Sampling and Analysis Plan

Phase II Environmental Investigation
SOCs 1-3 and 6-8
UMore Mining Area
Dakota County, Minnesota

Prepared for
University of Minnesota

May 2009

BARR

UMP003976

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UMore Mining Area
Dakota County, Minnesota

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Distribution List

The following individuals will be provided a copy of the final, approved version of this document as well as any subsequent additions/changes.

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1.0 Introduction

This Sampling and Analysis Plan (SAP) has been prepared as a supporting document to be used in conjunction with the Phase II Investigation Work Plan for Sites of Concern (SOCs) 1-3 and 6-8 (Work Plan) for the UMore Mining Area (UMA) located in the City of Rosemount and Empire Township, Dakota County, Minnesota. This SAP is intended to serve as a comprehensive reference to the standard sampling and analytical procedures to be followed during the implementation of the Phase II Investigation Work Plan for SOCs 1-3 and 6-8. In-depth specific Site background information, investigative approach and rationale, scope of work, and sampling network are detailed in the Work Plan. A brief summary is provided herein.

As detailed in Section 1.0 of the Work Plan, investigation tasks involve characterization of soil and groundwater to determine if a release of hazardous substances or petroleum has occurred. SOCs were identified based on previously identified recognized environmental conditions or on circumstantial historical data as determined in previous site Phase I Environmental Site Assessments (ESAs). Development plans for these SOCs include aggregate mining over a majority of the UMA. Therefore the scope of the investigation is intended to primarily determine if a release of hazardous substances or petroleum has occurred. If evidence of a release is discovered within these SOCs an additional investigation will be conducted consistent with CERCLA guidance. The data collected during this preliminary investigation may be used to support future investigations consistent with National Contingency Plan (NCP) requirements. For this reason, this SAP has been prepared consistent with the elements found in the EPA's QA/R-5 guidance (EPA, 2001) and the Minnesota Pollution Control Agency's SAP Development Guidance (September 2005).

This SAP is intended to supplement, and not replace the Work Plan. Persons participating in this investigation are expected to be familiar with the history of the UMA site, the goals of the investigation, and the purpose of each sample collected as presented in the Work Plan.

1.1 SAP Organization

This SAP is organized into eight sections. These sections include:

- Sections One: Introduction and this content detail
- Section Two: Project Description and Scope
- Section Three: Project Organization and Responsibilities
- Section Four: Field Sampling Plan

- Section Five: Quality Assurance/Quality Control
- Section Six: Laboratory QA/QC

2.0 Project Description and Scope

2.1 Project Description

The UMA is located approximately 17 miles south of St. Paul, Minnesota, west of US Highway 52 (Figure 1). The UMA consists of 1,711 acres and comprises roughly the western one-third of the University of Minnesota Outreach, Research, and Experimentation (UMore) Park property located in the City of Rosemount and Empire Township, Dakota County, Minnesota (Figure 2). The address for the UMore Park Administrative Office is 1605 160th Street West, Rosemount, MN 55068.

The majority of the UMA is currently used for agriculture purposes with a small percentage of the area used for administration and support of the University's research at UMore Park. The principal land use activities at the UMA since 1947 have related to agricultural research on crops and livestock associated with the University Agricultural Experiment Station (AES). The University also leases a portion of the cropland within the UMA to the U.S. Department of Agriculture (USDA). The operations related to the agricultural research with potential for releases to the environment include past and current storage of fuels, fertilizers, herbicides, and pesticides.

UMore Park, including the UMA, was once owned by the U.S. Government and was conveyed to the University in 1947 and 1948. UMore Park includes portions of the former GOW, which was constructed and operated from 1942 to 1945 by E.I DuPont de Nemours for the U.S. Government. The plant was established to manufacture smokeless gunpowder, oleum (an intermediate used in the manufacture of sulfuric acid), and nitric acid. Dinitrotoluene (DNT), aniline, dibutyl phthalate (DBP), and diphenylamine (DPA) were imported for use in the smokeless gunpowder manufacturing process. Other potential constituents related to the former GOW include metals, herbicides, asbestos, and volatile and semivolatile organic compounds. By 1946, GOW had been decommissioned and many of the buildings had been decontaminated and demolished by the federal government.

This Plan addresses six SOCs within the UMA that are unrelated to the former GOW production areas. The six SOCs were reviewed as part of a previous U.S. Army Corps of Engineers (USACE) Preliminary Assessment (PA) and were not carried forward for additional investigation. The SOCs are areas in which there is either a historical recognized environmental condition (e.g., closed petroleum or agricultural spill site) or an area of possible concern for mining activities based on circumstantial historical data. Therefore, the scope of work presented in this Plan is intended primarily to determine if a release of hazardous substances or petroleum has occurred. The

information collected in this investigation will be used to guide any subsequent investigations and to remediate areas consistent with future anticipated land use within the UMA in accordance with CERCLA Guidance and under authority of the MPCA Superfund Program staff.

Additional detailed information regarding the overall project description is provided in Section 1.0 of the Work Plan.

2.2 Scope of Work

The scope of the Phase II Investigation includes the advancement of subsurface soil borings, excavation of test trenches, the collection of groundwater samples from direct-push borings and/or temporary wells, and the collection of groundwater samples from existing wells, to determine if past activities at each of the SOCs have caused a release of hazardous substances or petroleum products to the environment. If contamination is present, the extent and magnitude of contamination may be assessed during this or future investigations. A summary of the sampling network and rationale table is provided as Table 1.

The samples will be analyzed for a suite of chemical compounds consistent with past land uses and activities. The target compounds for this investigation are provided in Table 2. Relevant risk-based criteria including Minnesota Department of Health (HRLs) and Minnesota Pollution Control Agency's Tier I SLVs and Tier II SRVs are also included in Table 2. Additional detailed information regarding the overall background and rationale is provided in Section 1.1 of the Work Plan.

Data from previous investigations will also be complied for inclusion into a hydrogeologic conceptual model to be used to guide future investigations and/or remediation. It is assumed that data included for the development of a hydrogeologic model will have met applicable data quality objectives.

Data quality objectives for this investigation are found in Section 5.

2.3 Schedule

As determined by the approval of the work plan, the approximate timeline for the Phase II Investigation is as follows:

- May 2009 – Final Work plan submitted for MPCA review.
- May 2009 – Phase II field work begins.

- Mid-July – Final laboratory results received.
- August 31, 2009 – Phase II Report submitted to MPCA.

Delays in approval will result in corresponding delay in the overall schedule shown above.

After the Phase II Investigation described in the Plan is complete, the scope of any supplemental investigation and/or remediation (if necessary) will be evaluated and discussed with the MPCA. Additional investigation activities will be addressed in a supplemental work plan and will follow the sampling and analytical procedures contained in this SAP.

2.4 Phase II Investigation Report

Data collected during the Phase II Investigation will be tabulated and mapped for presentation in the Phase II Report. The Report will summarize the findings of the investigation and recommendations for follow-up investigation activities, if necessary. It is anticipated that the extent of any environmental impacts within each SOC will be illustrated with a sample location map and a tabular summary of sampling results.

Soils data will be compared to the MPCA's Tier I and Tier II SRVs, considering the human-soil pathway for residential and industrial chronic risk scenarios (MPCA, 2005). Exposure concentrations will be based on the highest measured concentrations at each sample location. Groundwater samples will be compared to the MDH Health Risk Limits (HRLs) or applicable groundwater criteria. Summary tables will include comparisons to SLVs/SRVs and HRLs.

3.0 Project Organization and Responsibilities

This Section describes organizational structure for activities involved with this investigation including project management and oversight, field sampling, laboratory analysis. An organization chart for this project is illustrated on Figure 3.

3.1 University of Minnesota Responsibilities

The University of Minnesota (University), as the Property owner, is responsible for implementing the project, and has the authority to commit the resources necessary to meet project objectives and requirements. University of Minnesota Project Manager Janet Dalgleish will be responsible for reviewing all project deliverables and documents. She has overall authority and responsibility for technical aspects of the project.

3.2 Barr Engineering Co. Responsibilities

For the responsibilities delegated to Barr Engineering Company (Barr) by University, the following project team has been assembled.

The project team consists of a principal, project manager, field team leader, field geologists/engineers, quality assurance manager and a site safety officer.

The Barr principal, Allan Gebhard, is responsible for overall management of the project and assures that the goals of timeliness, quality, and cost-effectiveness are met.

The Barr project manager, Jim Aiken, is responsible for preparing work plans and scoping documents; coordination, scheduling, and oversight of project activities with project team members; and communicating with the client and subcontractors.

The Barr quality assurance officer, Marta Nelson, is responsible for auditing the sampling and analytical activities to ensure that the proper techniques and appropriate quality control procedures are followed, reviewing analytical results and quality control data, recommending corrective actions when necessary, and preparing a quality control report. The Barr quality assurance officer and project manager will be responsible for preparation, issuance, re-issuance and document control elements of this SAP.

The field team leader and site safety officer, Jim Eidem, is responsible for directing the field staff to ensure the data collection field activities meet the objectives of the RI. Data collection activities will include observing the soils investigation, observation of test trenching activities, collection of soil and water samples, soil classification, and preparation of field logs. Jim is also responsible for developing the project health and safety plan, and maintaining safety records.

The field team leader in conjunction with the Barr project manager and with approval of the University project manager, have the authority to stop or change work activities to ensure compliance with project goals and data quality objectives.

After regulatory authority approval (MPCA, etc), Barr will be responsible for managing and controlling the official approved SAP, in accordance with Barr's document and records management program. This program is administered by the Barr library staff. Copies of the approved SAP will be distributed to all signatories of this document.

3.3 Contract Laboratory Responsibilities

Legend Technical Services (Legend) in Saint Paul, Minnesota, will be responsible for analysis of the majority of samples for this investigation. Terri Olson, the project manager from Legend, will oversee sample analysis, data validation and quality assurance activities at the laboratory.

Additional information on the organizational structure, laboratory procedures and qualifications at Legend are provided in the laboratory Quality Assurance Manual (QAM). The laboratory QAM is on file at the Minnesota Pollution Control Agency (MPCA).

Other qualified analytical laboratories will be subcontracted through Legend to perform routine analytical work which may be undertaken at the site. Legend will be responsible for the shipment of samples to the identified subcontracted laboratories (Test America for perchlorate and nitrocellulose analyses and Braun Intertec for the Minnesota Department of Agriculture (MDA) for the List 1 and 2 pesticides). Prior to subcontracting to other laboratories, Legend will get approval from the project team beginning with the Barr project manager.

Legend is certified though the Minnesota Department of Health's (MDH) Environmental Laboratory Certification Program (when applicable for the target analytical list in Table 2, with one exception as footnoted on Table 2). Braun is certified by MDA for the List 1 and 2 pesticide analysis also. The perchlorate and nitrocellulose are not certifiable tests under the MDH program. Any additional

subcontracted laboratories will be certified by the MDH to perform analysis in Minnesota where applicable and will follow the processes and procedures as outlined in this SAP.

All laboratory reports will be prepared and submitted to Barr following each sampling event electronically.

3.4 Minnesota Pollution Control Agency

The MPCA has regulatory oversight responsibilities for this project. The MPCA project manager, Gary Krueger and Project Hydrogeologist, Dave Scheer, have overall responsibility for providing regulatory oversight and evaluation of the investigation and remediation activities and develop the appropriate response actions.

Quality Assurance Coordinator William Scruton is responsible for review of the analytical methods and the analytical reports specified in this SAP.

4.0 Field Sampling Plan

Field activities discussed in this section have been designed to provide the necessary data to complete the project objectives defined in Section 1.1 of this SAP.

Brief descriptions of the planned investigation activities are presented below. If changes to the scope of work described below are determined to be necessary prior to commencement of the investigation activities, an amendment to this SAP will be prepared and submitted.

4.1 Project Health and Safety

A project health and safety plan (PHASP) will be prepared for the investigation. A copy of the PHASP will be submitted to the University for review. The PHASP will be amended to incorporate any comments prior to the commencement of field investigation activities and will be reviewed by all field staff prior to the commencement of field activities.

All persons performing field investigative tasks for this project have experience working on hazardous waste sites and have completed OSHA 40-hour HAZWOPER safety training. All field staff will have reviewed the site-specific Project Health and Safety Plan (PHASP) prepared for this project and will be aware of the chemical and physical hazards specific to this project. A copy of the PHASP will remain onsite over the duration of field activities. The project field team leader will maintain a record of field staff and contractor training records.

4.2 Field Investigation Tasks

Field investigation tasks will consist of surface soil sampling, the installation of several direct-push soil borings for the collection of soil and groundwater samples, and performing test trenching. These tasks are described in the following paragraphs. Field investigation tasks and documentation will be performed in accordance with the Barr standard operating procedures (SOPs) applicable to the project, which are included in Appendix A. Copies of pertinent investigation forms are in Appendix B.

4.2.1 Soil Sample Collection and Analytical Parameters

In each boring, surface sample, or test trench, soil will be sampled continuously to the total depth of each borehole unless otherwise indicated in the Work Plan. Soil samples will be field screened at regular intervals by a Barr field geologist or engineer. The screening intervals will generally not exceed four feet. This field screening will consist of soil classification, inspection for visual evidence

of contamination (i.e., odor, discoloration, sheen, nearby stressed vegetation, or other field indications of potential soil impacts), and volatile organic vapor (headspace) screening. Soils encountered will be classified in accordance with visual and manual methods described in ASTM D-2488, Standard Practice for Description and Identification of Soils (Visual/Manual Method). A photoionization detector (PID) with a 10.6 eV, or higher, lamp will be used to perform headspace screening. Field screening will be done according to the SOPs presented in Appendix A. In general, the soil samples exhibiting evidence of significant contamination from an area will be submitted for laboratory analysis. A conceptual sampling scheme is shown on Figure 4.

Laboratory analysis of selected soil samples will include one or more of the following parameter groups: volatile organic compounds (VOCs), polynuclear aromatic hydrocarbons/semi-volatile organic compounds (PAHs/SVOC), organochlorine and organophosphorus pesticides, and priority pollutant list metals (i.e., antimony, arsenic, beryllium, cadmium, chromium [not speciated], copper, lead, mercury, nickel, selenium, silver, thallium and zinc). Analytical methods for the various analytical parameters and laboratory reporting limits are presented in Table 2. Table 3 identifies the sample containers, sample preservation methods, and holding times for each analytical parameter class.

In addition to investigative soil samples, QA/QC samples consisting of field blanks, field replicates, field duplicates, methanol blanks, and matrix spikes and matrix spike duplicates will be collected and analyzed according at a rate of 1 per every 10 field investigative samples or less, as shown in Table 4.

The analytical parameters for each soil sample will be in accordance with the Work Plan (and reproduced in Table 1). Soil sampling depths will be selected in accordance with Figure 4. If unexpected contamination or conditions are encountered during the investigation, the sampling approach, parameters, and number of samples may be reevaluated and adjusted. Soil sampling will be completed according to the SOPs presented in Appendix A.

4.2.2 Surface Soil Sampling

Surface soil samples will be collected from the locations indicated in Table 1. At each location, the surface vegetation and rooting zone (if present) will be removed and placed aside. The surface vegetation and rooting zone is anticipated to extend approximately 2 inches below the ground surface (bgs). Each surface soil sample will be collected beneath the rooting zone, within an approximate interval of 2 to 6 inches below the ground surface. For non-volatile parameters, soil between 2 to 6

inches bgs will be excavated with hand tools, placed in a stainless steel bowl, and homogenized prior to sample containerization. VOC samples will be collected as a discrete grab samples (no homogenization) from the 2 to 6 inch depth interval.

All equipment used for surface soil sampling will be decontaminated using an Alconox wash and potable water rinse between each sample location. Decontamination fluids will be disposed within the SOCs unless there is clear evidence of contamination (i.e., oily sheen or evidence of free-phase product). Decontamination fluids with clear evidence of contamination will be containerized, labeled, and stored onsite until characterization and disposal is arranged.

Planned surface sample locations are shown on Figures 11 through 17 in the Work Plan. Sampling locations may vary from planned locations based on conditions encountered in the field. After the surface soil samples have been collected, the vegetation and rooting zone soils (0 to 2 inches) will be replaced.

4.2.3 Soil Borings

Soil borings will be advanced using direct-push technology. Targeted total depths for each soil boring are detailed in the Work Plan and are summarized in Table 1. Any modifications to the targeted total depths will be made based on observations made during the course of field work. Based on available information and as detailed in the Work Plan, it is assumed that groundwater occurs approximately 50 feet below grade; therefore, the depth of the borings is anticipated to range from 10 to 60 feet below grade.

The planned boring locations are shown on Figures 11-14 of the Work Plan. Boring locations may vary from the planned locations depending on utility locations, accessibility, and other conditions encountered in the field. Boreholes will be sealed according to Minnesota Rules Chapter 4725.3850, and the required documentation will be compiled and submitted to the Minnesota Department of Health and Dakota County.

All drilling and sampling equipment that contacts soil or groundwater will be decontaminated using an Alconox wash and potable water rinse between each boring and sample location. Decontamination fluids will be disposed within the SOCs unless there is clear evidence of contamination (i.e., oily sheen or evidence of free-phase product). Decontamination fluids with clear evidence of contamination will be containerized, labeled, and stored onsite until characterization and disposal is arranged.

4.2.4 Test Trenching

Test trenches will be excavated in selected SOCs to determine the lateral and vertical extents of buried debris and/or potentially impacted soils in selected SOCs. Each test trench will be up to 6 feet wide and the lengths and depths of the trenches will based on the extent of the impacted soils or observed debris.

Samples from the test trenches will be collected for laboratory analysis in accordance with the Work Plan (and reproduced in Table 1). The depths at which the samples are collected will be in accordance with Figure 4. If impacted soils are encountered, samples will be preferentially taken of the soil demonstrating indications impacts, such as staining, mottling, and/or obvious evidence of contamination such as strong odor, unusual color, presence of liquids, or elevated headspace readings. If a sample of impacted soil is collected, additional sample(s) will be collected in the test trench (or nearby trenches) to assess the horizontal and vertical extent of soil impacts. Data from test trenches will be recorded on trench log forms or in a field notebook.

Each test trench will be backfilled with excavated soil/materials with the exception of product containers (drums, cans, buckets, etc.). In the event a product container is encountered, the product container will be removed (as long as it can be done safely) and placed in an overpack drum or suitable waste storage container (i.e., plastic lined roll-off box).

4.2.5 Groundwater Sample Collection and Analytical Parameters

Groundwater samples from the soil borings specified in the Work Plan (and summarized in Table 1) will be collected and submitted to the laboratory for analysis.

If groundwater is to be sampled from a boring without the use of a temporary well, a sealed stainless steel screen will be driven below the bottom of the borehole, the screen deployed, and a water sample collected for laboratory analysis. The groundwater sampler will consist of a 4-foot-long, 1.5-inch-outside-diameter, stainless steel sheath; a 4-foot-long, 1.5-inch-outside-diameter stainless steel screen; and an expendable drive point (or equivalent apparatus). The sampling sheath protects the screen and will be sealed at the bottom with an O-ring and the expendable drive point. The top of the sampler will be threaded to the direct-push drive rod string. At the desired sampling depth, the sampling sheath will be retracted and the screen exposed. A groundwater sample will be collected with ½-inch-inside-diameter (or smaller) polyethylene tubing fitted with a check valve (or with a peristaltic pump if feasible). A Barr geologist or engineer will observe the boring advancement and will perform the collection of groundwater samples. Samples for metals analyses will be filtered

with a 0.45 micron filter following the SOP for field filtration of groundwater samples found in Appendix A. Additional information on groundwater sampling procedures is presented in the SOPs found in Appendix A.

The groundwater samples collected from the boring locations will be analyzed for the contaminants of concern detailed in the Work Plan (and in Table 1). Analytical methods for the various analytes and laboratory reporting limits are presented in Table 2. Table 3 identifies the sample containers, sample preservation methods, and holding times for each analytical parameter class. Selection of analytical parameters will be based on the Work Plan details and on the conditions encountered in the field and evidence of contamination via field screening of the overlying soils. If unexpected contamination or conditions are encountered during the investigation, the sampling approach, parameters, and number of samples may be reevaluated and adjusted.

In addition to investigative groundwater samples, QA/QC samples consisting of field blanks, field duplicates, trip blanks, and matrix spikes and matrix spike duplicates will be collected and analyzed at a rate of 1 per every 10 field investigative samples or less, as shown in Table 4.

4.2.6 Permanent Well Sampling

Prior to groundwater sampling, depth to water and total depth will be recorded for each well. Wells will be purged prior to sampling and stabilization tests conducted at intervals of one well volume. Stabilization is considered achieved when groundwater stabilization parameters (pH, temperature, and specific conductance) show three consecutive values within the ranges specified in the SOPs for groundwater monitoring well sampling/purging (Appendix A).

4.2.6.1 Supply Wells

Water supply wells at the site may not be operational and may need to be opened or to have the pumps activated by a well contractor. Once operational, the wells will be sounded for depth, purged, and sampled for analytes specified in the Work Plan.

4.2.6.2 Monitoring Wells

Monitoring wells will be purged and sampled in accordance with the SOPs included in Appendix A.

4.2.7 Temporary Well Sampling

Temporary monitoring wells will be installed in direct push soil borings if determined necessary to collect groundwater samples due to slow recharge rates or excessive turbidity. If used, temporary wells will be constructed of one-inch diameter (nominal) PVC screens and risers. Temporary well screen intervals will target the water table and specific interval will be selected in the field based observations made during drilling. Groundwater samples will be collected from the temporary wells with ½-inch-inside-diameter (or smaller) polyethylene tubing fitted with a check valve (or with a peristaltic pump if feasible). Samples for metals analyses will be filtered with a 0.45 micron filter following the SOP for field filtration of groundwater samples found in Appendix A.

Measurement of groundwater elevations from the temporary wells for the purpose of determining the direction of groundwater flow is not within the scope of this investigation.

4.2.8 Surveying

Surveying at the site will measure sample locations with sufficient accuracy and precision to:

- Ensure that the sampling program provides adequate coverage of impacted areas and that the coverage can be accurately represented on maps of sufficient scale to illustrate the sample locations.

- Relocate the sample location with reasonable accuracy and precision so that field staff are able to locate additional sample locations or duplicate the initial samples if needed (assuming that field conditions are similar to those when originally sampled).

One or more of the following surveying methods may be used:

1. **Global Positioning System (GPS) Receiver** – The default method for locating the horizontal position of sampling locations at the Property will be by GPS receiver. Because the Property consists of open ground with relatively little overhead vegetation, submeter accuracy of GPS readings is attainable. Each point measured with GPS will be stored in UTM coordinates. In general vertical position (elevation) will be collected with GPS but cross-referenced with an optical survey where accuracy of 0.01 feet is required (e.g., for monitoring wells).

2. **Total Station** – Total station methods may be used to spot check the GPS readings and/or grid locations and elevations.

3. **Optical (Level) Survey** – This method will use an optical autolevel to acquire elevations where accuracy of 0.01 foot is needed. The level will be relative to a temporary or known benchmark. Measurements collected relative to a temporary benchmark will be converted once a permanent benchmark reference is obtained.

The final locations of all soil borings and test trenches will be surveyed using global positioning system (GPS) methods. Elevations will be estimated from topographic maps.

4.3 Sample Documentation

4.3.1 Sampling Labeling and Numbering

Soil samples will be represented by the SOC the sample is collected from, a letter designator representing the type of investigative method, a unique location number indicated in the Work Plan, and, in the case of soil samples, the sample bottom depth. Standard investigative designators are as follows:

- **SS (Surface Soil)**: Surface soil samples will be collected beneath the surface vegetation and the rooting zone, approximately from an interval of 2 to 6 inches below the ground surface. (Example: SOC1_SS1_2-6", etc.)
- **GP (Geoprobe Boring)**: Represents any direct-push boring installed for the purpose of collecting information on the stratigraphy or for collecting soil or groundwater samples collected from the drill stem or a temporary well installed in the geoprobe borehole. (Example: SOC1_GP1_0-6", etc.)
- **TT (Test Trench):** Represents any test pit excavated for the purpose of observing subsurface conditions or for collecting soil samples. (Example: SOC1_TT1_2-4', etc)

Groundwater samples collected from wells will be represented by a well type prefix, the well identification number, and the date of sample collection. Well type prefixes include:

- **MW (Monitoring Well):** Represents groundwater collected from a monitoring well.
- **WSW (Water Supply Well):** Represents groundwater collected from a supply well or stand pipe.

QA/QC samples will be identified with the following prefixes followed by a sequential number:

- **FB** (Field Blank): Represents a sample collected for QA/QC procedures.

- **DUP** (Duplicate): Represents a duplicate soil or groundwater sample collected for QA/QC procedures. (Example: SOC1_DUP1, or for groundwaters: MW_DUP1)
- **TB** (Trip Blank): Represents a blank container filled by the laboratory with ultra clean test water and are employed for VOC sample analysis.

A summary of proposed samples is shown in Table 1.

4.3.2 Chain of Custody (COC)

A Sample Chain of Custody Record (COC) will be initiated in the field at the time of sampling; two copies will accompany each set of samples (cooler) shipped to any laboratory. A third copy will be retained by the sampling team, and the second copy will be retained by the Barr quality assurance officer. An example of the COC is provided in Appendix B.

Each time responsibility for custody of the samples changes (with the exception of commercial shipping vendors), the new and previous custodians will sign the record and denote the date and time. A copy of the signed record will be made by the receiving laboratory. The final signed COC will be submitted with analytical results in the Field Sampling Report.

4.3.2.1 Field Chain of Custody Documentation

All signatures related to sample custody will be made in ink on the COC in a timely fashion. One or more signatures will be entered to identify the person or persons who are collecting the samples. Each time the custody of a sample or group of samples is transferred, a signature, date and time will be entered to document the transfer. The signatures, date, and time will be entered at the time of transfer; the row number will be used to define which bottles were transferred. A sample will be considered to be in custody if it is in any one of the following states:

- In actual physical possession.
- In view, after being in physical possession.
- In physical possession and locked up so that no one can tamper with it.
- In a secured area, restricted to authorized personnel.

4.3.2.2 Chain of Custody During Shipping and Transfer of Samples

When samples are shipped, the person sealing the shipping container will enter the time, date, and their signature on the COC. The laboratory part of the COC will be enclosed in the container; the top

page (first part) will be retained for the project file. A post office receipt, bill of lading, or similar document from the shipper will be retained as part of the permanent chain-of-custody documentation.

4.4 Sample Handling and Transport

All coolers shipped will be accompanied by a chain of custody form and will contain a complete address and return address. The samples will be kept at approximately 6 degrees Celsius during transport to laboratories. Before transporting samples, field personnel will perform the following tasks:

1. Verify that laboratory personnel will be present to receive the samples when they arrive.
2. Check labeling and documentation to ensure sample identity will be clear to laboratory personnel.
3. Hand deliver or ship samples in a manner that ensures samples will remain cool (about 6 degrees Celsius) until received by laboratory personnel.
4. Maintain the chain-of-custody according to procedures described above.
5. Verify that laboratory personnel have received samples in good order and understand COC.

4.5 Field Records

All field activities and data will be recorded in a dedicated field notebook or field record forms. Information will be recorded daily and will include date, work time(s), field data (boring logs, field screening results, sample intervals, field analytical data, QA/QC sample information, etc.), project health and safety information and issues, any scope changes and reasons for scope changes, internal Barr communications, client communications, decision-making processes and rationale, and other observations or activities relevant to the project.

4.6 Field Corrective Actions

Corrective action in the field may be needed when the sample network is changed (i.e., more/less samples, etc), or if sampling procedures and/or field analytical procedures require modification due to unexpected conditions (including equipment failure). Technical staff and project personnel will be responsible for reporting suspected technical deficiencies, QA nonconformance, or deficiencies in issued documents by reporting the situation to the field team leader. The project field team leader is then responsible for assessing the suspected problems in consultation with the project quality assurance officer and making a decision based on the potential for the situation to impact the quality

of the data. If it is determined that the situation constitutes a reportable nonconformance requiring corrective action, then a nonconformance report will be initiated by the project quality assurance officer.

The project field team leader will be responsible for ensuring that corrective actions are initiated by:

- Evaluating all reported nonconformances
- Controlling additional work on nonconforming items
- Determining disposition or action to be taken
- Maintaining a log of nonconformances
- Reviewing nonconformance reports and corrective actions taken
- Ensuring nonconformance reports are included in the final site documentation in project folders

Corrective action for field measurements may include:

- Repeat the measurement to check the error
- Check for all proper adjustments for ambient conditions such as temperature
- Check the batteries
- Re-calibration
- Verification of calibration
- Replace the instruments
- Stop work (if necessary)

If it becomes necessary to modify a program, the Barr Project Manager will notify the MPCA Project Manager of the anticipated change and implement the necessary changes after obtaining MPCA approval. The change in the program will be documented as a field change request that will be signed by the initiators. The field change request shall be attached to the file copy of the SAP

Implementation of corrective actions will be performed by the all field team members. Corrective action will be documented in quality assurance reports.

Corrective actions will be implemented and documented in the 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 MPCA.

4.6.1 Inspection/Acceptance of Supplies and Consumables

The quality of supplies and consumables using during sampling and analysis can affect data quality. All equipment that comes into contact with the samples must be sufficiently clean to prevent detectable cross-contamination and the concentrations in all calibration standards must be accurate and verified prior to use.

Cleaned and documented sample containers will be supplied by the laboratory. All containers will be visually inspected prior to use, and any suspect containers will be discarded.

Reagents of appropriate purity and suitably cleaned laboratory equipment will also be used for all stages of laboratory analyses. Details for acceptance requirements for supplies and consumables at the laboratory are provided in the laboratory's QAM.

All supplies are obtained from reputable suppliers with appropriate documentation and/or certification.

4.6.2 Documentation and Records

All data, files and electronic records collected as part of this investigation will be subject to Barr's records management system and will be retained for a minimum of 5 years following the completion of activities at the property. It is anticipated that the laboratory will retain all data in compliance with their associated QAM's, following all MDH protocols. Laboratory reports will include all of the review categories listed in Section 5.8.2 of the SAP. Laboratory data will be received electronically in Adobe text files and in the Barr formatted EDD (electronic data deliverable). Laboratory records are typically kept for a minimum of 5 years. Details on laboratory data retention and storage are provided in Section 4.2 of the Laboratory QAM (which has been submitted to the MPCA by Legend Technical Services under separate cover).

5.0 Quality Assurance/Quality Control

5.1 Data Quality Objectives

Data quality objectives (DQOs) are qualitative and quantitative statements that specify the quality of the analytical data needed to support decisions made regarding investigative activities. DQOs help to ensure that the data collected are of an adequate level of quality for their intended uses.

5.1.1 Project Data Quality Objectives

The data and information generated during this Phase II investigation will be used to: (1) determine the target analytes present in groundwater and soil; and (2) determine if concentrations are of significant health risk. Data quality objectives are presented below along with brief descriptions of steps that will be taken to address the two objectives referenced above. The data must satisfy the site data quality objectives presented below.

1. Analytical results must accurately represent groundwater and soil quality: Chemical analyses will be performed to confirm the target analytes present and their concentrations at each SOC.

2. Analytical results must satisfy quality control requirements for: accuracy, precision, representativeness, completeness and comparability (see the following section).

3. Field data requires an intermediate level of data quality compared to laboratory analysis done in a controlled environment: field data provides real-time data that may be necessary to make field decisions. Field data includes volatile organic headspace monitoring with a photo ionization detector (PID) (MPCA Method) and soil classification (ASTM D 2488).

4. The laboratory analyses will require a high level of data quality and will be used to determine the type and concentrations of chemical constituents present at the property. These analyses are characterized by established QA/QC protocols and documentation and provide qualitative and quantitative data. These methods are based on EPA protocols and are presented in Table 2. Analytical and data review procedures must be in accordance with recognized protocols to ensure the data is valid.

5.2 Quality Assurance Objectives

The fundamental quality assurance objectives (QAOs) with respect to precision, accuracy, completeness and sensitivity of laboratory analytical data are to meet the QC acceptance criteria of the analytical protocols which will in turn meet the project needs.

The overall QAOs are to develop and implement procedures for field sampling, chain of custody, laboratory analyses, and reporting that will provide the level of data required for determining the type and concentrations of potential target analytes in the soil and groundwater. Specific procedures to be used for sampling, chain of custody, calibration of field and laboratory instruments, laboratory analysis, data reporting, and corrective actions are described in the following sections.

The four individual QAOs are defined below, along with the means by which they are measured to monitor the compliance to the project needs.

5.2.1 Precision

Precision measures the reproducibility of measurements under a given set of conditions. Precision of analytical laboratory data may be assessed by comparing the analytical results between matrix spike/matrix spike duplicates (MS/MSD), laboratory duplicates, or masked field duplicate samples. Duplicate samples, when collected, processed and analyzed by the same organization, provide intra-laboratory precision information for the entire measurement system, including sample acquisition, handling, shipping, storage, preparation, and analysis. Field duplicate samples are submitted to the laboratory as blind or mask samples. Relative percent differences (%RPD) will be calculated for each pair of duplicate results (either MS/MSD, LCS/LCSD for field duplicate samples) when both values are reported as detected values using the following equation:

$$\%\,\mathrm{RPD} = \frac{S - D}{(S + D)/2} \times 100$$

Where: S = First sample value

D = Second sample value

The RPD limits for MS/MSD and LCS/LCSD are set by the laboratory. For this investigation RPDs greater than 25% for MS/MSD will be used as the data review acceptance critiera. Further discussion on these limits is included in the Barr SOP for data review located in Appendix A. The

laboratory duplicate (non-spiked) sample analysis is typically set by the methodology, but is typically 10 percent.

Field duplicate samples will be collected at a rate of 1 in every 20 or fewer samples. The RPD limits for field duplicate soil samples will be 40% and 30% for field duplicate groundwater samples. Native and duplicate sample results at or near the reporting limits can exaggerate RPD values therefore, these higher RPD values do not always indicate of poor precision. Duplicate samples should be collected from locations where target analytes are expected to be present.

5.2.2 Accuracy

Accuracy measures the bias in a measurement system. Accuracy of laboratory results may be assessed using the analytical results of matrix spikes, surrogate spikes, and laboratory control samples and field and laboratory blank samples. The percent recovery (%R) will be calculated using the following equation:

$$\%R = \frac{A - B}{C} \times 100$$

Where: A = The analyte concentration determined from the spiked sample
B = The native sample concentration of the unspiked sample
C = The concentration of the spike added

Percent recoveries for surrogate standards (for organic analyses only) and matrix spikes are established by the laboratory and are subject to change. In general, surrogate standard percent recovery limits for VOCs are 75-120%, for the semivolatile and/or PAH analyses the surrogate recoveries vary depending on the class of compound, but for purposes of this investigation acceptable limits will not exceed 30-150% (including pesticides). In general, for MS and LCS samples, percent recovery limits are 80-120% for VOCs and metals, for semivolatile and/or PAH analyses, the recoveries vary widely depending on the class of compounds, but for purposes of this investigation, acceptable limits will not exceed 30-150%. Typical percent recoveries for pesticides in MS and LCS samples is 70-130%.

These percent recoveries are subject to change. The current limits will be present along with all sample results within the laboratory reports.

Field blank samples will be collected and submitted at a rate of 1 for every 20 project samples. Field blank samples will be analyzed for the same parameters as the field samples following the methods specified in Table 2.

Results of method and field blanks will be evaluated to determine the presence of any gross systematic contamination issues to identify potential false positive results.

5.2.3 Completeness

Completeness is a measure of the amount of valid data obtained from a measurement system compared to the amount that was expected to be obtained under normal conditions. It is expected that the contracted laboratory will provide useable and acceptable data for at least 95% of all samples collected using the specified analytical method. The completeness goal for field measurements will also be 95%. The completeness may be calculated using the following equation:

$$\text{Completeness} = \frac{\text{Valid data obtained}}{\text{Total data expected}}$$

5.2.4 Sensitivity

The achievement of reporting limits depends on instrument sensitivity and matrix effects. The instrument sensitivity will be monitored by the laboratory. It is expected that the laboratory will meet the required sensitivities to the degree possible considering the sample matrix and composition. The laboratory target reporting limits for the monitored parameters are presented in Table 2. The actual reporting limits achieved may depend on sample size available, sample matrix interferences, and target and non-target parameter concentrations.

5.2.5 Comparability

Data comparability is the confidence with which one set of data can be compared with another. Comparability will be evaluated by documenting that the sampling plan is followed, and by documenting any deviations from the sampling plan. It will also be evaluated by the use of matrix spikes, field blanks, method blanks, field duplicates, holding times and historical data if available.

5.2.6 Representativeness

Representativeness expresses the degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition. Representativeness is a qualitative parameter that is dependent upon the proper design of the sampling program and proper laboratory protocol. The representativeness criteria will be satisfied by following the SAP and by the use of proper sampling techniques and appropriate analytical procedures. Sample collection procedures describe proper stabilization procedures for water samples that will aid in ensuring a sample is representative of site conditions. Representativeness will be assessed by the analysis of the field duplicate samples.

5.3 Field Equipment

In order to maintain the accuracy of all the instruments and measuring equipment used for conducting field tests, calibration procedures are to be followed prior to and during the use of the field instruments and equipment. Calibration of field equipment will be based on approved written procedures documented as SOPs and based on manufacturer's recommendations. Records of calibration, repairs, or replacement will be maintained. See Appendix A for approved written SOPs describing equipment use and documentation.

Equipment is inspected prior to each sampling event and routine maintenance is performed as recommended by the manufacturer.

Whenever possible, disposable equipment will be used to avoid the potential for cross-contamination and to limit the need for additional equipment blanks.

5.4 Field Activity Preparation and Field Decisions

Prior to visiting the Property, all team members will review the Work Plan, this SAP, and the Health and Safety Plan (HSP). If necessary, a project team meeting will also be conducted with the purpose of clarifying the tasks and objectives of the project and reviewing available Property information.

Before sampling commences, a visual evaluation will include observation of sampling points, routes of access, key landmarks, and assessment of potential hazards. During sample collection, the SAP will be followed in detail, and the sampling procedures and pertinent observations will be documented in field notes and on an appropriate scaled map of the sites.

5.5 Sampling Containers and Preservatives

Laboratory-supplied sampling containers and preservatives to be used for samples are shown in Table 3. The Laboratory QAM includes specific procedures for the following: sample container cleaning, testing, labeling and storage, preparation, and addition of preservatives.

All chemical preservatives are added to the container by the laboratory prior to sample collection. Samples preservatives are listed in Table 3. All chemical preservatives added to containers in the laboratory or field will meet the criteria of the laboratory's QA/QC program as reflected in the QAM. All samples will be thermally preserved in the field after sample collection by placing the samples in an insulated ice chest containing uncontaminated ice. The ice will be placed inside uncontaminated leak-proof plastic containers and the chain of custody record will be placed inside a zipper-type plastic bag. The cooler temperature will be checked and recorded upon receipt at the laboratory by measuring the temperature of the water within the temperature blank container to verify that the samples were kept at ≤6 degrees Celsius.

5.6 Decontamination, Storage and Transport of Equipment

All sampling-related equipment including filtration devices, personal protection equipment, and materials coming into contact with actual sampling equipment or with sampling personnel will be decontaminated as described below. Decontamination (in the field at each individual sampling point) will be performed before, between, and after working at each sampling point. All equipment will be handled in a manner that will minimize cross-contamination between samples.

Non-disposable equipment such as soil sampling apparatus (including: drilling equipment, stainless steel spoons or scoops, stainless steel compositing bowls, stainless steel hand augers, and split-spoon sample barrels) and submersible pumps will be carefully cleaned with Alconox® (or equivalent detergent solution) followed by three rinses with distilled water. All cleaning conducted in the field or field repairs will be documented in field records.

When transporting or storing equipment after cleaning, the equipment will be protected in a manner that minimizes the potential for contamination (i.e., plastic wrap).

5.7 QA/QC Samples

The sampling protocols define specific quality control procedures or activities which will be conducted in the field. Field blanks will be submitted to the analytical laboratories to provide the means to assess the quality of the data resulting from the field sampling procedures. Field blank

samples are analyzed to check for procedural contamination at the site which may cause sample cross-contamination.

Accuracy of the field measurements will be assessed using daily instrument calibration, calibration check, and analysis of blanks. Precision will be assessed on the basis of reproducibility by multiple analysis of a single sample.

Particular care will be exercised to avoid the following common ways in which cross contamination or background contamination may compromise groundwater samples:

- Improper storage or transportation of equipment.
- Contaminating the equipment or sample bottles on site by setting them on or near potential contamination sources such as uncovered ground, a contaminated vehicle, or vehicle exhaust.
- Handling bottles or equipment with dirty hands or gloves.
- Inadequate cleaning of well purging or sampling devices.

Special care will be exercised to prevent cross-contamination of sampling equipment, sampling bottles, or anything else that could potentially compromise the integrity of samples. Field methods quality assurance verification procedures are described below. Field personnel will work under the assumption that contamination exists in land surface soil and vegetation near sampling points, wash water, etc. Therefore, exposure to these media will be minimized by taking at least the following precautions:

- Minimizing the amount of rinse water left on washed materials.
- Minimizing the time sampling containers are exposed to airborne dust or volatile contaminants in ambient air.

Clean gloves made of appropriately inert material will be worn by all field technicians and changed between each new sampling point. Gloves will be kept clean while handling sampling-related materials.

5.7.1 Trip and Field Blanks

Trip blanks generally pertain to volatile organic samples only. Trip blanks are prepared prior to the sampling event in the actual containers used to transport the samples, and are kept with the investigative samples throughout the sampling event. They are packaged for shipment and sent for analysis along with the other samples. There should be one trip blank included in each cooler containing VOC samples. At no time after their preparation will the sample containers be opened before they reach the laboratory.

Field blanks (also known as equipment blanks or rinsate blanks) are defined as samples which are obtained by running analyte-free, deionized water through sample collection equipment (bailer, pump, auger, etc.) after decontamination and placing it in the appropriate sample containers for analysis. These samples will be used to determine if decontamination procedures have been sufficient. Using the above definition, soil field blanks are called rinsate samples.

Field blanks will be collected in the field for the target parameters in Table 2 for the target parameters associated with samples collected during the sampling event. Sample containers used for blank samples will be the same as for the actual analysis of sample water for these parameter groups. All containers shall be precleaned within the laboratory's QA/QC program in the same manner as primary sample bottles. The field blank containers will be filled in the field.

Field blanks will be collected and submitted at the frequency of one field blank per 20 samples. Field blank samples will be identified sequentially as FB-1, FB-2 etc.

Results of method blanks, trip blanks and field blanks will be evaluated to determine the presence of any potential false positive results.

5.7.2 Field Duplicate Samples

Duplicate samples are independent samples collected in such a manner that they are equally representative of the parameter(s) of interest at a given point in space and time. Duplicate samples, when collected, processed, and analyzed by the same organization, provide intra-laboratory precision information for the entire measurement system, including sample acquisition, sample homogeneity, handling, shipping, storage, preparation, and analysis. Field duplicate samples are submitted to the laboratory as blind or mask samples.

Field duplicate samples will be collected and submitted at the frequency of one in every 10 samples. These samples should be collected at locations where target analytes are expected to be present. Field duplicate samples will be identified with an alias sample bottle label (e.g., DUP), with the true identity recorded in the field notes.

5.8 Data Assessment

For the purposes of this document, data validation is defined as the evaluation of the technical usability of the data. Data verification is defined as the determination of adherence to SOPs, and this SAP, as appropriate. Data review will be performed as presented below. Verification is accomplished through laboratory audits and review of QC data.

Legend has participated in Barr's independent QA audit program for over 10 years, is audited on a biennial schedule and participates in Barr's blind sample program. All audit results are on file at Barr. Legend's last Barr audit occurred in February 2009 with favorable findings. No non-conformance issues were identified.

While the QA Officer may perform field audits, no field audit for this project is anticipated.

5.8.1 Laboratory Data Review and Validation

The first level of review occurs at the analyst level. Analysts are charged with the responsibility of monitoring all laboratory QA/QC activities, and verifying that systems are in control. Data validation also occurs on a sample-by-sample basis. The initial review is performed by the instrument operator or analyst who is responsible for assessing the following:

- Cross-checking all sample identification numbers on work sheets, extract vials, bottles, and instrument outputs.
- Verification that QA acceptance criteria are met.

- Verification that all calibrations, and oven temperatures are within QA acceptance criteria.
- Confirmation that chain-of-custody is intact based on accompanying paperwork.

The second level of validation and review should occur on all laboratory data. The laboratory QA officer is responsible for the QC and data review of analyses and reports. The QC review of QC analyses and applicable calibrations is completed and includes the following:

- Confirmation that all quality control blanks meet QA requirements for contamination, and that associated sample data are appropriately qualified when necessary.
- Confirmation that accuracy and precision QA criteria are met.
- Comparison of all laboratory duplicates with the original sample for acceptable replication.

After QC review the data are sent to report preparation. The final report review includes both data review and a review of report accuracy. The data review includes confirmation of all assessments previously made by the operator/analyst, and includes an evaluation of the following:

- Confirmation that analytical work sheets have been completed by the operator/analyst, including data and initials.
- Confirmation that designated procedures were followed relative to the correct procedure in making changes to data.

The final report review will assess the complete data report for completeness, accuracy of reported data, and comparison with project QC requirements.

Before the report is sent to Barr, it is reviewed by the laboratory project manager. This additional assessment includes the following:

- Making a comparative evaluation of data and of samples, for consistency of analytical results and resolution of discrepancies.
- Checking data report or case narrative for completeness.
- Verifying SAP specific requests have been met.

5.8.2 Barr Data Review and Validation

Data will be evaluated by the QA Officer or designee to determine if they meet project requirements. Data validation procedures will be followed using the method-specific QC acceptance limits specified in the SOPs. The specific requirements which will be checked during data validation are:

1. Holding times
2. Duplicate analyses data
3. Precision and accuracy data
4. Matrix spike and matrix spike duplicate data
5. Surrogate standards (where applicable)
6. Blank data
7. Overall data assessment

A copy of the Barr SOP for data review is included in Appendix A.

5.8.3 Data Verification

Data verification is defined as the determination of adherence to SOPs, the Work Plan, and this SAP, as appropriate. Internal and external laboratory audits measure adherence to these elements. In addition, internal and external verification of adherence to these elements will be completed through the evaluation of field and laboratory documentation.

6.0 Laboratory QA/QC

6.1 Laboratory Procedures

Analytical measurements of project samples will be conducted in accordance with established methods, procedures, and laboratory SOPs. All analytical project work will be performed according to the analytical methods specified in Table 2. Section 6.2.2 of the laboratory QAM provides details regarding training and initial demonstration of competency of laboratory staff.

Section 7.5.2 of the laboratory QAM provides information on the laboratory certification program. The laboratory certifications have been included in the SAP in Appendix C.

6.2 Laboratory Instrument Calibration

Calibration of laboratory equipment will be based on approved written procedures documented as SOPs and based on manufacturer's recommendations and analytical method requirements. The Laboratory QAM provides details regarding the calibration procedures and calibration frequency of all laboratory analytical systems and equipment. Records of calibration, repairs, or replacement will be filed and maintained at the laboratory and will be subject to review. Additional details pertinent to instrument calibration can be found in the laboratory QAM.

6.3 Laboratory Quality Assurance

The QC effort for laboratory analysis will meet or exceed those specified in the analytical methodologies utilized (EPA, Standard Methods, ASTM, etc).

The laboratory has a written comprehensive QA/QC program which provides rules and guidelines to ensure the reliability and validity of work conducted at the laboratory. The laboratory QA program is documented in the laboratory QAM, which is on file with Barr and with the MPCA. Compliance with the QA/QC program is coordinated and monitored by the laboratory's QA department, which is independent of the operating departments. Minnesota laboratory certification information for Legend and Braun Intertec are included in Appendix C.

The stated objectives of the laboratory QA/QC program are as follows:

- Ensure that all procedures are documented, including any changes in administrative and/or technical procedures.

- Ensure that all analytical procedures are conducted according to sound scientific principles and have been validated.
- Monitor the performance of the laboratory by a systematic inspection program and provide for a corrective action, as necessary.
- Collaborate with other laboratories in establishing quality levels, as appropriate.
- Ensure that all data are properly recorded and archived.

All laboratory procedures are documented in writing as either Standard Operating Procedures (SOPs) or method procedures and are edited and controlled by the Laboratory Quality Assurance Officer. Internal QC procedures for analytical services will be conducted by the laboratories in accordance with their SOPs and the individual method requirements in a manner consistent with appropriate U.S. EPA methods.

The laboratory utilizes quality control checks with specifications that include the types (sample spikes, surrogate spikes, reference samples controls, and blanks), the frequency, the compounds to be used for sample spikes and surrogate spikes, and the QC acceptance criteria for these checks.

The laboratory will document within each data package when either initial and ongoing instrument and analytical QC functions have not been met. Any samples analyzed and determined to be in nonconformance with the QC criteria will be reanalyzed if possible by the laboratory, if sufficient sample volume is available. It is expected that sufficient volume of samples will be collected to allow for reanalysis.

6.4 Laboratory Corrective Action

Corrective action in the laboratory may occur prior to, during and after initial analyses. A number of conditions such as broken sample containers, multiple phases, low/high pH readings, and potentially high concentration samples may be identified during sample log-in or just prior to analysis. Following consultation with lab analysts and section leaders, it may be necessary for the laboratory Quality Control Coordinator to approve the implementation of corrective action. The submitted standard operating procedures (SOPs) specify some conditions during or after analysis that may automatically trigger corrective action or optional procedures. These conditions may include dilution of samples, additional sample extract cleanup, automatic reinjection/reanalysis when certain quality control criteria are not met, etc.

Corrective actions are required whenever an out-of-control event or potential out-of-control event is noted. The investigative action taken is somewhat dependent on the analysis and the event.

Laboratory personnel are alerted that corrective actions may be necessary if:

- QC data are outside the warning or acceptable windows for precision and accuracy;
- Blanks contain target analytes above acceptable limits;
- Undesirable trends are detected in spike recoveries or RPD between duplicates;
- There are unusual changes in detection limits;
- Deficiencies are detected by the QA Department during internal or external audits or from the results of performance evaluation samples; or
- Inquiries concerning data quality are received

Corrective action procedures are often handled at the bench level by the analyst, who reviews the preparation or extraction procedure for possible errors, checks the instrument calibration, spike and calibration mixes, instrument sensitivity, and so on. If the problem persists or cannot be identified, the matter is referred to the laboratory supervisor, manager and/or QA department for further investigation. Once resolved, full documentation of the corrective action procedure is filed with the QA department.

These corrective actions are performed prior to release of the data from the laboratory. The corrective actions will be documented in both Legend's corrective action report (signed by analyst, section leader and quality control coordinator), and the narrative data report sent from the laboratory to the Barr QA Manager.

Corrective action is the process of identifying, recommending, approving and implementing measures to counter unacceptable procedures or out-of quality-control performance which can affect data quality. Corrective action can occur during field activities, laboratory analysis, data review, and data assessment. All corrective actions proposed and implemented will be documented in the regular quality assurance reports to management. Corrective action is only implemented after approval by the project manager or his designee. If immediate corrective action is required, approvals secured by telephone from the project manager should be documented in an additional memorandum. Corrective

action will be implemented if it is determined that the data generated does not meet the project objectives. Possible corrective actions might include:

1. No corrective action.
2. Reanalysis of samples.
3. Re-collection and analysis of samples.

For noncompliance problems, a formal corrective action program will be determined and implemented at the time the problem is identified. The person who identifies the problem will be responsible for notifying the project manager, who in turn will notify the MPCA. Implementation of corrective action will be confirmed in writing through the same channels.

Any nonconformance with the established quality control procedures in the Sampling and Analysis Plan will be identified and corrected in accordance with this section. The MPCA project manager, or their designee, will issue a nonconformance report for each nonconformance condition.

Corrective actions will be implemented and documented in the 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 stop-work order by the Barr or MPCA Project Manager.

7.0 References

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