F I N A L

Air Monitoring Quality Assurance Project Plan

Prepared for

PCC Structurals, Inc.

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Prepared by

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Acronyms and Abbreviations

%R	percent recovery
˚C	degrees Celsius
°F	degrees Fahrenheit
µg/m^3	microgram(s) per cubic meter
ARA	ARA Instruments
As	arsenic
ASTM	ASTM International
Be	beryllium
CCV	continuing calibration verification
Cd	cadmium
CFR	*Code of Federal Regulations*
Co	cobalt
COC	chain of custody
Cr	chromium
Cr^{6+}	hexavalent chromium
DQI	data quality indicator
DQO	data quality objective
EPA	U.S. Environmental Protection Agency
FTL	Field Team Leader
Hg	mercury
ICAL	initial calibration
ICP/MS	inductively coupled plasma mass spectrometry
ICV	initial calibration verification
LCS	laboratory control sample
lpm	liter(s) per minute
MDL	method detection limit
mm	millimeter
Mn	manganese
MQO	measurement quality objective
NA	not applicable
Ni	nickel
NIST	National Institute of Standards and Technology
Pb	lead

PCC	PCC Structurals, Inc.
PM	Project Manager
PM_{10}	particulate matter less than 10 microns in aerodynamic diameter
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
RL	reporting limit
RPD	relative percent difference
Se	selenium
SOP	standard operating procedure
SSC	Site Safety Coordinator

SECTION 1

Project Management

1.1 Distribution List

The persons designated to receive copies of the Quality Assurance Project Plan (QAPP), and any planned future revisions are listed below. This list, together with the document control information, will help ensure that key personnel in the implementation of the QAPP have up-to-date copies of the plan.

Name
Chris Myers, PCC Structurals, Inc. Director EHS
Jodi Lee, CH2M Technical Lead
Paul Duda, Chester LabNet Technical Service Representative
Paul Pope, ALS Labs Technical Service Representative

1.2 Project Task and Organization

A project team composed of CH2M HILL Engineers, Inc. (CH2M) and its subcontractors will be assembled. CH2M will have the overall responsibility for conducting the field activities specified in this QAPP and providing quality assurance (QA). Key project personnel identified to date and contact information are listed in Table 1-1. Team roles and responsibilities are described in Table 1-2.

Table 1-1. Key Project Personnel
Air Monitoring Quality Assurance Project Plan

Name	Title/Company
Jodi Lee	Technical Lead/CH2M
Paul Duda	Technical Service Representative/Chester LabNet
Paul Pope	ALS Labs Technical Service Representative/ALS Global
Rodrigo Gonzalez-Abraham	Data Manager/CH2M
Mark Fesler	Project Chemist/CH2M
Shannon Bartow	Field Team Lead/Site Safety Coordinator/CH2M

Table 1-2. Team Roles and Responsibilities
Air Monitoring Quality Assurance Project Plan

Technical Lead	• Assume overall responsibility for the technical aspects of the project • Support decision-making and implementing decisions for the project • Coordinate the technical input from subject matter experts • Provide guidance during implementation of field tasks • Review data • Provide technical review of deliverables
Data Manager	• Coordinate data management and reporting activities • Work with Project Chemist to ensure data quality and validation • Ensure data are collected, stored, and archived in accordance with contract requirements • Assist in preparing data deliverables

Table 1-2. Team Roles and Responsibilities
Air Monitoring Quality Assurance Project Plan

Project Chemist	• Oversee activities related to analytical chemistry • Include applicable analytical methods in the QAPP • Review preliminary and final analytical data packages from the laboratory • Coordinate data validation and reporting activities • Aid in evaluating data usability
FTL/SSC	• Supervise and direct the daily activities of the field team • Ensure that field activities are conducted in accordance with approved standard operating procedures (SOPs) and work plans • First point of contact for health and safety deviations from work plan or any questions pertaining to work conducted in field • Notify technical lead of near-misses, injuries, and incidents immediately. Fill out an Incident Report Form within 24 hours of an incident. Provide additional or updated information to the Health and Safety Manager after submitting initial incident report. Collaborate on incident investigations • Convey the progress of field activities, including deviations from the sampling plan, to the PM • Ensure feasible controls and safe work practices are considered before requiring personal protective equipment (PPE) • Identify and document nonconformances and corrective actions when necessary • Ensure good housekeeping at field location • Ensure documents are submitted for review prior to being filed in the project binder • Coordinate field activities with the laboratories • Manage waste generation
Field Team Members	• Ensure that field activities are conducted in accordance with this QAPP and instrument manuals • Ensure feasible controls and safe work practices are considered before requiring personal protective equipment • Ensure good housekeeping at field location • Verify that samples are collected, labeled, preserved, stored, and transported, as specified in this QAPP • Ensure documents are submitted for review prior to being filed in the project binder • Notify FTL/SSC, and PM of near-misses, injuries, and incidents immediately. Fill out an Incident Report Form within 24 hours of an incident. Provide additional or updated information to the Health and Safety Manager after submitting initial incident report. Collaborate on incident investigations
Chester LabNet	• Perform hexavalent chromium (Cr^{6+}) analyses following associated laboratory SOPs and QA/QC procedures • Maintain laboratory custody of samples • Adhere to all protocols in this QAPP • Prepare and submit report(s) on a weekly basis • Coordinate activities with other laboratories, as necessary
ALS	• Perform metals analyses following associated laboratory SOPs and QA/QC procedures • Maintain laboratory custody of samples • Adhere to all protocols in this QAPP • Prepare and submit report(s) on a weekly basis. • Coordinate activities with other laboratories, as necessary

1.3 Problem Definition and Background

1.3.1 Background and Objective

PCC Structurals, Inc. (PCC) is collecting air samples to determine the particulate matter less than 10 microns in aerodynamic diameter (PM_{10}) metals (inhalable coarse particles that are smaller than 10 micrometers in diameter) and total suspended particulate Cr^{6+} concentrations present in air in the vicinity of the PCC facility in southeast Portland.

Samples will be collected daily for 24 hours and subsequently analyzed for the following analytes: arsenic (As), beryllium (Be), cadmium (Cd), cobalt (Co), total chromium (Cr), lead (Pb), manganese (Mn), nickel (Ni), selenium (Se), and Cr^{6+}. A separate sampler is required for Cr^{6+} than for the other metals.

1.3.2 Source Environment Description

1.3.2.1 Topographical Description

Portland is located 60 miles east of the Pacific Ocean at the northern end of the Willamette Valley.

1.3.2.2 Land Use Description

Southeast Portland is a mix of industrial and residential facilities.

1.3.2.3 Climatological Description

The climate in the Portland area is mild. Average high daily temperature is 63.3 degrees Fahrenheit (°F), and the average low is 45.7°F, with an average of 35.98 inches of annual precipitation.

1.4 Project and Task Description

Metals and Cr^{6+} sampling will be conducted with ARA Instruments PM_{10} samplers. ARA is a designer and manufacturer of ambient monitoring equipment located in Eugene, Oregon. ARA has provided equipment to the Oregon Department of Environmental Quality and Lane County for ambient air monitoring. The monitors will be sited as much as feasibly possible according to the prevention of significant deterioration siting guidelines, in 40 *Code of Federal Regulations* (CFR) Part 58, Appendix E, "Probe and Monitoring Path Siting Criteria for Ambient Air Quality Monitoring" (1998).

Metals and Cr^{6+} will be collected every third day for up to 1 year per the U.S. Environmental Protection Agency (EPA) sampling schedule (EPA, 2017). The monitoring instruments will be set up to control the volume of air flow based on measured ambient conditions. The actual volume of air will be used to calculate the 24-hour concentration. The data management section of this document (Section 2.10) describes the data validation requirements and the criteria for calculating the 24-hour averages.

The data completeness goal for the sampling will be 80 percent completeness per quarter.

Tables 1-3 and 1-4 list the compounds and estimated method detection limit (MDL) for each proposed method.

Table 1-3. Metals by Inductively Coupled Plasma/Mass Spectrometry
Air Monitoring Quality Assurance Project Plan

Compound Name	Chemical Abstracts Service Number	MDL µg/m³	Oregon Department of Environmental Quality Ambient Benchmark Concentrations µg/m³
Arsenic	7440-38-2	0.0003	0.0002
Beryllium	7440-41-7	0.0003	0.0004
Cadmium	7440-43-9	0.0003	0.0006
Total Chromium	7440-47-3	0.0007	NA
Cobalt	7440-48-4	0.0003	0.1
Lead	7439-92-1	0.0003	0.15
Manganese	7439-96-5	0.0003	0.09
Nickel	7440-02-0	0.0003	0.004
Selenium	7782-49-2	0.002	NA

Table 1-3. Metals by Inductively Coupled Plasma/Mass Spectrometry
Air Monitoring Quality Assurance Project Plan

Compound Name	Chemical Abstracts Service Number	MDL µg/m³	Oregon Department of Environmental Quality Ambient Benchmark Concentrations µg/m³

Notes:

µg/m³ = microgram(s) per cubic meter

NA = not applicable

Table 1-4. Hexavalent Chromium by California Air Resources Board Method 039
Air Monitoring Quality Assurance Project Plan

Compound Name	Chemical Abstracts Service Number	MDL µg/m³	Oregon Department of Environmental Quality Ambient Benchmark Concentration µg/m³
Hexavalent Chromium	18540-29-9	0.000036	0.00008

1.5 Data Quality Objectives and Criteria for Measurement Data

1.5.1 Data Quality Objectives

The data quality objective (DQO) process for this project follows EPA guidance (EPA, 2002a and 2002b) and uses the seven-step DQO development process (Table 1-5). The DQOs provide a basis for the investigation activities to be performed, and ensure that data collected during the investigation will be of sufficient and adequate quality for their intended use.

Table 1-5. Data Quality Objective Development Process
Air Monitoring Quality Assurance Project Plan

Step 1: State the Problem	Representative monitored air quality data are not available for the seasonal variations that occur in this area.
Step 2: Identify the Decision	What is the air quality in the vicinity of the proposed site? Identify the range of concentrations for select pollutants in air over all seasonal conditions.
Step 3: Identify Information Inputs to the Decision	Monitor concentrations of the following pollutants: As, Be, Cd, Co, Cr, Pb, Mn, Ni, Se, and Cr^{6+}, for up to one year and compare to Oregon Ambient Benchmark Concentrations.
Step 4: Define the Boundaries of the Study	Perform sampling in the vicinity of PCC.
Step 5: Develop a Decision Rule	Collect air samples for target compounds from the identified location over a period of up to one year. Compare these data to the Oregon Ambient Benchmark Concentrations to assess local air quality.
Step 6: Specify Limits on Decision Errors	Random or systematic errors may be introduced during monitoring, data reduction, and data reporting. The QC measures set forth in this document serve to minimize these errors.
Step 7: Optimize the Design	The air monitoring procedures and location have been established to cost-effectively collect data that are of sufficient quality to fulfill the overall project objectives.

1.5.2 Data Quality Indicators

Controlling and assessing data quality to achieve the DQOs requires incorporation of appropriate data quality indicators (DQIs). DQIs relevant to this project are documented in the subsections below.

1.5.2.1 Completeness

Completeness is the ratio of the number of actual valid data points obtained through the measurement system to the number of data points expected or possible under normal conditions. Completeness will be calculated quarterly as shown in Equation 1.

$$Data\ completeness = \frac{Number\ of\ valid\ days}{Number\ of\ possible\ days}\ x\ 100 \quad (1)$$

The data completeness goal for this project is 80 percent per quarter. To comprise one valid calendar day, 18 of 24 hours of data must be valid.

1.5.2.2 Representativeness

Representativeness is a measure of the degree to which data accurately and precisely represents a characteristic of a population, parameter variations at a sampling point, a process or environmental condition. Representativeness depends on sampling and analytical variability and the variability of environmental media at the site. Representativeness is a qualitative "measure" of data quality.

The goal of achieving representative data starts with a properly designed and executed sampling program that carefully considers the overall DQOs for the project. Proper location controls and sample handling are critical to obtaining representative samples.

The goal of achieving representative data in the laboratory is measured by assessing accuracy and precision. A laboratory will provide representative data when proper analytical procedures are followed and holding times are met. In addition, laboratories must demonstrate that its staff is qualified to perform the analyses, is certified, and is proficient with analytical methods being employed.

1.5.2.3 Precision

Precision is a measure of reproducibility of analytical results. It can be defined as the degree of mutual agreement among individual measurements obtained under similar conditions. Laboratory precision will be evaluated as the relative percent difference (RPD) between duplicate samples, laboratory control sample (LCS), and LCS duplicate results.

The RPD will be calculated using the following equation:

$$RPD = \{(\left| S - D \right|)/[(S + D)/2]\} \times 100(1) \quad (2)$$

Where:

S = First sample value (original value)
D = Second sample value (duplicate value)

1.5.2.4 Bias

Bias assess whether there is a systematic deviation from the true concentration being reported. It is defined by EPA as the systematic or persistent distortion of a measurement process that causes error in one direction. Bias will be determined by estimating positive and negative deviation from the true value as a percentage of the true value.

1.5.3 Measurement Quality Objectives

Measurement quality objectives (MQOs) are identified to control and assess various elements of a data collection activity and provide the metric used to assess the DQIs above. Table 1-6 summarizes the MQOs for this project.

Table 1-6. Measurement Quality Objectives
Air Monitoring Quality Assurance Project Plan

Parameter	Requirement	Frequency	Acceptance Criteria
ARA PM_{10}	Flow Rate Verification	Once per month	+/- 6% of transfer standard
	Quarterly flow rate verification	Once per quarter	+/- 6% of transfer standard
	Temperature check	Once per month	+/- 2˚C
	Pressure check	Once per month	+/- 10 mm Hg
Metals	Precision	Duplicate samples	<20% RPD
	Completeness	Valid samples collected	>80%
Cr^{6+}	Precision	Duplicate samples	<20% RPD
	Completeness	Valid samples collected	>80%

Notes:
°C = degrees Celsius
Hg = mercury
mm = millimeter

1.6 Training

Project team members have been chosen with the necessary experience and technical skills to perform required project tasks. Personnel engaged in field activities will have the necessary experience to complete field tasks and will have completed a site-specific safety training orientation according to this QAPP and specific field procedures.

Subcontracted laboratories participating in analytical services will be certified by the National Environmental Laboratory Accreditation Program. The laboratory managers will be responsible for ensuring personnel have been properly trained and are qualified to perform their assigned tasks.

1.7 Documentation and Records

1.7.1 Field Data Reporting

Field sampling activities will be recorded in the site logbook. Unique sample identification numbers will be assigned to each sample, and will be noted in the site logbook. Site logbook entries will be described with as much detail as possible. Modifications to the sampling protocol will be documented in the site logbook.

Logbooks will be assigned to the field crew, but stored in a secure location when not in use. Field team members will record the following in the logbook: the status of equipment, the date, time, and field team member's initials, any maintenance, adjustments, out-of-control situations, relocations, downtime, or any other events pertinent to each instrument.

Entries will be made in ink, and no erasures will be allowed. If an incorrect entry is made, the information will be crossed out with a single strike mark and initialed. Any blank or unused portions of a page will be crossed out with a single diagonal line and initialed by the field personnel. Blank pages will be noted as being intentionally blank in the same manner.

Field personnel will provide comprehensive documentation of each aspect of field sampling, field calibrations, and sample chain-of-custody (COC) records. This documentation constitutes a record that allows for the reconstruction of all field events to aid in the data review and interpretation process. The documents, records, and information relating to the performance of the fieldwork will be retained in the project file. Examples of chain-of-custody forms are provided in the appendix to this QAPP.

1.7.2 Laboratory Data Reporting

Data reduction will be done manually or using appropriate application software. Quantitation procedures specified for each method will be followed. Typical calculations for analyses are based on regression analyses of calibration curves. Regression analysis is used to fit a curve through calibration standard data. Sample concentrations are calculated using the resulting regression equations. If data are reduced manually, the documentation must include the formulas used. Any application software used for data reduction must have been previously verified by the laboratory for accuracy. Documentation of the software's verification must be maintained on file in the laboratory. Documentation of data reduction must allow regeneration of the calculations.

Whenever possible, analytical data will be transferred directly from the instrument to a computerized data system. Raw data will be stored electronically and is not reported for this project. Laboratory data entered will be sufficient to document information used to arrive at reported values.

The data will undergo at least two levels of review at the laboratory before release. The analyst performing the tests initially will review 100 percent of the data. After the analyst's review has been completed, the data will be reviewed independently by a senior analyst or by the section supervisor for accuracy, compliance with calibration, and QC requirements, holding time compliance, and for completeness. Raw data will be examined to assess compliance with QC guidelines. In addition, samples and laboratory blanks will be checked for possible contamination or interferences. Analyte identification and quantitation must be verified. Calibration and QC results will be compared with the applicable control limits. Reporting limits (RLs) should be reviewed to make sure they meet the project objectives. Results of multiple dilutions should be reviewed for consistency. Any discrepancies must be resolved and corrected.

Deviations from guidelines will call for corrective action. Deviations determined to be caused by factors outside the laboratory's control, such as matrix interference, will be noted with an explanation in the report narrative. Calculations will be checked and the report reviewed for errors and oversights

Laboratory qualifiers will be applied when there are nonconformances that could potentially affect data usability. These qualifiers must be properly defined as part of the deliverables. Issues relevant to the quality of the data must be addressed in a case narrative. A copy of the data package will be filed in the project file.

Electronic data storage will be used when possible. The electronic data will be maintained in a manner that prevents inadvertent loss, corruption, and inappropriate alteration. Electronic data will be accessible and retrievable for a period of 5 years after project completion by the laboratory.

1.7.3 Electronic Analytical Record Format

The laboratory will deliver electronic data in the CH2M LabSpec7, EQuIS IV, or EQuIS V format. T

1.7.4 Project Record Maintenance and Storage

Project records will be stored and maintained in accordance with CH2M's data management plan, discussed in Section 2.10. Each project team member is responsible for filing project information or providing it to the administrative assistant familiar with the project filing system.

SECTION 2

Data Generation and Acquisition

2.1 Sampling Design and Locations

The monitors have been sited according to the prevention of significant deterioration siting guidelines in 40 CFR Part 58, Appendix E, "Probe and Monitoring Path Siting Criteria for Ambient Air Quality Monitoring," to the extent possible. The siting guidelines include placing instruments a significant distance from obstacles such as trees or buildings, large bodies of water, or other obstacles that could influence the airflow and measurements at the station.

2.2 Sampling Methods

2.2.1 Sample Preparation

Sample preparation is an essential component of sample collection. Filter samples will be prepared by the analytical laboratory, placed into cleaned cartridges, and shipped to the project office in Portland, Oregon.

2.2.2 Sample Collection

Metals – Air samples will be collected using an ARA PM_{10} ambient sampler. The sampler draws ambient air through the sample inlet onto a 47-mm-diameter Teflon sample filter. The sampler will be programmed at a flow rate of 16.7 liters per minute (lpm) for 24 (+/- 1) hours.

Cr^{6+} – Air samples will be collected using an ARA PM_{10} ambient sampler. The sampler draws ambient air through a modified sample inlet onto a 47-mm-diameter Cellulose sample filter. The sampler will be programmed at a flow rate of 15 lpm for 24 (+/- 1) hours.

2.2.3 Sample Preservation and Holding Time

Metals– Every 2 weeks, samples will be shipped at ambient temperature and analyzed within 14 days of receipt. There are no sample preservation requirements.

Cr^{6+} – Samples will immediately be placed in a cooler, transported back to the CH2M office, and stored in the project freezer. Every 2 weeks, a batch of samples will be transported in a cooler to Chester LabNet and analyzed within 14 days of receipt.

2.2.4 Field Corrective Action

Corrective action measures will be taken in the field to ensure the DQOs are attained. Potential problems and corrective actions are identified in Table 2-1.

Table 2-1. Field Corrective Action
Air Monitoring Quality Assurance Project Plan

Method	Item	Problem	Action	Documentation
Metals and Cr^{6+}	Filter inspection	Defective filter	• Reject filter	• Document in log book
Metals and Cr^{6+}	Sample Flow Rate	Incorrect flow during sample run	• Check programming of sampler • Verify flow and reset	• Document in log book • Notify field and data manager

Table 2-1. Field Corrective Action
Air Monitoring Quality Assurance Project Plan

Method	Item	Problem	Action	Documentation
Metals and Cr^{6+}	Monthly Flow Rate Verification	Incorrect flow during sample run	• Check programming of sampler • Verify flow and reset	• Document in log book • Notify field manager

2.3 Sample Handling and Custody

Sample custody procedures include the use of field logbooks, sample labels, custody seals, and COC forms. Each person involved with sample handling will be familiar with COC procedures prior to the start of field operations. A sample is considered to be in one's custody under the following circumstances:

- It is in one's actual possession.
- It is in one's view, after being in one's physical possession.
- It was in one's physical possession and that person locks it up to prevent tampering.
- It is in a designated and identified secure area.

Proper sample handling, shipment, and maintenance of a COC are key components of the quality system designed to obtain data that can be used to make project decisions. It is very important that all sample handling protocols and COC requirements be followed completely, accurately, and consistently.

A properly completed COC form will accompany samples to the laboratory. The unique sample identification numbers and descriptive identification information (for example, site location, date, and time) will be listed on the COC form. When transferring possession of samples, the individuals relinquishing and receiving them will sign, date, and note the time on the COC form.

2.4 Analytical Methods

After the samples have been properly collected and documented, they will be submitted to the selected laboratory subcontracted for analysis. Samples will be analyzed in accordance with this QAPP and laboratory SOPs. The target analytes and the required RLs have been specified in Tables 1-3 and 1-4 in Section 1.5 (Project and Task Description). A summary of the analytical methods is presented below.

Metals by Inductively Coupled Plasma/Mass Spectrometry – The filter samples are extracted using a microwave or hot acid. The resulting extract is nebulized into a radiofrequency inductively plasma where energy transfer processes cause dissolution, atomization, and ionization. The ions produced are entrained in the plasma gas and introduced by means of a water-cooled interface into a mass spectrometer. The ions produced in the plasma are sorted according to their mass-to-charge ratios and quantified with a channel electron multiplier.

Cr^{6+} by Chester LabNet Proprietary SOP based on California Air Resources Board SOP MDL 039 and ASTM D7614-12 – The filters are extracted in deionized (DI) water via sonication for 1 hour. The extract is analyzed by ion chromatography using a system comprised of a guard column, an analytical column, a post-column derivatization module, and a UV/VIS detector. In the analysis procedure, Cr^{6+} exists as chromate due to the near neutral pH of the eluent. After separation through the column, the Cr^{6+} forms a complex with the 1,5-diphenylcarbohydrazide, which can be detected at 530 nanometers.

2.5 Quality Control

Quality control (QC) is the overall system of technical activities that measures the attributes and performance of a process. QC activities are used to ensure that measurement certainty is maintained within acceptance criteria for the attainment of the DQOs.

2.5.1 Field Quality Control Procedures

Each filter is inspected before use. The ARA PM_{10} monitor's flow rate and variability in flow are reviewed for every 24-hour sample. The instrument's temperature, pressure, and flow rate are verified against a National Institute of Standards and Technology (NIST) traceable flow meter at least once per month. The criteria for data validation are outlined in Table 1-6 (Measurement Quality Objectives).

2.5.2 Laboratory Quality Control Procedures

Day-to-day QC is implemented through the use of various check samples or instruments that are used for comparison. Each analytical laboratory will have a QC program to assess the reliability and validity of the analyses being performed. The purpose and creation of QC samples is discussed and summarized below. Laboratory QC checks indicate the state of control that prevailed at the time of sample analysis. Field-originated blanks provide a way to monitor for potential contamination to which field samples are subjected. A minimum summary of QC requirements is outlined below. The analytical laboratories may perform more QC activities, according to their internal laboratory SOPs.

QC will be conducted in accordance with method specifications including, but not limited to the following:

- Method blanks
- Initial calibrations
- Continuing calibrations
- Replicates
- LCS
- Internal standards for inductively coupled plasma mass spectrometry (ICP/MS)

A laboratory QC batch is defined as a method blank, LCS, and a sample duplicate or replicate, depending on the method and 20 or fewer environmental samples of similar matrix that are extracted or analyzed together. Each preparation or analytical batch will be identified in such a way as to be able to associate environmental samples with the appropriate laboratory QC samples.

QC checks, minimum frequencies, acceptance criteria, corrective actions, and validation flagging criteria are included in Tables 2-2 and 2-3. Results detected between the RL and detection limit will be reported with a "J" qualifier. Nondetected parameters will be reported as the RL with a "U" qualifier.

Table 2-2. Quality Control Checks for Metals in Air by Inductively Coupled Plasma/Mass Spectrometry
Air Monitoring Quality Assurance Project Plan

Quality Control Check	Frequency	Data Quality Indicator	Criteria	Corrective Action
Initial Calibration - minimum of five levels	Initially and if continuing calibration no longer meets criteria	Accuracy	R2≥0.995 (linear regression)	Inspect the system for problems and perform required maintenance. Repeat initial calibration. Problem must be corrected. Samples may not be analyzed until there is a valid ICAL.
Initial Calibration Verification	Following every ICAL	Accuracy	%Difference ±10% from	Correct problem and verify second source standard. Rerun second source verification. If that fails,

Table 2-2. Quality Control Checks for Metals in Air by Inductively Coupled Plasma/Mass Spectrometry
Air Monitoring Quality Assurance Project Plan

Quality Control Check	Frequency	Data Quality Indicator	Criteria	Corrective Action
			expected concentration	correct problem and repeat initial calibration. Problem must be corrected. Samples may not be analyzed until there is a valid ICV.
Continuing Calibration Verification	Initial run of batch, every 10 samples	Accuracy	%Difference (%D) ±10% from expected concentration.	Reanalyze CCV. Identify and correct problem; reanalyze or where appropriate qualify the data. Repeat initial calibration if CCV corrective action is unsuccessful.
Method Blank	One per batch of samples (a batch cannot exceed 20 samples)	Contamination/Bias	No target analytes detected > RL	Note in case narrative and QC report summary.
Laboratory Control Sample	One per batch of samples	Accuracy	70-130 %R	Note in case narrative and QC report summary.
Laboratory Control Sample Duplicate	One per batch of samples	Precision	≤20 %RPD	Note in case narrative and QC report summary.

Notes:

%R = percent recovery

CCV = continuing calibration verification

ICAL = initial calibration

ICV = initial calibration verification

Table 2-3. Quality Control Checks for Cr^{6+} by Chester LabNet Proprietary SOP based on California Air Resources Board Method 039 and ASTM D7614-12
Air Monitoring Quality Assurance Project Plan

Quality Control Check	Frequency	Data Quality Indicator	Criteria	Corrective Action
Initial Calibration – minimum of five levels	Initially and if continuing calibration no longer meets criteria	Accuracy	R2≥0.995 (linear regression)	Inspect the system for problems and perform required maintenance. Repeat initial calibration. Problem must be corrected. Samples may not be analyzed until there is a valid ICAL.
Initial Calibration Verification	Following every ICAL	Accuracy	%R 90-110%	Reanalyze ICV. If no change, remake ICV/CCV solution and reanalyze. If no change, recalibrate. Problem must be corrected. Samples may not be analyzed until there is a valid ICV.
Continuing Calibration Verification	Initial run of batch, every 10 samples, and end of batch (all samples must	Accuracy	%R 90-110%	Reanalyze CCV. Identify and correct problem; reanalyze or where appropriate qualify the data. Repeat initial calibration if CCV corrective action is

Table 2-3. Quality Control Checks for Cr^{6+} by Chester LabNet Proprietary SOP based on California Air Resources Board Method 039 and ASTM D7614-12
Air Monitoring Quality Assurance Project Plan

Quality Control Check	Frequency	Data Quality Indicator	Criteria	Corrective Action
	be bracketed by two CCVs)			unsuccessful. Do not run samples if a CCV is out of control.
Laboratory Method Blank	Once every analytical batch of 20 or fewer samples	Contamination	No detected result greater than the method reporting limit	Reanalyze blank. Identify and correct problem. Reanalyze blank and affected samples. Qualify data, if necessary.
Laboratory Control Sample	Once every analytical batch of 20 or fewer samples	Accuracy/Bias	%R 80-120%	Reanalyze. Identify and correct the problem. Qualify data.
Laboratory Control Sample Duplicate	Once every analytical batch of 20 or fewer samples	Precision	≤20 %RPD	Reanalyze. Identify and correct the problem. Qualify data.

2.5.3 Quality Control Analyses/Parameters

QC samples will be collected to determine the accuracy and precision of the analytical results. The QC sample frequencies are as stated in Tables 2-2 and 2-3. Sampling activities will be conducted in accordance with the health, safety, and environment plan, and sample handling procedures will be performed in accordance to those specified in this QAPP.

2.5.4 Quality Control Analyses/Parameters Originated by the Laboratory

2.5.4.1 Method Blank

Blanks are used to monitor each preparation or analytical batch for interference and/or contamination from glassware, reagents, and other potential sources within the laboratory. A method blank is comprised of a blank impregnated filter that has never left the custody of the laboratory. This filter is taken through the entire extraction/analysis process. There will be at least one method blank per preparation or analytical batch. If a target analyte is found at a concentration in excess of that allowed, then corrective action must be performed to identify and eliminate the contamination source. No analytical data may be corrected for the concentration found in the blank.

2.5.4.2 Initial Calibration

A set of standards of known concentration and accuracy is used to establish a calibration curve. An ICV is a second source standard of known concentration and accuracy to verify the initial calibration.

2.5.4.3 Continuing Calibration

CCVs are performed with each analytical batch to verify that the initial calibration is still valid. This standard must be prepared from a difference stock source than the calibration standards and is typically a concentration in the mid-point of the calibration curve.

2.5.4.4 Laboratory Control Sample

The LCS will consist of a spiked blank filter that has never left the analytical laboratory. The filter will be spiked and taken through the entire extraction/analytical process. If LCS results are outside the specified control limits, the LCS will be reanalyzed. If still out of control, results will be flagged and noted in the case narrative.

2.5.4.5 Laboratory Replicate

A sample duplicate selected by the laboratory is called a laboratory replicate or duplicate. A duplicate aliquot of the sample extract is analyzed. The RPD between the results of the native sample and laboratory sample duplicate measures the precision of sample results.

2.5.4.6 Internal Standards

Internal standards are used in ICP/MS to determine the physical interferences or affects associated with the sample nebulization and transport processes as well as ion transmission efficiencies. These physical effects can include surface tension and viscosity of the sample matrix. Internal standards must be affected to the same degree as the analyte of interest to demonstrate that they compensate for these interferences. A minimum of three internal standards is used during data acquisition for any sample analyzed by ICP/MS. When the intensity level of an internal standard is less than 70 percent of the intensity of the zero standard used during calibration (calibration blank), the sample must be reanalyzed for the affected analytes after performing a fivefold dilution

2.6 Instrument and Equipment Testing, Inspection, and Maintenance

A preventive maintenance program consists of positive actions aimed toward preventing and detecting failure of monitoring systems. The overall objective of a routine preventive maintenance program is to increase measurement system reliability and provide complete data acquisition. Preventive maintenance schedules for monitoring instruments will be in accordance with the manufacturer's recommendations as noted in the instrument manuals. Only qualified personnel will service instruments and equipment. Maintenance actions, scheduled or unscheduled, will be documented in the project logbook.

2.7 Instrument and Equipment Calibration and Frequency

2.7.1 Field Equipment

The ARA PM_{10} samplers will be tested on a monthly basis for the duration of the project. Parameters that will be investigated include ambient temperature, barometric pressure, and flow rate. A single-point check of ambient pressure and ambient temperature sensors is performed using NIST-traceable standards. Acceptance criteria are 10-mm Hg for pressure, and +2°C for temperature. Results will be documented in the logbook

The single-point flow check is performed using a primary flow meter, which is calibrated or certified annually against a NIST-traceable standard. If the results of the flow check do not fall within the project's warning threshold of ± 4 percent, then the instrument is adjusted and rechecked. The criterion of ±6 percent is used for data validation.

Field blanks will be collected once per month. The operator will treat this sample filter or cassette in the same manner as a regular filter or cassette used for sampling with the sole exception that it will not be used to collect a sample. The field blank sample filter or cassette is to be loaded and unloaded from the

sampler, transported, stored, and shipped as usual, but the sampler will not be programmed for a sampling event using this sample filter or cassette.

2.7.1.1 Quarterly Verification Procedures

Every 3 months, the sampler's interior and PM_{10} inlet will be inspected for cleanliness and condition, after an as-is calibration verification check for temperature, pressure, and flow has been performed. If any of the sampler's calibrated systems fail to meet the MQOs presented in Table 1-6, the parameters may be adjusted to bring it within specification.

2.7.2 Laboratory Instruments

The instrument calibration procedures are described in the internal laboratory SOPs. Records of calibrations will be filed and maintained by the laboratory. These records will be subject to QA audit. The standards used to calibrate equipment will be traceable, directly or indirectly, to the NIST. Each standard received will be logged into standard receipt logs maintained by the individual analytical groups. Each group maintains a standards log that tracks the preparation of standards used for calibration and QC purposes.

2.8 Inspection and Acceptance of Supplies and Consumables

Consumables will be inspected to assure that the quality and function will adhere to the standards necessary to meet project objectives.

47-mm teflon filters will be visually inspected for defects and defective filters will be returned to the laboratory.

47-mm cellulose filters will be visually inspected for defects by the laboratory before loading into filter cassettes. Defective filters will not be loaded into filter cassettes.

2.9 Nondirect Measurements

Data required for project implementation and decision making that are not obtained from direct measurements include historical records, chemical and physical properties, geographic information, meteorological information, and external databases. These data will be obtained from nationally and/or internationally recognized sources such as:

- ASTM
- International Organization for Standardization
- NIST
- EPA
- U.S. Geological Survey
- U.S. Weather Service

2.10 Data Management

Data management entails storing, handling, accessing, and securing data collected during the project. Data gathered during this project will be consolidated and compiled into a project database that can be used to support project data reporting and exports. The following sections describe the project's data management process. The field team member is the first level of data screening, and the data manager or QA manager are the last. This section describes the necessary tasks to manage the project data in a reliable manner.

2.10.1 Field Data

Data management begins in the field at the monitoring site. The field team member will enter relevant sample collection information into the site logbook each time he/she visits the monitoring station.

For the duration of this monitoring project, data will be downloaded manually via USB by the site operator during each site visit. The site operator will upload this data to the project database for review by the data manager. The data manager checks the data for flags set by the instrument's internal logger. To comprise one valid calendar day, 18 of 24 hours of data must be valid. The project has a data completeness goal of 80 percent completeness per quarter. That is, if 80 percent of total days of operation for the monitoring period are valid, the monitoring for that period should be considered valid. The data manager will review the results from the field QA checks performed on the monitor as well as the performance audit results for further determination of data validity.

2.10.2 Laboratory Data

The data flow from the laboratory and field to the project staff and data users will be sufficiently documented to ensure that data are properly tracked, reviewed, and validated for use. In addition to the data management procedures outlined in Section 2.10 for analytical data, the laboratory will ensure that it maintains electronic records sufficient to recreate each analytical event. The minimum records the laboratory will keep contain the following:

- Raw data, including instrument printouts, bench worksheets, and compound identification and quantitation reports
- Laboratory-specific written SOPs for each analytical method and QA/QC function in place at the time of analysis of project samples

2.10.3 Data Reporting

Monthly data reports will be prepared that summarize the data gathered and discuss data validation and QA activities. The results of any performance audits and calibration certifications will be presented. The data will be presented in electronic format.

2.10.4 Archiving

Electronic versions will be archived in project files for the duration of the project, 5 years, or as specified in contractual agreements.

SECTION 3

Assessment and Oversight

3.1 Assessments and Response Actions

An assessment is defined as an evaluation process used to measure the performance or effectiveness of the quality program. The results of QA assessments indicate whether the control efforts are adequate or need to be improved. Documentation of QA/QC efforts implemented during the data collection, analysis, and reporting phases is important to data users, who can then consider the impact of these control efforts on the data quality.

Project assessments will be performed on an as-needed basis to evaluate the quality system. The purposes of the assessment are as follows:

- Confirm appropriate documents are properly completed and are kept current and orderly.
- Ensure measurement systems are accurate.
- Identify nonconformance or deficiencies and to initiate necessary corrective actions.
- Verify that QA procedures called for in this QAPP are properly followed and executed.

The senior technical consultant is responsible for ensuring conformance with the QAPP. Documents and records will be examined as necessary to evaluate whether the QA program is effective and properly implemented. Reports and recommendations must be prepared on each audit and submitted to the QA manager for retention in the project files.

3.2 Field Audits

Audit procedures for the ARA PM_{10} sampler call for comparing the audit flow rate measured by the audit device to the indicated sampler flow rate. Flow rates measured in lpm are compared at actual conditions of temperature and pressure. Field measurements of temperature and pressure are recorded using certified equipment traceable to NIST standards. The difference between the audit flow and the ARA PM_{10} sampler's indicated flow must be within ±6 percent to pass the audit. Audits will be performed quarterly by personnel not involved in daily operation of the station using equipment not used for the monthly calibration.

3.3 Laboratory Audits and Corrective Action

The laboratories utilized for this project are accredited by the National Environmental Laboratory Accreditation Program and are subject to external audits. Laboratory audits may be performed prior to the start of analyses for this project and at any time during the course of the project as deemed necessary.

Any project team member may initiate a field corrective action process. The corrective action process consists of identifying a problem, acting to eliminate the problem, monitoring the effectiveness of the corrective action, verifying that the problem has been eliminated, and documenting the corrective action.

Technical staff and project personnel will be responsible for reporting suspected technical or QA nonconformances or suspected deficiencies to the QA manager. If it is concluded that the situation warrants a reportable nonconformance requiring corrective action, a nonconformance report will be initiated by the QA manager.

The QA manager will be responsible for ensuring that corrective action for nonconformances are initiated by the following:

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

SECTION 4

Data Review, Validation, and Usability

4.1 Data Review and Validation

Data review and validation are the processes by which data generated in support of a project are reviewed against the data QA/QC requirements. The data are evaluated for precision and accuracy against the analytical protocol requirements. Nonconformance or deficiencies that could affect the precision or accuracy of the reported result are identified and noted in the laboratory case narrative. The effect on the result is then considered when assessing whether the result is sufficient to achieve DQOs. Deficiencies discovered as a result of data validation and review, as well as corrective actions implemented in response, will be documented and submitted as part of the project report.

4.2 Verification and Validation Methods

4.2.1 Verification

Personnel involved in the data verification function are the same as those generating the data. Before the data packages are released from the laboratory, the laboratory chemist is responsible for review and verification of the data. These procedures include the following:

- Review the data package for completeness. Results must be generated for samples submitted for analysis.
- Review COC records for discrepancies.
- Review for compliance with holding time and QC frequency requirements.
- Review QC sample results. Any exceedances must be documented in the case narrative. Corrective action must be taken as appropriate and may include qualifying (flagging) the data.
- Initiate corrective actions, as necessary, based on the data review findings. If there are exceedances that have a significant effect on data usability, then their effect on the data is discussed in a report section.

4.2.2 Validation

Laboratory data validation will be conducted by a CH2M project chemist or designee not directly involved with data collection or the site investigation. The electronic data deliverable provided by the laboratory will be entered into a data validation program and the program will be used to identify data that should either be qualified or rejected for project use. Data qualifiers will be added to the validated data and a report of changed data qualifiers obtained from the software.

CH2M will perform Stage 2A data validation in accordance with the procedures outlined in the *Guidance for Labelling Externally Validated Laboratory Analytical Data for Superfund Use* (EPA, 2009). The data will also be evaluated in accordance with the criteria contained in the *National Functional Guidelines for Inorganic Superfund Data Review* (EPA, 2014), and laboratory QC criteria (as applicable for each analytical method used). Validation will include the review of the following QC elements:

- COC records
- Case narrative
- Proper sample collection and handling procedures
- Holding times

- Field QC results
- Laboratory blank analysis
- MDLs and RLs
- Laboratory duplicate precision
- Matrix spike/matrix spike duplicate recoveries
- LCS recoveries
- Data completeness

Qualifiers will be added to data during validation as necessary. Qualifiers that may be applied to the data as a result of data validation will be limited to:

- U - The analyte was analyzed for but was not detected above the detection limit.
- J - The analyte was detected, but the associated numerical value is considered an estimated quantity.
- UJ -The analyte was not detected above the detection limit. However, the detection limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.
- R - The sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet QC criteria. The presence or absence of the analyte cannot be verified. No associated value is reported.

The corrective action and flagging criteria listed in the National Functional Guidelines (EPA, 2014) will be used as guidance for applying the above flags to the sample results.

4.3 Reconciliation with Data Quality Objectives

This process is intended to assess whether the data meet the planned DQOs for the project. The results are examined and an assessment is made to determine whether the data are of sufficient quality to support the DQOs. The data will be evaluated according to the DQIs and MQOs, as stated in Section 1.6 (Data Quality Objectives and Criteria for Measurement Data). If the data are sufficient to achieve project objectives, the PM will release the data and decisions may be made. If not, then corrective action may be required.

SECTION 5

References

U.S. Environmental Protection Agency (EPA). 2002a. *Guidance for Quality Assurance Project Plans*. EPA QA/G-5 (EPA 240/R-02/009). December.

U.S. Environmental Protection Agency (EPA). 2002b. *Quality Assurance Guidance Document - Model Quality Assurance Project Plan for the National Air Toxics Trends Stations*. EPA 454/R-02-007. December.

U.S. Environmental Protection Agency (EPA). 2009. *Guidance for Labelling Externally Validated Laboratory Analytical Data for Superfund Use.* EPA 540-R-08-005. January.

U.S. Environmental Protection Agency (EPA). 2014. *National Functional Guidelines for Inorganic Superfund Data Review*. August.

U.S. Environmental Protection Agency (EPA). 2017. *Ambient Monitoring Technology Information Center (AMTIC) Sampling Schedule Calendar*. July 17. Accessed November 2017. https://www3.epa.gov/ttn/amtic/calendar.html.

Appendix
Examples of Chain-of-Custody Forms

Company Name		
Contact	Phone	
E-Mail Address	Fax	
Report Address		
City	State	Zip
Billing Address		
City	State	Zip
PO #	Project	

CHESTER LabNet
12242 SW Garden Place
Tigard, OR 97223
(503) 624-2183
Fax (503) 624-2653
cln@chesterlab.net

CHAIN-OF-CUSTODY RECORD

LabNet ID	Field Sample ID	Site	Sample Date	Volume (m^3)	Particle Size	Analysis Requested										Remarks

Turn Around Time
☐ **Standard**
☐ **Rush** _____ (Specify)

Relinquished By: (Signature) Date/Time	Received By: (Signature) Date/Time	**Notes:**
Relinquished By: (Signature) Date/Time	Received By: (Signature) Date/Time	

[For lab use only]

ANALYTICAL REQUEST FORM

1. ☐ **REGULAR Status**

☐ **RUSH Status Requested - ADDITIONAL CHARGE**
RESULTS REQUIRED BY _____
DATE
CONTACT ALS SALT LAKE PRIOR TO SENDING SAMPLES

2. Date _____ Purchase Order No. _____

3. Company Name _____

Address _____

_____

Person to Contact _____

Telephone ( ) _____

Fax Telephone ( ) _____

E-mail Address _____

Billing Address (if different from above)

_____

_____

_____

4. Quote No. _____

ALS Project Manager _____

5. **Sample Collection**

Sampling Site _____

Industrial Process _____

Date of Collection _____

Time Collected _____

Date of Shipment _____

Chain of Custody No. _____

6. How did you first learn about ALS?

_____

_____

7. **REQUEST FOR ANALYSES**

Laboratory Use Only	Client Sample Number	Matrix*	Sample Volume	ANALYSES REQUESTED - Use method number if known	Units**

* Specify: Solid sorbent tube, e.g. Charcoal; Filter type; Impinger solution; Bulk sample; Blood; Urine; Tissue; Soil; Water; Other

** 1. µg/sample 2. mg/m^3 3. ppm 4. % 5. $\mu g/m^3$ 6. _____ (other) Please indicate one or more units in the column entitled Units**

Comments _____

_____

Possible Contamination and/or Chemical Hazards _____

7. **Chain of Custody (Optional)**

Relinquished by _____ Date/Time _____

Received by _____ Date/Time _____

Relinquished by _____ Date/Time _____

Received by _____ Date/Time _____

960 West LeVoy Drive / Salt Lake City, UT 84123 **800-356-9135 or 801-266-7700 / FAX: 801-268-9992**
ALS Environmental