QUALITY ASSURANCE PROJECT PLAN
FOR
REMEDIAL INVESTIGATION WORK PLAN

330 MAPLE ROAD SITE
AMHERST, NEW YORK

June 2006, revised September 2006 0105-002-100

Prepared for:

BENDERSON DEVELOPMENT COMPANY, LLC

QUALITY ASSURANCE PROJECT PLAN (QAPP)
FOR RI WORK PLAN
330 Maple Road Site

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1.0 INTRODUCTION

This Quality Assurance Project Plan (QAPP) presents the organization, objectives, planned activities, and specific quality assurance/quality control (QA/QC) procedures associated with the proposed scope of work for the investigation described in the Remedial Investigation (RI) Work Plan to be implemented at 330 Maple Road in Amherst, New York (see Figure 1). The RI is being performed by Benchmark Environmental Engineering & Science, PLLC (Benchmark) on behalf of Benderson Development Company, LLC in accordance with New York State Department of Environmental Conservation (NYSDEC) DER-10 guidance. A Sampling and Analysis Plan describing specific protocols for sample collection, sample handling and storage, chain-of-custody, and laboratory and field analyses to be performed as part of the RI is presented in Section 4.0 of this QAPP.

1.1 Background

The Site encompasses 26 acres on the north side of Maple Road in the Town of Amherst, New York. The BCP portion of the site is comprised of 26-acres of the 31.6-acre greater parcel (see Figure 2). The property is generally bounded by Maple Road to the south, residential property to the west, and a golf course to the north and east. Residential properties line the south side of Maple Road. The site is presently owned by Benderson Development Company, LLC, who plans to redevelop the property for mixed commercial and residential use structures with associated businesses, drives, and surface parking lots.

The Buffalo Shooting Club has occupied the property since approximately 1943. The Site presently consists of an outdoor shooting range and a two-story clubhouse. The shooting range consists of a berm along the northern property boundary, ten trap houses, and three sheds used to store targets and supplies. The clubhouse, located on the south side of the property, is a wood frame structure consisting of a kitchen and open floor plan on the first floor; offices on the second floor; and a former indoor shooting range in the basement. An area approximately 60 feet north of the trap houses spanning the width of the "shooting lanes" contains spent clay pigeon fragments.

A Phase I Environmental Site Assessment (ESA) was performed for the subject property by Great Lakes Environmental & Safety Consultants, Inc. in March 2005. The Phase I ESA indicated that the primary concern is potential lead contamination from shooting (gun) range activities, which cover a significant portion of the property. The

former indoor gun range located in the basement was also of concern. In April 2005, Great Lakes Environmental & Safety Consultants, Inc. performed limited Phase II environmental investigations at the Site. Due to the nature of the shooting activities, the Phase II investigations focused on sampling for lead and semi-volatile organic compounds (SVOCs) in surface and subsurface soil, and in the basement of the clubhouse. A total of 19 soil samples were collected for analysis of lead and one sample was analyzed for STARS List SVOCs. Based on the Phase II investigations, it was determined that site soil has been impacted with lead associated with lead bullets. Also, surfaces in the basement were wipe tested and indicated elevated levels of lead in collected dust. The Phase II indicated that the clay pigeon fragments are not considered a hazardous waste, but may need 'special waste approval' for disposal. Several SVOCs were detected in the samples collected from the debris area. Groundwater was not studied during this investigation.

In May 2006, Benchmark performed a supplemental soil investigation focused on collecting site-wide near-surface (i.e., 0-6 inches below ground surface) soil samples to evaluate the areal extent of previously identified lead impact on-site. The findings of that study indicated that the majority of the near-surface soils on-site have been impacted by lead. Results of the prior site investigations are more fully described in Section 2.8. Refer to Figure 2 for a site plan showing site-wide lead sample collection locations.

Benderson Development Company, LLC has elected to pursue cleanup and redevelopment of 330 Maple Road under the New York State Brownfield Cleanup Program (BCP), and has applied for entrance into the BCP with the intent to execute a Brownfield Cleanup Agreement (BCA) as a non-responsible party (volunteer) per ECL§27-1405.

1.2 QAPP Preparation Guidelines

All QA/QC procedures described herein are structured in accordance with applicable technical standards, and NYSDEC's requirements, regulations, guidance, and technical standards. Specifically, this QAPP has been prepared in accordance with:

- *USEPA Requirements for Quality Assurance Project Plans for Environmental Data Operations* (EPA QA/R-5, October 1998)
- *Region II CERCLA Quality Assurance Manual*, Revision I, EPA Region II, dated October 1989.

- *NYSDEC Technical Assistance and Guidance Memorandum (TAGM) 3014 – Quality Assurance Project Plan,* dated 1991.

- *NYSDEC Draft DER-10, Technical Guidance for Site Investigation and Remediation*, dated December 2002.

1.3 Scope of the QAPP

This QAPP was prepared to provide quality assurance (QA) guidelines to be implemented during the RI activities. This document may be modified for subsequent phases of investigative work, as necessary. The QAPP provides:

- A means to communicate to the persons executing the various activities exactly what is to be done, by whom, and when.

- A culmination to the planning process that ensures that the program includes provisions for obtaining quality data (e.g., suitable methods of field operations).

- A historical record that documents the investigation in terms of the methods used, calibration standards and frequencies planned, and auditing planned.

- A document that can be used by the Project Manager and QA Officer to assess if the activities planned are being implemented and their importance for accomplishing the goal of quality data.

- A plan to document and track project data and results.

- Detailed descriptions of the data documentation materials and procedures, project files, and tabular and graphical reports.

The QAPP is primarily concerned with the QA/QC aspects of the procedures involved in the collection, preservation, packaging, and transportation of samples; field testing; record keeping; data management; chain-of-custody procedures; laboratory analyses; and other necessary matters to assure that the investigation activities, once completed, will yield data whose integrity can be defended.

QA refers to the conduct of all planned and systematic actions necessary to perform satisfactorily all task-specific activities and to provide information and data confidence as a

result of such activities. The QA for task-specific activities includes the development of procedures, auditing, monitoring and surveillance of the performance.

QC refers to the activity performed to determine if the work activities conform to the requirements. This includes activities such as inspections of the work activities in the field (e.g., verification that the items and materials installed conform to applicable codes and design specifications). QA is an overview monitoring of the performance of QC activities through audits rather than first time inspections.

1.4 Project Description

1.4.1 Project Objectives

For sites entering the BCP at the point of investigation, NYSDEC requires completion of an RI to delineate the nature and extent of contamination on the property and potentially impacted off-site areas. The primary objectives of the RI are to:

- Collect additional groundwater and soil/fill samples, under strict QA/QC criteria, as necessary to confirm previous investigation results and fill data gaps.
- Determine if the concentrations of constituents of concern in site soil and/or groundwater pose potential unacceptable risks to human health and the environment.

1.4.2 Project Overview

Field team personnel will collect environmental samples in accordance with the rationale and protocols described in Section 4.0 and Appendix A (Field Operating Procedures) of this QAPP. NYSDEC-approved sample collection and handling techniques will be used. Samples for chemical analysis will be analyzed in accordance with NYSDEC ASP-2000 CLP methodology to meet the definitive-level data requirements. Laboratory analyzed water quality parameters and/or samples analyzed for other non-characterization purposes (e.g., to facilitate evaluation of treatability) will be performed by a laboratory using NYSDEC/USEPA-approved standard methods as identified in USEPA Methods for Chemical Analysis of Water and Wastes (40 CFR Part 136) or USEPA (SW 846) protocols. Analytical results will be evaluated by a qualified third-party data validation expert.

1.5 Project Schedule

RI activities are expected to begin at the Site in Fall 2006 and be completed within 2-3 weeks. Laboratory results should be available within three weeks after sample submittal. A draft RI report should be submitted to the NYSDEC and the NYSDOH approximately two months after completion of the field activities. Figure 3 presents a tentative project schedule for the major tasks to be performed in support of the RI.

2.0 PROJECT ORGANIZATION AND RESPONSIBILITY

The principal organizations involved in verifying achievement of RI goals for the 330 Maple Road Site include: the NYSDEC, the drilling subcontractor, the independent environmental laboratory, and the independent third-party data validator. Roles, responsibilities, and required qualifications of these organizations are discussed in the following subsections. Resumes for key management and QA personnel are included in Appendix C.

2.1 Management Responsibilities

2.1.1 NYSDEC and NYSDOH

It is the responsibility of the NYSDEC, in conjunction with the New York State Department of Health (NYSDOH), to review the RI Work Plan and supporting documents, including this QAPP, for completeness and conformance with the site-specific cleanup objectives and to make a decision to accept or reject these documents based on this review. The NYSDEC also has the responsibility and authority to review and approve all QA documentation collected during the remedial investigation and to confirm that the QA Plan was followed.

- *NYSDEC Representative(s):* — *Gregory Sutton, P.E., Project Manager*
  Michael Hinton, P.E., Project Engineer
- *NYSDOH Representative:* — *Mr. Matthew Forcucci, Project Manager*

2.1.2 Benchmark Environmental Engineering and Science, PLLC

Benchmark Environmental Engineering and Science, PLLC (Benchmark) is the prime consultant on this project and is responsible for the performance of all services required to implement the RI Work Plan (hereafter referred to as the Work Plan) including, but not limited to, field operations, laboratory testing, data management, data analysis, and reporting. Any one member of Benchmark's staff may fill more than one of the identified project

positions (e.g., field team leader and site safety and health officer). The various QA, field, laboratory and management responsibilities of key project personnel are defined below.

- *Benchmark Project Manager (PM):* *Michael Lesakowski*

  The Benchmark PM has the responsibility for ensuring that the project meets the Work Plan objectives. The PM will report directly to the NYSDEC/NYSDOH Project Managers and is responsible for technical and project oversight. The PM will:

  - Define project objectives and develop a detailed work plan schedule.
  - Establish project policy and procedures to address the specific needs of the project as a whole, as well as the objectives of each task.
  - Acquire and apply technical and corporate resources as needed to assure performance within budget and schedule constraints.
  - Develop and meet ongoing project and/or task staffing requirements, including mechanisms to review and evaluate each task product.
  - Review the work performed on each task to assure its quality, responsiveness, and timeliness.
  - Review and analyze overall task performance with respect to planned requirements and authorizations.
  - Review and approve all deliverables before their submission to NYSDEC.
  - Develop and meet ongoing project and/or task staffing requirements, including mechanisms to review and evaluate each task product.
  - Ultimately be responsible for the preparation and quality of interim and final reports.
  - Represent the project team at meetings.

- *FTL/SSHO:* *Bryan C. Hann*

  The Field Team Leader (FTL) has the responsibility for implementation of specific project tasks identified at the Site, and is responsible for the supervision of project field personnel, subconsultants, and subcontractors. The FTL reports directly to the Project Manager. The FTL will:

- Define daily develop work activities.
- Orient field staff concerning the project's special considerations.
- Monitor and direct subcontractor personnel.
- Review the work performed on each task to ensure its quality, responsiveness, and timeliness.
- Assure that field activities, including sample collection and handling, are carried out in accordance with this QAPP.

For this project the FTL will also serve as the Site Safety and Health Officer (SSHO). As such, he is responsible for implementing the procedures and required components of the Site Health and Safety Plan (HASP), determining levels of protection needed during field tasks, controlling site entry/exit, briefing the field team and subcontractors on site-specific health and safety issues, and all other responsibilities as identified in the HASP (see Appendix C of the Work Plan).

2.2 Quality Assurance (QA) Responsibilities

The QA Officer will have direct access to corporate executive staff as necessary, to resolve any QA dispute. She is responsible for auditing the implementation of the QA program in conformance with the demands of specific investigations and Benchmark policies, and NYSDEC requirements. The QA Officer has sufficient authority to stop work on the investigation as deemed necessary in the event of serious QA issues.

- *Project QA Officer:* *Thomas H. Forbes, P.E.*

Specific function and duties include:

- Performing QA audits on various phases of the field operations (see Section 10).
- Reviewing and approving QA plans and procedures.
- Providing QA technical assistance to project staff.
- Reporting on the adequacy, status, and effectiveness of the QA program on a regular basis to the Project Manager for technical operations.
- Responsible for assuring third party data review of all sample results from the analytical laboratory.

2.3 Field Responsibilities

Benchmark field personnel for this project are drawn from a pool of qualified resources. The Project Manager will use staff to gather and analyze data, and to prepare various task reports and support materials. All of the designated technical team members are experienced professionals who possess the degree of specialization and technical competence required to effectively and efficiently perform the required work.

2.4 Laboratory Responsibilities

Severn Trent Laboratories, Inc. (STL), the environmental laboratory retained by Benchmark located at 10 Hazelwood Drive, Amherst, New York 14228, is an independent, NY State Department of Health (NYSDOH) Environmental Laboratory Approval Program (ELAP)-certified facility approved to perform the analyses prescribed herein. STL also has NYSDOH Contract Laboratory Program (CLP) certification while maintaining ASP accreditation. Results of recent CLP proficiency test data are provided in Appendix B. STL will report directly to the QA Officer, and will be responsible for immediately notifying the QA Officer of any problems with sample receipt, analysis or quality control.

- *STL Client Services Manager:* *C. James Stellrecht*
  The Client Services Manager is responsible for the Client Services Department and will report directly to the Project Manager. The client services manager provides a complete interface with clients from initial project specification to final deliverables.

- *STL Laboratory Director:* *Chris Spencer*
  The Laboratory Director is a technical advisor and is responsible for summarizing and reporting overall unit performance. Responsibilities of the Laboratory Director include:

  - Provide technical, operational, and administrative leadership.
  - Allocation and management of personnel and equipment resources.
  - Quality performance of the facility.
  - Certification and accreditation activities.
  - Blind and reference sample analysis.

- *STL Quality Assurance Director (QA Director):* *Verl Preston*

  The QA Director has the overall responsibility for data after it leaves the laboratory. The QA Director will be independent of the laboratory but will communicate data issues through the Laboratory Director. In addition, the QA Director will:

  - Oversee laboratory QA.
  - Oversee QA/QC documentation.
  - Conduct detailed data review.
  - Determine whether to implement laboratory corrective actions, if required.
  - Define appropriate laboratory QA procedures.
  - Prepare laboratory SOPs.

  Independent QA review will be provided by the Laboratory Director and QA Director prior to release of all data to Benchmark.

- *STL Sample Management Office:* *Ken Kinecki*

  The Sample Management Office will report to the Laboratory Director. Responsibilities of the Sample Management Office will include:

  - Receiving and inspecting the incoming sample containers.
  - Recording the condition of the incoming sample containers.
  - Signing appropriate documents.
  - Verifying chain-of-custody.
  - Notifying laboratory manager and laboratory supervisor of sample receipt and inspection.
  - Assigning a unique identification number and customer number, and entering each into the sample-receiving log.
  - With the help of the laboratory manager, initiating transfer of the samples to appropriate lab sections.
  - Controlling and monitoring access/storage of samples and extracts.

- *STL Technical Staff (TS):*

  The TS will be responsible for sample analyses and identification of corrective actions. The staff will report directly to the Laboratory Director.

2.5 Other Subcontractor Personnel

2.5.1 Independent Third-Party Data Validator

Data Validation Services, Inc., the third-party data validator retained by Benchmark, will perform an independent data usability evaluation as recommended under NYSDEC's draft DER-10 guidance. The data usability evaluation will involve review of pertinent internal and external QC data as reported by the laboratory. QC parameters that will be evaluated in reference to compliance with the analytical methods, protocols, and deliverables requirements will include those items necessary to satisfy NYSDEC's requirements for preparation of a Data Usability Summary Report (DUSR). The specific data usability evaluation performed by the following key project personnel is defined below:

- *Data Usability:* *Judy Harry, Data Validation Services*

  The data validator has the responsibility for evaluating the data usability by examining the following:

  - Completeness of the data package as defined under the requirements of NYSDEC ASP-2000 CLP methodology Category B.
  - Compliance with required holding times.
  - Sample chain-of-custody forms
  - QC analysis data, including blanks, instrument tunings, calibrations, spikes, surrogate recoveries, duplicates, laboratory controls and sample data.
  - Agreement between laboratory raw data and data summary sheets, with verification that correct data qualifiers were used where appropriate.

  The data usability summary will present the review findings with a discussion of any data deficiencies, analytical protocol deviations, and QC problems encountered. Data deficiencies, analytical method protocol deviations, and QC problems will be described and their effect on the data presented. Recommendations for resampling/reanalysis will be made where deemed necessary. Data qualifications will be documented for each parameter following the USEPA National Functional and Regional Data Validation Guidelines (most recent updates).

2.5.2 Drilling Subcontractor

Earth Dimensions, the drilling subcontractor retained by Benchmark, will be responsible for assisting in performing well installation, sample collection, and investigation activities as directed by Benchmark.

- *Drilling Project Coordinator:* *Brian Bartron*
- *Drilling Project Manager:* *Brian Bartron*

2.6 Special Training Requirements and Certifications

The purpose of this section is to address any specialized or non-routine training requirements necessary for completion of the subject investigation. Sufficient information shall be provided to ensure that special training skills can be verified, documented, and updated as necessary.

2.6.1 Training

Requirements for specialized training for non-routine field sampling techniques, field analyses, laboratory analyses, and data validation are specified below.

Non-routine field sampling techniques: Currently there are no non-routine field sampling techniques that require specialized training.

Non-routine field analyses: Currently there are no non-routine field analyses that require specialized training.

Non-routine laboratory analyses: Currently there are no non-routine laboratory analyses techniques that require specialized training.

Data validation: Selected analyses to be validated for all matrices sampled will be validated by Ms. Judy Harry of Data Validation Services. Data validation will be performed using the most current methods and quality control criteria from USEPA's Contract Laboratory Program (CLP) National Functional Guidelines for Organic and Inorganic Data Review and USEPA Region 2 guidelines.

2.6.2 Data Validator Certification

Ms. Harry has already attained certifications required for implementing this plan for Data Validation Services. The data validator resume is presented in Appendix C.

2.7 Contacts

The names, addresses, and telephone numbers of key project personnel are as follows:

Michael DePriest: *Regional Director of Site Construction*	Benderson Development Company, LLC 570 Delaware Avenue Buffalo, New York 14202 Office: (716) 878-9601
Michael Lesakowski: *Project Manager*	Benchmark Environmental Engineering and Science 726 Exchange Street, Suite 624 Buffalo, New York 14210 Office: (716) 856-0599 Mobile: (716) 818-3954
Thomas Forbes, P.E..: *Project Quality Assurance Officer*	Benchmark Environmental Engineering and Science 726 Exchange Street, Suite 624 Buffalo, New York 14210 Office: (716) 856-0599
Jim Stellrecht: *Laboratory Client Services Manager*	Severn Trent Laboratories, Inc. 10 Hazelwood Drive, Suite 106 Amherst, New York 14228 (716) 691-2600
Gregory Sutton: *NYSDEC Project Manager*	NYSDEC Department of Environmental Remediation 270 Michigan Avenue Buffalo, NY 14203 (716) 851-7220
Mr. Matthew Forcucci: *NYSDOH Project Manager*	NYSDOH Western Regional Office 584 Delaware Ave. Buffalo, NY 14202 (716) 847-4385

3.0 QUALITY ASSURANCE OBJECTIVES FOR MEASUREMENT DATA

The overall objectives and criteria for assuring quality for this effort are discussed below. This QAPP addresses how the acquisition and handling of samples and the review and reporting of data will be documented. The objectives of this QAPP are to address the following:

- The procedures to be used to collect, preserve, package, and transport groundwater samples.
- Field data collection.
- Record keeping.
- Data management.
- Chain-of-custody procedures.
- Precision, accuracy, completeness, representativeness, decision rules, comparability and level of quality control effort conformance for sample analysis and data management by Severn Trent Laboratories, Inc. (STL) under NYSDEC CLP analytical methods.

Analytical methods and detection/reporting limits for chemical parameters to be analyzed during the RI for soil and groundwater are listed in Tables 1 and 2. Water levels and select water quality parameters (i.e., pH, turbidity, specific conductance, temperature) will be measured in the field as described in the FOPs (see Appendix A).

The goals for precision, accuracy, and completeness intended for use on this project are discussed in Sections 3.1 through 3.3 of this QAPP. Laboratory QA objectives are presented in the analytical laboratory's QA/QC Plan (see Appendix B). STL is the analytical laboratory selected to analyze environmental samples for this RI.

All data will be reported completely. No data will be omitted unless an error occurred in the analyses or the run was invalidated because of QC sample recovery or poor precision.

3.1 Precision

Precision is a measurement of the degree to which two or more measurements are in agreement, which is quantitatively assessed based on the standard deviation. Precision in the laboratory is assessed through the calculation of relative percent difference (RPD) and calculation of relative standard deviations (RSD) for three or more replicate samples. The equations to be used to verify precision for this investigation are found in Section 12.1 of this QAPP. General precision goals are provided in Table 3.

Laboratory precision will be assessed through the analysis of matrix spike/matrix spike duplicate (MS/MSD) and field duplicate samples for organic parameters. For inorganic parameters, precision will be assessed through the analysis of matrix spike/ duplicates and field duplicate samples. Precision for field parameters, including pH, turbidity, specific conductance, and temperature will be determined through duplicate analysis of 1 in every 20 samples. Precision control limits for field measured parameters are provided in Table 4.

3.2 Accuracy

Accuracy is the degree of agreement between an observed value and an accepted reference of true value. Accuracy in the field is assessed through the use of field blanks and trip blanks, and through the adherence to all sample handling, preservation and holding times. One trip blank will accompany each batch of water matrix sample containers shipped to the laboratory for VOC analysis. Laboratory accuracy is assessed through the analysis of a MS/MSD samples (1 per 20), standard reference materials (SRM), laboratory control samples (LCS), and surrogate compounds, and the determination of percent recoveries. The equation to be used for accuracy for this investigation is found in Section 12.1 of this QAPP. Accuracy control limits for the laboratory are given in Table 3.

Accuracy for field measured parameters including pH, turbidity, specific conductance, and temperature will be assessed through instrument calibration standards discussed in instrument calibration and maintenance FOPs (see Section 4.0). Accuracy control limits for field measured parameters are provided in Table 4.

3.3 Completeness

Data completeness is a measure of the amount of valid data obtained from a prescribed measurement system as compared with that expected and required to meet the project goals. Laboratory and field completeness will be addressed by applying data quality checks and assessments described in Sections 3.1, 3.2, and 9.0 to ensure that the data collected are valid and significant.

As shown on Table 3, the laboratory completeness objectives for this investigation will be 90 percent or greater. A third-party data validator will follow procedures described in Section 9.2 to assess the completeness and validity of laboratory data deliverables. For this investigation, 100 percent of all laboratory analytical results will undergo third-party data review. The completeness of an analysis will be documented by including in the report sufficient information to allow the data validator to assess the quality of the results. An ASP CLP Category B deliverables package will be required in support of third-party data review.

3.4 Data Representativeness

Data representativeness expresses the degree to which data accurately and precisely represents a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition within a defined spatial and/or temporal boundary. All proposed field-testing and measurement procedures were selected to maximize the degree to which the field data will represent the conditions at the Site, and the matrix being sampled or analyzed.

Performance System Audits (see Section 10.0) and the proper execution of field activities are the main mechanisms for ensuring data representativeness. Representativeness in the laboratory is ensured through the use of proper analytical procedures, appropriate methods, meeting sample holding times, and analyzing and assessing field duplicate samples.

3.5 Comparability

Data comparability expresses the confidence with which one data set can be compared to another data set. Procedures for field measurements (see Appendix A) will assure that tests performed at various locations across the Site are conducted using accepted procedures, in a consistent manner between locations and over time, and including appropriate QA/QC procedures to ensure the validity of the data. Sampling procedures for

environmental matrices are provided in Section 4.0 to ensure that samples are collected using accepted field techniques.

Environmental samples will be analyzed by STL using consistent protocols for sample preservation, holding times, sample preparation, analytical methodology, and QC as described in NYSDEC ASP-2000.

Analytical data will be comparable when similar sampling and analytical methods are used as documented in the QAPP. Comparability is also dependent on similar QA objectives. The field and laboratory parameter units to be used for this investigation are listed in Table 5.

3.6 Level of QC Effort for Sample Parameters

Field blank, method blank, trip blank, field duplicate, laboratory duplicate, laboratory control, standard reference materials (SRM) and matrix spike samples will be analyzed to assess the quality of the data resulting from the field sampling and analytical programs. QC samples are discussed below and summarized in Table 6.

- Field (equipment) blank samples are analyzed to check for potential cross-contamination if improperly cleaned/non-dedicated sampling equipment is used.

- Trip blanks are used to assess the potential for contamination of samples due to contaminant migration during sample shipment and storage.

- Method blank samples are generated within the laboratory and used to assess contamination resulting from laboratory procedures.

- Duplicate samples are analyzed to check for sampling and analytical reproducibility.

- MS/MSD and MS/Duplicate samples provide information about the effect of the sample matrix on the digestion and measurement methodology. Depending on site-specific circumstances, one MS/MSD or MS/Duplicate should be collected for every 20 or fewer investigative samples to be analyzed for organic and inorganic chemicals of a given matrix.

The general level of QC effort will be one field (blind) duplicate and one field blank (when non-dedicated equipment is used) for every 20 or fewer investigative samples of a given matrix. Additional sample volume will also be provided to the laboratory to allow one site-specific MS/MSD or MS/Duplicate for every 20 or fewer investigative samples of a given matrix. One trip blank consisting of distilled, deionized water will be included along with each sample delivery group of aqueous VOC samples.

4.0 SAMPLING AND ANALYSIS PLAN

The selection and rationale for the RI sampling program is discussed in the Work Plan. Methods and protocol to be used to collect environmental samples (i.e., soil and groundwater) for this investigation are described in the Benchmark Field Operating Procedures (FOPs) presented in Appendix A of this QAPP. Table 7 is a summary of the FOPs to be used during this investigation.

The number and type of environmental samples to be collected, parameter lists, required detection limits, and sample container requirements for each matrix (i.e., groundwater and soil samples) are summarized in Tables 1, 2, 6, and 8. The sampling program and related Site activities are discussed below. To the extent allowed by existing physical conditions at the facility, sample collection efforts will adhere to the specific methods presented herein. If alternative sampling locations or procedures are implemented in response to facility specific constraints, each will be selected on the basis of meeting data objectives. Such alternatives will be approved by NYSDEC before implementation and subsequently documented for inclusion in the project file.

4.1 Field Investigation Activities

4.1.1 Soil Investigation

To supplement the 2005-2006 preliminary site investigations performed by GLESC and Benchmark, additional surface and subsurface soil sampling will be performed to more fully delineate the nature and extent of contamination in Site soils. The soil investigation will include site-wide sampling for COPCs and limited sampling for volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), polychlorinated biphenyls (PCBs) and metals. Based on previous investigations, lead and, to a lesser degree, PAHs, have been identified within on-site soils. The soil investigation will serve to delineate the vertical and areal extent of lead and PAHs on-site and to assess whether other potential contaminants exist within on-site soils at concentrations of concern.

Soil samples will be collected using dedicated stainless steel sampling tools. Due to soil sample volume requirements, especially when collecting quality assurance/quality control (QA/QC) samples, additional soil volume may be required. As such, a second or possibly third soil boring maybe required to provide the necessary sample volume. Additional soil

borings will be advanced within a six-inch radius of the original soil boring and the soil samples will be homogenized in a dedicated bowl. Soil samples collected for VOC analysis will be grab samples collected prior to homogenization. Representative soil samples will be placed in pre-cleaned laboratory provided sample bottles, cooled to 4ºC in the field, and transported under chain-of-custody command to Severn Trent Laboratories, Inc. (STL), located in Amherst, New York, a New York State Department of Health (NYSDOH) ELAP-certified analytical laboratory. Soil samples will be submitted for total lead (site-wide), TCLP lead (select locations) and PAHs (select locations). For site characterization purposes, additional soil samples will be analyzed for TCL VOCs, TCL SVOCs, TCL PCBs and TAL Metals in accordance with NYSDEC ASP CLP methodology.

4.1.1.1 Total Lead Sampling

As previous preliminary site investigations have indicated that lead has impacted the near-surface soils, lead sampling will focus on collecting soil samples within 50-ft. by 50 ft. grids across the site and from zero to four-feet below ground surface (bgs). The top one foot bgs will be sampled in six-inch vertical intervals (i.e., 0-6 inches bgs and 6-12 inches bgs) and the remaining one ft. bgs to four ft. bgs samples will be collected in one-foot intervals (i.e., 1-2 ft. bgs, 2-3 ft. bgs and 3-4 ft. bgs). Upon sample collection, the 0-6 inches bgs and 6-12 inches bgs sample intervals will be analyzed for total lead and the remaining samples will be held at the laboratory for possible subsequent analysis. For samples that exceed 400 ppm total lead in the 6-12 inches bgs sample interval, the 1-2 ft. bgs sample interval will then be analyzed. The same protocol will be followed for the 2-3 ft. bgs and 3-4 ft. bgs sample intervals in sequence. With the exception of soil boring locations where monitoring wells are planned, soil samples will not be collected deeper than four ft. bgs during the planned investigation. If the data collected indicates significant contamination exists greater than four ft. bgs, additional samples will be planned for a subsequent field sampling event.

Based on the historic use of the site, there is the potential for lead shot to be present within soil samples, especially within surface soils in the area of the shooting range. Soil samples will be visually inspected for the presence of lead shot. If there is visible evidence of lead shot noted within a certain sample interval, that sample will not be analyzed and assumed to contain lead concentrations requiring remediation.

4.1.1.2 TCLP Lead Sampling

Previous investigations have identified total lead concentrations in surface soils up to 98,000 mg/kg and in subsurface soils up to 154,000 mg/kg. One sample analyzed for TCLP lead (SS-26) by Benchmark during the May 2006 Supplemental Lead Sampling Study also exceeded the TCLP hazardous waste characteristic threshold concentration of 5 mg/L. Therefore, to determine the extent of characteristic hazardous lead-containing soils on-site, select soil samples will be analyzed for TCLP lead. TCLP analysis will be completed for select samples based on the evaluation of total lead concentrations.

4.1.1.3 PAH Sampling

PAH sampling will be focused in the area of the shooting stations and in the area of the clay pigeons debris immediately north of the shooting stations (see Figure 3). PAH sampling will focus on collecting soil samples within 100 ft. by 100 ft. grids in the targeted area and from zero to four feet below ground surface (bgs). Similar to the lead sampling method, the top one foot bgs will be sampled in six-inch vertical intervals (i.e., 0-6 inches bgs and 6-12 inches bgs) and the remaining one ft. bgs to four ft. bgs samples will be collected in one-foot intervals (i.e., 1-2 ft. bgs, 2-3 ft. bgs and 3-4 ft. bgs). Upon sample collection, the 0-6 inches bgs and 6-12 inches bgs sample intervals will be analyzed and the remaining samples will be held at the laboratory for possible subsequent analysis based upon review of the initial upper 12 inches bgs data. For samples with elevated concentrations remaining in the 6-12 inches bgs sample interval, the 1-2 ft. bgs sample interval will then be analyzed. The same protocol will be followed for the 2-3 ft. bgs and 3-4 ft. bgs sample intervals in sequential order. With the exception of soil boring locations where monitoring wells are planned, soil samples will not be collected deeper than four ft. bgs.

4.1.1.4 Other Parameters Sampling

As a requirement of the NYSDEC BCP, surface and subsurface soil samples will be collected at select areas of the site and analyzed for volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), polychlorinated biphenyls (PCBs), pesticides, herbicides and/or metals to evaluate the potential presence of these contaminants. Five subsurface samples will be analyzed for Target Compound List (TCL) VOCs, TCL SVOCs, Target Analyte List (TAL) PCBs, TCL pesticides and herbicides, and TAL metals. Five surface samples will be analyzed for TCL SVOCs, TAL PCBs, TCL pesticides and

herbicides, and TAL metals. If target analytes are detected in soil samples above NYSDEC recommended cleanup objectives for restricted-residential use, additional samples will be planned for a subsequent field sampling event to delineate the extent of those contaminants.

4.1.2 Groundwater Investigation

Three monitoring wells, designated as MW-1, MW-2 and MW-3, will be installed at the approximate locations shown on Figure 3. The new monitoring wells will provide groundwater flow information as well as groundwater quality information. Monitoring well installation, well development, and groundwater sample collection are discussed in the sections below.

4.1.2.1 Monitoring Well Installation

Three borings will be advanced using hollow stem auger technology at the locations shown on Figure 3 to facilitate installation of four permanent groundwater monitoring wells, designated as MW-1 through MW-3. Based upon split spoon sample moisture descriptions and subsurface soil conditions, the installed monitoring wells will straddle the shallow groundwater table.

Each boring location will be advanced approximately 5 feet below the first encountered groundwater using hollow stem auger drilling methods. A 2-inch diameter, 2-foot long split spoon sampler will be advanced ahead of the auger string with a standard 140-pound hammer falling freely over a 30-inch fall until 24 inches have been penetrated or 50 blows applied. Recovered samples will be described in the field by qualified Benchmark personnel using the Unified Soil Classification System (USCS), scanned for total volatile organic vapors with a calibrated photoionization detector (PID) equipped with a 10.6 eV lamp (or equivalent), and characterized for impacts via visual and/or olfactory observations. All non-dedicated drilling tools and equipment will be decontaminated between boring locations using potable tap water and a phosphate-free detergent (e.g. Alconox).

Subsequent to boring completion, a 2-inch diameter flush-joint Schedule 40 PVC monitoring well will be installed at boring locations. Each well will be constructed with a 5-foot flush-joint Schedule 40 PVC, 0.010-inch machine slotted well screen. Each well screen and attached riser will be placed at the bottom of each borehole and a silica sand filter pack (size #0) will be installed from the base of the well to a maximum of 2 feet above the top of

the screen. A minimum 2-foot thick bentonite chip seal will then be installed and allowed to hydrate sufficiently to mitigate the potential for downhole grout contamination. If sufficient borehole annulus remains, cement/bentonite grout will be installed to approximately one-foot below ground surface via pressure tremie-pipe procedures. The newly installed monitoring wells will be completed with keyed alike locks, a lockable J-plug, and an 8-inch diameter steel flush mounted road box anchored within a 2-foot by 2-foot by 1-foot square concrete pad.

4.1.2.2 Well Development

Upon installation, but not within 24 hours, newly installed monitoring wells MW-1 through MW-3 will be developed in accordance with Benchmark and NYSDEC protocols. Development of the monitoring wells will be accomplished with dedicated disposable polyethylene bailers via surge and purge methodology. Field parameters including pH, temperature, turbidity and specific conductance will be measured periodically (i.e., every well volume or as necessary) during development. Field measurements will continue until they became relatively stable. Stability will be defined as variation between measurements of approximately 10 percent or less with no overall upward or downward trend in the measurements. A minimum of three well volumes will be evacuated from each monitoring well. Unless field observations suggest groundwater impact, development water from the monitoring wells will be discharged to the ground surface.

4.1.2.3 Groundwater Sample Collection

Prior to sample collection, static water levels will be measured and recorded from all on-site monitoring wells. Following water level measurement, Benchmark personnel will purge and sample the monitoring wells using either a peristaltic pump with dedicated pump tubing following low-flow/minimal drawdown purge and sample collection procedures or using a dedicated polyethylene bailer. Prior to sample collection, groundwater will be evacuated from each well at a low-flow rate (typically less than 0.1 L/min). Field measurements for pH, specific conductance, temperature, turbidity, and water level as well as visual and olfactory field observations will be periodically recorded and monitored for stabilization. Purging will be considered complete when pH, specific conductivity and temperature stabilize and when turbidity measurements fall below 50 Nephelometric Turbidity Units (NTU), or become stable above 50 NTU. Stability is defined as variation

between field measurements of 10 percent or less and no overall upward or downward trend in the measurements. Upon stabilization of field parameters, groundwater samples will be collected and analyzed as discussed below.

Upon arrival at each monitoring well, field personnel will visually inspect the monitoring well for defects and/or vandalism. Following location and inspection of each well, the static water level and total depth will be recorded and one standing well volume will be calculated. The following bulletized list describes each sample collection method that may be implemented during the RI.

- **Peristaltic Pump with Dedicated Pump Tubing**

  Wells less than 20 fbgs will be purged and sampled using a peristaltic pump and dedicated pump tubing following low-flow (minimal drawdown) purge and sample collection procedures in a manner similar to that described in the previous section. However, the pump will not require decontamination because all components are dedicated to each monitoring well.

- **Polyethylene Disposable Bailer**

  In the event of a pump malfunction, wells of any depth (up to 100 fbgs) may be purged and sampled using a polyethylene disposable bailer via direct grab. In general, a bottom filling dedicated polyethylene bailer is attached to a length of dedicated hollow-braid polypropylene rope and lowered into the well smoothly and slowly as not to agitate the groundwater or damage the well. Purging continues until a predetermined volume of water has been removed (typically three well volumes) or to dryness. Measurements for pH, temperature, specific conductance, dissolved oxygen (optional), Eh (optional), and turbidity are recorded following removal of each well volume. The well is purged until the readings for indicator parameters stabilize or the well is purged to dryness.

Prior to and immediately following collection of groundwater samples, field measurements for pH, specific conductance, temperature, turbidity, Eh, dissolved oxygen and water level as well as visual and olfactory field observations will be recorded. All collected groundwater samples will be placed in pre-cleaned, pre-preserved laboratory provided sample bottles, cooled to 4°C in the field, and transported under chain-of-custody command to STL for analysis.

If target analytes are detected in groundwater samples above NYSDEC groundwater quality standards (GWQS), additional rounds of groundwater sampling may be required.

4.1.2.4 Groundwater Sample Analyses

All groundwater samples will be analyzed for TCL VOCs, TCL SVOCs, PCBs, pesticides and TAL metals in accordance with NYSDEC ASP CLP methodology. All groundwater samples analyses will be reported with an ASP Category B deliverables package to allow for third party data usability assessment.

4.1.3 Field Specific Quality Assurance/Quality Control Sampling

In addition to the soil/fill and groundwater samples described above, field-specific quality assurance/quality control (QA/QC) samples will be collected and analyzed to ensure the reliability of the generated data as described in the QAPP (provided under separate cover) and to support the required third-party data usability assessment effort. Site-specific QA/QC samples will include matrix spikes, matrix spike duplicates, blind duplicates, and trip blanks as discussed below:

- **Blind Duplicate** - One blind duplicate will be collected and analyzed per 20 samples collected for the site-specific parameters per matrix (i.e., groundwater, soil). The location of the sample collection point will not be disclosed to the analytical laboratory, therefore the field sample containers will be returned to the laboratory identified only as the "blind duplicate". The well or sample location will be recorded in the Project Field Book and on the respective Water Sample Collection Log and the results will be compared to review analytical precision.

- **Matrix Spike/Matrix Spike Duplicate (MS/MSD)** – A sufficient volume of sample will be collected at one sampling location per 20 samples for MS/MSD analysis for the site-specific parameters per matrix (i.e., groundwater, soil). The laboratory will report the results of the MS/MSD analysis, which will be reviewed for sampling and analysis precision and accuracy.

Dedicated sampling equipment will be used to minimize field decontamination time and avoid the need for equipment blanks. QA/QC field sampling requirements are detailed further in the QAPP.

4.1.4 Bench-Scale Soil Treatability Testing

A previous investigation completed on-site by Benchmark reported an exceedance of the TCLP lead concentration threshold for hazardous waste toxicity characteristics of 5 mg/L. Based on total lead concentrations across the site, the potential exists that additional soil samples will exceed the TCLP lead threshold. Furthermore, it is likely that lead shot will be present in some soil samples and that lead shot may be contributing to soil samples exceeding the TCLP lead threshold. As such, bench-scale soil treatability testing will be completed during the RI to evaluate potential physical separation methods and/or soil amendments that would result in a reduction of the TCLP lead concentration below 5 mg/L and consequently result in the soil being considered a non-hazardous waste. Up to three soil amendments will be evaluated in up to three concentrations as described below.

Benchmark has previously completed treatability testing for evaluation of lead stabilization treatment methods. That testing included evaluation of phosphoric acid and Portland cement as soil amendments to reduce TCLP lead concentrations. The results of that testing, which were published in a paper titled "Large-scale Permanganate Oxidation and Chemical Metal Fixation in Soils at Inactive Coke Manufacturing Plant- Case Study" (Ref. 9), indicated that soil amendments, including 2% by weight addition of phosphoric acid, 5% by weight addition of phosphoric acid and 10% by weight addition of Portland cement, were effective lead stabilization treatment methods.

Following similar methods to testing previously completed by Benchmark, the following approach will be implemented.

- TCLP lead sample data collected during the RI will be reviewed to determine which areas of the site contain characteristic hazardous soil for lead. Two sample areas that exceeded the TCLP lead threshold will be selected for evaluation.
- Four five-gallon buckets of soil sample will be collected from each area using a hand-held shovel and transported under standard chain of custody to STL Laboratories. The bench-scale treatabilty tests will be completed at STL laboratories by Benchmark personnel.
- One homogenized sample will be placed and weighed in a disposable plastic container.

- Soil amendments will be weighed into aliquots, based on the weight of the soil sample and mixed into the soil. Deionized water may be used to enhance dispersion in the soil samples.
- Another homogenized soil sample will be passed through a sieve of small enough size to remove lead shot typically used in target and skeet shooting (i.e., 2.03 mm to 2.41 mm in diameter). Soil amendments will be added to the sieved sample in the same manner as the non-sieved sample.
- The treated soils will then be re-tested for TCLP lead.

4.2 Investigation-Derived Waste Management

During installation of the monitoring wells, excess soil cuttings will be containerized in 55-gallon drums. Groundwater from well development and purging will be discharged to the ground surface. However, if field observations suggest groundwater impact, the water will be containerized in 55-gallon drums. Drums will be labeled with regard to contents, origin, and date of generation using a paint stick marker on two sides and the top of each drum. The drums will be staged on-site pending soil and groundwater analyses and remedial measures assessment.

4.3 Site Mapping

A site map will be developed during the field investigation. All sample points and relevant site features, including buildings, will be located on the site map. Benchmark will employ a Trimble GeoXT handheld GPS unit to identify the locations of all soil borings and newly installed wells relative to New York State planar grid coordinates. Monitoring well elevations will be measured by Benchmark's surveyor. An isopotential map showing the general direction of groundwater flow will be prepared based on water level measurements relative to USGS vertical datum. The maps will be provided with the RI report.

5.0 CUSTODY PROCEDURES

Sample custody is controlled and maintained through the chain-of-custody procedures. Chain of custody is the means by which the possession and handling of samples will be tracked from the source (field) to their final disposition, the laboratory. A sample is considered to be in a person's custody if it is in the person's possession or it is in the person's view after being in his or her possession or it was in that person's possession and that person has locked it in a vehicle or room. Sample containers will be cleaned and preserved at the laboratory before shipment to the Site. The following section and FOPs for Sampling, Labeling, Storage, and Shipment, located in Appendix A, describe procedures for maintaining sample custody from the time samples are collected to the time they are received by the analytical laboratory. STL's laboratory chain-of-custody procedures are discussed in the STL Quality Assurance Manual located in Appendix B.

5.1 Field Custody Procedures

Field logbooks provide the means of recording data collection activities performed during the investigation. As such, entries will be described in as much detail as possible so that persons going to the facility could reconstruct a particular situation without reliance on memory. Field logbooks are bound field survey books or notebooks. Logbooks are assigned to field personnel, but will be stored in the document control center when not in use. Each logbook will be identified by the project-specific document number. The title page of each logbook will contain the following:

- Person to whom the logbook is assigned.
- Logbook number.
- Project name.
- Project start date.
- End date

Entries into the logbook will contain a variety of information. At the beginning of each entry, the date, start time, weather, names of all sampling team members present, level of personal protection equipment being used, and the signature of the person making the entry will be entered. The names of visitors to the Site, field sampling or investigation team

personnel and the purpose of their visit will also be recorded in the field logbook. Measurements made and samples collected will be recorded. All entries will be made in permanent ink, signed, and dated and no erasures will be made. If an incorrect entry is made, the information will be crossed out with a single strike mark that is signed and dated by the sampler. Whenever a sample location is surveyed, including compass and distance measurements or latitude/longitude information (e.g., obtained by using a global positioning system) the location information will be recorded. In the event that photographs are taken to document field activities, the number and brief description of the photographs taken will also be recorded. All equipment used to make measurements will be identified, along with the date of calibration.

Samples will be collected following the sampling procedures documented in Section 4.0 of this QAPP. The equipment used to collect samples will be noted, along with the time of sampling, sample description, depth at which the sample was collected, volume and number of containers. Sample identification numbers will be assigned prior to sample collection. Field duplicate samples, which will receive a separate sample identification number, will be noted under sample description.

The sample packaging and shipment procedures summarized below will ensure that the samples will arrive at the laboratory with the chain-of-custody intact. The protocol for specific sample numbering and other sample designations is included in an FOP provided in Appendix A of this QAPP. Examples of field custody documents and instructions for completion are also presented in Appendix A of this QAPP.

- The field sampler is personally responsible for the care and custody of the samples until they are transferred or properly dispatched. Field procedures have been designed such that as few people as possible will handle the samples.

- All bottles will be identified by the use of sample tags with sample numbers, sampling locations, date/time of collection, and type of analysis. The sample numbering system is presented in the FOP.

- Sample labels will be completed for each sample using waterproof ink unless prohibited by weather conditions. For example, a logbook notation would explain that a pencil was used to fill out the sample label because the ballpoint pen would not function in freezing weather.

- Samples will be accompanied by a properly completed chain-of-custody form (see FOP). The sample numbers and locations will be listed on the chain-of-custody form. When transferring the possession of samples, the individuals relinquishing and receiving will sign, date, and note the time on the record. This record documents transfer of custody of samples from the sampler to another person, to a mobile laboratory, to the permanent laboratory, or to/from a secure storage area.

Samples will be properly packaged and cooled to 4°C (soil and groundwater samples) for shipment and dispatched to the appropriate laboratory for analysis, with a separate signed custody record enclosed in and secured to the inside top of each sample box or cooler. Shipping containers will be locked and secured with strapping tape and custody seals for shipment to the laboratory. The custody seals will be attached to the front right and back left of the cooler and covered with clear plastic tape after being signed by the field team leader. The cooler will be strapped shut with strapping tape in at least two locations.

5.2 Laboratory Custody Procedures

Laboratory custody procedures for sample receiving and log-in; sample storage and numbering; tracking during sample preparation and analysis; and storage of data are described in Appendix B, the Laboratory QA Manual.

5.2.1 Sample Receipt

A sample custodian is responsible for receiving samples, completing chain-of-custody (COC) records, determining and documenting the condition of samples received through the Cooler Receipt and Preservation Form (CRPF, see Laboratory QA Manual, Appendix B), logging samples into the LIMS system based upon the order of log-in, and storing samples in appropriate limited-access storage areas. Chain-of-custody documentation is also maintained for the transfer of samples between STL, and for shipment of samples to subcontracted laboratories.

Upon sample receipt, an inventory of shipment contents is compared with the COC record, and any discrepancies, including broken containers, inappropriate container materials or preservatives, headspace in VOC samples, and incorrect or unclear sample identification, are documented and communicated to the appropriate project manager.

Each sample is given a unique laboratory code and an analytical request form is generated. The analytical request contains pertinent information for each sample, including:

- Client name
- Project number
- Task number
- Purchase order number
- Air bill number
- Chain-of-custody number
- Number of samples
- Sample descriptions
- Sample matrix type
- Date and time of sampling
- Analysis due dates
- Date and time of receipt by lab
- Client sample identification
- Any comments regarding special instructions or discrepancies

5.2.2 Sample Storage

Samples are stored in secure, limited-access areas. Walk-in coolers or refrigerators are maintained at 4°C, ± 2°C, or as required by the applicable regulatory program. The temperatures of all refrigerated storage areas are monitored and recorded a minimum of once per day. Deviations of temperature from the applicable range require corrective action, including moving samples to another storage location if necessary.

5.2.3 Sample Custody

Sample custody is defined by this document as an occurrence of any of the following:

- It is in someone's actual possession.
- It is in someone's view after being in his or her physical possession.

- It was in someone's possession and then locked, sealed, or secured in a manner that prevents unsuspected tampering.

- It is placed in a designated and secured area.

Samples are removed from storage areas by the sample custodian or analysts and transported to secure laboratory areas for analysis. Access to the laboratory and sample storage areas is restricted to laboratory personnel and escorted visitors only; all areas of the laboratory are therefore considered secure. If required by the applicable regulatory program, internal COC is documented in a log by the person moving the samples between laboratory and storage areas.

Laboratory documentation used to establish COC and sample identification may include the following:

- Field COC forms or other paperwork that arrives with the sample.

- The laboratory COC.

- Sample labels or tags are attached to each sample container.

- Sample custody seals.

- Sample preparation logs (i.e., extraction and digestion information) recorded in hardbound laboratory books that are filled out in legible handwriting, and signed and dated by the chemist.

- Sample analysis logs (e.g., metals, GC/MS, etc.) information recorded in hardbound laboratory books that are filled out in legible handwriting, and signed and dated by the chemist.

- Sample storage log (same as the laboratory COC).

- Sample disposition log, which documents sample disposal by a contracted waste disposal company.

5.2.4 Sample Tracking

All samples are maintained in the appropriate coolers prior to and after analysis. The analysts remove and return their samples as needed. Samples that require internal COC are relinquished to the analysts by the sample custodians. The analyst and sample custodian must sign the original COC relinquishing custody of the samples from the sample custodian to the analyst. When the samples are returned, the analyst will sign the original COC returning sample custody to the sample custodian. Sample extracts are relinquished to the instrumentation analysts by the preparatory analysts. Each preparation department tracks internal COC through their logbooks/spreadsheets.

Any change in the sample during the time of custody will be noted on the COC (e.g., sample breakage or depletion).

5.2.5 Sample Disposal

A minimum of 30 days following completion of the project, or after a period of time specified by any applicable project requirements, sample disposal is performed in compliance with federal, state, and local regulations. Alternatively, samples may be returned to the client by mutual agreement. All available data for each sample, including laboratory analysis results and any information provided by the client, are reviewed before sample disposal.

All samples are characterized according to hazardous/non-hazardous waste criteria and are segregated accordingly. All hazardous waste samples are disposed in accordance wih formal procedures outlined in STL's Standard Operating Procedure (SOP). It should be noted that all waste produced at the laboratory, including the laboratory's own various hazardous waste streams, is treated in accordance with all applicable local and Federal laws.

Complete Internal COC documentation is maintained for some samples from initial receipt through final disposal. This ensures that an accurate history of the sample from "cradle to grave" is generated. Internal Chain Documentation through disposal is in place at STL.

5.3 Project File

The project file will be the central repository for all documents, which constitute evidence relevant to sampling and analysis activities as described in this QAPP. Benchmark is the custodian of the evidence file and maintains the contents of evidence files for the

investigation, including all relevant records, reports, logs, field notebooks, pictures, subcontractor reports and data reviews in a secured, limited-access area and under custody of the Benchmark project manager. Information generated during this study by will be retained by Benchmark in the project file. The project file will include at a minimum:

- Field logbooks
- Field data and data deliverables
- Photographs
- Drawings
- Soil boring logs
- Laboratory data deliverables
- Data validation reports
- Data Assessment reports
- Progress reports, QA reports, interim project reports, etc.
- All custody documentation (tags, forms, air bills, etc.).

6.0 CALIBRATION PROCEDURES AND FREQUENCY

This section describes the calibration procedures and the frequency at which these procedures will be performed for both field and laboratory instruments.

6.1 Field Instrument Calibration

Quantitative field data to be obtained during groundwater sampling include pH, turbidity, specific conductance, temperature, and depth to groundwater. Quantitative water level measurements will be obtained with an electronic sounder or steel tape, which require no calibration. Quantitative field data to be obtained during soil sampling include screening for the presence of VOCs using a photoionization detector (PID).

FOPs located in Appendix A describe the field instruments used to monitor for these parameters and the calibration methods, standards, and frequency requirements for each instrument. Calibration results will be recorded in the Project Field Logbook.

6.2 Laboratory Instrument Calibration

All equipment and instruments used at STL are operated, maintained and calibrated according to the manufacturer's guidelines and recommendations, as well as to criteria set forth in the applicable analytical methodology. Operation and calibration are performed by personnel who have been properly trained in these procedures. Documentation of calibration information is maintained in appropriate reference files. The frequency of calibration and concentration of calibration standards are determined by the manufacturer's guidelines, the analytical method, or the requirements of special contracts. Generally, purchased standards have a shelf life of 12-36 months and prepared standards have a shelf life of 1-12 months. Recalibration is required at anytime the instrument is not operating correctly or functioning at the proper sensitivity. Brief descriptions of the calibration procedures for major laboratory equipment and instruments are described in STL's QA Manual (Appendix B).

7.0 ANALYTICAL PROCEDURES

Groundwater and soil samples collected during the RI activities will be analyzed by Severn Trent Laboratories, Inc. (STL), 10 Hazelwood Drive, Amherst, New York 14228, (716) 691-2600.

7.1 Field Analytical Procedures

Field procedures for collecting and preserving samples are described in FOPs located in Appendix A.

7.2 Laboratory Analytical Procedures

This section describes the analytical procedures to be followed in the laboratory. Laboratory analytical procedures will follow NYSDEC ASP-2000, CLP methodology. Analytical methods, method detection limits, and reporting limits selected for use in this investigation are listed in Tables 1 (soil) and 2 (groundwater). Sample container, preservation and holding time requirements are presented in Table 8. STL will provide analytical services; however, other laboratories may be used if necessary depending on project requirements. If a subcontract laboratory is required, the subcontracted laboratory's QA manual and copies of the State or Federal Certifications will be submitted to the NYSDEC prior to sample analysis. General laboratory analytical procedures and sample handling procedures are presented in STL's QA Manual in Appendix B.

7.2.1 Sample Preparation and Analytical Methods

The laboratory named above will implement the method SOPs. The laboratory SOPs for sample preparation, cleanup and analysis are based on NYSDEC ASP-2000 CLP methodology and USEPA procedures. These SOPs provide sufficient details specific to the methods identified for this project.

7.2.2 Confirmation Analysis Methods

The laboratory SOPs presented in Appendix B identify the confirmatory analysis appropriate for this project. The basis for these SOPs is NYSDEC ASP-2000 and USEPA

procedures. These protocols include second column confirmation for the gas chromatography methods.

In addition, confirmatory analysis may be performed by the evaluation of field duplicates and/or analytical results for split samples with the agency. Although analyte concentrations between duplicate analyses and split samples may vary, the target analytes present should be the same. This can be considered confirmation analysis.

7.2.3 Method Validation

In order to demonstrate that the laboratory is capable of detecting and quantifying analytes at specific levels required by regulatory agencies or clients, each laboratory establishes method detection limits (MDLs), instrument detection limits (IDLs), and practical quantitation limits (PQLs), as required by the specific method protocols. These limits, along with other related detection or quantitation limits, are defined as follows:

- *Method Detection Limit* (MDL) - the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero. The MDL is a theoretical, statistically derived value determined by preparing at least seven replicates of a low-level spiked matrix, which are taken through the entire sample preparation and analysis procedure; the standard deviation of the results is multiplied by the appropriate student's t value at the 99% confidence level to obtain the MDL. STL performs MDL studies using the procedure defined in 40 CFR Part 136, Appendix B, *Definition and Procedure for the Determination of the Method Detection Limit* - Revision 1.11. MDLs are determined for each method and instrument annually, at a minimum, or when significant modifications to the procedure or instrumentation have been made, as determined by laboratory manager.

- *Instrument Detection Limit* (IDL) - an estimate of the lowest concentration of a substance that can be reliably detected above background noise on an instrument. The IDL is a theoretical, statistically derived value, which is determined by analyzing seven replicates of a low-level standard on each of three non-consecutive days; the standard deviation of the results is multiplied by three to obtain the IDL.

- *Practical or Estimated Quantitation Limit* (PQL or EQL) - an estimate of the lowest concentration of a substance that can be reliably achieved within specified limits of precision and accuracy during routine laboratory operations. Typically, the

PQL (EQL) is a nominal value selected at a level between 3 and 10 times the MDL.

- *Contract Required Quantitation Limit* (CRQL) – an estimate of the lowest concentration of a substance that can be reliably achieved as specified in the method. Typically, the CRQL is higher than PQL.

8.0 INTERNAL QUALITY CONTROL CHECKS

8.1 Field Quality Control Checks

The QC criteria for each field measurement are provided in Table 6 of this QAPP. Assessment of field sampling precision and bias will be made by collecting field duplicates and field blanks for laboratory analysis. Collection of the samples will be in accordance with the applicable FOPs described in Section 4.0 of this QAPP at the frequency indicated in Section 3.0 of this QAPP.

Blind Duplicate soil and groundwater samples will be collected to allow determination of analytical precision. One duplicate soil and groundwater sample will be collected for every 20 samples or per sampling event if less than 20 samples are collected. Duplicate sample aliquots for soil and groundwater will be collected sequentially as grab samples after collection of the initial sample aliquot. The sample location will not be disclosed to the analytical laboratory.

One equipment blank will be collected for each day of sampling activity if non-dedicated sampling equipment is used. These equipment blank samples will be used as a QC check of the decontamination procedures for sampling equipment. A VOC travel blank (a.k.a., "trip blank") will be included in each cooler containing water matrix samples to be analyzed for VOCs and sent to the laboratory for analysis.

8.2 Laboratory Quality Control Checks

The internal QC checks for laboratory analyses of soil and groundwater samples that will be collected during this investigation are covered in the laboratory's QA Manual located in Appendix B. Laboratory analytical internal QA/QC will be conducted in accordance with NYSDEC ASP-2000 CLP methodology. The checks include internal QC methods covering surrogate spikes, duplicates, preparation blanks, calibration, lab quality control samples and reagent checks. A site-specific MS/MSD sample will be analyzed as a further QC check. The matrix spike samples will be analyzed at the same frequency as the duplicate samples. The matrix spike samples will allow accuracy to be determined by using the percent recovery of the spiked compounds. The purpose of the MS/MSD samples is to monitor any possible matrix effects specific to samples collected from the Site. Acceptable QC limits for the

MS/MSD samples are found in NYSDEC ASP-2000. The specific sample location that will be used for matrix spikes may be chosen by the Project Manager or Project QA Officer.

9.0 DATA REDUCTION, VALIDATION, AND REPORTING

All data generated through field activities, or by the laboratory operation shall be reduced and validated prior to reporting. The laboratory shall disseminate no data until it has been subjected to the procedures summarized below.

9.1 Data Reduction

9.1.1 Field Data Reduction Procedures

Field measurements of pH, turbidity, temperature, specific conductance, water level and volatile organic vapor content (via the PID) are read directly in the units of final use, as discussed in Section 3.0 of this QAPP and listed in Table 5. Field personnel are responsible for monitoring the collection and reporting of field data. Field personnel will review field measurements at the time of measurement and will re-measure a parameter as necessary to assure quality and accuracy is maintained.

Field data will be recorded on appropriate field data record forms as they are collected and will be maintained in Benchmark's office project file. The Project QA Officer will review field procedures and compare field data to previous measurements to assess comparability and accuracy of the field data measurements.

9.1.2 Laboratory Data Reduction Procedures

Results of laboratory analyses will be reported in units of final use, as discussed in Section 3.0 and listed in Table 5. Laboratory calculations will be performed as prescribed for a given analytical method or in conformance with acceptable laboratory standards at the time the calculation is performed.

The laboratory will retain QA/QC records for at least five years. Original laboratory reports will be stored in the Benchmark project files. Copies of raw data will be available for review at the laboratory. Copies of raw data also may be requested as part of the QA/QC review. For this project, Benchmark has requested a complete validatable data package (Category B deliverables), which fulfills all deliverable requirements as specified in the NYSDEC ASP-2000 CLP Statement of Work. The data package includes the following information:

- Transmittal letter.
- Sample number or numbers; matrix; date and time collected; date and time extracted/digested; date and time analyzed; chain of custody information; sample receipt information (e.g., container seals, cooler temperature); and field sampling log.
- Parameter requested.
- Results, including sample analytical results; duplicates; blanks; MS/MSDs; blank spikes; surrogate recoveries (if applicable); standard reference materials results; and low level matrix spike recoveries to confirm method detection limit.
- Surrogate recovery results for appropriate organic methods, including associated NYSDEC or STL acceptance criteria.
- Chain of Custody documents.
- Case narrative.
- Supporting QA/QC. This includes sample preparation, analysis and cleanup methods, sample preparation and cleanup logs; analysis run logs; MDLs, IDLs and methods used to determine MDL in the matrix; calibration data; percent solids for non-water samples; example calculations; data validation procedures, results and checklists; and documentation illustrating how blank water is determined to be analyte free.

The Project Manager, Project QA Officer, or appropriate personnel assigned by the Project Manager will review the laboratory data. Section 12.0 outlines the procedures for evaluating the accuracy and precision of data. If comparison of data to previous measurements or known conditions at the Site indicates anomalies, the laboratory will be instructed to review the submitted data while Benchmark reviews the methods used to obtain the data. If anomalies remain, the laboratory may be asked to re-analyze selected samples provided that holding times have not been exceeded.

9.2 Data Usability Evaluation

Data usability evaluation procedures shall be performed for both field and laboratory operations as described below.

9.2.1 Procedures Used to Evaluate Field Data Usability

Procedures to validate field data for this project will be facilitated by adherence to the FOPs identified in Appendix A. The performance of all field activities, calibration checks on all field instruments at the beginning of each day of use, manual checks of field calculations, checking for transcription errors and review of field log books is the responsibility of the Field Team Leader.

9.2.2 Procedures Used to Evaluate Laboratory Data Usability

Data evaluation will be performed by the third-party data validator using the most current methods and quality control criteria from the USEPA's Contract Laboratory Program, (CLP) *National Functional Guidelines for Organic Data Review,* and *Contract Laboratory Program, National Functional Guidelines for Inorganic Data Review*, as well as corresponding USEPA Region 2 guidance. Also, results of blanks, surrogate spikes, MS/MSDs, and laboratory control samples will be reviewed/evaluated by the data validator. All sample analytical data for each sample matrix shall be evaluated. The third-party data validation expert will also evaluate the overall completeness of the data package. Completeness checks will be administered on all data to determine whether deliverables specified in Section 9.1.2 of this QAPP are present. The reviewer will determine whether all required items are present and request copies of missing deliverables. The data review will be presented in a Data Usability Summary Report (DUSR), prepared in accordance with Appendix 2B of NYSDEC's draft DER-10 guidance. Appropriate data qualifiers will be added to the data summary tables and analytical report Form 1. Any data that would be rejected under USEPA Region 2 Data Validation Guidelines will also be rejected in the DUSR.

9.3 Data Reporting

Data reporting procedures shall be carried out for field and laboratory operations as indicated below.

9.3.1 Field Data Reporting

All investigation field documents will be accounted for when they are completed. Accountable documents include items such as field notebooks, sample logs, field data records, photographs, data packages, computer disks, and reports.

9.3.2 Laboratory Data Reporting

Analytical data will be summarized in tabular format with such information as sample identification, sample matrix description, parameters analyzed and their corresponding detected concentrations, and the detection limit. Analytical results will be incorporated into reports as data tables, maps showing sampling locations and analytical results, and supporting text.

10.0 PERFORMANCE SYSTEM AUDITS AND FREQUENCY

Performance and system audits of both field and laboratory activities will be conducted to verify that sampling and analysis are performed in accordance with the procedures established in the FOPs and this QAPP. The audits of field and laboratory activities include two independent parts, internal and external.

10.1 Field Performance and System Audits

10.1.1 Internal Field Audits

The QA Officer will conduct internal audits of field activities including sampling and field measurements. These audits will verify that all established procedures are being followed. Internal field audits will be conducted at least once at the beginning of the Site sample collection activities. Project duration may warrant subsequent audits on a monthly basis.

The audit program consists of the following:

- Observation of field activities to confirm that procedures are performed in accordance with project protocols and standard accepted methods, as detailed in the FOPs located in Appendix A.

- Review daily field records, monitoring well sampling records, and any other data collection sheets during and after field measurements.

10.1.2 External Field Audits

The NYSDEC Site Project Coordinator may conduct external field audits. External field audits may be conducted any time during the field operations. These audits may or may not be announced and are at the discretion of the NYSDEC. External field audits will be conducted according to the field activity information presented in this QAPP.

10.2 Laboratory System Audits

The adequacy and implementation of STL's QA plan are assessed on a continual basis through systems and performance audits. Systems audits evaluate practice against established quality system objectives and requirements. Performance audits measure the

comparability and accuracy of laboratory data through the analysis of reference materials for which the true value is unknown to the analyst. Audits may be performed by STL (internal), or by clients, regulatory agencies, or accreditation bodies (external).

10.2.1 Internal Laboratory Audits

The STL QA Coordinator schedules internal systems audits such that the laboratory's quality system and range of test capabilities are audited annually. The audits are conducted to determine the following:

- Whether the procedures defined in the quality system are being followed.
- Whether the objectives defined in the quality system are being achieved.
- Identify opportunities for improvement.

The STL QA Coordinator will conduct the laboratory audit. The QA Coordinator prepares an audit plan for each audit, which defines the scope of the audit, requirements that the audit will be conducted against, and the audit technique(s) to be used (observation, record review, interview). The internal system audits are scheduled as two auditing events and follow the audit plan.

The results of each audit are reported to the Laboratory Director and Supervisors for review and comment. Any deficiencies noted by the auditor are summarized in an audit report and corrective action is taken within a specified length of time to correct each deficiency. Should problems impacting data quality be found during an internal audit, any client whose data is adversely impacted will be given written notification if not already provided.

10.2.2 External Laboratory Audits

Upon client, regulatory agency, or accreditation body notification of intent to audit, the quality assurance officer notifies laboratory personnel and corporate quality assurance. During the audit, the quality assurance coordinator, or a designee, provides escort for the auditors, and participates in the pre-audit and post-audit conferences. Additional laboratory personnel are called upon as necessary during the course of the audit. An external audit will

be conducted upon request by appropriate NYSDEC QA staff. These audits may or may not be announced and are at the discretion of the NYSDEC.

External audits may include any or all of the following:

- Review of laboratory analytical procedures.
- Laboratory on-site visits (see below).
- Submission of performance evaluation samples to the laboratory for analysis.

Failure of any or all audit procedures chosen can lead to laboratory disqualification, and the requirement that another suitable laboratory be chosen.

An external on-site review may consist of:

- Sample receipt procedures
- Custody and sample security and log in procedures
- Calibration records
- Instrument logs and statistics (number and type)
- Review of QA procedures
- Review of logbooks
- Review of sample preparation procedures
- Sample analytical SOP review
- Instrument (normal or extends quantitation report) reviews
- Personnel interviews
- Review of deadlines and glassware prep
- A close out to offer potential corrective action

It is common practice when conducting an external laboratory audit to review one or more data packages from sample lots recently analyzed by the laboratory. This review will most likely include but not be limited to:

- Comparison of resulting data to the laboratory SOP or method, including coding for deviations.

- Verification of initial and continuing calibrations within control limits.

- Verification of surrogate recoveries and instrument tuning results where applicable.
- Review of extended quantitation reports for comparisons of library spectra to instrument spectra, where applicable.
- Recoveries on control standard runs.
- Review of run logs with run times, ensuring proper order of runs,
- Review of spike recoveries/QC sample data.
- Review of suspected manually integrated GC data and its cause (where applicable).
- Assurance that samples are run within holding times.

All data will be reviewed while on the premises of STL, so that any questionable data can be discussed with the staff.

Following the audit, the QA Officer provides a written summary of the audit to the laboratory manager, department supervisors, and corporate quality assurance. The summary includes the areas reviewed, and strengths and deficiencies identified during the audit.

The QA Coordinator initiates the corrective action process for each finding and is responsible for ensuring timely corrective action. The QA Coordinator prepares the audit report response, and prepares any follow-up responses as corrective actions are completed. The audit report and laboratory responses are copied to corporate quality assurance.

10.3 Laboratory Performance Audits

10.3.1 Internal Performance Audit

Internal performance audit samples are submitted at the discretion of the local QA Director as a supplement to the quality control checks run on a daily basis. The QA Director maintains a log of blind sample preparation in which the reference material used,

preparation, and true value(s) are documented. The reference materials submitted should be independent of the laboratory's initial calibration standards.

Acceptance criteria for internal performance audit sample results are those provided with the reference material. If no criteria are provided, performance criteria listed in the reference method are used. Internal performance audit results are scored and corrective action is initiated in the same manner as external samples. The Laboratory Director is responsible for ensuring timely corrective action.

10.3.2 External Performance Audit

External performance audit samples are run at the frequency required to obtain and maintain desired certifications, accreditations, and approvals. Additional studies may be run at the discretion of corporate QA or the local laboratory manager.

The QA Director initiates the corrective action process for each performance audit result scored as "fail." The Laboratory Director is responsible for ensuring timely corrective action. The audit report and laboratory responses are copied to corporate quality assurance.

11.0 PREVENTATIVE MAINTENANCE

11.1 Field Instrument Preventative Maintenance

Each piece of field equipment is checked according to its routine maintenance schedule and before field activities begin. Field equipment planned for use during this investigation includes:

- Photoionization detector (PID).
- Water quality meters (includes pH, turbidity, temperature and specific conductance).
- Electric water level indicator.

Field personnel will report all equipment maintenance and/or replacement needs to the Project QA Officer and will record the information on the daily field record. Calibration and Maintenance FOPs are provided in Appendix A.

11.2 Laboratory Instrument Preventative Maintenance

As part of the QA Program Plan, a routine preventative maintenance program is conducted by STL to minimize the occurrence of instrument failure and other system malfunctions. The analysts regularly perform instrument maintenance tasks (or coordinate with the vendor). All maintenance that is performed is in accordance with the manufacturer's specifications and is documented in the laboratory's maintenance logbooks. The maintenance logbooks used at STL contain extensive information about the instruments used at the laboratory.

Preventative maintenance procedures, frequencies, and other pertinent information are available for each instrument used at STL through SOPs and in the operating or maintenance manuals provided with the equipment. Responsibility for ensuring that routine maintenance is performed lies with the section supervisors. Each laboratory section maintains a critical parts inventory. The parts inventories include the items needed to perform the preventative maintenance procedures presented in STL's QA Manual provided in Appendix B of this QAPP.

11.3 Inspection/Acceptance Requirements for Supplies and Consumables

11.3.1 Field Supplies and Consumables

For this investigation, Benchmark will track critical supplies in the following manner.

Item	Date Received	Condition	Responsible Individual
Tyvek suits			
Disposable bailers			
Pump tubing			
Latex gloves			
Respirator cartridges			
Sample containers			
Decon materials			
Alconox detergent			
pH buffer solutions			
Calibration gases			

Labels indicating the following information on receipt and testing are to be used for critical supplies and consumables.

- Unique identification number (if not clearly shown).
- Date received.
- Date opened.
- Date tested (if performed).
- Date to be retested (if applicable).
- Expiration date.

11.3.2 Laboratory Supplies and Consumables

Supplies and consumables used in the analytical process shall have traceable documentation (e.g., labels or logbooks) for date received, date opened, and date expired. Inspection, testing and acceptance criteria for critical supplies and consumables are identified below.

Critical Supplies & Consumables	Inspection/ Acceptance Testing Requirements	Acceptance Criteria	Testing Method	Frequency	Responsible Individual	Handling/ Storage Conditions
Standards	Refer to the Manufacturer's Certificate of Analysis.					
Acids	< RL's for common lab contaminants	< RL's all elements	SW-846	Each Lot	Receiving / Laboratory Personnel	Vented Acid Cabinets
Solvents	< RL's for common lab contaminants	< RL's for common lab contaminants	SW-846	Each Lot	Receiving / Laboratory Personnel	Vented Solvent Cabinets

12.0 DATA PRECISION, ACCURACY, AND COMPLETENESS EVALUATION

The purpose of this section is to indicate the methods by which it will be assured that the data collected for this investigation is in accordance with the data quality objectives (DQOs) for the Site. Factors considered during this investigation include:

- The chemical constituents known and/or suspected to be of concern, as they relate to the data quality level parameters chosen.
- The choice of analytical and sample preparation methods with method detection limits that meet the data quality level concentrations for chemical constituents of concern.
- The risk-based preliminary remediation goal parameters chosen based on conditions and possible receptors associated with the site (e.g., human health data quality levels, soil screening guidance, etc.).

Once these goals and objectives are evaluated and chosen, analytical data quality will be assessed to determine if the objectives have been met. In addition, the data will be reviewed for indications of interferences to results caused by sample matrices, cross contamination during sampling, cross contamination in the laboratory, and sample preservation and storage anomalies (i.e., samples holding time or analytical instrument problems).

As discussed in Section 3.0 of this QAPP, the validity of data will be evaluated in terms of precision, accuracy, and completeness. Described below are ways in which these three parameters will be evaluated. Evaluations will be performed upon completion of investigation field activities.

12.1 Accuracy Assessment

Data accuracy, which is assessed for laboratory data only, is based on recoveries, expressed as the percentage of the true (known) concentration, from laboratory spiked samples and QA/QC samples generated by the analytical laboratory.

Percent recovery (%R) for MS/MSD results is determined according to the following equation:

$$R\% = \frac{(A - B)}{T} \times 100$$

Where A = measured concentration after spiking
B = background concentration
T = known true value of spike

Percent recovery (%R) for LCS and surrogate compound results is determined according to the following equation:

$$R\% = \frac{\text{Experimental concentration}}{\text{Known amount added}} \times 100$$

This information is reviewed periodically by the Project Manager or Project QA Officer. The goals for the recovery of any constituent in a spiked or QA/QC sample are presented in Table 3.

12.2 Precision Assessment

For data generated by the laboratory, data precision is estimated by comparing analytical results from duplicate samples. The comparison is made by calculating the relative percent difference (RPD) given by:

$$RPD\% = \frac{2(S_1 - S_2)}{S_1 + S_2} \times 100$$

Where S_1 = sample result
S_2 = duplicate result

This information is calculated and reviewed periodically by the Project Manager and/or Project QA Officer. The goals for data precision for duplicate samples are presented in Table 3. For data generated in the field, the precision goals are summarized in Table 4.

12.3 Completeness Assessment

Data completeness will be evaluated by comparing the objectives of investigation efforts with the data obtained and determining whether there are any shortcomings in required information. A series of protocols, described below, will be used to evaluate data completeness. The purpose is to accomplish the following:

- Rigorously assess the quality and adequacy of data collected during the investigation.
- Review data collected during the investigation to evaluate if the study's objectives are being addressed and met.
- Ensure that the data collected are valid by applying the quality checks described in this and other sections of the QAPP.

Data generated during the investigation will be evaluated for completeness; that is, the amount of data meeting project QA/QC goals. If data generated during field operations or during analytical procedures appear to deviate significantly from previous trends, the Project Manager or Project QA Officer will review field or laboratory procedures with the appropriate personnel to evaluate the cause of such deviations. Where data anomalies cannot be explained, resampling may be performed. Completeness is defined as the percentage of valid results according to the equation below:

$$\% \text{ completeness} = \frac{A}{B} \times 100$$

Where: A = number of valid results;
B = total number of possible results

The goals for data completeness for laboratory measurements were presented previously in Table 3.

12.4 Assessment of Data

To assess the integrity of the data generated during this investigation, the Project Manager and QA Officer will review the laboratory analytical data and field data in

accordance with procedures and protocols outlined in this QAPP. An assessment will be made to determine if the project objectives described in Section 1.0 have been achieved. Corrective Action described in Section 13.0 will be implemented, if necessary, to meet objectives for data integrity.

13.0 CORRECTIVE ACTION

Corrective action is the process of identifying, recommending, approving, and implementing measures to counter unacceptable procedures or out of QC performance that can affect data quality. Corrective action can occur during field activities, laboratory analyses, data validation, and data assessment. All corrective action proposed and implemented should be documented in the regular QA reports to management. Corrective action should be implemented only after approval by the Project Manager, or his/her designee. If immediate corrective action is required, approvals secured by telephone from the Project Manager should be documented in an additional memorandum.

For noncompliance problems, a formal corrective action program will be determined and implemented at the time the problem is identified. In the field, the person who identifies the problem is responsible for notifying the Field Team Leader, who will notify the Project Manager, who in turn will notify the NYSDEC Project Coordinator. If the problem is analytical in nature, information will be promptly communicated to the NYSDEC Project Coordinator via fax or telephone during that same day or the next business day. Implementation of corrective action will be confirmed in writing through the same channels. If noncompliance is observed in the laboratory or during data validation, the analyst or data validator will notify the Project Manager and communication will continue in the same manner as described above.

13.1 Field Corrective Action

If errors in field procedures are discovered during the observation or review of field activities by the Project QA Officer or his/her designee, corrective action will be initiated. Nonconformance to the QA/QC requirements of the FOPs will be identified by field audits or immediately by project staff who know or suspect that a procedure is not being performed in accordance with the requirements. The Project QA Officer or his designee will be informed immediately upon discovery of all deficiencies. Timely action will be taken if corrective action is necessary.

Corrective action in the field may be needed when the sample network is changed (i.e., more/less samples, sampling locations other than those specified in the Work Plan, etc.) or when sampling procedures and/or field analytical procedures require modification due to unexpected conditions. In general, the Project Manager and QA Officer may identify the

need for corrective action. The Project Manager will approve the corrective measure that will be implemented by the field team. It will be the responsibility of the Project Manager to ensure that corrective action has been implemented.

If the corrective action will supplement the existing sampling plan (e.g., additional soil borings) using existing and approved procedures in the QAPP, corrective action approved by the Project Manager will be documented. If the corrective actions result in less samples (or analytical fractions), alternate locations, etc., which may result in non-achievement of project QA objectives, it will be necessary that all levels of project management, including the NYSDEC Project Coordinator, concur with the proposed action.

Corrective action resulting from internal field audits will be implemented immediately if data may be adversely affected due to unapproved or improper use of approved methods. The QA Officer will identify deficiencies and recommend corrective action to the Project Manager. The Project Manager and field team will implement corrective actions. Corrective action will be documented in QA reports to the entire project management.

Corrective actions will be implemented and documented in the project field record book. No staff member will initiate corrective action without prior communication of findings through the proper channels. If corrective actions are insufficient, work may be stopped by the NYSDEC Project Coordinator.

If at any time a corrective action issue is identified that directly impacts project DQOs, the NYSDEC Project Coordinator will be notified immediately.

13.2 Laboratory Corrective Action

Corrective actions may be initiated if the QA goals are not achieved. The initial step in a corrective action is to instruct the analytical laboratory to examine its procedures to assess whether analytical or computational errors caused the anomalous result. If no error in laboratory procedures or sample collection and handling procedures can be identified, then the Project Manager will assess whether reanalysis or resampling is required or whether any protocol should be modified for future sampling events.

13.3 Data Validation & Assessment Corrective Action

The need for corrective action may be identified during the data validation or assessment processes. Potential types of corrective action may include resampling by the field team, or reinjection/reanalysis of samples by the laboratory.

These actions are dependent upon the ability to mobilize the field team, whether the data to be collected is necessary to meet the QA objectives (e.g., the holding time for samples is not exceeded, etc.). If the data validator identifies a corrective action situation, the Project Manager will be responsible for approving the corrective action implementation. All required corrective actions will be documented by the laboratory QA Coordinator.

14.0 QUALITY ASSURANCE REPORTS TO MANAGEMENT

The deliverables associated with the tasks identified in the Work Plan and monthly progress reports will contain separate QA sections in which data quality information collected during the reporting period is summarized. Those reports will be the responsibility of the Project Manager and will include the QA Officer's input on the accuracy, precision, and completeness of the data, as well as the results of the performance and system audits, and any corrective action needed or taken during the project.

14.1 Contents of Project QA Reports

The progress reports will contain, on a routine basis, a QA section describing all results of field and laboratory audits, all information generated during the past month reflecting on the achievement of specific DQOs, and a summary of corrective action that was implemented, and its immediate results on the project. The status of the project with respect to the Project Schedule included in this QAPP will be determined. Whenever necessary, updates on training provided, changes in key personnel, anticipated problems in the field or laboratory for the coming month that could bear on data quality along with proposed solutions, will be reported. Detailed references to QAPP modifications will also be highlighted. All QA reports will be prepared in written, final format by the Project Manager or his designee. To the extent possible, assessment of the project should also be performed on the basis of available QC data and overall results in relation to originally targeted objectives.

In the event of an emergency, or in case it is essential to implement corrective action immediately, QA reports can be made by telephone to the appropriate individuals, as identified in the Project Organization and Corrective Action sections of this QAPP. However, these events, and their resolution will be addressed thoroughly in the next monthly progress report.

14.2 Frequency and Distribution of QA Reports

The QA reports will be completed for all months during which sample collection and/or analysis occurs and will be presented as part of the monthly progress report.

14.3 Individuals Receiving/Reviewing QA Reports

The QA reports will be delivered to all progress report recipients, which shall include all individuals identified in the Project Organization chart and other individuals identified by NYSDEC.