Appendix O
Construction Quality Assurance Plan

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Former Reynolds Metals Reduction Plant – Longview

Construction Quality Assurance Plan

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ABBREVIATIONS

ASTM	ASTM International
BMP	best management practice
CAP	*Cleanup Action Plan*
CD	Consent Decree
CDID	Consolidated Diking Improvement District
CQA	construction quality assurance
CQAP	*Construction Quality Assurance Plan*
CQC	construction quality control
DAR	daily activity report
Ecology	Washington State Department of Ecology
Final EDR	*Final Engineering Design Report, Version 2*
Former Reynolds Plant	former Reynolds Metals Reduction Plant
GCL	geosynthetic clay liner
NPDES	National Pollutant Discharge Elimination System
PRB	permeable reactive barrier
QA	quality assurance
QC	quality control
RFI	request for information
SU	site unit
TESC	temporary erosion and sediment control

1 Introduction

This *Construction Quality Assurance Plan* (CQAP) describes the site-specific components of the Owner's construction quality assurance (CQA) program and identifies the steps to be used during construction management for the cleanup at the former Reynolds Metals Reduction Plant (Former Reynolds Plant) in Longview, Washington. This CQAP is an appendix to the *Final Engineering Design Report, Version 2* (Final EDR), prepared in accordance with the cleanup action as specified in the *Cleanup Action Plan* (CAP) (Ecology 2018a) pursuant to Consent Decree (CD) No. 18-2-01312-08 (Ecology 2018b).

1.1 Background

The site is located at 4029 Industrial Way, just outside the city limits of Longview in Cowlitz County, Washington, approximately 2.9 miles northwest of the center of Longview and 4.8 miles northwest of I-5. The property includes about 460 acres and is currently operated as a multimodal bulk materials handling facility. The site is approximately 10 feet above mean sea level and bounded by the Columbia River to the south; Consolidated Diking Improvement District (CDID) drainage ditches to the north, west, and east; Industrial Way along the northern boundary; and private property to the east.

The Former Reynolds Plant includes multiple areas (referred to as site units [SUs]) in the CAP that were used during facility operations to contain construction debris and other waste deposits (Figure O1). These areas are addressed as part of the Washington State Department of Ecology's (Ecology's) required cleanup action. To date, extensive work has been conducted to decommission inactive portions of the facilities, remove industrial materials and wastes from the property, and perform closures and cleanup actions. Additional background information can be found in the *Remedial Investigation and Feasibility Study* (Anchor QEA 2015).

The following remedial activities will occur at the various SUs during construction:

- **SU2 (West Landfill).** Excavation of the east and west portions of SU2 will be conducted, as well as placement of the material over the remaining footprint of SU2, which will be known as the West Landfill after construction is complete. Work in SU2 also includes berm and stormwater drainage elements to facilitate the waste consolidation and long-term drainage and construction of a low permeability cap. The excavated portions of SU2 will be backfilled with reactive material from the base of the excavation to the seasonal high groundwater level. Reactive backfill will be covered with select fill to the required finished grade, and the entire area will be hydroseeded.
- **SU3.** Construction activities in this SU include excavation of the SU, consolidation of excavated material at East Landfill No. 2, placement of reactive backfill from the base of the

excavation to the seasonal high groundwater level, backfill and compaction of select fill above the reactive material, and placement of a crushed gravel surface.

- **SU4.** Construction activities in this SU include placement of reactive backfill within pre-existing ditches. Each of the three SU4 ditches will be backfilled with reactive backfill material to the seasonal high groundwater level. Finally, compacted select fill will be placed above the reactive backfill and finished with a crushed gravel surface graded to generally match pre-construction grades and suitable for light vehicle traffic.
- **SU5.** Construction activities in this SU include a small excavation of the SU, consolidation of excavated material at East Landfill No. 2, and placement of reactive backfill. A pre-existing ditch in this SU will also be filled with reactive backfill to the seasonal high groundwater level, covered with compacted select backfill above this elevation, and graded to prevent future ponding of the area. The backfilled areas will be covered with a crushed gravel surface suitable for light vehicle traffic.
- **SU6 (East Landfill No. 2).** Construction activities in this SU/landfill include preparation for material placement, including regrading of existing material, consolidation of material excavated from SU3 and SU5, placement of a temporary cover material and erosion control measures, monitoring settlement of the landfill between construction seasons, regrading as required to meet final grades, construction of permanent drainage features, and construction of a low permeability cap.
- **SU7 (East Landfill No. 1).** Construction activities in this SU/landfill include preparation for material placement, including ground improvements under the berms, construction of berms and drainage features, consolidation of material excavated from SU8 and SU10, placement of a temporary cover material and erosion control measures, monitoring settlement of the landfill between construction seasons, regrading as required to meet final grades, construction of permanent drainage features, and construction of a low permeability cap.
- **SU8.** Construction activities in this SU include excavation of the SU, consolidation of excavated material at East Landfill No. 1, placement of select backfill overlain with topsoil, and hydroseeding.
- **SU10.** Construction activities in this SU include excavation of the SU, consolidation of excavated material at East Landfill No. 1, placement of select backfill overlain with topsoil, and hydroseeding.
- **Permeable Reactive Barrier.** Construction activities associated with this remedial action include site preparations, likely consisting of grading activities and possibly minor excavation of surficial material, and construction of a segmented permeable reactive barrier (PRB).
- **Stormwater Management Upgrades.** Construction activities associated with this portion of the project include ditch reconfigurations; construction of temporary stormwater collection and pumps to manage, convey, store, and treat stormwater during construction; and

construction and installation of force mains and pump stations to move water from the west and east sides of the site to facilitate long-term stormwater management.

1.2 Purpose

The purpose of this document is to describe the site-specific components of the CQA program and identify the steps to be used during construction management, including monitoring actions, reporting mechanisms, and documentation formats. It also identifies the responsibilities during construction for monitoring the performance of the Contractor's Work to complete the construction activities in accordance with the final design documents. Further, it describes the quality assurance (QA) methods and protocols of identified project staff to ensure they have a complete understanding of monitoring, feedback, and adjustment mechanisms. Construction quality control (CQC) will be the responsibility of the Contractor; however, this document summarizes partial quality control (QC) requirements as necessary to differentiate them from QA activities.

1.3 Plan Organization

The remainder of this report is organized as follows:

- **Section 2 – Roles and Responsibilities.** This section identifies the roles, responsibilities, and authorities of the parties involved in the remedial construction and QA/QC.
- **Section 3 – Documentation and Reporting.** This section outlines documentation requirements for CQA activities, including daily activity reports (DARs), monthly progress reports, documentation of project modifications, and other documentation and reporting requirements.
- **Section 4 – Quality Assurance Program.** This section describes the performance objectives and criteria, QA measures, inspection and verification activities, and contingency actions for each construction activity.
- **Section 5 – References.**

1.4 Terms and Definitions

The following terms and associated definitions are used within this report:

Construction Quality Assurance (CQA). A planned, systematic set of procedures and documentation designed to provide confidence that elements of the project meet the requirements of the Contract Documents. The process is used by the Owner to verify that the quality of construction meets the intent of the Drawings and Technical Specifications.

Construction Quality Control (CQC). A planned, systematic set of procedures and documentation designed to maintain the quality of project elements as they are constructed. The process used by the Contractor and its Subcontractors to control the quality of construction and meet the intent of the Drawings and Technical Specifications.

Contract Documents. The documents issued by the Owner that represent the agreement between the Owner and Contractor to perform the Work, including Contract forms, bid forms, Contract terms and conditions, Drawings, Technical Specifications, and addenda.

Contractor. The person, partnership, or corporation that has entered into an agreement with the Owner to perform the Work.

Drawings. The plans, profiles, sections, and details prepared by the Engineer and included with the Contract Documents to illustrate the location, dimensions, and nature of the Work to be performed.

Engineer. The person, partnership, or corporation responsible for preparing the design, including Drawings and Technical Specifications, and for providing site engineering services. The Engineer is also responsible for reviewing Contractor submittals and shop drawings, as needed, and for interpreting Drawings and Technical Specifications during construction.

Earthwork. Construction activity related to grading, excavation, and placement of aggregate materials as described in the Technical Specifications.

Geosynthetic Clay Liner (GCL). Composite barrier material composed of geotextile material and natural clay material.

Non-Conformance. A lack of some necessary quality, characteristic, or element that renders the quality of an item unacceptable.

Owner. The Owner is responsible for implementation of the design remedy. The Owner will have an Owner's Team for this project, which will consist of a Project Manager, Construction Manager, Inspector, Environment, Health and Safety Support, Engineer (as defined earlier), and other individuals as needed to properly manage, oversee, and ensure the success of the project. The Owner's Team will be referred to as Owner throughout this document. For this project, the Owner is responsible for QA, monitoring, observation, and sampling activities required to implement the CQA program.

Permeable Reactive Barrier (PRB). Vertical trenches, perpendicular to contaminated groundwater flow, that are backfilled with selected reactive media to enhance the natural attenuation process and further limit the mass flux of contaminants downgradient.

Remediation Water. Contaminated groundwater from the upper shallow water-bearing zone of the East and West Groundwater Areas and stormwater that comingles with contaminated groundwater and/or contaminated soils.

Site Unit (SU). Subareas of the project site where remediation efforts specific to the corresponding area will be implemented.

Subcontractor. A person, partnership, or corporation that has entered into an agreement with the Contractor to perform a specific portion of the Work.

Technical Specifications. Written requirements for materials and execution of the Work to be performed that are prepared by the Engineer and included with the Contract Documents. The Technical Specifications must be adhered to in order to successfully implement a component of the Work.

Work. The entirety of the Work required to complete the project as described in the Drawings and Technical Specifications.

2 Roles and Responsibilities

2.1 Project Staff and Organization

The primary parties involved in the project are described in this section.

The Owner (Northwest Alloys, Inc.). The Owner is the primary party responsible for managing the overall project and funding construction. The Owner's responsibilities include project funding, Contract administration, and overall project management. The Owner's Team is also the primary party responsible for implementing the CQA program, including monitoring the Contractor's work products, monitoring construction progress, reviewing submittals, documenting observations, and reporting CQA activities.

The Engineer (Anchor QEA, LLC). The Engineer is responsible for two main tasks. First, the Engineer is responsible for preparing the design such that successful implementation of the design will result in achieving the design criteria and construction activity-specific objectives. Additionally, the Engineer provides consultation during construction to assist with implementation of the remedial action to verify conformance with the approved design documents. The Engineer also works with the Contractor to resolve issues or conditions that arise during construction that were not contemplated in the design.

The Contractor and Its Subcontractors. The Contractor will be retained under direct Contract with the Owner to perform the complete Work described in the Contract Documents. The Contractor may subcontract specific project elements to Subcontractors. Among the Contractor's staff will be a Contractor-appointed CQC Supervisor, an individual within the organization who is responsible for overall management of the CQC Plan and has full authority to institute any and all actions necessary for the successful implementation of the CQC Plan to verify compliance with the Drawings and Technical Specifications.

Regulatory Agencies (Lead Agency: Washington State Department of Ecology). The regulatory agencies are responsible for providing general oversight of the project, coordinating public involvement, reviewing the design, and issuing permits. Garin Schrieve is the Ecology Project Manager for this project. Additional regulatory agencies involved in the project may include, but may not be limited to, the U.S. Army Corps of Engineers, the CDID, and local agencies of Cowlitz County, Washington. All coordination and correspondence with the regulatory agencies will occur through the Owner.

2.2 Communications

Routine communications will be maintained between the Owner and Contractor. Significant field communications at the site during construction will be summarized in the DAR.

Formal correspondence (e.g., responses to requests for information [RFIs] and change orders) with the Contractor will typically be prepared and reviewed by the Owner before being delivered to the Contractor. These formal pieces of correspondence typically impact the design approach, Contract Documents, or payment and are required to go through formal document review procedures by the Owner.

Communications with regulatory agencies will be initiated by the Owner. Communications may include telephone calls, emails, and formal letters. The Owner will summarize communications with the regulatory agencies in telephone calls or emails to capture written documentation of the discussion, decision points, and action items. Site visits from regulatory agency representatives will be noted in the DAR, and any formal decisions will be documented in formal written correspondence.

3 Documentation and Reporting

Documentation and reporting for CQA activities will include pre-construction documentation, construction documentation, and post-construction documentation as detailed in this section. The Contractor and Owner will work closely during the project to complete the Work as specified in the final design and collect the documentation required. Where practicable, electronic means of document storage will be used for the management of relevant construction documents. The following sections describe documentation that will be required throughout the remedial action.

3.1 Meetings

3.1.1 Pre-Construction Meeting

One pre-construction meeting will be conducted at the work site prior to commencement of any Work at the work site. The Owner, Contractor, and key Subcontractors will be required to attend. The purpose of the pre-construction meeting will be to review the following information:

- Project layout
- Drawings and Technical Specifications
- Project schedule and Work sequencing, including required milestones
- Project work areas, staging areas, the laydown area, haul roads, and parking lots
- Roles, responsibilities, and lines of communication and authority
- Site conditions, including Work restrictions, health and safety, and environmental protection requirements, and other administrative requirements for working at the site
- Reporting and documentation requirements
- Use of electronic storage, such as Microsoft SharePoint, for the management of meeting notes, reports, submittals, RFIs, change orders, and other relevant construction documents
- Testing equipment, testing procedures, and sampling procedures
- Procedures and processing of field decisions and changed condition notifications
- Permit conditions and other regulatory requirements (e.g., National Pollutant Discharge Elimination System [NPDES])
- The Contractor's understanding of QC requirements and CQC Plan

3.1.2 Daily Tailgate Meetings

The Contractor will hold daily tailgate meetings in accordance with Technical Specification Section 01 31 00 – Project Management and Coordination. Besides the Contractor, additional attendees may include the Owner, Subcontractors, inspectors, field staff, and other relevant parties. The purpose of this meeting is to have a field review of staff safety and potential safety concerns, as well as planned daily Work activities and related environmental concerns.

3.1.3 Weekly Progress Meetings

Weekly meetings will be held at the site or by telephone conference with the Owner, Contractor, and any key Subcontractors. Representatives of regulatory agencies may also choose to attend. Minutes from weekly progress meetings will be documented by the Owner and distributed to attendees. Meeting minutes will be stored electronically at a location designated by the Owner. Discussion topics at weekly meetings will include the following:

- Review minutes of previous meetings
- Health and safety issues
- Environmental protection
- Review of progress of the Work
- Review of monitoring results
- Field observations, problems, proposed changes, and decisions
- Review of submittals, schedule, and status of submittals
- Review of construction schedule
- Corrective measures to regain projected schedules if delays are incurred
- Coordination of projected progress
- Regulatory issues

3.1.4 Special Meetings

Special meetings may be called by the Owner as necessary to address items such as non-routine problems, safety issues, serious non-conformance issues, or design revisions. Special meetings will be held at the site or by telephone conference with the Owner, Contractor, and any relevant Subcontractors in attendance. Minutes from special meetings will be documented and stored electronically by the Owner and distributed to attendees.

3.2 Submittals

A submittal is anything specified in the Contract Documents (e.g., work plans, shop drawings, and similar) that requires review by the Owner. Submittals are required from the Contractor to supplement the Drawings and Technical Specifications by showing the detail necessary to construct, verify, and confirm items to be incorporated into the Work. Submittals are required from the Owner to document inspections and reviews of the Contractor's submittals.

Note that document control (review, distribution and storage, elimination of obsolete documents, and control of document changes) will be the responsibility of the Owner. The Owner will be responsible for maintaining a means of electronic storage and management of submittals, comments, and other documents related to the submittal review process. Submittals and the review of submittals will be tracked by the Owner. The Owner will lead the review process and provide the Contractor with comments within the duration outlined in the Technical Specifications. The steps of

the review process will be tracked in tabular form and kept with draft and final versions of submittals as well as a record of comments provided to the Contractor. This record will be made available to the Contractor upon request. Note that review responsibilities may be modified upon receipt of submittals from the Contractor pending submittal content. The Owner will determine if changes to review responsibilities are required as the Contractor provides the required submittals.

The Contractor will provide submittals directly to the Owner for review. The Owner will, in turn, provide feedback (e.g., comments, questions, or revisions) on the submittal back to the Contractor.

3.2.1 Pre-Construction Documentation

Pre-construction submittals required of the Contractor are listed in this section. The Contractor will submit all pre-construction submittals to the Owner within 10 days of the notice-of-award. Additional details on submittal content and dates of submittal are included in the Technical Specifications. The following are the required Contractor pre-construction submittals:

- Construction Work Plan, including construction schedule
- Health and Safety Plan
- CQC Plan
- Environmental Protection Plan

The content and structure of these reports are outline in the Technical Specifications.

3.2.2 Construction Documentation

The Owner will maintain a DAR and complete a monthly progress report. The contents of the DAR and monthly progress report are described in this section. The records described in this section will be maintained electronically.

3.2.2.1 Daily Activity Reporting

During construction activities, the Contractor, as a part of their overall CQC program, and the Owner, as a part of CQA, will each prepare and submit a DAR summarizing daily activities, as well as QA/QC processes occurring on site. The Contractor will submit each DAR at the start of business on the next day, and the Owner will complete a DAR supported by the Contractor's DAR this same day. The Owner will be responsible for electronic storage and management of the original DARs.

The DAR will contain, at a minimum, the following information:

- Weather conditions
- Date and period covered by report, including hours worked
- Documentation of daily health and safety briefings
- Summary of daily activities and Work progress
- Description of activities as identified by location

- Results of any QC inspections, tests, or monitoring activities
- Documents received from the Contractor, such as survey results, weigh tickets, laboratory data received, inspection reports, and written communications from members of the project team
- A daily activity log to record observations, measurements, inspections completed, data received, communications with other members of the project team, additional environmental controls that were implemented, problems encountered, and resolutions
- Any photographs deemed to be important for illustrating the Work conducted

Additional specific requirements of the DARs are identified and discussed in the Technical Specifications.

3.2.2.2 Construction Quality Assurance Forms

CQA forms are to be prepared and signed by the Owner and are to be legible and complete. CQA forms should be attached to the DAR. Examples of CQA forms include the following:

- Chain-of-custody forms
- Test request forms
- Sample logs
- Compaction test results
- Grain size test results
- Field density test results
- GCL logs
- Soil subgrade material acceptance forms

3.2.2.3 Monthly Progress Report

The Owner, with input from the Contractor, will prepare monthly progress summaries when construction is actively in progress. The monthly progress report will be submitted to Ecology. These summaries will facilitate the preparation of the As-Built Report (Section 3.2.3) and review of the Contractor's monthly payment requests. The monthly summary will identify progress organized by the following activities:

- Installation and maintenance of temporary controls and facilities
  - Temporary facilities installed (supported by Contractor's DARs)
  - Changes or improvements to temporary access and staging facilities
  - Installation and maintenance of temporary erosion and sediment control (TESC) best management practices (BMPs)
  - Observations and monitoring of performance for TESC BMPs
  - Installation and maintenance of temporary water control facilities to manage remediation water
  - Problems encountered while operating temporary water control facilities

  - Compliance with permit requirements for managing remediation water
  - Deviations from project design documents
- Excavation, consolidation, and backfilling
  - Area worked (supported by Contractor's DARs)
  - Material removed, placed, or backfilled (supported by Contractor's DARs)
  - Weight and volume of material consolidated on site or placed in excavated SUs
  - Compaction results
  - Surveys completed (supported by Contractor's DARs)
  - Problems encountered and corrective actions implemented
  - Deviations from project design documents
  - Import material testing results for reactive and non-reactive backfill
  - Verification of reactive backfill mixing
- Cap placement
  - Import material testing results
  - Area worked (supported by Contractor's DARs)
  - Surveys completed (supported by Contractor's DARs)
  - Problems encountered and corrective actions implemented
  - Deviations from project design documents
- PRB installation
  - Import material testing results
  - Verification of PRB media mixing
  - Problems encountered and corrective actions implemented
  - Deviations from project design documents
- Installation of permanent stormwater control facilities
  - Facilities installed (supported by Contractor's DARs)
  - Operational status of pumping and conveyance facilities
  - Material removed, placed, or backfilled (supported by Contractor's DARs)
  - Compaction results
  - Surveys completed to support installation of stormwater control facilities (supported by Contractor's DARs)
  - Results of pressure testing, tightness testing, pump testing, and other testing done to verify that stormwater facilities have been installed
  - Problems encountered and corrective actions implemented
  - Deviations from project design documents

3.2.2.4 Documentation and Control of Non-conformance

As soon as is practicably possible, the Owner will notify the Contractor of any non-conformance in the Work product, including but not limited to grades, alignment, materials, GCL panel layout,

overlap and seaming with bentonite, or documentation. The extent of the non-conformance will be identified through observations, sampling, testing, review of records, or other appropriate means. The noted non-conformance will be documented in writing by providing a summary of the non-conformance as part of the DAR. The Owner will notify the Contractor of the non-conformance through a direct line of communication, such as in-writing, verbally, or via email. Non-conformance notifications will be stored and tracked electronically by the Owner.

The non-conformance will be corrected as quickly as is practicable. Corrective actions for simple or routine non-conformances are addressed in the Technical Specifications. Corrective actions for complex or non-routine non-conformances, or for non-conformances not addressed in the Technical Specifications, will require the Owner's approval.

The status of non-conformances and corrective actions will be revisited and discussed during the weekly progress meetings to ensure issues are being handled in an expeditious and efficient manner.

3.2.2.5 Photographs and Multimedia Documentation

The Owner and the Contractor are to take photographs of selected areas of the Work to document procedures, techniques, Work progress, non-conformance, conformance, permit compliance, and completion of Work elements. Video or audio recordings may be used to supplement the photographic documentation.

Video and audio recordings may also be taken to document Work progress. Copies of multimedia recordings are to be provided to the Owner on a regular basis. All photographs, videos, and audio recordings will be stored in a systematic archive.

3.2.3 Post-Construction Documentation

When construction activities are complete, the Owner's Engineer responsible for the oversight of construction will prepare a report documenting all aspects of facility construction, including the Contractor's as-built drawings. The Owner will submit a Completion Report to Ecology, as required per the CD. The Completion Report will contain the following information:

- An opinion from the Owner's Engineer (who is a Washington-registered Professional Engineer) as to whether the cleanup action has been constructed in substantial compliance with the Drawings, Technical Specifications, and related documents
- A full description of all Work, including testing results and inspections
- As-built drawings

4 Quality Assurance Program

For each construction element, inspection and verification activities and QA measures will be implemented to verify performance objectives have been met. The intent of construction oversight and conducting QA monitoring is to confirm that the cleanup action has attained cleanup standards and met objectives. This level of performance monitoring is conducted through QA monitoring to determine that required grades have been met in excavations and backfill and capping and through visual inspection of construction, including inspection of excavations to verify removal of waste.

During the remedial action, the QA process will progress as follows:

- The Contractor will provide QC documentation to demonstrate that specific components of the final design have been properly implemented. The Owner will perform QA review of this documentation and supplemental testing and inspections to verify the Contractor's Work meets the Technical Specifications.
- The Contractor and Owner will coordinate and conduct inspection and verification activities (i.e., sampling, testing, and monitoring) to verify compliance with the approved design documents and that performance objectives and criteria have been met.

CQA activities are organized into the following project elements:

- Earthwork
- Settlement monitoring
- Performance monitoring
- Low permeability cap installation
- PRB installation
- Stormwater infrastructure
- Erosion control stabilization
- Site restoration and cleaning

4.1 Earthwork

The cleanup action includes excavation and on-site consolidation of impacted materials from five SUs (SU2, SU3, SU5, SU8, and SU10). Excavation is assumed to be conducted using typical dry excavation methods because remedial excavations are limited to depths above or immediately below the groundwater table at the time of construction. All excavations are expected to terminate within 1 to 2 feet of the locally observed dry weather groundwater table elevation. In most cases this will be sufficient to remove the extents of contamination, except for SU3 where waste is present below the expected groundwater elevation during the dry season. Three SUs (SU1, SU6, and SU7) will serve as consolidation landfills. These landfills are currently covered with topsoil and vegetation. The CQA activities include the following:

- Verification of clearing and grubbing

- Verification of excavation
- Verification of ground improvements under berms for East Landfill No. 1
- Verification of retaining berm construction
- Verification of waste consolidation
- Verification of import material quality
- Verification of backfill handling, placement, and compaction
- Verification of reactive backfill material

CQA activities described in Sections 4.1.1 through 4.1.8 will be implemented during the cleanup to verify performance objectives are met or items related to earthwork is completed according to the Drawings and Technical Specifications. Inspection and verification activities will be implemented and compared to criteria to determine if performance objectives have been achieved. Inspections and verification activities will be documented in the DARs.

4.1.1 Verification of Clearing and Grubbing

The following CQA activities will be conducted by the Owner to verify that clearing and grubbing has been conducted in accordance with project design documents:

- Verify that the limits of clearing are properly staked and that staking does not damage existing permanent site elements.
- Verify that existing vegetation designated to remain, including shrubs and trees, are clearly marked and are protected against damage during construction.
- Verify that clearing and grubbing is complete.
- For non-native vegetation (e.g., Himalayan blackberry), except for grass or turf, verify that vegetation and roots are removed to a depth of 2 to 4 inches below the existing ground surface and topsoil is segregated from vegetative matter.
- Verify that vegetation and grubbed material are placed in designated stockpile or disposal locations and that larger vegetation (i.e., shrubs and trees) have been sufficiently broken down into smaller chips for composting purposes.
- Verify that materials generated from clearing and grubbing do not include or contain any underlying waste.

4.1.2 Verification of Excavation

The following CQA activities will be conducted by the Owner to verify that excavation has been conducted in accordance with project design documents:

- Verify that excavation areas are properly staked and identified.
- Observe excavation activities at SU2, SU3, SU8, and SU10 and visually identify waste.
- Verify to the extent practicable that on-site groundwater elevations are sufficient for waste removal to known bottom elevations.

- For waste that extends below the observed groundwater elevation at the time of excavation, the Contractor will be required to remove wastes to a depth of up to 2 feet below the observed groundwater elevation. In these areas, direct the Contractor to perform test excavations at a frequency of one per 0.25 acre.
- Verify that specified slope requirements are met.

4.1.3 Verification of the Ground Improvements under Berms for East Landfill No. 1

Ground improvements are necessary to improve subsurface conditions under the berms associated with East Landfill No. 1 to strengthen soil conditions and reduce the potential for failure once berms are constructed over exiting soil. The following CQA activities will be performed to verify that the retaining berms meet the Technical Specifications:

- Verify that the locations of ground improvements are properly staked and identified.
- Observe ground improvement installation to verify methods are properly conducted and that depths and widths of the improved ground areas meet design requirements.
- Collect QA in situ grab samples at a rate of 10% of the total panels of the soil/grout mix after placement of the grout. The Contractor will also be collecting grab samples, and these samples are intended to be QA samples to verify the Contractor's results. Send to the laboratory to verify proper strength of mixture after partial curing (3- and 7-day test durations) to extrapolate full cure strength.
- Verify that roads and other access improvements to install the ground improvements have been removed and areas outside of the footprint of the landfill have been restored.

4.1.4 Verification of Retaining Berm Construction

The long-term stability of the on-site landfills is dependent on the strength of the materials that retain the respective waste deposit. The following is required for each landfill:

- **West Landfill.** Consolidation and compaction of existing waste within the limits shown on the Drawings
- **East Landfill No. 1.** Construction of a new retaining berm around the entire perimeter of the landfill
- **East Landfill No. 2.** Regrading and enhancement of the existing retaining berm around the entire perimeter of the landfill

The following CQA activities will be performed to verify that the retaining berms meet the Technical Specifications:

- Visually verify imported material is free of debris and is uniform.

- Verify the imported material for East Landfill No. 1 meets the gradation requirements and matches information provided on the supplier's forms.
- Verify final grading has been completed to the required tolerances through visual observation of placement and review of Contractor-provided progress surveys as layers are completed.
- Verify that the final ground surface is free of significant pits, ridges, depressions, or other topographic features through visual means and review of Contractor-provided progress surveys.
- Verify slope grade through visual observation of placement and review of Contractor-provided progress surveys.
- Verify proper compaction through compaction testing with a nuclear densometer gauge at the frequency established in Table O1.

Table O1
Earthwork Sampling and Testing Frequency

Material Category and Tests	Frequency (minimum)
Existing On-Site Material for Excavation/Consolidation	
Visual verification of compaction methods and consistency via hand-held soil t-probe	Ongoing during placement and at the discretion of the Owner
Select/General Backfill	
In-Place Density and Moisture, Nuclear Method (Method ASTM D6938)	1 per 5,000 cubic yards in various lifts (above groundwater elevation only)
Soil Subgrade Material	
In-Place Density and Moisture, Nuclear Method (Method ASTM D6938)	1 per 100,000 square feet
Gravel Surface Material	
In-Place Density and Moisture Content, Nuclear Method (Method ASTM D6938)	3 per 100,000 square feet
Berm and Anchor Trenches	
In-Place Density and Moisture Content, Nuclear Method (Method ASTM D6938)	1 per 500 linear feet in various lifts

4.1.5 Verification of Waste Consolidation in Landfills

The following CQA activities will be conducted by the Owner to verify that waste consolidation, placement, and compaction have been conducted in accordance with project design documents:

- Verify that waste and soils excavated from SU2, SU3, SU5, SU8, and SU10 are placed into their corresponding consolidation landfills.
- Observe stockpiling of waste into the consolidation landfills.
- Observe spreading and verify compaction of waste as per Table O1.

- Verify that materials unsuitable for consolidation in the landfills (e.g., rebar or concrete within the upper foot of fill) is properly separated and stockpiled for appropriate off-site disposal.
- Verify that waste is placed to the grades and elevations are specified.
- Verify that interim (seasonal) and final grading has been completed to the required grades and tolerances through visual observation of placement and review of Contractor-provided progress surveys.
- In locations where the GCL is placed over compacted waste or imported soil subgrade, the following requirements also apply:
  - Verify that the final surface (either soil subgrade or waste material) has been compacted with a smooth-drum roller to form a firm, stable base.
  - Verify that the final ground surface is free of pits, ridges, depressions, or other topographic features involving more than 1 inch of relief over a 1-foot distance.
  - Verify that no soil particles greater than specified limits are exposed on the finished surface (i.e., greater than 1/2-inch-diameter protrusions).
  - Obtain the liner installer's acceptance of the subgrade in writing.

4.1.6 Verification of Import Material Quality

The following CQA activities will be conducted by the Owner to verify that import material quality is in accordance with project design documents:

- Review material submittals and pre-construction testing results.
- Inspect stockpile locations, if required, for suitability and installation of erosion control measures.
- Perform compaction testing of material during installation at the frequencies established in Table O1.

The Contractor will identify proposed sources of material and submit test results to demonstrate that the proposed materials meet the Technical Specifications. Definitions and requirements for the materials are presented in the Technical Specifications. Material submittals will be reviewed by the Owner and will be either accepted or rejected.

Representative samples of materials will be provided to the Owner by the Contractor. The samples will be submitted to a qualified laboratory for testing in accordance with applicable ASTM International (ASTM) standards.

4.1.6.1 Test Frequency

In general, the Contractor will be responsible for sampling and providing information regarding import material particle size/soil classification, moisture density relationship, and any additional source material tests for submittal acceptance by the Owner before importing. These requirements

are described in the Technical Specifications. In situ material tests, such as in-place density and moisture testing, will be conducted by the Owner at the frequency specified in Table O1, unless otherwise divided between the Owner and the Contractor as described in the Technical Specifications. Additional testing may be conducted whenever required, based on the judgment of the Owner, to demonstrate that the Work or materials meet the Technical Specifications, material has not been damaged after successfully passing previous tests, or whenever additional data are needed for appropriate engineering evaluation.

4.1.6.2 Test Numbering

The Owner will establish a system of unique numbers to identify material samples and field test locations and will maintain a log or tracking spreadsheet of sample and test numbers. Failing samples that are to be retested are to be assigned the original sample number with a letter suffix. The log or tracking spreadsheet is to include the sample number, the date sampled, the tests to be performed, the name of the person who collected the sample, and the location of the sample. If the tests are performed at the site, the log or tracking spreadsheet is to include the date the tests were performed, the name of the person who performed the tests, and the test results. If the tests are performed off site, the log or tracking spreadsheet is to include the date the sample was shipped off site, the name of the laboratory, the test results, and the date the test results were received.

4.1.7 Verification of Backfill Handling, Placement, and Compaction in SU Excavations

The following CQA activities will be conducted by the Owner to verify that waste consolidation, placement, and compaction have been conducted in accordance with project design documents:

- Verify that reactive backfill material (Section 4.1.8 discusses additional QA activities) is placed below the seasonal high groundwater level in SU2 and SU3, backfilled and compacted with select fill above the seasonal high groundwater level, and finished with a crushed gravel surface.
- Verify that in each of the three pre-existing SU4 ditches, reactive backfill is placed from the bottom of the ditch to the seasonal high groundwater level, followed by compacted select fill, and finished with a crushed gravel surface.
- Verify that in the pre-existing ditch within SU5, reactive backfill is placed from the bottom of the ditch or excavation to the seasonal high groundwater level, followed by compacted select fill, and finished with a crushed gravel surface.
- Verify that the subgrade is compacted to meet the requirements of the Technical Specifications as determined by the standard Proctor method (ASTM D1557) and that in-place compaction density requirements have been met as per Table O1.
- Verify that final grading has been completed to the required grades and tolerances through visual observation of placement and review of Contractor-provided progress surveys.

4.1.8 Verification of Reactive Backfill Material Composition

Reactive backfill is a mixture of activated alumina and select backfill. The following CQA activities will be conducted by the Owner to verify that reactive backfill material is handled in accordance with project design documents:

- Record the batch and lot numbers for the delivered activated alumina. Ten percent of each received load (each load is 20 supersacks, so 2 supersacks) will be verified against the manufacturer's specification (Attachment O1).
- Sample all imported aggregate material at the source and test for compliance with physical design requirements prior to acceptance for use by the Contractor. Verify that proper documentation has been provided in advance of material being imported to the site.
- Review the Contractor's daily QC reports documenting the mass mixing of the reactive backfill.
- Verify that the Contractor is meeting mixing requirements for reactive material and aggregate material as outlined in the Technical Specifications. Observe mixing operations.
- Visually inspect the blended reactive backfill material to verify that it is free of detritus and the material is uniform.

4.2 Settlement Monitoring and Year 2 Grading

The following CQA activities will be conducted by the Owner to determine settlement that occurs between construction seasons and, if needed, provide updated design input to the Contractor, in accordance with project design documents:

- At or immediately prior to the start of Construction Season 2, conduct a survey of East Landfill No. 1 and East Landfill No. 2. Compare the survey results with the previous surveyed elevations and the model-predicted settlement in Appendix B of the Final EDR. Based on the review, adjust the final cover grading plans shown on the Drawings.
- Verify that Year 2 grading conforms to the required grades and elevations and that the final ground surface is free of pits, ridges, depressions, or other topographic features involving more than 4 inches of relief over a 1-foot distance. The minimum grade must be 2%.
- Verify that the subgrade is compacted to meet the requirements of the Technical Specifications as determined by the standard Proctor method (ASTM D1557) and that in-place density requirements have been met.
- Verify that no soil particles greater than specified limits are exposed on the finished surface.
- Verify that an as-built survey of the soil subgrade material is performed.
- Obtain the liner installer's acceptance of the subgrade in writing.

4.3 Waste Management

This section describes the waste management procedures for solid waste generated from excavation that is not suitable for consolidation in the on-site landfills and must be disposed of off site. Characterization of waste will be required for any solid wastes that will be taken off site for disposal. Potential solid wastes that may require off-site disposal include but are not limited to scrap metals, concrete, and organics material from clearing and grubbing.

The Owner will manage solid wastes for offsite disposal and will maintain recordkeeping requirements, including hazardous and non-hazardous waste characterizations, waste profiles, and waste manifests in accordance with Ecology's Dangerous Waste regulations.

The Contractor will manage decontamination water as specified in the Technical Specifications. The Owner will be responsible for the following:

- Verify the frequency of testing per volume of decontamination water and its conformance with the requirements of the Technical Specifications.
- Verify that once tested, decontamination water is delivered to the appropriate on-site treatment facility.
- Observe and track the rate at which decontamination water is delivered to on-site treatment facilities and that it does not overload the capacity of the treatment system(s).

4.4 Low Permeability Cap Installation

This section summarizes the CQA activities that will be performed to verify that low permeability cap installation meets the Technical Specification requirements. The CQA activities include the following:

- Verification of import material quality
- Verification of material handling, placement, and compaction of aggregate layers
- Verification of GCL delivery
- Verification of GCL placement
- Verification of drainage layer
- Verification of geotextile

Refer to Section 4.1 for earthwork-related CQA activities associated with the soil subgrade material, which underlies the low permeability cap.

4.4.1 Verification of Import Material Quality

The following CQA activities will be conducted by the Owner to verify that import material quality is in accordance with project design documents:

- Review material submittals and pre-construction testing results to determine that import material meets the Technical Specification requirements.

- For GCL, obtain conformance test samples at the place of manufacture and arrange for testing at a third-party laboratory prior to shipment to verify that the material hydraulic conductivity meets the project's Technical Specifications.
- For GCL, review the manufacturer's installation manual and installer's QC manual to verify the Contractor's installation methods meet the manufacturer's recommendations.
- Perform sampling and physical testing of material during installation at the frequencies established in Table O1 to verify material quality in situ.

The Contractor will identify proposed sources of material and submit test results to demonstrate that the proposed materials meet the Technical Specifications. Definitions and requirements for the materials are presented in the Technical Specifications. Material submittals will be reviewed by the Owner and will be either accepted or rejected.

Representative samples of materials will be provided to the Owner by the Contractor. The samples will be submitted to a qualified laboratory for testing in accordance with applicable ASTM standards.

4.4.2 Verification of Material Handling, Placement, and Compaction of Aggregate Layers

The following CQA activities will be conducted by the Owner to verify that material handling, placement, and compaction of aggregate layers is in accordance with project design documents:

- Establish stockpile location(s) if required.
- Verify that final grading has been completed to the required tolerances and smooth-drum rolled.
- Verify that the final waste consolidation surface or soil subgrade has been smooth-rolled and is free of debris, pits, ridges, depressions, or other topographic features involving more than 1 inch of relief over a 1-foot distance.
- Verify placement of soil subgrade and topsoil thicknesses are within specified tolerances through visual observation of placement and review of Contractor-provided progress surveys.
- Verify that no protrusions greater than specified limits (1/2 inch) are exposed on the finished surface beneath the GCL.
- Verify by visual inspection that the cap is free of surficial debris.
- Obtain the liner installer's acceptance of the subgrade in writing.

4.4.3 Verification of GCL Delivery

The following CQA activities will be conducted by the Owner to verify that the GCL is in accordance with project design documents:

- Review documentation and certifications provided by the manufacturer.
- Compare the shipment to the packing list and manufacturer's QC documentation.

- Verify that the GCL is free from damage at the time of delivery, including the packaging. If the packaging has been damaged, exposing more than 10% of the GCL, and a significant precipitation event (greater than 0.5 inch over 24 hours) has occurred, inspect the GCL. As an initial measure of relative hydration, if a person's hand- or footprint remains marked on a panel of GCL that has been deployed, hydration should be suspected. If hydration is suspected, obtain a sample of the bentonite within the GCL and analyze for moisture content using ASTM D2216 or D4643. If the moisture content is less than 50% higher than the delivered moisture content of the product and the outer geotextile remains intact/unstretched, the GCL can be used. Verify that any areas that do not meet these criteria are marked and not installed.
- Record the date received and the roll number, size, lot number, and manufacturer.
- Verify the Contractor has a dry storage location for the GCL.
- Verify that the GCL is stored in accordance with the manufacturer's recommendations, protected from the weather, and stacked no greater than three rolls high.

4.4.4 Verification of GCL Placement

The following CQA activities will be conducted by the Owner to verify that GCL placement has been conducted in accordance with project design documents:

- Verify that the slopes of the landfills conform to the grades required.
- Review the panel layout submittal.
- Verify that any construction stakes, survey hubs, debris, rocks, or other objects have been removed from the subgrade area, and verify that the soil subgrade material is not saturated or desiccated. The surface upon which the GCL will be installed shall be suitably prepared to not damage the GCL.
- Verify that the quality of the subgrade meets requirements, and acquire documented acceptance of the subgrade by the installer.
- Verify that the GCL has not been damaged.
- Verify that the weather is suitable for placement and that the GCL has not become prematurely hydrated prior to being installed.
- If a significant precipitation event occurs prior to covering the GCL, premature hydration should be evaluated. As an initial measure of relative hydration, if a person's footprint remains marked on a panel of GCL that had been deployed, hydration should be suspected. If hydration is suspected, obtain a sample of the bentonite within the GCL and analyze for moisture content using ASTM D2216 or D4643. Collect one sample per 100 square feet. If the moisture content is less than 50% higher than the delivered moisture content of the product and the outer geotextile remains intact/unstretched, the GCL can be covered and remain in place. Verify that any areas that do not meet these criteria are removed and replaced.

- Observe panel placement and verify that the GCL is not damaged by handling, wrinkles are minimized, and panels are anchored as needed to prevent wind damage.
- Verify that the GCL is not dragged over the surface, except for slight adjustments for obtaining correct overlap of panels.
- Observe Work activities, verify that staff working on the GCL or operating equipment on the GCL protect the GCL from damage, and record weather conditions.
- Verify that only the GCL panels that can be seamed and covered that day are deployed.
- Observe that the GCL is installed in general conformance with ASTM D6102 and with the manufacturer's recommendations.
- Record the daily location of panel placement, dimensions, roll numbers associated with each panel, seam numbers, and repair locations.
- Maintain a summary of the GCL panel layout drawing showing panel placement progress.
- Verify that panels have been overlapped the required amount for each seam.
- Verify that the required amount of bentonite has been applied to each seam.
- Record defects and repair of defects.
- Verify that repairs have been completed in accordance with the manufacturer's instructions as required.
- Verify that all GCL placed has been covered each day and is not left exposed.

4.4.5 Verification of Drainage Layer

The following CQA activities will be conducted by the Owner to verify that the drainage layer quality is in accordance with project design documents:

- Verify by visual inspection that the drainage layer is free of surficial debris.
- Verify that the gradation and material quality requirements of the drainage layer are fulfilled according to the Technical Specifications.
- Observe Work activities and verify that the Contractor working on drainage layer material or operating equipment on the drainage layer material protect the underlying material from damage, including the following:
  - There is sufficient material thickness to support vehicle operation.
  - Vehicle operations take care to avoid damage to underlaying material through sudden maneuvering, accelerating, and decelerating.
  - Material is placed and graded upslope. No material should be pushed downslope.
- Verify that the final ground surface is free of significant pits, ridges, depressions, or other topographic features through visual inspection.

4.4.6 Verification of Geotextile

The following CQA activities will be conducted by the Owner to verify that geotextile is in accordance with project design documents:

- Establish a storage location for the geotextile filter.
- Verify that the geotextile filter is free from damage at the time of delivery.
- Review documentation and certifications provided by the manufacturer.
- Record the date received and the roll number, size, lot number, and manufacturer.
- Observe geotextile filter placement and verify that the geotextile filter is not damaged by handling and panels are anchored as required.
- Observe Work activities and verify that staff working on the geotextile or operating equipment on the geotextile protect the underlying material from damage.
- Verify that geotextile filter defects are repaired as required.
- Verify that the panels are joined as required.

4.5 PRB Installation

One element of the project remedial action is groundwater treatment through the construction of a segmented PRB. These PRBs will be installed north and west of the Closed Black Mud Pond to intercept groundwater prior to reaching the CDID ditch. The PRBs will be backfilled (from bottom to top) with PRB media, geotextile, general fill, and topsoil. This section describes the CQA procedures for the PRB installation activities.

The Owner will monitor installation of the PRBs to verify the performance objectives. The CQA activities include the following:

- Verification of import material
- Verification of PRB installation

QA measures described in Sections 4.5.1 and 4.5.2 will be implemented during the cleanup to verify performance objectives are met and construction is completed according to the Drawings and Technical Specifications. Inspection and verification activities will be implemented and compared to criteria to determine if performance objectives have been achieved.

4.5.1 Verification of PRB Material Composition

The following CQA activities will be conducted by the Owner to verify that the material for the PRB is in accordance with project design documents:

- Record the batch and lot numbers for the delivered activated alumina. Ten percent of each received load (each load is 20 supersacks, so 2 supersacks) will be verified against the manufacturer's specification (Attachment O1).

- Review the Contractor's daily QC reports documenting the mass mixing of the reactive backfill.
- Verify that the Contractor has sampled PRB materials at the frequency required by the Technical Specifications to verify the material's quality.
- Verify that the Contractor is meeting mixing requirements for reactive material and aggregate material as outlined in the Technical Specifications.
- Visually inspect the blended reactive material to verify that it is free of detritus and the material is uniform.
- Sample all imported aggregate material at the source and test for compliance with physical design requirements prior to acceptance for use by the Contractor. Verify that proper documentation has been provided in advance of material being imported to the site.
- Collect one sample for every 150 cubic yards of blended reactive media for chemical analysis and sieve analysis to verify that the material meets the Technical Specifications. Test per the standard operating procedure (Attachment O2) to verify the percentage of total alumina in the blended reactive media.
- Perform three rounds of testing of the blended reactive media, as per Attachment O2, during the initial 100 linear feet of PRB installation. The Contractor will be required to slow down production rates to accommodate this testing. Communicate the results of the testing in real time to the Contractor, who will be required to adjust the ratios of blended reactive media accordingly to achieve the required ratio of activated alumina.
- Record the manufacturer's batch and lot number for geosynthetic material. Check the storage and handling of geotextile material to verify that the material is not damaged prior to installation. Prior to installation of geotextile material, inspect the subgrade surface for smooth and uniform surface. Check all installation of geotextile material to verify compliance with design requirements.

4.5.2 Verification of PRB installation

The following CQA activities will be conducted by the Owner to verify that the PRB has been installed in accordance with project design documents:

- Verify that the PRBs have been installed to the depths shown on the Drawings.
- Track weights of individual materials placed within the PRB alignment against the estimated total volume of PRB constructed. Discuss results with Contractor daily to determine if adjustments to the mixing ratio are necessary to achieve the required in situ mass of activated alumina.
- Verify the PRB thickness by tracking the backfill quantity and linear length of PRB installed.
- Survey the thickness and final elevations of each layer of earthen material above the PRB to verify that that design elevations have been reached.

4.6 Stormwater Infrastructure

This section describes the CQA procedures for installation of ditches, storm drains, stormwater structures, pump stations, and stormwater force main pipeline to complete the following elements of the project:

- Installation of temporary water control systems to manage remediation water during construction, including sumps, pumps, and pipes
- Reconfiguration of drainage ditches and construction of storm drains, manholes, and other appurtenances needed to convey stormwater runoff from the West Landfill and East Landfills to pumping facilities
- Construction of pump stations for both the West Landfill and East Landfills
- Construction of force mains to convey pumped water from the West Landfill Pump Station and the East Landfill Pump Station to Facility 77

4.6.1 Monitoring

The Owner will conduct the following monitoring of the components identified:

- Delivery
  - Verify that pipe, manholes, valves, and other materials and equipment are free from damage at the time of delivery.
  - Establish a storage location for pipe, manholes, valves, and other equipment.
  - Review documentation and certifications provided by the manufacturer.
  - Record the date received and the lot number and manufacturer.
- Pipe installation
  - Verify that pipe trenches are excavated and backfilled as required.
  - Verify placement and compaction of backfill materials.
  - Verify that pipe is installed along the alignments and at the slopes required.
  - Verify that pipes are of the required sizes.
  - Verify that energy dissipators are fabricated and installed as required.
  - Verify that the GCL, geomembrane, and any site utilities are not damaged during the installation of storm drains, manholes, pumping facilities, force mains, and other stormwater control facilities.
  - Verify that the interiors of the installed culverts and energy dissipators are free of rocks, soil, debris, or other material that may block surface water flow.
  - Complete air tightness testing for gravity storm drains and pressure testing for force mains as required.
- Pump systems
  - Verify the concrete materials meet the material requirements in the Technical Specifications.

- Verify that structure excavations are completed and that backfill is placed as required.
- Verify placement and compaction of backfill materials.
- Verify that cast-in-place concrete structures are formed, reinforced, and constructed, finished, and cured as required.
- Verify that pre-cast concrete structures are undamaged and meet the material requirements of the Technical Specifications.
- Verify that structures are installed plumb and at the elevations and to the dimensions shown on the Drawings.
- Verify that penetrations are properly sealed.
- Verify that pumps, valves, and other equipment are installed plumb and are adequately supported by rails, stands, or other equipment as required.
- Verify that electrical improvements are installed to meet the required codes.
- Complete pump testing to ensure that pumps deliver the specified capacity and respond to pump controls.

4.6.2 Verification of Material Quality

The Contractor will identify proposed sources of pipe, manholes and other pre-cast concrete structures, cast-in-place concrete, valves, and other materials and submit test results to demonstrate that the proposed materials meet the Technical Specifications. Definitions and requirements for the materials are presented in the Technical Specifications. Material submittals will be reviewed by the Owner and will be either accepted or rejected.

4.7 Erosion Control Stabilization

The following CQA activities will be conducted by the Owner to verify the installation and maintenance of temporary erosion, sediment, and pollution controls at the work site. The CQA activities include the following:

- Verification of erosion and sediment controls
- Verification of stockpile covers

4.7.1 Verification of Erosion and Sediment Controls

The following CQA activities will be conducted by the Owner to verify that TESC BMPs have been installed in accordance with project design documents:

- Verify that silt fence material, straw wattles, and other erosion or pollution controls are free from damage at the time of delivery.
- Review documentation and certifications provided by the manufacturer.

- Verify that TESC BMPs have been implemented in accordance with the requirements and procedures outlined in the Drawings, Technical Specifications, state standards or guidelines for TESC BMPs, and all regulatory authorities having jurisdiction.
- Verify that the TESC BMPs are implemented and maintained to the satisfaction of the Owner at all times.
- Verify that a Certified Erosion and Sediment Control Lead (CESCL) representative of the Contractor inspects all TESC BMPs on a daily basis or weekly when construction activities are not actively occurring.
- Verify that the Contractor maintains adequate controls and procedures for spill pollution prevention and containment during construction, including verifying spill kits are present and well stocked.
- Verify that all erosion controls remain in place and are sufficient to maintain long-term stabilization of the site between construction seasons.

4.7.2 Verification of Stockpile Covers

The following CQA activities will be conducted by the Owner to verify that stockpiles have been covered in accordance with project design documents:

- Verify that standing stockpiles of material are properly covered and contained with linear erosion controls to prevent sediment-laden runoff from being generated.
- Verify that the Contractor has implemented interim covers appropriately for stabilization and winterization of East Landfill No. 1 and East Landfill No. 2 between construction seasons.

Specific requirements for TESC BMPs and spill prevention and control will be outlined in the Contractor's Environmental Protection Plan.

4.8 Site Restoration and Cleaning

This section describes the CQA procedures for surface and slope treatments to complete the following elements of the project:

- Verification of material delivery and storage
- Verification of material quality
- Verification of slope treatments
- Verification of hydroseeding
- Verification of site cleanup

Sections 4.8.1 through 4.8.5 describe the monitoring to be performed for the components identified.

4.8.1 Verification of Material Delivery and Storage

The following CQA activities will be conducted by the Owner to verify that material storage is in accordance with project design documents:

- Verify that hydroseeding material, stabilization materials, and stone are free from damage at the time of delivery.
- Establish a storage location for materials and products as required.
- Review documentation and certifications provided by the manufacturer.
- Record the date received, lot number, and manufacturer for each product.

4.8.2 Verification of Material Quality

The Contractor will identify proposed sources of materials and products and will submit test results or certifications to demonstrate that the proposed materials meet Technical Specifications. Definitions and requirements for the materials are presented in the Technical Specifications. Material submittals will be reviewed by the Owner and will be either accepted or rejected.

4.8.3 Verification of Slope Treatments

The following CQA activities will be conducted by the Owner to verify that slope treatment is in accordance with project design documents:

- Verify that erosion control blankets are installed in the locations required.
- Verify that erosion control blankets are installed in good contact with the ground surface and are anchored as required.
- Verify that splices are made as required.
- Verify that the placement of slope treatments for stabilization does not create pits, ridges, depressions, or other topographic features.
- Verify that the placement of slope treatments have full coverage over areas of placement and are applied uniformly.

4.8.4 Verification of Hydroseeding

The following CQA activities will be conducted by the Owner to verify that hydroseeding placement is in accordance with project design documents:

- Verify the dates on which hydroseeding occurs.
- Record the weather conditions at the time of hydroseeding.
- Verify that the appropriate seed mix is applied as required and that the seed mix meets the requirements of applicable permitting agencies.
- Verify that hydroseed and related materials are applied uniformly to disturbed areas.
- Verify that hydroseeded areas are maintained.

4.8.5 Verification of Site Restoration

The following CQA activities will be conducted by the Owner to verify that site restoration is in accordance with project design documents:

- Verify that all stockpiles have been removed.
- Verify that all trash, debris, and other construction-generated wastes are removed from the site.
- Verify that the site is stabilized and that any erosion or sediment controls that are necessary to maintain site stabilization remain in place.
- Verify that roads used for construction have been swept and normal traffic conditions can resume on site.
- Verify that any and all temporary facilities have been removed.

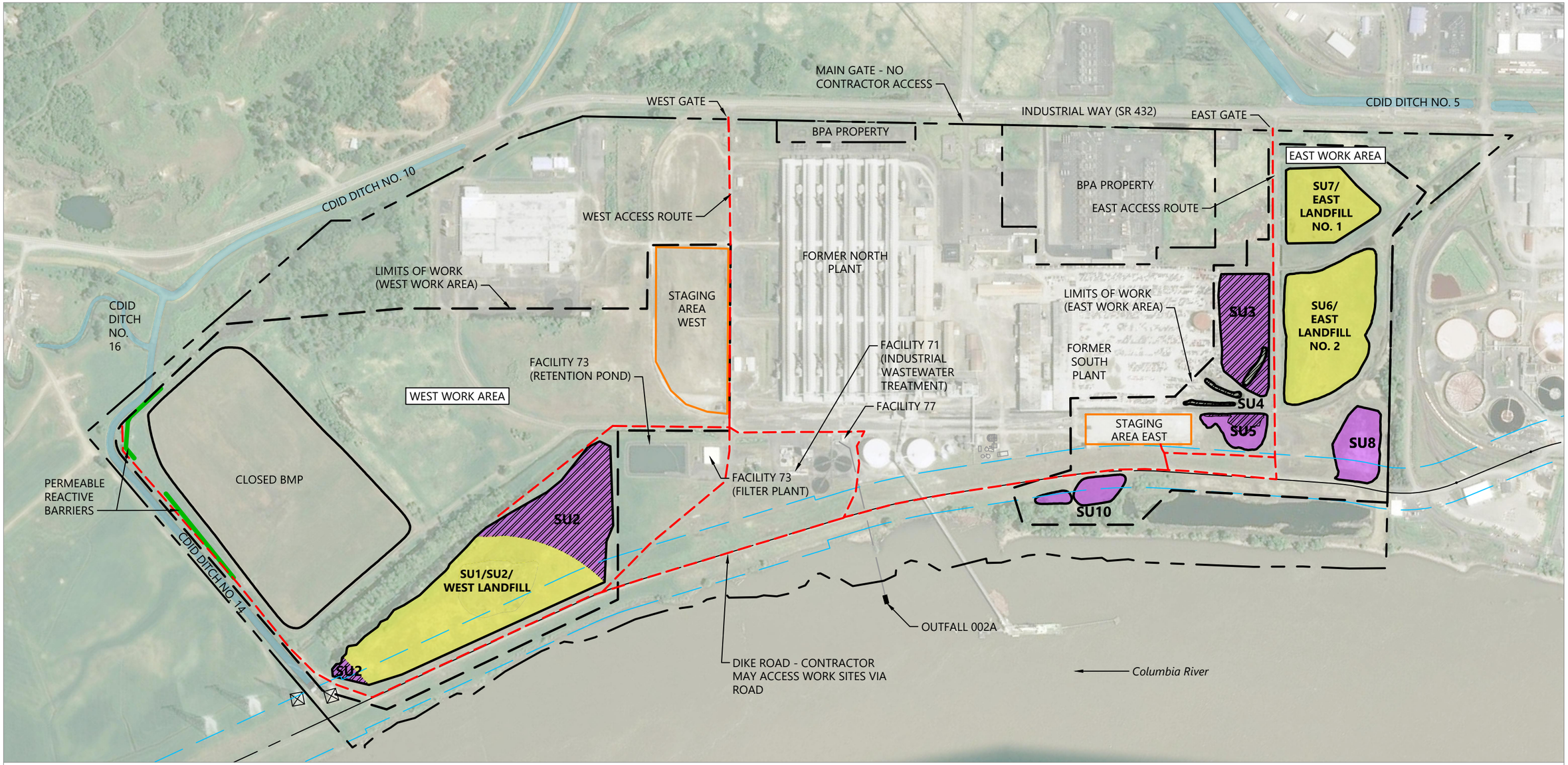
5 References

Anchor QEA (Anchor QEA, LLC), 2015. *Remedial Investigation and Feasibility Study*. Former Reynolds Metals Reduction Plant – Longview. Submitted on behalf of Northwest Alloys, Inc., and Millennium Bulk Terminals – Longview, LLC. January 2015.

Ecology (Washington State Department of Ecology), 2018a. *Cleanup Action Plan*. Former Reynolds Metals Reduction Plant – Longview. October 2018.

Ecology, 2018b. *Consent Decree*. Former Reynolds Metals Reduction Plant – Longview. December 13, 2018.

Figure



SOURCE: Drawing prepared from ALTA Survey (Minister & Glaeser Surveying, Inc.) conducted on November 11, 2010. Aerial image from Bing Maps.
HORIZONTAL DATUM: Washington State Plane South Zone, NAD83, U.S. Survey Feet

LEGEND:

- Low Permeability Cap
- Excavate And Consolidate On Site
- Permeable Reactive Barrier
- Reactive Backfill
- CDID Levee Right-of-Way (ROW)
- Site Access Route
- Staging Area
- Limits of Work

0 600
Feet

Publish Date: 2021/07/29 9:17 AM | User: tgriga
Filepath: K:\Projects\0730-MBT-Longview\0730-RP-072 (Overview).dwg Figure O1

ANCHOR QEA

Figure O1
Overall Site Plan

Construction Quality Assurance Plan
Former Reynolds Metals Reduction Plant – Longview

Attachment O1
SOP: Activated Alumina Quality Assurance Testing

Activated Alumina Quality Assurance Testing

Scope and Application

This standard operating procedure (SOP) describes a method for testing of activated alumina to confirm the material meets the manufacturer's minimum specification for aluminum oxide content using a portable X-ray fluorescence (XRF) analyzer. The method is intended to be used as part of construction quality control processes for bulk shipments of activated alumina to be used as a reactive amendment in permeable reactive barriers and reactive backfill. Procedures outlined in this SOP will be followed, and any deviations must be noted.

Health and Safety

All work will be performed in accordance with the Environmental Geochemistry Laboratory (EGL) Chemical Hygiene Plan by appropriately trained staff approved by the Laboratory Manager. Appropriate personal protective equipment (PPE) will be worn at all times while handling samples, including a laboratory coat, safety goggles, N95 face mask, and nitrile gloves, unless requirements of safety data sheets (SDSs) or the site-specific Health and Safety Plan (HASP) are more stringent. Potential hazards associated with this SOP include the handling of fine particles of activated alumina and the operation of an XRF analyzer. Work is to be performed in an operational fume hood when handling activated alumina to avoid inhaling fine dust particles of activated alumina. Staff will review all applicable SDSs prior to beginning work (see "Safety Data Sheets" section). Additionally, the project-specific HASP must be reviewed.

Equipment and Supplies

The following is a list of equipment that may be necessary to carry out the procedures contained in this SOP; additional equipment may be required:

- PPE
- Analytical balance of appropriate precision (1/1000 gram)
- Aluminum oxide (Al_2O_3, American Chemical Society [ACS] grade)
- Sucrose (ACS grade)
- Drying oven (110°C)
- Plastic weigh boats
- Zipper plastic bags
- Ceramic dish
- Plastic scoop
- Plastic spatula
- Pestle and mortar

- Stainless-steel pan
- Reagent water
- 4-ounce glass jars
- Kimwipes
- Niton XL3t GOLDD+ Ultra Handheld XRF Analyzer with shielded support stand
- Sample cups, rings, and caps suitable for XRF analysis
- Polypropylene thin film

Procedure

1. Put on the PPE described in the "Health and Safety" section.
2. Collect a visually representative sample of activated alumina from a super sack using a plastic scoop and transfer to a plastic jar.
3. Cap and shake the jar for at least 15 seconds to homogenize the sample.
4. Label a plastic weigh boat with the sample ID.
5. Measure and record the mass of the plastic weigh boat using an analytical balance.
6. Transfer approximately 20 grams of sample to the weigh boat.
7. Take a photograph of the sample using a digital camera.
8. Measure and record the mass of the activated alumina sample and plastic weigh boat using an analytical balance.
9. Place the weigh boat on a metal pan and dry the sample in a drying oven at 110°C for 24 hours to remove most of the moisture.
10. Remove the sample from the drying oven and immediately measure and record the mass of the plastic weigh boat and dry sample to determine the moisture content.
11. Grind the sample using a pestle and mortar set.
12. Following the XRF Operating Manual, fill an XRF sample holder to approximately 80% capacity with the ground sample.
13. Following the XRF Operating Manual, analyze the sample to determine the aluminum concentration.
14. After the completion of XRF analysis, store the sample in a labeled 4-ounce glass jar.

Preparation of Standards

Prior to analyzing activated alumina samples, a standard must be prepared and analyzed. The standard is prepared from ACS grade Al_2O_3 powder following the same procedures as the sample preparation steps Nos. 1 through 9 and analyzed as per step No. 12. The analysis result for the standard (which contains 100.0 weight % Al_2O_3 or 52.93 weight % Al) is used to define a custom calibration factor for analysis of Al in activated alumina. During analysis of activated alumina samples, the standard will be analyzed at the beginning and end of the session as well as at a minimum after

every 10 samples analyzed as an ongoing calibration check. If the standard check results deviate by more than 5% from the standard value, recalibration will be performed and a new custom calibration factor will be determined prior to analysis of activated alumina samples.

Quality Assessment Criteria for Activated Alumina

The aluminum concentration in an activated alumina sample will be divided by the aluminum concentration of the Al_2O_3 standard to determine the Al_2O_3 concentration in the sample. The Al_2O_3 concentration in the activated alumina sample must be equal to or greater than the manufacturer's stated minimum concentration for the specific product (e.g., 70% for Axens ActiGuard F 14x28) to be acceptable.

Safety Data Sheet

- ActiGuard F 14×28 activated alumina obtained from Axens Canada Specialty Aluminas Inc.

Attachment O2
SOP: Field Confirmation of Activated Alumina Content in Reactive Barrier Media by X-Ray Fluorescence Analyzer

Field Confirmation of Activated Alumina Content in Reactive Barrier Media by X-Ray Fluorescence Analyzer

Scope and Application

This standard operating procedure (SOP) describes a method to be used to determine the concentration of activated alumina amendment in a sample of sand and gravel using a portable X-ray fluorescence (XRF) analyzer. The method is intended to be used as part of construction quality control processes to confirm the dose of activated alumina in reactive media during construction of a permeable reactive barrier (PRB). Procedures outlined in this SOP will be followed, and any deviations must be noted.

Health and Safety

All work will be performed by approved staff who are trained using the Anchor QEA, LLC, Portland Environmental Geochemical Laboratory Chemical Hygiene Plan. Appropriate personal protective equipment (PPE) will be worn at all times while handling samples, including a laboratory coat, safety goggles, N95 face mask, and nitrile gloves, unless requirements of safety data sheets (SDSs) or the site-specific Health and Safety Plan (HASP) are more stringent. Potential hazards associated with this SOP include the handling of fine particles and the handling of XRF analyzer. Staff will review all applicable SDSs prior to beginning work (see "Safety Data Sheet" section). Additionally, the project-specific HASP must be reviewed.

Equipment and Supplies

The following is a list of equipment that may be necessary to carry out the procedures contained in this SOP; additional equipment may be required:

- PPE
- Analytical balance of appropriate precision (1/1000 gram)
- Drying oven (110°C)
- Plastic weigh boats
- Zipper plastic bags
- Digital camera
- Plastic scoop
- Plastic spatula
- Standard sieve set
- Metal pan
- No. 10 standard sieve (small size) to retrieve milling media
- PQ-N04 Planetary Ball Mill

- Zirconia planetary ball mill grinding jar
- Milling media/grinding balls
- Reagent water
- Methanol
- Plastic weigh boats
- Small plastic bags
- 4-ounce glass jars
- Kimwipes
- Niton XL3t GOLDD+ Ultra Handheld XRF Analyzer with shielded support stand
- Sample cups, rings, and caps suitable for XRF analysis
- Polypropylene thin film

Procedure

1. Put on the PPE described in the "Health and Safety" section.
2. Collect a representative bulk sample of the PRB reactive media mixture into a plastic bag using a plastic scoop, ensuring the sample is representative of media that is being used in construction.
3. Transfer the sample into a plastic bowl and thoroughly composite using a plastic scoop.
4. Take a photograph of the sample using a digital camera.
5. Label a plastic weigh boat with the sample date and time and measure and record the mass of the labeled weigh boat.
6. Transfer approximately 100 grams of the sample to the weigh boat.
7. Measure and record the mass of the wet sample and plastic weight boat using an analytical balance.
8. Place the weigh boat on a metal pan and dry the sample in a drying oven at 110°C for 15 minutes to remove most of the moisture.
   Note: This step is to make sample handling easier in the following ball milling process, and it is not necessary to completely dry the sample.
9. Remove the sample from the drying oven and immediately measure and record the mass of the plastic weigh boat and dry sample.
10. Use a No. 18 standard sieve to remove gravel and materials coarser than activated alumina from the sample.
11. Weigh and record the mass of the portion retained on the No. 18 standard sieve.
12. Transfer the sieved sample (passing the No. 18 standard sieve) into a zirconia planetary ball mill grinding jar. Fill the jar to about 60% capacity.
13. Following the ball mill processing SOP (Attachment O2-1), run the planetary ball mill in unidirectional mode for 15 minutes to grind the sample.

14. Following the XRF SOP (Attachment O2-2), fill an XRF sample holder to approximately 80% capacity with the ground sample.
15. Following the XRF SOP, analyze the sample to determine the aluminum concentration.
16. After the completion of XRF analysis, store the sample in a labeled 4-ounce glass jar.

Preparation of Standards

Prior to analyzing field samples, standards must be prepared and analyzed. Standards are prepared by mixing a pre-weighed amount of activated alumina with the PRB sand media (portion passing the No. 18 sieve) at three activated alumina doses, one at the target dose, and the other two 5% higher and 5% lower. Measure the aluminum concentration in the standards following the same procedure described in the previous section. The standard readings are used to develop a linear or polynomial least-squares curve fit that brackets the target activated alumina dose. All three standards will be measured at the beginning of each day to produce a daily standard curve of activated alumina content versus aluminum concentration. This approach accounts for sample matrix effects and corrects for the aluminum in the PRB sand matrix, which is naturally present at low concentrations. The activated alumina target dose standard will also be measured before and after each sample measurement as an ongoing calibration check.

Evaluation of Activated Alumina Content

The activated alumina content of the sample fraction passing the No. 18 sieve will be determined. The activated alumina content in the bulk PRB media mixture will then be calculated using Equation 1. The calculated sample activated alumina dose is then compared to the target activated alumina dose.

Equation 1

$$D = D' \times \frac{M_{<\#18}}{M_{tot}}$$

where:

D	=	activated alumina dose in bulk PRB media
D'	=	activated alumina concentration in sample fraction passing the No. 18 sieve
$M_{<\#18}$	=	mass of sample passing the No. 18 sieve
M_{tot}	=	mass of the entire sample

Safety Data Sheet

- ActiGuard F 14×28 activated alumina obtained from Axens Canada Specialty Aluminas Inc.

Attachment O2-1
SOP: Grain Size Reduction Using a Planetary Ball Mill

Grain Size Reduction Using a Planetary Ball Mill

Scope and Application

This standard operating procedure (SOP) describes how to process soil and sediment samples into a powder using a planetary ball mill. Powdered samples can be used for X-ray fluorescence (XRF) and other analyses. Procedures for extraction outlined in this SOP will be followed, and any deviations must be noted.

Equipment and Supplies

The following is a list of equipment that may be necessary to carry out the procedures contained in this SOP; additional equipment may be required:

- PQ-N04 Planetary Ball Mill
- Zirconia planetary ball mill grinding jar
- Milling media/grinding balls
- Analytical balance appropriate for mass range
- Large No. 10 sieve
- Small (flat) No. 10 sieve
- Plastic weigh boats
- Small plastic bags
- 4- or 8-ounce glass jars
- Kimwipes

Procedure

1. Weigh out wet sample into a plastic weigh boat. Record sample mass.
2. Place wet sample, along with several oxygen adsorbers and/or desiccant, into the glove box. The incubator set to 40°C can also be used to help samples dry faster. Make sure oxygen levels are approximately 1% or less and the glove box is airtight. Leave the sample in glove box until the sample is completely dry.
3. Repeat steps 1 and 2 for each sample.
4. Remove sample from glove box and process through a large No. 10 sieve to remove any large rock fragments or debris and break up clots of material. Transfer any retained rocks and debris to a small plastic bag. Clean No. 10 sieve with a Kimwipe and methanol between samples (allow sieve to dry before moving on to next sample).
5. Transfer sieved sample into a Zirconia planetary ball mill grinding jar. Fill jar to about 60% capacity.

6. Place several grinding balls into grinding jar. The smaller balls work best for samples that need more grinding, but the larger balls can also be used. Use about 20 to 30 small balls or 15 to 20 large balls per jar. Only fill the jar to 75% to 80% capacity.
7. Repeat steps 4, 5, and 6 for up to four samples (one for each available Zirconia planetary ball mill grinding jar).
8. Secure samples tightly into the ball mill with jar clamping device. Tighten the pressure screw (blue) as far as it will go first and then tighten the locking screw (metal bar) second (Figures 1 and 2). Give the clamping device a small tug after tightening. If the jar still moves around a little bit, try unscrewing the clamping device and tightening again. **The jar needs to be as secure as possible before turning on the machine. Secure with hands only. Do not use a hammer when tightening the jar clamping devices (see user manual for more information).** Close the door and secure with the safety latch (Figure 3).
    a. Note, only run the ball mill with two or four grinding jars. If only one or three samples are available, fill a second or fourth jar with enough grinding balls to balance the weight in the planetary ball mill. When using only two jars, load them across from, never immediately next to, each other.

Figure 1
Secure Zirconium Jar with Pressure Screw

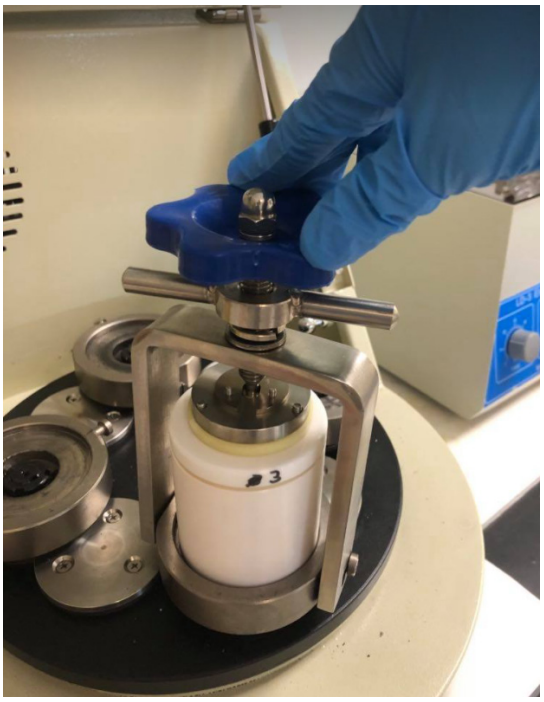


Figure 2
Secure Zirconium Jar with Locking Screw

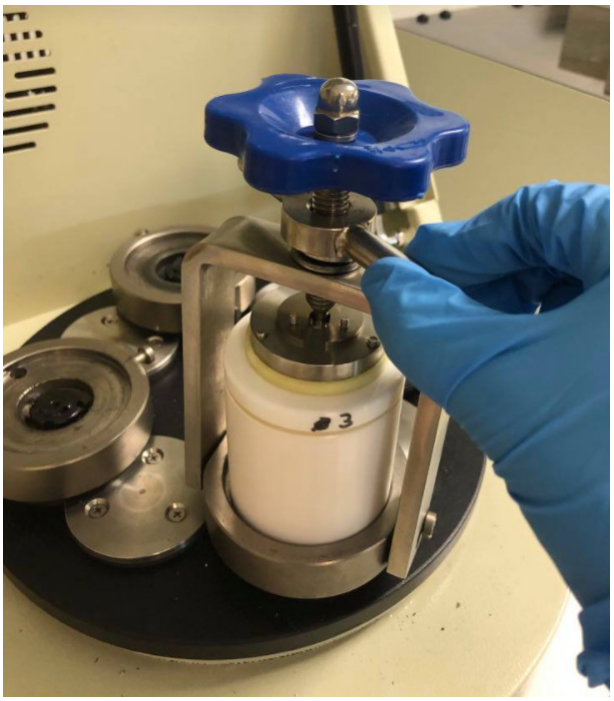


Figure 3
Secure Samples with Safety Latch

9. Run the planetary ball mill in unidirectional mode for 15 minutes. To do this, turn large ON button, then press the smaller green button on the left (Figures 4 and 5). To stop rotation, press the red button next to the green button (Figure 6). To turn off the machine, press the large OFF button (Figure 4). Unidirectional mode should suffice for processing samples. If another mode of operation is required (e.g., bidirectional, inserting a pause) see the user's manual for menu options and settings.

Figure 4
Turn on Planetary Ball Mill

Figure 5
Start Run

Figure 6
Stop Run

10. Unclamp grinding jars and take to a clean workstation. Allow jars to rest for 5 minutes. Do not open jars immediately as there will be fine particles suspended in the cup.
11. Label and weigh clear glass 4- or 8-ounce jar(s).
12. Place glass jars on top of large plastic weigh boat(s).
13. Retrieve a No. 10 sieve and place over a glass jar (this works best if a small, flat sieve is used).
14. Slowly scoop out sample from a grinding jar over the sieve. Gently shake or use a spatula to help grinded powder descend into the glass jar. Transfer grinding balls into the weigh boat. Repeat the process until all powder has been retrieved. Clean the No. 10 sieve with a Kimwipe and methanol between samples (allow sieve to dry before moving on to next sample). Repeat the process for any other grinding jars.
15. If XRF samples are being processed on powdered samples, collect a subsample from the glass jar into an XRF vial.
16. Weigh the glass jar and calculate final (dry) sample weight. It will be useful to know how much sample is available for subsequent tests to be performed on the sample.
17. Repeat steps 14 to 16 for other samples processed in the same batch (up to four samples per batch).
18. Rinse grinding jars and grinding balls with soapy water. It is best to wash the grinding balls in a large beaker or on a large sieve (so that no balls are lost).
19. Transfer grinding jars and balls to a fume hood. Make a 10% nitric acid solution and pour solution into the beaker containing the grinding balls and into each grinding jar. Cap and gently shake the jars to wet the entire inside surface with acid. Let items soak for a few minutes.

20. Pour out nitric acid solution into a waste container (neutralize later before disposal).
21. Wipe jar(s), lid(s), and balls with a moist paper towel. This will remove any color stains from grinding samples.
22. Rinse jar(s), lids(s), and balls with deionized solution and wipe dry. Use methanol to help dry faster if needed.
23. Repeat steps 4 to 22 until all samples have been processed. Note that the planetary ball mill can only process up to four samples at a time.

Project Close Out

Final products from this experiment will include the following: 1) residual ground samples (100 milliliter per sample); and 2) residual cleaning solution (nitric acid and methanol). Residual solutions should not enter drains. Laboratory staff, project managers, and health and safety staff will coordinate to characterize and dispose of the remaining materials from the experiment if necessary.

Attachment O2-2
SOP: X-Ray Fluorescence Spectroscopy

X-Ray Fluorescence Spectroscopy

Scope and Application

This standard operating procedure (SOP) is applicable to the use of an X-ray fluorescence (XRF) analyzer. XRF is a non-destructive analytical technique used to determine the elemental composition of materials. XRF analyzers measure the fluorescent (or secondary) X-rays emitted from a sample when excited by a primary X-ray source. Each of the elements present in a sample produces a set of characteristic X-rays or "fingerprints." XRF is an appropriate tool to use for qualitative and quantitative measurements for elements heavier than sodium. Elements lighter than or equal to sodium will not be detected. Procedures outlined in this SOP will be followed, and any deviations must be noted.

Equipment and Supplies

- Niton XL3t GOLDD+ Ultra Handheld XRF Analyzer with shielded support stand
- Thermo Scientific non-destructive testing (NDT) software downloaded on a PC
- Dried and ground sample(s)
- Sample cups, rings, and caps suitable for XRF[1] analysis
- Polypropylene Thin Film[2]

Procedure – Sample Cup Assembly

1. Place thin film over barrel (C, Figure 1).
2. Push closed ring cap (C, Figure 1) cover sample cup barrel with overlying thin film (B, Figure 1). Apply sufficient pressure so that the barrel and closed ring cap are securely attached to each other.
3. Fill sample container to approximately 80% capacity with dry and ground sample. Sample may be ground using a mortar and pestle or a planetary ball mill (see appropriate SOPs for information on this procedure).
4. Place a thin film over the barrel.
5. Stretch the thin film so that it is taut and place it over the barrel (C, Figure 1) the film. When handling thin film, try to touch only the edge of the film and not the center part. Firmly push open ring cap and thin film into the barrel (B, Figure 1) until a click is heard. Inspect the sample container to make sure that all components are flush with each other. Figure 2 illustrates the final assembly. The open end of the sample cup will be exposed to the XRF for analysis.
6. Label sample cup assembly with sample ID.

[1] Purchase link here: https://www.premierlabsupply.com/product/double-open-ended-cupringcap-suitable-for-niton-sc-4331/
[2] Purchase link here: https://www.premierlabsupply.com/product/polypropylene-film-4-0/

7. Repeat steps 1 through 5 for each sample that needs to be analyzed[3]

Figure 1
Sample Cup Components

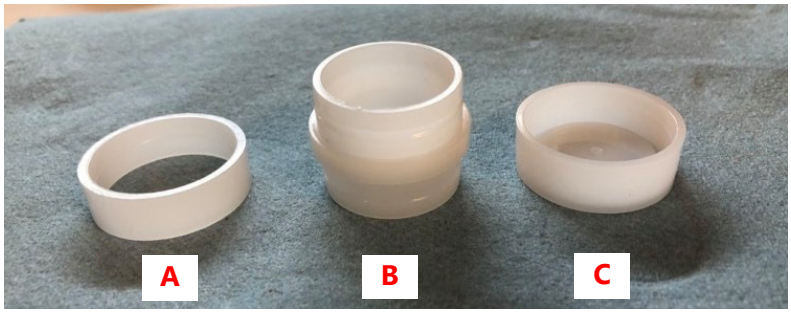


Figure 2
Sample Cup Assembly

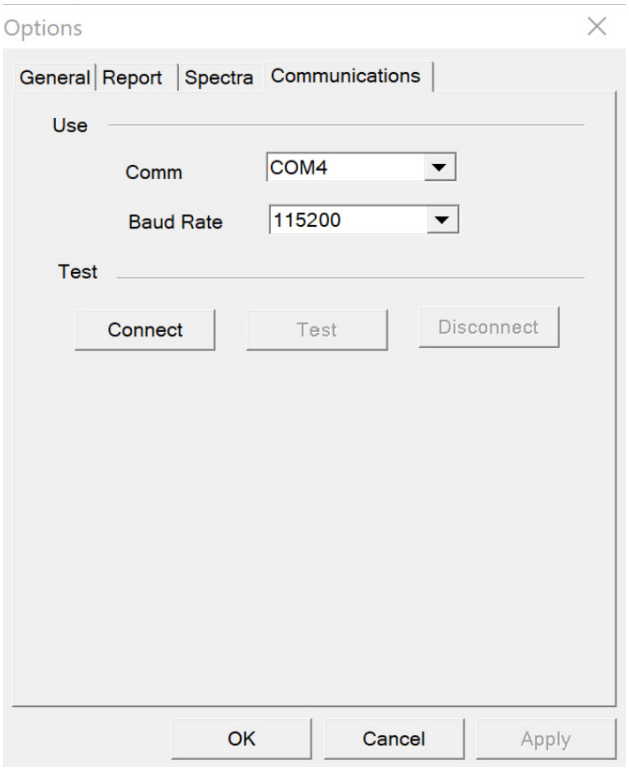
Procedure – Analysis with XRF

1. Download NDTr software onto PC at: https://portables.thermoscientific.com/?tab=xrf&productline=xrf. You will need to create an account to do this.
2. Turn instrument on (power button on the left-hand side of instrument below XRF screen). Hold the on button down for a couple of seconds.

[3] Note that cups, rings, and caps can be reused, but thin films should not be reused. It is recommended to completely clean sample cup components if reuse is desired. To open the sample cup, use a flathead screwdriver to pry the top and bottom off of the barrel in the seam where they are joined. This procedure might also be necessary if a thin film accidentally rips during the assembly process.

3. The first time that you open, go to "Tools" > "Options" > "Communications." The comm port may change based on each computer it is installed on, but the baud rate needs to be as indicated in Figure 3.

Figure 3
Appropriate Com Settings



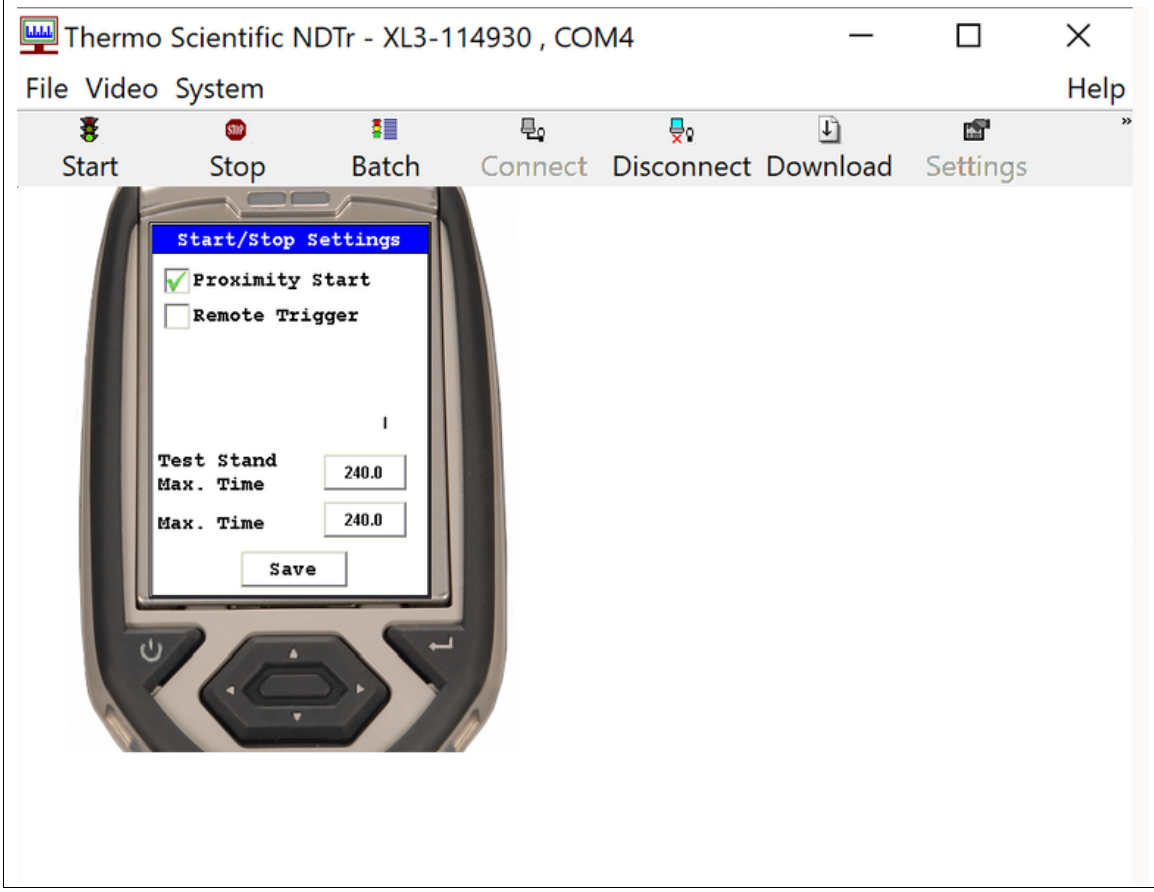
4. Press to log on to the instrument or on the screen. Tap instrument or click screen once. A warning will pop up, and click "Yes" to proceed. Insert code 1234 on the instrument or the screen.
5. Mirror NDTr software from the XRF instrument to PC by clicking "Utilities" > "NDTr."
6. Once the software is on and connected to the device, the main instrument panel will appear. Perform a system check by closing the XRF lid and then clicking on the "System Check" icon once (Figure 4).

Figure 4
System Check

7. Periodically perform a check on the system date and time to ensure that it is accurate. This will help with data tracking. ("System" > "Date & Time" > "Check Correct")
8. Make sure that the maximum run time is longer than the sum of all individual ranges ("Advanced" > "Start/Stop"). Default will be 240 seconds at 60 seconds per range (Figure 5).[4]

[4] If range times change, run standards to ensure comparable results. If run time is changed from 60 seconds to a shorter period (e.g., 30 seconds), make sure that the reported error is not significantly larger.

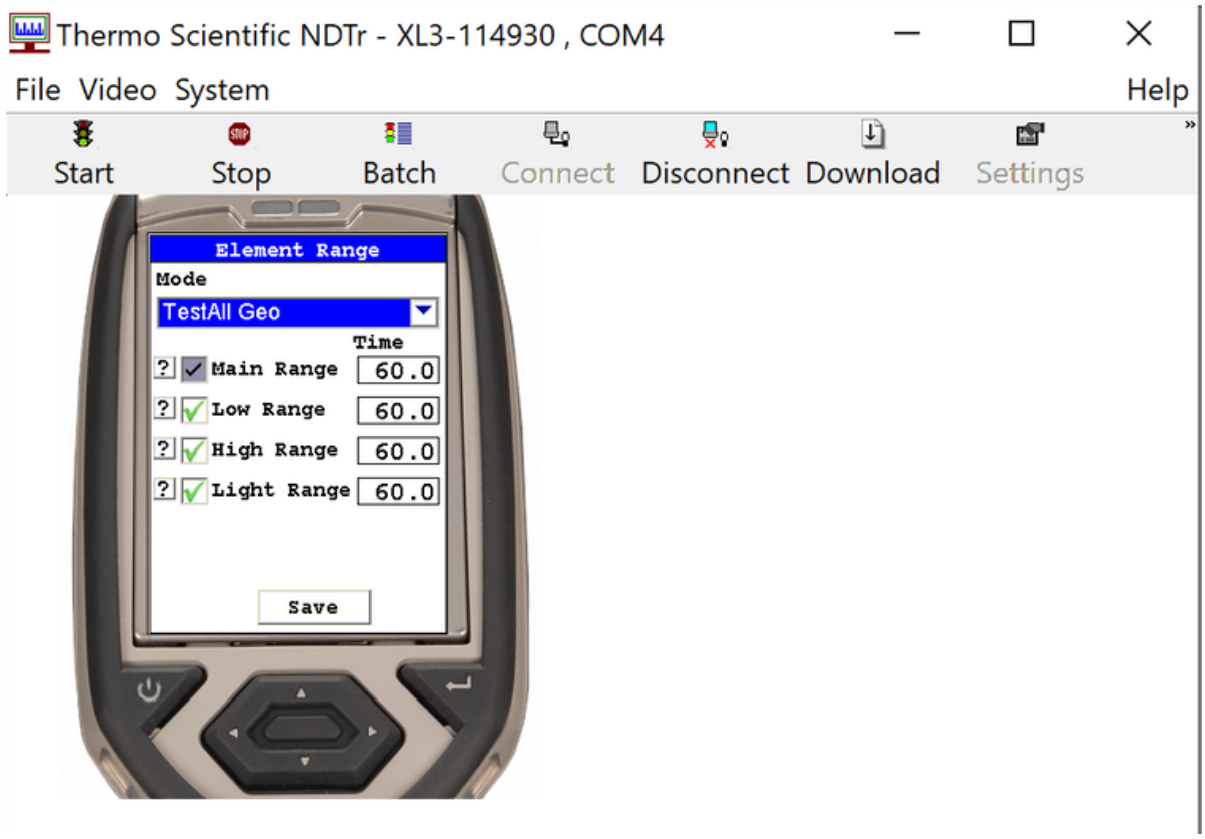
Figure 5
Start/Stop Settings



9. Select the base method for analysis ("Sample Type" > "Soils and Minerals" > "TestAllGeo". Click each icon once and wait for new window to appear. Note that "Mining Cu/Zn" can also be used, but it does not have as many available elements, and quantitation limits are not as good as "TestAllGeo." "TestAllGeo" only needs to be selected one time.
10. From this screen, scroll down to "Tools" > "Element Range" to edit the times for each range. Make sure there is a green checkmark next to all ranges. Click "Save" (Figure 6).[5]

[5] Only the sample type needs to be chosen. Sorting the elements prior to the run is not necessary since it can be done easily in the excel export after analysis.

Figure 6
Set Individual Range Run Times



11. The instrument is now ready to analyze samples. The blank and quality assurance/quality control standards should be run first in the following order:
    a. Blank SiO_2
    b. Standard RCRA1
    c. Standard U.S. Geological Survey
    d. Standard sdar-12

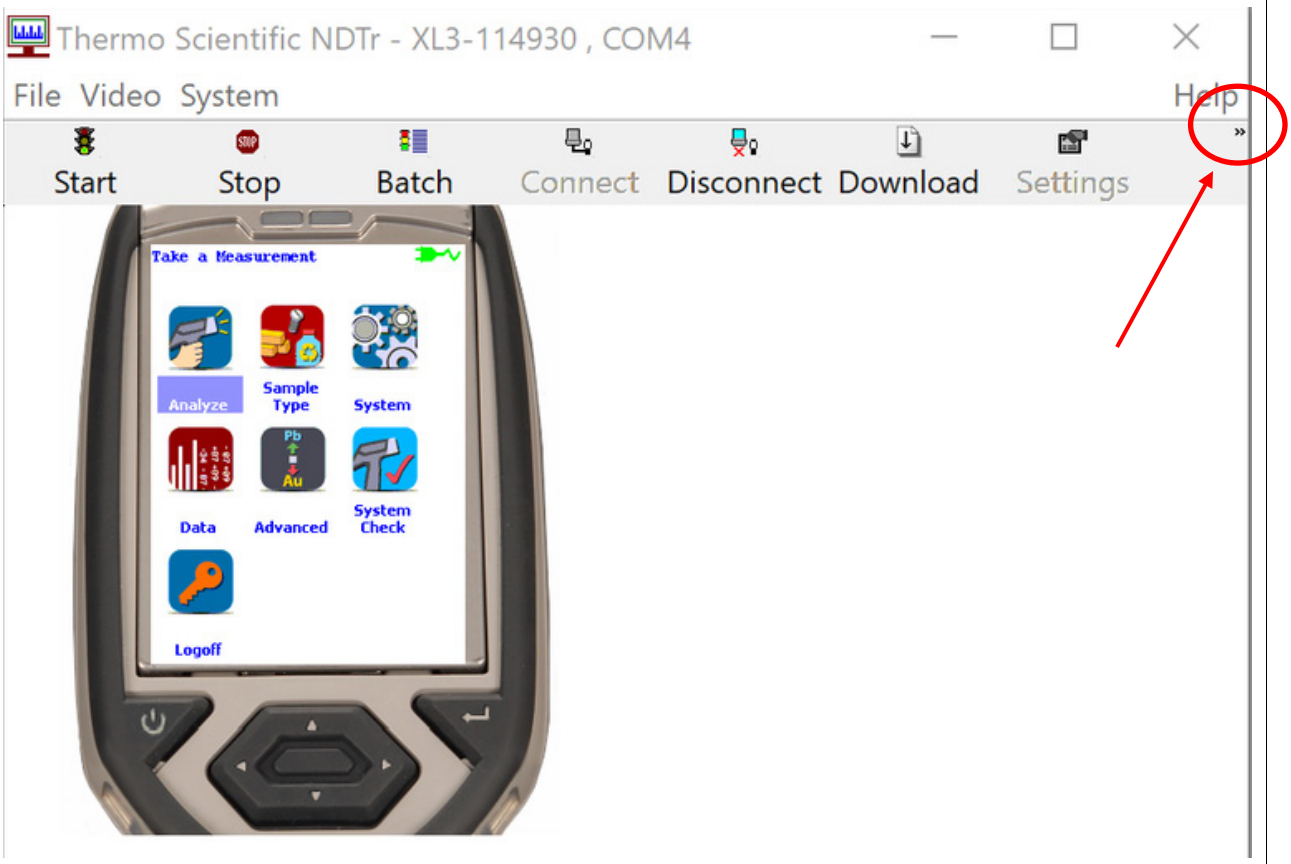
    After the blank and standards are run, the samples may be loaded and processed.

12. To commence the run, navigate to "Analyze."
13. Document the sample ID under "Data Entry." If a blank or standard is being processed, record the blank or standard ID within the sample name by clicking on keyboard icon.
14. Gently wipe off the sample cup's exposed thin film with a Kimwipe.
15. Open the XRF lid and place sample cup face-down over the device aperture. The exposed thin-film side should be down and facing the XRF instrument. Make sure that the sample inside

of the sample cup covers the entire exposed surface area of the thin film. A couple gentle taps on the counter or XRF stand plate can aid with compaction.

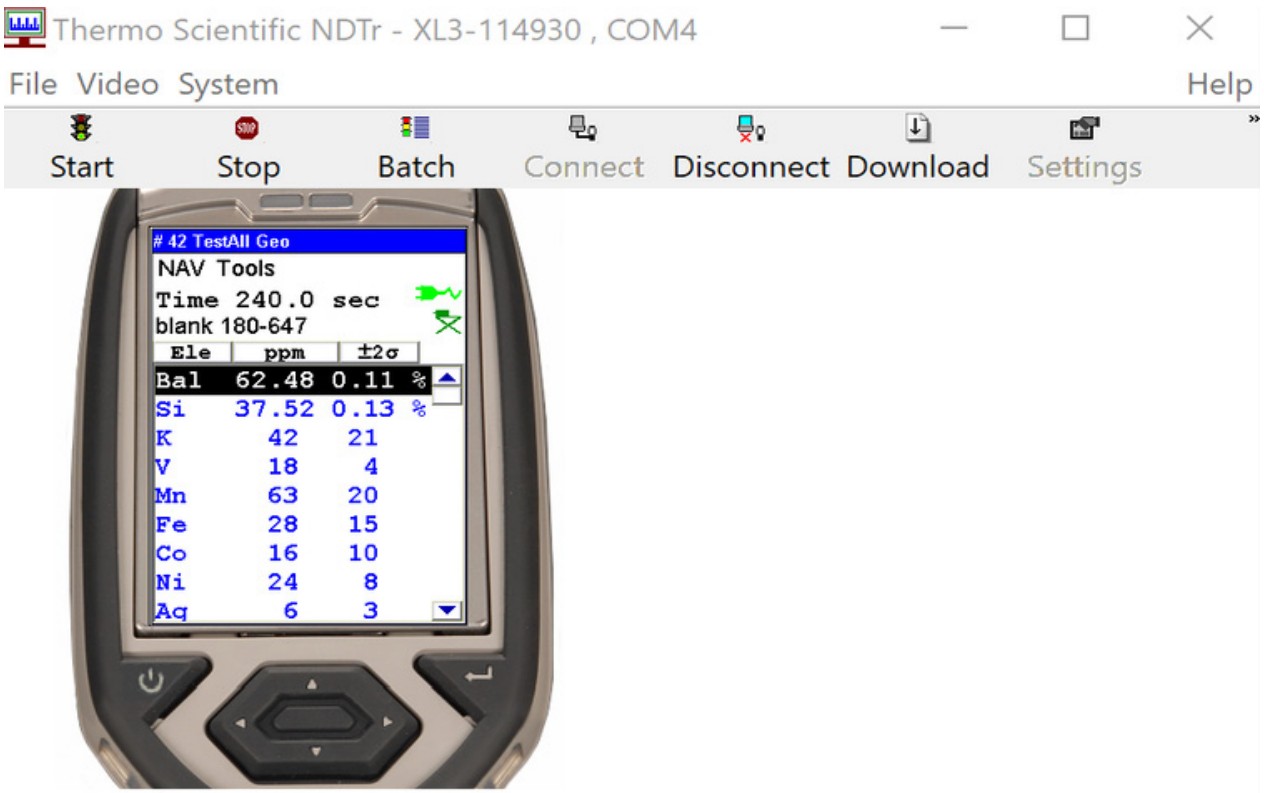
16. Note, if there is dust on the surface, you can clean it with a cleaning duster (compacted air). If you turn on the camera view, it will be easy to see if there is any dust that needs to be cleaned. To do that, click on the ">>" icon on the right-hand side of the screen and click on the camera icon that pops up (Figure 7). Choose video size under "Video."

Figure 7
Turn on Instrument Camera



17. Close and lock the lid.
18. Press "Start" to start the run. Red flashing lights indicate that run is in progress. There will be several beeps from the instrument as the sample is analyzed. Wait for XRF to indicate that the run has been successful. Example results for Blank SiO_2 are shown in Figure 8. Press the back button on the device to get back to the main menu.
19. Navigate to "Data" > "View Data" to explore results from this run and any subsequent runs (the instrument stores it in memory).

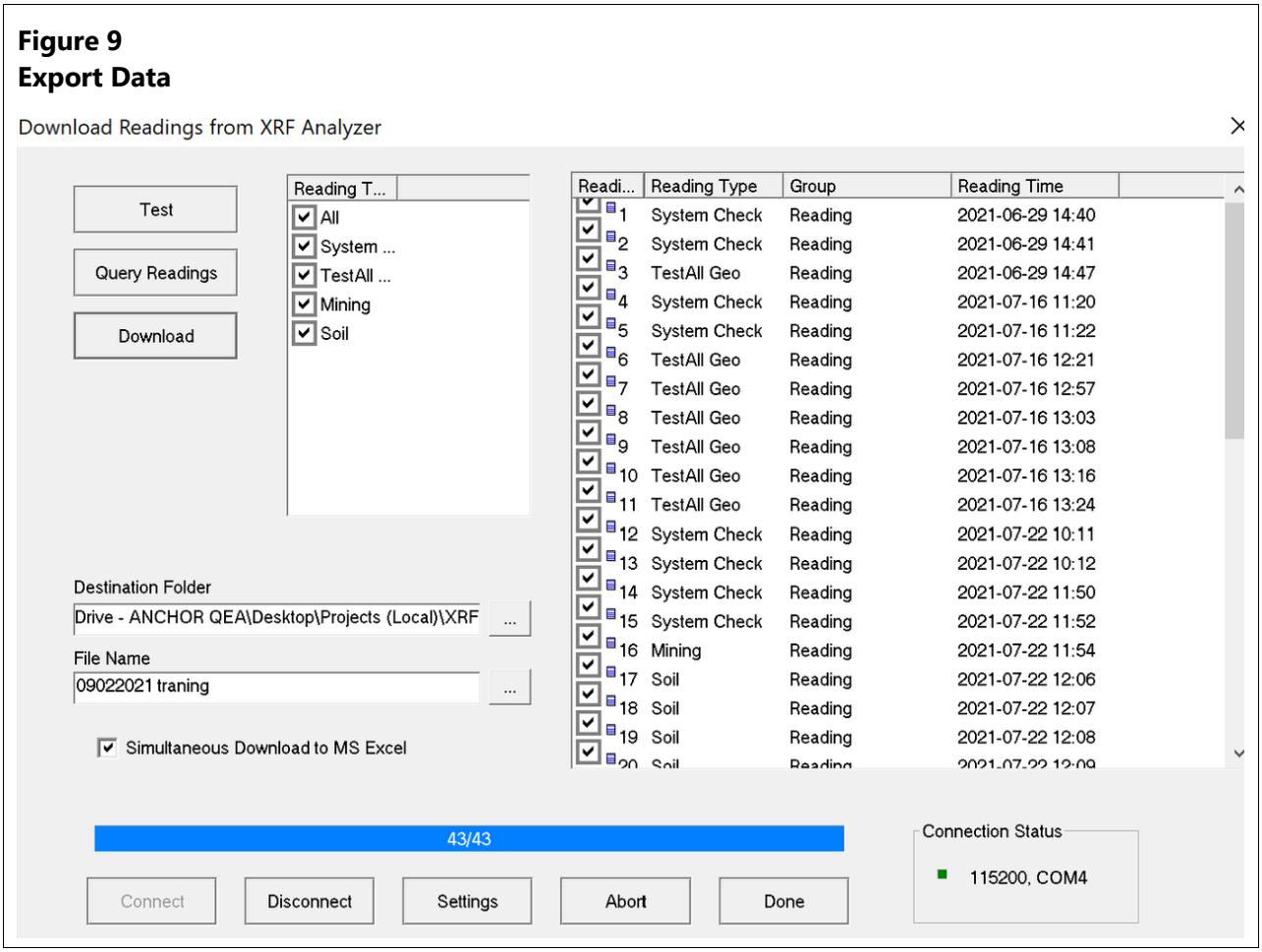
Figure 8
Example Results for Blank SiO_2



20. Follow steps 8 through 13 to process the blank, standards, and samples. To start a new sample, navigate back to "Analyze." After inserting the sample name, load the new sample and press "Start."
21. The reference materials (blank and standards) provided with the analyzer help ensure the ongoing performance of the analyzer. These standards should be analyzed on a regular basis and checked against the "Thermo Scientific Niton XRF Analyzers Certificate of Analysis." A copy of this is kept next to the instrument and is included in Attachment A.
22. Once all samples have been processed, press "Disconnect" in the NDTr software.
23. Query all readings ("Download" > "Query Readings").
24. Select "All" under "Reading" category to select samples.
25. Set the destination folder and add an appropriate filename.
26. Click "Simultaneous download to MS Excel."
27. Click "Download." This will obtain the material from the analyzer.

28. Click "Done." This will create the NDTr raw instrument file and Excel files at the same time.

Figure 9
Export Data



29. Save the raw instrument file just in case it is necessary to open it and look at the run details on the instrument again.
30. Open the Excel sheet. Sort columns alphabetically in the Excel sheet (in the "Sort" dialog box, click "Options…" and then select the "Sort Left to Right" radio button). Note that readings are in parts per million.

Quality Assurance/Quality Control

A duplicate sample should be processed with every 10 samples. If there is not enough sample mass to produce two separate sample cups for the duplicate sample, simply conduct two independent runs with the same sample vial. A blank and one of the standards (preferably the Resource Conservation and Recovery Act [RCRA] standard) should be processed at the end of the run or every

20 samples, whichever comes first. This will ensure that there was no drift in the instrument during the session.

The reproducibility is determined for duplicate samples as shown in Equation 1.

Equation 1

$$RPD = \frac{(X_1 - X_2) \times 100}{(X_1 + X_2) \div 2}$$

where:

RPD	=	relative percent difference
X_1	=	larger result value
X_2	=	smaller result value

Project Close Out

Final products from this experiment will include the following: 1) sample holder with dry samples. Laboratory staff, project managers, and health and safety staff will coordinate to characterize and dispose of the remaining materials from the experiment if necessary.

Attachment A
Thermo Scientific XRF Flyer

Thermo Scientific™ Niton™ XRF Analyzers

CERTIFICATE OF ANALYSIS

Type P/N Element	RM 180-706 USGS SdAR-M2	CRM 180-649 NIST 2709a	Blank 180-647 SiO2 99.995%	QC Material 180-661 RCRA1
Ba Barium 56	990	979	<10	1000
Cs Cesium 55	12		<10	
Te Tellurium 52	<10		<10	
Sb Antimony 51	107	<30	<10	
Sn Tin 50	<10		<10	
Cd Cadmium 48	<10	<10	<10	500
Ag Silver 47	15		<10	500
Pd Palladium 46			<10	
Mo Molybdenum 42	13.3		<10	
Zr Zirconium 40	259	195	<10	
Sr Strontium 38	144	239	<10	
U Uranium 92	<10	<10	<10	
Rb Rubidium 37	149	99	<10	
Th Thorium 90	14.2	10.9	<10	
Pb Lead 82	808	17.3	<10	500

Type P/N Element	RM 180-706 USGS SdAR-M2	CRM 180-649 NIST 2709a	Blank 180-647 SiO2 99.995%	QC Material 180-661 RCRA1
Au Gold 79	<10		<10	
Se Selenium 34	<10		<10	500
As Arsenic 33	76	10.5	<10	500
Hg Mercury 80	<10	0.9	<10	
Zn Zinc 30	760	103	<10	
W Tungsten 74	<10		<10	
Cu Copper 29	236	33.9	<10	
Ni Nickel 28	48.8	85	<10	
Co Cobalt 27	<50	<50	<10	
Fe Iron 26	18395	33600	<10	
Mn Manganese 25	1038	529	<10	
Cr Chromium 24	49.6	130	<10	500
V Vanadium 23	25.2	110	<10	
Ti Titanium 22	1798	3360	<10	
Sc Scandium 21	<10	11.1	<10	

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—continued next page

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Thermo SCIENTIFIC

Thermo Scientific Niton XRF Analyzers

CERTIFICATE OF ANALYSIS — PAGE 2

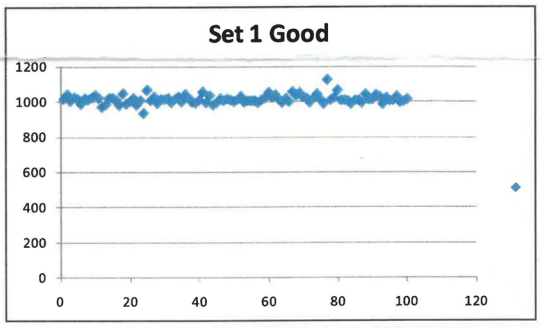
Use of reference materials

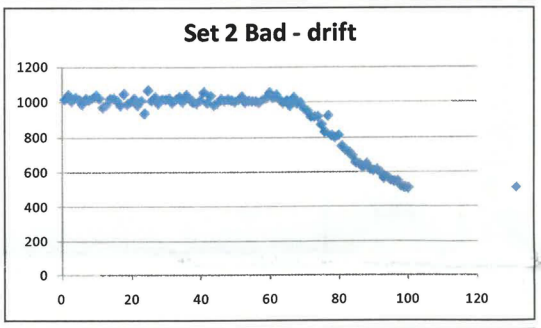
The reference materials provided with your analyzer are to help ensure the ongoing performance of your analyzer. These standards should be analyzed on a daily basis and the values obtained checked against this certificate of analysis. For quality assurance purposes you may wish to keep a running chart of the values obtained and monitor them for consistency.

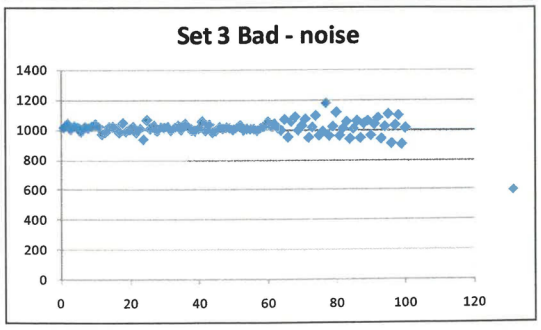
If one or more of the elements begins to change in terms of reported concentration outside of the normal expected variability, the sample may have become damaged or contaminated. This may occur for a number of reasons. For example, oils and salts may transfer from hand contact onto the surface, dust or lint from the surroundings may be deposited onto the sample, or the thin film on the front of the cup may have pinholes or have been torn. If the cup film has torn or has been damaged in any other way, it should be replaced immediately; this will prevent loss of the material and prevent contamination of the instrument and other samples.

If the film has been torn and the sample exposed for a period of time, then it may be best to assume the sample is contaminated. Dispose of it following your local regulations, and then replace it as soon as possible. Also check the front window of the instrument and clean or replace it if necessary.

Examples of daily quality assurance charts are shown below; learn to understand normal variance and recognize drift and noise. Results from your instrument may be as much as +/-20% of the listed values, depending on the model you have. However, by using the same integration time every time, your results should be consistent with themselves. If you have more questions, please refer to the Statistical Aspects of Spectrometry section of the manual under Reference Documents, or call our Customer Support group.







Type P/N Element	RM 180-706 USGS SdAR-M2	CRM 180-649 NIST 2709a	Blank 180-647 SiO2 99.995%	QC Material 180-661 RCRA1
Ca Calcium 20	6003	19100	<10	
K Potassium 19	41507	21100	<10	
Cl Chlorine 17				
S Sulfur 16	970		<10	
P Phosphorus 15	345	688	<10	
Si Silicon 14	343331	303000	467400	
Al Aluminum 13	65997	73700	<10	
Mg Magnesium 12	2955	14600	<10	

Requires GOLDD technology for mining & minerals mode

Notes:

- All results are listed in ppm (mg/kg).
- To convert to %, divide by 10,000; e.g., 33,600ppm Fe (NIST 2709) is 3.36%.
- Original certificates of analysis (if available) are on the Virtual Center of Excellence (vCoE) and can be requested from customer support.
- While every effort is made to ensure the high quality of these reference samples and their data, the use of the materials and interpretation of the results is the sole responsibility of the user.

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