Site-Specific Addendum to Arizona Department of Environmental Quality Remedial Projects Section Quality Assurance Program Plan

Incremental Sampling Methodology
Sampling and Analysis Plan for the Humboldt Smelter

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ACRONYMS AND ABBREVIATIONS

Acronyms/Abbreviations	Definition
%R	percent recovery
95 UCL	95th percentile upper confidence limit on the mean
ADEQ	Arizona Department of Environmental Quality
ADHS	Arizona Department of Health Services
ALM	Adult Lead Model – 2017 Model Version
APNs	Assessor Parcel Numbers (Yavapai County)
ARAR	Applicable or Relevant and Appropriate Requirement
bgs	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COC	chemical of concern
DQO	data quality objective
EAL	environmental action level
EDD	electronic data deliverable
EHQ	ecological hazard quotient
ELCR	excess lifetime cancer risk
FS	Feasibility Study
ft^2	square foot
GC	gas chromatography
GC/MS	gas chromatography/mass spectrometry
GPS	global positioning system
HASP	Health and Safety Plan
HI	hazard index
IDW	investigation-derived waste
IEUBK	integrated exposure update biokinetic (model for lead)
IKM-HS	Iron King Mine-Humboldt Smelter
LCS	laboratory control sample
LCSD	laboratory control sample duplicate
MDL	method detection limit
µg/kg	microgram per kilogram
µg/L	microgram per liter
mg/kg	milligram per kilogram
mg/L	milligram per liter

Acronyms/Abbreviations	Definition
MS	matrix spike
NHPA	National Historic Preservation Act
NPL	National Priorities List
OSHA	occupational safety and health administration
PARCC	precision, accuracy, representativeness, comparability, and completeness
PP Metals	Priority Pollutant Metals
PPE	personal protective equipment
PRG	Preliminary Remediation Goal
QA	quality assurance
QAP	Quality Assurance Program
QAPP	Quality Assurance Program Plan
QAPP-A	Quality Assurance Program Plan Addendum
QC	quality control
RA	Remedial Action
RD	Remedial Design
RI	Remedial Investigation
RL	reporting limit
ROD	Record of Decision
RPM	Remedial Project Manager
RPD	relative percent difference
TAT	turn-round time
USEPA	United States Environmental Protection Agency
XRF	x-ray fluorescence

1.0 INTRODUCTION

Tetra Tech, Inc. (Tetra Tech) has prepared this *Site-Specific Addendum to Arizona Department of Environmental Quality* (ADEQ) *Remedial Projects Section* (RPS) *Quality Assurance Program Plan* (QAPP) - *Incremental Sampling Methodology* (ISM) *Sampling and Analysis Plan for the Humboldt Smelter*, here-forward referred to as a QAPP-A, to provide a path forward to investigate potential data gaps in areas of the former Humboldt Smelter property. The QAPP-A presents an ISM[1] approach, which will be used to determine areas of the former Humboldt Smelter property which may require decisions made and/or action taken during the Remedial Design/Remedial Action (RD/RA) phase of work at the United States Environmental Protection Agency (USEPA) former Iron King Mine-Humboldt Smelter (IKM-HS) Superfund Site. This document has been developed to work in coordination with, and as an addendum to, the ADEQ RPS QAPP approved by the USEPA in 2023.

The former IKM-HS properties lie within the boundary of Dewey-Humboldt in Yavapai County, Arizona. Dewey-Humboldt covers an area of approximately 19 square miles or 12,000 acres and is at an elevation of approximately 4,600 feet above mean sea level and is approximately 85 miles north of Phoenix. Highway 69 bisects the town north to south and separates IKM from the Humboldt Smelter property and its associated parcels.

The Humboldt Smelter property lies about a half mile east of Highway 69 and is made up of several Yavapai County parcels, assigned Assessor Parcel Numbers (APNs). No active facilities or businesses currently operate on the Humboldt Smelter property, though remnants from at least three former smelter operations remain. The Humboldt Smelter property is bounded by the Agua Fria River to the east, Chaparral Gulch to the south, and residential areas of Dewey-Humboldt to the north and west.

The Humboldt Smelter property is separated into three topographic features (see **Figure A**, on the following page). On the west end of the property is a depression that contains mine tailings, referred to as the smelter tailings swale. These tailings and from ore processing activities at the smelter property itself. On the southwestern portion of the property lie tailings from a different source, the result of a tailings dam release at the IKM which crossed Highway 69 and impacted Chaparral Gulch. The center of the property is a high plateau on which most of the smelting took place. And on the smelter plateau, there are contaminated soils and a waste material called dross (a fine-grained, grey colored waste) imported from a metals reprocessing facility after the smelter closed. Also present is loose, pulverized slag, a waste that is essentially a hardened man-made lava which remains after molten metals of interest are removed and concentrated during smelting. The east end of the property is the Agua Fria River and a canyon. A large deposit of hardened smelter slag hangs from the plateau above the river.

[1] ISM is a structured, composite, sampling and processing protocol that reduces data variability and provides a reasonably unbiased estimate of mean contaminant concentrations in a volume of soil targeted for sampling (ITRC, 2020).

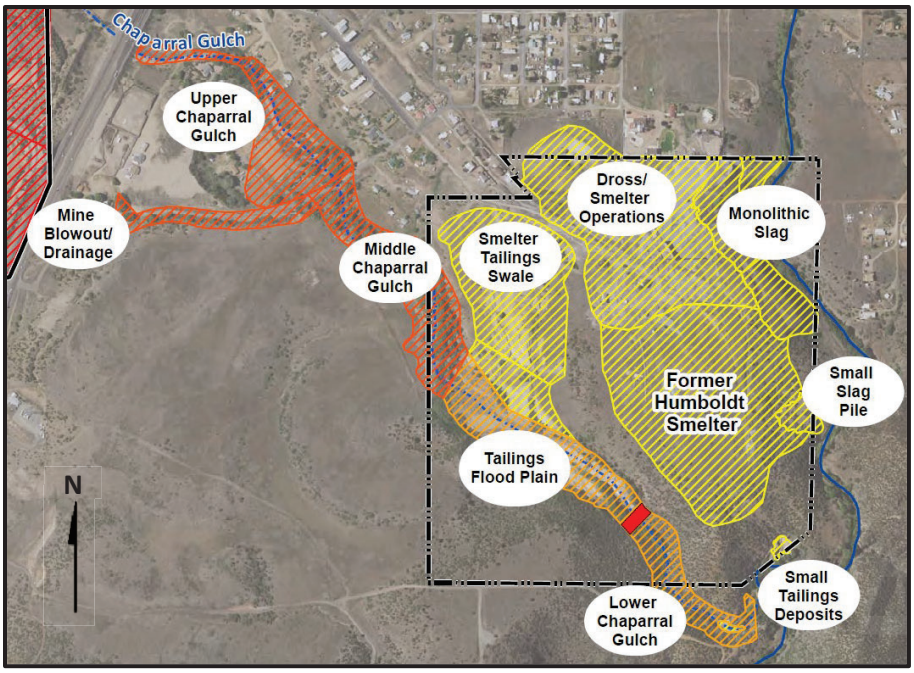

Figure A: General Humboldt Smelter Features
(Image Credit: Tetra Tech, 2020; trimmed from Figure ES-1)

The target parcels which will be investigated during the Humboldt Smelter ISM project (here-forward referred to as the HS-ISM Project) include the following Yavapai County APNs with their respective ownership-type in parentheses:

- Residential:
  - APN 402-11-001 (private entity)
  - APN 402-11-002 (private entity)
  - APN 800-27-004U (Town of Dewey-Humboldt right-of-way)
  - APN 402-11-044 (a portion of a parcel owned by Greenfields[2], on east side of river)
  - APN 402-01-046 (a portion of a Greenfields parcel, on east side of river)
- Industrial:
  - APN 402-11-044 (the majority of a Greenfields parcel, on west side of river)
  - APN 402-01-046 (a portion of a Greenfields parcel, on west side of river)
  - APN 402-06-027 (Greenfields)
  - APN 402-06-027A (Greenfields)
  - APN 402-11-031B (private entity)
  - APN 800-05-003A (BLM)
  - APN 800-27-005T (Town of Dewey-Humboldt right-of-way)

[2] Greenfields Enterprises LLC, an entity which owns the majority of the land encompassed by the Humboldt Smelter property.

The HS-ISM Project area is illustrated on the attached **Figure 1**. As indicated, the majority of the investigation area lies on the west side of the Agua Fria River, on the former Humboldt Smelter property. However, note that there are parcels included on the east side of the Agua Fria River as well. These parcels have been included because they potentially lie in an area where wind-borne deposition may have occurred.

2.0 BACKGROUND

A detailed history of the IKM-HS site, including operations and activities which took place on the Humboldt Smelter property, can be found in the IKM-HS Remedial Investigation Report (CH_2M, 2016) and Feasibility Study (Tetra Tech, 2022).

2.1 Physical Setting

The IKM-HS site is generally separated into three distinct geographic categories:

- The former IKM: Located on the west side of Highway 69 and consisting of multiple Yavapai County parcels. The IKM property has historically been referred to geographically as the area of mine tailings pile, mineworks, and waste rock at the former mine, and contaminated soils in open areas north and south of the mine.
- The former Humboldt Smelter property: Located on the east side of Highway 69 and consisting of multiple Yavapai County parcels. The Humboldt Smelter property has historically been referred to geographically as the area on the plateau above Chaparral Gulch and the Agua Fria River. The area consists of contaminated smelter operational areas, waste dross, slag, demolished former smelter structures, and contaminated soil on the plateau above Chaparral Gulch and the Agua Fria River.
- Chaparral Gulch: Specifically, the area of the gulch on the east side of Highway 69 to the Agua Fria River. Tailings are found throughout this area from a breached tailings impoundment originating across Highway 69 at the IKM. The gulch sits in a flood plain with intermixed tailings from the former mine and from former smelter activities. A dam was built to hold back the tailings from entering the Lower Chaparral Gulch upstream of the confluence of the gulch with the Agua Fria River.

2.2 Basic Geology

The basic geology of the Humboldt Smelter property is as follows (illustrated on **Figure B**):

- The upper member of the Hickey formation is a sequence of overlapping alluvial fan deposits that are exposed over a wide area of the site.
- The middle member of the Hickey formation consists of basaltic flows, ash, and cinders that commonly occur at the base of the unit.

- The lower member of the Hickey formation consists of poorly sorted conglomerate with discontinuous gravel layers cemented with a calcareous matrix.

- The Spud Mountain Series crops out near the eastern boundary of the former Humboldt Smelter property, and in uplands farther east of the Agua Fria River. This geology is characterized by interbedded pelitic and tuffaceous metasediments, metatuffs, metamorphosed basalt, and andesite flows. These rocks crop out near the eastern boundary of the former Humboldt Smelter property, and in uplands farther east of the Agua Fria River (Tetra Tech, 2022).

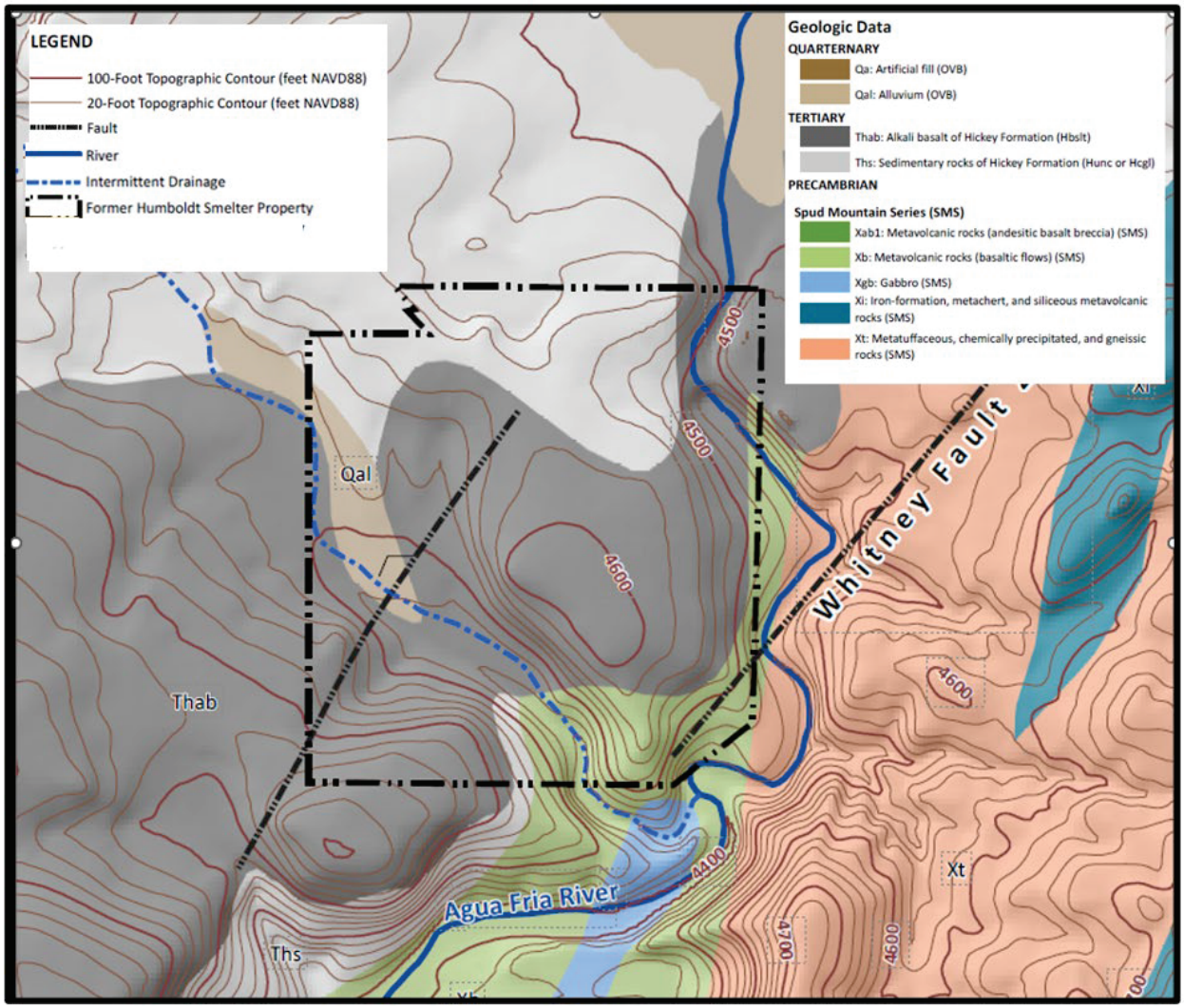

Figure B: General Geology of HS-ISM Project Area

2.3 Summary of Investigation Milestones

Table 1: IKM-HS Investigation Milestones

Investigation Milestone	Reference Document
IKM-HS listed as a National Priorities List (NPL) site	USEPA, 2008
Remedial Investigation (RI)	CH2M, 2016
Feasibility Study (FS)	Tetra Tech, 2022
Proposed Plan	USEPA, 2023a

3.0 PROJECT DESCRIPTION AND SAMPLING DESIGN

3.1 Project Description

From the late 1800s until about 1937, the former three smelting facilities were located on the Humboldt Smelter property. These facilities crushed rock ores containing copper and lead and melted them in furnaces. The most well-known smelter of the three is the Humboldt Smelter, which operated from approximately 1906 until 1937. The Humboldt Smelter was located on a high and flat plateau at the smelter property. In addition to smelting, the Humboldt Smelter also did ore concentrating which resulted in tailings waste on the Humboldt Smelter property. After the smelter facility was demolished in the late 1930s, additional ore processing continued in 1940s in the same area, adding additional tailings to the depression. Later still, waste aluminum dross was imported to, and deposited on, the Humboldt Smelter property. Many of the buildings associated with Humboldt Smelter were demolished and removed by 1937. In 2022, ADEQ took down the remaining Humboldt Smelter smokestack and converter flue. Upon completion of the smelter dismantling, all brick debris was consolidated in place around the stack foundation and encapsulated utilizing sprayed concrete. Additional fencing was installed within the smelter plateau to deter trespass. Finally, due to the overall condition of existing dust-control cover (Posi-Shell®) at the site, existing Posi-Shell® installed in 2019 was repaired or amended in 2022.

The USEPA has recently completed the FS and Proposed Plan for the remediation of the IKM-HS. To assist EPA in preparing for remedial design by 2024, ADEQ has requested pre-design assessment activities be completed at the IKM-HS to characterize any remaining data gaps and determine required permits necessary to move the project forward. ADEQ has requested Tetra Tech focus pre-design assessment to Alternative 3B from the FS, which proposes the construction of two repositories on the east (Smelter Tailings Swale Repository) and west (the Main Tailings Pile Repository) side of the of Highway 69, with waste being placed in the repository on the side of the highway where the waste is currently located.

The goal of the HS-ISM Project is to collect additional characterization data from potential wind entrainment, as well as other operations activities, which may have caused impact to areas of the

Humboldt Smelter property. The Data Quality Objectives (DQOs) proposed to meet this objective are discussed in detail in **Section 5.1**.

3.2 Project Plan and Sampling Design

The soil samples collected during this investigation will provide information to further characterize the Humboldt Smelter property. The data collected will assist the USEPA in assessments for risk management decisions[3] at decision points during the HS-ISM Project investigation, and later during the Remedial Design/Remedial Action (RD/RA) phase of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) process.

Figure 1 illustrates the HS-ISM Project area, and **Figure 2** presents the DUs to be evaluated across the HS-ISM Project area. As shown in **Table 2**, below, the total number of DUs proposed for evaluation is as follows:

Table 2: Decision Unit Count

Residential			
Acres	**1/4-acre DUs at 0 to 6" depth**	**1/4-acre DUs at 6 to 12" depth**	**Total DUs**
8.25	33	33	66
Industrial			
Acres	**1-acre DUs at 0 to 6" depth**	**1-acre DUs at 6 to 12" depth**	**Total DUs**
54	54	54	108

The actual total number will be contingent on final QAPP-A approval, as well as access agreements in place at the start of the field sampling program.

The following bullets present a summary of the proposed sampling plan, the steps of which will be expounded upon in greater detail in the DQOs detailed in **Section 5.1** and in the Project Quality Control (QC) Objectives presented in **Section 5.2**:

- For the initial investigation activities[4], the DU sizes will be:
    - Residential: 0.25 acres

[3] Although risk management and risk assessments often go together, risk management decisions are not intrinsically linked to risk assessments and can be based on multiple investigation types and collected lines of evidence. USEPA defines risk management as a distinctly different process from a risk assessment (USEPA, 2023b). Risk management is a process where the results of investigations are integrated with other considerations, such as economic or legal concerns, to reach decisions regarding the necessity and practicability of implementing various risk-reduction activities. These decisions are referred to as "risk management decisions".

[4] The proposed investigation activities will be conducted in a minimum of two phases, as detailed in this QAPP-A.

- Industrial: 1 acre

- Using a hand-held drill auger and bucket, samples will be collected at 0 to 6 inches below ground surface (bgs) and 6 to 12 inches bgs. This will result in two "parent" samples collected per DU, not inclusive of replicates, which are discussed in the next bullet. The samples will be named as detailed in **Section 7.3**. Details on sample collection tools and methodology are included in Section **3.3**.

- Replicate sampling is proposed to occur initially in approximately 11.5% of the total DUs. As prescribed by ISM guidance (ITRC, 2020; HDOH, 2021), the use of replicates produces a more complete data set and supports more defensible decisions, but the need and number of replicate samples necessary to meet DQOs and quality control (QC) requirements are project-specific decisions. Further detail on field replicates and their role in QC of data, is detailed in **Section 5.2.1**.

- Replicates will be collected from approximately 11.5% of the total the DUs, represented by 8 residential DUs and 12 industrial DUs, **at the start of the project**, as shown in **Table 3**, below. The rationale for this is to allow for an evaluation of the replicates at the start of the project. Replicate samples will consist of increments collected by stepping out in two different directions within a few feet from each original (parent) increment location. Each replicate sample will consist of the same number of increments as the parent sample but from different locations and with the same overall increment coverage or spacing.

Table 3: Decision Unit Replicate Count

Residential		
Represented Acreage	**Total DUs**	**DUs with Replicates**
8.25	66	8
Industrial		
Represented Acreage	**Total DUs**	**DUs with Replicates**
54	108	12

- As illustrated in the attached **Figure 3** and shown on **Table 3**, the DUs selected to represent approximately 11.5% will be spaced throughout the HS-ISM Project area to allow for different topographies, geologies, and depositional environments to be investigated and understood. These select DUs will be spaced such that roughly half are placed in a pairing of two DUs adjacent to each other, to allow for comparison of results observed in DUs with relatively similar characteristics. The remaining DUs will be spaced singularly across the project area as shown in **Figure 3** and detailed below in **Table 4**.

Table 4: Initial Decision Unit Spatial Pairing

Decision Unit Spatial Pairing			
Total DUs	**~11.5% of DUs**	**Paired DUs**	**Singularly Spaced DUs**
66 Residential	8	two sets of paired DUs (accounts for 4 DUs total)	4
108 Industrial	12	three sets of paired DUs (accounts for 6 DUs total	6

The rationale for collecting the replicates initially is to establish geographic distributions of chemical results and quantitative metrics regarding data repeatability. The data from these DUs will be evaluated immediately and project adjustments may be made, as detailed in **Section 5.1.3**, to ensure the project data, and ultimately the risk management decisions made from the data, are defensible.

- The number of increments proposed for each DU in which a replicate is proposed is as follows and is shown in **Table 5** on the following page:
    - Thirty (30) increments will be used to compose the ISM samples from 75% of the total replicate DUs. This results in 15 DUs sampled initially using 30 increments per sample.
    - Fifty (50) increments will be used to compose the ISM samples from 25% of the total replicate DUs. This results in 5 DUs sampled initially using 50 increments per sample.

Table 5: Initial Increment Count

Increment Count			
Total DUs	**~11.5% of DUs**	**DUs with 30 increments**	**DUs with 50 increments**
66 Residential	8	6	2
108 Industrial	12	9	3
Total	20	15	5

Figure 4 illustrates the sampling layout for both increment grid types.

- As illustrated in **Figure 3** and shown on **Table 6**, below, the DUs are laid out to consider good topographic, operational, and spatial distribution. The sampling distribution of the 11.5% DUs is as follows:

Table 6: Initial Decision Unit Pairing and Laterally and with Depth

Pairing and Laterally and with Depth								
~11.5% of DUs	Individual 0-6"	Individual 0-6" and 6-12"	Paired Laterally 0-6"	Paired Laterally 0-6" and 6-12"	Individual 0-6"	Individual 0-6" and 6-12"	Paired Laterally 0-6"	Paired Laterally 0-6" and 6-12"
	30-increment				50-increment			
8 Residential	2 DUs	-	-	4 DUs (2 pair)	2 DUs	-	-	-
12 Industrial	1 DU	2 DUs (1 pair)	2 DUs (1 pair)	4 DUs (2 pair)	1 DU	2 DUs (1 pair)	-	-

- ISM samples collected during this initial phase of the HS-ISM Project will be shipped to an Arizona Department of Health Service (ADHS)-certified laboratory and will be analyzed for the 13 Priority Pollutant (PP) Metals by the methods described in **Section 4.2**, on an expedited (5 to 6-day) laboratory turn-around time (TAT).
- Once the replicate data are received, relative standard deviations (RSDs) will be calculated, as presented in **Section 5.1.3**. The RSDs from the replicate results will be used to determine Decision Point 1. All replicate samples will be collected prior to any singlet sampling and evaluated to provide clarity on Decision Point 1. At Decision Point 1, the project team will evaluate the RSDs and determine what number of increments is appropriate to move forward with, based on the replicate data point evaluations. All decisions regarding a change in scope will be discussed with ADEQ and USEPA, including but not limited to, the ADEQ Program Manager, ADEQ Project Manager, USEPA Remedial Project Manager (RPM) and the USEPA Region IX Quality Assurance Program (QAP). The assessments for risk management decisions that come out of these meetings will be formally documented in a QAPP-A Amendment (Technical Memorandum).
- After a decision has been made regarding the number of increments moving forward based on these first 11.5% of DUs, the field team will continue sampling the remaining DUs (1/4-acre residential and 1-acre industrial) collecting singlet samples from these DU. The expedited laboratory TAT of 5 to 6 days (subject to availability) may be halted at this time and replaced with a standard 10-day TAT, except as deemed necessary at decision points or as instructed by ADEQ and/or USEPA.
- As the field team continues to collect data, Tetra Tech will begin evaluating the singlet data as it is received from the laboratory to determine when a second decision point has been triggered.
- Decision Point 2 will be triggered once a trend in the singlet data indicates whether there are enough lines of evidence to support increasing the sizes of the DUs to a larger aerial extent. Upon conferring with ADEQ and the USEPA RPM and QAP, Tetra Tech will either:
    - Increase the DUs to an aerial extent agreed upon during the Decision Point 2 meeting, or

- Continue collecting singlet data in QAPP-A-proposed DU sizes of ¼ acre residential and 1-acre industrial.

More information on how this decision will be made is included in the DQO process, in Step 3 of the DQO process, in **Section 5.1.3.**

- Assuming the decision is made to increase the DU size, QC checks will be implemented with replicate samples collected at a rate of 1 in 10 (or 10%) from the newly sized DUs, to ensure the decision to scale-up to larger DUs remains applicable. RSDs will be evaluated in these replicate DUs to ensure the RSDs support the decision to remain at a larger DU size.
- Meetings will occur periodically throughout the entire HS-ISM Project field deployment, to ensure USEPA and ADEQ concur with the data trends. One such Interim Decision Point would occur if Tetra Tech begins to see the data suggests decreasing the DU sizes back to the original 1/4-acre residential and 1-acre industrial due to RSD values not supporting the increased DU sizes**.** In the event such a decision is made, Tetra Tech will confer with ADEQ and the USEPA RPM and QAP, to decide if the decision necessitates re-sampling any of the sized-up DUs which had been sampled earlier and used in the decision-making process. Since the RSD value is a statistical measure for evaluating the overall precision of the sampling, on-going evaluation must be done to determine whether the underlying assumptions of the statistical methods hold, and whether departures are acceptable (statistically close) or unacceptable (statistically exceed acceptable levels), given the actual data. The variability of RSDs is discussed further in **Section 5.1.3** on **Page 17**.
- Samples collected through the entirety of the HS-ISM Project will be shipped to an ADHS-certified laboratory, as detailed in **Section 4.2**, to be analyzed for the 13 PP Metals on an expedited turn-around time at the start of the project and likely shifted to a standard turn-around time once additional assessments for risk management decisions have been made.
- Upon receipt of all singlet results, Decision Point 3 will be triggered[5]. Decision Point 3 will be the proposed application of the RSDs to singlet results. Tetra Tech will confer with ADEQ and the USEPA RPM and QAP, to decide on the application of the proposed RSDs to calculate the 95UCL.
- Once a decision has been made regarding Decision Point 3, a 95th percentile upper confidence limit on the mean (95UCL) will be calculated using the replicate data. Replicate RSDs or RSD averages will be applied to singlet results with similar depositional areas, topography and geology, and chemical concentrations. Tetra Tech will present to ADEQ and the USEPA RPM and QAP, the 95UCLs and confer with the team to determine the acceptable path forward with the data.

[5] It is important to note that this decision point could happen sooner if the entire project team concurs. What is referred to here as Decision Point 3 could be evaluated as early as during Decision Point 1, if the RSDs are observed to fall statistically close, such as within 5% of each other.

For reference, **Table 7**, presents a summary of Decision Points presented in the bullets above:

Table 7: Summary of Sampling Plan Decision Points

Decision Point	Details
Decision Point 1	Tetra Tech and regulatory representatives (the project team) will evaluate the RSDs and determine what number of increments is appropriate to move forward with, based on the replicate data point evaluations.
Decision Point 2	The project team will meet to discuss trends in the singlet data to agree on whether there are enough lines of evidence to support increasing the sizes of the DUs to a larger areal extent.
Decision Point 3	The project team will meet to agree upon the application of the proposed RSDs to calculate the 95UCL.
Interim Decision Points	The project team will meet if any prior Decision Point needs to be revisited; it field variances occur; if any data, field events, or findings require regulatory input.

As indicated throughout this section, the DQO portion of this QAPP-A (**Section 5.1** and associated subsections) provides greater detail on the data evaluation process.

3.3 Sample Collection Methodology

3.3.1 Tools

Tetra Tech will use the following tools to perform the ISM sampling activities:

- Hand-held global positioning system (GPS) device;
- Stakes and rope to mark the four corners of a DU and rope it off;
- Collect-N-Go™ soil sample collection bucket/system (see embedded **Figure C**);
- Collect-N-Go™ 15.5” soil auger with 3/8” non-slotted shank (see embedded **Figure C**);
- Slotted Drive System (SDS) Cordless Rotary Hammer/Drill (see embedded **Figure C**);
- SDS Keyed Locking Chuck Adapter (see embedded **Figure C**);
- Ziploc Bags (see **Section 7.1** - **Table 12** and **Appendix A**);
- Laboratory labels and writing implements.

- All appropriate personal protective equipment defined in the site-specific Health and Safety Plan (HASP) including, but not limited to:
    - Steel-toed or equivalent composite boots;
    - Leather gloves or other similarly protective gloves when operating equipment;
    - Eye protection when operating hand-held drills; and
    - Nitrile gloves when handling soil or sample material;

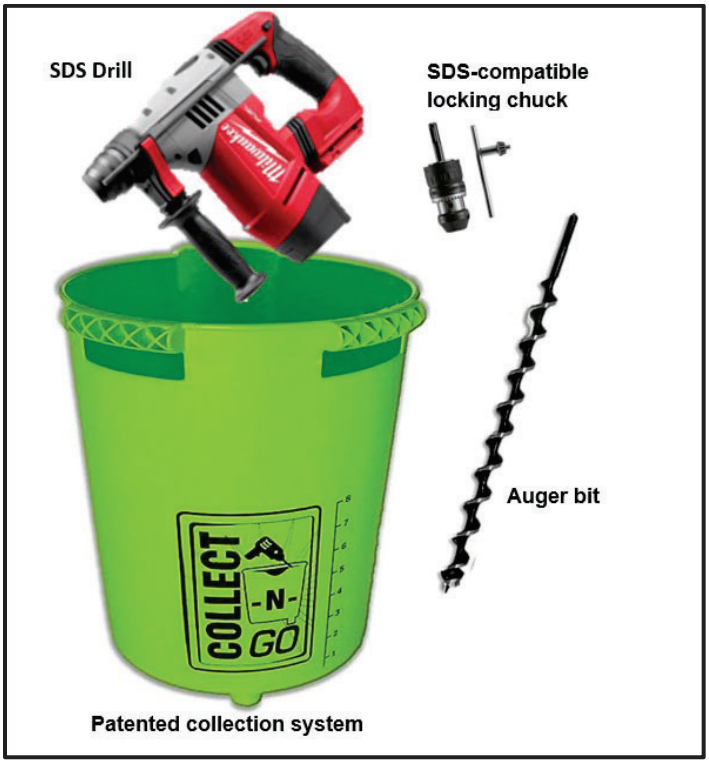

Figure C: Field Tools

3.3.2 Technique/Approach

Tetra Tech will employ the following sampling approach/techniques while conducting the sampling plan described in **Section 3.2**:

- A GPS overlay will be developed for field staff to utilize in the field to find and mark off the four corners of the DU with stakes and rope. The GPS will then be used to field-locate the parent sample nodes for each of the 30 or 50 increment DU spatial layouts.
- Prior to collecting the samples within a given DU, surface clearing of debris and vegetation will be done manually to ensure minimal disturbance of surface soils and desert vegetation. Wherever possible, the sample will be collected adjacent to roots and existing foliage (rather than removing

these roots or drilling into) to avoid disturbing the natural vegetation in the arid landscape. This vegetation is crucial to minimizing soil erosion and wind-blown dust.

- A heavy-duty cordless SDS drill will be used in conjunction with the Collect-N-Go™ soil sample collection bucket/system. The Collect-N-Go™ 15.5" soil auger with 3/8" non-slotted shank is locked into the drill with a keyed SDS chuck adapter. These drills can generally be used for up to 100 increments per battery[6] and field chargers are available for vehicles.
- The field technician wearing leather gloves and utilizing the drill and collection kit will begin at a corner of each DU and begin sampling in an orthogonal pattern, either moving from north to south or east to west, to collect subsamples from the 30/50 locations within each DU (see **Figure 4**).
- Parent samples will be collected by drilling to the appropriate depth (either 0 to 6 inches or 6 to 12 inches, depending on target DU). The Collect-N-Go™ soil sample collection bucket is specially made for this purpose and has a soil collector tube embedded in its base to assure maximum soil collection and minimum soil loss while collecting subsamples within a sample area.
    - For DUs with replicate sampling, replicate samples will consist of increments collected by stepping out in two different directions within a few feet from each original (parent) increment location. Each replicate sample will consist of the same number of increments as the parent sample but from different locations and with the same overall increment coverage or spacing.
- Nitrile gloves will be worn during sample handling. Deconning between each DU and each replicate will be conducted as detailed in **Section 8.1**.
- The soil increments (parent for DUs with singlets; parent plus two additional samples for DUs with replicates) will be mixed to form one multi-increment composite sample and placed within a sealed and labeled, 1-gallon Ziplock Bag[7] and then resealed with a second 1-gallon Ziplock Bag to ensure the sample remains dry and maintains integrity.
- Samples will be stored in a cooler on ice after collection and shipped to the ADHS-approved laboratory for analysis on fresh ice and with a completed chain of custody. More detail on sampling handling including naming convention, storage, and transport to laboratory, are provided in **Section 7.2**.

3.4 Cultural and Historic Preservation

ADEQ and Tetra Tech conferred with the USEPA regarding the conditions to ensure the requirements of the National Historic Preservation Act (NHPA) are met. A determination was made that, given the number

[6] Potential number of increments collected per charge comes from the State of Hawaii, Department of Health (HDOH, 2016).

[7] Variance from Pace Labs to use Ziploc Bags has been included in **Appendix A**.

of project acres, distribution, and the size of the ISM DUs, it is calculated that less than 1% (.0027%) of the total surface area of the Humboldt Smelter site has the potential to be disturbed. Therefore, the testing is not considered substantial enough to alter a historic property in a significant manner, or remove pertinent data yielding information important to history or prehistory, including surface artifacts, features, or subsurface intact cultural deposits. The USEPA determined the testing would not rise to a level of an adverse effect to a historic property assuming one were present, and made a finding of *No Potential to Cause Effect* pursuant to 36 Code of Federal Regulations §800.5 (a)(1) under Section 106 of the NHPA (see **Appendix B**).

4.0 PROJECT MEASUREMENTS

4.1 Preliminary Remediation Goals

The PRGs were developed to protect human health and the environment from unacceptable risks from contaminants at the IKM-HS Site. PRGs are chemical concentrations in soil, sediment, and surface water that are sufficient to protect human health and the environment. PRGs are not necessarily final cleanup levels. Final cleanup levels will be established in the Record of Decision (ROD).

The PRGs generally are the lower of either:

1) a human health risk-based target level,
2) an ecological hazard quotient (EHQ) of 1 for any species, or
3) a chemical-specific applicable or relevant and appropriate requirement (ARAR).

Note that a PRG cannot be lower than background contaminant levels. As established in the Proposed Plan for the IKM-HS, arsenic and lead are the predominant constituents of concern driving remedial activities. As such, the decision points in the project and risk management assessments will focus on arsenic and lead concentrations in the samples.

The following table shows the PRGs for the IKM-HS, as published in the Proposed Plan (USEPA, 2023a):

Table 8: Preliminary Remediation Goals

Risk Exposure Scenario	PRG (mg/kg)	Notes on Development of PRG
Lead: Residential	**197**	Developed from integrated exposure update biokinetic (IEUBK) Model for child with target blood level of 5 micrograms per deciliter.
Lead: Occupational	**460**	Adult Lead Model (ALM) with outdoor exposure assumption
Lead: Recreational	**2,212**	ALM with teenage exposure assumed 52 days/ year
Lead: Ecological	**559**	Ecological Hazard Quotient of 1

Risk Exposure Scenario	PRG (mg/kg)	Notes on Development of PRG
Arsenic: Residential	**TBD**	The Proposed Plan PRG value is under review. The final data from the laboratory will be compared to an established PRG value approved by the USEPA.
Arsenic: Occupational	**884**	Risk target based on lesser of HI of 1 and excess lifetime cancer risk (ELCR) of 1 x 10^{-4}.
Arsenic: Recreational	**274**	Risk target based on less of HI of 1 and ELCR of 10^{-5} with a teenage exposure assumption of 52 days per year
TBD = to be determined		

Although Tetra Tech will be sampling for the 13 PP Metals, for the purposes of the current scope of the HS-ISM Project, Tetra Tech will be making field decisions and developing RSDs from the data collected for arsenic and lead only. All other metals data will be provided to the USEPA for reference and potential use in evaluations outside the scope of this project.

4.2 Analytical Methods

Tetra Tech will submit HS-ISM Project samples for analysis to Pace Analytical (Pace Labs), an ADHS-certified laboratory licensed under AZ0612. Samples will either be couriered or shipped overnight.

Pace Labs' standard operating procedure (SOP) document for ISM analysis is included as **Appendix A**. It is important to note that Pace Labs' SOP indicates samples are dried, ground, and homogenized before subsamples are taken for sample preparation. Grinding results in particle size reduction, which is understood to improve the reproducibility of subsampling (ITRC, 2020), thereby potentially reducing RSDs. Furthermore, homogenizing the dry, ground sample can further reduce heterogeneity and facilitate representative subsampling (ITRC, 2020).

Samples collected during the HS-ISM Project will be analyzed via USEPA Methods 6010D/6020B/7470A for the 13 PP Metals, which includes antimony, arsenic, beryllium, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, thallium, and zinc.

Samples will be on an initial expedited TAT of 5 to 6-days (subject to availability) at the outset of the project and the TAT will likely be extended to a standard 10 days as the project progresses.

5.0 DATA QUALITY OBJECTIVES AND CRITERIA

5.1 Data Quality Objectives

The DQO process is a procedure which is used to prepare organized plans for collecting environmental data of a known quantity and known quality to support decision-making. The DQO process follows seven

established steps to ascertain and document performance and acceptance criteria for the framework of a project. The USEPA has published guidance for use in establishing site-specific DQOs (USEPA, 2006).

DQOs are qualitative and quantitative statements derived from the outputs of the first six steps of the DQO process. These statements will clarify the study objectives, define the most appropriate type of data to collect, determine the appropriate conditions from which to collect the data, and specify tolerable limits on decision errors which will be used as the basis for establishing the quantity and quality of data needed to support the decision. The seven steps used to the DQO process are used to generate the optimal design for sampling and analytical work.

5.1.1 Step 1: State the Problem

The IKM-HS Superfund Site contains a mix of residential and commercial-zoned properties which need to meet the target end remediation goals for the site. As residual metals may be present in the HS-ISM Project area, soil within the subject parcels needs to be adequately characterized to determine proper remedial action. Analytical results from previous investigations did not fully represent site characteristics; therefore, additional soil sampling is necessary to adequately characterize the properties.

5.1.2 Step 2: Identify the Decisions

Which areas of the former Humboldt Smelter property will require decisions made and/or action taken during the RD/RA phase of work?

5.1.3 Step 3: Identify Inputs to the Decisions

The data inputs that *have been* used to develop this QAPP-A include:

- Historic knowledge regarding use of the parcels,
- USEPA's risk management decisions to date,
- GPS locational data as well as topographic and geological inputs,
- Analytical results from prior soil sampling,
- Quality assurance and QC requirements (QA/QC), and
- The applicability of the respective PRGs.

The data inputs that *will be* used as inputs to decision making are detailed below.

Section 3.0 of the QAPP-A details the project description and sampling plan design. The following bullets detail how the data collected will be used as inputs to assessments of risk management decisions, and where specific decision points will be in the process:

- ISM will be used to characterize concentrations in soil at two depth horizons in each DU. At the outset of the investigation, replicate samples will be collected from approximately 11.5% of the

total DUs (see **Table 3**). ISM soil samples will be analyzed for the 13 PP Metals[8] on a 5 to 6-day turnaround time. During this phase of the investigation, singlet samples (DUs without replicates) will not be collected.

- The results from the replicate analysis will then be used to calculate relative standard deviations (RSDs) for the arsenic and lead results within each DU where ISM replicates were collected. The resulting RSDs provide a quantitative evaluation of the ability of the increments to represent the contaminant heterogeneity and thereby measures the confidence of the reproducibility and accuracy of chemical analytical results for each DU. The RSD will be calculated as follows:

$$RSD(\%)_{triplicates} = \frac{SD_{triplicates}}{x_{avg}} \times 100\%$$

Where:

x_{avg} = mean of all results in the dataset, and
SD = standard deviation of a set of replicate results, calculated as:

$$SD_{triplicates} = \sqrt{\frac{\sum(x - x_{avg})^2}{n - 1}}$$

Where:

Σ = sum of
x = each result in the replicate dataset,
x_{avg} = mean of all results in the dataset, and
n = the number of replicates

- As detailed in **Section 3.2**, this marks Decision Point 1 in the data evaluation process. All replicate samples will be collected prior to any singlet sampling and evaluated in an effort to provide clarity on Decision Point 1. Typically, an RSD for replicate sample data which is less than 35% suggests the sampling method has good reproducibility and the data can be used for reliable decision making (HDOH, 2020). Good precision implies that the sampling method used, including the number, spacing, size, and shape of increments collected, was adequate to represent and reflect small- and large-scale heterogeneity of contaminant distribution within the DU and that error in the laboratory processing and analysis methods was low.

  An RSD of greater 35% but less than 50% indicates less reliable information for decision-making but may still be acceptable given the safety factor built into risk-based action levels (HDOH, 2020). The greater the RSD, the less confidence there is that the mean contaminant concentration estimated for any individual DU is representative of the true mean for the DU (HDOH, 2016).

[8] Note: Tetra Tech will be making field decisions and developing RSDs from the data collected for arsenic and lead only. All other metals data will be provided to the USEPA for reference and potential use in evaluations outside the scope of this project.

However, it is important to note that lower confidence associated with a higher RSDs can be eliminated when applying a 95UCL to the DU result, since the confidence interval incorporates the higher RSD.

The focus of Decision Point 1 is to determine if the RSDs for 30 increments represent the heterogeneity with DUs comparable to the RSDs for 50 increments. While ISM procedures are designed to reduce both field contributions (**Section 5.2.1.1**) and laboratory contributions (**Section 5.2.2.1**) to data variability, some variability is inevitable. Measurements provided by replicate sampling can be used to document whether the procedures sufficiently reduce variability for the soil matrix and contaminants. This step in the process requires a qualitative and quantitative evaluation of the RSDs to make this determination. This evaluation is conducted as follows:

- Laboratory Replicate Evaluation

  Laboratory replicates are evaluated quantitatively and qualitatively to determine overall data usability. Quantitative evaluation involves calculating an RSD from the laboratory replicates (**Section 5.2.1.1**) as a measure of variability. Qualitative evaluation involves assessing proximity of the results to the reporting limits, whether concentration ranges of laboratory replicates agree generally (low, moderate, or elevated), and whether these exceed the PRGs. Low or high variability can indicate complexity of the matrix. Consistently high variability may indicate a complex matrix with "particle effects" that cannot be fully eliminated even by enhanced laboratory protocols such as further grinding or rotary sectorial splitter sorting of the sample. High subsampling variability leads to high variability in field sample results. If variability in field samples is too high to meet desired decision confidence, a mathematical determination of relative contributions of field, subsampling, and analytical variability will be performed. If subsampling variability is determined to be a significant contributor to overall data variability, corrective action may be required including modifying procedures for sample processing and subsampling.

- Field Replicate Evaluation

  Field replicates are evaluated quantitatively and qualitatively consistent with the evaluation of the laboratory replicates to determine whether sampling activities are possibly affecting field sample results. High subsampling variability leads to high variability in field sample results. If variability in field samples is too high to meet desired decision confidence, a mathematical determination of relative contributions of field, subsampling, and analytical variability would need to be performed. If subsampling variability is determined to be a significant contributor to overall data variability, corrective action may be required including modifying procedures for sample processing and subsampling.

Tetra Tech will be actively conferring with ADEQ and USEPA, and decisions will be made regarding observed RSD values from the field and laboratory replicate data, and the number of increments to be collected for each sample moving forward will be the output of Decision Point 1.

- Once an increment size has been selected at Decision Point 1, the field time will continue sampling DUs (1/4-acre residential and 1-acre industrial), collecting singlet samples from each DU using that number of increments. As the field team continues to collect data, Tetra Tech will begin evaluating the singlet data as it is received from the laboratory to determine when a second decision point has been triggered.
- As detailed in **Section 3.2**, Decision Point 2 will be triggered once a trend in the singlet data indicates whether there are enough lines of evidence to support increasing the DUs to a larger aerial extent. A trend in the data would appear when evaluating adjacent DUs of similar topography, use, size, and history. For example, when evaluating two 0.25-acre residential DUs which are adjacent, are similar results observed in the data such that there is not expected to be a loss of confidence or repeatability with the data and there is a benefit the project to increasing the size of the DU to a 0.50 acre? If the answer to this decision is "yes", then increasing the DU sizes could be implemented provided QC checks were to remain in place (further discussed in the next bullets) to ensure the data is defensible.
- If the decision is made to increase the DU size, QC samples (replicates) will be collected at a rate of 1 in 10 (or 10%) from the newly-sized DUs. RSDs will be evaluated in these replicate DUs to ensure the RSDs support the decision to remain at a larger DU size.
- Interim Decision Point meetings will occur, as needed, throughout the project as incoming singlet data is reviewed. Such a meeting would be necessary if Tetra Tech sees data trends suggesting that it is critical to decrease the DUs due to RSD values no longer supporting the increased DU sizes, or to increase the DU sizes again if deemed appropriate.
- Upon receipt of all singlet results, Decision Point 3 will be triggered to decide on the application of the proposed RSDs to calculate the 95UCL.
- Based on the determination(s) made in Decision Point 3, a 95UCL will be calculated as follows:

$$95UCL = C_{avg} + SD \times \sqrt{\frac{\left(\frac{1}{\alpha} - 1\right)}{n}}$$

Where:

C_{avg} = mean concentration of the replicate samples
α = Error rate based on a 95% confidence (as 0.05)
n = number of replicates
SD = standard deviation of a set of replicate results

A calculated 95UCL concentration for each arsenic and lead at each DU will be compared with PRGs to determine what decisions are appropriate to proceed with. Tetra Tech will present ADEQ and the USEPA with the 95UCLs to confer and determine the acceptable path forward with the data, as detailed in **Section 3.2**.

All the bullets above defined in this step of the DQO process are part identifying the inputs which will go into the HS-ISM Project decisions. Step 5 of the DQO process (**Section 5.1.5**) presents the Decision Rules associated with the project.

5.1.4 Step 4: Define Study Boundaries

- **Spatial**: Spatial boundaries consist of the geographical boundaries of the decision units as specified in this QAPP-A, the legal boundaries of the parcels, the IKM-HS project-wide boundaries, and a soil depth of 0 to 6 inches and 6 to 12 inches bgs.
- **Temporal**: Field activities are scheduled to commence in mid to late 2023, followed by additional time for laboratory analyses, data validation, data quality assessment, and evaluation of sample results. A schedule of activities has been provided to the USEPA under separate cover and is a living document, updated as assessments of risk management decisions are made.

5.1.5 Step 5: Develop Decision Rules

1. If the 95UCL of arsenic or lead concentrations are detected above the established PRGs within an individual ¼ acre residential DU, the results will be subject to an assessment of risk management decisions based on lines of evidence in order to meet the target goals as stated in the Problem Statement in **Section 5.1.1**.
2. If the 95UCL of arsenic or lead concentrations are detected above the established PRGs within an individual 1-acre commercial DU, the results will be subject to an assessment of risk management decisions based on lines of evidence - potentially the DU will be further divided into smaller DUs and resampled and evaluated per the Decision Rule established in #1, above.
3. If the 95UCL of arsenic or lead concentrations are detected below the established PRGs within an individual residential or industrial DU, this will meet the target goals as stated in the Problem Statement in **Section 5.1.1**. The results will be considered acceptable to require no additional ISM investigation, and the land will be subject to determinations to be made by USEPA outside the scope of this project.

5.1.6 Step 6: Specify Tolerable Limits on Decision Errors

- Analytical data must meet the project specifications for precision, accuracy, representativeness, completeness, and comparability (PARCC) as prescribed by the quality assurance objectives outlined in this QAPP-A in **Section 5.3**.
- Data must provide a representative estimate of the mean concentrations of lead and arsenic for each DU. Representativeness will be assessed through the qualitative and quantitative evaluation of the RSDs.
- Application of the RSD and 95UCL to the result of each DU will effectively manage any uncertainty associated with sample results.

5.1.7 Step 7: Optimize the Sampling Design

The following critical optimization strategies will be used to achieve the target goals of the Problem Statement, defined in **Section 5.1.1**.

1. Decision Point 1, as discussed in **Section 3.2** and shown in **Table 7**: The sampling design will be optimized through an evaluation of the RSDs for replicates with 30 and 50 increments, so the appropriate number of increments is established prior to implementing the singlet sampling.
2. Decision Point 2, as discussed in **Section 3.2** and shown in **Table 7**: The sampling design will be optimized through an evaluation of DU size as the project continues, in order to ensure that DU sizes match the confidence in the decisions required.

The optimization of the sampling design is critical to an ISM project and is iterative throughout the project. This is why there may also be applicable Interim Decision Points during the sampling program.

5.2 Project Quality Control Objectives

The ADEQ QAPP is included as **Appendix C** and has been used for reference to ensure ADEQ's expectations for project QA/QC are met. **Table 9** illustrates the samples which will be collected to support evaluation of PARCC parameters prescribed in **Section 5.3**.

Table 9: Quality Control Samples

QC Type	Precision	Accuracy	Frequency
Field QC	Replicate RPD	Field Replicates	1 per 10 ISM soil samples
		Field Blanks	1 per 20 samples
		Equipment Rinsate	1 per day per reusable equipment
Laboratory QC	MS/MSD RPD Replicate RPD	MS/MSD %R	1 per 20 samples
		Method Blanks	1 per 20 samples
		LCS or Blank Spikes	1 per 20 samples
		Laboratory Replicates	5 residential and 5 industrial completed on replicate field samples
		Surrogate Standards %R	every sample
		Internal Standards %R	every sample

Notes: %R - Percent recovery; LCS - laboratory control sample; MS - matrix spike; MSD - matrix spike duplicate; RPD - relative percent difference;

The following sections provide detail on these QC samples.

5.2.1 Field Quality Control Samples

The following sections provide detail on the field samples which are proposed to ensure field QC is properly evaluated and maintained.

5.2.1.1 Field Replicates/Field Triplicates

Replicate samples (a set of three) will be collected in approximately 11.5% of the total DUs (see **Table 3**). Replicate samples will consist of increments collected by stepping out in two different directions within a few feet from each original (parent) increment location. Each replicate sample will consist of the same number of increments as the parent sample but from different locations and with the same overall increment coverage or spacing. The samples will be analyzed for the 13 PP Metals on a standard laboratory turnaround time.

Results from the replicate analysis will then be used to calculate RSDs for the ISM metals results within each DU where replicates were collected. The resulting RSDs provide a quantitative evaluation of the ability of the increments to represent the contaminant heterogeneity and thereby measures the confidence of the reproducibility and accuracy of chemical analytical results for each DU.

The RSDs will then be used to calculate a 95UCL for each DU result in the full-scale investigation as an additional measure to help ensure that the ISM is not underestimating the concentrations of each COC.

Rate of Collection: Tetra Tech will collect field replicates at a rate of 11.5% of DUs at the start of the investigation and then at a minimum rate of 10% thereafter each time a change is made to sampling protocol (ie: DU size is increased).

5.2.1.2 Field Blanks

A field blank is a clean sample of laboratory-supplied DI water that is placed in a sample container in the laboratory and treated as a sample in all respects, including shipment to the sampling site, exposure to sampling site conditions (opening, sealing, and labeling), storage, and all analytical procedures. The purpose of a field blank is to determine if method analytes or other interferences are introduced into the sample from handling, shipping, storage, and/or the field environment.

Rate of Collection: Tetra Tech will collect a field blank at a rate of one per 20 samples.

5.2.1.3 Equipment Blanks

An equipment blank, also known as a rinsate blank, is collected to check the cleanliness of sampling devices and adequacy of field deconning procedures. An equipment blank is prepared by pouring deionized water over or into reusable sampling equipment following decontamination, usually midway through a day of sampling. The equipment blank is collected for laboratory analysis to show proper sampling procedures and deconning is taking place between sample collection. The equipment blank is submitted to the laboratory as a sample to be analyzed by the same method as the parent samples.

Rate of Collection: Tetra Tech will collect one equipment blank per type of reusable sampling equipment per day.

5.2.1.4 Temperature Blanks

A temperature blank may also be referred to as a cooler temperature indicator. With most laboratories, a temperature blank will accompany each ice chest/cooler. A temperature blank is a water-filled sample container that is not opened or removed from the cooler during any part of the sampling event. When

the samples are returned to the laboratory, the temperature of this blank is used to measure the cooler contents' temperature, to ensure that all samples are received at the requisite 6 °C or less.

Rate of Use: One temperature blank should be provided by the laboratory per cooler.

5.2.2 Laboratory Quality Control Samples

Laboratory QC samples are prepared and analyzed at the laboratory to evaluate the effectiveness of sample preparation and analysis and to assess analytical precision and accuracy. The types of laboratory QC samples that will be used for this project and their required frequencies are discussed in the following sections.

5.2.2.1 Laboratory Replicates/ Laboratory Triplicates

An analytical laboratory replicate (a triplicate for ISM analysis) is a subsample of a routine sample that is homogenized, divided into separate containers, and analyzed using the same analytical method. It is used to determine method precision, but because it is not a blind sample, it can only be used as an internal control tool and not as an unbiased estimate of analytical precision.

5.2.2.2 Matrix Spikes and Matrix Spike Duplicates

Laboratory analytical precision is evaluated by analyzing matrix spike (MS) and matrix spike duplicate (MSD) samples. Analytical precision will be assessed through the analysis of laboratory control samples (LCS) and laboratory control sample duplicates (LCSD). For this project, MS/MSD samples will be generated for soil sample data. Aqueous MS/MSD analyses are not required for equipment blanks. The results of the analysis of each MS/MSD pair will be used to calculate an RPD for evaluating precision.

An MS sample is a field-collected QC sample submitted to the laboratory. The laboratory "spikes" the sample with a known concentration of the selected site analyte(s). The MS sample is then analyzed as a method performance assessment and is used to measure the effects of interferences caused by the sample matrix. Poor spike recoveries for MS samples infers the field sample is causing matrix interference issues.

An MSD sample is an additional replicate of the MS sample. The MSD sample follows the same sample preparation and analytical testing as the MS sample and the parent sample. MSD samples are used to document the precision and bias of a method for a specific sample matrix.

Upon completing analysis on the MS and MSD samples, the laboratory will report the RPD for each analyte as a means of measuring reproducibility. RPD is the difference between any two samples (in this case, the MS and MSD samples) which is then divided by the average of the two samples and then multiplied by 100 so the result is expressed as a percent.

Rate of Collection: Tetra Tech will submit one MS/MSD volume for analysis per 20 samples collected.

5.2.2.3 Method Blanks

Method blanks are prepared by the laboratory to evaluate whether contamination is originating from the reagents used in sample handling, preparation, or analysis. They are critical in distinguishing between

low-level field contamination and laboratory contamination. A method blank consists of laboratory analyte-free water and all of the reagents used in the analytical procedure. It is prepared for every analysis in the same manner as a field sample and is processed through all of the analytical steps. Method blanks will be prepared at the frequency prescribed in the individual analytical method.

5.2.2.4 Laboratory Control Samples or Blank Spikes

An LCS, or blank spike, originates in the laboratory as deionized or distilled water that has been spiked with standard reference materials of a known concentration. An LCS is analyzed to verify the accuracy of the calibration standards. These internal QC samples are also used to evaluate laboratory accuracy in the presence of matrix interference for field samples. LCSs are processed through the same analytical procedure as field samples. LCSs will be analyzed at the frequency prescribed in the analytical method.

5.2.2.5 Internal Standards

Internal standards are compounds that are added to every method blank, MS/MSD, and sample or sample extract at a known concentration prior to analysis. Internal standards are used as the basis for quantification of GC/MS target compounds and ensure that the GC/MS sensitivity and response are stable during the analytical run. An internal standard is used to evaluate the efficiency of the sample introduction process and monitors the efficiency of the analytical procedure for each sample matrix encountered.

5.2.3 Maintenance of Laboratory Equipment

Pace Labs will follow a maintenance schedule for each instrument used to analyze samples collected from the property. All instruments will be serviced at scheduled intervals necessary to optimize factory specifications. Routine preventive maintenance and major repairs are usually documented by a laboratory in a maintenance logbook.

5.2.4 Calibration of Laboratory Equipment

Laboratory equipment calibration procedures and frequencies will follow the requirements specified by the laboratory analytical methods used. Qualified analysts calibrate laboratory equipment and document the procedures and results in a logbook.

5.2.5 Inspection and Acceptance of Supplies and Consumables

The field manager will have primary responsibility for identifying the types and quantities of supplies and consumables needed to complete the project and is also responsible for determining acceptance criteria for these items.

Supplies and consumables can be received either at the office or at the work site. When supplies are received at the office, the field manager will sort them according to vendor, check packing slips against purchase orders, and inspect the condition of all supplies before they are accepted for use on a project. If an item does not meet the acceptance criteria, deficiencies will be noted on the packing slip and purchase order, and the item will then be returned to the vendor for replacement or repair.

Procedures for receiving supplies and consumables in the field are similar. When supplies are received, the field manager will inspect all items against the acceptance criteria. Any deficiencies or problems will be noted in the field logbook, and deficient items will be returned for immediate replacement.

Analytical laboratories are required to provide certified clean containers for all analyses. These containers must meet USEPA standards described in the 1992 USEPA guidance document titled "Specifications and Guidance for Contaminant-Free Sample Containers."

5.3 Project Quality Assurance Objectives

All analytical results will be evaluated in accordance with precision, accuracy, representativeness, comparability, and completeness (PARCC) parameters to ensure the attainment of project-specific DQOs.

Table 10: Quality Control Samples and Associated PARCC Parameters

QC Sample	PARCC Parameter	Measurement Performance Criteria
Field Replicates (F)	Precision	RSD < 35% and qualitative evaluation
Equipment Blank (F)	Bias/ Contamination	no analytes detected >1/2 reporting limit or >1/10 sample concentration, whichever is greater
Temperature Blank (F)	Accuracy/ Representativeness	0 - 6 °C from time of collection until shipped to the laboratory.
Laboratory Replicates (L)	Precision	RSD < 35%
Matrix Spike (L)	Precision	RPD < 30%
Matrix Spike Duplicate (L)	Precision	RPD < 30%
Notes: (F) – Field QC; (L) – Laboratory QC		

The following subsections detail the objectives relating to each of the PARCC parameters.

5.3.1 Precision

Precision is the degree of mutual agreement between individual measurements of the same property under similar conditions. Usually, combined field and laboratory precision are evaluated by collecting and analyzing field replicates and then calculating the variance between the samples, typically as an RPD:

$$RPD = \frac{|A-B|}{(A+B)/2} \; x \; 100\%$$

where:

A = First duplicate concentration

B = Second duplicate concentration

Field sampling precision is evaluated by analyzing field replicate samples.

5.3.2 Accuracy

Accuracy is the degree of agreement between an analytical measurement and a reference accepted as a true value. The accuracy of a measurement system can be affected by errors introduced by cross-contamination in the field sampling process, sample preservation, sample handling, matrix sample preparation, analytical techniques, and cross-contamination in the laboratory. A program of sample spiking will be conducted to evaluate laboratory accuracy. This program includes analysis of the MS and MSD samples, LCS or blank spikes, surrogate standards, and method blanks. MS/MSD samples and LCS/LCSD or blank spike samples are analyzed at a frequency of one per batch; a batch of samples is limited to 20 samples. Surrogate standards and internal calibration standards, where applicable, are added to every sample analyzed for organic constituents. The results of the spiked samples are used to calculate the percent recovery for evaluating accuracy.

5.3.3 Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represent the characteristics of a population, variations in a parameter at a sampling point, or an environmental condition that they are intended to represent. For this project, representative data will be obtained through the implementation of ISM and appropriate replicate sampling.

Laboratory representativeness of data will also be ensured through consistent application of established field and laboratory procedures. Laboratory blank samples will be evaluated for the presence of contaminants to aid in evaluating the representativeness of sample results. Data determined to be nonrepresentative, by comparison with existing data, will be used only if accompanied by appropriate qualifiers and limits of uncertainty.

5.3.4 Completeness

Completeness is a measure of the percentage of project-specific data that are valid. Valid data are obtained when samples are collected and analyzed in accordance with QC procedures outlined in this QAPP-A, and when none of the QC criteria that affect data usability are exceeded. When all data validation is completed, the percent completeness value will be calculated by dividing the number of useable sample results by the total number of sample results planned for this investigation.

5.3.5 Comparability

Comparability expresses the confidence with which one data set can be compared with another. Comparability of data will be evaluated through the collection of field replicates. Field procedures will be standardized to ensure comparability. The comparability of laboratory data will be assured by use of established and approved analytical methods, consistency in the basis of analysis (wet weight, volume, or similar units), and consistency in reporting units (parts per million, parts per billion, and so forth).

6.0 PROJECT ORGANIZATION

6.1 Project Hierarchy

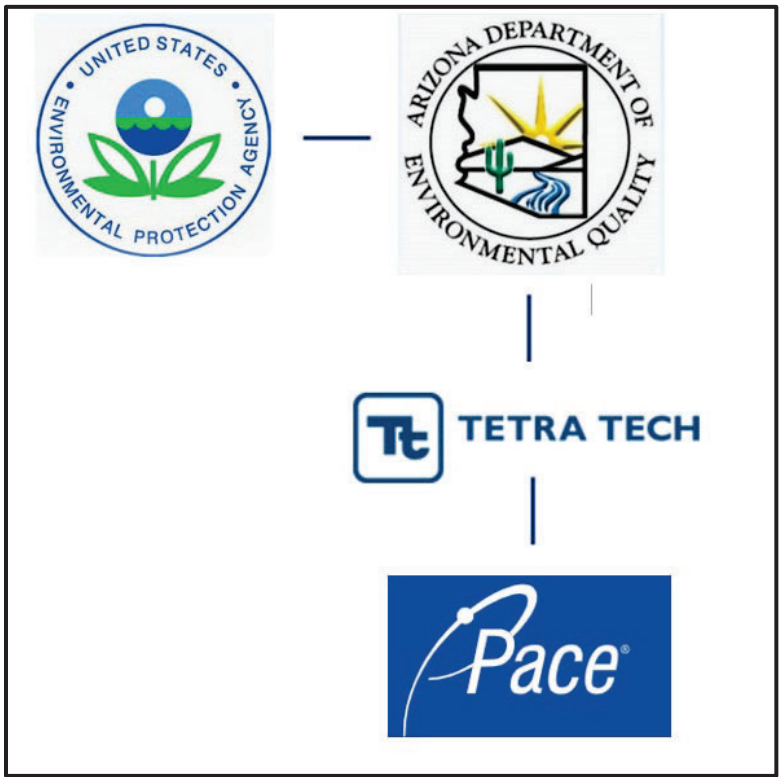

Figure D: General Project Hierarchy

Table 11: Key Project Personnel

Name	Org.	Role	Responsibilities	Contact Information
Karin Harker	ADEQ	Program Manager	Oversees Federal programs at ADEQ	P: 602-771-0361 harker.karin@azdeq.gov

Name	Org.	Role	Responsibilities	Contact Information
Katelyn Kane-Devries, RG	ADEQ	Project Manager	Responsible for project management and technical oversight of the IKM-HS	P: 602-771-0167 kane-devries.katelyn@azdeq.gov
Mikel Morales	ADEQ	Project Engineer	Responsible for assisting with project management of the IKM-HS and technical support	P: 602-771-4182 morales.mikel@azdeq.gov
Jeff Dhont	USEPA Region IX	RPM	Federal Superfund Project Manager responsible for project management and technical oversight of the IKM-HS	P: 415-972-3020 dhont.jeff@epa.gov
Marlon Mezquita	USEPA Region IX	QA Officer	Responsible for QA/QC document review and decision-making on behalf of the USEPA Region IX	P: 415-972-3808 mezquita.marlon@epa.gov
Scott Grossman	USEPA Region II	ISM Subject Matter Expert	Responsible for assisting USEPA with ISM technical support	P: 732-452-6407 grossman.scott@epa.gov
Mekaela Bennett	Tetra Tech	Project Manager	Responsible for project execution and management. Responsible for coordination with ADEQ.	P: 520-878-8667 Mekaela.Bennett@tetratech.com
Ryan Toomey	Tetra Tech	Local Health and Safety Manager	Provides oversight and support of field activities; coordinates medical monitoring program and training. Develops Tetra Tech HASP.	P: 480-438-9091 ryan.toomey@tetratech.com
Jason Brodersen, PG, QSD	Tetra Tech	ISM Subject Matter Expert	Provides ISM expertise to QAPP-A development and project planning. Identifies areas where a technical solution would improve or enhance project performance.	P: 415-497-9060 Jason.Brodersen@tetratech.com
Joey Pace, PMP	Tetra Tech	Technical Reviewer and Editor	Prepares relevant project documents and assists Tetra Tech Project Managers with responsibilities related to project.	P: 480-430-4087 joey.pace@tetratech.com

Name	Org.	Role	Responsibilities	Contact Information
Dylan Begley, GIT	Tetra Tech	Field Lead	Deploys operations in the field under Tetra Tech Project Manager's guidance; Oversees day-to-day field activities and verifies field sampling follows QAPP-A.	P: 623-271-0886 dylan.begley@tetratech.com
Daphne Richards/ Andi Jones	Pace Labs	Contract Laboratory Project Manager	Delivers analytical services that meet QAPP-A requirements. Works with project team to confirm sample delivery schedules and sample analyses. Reviews laboratory data package before delivery to Tetra Tech.	P: 615-773-9662 daphne.richards@pacelabs.com P: 615-583-2006 andi.jones@pacelabs.com

6.2 Health and Safety Plan

Tetra Tech will utilize a HASP pertaining to the work to be conducted onsite. The HASP will meet the requirements of applicable federal, state, and local regulations. The HASP will include information on the following:

- Work Areas
- Hazard Communication
- Chemicals of Concern
- Personnel Protection Program
- Initial On-site Training for Personnel
- Emergency and First-Aid Requirements
- Activity Hazard Analysis

The HASP will also address site worker and operator safety.

6.3 Documents and Records

6.3.1 Field Documentation

Complete and accurate documentation is essential to demonstrate that field measurement and sampling procedures are carried out as described in the QAPP-A. Field personnel will use Tetra Tech Daily Logs and field books to record and document field activities. At a minimum, the following information will be recorded each day:

- Name and affiliation of all on-site personnel or visitors;
- Weather conditions during the field activity;

- Summary of daily activities and significant events;
- References to other field logbooks or forms that contain specific information;
- Discussions of problems encountered and their resolution;
- Discussions of deviations from the QAPP-A or other principal documents; and
- Description of all photographs taken.

6.3.2 Data Package Format

The laboratory will provide an Electronic Data Deliverable and an Adobe PDF of all laboratory results in an analytical data package. Results to be included in the analytical data package are as follows:

- Target analyte results for each sample and associated analytical methods requested on the chain-of-custody form;
- Method and instrument blanks and preparation and calibration blank results;
- Percent recoveries for the spike compounds in the MS/MSD; and
- All re-analysis, re-extractions, or dilutions, including those associated with samples and the specified laboratory QC samples.

6.3.3 Reports Generated

A Technical Memorandum will be generated upon completion of the field activities and submitted within 45 days of receipt of all laboratory data packages.

7.0 SAMPLE MANAGEMENT

7.1 Sample Containers and Holding Times

Table 12: Sample Containers, Preservatives, and Holding Times

Parameter	Sample Type	Analytical Method	Sample Container	Preservative	Holding Time
Metals	Solid - Parent Samples, Replicates, MS/MSD	USEPA Methods 6010D/ 6020B/ 7470A	1-gallon Ziploc Bags*	6 °C	6 months
Metals	Aqueous – Field and Equipment Blanks	USEPA Methods 6010D/ 6020B/ 7470A	250-mL plastic	HNO3, pH <2, 6 °C	180 days (28 days for mercury)

* Due to the nature of the terrain (staff will be backpacking in much of the supplies) and the shipping requirements for this project (overnight Fed-ex, late drop-off), Tetra Tech requested the variance to use Ziploc Bags rather than glass jars for ISM sample collection. There is no risk of cross-contamination, and the shipping cost savings (weight reduction, less padding required so less coolers) will be significant. Pace Labs concurred with the requested variance and the approval electronic correspondence is included in **Appendix A**.

7.2 Sample Handling and Custody

This section presents the methodology for sample handling, including identification, labeling, chain-of-custody, and shipment or delivery procedures.

7.3 Sample Identification

All samples will be labeled with a project-specific identification (ID) number. The ID will be used to provide sample-specific information, which will not be revealed to the analytical laboratory. This number will be formatted as follows: **HS-$DU#-D-T**

Where:

HS	Specifies the HS-ISM project
$	Specifies the DU Type (Residential = **R**; Industrial= **I**)
DU#	Specifies the Decision Unit number
D	Specifies the depth horizon (0”-6” = **A**; 6”-12” = **B**)
T	Specifies the type of sample (**P** for parent sample; **R1** or **R2** for replicate sample)

For example, a second field replicate sample collected from industrial DU 12 at a depth of 6-inches bgs would be labeled as follows: **HS-IDU12-A-R2**

7.4 Sample Labels

As indicated in **Section 3.3.2**, soil samples will be placed within a labeled, 1-gallon Ziplock Bag[9] and then resealed within a second 1-gallon Ziplock Bag to ensure the sample remains dry and maintains integrity. The label will be completed with the following information, written in ink:

- Project name and location or identifier
- Project number
- Date and time of collection
- Analyses to be performed
- Sample collector’s initials

After labeling, each sample will be refrigerated or placed in a cooler that contains ice to maintain the sample temperature at or below 6 °C.

7.5 Chain-of-Custody

The chain-of-custody provides an accurate written record that traces the possession of individual samples from the time of collection in the field to the time of acceptance at the laboratory. The chain-of-custody

[9] Variance from Pace Labs to use Ziploc Bags has been included in **Appendix A**.

will document all samples collected and the analysis requested. It is the responsibility of the field team leader to ensure that all samples are handled properly to maintain their integrity from collection until shipment. The chain-of-custody serves as an analytical request form and has a space to record the sample condition upon receipt.

Upon receipt, the laboratory will sign the chain-of-custody and provide Tetra Tech an electronic copy. The laboratory will check temperature of the samples or cooler upon receipt and will document this information on the chain-of- custody, as well as documenting the samples' conditions upon receipt.

7.6 Sample Shipment

Soil samples will be transferred directly to the laboratory for immediate analysis. All samples will be recorded on the chain-of-custody. Sample containers will be placed in insulated coolers. Coolers will be chilled ice in double, sealable bags. Samples will be placed in the lower portion of the cooler, and ice will occupy the upper portion of the cooler and surrounding the samples. The samples will be transported directly to Pace Labs in Phoenix and relinquished to the laboratory via chain-of-custody.

7.7 Project Analytical Requirements

For this investigation, analysis of soil samples will be conducted by Pace Labs, an ADHS-certified laboratory. The analytical method selected for this investigation is USEPA 6010D/6020B/7470A for the 13 PP Metals.

8.0 DECONTAMINATION AND MANAGEMENT OF INVESTIGATION-DERIVED WASTE

8.1 Decontamination

Decontamination (deconning) of equipment, such as the drill auger, bucket, and sample scoops, will occur between each DU and each replicate. Equipment will be decontaminated using Alconox detergent scrub, followed by rinses with deionized water. Clean equipment will be stored in an uncontaminated area until further use.

All consumable equipment (for example, gloves) will be treated as investigation-derived waste (IDW) for offsite disposal and will be discarded in accordance with the procedures described in **Section 8.2**, below.

8.2 Management of Investigation-Derived Waste

Expected IDW includes soil from the hand-drilled holes, decontamination (decon) water, disposable field sampling, and PPE.

Soil from the hand-drilled holes will be returned to the boreholes and lightly compacted, to allow for future determination of risk management decisions, and in keeping with the allowable option for IDW defined in ADEQ's Policy for IDW (Policy Document 4013.001). In addition, very little decon water will be

produced because of the method of equipment deconning procedures used by Tetra Tech which includes utilizing spray bottles for application and disposable paper towels for cleaning and drying. Very little, if any, decon water will be discharged to the ground surface; however, the discharge of some decon water may occur and is therefore deemed acceptable pursuant to Section 7.3.1.1.2 of the Policy Document.

Nonhazardous IDW, such as scoops, gloves, and other PPE, will be disposed of in a timely manner following field work.

9.0 DATA MANAGEMENT

Data consist of handwritten (chains-of-custody, field notes, etc.), analytical, and validation data. An information management system is necessary to ensure efficient access to this data so that decisions can be made in a timely manner.

9.1 Data-Tracking Procedures

To assist data tracking and adherence to the QAPP-A, field or office personnel will track samples using a spreadsheet or database. All data generated in support of this investigation will be tracked by Tetra Tech for reporting purposes.

9.2 Data Pathways

Data are generated from three primary pathways for this project:

1. Data derived from field activities,
2. Laboratory analytical data, and
3. Validated laboratory data.

Computer files will be backed up to prevent loss of information. Hard-copy data will be stored in secure areas, and electronic data will be stored on Tetra Tech's internal server which prevents access to users without authorization.

9.3 Data Validation and Usability

This section presents the data review, verification, validation, and reconciliation procedures to be followed during the investigation.

9.3.1 Field Data Verification

Project team personnel will verify field data through reviews of data sets to identify inconsistencies or anomalous values. Any inconsistencies discovered will be resolved as soon as possible by seeking clarification from field personnel responsible for data collection. All field personnel will be responsible for following the sampling and documentation procedures described in this QAPP-A so that defensible and justifiable data are obtained.

Data values that are significantly different from the population are called "outliers." A systematic effort will be made to identify any outliers or errors before field personnel report the data. Outliers can result from improper sampling or measurement methodology, data transcription errors, calculation errors, or natural causes. Outliers that result from errors found during data verification will be identified and corrected; outliers that cannot be attributed to errors in sampling, measurement, transcription, or calculation will be clearly identified in project reports.

9.3.2 Laboratory Data Verification

Laboratory personnel will verify analytical data at the time of analysis and reporting and through subsequent reviews of the raw data for any nonconformance to the requirements of the analytical method. Laboratory personnel will make a systematic effort to identify any outliers or errors before they report the data. Outliers that result from errors found during data verification will be identified and corrected.

Outliers that cannot be attributed to errors in analysis, transcription, or calculation will be clearly identified in the case narrative section of the analytical data package.

9.3.3 Laboratory Data Validation

All data will be reviewed by Tetra Tech to confirm results conform with PARCC requirements as prescribed in **Section 5.2**. Data validation will be performed to meet the requirements specified in ADEQ's QAPP and specific to the requirements of ADEQ QAPP Section D.2.2 regarding approaches to data validation. As prescribed in the QAPP, data validation generally includes the following steps:

- Evaluate field records for completeness and consistency;
- Review field QC information;
- Summarize deviations and determine effects on data quality;
- Summarize number and type of samples collected;
- Review data records to determine method, procedural and contractual QC compliance or noncompliance;
- Review verified, reported sample results collectively for the data set as a whole, including laboratory qualifiers;
- Summarize data and QC deficiencies and evaluate the impact on overall data quality.

10.0 PROJECT DATA REPORTING TO ADEQ

A Technical Memorandum will be generated upon completion of the field activities and submitted within 45 days of receipt of all laboratory data packages.

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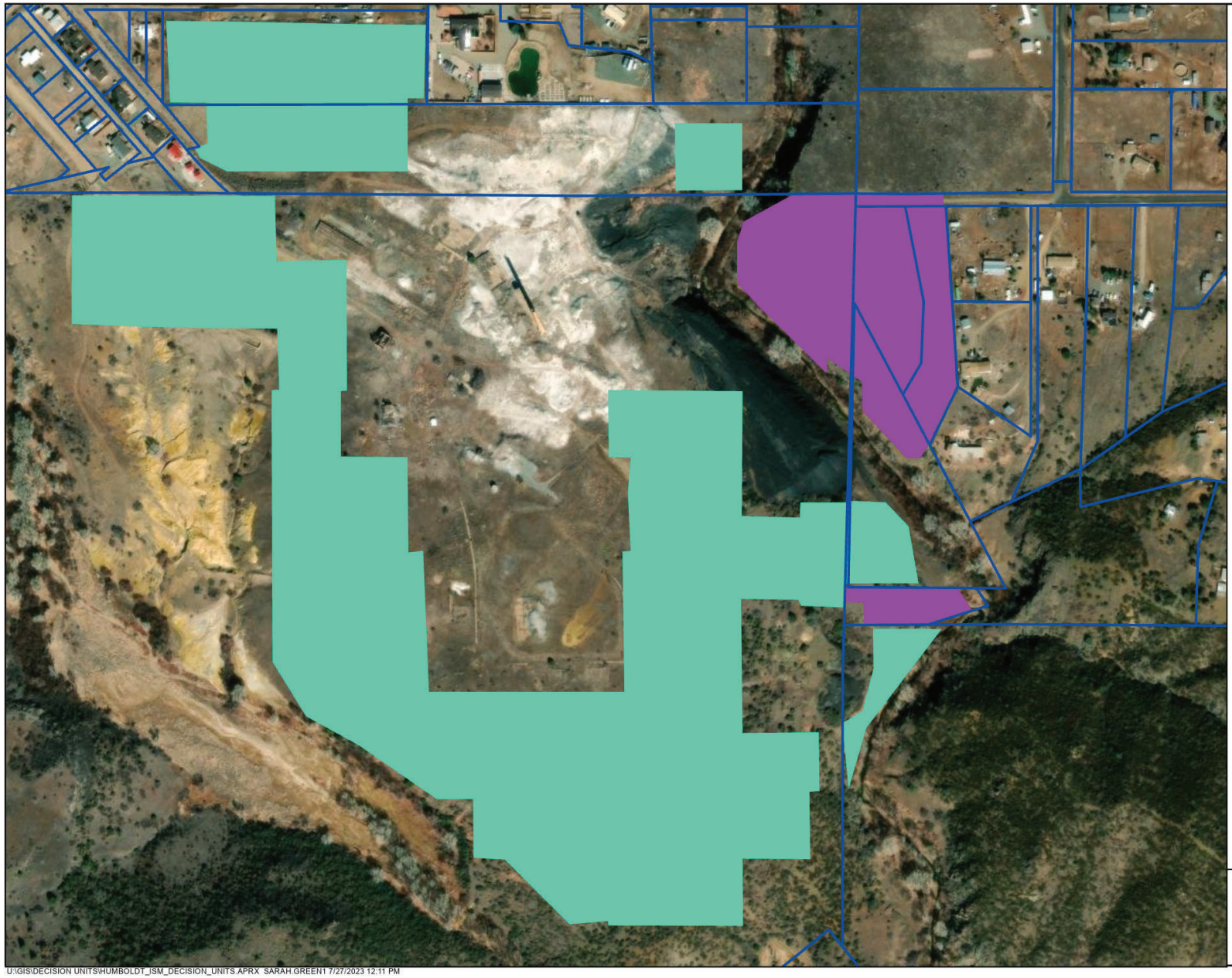
Figures



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Legend

Yavapai County Parcels

Anticipated Future Land Use

Industrial (~54 acres)

Residential (~8.25 acres)

N

0 500 1,000 1,500

Scale in Feet

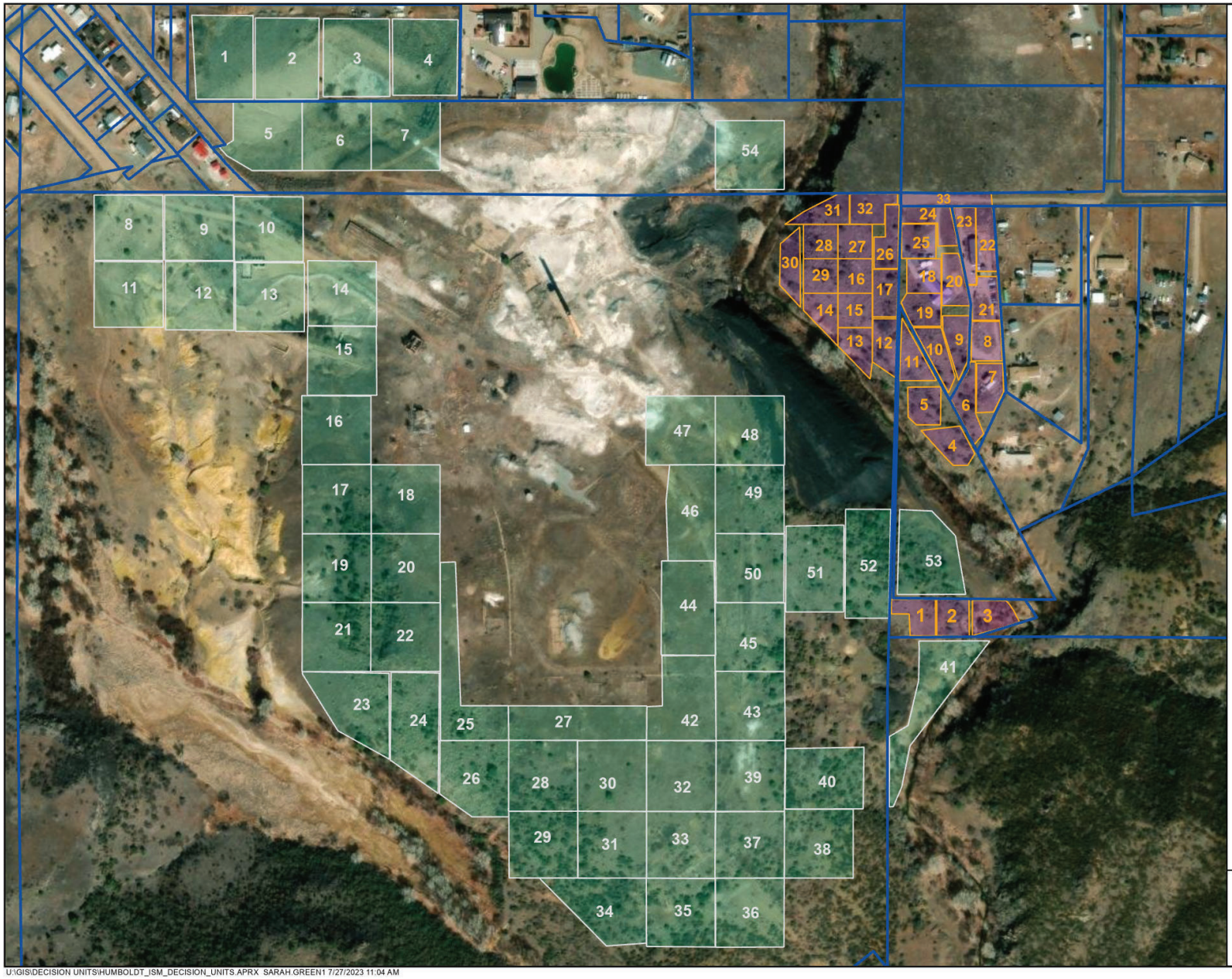
Notes:
The boundaries of the former Iron King Mine and former Humboldt Smelter represent property boundaries and do not directly correspond to the area of historical operations or impacts.
Image Source: USDA 2015.

ISM Incremental Sampling Methodology

TETRA TECH

Figure 1: HS-ISM Project Investigation Area

Iron King Mine / Humboldt Smelter Superfund Site



Legend

- Industrial Decision Units (54)
- Residential Decision Units (33)
- Yavapai County Parcels

N

0 500 1,000 1,500

Scale in Feet

Notes:
The boundaries of the former Iron King Mine and former Humboldt Smelter represent property boundaries and do not directly correspond to the area of historical operations or impacts.
Image Source: USDA 2015.

ISM Incremental Sampling Methodology
White numbers are the industrial decision unit numbers.
Orange numbers are the residential decision unit numbers.

TETRA TECH

Figure 2: HS-ISM Project Decision Units

Iron King Mine / Humboldt Smelter Superfund Site

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Legend

- R30s - Residential/30 increments/ shallow DU
- R30sd - Residential/30 increments/ shallow and deep DU
- R50s - Residential/50 increments/ shallow DU
- I30s - Industrial/30 increments/ shallow DU
- I30sd - Industrial/30 increments/ shallow and deep DU
- I50s - Industrial/50 increments/ shallow DU
- I50sd - Industrial/50 increments/ shallow and deep DU
- Yavapai County Parcels

N

0 500 1,000 1,500

Scale in Feet

Notes:
The boundaries of the former Iron King Mine and former Humboldt Smelter represent property boundaries and do not directly correspond to the area of historical operations or impacts.
Image Source: USDA 2015.

ISM Incremental Sampling Methodology
White numbers are the industrial decision unit numbers
Orange numbers are the residential decision unit numbers
I - Industrial
R - Residential
S - Shallow
D - Deep
30 - 30 increments
50 - 50 increments

TETRA TECH

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Figure 3: HS-ISM Project Replicate Decision Units

Iron King Mine / Humboldt Smelter Superfund Site

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Legend

- R30s - Residential/30 increments/ shallow DU
- R30sd - Residential/30 increments/ shallow and deep DU
- R50s - Residential/50 increments/ shallow DU
- I30s - Industrial/30 increments/ shallow DU
- I30sd - Industrial/30 increments/ shallow and deep DU
- I50s - Industrial/50 increments/ shallow DU
- I50sd - Industrial/50 increments/ shallow and deep DU
- Example 30 increment sampling
- Example 50 increment sampling
- Yavapai County Parcels
- White arrows represent the planned travel path for ISM increment collection

N

0 500 1,000 1,500

Scale in Feet

Notes:
The boundaries of the former Iron King Mine and former Humboldt Smelter represent property boundaries and do not directly correspond to the area of historical operations or impacts.
Image Source: USDA 2015.

ISM Incremental Sampling Methodology
White numbers are the industrial decision unit numbers
Orange numbers are the residential decision unit numbers
I - Industrial
R - Residential
S - Shallow
D - Deep
30 - 30 increments
50 - 50 increments

TETRA TECH

Figure 4: HS-ISM Project Decision Unit Sampling

Iron King Mine / Humboldt Smelter Superfund Site

Appendix A

Pace Analytical®
ENVIRONMENTAL SCIENCES

Document Information

Document Number: ENV-SOP-MTJL-0112 **Revision:** 05

Document Title: Multi-Increment Sampling

Department(s): SVOA

Date Information

Effective Date: 17 Feb 2022

Notes

Document Notes:

All Dates and Times are listed in: Central Time Zone

Signature Manifest

Document Number: ENV-SOP-MTJL-0112 **Revision:** 05

Title: Multi-Increment Sampling

All dates and times are in Central Time Zone.

ENV-SOP-MTJL-0112

QM Approval

Name/Signature	Title	Date	Meaning/Reason
Rebecca King (010125)	Manager - Quality	17 Feb 2022, 11:42:57 AM	Approved

Management Approval

Name/Signature	Title	Date	Meaning/Reason
Kyle Moore (006492)	Supervisor	14 Dec 2021, 03:29:55 PM	Approved
Michael Jones (006596)	Quality Analyst 3	17 Dec 2021, 12:44:45 PM	Approved

Pace Analytical™

TEST METHOD STANDARD OPERATING PROCEDURE
TITLE: Multi-Increment Sampling
TEST METHOD: NA
ISSUER: Pace Analytical National Center for Testing & Innovation

1.0 Scope and Application

1.1 Appendix A of EPA Method 8330B (SW-846) specifically addresses field sampling. The appendix provides guidance for explosive residue sample collection, handling, and laboratory processing techniques. Method 8330B recommends the use of multi-increment (MI) sampling, which involves the extraction of a representative portion of material from within a single decision unit which will adequately address potential compositional and distributional heterogeneity. In MI sampling, several increments from the same decision unit are combined to form one sample that is submitted for laboratory analysis. The procedures for MI sampling are specifically designed to minimize sampling error and provide a more scientifically-representative mean concentration of the contaminant(s) present in the decision unit.

1.2 Initial demonstration for achieving samples size below 75µm per DOD/DOE QSM is on file in the QA department.

2.0 Summary of Method

2.1 Samples are dried, ground, and homogenized before subsamples are taken for sample preparation.

3.0 Interferences

3.1 Care must be taken to not cross-contaminate samples during the drying, sieving, and grinding procedures. Grinding blanks are required to verify procedure is free from cross contamination.

3.2 The drying process may result in quantitative losses of some analytes. Project Managers may consider eliminating the drying process prior to analysis or removing poor performers from the target analyte list if drying is required.

4.0 Definitions

4.1 Sieve: A device made of wire mesh held in a frame through which finer particles of a mixture of various sizes may be passed to separate them from coarser ones or through which soft materials may be forced for reduction to fine particles.

4.2 Shatterbox: A device for mechanically pulverizing a sample or material.

4.3 Ball Mill: A device using ceramic pellets and rotation in a closed container to pulverize the contents.

4.4 Refer to the Laboratory Quality Manual for a glossary of common lab terms and definitions.

5.0 Health and Safety

5.1 The toxicity or carcinogenicity of each chemical material used in the laboratory has not been fully established. Each chemical should be regarded as a potential health hazard and exposure to these compounds should be as low as reasonably achievable.

5.2 The laboratory maintains documentation of hazard assessments and OSHA regulations regarding the safe handling of the chemicals specified in each method. Safety data sheets for all hazardous chemicals are available to all personnel. Employees must abide by the health, safety and environmental (HSE) policies and procedures specified in this SOP and in the Pace National Chemical Hygiene / Safety Manual.

5.3 Personal protective equipment (PPE) such as safety glasses, gloves, and a laboratory coat must be worn in designated areas and while handling samples and chemical materials to protect against physical contact with samples that contain potentially hazardous chemicals and exposure to chemical materials used in the procedure.

5.4 Concentrated corrosives present additional hazards and are damaging to skin and mucus membranes. Use these acids in a fume hood whenever possible with additional PPE designed for handing these materials. If eye or skin contact occurs, flush with large volumes of water. When working with acids, always add acid to water to prevent violent reactions. Any processes that emit large volumes of solvents (evaporation/concentration processes) must be in a hood or apparatus that prevents employee exposure.

5.5 Contact your supervisor or local HSE coordinator with questions or concerns regarding safety protocol or safe handling procedures for this procedure.

6.0 Sample Collection, Preservation, Holding Time, and Storage

6.1 Samples should be collected in accordance with a sampling plan and procedures appropriate to achieve the regulatory, scientific, and data quality objectives for the project.

6.2 Pace National will typically receive samples in 4-8oz containers for processing.

7.0 Equipment and Supplies

7.1 Sieve: 10mesh

7.2 Grinder: Shatterbox or equivalent capable of reducing particle size to <75µm

7.3 Drying rack

7.4 12-inch brass pans

7.5 Aluminum baking sheets

8.0 Reagents and Standards

8.1 All reagents and standards must be recorded in the appropriate preparation log and assigned a unique number. See ENV-SOP-MTJL-0041, *Standard Logger – Tree Operation*. Additional information regarding reagent preparation can be found in the Standards Logger (Tree) digital archive system. All spiking solutions and surrogate standard solutions should be replaced at least every six months or sooner if a problem is detected unless otherwise noted.

9.0 Procedure

9.1 All sample contents within the container are emptied into a pan/weigh boat and dried to a constant weight.

9.1.1 A Blank matrix must be dried with samples.

9.1.2 Obtain a clean pan/weigh boat and record the tare weight.

9.1.3 Empty the entire contents of the sample container into the pan/weigh boat.

9.1.4 Using gloved hands break the soil into small pieces as necessary to facilitate the drying process. Use fresh gloves for each sample to prevent cross contamination.

9.1.5 Record the initial weight of the entire sample.

9.1.6 After the initial weight is obtained, dry the sample at room temperature in a hood for approximately 24 hours. Then obtain a 2nd sample weight.

9.1.7 Continue the drying process for approximately 12 hours and obtain a 3rd sample weight.

9.1.8 Two consecutive weights of less than 10% difference, taken approximately 12 hours apart, is considered to be dried to a constant weight.

9.1.9 Dates/Times are recorded as well as the ambient temperature with each weighing of samples.

9.2 For all methods or when client-specific data quality objectives (DQOs) require grinding, dried sample is introduced into the shatterbox or equivalent. The entire sample must be ground. If multiple portions are ground separately, the aliquots must be combined prior to subsampling for extraction. Samples are ground up to three-minute intervals. Intervals and duration are dependent on the sample matrix and analytes of interest for the specific project. The Blank and weekly check sample must also proceed through this step.

9.3 Dried sample material is passed through a 10mesh (2mm) sieve (may be assisted using gloved hands). Do not intentionally include vegetation unless project specifications include this requirement. Depending on sample matrix, sieving may be performed initially to facilitate the drying process.

9.4 The Blank matrix is ground at the end of each batch. A blank will also be ground after any sample of known concentration above detectable limits, including quality control samples.

9.5 Each sample/QC is spread into a pan in order to perform sufficient subsampling of the final sample aliquot. At least 30 sample increments must be taken for the subsampling procedure. The sample volume extracted for analysis should represent the entire ground sample.

NOTE: If sample volume does not allow 30 aliquots, a note will be made on the extraction log.

9.6 See the specific method extraction SOP for further processing information.

10.0 Data Analysis and Calculations

10.1 See the Laboratory Quality Assurance Manual for equations for common calculations.

11.0 Quality Control and Method Performance

11.1 Analyst Qualifications and Training

11.1.1 Employees that perform any step of this procedure must have a completed Read and Acknowledgment Statement for this version of the SOP in their training record. In addition, prior to unsupervised (independent) work on any client sample, analysts that prepare or analyze samples must have successful initial demonstration of capability (IDOC) and must successfully demonstrate on-going proficiency on an annual basis. Successful means the initial and on-going DOC met criteria, documentation of the DOC is complete, and the DOC record is in the employee's training file. Refer to ENV-SOP-MTJL-0015, *Technical Training and Personnel Qualifications for Chemistry* for more information.

12.0 Data Review And Corrective Action

12.1 Data Review

12.1.1 Pace National's data review process includes a series of checks performed at different stages of the analytical process by different people to ensure that SOPs were followed, the analytical record is complete and properly documented, proper corrective actions were taken for QC failure and other nonconformance(s), and that test results are reported with proper qualification.

12.1.2 The review steps and checks that occur as employees complete tasks and review their own work is called primary review.

12.1.3 All data and results are also reviewed by an experienced peer or supervisor. Secondary review is performed to verify SOPs were followed, that calibration, instrument performance, and QC criteria were met and/or proper corrective actions were taken, qualitative ID and quantitative measurement is accurate, all manual integrations are justified and documented in accordance with the Pace National's SOP for manual integration, calculations are correct, the analytical record is complete and traceable, and that results are properly qualified.

12.1.4 A third-level review, called a completeness check, is performed by reporting or project management staff to verify the data report is not missing information and project specifications were met.

12.1.5 Refer to ENV-SOP-MTJL-0014, *Data Handling and Reporting* and ENV-SOP-MTJL-0038, *Data Review* for specific instructions and requirements for each step of the data review process.

12.2 Corrective Action

12.2.1 Corrective action is expected any time QC or sample results are not within acceptance criteria. If corrective action is not taken or was not successful, the decision/outcome must be documented in the analytical record. The primary analyst has primary responsibility for taking corrective action when QA/QC criteria are not met. Secondary data reviewers must verify that appropriate action was taken and/or that results reported with QC failure are properly qualified.

13.0 Pollution Prevention and Waste Management

13.1 Pace National proactively seeks ways to minimize waste generated during our work processes. Some examples of pollution prevention include but are not limited to: reduced

solvent extraction, solvent capture, use of reusable cycletainers for solvent management, and real-time purchasing.

13.2 The EPA requires that laboratory waste management practices be conducted consistent with all applicable federal and state laws and regulations. Excess reagents, samples and method process wastes must be characterized and disposed of in an acceptable manner in accordance with Pace National's Chemical Hygiene Plan / Safety Manual.

14.0 Modifications

14.1 Pace National is set up currently to process from 4oz/8oz/16oz/32oz jars that have been prepared in the field from bulk containers. Pace National cannot currently process bulk samples for this method.

14.2 Due to limited sample volume received as listed in 14.1:

14.2.1 Duplicate subsampling is performed rather than triplicate

15.0 Responsibilities

15.1 Pace National employees that perform any part this procedure in their work activities must have a signed Read and Acknowledgement Statement in their training file for this version of the SOP. The employee is responsible for following the procedures in this SOP and handling temporary departures from this SOP in accordance with Pace National's policy for temporary departure.

15.2 Pace National supervisors/managers are responsible for training employees on the procedures in this SOP and monitoring the implementation of this SOP in their work area.

16.0 Attachments

16.1 Not applicable to this SOP

17.0 References

17.1 Nitroaromatics, Nitramines, and Nitrate Esters by High Performance Liquid Chromatography (HPLC), SW-846 Method 8330B, Revision 2, October 2006, Appendix A.

17.2 Quality Systems Manual (QSM) for Environmental Laboratories, Department of Defense (DoD), Version 5.1, 2017.

TEST METHOD STANDARD OPERATING PROCEDURE
TITLE: Multi-Increment Sampling
TEST METHOD: NA
ISSUER: Pace Analytical National Center for Testing & Innovation

18.0 Revision History

This Version:

Section	Description of Change
7.3, 7.4, 7.5, 9.2. Removed 8.2, 9.6, & 14.3.	Process update and removal of 8330 prep steps.

This document supersedes the following document(s):

Document Number	Title	Version
ESC Lab Sciences SOP #330377	ESC Lab Sciences SOP #330377	1
ESC Lab Sciences SOP #330377	ESC Lab Sciences SOP #330377	2
ESC Lab Sciences SOP #330377	ESC Lab Sciences SOP #330377	3
ENV-SOP-MTJL-0112	Multi-Increment Sampling	01
ENV-SOP-MTJL-0112	Multi-Increment Sampling	02
ENV-SOP-MTJL-0112	Multi-Increment Sampling	03
ENV-SOP-MTJL-0112	Multi-Increment Sampling	04

From:	Katelyn Kane Devries
To:	Pace, Joey; Mikel Morales; Bennett, Mekaela
Subject:	Fwd: FW: ISM Container Requirements (request for QC variance)
Date:	Thursday, August 10, 2023 2:15:00 PM

See Marlon's email below.

Regards,

Katelyn Kane-DeVries, RG
Project Manager/ Hydrogeologist, Federal Projects Unit
Waste Programs Division
Ph: 602-771-0167

---------- Forwarded message ---------
From: **Mezquita, Marlon** <Mezquita.Marlon@epa.gov>
Date: Thu, Aug 10, 2023 at 1:03 PM
Subject: RE: FW: ISM Container Requirements (request for QC variance)
To: Katelyn Kane Devries <kane-devries.katelyn@azdeq.gov>, Lawrence, Anne <Lawrence.Anne@epa.gov>
Cc: Dhont, Jeffrey <Dhont.Jeff@epa.gov>, Mikel Morales <morales.mikel@azdeq.gov>

Hi Katelyn,

Thanks for the quick reply. Yes, appending the SAP with the PACE Labs email acknowledgement/acceptance of ISM soil samples in Ziploc bags is acceptable.

Much appreciated,

Marlon

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
Marlon Mezquita, Chemical Engineer, PE

Quality Assurance Branch

US EPA Region 9, Lab Services and Applied Sciences Division (LSS-3)
75 Hawthorne Street
San Francisco, CA 94105
Phone: (415) 972-3808
Fax: (415) 947-3564
email: Mezquita.Marlon@epa.gov
R9 QA Web Page: https://www.epa.gov/quality/quality-assurance-planning-region-9
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~

From: Katelyn Kane Devries <kane-devries.katelyn@azdeq.gov>
Sent: Thursday, August 10, 2023 12:51 PM
To: Lawrence, Anne <Lawrence.Anne@epa.gov>; Mezquita, Marlon <Mezquita.Marlon@epa.gov>
Cc: Dhont, Jeffrey <Dhont.Jeff@epa.gov>; Mikel Morales <morales.mikel@azdeq.gov>
Subject: Fwd: FW: ISM Container Requirements (request for QC variance)

Hello Marlon,

Per your request from yesterdays meeting would including the below email chain be sufficient to address your concern for a variance from the Lab SOP on sample containers if added to the HS ISM SAP?

Regards,

Katelyn Kane-DeVries, RG
Project Manager/ Hydrogeologist, Federal Projects Unit

Waste Programs Division

Ph: 602-771-0167

azdeq.gov

Your feedback matters to ADEQ. Visit azdeq.gov/feedback

---------- Forwarded message ---------
From: **Pace, Joey** <JOEY.PACE@tetratech.com>
Date: Thu, Aug 10, 2023 at 9:22 AM
Subject: FW: ISM Container Requirements (request for QC variance)
To: kane-devries.katelyn@azdeq.gov <kane-devries.katelyn@azdeq.gov>
Cc: Bennett, Mekaela <Mekaela.Bennett@tetratech.com>

Hi Katelyn: Tetra Tech received the included response from Pace Labs regarding using Ziplock bags. Below Daphne's response, you can see I provided complete details as to why we were asking for this change in containers, including the fact U.S. EPA was requiring the documentation since it is a variance from Pace's SOP. Could you find out from Annie and/or Marlon if this is sufficient to include in our ISM QAPP Addendum?

Regards,

Joey Pace, PMP | Senior Env. Scientist | Tetra Tech
Direct **+1 (480) 430-4087** | joey.pace@tetratech.com

From: Daphne Richards <Daphne.Richards@pacelabs.com>
Sent: Thursday, August 10, 2023 8:38 AM
To: Pace, Joey <JOEY.PACE@tetratech.com>
Cc: Bennett, Mekaela <Mekaela.Bennett@tetratech.com>
Subject: RE: ISM Container Requirements (request for QC variance)

Hi Joey,

It will not be a problem to send the samples in Ziploc bags for metals analysis and ISM prep. If you have any other questions please let me know.

Thanks

Daphne Richards

Project Manager 2 I National

12065 Lebanon Road I Mt. Juliet, TN 37122

O. 615.773.9662 I pacelabs.com

From: Pace, Joey <JOEY.PACE@tetratech.com>
Sent: Wednesday, August 9, 2023 5:50 PM
To: Andi Jones <andi.jones@pacelabs.com>
Cc: Bennett, Mekaela <Mekaela.Bennett@tetratech.com>; Daphne Richards <Daphne.Richards@pacelabs.com>
Subject: ISM Container Requirements (request for QC variance)

Hi Andi: I have from an earlier communication from you that Pace Labs typically requests a 1-liter glass jar for metals in soil samples collected for Incremental Sampling Methodology (ISM). I noticed the Pace SOP for ISM states "we typically receive samples in 4 to 8 oz containers for processing".

Tetra Tech would like to ask Pace Labs if we can request a variance to this requirement so we can submit our samples in Ziploc bags? The USEPA will be signing off on our Work Plan for this project and has told us they are fine with this variance, as long as the lab indicates they are fine with it. We are requesting this variance to help us save on sample shipping weight, breakage in the field, and to save on costs for extra packaging (i.e. bubble wrap), as well as to eliminate the room the packaging takes up in coolers.

Tetra Tech is proposing to use double-bagging with the soil placed in Ziploc bags with the sample label placed on the inner bag, to protect the label from cooler ice.

Would you please check with your QC Dept and let us know by responding to this email if Pace Labs agrees to this variance. This would be in relation to ISM to be conducted at Iron King Mine in Dewey-Humboldt, Arizona.

Thank you very much for your time.

Joey Pace, PMP | Senior Env. Scientist | Tetra Tech
Direct **+1 (480) 430-4087** | joey.pace@tetratech.com

Appendix B

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IX
75 Hawthorne Street
San Francisco, CA 94105-3901

August 22, 2023

MEMORANDUM

TO: FILE

FROM: Jeffrey Dhont
Remedial Project Manager
US EPA Region 9

SUBJECT: Finding of No Potential to Cause Effect
Incremental Sampling Methodology (ISM) at the Iron King Mine-Humboldt Smelter Superfund Site for Environmental Protection Agency (EPA), Yavapai County, Arizona

The Environmental Protection Agency (EPA), Region 9, is proposing to complete Incremental sampling methodology (ISM) testing in two areas near the Humboldt Smelter site (site number AZ N:8:71[AMS]). The Smelter site was recommended eligible for the National Register of Historic Places (NRHP) for its potential to yield information important to history (NRHP Criterion D). EPA will be completing ISM testing within 33 and 54, ¼ and 1 acre decision units (plots). 30 points within each plot will be collected for ISM tests, 990 points spread across 8.25 acres (¼-acre plots) and 1620 points spread across 54 acres (1-acre plots), at a maximum 2 inches (in.) in diameter, a maximum depth of 12 in., and all will be dug with hand equipment.

Given the number of project acres, distribution, and the size of the ISM tests, it is calculated that less than 1% (.0027%) of the total surface area has the potential to be disturbed. Therefore, the testing is not considered substantial enough to alter a historic property in a significant manner, or remove pertinent data yielding information important to history or prehistory, including surface artifacts, features, or subsurface intact cultural deposits. The EPA has determined the testing would not rise to a level of an adverse effect to a historic property assuming one were present. EPA makes a finding of *No Potential to Cause Effect* pursuant to 36 CFR §800.5 (a)(1) under Section 106 of the National Historic Preservation Act (54 U.S.C. § 306108) (Section 106).

Because the testing will not alter a historic property in a manner, or to an extent that would cause effect under Section 106, EPA is not required to contact the State Historic Preservation Officer, Tribal Historic Preservation Officer, or other interested parties. This Memorandum for Record will serve as documentation of the EPA's compliance with Section 106, 36 CFR Part 800 regarding historic properties.

Appendix C

REMEDIAL PROJECTS SECTION

QUALITY ASSURANCE PROGRAM PLAN

Prepared by

Remedial Projects Section
September 2022
Revision 02

Summary of Revisions

This is a new Remedial Projects Section Program Quality Assurance Program Plan (QAPP) and there are no revisions.

Document Change Log

Revision Number	Date	Responsible Party	Description of Change
0.01		Lowell Carty	New Document; Initial Release
0.02	9/2/2022	Tina LePage	New Document; Initial Release

A.1 TITLE AND APPROVAL PAGE

Quality Assurance Program Plan for Remedial Projects Section

The Arizona Department of Environmental Quality (ADEQ) has prepared this Quality Assurance Program Plan (QAPP) following the *EPA Requirements for Quality Assurance Project Plans (EPA QA/R-5)* dated March 2001, the *EPA Guidance for Quality Assurance Project Plans (EPA QA/G-5)* dated December 2002, the *EPA Region 9 Requirements for Quality Assurance Program Plan (R9QA/03.2)* dated March 2012, and the *ADEQ Quality Management Plan* dated April 2022.

This QA Program Plan is hereby recommended for approval and commits the Department to follow the elements described within.

Arizona Department of Environmental Quality

Signature: _____ Date: _____
Laura L. Malone, Director, Waste Programs Division
E-mail: malone.laura@azdeq.gov

Signature: _____ Date: _____
Tina LePage, Manager, Remedial Projects Section
E-mail: lepage.tina@azdeq.gov

Signature: _____ Date: _____
Karin Harker, Manager, Federal Projects Unit
E-mail: harker.karin@azdeq.gov

Signature: _____ Date: _____
Thomas Titus, Manager, Remedial Projects Unit
E-mail: titus.tom@azdeq.gov

Signature: _____ Date: _____
Scott Green, Manager, Voluntary Remediation Program
E-mail: green.scott@azdeq.gov

Signature: _____ Date: _____
Mary Charlson, Quality Assurance Specialist, Remedial Projects Section
E-mail: charlson.mary@azdeq.gov

Signature: _____ Date: _____
Paula Panzino, Quality Assurance Manager, Director's Office
E-mail: panzino.paula@azdeq.gov

EPA Region 9

Signature: _____ Date: _____
Nada Hollan Burke, EPA Superfund and Emergency Management

Signature: _____ Date: _____
Audrey L. Johnson, Quality Assurance Manager

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Figure A.1 Remedial project Section Organization Chart
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APPENDICES

Appendix A	Arizona Administrative Code Applicable to ADHS Laboratories
Appendix B	Arizona Administrative Code for Soil Remediation and Water Quality Standards
Appendix C	ADEQ Specific Quality Assurance Guidance and Policies
Appendix D	Standard Operating Procedures

ACRONYMS AND ABBREVIATIONS

AAC	Arizona Administrative Code
ADEQ	Arizona Department of Environmental Quality
ADHS	Arizona Department of Health Services
ADQ	Audit of Data Quality
AQPM	Agency-wide QA/QC Program Management
ARS	Arizona Revised Statutes
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CSM	Conceptual Site Model
DQA	Data Quality Assessment
DQI	Data Quality Indicator
DQO	Data Quality Objective
EDD	Electronic data deliverable
EPA	Environmental Protection Agency
LCS	Laboratory Control Sample
MDL	Method Detection Limit
MQO	Measurement Quality Objective
MS/MSD	Matrix Spike and Matrix Spike Duplicate
MSR	Management System Review
MPC	Measurement Performance Criteria
PARCCS	Precision, Accuracy, Representativeness, Completeness, Comparability, and Sensitivity
PQL	Practical Quantitation Limit
PRAP	Proposed Remedial Action Plan
PRQL	Project Required Quantitation Limit
QA	Quality Assurance
QAPjP	Quality Assurance Project Plan
QC	Quality Control
QCSR	Quality Control Summary Report
QMP	Quality Management Plan
RCRA	Resource Conservation and Recovery Act
RPD	Relative Percent Difference
RPS	Remedial Projects Section
RSD	Relative Standard Deviation
SDWA	Safe Drinking Water Act
SOP	Standard Operating Procedure
VOC	Volatile Organic Compound
VRP	Voluntary Remediation Program
WQARF	Water Quality Assurance Revolving Fund
WPD	Waste Programs Division

A.3 DISTRIBUTION LIST

This document will be updated at least every five years and reviewed annually. Whenever a new version of this document is approved, the Unit Manager will save it on the Arizona Department of Environmental Quality (ADEQ)'s shared network drive at J:\COMMON\ADEQ QUALITY MANAGEMENT PROGRAM\RPU and send email notification to ADEQ's Quality Management team, plus all members of the Division including staff, managers, and administrative assistants. The roles of these teams, managers, and staff with respect to this project are discussed in Section A.5.

SECTION A PROGRAM MANAGEMENT

A.4 PROGRAM ORGANIZATION

This Quality Assurance Program Plan (Program Plan) establishes the requirements for collecting data as part of the Remedial Projects Section (RPS) Value Stream projects. The purpose of the Program Plan is to establish quality assurance (QA) and quality control (QC) standards and procedures to be applied to RPS projects to produce data that are scientifically valid and defensible, and of known and documented quality.

ADEQ's RPS operates within the Waste Programs Division (WPD) of ADEQ. This Division functions as a consolidated source of environmental cleanup in the State of Arizona, with authorities and responsibilities arising from delegated authorities through Resource Recovery Conservation and Recovery Act (RCRA), the Clean Water Act (CWA) and from cooperative work agreements through CERCLA. The RPS is one component of the WPD and consists of full-time employees and managers/supervisors.

ADEQ's Director has delegated day-to-day responsibility for overseeing the Quality Management Plan to ADEQ's Quality Assurance Manager (QAM). The QAM functions as the Agency's technical QA expert. The QAM has developed a team of QA specialists made up of designated QA/QC personnel from each of the agency's three environmental Divisions and the QAM resides in the Office of Environmental Excellence for reasons of autonomy. The QA Team began biweekly meetings in August 2018. The QAM is not routinely involved with the day-to-day activities of the hazardous waste program or in any of the planning phases of a project or in the review/approval of Site Assessment Plans (SAPs). However, the QAM can be requested to assist in the review of quality assurance and control practices when necessary.

ADEQ's Quality Management System (QMS) requires that all environmental monitoring and measurement efforts mandated or supported by the United States Environmental Protection Agency (EPA) have in place a centrally managed Quality Assurance Program Plan (QAPP). ADEQ's QMS is being implemented to satisfy the policy and program requirements of the EPA Order CIO 2105-P-01-0 which provides requirements for the conduct of quality management practices, including quality assurance (QA) and quality control (QC) for environmental data generation, as a non-EPA organization performing work on behalf of EPA.

The content of this Program Plan fulfills the US EPA requirement for programs receiving Federal grant monies and environmental monitoring and measurement efforts mandated or supported by US EPA have in place a centrally managed Program Plan.

ADEQ's RPS maintains procedures to ensure the precision, accuracy, completeness, comparability and representativeness of data generated for environmental programs operated under the RPS. The environmental programs or Value Streams operated under the RPS include the Remedial Projects Unit (RPU) or the Water Quality Assurance Revolving Fund (WQARF), the Voluntary Remediation Program (VRP) and the Federal Projects Unit (FPU). A current RPS organization chart is provided as Figure A.1.

A.4.1 Remedial Projects Unit Value Stream

The Remedial Projects Unit oversees the WQARF Program. The WQARF Program (Arizona Revised Statute (ARS) Title 49, Chapter 2, Article 5), created under Arizona's Environmental Quality Act of 1986, has remedial action, abatement, and liability provisions. This revolving fund may be used for a variety of purposes, such as: 1) providing funds for costs incurred for remedial actions taken if a responsible party cannot be identified or refuses to undertake remedial actions relating to hazardous substances released into the environment; and 2) providing funds for the costs of conducting site investigations, feasibility studies, health-effects studies and risk assessments. The WQARF Program conducts these efforts throughout Arizona with support from state and federal funds. The WQARF Program also oversees privately-funded cleanup efforts.

A.4.2 Voluntary Remediation Program Value Stream

The Voluntary Remediation Program (ARS § Title 49, Chapter 1, Article 5) was created in 2000 so property owners, prospective purchasers and other interested parties could investigate or clean up a contaminated site in cooperation with ADEQ. VRP provides a streamlined process for participants by having a single point of contact at ADEQ to address applicable cross-program remediation efforts. ADEQ reviews these voluntary remedial actions and provides closure documents for successful site remediation.

A.4.3 Federal Projects Unit Value Stream

The Federal Projects Unit provides oversight of federally managed sites such as Comprehensive Environmental Response Compensation and Liability Act (CERCLA) and Department of Defense (DoD) sites. ADEQ's Federal Projects staff provides oversight of contaminated sites in Arizona that are governed and funded under CERCLA (1980), commonly known as Superfund. The National Priorities List (NPL) is a list of sites that pose the greatest potential threat to human health and the environment. The NPL is the list of national priorities among the known releases or threatened releases of hazardous substances, pollutants, or contaminants throughout the United States and its territories. The NPL guides the EPA in determining which sites warrant further investigation. In addition to the CERCLA sites, the Federal Projects staff provides state review and oversight at DoD sites.

Under this organizational structure, the Section Manager is responsible for overall management, direction, coordination and guidance for all Remedial Project Section Value Streams. The Section Manager is responsible for overseeing the entire RPS program and budget. The three Value Streams (WQARF, FPU and VRP) are led by supervisors who, along with their staff, carry out program tasks. The Administrative Assistant, the Special Projects/Principal Hydrogeologist and Value Stream supervisors all report directly to the Section Manager.

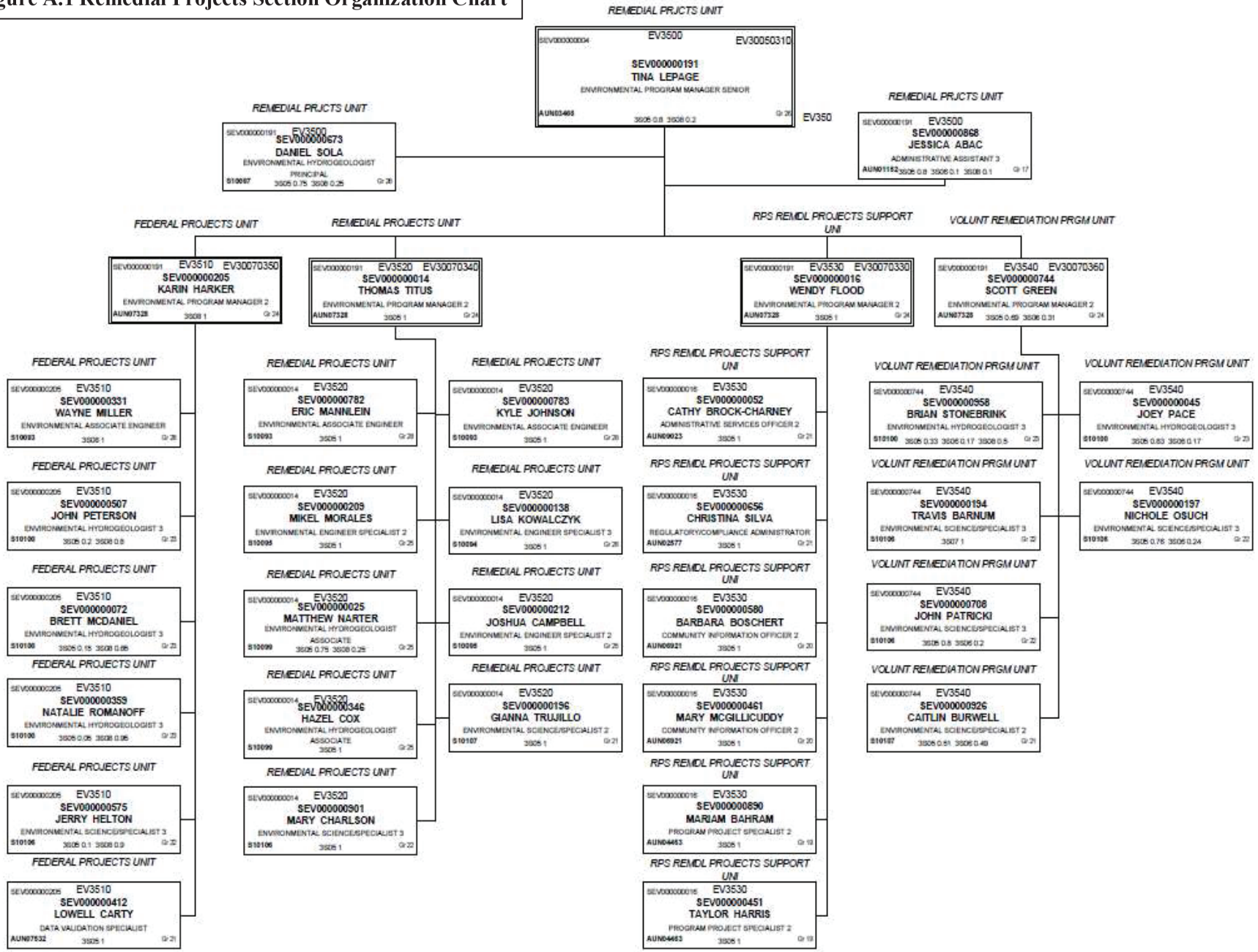
Value Stream Managers are responsible for their individual program's overall development of the sampling design and protocols discussed in this QA program plan, as well as ensuring protocols are followed. On a routine basis, the Value Stream Managers coordinate with their staff and contractors to review field and laboratory roles and responsibilities, sampling and field measurement requirements, analytical requirements, sampling schedule and requirements for field and laboratory documentation. This coordination minimizes potential problems that could

occur. The Value Stream Managers are also responsible for ensuring that any amended versions of the QA program plan are provided to the EPA for approval and then distributed to the appropriate individuals and organizations.

ADEQ may also hire contractors to collect environmental data. ADEQ or contractors staff collect samples and make field measurements according to policies and procedures established in the QA program plan. All staff must follow this QA program plan or other QA plans approved by ADEQ. ADEQ or contractors staff also communicate with the analytical laboratory regarding sample delivery and schedule. Contractors will report and provide data to each Value Stream Manager.

The QAM is independent of the Executive Leadership Team who are the policy making group for ADEQ. With this separation of groups, Leadership Team, Value Stream QA Specialists, and the QAM, autonomy is preserved in fact and appearance. The ultimate responsibility for Quality Assurance for ADEQ lies with the agency Director. Details regarding the roles and responsibilities of the QAM and QA Specialists can be found in A.6 of this QAPP and Section 1.4.2 of ADEQ's Quality Management Plan, 2022.

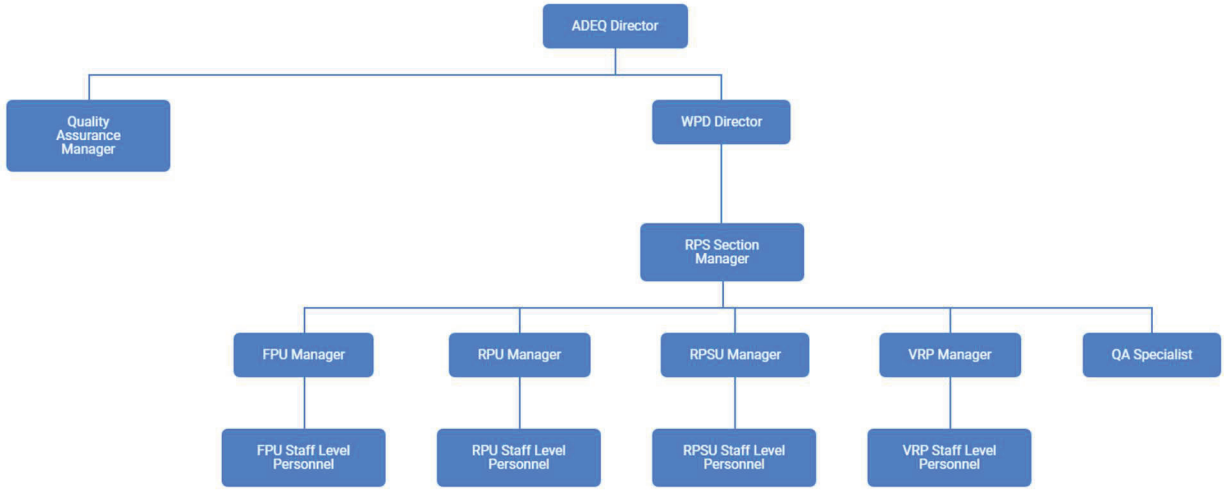
Figure A.1 Remedial Projects Section Organization Chart



The operation of the RPS involves a number of parties/organizations with specific responsibilities related to data quality. These parties/organizations have specific functions related to the operation of the RPS. The following paragraphs discuss these organizations and their general responsibilities, followed by discussions of specific responsibilities held by various individuals within those organizations.

An organizational chart showing all the parties/organizations involved in the data quality system has been included as Figure A.2: Components of the Quality System for ADEQ's RPS. Figure A.2 identifies entities based on their applicable data roles. The defined RPS includes: 1) Section Manager; 2) Federal Projects Unit Manager; 3) Remedial Projects Unit Manager; 4) RPU Support Manager; 5) Voluntary Remediation Program Unit Manager; and 6) staff level personnel.

Figure A.2 Components of the Quality System for ADEQ's RPS



A.5 ORGANIZATIONAL ROLES AND RESPONSIBILITIES

Environmental Protection Agency (EPA)

EPA works closely with Arizona in implementing the WQARF Program by providing grant funding, setting national goals and priorities, and conducting program oversight. Each year, EPA identifies the national priorities for implementing all of its programs, including the CERCLA programs. These priorities form the basis for EPA and ADEQ workload negotiations for the upcoming year as part of the establishment of grant funding. Also, EPA regional staff has oversight responsibilities to promote national consistency in CERCLA implementation, encourage coordination and agreement between EPA and ADEQ on technical and management issues, ensure proper enforcement by the ADEQ and ensure appropriate expenditure of federal grant funds.

Arizona Department of Environmental Quality (ADEQ)

ADEQ is responsible for the operation of the RPS. All RPS programmatic activities reside in the WPD of ADEQ. This section has one designated Section Manager and four Unit Supervisors. Three of the units are involved with collection of environmental data. The other unit is a support unit comprising of a legal team and a community involvement team. The legal team assists with the collection of historical environmental data. These four units within the RPS execute the programmatic activities.

Environmental Laboratory Services

All parties and organizations submitting data generated for and submitted to ADEQ's RPS are required to use analytical laboratories licensed by the Arizona Department of Health Services (ADHS). The licensed analytical laboratories are required to follow all Arizona Administrative Code (AAC) applicable to ADHS laboratories (Appendix A). The data produced from the analysis of environmental samples provide information to make informed decisions relating to the health and welfare of Arizona's citizens. These data must be of known quality, technically sound and legally defensible.

Upon application for an environmental laboratory license, ADHS shall issue the license if, after investigation, ADHS determines that the application conforms to the standards established by ADHS. The ADHS Director shall prescribe rules providing for minimum standards of proficiency, methodology, quality assurance, operation, and safety for environmental laboratories and may prescribe standards for personnel education, training, and experience to meet Federal environmental statutes or regulation. The ADHS Director may also allow reciprocity with other states and prescribe reporting formats for compliance testing results. Development of the rules shall be in cooperation with the Director of ADEQ and shall be consistent with Title 49 (Section 49-101 et seq.). Unless exempted by ARS § 36-495.02, no person may operate or maintain an environmental laboratory without a license issued by the ADHS pursuant to ARS §§ 36-495.03 through 36-495.14.

The RPS relies on the ADHS licensing program for the satisfaction of many of the QA elements associated with laboratory operation and reporting (see Appendix A of this QA Program Plan). ADHS maintains oversight of analytical laboratory QC procedures regarding all environmental samples submitted for meeting requirements of a federal or state regulatory program. QA plans, as required by AAC R9-14-615.B, describe licensed laboratory QA responsibilities. ADHS maintains a list of licensed laboratories and periodically inspects them to ensure compliance.

The RPS also has the option of having audits performed by ADEQ's QAM or QA Specialists on laboratories licensed by ADHS. All ADEQ laboratory audits must be performed in accordance with Section 2.3.2 of ADEQ's April 2022 Quality Management Plan.

Weekly ADHS places an Active Lab Info file in a folder that is added to the Arizona Water Quality Database to ensure license status is verified for data captured in the database and used for decision making.

Facility Owners/Operators, Property Owners and Consultants

As primary data generators, the Facility Owner/Operators and Property Owners – either directly or through their environmental contractors - are responsible for the implementation and documentation of specific QC elements, such as the collection and analysis of field blanks, field duplicates and rinsate samples, to satisfy the requirements of the QA Program Plan.

Please note: Facility Owner/Operators and Property Owners rarely employ staff that are qualified to satisfy the requirements of a QA Program Plan and, therefore, hire environmental contractors to generate environmental data. Also, reports requiring a certified Arizona Board of Technical Registration registrant's seal must meet all of the Arizona Board of Technical Registration requirements under ARS Title 32, Chapter 1 and the rules made under that Chapter.

The documentation of all environmental data collection activities must meet the following minimum requirements:

- Documentation of data must be direct, prompt, and legible. All reported data must be uniquely traceable to the raw data. Documentation of all data reduction formulas must occur.
- All original data records include, as appropriate, a description of the data collected, units of measurement, unique sample identification, station or location identification (if applicable), name (signature or initials) of the person collecting the data, and date of data collection.
- Any changes to the original (raw data) entry must not obscure the original entry. The person making the change must document the rationale and initial and date the change.

Development of Standard Operating Procedures (SOPs) for data collection should follow EPA's Guidance for Preparation of Standard Operating Procedures for Quality-Related Operations (EPA, 2007a). SOPs should be included as an appendix of all the Planning Documents and Reports referenced in submitted to ADEQ's RPS. Any QA or QC should be included as an appendix to all planning documents and reports submitted to ADEQ's RPS. The field team should document rationale for any deviations from an SOP and include that documentation in all planning documents and reports submitted to ADEQ's RPS.

A.6 INDIVIDUAL ROLES AND RESPONSIBILITIES

In addition to those general responsibilities maintained by the above organizations, individuals involved in RPS activities have specific QA responsibilities. These individuals are referred to herein by a given project title or position, since these assigned duties will be unaffected by staff changes within these positions. The listed individuals below correspond to the organization structure outlined above. They are described according to the level of direct oversight those individuals provide in the RPS's QA system.

EPA Region 9, Arizona Project Officer

The EPA Arizona Project Officer for grant funding has responsibility to:

- Monitor ADEQ's progress and activities required to meet grant commitments;
- Review progress reports to ensure ADEQ is performing the work as agreed and approved in the grant application;
- Serve as the focal point for programmatic and technical issues;
- Ensure completion of EPA's programmatic terms and conditions; and
- Maintain proper grant documentation.

EPA Region 9, Quality Assurance Office

Prior to the implementation of QA elements as outlined in this QAPP, this document will be reviewed and approved by the EPA Region 9 QA Office. Revisions will be made in accordance with EPA-provided comments until the QAPP is finalized. Once the document is finalized, any proposed revisions to the QAPP will be considered by the EPA Region 9 QA Office prior to inclusion in a revised document. Any substantial deviations from the prescribed performance of QA elements as outlined in the approved QAPP will be documented and submitted as part of a Technical System Audit (TSA) prepared by the ADEQ QAM

Director, Arizona Department of Environmental Quality

The ADEQ Director has overall responsibility for ADEQ's QA Program as outlined in EPA Order CIO 2105.0 (formerly 5360.1 A2). More specifically, the ADEQ Director is responsible for ensuring that QA is an identifiable activity having adequate resources allocated for the accomplishment of the mission's goals for ADEQ's divisions and Southern Regional Office. These goals include providing the resources for the collection of the right type, quantity, and quality of data generated in-house and externally. The Director has delegated this responsibility to the QAM.

Environmental Laboratory Services

The RPS relies on the ADHS licensing program for the satisfaction of many of the QA elements associated with laboratory operation and reporting (see Appendix A of this QA Program Plan). ADHS maintains oversight of analytical laboratory QC procedures regarding all environmental samples submitted for meeting requirements of a federal or state regulatory program. QA plans, as required by AAC R9-14-615.B, describe licensed laboratory QA responsibilities. ADHS maintains a list of licensed laboratories and periodically inspects them to ensure compliance.

The RPS also has the option of having audits performed by ADEQ's QA/QC Manager or QA/QC Representatives on laboratories licensed by ADHS. All ADEQ laboratory audits must be performed in accordance with Section 2.3.2 of ADEQ's April 2022 Quality Management Plan.

Director, Waste Programs Division (WPD) of ADEQ

ADEQ, through its combined authorities from state-delegated environmental programs, oversees all site investigations and cleanups conducted in the State of Arizona. The Director of the Waste Programs Division (Division Director) is responsible for the administration of all these cleanup authorities. In addition, because site cleanup regulations play an integral part in the development of data quality guidelines, the Division Director plays an important function in determining data quality and sufficiency for the WPD which includes the RPS.

The regulations governing investigations and cleanups (ARS Title 49 – The Environment) in Arizona determine, on a general level, the type and amount of data necessary to make decisions regarding issuance of permits, Notice of Violations (NOVs), compliance orders, and the issuance of determination letters (e.g. "No Further Action" letters). The Division Director is responsible for ensuring a consistent application of these regulations across all WPD cleanup sites. All site information is available to the Division Director for review and consideration of site decisions. The Division Director also holds regular supervisor-level meetings to discuss ADEQ issues and WPD operations.

Section Manager, Remedial Projects Section, Waste Programs Division

The Manager of the RPS (Section Manager) is responsible for staff level participation in all the administrative and technical areas of the four units within the section. The Section Manager is responsible for ensuring that the four units perform their functions consistent with WPD policies and procedures. The Section Manager's level of review will routinely consist of ensuring that the proper staff members reviewed, commented and drafted an appropriate decision or comment letter. The Value Stream Managers are also responsible for ensuring that any amended versions of the QA program plan are provided to the EPA for approval and then distributed to the appropriate individuals and organizations. The RPS Manager ensures that the RPS meets program goals.

Unit Supervisor, Remedial Projects Unit Value Stream

The Unit Supervisor of the Remedial Projects Unit is responsible for staff level participation in all the administrative and technical areas of the Remedial Projects Unit. The Unit Supervisor's level of supervision routinely consists of ensuring staff members perform inspections and review, comment on, and draft an appropriate response to submitted planning documents and reports. The Unit Supervisor will also edit, if necessary, decision/response letters. The Unit Supervisor is responsible for final approval of submitted planning documents and reports.

Unit Supervisor, Voluntary Remediation Program Value Stream

The Unit Supervisor of the VRP Value Stream is responsible for staff level participation in all the administrative and technical areas of the VRP Value Stream. The Unit Supervisor's level of review will routinely consist of ensuring staff members carry out document reviews and comment on and draft an appropriate response to submitted planning documents and reports. The Unit Supervisor will also edit, if necessary, comment or decision letter. The Unit Supervisor is responsible for final approval of submitted planning documents and reports.

Unit Supervisor, Federal Projects Unit Value Stream

The Unit Supervisor of the Federal Projects Unit Value Stream is responsible for staff level participation in all the administrative and technical areas of the Federal Projects Unit Value Stream. The Unit Supervisor's level of review will routinely consist of ensuring staff members carry out document reviews and comment on and draft an appropriate response to submitted planning documents and reports. The Unit Supervisor will also edit, if necessary, comment or decision letter. The Unit Supervisor is responsible for final approval of submitted planning documents and reports.

Unit Supervisor, Remedial Projects Support Unit

The Unit Supervisor of the Remedial Projects Support Unit is responsible for staff level participation in ADEQ's RPS community involvement and responsible party identification. The Unit Supervisor's level of review routinely consists of ensuring that proper staff members carry out their assigned duties with respect to community involvement and responsible party identification. This unit is not responsible for any environmental data collection, analysis, quality assurance, or quality control.

Staff Level Personnel - Remedial Projects Unit

Staff level personnel consist of Environmental Hydrogeologists, Engineers and Scientists. Their responsibilities with QC may involve reviewing planning documents and reports submitted by the Facility Owner/Operators – either directly or through their contractors – or WQARF Program contractors assigned by ADEQ to investigate and remediate soil and groundwater contamination. In addition, collection of soil, groundwater and soil gas samples occurs directly by staff during split sampling events at facilities being investigated for entry into the WQARF Program.

During the Preliminary Investigation phase, available data are gathered and reviewed by WQARF Program staff level personnel. Part of this available data normally contains sampling results for soil, soil gas and/or groundwater.

Proposed investigations or remedial actions are typically detailed in a work plan or proposed remedial action plan (PRAP), which is reviewed, commented upon and approved by a Unit Supervisor after resolution of all issues and before the investigation or remedial actions begin. The following is a short list of some of the most common goals for sampling:

a. To document a discharge;
b. To determine the substance discharged;
c. To document the source of discharge;
d. To document the discharge meets certain parameters;
e. To establish the amount/concentration of a substance in a discharge;
f. To document the extent and degree of contamination; or
g. To document that an area is below clean-up standards.

On the infrequent occasions when ADEQ staff collects samples and has them analyzed by an ADHS approved laboratory (i.e. during split sampling events), the Technical Support person is available to assist the various staff level personnel when necessary. The Technical Support person, upon request from the staff level personnel, Unit Supervisor or Section Manager, will review this data with regards to QA Program Plan requirements, sampling goals and data quality objectives (DQO's).

Staff Level Personnel - Federal Projects Unit

Staff level personnel consist of Environmental Hydrogeologists, Engineers and Scientists. Their responsibilities with QC may involve reviewing planning documents and reports submitted by the Property Owner – either directly or through their contractors.

Work plans typically detail proposed investigations or remedial actions. Approval of work plans occur after review, comment, and resolution of all issues and before the investigation or remedial actions begin. The following is a short list of some of the most common goals for sampling:

Federal Projects:

a. To document a discharge;
b. To determine the substance discharged;
c. To document the source of discharge;
d. To document that the discharge meets certain parameters;
e. To establish the amount/concentration of a substance in a discharge;
f. To document the extent and degree of contamination; or
g. To document that an area is below clean-up standards.

On the infrequent occasions when ADEQ staff collects samples and has them analyzed by an ADHS approved laboratory (i.e. during split sampling events), the Technical Support person is available to assist the various staff level personnel when necessary. Technical Support, upon request from staff level personnel, Unit Supervisor or Section Manager, will review this data with regards to QA Program Plan requirements, sampling goals and DQO's.

Staff Level Personnel – Voluntary Remediation Program Unit

Staff level personnel consist of Environmental Hydrogeologists, Engineers and Scientists. Their responsibilities with QC may involve reviewing planning documents and reports submitted by the Property Owner – either directly or through their contractors.

Work plans typically detail proposed investigations or remedial actions. Approval of work plans occur after review, comment, and resolution of all issues and before the investigation or remedial actions begin. The following is a short list of some of the most common goals for sampling:

Voluntary Remediation Program:

a) Site characterization;
b) Determining effectiveness of remedial efforts; and
c) Determining if a No Further Action request is appropriate

Remedial Projects Section Technical Support

Technical Support is available to assist with site assessment and/or remediation issues to ensure the investigation and data collection efforts of the environmental consultant and facility meet QA objectives. Technical Support is technical staff placed in an "Associate", "Senior", or "Principal" position. Described below are three major activities for Technical Support:

1 Review of Planning Documents - Technical Support is available to assist staff members when necessary. Technical Support is available upon request from staff level personnel, Unit Supervisor or Section Manager, and will review and comment on the submitted planning documents with regards to QA Program Plan requirements, project goals and DQO's.

2. Development of DQOs - An initial scoping session may be held with all available /stakeholders to outline project goals and DQOs prior to the preparation of planning documents by the Facility/Responsible Party/Property Owner or its contractor. These initial meetings will roughly follow EPA's 2006 Guidance on Systematic Planning using the Data Quality Objectives Planning Process for guidance on the standard DQO process. The results of these initial meetings will guide the development of the project-specific planning documents.

3. Review of Data Reports - Technical Support will be available to assist the various staff level personnel when necessary. Technical Support is available upon request by staff level personnel, the Unit Supervisor, or the Section Manager. Technical Support will review submittals generated under planning documents with regards to QA Program Plan requirements, project goals, and DQO's.

On the infrequent occasions when ADEQ staff collects samples and has them analyzed by an ADHS approved laboratory (i.e. during split sampling events), the Technical Support person is available to assist the various staff level personnel when necessary. The Technical Support person, upon request from the staff level personnel, Unit Supervisor or Section Manager, will review this data with regards to QA Program Plan requirements, sampling goals and DQO's. When requested by the staff level personnel, the Unit Supervisor, or the Section Manager, Technical Support will prepare comments for revision of the data reports.

Quality Assurance Manager (QAM)

ADEQ's Director has delegated authority for the QMS to the QAM. The QAM resides in the Office of Environmental Excellence, outside of the Divisions, and reports to the Director. The QAM, together with assistance of QA/QC specialists from each Value Stream implements the QMP for each Division within ADEQ. The responsibilities of the QAM include: dispute resolution, managing the implementation of QMS through periodic leadership communications and trainings, updates to the ADEQ QMP, designation of QA Specialists throughout the Agency; reviewing and approving QAPPs, determining internal and external audit schedules and if audit corrective actions have been completed, and conducting management service reviews. Dispute resolution typically will be conducted through utilization of the Arizona Management System, which, depending on the nature of the dispute, can involve escalation to the appropriate Executive Leadership Team member (Division Directors, Director, Deputy Director, and Chief Officers). Quality disputes will be discussed during the bi-weekly QMS meetings to determine if there are impacts that may affect other Divisions and or ADEQ as a whole, however, the QAM retains the authority to make the final decision.

The QAM is responsible for reviewing all internal QA/QC documentation, including QAPPs, Quality Assurance Project Plans (QAPjPs), and audit findings. The QA/QC specialist that oversaw generation of the QAPP may choose to address those comments, or delegate that responsibility to subject matter experts and others within the Value Stream or Unit. Draft review by the QAM will precede all EPA document deliverables.

The QAM may provide assessment of RPS activities through the activities listed below:

- Technical System Audits
- Performance Evaluations
- Audits of Data Quality
- Data Quality Assessments

The QAM reviews and can revise the QAPP. The QAPP will be updated to accommodate new developments in QA/QC as necessary, or every 5 years. Revisions to the QAPP may become necessary through several different routes, and the QAM or the QA/QC Specialists will be responsible for responding and making these revisions when appropriate. During regular contact with the EPA, the EPA QA Officer may make suggestions for improving quality performance that could be incorporated into the QAPP. During a TSA, the QAM will examine the QAPP and the performance of the RPS and may make suggestions for improved performance that can result in revisions to the QAPP. A facility owner/operator, permittee, or, environmental consultant may request revisions to the QAPP in response to changes in industry-wide field methodology or for the addition of new or innovative technologies. Development and acceptance of new and more sophisticated analytical methods that provide lower detection limits, or other improvements can also be acceptable basis(es) for revisions to the QAPP.

The QAM is not be routinely involved with the day-to-day activities of the RPS, does not routinely participate in any of the planning phases of a project, and is not be involved with the review/approval of SAPs. The QAM, though, can be requested to assist in the review of data when necessary.

QA Specialist

The QA specialist provides the bridge between the QAM, the VS, and unit programs. The QA Specialist provides assessment of RPS activities through the processes listed below:

- Oversight of QAPP generation, and amendment;
- Oversight of uniform presentation of SOPs;
- Implementation of QMS Training;
- Planning, scheduling and implementation of the QMS audit program; and
- Generation of standard work for all the QMS processes listed above.

QA Specialists take on the role of auditors for VSs other than their own enabling them to avoid potential conflicts of interest and continue with their routine working responsibilities. QA Specialists are required to have at least one performance goal related to the work they are performing for ADEQ's QMS. Although the QA Specialists will continue to report directly to their Value Stream or Unit Managers, the QAM may be given the opportunity to provide the relevant manager with feedback related to their performance as a QA Specialist.

A.7 PROBLEM DEFINITION/BACKGROUND

ADEQ RPS administers investigative and remedial measures for hazardous substances through the Arizona Revised Statutes and Arizona Administrative Code. The regulations establish a system for identifying, investigating and remediating hazardous substances beginning with discovery of its release into the environment and ending in site closure. In practical terms, this means regulating a large number of facilities that handle hazardous substances. In administering the regulations, the RPS performs targeted education and outreach functions to facilities and the general public.

There are two sets of program activities that are environmental data related, namely sample collection and review of laboratory analytical data. Typically, samples used for generating data on which program decisions are made are collected by facility owners and/or operators, contractors, or RPS staff. The samples are then analyzed by a laboratory licensed by the ADHS.

Analytical data are used by the RPS to make various decisions to determine whether a release to the environment has or has not occurred. To assess compliance with the regulations applicable to this task, the RPS must evaluate laboratory data. The RPS compares laboratory data with regulatory standards such Soil Remediation Standards (SRLs), Aquifer Water Quality Standards (AWQS), Maximum Contaminant Levels (MCLs) and ADEQ's Soil Vapor Sampling Guidance to determine whether a release has occurred to the environment. Evaluation of laboratory data also provides information as to the extent above which a standard is exceeded allowing program staff to gauge the severity of the threat posed by the release to the environment. Table A1 shows contaminants commonly found at RPS facilities.

Table A.1 Common Constituents Found at RPS Facilities in Soil, Groundwater and/or Soil Vapor

Constituent	SOIL	GROUNDWATER	SOIL VAPOR
Volatile Organic Compounds:			
1,2-Dichloroethane (DCA)	X	X	X
1,1-Dichloroethylene (DCE)	X	X	X
1,2-Dichloroethylene (cis)	X	X	X
1,2-Dichloroethylene (trans)	X	X	X
Tetrachloroethylene (PCE)	X	X	X
Trichloroethylene (TCE)	X	X	X
Metals:			
Chromium III	X	X	
Chromium VI	X	X	
Arsenic	X	X	
Selenium	X	X	
Lead	X	X	

A.7.1 Establishment of Media-Specific Regulatory Levels

ADEQ has authority to require owners and operators to conduct remedial actions at the site of a release. A remedial action is defined at ARS § 49-281. The term remedial action refers to actions intended to stop, minimize and mitigate damage to the public health and the environment. ADEQ has the authority to set regulatory levels for investigation and remediation of soil, groundwater and surface water.

Remediation Standards for Soils

AAC Title 18, Chapter 7 Article 2 (Soil Remediation Standards) establishes remediation standards for soils. ADEQ has three standards for soil: Background, Pre-determined and Site Specific. Appendix B contains the weblinks for Arizona's Soil Remediation Standards rule which details how each standard is established. Appendix B also contains a table that list regulatory levels for chemicals found at typical RPS sites.

Water Quality Standards for Groundwater and Surface Water

AAC Title 18, Chapter 11 (Water Quality Standards) establishes remediation standards for groundwater and surface water. Articles 1 and 4 establish water quality standards for surface water and aquifer water, respectively. Appendix B contains the weblinks for Arizona's Water Quality Standards rule. For those chemicals that do not have an established Aquifer Water Quality Standard, the Narrative Aquifer Water Quality Standards (AAC R18-11-405) apply.

A.7.2 Measurement Quality Objectives and Data Quality Indicators

DQIs, as defined by EPA, involve precision, accuracy, representativeness, completeness, comparability, and sensitivity, also known as "PARCCS" parameters. Utilization of DQIs is part of the data evaluation processes. In general, project data quality needs (i.e. the MQOs) determine PARCCS parameters. The extent to which program or project QC results meets MQOs determines whether data are acceptable for the intended use.

Analysis involves the characterization of samples based on chemical and/or physical properties. Analyses result in generating raw data from instrumental analysis, chemical analysis, or physical testing. The analytical methods used will be specific, sensitive enough to answer the question posed by the RPS objectives and meet the data quality goals associated with those objectives. MQOs are the project or program QC criteria defined for various DQIs. During the planning phase, these set pre-determined limits on the acceptability of the data in regards to accuracy/bias, and precision, completeness and sensitivity.

Identifying DQIs and establishing QC samples and Measurement Performance Criteria (MPC) to assess each DQI are key components of project planning and development. These components demonstrate an understanding of how "good" the data need to be to support project decisions, and help to ensure there is a well-defined system in place to assess that data quality once data collection/generation activities are complete.

ADEQ has established the following policies, procedures, and/or guidance for sample collection and analytical techniques. These procedures, where relevant, apply to all analytical data being generated for use by the RPS. These procedures should be followed unless special exceptions

have been requested and approved, and/or deviations are outlined in an RPS SAP. The following documents can be found in their entirety in Appendix C.

- ADEQ Temperature/Preservation Guidance;
- Substantive Policy 0154 - Addressing Spike and Surrogate Recovery As They Relate To Matrix Effects In Water, Air, Sludge And Soil Matrices Policy; and
- Substantive Policy 0170 - Implementation of EPA Method 5035 - Soil Preparation For EPA Method 8015B, 8021B and 8260B.

DQIs, as defined by EPA, involve precision, accuracy, representativeness, completeness, comparability, and sensitivity, also known as "PARCCS" parameters. Utilization of DQIs is part of the data evaluation processes. In general, project data quality needs (i.e. the MQOs) determine PARCCS parameters. The extent to which program or project QC results meets MQOs determines whether data are acceptable for the intended use.

MQOs are the acceptance thresholds or goals for project data, usually based on the individual DQIs for each matrix and analyte group or analyte. MQOs are project-or method-specific quality acceptance criteria established to support project-specific DQOs, as well as decisions made based on the quality of the data. MQOs define whether the data are usable and meet project needs. Like DQOs, MQOs can be quantitative or qualitative statements.

MQOs specify what the QC acceptance criteria are for each analysis. AAC R9-14-615 details QA requirements for ADHS licensed laboratories. Regardless of how the laboratory evaluates performance, the laboratory's acceptance criteria must meet the needs of each project. This QA Program Plan provides general requirements, but individual planning documents will provide project or site-specific requirements.

ADEQ Project/Case Managers may consult with the ADEQ QAM, or research a variety of published or written materials, to aid them in selecting or developing measurement technologies. RPS staff professional knowledge is used to identify appropriate analytical procedures. General DQIs for RPS are provided in Table A2 below.

Table A.2 Example of Soil and Water Samples Analyzed Using EPA Method 8260B.

Compound (Laboratory Method - EPA Method 8260B)	**Matrix Spike (% Recovery Limits)**	**Laboratory Control Sample (% Recovery Limits)**	**Method Blank Result (ug/l)**	**Surrogates (% Recovery Limits)**
	Matrix Spike Duplicate (Relative % Difference)	**Laboratory Control Sample Duplicate (Relative % Difference)**	**Method Detection Limit (ug/l)**	
Benzene	68-131	68-130	ND	
	32	20	2.0	
Carbon Tetrachloride	65-147	60-150	ND	
	35	25	5.0	
PCE	67-131	70-130	ND	
	31	20	2.0	
TCE	66-132	70-130	ND	
	29	20	2.0	
Dibromofluoromethane				70-130
Toluene				70-130
4-Bromofluorobenzene				70-130

PCE = tetrachloroethylene
TCE = trichloroethylene
ND = Not detected at laboratory reporting limits
ug/l = micrograms per liter
% = percent

A.7.3 QUALITY OBJECTIVES AND CRITERIA FOR MEASUREMENT OF DATA

This section is broken into two parts, consistent with EPA Region 9 guidance for QA Program Plans. The first section documents regulatory levels that are specific to the ADEQ; these regulatory levels serve as the driver for site assessments and cleanup. The second section discusses Measurement Quality Objectives (MQOs) and Data Quality Indicators (DQIs) under the RPS.

The Data Quality Objective (DQO) process is used to systematically plan for generating environmental data of a known quality to support decisions. This is done through focused, documented sampling, testing, and data evaluation activities. It entails using a systematic planning approach that includes hypothesis testing to differentiate between two or more clearly defined alternatives.

Each scenario for which data is to be generated is unique because of the various variables that must be considered, including regulatory requirements, waste characteristics, facility-specific characteristics, and others. Therefore, the DQO process for the RPS is intended to yield qualitative and quantitative statements that answer four basic questions:

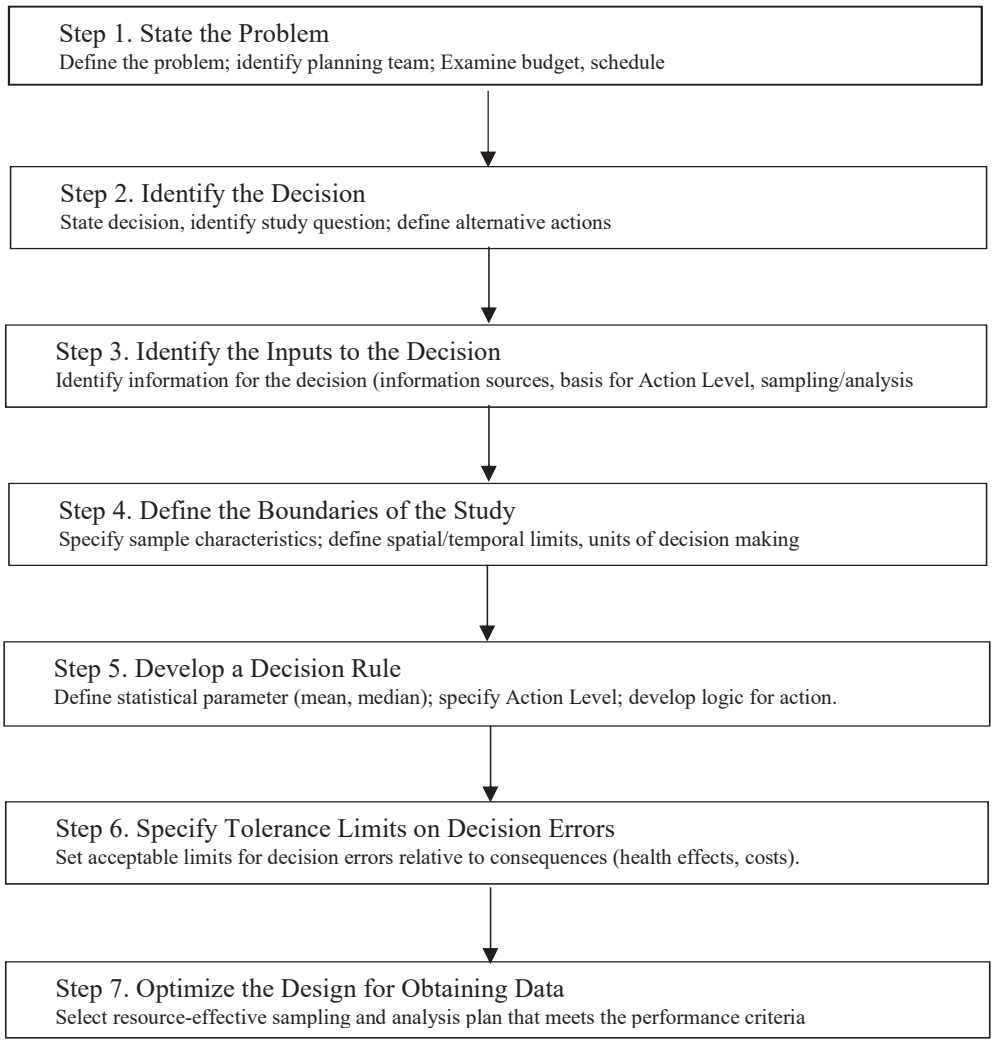
- What data is needed?
- Why is it needed?
- How will the data be used?
- What tolerance is allowed for decision errors?

After the verification and validation of data, evaluation of the data against project DQOs occurs. Implementation of the DQA process completes the data life cycle by providing the assessment needed to determine achievement of project objectives. Two 2006 EPA guidance documents on DQA are available from EPA at: https://www.epa.gov/quality/agency-wide-quality-system-documents.

DQA is the scientific and statistical evaluation of environmental data to determine if they meet the planning objectives of the project, and thus are of the right type, quality, and quantity to support their intended use. The document Data Quality Assessment - A Reviewers Guide (EPA, 2006b) broadly describes the statistical aspects of DQA in evaluating environmental data sets. Data Quality Assessment - Statistical Methods for Practitioners (EPA, 2006c), the companion guidance document on statistical methods for practitioners, provides a more detailed discussion on implementation of graphical and statistical tools. These EPA guidance documents discuss the use of DQA to support environmental decision-making (e.g., compliance determinations).

The DQO Process consists of seven planning steps as shown in Figure A.3.

Figure A.3 Data Quality Objective Process



The outputs of the DQO process are used to define the quality control requirements for sampling, analysis, and data assessment. These requirements are then incorporated into a site-specific QAPP, WAP, SAP, or similar planning document. The RPS utilizes the DQO Process in its sampling plans and is encouraging facility owners, operators, consultants, and contractors to incorporate it their plans for sample collection.

The RPS notes that one of the most important features of the DQO process is that it is iterative. It is not critical to "get it right the first time." If the initial design is not feasible, then an iteration can be done on one or more of the earlier planning steps to identify a sampling design that will meet the budget and generate data that are adequate for the decision. Failure to establish DQOs prior to implementing field and laboratory activities can result in undesirable outcomes such as inefficiencies, increased or unnecessary costs, or the generation of unusable data.

A.8 SPECIAL TRAINING/CERTIFICATION

ADEQ's Unit Supervisors are responsible for ensuring each staff member involved with collecting or analyzing environmental data has the necessary technical, quality assurance, and project management training required for his or her assigned tasks and functions. Section Managers are also responsible for ensuring that technical staff maintains the necessary level of proficiency to effectively meet ADEQ's QA/QC responsibilities. ADEQ's Quality Management System training programs defines QA/QC training needs and is being transitioned to computer-based training. All staff are required to take basic QMS training as a part of their onboarding requirements.

Core training will be coordinated through the QAM in conjunction with various Division supervisory personnel. Intermediate and advanced skill training will be arranged when the appropriate Agency staff identify the need. The QAM or QA Specialist, in conjunction with Program management, will identify continuing professional training requirements and address those requirements utilizing external resources for the latest technological advances and evolution in industry standards.

ADEQ staff members are encouraged by their managers/supervisors to draw upon their educational background, experience, technical training, and on-the-job training to enhance their understanding and performance of QA-related procedures.

ADEQ's training program will offer, or arrange for through a third-party vendor, courses on the following subject matter on a schedule and frequency suited to meet the needs of ADEQ's staff with QA responsibilities:

- An Orientation to Quality Assurance Management
- Establishing Data Quality Objectives
- Preparing Quality Assurance Project Plans
- How to Perform an Audit of Data Quality and Data Quality Assessment

Staff will be encouraged to attend meetings and seminars, and to take formal training, in accordance with ADEQ's training policy, to enhance their understanding of Program specific QA requirements within the Programs they work. QA training records are maintained by the Office of Environmental Excellence and will be transitioned to Tracor, the Arizona state training software as the QMS training is transitioned to a computer-based format. In addition, all planning documents and reports listed in Figure A.3 are required (AAC R1812-264) to have an Arizona Professional Registrant's signature and seal.

A.9 DOCUMENTS AND REPORTS

Throughout the life of the RPS, there may be changes to program requirements, or modifications to the way environmental data are collected, or changes to the definitions of enforcement activities. Therefore, this QA Program Plan is a dynamic document that is subject to revision, as needed. RPS personnel, Technical Support and QA/QC personnel will examine and revise this QA Program Plan annually. Re-submittal of this plan to the EPA Region 9 QA manager for

review, though, will occur once every five years or as otherwise needed. Dissemination of approved revisions include personnel on the Distribution List.

A.9.1 Environmental Data Documentation

This QA Program Plan and referenced policy, guidance and SOPs include written procedures for all methods and procedures related to the collection, processing, analysis, reporting, and tracking of environmental data. All data generated for and submitted to ADEQ's RPS, including data from split sampling and inspections, must be of sufficient quality to withstand challenges to their validity, accuracy and legibility. To meet this objective, utilization of standardized formats and prescribed procedures occurs to record data. The documentation of all environmental data collection activities must meet the following minimum requirements:

- Document data directly, promptly, and legibly. All reported data must be uniquely traceable to the raw data. Document all data reduction formulas.
- All original data records include, as appropriate, a description of the data collected, units of measurement, unique sample identification, station or location identification (if applicable), name (signature or initials) of the person collecting the data, and date of data collection.
- Any changes to the original (raw data) entry must not obscure the original entry. Document the reason for the change. The person making the change initials and dates the change.

Discussions of other specific documentation requirements are throughout this QA Program Plan and referenced in SOPs.

A.9.2 Field Documentation and Forms

Completion of appropriate field documentation and forms for each sample is the responsibility of the field personnel. Field personnel accomplish the following: 1) maintain records for each field activity to ensure that samples and data are traceable and defensible; 2) document field records on field forms or in designated field logbooks to provide a secure record of field activities, observations and measurements during sampling; and 3) record field data and observations in real time on activity-specific data forms.

A.9.3 Project Files

RPS personnel are responsible for the maintenance of the project file. The project file will consist of all site documents specifically listed in Section A5 of this QA Program Plan. Additionally, RPS personnel will collect and include in the project file all other relevant project documentation in the file. These additional documents may include any official correspondence that does not correspond to any of those previously listed documents. The project file will also include all information not related to data generation, including documentation of all public involvement or community notification efforts.

A.9.4 Routine Records Management Quality Assurance

ADEQ Records Management Process addresses the system employed by the Agency for handling documents. This plan outlines the roles and responsibilities for management and staff concerning chain of custody procedures and records management.

ADEQ document control procedures require that documents generated, or obtained, by Agency personnel are accounted for when a project is completed. ADEQ's Records Management System dictates the procedures for checking-in and checking-out files for ADEQ staff, external clients, and the public. ADEQ managers/supervisors/directors will ensure achievement that the objectives of the Records Management Process. These objectives include the following:

- Prevent the creation of unnecessary records in any media;
- Promote the continuous development of filing systems and structures that allow for the efficient organization, maintenance, and retrieval of records;
- Ensure that records of continuing value are preserved, but that valueless or noncurrent information is disposed of or transferred to storage in a timely manner in accordance with ADEQ and/or ADHS records retention requirements;
- Ensure that the acquisition and use of all direct paper to microform systems and equipment, or electronic digital imaging, are technically feasible, cost-effective, and most importantly, satisfy Program needs;
- Preserve and protect information that is vital to the essential functions or mission of the organization. Preserve and protect information that is essential to the legal rights and interests of individual citizens and the government.

ADEQ maintains an internal electronic database to track project related documents. This database, **A**ri**z**ona **U**nified **R**epository for **I**nformational **T**racking of the **E**nvironment or AZURITE, maintains lists of project related documents. Electronic back-up of this database occurs on a nightly basis.

ADEQ currently maintains an internal electronic groundwater quality database to track groundwater sampling results collected from RPS projects. Electronic back-up of this database occurs on a nightly basis.

ADEQ data that is cloud based or stored in the State Data Center is considered secure. Data loss mitigation efforts include Uninterruptible Power Supplies (UPS) and backup generators. Source data for RPS is obtained from laboratory data sheets and reports or data submitted by contractors. RPS takes appropriate measures to prevent and address data loss at the source by electronic storage/scan of paper documents.

The current electronic mail (e-mail) tool, Google Mail, is a cloud-based storage system that is considered secure. Employee's inbox storage space is unlimited. E-mail messages that are considered critical artifacts to a program should be saved as a PDF and stored in the appropriate program folder/file location. Electronic mail messages that are moved to "trash" are archived

after 30 days, but can be retrieved via an Information Technology Service Desk Request. Microsoft Outlook e-mail files have been saved to the J:/Drive and also can be retrieved as needed with a Service Desk Request.

A.9.5 Revisions to the QA Program Plan

Throughout the life of ADEQ's RPS, there may be changes to program requirements, or modifications to the way environmental data are collected, or changes to how enforcement activities are defined. Therefore, this QAPP is recognized as a dynamic document that is subject to revision, as needed. The RPS personnel, Technical Support and QA/QC personnel will examine and revise this QAPP annually, although the plan will only be resubmitted to EPA Region 9 QA manager for review once every five years or as otherwise needed. Approved revisions will be disseminated to personnel included on the Distribution List (page 7).

SECTION B DATA GENERATION AND ACQUISITION

B.1 SAMPLING PROCESS (NETWORK) DESIGN

RPS conducts site investigations to determine if site media are contaminated. Multiple phases of investigation may be necessary to determine characteristics of the contamination if the initial site assessment finds evidence of contamination. Site characterization includes evaluating the threat posed by the contamination and determining potential solutions for cleanup of the contamination. This QA Program Plan documents the planning, implementation, and assessment procedures for data generated for and submitted to ADEQ's RPS. It describes specific applications of QA and QC activities throughout the course of investigations and cleanup.

A RPS site investigation routinely involves one or more of the following activities: a background investigation on the history of site use, a field investigation that includes sample collection and analysis, an evaluation of cleanup options and costs and an assessment of the usability of resulting data. Typically, the first step is to investigate site history to identify past uses of the property, including types and amounts of chemicals that may have been used onsite and any disposal activities that may have contributed to contamination.

This QA Program Plan includes requirements for measurements collected for a typical facility. The conceptual site model (CSM) largely dictates the specific design and extent of a facility site investigation, resource needs, and the required level of data quality and QC. Planning documents outline and describe project-specific DQOs and sampling design.

The following sections describe sampling and analysis requirements in the RPS. Site-specific information required in project-specific planning documents includes the number and location of samples, types of samples to be collected, measurement parameters, sampling frequencies, design of sampling networks for monitoring and the time period over which sampling activities are to occur. Review and approval by RPS personnel is required for all project-specific planning documents.

B.1.1 Sampling Design

A sampling design specifies the number and location of samples collected at a site. Study objectives guide sampling design strategies. Sampling design strategies should factor in the conditions unique to the site, including data gaps in the CSM, exposure potential, projected site reuse, and available resources. As noted above, identification of sampling design strategies occurs during the systematic planning process and the project-specific planning document contains descriptions of the sampling design strategy.

Typical designs for the collection of samples at RPS sites include biased sampling, statistically based sampling, one-time events, and ongoing (multi-phase) events. Biased sampling specifies sampling locations based on the judgment of the field team leader and sampling plan designer. Statistically based sampling designs use random or systematic sampling locations designed to avoid bias, as with investigation exposure area decision units at mining sites. A key distinction

in sampling design is between judgmental sampling (also called authoritative or biased sampling), in which sample numbers and locations are selected based on expert knowledge of the problem, and probability-based sampling, in which sample numbers and locations are selected based on randomization and each member of the target population has a known probability of being included in the sample. Judgmental sampling has advantages for source area decision unit investigations, such as investigations involving dry cleaners.

Probabilistic sampling typically takes more effort to implement than judgmental sampling. However, a probability-based sampling design has the advantage of allowing the use of statistical tests, which permit specification of confidence and uncertainty of the results. Probability-based designs do not preclude the use of expert knowledge or the use of existing data to establish the sampling design. An efficient sampling design is one that uses all available prior information to stratify the site (in order to improve the representativeness of the resulting samples) and set appropriate parameters. Common types of probabilistic sampling designs include simple random, stratified, systematic and grid, composite, and others.

Please note that a single sampling event may not provide an adequate characterization of the contamination onsite, especially when the CSM contains significant data gaps. In these situations, multievent sampling may be helpful. The systematic planning process should help identify the need for this sort of investigation.

Additional information on the development of sampling strategies is available in ADEQ's Site Investigation Guidance Manual (ADEQ, 2014), EPA's Guidance on Choosing a Sampling Design for Environmental Data Collection (EPA, 2002b), EPA's Guidance on Systematic Planning Using the Data Quality Objectives Process (EPA, 2006a), and EPA's Guidance for Developing Standard Operating Procedures (EPA, 2007b).

B.1.2 Sample Types and Matrices

Sample types typically include surface soil, subsurface soil, groundwater and surface water. Some sites require sampling of sediment, pore water, sludge, air (soil gas or vapors) and other non-routine matrices such as building materials. Samples collected can be discrete (grab) or composite samples. Discrete samples are useful for identifying and quantifying chemicals in areas of a site where there is suspected contamination. The number of discrete samples should be determined during the systematic planning process. Composite samples are useful for identifying the average concentrations of contaminants across a site. Composite samples are composed of more than one discrete sample collected from different locations. Submittal to the analytical laboratory as a single sample occurs after mixture of the samples into a single homogeneous sample. Multi-increment (MI) samples represent a specific type of composite sample (Interstate Technical Regulatory Committee, 2012). The number of composite samples and the number of individual samples within a composite sample should be based on the goals established during the DQO process.

Background samples should be collected from the same media as site samples, from areas on or near the site that are unlikely to be contaminated by site-related chemicals. Analysis of background samples for the same parameters as the site samples assists in determining

background concentrations of chemicals. Typically, collection of background data for naturally occurring inorganic chemicals, such as metals, occurs. The typical assumption for manmade organic chemicals background concentrations is 0%. It is the responsibility of the applicant to demonstrate if there is an "anthropogenic background" for organic chemicals that is unrelated to site activities.

B.1.3 Sampling Locations and Frequencies

Identification of sampling locations and schedule for sampling occurs during the systematic planning process. The sampling duration and frequency or whether the work will be done in phases is also determined during the systematic planning process. For instance, if initial investigations indicate that contaminant levels in soils are below regulatory thresholds, no additional sampling would be required. If initial investigations indicate contaminant levels in soils are above cleanup standards, additional sampling would be required during remedial activities and/or post remedial activities.

B.1.4 Sampling Event Planning

Advance planning for field sampling events is required to ensure that the necessary arrangements are in place and that equipment is ready. Listed are considerations when planning a sampling event:

1. Sample Handling and Custody Procedures - Field personnel will make arrangements with the appropriate laboratory for proper sample containers and custody procedures (described further in Section B3).

2. Equipment - Prior to collection of any sample, field personnel will ensure that all sampling equipment has been properly assembled, decontaminated, calibrated and is functioning properly prior to use. Field personnel must use equipment according to manufacturer's instructions and decontaminate equipment according to the appropriate SOPs (Appendix D).

3. Field Forms - Prior to the sampling event, field personnel will assemble all necessary field forms, such field log books, soil and groundwater sampling forms, and boring logs. Site specific needs establish the need for developing site specific forms.

4. Health and Safety - Field personnel will ensure that all site-specific health and safety procedures are considered and that personal protective equipment (PPE) is gathered.

5. Investigation-Derived Waste - Field personnel will plan for the generation of investigation-derived waste (IDW), and should assemble the appropriate IDW containers prior to the sampling event.

6. Field Audits —-Field personnel will plan to conduct periodic field system audits for ongoing sampling events.

7. Paperwork and Permits - Field personnel will also ensure prior to the sampling event that other applicable paperwork is in order, such as permits and access agreements.

8. Site Access - Site access will be obtained by either the RPS Facility owner/operator's consultant or by RPS Project Managers for State Lead program sites. The RPS program has standard work for site access, which includes the process for escalation to management for assistance. J:\WPD\REMEDIAL\1. RPS SW\RPSU SW\Legal Support\Access Agreement.

B.2 SAMPLING METHODS

The systematic planning process and project-specific planning documents establish site-specific sampling methods as well as the numbers and types of samples collected. Details of sample collection methods will depend upon site conditions, equipment limitations, chemicals of concern, sample matrices, and cost. Collection methods will follow an ADEQ or EPA approved sampling protocol, unless unforeseen circumstances do not allow for an approved collection method. The following sections present general information on sampling methods for various media, including surface water, groundwater, drinking water, soil, soil vapor, sediment, pore water, sludge, air, and non-routine matrices such as building materials.

Additional methods may be used with approval of the RPS. General guidelines for field sampling are included in the EPA Standard Operating Procedure (SOP) on General Field Sampling Guidelines (Appendix D). EPA SOPs for field sampling methods are available for download at: https://clu-in.org/publications/db/db_search.cgi?title=1&submit_search=1&cat=18.

B.2.1 Soil Samples

Soil samples collected at RPS sites may include surface and subsurface samples. Sample types may be discrete or composite samples. There are a variety of acceptable methods for collection of soil samples. Selection of an appropriate method will depend on site conditions and the sampling design. Methods commonly used to collect soil samples include drilling soil borings, digging test pits, sampling via hand auger, and digging with a shovel or trowel. Additional information on the collection of soil samples can be found in EPA's Preparation of Soil Sampling Protocols: Sampling Techniques and Strategies (EPA, 1992b) and in the referenced EPA SOP for soil sampling (Appendix D).

B.2.2 Groundwater Samples

Groundwater sample collection is typical during RPS site investigations and cleanups. Collection of groundwater samples may be one-time or ongoing and periodic. Groundwater sample collection can occur from soil borings, temporary well points, monitoring wells, and existing wells (e.g., municipal or community supply wells, domestic water wells, irrigation wells, or industrial supply wells). Shallow, intermediate, deep, and perched aquifers contain groundwater.

Groundwater samples collected from soil borings at specific depth intervals assist in location selection for future monitoring wells. Collection of these one-time samples using a direct-push groundwater sampling method is typical. Appendix D of this QA Program Plan contains an SOP for direct-push groundwater sampling.

Groundwater sample collection from permanently installed monitoring wells is typical. Proper installation according to state regulations (see ARS Title 45, Chapter 2, Article 10) and proper development according to an Arizona Department of Water Resources (ADWR), ADEQ, or EPA-approved protocol of monitoring wells is required. Field logbooks and subsequent reports must note non-standard wells or problems encountered during well installation and sampling. SOPs describing groundwater monitoring well sampling, monitoring well installation and monitoring well development are included in Appendix D.

B.2.3 Surface Water Samples

Surface water sample collection is typical during RPS site investigations and cleanups when evaluating whether contaminants have migrated to nearby surface water bodies. Physical evidence such as odors, organic films on water surfaces, and soil discoloration in the vicinity of surface water are indicators of possible contamination. Surface water samples include representative liquid samples collected from streams, brooks, rivers, lakes, ponds, lagoons, seeps, estuaries, drainage ways, sewers, channels, wetlands, surface water impoundments, and other surface water bodies. Sample collection occurs at the surface or at depth within the water body. Surface water samples will be collected in general accordance with the SOP for surface water sampling included in Appendix D.

B.2.4 Pore Water Samples

Pore water is water contained within the upper few centimeters of sediments just below the surface water/sediment interface. This interface is the hyporheic zone. Typical equipment utilized for sampling of this zone are seepage meters and push-point pore water samplers or lysimeters. Discharge of groundwater to surface water through the hyporheic zone is unlikely to be homogeneous; therefore, determining locations for pore water sampling can involve additional investigative steps.

B.2.5 Sediment Samples

Sediment sample collection occurs for the analysis of biological, chemical, or physical parameters in sediments. There are many factors to consider when choosing sediment sampling equipment including, but not limited to, site access, sample volume requirements, sediment texture, target depth for sediment collection, and flowing versus standing water. In general, use of piston samplers are best for soft, fine-grained sediments where sediments at depth are required. Grab/dredge samplers are best for coarse, shallow sediments and where large volumes of sediment are required. The SOP for sediment sampling provides additional information on the collection of sediment samples (Appendix D).

B.2.6 Sludge Samples

Sampling of sludge could involve a number of different situations and will likely depend upon site conditions. Therefore, project-specific planning document will detail collection of sludge samples. Catch basins and drywells are common settings where sludge sampling occurs.

B.2.7 Air/Soil Vapor Samples

Collection of air sampling is typical at sites where vapor inhalation of contaminants is or may be an exposure issue. Collection of soil vapor samples is routine to investigate releases of VOCs. Air sampling and soil vapor sampling is more complex than soil or water sampling because of the reactivity of chemical compounds in the gas matrix and sample interaction with the sampling equipment and media. A number of factors, including site conditions, sampling objectives, chemicals of concern, analytical methods, and cost, forms the basis for selecting air and soil vapor sampling equipment. Methods to sample air at active facilities include, but are not limited to, soil gas sampling or sampling with flux chambers. Typical sampling containers include tedlar bags, stainless steel Summa canisters, gas tight syringes, and glass sorbent traps used with sampling pumps. Sources of information for air and soil vapor sampling and analysis are: http://www.airtoxics.com in EPA's SOP for general air sampling guidelines (Appendix D) and ADEQ's Soil Vapor Sampling Guidance.

B.2.8 Building Materials Samples

Sampling at RPS sites can involve non-routine sampling of unusual sample matrices, such as building materials. These matrices include concrete slabs or other types of building materials. Development of site-specific sample collection procedures occurs, if needed, for sampling such non-routine matrices. Sampling personnel will coordinate with the analytical laboratory on the anticipated sample collection and handling methods to ensure that the sample data will meet all QA/QC requirements. Additional information on the collection of non-routine sample matrices is in EPA's SOP for chip, wipe and sweep sampling (Appendix D).

B.3 SAMPLE HANDLING AND CUSTODY

Chain of custody procedures differ among laboratories. Title 9, Chapter 14, Article 6 of the Arizona Administrative Code (R9-14-615) details the necessary documentation for sample control activities at an ADHS licensed laboratory. Identification of custody procedures of the analyzing laboratory occurs prior to field activities. Field personnel must arrange with the appropriate laboratory for proper sample containers, preservatives, holding times and chain of custody forms. The custody of a sample must be traceable from the time of sample collection to the reporting of results. Chain of custody procedures provide a mechanism for documenting information related to sample collection and handling. Completion of a chain-of-custody form must occur after sample collection and prior to sample shipment or release. Cross-checking of the chain-of-custody form, sample labels and field documentation is necessary to verify sample identification, date and time sample was collected, type of analyses, number of containers, sample volume, preservatives and type of containers. Additional information on sample handing and custody procedures is in EPA's SOPs for specific sample collection methods. Appendix D of this QA Program Plan references SOPs and forms for sample handling, custody (chain-of-custody forms), and transport.

B.4 ANALYTICAL METHODS

All analytical methods used to analyze samples must comply with relevant requirements of applicable federal or state programs for which they were collected, such as the CWA, SDWA, RCRA, Clean Air Act, or use other EPA-approved alternate methods. The most recently

approved methods under the CWA and SDWA are located in the Code of Federal Regulations under 40 CFR Part 136. The EPA website at https://www.epa.gov/RPS-sw846/sw-846-compendium contains the current approved methods under RCRA SW-846. Exhibit 1 of Title 9, Chapter 14 of the Arizona Administrative Code details ADHS approved methods with corresponding analytes. ADHS weekly provides an update of the licensed laboratories, methods and analytes that is captured in the database. This allow for checks on any data captured in the database.

ADHS exceptions are permitted under ARS § 36-495.02 for the federal projects unit where laboratories certified under the National Environmental Laboratory Accreditation Conference (NELAC) may be used.

B.5 QUALITY CONTROL

QC requirements are integral to the success of a QA program. QC covers the overall system of technical activities that measure the performance of a process against defined standards to verify that they meet predefined requirements. Because errors can occur in the field, laboratory, or office, it is necessary for QC to be part of each of these functions. This QA Program Plan describes and defines the general quality objectives of the RPS. Project-specific planning documents define site-specific quality objectives. This approach to quality system management ensures conducting quality activities throughout the data generation process but allows for the flexibility to tailor quality-related activities to individual site-specific data needs.

QA and QC parameters apply to the two primary types of data - definitive and non-definitive data - regardless of whether the data collection activity is associated with field measurements or laboratory measurements. Non-definitive data are frequently collected during the first stage of a multi-phase screening investigation, using rapid, less precise methods of analysis with less rigorous sample preparation. Non-definitive data can provide analyte identification and quantification, although both may be relatively imprecise. Typically, confirmation of 5 to 10 percent of non-definitive samples or all critical samples occurs using analytical methods, QA/QC procedures, and criteria associated with definitive data. Non-definitive data without associated confirmation data are of unknown quality. Qualitative, nondefinitive data identify the presence of contaminants and classes of contaminants and can help focus the collection of definitive data, which is generally the more expensive of the two. Some data uses, such as risk assessments, require definitive data.

Use of EPA's Guidance for Preparation of Standard Operating Procedures for Quality Related Operations (EPA, 2007a) is typical for developing SOPs. SOPs should be included as an appendix of all planning documents and reports generated for and submitted to ADEQ's RPS. The project field team should document reasoning for any deviations from an SOP and include that documentation in all planning documents and reports generated for and submitted to ADEQ's RPS. The Arizona Department of Health Services (ADHS) is responsible for reviewing the standard operating procedures developed by and used for environmental laboratories. ADHS is also responsible for licensing of environmental laboratories under Title 9, Chapter 14, Article 6 – Licensing of Environmental Laboratories.

B.5.1 Quality Control in the Field

Description of QC parameters in detail for each step of field work should also include specific corrective actions for difficulties encountered in the field. Evaluation of field sampling procedures requires the collection and evaluation of field QC samples. To provide a means of assessing data quality resulting from the field sampling program, collection and submittal to the analytical laboratory includes trip blanks, rinsate blanks, field duplicates, and extra volume for matrix spikes and matrix spike duplicates. Subsequent paragraphs contained in this section of this QA Program Plan note collection frequencies for field QC samples.

Field QC requirements and documentation of all field sampling and observations are critical for providing a historical record for analysis of the usability of the data produced. The official field log book will contain documentation of field activities that involve the collection and measurement of environmental data. Recording related field activities as explained below can require developing additional forms.

SOPs delineate the step-by-step approach that field personnel must follow in collecting samples, taking field measurements, decontaminating equipment, handling investigative derived waste (IDW), and calibrating instruments. Most qualified sampling contractors and State and Federal certified laboratories develop SOPs and analytical methods as part of their overall QA program. Use of EPA's Guidance for Preparation of Standard Operating Procedures for Quality-Related Operations (EPA, 2007a) is typical for developing SOPs. SOPs should be included as an appendix of all planning documents and reports generated for and submitted to ADEQ's RPS. The project field team should document reasoning for any deviations from an SOP and include that documentation in all planning documents and reports generated for and submitted to ADEQ's RPS. Typically, sampling is conducted by contractors who follow the SOPs chosen for the site.

B.5.2 Field Documentation

The field team should record field activities in indelible ink, in a permanently bound notebook with prenumbered pages or on a preprinted form. For each sampling event, the field team must provide the site name, physical location, date, sampling start and finish times, names of field personnel, level of protection, documentation of any deviation from protocol, and signatures of field personnel. For individual samples, field teams should ensure that field logbooks document the exact location and time the sample was taken, any measurement made (with real-time equipment), a physical description of the sample, sample ID number, sampling depth, sample volume, sample type, and the equipment used to collect the sample. This information can be critical to later evaluations of the resulting data's usability.

Complete and accurate documentation is necessary to demonstrate that field measurement and sampling procedures are in accordance with this QA Program Plan and any project specific planning document. Field personnel will use permanently bound field logbooks with sequentially numbered pages to record and document field activities. The logbook will list the contract name and number, the project name, the site name, and the names of subcontractors, the service client, and the project manager. The contractors performing field work should develop field forms to

record field activities. At a minimum, the field logbook must document the following information:

- Name and affiliation of all on-site personnel or visitors
- Weather conditions during the field activity
- Summary of daily activities and significant events
- Notes of conversations with coordinating officials
- References to other field logbooks or forms that contain specific information
- Discussions of problems encountered and their resolution
- Discussions of deviations from the project-specific planning document or other governing documents
- Description of all photographs taken

The contractors performing field work are expected to develop field forms to record field activities. Labeling individual samples should occur in the field. Labels should include sample location, sample number, date and time of collection, sample type, sampler's name, and method used to preserve the sample, if applicable. Sample preservation involves the treatment of a sample usually through the addition of a compound that adjusts pH to retain the sample properties, including concentrations of substances, until analysis of the sample. The field team should create a table listing the total number of samples, types of sample matrices, all analyses planned for each sample differentiating critical measurements and other information that may be relevant to later assessments of the data usability. Typically, report submittals to ADEQ contain copies of field forms that contain field data.

B.5.3 Trip Blanks

Trip blank samples help evaluate whether the shipping and handling procedures are introducing contaminants into the samples or if cross-contamination in the form of migration of VOCs between the collected samples. One trip blank submitted to the laboratory for analysis is necessary each day that samples are collected. Trip blanks for soil and water samples are volatile organic analysis (VOA) vials filled with purged deionized water that remain closed while transported to the field and then returned to the laboratory without being opened.

B.5.4 Rinsate Blanks

Rinsate blanks help evaluate the potential for cross-contamination of samples during collection. Collection of rinsate blanks occurs at a rate of one per day per matrix when using non-dedicated and nondisposable sampling equipment in the field. Collection of equipment rinsate blanks occurs by passing organic-free water through or over the decontaminated sampling equipment and collecting the rinse water in appropriate sample containers.

Rinsate blank analysis is for the same parameters as the associated field samples. Rinsate blanks should not contain detectable concentrations of target analytes greater than the Project Required Quantitation Limit (PRQL) for the compound. Any detection of target analytes in a rinsate blank will result in an investigation to determine effect on overall data usability. Affected results will be qualified as estimates or as non-detects at an elevated PRQL as appropriate.

B.5.5 Field Duplicate Samples

Collection of field duplicate water and air samples occurs simultaneously in separate containers. The purpose of field duplicates is to allow evaluation of the contribution of random error from sampling to the total error associated with the data. One set of field duplicates will be collected and submitted for every twenty field samples collected (and at least one per sampling day if less than twenty are collected) for water, soil, and air. Field duplicate precision will be evaluated as described below.

B.5.6 Matrix Spike/Matrix Spike Duplicates (Field Requirements)

Double sample volume should be collected at a rate of one per twenty samples per matrix (minimum of once per sampling event) to ensure that the laboratory has sufficient volume to perform matrix spikes and matrix spike duplicates (MS/MSDs).

B.5.7 Inter-laboratory Split Samples (Field Requirements)

Inter-laboratory split samples are field duplicates (liquid matrices) or split samples (solid matrices) submitted to both the primary laboratory and a secondary or QC laboratory. Collection of inter-laboratory split samples occurs simultaneously with a sample from the same source under identical conditions into separate containers. Results from the split samples help assess laboratory performance by comparison of qualitative and quantitative results from the two laboratories, including indications of matrix interferences such as elevated PRQLs. In order to provide useful information, however, the split sample must be directly associated with the original (primary) sample to evaluate laboratory performance. Field personnel determine the association and maintain the association during the data import process.

B.5.8 Quality Control in the Laboratory

Compliance monitoring on ADHS licensed laboratories is conducted by the ADHS as described in Title 9, Chapter 14, Article 6 of the Arizona Administrative Code (AAC R9-14-605 – Compliance Monitoring). ADEQ also conducts Technical Systems Audits on ADHS licensed laboratories (ADEQ contract laboratories and contract laboratories of contractors who submit analytical data to ADEQ). The primary goals of TSAs will be to review the laboratory organization, operation, and capabilities; determine the reliability of data; and note corrective action for any apparent deficiencies. The ADEQ QA/QC Manager or QA/QC Representatives selects auditors for TSAs based on their technical proficiency in the subject area. The designated auditors will be responsible for planning and conducting the audit, and reporting the findings to the laboratory manager and to the ADEQ QA/QC Manager or QA/QC Representatives.

B.6 INSTRUMENT/EQUIPMENT TESTING, INSPECTION AND MAINTENANCE

Calibration of all analytical instrumentation is required to ensure that the analytical system is operating correctly and functioning at the sensitivity that is required to meet project-specific DQOs. Each instrument will be calibrated with standard solutions appropriate to the instrument and analytical method, in accordance with the methodology specified and at the QC frequency specified in laboratory or field sampling SOPs.

Owners and/or operators and their contractors may use field equipment such as pH meters, dissolved oxygen meters, PIDs, and others to take environmental measurements. Such equipment

must be properly maintained, calibrated, and tested prior to use according to written SOPs, and follow the equipment manufacturer's recommendations. Testing, maintenance, inspection, and calibration, schedule should be included in the SAP as applicable.

B.7 INSTRUMENT/EQUIPMENT CALIBRATION AND FREQUENCY

B.7.1 Field-Based Instruments

Appropriate operation and maintenance of field equipment and documentation of such is the responsibility of the operator. When this equipment is owned by a contractor or a rental company, the operator is responsible for ensuring proper maintenance and calibration procedures are followed prior to use in data collection efforts. The operator is also responsible for documentation of conditions of use upon conducting routine inspection, typically prior to use. Typically the operator will be a contractor, either to ADEQ or the responsible party.

Field equipment, if used, will be calibrated at the beginning of the field effort and at prescribed intervals. The calibration frequency depends on the type and stability of equipment, the intended use of the equipment and the recommendation of the manufacturer. Detailed calibration procedures for field equipment are available from the specific manufacturers' instruction manuals, and general guidelines are included in SOPs. All calibration information will be recorded in a field logbook or on field forms. A label that specifies the scheduled date of the next calibration will be attached to the field equipment. If this type of identification is not feasible, equipment calibration records will be readily available for reference. Field-based analytical instruments, such as turbidimeters and pH electrodes must be calibrated following manufacturers' instructions and frequency recommendations (or following appropriate SOPs) before they may be used for collecting data.

Sampling and analysis generally require the use of different pieces of equipment and tools in the gathering of environmental data. A field preventive maintenance protocol involves ensuring that all field equipment has been properly calibrated, charged, and inspected prior to and at the end of each working day and that replacement parts are available.

Inspection of all field equipment is required to determine if it is adequate and appropriate for the media, parameters, and required testing. Data may be generated onsite through the use of real-time equipment, such as photoionization detectors (PIDs), organic vapor analyzers, and pH meters.

For field-testing, examination of equipment occurs to ensure that it is in working condition and properly calibrated. The team is required to track the transfer of samples. Staff calibrate field instruments according to the method and schedule specified in an SOP. The manufacturer's operating manual usually forms the basis for these types of SOPs. Calibration of field equipment occurs more often than specified in the SOP when using equipment under adverse or extreme field conditions.

All field instruments should be tested, inspected, and maintained according to the manufacturer's guidelines and recommendations. Data collected from improperly functioning equipment will not

be used. ADEQ contractors, Owner/Operator contractors, and property owner contractors typically are the ones that collect field data and are responsible for the correct operation of their equipment. ADEQ staff, on rare occasion, does collect field data. ADEQ staff should follow the equipment manufacturers operating manual for ensuring proper operation of any utilized equipment.

Maintenance of records for equipment testing, inspection, and maintenance occurs in a bound logbook for each piece of equipment. Recorded in the logbook are the date, time, name of inspector, equipment inspected, and the results of testing and inspection. Inspection occurs on all equipment or systems requiring periodic maintenance.

Preventive maintenance for most field equipment is carried out in accordance with procedures and schedules recommended in (1) the equipment manufacturer's literature or operating manual or (2) SOPs that describe equipment operation associated with particular applications of the instrument. However, critical measurements for field equipment may require more stringent testing, inspection, and maintenance procedures. Unscheduled testing, inspection, and maintenance occurs on equipment whose condition is suspect. Reporting in the daily field QC report occurs for any significant problems with field equipment.

B.7.2 Laboratory Instruments

Calibration and maintenance of analytical instruments will be conducted in accordance with the QC requirements identified in each laboratory SOP and in QA manuals, along with the manufacturers' instructions. General requirements are discussed below.

The history of calibration and maintenance for instruments in the subcontract laboratory is an important aspect of the project's overall QA/QC program. As such, all initial and continuing calibration procedures will be implemented by trained personnel following the manufacturer's instructions and in accordance with applicable EPA protocols to ensure the equipment is functioning within the tolerances established by the manufacturer and the method-specific analytical requirements.

The laboratory will obtain calibration standards from commercial vendors for both inorganic and organic compounds and analytes. Stock solutions for surrogate standards and other inorganic mixes will be made from reagent-grade chemicals or as specified in the analytical method. Stock standards will also be used to make intermediate standards that will be used to prepare calibration standards. Special attention will be paid to expiration dating, proper labeling, proper refrigeration and freedom from contamination. Documentation on receipt, mixing and use of standards will be recorded in the appropriate laboratory logbook. Logbooks must be permanently bound. Additional specific handling and documentation requirements for the use of standards may be provided in subcontractor laboratory QA plans.

The verification standards for initial calibrations should be analyzed after the instrument calibration to verify the preparation and concentration of the calibration standards. The verification standards for continuing calibrations should be analyzed (as per method requirements) to verify the calibration of the analytical system over time.

Analytical balances will be calibrated annually according to manufacturer's instructions and have a calibration check before each use by laboratory personnel. Balance calibration shall be documented in hardbound logbooks with pre-numbered pages.

All refrigerators and incubators will be monitored for proper temperature by measuring and recording internal temperatures on a daily basis. At a minimum, thermometers used for these measurements will be calibrated annually, according to manufacturer's instructions.

The subcontract laboratories will maintain an appropriate water supply system that is capable of furnishing ASTM Type II polished water to the various analytical areas.

B.8 INSPECTION/ACCEPTANCE OF SUPPLIES AND CONSUMABLES

The laboratory shall inspect supplies and consumables prior to their use in analysis. The description of materials provided in the method shall be used as a guideline for establishing the acceptance criteria for these materials. Purity of reagents shall be monitored by analysis of LCSs. An inventory and storage system for these materials shall assure use before manufacturers' expiration dates and storage under safe and chemically compatible conditions.

Analytical laboratories are required to provide certified clean containers for all analyses. These containers must meet EPA standards described in Specifications and Guidance for Obtaining Contaminant-Free Sampling Containers (EPA, 1992c).

Procedures for receiving supplies and consumables in the field are similar. When supplies are received, the project manager or field team leader will log the supplies into a supply logbook and then inspect all items against the acceptance criteria. The laboratory will provide sample containers, labels, chain-of-custody forms, and coolers, as requested by the program. Properly cleaned sample containers must be provided so that no target compound contamination occurs from contact with the sample container. Equally important is that where applicable, the laboratory must provide preservative reagents that are free of target analytes or other contaminants. Any deficiencies or problems will be noted in the field logbook, and deficient items will be returned for immediate replacement.

B.9 NON-DIRECT-MEASUREMENTS

Environmental data generation typically involves planning, sampling, analysis, investigation, and data review. In planning their investigations, project teams generally use existing data to develop sampling designs and to decide how much and what type of data to collect. The term existing data are synonymous with "secondary data" and "non-direct measurements". Existing data may come from a number of sources, including other studies, government databases, etc. The original purpose for collecting these secondary data may be very different from that of the current investigation. Also, these secondary data may have been collected using different sampling methods (composite vs. grab, random vs. hot spot sampling), and/or analytical methods than those selected for the current investigation.

Basing decisions on existing data may result in errors if secondary data were not generated for the same purpose or using the same methods as the current investigation. Biased data can impact final conclusions. Therefore, before using secondary data, project team members should evaluate the data to identify any limitations on their use. Also, to ensure transparency in decision making, project team members clearly document criteria and reasons for ***including*** and ***excluding*** certain data from use. Failure to clearly document why data are included or excluded can result in the appearance of biased data selection and diminish the product's credibility.

Sources of secondary data include the following:

- Environmental indicator data obtained from federal/state/local databases and records
- Existing sampling and analytical data from a previous investigation of the area
- Computer model simulations and applications pertaining to other studies
- Historical data (e.g., from organization's/facility's corporate records and/or federal/state local records pertaining to previous monitoring events, site investigations, etc.)
- Background information/data from organization's/facility's corporate records and/or federal/state/local records pertaining to site-specific industrial processes, process by-products, past and current chemical uses, raw material and finished product testing, waste testing and disposal practices, and potential chemical breakdown products
- Data generated to verify innovative technologies and methods
- Data obtained from computer databases (such as manufacturers' process/product information, waste management or effluent information, and EPA or state data bases)
- Literature files/searches
- Publications
- Photographs
- Topographical maps
- Meteorological data

B.10 DATA MANAGEMENT

Field staff record field data generated for RPS, such as sample ID and latitude/longitude coordinates, groundwater monitor well data on field data sheets or hand-held computers. Field data are reported to the Project Manager through submission of field notebooks or field sampling data sheets by RPS field staff or contractor field staff.

Laboratory analytical reports will include QC results and any other necessary analytical information, enabling reviewers to determine data quality. Laboratory data should be submitted to the ADEQ Project Manager in both printed and electronic form. Rapid turnaround data from the laboratory are reported to the Project Manager, if requested, but rapid turnaround is generally not required. Copies of field logs, a copy of chain-of-custody forms, original preliminary and final lab reports and electronic media reports must be kept by contractors for review by ADEQ.

The field crew must retain original field logs. The contract laboratory shall retain chain-of-custody forms. Logs and lab reports are maintained in facility files as hard copies, and are also maintained on ADEQ's common J:\ drive in facility-specific folders. The contract laboratory will retain copies of the preliminary and final data reports.

Project files follow the ADEQ's retention schedule outlined in State policies. The retention policy provides essential information, guidance and tools necessary for ADEQ to manage and operate an effective records management system and disposition program. Individual project files are located in the Record Center, on the first floor of ADEQ's Phoenix office. ADEQ's Record Retention Schedule is attached as Appendix C.

SECTION C ASSESSMENT AND OVERSIGHT

C.1 ASSESSMENT AND RESPONSE ACTIONS

Assessment and response actions are part of the quality system for ensuring and documenting that procedures required by this QA Program Plan are being followed during the generation of data to be included in all planning documents and reports generated for and submitted to RPS.

During the planning process, many options for sampling, sample handling, sample analysis and data reduction are evaluated. Selection of specific options depends on the nature of the corrective action or monitoring activity. This section of the QA Program Plan describes the internal and external checks necessary to ensure correct implementation of all elements. In addition, needed checks ensure adequate data quality and implementation of timely and effective corrective actions. Documenting all internal assessments is a critical component of the quality system.

ADEQ employs several QA assessment tools designed to provide a better understanding of the components of, and the basis for improving, the ADEQ Quality Management System. Internal (Programmatic) and External QA audits are one of the principal tools for determining the effectiveness of the ADEQ QA/QC components. QA/QC specialists current conduct Audits of Data Quality and Technical Systems Audits of programs whose staff collect data used for compliance, assessment and prevention purposes. These audit types are discussed in greater detail in subsequent subsections. Data Quality Assessments will be conducted on a project-by-project basis. QA audit frequency and scheduling will vary with the type of review conducted. Assessment activities are scheduled and conducted at the direction of the QAM in accordance with the internal audit standard work requirements (ADEQ, 2019). The internal audit standard work is maintained at J:\Common\ADEQ Quality Management Program\Projects. All audit findings are shared with the Value Stream Managers and are tracked by the audit team until the VS implements successful countermeasures.

C.1.1 Management Systems Review (MSR)

An MSR is an independent assessment of a Program's QA management practices and data collection procedures. Generally, the ADEQ QA/QC Manager or QA/QC Representatives performs the MSR. The EPA QA Office can also conduct MSRs. The MSR will qualitatively assess a program to determine if the ADEQ Quality Management System is adequate to ensure the quality of the Program's data. MSRs address the effectiveness of management controls in achieving and assuring data quality, the adequacy of resources and personnel devoted to QA functions, the effectiveness of training and assessments, and the applicability of data quality requirements. While MSRs can identify significant QA concerns and areas of needed improvement, they also point out noteworthy accomplishments.

Most MSRs will examine the following items:

- Assessment of the overall effectiveness of the QA management system, as measured by its adherence to the approved QMP;
- Procedures for developing Data Quality Objectives (DQOs);

- Procedures for developing and approving QA Program Plans and Quality Assurance Project Plans (QAPjPs);
- Effectiveness of existing QA Program Plan guidance and QAPjPs;
- Procedures for developing and approving SOPs;
- Procedures, criteria, and schedules for conducting QA audits;
- Tracking systems for assuring that the QA Program is operating effectively, and that corrective actions disclosed by QA audits have been taken;
- Responsibilities and authorities of various line managers and QA personnel for implementing the QA program;
- Degree of management support;
- Level of financial and other resources committed to implementing the QA Program.

The ADEQ QA/QC Manager or QA/QC Representatives utilizes EPA's Guidance on Assessing Quality Systems (Management Systems Review Process, 2003) for conducting MSRs.

The following lists the objectives of reviews for any ADEQ related Quality Assurance Programs:

- Identify any data quality problems;
- Identify benchmark practices for use in other Agency Programs;
- Propose recommendations for resolving quality problems;
- Confirm implementation and effectiveness of any recommended corrective actions.

C.1.2 Assessment of Program Activities

Technical Systems Audits (TSAs)

The purpose of a Technical Systems Audit is to assess the sampling and analytical quality control procedures used to generate environmental data. TSAs entail a comprehensive, on-site evaluation of the field equipment; sampling and analyses procedures; documentation; data validation; and training procedures for collecting or processing environmental data. TSAs occur for both laboratory and field activities.

Laboratory TSAs

TSAs occur on entities that submit analytical data to ADEQ. These entities are the ADEQ contract laboratories, and contract laboratories of Owner/Operator contractors. The primary goals of TSAs will be to review the laboratory organization, operation, and capabilities; determine the reliability of data; and note corrective action for any apparent deficiencies. ADHS, rather than ADEQ, is responsible for licensing environmental laboratories and can conduct audits and inspections at environmental laboratories. ADEQ's QA\QC staff can work with ADHS to identify laboratories to audit/inspect.

Field TSAs

Oversight of field operations is an important part of the quality assurance process. The ADEQ QA/QC Manager or QA/QC Representatives will conduct QA audits of field sampling activities, both for its own field operations, and on those contractors that collect samples for RPS Programs. ADEQ will specify frequency and procedures for conducting field TSAs within specific Program areas. When project-specific planning documents are reviewed, and also during any MSRs or other QA audits, ADEQ's QA/QC Manager or QA/QC Representatives will determine the necessity of field TSAs. Specific items observed during the audit may include:

- Availability of approved project plans such as the project-specific planning document and Health and Safety Plan (HASP) to all project members
- Documentation of personnel qualifications and training
- Sample collection, identification, preservation, handling and shipping procedures
- Decontamination procedures used to clean sampling equipment
- Equipment calibration and maintenance
- Completeness of logbooks and other field records (including nonconformance documentation)

Performance Evaluations

Use of Performance Evaluation (PE) samples help assess the ability of a laboratory, or field measurement system, to provide reliable data. PE samples are for laboratories providing analytical services, directly or indirectly, for ADEQ and will be traceable, whenever possible, through the National Institute of Standards and Technology (NIST). The evaluation consists of providing a reference "blind" or "double blind" sample to the laboratory for analysis. A PE sample contains known concentrations of chemical constituents, or pollutants, of interest and will normally be in the appropriate media (e.g., soil, water, air). The analytical results obtained by the laboratory are compared to the known concentrations of the chemical constituents contained in the PE sample(s) as a means of determining if the laboratory demonstrated its ability to properly identify, and quantify, pollutants within established, or calculated, control limits.

The RPS schedules PE samples on an as-needed basis depending on the laboratory. All PE studies performed for ADEQ, whether required on a regular basis or performed on a one-time basis, will be coordinated through or requested from the ADEQ QA/QC Manager or QA/QC Representatives or designee. For external projects requiring PEs, the Task/Work Assignment, Task/Delivery Order, or similar document needs to outline the specific details of the Performance Evaluation so the associated costs can be included in the contractor proposal. The results of PEs provide a means for assessing overall data integrity and used as criteria for selecting candidates for on-site evaluations.

Audits of Data Quality

EPA 2001 Guidance for Quality Assurance Project Plans defines an audit of data quality (ADQ) as "a qualitative and quantitative evaluation of the documentation and procedures associated with environmental measurements to verify that the resulting data are of acceptable quality." This assessment primarily involves an evaluation of the completeness of the documentation of field and analytical procedures and quality control results. Also, it usually involves tracing the paper

trail accompanying the data from sample collection and custody to analytical results and entry into a database. This technique is the common verification process involved in entering data residing in large regulatory databases.

Results of both Data Quality Assessments (DQAs) and data quality audits can be used in at least two ways. One use is in making recommendations for changes in the design and performance of data collection efforts and in the use and documentation of QC procedures. A second use is as a guide for the planning and acquisition of supplemental data for the project and potentially for other related projects. Problems identified through DQAs may trigger the need for an MSR to determine management deficiencies or a TSA to identify technical problems.

Data Quality Assessments (DQAs)

A DQA refers to the process used to determine whether the quality of a given data set is adequate for its intended use. DQAs may occur on selected projects and/or data generation processes. The purpose of this type of evaluation is to determine whether the data collected are acceptable to the decision-maker or end user. Assessments generally take during the data generation process. As data accumulates, aspects of the project such as surveillance of field and laboratory operations, consistency of the data with MQOs, successfully completing performance evaluation sample studies, and so forth, helps assess whether the data are valid and acceptable. ADEQ disregards rejected or questionable data in its decision making, except in limited circumstances, such as a rough site screening.

Once data are of known and acceptable quality, then evaluation of the results in the context of the Data Quality Objectives for the project occurs. For most circumstances involving source area decision units, sample results involve a 1:1 sample comparison to regulatory standards or laboratory detection limits. For circumstances involving exposure area decision units, the RPS typically use statistics on sample results (e.g. metal contaminants in soils from windblown deposits emanated from tailings piles or smokestack plumes). EPA's Data Quality Assessment - A Reviewers Guide (EPA, 2006b) and Data Quality Assessment - Statistical Methods for Practitioner (EPA, 2006c) discusses the types and uses of statistical analyses.

An assessment also occurs as to whether there is a sufficient quantity of data to support program or project decisions, and whether the original sampling design was appropriate. In some cases, the data may suggest that additional data are required to achieve a higher statistical confidence level. This could be because of overlooking too many invalidated data points, not collecting samples over a long enough time period, or missing a vital sampling area not previously considered important. In other cases, an assessment might show that data of a different type are required, or that the sensitivity of the instrument used in the measurement was not adequate to meet project objectives. If necessary, ADEQ's QA/QC Manager or QA/QC Representatives can review data generated by contract laboratories, for the ADEQ RPS Programs. These data review activities should use checklists, standard operating procedures, and standardized qualification codes to indicate data quality.

Peer Reviews

Peer reviews are not strictly an internal QA function; rather, they are technical scientific reviews that evaluate assumptions, calculations, methods, and conclusions. The ADEQ will use internal expertise to evaluate different technical aspects of the reports produced by contractors and Owner/Operators.

C.1.3 Documentation of Investigations

Once every four years every major Agency Program attempts an MSR. TSA's occur if specifically requested by ADEQ's Project/Case Manager, the findings of another audit or review necessitate another, or if the ADEQ QA/QC Manager or QA/QC Representatives plans one. MSRs and TSAs are generally conducted by ADEQ's QAM and focuses on RPS adherence to the approved Agency QMP and its QAPP. Results will be reported to the audited organization in the form of a written report within 14 calendar days of the completion of the audit, or a mutually agreed upon alternative. Written comments by ADEQ's Project/Case Manager must be supplied to ADEQ's QA/QC Manager or QA/QC Representatives within 14 calendar days of receipt of the audit findings, or a mutually agreed upon alternative. Copies of the TSA Audit Final Report will be stored in the project file and also with ADEQ's QA/QC Manager or QA/QC Representatives. Distribution of additional copies occurs as appropriate.

Addressing nonconformance to practices and procedures outlined in this QA Program Plan or a project specific planning document submitted to ADEQ by an Owner/Operator should happen in a timely manner to ensure correction of nonconforming issues or deficiencies. The ultimate responsibility to ensure that all issues and deficiencies are satisfactorily resolved rests with the Unit Supervisors and Section Manager. Arizona Administrative Code allows Owner/Operators to satisfactorily correct deficiencies in a planning document.

The RPS will have 30 days to prepare a written response to the reviewer's assessment memorandum. If the evaluation report recommends corrective actions, the RPS should address these recommendations and include a schedule for making any appropriate changes in its quality assurance procedures. The ADEQ Leadership team uses these reviews to gauge the effectiveness of the Agency QMP and of the RPS approach to data quality management.

C.2 REPORTS TO MANAGEMENT

Effective management of environmental data collection requires (1) timely assessment and review of all activities and (2) open communication, interaction, and feedback among all project participants. This section outlines the reporting requirements for activities conducted under the RPS, including Owner/Operator led projects. Required reports provide a structure for evaluating the management of program schedules, assessing the effect of deviations from approved program or project-specific planning document on data quality, and determining the potential uncertainties in decisions made based on the data. Senior technical staff, case/project managers, and the QA/QC Representative review these reports and provide summaries on any identified data quality issue. Typically, these summaries are in memo form for specific projects or, for program concerns, presented orally at unit or section meetings where discussion occurs. Required reports keep managers and project members informed on the performance of QA/QC activities. Data quality summaries by ADEQ staff provide the results of project-specific audits,

list any significant problems and discuss the solutions and corrective actions implemented or to be implemented to resolve QA/QC problems.

C.2.1 Frequency, Content and Distribution of Reports

Field, technical, laboratory or QA personnel generate QA/QC reports and send them to the RPS, as required throughout the duration of the project. These QA/QC reports are in written memo or oral form, depending on the problems observed. A summary of the information included in these QA reports is normally included in ADEQ's required reporting (See Figures A2).

The contractor field team will record daily activities in a field log book to summarize activities throughout the field investigation. This daily log book will describe sampling and field measurements, equipment used, subcontractor personnel on site, QA/QC and health and safety activities, problems encountered, corrective actions taken, deviations from the QA Program Plan or project-specific planning document, and explanations for the deviations. The field team leader prepares the daily log book and submits it to the RPS, if requested. The final report for field investigations will summarize the content of the daily log book.

The required reports submitted for the project should include discussion of the following QA/QC report elements, if appropriate:

- Sampling and support equipment that were used, other than those specified in the approved QA Program or project-specific planning document.
- Preservation or holding-time requirements for any sample that were not met
- QC checks (field and laboratory) that were found to be unacceptable
- Analytical requirements for precision, accuracy, or method detection limit/practical quantitation limit (MDL/PQL) that were not met
- Sample collection protocols or analytical methods specified in the QA Program Plan that were not met
- Any activity or event that affected the quality of the data
- Any corrective actions that were initiated as a result of deficiencies
- Any internal or external systems or performance audits that were conducted

The QA/QC report contains an emphasis on evaluating whether project MQOs and data are of adequate quality to support the required decisions stated in the project DQOs. The following example contains a list of recommended topics for use in developing a comprehensive QA/QC report, if necessary. The information listed below should be contained within a QA Report, if appropriate.

C.2.2 Identify Responsible Organizations and Individuals

The facility owner, operator, property owner, or state or federal government – either directly or through its contractor - is responsible for preparing planning documents and reports and

incorporating any comments received from RPS personnel. These parties are responsible for ensuring that a complete environmental laboratory report is included in all planning documents and reports, if applicable, generated for and submitted to the RPS.

SECTION D DATA VALIDATION AND USABILITY

D.1 DATA VERIFICATION AND VALIDATION REQUIREMENTS

This section describes the planned procedures to review, verify and validate field and laboratory data. This section also discusses procedures for verifying that data are sufficient to meet DQOs and MQOs for the project. Data verification, validation, and assessment ensures that environmental programs and decisions are supported by the type and quality of data needed and expected for the intended use.

Data verification and validation confirms the integrity of the data generated over the life of the project. The process for determining if the data satisfy program-defined requirements involves evaluating and interpreting the data, in addition to verifying meeting QC requirements. The systematic planning approaches described in ADEQ's Waste Programs Division Site Investigation Guidance Manual – the DQO Process and the Triad Approach - should produce data that provide answers to critical study questions. ADEQ's RPS utilizes the Triad Approach which contains some elements of the DQO Process.

EPA's Guidance on Environmental Data Verification and Data Validation (EPA, 2002c) presents the process for verifying and validating data. Section 5 of this EPA guidance provides tools and techniques for data verification and validation: https://www.epa.gov/quality/agency-wide-quality-system-documents.

D.1.1 Data Verification

Data verification is the process of evaluating the completeness, correctness, conformance, and compliance of a specific data set against the method, procedural or contractual requirements. Data verification evaluates adherence to data generation sampling protocols, SOPs, analytical methods, and project specific planning documents. Verification also involves examining the data for errors or omissions. Field and laboratory staff can verify that the work is producing appropriate outputs.

Project team personnel, whether they are ADEQ contractors, ADEQ staff, or Owner/Operators, will verify field data through reviews of data sets to identify inconsistencies or anomalous values. Any inconsistencies discovered will be resolved as soon as possible by seeking clarification from field personnel responsible for data collection. To obtain defensible and justifiable data, all field personnel will be responsible for following the sampling and documentation procedures described in the project-specific planning document.

Laboratory personnel will verify analytical data at the time of analysis and reporting and through subsequent reviews of the raw data for any non-conformances to the requirements of the analytical method. Laboratory personnel will make a systematic effort to identify any outliers or errors before they report the data. Outliers are corrected if found to be the result of errors. The case narrative section of the analytical data package clearly identifies outliers not attributed to errors in analysis, transcription, or calculation. The laboratory must verify all analytical data generated for and submitted to the RPS.

Verified data are checked for a variety of topics including transcription errors, correct application of dilution factors, appropriate reporting of dry weight versus wet weight, and correct usage of conversion factors, among others. Verified data may have laboratory qualifiers. Verified data are one output of this process.

A second output from the verification process is documentation, which may include a certification statement signed by the laboratory manager and included in the data package. Narratives on technical issues, non-compliance and any corrective action taken are included in the laboratory data package. Records from field activities are likely to be logbooks or handwritten notes, all of which require dates and signatures.

A laboratory QA manual is used to assist in accepting, rejecting, or qualifying the data generated by the laboratory. ADEQ, though, makes the decision on whether or not to use the data. The laboratory management is responsible for validating the data generated by the laboratory. The laboratory personnel must verify that the measurement process was "in control" (i.e., all specified MQOs for the DQIs were met, or acceptable deviations are explained) for each batch of samples before proceeding with analysis of a subsequent batch. In addition, each laboratory must establish a system for detecting and reducing transcription and/or calculation errors prior to reporting data. When deviations are noted, the laboratory shall submit data that have acceptable deviations explained. When there are unmet QA requirements, reanalysis of the sample occurs when possible. Only the results of the reanalysis will be submitted, provided these results are acceptable.

D.1.2 Data Validation

Data validation is a systematic process for reviewing a body of data against a pre-established set of acceptance criteria defined in this QAPP and in project-specific SAPs. Data validation is an analyte- and sample-specific process that extends the evaluation of data beyond data verification and is performed to determine the analytical quality of a specific data set.

The RPS performs a partial validation on selected analytical data routinely generated for and submitted to RPS. This partial validation involves an examination of the data package to determine whether MQOs for precision, accuracy and sensitivity have been met. Partial validation is based on discrepancies noted during the verification step. For example, perhaps some, but not all, surrogates in a method requiring an organic extraction are outside method defined acceptance criteria, but other QC data such as precision of the measurements and blank data are acceptable. This might lead to a review that is centered on surrogate recoveries. The intent of the partial validation is to qualify data so that the user is alerted that s/he should understand the limitations when making decisions based on the data. Full data validation should occur if results are used in court cases.

D.1.3 Data Quality Assessment

A Data Quality Assessment (DQA) refers to the process used to determine whether the quality of a given data set is adequate for its intended use. DQAs can be performed on all, or selected projects and/or data generation processes. The purpose of this type of evaluation is to determine whether the data collected are acceptable to the decision-maker or end user. Assessments

generally take place at one of two points in the data generation process. First, as data are generated, aspects of the project such as surveillance of field and laboratory operations, consistency of the data with MQOs, successfully completing performance evaluation sample studies, and so forth, can be used to arrive at an assessment of whether the data are valid and acceptable. Rejected or questionable data cannot be used by ADEQ in its decision making, except in limited circumstances, such as a rough site screening.

Once data have been examined and assessed, and they are found to be of known and acceptable quality, then the results can be evaluated in the context of the DQO's for the project. In some, but not all, cases this may involve a statistical evaluation such as null hypotheses testing. In others, it may involve a comparison to regulatory action levels. An assessment must also be made as to whether there is a sufficient quantity of data to support program or project decisions, and whether the original sampling design was appropriate. In some cases, the data may suggest that additional data are required to achieve a higher statistical confidence level. This could be because too many data points were invalidated, that samples were not collected over a long enough time period, or that a vital sampling area not previously considered important, was missed. In other cases, an assessment might show that data of a different type are required, or that the sensitivity of the instrument used in the measurement was not adequate to meet project objectives. Thus, both types of assessments are vital to the successful completion of a project.

These data review activities use checklists, SOPs, and standardized qualification codes to indicate data quality. The use of checklists and SOPs help standardize the data review process. The extent and level of verification for individual data sets should clearly be defined in the project's SAP or other planning document.

D.2 APPROACHES TO VERIFICATION, VALIDATION AND ASSESSMENT

The integrity of the data generated over the life of the project is confirmed by data verification and validation. The process for determining if the data satisfy program-defined requirements involves evaluating and interpreting the data, in addition to verifying that QC requirements were met. Projects planned using EPA's DQO process should produce data that provide answers to critical study questions.

The process for verifying and validating data is presented in EPA Guidance on Environmental Data Verification and Data Validation (EPA, 2002c). Section 5 of this EPA guidance provides tools and techniques for data verification and validation: https://www.epa.gov/quality/guidance-environmental-data-verification-and-data-validation.

D.2.1 Approaches to Data Verification

Project team personnel will verify field data through reviews of data sets to identify inconsistencies or anomalous values. Any inconsistencies discovered will be resolved as soon as possible by seeking clarification from field personnel responsible for data collection. All field personnel will be responsible for following the sampling and documentation procedures described in the project SAP so that defensible and justifiable data are obtained.

Laboratory personnel will verify analytical data at the time of analysis and reporting and through subsequent reviews of the raw data for any non-compliance with the requirements of the analytical method. Laboratory personnel will make a systematic effort to identify any outliers or errors before they report the data. Outliers that are found to be the result of errors will be identified and corrected; outliers that cannot be attributed to errors in analysis, transcription, or calculation will be clearly identified in the case narrative section of the analytical data package. All analytical data generated for and submitted to ADEQ's RPS are to be verified by the laboratory.

Verified data are checked for a variety of topics including transcription errors, correct application of dilution factors, appropriate reporting of dry weight versus wet weight and correct usage of conversion factors, among others. Verified data may have laboratory qualifiers. Verified data are one output of this process.

A second output from the verification process is documentation, which may include a certification statement signed by the laboratory manager and included in the data package. Narratives on technical issues, non-compliance and any corrective action taken are included in the laboratory data package. Records from field activities are likely to be logbooks or handwritten notes, all of which should be dated and signed.

The laboratory QA manual must be used to accept, reject or qualify the data generated by the laboratory. ADEQ, though, makes the decision on whether or not to use the data. The laboratory management is responsible for validating the data generated by the laboratory. The laboratory personnel must verify that the measurement process was "in control" (i.e., all specified MQOs for the DQIs were met, or acceptable deviations are explained) for each batch of samples before proceeding with analysis of a subsequent batch. In addition, each laboratory must establish a system for detecting and reducing transcription and/or calculation errors prior to reporting data. Only data that have acceptable deviations explained, should be submitted by the laboratory. When QA requirements have not been met, the samples should be reanalyzed when possible, and only the results of the reanalysis will be submitted, provided these results are acceptable.

D.2.2 Approaches to Data Validation

Data validation determines the analytical quality of data within a specific data set; it is an analyte- and sample-specific process based on achieving the MQOs set forth in the planning documents for the project. Validation assesses whether data quality goals specified in the planning phase have been achieved. Unlike data verification, which may be done by the laboratory, data validation is typically performed by a qualified person who is not affiliated with the laboratory. Validation of analytical data generated for and submitted to ADEQ's RPS is performed by the Unit Manager, staff level personnel or, upon request, Technical Support.

The level of data validation depends on the size and complexity of the project and the decisions to be made. Basically, data validation is the process of evaluating the available data against the project MQOs to make sure that the objectives are met. Cursory validation is performed on data generated for and submitted to ADEQ's RPS. If full data validation is ever needed on an RPS project, the QAM will be notified. Criteria for data validation are summarized in Table D-1.

The personnel validating the data should be familiar with the project-specific MQOs. So, the validator should have access to the QAPP, SAPs, SOPs and approved analytical methods. The validator must identify these and other project records, obtain records produced during data verification, and validate the records by determining whether the data quality meets goals established in the planning documents.

Data validation generally includes the following steps:

Validation of Field Data

1. Evaluate field records for completeness and consistency;
2. Review field QC information;
3. Summarize deviations and determine effects on data quality;
4. Summarize number and type of samples collected.

Validation of Laboratory Data

1. Assemble planning documents and data to be validated. Review data records to determine method, procedural and contractual QC compliance or noncompliance;
2. Review verified, reported sample results collectively for the data set as a whole, including laboratory qualifiers;
3. Summarize data and QC deficiencies and evaluate the impact on overall data quality.

Any field or laboratory data that did not meet the quality goals established in the planning documents are summarized in a comment letter to the party responsible for performing the Site Assessment.

D.2.3 Approaches to Data Assessment

The purpose of a data assessment is to integrate all aspects of data generation to determine the usability of the data. The final step in the process is to compare the data obtained to the DQOs established by the program in its QAPP or else in project-specific planning documents. Aspects of the sampling program evaluated during the data assessment include sampling design, sample collection procedures and sample handling. Analytical procedures (both field and laboratory) and QC procedures are also reviewed during the process. Field and laboratory instrument calibration logbooks are maintained by the environmental consultant and laboratories, respectively, and are reviewed by the appropriate personnel (Unit Manager, staff level personnel, Technical Support and/or QAM) on an as needed basis. Criteria for evaluating all aspects are provided in the following paragraphs.

D2.3.1 Sampling Design

Samples should conform to the type and location specified in the project-specific SAP or other planning document. Any deviations should be noted, along with the likely effect on the usability of the data for its intended purpose. EPA also provides guidance in its Guidance on Choosing a Sampling Design for Environmental Data Collection (EPA, 2002b).

D2.3.2 Sample Collection Procedures

The data reviewer (i.e. typically the field team leader from the contracted environmental

consultant) should verify that the appropriate specified methods were used during sampling. The reviewer should:

1 Evaluate the field records for consistency;
2 Review QC information;
3 Summarize deviations and determine their effect on data quality;
4 Summarize the samples collected;
5 Prepare a field data verification summary.

Improper field practices can compromise the usability of a data set. Specific issues to look for include mislabeling of sample containers, problems with field instruments, improper documentation (such as failure to properly fill in the log book), improper collection of VOC samples (such as leaving a cap off a container or collecting VOC samples from a well-mixed composite sample), biasing sampling locations or forgetting to obtain location information for each sample, improper purging of monitoring wells, improper decontamination procedures or intentionally cutting corners by collecting many samples from one location to save time.

For preparation of the field data verification summary, the field team leader should evaluate field records and notebooks for consistency with field methods and procedures described in the SAP to ensure that these procedures were followed properly or that deviations from the procedures will still yield data of acceptable quality. The verification summary should include observations on (1) the consistency and completeness of field records, (2) the adequacy of field QC information, (3) any deviations from SAP procedures and the probable effect of the deviations on data quality and (4) the number and types of samples collected and how this compares with specifications in the SAP. The different parts of the data verification summary are typically incorporated into the final deliverable to the RPS personnel for review. The RPS personnel can request from the RPS facility owner or operator copies of field records and notebooks for their own review on an as needed basis.

Most qualified sampling contractors, State and Federally certified laboratories develop SOPs and analytical methods as part of their overall QA program. SOPs should be developed following EPA 2007 Guidance for Preparation of Standard Operating Procedures for Quality-Related Operations. The field team should document which SOPs they are using in the field and any deviations from an SOP.

D2.3.3 Sample Handling

QA personnel should confirm that samples were handled in accordance with protocols required in the QAPP, SAP, or other planning documents. Sample containers and preservation methods should be confirmed as appropriate for the nature of the sample and type of data generated from the sample. Chain-of-custody records and storage conditions should be checked to ensure the representativeness and integrity of the samples.

D2.3.4 Analytical Procedures

Section B4 of this QAPP identified the requirements of analytical methods used to generate the data. Each sample should be verified to ensure that the procedures used to generate the data were

implemented as specified. Acceptance criteria for these data follow those used in data validation, with suitable codes to characterize any deviations from the procedure.

D2.3.5 Quality Control

Section B5 of this QAPP specifies the QC checks that should be performed during sample collection, handling and analysis. Here, the QA reviewer should confirm that results for QC samples were evaluated against acceptance criteria (i.e., MQOs) specified in Section B.

D2.3.6 Calibrations

Section B7 of this QAPP addressed the calibration of instruments and equipment and the information required to ensure that the calibrations (1) were performed within an acceptable timeframe prior to generation of measurement data; (2) were performed in proper sequence, included the proper number of calibration points; (3) were performed using standards that bracketed the range of reported measurements (i.e., were within the linear working range of the instrument) and (4) had acceptable linearity checks to ensure the measurement system was stable when the calibration was performed. The environmental consultant performing the field work for the RPS facility owner or operator is responsible for the calibration of all field sampling equipment. Contracted environmental laboratories are responsible for the calibration of all laboratory equipment used to analyze samples collected for and submitted to ADEQ's RPS. All equipment and instrument calibrations shall be recorded in an appropriate log book and be made available to the RPS personnel upon request.

D2.3.7 Data Reduction and Processing

Internal checks by laboratory staff should verify the integrity of the raw data generated by the analyses. Electronic data deliverables (EDDs) automatically produced by the laboratory should help minimize data entry errors. Steps in data reduction should be clearly documented so that the validity of the analysis can be properly assessed.

Data should be cross-checked to confirm consistency or comparability in analytical methods and detection limits, units of measurement, compatibility of file types or software and other critical factors that affect how the data will ultimately be interpreted to influence conclusions and recommendations.

D.3 RECONCILIATION WITH DATA QULAITY OBJECTIVES

After the data have been verified and validated, the data are evaluated against project DQOs. Implementation of the DQA process completes the data life cycle by providing the assessment needed to determine if project objectives were achieved.

Two 2006 EPA guidance documents on DQA are available from EPA at http://www.epa.gov/quality/qa_docs.html. DQA is the scientific and statistical evaluation of environmental data to determine if they meet the planning objectives of the project, and thus are of the right type, quality and quantity to support their intended use. Data Quality Assessment - A Reviewers Guide broadly describes the statistical aspects of DQA in evaluating environmental data sets. A more detailed discussion on implementation of graphical and statistical tools is found in the companion guidance document on statistical methods for practitioners Data Quality

Assessment - Statistical Methods for Practitioners (EPA, 2006c), *see* https://nepis.epa.gov/Exe/ZyPDF.cgi/900B0D00.PDF?Dockey=900B0D00.PDF.
These EPA guidance documents discuss the use of DQA to support environmental decision-making (e.g., compliance determinations).

The DQA process is built on a fundamental premise: data quality is meaningful only when it relates to the intended use of the data. Data quality does not exist in a vacuum. A reviewer needs to know in what context a data set is to be used, in order to establish a relevant yardstick for judging whether or not the data are acceptable. By applying the DQA process, a reviewer can answer four important questions:

1 Can a decision (or estimate) be made with the desired level of certainty, given the quality of the data?
2 How well did the sampling design perform?
3 If the same sampling design strategy is used again for a similar study, would the data be expected to support the same intended use with the desired level of certainty?
4 Is it likely that sufficient samples were taken to enable the reviewer to see an effect if there really were an effect? That is, is the quantity of data sufficient?

D.3.1 Purpose/Background

This section outlines methods for evaluating the results obtained from the sampling and analysis. Scientific and statistical evaluations of the data are used to determine if the data collected are of the right type, quantity and quality to support their intended use and to adequately address the primary study questions.

Please note that statistical evaluations of data generated for and submitted to ADEQ's RPS are rarely employed. This is because judgmental sampling is most always the appropriate method for collecting samples for situations encountered. The goal of judgmental sampling is to use process or site knowledge to choose one or more sampling locations to represent the average concentration or typical property. Commonly, in the RPS, judgmental sampling is done by all RPS staff, and is done under circumstances such as the following:

- Preliminary information is needed about a waste stream or site to facilitate planning;
- Site assessment to identify a potential or actual release;
- Determining the chemical makeup of a spilled material;
- Screening samples in the field to identify "hot" samples for subsequent analysis in a laboratory;
- Support development of an enforcement case.

Generally, based on knowledge of the facility processes, and discussions with the RP, the RPSICU compliance staff would identify sample locations and determine the number and type, i.e., grab, or composite, samples to collect to the DQOs.

For the rare occasion when a project needs a statistical evaluation, confidence intervals (step 3 of the "Five Steps of Statistical DQA" in Section D3.2 below) is the statistic that would most likely best fit the project. If statistical evaluation other than confidence intervals is needed, a contractor may be selected to perform independent statistical evaluations in accordance with the DQA process outlined in this QAPP.

D.3.2 Reconciling Results with Program Objectives or DQOs

EPA guidance documents for data evaluation (EPA 2006) describe an iterative five-step process called the "Five Steps of Statistical DQA":

1. Review the DQOs and sampling design described in the project planning documents;

2. Conduct a preliminary data review or exploratory data analysis to understand the character and structure of the data set and to evaluate whether there are any anomalies in the data that may not have been noticed during data verification and validation. Are there outliers or other anomalies that should be further investigated before continuing with statistical testing?

3. Select a statistical test. Choose appropriate statistical tests based on the characteristics of the data and the questions that the investigation was intended to address.

4. Verify the assumptions of the statistical tests and assess the effect that violations of test assumptions may have on the result (i.e., is the test sufficiently robust to provide a valid result at a reasonable level of confidence?) and consider other factors (i.e., Are there effects of seasonality that must be considered? Would alternative statistical tests be better suited to the data than the tests proposed in the planning documents?).

5. Draw conclusions from the data. Using multiple lines of evidence, the results of statistical tests and professional judgment, the data analyst should be able to provide conclusions and recommendations for the site. In some cases, the conclusion may be that more data are needed to answer the primary study questions.

If DQOs have not been adequately developed, the RPS compliance and technical support staff may need to review the planning documents and sampling design, and then define the statistical hypotheses to be tested and establish tolerable limits on decision errors.

When the DQOs are qualitative, judgmental sampling is utilized and statistical tools are not appropriate, the ADEQ will still systematically assess data quality and data usability. This DQA assessment – Four Steps of DQA for Qualitative DQOs - will include the following:

1. A review of the sampling design and sampling methods to verify that these were implemented as planned and are adequate to support project objectives;
2. A review of project-specific MQOs for precision, accuracy, representativeness, completeness, comparability and quantitation limits to evaluate whether acceptance

criteria have been met;

3. A review of project-specific DQOs to assess whether they have been achieved by the data collected; and
4. An evaluation of any limitations associated with the decisions to be made based on the data collected. For example, if data completeness is only 90 percent compared to a project-specific completeness objective of 95 percent, the data may still be usable to support a decision, but at a lower level of confidence.

D3.2.1 Review DQOs and Sampling Design

Step 1 of the DQA process should (1) document or define the project specific DQOs, (2) verify that the hypothesis is consistent with project objectives and (3) identify any deviations from the sampling plan and assess the potential effect of the deviations.

The objectives of the study should be reviewed in order to provide a context for analyzing the data. If a systematic planning process has been implemented before the data are collected, then this step reviews the study objectives to evaluate whether project goals have been met and whether the study questions have been adequately answered. If no clear planning process was used, the reviewer should:

- Develop a concise definition of the problem (DQO Step 1) and of the methodology of how the data were collected (DQO Step 2). These two steps should provide the fundamental reason for collecting the environmental data and identify all potential actions that could result from the data analysis.
- Identify the target population and determine if any essential information is missing (DQO Step 3). If so, either collect the missing information before proceeding, or select a different approach to resolving the problem.
- Specify the scale of determination (any subpopulations of interest) and any boundaries on the study (DQO Step 4) based on the sampling design. The scale of determination is the smallest area or time period to which the conclusions of the study will apply. The apparent sampling design and implementation may restrict how small or how large the scale of determination can be.
- Evaluate whether the data support the conclusions offered (DQO Step 5). The overall type of sampling design and the manner in which data were collected will likely place constraints on how the data can be used and interpreted. The data analyst should assess whether features of the design support or contradict the stated objectives of the study. Were there deviations from the planned design? What might be the effect of these deviations? Are data adequate to address the primary study questions? How do these objectives translate into statistical hypotheses (null and alternative hypotheses)?

The design and sampling strategy should be discussed in clear detail in the SAP. The overall type of sampling design and the manner in which samples were collected or measurements were taken will place conditions and constraints on how the data can be used and interpreted.

A key distinction in sampling design is between judgmental sampling (also called authoritative or biased sampling), in which sample numbers and locations are selected based on expert

knowledge of the problem, and probability-based sampling, in which sample numbers and locations are selected based on randomization, and each member of the target population has a known probability of being included in the sample. Judgmental sampling has some advantages and is appropriate in some cases. This type of sampling should be considered when the objectives of the investigation are not of a statistical nature (for example, when the objective of a study is to identify specific locations of leaks/hot spots or when the study is focused solely on the sampling locations themselves). Generally, conclusions drawn from judgmental samples apply only to those individual samples.

Probabilistic sampling typically takes more effort to implement than judgmental sampling, because systematic or random locations must be selected for sampling. However, a probability-based sampling design has the advantage of allowing the use of statistical tests, which permit confidence and uncertainty of the results to be specified. Probability-based designs do not preclude the use of expert knowledge or the use of existing data to establish the sampling design. An efficient sampling design is one that uses all available prior information to stratify the site (in order to improve the representativeness of the resulting samples) and set appropriate parameters. Common types of probabilistic sampling designs include the following:

- Simple random sampling – the method of sampling where samples are collected at random times or locations throughout the sampling period or study area.
- Stratified sampling – a sampling method where a population is divided into non-overlapping subpopulations called "strata," and sampling locations are selected randomly within each stratum using a random or systematic sampling design.
- Systematic and grid sampling – a randomly selected unit (in space or time) establishes the starting place of a systematic pattern that is repeated throughout the population. With some important assumptions, can be shown to be equivalent to simple random sampling.
- Ranked set sampling – a field sampling design where expert judgment or an auxiliary measurement method is used in combination with simple random sampling to determine which locations should be sampled.
- Adaptive cluster sampling – a sampling method in which some samples are taken using simple random sampling, and additional samples are taken at locations where measurements exceed some threshold value.
- Composite sampling – a sampling method in which multiple samples are physically mixed into a larger sample and samples for analysis drawn from this larger sample. This technique can be highly cost-effective (but at the expense of variability estimation) and had the advantage it can be used in conjunction with any other sampling design. (Multi-increment sampling is a particular form of composite sampling, and may be an effective design for certain types of sites to answer certain types of questions).

Regardless of the type of sampling scheme, the reviewer should review the description of the sampling design and look for design features that support the project objectives. For example, if the goal of the study is to make a decision about the average (defined here as the arithmetic mean) concentration of a contaminant in an effluent stream over time, then composite samples

may be an appropriate sampling design. If the goal of the study is to find hot spots of contamination or sources of contamination, compositing should be used with caution, to avoid "averaging away" hot spots.
The reviewer should also look for potential problems in the implementation of the sampling design. For example, if simple random sampling was used to collect the data, can the reviewer be confident that the sampling locations or data points were truly random? Small deviations from a sampling plan probably have minimal effect on the conclusions drawn from the data set, but the effects of significant or substantial deviations should be carefully assessed. Finally, the reviewer should verify that the data are consistent with the project-specific SAP and the overall objectives of the study.

D3.2.2 Conduct Preliminary Data Review

For Probabilistic sampling, Step 2 of the DQA process reviews graphical representations of the data and calculates some basic statistical quantities. By reviewing the data both numerically and graphically, the reviewer can understand the structure of the data, and thereby identify appropriate use of the data. For judgmental sampling there is no probability-based theory for reliably estimating the magnitude of sampling errors. Any inference is confined to the sample locations judgmentally selected in the field.

Nevertheless, it is still possible to commit decision errors. Measurement errors can occur during sample analysis. Sampling errors can be caused by variability of contaminant concentrations in visibly stained soil areas. In the case of judgmental sampling, the magnitude of sampling errors cannot be reliably estimated, however, measurement error can be quantified. Assessments for judgment sampling data are done initially by the RPS compliance staff, and a final review is performed by the program's technical support staff.

Statistical quantities numerically describe the data. The quantities that are typically calculated include the arithmetic or geometric mean, the median and other percentiles and the standard deviation. These quantities provide estimates of characteristics for the sample population and allow one to make inferences about the population from which the data were drawn. Graphical representations permit the reviewer to identify patterns and relationships within the data, confirm or disprove assumptions and identify potential problems.

The preliminary data review allows the reviewer to understand the structure and characteristics of the data set and the population from which these data were drawn. Graphical depictions of the data permit the analyst to identify anomalies that may require further investigation or perhaps even reanalysis by the laboratory. Output from DQA Step 2 typically includes (1) tables of summary statistics and (2) graphs and/or statistical plots of the data.

D3.2.3 Select Statistical Test

Under Step 3 of the DQA process, the data analyst selects the most appropriate statistical test or method for evaluating the data. The statistical method will be selected based on the sampling plan used to collect the data, the type of data distribution and the assumptions made in setting the DQOs, noting any deviations from these assumptions. Conclusions about other aspects of the data set or the stated null hypothesis are made based on the results of this evaluation. EPA DQA

guidance provides a discussion (with mathematical formulas and examples for conducting statistical tests) of the process for statistically evaluating environmental data. Detailed technical information that reviewers can use to select appropriate procedures may be found in Chapter 3 of EPA's 2006 Data Quality Assessment: Statistical Methods for Practitioners (EPA, 2006c).

For the rare occasion when an RPS project needs a statistical evaluation, confidence intervals (step 3 of the "Five Steps of Statistical DQA" in Section D3.2 above) is the statistic that would most likely best fit the RPS project. For example, the project's objective may be to estimate the average level of pollution for a particular contaminant. A reviewer can describe the desired (or achieved) degree of uncertainty in the estimate by establishing confidence limits within which one can be reasonably certain that the true value will lie. When interpreting a confidence interval statement such as "The 95% confidence interval for the mean is 19.1 to 26.3", the implication is that the best estimate for the unknown population mean is 22.7 (halfway between 19.1 and 26.3), and that we are 95% certain that the interval 19.1 to 26.3 captures the unknown population mean.

If a particular statistical procedure was specified in the project SAP, the reviewer should use the results of the preliminary data review to determine if the procedure is appropriate for the data collected. If not, then the reviewer should document why the procedure is deemed inappropriate, and then select a different method. The EPA's Quality Assessment guidance document (EPA 2006) provides alternatives for several statistical procedures. If a particular procedure has not been specified, then the reviewer should select a statistical test or method based on the study objectives, results of the preliminary data review, and key assumptions necessary for the method.

All statistical tests make assumptions about the data. For instance, the t-test, which is a parametric test used to compare two data sets, assumes that each data set approximates a normal distribution and that the two data sets have approximately equal variance. In contrast to parametric tests like the t-test, nonparametric tests make much weaker assumptions about the distributional form of the data. However, both parametric and nonparametric tests assume that the data are derived from statistically independent samples. Common assumptions of statistical tests include distributional form of the data, independence, dispersion characteristics, approximate homogeneity and the basis for randomization in the sampling design. For example, the one-sample t-test assumes random and independent samples, an approximately normal distribution, no outliers and no more than a small percentage of non-detections.

Statistical methods that are insensitive to small or moderate departures from the assumptions are called "robust." However, some tests rely on the data meeting certain key assumptions in order for the test results to be valid. The reviewer should note any sensitive assumptions where relatively small deviations could jeopardize the validity of the test results.

After completing Step 3 of the DQA process, the data analyst or reviewer should have selected appropriate statistical tests and noted the critical assumptions of the statistical tests.

D3.2.4 Verify Assumptions of Statistical Tests

The validity of a statistical test or method depends on the key assumptions underlying the test, and whether the data violate these assumptions. Minor deviations from assumptions are usually not critical if the statistical technique is sufficiently robust to compensate for such deviations. If the data do not show serious deviations from the key assumptions of the statistical method, then the DQA process continues to Step 5, 'Draw Conclusions from the Data.' However, it is possible that if one or more of the assumptions are called into question, this could require a re-evaluation of which test may be most appropriate for the data. It is true that some deviations do not invalidate the results of a statistical test, but this should be confirmed here in Step 4 of the DQA process. For example, deviation from normality may not be seriously important for a large sample size, but could be critically important for a small sample size.

This step in the DQA process is an important check on the validity and reliability of the conclusions that are drawn. Outputs from this step include documentation of the method used to verify assumptions and verification that the test results are valid. Additionally, the reviewer should provide a description of any corrective actions that were taken.

D3.2.5 Draw Conclusions from Data

Step 5 of the DQA process represents the culmination of the planning, implementation and assessment phases of the project operations. In this step, the data analyst draws conclusions that address the project objectives. All of the analysis and review conducted in Steps 1 through 4 should ensure that the conclusions drawn in Step 5 adequately address project objectives in a scientifically defensible manner.

In Step 1, the project objectives are reviewed (or developed retrospectively) and the sampling design is evaluated. In Step 2, the implementation of the sampling scheme is reviewed and a preliminary picture of the data set is developed. In Step 3, the appropriate statistical tests are selected. Finally, the underlying assumptions of the statistical test are verified in Step 4.

Conclusions drawn in the final step of the DQA process allow the reviewer or data analyst to present valid statistical results with a specified level of significance. The confidence and power of the tests are stated, along with the study conclusions in plain English. Finally, the data analyst provides an assessment of the overall performance of the sampling design and identifies additional data that may be needed (that is, data gaps are identified).

If data were collected using a judgmental sampling design or if few samples were collected, professional judgment rather than formal statistical testing may be applied to draw conclusions. Or, statistical tests may be applied, recognizing that the results may present a biased "worst-case scenario." For example, if the data from biased samples (e.g., selective sampling of visibly stained soils) are used in a one-sample statistical test to compare concentrations against a cleanup standard or action level, and test results show that concentrations do not exceed the action level, then a conclusion can be drawn. If test results show that concentrations do exceed the action level, then, in formulating conclusions, the reviewer should balance the test results against the knowledge that the data were biased toward the sampling of "hot spots."

Table D.1 – Criteria for Partial and Full Data Validation

Analytical Group	Criteria for Partial Data Validation	Criteria for Full Data Validation
Organic Analyses	• Holding times • Calibration • Blanks • Surrogate recovery • Matrix spike and matrix spike duplicate recovery • Laboratory control sample or blank spike • Internal standard performance • Field duplicate sample analysis • Temperature • Overall assessment of SDG data	• Holding times • Gas Chromatography/Mass • Spectroscopy tuning • Calibration • Blanks • Surrogate recovery • Matrix spike and matrix spike duplicate recovery • Laboratory control sample or blank spike • Internal standard performance • Field duplicate sample analysis • Compound identification • Target compound list identification • Compound quantitation and reported detection limits • Tentatively identified compounds • System performance • Temperature • Overall assessment of SDG data
Inorganic Analyses	• Holding times • Calibration • Blanks • Matrix spike recovery • Matrix duplicate sample analysis • Laboratory control sample or blank • Field duplicate sample analysis • Temperature • ICP serial dilution • Overall assessment of SDG data	• Holding time • Calibration • Blanks • ICP interference check sample • Matrix spike recovery • Matrix duplicate sample analysis • Laboratory control sample • Field duplicate sample analysis • Graphite furnace atomic absorption QC • Sample result verification • Temperature • ICP serial dilution • Detection limits • Overall assessment of SDG data

Notes:
ICP = Inductively coupled plasma (emission spectroscopy)
SDG = Sample delivery group
QC = Quality Control

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ADEQ, 2014. Site Investigation Guidance Manual

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EPA, 2012. Guidance for Quality Assurance Project Plans (R9QA/032), March

APPENDICES

Appendix A	Arizona Administrative Code Applicable to ADHS Laboratories
Appendix B	Arizona Administrative Code for Soil Remediation Standards and Water Quality Standards
Appendix C	ADEQ Specific Quality Assurance Guidance and Policies
Appendix D	Standard Operating Procedures

Appendix A Arizona Administrative Code Applicable to ADHS Laboratories

Below is the hyperlink to the Arizona Administrative Code for Title 9 (Health Services) Chapter 14 (Department of Health Services Laboratories):

http://apps.azsos.gov/public_services/Title_09/9-14.pdf

Appendix B Arizona Administrative Code for Soil Remediation Standards and Water Quality Standards

Below is the hyperlink to the Arizona Administrative Code for Title 18 (Environmental Quality) Chapter 7 (Department of Environmental Quality Remedial Action) Article 2 (Soil Remediation Standards):

http://apps.azsos.gov/public_services/Title_18/18-07.pdf

Below is the hyperlink to the Arizona Administrative Code for Title 18 (Environmental Quality) Chapter 11 (Department of Environmental Quality Water Quality Standards):

http://apps.azsos.gov/public_services/Title_18/18-11.pdf

Appendix C ADEQ Specific Quality Assurance Guidance and Policies

ADEQ's Waste Programs Division Site Investigation Guidance is available at the following link:

http://legacy.azdeq.gov/environ/waste/download/SI_Guidance_Manual_Final.pdf

ADEQ's Soil Vapor Sampling Guidance dated May 2011 is available at the following link:

http://static.azdeq.gov/legal/subs_policy_svsg.pdf

The Arizona Department of Health Services (ADHS) issued information Update #119 (VOCs in 8260B) on May 15, 2014 and is available at the following link:

http://www.azdhs.gov/documents/preparedness/state-laboratory/lab-licensure-certification/technicalresources/information-updates/information-update-119.pdf

ADHS issued an update in November 2011 for VOCs to be added to the EPA Method TO-15 (the original list was dated July 1999). The information update is available at the following link:

http://www.azdhs.gov/documents/preparedness/state-laboratory/lab-licensure-certification/technicalresources/information-updates/2011.pdf

ADEQ Temperature/Preservation Guidance (see following pages);

Substantive Policy 0154 - Addressing Spike And Surrogate Recovery As They Relate To Matrix Effects In Water, Air, Sludge And Soil Matrices Policy; and

Substantive Policy 0170 - Implementation of EPA Method 5035 - Soil Preparation for EPA Method 8015B, 8021B and 8260B.

ADEQ Recommended Methodology for Locational Data (see following pages)

ADEQ Retention Schedule (see following pages)

Retention Work Instruction

General Records Series	General Ret Total	General Ret Remarks
Duplicates / Copies	------	Not longer than official record is kept
Working Papers/Feeder Documents	------	After final document has been created or administrative or reference value has been served, whichever is longer
Publications	1 year	After superseded or obsolete (Obtain publication number from ADEQ Communications Office)
Email/Correspondence:		
Non-Case or Project	------	After administrative or reference value has been served
Program:		
Official Record	------	Retain with, and for same period as required for, Program record series
Copies	------	Not longer than official record is kept
Databases:		
Field/Data Collection Sheets	------	After entered data is verified or after administrative or reference value has been served, whichever is later
Electronic Data	------	After superseded or obsolete or after administrative or reference value has been served, whichever is later
Legislation Records:		
Case Files for legislation proposed by agency	Permanent	Preserve pursuant to ARS §39-101
Legislation Tracking Files	1 year	After either calendar year or fiscal year passed into law or defeated
Litigation	------	No record shall be destroyed that is part of an ongoing litigation
Personnel:		
Hiring Selection Records	Not longer than 2 years 6 months	After either calendar year or fiscal year created or received
Section/Supervisor Personnel Files	between 6 months and 5 years	After either calendar year or fiscal year employee terminated or transferred
Employee Leave and Time Records	Between 1 and 3 years	After fiscal year created or received
Travel Claims	Between 1 and 3 years	After fiscal year created or received
Budget Records	Not longer than 3 years	After fiscal year covered by budget
Purchase Orders	Between 1 and 3 years	After fiscal year created or received
Contracts, ISAs, and IGAs etc.	Not Longer than 6 Years	After either calendar year or fiscal year fulfilled, cancelled or revoked

Audits	Not Longer than 7 Years	After fiscal year report completed or after reference value has been served, whichever is later
ADEQ Annual Reports	Not longer than 10 years	After either calendar year or fiscal year reported or after reference value has been served, whichever is later.
ADEQ Strategic Plans and Goal Records (including 5-year, 10-year and long range planning records)	Not longer than 5 years	After either calendar year or fiscal year created or received or after administrative value has been served, whichever is later
Transitory Materials:		
Lists, Logs, and Reading/Reference Files	------	After administrative or reference value has been served
Appointment Calendars/Planners	1 Year	After calendar year of last entry or after administrative or reference value has been served, whichever is later
Grants:		
Historically Significant	Permanent	Preserve pursuant to ARS §39-101
All Other Program Records	3 years	After fiscal year quarterly, annual or final expenditure report submitted and approved or after funding agency requirements are met, whichever is longer
Unsuccessful Grant Application Records	1 year	After rejected or withdrawn or after administrative or reference value has been served, whichever is later
Committee, Board, Commission, Council, or Task Force Records (Decision Making):		
Meeting minutes (including information needed to clarify minutes)	Permanent	Preserve pursuant to ARS §39-101
Reports/Studies resulting in no action	5 years	After either calendar year or fiscal year submitted or after administrative value has ended, whichever is later
Reports/Studies resulting in a project	------	File with project records
Everything other than meeting minutes and reports/studies	3 years	After either calendar year or fiscal year created or received
Committee or Task Force Records (Non-Decision Making):	------	After administrative or reference value has been served
Progress/ Activity/Statistical Reports (including weekly or monthly reports to supervisors and managers and status reports but not including official agency annual report)	------	After administrative or reference value has been served
Rule Making Records	1 year	After either calendar year or fiscal year rule is rejected, superseded or no longer in effect, or after administrative or reference value has been served, whichever is later
Customer Service Records (including customer surveys)	------	After administrative or reference value has been served
Maps		
With Publication Number	1 year	After superseded or obsolete (Obtain publication number from ADEQ Communications Office)
Without Publication Number	------	After administrative or reference value has been served
Federal Mandates	------	Retain for time period required by Federal Agency

Outreach Materials	------	After administrative or reference value has been served

Division *WPD* **Office** Remedial Projects Section

Records Series	*Ret Total*	*Ret Remarks*
1. Water Quality Assurance Revolving Fund Files	30	After fiscal year quarterly, annual or final expenditure report submitted and approved or after funding agency requirements are met, whichever is longer
2. Department of Defense	30	After fiscal year quarterly, annual or final expenditure report submitted and approved or after funding agency requirements are met, whichever is longer
3. National Priority List	10	After site closure
4. Potentially Responsible Party	30	After case resolved
5. Prospective Purchaser Agreement	30	After case resolved
6. Voluntary Remediation Program Site Files	30	After facility closed 40 C.F.R. 258.61(a) (2013)

ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY

DATE: January 24, 2002

ADEQ TEMPERATURE/PRESERVATION GUIDANCE POLICY

To help assure the validity and documentation of data generated for use by ADEQ, the QA Unit requires that the elements listed below be fulfilled. If the requirements listed below are not fulfilled, the data *may* be considered unacceptable for compliance or enforcement purposes.

Temperature Documentation Requirements

The documentation of the presence of "wet" ice with samples is not a substitute for measuring temperature. At a minimum, the temperature of a temperature blank must be recorded for each cooler upon sample receipt. The preferred procedure for documenting sample temperature is to record the temperature on the chain of custody.

It is, however, *recommended* that the temperature of each sample be recorded upon sample receipt. The measurement of a temperature blank is not required if each sample temperature is documented.

The sole use of "blue" ice is strongly discouraged for use by laboratories generating data that will be submitted to ADEQ. "If 'blue' ice is used, it should be frozen at the time of sampling, the sample should be chilled before packing, and special notice must be taken at sample receipt to be certain the required temperature (4C) has been maintained." ***Manual for the Certification of Laboratories Analyzing Drinking Water***, page IV-3, section 6.2. There must be documentation substantiating that the "blue" ice was frozen at the time of sampling and that the sample was chilled before packing.

The QA Unit acknowledges that all samples may not have time to equilibrate to 4±2°C due to an insufficient time between sample collection and sample submittal to the laboratory. The rejection of data in these situations will not be automatic. Each of these occurrences will be evaluated on an individual basis to determine if a good faith effort has been made to maintain the samples at the required temperatures.

Chemical Preservation Requirements

All pH adjustments performed by the laboratory must be recorded.

The pH of a sample must be recorded by the laboratory either upon receipt or before analysis, as appropriate to the specific method. Recording the pH of a sample may be documented on the chain of custody or some other appropriate form.

In lieu of a laboratory verifying that a sample has been preserved to the appropriate pH in the field, written documentation such as a laboratory copy of a sampler's field notes also provides adequate documentation of proper preservation.

Rev 20210923

ADEQ Recommended Methodology for Locational Data

Preferred
Use:
For Water Level purposes and latitude/longitude and legal description/location, property boundaries, etc. (legal purposes)
Methodology: Line Survey
Elevation accuracy 0.01 ft
Latitude and longitude: 1.00 ft

Acceptable/Adequate (no water level measurements planned)
Water Level not required and latitude/longitude (specific location needed)
Methodology: GIS Receivers, RTK GPS, High Accuracy GPS
Elevation less than 1.00 ft
Latitude and longitude less than 3.00 ft

Better than less accurate methods (Lots of older data with these methods may need to be identified for enhancements with above methods)
Water level not required and latitude and longitude needed for general location
Methodology: Autonomous GPS, GPS Post Processing, other
Elevation less than 100.00 ft
Latitude and Longitude less than 6.00 to 15.00 ft

We can and should do better than this
Ability to find property not well on property, may search for well or have residents
Grant access and identify well on property
Address
Geocoding
Digitized
Similar to ADWR Cadastral Coordinates

Preferred
For Water Level purposes and latitude/longitude and legal description/location, property boundaries, etc. (legal purposes)
Methodology: Line Survey
Elevation accuracy 0.01 ft
Latitude and longitude: 1.00 ft

Acceptable/Adequate (no water level measurements planned)
Use
Water Level not required and latitude/longitude (specific location needed)
Methodology: GIS Receivers, RTK GPS, High Accuracy GPS
Elevation less than 1.00 ft
Latitude and longitude less than 3.00 ft

Appendix D Standard Operating Procedures

This appendix contains references and web addresses for numerous standard operating procedures (SOPs) from the U.S. Environmental Protection Agency (EPA). General sampling guidelines are included in the EPA SOP on General Field Sampling Guidelines. SOPs delineate the step-by-step approach that field personnel must follow in collecting samples, taking field measurements, decontaminating equipment, handling IDW and calibrating instruments. Most qualified sampling contractors and State and Federally certified laboratories develop SOPs and analytical methods as part of their overall QA program. EPA's April 2007 Guidance for Preparation of Standard Operating Procedures for Quality-Related Operations (EPA/600/B-07/0001) is a guide for developing SOPs. The field team should document which SOPs they are using in the field and any deviations from an SOP.

EPA SOPs for field sampling methods are available for download at:

https://clu-in.org/publications/db/db_search.cgi?title=1&submit_search=1&cat=18

Field personnel will ensure that all sampling equipment has been properly assembled, decontaminated and calibrated, and is functioning properly prior to use. Equipment use and decontamination is in accordance to manufacturer's instructions and in accordance to the EPA SOP for Sampling Equipment Decontamination. The following list provides references and web addresses for a variety of SOPs provided by the EPA.

Analysis of Polynuclear Aromatic Hydrocarbons (PAHs) in Air by GC/MS **Published 03/13/2002**

Provides guidance on the requirements for the analysis of Polynuclear Aromatic Hydrocarbons (PAH) compounds in air samples using gas chromatography/mass spectrometry (GC/MS). Download (667KB/29pp/)

Analysis of Polynuclear Aromatic Hydrocarbons (PAHs) in Dust by GC/MS-SIM **Published 03/14/2005**

Outlines the preparation and analysis of polynuclear aromatic hydrocarbons (PAHs) in dust matrices using gas chromatography/mass spectrometry (GC/MS) in the select ion monitoring (SIM) mode. Download (467KB/29pp/PDF)

Data Validation Procedures for Routine Volatile Organic Analysis **Published 01/13/2004**

Outlines a protocol for evaluation and validation of the volatile organic compound data generated by the Response Engineering and Analytical Contract laboratory as well as VOC data generated by subcontracted labs. Download (1KB/53pp/PDF)

Description and Identification of Soils

Published 06/11/2020

Outlines a consistent method for describing oils that are to be sampled and analyzed in the course of a site investigation. Soil descriptions and identifications provide key information when investigating RPS sites.
https://www.epa.gov/sites/default/files/2015-06/documents/Soil-Sampling.pdf

Determination of Granular Soil Permeability (Constant Head)

Published 06/27/2003

Outlines the procedure for the determination of the coefficient of permeability by a constant-head method for granular soils. Download (572KB/14pp/PDF)

Drum Sampling

Published 11/16/1994

Provides technical guidance on implementing safe and cost-effective response actions at hazardous waste sites containing drums with unknown contents. Download (806KB/32pp/PDF)

Field Analysis of Volatile Organic Compounds in Tedlar Bag AIR Samples by GC/MS (Triad GC/MS - Based on EPA TO-15A)

Published 01/19/2006

Describes the field gas GC/MS analysis of air sample collected in Tedlar bags. This procedure generates field screening data in ppbv and is based on EPA Compendium Method TO-15. Download (360KB/17pp/PDF)

GC/MS Analysis of Sorbent Tubes and Canisters (EPA TO-15 and TO-17)

Published 03/24/2006

Outlines the steps for the analysis of air samples collected on either sorbent tubes or in SUMMA® canisters by Gas Chromatography/Mass Spectrometry (GC/MS). Download (2KB/34pp/PDF)

General Air Sampling Guidelines

Published 03/30/2016

Provides guidance in developing and implementing sampling plans to assess the impact of hazardous waste sites on ambient air.
https://www.epa.gov/sites/default/files/2016-04/documents/ambient_air_sampling303_af.r5.pdf

Groundwater Well Sampling

Published 04/26/2017

Provides general information on sampling groundwater wells and ensures that the sample is representative of the particular groundwater zone being sampled

https://www.epa.gov/sites/default/files/2017-07/documents/groundwater_sampling301_af.r4.pdf

Handling Potentially High Hazard Environmental Samples

Published 10/24/1994

Describes safe lab practices for the preparation and analysis of samples which may contain unknown concentrations of hazardous materials. It will focus on the practices for a mobile High Hazard lab. Download (271KB/11pp/PDF)

Indoor Air Analysis of Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry

Published 06/03/2002

Provides guidance on the requirements needed to analyze Volatile Organic Compounds (VOCs) in air samples using gas chromatography/mass spectrometry (GC/MS). Download (606KB/25pp/PDF)

Investigation-Derived Waste Management

Published 05/08/2020

IDW includes soil cuttings, drilling muds, purged groundwater, decontamination fluids (water and other fluids), disposable sampling equipment, and disposable personal protective equipment (PPE).
https://www.epa.gov/sites/default/files/2015-06/documents/Management-of-IDW.pdf

Manual Water Level Measurements

Published 12/10/2002

Provides guidelines for the determination of the depth to water measurements in an open borehole, a cased borehole, a monitor well, or a piezometer. Download (106KB/8pp/PDF)

Mobile Laboratory VOC GC/MS Analysis of WTC Tedlar Bag Air Samples

Published 11/19/2001

Describes the Gas Chromatography/Mass Spectrometry (GC/MS) analysis of air samples collected using Tedlar bags. The methods are applicable to the analysis of Volatile Organic Compounds (VOCs). Download (333KB/13pp/PDF)

Monitor Well Development

Published 09/06/2001

Provides guidance on the development of groundwater monitor wells to ensure removal of fine-grained sediments (fines) from the vicinity of the well screen. The most common well development methods are: surging, jetting, over pumping, and bailing. Download (214KB/7pp/PDF)

Monitor Well Installation

Published 01/16/2018

Methods used for the installation of the wells. Monitor well installation creates a permanent access for the collection of samples to assess groundwater quality and the hydrogeologic properties of the aquifer, in which contaminants may exist.

https://www.epa.gov/sites/default/files/2016-01/documents/design_and_installation_of_monitoring_wells.pdf

Operation of the Hapsite Field Portable Gas Chromatograph/Mass Spectrometer (GC/MS) (Triad GC/MS - Based on EPA/TO-15A)

Published 01/26/2006

Describes the operation of the Inficon HAPSITE field-portable gas chromatograph/mass spectrometer (GC/MS). Download (1KB/47pp/PDF)

Procedures for Automated Summa Canister Cleaning

Published 12/31/2008

Intended for use when cleaning polished stainless-steel SUMMA type or glass-lined Silco type canisters. Download (497KB/14pp/PDF)

Processing Air Samples with the Portable Sample Concentrator

Published 12/22/1994

Defines the means of processing air samples with a portable sample concentrator. The sample concentrator is a field portable sorption tube concentration device used to concentrate dilute air samples prior to chromatographic analysis. Download (277KB/13pp/PDF)

Quality Assurance/Quality Control Samples

Published 08/11/1994

Describes typical Quality Assurance/Quality Control (QA/QC) samples that are collected in the field, or prepared for or by the laboratory. The QA/QC samples identified in this SOP are representative for soil, water and air matrices. Download (198KB/12pp/PDF)

Retrieving Meteorological Information

Published 12/04/1994

Defines the protocol for retrieving meteorological information to be used as inputs to categorize on-site field conditions in 'real-time.' Download (64KB/5pp/PDF)

Routine Analysis of Semivolatiles in Soil/Sediment by GC/MS (EPA/SW-846 -846 Methods 3600C/3640A - Optional)

Published 01/03/2006

Outlines the preparation and analysis of base/neutral/acid extractable (BNA) compounds in soil/sediment matrices using a gas chromatograph/mass spectrometer (GC/MS). Download (574KB/34pp/PDF)

3500B/3510C/8000B/8270C)

Published 01/23/2006

Outlines the preparation and analysis of base/neutral/acid (BNA) compounds in water matrices using a gas chromatograph/mass spectrometer (GC/MS). Download (671KB/32pp/PDF)

Routine Analysis of Semivolatiles in Water by GC/MS (EPA/SW-846 Methods

Sample Documentation

Published 09/14/2002

Defines the procedures for preparing and maintaining documentation which provides the details of field sampling activities.
Download (596KB/19pp/PDF)

Sampling Equipment Decontamination

Published 06/22/2020

Provides a description of the methods used for preventing, minimizing, or limiting cross-contamination of samples due to inappropriate or inadequate equipment decontamination.

https://www.epa.gov/sites/default/files/2016-01/documents/field_equipment_cleaning_and_decontamination205_af.r3.pdf

Sample Storage, Preservation and Handling

Published 08/11/1994

Provides general guidelines for the storage and preservation of water and soil/sediment samples. Download (214KB/7pp/PDF)

Sample Packing and Shipment

Published 08/23/2020

Summarizes requirements for the packaging, marking/labeling, and shipping of environmental and hazardous mat samples.

https://www.epa.gov/sites/default/files/2015-06/documents/Shipping-Environmental-and-Waste-Samples.pdf

The following list provides references and web addresses for a variety of SOPs provided by ASTM:

ASTM D 5088- 02(2008) Standards Practice for Decontamination of Field Equipment Used at Waste Sites

ASTM D 5679-95a. 1995. Standard Practice for Sampling Consolidated Solids in Drums or Similar Containers

ASTM D 5680-95a. 1995. Standard Practice for Sampling Unconsolidated Solids in Drums or Similar Containers.

ASTM D 5743-97. 1997. Standard Practice for Sampling Single or Multilayered Liquids, With or Without Solids, in Drums or Similar Containers

ASTM D 6063-96. 1996. Standard Guide for Sampling of Drums and Similar Containers by Field Personnel

ASTM D6232 - 2008 Standard Guide for Selection of Sampling Equipment for Waste and Contaminated Media Data Collection Activities