfaces. Approximately 50 grams of the fractured rock material will be collected. The sample container will be capped. The sample will be weighed to determine the weight of the rock chips/fragments. Final weight will be recorded in the field notebook. The jar will be re-opened and approximately 50 ml of purge and trap grade methanol will be introduced into each sample jar. If necessary, a larger volume of methanol will be used to cover the rock fragments. Caps will be added to the sample jars. The methanol volume will be recorded in the field notebook. The sample will be agitated for one to two minutes and then allowed to sit. After several hours the sample will be re-agitated for approximately one minute and then be allowed to bathe in the methanol for a period of 24-48 hours.

After allowing the sample to soak for 24 to 48 hours, a disposable pipette will be used to collect an aliquot of methanol from the wide mouth sample jar. Approximately 20 ml of the methanol will be transferred to a 40 ml vial and cap (avoiding stirring up the fine particles in the vial). The sample identification information will be recorded on the sample label and attached to the vial.

Samples will be analyzed by purge and trap analysis using USEPA Method 8260B procedures developed for high concentration soils. Sample collection data along with the analytical results from the laboratory will be used to determine total mass of target compounds present in the fracture zone. Detection levels will be approximately 5 micrograms (µg)/core sample for target VOCs reported by the laboratory. The following calculation will be used to determine total mass of a detected target compound:

Mass of Compound (µg) = (A * B * C)/D

A = Concentration of Aqueous Analysis in micrograms per liter (µg/L)
B = Purge and trap purge volume in L
C = Volume of methanol used during sample collection in ml
D = Volume of methanol extract used during analysis in ml

Detection limit example:

5 µg = (1 µg/L * .005 L * 100 ml)/.1 ml
The sample jars should be stored at less than 20 degrees Celsius and should be disposed of if exposed to any volatile vapors or fumes (i.e. gasoline, diesel).

Information and data such as; date, boring ID, overburden thickness, total depth, and other details will be recorded in the field logbook. The sample collection information will be used in calculations of volumes of VOCs present in the rock core.

4.5.4 General Water Sampling Methodology

The location and distribution of contaminants at a given site are governed by many factors, including:

- site operation or waste disposal practices;
- site design;

- site closure;
- waste characteristics;
- site topography and surface drainage;
- climate; and
- site hydrogeology.

Development of a water sampling plan that will effectively reveal the distribution and magnitude of contamination at a specific site requires:

- an assessment of the factors listed above;
- evaluation of the methodology and results of any previous sampling and analysis program which have been completed at the site; and
- definition of the scope and objectives of the project.

4.5.4.1 Surface Water Sampling

The technique for surface water sampling must be selected after addressing such items as:

- depth of water body;
- flow rate;
- stratification;
- specific gravity/solubility of anticipated analytical parameters;
- seasonal variations; and
- analytical parameters of interest.

The exact location of each surface water sample will be established in the field at the time of sampling. General sampling areas will be presented in the project-specific FAP. If surface water samples are to be collocated with sediment samples, surface water samples should always be collected before the sediment sample. The sample site will be noted on a site plan or aerial photograph and marked in the field with flagging and/or a wooden stake. The stake will be labeled with the sample site number.

The sample will be taken in the following manner:

1. Collect the sample from the surface water body by immersing a clean sample bottle. If a stream is being sampled, collect the sample while facing upstream with the opening of the sampling device oriented upstream but avoiding floating debris.
2. Or, directly fill the appropriate sample containers from a sampling device if one is needed.
3. Measure the following parameters, if possible, in the water body, not the sample:

    - PID reading;
    - temperature;
    - pH;
    - specific conductance;
    - elevation of significant surface water bodies; and
    - any other project-specific field measurements required.

    If direct measurement is not possible, measure these parameters from water remaining in the sampling device or another sample bottle. This information will be recorded on the Surface Water and Sediment FDR (Figure 4.14), sample labels will be completed, and COC procedures will be initiated.
4. Complete the sample data record and field logbook entry. Include any observations of special conditions such as color, odor, etc.

4.5.4.2 Pore Water Sampling

Pore water samples will be collected to locate contamination in groundwater discharge areas (i.e. ponds, steams, etc) in regions down gradient of suspected source areas. Impacted groundwater may then be traced up gradient from the discharge areas to the contaminant source. Pore water samples are usually collected using the following items:

- Peristaltic pump capable of a flow rate between 50 and 500 ml/minute and appropriate power supply.

- Field probe and flow-through cell (e.g., YSI) for measuring pH, temperature, conductance (and/or specific conductance), DO and oxidation-reduction potential (ORP) of groundwater, and a turbidity meter.
- DO meter
- Pore water sampling device, a 3/8-inch stainless steel slotted tip probe consisting of two parts; a strengthening rod and the pore water sampler, or a hollow tube with small holes in the tip to allow groundwater to percolate through.
- Calibration solutions for the field probes
- Water level tape
- Tubing, connections and tools as appropriate
- Graduated cylinder and stopwatch
- Groundwater grab FDR
- PPE
- Decontamination supplies (e.g., DI water, Liquinox soap, paper towels)
- Sample containers and cooler (provided by the laboratory)
- Ice for sample preservation
- Clean plastic sheeting, paper towels and miscellaneous supplies

The exact location of each pore water sample will be established in the field at the time of sampling. General sampling areas will be presented in the project-specific FAP. The sample site will be noted on a site plan or aerial photograph and marked in the field with flagging and/or a wooden stake. The stake will be labeled with the sample site number.

The sample will be taken in the following manner:

1. The pore water sampling device is inserted into the river/stream bed location to a desired depth, deep enough as to ensure the sample collected will contain only groundwater and no surface water.
2. The strengthening rod is then removed from the pore water sampling device, and the pore water sampler is then connected to the peristaltic pump using the appropriate tubing.
3. The pump is then turned on, allowing for the removal of particulate.

4. The DO concentrations will then be measured and compared to the associated surface water DO concentrations to ensure that the representative sample is not surface water.
5. Low flow purging and sampling protocol is not required, but may be conducted if desired.
6. During purging, collect at least one set of field parameters (turbidity, D.O., specific conductivity, temperature, pH, ORP) using a flow through cell (the flow through cell cannot be used for turbidity measurements and the sample for turbidity measurement must be collected prior to entering the flow through cell).
    - Turbidity (+/- 10% for values >10 NTU)
    - DO (+/- 10%)
    - Specific conductivity (+/- 3%)
    - Temperature (+/- 10%)
    - pH (± 0.1 unit)
    - ORP (± 10 millivolts)
7. During purging and sampling the tubing should remain filled with water.
8. Disconnect the tubing from the flow through cell to collect the analytical samples. Water samples for laboratory analyses must not be collected after water has passed through the flow through assembly. Fill sample containers directly from the tubing without alterations to the pumping rate.
9. The VOC fraction shall be collected first. The VOC sample container shall be completely filled without air space within the container. The remaining samples shall be collected for polynuclear aromatic hydrocarbons (PAHs), PCBs, metals, and any other fraction specified in the project-specific FAP for the sample location.
10. For subsequent sampling efforts, duplicate the pump intake depth and final purge rate from the initial sampling event (use final pump dial setting information).
11. The pore water sampling device and associated strengthening rod will be decontaminated appropriately before further use (See Section 4.3)
12. Complete the Low flow Groundwater Sampling Record (Figure 4.17) after each pore water sample is collected. Include any observations made during sampling such as color, odor, etc., in the field logbook and field sample data record.

4.5.4.3 Groundwater Sampling

Sampling of groundwater monitoring wells will proceed from the upgradient or background wells to the downgradient or potentially contaminated wells, as best as can be determined. Appropriate groundwater sampling techniques will be identified in the project-specific FAP, and approved in advance by NYSDEC. The following activities shall be performed immediately prior to purging each well:

1. Check the well for proper identification and location.
2. Measure and record the height of the protective casing above ground surface.
3. After unlocking the well and removing any well caps, measure and record the ambient and well-mouth organic vapor levels using a PID.
4. Measure and record the distance between the top of the well and the top of the protective casing.
5. Using the electronic water level meter, measure and record the static water level in the well and the depth to the well bottom to the nearest 0.01 ft. Measurements will be referenced from the top of the well riser as opposed to the protective casing, when feasible. The point of measurement and the depth to water will be recorded in the logbook and Groundwater Sample Data Records (Figure 4.10 and Figure 4.17). The water level meter is decontaminated upon removal as described in Subsection 4.3.3. In areas where light non-aqueous phase liquids (LNAPLs) are anticipated, an interface probe will be used to measure the thickness of free product present.
6. Calculate the volume of water in the well. Volume in gallons for a well equals 0.041 times the square of the ID of the well riser, in inches, times the depth of water, in ft. Volume calculations are detailed on the Groundwater Sample Data Record.

4.5.4.3.1 Groundwater Sampling Using Three Purged Well Volumes

The following steps outline the purging and sample collection activities for purged well volume sampling.

Upon completion of the measurements and calculations described in Section 4.5.2.2., sampling will commence in the sequence listed below, utilizing the appropriate purging technique (1a, 1b, or 1c):

1. Lower the pump intake into the well. For shallow groundwater situations, the pump intake will be lowered to the top of the well screen to begin purging (see Step No. 2). Modifications to this setup may be used in certain situations:

a. If the well screen is very large, and pumping from the top is impractical, the pump intake will be lowered to the approximate mid-point of the screened portion of the well.

b. If the well is situated in tight formations such as tills, clays or rock, the purging of the well will be performed from near the top of the well screen. As the water level in the well is lowered by purging, the pump is also lowered.

c. If the well is in a highly productive aquifer, purging will progress by purging at intervals in the well screen, from the top of the water column downward, to avoid leaving stagnant water in the well.

To avoid aeration of the sandpack, the water level will not be allowed, to the extent feasible, to fall below the top of the filter pack during purging except possibly in tight formations (see 1b above), where purging the well (and sandpack) dry can be unavoidable. The selection of the pump to be used for well purging will be presented in project-specific FAP, and approved in advance by NYSDEC.

Considerations in pump selection are depth to water, the level of contamination anticipated, site access, and cost. Readily available choices include peristaltic pumps (good for shallow groundwater depths), disposable submersible pumps, such as a Whale® pump (good for moderate groundwater depths and contamination), and stainless steel/Teflon® submersible pumps, such as the Redi-Flow® (good for most applications). Teflon bailers may also be used (good for shorter water columns).

1. Purge the well. Monitor the field parameters, pH, temperature, turbidity, and specific conductivity, and measure the volume of groundwater being pumped. In situ parameters may be monitored in a beaker filled from the pump discharge or in-line with the pump discharge. Purging of the standing well water is considered complete when any of the following is achieved:
   - a minimum of three well volumes has been purged,
   - the well has been pumped dry and allowed to recharge.
2. Record the in situ parameters, temperature, pH, specific conductivity, and turbidity in the field logbook and Low flow Groundwater Sampling Record (Figure 4.17).
3. After purging, the pump intake or the bailer will be lowered to the middle of the screened interval or mid-point of the static water level. If the analysis to be performed is for LNAPLs, then the bailer will be lowered to the top of the water column for sample collection.
4. Collect the sample(s). VOC samples are filled directly from a bailer or pump discharge with as little agitation as possible. Other samples can be placed directly into the appropriate container from the bailer or pump discharge.

5. Remove the pump or bailer from the well and decontaminate the pump, tubing or bailer by flushing with the decontamination fluid specified in Subsection 4.3.3, or dispose.
6. Complete the Low flow Groundwater Sampling Record (Figure 4.17) after each well is sampled. Include any observations made during sampling such as color, odor, etc., in the field logbook and field sample data record.
7. Secure the well cap and lock.

4.5.4.3.2 Low Flow Groundwater Sampling.

The following steps outline the purging and sample collection activities for low-flow sampling. Data will be recorded on the Low flow Groundwater Sampling Record (Figure 4.17). Pumps and probes may differ depending on the well diameter, groundwater constituents and depth to groundwater, but generally, sampling will require the following equipment:

- Peristaltic, bladder or inertial pump capable of a flow rate between 50 and 500 ml/minute and appropriate power supply. The pump type will principally depend on the depth to water and well diameter. Bladder pumps are preferred; peristaltic pumps are acceptable only for wells where the depth to water is less than about 25 ft; Inertail pumps are only recommended for narrow diameter wells that cannot be sampled using a bladder or peristaltic pump.
- Field probe and flow-through cell (e.g., YSI) for measuring pH, temperature, conductance (and/or specific conductance), DO and ORP of groundwater, and a standalone turbidity meter (e.g. Hach).
- Calibration solutions for the field probes
- Water level tape
- Tubing, connections and tools as appropriate
- Graduated cylinder and stopwatch
- Ring stand setup
- 5-gallon bucket and funnel for purge water
- Low flow groundwater FDR
- PPE
- Decontamination supplies (e.g., DI water, Liquinox soap, paper towels)
- Sample containers and cooler (provided by the laboratory)
- Ice for sample preservation

- Clean plastic sheeting, paper towels and miscellaneous supplies

Field parameter measurements shall be made using instrumentation and a commercially manufactured flow through cell. Dedicated high density polyethylene (HDPE) tubing shall be used. Further details on the low-flow purging and sampling procedure are presented in the "USEPA Region 1 - New England Low Stress (low-flow) Purging and Sampling Procedures for the Collection of Ground Water Samples from Monitoring Wells", Revision 3, January 19, 2010 (USEPA, 2010a). Sample collection information shall be recorded on the Low Flow Groundwater Sampling Record (Figure 4.17). The pH stabilization criteria of +/-0.2 units specified in this subsection shall not take precedence over the pH stabilization criteria of +/- 0.1 units specified in the USEPA guidance. The USEPA guidance shall be used for purging and sampling procedures only.

Sampling will be conducted using the following procedure:

1. Determine target depth for location of the pump intake. Target depth should be the portion of the screened interval that intersects the zone of highest K. If the zone of highest K is unknown, or if the screen is placed within homogenous material, then the target depth shall be the midpoint of the saturated screen length. Primary flow zones should be identified in wells with screen lengths longer than 10 ft.
2. Measure and record the depth to water. Care should be taken to minimize disturbance of the water column within the well during pre-sample measurements.
3. Decontaminate pump prior to use (if pumps are dedicated then this applies to the initial effort only). Attach appropriate length of dedicated HDPE tubing or mark the tubing at the appropriate point so that when the pump and tubing are lowered into the well, and the mark is at the top of the well riser, the pump shall be located at the target depth within the screened interval.
4. Carefully lower the pump to the predetermined target depth. Start the pump at a purge rate low enough to achieve 0.3 ft of drawdown or less based on historical data. If sampling the well for the first time, start the pump at the lowest possible setting (or approximately 100-ml per minute) and slowly increase the speed until discharge occurs. Check water level. Adjust pump speed until there is little or no drawdown (less than 0.3 ft) if possible. If stabilized drawdown cannot be achieved, use the no-purge method described later in this section.
5. Monitor and record pumping rate and water levels every 3 to 5 minutes (or as appropriate) during purging. Record any adjustments to pumping rates.
6. During purging, monitor field parameters using a flow through cell (the flow through cell cannot be used for turbidity measurements and the sample for turbidity measurement must be

collected prior to entering the flow through cell). Purging is considered complete and sampling may begin when the field parameters have stabilized. Stabilization is considered to be achieved when three consecutive readings, taken at 3 to 5 minute intervals, are within the following limits:

- Turbidity (+/- 10% for values >10 NTUs if turbidity is greater than 10 and well is not stable, continue purging well for up to two hours, collect sample and document on field data record and in log book (collection of a filtered sample for metals analysis may be necessary if turbidity is greater than 50 NTUs).)
- DO (+/- 10% for values greater than 0.5 milligram per liter (mg/L). If three dissolved oxygen values are < 0.5 mg/L, consider the values stabilized)
- Specific conductivity (+/- 3%)
- Temperature (+/- 3%)
- pH (± 0.1 unit)
- ORP (± 10 millivolts)

7. The final purge volume must be greater than the stabilized drawdown volume plus the tubing extraction volume.
8. During purging and sampling the tubing should remain filled with water.
9. Disconnect the tubing from the flow through cell to collect the analytical samples. Water samples for laboratory analyses must not be collected after water has passed through the flow through assembly. Fill sample containers directly from the tubing without alterations to the pumping rate.
10. The VOC fraction shall be collected first. The VOC sample container shall be completely filled without air space within the container. The remaining samples shall be collected for PAHs, PCBs, metals, and any other fraction specified in the project-specific FAP for the sample location.
11. For subsequent sampling efforts, duplicate the pump intake depth and final purge rate from the initial sampling event (use final pump dial setting information).
12. If using non-dedicated equipment, remove the pump and decontaminate by flushing with the decontamination fluid specified in Subsection 4.3.3, or dispose. Obtain and record a depth to bottom of well measurement before closing the well.
13. Complete the Low flow Groundwater Sampling Record (Figure 4.17) after each well is sampled. Include any observations made during sampling such as color, odor, etc., in the field logbook and field sample data record.
14. Secure the well cap and lock.

4.5.4.3.3 Groundwater sampling using aqueous diffusion samplers

This procedure is designed to permit the collection of representative groundwater samples for analysis of VOCs. Groundwater sampling using aqueous diffusion samplers will be conducted using the procedures described below and in accordance with the User's Guide for Polyethylene-Based Passive Diffusion Bag Samplers to Obtain Volatile Organic Compound Concentrations in Wells (Vroblesky, 2001).

Aqueous diffusion samplers are constructed by sealing de-ionized water in polyethylene tubing (1-millimeter thickness is typical). Tubing sizes vary, but can be up to 2-feet long. Samplers can be acquired pre-filled with laboratory de-ionized water, or assembled by the sampler. If assembled by the sampler, on option is to seal the de-ionized water in the polytubing by using a heat seal device. One end of the polytube is rolled over onto itself several times then heat is applied to seal this end. The polytube is then filled with de-ionized water. The top end (unsealed end) of the tube is then rolled over onto itself until there is no headspace in the polytube; heat is then applied to seal this end. Care is taken to ensure that no headspace or air bubbles are present in the tube prior to sealing the top end. The samplers are weighted with stainless steel weights, and a stainless steel line is attached to the top of the sampler for placement and retrieval.

The sampling generally uses the following equipment/items:

- Well construction data, location map, and field data from the previous sampling event,
- Diffusion sampler filled with de-ionized water and weight attached to bottom,
- Stainless steel cable of the required length for setting and attaching the sampler,
- Field probe and flow-through cell (e.g., YSI) for measuring pH, temperature, conductance (and/or specific conductance), DO and ORP of groundwater, and a standalone turbidity meter (e.g. Hach),
- Calibration solutions for the field probes,
- Water level tape (0.01-ft accuracy),
- Field Data Record,
- PPE,

- Decontamination supplies (e.g., DI water, Liquinox soap, paper towels),
- Sample containers and cooler (provided by the laboratory),
- Ice for sample preservation, and
- Clean plastic sheeting, and miscellaneous supplies.

Sampling will be conducted using the following procedures:

1. Enter the following information in the field logbook and FDR, as appropriate, prior to installation of the diffusion sampler: date and time of sampler installation, depth of sampler, and total depth of well.
2. Attaching weight to the base of the sampler and stainless steel line to the top of the sampler.
3. Install the sampler at the predetermined depth, attaching the top of the line to a secure location at the ground surface and the well cap should be replaced to ensure surface water does not enter the well. The depth of the sampler will be determined prior to installation, based on previous sampling data or previously collected aqueous diffusion samplers.
4. Allow the sampler to equilibrate for approximately 14 days. Return after no less than 14 days to retrieve the sampler. Samplers can remain in the well for longer than 14 days, if necessary.
5. Enter the following information in the field logbook and FDR, as appropriate, during retrieval of diffusion sampler: date and time of sampler retrieval, analytical method, and quality assurance/quality control data as necessary.
6. Retrieve the diffusion sampler from the well and note any observations on the FDR (possible tears, iron build up, etc.).
7. After retrieving sampler, install an in-well water quality parameter meter such as a YSI 556 or equivalent. Remove the line and weight, and make a diagonal cut toward the top of the sampler. The diagonal cut allows easier filling of the sample containers. A dealer supplied discharge device may also be used.
8. Begin filling the volatile organic compound sample containers from the diagonal cut or discharge device by allowing the water to flow gently down the inside of the container with as little agitation or minimal aeration as possible.
9. Label each sample container upon filling. Placed sample containers into a cooler with ice.
10. After sample collection is complete, record water quality parameter readings and then remove the water quality meter from the well. Cap and lock the well.
11. Complete remaining portions of the FDR after each well is sampled, including sample date and time (time of retrieval from the well), well sampling sequence, types of sample bottles

used, sample identification numbers, preservatives used, parameters requested for analysis, and field observations of the sampling event.

4.5.4.4 Domestic Well Sampling

Domestic wells will be sampled using the same procedures described for groundwater monitoring wells, with the exception of using in-place plumbing equipment. Prior to any sampling, MACTEC personnel will contact the well owner and complete a Groundwater Usage Survey (Figure 4.18). The information provided on the survey will be used to identify downgradient domestic wells.

The sampling point at each domestic well location will be determined at the time of sampling and will be as close to the pump as practical. When possible, samples will be taken up-line from aerators, softeners, or filtering systems. If there is no outlet available up-line from the water treatment system, attempts will be made to by-pass the system, if possible.

When the necessary information is available, the purge volume will be calculated to ensure purging of one storage volume, based on pressure tank volume, before sampling. If such information is unavailable, the tap will be opened and the water will be allowed to run for a minimum of fifteen minutes and until the pH and temperature stabilize. Sample containers will be filled directly from the tap or faucet. Samples will be collected as described for monitoring well samples, except that samples collected for inorganic analyses will not be filtered so that the samples will accurately represent the quality of water ingested by residents.

4.5.5 General Sediment Sampling Methodology

Sediment sampling procedures are designed to obtain representative samples of the sediment from streams, lakes, ponds, wetlands, and lagoons for chemical analysis.

The exact location of each sediment sample will be established in the field at the time of sampling. Sediment sampling points are often collocated with surface water samples. Sediment samples should always be collected after the surface water sample. Sediments in shallow water conditions may be collected without the use of a boat if agitation of sediment prior to collection can be avoided.

Sediment samples will be collected in the following manner:

1. Select the sample location, identify it on a Site map, and set the wooden stake, as close as practicable, onshore. For offshore sampling locations, temporary buoys may be set or the location may be located with global positioning system (GPS).
2. Verify sediment sampling point is within the depositional area identified during the initial Site reconnaissance.
3. Remove large stones and plant debris that are not an integral component of this sediment media. Exercise caution to avoid disturbing the sediments at the sampling point.
4. Use a gravity corer, hand corer, hand auger, trowel, Ponar® dredge, or other equivalent equipment to collect sediment samples. A stainless steel spoon and bowl may be used for locations that are shallow (i.e., less than 6-inches). If the water is shallow enough, push the gravity corer or hand auger directly into the substrate until approximately one inch or less of the sampling device is above the sediment/water interface. If the substrate is hard or coarse, the corer may be rotated gently while it is pushed to facilitate greater penetration and reduce core compaction.
5. Remove the sampling apparatus gently from the sediment to avoid losing the sample, and rise to the surface.
6. Hold the sampling device above the water to allow residual surface water to run off the device. When water is no longer running off the device, transfer the sediment sample to a stainless steel bowl. Collect a minimum of 500 grams of sediment at each location. For example, with the gravity corer, one tube with a 4-inch-long core, 2-inch outside diameter, and wall thickness of 1/8-inch is adequate for one sample, as the volume of each core would be approximately 750 ml. For other tube sizes and core lengths, the number of tubes necessary can be calculated by using the formula for the volume of a cylinder (i.e., $\pi r^2 h$).
7. Sediment samples may have high percent moisture content. Prior to transferring sample aliquots to appropriate containers, standing water should be decanted from the stainless steel bowl.
8. If sediment samples are scheduled for VOC analysis, collect this parameter first. Do not homogenize the sample at this point. For VOC sample collection, preserved (methanol) or unpreserved sampling techniques may be used. The use of preserved sampling techniques is preferred, but unpreserved sampling technique may be used if requested by the NYSDEC PM. The technique to be used will be identified in the project-specific FAP.

Preserved Collection - Advance a latex free, medical grade 10 cubic centimeter (cc) plastic syringe, designed to reduce the exposure of the sediment sample to air, directly into the sediment core or contents in the stainless steel bowl. Transfer the sediment sample into the pre-labeled, pre-preserved and pre-weighed vial and replace the cap. Do not attach any labels or tape to the pre-weighed sample vials. The volume of sediment collected will depend on the volume of methanol. An approximate equal volume of sediment and methanol will be added to the sample vials. Collect an additional sediment jar for percent solids determination. Label this additional jar "VOC percent solid" and the same sample information as the original sample.

Unpreserved Collection – Transfer the sediment sample using a stainless steel spoon or spatula directly to a 2 oz sample container. Fill the sample container completely to reduce the exposure of the sediment sample to air and cap.

9. If Acid Volatile Sulfide: Simultaneously Extracted Metals (AVS:SEM) will be collected, collect the AVS:SEM sample in air-tight syringes to prevent exposure of sediments to oxygen during sample collection and storage. The field samplers will collect approximately 10 grams of sample in each syringe. The filled syringe will be capped immediately. The laboratory must keep the sample in the syringe until introduction to the apparatus. The sample will remain capped until the AVS:SEM apparatus is set up and purged to eliminate oxygen. The sample syringe will be opened and sediment will be immediately transferred to the apparatus. Sample weight will be determined by calculation by weighing the syringe before and after sample transfer.
10. After the AVS:SEM sample has been collected, homogenize the sediment within the stainless steel bowl with a stainless steel spoon so that each sample aliquot is representative of the whole. Take care to ensure that sufficient sediment is present in the stainless steel bowl to fill all of the associated sample fractions (containers) and duplicate fractions, if necessary. Collect the remaining sample fractions (e.g., SVOCs, PCBs, and metals) using a stainless steel spoon and transfer the sediment into the sample containers.

Sediment sampling information is recorded on the Surface Water Sediment FDR (Figure 4.14) and/or in the logbook.

4.5.6 General Air Sampling Methodology

Air sampling work will be performed in accordance with DER-10 Technical Guidance for Site Investigation and Remediation (NYSDEC, 2010a), DER-13 Strategy for Evaluating Soil Vapor Intrusion at Remedial Sites in New York (NYSDEC, 2006a), and the NYSDOH Guidance for Evaluating Soil Vapor Intrusion in the State of New York (NYSDOH, 2006).

Substructure soil vapor, soil vapor, and/or ambient air sampling may be used to evaluate human exposure to VOCs through vapor intrusion. Field data from the collection of air samples will be recorded on a field data form (Figure 4.19).

4.5.6.1 24-Hour Substructure Soil Vapor Sampling

Substructure soil vapor samples will be collected from beneath residential, commercial, industrial, institutional, and multiuse buildings using SUMMA® type air canisters equipped with metering flow controllers for the purpose of collecting a "time-averaged" soil vapor sample. This technique is intended for 24-hour sample collection and may be collected in conjunction with indoor air samples. In some instances, 20-minute grab soil vapor samples will be permitted to identify potential VOC contamination beneath the slab (See Subsection 4.5.5.2). Substructure soil vapor samples may be collected from one of the following areas:

Area 1) Subslab soil vapor sample obtained via a temporary installed sampling port through apparent vapor barrier (such as floor slab or plastic liner); or

Area 2) Air sample obtained from crawl space or basement without an apparent vapor barrier.

Substructure soil vapor grab sampling will require the following equipment:

- Documentation of access permission from the owner to complete the sampling
- 6-liter, stainless steel, pre-evacuated SUMMA®-type canister - laboratory provided
- Pressure gauge with integrated 24-hour metering valve - laboratory provided
- Two, 9/16-inch, open-end wrenches
- PID – part per billion range -for screening crawl space/cracks
- Utility Knife
- Electric hammer drill with 1-inch and 3/8-inch diameter drill bits
- Two 50-ft long electrical extension cords
- ¼-inch O.D. Teflon® tubing

- ¼-inch stainless steel valve and stainless steel "tee" type fitting
- 60 cc polyethylene syringe for purging tubing
- 1-inch diameter laboratory grade rubber stopper with ¼-inch port
- Unscented beeswax, pan, and heat plate, or other NYSDEC approved seal.
- Quick-drying expansive Portland cement
- Wristwatch
- Digital camera
- Flashlight
- Indoor Air Quality Questionnaire and Building Inventory Form (Appendix A)
- COC form - laboratory provided

Procedure for Substructure Soil Vapor Sample Collection:

The procedures for substructure soil vapor sample collections will be dependent on location category. During the occupant/owner interview and building survey the lowest accessible portion of the building (e.g., crawl space, basement, or first floor of slab-on-grade construction) will be observed to assess which substructure sampling area category is applicable. The steps provided below should be considered a general guidance on the collection of substructure soil vapor samples for each location category; the sequence can be modified as needed based on site- or project-specific conditions at the time of sample collection.

Area 1: Subslab soil vapor sample obtained via temporary installed sampling port through apparent vapor barrier (i.e. floor slab or plastic liner).

1. **Select and prepare the sample collection point.**
   - Conduct interview with occupant/owner. Complete Indoor Air Quality Questionnaire and Building Inventory Form (Appendix A).
   - Observe the condition of the building floor slab for apparent penetrations such as concrete floor cracks, floor drains, or sump holes.
   - Note the floor conditions on the sampling form and select a potential location or locations for a temporary subsurface probe.

- The location or locations should be central to the building away from foundation walls and apparent penetrations.
- Review the proposed location or locations with the occupant/owner describing how the sampling port or ports will be installed.
- After receiving' permission from the occupant/owner, mark the proposed location(s) and describe the location(s) on the sampling form.
- Using the PID, screen indoor air in the area of floor penetrations such as concrete floor cracks, floor drains, or sump holes. Record the indoor air PID readings on the sampling form.

2. Installation of temporary subsurface sample point

- Drill a 1-inch diameter hole about to 2 inches into the concrete slab using an electric hammer drill.
- Extend the hole through the remaining thickness of the slab using a 3/8-inch drill bit. Extend the hold about three inches into the subslab material using either the drill bit or a steel probe rod. Sweep hole to remove excess dust.
- Insert a section of ¼-inch O.D. Teflon® tubing to the bottom of the floor slab. Seal the annular space between the 1-inch hole and 1/4-inch tubing by seating a tapered laboratory-grade rubber plug perforated with a 1/4-inch hole into the probe hole and if necessary capping the stopper with a beeswax seal, or other seal approved by the NYSDEC. The beeswax will be melted with an electric heat plate.
- Connect the ¼ -inch Teflon® tubing to a stainless steel valve using compression fittings. Open the in-line valve and purge the probe tubing using a polyethylene 60 cc syringe. Close the valve, remove and cap the syringe, and connect the ¼-inch Teflon® tubing and in-line valve to a SUMMA®-type canister. The air/soil vapor syringe will be discharge out of doors. For duplicate sample locations connect a second canister before purging by installing a 1/4-inch stainless steel "tee" fitting between the probe discharge tubing and the stainless steel valve.

3. Preparation of 24-hour SUMMA®-type canister and collection of sample

- Place SUMMA®-type canister adjacent to the temporary sampling port.
- Record SUMMA®-type canister serial number on sampling summary form and COC.
- Record sample identification on canister identification tag, and record on sampling summary form and COC.
- Remove brass plug from canister fitting.
- Install pressure gauge/metering valve on canister valve fitting and tighten. If pressure gauge has additional (2nd) fitting, install brass plug from canister fitting into gauge fitting and tighten.
- Open and close canister valve.
- Record gauge pressure on sample summary form and COC. Gauge pressure must read >25 inches Hg. Replace SUMMA®-type canister if gauge pressure reads <25 inches Hg.
- Remove brass plug from gauge fitting and store for later use.
- Connect subsurface probe to end of in-line particular filter via ¼-inch O.D. Teflon® tubing and "swagelok®-type" fittings.
- Open canister valve and in-line stainless steel valve to initiate sample collection.
- Record date and local time (24-hour basis) of valve opening on sampling summary form and COC.
- Take digital photograph of SUMMA®-type canister and surrounding area.

4. Termination of 24-hour sample collection

- Revisit SUMMA®-type canister approximately at end of sample collection period (e.g., 24 hours after initiation of sample collection) and record gauge pressure on sampling form and COC.
- Record date and local time (24-hour basis) of valve closing on sampling form and COC.
- Close canister valve.
- Disconnect Teflon® tubing and remove pressure gauge / flow valve from canister.

- Reinstall brass plug on canister fitting and tighten.
- Remove SUMMA®-type canister from sample collection area.
- Remove temporary probe and rubber stopper and fill the hole with a quick drying hydraulic cement. Finish flush with floor surface.

Area 2: Air sample obtained from crawl space or basement without an apparent vapor barrier.

1. Select and prepare the sample collection point

- Conduct interview with occupant/owner. Complete Indoor Air Quality Questionnaire and Building Inventory Form (Appendix A).
- Observe the area for the apparent presence of items or materials that may potentially produce or emit VOCs and interfere with analytical laboratory analysis of the collected sample. Record relevant information on Building Inventory Form and document with digital photographs.
- Using the PID, screen indoor air in the location intended for sampling and in the vicinity of potential VOC sources (i.e. paints, glues, household cleaners, dry cleaned clothes, etc.) to assess the potential gross presence of VOCs. Record PID readings on the sampling form. Items or materials exhibiting PID readings shall be considered probable sources of VOCs and, given approval of the owner or occupant, will be removed prior to sampling. If practical, sampling will be rescheduled for 24-hours later.

2. Preparation of 24-Hour SUMMA®-type canister and collection of sample

- Place SUMMA®-type canister at breathing zone height (approximately 3 to 5 ft above basement floor or about 1 ft above floor of crawl space). Canister can be placed on a stable surface, such as a table or bookshelf, or affixing to a wall or ceiling support with nylon rope. Avoid placing canisters near windows or other potential sources of drafts and air supply vents.
- Record SUMMA®-type canister serial number on sampling summary form and COC.
- Record sample identification on canister identification tag, and record on sampling summary form and COC.
- Remove brass plug from canister fitting.

- Install pressure gauge / metering valve on canister valve fitting and tighten. If pressure gauge has additional (2nd) fitting, install brass plug from canister fitting into gauge fitting and tighten.
- Open and close canister valve.
- Record gauge pressure on sample summary form and COC. Gauge pressure must read >25 inches Hg. Replace SUMMA®-type canister if gauge pressure reads <25 inches Hg.
- Remove brass plug from gauge fitting and store for later use.
- Open canister valve to initiate sample collection.
- Record date and local time (24-hour basis) of valve opening on sampling summary form and COC.
- Take digital photograph of SUMMA®-type canister and surrounding area.

3. Termination of 24-hour sample collection

- Revisit SUMMA®-type canister approximately at end of sample collection period (e.g., 24 hours after initiation of sample collection) and record gauge pressure on sampling form and COC.
- Record date and local time (24-hour basis) of valve closing on sampling form and COC.
- Close canister valve.
- Remove pressure gauge / flow valve from canister.
- Reinstall brass plug on canister fitting and tighten.
- Remove SUMMA®-type canister from sample collection area.

4. Preparation and shipment of sample to analytical laboratory

- Pack SUMMA®-type canister in shipping container, note presence of brass plug installed in tank fitting.
- Complete COC and place requisite copies in shipping container.
- Close shipping container and affix custody seal to container closure.

Quality Assurance/Quality Control (QA/QC) samples:

The collection of QA/QC samples will include the submittal of blind sample duplicates to the analytical laboratory for analyses of target compounds. Area 2- type duplicate samples will be collected "side-by-side" over the same time interval. Area 1- type duplicate samples will be obtained using a stainless steel "tee" type fitting and 1/4-inch O.D. Teflon®- tubing connected to the same subsurface probe.

4.5.6.2 Substructure Soil Vapor Grab Sampling

Substructure soil vapor grab samples will be collected from beneath residential, commercial, industrial, institutional, and multiuse buildings with an apparent vapor barrier using SUMMA® type air canisters equipped with metering flow controllers. This technique is intended for 20 minute sample collection. Substructure soil vapor grab samples may be collected from a temporary installed sampling port through an apparent vapor barrier (such as floor slab or plastic liner).

Substructure soil vapor grab sampling will require the following equipment:

- Documentation of access permission from the owner to complete the sampling
- 1.4-liter, stainless steel, pre-evacuated SUMMA® canister - laboratory provided
- Pressure gauge with integrated 20-minute metering valve - laboratory provided
- PID
- Utility Knife
- Electric hammer drill with 3/8-inch diameter drill bit
- Two 50-ft long electrical extension cords
- ¼-inch O.D. Teflon® tubing
- ¼-inch stainless steel valve and stainless steel "tee" type fitting
- 3/16-inch I.D. silastic tubing
- 60 cc polyethylene syringe for purging tubing
- Quick-drying hydraulic cement

- Wristwatch
- Digital camera
- Flashlight
- Dust pan and broom
- Indoor Air Quality Questionnaire and Building Inventory Form (Appendix A)
- COC form - laboratory provided

Procedure for 20-Minute Substructure Soil Vapor Grab Sample Collection

During the occupant/owner interview and building survey the lowest accessible portion of the building (e.g., crawl space, basement, or first floor of slab-on-grade construction) will be observed to assess applicability of sampling technique (i.e., Is there a vapor barrier?). The steps provided below should be considered a general guidance on the collection of substructure soil vapor samples; the sequence can be modified as needed based on site- or project-specific conditions at the time of sample collection.

Selection and preparation of sample collection point

A. Conduct interview with occupant/owner. Complete the Indoor Air Quality Questionnaire and Building Inventory Form (Appendix A).
B. Observe the condition of the building floor slab for apparent penetrations such as concrete floor cracks, floor drains, or sump holes. Note the floor conditions on the sampling form and select a potential location or locations for a temporary subsurface probe. The location or locations should be central to the building away from foundation walls and apparent penetrations. Review the proposed location or locations with the occupant/owner describing how the sampling port or ports will be installed. After receiving' permission from the occupant/owner, mark the proposed location(s) and describe the location(s) on the sampling form.
C. Using the PID, screen indoor air in the area of floor penetrations such as concrete floor cracks, floor drains, or sump holes. Record the indoor air PID readings on the sampling form.

Installation of temporary subsurface sample point

A. Drill a 3/8-inch diameter hole through the thickness of the slab. Extend the hold about two inches into the subslab material using either the drill bit or a steel probe rod.

B. Insert a section of 1/4-inch O.D. Teflon® tubing to the bottom of the floor slab. Seal the annular space between the 3/8-inch hole and 1/4-inch tubing with either a beeswax seal, or with a NYSDEC approved putty/seal (i.e. non-VOC emitting play dough). The beeswax will be melted with an electric hot plate.

C. Connect the 1/4-inch Teflon® tubing to a stainless steel valve using 3/16-inch ID silastic tubing. Open the in-line valve and purge the probe tubing using a polyethylene 60 cc syringe (purging with a PID is also acceptable if no indoor air samples are to be collected). Close the valve, remove and cap the syringe, and connect the silastic tubing to the in-line valve on the SUMMA® canister. The air/soil vapor syringe will be discharge out of doors if indoor air samples are to be collected. For duplicate sample locations connect a second canister before purging by installing a 1/4-inch stainless steel "tee" fitting between the probe discharge tubing and the stainless steel valve.

Preparation of 20-minute SUMMA® canister and collection of sample

A. Place SUMMA® canister adjacent to the temporary sampling port.

B. Record SUMMA® canister serial number on sampling summary form and COC.

C. Record sample identification on canister identification tag, and record on sampling summary form and COC.

D. Remove plastic cap canister fitting.

E. Open and close canister valve.

F. Record gauge pressure on sample summary form and COC. Gauge pressure must read >25 inches Hg. Replace SUMMA® canister if gauge pressure reads <25 inches Hg.

G. Connect canister to silastic tubing already connected to the subsurface probe.

H. Open canister valve and in-line stainless steel valve to initiate sample collection.

I. Record date and local time (20-minute basis) of valve opening on sampling summary form and COC.

J. Take digital photograph of SUMMA® canister and surrounding area.

Termination of 20-minute sample collection

A. Upon completion of 20 minute sample collection, record gauge pressure on sampling form and COC.
B. Record date and local time (20 minute basis) of valve closing on sampling form and COC.
C. Close canister valve.
D. Disconnect silastic tubing and recap pressure gauge.
E. Remove SUMMA® canister from sample collection area.
F. Remove temporary probe from hole. Fill hole with a quick drying hydraulic cement. Finish flush with floor surface.

4.5.6.3 Indoor Air Sampling

Indoor air samples will be collected from residential, commercial, industrial, institutional, and multiuse buildings. This technique is intended to be a general directive for the collection of indoor air samples using SUMMA®-type air canisters equipped with metering flow controllers for the purpose of collecting a "time-averaged" indoor air sample. This procedure is intended for 24-hour sample collection and may be collected in conjunction with 24 hour substructure soil vapor sampling. Indoor air data will be recorded on a field data form (Figure 4.19).

For the purposes of evaluating the potential vapor migration from soils and groundwater into indoor air, samples will be collected from the lowest usable area of the building. Indoor air samples may be collected from one of the following areas:

1. Unfinished basement or unfinished first floor of slab-on-grade building;
2. Finished basement or finished first floor of slab-on-grade building; or
3. First floor living area above a dirt-floored crawl space or unfinished basement.

Indoor air sampling will require the following equipment:

- Documentation of access permission from the owner to complete the sampling
- 6-liter, stainless steel, pre-evacuated SUMMA®-type canister - laboratory provided
- Pressure gauge with integrated 24-hour metering valve - laboratory provided
- Two, 9/16-inch, open-end wrenches
- PID – part per billion range detector for screening indoor air
- Wristwatch
- Digital camera
- Indoor Air Quality Questionnaire and Building Inventory Form (Appendix A)
- COC form -laboratory provided

Procedure for Indoor Air Sample Collection

The following section provides a general guidance on the collection of indoor air samples; the sequence can be modified as needed based on site specific conditions at the time of sample collection.

Selection and Preparation of indoor air sample collection area

A. Conduct interview with occupant/owner. Complete Indoor Air Quality Questionnaire and Building Inventory Form (Appendix A).
B. Observe the area for the apparent presence of items or materials that may potentially produce or emit VOCs and interfere with analytical laboratory analysis of the collected sample. Record relevant information on Building Inventory Form and document with digital photographs.
C. Using the PID, screen indoor air in the location intended for sampling and in the vicinity of potential VOC sources (i.e. paints, glues, household cleaners, dry cleaned clothes, etc.) to assess the potential gross presence of VOCs. Record PID readings on the sampling form. Items or materials exhibiting PID readings shall be considered probable sources of VOCs and, given approval of the owner or occupant, will be removed prior to sampling. If practical, sampling will be rescheduled for 24-hours later.

Preparation of SUMMA®-type canister and collection of indoor air sample

A. Place SUMMA®-type canister at breathing zone height (approximately 3 to 5 ft above floor). Canister can be placed on a stable surface, such as a table or bookshelf, or affixing to a wall or ceiling support with nylon rope. Avoid placing canisters near windows or other potential sources of drafts and air supply vents.

B. Record SUMMA®-type canister serial number on sampling summary form and COC.

C. Record sample identification on canister identification tag, and record on sampling summary form and COC.

D. Remove brass plug from canister fitting.

E. Install pressure gauge / metering valve on canister valve fitting and tighten. If pressure gauge has additional (2nd) fitting, install brass plug from canister fitting into gauge fitting and tighten.

F. Open and close canister valve.

G. Record gauge pressure on sample summary form and COC. Gauge pressure must read >25 inches Hg. Replace SUMMA®-type canister if gauge pressure reads <25 inches Hg.

H. Remove brass plug from gauge fitting and store for later use.

I. Open canister valve to initiate sample collection.

J. Record date and local time (24-hour basis) of valve opening on sampling summary form and COC.

K. Take digital photograph of SUMMA®-type canister and surrounding area.

Termination of indoor air sample collection

A. Revisit SUMMA®-type canister approximately at end of sample collection period (e.g., 24 hours after initiation of sample collection) and record gauge pressure on sampling form and COC.

B. Record date and local time (24-hour basis) of valve closing on sampling form and COC.

C. Close canister valve.

D. Remove pressure gauge / flow valve from canister.

E. Reinstall brass plug on canister fitting and tighten.

F. Remove SUMMA®-type canister from sample collection area.

Preparation and shipment of sample to analytical laboratory

A. Pack SUMMA®-type canister in shipping container, note presence of brass plug installed in tank fitting.
B. Complete COC and place requisite copies in shipping container.
C. Close shipping container and affix custody seal to container closure.

Quality Assurance/Quality Control (QA/QC) samples:

The collection of QA/QC samples will include the submittal of blind sample duplicates to the analytical laboratory for analyses of target compounds. Duplicate samples will be collected "side-by-side" over the same time interval.

4.5.6.4 Ambient Air Sampling

Ambient (outdoor) air samples will be collected in the vicinity of residential, commercial, industrial, institutional, and multiuse buildings. This technique is intended to be a general directive for the collection of ambient air samples using SUMMA®-type air canisters equipped with metering flow controllers for the purpose of collecting a "time-averaged" ambient air sample. This procedure is intended for 24-hour sample collection. Ambient air sampling information will be recorded on the FDR (Figure 4.19).

Ambient air sampling will require the following equipment:

- Documentation of access permission from the owner to complete the sampling
- 6-liter, stainless steel, pre-evacuated SUMMA®-type canister - laboratory provided
- Pressure gauge with integrated 24-hour metering valve - laboratory provided
- Two, 9/16-inch, open-end wrenches
- PID – part per billion range detector for screening air
- Wristwatch

- Digital camera
- Indoor Air Quality Questionnaire and Building Inventory Form (Appendix A)
- COC form - laboratory provided

Procedure for Ambient (outdoor) Air Sample Collection

The following section provides a general guidance on the collection of ambient air samples; the sequence can be modified as needed based on site specific conditions at the time of sample collection.

Selection and Preparation of ambient sample collection area

A. Conduct interview with occupant/owner. Complete Indoor Air Quality Questionnaire and Building Inventory Form. (Appendix A).
B. Choose an area for sample collection that is upwind of the property (properties) being assessed, if possible. Collect sample away from wind breaks, if possible.
C. Observe the area for the apparent presence of items or materials that may potentially produce or emit VOCs and interfere with analytical laboratory analysis of the collected sample (i.e. fuel tanks, gasoline, paint storage, etc.). Record relevant information on Building Inventory Form and document with digital photographs.
D. Using the PID, screen ambient air in the location intended for sampling to assess the potential gross presence of VOCs. Record PID readings on the sampling form.

Preparation of SUMMA® canister and collection of ambient sample

A. Place SUMMA®-type canister approximately 5 ft above ground (or equivalent to the mid-point of the ground story of the building(s). Canister can be placed on a stable surface, or suspended from structure with nylon rope.
B. Record SUMMA®-type canister serial number on sampling summary form and COC.
C. Record sample identification on canister identification tag, and record on sampling summary form and COC.
D. Remove brass plug from canister fitting.

E. Install pressure gauge/metering valve on canister valve fitting and tighten. If pressure gauge has additional (2nd) fitting, install brass plug from canister fitting into gauge fitting and tighten.

F. Open and close canister valve.

G. Record gauge pressure on sample summary form and COC. Gauge pressure must read >25 inches Hg. Replace SUMMA®-type canister if gauge pressure reads <25 inches Hg.

H. Remove brass plug from gauge fitting and store for later use.

I. Open canister valve to initiate sample collection.

J. Record date and local time (24-hour basis) of valve opening on sampling summary form and COC.

K. Take digital photograph of SUMMA®-type canister and surrounding area.

Termination of ambient sample collection

A. Revisit SUMMA®-type canister approximately at end of sample collection period (e.g., 24 hours after initiation of sample collection) and record gauge pressure on sampling form and COC.

B. Record date and local time (24-hour basis) of valve closing on sampling form and COC.

C. Close canister valve.

D. Remove pressure gauge / flow valve from canister.

E. Reinstall brass plug on canister fitting and tighten.

F. Remove SUMMA®-type canister from sample collection area.

Preparation and shipment of sample to analytical laboratory

A. Pack SUMMA®-type canister in shipping container, note presence of brass plug installed in tank fitting.

B. Complete COC and place requisite copies in shipping container.

C. Close shipping container and affix custody seal to container closure.

Quality Assurance/Quality Control (QA/QC) samples:

The collection of QA/QC samples will include the submittal of blind sample duplicates to the analytical laboratory for analyses of target compounds. Duplicate samples will be collected "side-by-side" over the same time interval.

4.6 DRUM SAMPLING

Sampling personnel will develop an exclusion zone at the drum location in accordance with the project-specific HASP. The work area will be cleared of all physical hazards. Plastic sheeting will be used around the drums to protect the ground surface during sampling. Sample jars will be labeled in accordance with the project-specific FAP. Sampling will be performed at the level of personal protection specified in the project-specific HASP. Due to the potential release of hazardous gases, MACTEC will only sample drums already open to the atmosphere and will not open drums or perform remote sampling. The ambient air conditions in and around the drums will be monitored using a PID.

Documentation in the field logbook should begin with a visual inspection of the drum, noting any holes, markings and weak spots. Any readings detected with the PID should be recorded. A description of the drum contents should be recorded (color, consistency, etc.).

Solids can be sampled from the drums using several methods: a bucket auger, hand auger, or hand scoop; if the drums are open to the atmosphere. When the drum has been sampled, all sampling equipment should be decontaminated as described in the project-specific HASP.

4.7 AQUIFER CHARACTERIZATION

Aquifer testing activities include water level measurements and in situ K testing. These tests are designed to characterize groundwater flow patterns and to assess aquifer characteristics.

4.7.1 Water Level Measurements

Groundwater level measurements can be made in monitoring wells, private or public drinking water wells, piezometers, or open boreholes. Water level measurements in monitoring wells should be made before purging and evacuation for groundwater sampling.

The procedures for water level measurements are:

1. Check the well for proper identification and location.
2. Measure and record the height of protective casing from ground surface to check for settlement or heave.
3. After unlocking the well and removing any well caps, measure and record the ambient and well-mouth organic vapor levels using a PID. This level will be recorded in the field notebook and the appropriate health and safety actions taken, in accordance with the project-specific HASP.
4. Measure and record the distance between the top of the well riser and the top of the protective casing to check for heave or settling.
5. Using an electronic water level meter (or similar measuring device), measure and record the static water level in the well and the depth to the well bottom to the nearest 0.01 ft. Measurements will be referenced from the top of the well riser, as opposed to the protective casing, when feasible. An interface probe will be used in areas where LNAPLs are anticipated. (The water level meter should be decontaminated after use according to the procedures specified in Subsection 4.3.3).

All well measurements will be recorded, along with the date and time of measurement, in the field notebook. Every well will have a clearly established reference point of known elevation, normally a painted mark on the upper edge of the riser pipe.

4.7.2 Hydraulic Conductivity Testing

In situ K testing is designed to provide information about aquifer characteristics by measuring aquifer response to stress, such as a sudden fall or rise in water levels. The most common form of K testing is called a slug test. Slug tests yield approximate values for K; representative of the portion of aquifer within a small radius directly adjacent to the well boring that is stressed.

There are two kinds of slug tests, rising-head and falling-head tests. In a falling-head test, the operator induces a rise in the water level and records the water level return to static. In a rising-head test, the water level in the well is suddenly lowered and the water level rise to static is recorded. Rising-head tests are preferred in wells with screens that straddle the water table. Either rising- or falling-head tests may be performed in wells completed below the water table. The type of tests to be run will be specified in the project-specific FAP.

Prior to beginning the test, the static water level will be measured and recorded using the procedures for obtaining water levels presented in Subsection 4.7.1.

To begin the test, there are several ways to induce a rise or fall in water levels including:

- introduction of a cylindrical mass, or slug, into the well that displaces a volume of water and raises the water level above static;
- removal of the slug, after aquifer equilibration, effectively lowering the water level below static level;
- addition of a volume of water to the well raising the water level; or
- removal of a volume of water by pumping and lowering the water level.

Choice of a method depends on several factors, most concerning the level of contaminants in the well. Pumping to lower the water level is less desirable if the purged water will require containerization due to contaminant concentrations. In such cases, introduction of a slug is preferred, taking proper precautions to minimize cross-contamination between wells. The purpose of the well is also important in choosing a method. Water should not be added to a well that will be sampled for chemical analysis. Well design also should be considered. The method of inducing stress in the aquifer will be specified in the project-specific FAP.

The water level return to static can be measured using an electronic water level meter or a pressure transducer connected to a data logger. Readings should be taken at least every half minute for the first 10 minutes, every 5 minutes for the period of 10 to 50 minutes, every 10 minutes for the period 50 to 100 minutes, every 30 minutes for the period of 100 minutes to 5 hours, and every hour for the period 5 to 24 hours. The pressure transducer with data logger is the preferred method and is required for wells with high K values and short recovery times. The data logger can be set to record data several times a second. Recovery data should be recorded until the well recovers 90 percent of its static water level.

When using a pressure transducer and data logger, all input parameters for equipment operation will be recorded in the field notebook and on an Aquifer Testing Completion Checklist (Figure 4.20). Test data from the data logger will be downloaded to a computer disk either in the field or upon return to the office.

The following additional information is required to reduce the test data and derive a value for the K:

- initial drawdown (i.e., difference between static water level and the level after stressing);
- well screen and riser diameter;
- effective length of the screened interval; and
- borehole diameter.

In water table wells where the head changes occur in the sandpack/screen interval during aquifer testing or where permeability of the sandpack is much greater than the formation, the riser radius (r) approaches the borehole radius (R) and the length (L) varies over the duration of the test. In order to avoid selection of an inappropriate value of riser radius and resulting permeability underestimates, compensation for the extra void space is necessary. The "effective radius (r_e)", derived from the radii of the borehole (R) and riser (r), and the porosity of the sandpack (n), should be considered as:

$$r_e = [r^2 (1\text{-}n) + nR^2]^{1/2}$$

The value of L (length of sandpack) should also be adjusted accordingly (Bouwer, et al., 1976; Palmer and Paul, 1987).

The data will be reduced using the AQTESOLV software package (Geraghty & Miller, 1991). This program utilizes either Bouwer and Rice (1976) or Cooper, Bredehoeft, and Papadopulos (1976) methodologies for slug test data reduction. The output of the AQTESOLV program is a graph of data with a fitted curve and K or transmissivity value. Any other data reduction method to be used will be specified in the project-specific FAP.

4.7.3 Packer Testing

Water pressure tests or "packer tests" are in situ tests performed to measure the permeability of a specific zone in a bedrock borehole. Water pressure tests are used to estimate bedrock permeabilities for hydrogeologic studies and in estimating grouting and dewatering requirements for construction purposes.

Packer tests may be done during the advancement of the borehole or after drilling is completed. Packer tests are usually conducted in NW-size (i.e., 3-inch) boreholes, but can be conducted in boreholes of a larger size. The test involves placing expandable packers, either mechanical or pneumatic in a borehole. A pneumatic packer assembly is preferred because it is easier to use and provides a more positive seal. A section of the borehole, usually five ft in length, is sealed off with the packers. Water is then pumped through the zone between the packers at a known pressure. The rate of flow into the formation is measured with a flow meter. The apparent gross permeability of the test zone is calculated using the data obtained in the test.

Methodology.

1. Flush the borehole with clean water to remove cuttings. Measure the depth of the borehole, and check for caving. Be sure that an adequate reserve of water is available to avoid running out of water during a test.
2. Determine the test zone. The test section length should be a minimum of 5 times the diameter of the borehole. Avoid placing the packer in a zone of fractured rock or in the bottom of the casing because leakage will occur. Keep the rock core or drilling logs handy to refer to during the test.
3. Determine Maximum Allowable Gauge Pressure (MGP) according to the formula below (U.S. Bureau of Reclamation, 1977). In order to avoid hydrofracturing (i.e., loosening) the rock mass, do not exceed MGP during testing.

$$MGP\ (psi) = (Z)(K)$$

where,

Z	=	depth in ft from top of the upper packer to ground surface
K	=	0.5 pounds per square inch (psi)/ft

4. Prior to the start of actual permeability testing, the packer system should be tested for leakage by installing the packer in a piece of steel casing and conducting the test as if it was being done in the borehole. The water pressure must not exceed maximum packer inflation pressure. Check the hose for leaks. Check the water meter to assure that it is working properly.
5. If possible, determine the static water level in the borehole prior to the installation of the packer.
6. Assemble and install the packer equipment in the borehole. Measure each rod and top of coupling as it goes into the hole. Be sure rods are tightened to prevent leakage at the joints; Teflon® tape may be helpful. Number the rods for easy tracking of the packer location for sequential tests. Lower the equipment to the location of the deepest test. Figures 4.21, 4.22, and 4.23 depict arrangement of equipment.
7. Before performing the first test, bleed air out of the lines by forcing water through the packer system assembly before the packers are inflated. Inflate both packers to at least 150 psi. Double packers are usually spaced five ft apart, but spacing can be varied to meet specific test requirements.

8. Before starting the test, record the following information in the field logbook and Packer Test Log (Figure 4.24).

   - test number;
   - test section;
   - hole size;
   - height of pressure gauge above ground surface;
   - ground surface elevation; and
   - depths to rock surface, groundwater, bottom of boring, bottom of upper packer to top of lower packer.

9. Test should be conducted in three steps: The first at one-half the MGP with packers at 150 psi; the second at full MGP with packers at 150 psi; and the third at full MGP with the packers at 170 psi.

   a. <u>Step 1, One-half MGP at 150 psi on Packers</u>. Pump water into the system and record observations of gauge pressure and water meter at 30 second intervals until a constant rate of flow is reached.

   b. <u>Step 2, Full MGP at 150 psi on Packers</u>. Pump water into system and record observations of gauge psi pressure and water meter at 30 second intervals until a constant rate of flow is reached

   c. <u>Step 3, Full MGP at 170 psi on Packers</u>. Increase pressure on packers by 20 psi. Pump water into the system and record observations of gauge pressure and water meter at 30 second intervals until a constant rate of flow is reached. The results of Steps 2 and 3 should be similar. If they are not, Step 3 should be repeated, increasing the packer pressure by an additional 20 psi until consistent results are achieved. Do not exceed the maximum packer pressure (220 psi).

   d. For all test steps, record water levels in the casing during test, if the water level rises during the test, the packers may not be sealed and the test results may be suspect. Measurements of doubtful accuracy must be noted, along with a description of the questionable aspects. If possible, testing should be continued until accurate data is obtained. It may be necessary to move the packer assembly a short distance to obtain an adequate seal.

10. If leakage of water from the packed section into the surrounding rock is so great that the MGP cannot be reached, run the pump at its full capacity with the bypass valve closed. Record the amount of water pumped into the test section, at 30-second intervals, with associated pressure readings.

11. Upon completion of the test, deflate the packers and move to the next test depth. Complete log sheets (Figure 4.23).
12. The same test methodology may be used with a single packer. Single packer tests are conducted as the borehole is advanced using the bottom of the borehole in place of the second packer.

Resolution of Common Packer Test Problems

Packers move up out of the hole at the start of the test. Occasionally, particularly in low permeability rocks, the packer assembly may lift out of the hole due to the water pressure. Observers should stay clear of the top of the borehole to avoid injury. It may be helpful to deflate and re-inflate the packers to obtain a more positive seal in the borehole. Also, the rig drive head can be placed over the top of the swivel to help to hold the packers in place during the testing.

Pumping excessive amounts of water into the formation. In certain types of hydrogeologic or contaminant investigations, large quantities of water should not be pumped into the aquifer as this may impact local groundwater quality. If this is a concern, packer tests should be avoided. Alternatively, falling or rising head tests may be performed or geophysical borehole data may be obtained.

Jamming of the packers in the borehole. Packers may become caught in the borehole for two reasons: (1) caving of the formation amount the packers, or (2) failure of the packers to deflate. In the later case, it is generally advisable to re-inflate and deflate the packers a second time to try and remedy the problem. Forcibly removing the packers from the hole should be avoided as they may become permanently lodged or damaged. In some instances it may be helpful to pump water through the system to help lubricate the equipment for removal. Packer tests in soft, broken or cavernous formations should be attempted with great caution.

Malfunctioning water meter. Water meters are sensitive instruments and are subject to malfunctions due to clogging by debris or mechanical failure. It is important to check the water meter prior to use to be certain that it is working properly. Generally, it is best to place the water meter in a horizontal position, particularly for low flow measurements. It is also important to determine what the units of the meter dial are prior to use, as they are often poorly marked.

Data Evaluation. Compute the rock mass K. Additional data required for each test are as follows: (1) depth of hole at time of each test; (2) depth to bottom of top packer; (3) depth to top of bottom packer; (4) depth to water level in borehole at frequent intervals; (5) elevation of piezometric level; (6) length of test section; (7) radius of hole; (8) length of packer; (9) height of pressure gauge above ground surface; (10) height of water swivel above ground surface; and (11) description of material tested. Item 4 is important since a rise in water level in the borehole may indicate leakage from the test section.

The formulas used to compute the K from pressure test data are:

$$K \quad C\frac{Q}{2(\prod)LH}\ln\frac{L}{r} \qquad L \geq 10r$$

$$K \quad C\frac{Q}{2(\prod)LH_T}\ln\frac{L}{2r} \qquad 10r \quad L \quad r$$

where,

K	=	hydraulic conductivity (ft/day)
Q	=	constant rate of flow into the hole (gallons per minute)
L	=	length of the test section (ft)
H_T	=	differential head on the test section ($H_g + H_p$ in ft)
r	=	radius of the borehole (ft)

C = Conversion factor for K in units of ft/day C equals $1.928\text{x}10^2$

Note: Hg is equal to elevation head (distance from swivel to static water level). Hp is equal to pressure head calculated in ft from pressure gauge. For the unsaturated condition (i.e., static water is below bottom of lower packer), Hg is equal to distance in ft from swivel to center of test section.

These formulas provide only approximate values of K since they are based on several simplifying assumptions and do not take into account the flow of water from the test section back to the borehole (U.S. Bureau of Reclamation, 1968). Because of the heterogenous and anisotropic nature of water bearing rock formations, K value is referred to as apparent gross K. However, they give values of the correct magnitude and are suitable for practical purposes. The following listing provides a general grouping of rock mass K.

ROCK MASS HYDRAULIC CONDUCTIVITY

Hydraulic Conductivity Grouping	Range of Results
Very Low, equivalent to clay	Less than $1\text{x}10^{-4}$ ft/day
Low, equivalent to silt	$1\text{x}10^{-4}$ to $1\text{x}10^{-2}$ ft/day
Medium, equivalent to fine sand	$1\text{x}10^{-2}$ to 10^{-1} ft/day
High, equivalent to sand	$1\text{x}10^{-1}$ to $1\text{x}10^{1}$ ft/day
Very High, equivalent to clean sand or gravel	More than $1\text{x}10^{1}$ ft/day

4.8 SURVEYS

Depending on the site and accuracy needed, surveys of site features and/or sampling locations may be conducted using either 1) a New York registered surveyor, 2) GPS receiver, 3) three point ties to known structures/points, or 4) approximation based on coordinate correct orthophotograph (i.e., within a geographic information system (GIS)). Survey requirements will be described in the project-specific FAP. Descriptions of surveys using registered land surveyors and GPS receivers are described in the following sub-sections.

4.8.1 Elevation and Location Survey

Elevation and location surveys will be conducted by a New York-registered professional land surveyor.

Elevations will be referenced to mean sea level, 1983 General Adjustment and will be measured at 0.01 ft for monitoring well casings and 0.1 ft for ground surfaces. Horizontal locations will be tied into the NYS Plane Coordinate system, to the nearest 0.1 ft.

The actual surveying techniques and the required equipment to be employed, and the required accuracy and precision, are dependent upon the field conditions and the nature of the sampling stations and/or techniques to be employed. All field measurements shall be performed at least once and re-measured (i.e., checked) at least once. All survey observations and measurements shall be properly recorded by the designated member of the survey crew in bound field books, in accordance with the requirements of these guidelines.

Any calibrations performed upon surveying equipment in connection with this work shall be properly documented with regard to personnel, date, instrument number, calibration readings, procedures and standards employed, adjustments made, comments and/or observations, etc.

All analysis employed in the reduction of field data, calculations, production of maps/drawings, etc. shall follow commonly-accepted professional survey practices which are appropriate for the task at hand, including all appropriate procedures for QC to check and review the work. Computer programs used to reduce data shall have first been certified to yield repeatable results within the required limits of accuracy. All office calculations, data reduction, map making, etc. shall be performed in a neat, sequential, and logical order to facilitate future review.

The installed locations of all benchmarks, baselines and monuments shall be appropriately documented on a base map to indicate their relative locations. Benchmarks will be described with respect to their construction and location, on map, in addition to their grid coordinates.

Survey deliverable formats will be specified in the project-specific FAP. Depending on the site, deliverables may consist of an electronic table (i.e. Excel) with the location identification, horizontal location (x,y), and vertical elevation (z). If maps/drawings are required, final maps will be submitted in Adobe PDF format with an electronic signature. Drawings shall also be submitted in AutoCAD 2010 format or later and shall incorporate the use of model space/paper space sheet file formatting. One plotted sheet formatted per dwg file. Model files will coordinate correct and logically formatted for effective layer control of data. All entities shall be globally controlled by layer and sheet files shall be formatted to plot with acad.ctb as distributed with the Autodesk software. In the event that another .ctb file is used, it shall be submitted with the drawings. Whether submitting with Acad.ctb, or other, all entities will have lineweight controlled with the lineweight setting and not by color assignment. Model files containing objects created as intelligent, civil3d or TINN, to name a couple, shall maintain their intelligence when delivered.

If required, paper copies of the final maps will also be submitted in the specified map size. If one sheet is not sufficient, the mapped area may be divided into sections, one per sheet, and appropriate references and match lines provided. Maps shall be of a suitable scale to show appropriate detail clearly. Although this varies with the size of the site mapped, appropriate map scales generally range from 1 inch = 50 ft to 1 inch = 200 ft. The scale used will be clearly shown on the map both graphically (e.g., bar scale) and numerically (e.g., 1 inch = 50 ft). Each map will also indicate a true north meridian, preferably oriented toward the top of the page, and will be provided with appropriate borders, legends, title boxes, notes, data references and means of identifying author, checkers, etc.

The following paragraphs summarize specific surveying requirements appropriate to various sampling locales.

Borings and Test Pits. Horizontal locations and ground surface elevations for borings and test pits are indicated on boring/test pit logs and may be used to construct geologic sections or profiles. Horizontal locations should be staked to the nearest ft, and ground surface elevations measured to 0.1 ft.

Monitoring Wells and Piezometers. In general, horizontal location, well riser elevation, and ground surface elevation criteria for wells and piezometers are similar to those of test pits or borings. However, the surveyor should measure and mark the elevation of the top of the riser to 0.01 ft as this point will be used as a reference to measure precise groundwater elevations. For monitoring wells, pumping wells, and piezometers, a permanent mark will be made on the riser, protective casing, or other point of reference both for surveying purposes and to enable reproducible depth to water measurements.

Surface Water Sampling. When grab samples are obtained from the edges of surface water bodies, the samplers should install a location stake at the shoreline marked with the station number and coordinates, if appropriate. This stake may also be used as a reference point for measuring the water surface elevation (to the nearest 0.01 ft). In certain cases, this may not be required, since the sampler can estimate and mark the appropriate location and elevation directly on a Site Topographic Map or Orthophoto Map. Such locations do not require great location accuracy (within several ft), since they are usually only indicated graphically on the Site Map.

When samples are to be taken within the surface water body away from the shoreline, better horizontal control is usually required. Sampling locations are determined by the sampler using on-shore baselines or ranges.

Surface Soil/Waste Sampling. Measurement and layout requirements for obtaining a single grab sample of soil or waste are comparable to those for obtaining surface water grab samples from the shoreline. Where a composited sample is to be collected from a sampling grid, the surveyors must stake out the grid, and indicate the station number(s), coordinates or orientation of the grid, and ground elevation(s) on the stakes. Generally, a precision of no better than the nearest ft for location, and 0.1 ft for elevation will suffice from grab or grid surface sampling.

4.8.2 Global Positioning Survey

GPS is a geographic data collection system which uses satellites to locate positions and log time. The system can be used as a data capture or in navigation mode to assist in geographic referencing for returning to points previously entered.

GPS typically consist of a portable receiver, a base station receiver, data loggers, processing software, and a field computer. Data can be collected in point, line, or area format. The datum and coordinate system used can be specified to the nature of the job and application. For differential correction, used to correlate a known steady position relative to the rover - mobile data collection unit, a fixed community base station within 300 miles of the survey can be employed or a field operated base station unit can be used.

Accuracy is determined by several factors including the type of equipment. Sub-meter accuracy systems are most often used. A few constraints for acquiring sub-meter accuracy are based on the satellite geometry - the arrangement and number of satellites in 'view' of the position, the altitude of the satellites, and the satellite's health. Signal strength can be affected by buildings blocking the satellite's signal or a dense tree canopy that can weaken the signal will also limit the accuracy of the survey. Another consideration is Position Dilution of Precision which needs to be within a specified range to acquire high accuracy. The amount of time at each position increases the accuracy of the fix by allowing more positions to be logged. Timing and careful planning can remedy or limit the affects to most signal strength problems.

Post processing of collected GPS data is recommended to increase the accuracy of the surveyed data. Data can then be transferred onto an existing computer aided design (CADD) map or used to construct a site map within a GIS. Typical environmental applications include generating real time site maps, wetland delineation, mapping soil boring locations, groundwater grab sample locations, and mapping surface water/sediment sampling locations.

4.9 MANAGEMENT OF INVESTIGATION-DERIVED WASTES

Specific procedures for handling contaminated environmental materials and contaminated, disposable, personal safety equipment will be presented in the project-specific FAP and/or HASP. In general, MACTEC is responsible for collecting, controlling, and staging hazardous materials generated during field investigations. Manifest signature and ultimate disposal are the responsibility of the NYSDEC; however, MACTEC may assist in the planning and coordination of these activities, if required.

Contaminated soil and water will be handled in accordance with NYSDEC guidance documents unless otherwise specified in the project-specific FAP.

4.9.1 Soil Disposal

DER-10 distinguishes between soils from on-site locations and from off-site locations that are not known to be contaminated.

Alternatives for on-site disposal of non-hazardous soils include:

- backfill inside test borings not completed as monitoring wells;
- collect and dispose on-site (after characterization);
- temporarily store on-site for on plastic sheeting and covered with plastic prior to off-site disposal;
- transport from off-site areas to site (without need to manifest or contract with licensed hauler)

Non-hazardous waste can also be transported off-site to a solid waste management facility.

Hazardous soils can be transported off-site to a properly permitted treatment, storage, or disposal facility. Prior to shipping for off-site disposal, representative samples of waste material will be analyzed to establish requirements for the proper management and disposal of wastes. These materials will be transported by a licensed hauler and accompanied by the proper manifests.

All of these disposal alternatives are subject to precautions listed in DER-10, including the general requirement that the soils be handled and disposed of in “a manner that does not pose a threat to health and the environment." Overall, handling and disposal of drill cuttings and other soil will be identified and addressed in the project-specific FAP.

4.9.2 Water Disposal

Investigation generated water/fluid (i.e. well development and purge water) is to be containerized upon production. Containerized water is to be managed and discharged/disposed of as outlined in DER-10, and pursuant to applicable guidance and regulations. Containers shall be labeled and securely staged in an area with secondary containment. NAPL shall not be released to the ground surface, but may be decanted and combined in one container, providing it all comes from monitoring wells associated with the same site.

The contents of the containers will be properly treated or disposed of if any of the following are noted: 1) visual evidence of contamination such as color, sheen, or free product/NAPL, 2) olfactory evidence of contamination, or 3) concentrations of contaminants above groundwater standards at levels of concern are known to be present in the monitoring wells based on historic sampling. Treatment or disposal will be at 1) a permitted facility (either on-site or off-site), or 2) at an on-site treatment unit brought to the site, properly designed to handle the water/fluids, where a permit waiver has been granted by the NYSDEC.

If none of the above are noted, groundwater can be recharged to unpaved ground into the same groundwater unit, within, or directly adjacent to a source area in a manner that does not result in surface water runoff. The water may also be added to the influent of a remedial treatment system designed to treat water, if one is operational at the Site. Overall, the management and disposal of groundwater will be specified in the project-specific FAP.

5.0 SAMPLE CUSTODY PROCEDURES

5.1 GENERAL

MACTEC has established a program of sample COC that is followed during analytical sample handling activities in both field and laboratory operations. This program is designed to assure that each sample is accounted for at all times. To maintain this level of sample monitoring, computer-generated sample container labels and shipping manifests are normally employed. Field data sheets and COC records must be completed by the appropriate sampling and laboratory personnel for each sample. The objectives of the MACTEC COC program are to ensure:

- samples are uniquely identified;
- samples are collected for all scheduled analyses;
- the correct samples are analyzed for requested analyses and are traceable to their records;
- descriptions of important sample characteristics and field observations are recorded;
- samples are protected from loss and/or are identified if damaged;
- alteration of samples (e.g., filtration, preservation) is documented;
- a forensic record of sample integrity is established;
- sample security is maintained; and
- relevant field information is recorded including location, sample number, date and time, identification of field samples, and individuals collecting the samples.

The COC protocol followed by the sampling crews involves the following steps:

- documenting procedures and amounts of reagents added to the sample during sample preparation and sample preservation;
- recording sampling locations, sample bottle identification, and specific sample collection procedures on the appropriate forms;
- using pre-prepared sample labels that contain all information necessary for effective sample tracking; and

- completing standard FDR forms to establish analytical sample custody in the field before sample shipment (see Subsection 4.5).

Prepared labels are normally developed for each sample to be collected. Each label is numbered to correspond with the appropriate sample(s) to be collected.

The COC record is used to document sample-handling information (i.e., sample location, sample identification, and number of containers corresponding to each sample number). The following information is recorded on the COC record:

- project reference;
- the site location code, sample identification number, date of collection, time of collection, sample bottle number, preservation, and sample type, number of containers, sample matrix;
- the names of the sampler(s) and the person shipping the samples;
- serial number of custody seals and shipping cases;
- the date and time that the samples were delivered for shipping;
- analyses required; and
- the names of those responsible for receiving the samples at the laboratory.

An example of a COC is shown in Figure 5.1. This type of COC is completed in triplicate. Two copies accompany the analytical samples to the laboratory; another is kept by the sample crew leader and maintained in the project file. The third copy is sent back with the analytical data package. In the case of computer generated COCs, the original COC is shipped with the samples to the laboratory. When this shipment is received by the laboratory, the COC is signed by the laboratory and returned with the test results as part of the data package submittal.

5.2 ANALYTICAL SAMPLE TRACKING

Tracking of samples commences at the time of sample collection. A project-specific database of anticipated sample collection is created as COCs are received from the field. The FOL will contact the laboratory to verify:

- analytical program;
- turnaround time;
- laboratory internal identification numbers; and
- COC for shipped samples

MACTEC uses the computerized tracking database to verify the completeness of data packages and electronic deliverables. Missing information is pursued by the project chemist, technical project leader, and QAO.

5.2.1 Field Sample Tracking System

The purpose of this section is to outline the steps associated with computerized field sample tracking of analytical samples collected during remedial investigations. This section includes computerized procedures applicable to tracking samples from label production through shipping samples to the lab with a completed COC. Specific steps and details are described for the primary tasks of initial sample creation, label production, post sample collection data entry and creation of COC for shipping to lab.

Additional manual sample tracking procedures and chain of custody forms may be used during investigations. The procedures described in this section only address those tasks that will use the computerized sample tracking program.

Equipment and Supplies

- PC Computer with Windows
- MS Access 97 or greater (2003 preferred)
- Copy of the MACTEC Field Sample Tracking Program
- Compatible Printer
- Avery 5260 Labels

5.2.1.1 Field Sample Tracking Program Overview

To start the Field Sample Tracking Program, "double-click" the Field Sample Tracking Program shortcut on your computer desktop. This will start Access and load the Field Sample Tracking Program. When it starts you will see the main form you will use for creating labels and tracking samples (Figure 5.2). From here you can add new samples, add methods to samples, print labels, track the status of samples, print COCs, and assign samples to a Sample Delivery Group (SDG).

The upper area of the form contains information about the sample such as by whom, when and where it was collected. Below the sample information is a box containing the analysis method information for the sample. Each analysis will have a method name, status, bottle information SDG and fraction. **The status field is used to track where in the sample collecting and shipping process the analysis is located**. It will change at every step of the sample tracking process.

You can also move through the samples using the form navigation buttons at the bottom of the form. The left and right arrows will jump you one sample forward or backward and the arrows with a line will take you to the first or last sample, respectively. The arrow with an asterisk is the Add New Sample Button, which will be used later. There are also 2 buttons that allow you to quickly navigate the samples if you know the Field Sample ID or the sample number.

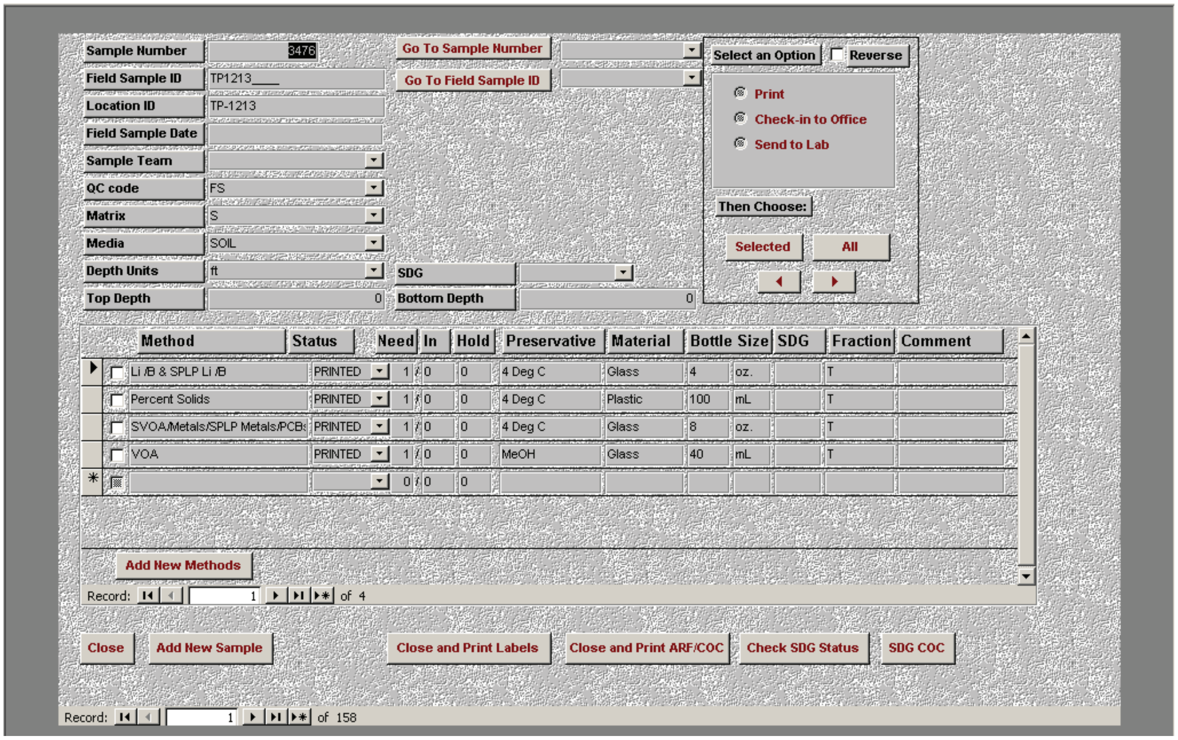


Figure 5.2: Field Sample Tracking Program - Main Form

To jump to a sample if you know the Field Sample ID, enter it in the text box next to the Go To Field Sample ID button (or select it from the drop down) and press the button. Note that this will take you to the first occurrence of the field Sample ID, if it happens to be listed more than once.
To jump to a sample if you know the Sample Number, enter it in the text box next to the Go To Sample Number button (or select it from the drop down) and press the button.

To the right of the sample information is a box containing radio selection buttons, two buttons labeled “Selected” and “All” and two buttons with arrows. The two buttons with arrows can be used to move to the next sample forward or backward in the list. The radio selection and the “Selected” and “All” buttons are used to change the status field for a method. Their use will be explained in the following sections.

5.2.1.2 Initial Sample Creation

This step can be done for the majority of the samples using the sample information found in the project-specific FAPs. Individual samples can be created as necessary (see Figure 5.2).

- Press the Add New Sample Button
- Enter the Field Sample ID, Location ID and Sample Date if known.
- Select Sample Team, QC Code, Matrix and Media from drop down selections
- Add new methods (see add new methods section)

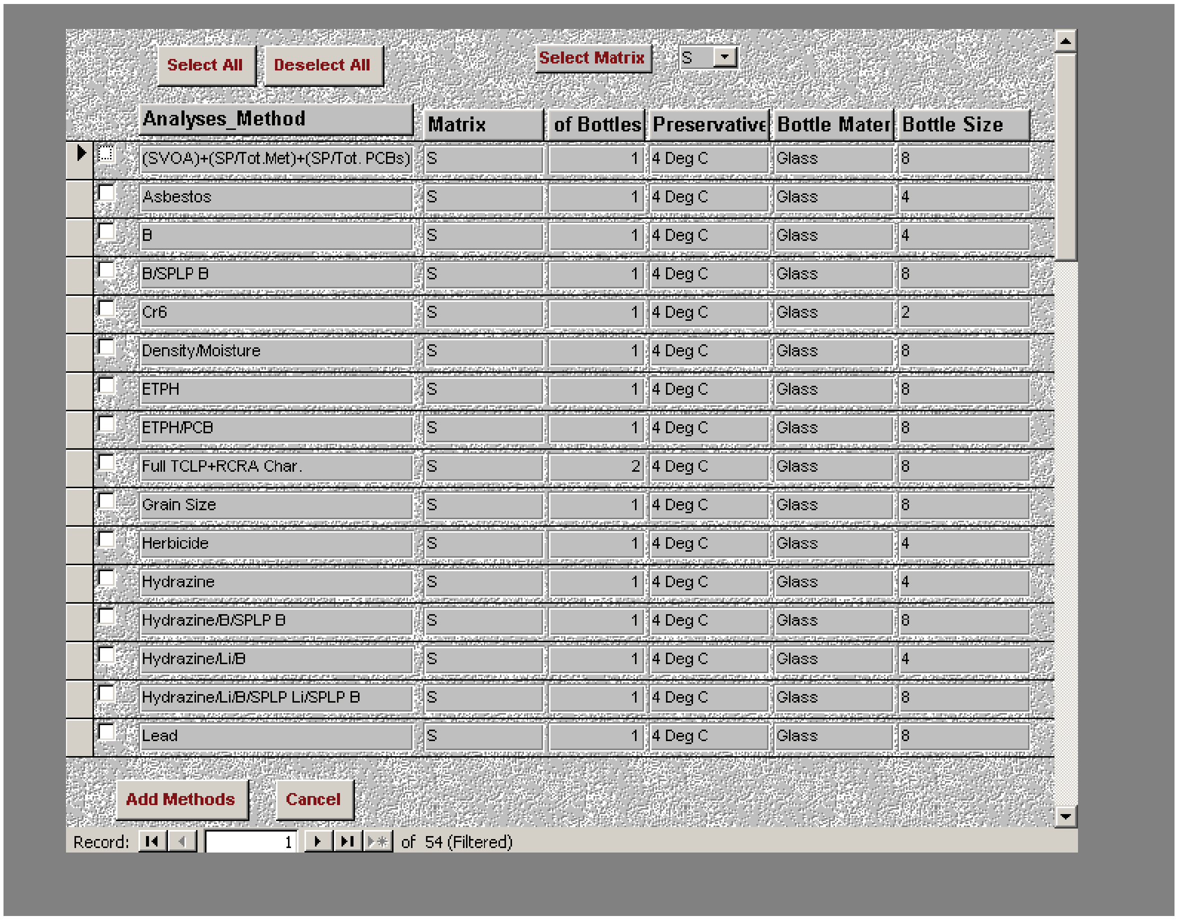
Underline spaces may be used if sample depth is a part of the Field Sample ID, but is unknown at the time of the sample creation. The correct Field Sample ID can be entered after the sample is collected. After the sample is created, the analytical methods needed are added. The Field Sample Tracking Program method list is dependent on Matrix, so make sure Matrix has been selected before adding methods to a sample.

- Press the Add New Methods Button – this will open a selection form (see Figure 5.3).
- Select methods to add to the sample by checking the box to the left of method name.
- When you have selected all methods you wish to add, press the Add Methods Button.

You will return to the Field Sample Tracking Screen and the added methods will now be in the method box. Their status is initially set to “NEW”.

5.2.1.3 Label Production

Methods that will have labels printed need to have a status of “PRINT”. For methods with a Status of “NEW” use the following procedures:



Analyses_Method	Matrix	of Bottles	Preservative	Bottle Mater	Bottle Size
(SVOA)+(SP/Tot.Met)+(SP/Tot. PCBs)	S	1	4 Deg C	Glass	8
Asbestos	S	1	4 Deg C	Glass	4
B	S	1	4 Deg C	Glass	4
B/SPLP B	S	1	4 Deg C	Glass	8
Cr6	S	1	4 Deg C	Glass	2
Density/Moisture	S	1	4 Deg C	Glass	8
ETPH	S	1	4 Deg C	Glass	8
ETPH/PCB	S	1	4 Deg C	Glass	8
Full TCLP+RCRA Char.	S	2	4 Deg C	Glass	8
Grain Size	S	1	4 Deg C	Glass	8
Herbicide	S	1	4 Deg C	Glass	4
Hydrazine	S	1	4 Deg C	Glass	4
Hydrazine/B/SPLP B	S	1	4 Deg C	Glass	8
Hydrazine/Li/B	S	1	4 Deg C	Glass	4
Hydrazine/Li/B/SPLP Li/SPLP B	S	1	4 Deg C	Glass	8
Lead	S	1	4 Deg C	Glass	8

Figure 5.3: Field Sample Tracking Program - Selection Form

- Navigate to a sample you wish to print labels for.
- Set the Radio button in the upper left box to "Print".
- If you wish to print labels for all methods for the sample, press the All Button.
- If you wish to print less than all of the methods, check the box next to the method name you wish to print. When you have selected the methods you wish to print, press the Selected button.

Repeat this process for all samples that you wish to print labels for. In addition, you can manually change the status to "PRINT" for any method by using the drop down selector in the status field. This may be done to reprint labels that have already been printed before. When you have finished identifying all of the methods that need to print labels, press the Close and Print Labels Button.

Press the Print Labels and Return to Main Form Button that appears. A preview of the labels to be printed will appear for your review. If it looks satisfactory, press the print icon and close the preview. The labels will start printing on the printer containing the Avery 5260 Labels. If the print preview on the screen is not satisfactory, just close the preview.

A Message box with the Choice “Change PRINT Status of Analyses” will appear. Choose the CHANGE button if you samples have printed to your satisfaction. This will change the method status to “PRINTED”. If you choose “KEEP” the status will remain at “PRINT” and the methods will show up in the next batch of labels. Use this option if you find an error in your preview, experience a printer error, or just wanted to print a test page of labels.

5.2.1.4 Post Sampling Data Entry

After a sample is collected in the field, it needs to be recorded as “Checked in to the Office” (or field trailer or where ever the field tracking computer is being operated).

For methods with a Status of “PRINTED” use the following recipe:

- Navigate to a sample you wish to check in.
- Enter information about sample date and time in the sample collection section.
- Enter information about sample depth, if appropriate.
- Set the Radio button in the upper right box to “Check-in to Office”.
- If you wish to check in all methods for the sample, press the “All” Button.

If you wish to check in less than all of the methods, check the box next to the method name you wish to check in. When you have selected the methods you wish to check in, press the “Selected” button. Edit the In field of a method if less than the number of required bottles has returned – if necessary (due to bottle breakage, less than enough sample material). Repeat this process for all samples that you wish to check in. In addition, you can manually change the status to “IN LAB” using the drop down selector in the status field.

5.2.1.5 Off-Site Laboratory Samples

Sample containers will be weighed by the off-site laboratory sample manager immediately upon receipt at the off-site laboratory. The sample manager will record the container identification number and post-sampling container weight on the chain of custody. A trip blank will accompany each shipment of samples to the off-site laboratory. The trip blank will consist of a sample container with methanol prepared by the off-site laboratory for the same analytical method as the field samples.

5.2.1.6 COC Production and Sample Shipping

For methods with a Status of “IN LAB” use the following procedure:

- Navigate to a sample you wish to ship to a lab.
- Set the Radio button in the upper right box to “Send to Lab”.
- If you wish to ship all methods for the sample, press the “All” Button.
- If you wish to ship less than all of the methods, check the box next to the method name you wish to ship. When you have selected the methods you wish to ship, press the “Selected” button.

Repeat this process for all samples that you wish to ship to a lab. In addition, you can manually change the status to “SHIP” using the drop down selector in the status field. When you have finished identifying all of the methods that need to be shipped to a lab, press the Close and Print Analysis Request Form (ARF)/COC Button.

Press the Print COC/ARF and Return to Main Form Button that appears. A preview of the COC/ARF to be printed will appear for your review. If it looks satisfactory, press the print icon and close the preview (see Figure 5.4 for an example of a printed COC). If not satisfactory, just close the preview.

Chain Of Custody/Analysis Request Form

Gent Uniform - Massapequa NY

MACTEC E&C
Brandon Shaw
207 828-3367

Lab: Accutest

Field Sample ID	Sample Date	Sample Time	QC Code	Qty Total	Qty Each	Bottle Size and Material			Preservative	Media	Method	Fraction
130056MW00301504XX	1/31/2011	14:45	FS	4								
					2	1	Liter	Amber	4 Deg. C	GW	SVOC 8270C	T
					2	40	mL	Vial	4 Deg. C	GW	VOCs 8260B	T
130056MW01602204XX	2/1/2011	15:17	FS	5								
					1	500	mL	Poly	HNO3	GW	TAL Metals 6010B/7470	T
					2	1	Liter	Amber	4 Deg. C	GW	SVOC 8270C	T
					2	40	mL	Vial	4 Deg. C	GW	VOCs 8260B	T

QC Codes: FS=Field Sample, FD=Field duplicate, MS=Matrix Spike, MSD=Matrix Spike Duplicate, EB=Rinsated Blank, TB=Trip Blank

*** 24 Hold Time on Hexavalent Chromium (Cr+6) Samples* *# of Ice Bags________* *Turn around time = Standard / Deliverable = ASP-B*

Number of coolers shipped:_______ *Samples Shipped via ______________* *Shipping Tracking Number:________________________*

Relinquished:_____________________ Date: ___/___/___ Time:_____ Received:___________________ Date: ___/___/___ Time:____

Relinquished:_____________________ Date: ___/___/___ Time:_____ Received:___________________ Date: ___/___/___ Time:____

Tuesday, May 10, 2011 *Page 1 of 1*

Figure 5.4: Field Sample Tracking Program – Example Chain of Custody Record

A Message box with the Choice "Change Status of Analyses from SHIP to SHIPPED" will appear. Choose the CHANGE button if you samples have printed to your satisfaction. This will change the method status to "SHIPPED". If you choose "KEEP" the status will remain at "SHIP" and the methods will show up in the next batch of COC/ARF to ship. Use this option if you find an error in your preview or just wanted to print a COC/ARF test page.

5.3 ANALYTICAL SAMPLE SHIPPING

Packing. Sample containers are generally packed in metal or hard plastic, insulated coolers for shipment. Bottles are packed tightly to minimize motion. Styrofoam, vermiculite, and "bubble pack" are suitable packing material for most instances. Ice is placed in double Ziploc® bags and added to the cooler along with all paperwork which is sealed in a separate Ziploc® bag. The cooler top is then taped shut. The samples are shipped to the laboratory together with the COC documents and the ARFs.

Shipping. The standard procedure for shipping environmental samples to the analytical laboratory is as follows:

1. All shipping of environmental samples collected by MACTEC personnel must be done through FedEx, or equivalent overnight delivery service. Receipts are retained as part of the COC documentation. Samples will be shipped to the laboratory within 24 to 48 hours of sampling unless other arrangements are made with the laboratory.
2. If prompt shipping and laboratory receipt of the samples cannot be guaranteed, (e.g., Sunday arrival), the samplers will be responsible for proper storage and custody of the samples until adequate shipping arrangements can be made.

The site leader keeps the laboratory informed of all field sampling activities. This communication is critical to allow the laboratory enough time to prepare for the sample shipment arrival.

6.0 CALIBRATION PROCEDURES

6.1 CALIBRATION PROCEDURES FOR LABORATORY EQUIPMENT

The calibration procedures used by the contract laboratories are specified by the referenced analytical methods and the NYSDEC ASP (NYSDEC, 2005) and are addressed in the QA documents for the laboratory subcontractor.

6.2 CONTROL OF MEASURING AND TEST EQUIPMENT

Inspection, measurement, and test equipment shall be controlled, calibrated, adjusted, and maintained at prescribed intervals. Critical spare parts will be kept on inventory to minimize downtime. Calibration shall be performed against certified equipment having known valid relationships to nationally recognized standards. If no national standard exists, the basis for calibration shall be documented.

The method and interval of calibration shall be defined and shall be based on equipment type, stability characteristics, required accuracy, and other considerations affecting measurement control. Special calibration shall be performed when accuracy of the equipment becomes suspect. When inspection, measurement, or test equipment are found to be out of tolerance, an evaluation shall be made of the validity and acceptability of previous inspection or test results. If any inspection, measurement, or test equipment is consistently found to be out of calibration, it shall not be made available for use. Records shall be maintained and equipment shall be suitably marked to indicate calibration status.

6.3 FIELD INSTRUMENT CALIBRATION

Each piece of equipment will be calibrated daily prior to use or as specified by the manufacturer. In addition, field instruments will be calibrated at the end of the day to monitor instrumental drift subsequent to field activities. Field instruments used to measure water quality parameters for groundwater and surface water should be calibrated following procedures outlined in the USEPA Region 1 Calibration of Field Instruments SOP, Revision 2, dated January 19, 2010 (USEPA, 2010b). Calibration procedures and corrective actions are summarized on Table 6.1. Calibration data are recorded on a Field Instrumentation QA Record (Figure 6.1). The manufacturer and lot number of all standards will be noted on the field instrument QA record. The types of field measurements that may be made include but are not limited to the following:

- pH;
- specific conductance;
- temperature;
- DO;
- organic vapors; and
- turbidity.

7.0 ANALYTICAL PROGRAM

7.1 SELECTION OF PARAMETERS

Laboratory analyses will be scheduled based on historical information regarding potentially hazardous material disposal, previous site information, the determination of data objectives, and NYSDEC criteria. Specific parameters will be outlined in the project-specific FAP.

7.2 SELECTION OF PROCEDURES

The detailed sampling program and associated analytical methods will be documented in the project-specific FAP. The subcontract laboratory analytical procedures to be used for this program will be selected from the NYSDEC ASP (NYSDEC, 2005).

The uses of on-site field screening procedures may also be incorporated into field investigation programs. Target analytes and field screening procedures will be defined in the project FAPs.

7.2.1 Off-site Subcontract Laboratory Analytical Methods

Off-site subcontract laboratory methods will be identified in the project FAPs. The analytical parameters listed below represent methods that are commonly used during site investigation projects.

<u>USEPA SW-846</u>

- VOCs by Method 8260
- SVOCs by Method 8270
- Pesticides by Method 8081
- PCBs by Method 8082
- Organophosphorus Pesticides by Method 8141

- Herbicides by Method 8151
- Metals by Methods 6010 and 6020
- Cyanide by Method 9010 or 9012
- Toxicity Characteristics Leaching Procedure 1311
- RCRA Characteristics

USEPA Contract Laboratory Program (CLP)

- VOCs by CLP SOW
- SVOCs by CLP SOW
- Pesticide/PCBs by CLP SOW
- TAL Metals by CLP SOW

Soil Vapor and Ambient Air

- VOCs by USEPA Method TO-15
- Modified USEPA 8260 with Tedlar bags or sorbent traps

USEPA Drinking Water (Target compound lists will be determined on a project-specific basis.)

- VOCs by Method 524.2

USEPA Waste Water Methods

- VOCs by Method 624
- SVOCs by Method 625
- Pesticides/PCBs by Method 608

For non-CLP methods, the exact TCL, and the quantitation limits and method detection limits, will be identified for each project sampling task in the project-specific FAPs. The detection limits will be evaluated during the development of data quality objects to ensure that detection limits are low enough to meet project objectives.

7.2.1.1 Field Preservation of Soil VOC Samples

In accordance with ASP Exhibit 1, Part II, VOC soil samples will be collected in accordance with preservation procedures identified in USEPA Method 5035. This requires the use of sample collection and handling procedures that restrict the loss of VOCs due to volatilization or biodegradation. Sample collection procedures are described in subsection 4.5.2.1. The following options for sample collection are identified in Method 5035:

- Encore samplers with analysis or preservation within 48 hours
- closed-system low concentration vials with freezing
- closed-system low concentration vials with sodium bisulfate preservation
- high concentration vials with methanol preservation

7.2.1.2 Tentatively Identified Compounds

During the project planning process, a decision will be made regarding the reporting of Tentatively Identified Compounds (TICs). The MACTEC PM and technical staff will obtain direction on a project by project basis from the NYSDEC PM to determine if the reporting of TICs for VOC and/or SVOC methods is needed. If the reporting of TICs is needed, MACTEC will instruct the lab to report TICs. TIC data will be reviewed during the data validation or data usability evaluation process and TICs detected in samples will be tabulated and summarized in project reports.

7.2.2 Field Screening Analytical Methods

Analytical chemistry data may be collected in the field using field analytical techniques. Field screening procedures may be used to support a number of activities that require real time data for decision making in the field. Use of field screening may also be added to a project as a cost effective means of collecting a larger number of samples. Field screening data may be qualitative or quantitative depending on the project objectives. In situations where obtaining quantitative data is a DQO, a subset of samples will be collected as split samples and analyzed at an off-site laboratory. A data comparison study will be completed to evaluate the comparability of the results.

The following scenarios may incorporate the use of field screening data:

- Screening of soil, water, or air samples for presence, absence, or relative concentration of contaminants
- Screening of soil sampling intervals to provide data for selection of samples shipped to an off-site laboratory
- Screening of groundwater intervals for well screen placement decisions
- Screening of soil, water, or air samples for the selection of soil or groundwater exploration locations

Portable Gas Chromatograph. A Portable Gas Chromatograph, such as a Photovac Voyager, may be used for VOC screening of soil, water, or air samples. The instrument is calibrated with known concentration standards and provides a means of collecting real time data on VOCs. Field screening objectives, target compounds, reporting limits, and Standard Operating Procedures (SOPs) will be identified in the project-specific FAPs.

Mobile Laboratory Services. For some projects, a mobile laboratory may be set up on the facility to provide on-site laboratory services using USEPA methods. These methods may include analyses for VOCs, SVOCs, pesticides, PCBs, metals, or any other target analytes that are included in the program. Mobile laboratory objectives, target analytes, reporting limits, and SOPs will be identified in the project-specific FAPs.

Field Test Kits. A variety of field test kits are available for testing water chemistry parameters or target analytes. Methods have been approved as field screening procedures by the USEPA (USEPA; 1996). These include colorimetric tests and immunoassay methods. The following field screening methods may be considered for use in support of field investigation activities:

- Pentachlorophenol by Method 4010A
- PCBs by Method 4020

- Petroleum Hydrocarbons by Method 4030
- PAH by Method 4035
- Ferrous Iron by HACH kit
- Hexavalent Chromium by HACH kit
- Sulfide by HACH

Field screening objectives, target compounds, reporting limits, and SOPs will be identified in the project FAPs.

7.2.3 Sediment Moisture Content.

Sediment samples may have high percent moisture content. With the exception of samples for VOC and AVS:SEM analysis, the laboratory will take steps to reduce the effect of moisture content and achieve the reporting limits and project action limits. Potential steps include:

- Centrifuging the sample and decanting off the layer of water above the solid matrix;
- Sample drying;
- Increasing sample volume size;
- Performing multiple extractions and combining extracts prior to analysis; or,
- Other alternatives proposed by the laboratory.

7.3 LABORATORY CERTIFICATION

Analyses will be performed by a laboratory certified by the NYSDOH ELAP. The selected laboratory will be identified in the project-specific FAP.

7.4 LABORATORY DATA PACKAGE DELIVERABLES

Data reporting requirements for each project-specific sampling event will be defined in the project FAP. Data packages for most analytical data sets will be either Category A, Category B, or CLP as defined in the ASP (NYSDEC, 2005).

7.5 DATA MANAGEMENT & LABORATORY ELECTRONIC DATA DELIVERABLE

MACTEC uses a standardized data management process for all WAs completed under the NYSDEC program. This includes routines to capture sample information at all stages of a site investigation and storage of electronic data in a permanent database. MACTEC has developed the Technical Environmental Database (TED), a SQL Server based relational database. MACTEC requires the laboratories to submit analytical results in an EQuIS-based TED electronic data deliverable (EDD) format for uploading into TED. A description of the TED EDD format is presented in Table 7.1.

8.0 DATA REDUCTION, VALIDATION AND REPORTING

General procedure for chemistry reviews of lab data generated during SI and remedial actions are specified in this FAP/QAPP. For most projects, full data validation will not be completed. A DUSR will be completed. If directed from the NYSDEC PM due to a project-specific QA goal, a full data validation or third party validation will be completed. MACTEC will establish protocols for data reduction, validation, and reporting in the project-specific FAP.

8.1 REDUCTION

Data reduction is the process of converting measurement system outputs to an expression of the parameter which is consistent with the comparability objective. Calculations made during data reduction are described in the referenced analytical methods and in the participating laboratory QA Program.

Upon receipt, analytical data packages are turned over to the data management staff for reduction to standard data tabulations. Analytical data includes hard copy, and electronic data deliverables that are downloaded directly to the TED. During the data review process the electronic data are checked against the hardcopy data package to verify that no systematic error occurred during the production of the electronic deliverable.

Completed data tabulations are provided to the data validation staff along with the original data packages.

8.2 DUSR AND VALIDATION

For the majority of analytical data collected under this program, a data usability review will be completed in accordance with NYSDEC Division of Environmental Remediation guidance DER-10, Appendix 2B for Data Usability Summary Reports (NYSDEC, 2010a). During the DUSR review the results are reviewed using the laboratory hardcopy deliverables to verify that results were reported and qualified correctly by the laboratory, and to evaluate QC measurements to determine the usability of results. Additional data qualifiers may be added to the results using professional judgment of the project chemist and general procedures specified in USEPA Region II validation guidelines.

A DUSR is prepared for each project sampling task by the project chemist or scientist. The MACTEC QAO, or designee, completes a final review of the DUSR before data are finalized. The DUSR includes the following information:

- Site Location and Sampling Event
- Subcontract Laboratory Name and Address
- Summary of Analytical Methods
- Data Quality Observations and Data Qualification Summary
- Table of Final Results and Qualifiers

If a formal validation of data is required, the requirement will be identified in the project FAP and confirmed with the NYSDEC PM. Validation of laboratory data will be performed in accordance with *National Functional Guidelines for Organics Review*, (USEPA, 1999) and *Laboratory Data Validation, Functional Guidelines for Evaluating Inorganics Analyses* (USEPA, 2004), as well as the appropriate USEPA Region II revisions to these protocols.

An example summary of the presentation of final DUSR or validation results is included in Figure 8.1.

8.3 DATA MANAGEMENT AND NYSDEC EDD REPORTING

MACTEC's TED will be used for all analytical data generated as part of the NYSDEC program. TED contains fields to store raw laboratory results, validated laboratory results, site spatial data and geotechnical information. Federal and NYS project-specific regulatory standards have also been included in the database and are available to project for comparison to laboratory results.

Computerized routines in TED are used to produce temporary data spreadsheets for data review and data qualification during completion of DUSRs and validation reports. These spreadsheets are used to input final results and qualifiers into the TED once data review is completed. Final cross tabulation data tables including complete results for all samples and methods are produced with each DUSR directly from the TED. An example of a final data table is included in Figure 8.1.

A variety of other data outputs are routinely created from data in TED. These include risk assessment statistical tables, laboratory split sample comparison tables, detected contaminant crosstab tables (hit tables), and comparison to applicable or relevant and appropriate requirements crosstab tables (Exceedance tables). Analytical results in TED can be used in a variety of GIS data graphics and plotting programs including CADD. The following tables are often prepared to present data in site reports:

- Hits Only Cross Tabulation Tables
- Analyte Frequency and Concentration Summary Tables
- Data Comparisons to Regulatory Standards

User access to TED projects is password protected. Users are assigned roles which limit their ability to modify data. The majority of users have only read capability. TED files are fully backed up on a nightly schedule, with incremental backups scheduled throughout the day. Updates and Deletes to the database are recorded and preserved for tracking, along with a date stamp and the users initials.

TED is also used for computerized sample tracking for projects that choose to use the Tracking Module. In TED, the sample tracking programs are used to provide labels and bottle information before samples are collected through automated COC and shipping information for shipping samples to the lab to producing a tracking file to quickly verify that all analyses requested from the lab are returned.

8.3.1 NYSDEC Electronic Data Deliverable

Beginning in 2011, all laboratory data (and other required associated data) shall be submitted to the NYSDEC in an electronic format in accordance with the NYSDEC Electronic Document Standards (EDS) and EDD that complies with the Department's Electronics Data Warehouse Standards or as otherwise directed by the NYSDEC PM.

All final documents are to be submitted in an electronic format that complies with the most recent DER's EDS. Until such time as the Department establishes an EDS final documents are to be submitted as an Adobe© PDF document.

All final data sets shall be provided in a NYSDEC EQuIS EDD format that complies with the most recent guidance at the NYSDEC EDD Submission Website (http://www.dec.ny.gov/chemical/62440.html). The delivery of data in the NYSDEC EQuIS EDD format may be specified for a subset of tasks in the project-specific FAPs. For these projects, a computerized routine is used to convert the TED data directly into the NYSDEC EQuIS EDD format. It will be the responsibility of the MACTEC PM to identify the need for an NYSDEC EQuIS EDD prior to initiating field activities.

9.0 INTERNAL QUALITY CONTROL

9.1 FIELD QUALITY CONTROL

QC procedures have been established for MACTEC field activities. Field QC activities include the use of calibration standards for pH, specific conductance, temperature, and PIDs as described in Section 6.

A routine process of collecting field QC samples will be incorporated into all field programs unless otherwise directed by the NYSDEC PM. Field QC samples to be submitted to the laboratory include:

- trip blanks
- equipment blanks
- field duplicates
- matrix spikes

These samples provide a quantitative basis for evaluating the data reported. The project-specific FAP will specify the number and type of QC samples to be obtained during field activities.

Trip Blanks. Trip blanks are required for assessing the potential for contaminating aqueous VOC samples during sample shipment. The trip blank consists of a VOC sample container filled by the laboratory with reagent water and is shipped to the site with other VOC sample containers. A trip blank is included with each shipment of water samples scheduled for VOC analysis and will be analyzed with the other VOC samples.

Soil samples that are collected as unpreserved samples will utilize a water trip blank. Soil samples that are preserved in the field will utilize a trip blank that is prepared with the preservation fluid used in the actual samples (sodium bisulfate or methanol).

Field Duplicates. Field duplicates of soil and water samples will be submitted for analysis of all project-specific parameters at a rate of 5 percent of the samples collected. These duplicates are intended to assess the homogeneity of the sampled media and the precision of the sampling protocol.

Equipment Blanks. Equipment blanks (i.e., rinsate blanks) for the bailer, sampling pump, and/or tubing assembly are scheduled during monitoring well sampling at a rate of 5 percent of the samples collected. VOCs and SVOCs or inorganics present within the bailer, pump apparatus, or discharge tubing are assessed by collecting a sample of reagent water passed through the sampling apparatus after washing with the decontamination solution followed by at least one rinse with reagent water. If dedicated equipment is used at a site, the need for equipment blanks may be dropped from the sampling program.

Soil equipment blanks are collected during each field event at a rate of 5 percent of the samples collected. VOC, SVOC, or inorganics present within or on the sampling apparatus where intimate contact with the sample occurs (i.e., split-spoon, trowel), are assessed by rinsing the sampling apparatus with deionized water following decontamination. Rinsate blanks are collected directly into the appropriate water container.

Matrix Spike/Matrix Spike Duplicates (MS/MSD). The NYSDEC ASP requires the laboratory to analyze MS/MSDs for organic analyses at a frequency of 5 percent. To meet this requirement the MACTEC FOL will select samples for MS/MSD analyses and will provide additional sample volume to the laboratory.

9.2 QUALITY REVIEW OF STUDIES AND REPORT PREPARATION

Quality reviews are performed during the course of a project to ensure that all project deliverables meet currently accepted professional standards. The level of effort for each assignment will vary depending on type of assignment, project objectives and goals, duration, and size. Review of the project will entail periodic discussions between technical staff, Task Leaders, Site Managers, QAO, PM, and Program Manager.

To enhance the professional quality of the company's studies and reports, the PM and Program Manager will:

- require that reports refer to and are consistent in scope with the project proposal and contract; and
- require that the report be organized and written so that (1) NYSDEC understands the risks and uncertainties associated with the report and (2) facts are distinguished from opinion, and risks and limitations are identified.

Implementation of QC for reports involves the use of a technical review routing and sign-off forms. Figure 9.1 illustrates the Deliverable Review Tracking Form. The PM and Program Manager provide final review and release for all deliverables.

10.0 QA PERFORMANCE AND SYSTEM AUDITS

QA audits may be performed to verify that proper procedures, documentation, and QA/QC measures are being used to provide data of acceptable quality and that subsequent calculation, interpretation and other project outputs are checked and validated. Audits may be completed by MACTEC or by the NYSDEC or other agencies with interest in the project. Both scheduled and unscheduled audits are possible. Audits of laboratories, field program tasks, subcontractors, or other activities that are included in projects.

The QAO may conduct project audits of calculations, interpretations and reports which are based on the measurement system outputs, and system and performance audits. Scheduled audits will be identified in the project FAP as a project-specific task. Unscheduled audits may also be performed following a request from the NYSDEC PM, the MACTEC Program Manager, or QAO.

The scheduling of QA and system audits completed by MACTEC will be determined on a project-specific basis and identified in the WA Issuance from the NYSDEC. During the project scoping process, the MACTEC PM and technical leaders, in consultation with the NYSDEC PM, will evaluate the project scope, quality goals, and execution tasks, and determine if audits are needed. If audits are included in the scope of the project, the MACTEC QAO will complete the audits and provide a formal audit report to the MACTEC PM and the NYSDEC for review. Audits are completed using the following processes:

<u>Audit Planning</u>

- Review project FAP and QAPP
- prepare checklist based on project plans or other applicable guidance documents
- schedule audit to observe target processes
- identify project contacts

Audit Execution

- travel to and from project location
- pre-audit meeting with project staff
- observation and evaluations of target processes and personnel
- post-audit meeting and summary of observations and findings
- implement corrective actions if necessary

Audit Reporting

- complete audit report
- review observations and findings with PM
- implement additional corrective actions if necessary
- track corrective actions and document closure of actions

In general, environmental laboratory approval is based on certification of the NYSDOH ELAP and laboratory audits will not be completed by MACTEC unless specifically requested by NYSDEC. It will be the responsibility of MACTEC to determine that laboratories are certified under ELAP and that they maintain the certification for the duration of the project.

10.1 PROJECT SYSTEMS AUDIT

A project systems audit may be conducted on all components of measurement systems to determine proper selection of procedures and utilization of resources. The systems audit may include evaluation of the following aspects of field and/or laboratory procedures.

Organization and Personnel. The project organization is reviewed for compliance with the proposed organization and for clarity of assigned responsibility. Personnel assigned to the project will be reviewed to determine that assigned responsibility, skill, and training of the personnel are properly matched. The PM maintains firsthand knowledge of the project-team's capabilities and will discuss the organization's efficacy with the QAO. Assigned personnel may be interviewed by the QAO during an audit.

Facilities and Equipment. The audit will address whether field equipment and analytical instruments are selected and used to meet requirements specified by the project objectives stated in the project-specific FAP. Equipment and facilities provided for personnel health and safety may also be evaluated. Calibration and documentation procedures for instruments used in the field are also reviewed.

Analytical Methodology. A review of analytical methodology relative to data requirements for the project will be performed. An on-site observation of analyst technique, data reduction, and record keeping may be performed, if necessary. Periodic review of precision and accuracy of data will be performed.

Sampling and Sample Handling Procedure. A field audit of sampling activities may be performed by the MACTEC QAO. Field documentation may be reviewed. The site visit will be documented in an audit report.

Data Handling. During a system audit, the QAO will review data handling procedures with the Task Leaders and Site Managers. Accuracy, consistency, documentation, and appropriate selection of methodologies will be discussed.

10.2 PROJECT REVIEW

Project reviews are scheduled and conducted periodically by the Program Manager. The intent of project review is to assess scope and contractual compliance and overall technical quality of the contracted services.

10.3 QUALITY ASSURANCE AUDIT REPORT

A written report of the QA project/system audit is prepared to include:

- an assessment of project team status in each of the major project areas;
- clear statements of areas requiring improvement or problems to be corrected;

- recommendations and assistance will be provided regarding proposed corrective actions or system improvements. (If no action is required, the report will state that the QA audit was satisfactorily completed); and
- a timetable for any corrective action required.

11.0 PREVENTIVE MAINTENANCE

11.1 ANALYTICAL INSTRUMENTATION

Preventive maintenance of analytical instrumentation is addressed by the subcontract laboratories SOPs that are presented in the Laboratory QA documents.

11.2 FIELD INSTRUMENTS

Preventive maintenance of field equipment is performed by field chemists and field operations support staff, and routinely precedes each sampling event. More extensive maintenance is performed on the basis of hours in use. Field instrumentation is calibrated on a regular schedule. In the event that field equipment calibration is not met, a review of instrument maintenance options will be completed. When possible, maintenance steps will be completed to bring instruments into calibration. Sampling crews report on the performance of the equipment after each sampling event. Critical spare parts are kept in stock.