

# **QUALITY ASSURANCE PROJECT PLAN**

CSMRI SITE REMEDIATION

April 15, 2004

*Prepared for:*

Colorado School of Mines  
Golden, Colorado

*Prepared by:*

New Horizons Environmental Consultants, Inc.  
6585 S. Wright Street  
Littleton, CO 80127

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**CSMRI Site Remediation**

Approved By: \_\_\_\_\_

Linn Havelick  
Environmental Health and Safety Director  
Colorado School of Mines

Date: \_\_\_\_\_

Approved By: \_\_\_\_\_

Robert Krumberger  
Project Manager  
New Horizons Environmental Consultants, Inc.

Date: \_\_\_\_\_

Approved By: \_\_\_\_\_

Jack Tadaro  
Radiation Safety Officer  
New Horizons Environmental Consultants, Inc.

Date: \_\_\_\_\_

Approved By: \_\_\_\_\_

Sally Cuffin  
Project Quality Assurance Manager  
New Horizons Environmental Consultants, Inc.

Date: \_\_\_\_\_

# QUALITY ASSURANCE PROJECT PLAN

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Figure 1 CSMRI Site

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# QUALITY ASSURANCE PROJECT PLAN

## CSMRI SITE REMEDIATION

### 1.0 INTRODUCTION

The purpose of the *Quality Assurance Project Plan* (QAPP) is to document the procedures required for project quality assurance (QA), quality control (QC), and data validation for all sampling and analysis activities related to the CSMRI Remediation Site located in Golden, CO (Site). The QAPP describes the specific QA procedures that will be followed for sampling, sample handling and storage, chain of custody (COC), and laboratory and field analysis. The goal of the QAPP is to identify and implement sampling and analytical methodologies that limit the introduction of error into analytical data. The QAPP provides the methodology to ensure that project data will be of adequate quantity, quality, and usability for their intended purpose, and further ensures that such data are authentic, appropriately documented, and technically defensible. The document also will be part of the Site Decommissioning Plan.

Quality assurance elements for a project are the procedures used to control those unmeasurable components of a project such as using the proper sampling techniques, collecting a representative sample, specifying the proper analysis, etc. The documented procedures are used to establish adequate data quality. Examples of these procedures include generation of maintenance and calibration logs for all instruments and equipment, specification of materials acceptable for equipment and supplies, and documentation of sample collection and analysis. Although not measurable, quality assurance procedures are essential to produce quality information.

Quality control data are the data generated to estimate the magnitude of bias and variability in the processes for obtaining the environmental data. These processes include both the field processes for obtaining the data and the laboratory processes of sample analysis.

Quality assessment is the overall process of assessing the quality of the environmental data by reviewing the application of the QA elements and the analysis of the QC data. Quality assessment encompasses both the measurable and unmeasurable factors affecting the quality of the environmental data. Assessment of these factors may identify limitations that require modifications to procedures or protocols for sample collection and analysis or affect the desired interpretation and use of the environmental data.

All QA/QC procedures described in this QAPP comply with applicable professional technical standards, Colorado Department of Public Health and Environment (CDPHE) requirements, U.S. Environmental Protection Agency (EPA) requirements, U.S. Nuclear Regulatory Commission (NRC) guidance, applicable governmental regulations and guidelines, and project specific goals and requirements. This QAPP was prepared in accordance with United States Environmental Protection Agency (EPA) QAPP guidance documents, in particular the *EPA Guidance for Quality Assurance Program Plans, EPA QA/G-5*, (EPA/600/R-98/018, February 1998).

The QAPP is a planning document only and may be changed as necessary to meet project requirements.

## 2.0 PROJECT MANAGEMENT

### 2.1 Project/Task Organization

New Horizons Environmental Consultants, Inc. (New Horizons) will excavate and dispose of an estimated 10,000 cubic yards of soil and minor amounts of building debris from the CSMRI Site Remediation in order to meet the unrestricted use requirements for the Site. Remediation requirements will include sampling of soils destined for off-site disposal to meet landfill acceptance criteria and on-site verification sampling to meet the requirements for unrestricted use. A ground- and surface-water monitoring program will be implemented to document the natural attenuation; however, that monitoring program will be covered in separate documentation.

The following describes the management structure that will be in place during the remediation phase of the project.

#### 2.1.1 Project Manager

The New Horizons Project Manager (PM) will have overall responsibility for ensuring that the project meets applicable EPA and CDPHE requirements, Site specific data quality objectives (DQOs), and Site project requirements. In addition, the PM or their designated employee will be responsible for technical QC and project oversight. The PM will be responsible for the generation of project planning documents, procedures, and policies, and for ensuring that these plans, policies, and procedures are successfully implemented in the field.

#### 2.1.2 Field Supervisor

The New Horizons Field Supervisor will be responsible for implementing the technical and administrative aspects of the project and for ensuring site technical staff successfully carry out the project work plans. The Field Supervisor will have the authority to commit the resources necessary to meet project objectives and requirements. The Field Supervisor will ensure that technical, financial, and scheduling objectives are successfully achieved.

The Field Supervisor will be responsible for implementing plans, procedures, and policies required to successfully complete the project. As such, the Field Supervisor will have the following duties:

- Prepare and modify schedules as necessary to maintain orderly progress toward project objectives.
- Determine project needs for manpower and technical expertise.
- Orient and supervise project team leaders and technical staff.
- Ensure that adequate staffing, supplies, and equipment are available and in working order to perform project tasks.
- Review work in progress for conformance with project plans, procedures, and policies.
- Review overall project performance with regard to conformance with schedules, work plans, policies, and procedures.
- Prepare regular reports to the PM describing progress toward project objectives, operational considerations bearing upon project progress, and overall project team performance with regard to accomplishment of objectives and conformance with established plans, procedures, and policies.
- Implement corrective actions as needed to maintain project quality.

### 2.1.3 Technical Staff

The technical staff will perform individual tasks under the immediate supervision of the senior technical staff or Field Supervisor. The technical staff will be responsible for the successful accomplishment of field tasks described in the work plans.

### 2.1.4 Site Quality Assurance Manager

The Site QA Manager will operate outside of the direct chain of command for work operations and will be directly responsible to the PM for oversight of project quality objectives. The Site QA Manager will also be responsible for auditing the implementation of the QA program established in this QAPP and corporate QA/QC policies. The Site QA Manager's specific duties include the following:

- Performing the project quality assessment,
- QA audits of various phases of the field operations and project reports,
- Originate, review, and/or approve QA plans and procedures,
- Provide technical expertise for implementation of QA procedures, and
- Provide timely information to the PM with regard to conformance of project activities to the requirements of the QAPP, regulatory requirements, or corporate QA/QC policies and procedures.

### 2.1.5 Management Structure

The Field Supervisor is responsible for conducting the CSMRI Site work activities in conformance with the project work plans. The Site Safety Officer (SSO) is responsible for compliance with the requirements of the Occupational Safety and Health Administration (OSHA) and company health and safety policies, practices, and requirements. The Radiation Safety Officer (RSO) is responsible for maintaining employee and contractor exposure to radioactivity is as low as reasonably achievable (ALARA). Given these responsibilities, there is considerable overlap of duties because the conduct of site operations, site safety, and radiation protection address many of the same conditions and materials.

In practice, the designated PM, Field Supervisor, and SSO/RSO shall have worked together previously in similar situations. Each defines the requirements specific to his position, and a collaborative approach to satisfying the practical and regulatory requirements of each activity is utilized for planning and executing work operations. The SSO/RSO is authorized to order a temporary cessation of work operations through the Field Supervisor in the event that unacceptable conditions are present or work practices are not in accordance with occupational safety or radiation control requirements.

The Site QA Manager operates outside the Site chain of command. The QA function reports directly to the PM with overall administrative responsibility for project activities. In those instances where responsibility for QA and a particular site activity overlap, then QA responsibility for that activity is designated to some other qualified person.

## 2.2 Problem Definition/Background



The 6-acre Site is located on the south side of Clear Creek, east of U.S. Highway 6, in the northeast quarter of the northwest quarter of Section 33, Township 3 South, Range 70 West. The main entrance to the Site is located about 475 feet northwest of the intersection of Birch and 12<sup>th</sup> Street in Golden, Colorado. A chain-link fence restricts access to the Site, except for a small area located south of 12<sup>th</sup> Street known as the Clay Pits area.

Prior cleanup activities at the Site have included the removal and stockpiling of material from a former settling pond, off-site disposal of the stockpile, building cleanup and demolition, and removal of concrete and asphalt associated with floors and foundations of the former buildings.

A Site characterization study was performed from late 2002 through early 2003. Information from the study was presented in a Remedial Investigation/Feasibility Study (RI/FS) that was released for comment in January 2004. Characterization data that was generated during RI/FS indicated that two primary types of material (primarily soil) were located on the Site. Laboratory analysis showed that these materials could be classified technologically enhanced naturally occurring radioactive material (TENORM) and solid waste. The TENORM material has been designated Class 1 area material as defined by the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) guidance and is located in a number of discrete areas around the Site. A minimal amount of this waste was above the toxicity characteristic leaching procedure (TCLP) limits, but on average the material would not be classified as hazardous waste because of metals concentrations. Site specific metals of concern include arsenic, cadmium, lead, and mercury. The remainder of the Site contains areas with elevated concentrations of metals (but below TCLP limits) and potential areas with limited radionuclide activity. This material has been classified as solid waste and because of the potential for some radionuclide activity it has been classified as Class 2 area material (MARSSIM defined Class 2 areas).

The purpose of this QAPP is to document the QA/QC procedures necessary to ensure soil sent to disposal facilities meet the facility specific waste acceptance criteria and verification samples collected after the removal operations are of sufficient quantity and quality to support the unrestricted future use criteria.

### **2.3 Project/Task Description and Schedule**

The remedial phase of the project will include the following field operations:

- Perform monitoring required to measure and control employee and worker exposure to radioactivity during the performance of field operations (continued throughout project),
- Excavation and packaging of the Class 1 areas material (TENORM and metals affected material).
- Sampling and monitoring the Class 1 area material to ensure that the material will meet the selected landfill acceptance criteria (American Ecology, Grand View, Idaho and/or Waste Management - CSI, Bennett, Colorado),
- Sampling the soil remaining under the Class 1 areas to ensure that sufficient material (TENORM) has been removed,
- Removal of soil with Site specific metals of concern and potential radionuclide activity (MARSSIM Class 2 areas) for disposal at a waste disposal facility with compatible waste acceptance criteria (BFI - Foothills, Golden, CO and/or Waste Management - CSI),

- Sampling and monitoring of metals affected / Class 2 soil to determine if it meets the guidance provided by in the Colorado Department of Public Health and Environment (CDPHE) memorandum dated February 25, 2004 for radionuclide activity,
- Verification sampling and monitoring of property after soil removal is complete (radionuclides and metals),
- Monitor surface and ground water to document natural attenuation of radionuclides (see Ground- and Surface-Water Sampling Plan).

All activities must be performed in accordance with health and safety requirements and samples and measurements necessary to quantify exposures will be part of this QAPP.

Excavation and disposal operations are currently scheduled to start in April 2004 and continue for three to four months.

Screening instruments [field meters and In Situ Object Counting System (ISOCS) instrumentation] will be used to control excavation volumes and the ISOCS and laboratory analysis will be used for the sample analysis.

A Colorado licensed professional land surveyor will document all relevant sample locations and soil excavation.

Documentation for the remedial phase of the project will include records of field meters, sample positions, ISOCS analytical results (both screening and verification), laboratory analytical data, and chain of custody (COC) forms. The analytical data will reviewed and evaluated to determine if project objectives have been met and published in a final report.

### *2.3.1 Scheduled Project Activities, Including Measurement Activities*

Field measurements and sample collection will be performed throughout the project.

The ISOCS instrument may be used prior to the beginning of excavation operations to analyze some preliminary calibration samples. ISOCS screening samples will be evaluated within a 4-hour window. The results of ISOCS verification samples will be reported within 72 hours.

Radionuclide and metals laboratory samples may be held up to five days prior to laboratory submittal. Laboratory samples may be rush or standard delivery samples depending on project needs.

Air monitoring samples will be initially evaluated on site to promptly address specific health issues. Samples submitted for laboratory analysis will be standard delivery samples unless otherwise specified by the PM or QA Manager.

## **2.4 Data Quality Objectives and Criteria for Measurement Data**

Data collected for the remediation phase of the project will be used to:

- Document all exposures during remedial operations.
- Make decisions about the proper disposal site selection,
- Verify that shipped material meets the appropriate landfill waste acceptance criteria and shipping regulations, and

- Verify that sufficient material has been removed to support unrestricted future use of the property.

Although not part of the actual remediation process, ground- and surface-water samples will be collected for comparison to published U.S. Environmental Protection Agency (EPA) maximum contamination levels (MCLs). This information will be collected to demonstrate that natural attenuation is occurring in the ground water after the source material has been removed. Ground- and surface-water samples will be collected on a quarterly basis for at least two years after the completion of the Site remediation. The CDPHE will review the program at that time to determine if additional sampling is required.

Data necessary to support these objectives includes field meter and ISOCS screening data, ISOCS and analytical laboratory data, sample positional data, field parameter data (ground and surface water), and health and safety monitoring data. All verification sampling will be performed in accordance with the following guidance:

- Radionuclides: *The Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)*, NUREG-1575, Rev. 1, EPA 402-R-97-016, Rev. 1, DOE/EH-0624, Rev. 1.
- Metals: *The Superfund Lead-Contaminated Residential Sites Handbook*, U.S. Environmental Protection Agency, OSWER 9285.7-50, August 2003.

In addition to the guidance documents, the following software was used to assist in determining the verification sampling requirements.

- *RESRAD*, Version 6.21 software, U. S. Department of Energy and U.S. Nuclear Regulatory Commission, developed by Environmental Assessment Division of Argonne National Laboratory, September 2002.
- *Visual Sampling Plan (VSP)*, Version 2 software, Pacific Northwest National Laboratory, Contract DE-AC06-76RL01830.

Ground- and surface-water sampling will be performed in accordance with the following guidance.

- *U.S. Geological Survey National Water-Quality Assessment Protocols - Ground and Surface Water*, USGS Open File Report 94-455 and USGS Open File Report 95-399.

The overall quality objective is to develop and implement procedures for field sampling, laboratory analysis, and reporting that will provide results which are technically sound, capable of supporting engineering decisions, and legally defensible in a court of law. Specific procedures for sampling, laboratory instruments calibration, laboratory analysis, documentation, reporting of data, internal quality control, QC audits, preventive maintenance of field equipment, and corrective action are described in other sections of this QAPP.

#### 2.4.1 Problem

To properly identify the data quality objectives for the project, the circumstances that lead to the remedial operation (the problem) should be defined.

As described in section 2.2, characterization data collected as part of the Site RI/FS (completed in January 2004) identified elevated radionuclides and metals. Following community and regulatory

input to the RI/FS a remediation alternative was selected that required the affected material to be removed from the Site and disposed of in appropriate landfills. Following meetings with the Colorado Department of Public Health and Environment (CDPHE), a specific plan was adopted that required a portion of material to be sent to a specialized landfill with the remainder going to a Subtitle D landfill.

Based on data generated by the Site characterization, MARSSIM defined Class 1 and Class 2 areas were identified. Class 1 areas are identified in Figure 1. After the removal of the Class 1 areas, the entire Site is a Class 2 area. The Class 1 or TENORM material is to be excavated and shipped to American Ecology in Grandview, Idaho and/or Waste Management - CSI in Bennett, Colorado (a landfill specific risk assessment must be completed prior to material acceptance at CSI). Class 2 material included soils affected by metals concentrations that also had the potential for radionuclide contamination. CDPHE provided a memorandum that detailed the allowable levels of radionuclides that could be accepted by the Subtitle D landfill (BFI-Foothills located north of Golden, Colorado). Waste acceptance criteria for both landfills are discussed in the Site Sampling and Analysis Plan.

Following the removal activities the final survey and verification samples must meet the requirements of the Site specific derived concentration guideline levels (DCGLs) and the proposed Tier 2 soil standards (with the exception of the Site specific standard for arsenic).

Characterization data also identified elevated uranium concentrations in the ground water monitoring wells at the Site boundary with Clear Creek. The ground and surface water will be monitored during and following the excavation operations to determine if natural attenuation is occurring.

#### *2.4.2 Decisions*

Several questions (decisions) must be answered for the proper completion of the project. The questions include:

- Were sufficient safeguards in place to protect the on-site workers and surrounding community during the excavation and transportation operations?
- Was the waste properly characterized to meet the landfill acceptance (i.e., were sufficient measurements made and samples collected and was the data properly analyzed)?
- Was sufficient material removed to meet the Site specific DCGLs?
- Was sufficient material removed to meet the proposed Tier 2 soil standards (with the exception of arsenic, which will be regulated to background concentrations)?
- Does the water-quality data indicate that natural attenuation is occurring (this decision cannot be made for at least two years)?

The final survey and verification samples must demonstrate that the DCGLs are met or area averaging (small areas) provides sufficient protection to allow free release of the property. Proposed Tier 2 soil standards also must be met. Sufficient data must be available to show that the cleanup requirements have been met. Ground- and surface-water data must show that natural attenuation is occurring.

#### *2.4.3 Inputs to the Decision*

Inputs to the decision include the following data sources (and the corresponding affected decision):

- RI/FS characterization data that will be used to identify material in specific areas (DCGLs, excavation control, waste acceptance criteria, Site verification),
- Air monitoring data (occupational health),
- Dosimetry data (occupational health),
- Portable radiation meter survey data (excavation control, transportation requirements, waste acceptance criteria, final survey),
- ISOCS analytical data (waste acceptance criteria, transportation requirements, Site verification),
- Laboratory analytical data (waste acceptance criteria, Site verification, drinking water standards),
- Field parameter data (ground- and surface-water samples),
- Survey data (excavation control, final site topography), and
- Analytical review (waste acceptance criteria, Site verification, drinking water standards).

The DCGLs for the Site remediation were determined using RESRAD 6.21. The assumed receptor was an urban resident who used the Site ground water for drinking water and used it to water a backyard garden. The model also assumed the resident consumed fruits and vegetables from the backyard garden.

#### 2.4.4 Boundaries

Spatial boundaries for the remedial operations are limited to the Site as described in section 1.0 (see Figure 1). Temporal boundaries modeled during the RI/FS included up to 1,000 years into the future.

#### 2.4.5 Decision Rules

A number of decision rules were used to determine the requirements for the Site operations.

##### 2.4.5.1 Occupational Health Requirements

See Site specific Health and Safety Plan.

##### 2.4.5.2 Transportation Regulations

See Site specific Material Handling and Safety Plan.

##### 2.4.5.3 Landfill Acceptance Criteria

The American Ecology waste acceptance criteria applies to the Class 1 area material (TENORM). See Appendix B of the Site specific Sampling and Analysis Plan.

Solid waste going to a Subtitle D landfill will be controlled by the ANSI/HSP N13.12-1999 standard (*Surface and volume radioactivity standards for clearance*, American National Standards Institute, Inc. /Health Physics Society, 1999).

##### 2.4.5.4 Derived Concentration Guideline Levels

The Site has been divided into Class 1 and Class 2 areas for the verification sampling according to MARSSIM guidance. The Class 1 areas were evaluated using Visual Sampling Plan (VSP), Version 2, software (Pacific Northwest National Laboratory, Contract DE-AC06-76RL01830) "hotspot" assumptions to determine the number of samples required to verify the removal of the material. The

remainder of the Site has been designated Class 2 (two units) and the following the removal of the Class 1 material, the underlying area also will become fall into the Class 2 category. Analytical data (ISOCS and/or laboratory) from the verification samples will be compared to a fixed threshold [the sum of the fractions for the agreed upon (residential maximally exposed individual) derived concentration guideline levels (DCGLs)]. The Site specific DCGLs are as follows:

<b>Radionuclide</b>	<b>Urban Resident – 15 mrem/yr</b>
Lead-210	4.44
Polonium-210	192
Radium-226	1.44
Radium-228	2.20
Thorium-228	3.77
Thorium-230	9.83
Thorium-232	1.48
Uranium-234	253
Uranium-235	4.88
Uranium-238	20.2

Note: All units in picocuries per gram

The Site will be assumed dirty with decision errors for the final Site verification samples of 5-percent for the false rejection rate (alpha) and 10-percent for the false acceptance rate (beta). The Wilcoxon ranked sum test was used to determine the required number of samples.

The following background activities will be used for the Site remediation:

<b>Radioisotope</b>	<b>Background Activity <sup>1</sup></b>
Radium-226	2.7
Radium-228	2.4
Thorium-228	2.7
Thorium-230	1.7
Thorium-232	2.4
Uranium-234	1.9
Uranium-235	0.098
Uranium-238	1.6

<sup>1</sup> The background activity for the remediation effort is the 95-percentile upper confidence limit.

2.4.5.5 Proposed Tier 2 Soil Standards

Soil sample metals concentrations will be determined from samples composited from one-quarter parcels in accordance with the EPA Superfund Lead Handbook. Metals of concern for the Site include arsenic, cadmium, lead, and mercury. Metal concentrations will be compared to the proposed Tier 2 soil standards with the exception of arsenic. Background arsenic concentrations in the vicinity of the Site are naturally elevated with the 95-percent upper confidence limit for the site being 13 milligrams per kilogram. The applicable standards are provided in the following table.

<b>Metal</b>	<b>Proposed Standard (milligram/kilogram)</b>
Arsenic	13 <sup>1</sup>
Cadmium	76.1
Lead	400
Mercury (elemental)	1.1
Mercury (compounds)	23

<sup>1</sup> Site specific arsenic soil standard

*2.4.6 Limits on Decision Errors*

For purposes of determining sample number requirements and locations, the Site will be assumed dirty with decision errors for the final Site verification samples of 5-percent for the false rejection rate (alpha) and 10-percent for the false acceptance rate (beta).

*2.4.7 Optimize Project Design*

The HSP, SAP, and MHTP detail the approach for addressing the various aspects of the project. Review of the plans and planning discussions will be used to refine the approach. Additional optimization will be performed as the project gets underway and will be incorporated into the appropriate plan.

**2.5 Measurement Performance Criteria**

Procedures established in the QAPP are designed to ensure the generation of accurate and precise data, which demonstrates that project goals have been met. Controls must be in place to minimize bias and variability in the data.

A number of factors must be addressed to ensure the data accurately represent the actual project operation.

*2.5.1 Sample Collection*

Sample collection procedures must be collected from representative material, using clean sampling equipment and containers. The samples must be properly stored, transported, and documented. The Site QA Manager will supervise sampling personnel to verify sampling, storage, and transportation procedures are followed. If discrepancies are noted, corrective action will be initiated, which may include retraining, alternative sample containers, or revised procedures.

*2.5.2 Radiation Meter Calibration*

Specified calibration procedures must be followed for all field radiation meter to ensure proper operation. The Radiation Safety Officer (RSO) or Site QA Manager will review instrument calibrations to ensure the procedures are being followed. If discrepancies are noted, corrective action will be initiated, which may include retraining, equipment replacement, or revised procedures.

*2.5.3 Field Parameter Meter Calibration*

Manufacturer specific calibrations procedures must be followed for each day of ground- or surface-water sample collection. The Site QA Manager will review meter calibrations to ensure the procedures are being followed.

#### *2.5.4 In Situ Counting Object System*

After the completion of Site specific calibrations and the determination of instrument efficiency, the ISOCS results will be evaluated by the Site QA Manager to verify the instrument is generating reproducible results. This will be accomplished by comparing results of samples that are analyzed by both the ISOCS and the laboratory. The information also will be used to determine if specific isotopes are in secular equilibrium. If a significant discrepancy appears between the ISOCS and the laboratory, both the ISOCS and laboratory internal quality control records will be reviewed in detail. The ISOCS data will be reviewed to ensure the agreed upon detection limits are met. If significant bias or variability is discovered, the purpose of the ISOCS instrumentation will be re-evaluated.

#### *2.5.5 Laboratory*

Laboratory data will be reviewed to determine how often they fail to meet their internal quality control requirements. Laboratory duplicates, spikes, and surrogates will be examined to determine if the results are of sufficient quality. Additional methods such as anion / cation balances (water samples) will be used to determine if quality control problems exist.

#### *2.5.6 Survey Data*

The surveyors will provide the Site QA Manager with weekly AutoCAD LT file updates for review. The purposed of the review is to ensure that excavation volumes are updated and sample locations have been properly identified. If discrepancies are noted, corrective action will be initiated, which may include revising the drawings, re-surveying an area or sample location, or replacing Site specific surveying equipment.

#### *2.5.7 Documentation*

Significant documentation will be generated by the project. Documentation will be reviewed for discrepancies, missing information, missing signatures, etc. on a weekly basis (minimum frequency). Document deficiencies will be brought to the attention of the appropriate personnel as soon as possible for correction. Documentation may be modified if a more appropriate method is identified.

## **2.6 Special Training Requirements/Certification**

Samples will be collected by personnel with current 40-hr HAZWOPER certification. Documentation of the certification will be maintained on site.

Instrument specific training will be provided to the appropriate Site personnel.

A Colorado licensed professional land surveyor will determine sample locations.

Canberra personnel trained in the proper equipment shall perform all ISOCS measurements/analyses.



## 2.7 Documentation and Records

The project will generate the following documentation, which will be included in the final report:

- Field meter calibration and corrective action reports,
- Safety reports,
- Survey data (excavation volumes and coordinates - drawings, coordinates and calculations),
- Shipping manifests,
- Equipment survey reports,
- ISOCS screening and verification sample reports - soils,
- ISOCS calibration and corrective action reports,
- ISOCS validation data reports,
- Laboratory analytical reports and supporting data (includes calibration and corrective action data), - soil, ground and surface water,
- Field meter calibration reports,
- Chain-of-custody forms,
- Applicable field notes (sample collection and field meter measurements), and
- Interpretation of ISOCS and laboratory data (statistical summaries, instrument comparisons, secular equilibrium determinations, etc.), and

The data report will summarize the remedial activities including excavation and shipping operations. Any modifications to initial procedures caused by unforeseen problems will be discussed. Characterization data will be supplied if previously unidentified areas of elevated radionuclide activity are discovered along with any modifications necessary to adequately verify the new area(s). All measurement and analytical data will be summarized and the necessary calculations will be performed to show compliance with MARSSIM guidance, Site specific cleanup levels (radionuclides and metals), and landfill acceptance criteria.

The final data report will be maintained in the Colorado School of Mines document repository.

## 3.0 MEASUREMENT/DATA ACQUISITION

### 3.1 Sampling Process Design

The Site sampling process design primarily followed the guidance provided in MARSSIM and the Superfund Lead-Contaminated Residential Sites Handbook (EPA, OSWER 9285.7-50, August 2003). Sample locations were determined with the assistance of the RESRAD 6.21 and VSP software and the appropriate guidance. Details of the sampling process are provided in the CSMRI Site Remediation Sampling and Analysis Plan (SAP). Ground -water samples will be collected from existing and new monitoring wells. Surface-water samples will be collected from three locations, upgradient, along the Site ground-water interface, and downgradient of the Site.

### 3.2 Sample Methods Requirements

The following sections describe the sample types, number, documentation, and sample collection methods for the project.

Split samples will be collected at a rate of at least 10-percent of the total samples.

### *3.2.1 Waste Characterization Samples*

The waste characterization samples fall into two categories, the Class 1 area material and the metals affected / Class 2 area material. A statistically significant number of samples (about 30) will be collected from each category and analyzed for radionuclides to ensure the appropriate landfill acceptance criteria and transportation regulations are met.

#### *3.2.1.1 Waste Characterization Samples - Sample Locations, Numbering, and Documentation*

During loading operations into the Lift Liner™ bags (see Material Transport Plan) about 30 random samples will be collected from the Class 1 areas material. The purpose of these samples is to ensure that the facility acceptance criteria are met. These samples will not require positional information, but the general area that the material was excavated from will be noted in the field notebook. Data required for all samples includes a description of soil type (e.g., silt, clay, sand) and the estimated percentages of the type. Soil color also shall be noted in the field notebook.

About 30 random samples will be collected from the metals affected / Class 2 area stockpiles. This data set will be generated to verify that the average radionuclide activities are within the limits designated by CDPHE. These samples will not require positional information, but the general area that the stockpile came from should be noted in the field notebook. At least 10 percent of all samples will be split samples.

Sample numbering will be as follows. Samples from the Lift Liner™ bags (Class 1 area materials) will be sequentially numbered as follows: AE1001, AE1002, AE1003, etc. Split samples from the bags will be labeled with an S suffix (e.g., AE1002-S). Samples from the Class 2 area material stockpiles will be sequentially numbered as follows: BF1001, BF1002, BF1003, etc. Split samples from the Class 2 area material will be labeled with an S suffix (e.g., BF1002-S). Sample numbers will be legibly written on the sample containers (see SAP section 3.2.3) and the chain-of-custody applicable (COC) form. Company name (NHEC), sample number, date, and time of collection will be marked with permanent ink on each sample container.

All samples will be documented on the internal COC form and/or the laboratory specific COC form. The COC form must accompany the sample when the sample is transferred between the sampling personnel and ISOCS or laboratory personnel. If the sample is not under the direct supervision of sampling, ISOCS, or laboratory personnel, it will be maintained in a secure location. Sample COC forms are provided in Appendix C.

#### *3.2.1.2 Waste Characterization Samples - Sample Collection Methodology*

Waste characterization samples will be collected by compositing five aliquots of about 500 cubic centimeters into a clean plastic container (preferably white or clear plastic) and homogenized. Cobbles, gravel, and organic material will be minimized in the samples. Because of the quantity of clay on site, screens or other methods may be required to produce an acceptable sample. After the samples have been homogenized, the soil will be placed in a 500-milliliter plastic jar filled to the top. The jar will be shaken, etc. to maximize the amount of soil in each jar. Split samples will be collected from least 10 percent of all the waste characterization samples. If a split sample is required, a second

500-milliliter jar will be filled as previously described. Company name (NHEC), sample number, date, and time of collection will be marked with permanent ink on the sample jar lid. If the sample is to be submitted to the analytical laboratory, a circled "L" will be written on the jar lid (preferably in red ink). Samples will then be placed inside two resealable plastic bags. Laboratory samples also will include an additional 250 to 500 cubic centimeters of soil placed inside two resealable plastic bags. The additional material is necessary for alpha spectroscopy and/or metals analysis. Company name (NHEC), sample number, date, and time of collection will be marked with permanent ink on the sample bag (directly on the bag or on a sample label applied to the bag). A plastic bag will be used to keep the laboratory sample jars and bags together. Certified clean sample containers shall be used for all samples.

The waste disposal facilities may request additional toxic characteristic leaching procedure (TCLP) data. If required, the appropriate containers will be obtained from the laboratory and filled with homogenized soil. If TCLP samples are requested the sample numbering protocol described in section 3.2.2 will be followed.

### 3.2.2 Verification Samples

The verification samples fall into two categories, verification that sufficient material has been removed from the Class 1 areas and the final verification samples that show the metals affected / Class 2 material has been removed. The final verification samples ensure the agreed upon cleanup levels have been met (both radionuclides and metals) and the Site can be available for unrestricted use. The verification samples will be used in conjunction with on-site portable field radiation meters to determine if the material identified during the RI/FS has been excavated and removed from the Site.

The following guidance documents and software were used to determine sampling frequency and location for the verification samples:

- *Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)*, NUREG-1575, Rev. 1, EPA 402-R-97-016, Rev. 1, DOE/EH-0624, Rev. 1
- *RESRAD*, Version 6.21 software, U. S. Department of Energy and U.S. Nuclear Regulatory Commission, developed by Environmental Assessment Division of Argonne National Laboratory, September 2002.
- *The Superfund Lead-Contaminated Residential Sites Handbook*, U.S. Environmental Protection Agency, OSWER 9285.7-50, August 2003
- *Visual Sampling Plan (VSP)*, Version 2 software, Pacific Northwest National Laboratory, Contract DE-AC06-76RL01830.

#### 3.2.2.1 Verification Samples - Sample Locations, Numbering, and Documentation

Samples locations were selected in accordance with MARSSIM guidance. VSP software was used to assist with the sample location selection process. *The Superfund Lead-Contaminated Residential Sites Handbook* was used to determine the verification sampling requirements for metals.

For purposes of determining sample number requirements, the Site will be assumed dirty with decision errors for the final Site verification samples of 5-percent for the false rejection rate (alpha) and 10-percent for the false acceptance rate (beta).

### 3.2.2.1.1 Verification Samples - Sample Locations, Numbering, and Documentation - Radionuclides (TENORM/Class 1 area material)

After the Class 1 area material has been removed the underlying soil must be evaluated to determine if all of the TENORM material has been removed. The VSP designated "hotspot" sampling was assumed to determine the required sampling grid. RESRAD 6.21 was used in combination with RI characterization data to determine the size of the hotspot that needed to be evaluated. The residential maximally exposed individual receptor was assumed with a limiting dose of 15 millirem per year (mrem/yr). Using the radionuclides of concern a 1.8-meter diameter hotspot was determined. Assuming a triangular grid, about 55 samples would be required to adequately address the Class 1 areas. Ten to twelve additional samples may be required to adequately characterize the sidewalls of the excavation needed for the extraction(s) of this soil. Additional samples may be collected if previously unidentified areas of elevated activity are discovered during the remedial operations. At least 10 percent of all samples will be split samples.

Details of the VSP calculations and the associated sample location diagrams are provided in Appendix D. Sample collection methods are provided in following section.

Sample numbering for the former Class 1 areas will be as follows. Samples will be sequentially numbered as follows: C1001, C1002, C1003, etc. Split samples from the areas will be labeled with an S suffix (e.g., C1002-S). Sample numbers will be legibly written on the sample containers (see SAP section 3.2.3) and the chain-of-custody applicable (COC) form. Company name (NHEC), sample number, date, and time of collection will be marked with permanent ink on each sample container. If the sample is to be submitted to the analytical laboratory, a circled "L" will be written on the jar lid (preferably in red ink).

A general description of the sample material will be noted in the field notebook. Data required for all samples includes a description of soil type (e.g., silt, clay, sand) and the estimated percentages of the type. Soil color also shall be noted in the field notebook.

Prior to the Class 1 area sample collection, the surveyors will determine the sample locations using a random start triangular grid (1.8 meters between locations) for the Class 1 areas. Each sample location will be recorded electronically and cross-referenced by sample number in a bound field notebook. Location markers labeled with the appropriate sample number will be placed at each sample location.

All samples will be documented on the internal COC form and/or the laboratory specific COC form. The COC form must accompany the sample when the sample is transferred between the sampling personnel and ISOCS or laboratory personnel. If the sample is not under the direct supervision of sampling, ISOCS, or laboratory personnel, it will be maintained in a secure location. Sample COC forms are provided in Appendix C.

### 3.2.2.1.2 Verification Samples - Sample Collection Methodology - Radionuclides (Class 1 areas)

Prior to the collection of any soil sample a 10-second gamma measurement of the location will be made and recorded along with the sample number in the field notebook. A gamma measurement for each associated composite location also will be made and recorded.

Radionuclide soil samples will be obtained from the uppermost 15 centimeters of surface soil. The sample should be approximately cylindrical in cross section so that all horizontal components are equally represented in the sample. The soil at the selected sample location will be composited with four additional samples (equal volume) collected randomly within a radius of two meters. The five aliquots (about 500 cubic centimeters each) will be composited into a clean plastic container (preferably white or clear plastic) and homogenized. Cobbles, gravel, and organic material will be minimized in the samples. Because of the quantity of clay on site, screens or other methods may be required to produce an acceptable sample. After the samples have been homogenized, the soil will be placed in a 500-milliliter plastic jar filled to the top. The jar will be shaken, etc. to maximize the amount of soil in each jar. Samples will then be placed inside two resealable plastic bags. Laboratory samples also will include an additional 250 to 500 cubic centimeters of soil placed inside two resealable plastic bags. The additional material is necessary for alpha spectroscopy and/or metals analysis. A plastic bag will be used to keep the laboratory sample jars and bags together. Certified clean sample containers shall be used for all samples.

All relevant sampling data will be entered on an on-site chain-of-custody form that will be kept with the samples to monitor the transfer of sample control (i.e., field technician to ISOCS personnel). A separate chain-of-custody form will be filled out for all samples submitted to the laboratory. No special preservatives are required for the radionuclide samples.

#### 3.2.2.1.3 Verification Samples - Sample Locations, Numbering, and Documentation - Radionuclides (Class 2 area material)

VSP was used to develop the sampling requirements for the Class 2 areas (only the radionuclide portion of the waste was addressed with VSP), which will include the entire Site with the exception the Class 1 areas. MARSSIM limits Class 2 areas to a maximum size of 10,000 square meters to ensure sufficient sampling density. Excluding the Class 1 areas, about 19,000 square meters of property remain, which requires two Class 2 areas. Dividing the Site along the former main street produces the required Class 2 areas. The sampling goal was to compare the average concentration to a fixed threshold, assuming the data was not normally distributed, and use systematic grid sampling. The Wilcoxon signed ranks test was used for comparison to the Site background activities. Assumptions used for the Class 2 sampling area included: the Site was assumed to be dirty, a 5-percent false rejection rate, a 10-percent false acceptance rate, an action level ( $DCGL_w$ ) of 1 (multiple radionuclides - sum of the fractions), width of the gray region ( $\delta$ ) of 0.5 (half of the  $DCGL_w$ ), and an estimated standard deviation of 1.8 (estimated from characterization survey data). Because the comparison of the ISOCS and laboratory data still needs to be performed, no measurement quality objectives were selected. VSP indicates that about 130 verification samples will need to be collected from each Class 2 area (about 260 samples total). Additional samples may be collected if previously unidentified areas of elevated activity are discovered during the remedial operations. At least 10 percent of all samples will be split samples.

Details of the VSP calculations and the associated sample location diagrams are provided in Appendix E. Sample collection methods are provided in following section.

Sample numbering for the former metals affected / Class 2 areas will be as follows. Samples will be sequentially numbered as follows: C2001, C2002, C2003, etc. Split samples from the areas will be labeled with an S suffix (e.g., C2002-S). Sample numbers will be legibly written on the sample containers (see SAP section 3.2.3) and the chain-of-custody applicable (COC) form. Company name

(NHEC), sample number, date, and time of collection will be marked with permanent ink on each sample container. If the sample is to be submitted to the analytical laboratory, a circled "L" will be written on the jar lid (preferably in red ink).

A general description of the sample material will be noted in the field notebook. Data required for all samples includes a description of soil type (e.g., silt, clay, sand) and the estimated percentages of the type. Soil color also shall be noted in the field notebook.

After the completion of the Site excavation and prior to verification sample collection, the surveyors will determine the sample locations using a random start triangular grid [about 2.7 meters (8.7 feet) between locations]. Each sample location will be recorded electronically and cross-referenced by sample number in a bound field notebook. Location markers labeled with the appropriate sample number will be placed at each sample location.

#### *3.2.2.1.4 Verification Samples - Sample Collection Methodology - Radionuclides (Class 2 areas)*

Prior to the collection of any soil sample a 10-second gamma measurement of the location will be made and recorded along with the sample number in the field notebook. A gamma measurement for each associated composite location also will be made and recorded.

Radionuclide soil samples will be obtained from the uppermost 15 centimeters of surface soil. The sample should be approximately cylindrical in cross section so that all horizontal components are equally represented in the sample. The soil at the selected sample location will be composited with four additional samples (equal volume) collected randomly within a radius of two meters. The five aliquots (about 500 cubic centimeters each) will be composited into a clean plastic container (preferably white or clear plastic) and homogenized. Cobbles, gravel, and organic material will be minimized in the samples. Because of the quantity of clay on site, screens or other methods may be required to produce an acceptable sample. After the samples have been homogenized, the soil will be placed in a 500-milliliter plastic jar filled to the top. The jar will be shaken, etc. to maximize the amount of soil in each jar. Samples will then be placed inside two resealable plastic bags. Laboratory samples also will include an additional 250 to 500 cubic centimeters of soil placed inside two resealable plastic bags. The additional material is necessary for alpha spectroscopy and/or metals analysis. A plastic bag will be used to keep the laboratory sample jars and bags together. Certified clean sample containers shall be used for all samples.

All relevant sampling data will be entered on an on site chain-of-custody form that will be kept with the samples to monitor the transfer of sample control (i.e., field technician to ISOCS personnel). A separate chain-of-custody form will be filled out for all samples submitted to the laboratory. No special preservatives are required for the radionuclide samples.

#### *3.2.2.1.5 Verification Samples - Sample Locations, Numbering, and Documentation - Metals (Class 2 area material)*

Verification samples also will be evaluated for metals after the remedial operations (excavation) have been completed. *The Superfund Lead-Contaminated Residential Sites Handbook* recommends that each quarter acre be sampled using a five point composite sample. Verification will require about 24 such samples. At least 10 percent of all samples will be split samples.

Sample numbering for the metals samples will be as follows. Samples will be sequentially numbered as follows: M101, M102, M103, etc. Split samples from the areas will be labeled with an S suffix (e.g., M102-S). Sample numbers will be legibly written on the sample containers (see SAP section 3.2.3) and the chain-of-custody applicable (COC) form.

A general description of the sample material will be noted in the field notebook. Data required for all samples includes a description of soil type (e.g., silt, clay, sand) and the estimated percentages of the type. Soil color also shall be noted in the field notebook.

To determine the metals sample locations, the surveyors will divide the Site into one-quarter acre parcel and position a sample marker about in the center of each parcel. Each sample location will be recorded electronically and cross-referenced by sample number in a bound field notebook. Location markers labeled with the appropriate sample number will be placed at each sample location.

Additional metals samples may be required for areas that were not sufficiently characterized during the RI or if new areas are identified during the remediation operations.

#### *3.2.2.1.6 Verification Samples - Sample Collection Methodology - Metals (Class 2 areas)*

The Site will be divided into quarter-acre areas to determine the locations for metals samples. Five equal volume (500 cubic centimeters) samples will be collected at random within the quarter acre areas. As with the radionuclide samples, a cylindrical sample about 15 centimeters deep will be collected. The five samples will be homogenized in a five-gallon plastic bucket (preferably white or clear plastic) with minimal cobbles, gravel, or organic material introduced into the sample. After the sample has been homogenized, about 500-milliliter of material will be placed in double resealable plastic bags and marked with the appropriate sample number, date, and time of collection. Sample collection will be documented on a chain-of-custody form. Certified clean sample containers shall be used for all samples. All metal samples will be placed on ice (4°C) until delivered to the laboratory (requirement for mercury). In addition, all metals samples will be promptly delivered to the laboratory because of the 30-day holding time for mercury.

All relevant sampling data will be entered on an on site chain-of-custody form that will be kept with the samples to monitor the transfer of sample control (i.e., field technician to ISOCS personnel). A separate chain-of-custody form will be filled out for all samples submitted to the laboratory.

#### *3.2.3 Previously Inaccessible or Unidentified Area Samples*

The area around the previously active City of Golden water mains (near the former Building 101) will be characterized to determine if it falls into the Class 1 or Class 2 categories. The material is adjacent to material that has been identified as Class 1 material (some Class 1 material was found to overly the pipelines) and will be approached as a Class 1 excavation. If sufficient visual clues such as color coupled with portable radiation meter measurements indicate the material is Class 1, it will be placed directly into the Lift Liner™ bags. If obvious indications of activity are not available, samples will be collected to characterize the material. Sufficient samples must be collected to confidently disposition the material to the appropriate disposal site.

Excavation operations often reveal additional areas of material that were not identified during the characterization investigation. Color and portable radiation meter measurements will be used to make an initial determination of the material disposition. However, if obvious indications of activity are not available, samples will be collected to characterize the material. Sufficient samples must be collected to confidently disposition the material to the appropriate disposal site.

Because this material has not been previously characterized, a limited amount of TCLP samples may be required.

### *3.2.3.1 Previously Inaccessible or Unidentified Area Samples - Sample Locations, Numbering, and Documentation*

Characterization samples will be primarily evaluated for radionuclides to determine if the area is Class 1 or Class 2 area material. Some metals samples may be collected at the discretion of the Project Manager or RSO. Actual sample collection locations will be selected after the area has been exposed and a preliminary evaluation (visual and instrument check) is complete.

Sample numbering for these areas will be as follows. Samples will be sequentially numbered as follows: PL101, PL102, PL103, etc. for the City of Golden pipeline area. Split samples from the areas will be labeled with an S suffix (e.g., PL102-S). Previously unidentified area sample areas will be numbered as Ux101, Ux102, Ux103, etc. where the "x" will be replaced with a letter (A, B, C) that designated the sequence in which the areas were discovered. The area and corresponding letter code must be noted in the field notebook. Split samples from the areas will be labeled with an S suffix (e.g., Ux102-S). Sample numbers will be legibly written on the sample containers (see SAP section 3.2.3) and the chain-of-custody applicable (COC) form.

A general description of the sample material will be noted in the field notebook. Data required for all samples includes a description of soil type (e.g., silt, clay, sand) and the estimated percentages of the type. Soil color also shall be noted in the field notebook.

### *3.2.3.2 Previously Inaccessible or Unidentified Area Samples - Sample Collection Methodology*

Prior to the collection of any soil sample a 10-second gamma measurement of the location will be made and recorded along with the sample number in the field notebook. A gamma measurement for each associated composite location also will be made and recorded.

Radionuclide soil samples will be obtained from the uppermost 15 centimeters of surface soil. The sample should be approximately cylindrical in cross section so that all horizontal components are equally represented in the sample. The soil at the selected sample location will be composited with four additional samples (equal volume) collected randomly within a radius of two meters. The five aliquots (about 500 cubic centimeters each) will be composited into a clean plastic container (preferably white or clear plastic) and homogenized. Cobbles, gravel, and organic material will be minimized in the samples. Because of the quantity of clay on site, screens or other methods may be required to produce an acceptable sample. After the samples have been homogenized, the soil will be placed in a 500-milliliter plastic jar filled to the top. The jar will be shaken, etc. to maximize the amount of soil in each jar. Samples will then be placed inside two resealable plastic bags. Laboratory samples also will include an additional 250 to 500 cubic centimeters of soil placed inside two resealable plastic bags. The additional material is necessary for alpha spectroscopy and/or metals



analysis. A plastic bag will be used to keep the laboratory sample jars and bags together. Certified clean sample containers shall be used for all samples.

All relevant sampling data will be entered on an on site chain-of-custody form that will be kept with the samples to monitor the transfer of sample control (i.e., field technician to ISOCS personnel). A separate chain-of-custody form will be filled out for all samples submitted to the laboratory. No special preservatives are required for the radionuclide samples. Metals samples that are collected must be maintained on ice and promptly delivered to the laboratory.

### *3.2.4 Ground- and Surface Water Samples*

Ground- and surface-water samples will be collected on a quarterly basis to determine if natural attenuation is occurring. Sample results will be compared to current EPA MCLs.

#### *3.2.4.1 Ground- and Surface Water Samples - Sample Locations, Numbering, and Documentation*

Ground- and surface-water sample locations are show on Figure 2. Samples will be numbered with the appropriate well or sample location designation (e.g., CSMRI-04). At least one duplicate sample (metals and radionuclides) will be collected for each sampling round. Documentation will include recording the field parameters, proper labeling of the sample containers, completion of the COC, and general observations at the time of the sample collection (e.g., initial low dissolved oxygen readings, high or low surface water flows, excessive turbidity, etc.).

#### *3.2.4.2 Ground- and Surface Water Samples - Sample Collection Methodology*

Ground-water samples will be collected using a Grundfos Rediflo-2 ground-water sampling pump. All wells will be purged of at least three well volumes, but purging may be continued until field parameters stabilized. Micro-purging techniques may be used on wells with low recharge (or may be sampled using dedicated bailers). A WTW Model 340i multi-parameter meter will be used in combination with a flow-through cell to measure field parameters (dissolved oxygen, pH, specific conductance, and temperature) during sample collection. Water purged from the wells will be stored in temporary containers until sample analysis has been completed.

Surface-water samples will be collected using a point-integrating sampler. Samples may be biased toward the surface water/sediment interface. Surface-water field parameters will be determined in stream for the following field parameters: dissolved oxygen, specific conductance, and temperature. A grab sample will be collected from the stream to determine pH (to minimize streaming potential). Personnel will position themselves downstream of the actual field parameter and sample location to minimize sediment disturbance. Field parameters will be measured just before the samples are collected.

The multi-parameter meter shall be calibrated daily in accordance with the manufacturer's specifications. Calibration solutions will be checked to ensure they have not expired. All calibration information will be documented in a bound field notebook.

If possible, a surface-water discharge measurement will be made at the time of the sample collection. If discharge measurements are not made at the time of sample collection, an estimated value will be determined by the upgradient USGS Clear Creek at Golden stream gage.

All water samples will be collected in certified clean sample containers supplied by the analytical laboratory. Sample containers for radionuclides and metals come with appropriate preservatives and must be handled with care.

### 3.2.5 Decontamination Procedures

All sampling equipment - trowels, buckets, augers, etc. - shall be cleaned between sample collection sites. Cleaning may include brushing or scrapping followed by washing with an approved detergent and water, followed by rinsing with clean water. Certified clean sample containers shall be used for all samples.

All ground- and surface-water sampling equipment will be cleaned prior to sample collection. Equipment (pumps, flow through chambers, etc.) will be cleaned using of warm water with an appropriate detergent (Liqui-Nox or equivalent) and rinsing with deionized or distilled water. Sample containers may be rinsed with the sample water (if no preservative is in the bottle) prior to sample collection. Certified clean sampling hoses/tubing will be used for each ground-water monitoring well.

### 3.2.6 Sample Storage

Soil samples will be placed in the on-site sample locker with the corresponding chain of custody. Metals samples will be stored in coolers on ice (4°C - requirement for mercury) and shipped to the laboratory within one day of collection. All water samples will be stored on ice and delivered to the laboratory within 36 hours.

## 3.3 Sample Handling and Custody Requirements

New Horizons and subcontractor personnel will maintain a documented chain-of-custody (COC) record for all analytical samples submitted for on- and off-site analysis. The COC documents that the sample was in the possession of a specified individual until it has been transferred to another responsible individual, stored in a secure location, or shipped to a laboratory (COC must accompany the samples).

### 3.3.1 Field Procedures

The following steps must be taken by field personnel to ensure maintenance of unbroken custody over field samples:

- Use only approved containers for acquiring samples,
- Properly label all sample containers at the time of sample acquisition,
- Record all required sampling information in field notebooks and/or sampling forms as applicable (e.g., soil type, color, etc.),
- Ensure that labels are legible and intact after sampling or write information directly on sample container,
- Immediately place samples in a designated container (cooler, etc.) that accompanies the sampling personnel until custody can be surrendered,
- Place the sample in a secure location if not transferring to another individual,

- Document all changes of sample custody such as transfer to on site contractors (ISOCS) or to the laboratory, and
- Use an appropriate custody seal on the sample container during shipment to ensure no tampering in route to the laboratory.

### 3.3.2 *Approved Sample Containers*

Samples will be placed and transported in containers appropriate to the sample matrix and analytical parameters. Samples will be placed in suitable containers based on the requirements of the individual analytical method. Among these containers are:

- Sealed filter cassettes for personal and work area air monitoring samples,
- Five-hundred milliliter polypropylene jars for radiochemical samples, and
- Resealable plastic bags of suitable size for airborne radionuclide samples and metal samples.

### 3.3.3 *Sample Label Requirements*

Samples will be labeled with the following minimum information:

- Date and time of sample,
- Unique sample number,
- Project identification or company name,
- Name of sampler,
- Requested analysis,
- Preservative (if applicable), and
- Matrix identification.

Other information may be included on the sample label if appropriate.

### 3.3.4 *Sample Documentation*

Sampling activity is documented in field notebooks or on field sampling forms. If a standard form is available for the documentation of sampling activities, it should be used. Otherwise, the relevant information should be recorded in field logbooks. The following information will be recorded:

- Sample point designation (if applicable),
- Type of material sampled (e.g., soil, water, etc.)
- Appearance of sample material (e.g., soil type and color, water turbidity, etc.),
- Relevant sampling device operating conditions (such as voltage, flow rate, or other applicable information),
- Site conditions that might affect sample characteristics or integrity,
- Results of any field measurements,
- Calibration information or references for field instruments used,
- Quantities of sample obtained or quantity of material sampled, and
- Any other information necessary to locate the sample in time and space and apply the results of the analysis to project objectives.

### 3.3.5 *Preservatives*

With the exception of ice (metals samples only - for mercury), no preservatives are required for most of the soil samples addressed in the SAP.

Ground- and surface-water samples require the following preservatives:

<b>Sample Type</b>	<b>Preservative</b>
Anions	Ice
Radionuclides	Ice, Nitric Acid
Metals	Ice, Nitric Acid
Volatile Organic Compounds	Ice, Hydrochloric Acid

The laboratory typically provides the sample containers with the appropriate preservative (except the ice). If sample containers do not have the appropriate preservative a source of laboratory grade acid will be obtained and acid will be added to the container until a pH of less than 2 is achieved.

If additional specialized samples needing preservation are required, the laboratory will be contacted to provide sample containers with the method specific preservatives.

### 3.4 Analytical Requirements

#### 3.4.1 Laboratory Analytical Procedures

Samples will be analyzed at a CDPHE certified environmental/radionuclides laboratory. Samples designated for laboratory analysis will be analyzed in accordance with laboratory specific internal procedures for the specified analytical method. The laboratory methods used for this project will include:

<b>Analyte</b>	<b>Analytical Procedure</b>	<b>Specific Method</b>
Uranium and Thorium	Alpha Spectroscopy	ASTM (Paragon 714R8 or equivalent)
Radium, Polonium-210	Gamma Spectroscopy	ASTM (Paragon 713R7 or equivalent)
Lead-210	Gamma Spectroscopy	RAD-A013
Metals	Inductively Coupled Plasma - Atomic Emission Spectrometry	SW6010B
Metals - Mercury	Cold Vapor Atomic Adsorption	SW7471A
Gross alpha and beta - Water		ASTM (Paragon 728R8 or equivalent)
Radionuclides - Water	Alpha Spectroscopy	ASTM (Paragon 714R8 or equivalent)
Volatile Organic Compounds - Water	Gas Chromatography/Mass Spectrometry	SW8260
Metals/cations - Water	Inductively Coupled Plasma - Mass Spectrometry	SW6010
Mercury - Water	Cold Vapor Atomic Adsorption	SW7470A
Anions - Water	Ion Exchange Chromatography	EPA300.0
Alkalinity	Alkalinity - Titrimetric, pH 4.5	EPA310.1

Soil sample detection limits for the required analytes are as follows:

<b>Radionuclide/ Metal</b>	<b>Units</b>	<b>Detection Limit</b>
Lead-210	pCi/g	0.6
Polonium-210	pCi/g	0.1
Radium-226	pCi/g	0.2
Radium-228	pCi/g	0.5
Thorium-228	pCi/g	0.1
Thorium-230	pCi/g	0.1
Thorium-232	pCi/g	0.1
Uranium-234	pCi/g	0.1
Uranium-235	pCi/g	0.1
Uranium-238	pCi/g	0.1
Arsenic	mg/kg	0.1
Cadmium	mg/kg	0.1
Lead	mg/kg	0.1
Mercury	mg/kg	0.1

Water sample detection limits for the required analytes are as follows:

<b>Analyte</b>	<b>Units</b>	<b>Detection Limit</b>
Arsenic	µg/L	10
Cadmium	µg/L	10
Mercury	µg/L	0.2
Lead	µg/L	3.0
Bicarbonate as CaCO <sub>3</sub>	mg/L	10
Carbonate as CaCO <sub>3</sub>	mg/L	10
Chloride	mg/L	1
Fluoride	mg/L	0.1
Nitrate, as N	mg/L	0.2
Nitrite, as N	mg/L	0.1
Sulfate	mg/L	1.0
Calcium	mg/L	1.0
Magnesium	mg/L	1.0
Potassium	mg/L	1.0
Sodium	mg/L	1.0
Volatile Organic Compounds	µg/L	1.0 <sup>1</sup>
Gross alpha and beta	pCi/L	3.0
Radium-226	pCi/L	1.0
Radium-228	pCi/L	1.0
Thorium-228	pCi/L	0.2
Thorium-230	pCi/L	0.1
Thorium-232	pCi/L	0.1
Uranium-234	pCi/L	0.1
Uranium-235	pCi/L	0.1

<sup>1</sup> Typical concentration - some analytes 10 µg/L)

Additional analytical procedures may be identified during the project in response to previously unidentified material or additional analytical requirements (e.g., TCLP). The PM or QA Manager will review appropriate methods and contact the laboratory to determine the appropriate sample methods and detection limits.

### 3.4.2 *In Situ Object Counting System Analytical Procedures*

The ISOCS equipment will be operated in accordance with the Canberra Industries practices and procedures. Equipment specific method detection limits (MDL) will be in accordance with the ISOCS statement of work (CSMRI Remediation Sampling and Analysis Plan - Appendix A) and are listed below. The MDLs may be modified as necessary in response to on site conditions and equipment limitations. The ISOCS instrument will be calibrated daily using a site-specific standard.

<b>Radionuclide</b>	<b>Minimum Detection Limits (picocuries per gram)</b>
Lead-210	0.7
Polonium-210	0.7
Radium-226	1.0
Radium-228	1.0
Thorium-228	1.0
Thorium-230	1.0
Thorium-232	1.0
Uranium-234*	1.7
Uranium-235*	0.17
Uranium-238*	1.7

### 3.4.3 *Field Equipment Analytical Procedures*

Radioactivity will be measured with a variety of instruments. The two principal types of radiation measurement instruments used during the Site activities will be the gamma scintillation detector and the alpha scintillation detector.

Alpha scintillation measurements are obtained with the detector in direct contact with the sample surface. Care must be exercised not to damage the sensitive mylar film covering the light-sensitive detector. Alpha counts may be obtained using the ratemeter mode for frisking or by a scaler counter with a counting period of one minute for more precise measurements of surface activity.

Gamma radiation field strength measurements are obtained with the detector located at a height of approximately one-meter above the surface. Gamma radiation field strength measurements are obtained in the ratemeter mode. The method for measurement of the terrestrial component of gamma radiation is presented in detail in the SAP.

Removable radioactivity is measured by obtaining wipe samples. Each wipe sample contains the removable radioactivity present on 300 square centimeters (cm<sup>2</sup>). Each wipe sample will be placed in the counting chamber of a calibrated dual channel wipe counter and counted for a preset period of time. The period of time for the count will be determined by the calculated minimum detectable activity (MDA) for the specific detector based on its operating characteristics. Minimum detectable activity (MDA) is a function of instrument background. Therefore, an MDA will be calculated for the project specific transportation and sampling background conditions. The MDA will be determined using the following approach.

The lower limit of detection (LLD) for each instrument is the smallest amount of net activity above background that will be registered as positive with a given level of confidence (typically a probability of 0.05 or an upper confidence level of 95-percent), assuming a normal distribution. Previously

published methods of determining the LLD [also referred to as the detection limit (DL)] have been recently challenged and several guidance documents and standards are adopting new equations [*Multi-Agency Radiological Laboratory Analytical Protocols Manual and ISO-11929 Part 1 (2000)*]. The following equation (or slightly modified versions) has been proposed for general use:

$$DL_{McCroan}(R_{n,\alpha}) = \frac{k_{\alpha}^2}{2t_b} + \frac{k_{\alpha}}{2} \sqrt{\frac{k_{\alpha}^2}{t_{\alpha}^2} + 4R_b \left( \frac{1}{t_g} + \frac{1}{t_b} \right)} \quad (\text{McCroan's Rule})$$

where  $k_{\alpha}$  is the statistical z score for a specific level of confidence (type I error),  $t_g$  is the gross count time, and  $t_b$  is the background count time (Strom, D.J. and MacLellan, J.A., 2001, *Evaluation of eight decision rules for low-level radioactivity counting*, Radiation and Health Protection, Pacific Northwest National Laboratory, Richland, WA). . Or rewriting the equation for the 95-percent confidence level.

$$DL = \frac{2.706}{t_b} + 0.823 \sqrt{\frac{2.706}{t_b^2} + 4R_b \left( \frac{1}{t_g} + \frac{1}{t_b} \right)}$$

To determine the minimum detectable contamination (MDC), the detection limit must be corrected for instrument efficiency, or:

$$MDC_{Cont} = \frac{DL}{\epsilon_i}$$

This equation assumes that the efficiency includes the probe area correction factors (Martin, J.E., 2000, *Physics for Radiation Protection*, John Wiley & Sons, New York, pg. 483).

The  $MDC_{Cont}$  equation may be modified for specific applications such as air monitoring samples. The basic equation may be modified to determine the minimum detectable concentration ( $MDC_{Conc}$ ) by including correction factors for filter efficiency, chemical recovery, and flow rate.

Airborne radioactivity will be measured using the same procedure and equipment as that specified for wipe samples. The counting time will be determined by the calculated MDA and the sample volume.

The  $MDC_{Cont}$  data also will be correlated with analytical data produced by the on-site In Situ Object Counting System (see section 3.1.2) and laboratory data to provide a screening tool for soil excavation and off-site shipment.

### 3.5 Quality Control Requirements

The following sections discuss the QC requirements for the types of samples required by this project. The samples include personal and work area air samples, environmental radioactivity survey samples (e.g., equipment wipe samples), soil samples to access disposal categories and verify cleanup requirements, and samples of previously unidentified materials (if necessary).

#### 3.5.1 Occupation Health Samples Quality Control Requirements

Occupational health samples addressed in this QAPP consist of personal breathing zone and work area air monitoring samples to be obtained during the course of Site activities, and wipe samples for the measurement of removable radioactivity. In the case of air samples, the analytical methods specify a number of blank analyses. Each batch of personal breathing zone and work area air monitoring samples that will be analyzed must be accompanied by a minimum of two blanks or ten-

percent of the total number of samples in the batch. For this monitoring effort, fewer than ten samples will be submitted for analysis at any given time, so two blanks will be submitted for each analyte. Personal breathing zone and work area samples for radiochemical analysis must be accompanied by one blank per day. Verification duplicates for wipe samples will be collected at a frequency of approximately ten-percent of samples.

#### *3.5.2 Personal Air Samples Quality Control Requirements*

Air samples obtained from individual workers' breathing zones will be subject to the level of QC effort provided in the relevant analytical method as described in the previous paragraph. Personal air monitoring is anticipated for total dust and radionuclides (when applicable). Where such methods exist, the analytical methods established by the National Institute of Occupational Safety and Health (NIOSH) will be used for the analysis of these constituents. In the event that there is no published NIOSH method, other technically sound determinative methods will be utilized. Samples of other airborne contaminants or potential airborne contaminants may be collected and analyzed as site conditions or materials encountered may dictate.

#### *3.5.3 Soil Sample Quality Control Requirements*

Every effort will be made during the soil sample collection to produce well-mixed soil samples free of excessive gravel, pebbles, or organic material. Split soil samples will be collected from a minimum of ten-percent of all sample sites. Sampling procedures should limit cross contamination and soil heterogeneity makes field blanks (e.g., equipment and media blanks) of questionable value. However, sufficient sample volume will be provided for internal laboratory QC operations.

#### *3.5.4 Water Sample Quality Control Requirements*

At least one duplicate (radionuclides and metals) sample will be collected when the ground- and surface-water samples are collected. Transportation and/or equipment blanks may be used if analytical data appears to contain typical laboratory contaminants or analytes that were not previously identified in the characterization data.

#### *3.5.5 In Situ Object Counting System Quality Control Requirements*

The ISOCS instrumentation shall be operated in accordance with internal Canberra procedures. The instrument shall be calibrated daily (using a Site specific standard) and after problems have been identified and corrected. At least ten percent of all of the sample runs shall be split samples. Instrument duplicate samples shall be run in accordance with internal Canberra procedures.

#### *3.5.6 Laboratory Quality Control Requirements*

Laboratory QC shall be in accordance with established internal laboratory procedures that were reviewed as part of their certification. Standard QA/QC procedures include initial calibration, continuing calibration, reagent blanks (where applicable), laboratory control samples (for radionuclide samples), laboratory duplicates, serial dilutions (as needed), tracer samples (both chemical and radionuclide), and matrix spike/matrix spike duplicates (i.e., addition of known quantities of chemicals or radionuclides).



All laboratory quality control samples shall be reported along with the standard sample analyses. Problems with laboratory QC shall be reported in the laboratory data package. Analysis that are out of accepted laboratory QC ranges shall be reported to the PM or QA Manager to determine if the samples need to be rerun. Problems with QC shall be corrected as soon as possible and affected samples may require re-analysis.

### **3.6 Instrument/Equipment Testing, Inspection, And Maintenance Requirements**

All instrumentation used for this project shall require testing, inspection, and maintenance. Equipment problems will be identified in a timely manner and the instrument will be repaired or replaced as soon as possible. Instrumentation that will or may be used on this project includes:

- Hand-held radiation survey instruments,
- Field parameter meters (water samples),
- Organic vapor analyzers (if necessary),
- Combustible gas detectors (if necessary),
- Specific gas monitors (if necessary),
- Various air sampling pumps of capacities from two liters per minute to 40 cubic feet per minute,
- ISOCS, and
- Laboratory analytical instruments.

#### *3.6.1 Field Instrument Preventive Testing, Inspection, and Maintenance*

Manufacturer or vendor specified preventive maintenance procedures and/or consumable item replacement schedules shall be strictly followed for all field instrumentation/equipment.

Field instrumentation/equipment will be function checked and/or calibrated before being assigned to the field activity. Function testing and/or calibration in the field will be performed daily or in conformance with the manufacturer's recommendations. A sufficient inventory of repair items and consumable components will be maintained on the site to keep the field instruments and equipment in service. Arrangements will be made with off-site vendors and service companies for repair and maintenance of instruments that require specialized equipment or skills.

#### *3.6.2 Laboratory/ISOCS Instrument Preventive Maintenance*

Laboratory instrumentation shall be maintained in accordance with certified internal laboratory procedures. The ISOCS instrumentation will be tested, inspected, and maintained in accordance with internal Canberra procedures. Maintenance problems shall be brought to the attention of the PM or QA Manager if data quality is affected.

#### *3.6.3 Instrument Calibration and Frequency*

All field instrumentation shall be calibrated in accordance with the SAP or Ground- and Surface-Water Sampling Plan. Laboratory/ISOCS instrumentation shall be calibrated in accordance with internal procedures.

### **3.7 Inspection/Acceptance Requirements For Supplies And Consumables**

Certified clean containers shall be used for all samples. The documentation of the sample containers shall be maintained with the project files.

Supplies and consumables used by the ISOCS and laboratory shall be evaluated in accordance with their internal standard procedures to ensure QC is maintained. A record of this process shall be maintained with the project files and/or presented in the data package.

### **3.8 Data Management**

Data generated during this project must be technically sound, capable of supporting engineering decisions, and legally defensible in a court of law. Data must be managed to ensure that all data is of adequate quantity, quality, and usability for their intended purpose, and further ensures that such data are authentic, appropriately documented, and technically defensible.

Site data will be reported to project management in the form of summary tables and reports. Regular reports will be submitted to the PM on health and safety exposure monitoring, sampling activities, perimeter air quality, radiation surveys on vehicles exiting the site, and quantities of materials removed from the site for management. Other information will be compiled and submitted as requested by the PM. Numerical data summaries and reports of information subject to this QAPP will be reviewed and endorsed by the Site QA Manager before submittal in final form. Any specific deficiencies or reservations regarding the reported data, data reduction, or conclusions will be identified by the Site QA Manager in a transmittal accompanying the report.

#### *3.8.1 Data Recording*

Data for this project will be in written and electronic form. Data will be recorded in field notebooks, COC forms, instrumentation visual output, instrumentation digital output, and software generated digital output. All of this data must be accurately recorded and cross-checked to verify quality data is produced for decision making and the final report. Each employee shall be responsible for accurately filling out sample labels, COC forms, and field notebook entries. Instruments must be accurately read and entered into field notebooks. Equipment problems and corrective actions shall be noted as necessary.

The ISOCS data will be provided verbally for screening decisions and electronically for data management. Relevant QC information shall be provided with the electronic report.

Laboratory analyses will be provided in standard laboratory data packages with appropriate QC documentation.

#### *3.8.2 Data Validation*

Because of the short-term nature and limited resources of this project, data validation shall primarily rely on the internal QC programs of ISOCS instrumentation and the analytical laboratory.

Data validation will be required for both chemical and radionuclides and should follow guidelines such as the *National Functional Guidelines for Data Validation*. Validation review should include confirmation that initial and continuing calibrations were performed, analytes are absent in the reagent blank (if appropriate), and recoveries from the Laboratory Control Sample are within acceptable limits. Review also should address split and or duplicate analysis; however, these samples

may be of limited value with heterogeneous soils. Tracer and spike recovery rates should be checked for compliance with specific control limits. Documented internal laboratory limits shall be used for the validation.

The laboratory and ISOCS should sufficiently document the sample analysis to allow third party data validation if necessary.

### *3.8.3 Data Transformation*

Data transformation will primarily be limited to determination of instrument detection limits (see section 3.4.4) and statistical interpretation of the data. The required equation for instrument detection limits shall be entered into a Microsoft Excel spreadsheet with data cells available for the input parameters. The equation cells shall be protected to prevent unauthorized tampering. The input parameters should be checked during each use to ensure accurate data generation.

Statistical interpretation of the data will be primarily performed in Microsoft Excel using accepted statistical methods (according to MARSSIM and other environmental guidance). Data input to Excel will rely on electronic submittals from the laboratory and ISOCS. The data input section will be reviewed as needed if the input parameters must be entered by hand.

### *3.8.4 Data Transmittal*

All data from the laboratory and ISOCS shall be in electronic format. The laboratory will provide an electronic data deliverable (EDD) of the data prior to sending the final data report in pdf format. The EDD shall be in space or comma separated ASCII format or in Excel spreadsheet format to allow easy downloading. The ISOCS data will be in pdf format that will allow numerical access to the QA Manager.

### *3.8.5 Data Reduction and Analysis*

Data reduction techniques will include general data review ("sanity check"), statistical analysis including looking for outliers, relational and statistical plotting of data, and plotting of data on the previously generated Site maps. If outliers or other data values appear incorrect, the data reduction method used will be reviewed. If the method appears valid the raw data will be examined for inconsistency or input errors. To ensure that problems are promptly identified, data reduction operations will be performed throughout the project.

Data reduction for laboratory data will be performed in accordance with the laboratory internal procedures. If alternative methods are required because of previously unidentified sample requirements, the PM, QA Manager, and the laboratory will determine the appropriate method and data reduction needs.

Each laboratory utilized as a vendor of analytical services in support of this project will supply information relating to their internal management procedures for data reduction. The Site QA Manager will review the laboratory procedures.

### *3.8.6 Data Tracking*

The QA Manager will be responsible for the project data tracking. This will include checking of the field notebook for completeness and consistency, review of COC forms, and review of ISOCS and laboratory submittals. The QA Manager shall maintain close communication with the ISOCS and laboratory personnel to ensure timely delivery of the data. Data delivery delays quickly addressed because of the effects on project schedules. If delivery problems are not quickly resolved, the QA Manager or PM will initiate corrective action measures.

#### *3.8.7 Data Storage and Retrieval*

All project data will be maintained in with hard or electronic copies. Backup copies of all ISOCS and laboratory submittals will be maintained on CD or equivalent. All of the appropriate data will be provided in the final project data report. The majority of the final data report will be in electronic format, but some submittals may be in hard copy form.

## **4.0 ASSESSMENT/OVERSIGHT**

### **4.1 Assessments and Response Actions**

Performance and system audits of field activities will be conducted to verify that activities are performed in accordance with the procedures established by or provided in the SAP and QAPP. Audits of field activities will be conducted by or under the direction of the Site QA Manager. The audit will include a review of applicable records, record-keeping practices, and field operations to ascertain that field activities are conducted in accordance with established procedures.

A field audit will take place at the commencement of the project to determine that personnel are aware of and capable of executing project activities in accordance with the procedures established for those activities. Follow-up audits will be carried out to ensure that established procedures continue to be followed. At least one project-wide follow-up audit will be performed. Audits may also be performed to check on the implementation of specified corrective actions.

The Site QA Manager will prepare a written record of any field audits performed. The findings of any such audits, including any corrective actions recommended or required, will be included in this record.

Corrective actions may be required for either field or laboratory actions. The procedures for initiating a corrective action are similar in both cases.

#### *4.1.1 Field Corrective Actions*

Corrective actions may be required in the field to correct situations or conditions with a negative impact on data or sample quality. These conditions may arise from an instrument or device malfunction or from a failure to follow established procedures.

##### *4.1.1.1 Instrument Malfunction Corrective Actions*

A formal corrective action will be implemented as soon as the existence of an equipment or instrument malfunction is brought to the attention of the Site QA Manager. The Site QA Manager will undertake the following actions:

- Identify the item that is not functioning properly,
- If possible, determine how long the item has been malfunctioning,
- Remove the item from service and order its repair or replacement, and
- Evaluate the effect of the malfunction on current and past operations.

The Site QA Manager will make a written record of the circumstances of the corrective action. If the condition results in the impairment of the quality of data already collected, the Site QA Manager will identify the affected data, evaluate the effect of the equipment malfunction, and take appropriate action to correct the affected data, if this is possible. Corrected data will be noted as such, together with a statement of how the correction was performed. Data that cannot be corrected will be identified. Limitations on the future useability of the data will be noted.

The Site QA Manager will conduct such follow-up investigations as may be required in the event of an equipment malfunction. The effectiveness of any repairs, replacement, or recalibration will be examined and evaluated.

#### *4.1.1.2 Procedural Corrective Actions*

Failure to follow approved procedures for field operations will also result in a formal corrective action. When the Site QA Manager becomes aware of a breakdown in procedural discipline, several actions must be undertaken. These include the following:

- Consultation with the Project Manager to identify the situation and define its scope and significance,
- Evaluate the effect on data quality of the failure to follow approved procedures,
- Determine the extent and duration of the procedural breakdown,
- Instruct affected personnel in the proper procedure,
- Conduct follow-up inspections, observations, or audits to ensure that the procedure is being properly utilized, and
- Prepare a written record of the corrective action.

#### *4.1.1.3 Laboratory or ISOCS Corrective Actions*

Implementation of corrective actions will be the responsibility of the laboratory's or ISOCS's QA personnel. In the event that Contractor personnel discover errors or inconsistencies with laboratory data, the Site QA Manager will initiate an investigation to determine if a corrective action is required. Corrective action may be ordered by the Site QA Manager in the event that any condition or circumstance results in the impairment of laboratory data.

The laboratory will be required to inform the Site QA Manager of any laboratory corrective actions undertaken and identify any data whose usefulness may be affected by the condition or circumstance causing the corrective action. This requirement applies for corrective actions initiated by the laboratory as well any corrective actions ordered by the Contractor.

## **4.2 Reports to Management**

The Site QA Manager will make a weekly verbal or written QA report to the PM. This report will summarize routine QA operations, result of any audits conducted during the week, status of

continuing corrective actions, corrective actions initiated during the week, and any other matters relevant to QA issues affecting the project. Verbal reports will be made during weeks with minimal problems.

A summary of QA activities, including any conditions or situations affecting data completeness or quality, corrective actions, and outcomes of corrective actions will be prepared as part of the final report. The report will address completeness and reliability of data generated during project activities, quality and completeness of documentation, and identify data and documentation that is incomplete or not in conformance with the requirements of the project requirements.

## **5.0 PROJECT SPECIFIC DATA VALIDATION**

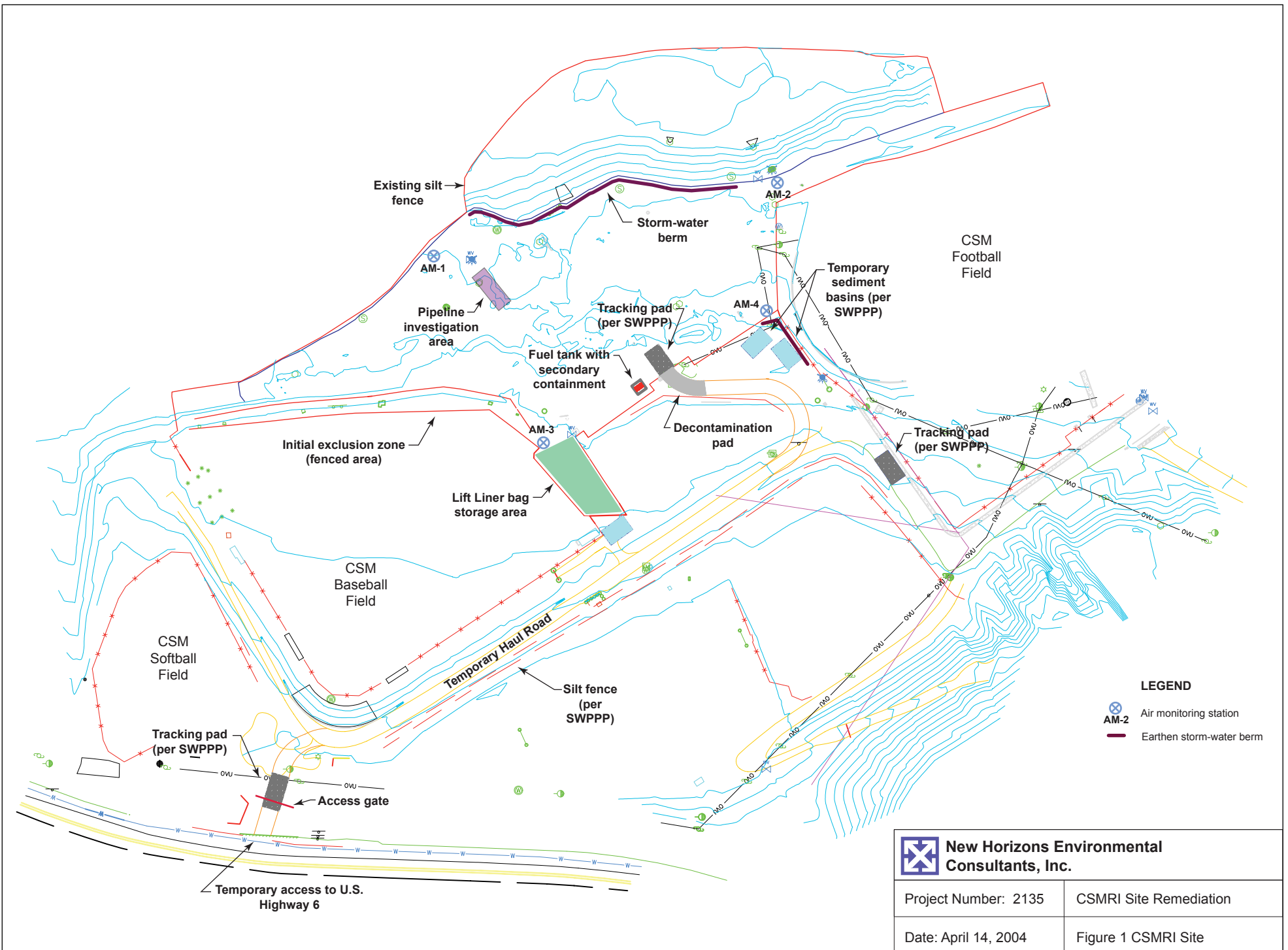
The project data shall be reviewed by the QA Manager throughout the project to ensure the data quality objectives are being met and the reported data is accurate and complete. Because meeting specified landfill acceptance criteria and DCGLs is vital to the project completion, the data will be reviewed continuously. Samples that indicate that material to be shipped off site is above transportation regulations or landfill acceptance criteria will be brought to the attention of the PM prior to any material shipment. Verification samples that do not meet DCGL limits will require additional excavation activities. Data review and validation will be a continuing effort throughout the project.


Environmental sampling that indicate potentially excessive exposures will be brought to the attention of the PM by the HSO or RSO as soon as the information is available. Again data review and validation for environmental samples will be a continuing effort throughout the project.

## **6.0 QAPP REVISIONS**

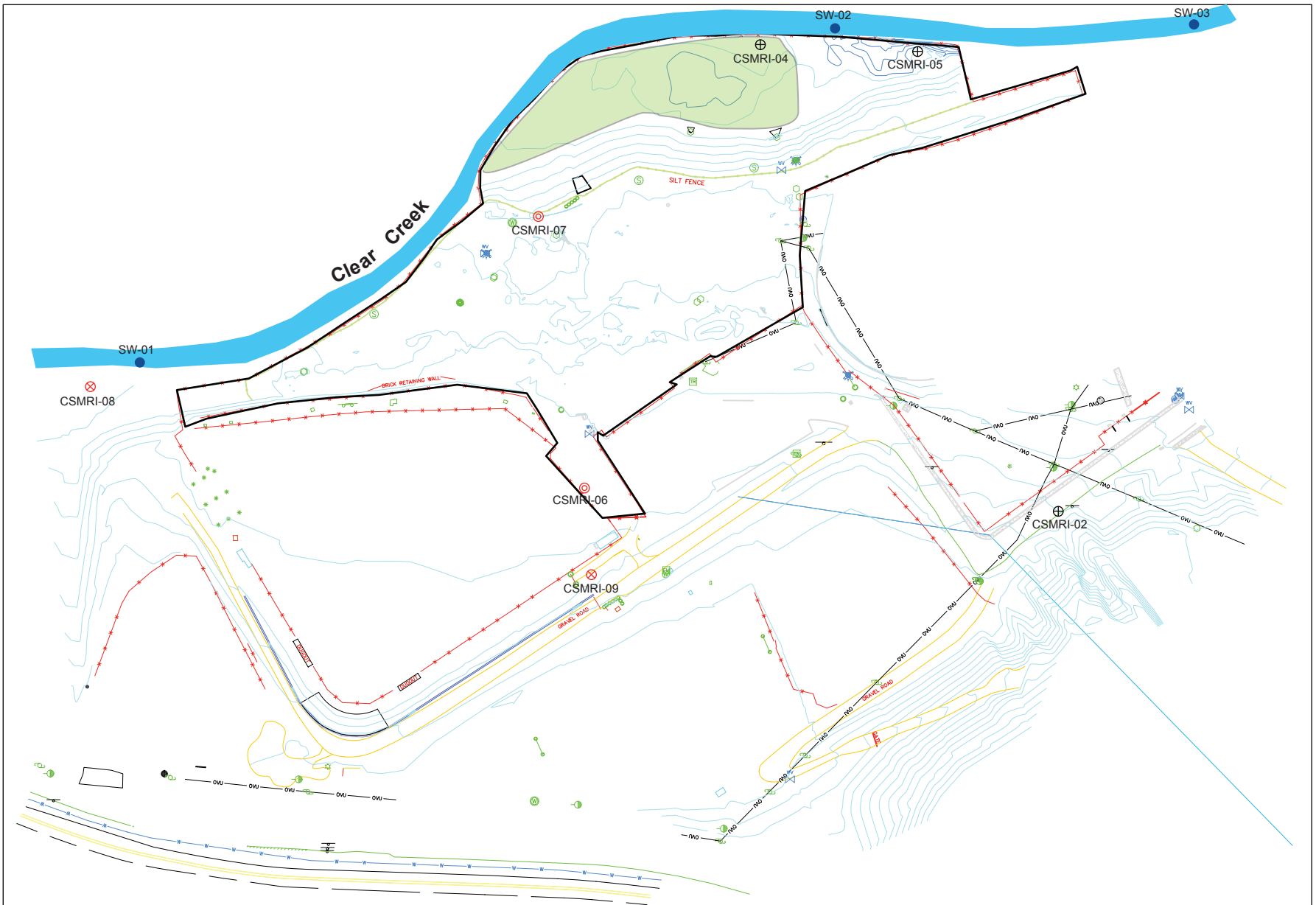
During the course of environmental data collection, it is possible that changes will occur and revisions to the QAPP will have to be made. Any changes to the technical procedures should be evaluated the QA Manager and PM to determine if they significantly affect the technical and quality objectives of the project. If so, the QAPP should be revised and re-approved, and a revised copy should be sent to all the persons on the distribution list.

## **FIGURES**



 <b>New Horizons Environmental Consultants, Inc.</b>	
Project Number: 2135	CSMRI Site Remediation
Date: April 14, 2004	Figure 1 CSMRI Site





**LEGEND**

- ⊕ Existing Monitoring Well
- ⊙ Abandoned Monitoring Well
- ⊗ Proposed Monitoring Well
- Surface-Water Sample Location

**Figure 2** Ground- and Surface Water Monitoring Locations

**Project:** CSMRI Site Remediation

**Project Number:** 2135    **Date:** March 28, 2004



**New Horizons Environmental Consultants, Inc.**  
 6585 South Wright Street  
 Littleton, CO 80127-4806