ANNUAL GROUNDWATER MONITORING AND CORRECTIVE ACTION REPORT FOR 2017
Coal Combustion Residual Rule Groundwater Monitoring System Compliance
Four Corners Power Plant
Fruitland, New Mexico

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LIST OF ACRONYMS AND ABBREVIATIONS

§	Section
Amec Foster Wheeler	Amec Foster Wheeler, Environment & Infrastructure, Inc.
AMSL	above mean sea level
APS	Arizona Public Service
CCR	coal combustion residuals
CFR	Code of Federal Regulations
CSM	Conceptual Site Model
CWTP	Combined Waste Treatment Pond
DFADA	Dry Fly Ash Disposal Area
EDA	exploratory data analysis
FCPP	Four Corners Power Plant
ft	foot, feet
GWPS	groundwater protection standard
LAI	Lined Ash Impoundment
LDWP	Lined Decant Water Pond
MCL	Maximum Contaminant Level
Multiunit 1	CCR multiunit comprised of the LAI and LDWP
SAP	Sampling and Analysis Plan
SSI	statistically significant increase
SSL	statistically significant level
URS	Upper Retention Sump
USEPA	United States Environmental Protection Agency

1.0 INTRODUCTION

This Annual Groundwater Monitoring and Corrective Action Report for 2017 (Annual Report) was prepared on behalf of Arizona Public Service (APS) by Amec Foster Wheeler Environment & Infrastructure, Inc. (Amec Foster Wheeler) for the Four Corners Power Plant (FCPP) located in Fruitland, New Mexico. The Annual Report summarizes groundwater monitoring and corrective action data collected to support compliance with coal combustion residuals (CCR) groundwater monitoring requirements detailed in 40 Code of Federal Regulations (CFR) Sections (§) 257.90 through 257.98 (herein referred to as the CCR Rule) (Federal Register, 2015).

The CCR Rule became effective on October 19, 2015 and established standards for the disposal of CCR in landfills and surface impoundments (CCR units). In particular, the rule set forth groundwater monitoring and corrective action requirements for CCR units. The rule includes the requirement for an “annual groundwater monitoring and corrective action report” to be prepared by January 31 for the preceding calendar year. The annual report is intended to document the status of the groundwater monitoring and corrective action program for each CCR unit, summarize key actions completed, and forecast key activities for the upcoming year.

This is the first Annual Report prepared for the site and addresses calendar year 2017 (the reporting period); applicable information collected prior to 2017 in support of site CCR groundwater monitoring program compliance is also included.

The remainder of this section (Section 1.0) provides a summary description of the power generating facility, the CCR units present at the facility, and the facility’s environmental setting which forms the basis for assessment of underlying groundwater conditions. Sections 2.0 and 3.0 present groundwater monitoring and corrective action activities performed during the reporting period, respectively. Key activities identified for the upcoming year are presented in Section 4.0. Section 5.0 presents report references.

1.1 Site Background

1.1.1 Facility and CCR Unit Description

Facility Description. FCPP is an operating power plant owned by APS and four other utilities. The plant burns low sulfur coal in two electrical generating units (Units 4 and 5) and has a net generating capacity of 1,540 megawatts. FCPP formerly had five generating units and a capacity of 2,040 megawatts; Units 1, 2, and 3 were retired in December 2013 and decommissioned between 2014 and 2016. Coal burned at the plant is generally sourced from the nearby Navajo Mine (Navajo Transitional Energy Company, 2016).

Facility Location. The plant and associated infrastructure are located approximately 20 miles southwest of the city of Farmington, in the Colorado Plateau physiographic province of northwestern New Mexico (Figure 1-1). The land on which the plant resides is leased from the Navajo Nation and is primarily located in Section 36, Township 29 North, and Range 16 West.

CCR Unit Description. Plant infrastructure includes three single CCR units and one CCR multiunit (referred to as Multiunit 1) which are located in the main plant area and to the west of the plant within the FCPP lease boundary (also known as the disposal area), respectively (Figure 1-2). Table 1-1 summarizes the location, function, operation, size/construction, and history of each unit. The boundaries of CCR units depicted in Figure 1-2 are based on available historical plans for the units.

1.1.2 Environmental Setting

Climate. The plant is located in a semi-arid climate on the western flank of the San Juan Basin. The area receives an average of 8.6 inches of precipitation and 12.6 inches of snow per year.

Topography. The main plant area of the FCPP is located at an elevation of approximately 5,340 to 5,360 feet (ft) above mean sea level (AMSL). The topography of the FCPP area is characterized by rolling terrain, steep escarpments, and incised drainages/arroyos. In the vicinity of the plant, the ground surface is relatively flat, sloping to the west at approximately 20 ft per mile; however, surface drainage immediately near Morgan Lake flows towards the lake. About one mile west of the plant, the level ground surface drops rapidly to 5,200 ft AMSL. Chaco Wash (a.k.a. Chaco River) is located west of this abrupt change in elevation and ephemerally flows north to the San Juan River.

Surface Water Hydrology. FCPP is situated on the southern bank of Morgan Lake, an approximately 1,300-acre man-made lake that has a maximum storage capacity of 39,000 acre-ft of water and supplies cooling water to the plant. Morgan Lake was formed by damming a westerly flowing stream (now known as ‘No Name Wash’) and is replenished by an underground pipeline (i.e., aqueduct) that routes flow from the San Juan River located approximately 3 miles north of the FCPP. The typical water surface elevation of the lake is 5,330 ft AMSL. Morgan Dam discharges to ‘No Name Wash’ which flows west of the lake to Chaco Wash.

Site Geology. The San Juan Basin is a structural depression that lies at the eastern edge of the Colorado Plateau (Dames & Moore, 1988). The dominant geographic feature in the vicinity of FCPP is the Hogback Monocline located to the west of the plant; this monocline is a steep (38 degree) eastward-dipping flank composed of Cretaceous sedimentary rock (Dames & Moore, 1988).

There are two ‘uppermost geologic units’ that underlie the FCPP site and immediate vicinity. These units are expected to influence groundwater flow and variations in naturally occurring constituent concentrations across the site. The units are as follows:

- Pictured Cliffs Sandstone: The Pictured Cliffs Sandstone is the uppermost geologic unit beneath the plant and the CCR units located in this vicinity (i.e., the Upper Retention Sump [URS] and the Combined Waste Treatment Pond [CWTP] as depicted in Figure 1-2). This unit is a fine- to medium-grained marine sandstone. The lower portions of the Pictured Cliffs Sandstone represent a transitional sequence between this formation and the underlying Lewis Shale as indicated by alternating thin beds of very fine-grained sandstone and silty shale. The Pictured Cliffs Sandstone forms a capstone on an exposed cliff face located between the plant site and the CCR units located to the west (i.e., the

Lined Ash Impoundment [LAI], Lined Decant Water Pond [LDWP] and the Dry Fly Ash Disposal Area [DFADA]).

- Lewis Shale: The Lewis Shale is a marine shale that contains evaporite deposits resulting in naturally occurring saline groundwater conditions. The Lewis Shale is the uppermost geologic unit that underlies the LAI, LDWP, and DFADA and spans west of the Pictured Cliffs Sandstone cliff face approximately 1.5 miles westward to the base of the Hogback Monocline. The regional thickness of the Lewis Shale is approximately 500 ft and is underlain by Cliff House Sandstone. The Lewis Shale consists of a weathered shale subunit overlying a hard, unweathered shale subunit. The thickness of the weathered shale varies between 11 and 47 ft with an average thickness of 30 ft within the vicinity of the site (Dames & Moore, 1988). The weathered shale is not as thick when overlain by Pictured Cliffs Sandstone in the vicinity of the plant site. This subunit contains thin sandstone lenses that vary in thickness from 1 to 7 ft; the sandstone is fine to very fine-grained and cemented by calcium carbonate (Dames & Moore, 1988). The unweathered shale is significantly less permeable than the weathered shale. The unweathered shale is very fine-grained to silty, and contains periodic siltstone and sandstone lenses (Dames & Moore, 1988). The surface of the unweathered shale slopes towards the Chaco Wash at approximately the same slope as land surface (Dames & Moore, 1988) but displays some irregularity resulting in varying levels of saturated thickness in the weathered shale. The Lewis Shale is variably saturated and hydraulically interconnected with alluvial deposits of Chaco Wash. The low-permeability unweathered shale underlying the Pictured Cliffs Sandstone results in a perched saturated zone beneath the plant.

Applicable Hydrostratigraphy. Three general hydrostratigraphic units are conceptualized beneath the FCPP and associated CCR units. These units form the basis for the CSM developed by AECOM (2017) for the purpose of designing the site CCR groundwater monitoring system and establish the working basis for statistically evaluating groundwater conditions underlying the site.

The first hydrostratigraphic unit (Pictured Cliffs Sandstone) is dominant only under the plant area, which is located in an elevated area south of Morgan Lake (Figure 1-2). Two CCR units (i.e., the URS and CWTP) reside within this area. The Pictured Cliffs Sandstone is the uppermost water bearing unit for the plant area and extends from ground surface (between approximately 5,340 to 5,360 ft AMSL) to approximately 5,300 ft AMSL in the plant area. Groundwater in this area is strongly influenced by Morgan Lake (at a surface elevation of approximately 5,330 ft AMSL) and generally flows northward towards the lake. However, construction and operations of the plant have resulted in disturbed ground conditions and associated impacts are not well understood.

The second hydrostratigraphic unit (Weathered Lewis Shale/Alluvium) underlies the Pictured Cliffs Sandstone in the plant area and the Multiunit 1/DFADA CCR units in the disposal area, approximately 1 mile west of the plant (Figure 1-2). The Weathered Lewis Shale and the hydraulically connected alluvial deposits along Chaco Wash are designated as the uppermost water bearing unit in the disposal area. Although the Lewis Shale is geologically continuous in this area, it is unsaturated in the vicinity of the DFADA. The water table in the Weathered Lewis Shale can exhibit local seasonal fluctuations that are attributed to interactions between rates of groundwater recharge and discharge (Dames & Moore, 1988) from/to Morgan Lake, historical unlined ponds, and Chaco Wash. Groundwater flow generally follows the surface topography and descends to the west-southwest in the disposal area, mainly in the weathered shale and in local alluvial channels that drain toward the Chaco Wash (APS, 2013).

The third hydrostratigraphic unit (Unweathered Lewis Shale) consists of the Unweathered Lewis Shale and is a regionally extensive confining unit that forms the base of the uppermost aquifers in the plant and disposal areas.

1.2 CCR Groundwater Monitoring System

Multiple monitoring wells are in place at FCPP to monitor groundwater conditions beneath the four site CCR units and support ongoing assessment of impacts from potential leakage. Table 1-2 identifies each well with associated CCR unit information, the date of well installation, and summary well construction details. Figure 1-2 presents a map with well locations.

Installation of the FCPP CCR groundwater monitoring system is summarized in the *CCR Monitoring Well Network Report and Certification* and is identified as compliant with 40 CFR §257.91(a) through (e) (AECOM, 2017). Per the CCR Rule, site monitoring systems are required to evaluate groundwater quality that is representative of background (i.e., groundwater that has not been affected by leakage from a CCR unit) and groundwater passing the downgradient boundary of each CCR unit, in the uppermost water bearing hydrostratigraphic unit underlying the CCR unit.

1.2.1 Monitoring System Description

Background Groundwater Monitoring Wells. Background water quality at the site can be established by a single monitoring well or a group of monitoring wells. If a group of monitoring wells is used, these wells should be screened within the same lithologic unit, exhibit similar groundwater chemistry, illustrate similar statistical merits, and be supported by the Conceptual Site Model (CSM). The grouping and adequacy of background wells identified for FCPP to assess background water quality are assumed adequate until proven otherwise.

Per the *CCR Monitoring Well Network Report and Certification*, the following monitoring wells are designated as “background monitoring wells” for the respective geologic and hydrostratigraphic conditions underlying the FCPP (AECOM, 2017):

- Background Wells for the Pictured Cliffs Sandstone: Three wells (MW-71, MW-72, and MW-73) were installed to assess background groundwater quality for both the URS and the CWTP overlying the Pictured Cliffs Sandstone.
- Background Wells for the Weathered Lewis Shale/Alluvium: Seven wells upgradient of Multiunit 1 and the DFADA, including MW-12R, MW-49A, MW-51, MW-50A, MW 43, MW-55R and MW-74, are designated to assess background groundwater quality for the Weathered Lewis Shale/Alluvium. Many of these wells are routinely either dry or have a limited saturated thickness which precludes sampling; the wells are included in the program in case conditions change in the future.

Due to the natural heterogeneity of the geologic and hydrostratigraphic conditions underlying the FCPP, background constituent concentrations are expected to be spatially heterogeneic across the site. The site is also expected to exhibit temporal heterogeneity due to local climatic regimes, potential leakage from Morgan Lake, and potential operational activity at the site. The adequacy of designated background monitoring wells will be assessed on an ongoing basis using groundwater elevation data, boron data, a working understanding of the spatial heterogeneity of geochemistry underlying the FCPP, and the statistical merits of the constituents of concern. Historic groundwater chemistry data may be consulted during this evaluation but data preceding December 2011 will not be considered due to noted “matrix interference issues associated with saline waters” in samples analyzed prior to this date (APS, 2013).

Downgradient Monitoring Well Networks. A total of 18 downgradient wells are in place at the site to monitor the downgradient groundwater conditions of each CCR unit (Table 1-2; Figure 1-2). Nine of these monitoring wells are installed in the Pictured Cliffs Sandstone. The remaining nine other wells are completed in the Weathered Lewis Shale/Alluvium. The grouping of monitoring wells, spatial density, and coverage of the monitoring well network are assumed representative and adequate until proven otherwise. These wells are identified by respective CCR unit, as described below:

- URS Downgradient Wells (Pictured Cliffs Sandstone): The groundwater flow direction underlying the URS is radially outward from the CCR unit. On this basis, five wells, MW-66, MW-67, MW-68, MW-69, and MW-70 were installed around the perimeter of the URS. Each of these wells are screened within the Pictured Cliffs Sandstone.
- CWTP Downgradient Wells (Pictured Cliffs Sandstone): Similar to the URS, the groundwater flow direction underlying the CWTP is radially outward from the CCR unit. Four monitoring wells, including MW-62, MW-63, MW-64, and MW-65, were installed around the perimeter of the CWTP. Each of these wells are screened within the Pictured Cliffs Sandstone.
- Multiunit 1 Downgradient Wells (Weathered Lewis Shale/Alluvium): Six downgradient monitoring wells are in place below the toe of the western to southwestern edge of Multiunit 1: MW-7, MW 8, MW-40R, MW-61, MW-75 and MW-76. Two wells, MW-40R and MW-76, are routinely either dry or have a limited saturated thickness which precludes sampling; the wells are included in the program in case conditions change in the future. The screened interval for each well resides within the Weathered Lewis Shale/Alluvium.
- DFADA Downgradient Wells (Weathered Lewis Shale/Alluvium): Four existing wells are identified downgradient of the DFADA: MW-13, MW-44, MW-10 and MW-48. Each well, except MW 48, is screened within the Weathered Lewis Shale/Alluvium. The screened interval for MW-48 resides within the Unweathered Lewis Shale. The downgradient DFADA wells are known to be dry; this groundwater monitoring system was designed to detect releases since the next underlying aquifer (in the Cliff House Sandstone) is separated from the CCR unit by several hundred feet of Lewis Shale, a regional aquitard.

Supplementary Site Monitoring Wells. There are many groundwater monitoring wells at the site that are not part of the CCR groundwater monitoring system but may provide useful information to the program. Figure 1-2 identifies these wells. MW-54 is completed within Multiunit 1 and MW-

60 is not considered downgradient of Multiunit 1; however, elevations in these wells may be monitored periodically to evaluate the direction of groundwater flow in the disposal area. LS-1 and LS-2 are completed in the Unweathered Lewis Shale.

1.2.2 Implemented Changes to Monitoring System

Most of the wells that comprise the site CCR groundwater monitoring system were installed prior to 2017 (Table 1-2). During the reporting period, four new wells (MW-73, MW-74, MW-75, and MW-76; Figure 1-2) were installed to supplement existing background wells and groundwater monitoring downgradient of Multiunit 1. Well installation is documented in Appendix A of the *CCR Monitoring Well Network Report and Certification* (AECOM, 2017). Section 2.1.2 presents additional discussion regarding the rationale for the installation of these new wells.

There were no CCR groundwater monitoring system wells that were decommissioned during the reporting period.

2.0 GROUNDWATER MONITORING PROGRAM

The groundwater monitoring and corrective action process defined in the CCR Rule includes a phased approach to groundwater monitoring, leading (if applicable) to the establishment of groundwater protection standards (GWPSs) for each CCR unit. Exceedances of the GWPSs that are determined to be statistically significant can trigger requirements for additional groundwater characterization and corrective action assessment followed by implementation.

The first phase of groundwater monitoring is the detection monitoring phase. This phase focuses on a set of constituents (listed in Appendix III of the CCR rule) that are the more mobile components of CCR and therefore represent indicators of possible impacts from CCR in groundwater. If statistically significant increases (SSIs) of any of the Appendix III constituents relative to background conditions are detected in the downgradient waste boundary wells, and cannot be demonstrated to be associated with a source other than the CCR unit, then groundwater monitoring moves into the second phase, assessment monitoring.

The second phase of groundwater monitoring focuses on the constituents listed in Appendix IV of the CCR Rule. The Appendix IV constituents generally are less mobile and occur at lower concentrations in groundwater than the Appendix III constituents. Concentrations of Appendix IV constituents in downgradient wells are compared to GWPSs. The GWPSs, established for Appendix IV constituents only, are the higher of either the federal Safe Drinking Water Act Maximum Contaminant Level (MCL) or the background concentration for each constituent.

If exceedances of the GWPSs are determined to be occurring in the downgradient boundary wells at statistically significant levels (SSLs), and no alternative sources for the exceedances can be demonstrated, then both additional groundwater characterization and assessment of corrective actions are initiated. Following assessment of corrective measures, a remedy (or set of remedial activities) is selected and implemented as the groundwater corrective action program for the CCR unit. According to the CCR Rule, groundwater corrective action will continue until compliance with the GWPSs has been attained in all impacted wells, and sustained for a period of three consecutive years.

2.1 Program Status

2.1.1 Summary of Key Actions Completed

As indicated in Section 1.0, this report serves as the first annual report prepared for the site CCR groundwater monitoring program. As such, some compliance activities began prior to the reporting period. A summary of key actions conducted at the site through the end of 2017 to address CCR Rule requirements is as follows:

- Groundwater Monitoring Well Installation – 40 CFR §257.90(b)(i) requires installation of the site groundwater monitoring system no later than October 17, 2017. Based on an evaluation of monitoring system requirements and a review of existing groundwater monitoring wells at the site for applicability to the program, 18 new CCR monitoring wells were installed from September 2015 through March 2017 (Table 1-2). Installation of these wells is documented in Appendix A of the *CCR Monitoring Well Network Report and Certification* (AECOM, 2017). This report was issued on September 18, 2017 and includes an engineering certification that the groundwater monitoring network complies with the CCR groundwater monitoring system requirements identified in 40 CFR §257.91(a) through (e).
- Development of the Groundwater Sampling and Analysis Program – 40 CFR §257.90(b)(ii) requires development of the site groundwater sampling and analysis program to include selection of the statistical procedures to be used for evaluating groundwater monitoring data no later than October 17, 2017. The statistical procedures that will be used to evaluate CCR detection monitoring data collected at the site are documented in the *Statistical Data Analysis Work Plan* (Amec Foster Wheeler, 2017). This report was issued on October 13, 2017 and includes an engineering certification that the statistical methods described in the document comply with the statistical analysis requirements identified in 40 CFR §257.93.
- Initiation of the Detection Monitoring Program – 40 CFR §257.90(b)(iii) requires the initiation of a detection monitoring program (including the collection of a minimum of eight independent samples from each background and downgradient well evaluating existing CCR units) by October 17, 2017. Section 2.2 presents the results of detection monitoring efforts completed by October 17, 2017 to address this requirement as well as documentation of the first detection monitoring event not associated with the eight initial independent samples evaluating existing CCR units (conducted in November 2017).
- Initiation of Statistical Analyses for Appendix III Constituents – 40 CFR §257.90(b)(iv) requires owners/operators of existing CCR units to begin evaluating groundwater monitoring data for SSIs over background levels for Appendix III constituents by October 17, 2017. As discussed in Section 2.3, collection of the eight initial rounds of Appendix III constituent data from applicable background and downgradient wells was complete by October 11, 2017 and statistical analysis of collected data began thereafter.

2.1.2 Problems Encountered and Resolutions to Problems

CCR groundwater monitoring began at FCPP on November 4, 2015 after a preliminary groundwater monitoring system was identified for site CCR units. Based on evaluation of data collected in 2015 and 2016, the following potential limitations of the preliminary CCR groundwater monitoring system were identified:

- Inadequate Background Data for the Pictured Cliffs Sandstone – MW-71 and MW-72 were installed to evaluate background water quality for downgradient wells completed in the Pictured Cliffs Sandstone. However, groundwater elevation data collected from these wells suggested that the wells may be influenced by mounding under the URS which could impact whether the wells are representative of background.
- Inadequate Background Data for the Weathered Lewis Shale/Alluvium – Although six wells were initially identified to evaluate background water quality for downgradient wells completed in the Weathered Lewis Shale/Alluvium, two of these wells could be potentially impacted by water from Multiunit 1 or the DFADA (MW-49A and MW-12R, respectively) based on their spatial proximity to the units (AECOM, 2017) and four wells (MW-43, MW-50A, MW-51, and MW-55R) are routinely dry or have a limited saturated thickness which precluded sampling.
- Inadequate Downgradient Data for Multiunit 1 – MW-7, MW-8, MW-40R, and MW-61 were initially identified as downgradient monitoring wells for Multiunit 1. However, MW-7 and MW-61 were the only wells from which samples could be reliably collected in 2015 and 2016; MW-8 and MW-40R were at various times either dry or had limited saturated thickness which precluded sampling.

To address these potential limitations, new wells MW-73 (background Pictured Cliffs Sandstone well), MW-74 (background Weathered Lewis Shale/Alluvium well), MW-75 (Multiunit 1 downgradient well), and MW-76 (Multiunit 1 downgradient well) were installed from January 18, 2017 through March 16, 2017. To promote statistical analysis of sample data collected during the initial eight rounds of sampling background and downgradient wells, wells that were sampled prior to these well installation activities were resampled concurrent with the wells installed in 2017 until all wells had been sampled a minimum of eight times.

2.1.3 Groundwater Monitoring Program Transitions

All CCR units were in detection monitoring throughout the reporting period.

2.1.4 Alternate Source Demonstrations

There were no alternate source demonstrations performed during the reporting period.

2.2 Monitoring Data Collected

Appendix A presents the site Sampling and Analysis Plan (SAP) used during the CCR groundwater monitoring program. The SAP documents the methods and procedures used to conduct groundwater sampling, analyze collected samples for CCR constituents and assess associated analytical data for quality assurance purposes. The SAP was prepared in 2015 and has been revised to reflect the updated groundwater monitoring system completed in 2017.

2.2.1 Water Level Monitoring

APS conducted depth to groundwater monitoring during each sampling event in accordance with the SAP. Appendix B presents associated data and hydrographs depicting collected groundwater elevations over time. Groundwater elevations in the Pictured Cliffs Sandstone (i.e., plant area) and Weathered Lewis Shale/Alluvium (i.e., disposal area) are graphed independently based on assessment of the data during initial CSM development; review of the data suggests that the two groundwater systems are likely not in direct communication. As shown in monitoring well hydrographs, groundwater elevations were relatively stable over the period monitored with the following exceptions:

- MW-7: There was a marked increasing trend in water levels noted at this well after the October 2016 monitoring round; levels stabilized in 2017 approximately 7 ft higher than those observed in early 2016.
- MW-8: Groundwater elevations at this well were more variable over the period of monitoring than other wells in the vicinity. The range of variation was approximately 3 ft.
- MW-49A: Groundwater elevations abruptly increased by approximately 10 ft between late 2015 and April 2016. It is possible that the well is slow to recover and redevelopment of the well prior to the initiation of CCR groundwater monitoring may have contributed to observed changes in groundwater elevations at this well.
- MW-66, MW-67, MW-68, MW-69 and MW-70 (the downgradient URS wells): Variable water levels in the URS likely contributed to the fluctuations in groundwater elevations (of up to 3 ft) noted in these wells.
- MW-73: There was about a 1.5 ft decline in the groundwater elevation observed at this new well installed near Morgan Lake in early 2017 (Figure 1-2). The lowest elevation (5,328.2 ft AMSL) was observed in August 2017.
- MW-74: The water level at this well located downstream of Morgan Lake declined by 3 ft from January 2017 to August 2017.

The significance of these exceptions will be evaluated as additional data are collected.

Figures 2-1 through 2-8 present quarterly potentiometric surface maps that are representative of conditions at the time of groundwater sampling based on hydrograph data. The estimated direction and gradient of groundwater flow derived from collected groundwater elevation data are noted in these figures. As indicated, groundwater appears to flow towards Morgan Lake in the plant area and towards Chaco Wash in the disposal area. Groundwater appears to mound under the URS.

2.2.2 Sample Collection

APS collected, labeled, preserved, and shipped groundwater samples in general accordance with the SAP. The primary deviation from the SAP was that low-flow sampling (with an associated groundwater purge prior to sample collection) was only utilized when sufficient water was available for sampling. Table 2-1 identifies which wells were sampled using this collection method. In some instances, the wells were either pumped dry during sampling or had limited groundwater and a sample could not be collected. Collected groundwater samples were not field filtered prior to analysis.

Table 2-1 summarizes the number of groundwater samples that were collected for analysis from each background and downgradient well, the dates the samples were collected, and whether the sample was required by the detection monitoring or assessment monitoring programs. Quality control samples (i.e., field duplicates, field blanks and extra sample volume for matrix spike samples) were collected during each groundwater monitoring event; however, the numbers of samples presented in Table 2-1 do not identify or reflect these supplemental samples.

2.2.3 Sample Analysis and Data Validation

APS submitted groundwater samples to TestAmerica Laboratories, Inc. (TestAmerica) located in Phoenix, Arizona. TestAmerica is an Arizona Department of Health Services-licensed laboratory (AZ0728). Appendix C presents the associated Laboratory Reports of Analysis. Samples collected from November 2015 through October 2017 (Table 2-1) were evaluated for both Appendix III and Appendix IV constituents in accordance with 40 CFR §257.94(b). The samples collected in November 2017 correspond to the first semiannual detection monitoring round for the site and were evaluated for Appendix III constituents only. The SAP identifies these constituents and associated analytical methods.

Following receipt of final laboratory reports of analysis, the reports and associated sample data were evaluated for quality assurance purposes. The scope of the review was a United States Environmental Protection Agency (USEPA) Stage 2A validation. Appendix C presents Data Validation Reports for each monitoring event that document these reviews.

2.2.4 Sample Results

Appendix C presents sample results in the Laboratory Reports of Analysis. The sampling coverage and frequency of the groundwater monitoring system is assumed representative and adequate of spatial and temporal heterogeneity until proven otherwise.

2.3 Statistical Analysis of Monitoring Data

During the reporting period, exploratory data analysis (EDA) of Appendix III constituent data collected during the initial eight rounds of detection monitoring was performed in accordance with the site *Statistical Data Analysis Work Plan* (Amec Foster Wheeler, 2017). This analysis was ongoing as of December 31, 2017.

3.0 CORRECTIVE ACTION PROGRAM

No corrective action activities occurred during the reporting period.

4.0 KEY ACTIVITIES FOR UPCOMING YEAR

During 2018, the following key activities will likely be conducted to support CCR groundwater monitoring compliance at the site:

- Completion of Statistical Analyses for Appendix III Constituents – Per 40 CFR §257.93(h)(2), within 90 days of completing sampling and analysis of the eight initial rounds of detection monitoring in background and downgradient wells, a statistical analysis of collected Appendix III data must determine whether there has been a SSI over background for any constituent at each monitoring well.
- Continued Detection Monitoring for Site CCR Units – Per 40 CFR §257.94(b), detection monitoring (including analysis of collected samples for Appendix III constituents) shall be conducted on a semiannual basis during the active life of the CCR unit.
- Initiation of Assessment Monitoring for CCR Units with an SSI over Background (as applicable) – Per 40 CFR §257.94(e)(1), within 90 days of detecting an SSI over background levels for any Appendix III constituent, an assessment monitoring program must be established.
- Completion of Statistical Analyses for Appendix IV Constituents (as applicable) – Per 40 CFR §257.93(h)(2), within 90 days of completing sampling and analysis of any CCR units in assessment monitoring, a statistical analysis of collected Appendix III data must determine whether there has been a SSI over background for any constituent at each monitoring well.
- Preparation of an Annual Groundwater Monitoring and Corrective Action Report – Per 40 CFR §257.90(e), an annual report must be prepared no later than January 31 of the year following the calendar year documented in the report.

Since the CCR Rule is implemented in phases based on analysis of data collected during the groundwater monitoring program, the foregoing list only includes reasonably probable activities that will occur in 2018; this list is not comprehensive.

5.0 REFERENCES

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TABLES

Table 1-1
Description of Coal Combustion Residual Units
Four Corners Power Plant
Fruitland, New Mexico

CCR Unit	Location	Function	Operation	Size/Construction	History
Upper Retention Sump (URS)	*Plant Area* NW1/4 of Section 36, T29N, R16W	*Single CCR unit*. Impoundment. Surge pond for FGD system.	FGD system discharge is discharged into the sump via 10 plus controlled/monitored lines. Pond contents are recirculated back into the FGD process via a pump chamber located on the south end of the pond. Solids are periodically removed from the sump.	- 1.07 acres in areal extent - Soil-cement liner on bottom and inside slopes	Placed in service around 1983.
Combined Waste Treatment Pond (CWTP)	*East of Plant, Adjacent to Morgan Lake* SE1/4 of Section 25, T29N, R16W	*Single CCR Unit*. Impoundment. Detention pond used as a settling and stabilization basin for ash-impacted and other Plant wastewater flows prior to discharge to Morgan Lake in accordance with an NPDES permit.	The primary source of water to the CWTP is from hydrobins which separate transport water from bottom ash generated in plant Units 4 and 5. Seven earthen basins in the western edge of the CWTP promote sediment settling prior to the water decanting into the main portion of the CWTP and then overflowing into the cooling water discharge canal at the northeast corner of the pond.	- 13.7 acres in areal extent	Constructed in 1978.
Lined Ash Impoundment (LAI)	*Disposal Area* E1/2 of Section 34, T29N, R16W	*Part of a CCR multiunit with the LDWP* that receives fly ash, flue gas desulfurization (FGD) waste and associated residuals as a slurry from the plant. Impoundment.	Waste is discharged into the pond in the northeast portion of the pond. Decanted flow discharges via a vertical drop structure through a toe drain into the LDWP.	- 75 acres in areal extent - 60 mil HDPE liner - 5,364 acre-ft design capacity - 5,275.2 ft AMSL maximum working level	Constructed on top of closed Ash Ponds 4 and 5 and placed in service in 2004.
Lined Decant Water Pond (LDWP)	*Disposal Area* E1/2 of Section 34, T29N, R16W	*Part of a CCR multiunit with the LAI* that receives decanted water from the LAI. Impoundment.	Decanted water is discharged into the LAI via gravity; the water is pumped from the LDWP back to the plant for reuse in operations.	- 45 acres in areal extent - Two 60 mil HDPE liners separated by a leak detection layer - 435 acre-ft design capacity - 5,213.2 ft AMSL maximum working level	Constructed on top of closed Ash Pond 3 and placed in service in 2003.
Dry Fly Ash Disposal Area (DFADA)	*Disposal Area* SE1/4 of Section 34, T29N, R16W	*Single CCR unit*. Landfill. Disposal of dry fly ash, bottom ash, and construction debris. In the future, FGD solids will be mixed with fly ash at the plant and landfilled in the DFADA.	The DFADA is filled in general accordance with a stacking plan. Leachate generated from the DFADA cells is pumped into trucks and used for dust control or can be transferred to the LDWP.	- 3 conjoined cells (DFADA 1, 2, and 3) with areal extents of 37 acres, 32 acres, and 15 acres, respectively - 3,125 acre-ft design capacity - DFADA 1: compacted clay overlain by 60 mil HDPE liner and drainage layer - DFADA 2 and 3: geosynthetic clay liner overlain by 60 mil HDPE liner and drainage layer - Leachate collection system drains each DFADA cell - DFADA 4 is planned but not yet constructed	Constructed in 2007 (DFADA 1), 2012 (DFADA 2), and 2014 (DFADA 3).

Notes:

AMSL - above mean sea level
CCR - Coal combustion residuals
CWTP - Combined Waste Treatment Pond
DFADA - Dry Fly Ash Disposal Area
FGD - flue gas desulfurization
ft - feet
HDPE - high density polyethylene
LAI - Lined Ash Impoundment
LDWP - Lined Decant Water Pond
NPDES - National Pollutant Discharge Elimination System
URS - Upper Retention Sump

Table 2
Coal Combustion Residual Groundwater Monitoring System Summary
APS Four Corners Power Plant
Fruitland, New Mexico

Well	CCR Unit	Well Location Relative to CCR Unit	Hydrogeologic Unit	Date Installed	Borehole Depth [ft bgs]	Top of Casing Elevation [ft AMSL]	Ground Surface Elevation [ft AMSL]	Top of Screen [ft bgs]	Bottom of Screen [ft bgs]	Screen Length [ft]	Top Screen Elevation [ft AMSL]	Bottom Screen Elevation [ft AMSL]	Bottom Borehole Elevation [ft AMSL]
MW-66	URS	Downgradient	Pictured Cliffs Sandstone	9/27/2015	33	5,344.69	5,344.7	15	25	10	5,329.7	5,319.7	5,311.7
MW-67	URS	Downgradient	Pictured Cliffs Sandstone	9/11/2015	31	5,356.42	5,354.0	19.6	29.6	10	5,334.4	5,324.4	5,323.0
MW-68	URS	Downgradient	Pictured Cliffs Sandstone	9/10/2015	30	5,353.58	5,354.0	19	29	10	5,335.0	5,325.0	5,324.0
MW-69	URS	Downgradient	Pictured Cliffs Sandstone	9/9/2015	35	5,357.66	5,355.3	24.3	34.3	10	5,331.0	5,321.0	5,320.3
MW-70	URS	Downgradient	Pictured Cliffs Sandstone	9/30/2015	53	5,371.12	5,368.6	40	50	10	5,328.6	5,318.6	5,315.6
MW-71	URS	Unknown	Pictured Cliffs Sandstone	3/12016	50	5,362.91	5,363.6	22.5	42.5	20	5,341.1	5,321.1	5,313.6
MW-72	URS	Unknown	Pictured Cliffs Sandstone	3/2/2016	61	5,381.62	5,379.1	50.7	60.7	10	5,328.4	5,318.4	5,318.1
MW-73	URS/CWTP	Varies	Pictured Cliffs Sandstone	1/18/2017	45	5,353.95	5,351.9	28.9	43.9	15	5,323.0	5,308.0	5,306.9
MW-62	CWTP	Downgradient	Pictured Cliffs Sandstone	9/28/2015	20	5,341.87	5,339.4	10	20	10	5,329.4	5,319.4	5,319.4
MW-63	CWTP	Downgradient	Pictured Cliffs Sandstone	9/25/2015	20	5,337.02	5,337.0	9	19	10	5,328.0	5,318.0	5,317.0
MW-64	CWTP	Downgradient	Pictured Cliffs Sandstone	9/26/2015	25	5,337.66	5,337.7	10	20	10	5,327.7	5,317.7	5,312.7
MW-65	CWTP	Downgradient	Pictured Cliffs Sandstone	9/27/2015	20	5,339.74	5,337.2	8	18	10	5,329.2	5,319.2	5,317.2
MW-7	Multiunit 1	Downgradient	Lewis Shale	3/11/1987*	60	5,149.32	5,148.3	14.7	34.7	20	5,133.6	5,113.6	5,088.3
MW-8	Multiunit 1	Downgradient	Lewis Shale	3/11/1987*	74	5,122.56	5,120.9	28	48	20	5,093.2	5,073.2	5,046.9
MW-12R	Multiunit 1	Upgradient	Lewis Shale	3/27/2012	70	5,264.44	5,261.7	13.5	33.5	20	5,248.2	5,228.2	5,191.7
MW-40R	Multiunit 1	Downgradient	Lewis Shale	9/17/2015	25	5,137.43	5,134.8	14.3	24.3	10	5,120.5	5,110.5	5,109.8
MW-43	Multiunit 1	Upgradient	Lewis Shale	3/24/2012	60	5,271.58	5,269.4	16	26	10	5,253.4	5,243.4	5,209.4
MW-49A	Multiunit 1	Upgradient	Lewis Shale	5/18/2013	68	5,285.83	5,281.4	50	65	15	5,231.4	5,216.4	5,213.4
MW-50A	Multiunit 1	Upgradient	Lewis Shale	5/7/2013	63	5,335.97	5,333.2	28	43	15	5,305.2	5,290.2	5,270.2
MW-51	Multiunit 1	Upgradient	Lewis Shale	4/28/2013	80	5,288.14	5,285.1	20	30	10	5,265.1	5,255.1	5,205.1
MW-61	Multiunit 1	Downgradient	Lewis Shale	9/16/2015	35	5,129.19	5,126.6	24.2	34.2	10	5,102.4	5,092.4	5,091.6
MW-74	Multiunit 1	Upgradient	Lewis Shale	1/18/2017	40	5,219.09	5,216.7	8.1	18.1	10	5,208.6	5,198.6	5,176.7
MW-75	Multiunit 1	Downgradient	Lewis Shale	3/15/2017	41	5,126.80	5,124.8	29.0	39.0	10	5,095.8	5,085.8	5,083.8
MW-76	Multiunit 1	Downgradient	Lewis Shale	3/16/2017	33	5,116.23	5,114.3	11.8	26.8	15	5,102.5	5,087.5	5,081.3
MW-10	DFADA	Downgradient	Lewis Shale	3/12/1987	35	5,150.71	5,149.7	13	33	20	5,136.7	5,116.7	5,114.7
MW-13	DFADA	Downgradient	Lewis Shale	8/31/1987	60	5,150.75	5,149.5	34.9	54.9	20	5,114.6	5,094.6	5,089.5
MW-44	DFADA	Downgradient	Lewis Shale	3/28/2012	40	5,146.89	5,145.2	13.5	23.5	10	5,131.7	5,121.7	5,105.2
MW-48	DFADA	Downgradient	Lewis Shale	5/14/2013	80	5,165.96	5,163.4	35	60	25	5,128.4	5,103.4	5,083.4
MW-55R	DFADA	Upgradient	Lewis Shale	9/13/2015	95	5,243.96	5,241.4	72.9	92.9	20	5,168.5	5,148.5	5,146.4

Notes:

Source of presented information presented is AECOM, 2017

Vertical datum is NAVD 88

* - Estimated

AMSL - Above mean sea level

bgs - below ground surface

btoc - below top of casing

CCR - coal combustion residual(s)

CWTP - Combined Waste Treatment Pond

Table 2-1
Sampling Summary
Four Corners Power Plant
Fruitland, New Mexico

Sampling Dates	Monitoring Program	Sample Collection Method by Well														
		MW-7	**MW-8**	**MW-10**	**MW-12R**	**MW-13**	**MW-40R**	**MW-43**	**MW-44**	**MW-48**	**MW-49A**	**MW-50A**	**MW-51**	**MW-55R**	**MW-61**	**MW-62**
November 4-9, 2015	Detection (8 Initial Rounds)	LF	D	D	D	D	D	D	D	D	D	D	D	D	LF	LF
December 1, 2015	Detection (8 Initial Rounds)	---	B	---	B	---	---	B	---	---	B	B	---	---	---	---
March 5-7, 2016	Detection (8 Initial Rounds)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
April 26-27, 2016	Detection (8 Initial Rounds)	LF	LF	D	D	D	D	D	D	D	LF	D	D	D	LF	LF
June 5-7, 2016	Detection (8 Initial Rounds)	LF	LF	D	D	D	D	D	D	D	LF	D	D	D	LF	LF
August 20-21, 2016	Detection (8 Initial Rounds)	LF	LF	D	D	D	D	D	D	D	LF	D	D	D	LF	LF
September 12-15, 2016	Detection (8 Initial Rounds)	LF	LF	D	D	D	D	D	D	D	LF	D	D	D	LF	LF
October 19-20, 2016	Detection (8 Initial Rounds)	LF	D	D	D	D	D	D	D	D	LF	D	D	D	LF	LF
January 31-February 2, 2017	Detection (8 Initial Rounds)	LF	D	D	D	D	B	D	D	D	LF	D	D	D	LF	LF
April 16-18, 2017	Detection (8 Initial Rounds)	LF	LF	D	D	D	D	D	D	D	LF	D	D	D	LF	LF
May 1-3, 2017	Detection (8 Initial Rounds)	LF	LF	D	D	D	D	D	D	D	LF	D	D	D	LF	LF
May 28-30, 2017	Detection (8 Initial Rounds)	LF	LF	D	D	D	D	D	D	D	LF	D	D	D	LF	LF
June 21-22, 2017	Detection (8 Initial Rounds)	LF	D	D	D	D	D	D	D	D	LF	D	D	D	LF	LF
July 21-22, 2017	Detection (8 Initial Rounds)	LF	D	D	D	D	D	D	D	D	LF	D	D	D	LF	LF
August 9-10, 2017	Detection (8 Initial Rounds)	LF	D	D	D	D	D	D	D	D	LF	D	D	D	LF	LF
August 16-17, 2017	Detection (8 Initial Rounds)	LF	D	D	D	D	D	D	D	D	LF	D	D	D	LF	LF
September 9-11, 2017	Detection (8 Initial Rounds)	LF	D	D	D	D	D	D	D	D	LF	D	D	D	LF	LF
October 11-13, 2017	Detection (8 Initial Rounds)	LF	D	D	D	D	D	D	D	D	LF	D	D	D	LF	LF
November 29-30, 2017	Detection	LF	D	D	D	D	D	D	D	D	LF	D	D	D	LF	LF
Number of Samples Collected from Well:		*17*	*8*	*0*	*1*	*0*	*1*	*1*	*0*	*0*	*17*	*1*	*0*	*0*	*17*	*17*

Notes:

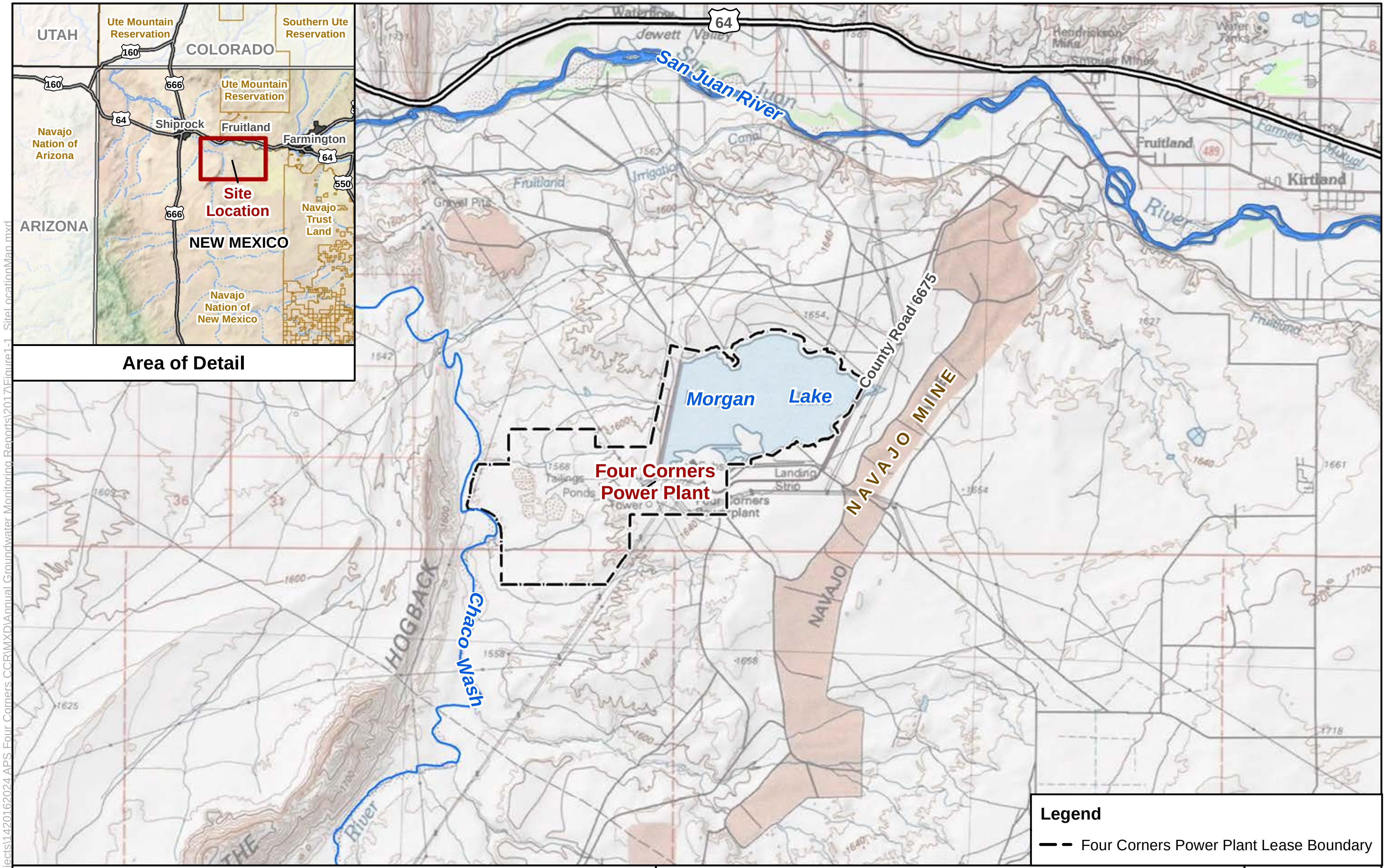
LF - Sampled using a low-flow sampling pump
D - Dry or no sample collected due to insufficient water
B - Sampled using a bailer or Hydrasleeve sampler
'---' - Not sampled during sampling dates noted

Table 2-1
Sampling Summary
Four Corners Power Plant
Fruitland, New Mexico

Sampling Dates	Monitoring Program	Sample Collection Method by Well												
		MW-63	**MW-64**	**MW-65**	**MW-66**	**MW-67**	**MW-68**	**MW-69**	**MW-70**	**MW-71**	**MW-72**	**MW-73**	**MW-74**	**MW-75**
November 4-9, 2015	Detection (8 Initial Rounds)	LF	LF	LF	LF	LF	LF	LF	LF	---	---	---	---	---
December 1, 2015	Detection (8 Initial Rounds)	---	---	---	---	---	---	---	---	---	---	---	---	---
March 5-7, 2016	Detection (8 Initial Rounds)	---	---	---	---	---	---	---	---	LF	LF	---	---	---
April 26-27, 2016	Detection (8 Initial Rounds)	LF	LF	LF	LF	LF	LF	LF	LF	LF	LF	---	---	---
June 5-7, 2016	Detection (8 Initial Rounds)	LF	LF	LF	LF	LF	LF	LF	LF	LF	LF	---	---	---
August 20-21, 2016	Detection (8 Initial Rounds)	LF	LF	LF	LF	LF	LF	LF	LF	LF	LF	---	---	---
September 12-15, 2016	Detection (8 Initial Rounds)	LF	LF	LF	LF	LF	LF	LF	LF	LF	LF	---	---	---
October 19-20, 2016	Detection (8 Initial Rounds)	LF	LF	LF	LF	LF	LF	LF	LF	LF	LF	---	---	---
January 31-February 2, 2017	Detection (8 Initial Rounds)	LF	LF	LF	LF	LF	LF	LF	LF	LF	LF	LF	LF	---
April 16-18, 2017	Detection (8 Initial Rounds)	LF	LF	LF	LF	LF	LF	LF	LF	LF	LF	LF	LF	LF
May 1-3, 2017	Detection (8 Initial Rounds)	LF	LF	LF	LF	LF	LF	LF	LF	LF	LF	LF	LF	LF
May 28-30, 2017	Detection (8 Initial Rounds)	LF	LF	LF	LF	LF	LF	LF	LF	LF	LF	LF	LF	LF
June 21-22, 2017	Detection (8 Initial Rounds)	LF	LF	LF	LF	LF	LF	LF	LF	LF	LF	LF	LF	LF
July 21-22, 2017	Detection (8 Initial Rounds)	LF	LF	LF	LF	LF	LF	LF	LF	LF	LF	LF	LF	LF
August 9-10, 2017	Detection (8 Initial Rounds)	LF	LF	LF	LF	LF	LF	LF	LF	LF	LF	LF	LF	LF
August 16-17, 2017	Detection (8 Initial Rounds)	LF	LF	LF	LF	LF	LF	LF	LF	LF	LF	LF	D	LF
September 9-11, 2017	Detection (8 Initial Rounds)	LF	LF	LF	LF	LF	LF	LF	LF	LF	LF	LF	LF	LF
October 11-13, 2017	Detection (8 Initial Rounds)	LF	LF	LF	LF	LF	LF	LF	LF	LF	LF	LF	HS	LF
November 29-30, 2017	Detection	LF	LF	LF	LF	LF	LF	LF	LF	LF	LF	LF	LF	LF
Number of Samples Collected from Well:		*17*	*17*	*17*	*17*	*17*	*17*	*17*	*17*	*17*	*17*	*11*	*10*	*10*

Notes:
LF - Sampled using a low-flow sampling pump
D - Dry or no sample collected due to insufficient water
B - Sampled using a bailer or Hydrasleeve sampler
'---' - Not sampled during sampling dates noted

FIGURES



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Job No.: 14-2016-2024
PM: NC
Date: 1/15/2018
Scale: 1" = 1.5 miles

The map shown here has been created with all due and reasonable care and is strictly for use with Amec Foster Wheeler Project Number 14-2016-2024. This map has not been certified by a licensed land surveyor, and any third party use of this map comes without warranties of any kind. Amec Foster Wheeler assumes no liability, direct or indirect, whatsoever for any such third party or unintended use.

Arizona Public Service
Four Corners Power Plant
Fruitland, New Mexico

Site Location Map

FIGURE
1-1

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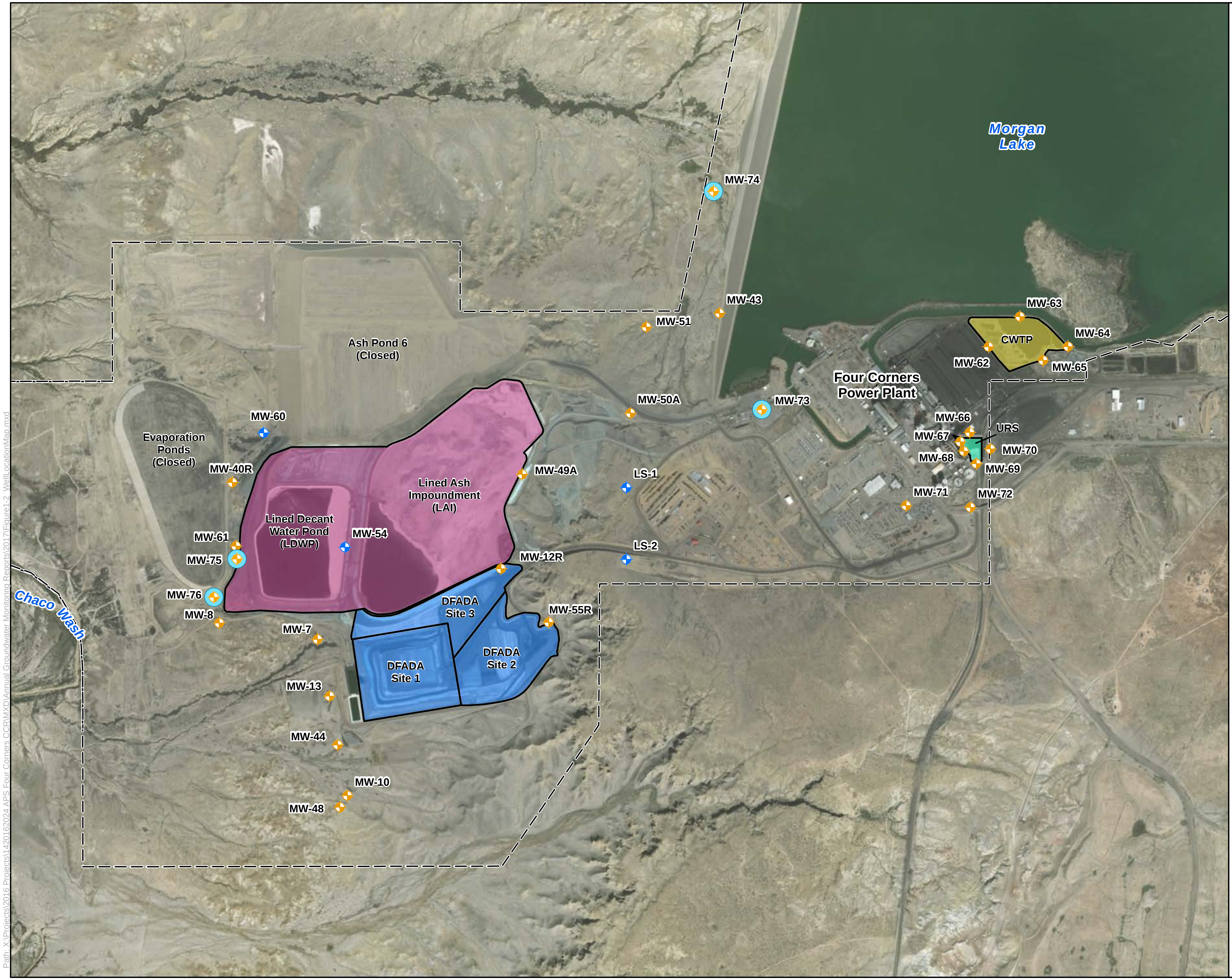

Legend

◆ CCR Monitoring Well Location
◆ Supplementary Site Monitoring Well Location
● CCR Monitoring Well Location Installed in 2017
— — FCPP Lease Boundary

CCR Units

🟪 Multiunit 1 (LAI and LDWP)
🟦 Dry Fly Ash Disposal Area (DFADA)
🟨 Combined Waste Treatment Pond (CWTP)
🟩 Upper Retention Sump (URS)

Notes:

CCR	Coal Combustion Residuals
CWTP	Combined Waste Treatment Pond
DFADA	Dry Fly Ash Disposal Area
FCPP	Four Corners Power Plant
LAI	Lined Ash Impoundment
LDWP	Lined Decant Water Pond
URS	Upper Retention Sump

0 350 700 1,400
Feet

N

Arizona Public Service
Four Corners Power Plant
Fruitland, New Mexico

CCR Units and Monitoring System Summary

FIGURE
1-2

Job No.: 14-2016-2024
PM: NC
Date: 1/16/2018
Scale: 1" = 1400'

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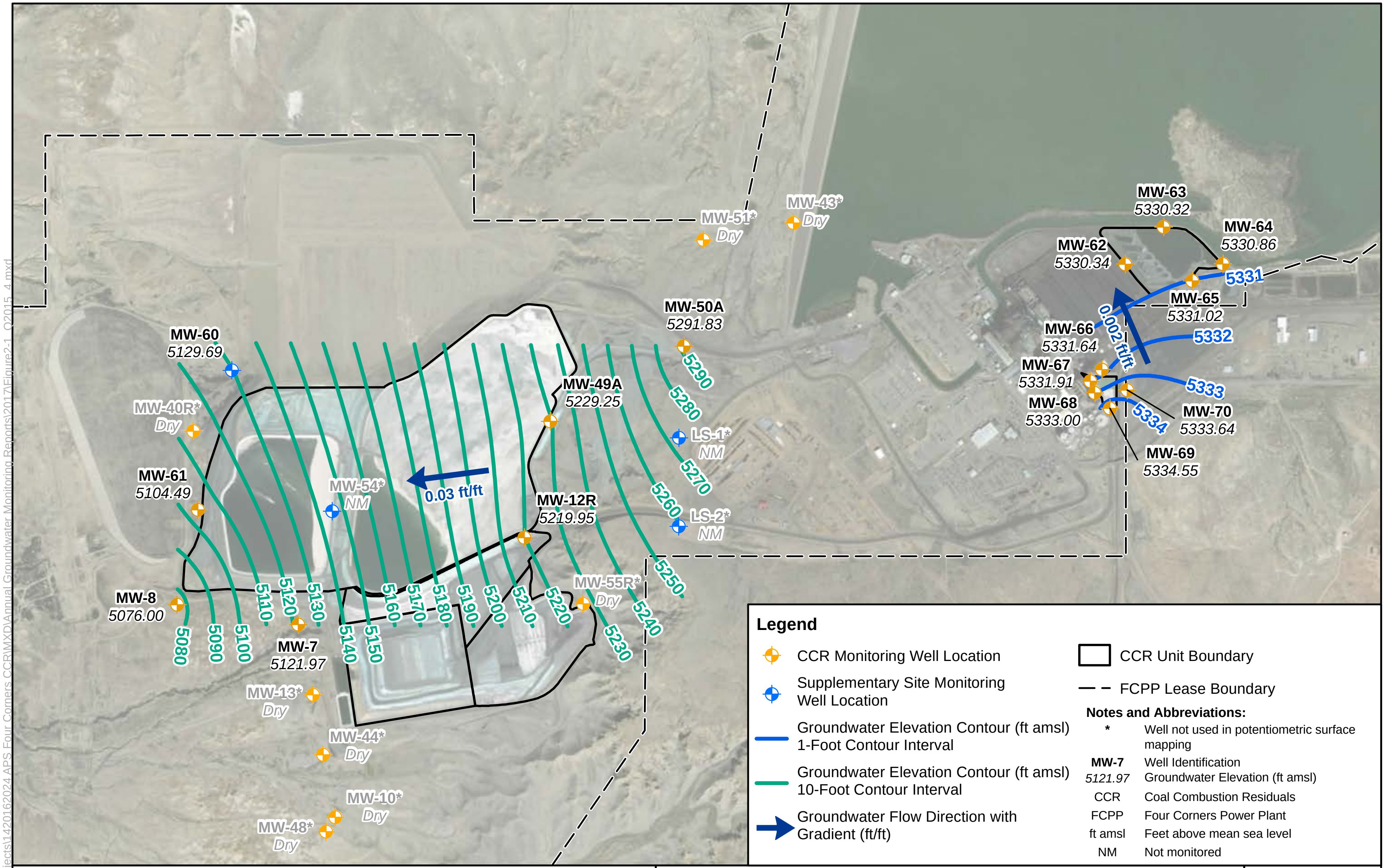

Legend

⊕	CCR Monitoring Well Location	☐	CCR Unit Boundary
⊕	Supplementary Site Monitoring Well Location	— —	FCPP Lease Boundary
—	Groundwater Elevation Contour (ft amsl) 1-Foot Contour Interval		
—	Groundwater Elevation Contour (ft amsl) 10-Foot Contour Interval		
➡	Groundwater Flow Direction with Gradient (ft/ft)		

Notes and Abbreviations:

*	Well not used in potentiometric surface mapping
MW-7 *5121.97*	Well Identification Groundwater Elevation (ft amsl)
CCR	Coal Combustion Residuals
FCPP	Four Corners Power Plant
ft amsl	Feet above mean sea level
NM	Not monitored

0 400 800 1,600 2,400
Feet

Job No.:	14-2016-2024
PM:	NC
Date:	1/16/2018
Scale:	1" = 1600'

N

Arizona Public Service
Four Corners Power Plant
Fruitland, New Mexico

Potentiometric Surface Map
4th Quarter 2015 (11/3-11/9/2015 and 11/14/2015)

FIGURE
2-1

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wheeler

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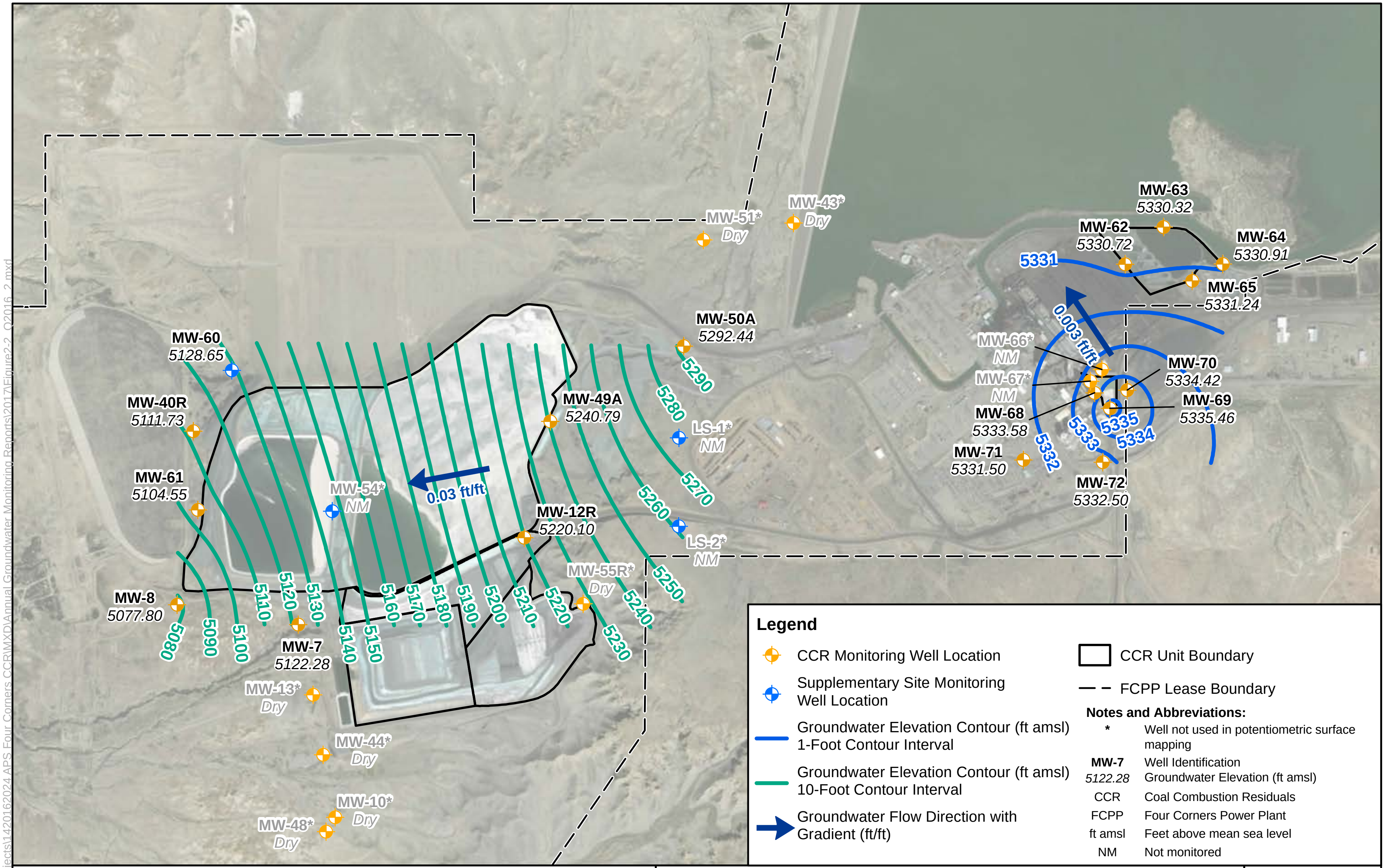

Legend

⊕	CCR Monitoring Well Location
⊕	Supplementary Site Monitoring Well Location
—	Groundwater Elevation Contour (ft amsl) 1-Foot Contour Interval
—	Groundwater Elevation Contour (ft amsl) 10-Foot Contour Interval
➡	Groundwater Flow Direction with Gradient (ft/ft)
☐	CCR Unit Boundary
– –	FCPP Lease Boundary

Notes and Abbreviations:

*	Well not used in potentiometric surface mapping
MW-7 *5122.28*	Well Identification Groundwater Elevation (ft amsl)
CCR	Coal Combustion Residuals
FCPP	Four Corners Power Plant
ft amsl	Feet above mean sea level
NM	Not monitored

0 400 800 1,600 2,400
Feet

N

Job No.:	14-2016-2024
PM:	NC
Date:	1/16/2018
Scale:	1" = 1600'

Arizona Public Service
Four Corners Power Plant
Fruitland, New Mexico

Potentiometric Surface Map
2nd Quarter 2016 (4/25/2016)

FIGURE
2-2

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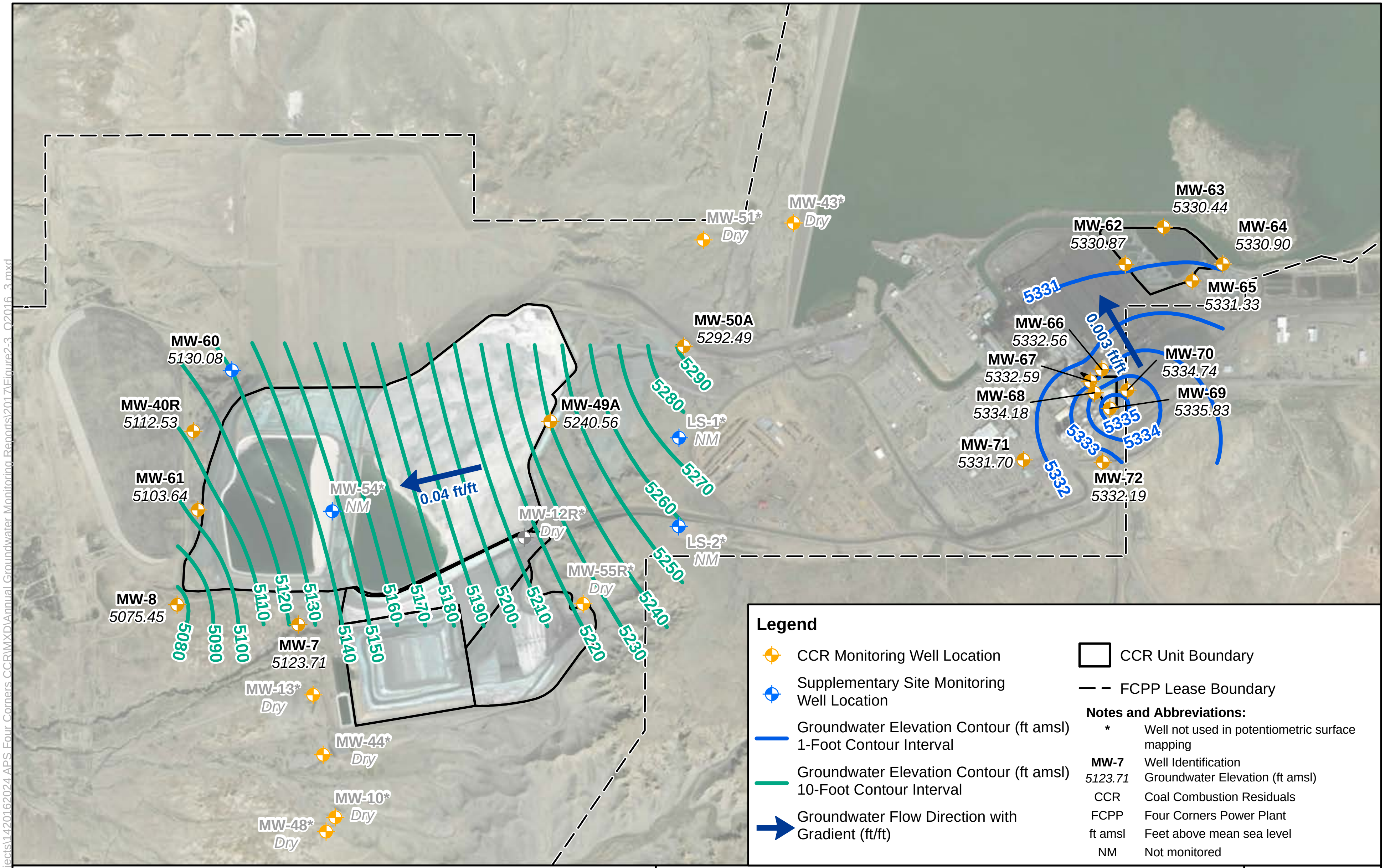

Legend

⊕	CCR Monitoring Well Location
⊕	Supplementary Site Monitoring Well Location
━	Groundwater Elevation Contour (ft amsl) 1-Foot Contour Interval
━	Groundwater Elevation Contour (ft amsl) 10-Foot Contour Interval
➡	Groundwater Flow Direction with Gradient (ft/ft)
☐	CCR Unit Boundary
— —	FCPP Lease Boundary

Notes and Abbreviations:

*	Well not used in potentiometric surface mapping
MW-7 *5123.71*	Well Identification Groundwater Elevation (ft amsl)
CCR	Coal Combustion Residuals
FCPP	Four Corners Power Plant
ft amsl	Feet above mean sea level
NM	Not monitored

0 400 800 1,600 2,400
Feet

Job No.:	14-2016-2024
PM:	NC
Date:	1/16/2018
Scale:	1" = 1600'

N

Arizona Public Service
Four Corners Power Plant
Fruitland, New Mexico

Potentiometric Surface Map
3rd Quarter 2016 (9/12/2016)

FIGURE
2-3

amec
foster
wheeler

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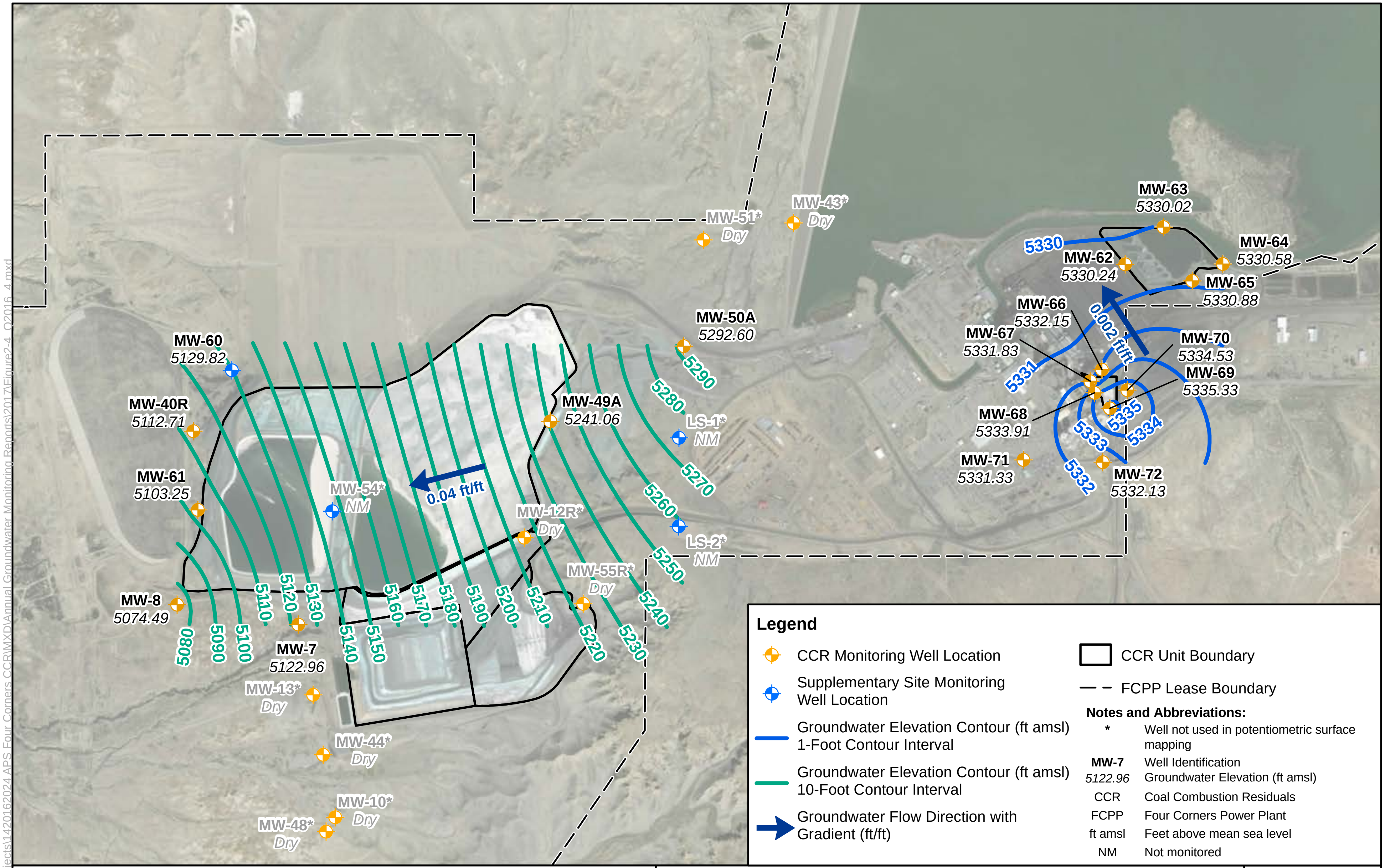


Legend

⊕	CCR Monitoring Well Location
⊕	Supplementary Site Monitoring Well Location
—	Groundwater Elevation Contour (ft amsl) 1-Foot Contour Interval
—	Groundwater Elevation Contour (ft amsl) 10-Foot Contour Interval
➡	Groundwater Flow Direction with Gradient (ft/ft)
☐	CCR Unit Boundary
– –	FCPP Lease Boundary

Notes and Abbreviations:

*	Well not used in potentiometric surface mapping
MW-7 *5122.96*	Well Identification Groundwater Elevation (ft amsl)
CCR	Coal Combustion Residuals
FCPP	Four Corners Power Plant
ft amsl	Feet above mean sea level
NM	Not monitored

0 400 800 1,600 2,400
Feet

N

Job No.:	14-2016-2024
PM:	NC
Date:	1/16/2018
Scale:	1" = 1600'

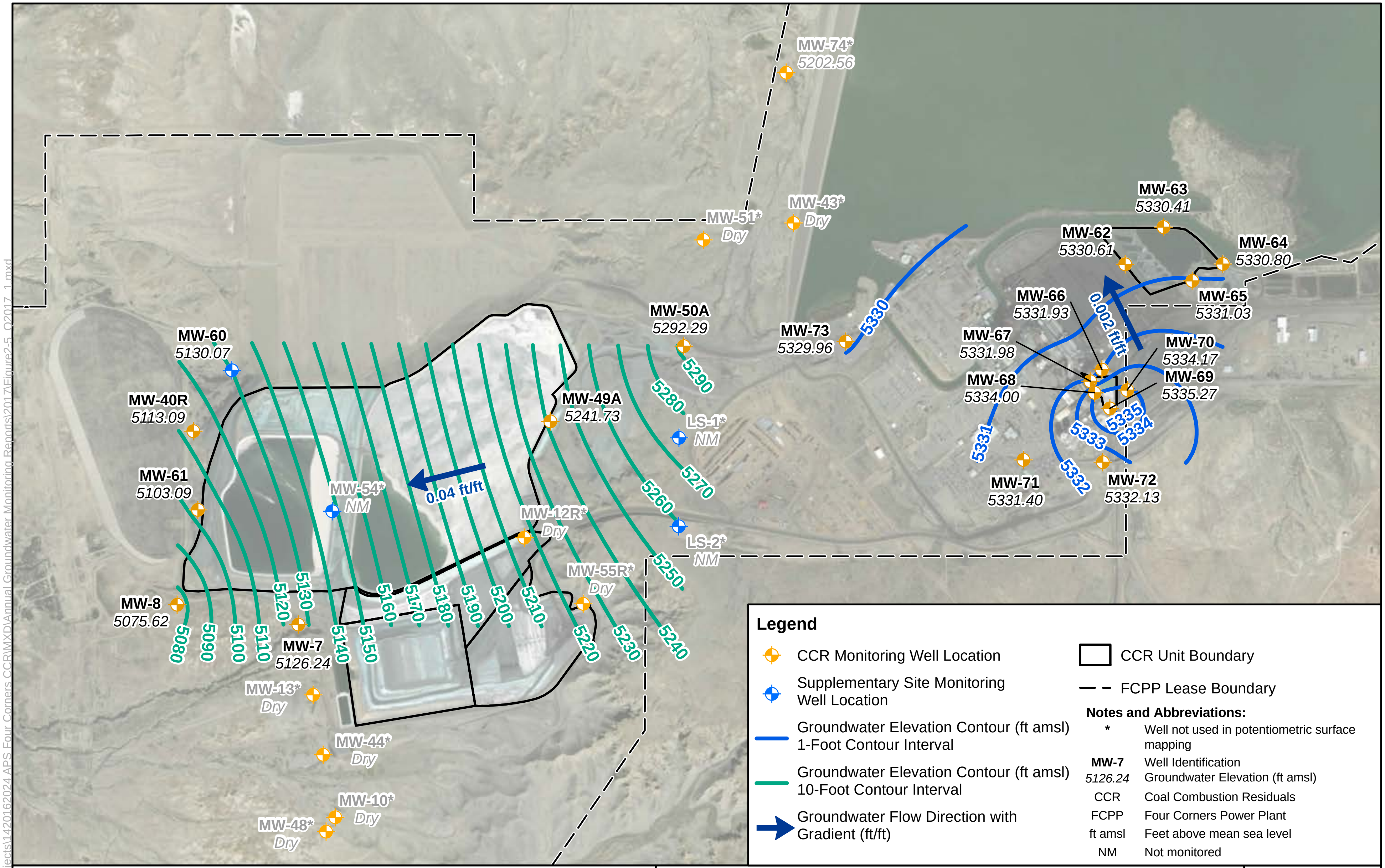
Arizona Public Service
Four Corners Power Plant
Fruitland, New Mexico

Potentiometric Surface Map
4th Quarter 2016 (10/19-10/20/2016)

FIGURE
2-4

amec
foster
wheeler

Path: X:\Projects\2016 Projects\1420162024 APS Four Corners CCR\MXD\Annual Groundwater Monitoring Reports\2017\Figure2-4_Q2016_4.mxd



Legend

- 🟠 CCR Monitoring Well Location
- 🔵 Supplementary Site Monitoring Well Location
- Groundwater Elevation Contour (ft amsl) 1-Foot Contour Interval
- Groundwater Elevation Contour (ft amsl) 10-Foot Contour Interval
- ➡ Groundwater Flow Direction with Gradient (ft/ft)
- ☐ CCR Unit Boundary
- – – FCPP Lease Boundary

Notes and Abbreviations:

*	Well not used in potentiometric surface mapping
MW-7 *5126.24*	Well Identification Groundwater Elevation (ft amsl)
CCR	Coal Combustion Residuals
FCPP	Four Corners Power Plant
ft amsl	Feet above mean sea level
NM	Not monitored

0 400 800 1,600 2,400
Feet

N

Job No.:	14-2016-2024
PM:	NC
Date:	1/16/2018
Scale:	1" = 1600'

Arizona Public Service
Four Corners Power Plant
Fruitland, New Mexico

Potentiometric Surface Map
1st Quarter 2017 (1/31-2/1/2017)

FIGURE
2-5

amec
foster
wheeler

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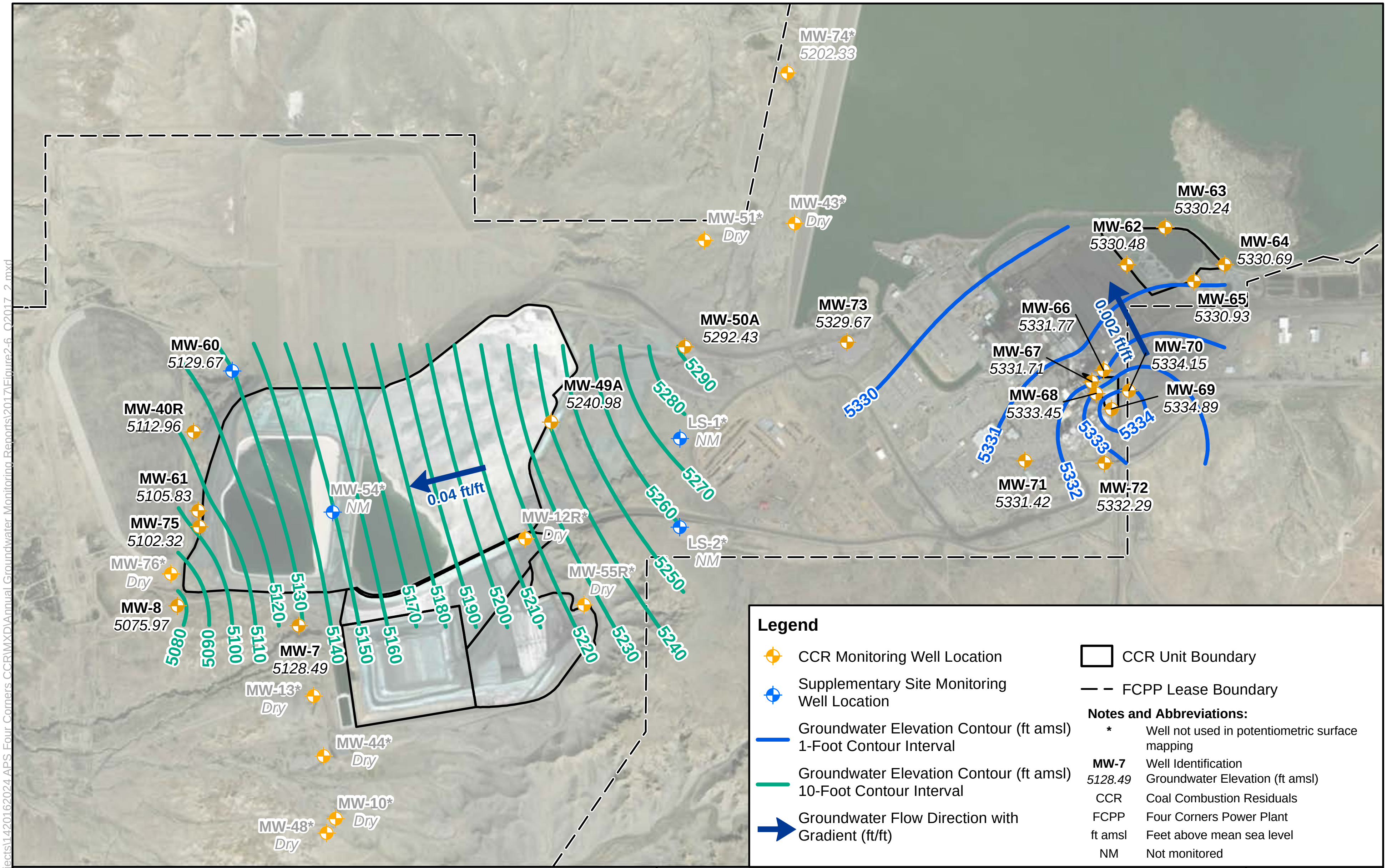

Legend

⊕	CCR Monitoring Well Location	☐	CCR Unit Boundary
⊕	Supplementary Site Monitoring Well Location	— —	FCPP Lease Boundary
—	Groundwater Elevation Contour (ft amsl) 1-Foot Contour Interval		
—	Groundwater Elevation Contour (ft amsl) 10-Foot Contour Interval		
➡	Groundwater Flow Direction with Gradient (ft/ft)		

Notes and Abbreviations:

*	Well not used in potentiometric surface mapping
MW-7	Well Identification
5128.49	Groundwater Elevation (ft amsl)
CCR	Coal Combustion Residuals
FCPP	Four Corners Power Plant
ft amsl	Feet above mean sea level
NM	Not monitored

0 400 800 1,600 2,400
Feet

Job No.:	14-2016-2024
PM:	NC
Date:	1/16/2018
Scale:	1" = 1600'

N

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Arizona Public Service
Four Corners Power Plant
Fruitland, New Mexico

Potentiometric Surface Map
2nd Quarter 2017 (5/1/2017)

FIGURE
2-6

amec
foster
wheeler

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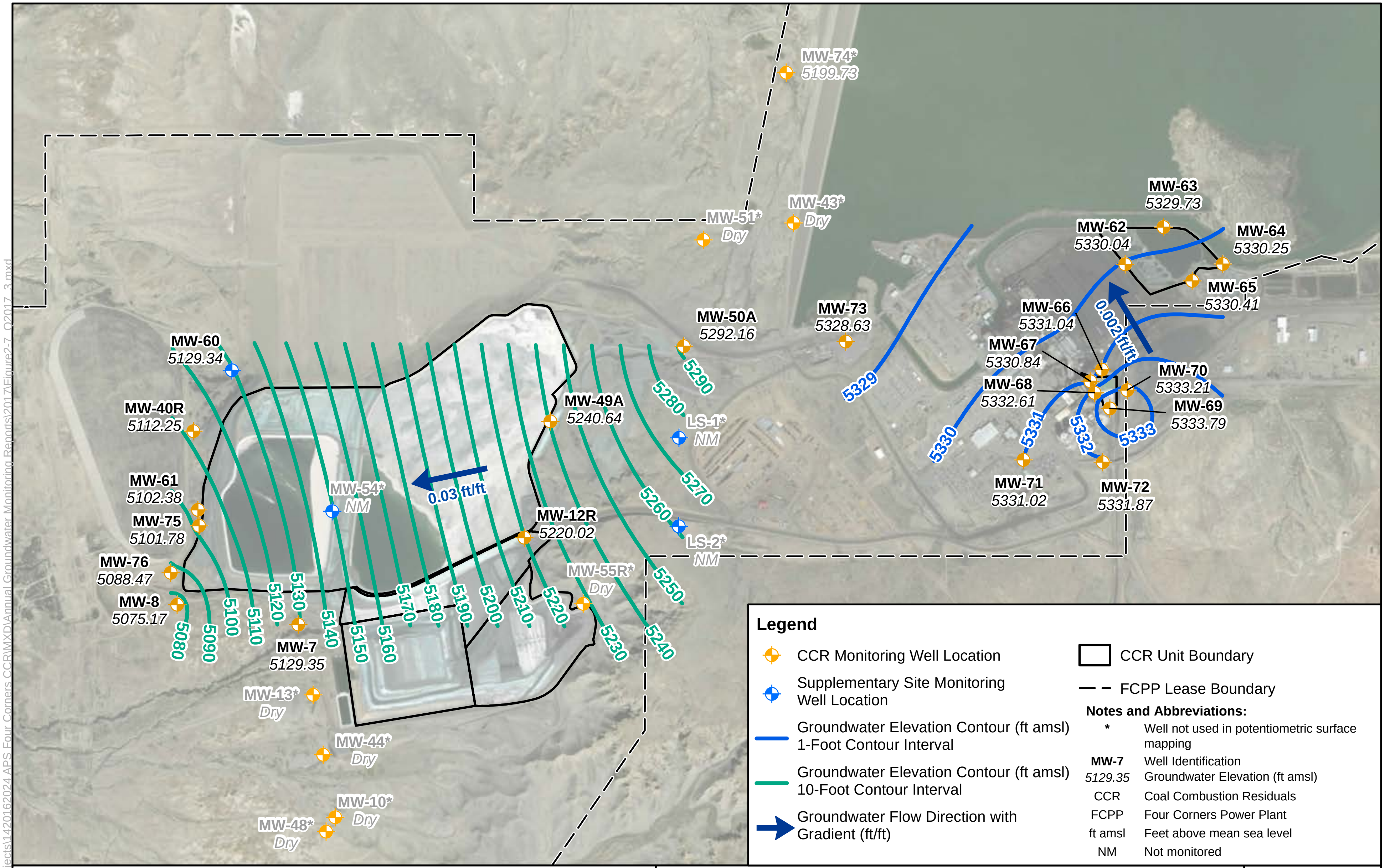

Job No.:	14-2016-2024
PM:	NC
Date:	1/16/2018
Scale:	1" = 1600'

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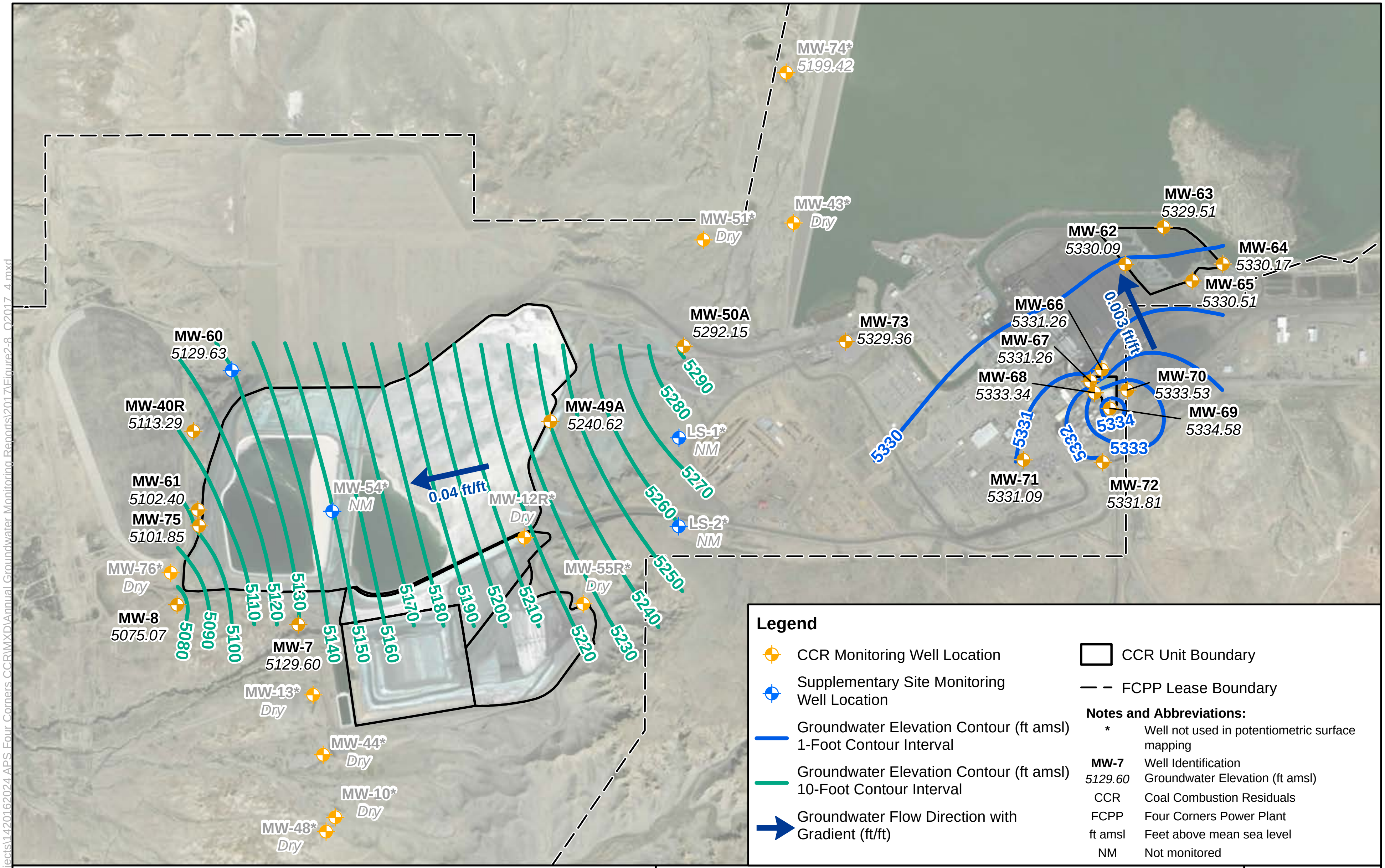
Arizona Public Service
Four Corners Power Plant
Fruitland, New Mexico

Potentiometric Surface Map
3rd Quarter 2017 (9/9/2017)

FIGURE
2-7

amec foster wheeler

Path: X:\Projects\2016 Projects\1420162024 APS Four Corners CCR\MXD\Annual Groundwater Monitoring Reports\2017\Figure2-7_Q2017_3.mxd



Legend

- ✦ CCR Monitoring Well Location
- ✦ Supplementary Site Monitoring Well Location
- Groundwater Elevation Contour (ft amsl) 1-Foot Contour Interval
- Groundwater Elevation Contour (ft amsl) 10-Foot Contour Interval
- ➡ Groundwater Flow Direction with Gradient (ft/ft)
- ☐ CCR Unit Boundary
- — — FCPP Lease Boundary

Notes and Abbreviations:

*	Well not used in potentiometric surface mapping
MW-7 *5129.60*	Well Identification Groundwater Elevation (ft amsl)
CCR	Coal Combustion Residuals
FCPP	Four Corners Power Plant
ft amsl	Feet above mean sea level
NM	Not monitored

0 400 800 1,600 2,400
Feet

N

Job No.:	14-2016-2024
PM:	NC
Date:	1/16/2018
Scale:	1" = 1600'

The map shown here has been created with all due and reasonable care and is strictly for use with Amec Foster Wheeler Project Number 14-2016-2024. This map has not been certified by a licensed land surveyor, and any third party use of this map comes without warranties of any kind. Amec Foster Wheeler assumes no liability, direct or indirect, whatsoever for any such third party or unintended use.

Arizona Public Service
Four Corners Power Plant
Fruitland, New Mexico

Potentiometric Surface Map
4th Quarter 2017 (10/11/2017)

FIGURE
2-8

amec foster wheeler

Path: X:\Projects\2016 Projects\1420162024 APS Four Corners CCR\MXD\Annual Groundwater Monitoring Reports\2017\Figure2-8_Q2017_4.mxd

APPENDIX A

SAMPLING AND ANALYSIS PLAN, COAL COMBUSTION RESIDUAL (CCR) GROUNDWATER MONITORING (AECOM, 2015)

Sampling and Analysis Plan
Coal Combustion Residual (CCR) Groundwater Monitoring

Four Corners Power Plant
Arizona Public Service
Farmington, New Mexico

Prepared for:
Arizona Public Service

December 2015
Revised January 2018

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List of Acronyms

AECOM	AECOM Technical Services, Inc.
APS	Arizona Public Service
bgs	below ground surface
°C	degrees Celsius
CCR	Coal Combustion Residuals
CFR	Code of Federal Regulations
CoC	Chain-of-Custody
COCs	constituents of concern
CWTP	Combined Waste Treatment Pond
DFADA	Dry Flash Ash Disposal Area
DO	dissolved oxygen
DTW	depth to water
EPA	Environmental Protection Agency
FCPP	Four Corners Power Plant
GC/MS	gas chromatography / mass spectrometry
HASP	Health and Safety Plan
LAI	Lined Ash Impoundment
LDWP	Lined Decant Water Pond
L/min	liters per minute
LOQ	limit of quantification
LRL	laboratory reporting limit
MCL	Maximum Contaminant Level
NTU	nephelometric turbidity unit
ORP	Oxidation Reduction Potential
pCi/L	PicoCuries per Liter
QAPP	Quality Assurance Project Plan
QA/QC	Quality Assurance / Quality Control
SAP	Sampling Analysis Plan
SOPS	Standard Operating Procedures
URS	Upper Retention Sump

1 Introduction

This Sampling and Analysis Plan (SAP) presents the methods and procedures to be used to conduct groundwater sampling to evaluate the potential effect of coal combustion residual (CCR) surface impoundments or landfills on groundwater quality at the Four Corners Power Plant (FCPP). This groundwater monitoring is required by the final federal rule for CCR disposal landfills and impoundments, (40 Code of Federal Regulations (CFR) parts 257 and 261 pursuant to sections 40 CFR §§ 257.90 through 257.95 (Rule)). The purpose of the groundwater sampling is to: 1) evaluate the quality of background groundwater where the groundwater quality is not affected by CCR surface impoundments or landfills (known as CCR units); and 2) evaluate the quality of groundwater passing the waste boundary of the CCR unit. The evaluation will be conducted using statistical methods as described in the Rule. The statistical methods will be described in a separate report. This SAP meets the requirements of 40 CFR § 257.93 and includes the following:

- Quality assurance manager and designation of responsibility;
- Sample collection methods and standard operating procedures (SOPs);
- Sample identification, preservation, shipment, and chain of custody procedures;
- Analytical procedures (Environmental Protection Agency (EPA) approved methods),
- Quality Assurance / Quality Control (QA/QC) procedures to comply with the Arizona Public Service (APS) Quality Assurance Project Plan (QAPP); and
- Data reporting and data validation protocols

1.1 Project Description

FCPP is located approximately 15 miles west of Farmington, New Mexico and is jointly owned by APS and four other utilities in the Southwest (Figure 1). The Plant is operated by APS.

AECOM Technical Services, Inc. (AECOM) developed the original SAP to meet the groundwater monitoring requirements of the federal rules for CCR disposal landfills and impoundments. This SAP is intended to address groundwater monitoring requirements pursuant to sections 40 CFR § 257.90 through 257.95 as applicable to FCPP. Information in this SAP has been updated and revised by APS.

The CCR Rule (§ 257.91 (d) (2)) allows groundwater monitoring networks for multiple adjacent disposal units to be combined into a single monitoring network for more than one unit (termed “multiunit” in the Rule). One CCR multiunit and three single CCR units were identified at FCPP (Figures 1 and 2):

- CCR Multiunit 1: Lined Decant Water Pond (LDWP) and Lined Ash Impoundment (LAI),
- Dry Fly Ash Disposal Area (DFADA),
- Combined Waste Treatment Pond (CWTP), and
- Upper Retention Sump (URS).

1.2 Project Schedule

The field activities described within this SAP will meet the background sampling requirements of the Rule which requires that a minimum of eight independent sampling rounds be completed prior to October 17, 2017 (§ 257.94). The sampling was initiated on a quarterly schedule for those monitoring wells installed in 2015. Additional monitoring wells were needed to further define background groundwater quality and to complete the CCR well networks as required by the Rule. The addition of wells in 2016 and 2017 required an acceleration of the sampling schedule in order to complete eight sampling rounds for the new wells. Further details of the well network are provided below.

2 Monitor Well Network

The monitoring well network to be used for CCR groundwater monitoring program consists of a combination of previously existing monitor wells and newly installed monitor wells. Ten existing monitor wells were determined to be suitable for use in the required groundwater monitoring program. AECOM prepared a scope of work and subcontracted Cascade Drilling, L.P., of Peoria Arizona, to drill and install the groundwater monitor wells at the FCPP necessary to complete the CCR monitoring network as required in the Rule.

In September and October 2015, 12 monitor wells were installed to complete the groundwater monitoring networks for the four identified CCR units/multiunit. Nine monitor wells were installed on FCPP property and four monitor wells were installed on the adjacent BHP property (Figures 2 and 3). Two monitoring wells (MW-61 and MW-40R) were installed downgradient of CCR Multiunit 1. One monitor well (MW-55R) was installed upgradient of the DFADA. Ten existing Lewis Shale monitor wells were identified as part of the monitoring network for CCR Multiunit 1 and the DFADA.

Four monitor wells (MW-62, MW-63, MW-64, and MW-65) were installed at the CWTP and five monitor wells (MW-66, MW-67, MW-68, MW-69, and MW-70) were installed at the URS. In March 2017, two additional monitor wells (MW-71 and MW-72) were installed at the URS and CWTP to further define the quality of groundwater unaffected by the CCR units. These wells are completed in the Pictured Cliff sandstone.

Two monitor wells (MW-73 and MW-74) were installed in January 2017 as background wells for the Pictured Cliff and Lewis Shale aquifers, respectively. Because of inconsistent saturated conditions in downgradient monitoring wells at Multiunit 1, two additional wells (MW-75 and MW-76) were installed in March 2017 to ensure adequate downgradient monitoring coverage.

A total of 30 monitor wells comprise the groundwater monitoring network (Table 2).

TABLE 1 - FOUR CORNERS CCR MONITORING WELL NETWORK

Well Name	Well Location with respect to CCR Unit	Northing	Easting	Ground Surface Elevation	Measuring Point Elevation	Total Depth (bgs)	Well Depth (bMPt)	Screened Interval (bgs)	Casing Diameter
MW-7	Multiunit downgradient	2067347.919	2524866.308	5,148.29	5,149.32	34.7	35.73	14.7 - 34.7	4
MW-8	Multiunit downgradient	2067581.981	2523451.559	5,120.85	5,122.56	47.7	49.41	27.7 - 47.7	4
MW-10	DFADA downgradient	2065094.409	2525297.908	5,149.65	5,150.71	33	34.06	13 - 33	4
MW-12R	DFADA upgradient	2068365.170	2527509.566	5,261.71	5,264.70	33.5	36.49	13.5 - 33.5	4
MW-13	DFADA downgradient	2066528.206	2525040.922	5,149.52	5,150.75	54.9	56.13	34.9 - 54.9	4
MW-40R	Multiunit downgradient	2069601.830	2523646.840	5,134.83	5,137.43	25	27.6	14.3 - 24.3	4.6
MW-43	Multiunit upgradient	2072045.990	2530655.841	5,269.42	5,271.58	26	28.16	16 - 26	4
MW-44	DFADA downgradient	2065826.301	2525157.767	5,145.15	5,146.89	23.5	25.24	13.5 - 23.5	4
MW-48	DFADA downgradient	2064927.037	2525190.543	5,163.43	5,165.96	60	62.53	35 - 60	4
MW-49A*	Multiunit upgradient	2069725.717	2527814.060	5,281.38	5,285.83	65	69.45	50 - 65	4
MW-50A	Multiunit upgradient	2070606.207	2529372.844	5,333.20	5,335.67	42.5	44.97	27.5 - 42.5	4
MW-51	Multiunit upgradient	2071847.788	2529602.779	5,285.14	5,287.52	30	32.38	20 - 30	4
MW-55R	DFADA upgradient	2067559.860	2523692.190	5,241.36	5,243.96	95	97.6	74.3 - 94.3	4.6
MW-61	Multiunit downgradient	2068690.790	2523692.190	5,126.59	5,129.19	31.6	34.2	21 - 31	4
MW-62	CWTP downgradient	2071562.930	2534532.680	5,339.37	5,341.87	20	22.5	9.3 - 19.3	4.6
MW-63	CWTP downgradient	2071996.920	2534981.780		5,337.02	20	20	9.3 - 19.3	4.6
MW-64	CWTP downgradient	2071564.570	2535675.100		5,337.66	18	18	10.3 - 20.3	4.6
MW-65	CWTP downgradient	2071367.360	2535315.810	5,337.24	5,339.74	19	21.5	7.3 - 17.3	4.6
MW-66	URS downgradient	2070329.330	2534260.150		5,344.69	25	25	14.3 - 24.3	4.6
MW-67	URS downgradient	2070194.390	2534124.220	5,354.02	5,356.42	31	33.4	20.7 - 30.7	4.6
MW-68	URS downgradient	2070059.510	2534176.270		5,353.58	29	29	18.3 - 28.3	4.6
MW-69	URS downgradient	2069877.990	2534353.890	5,355.26	5,357.66	35	37.4	24.7 - 34.7	4.6
MW-70	URS downgradient	2070090.580	2534558.230	5,368.52	5,371.12	50	52.6	39.7 - 49.7	4.6
MW-71	URS/CWTP upgradient	2069273.310	2533344.690	5,363.60	5,362.91	50	49.3	22.5 - 42.5	4
MW-72	URS/CWTP upgradient	2069248.070	2534270.980	5,379.10	5,381.62	61	63.5	50.7 - 60.7	4
MW-73	URS/CWTP upgradient	2070658.000	2531266.170	5,351.90	5,353.95	45	47	28.9 - 43.9	4
MW-74	Multiunit upgradient	2073802.410	2530570.320	5,216.70	5,219.09	40	42.4	8.1 - 18.1	4
MW-75	Multiunit downgradient	2068503.980	2523705.350	5,124.80	5,126.80	41	43	29.0 - 39.0	4
MW-76	Multiunit downgradient	2067954.000	2523375.130	5,114.30	5,116.23	33	34.9	11.8 - 26.8	4

* Measuring Pt Elev is top of bladder pump sounding port (0.13" above top of PVC)

Documentation of the drilling, well construction, and development activities are presented in the Final CCR Monitoring Well Network Report and Certification dated September 15, 2017.

3 Project Organization

APS contracted with AECOM for the performance and management of the well installation and first round of sampling work described in this Sampling and Analysis Plan. APS decided to use existing staff to complete the remaining 7 rounds of background sampling. At this time, APS continues to provide field sampling resources with existing staff.

3.1 APS Project Manager

The APS Project Manager, Michele Robertson, will work with the AECOM Project Manager to coordinate resources and review project deliverables. Ms. Robertson is the primary APS point of contact for AECOM and Amec Project Managers.

3.2 Project Manager

The AECOM Project Manager, Daniel Sola, managed and directed the first round of CCR groundwater monitoring for FCPP, ensured that adequate qualified resources were available, and that all project personnel understood the project goals and were properly trained. Ms. Natalie Chrisman is the Amec Project Manager. Amec Foster Wheeler continues to provide QA checks of data quality, to identify corrective actions, and to communicate with the laboratory, if warranted.

3.3 Quality Assurance Manager

The AECOM Quality Assurance (QA) Manager, Ms. Marianne Burrus, had responsibility to ensure all laboratory procedures follow the protocols established in the QAPP for the first sampling round. Ms. Chrisman, as Amec project manager, has assumed responsibilities for the project that include ensuring data verification/validation tasks are conducted. If Ms. Chrisman determines that laboratory procedures do not adhere to the established protocols and the data integrity may be impacted, it is her responsibility to inform the APS Project Manager so that corrections can be promptly initiated at the laboratory. Data validation reports are completed following each sampling event.

3.4 Field Staff

The AECOM Field Manager, Rick Smith was responsible for sample collection protocols and sample management including documentation, packaging, and shipment of samples to the analytical laboratory. APS staff assumed these responsibilities starting in April 2016 through the present. Field staff are responsible for understanding and implementing the project tasks in accordance with this SAP and associated SOPs.

4 Quality Assurance Project Plan

Appendix A contains the APS Quality Assurance Project plan (QAPP). An update to Table 2.8 of the QAPP applies to the CCR groundwater sampling.

Groundwater Protection Standards have not yet been established for the Site, and are pending completion of the statistical background evaluation required by the Rules. EPA MCLs were used to assess detection limits and to select laboratory methods. Twelve of the constituents listed in Appendix III and Appendix IV to 40 CFR § 257.90 have MCLs and nine do not. Appendix B presents an updated version of the APS QAPP Table 2.8, reflecting the current MCLs.

5 Field Activities

5.1 Health and Safety Plan

AECOM followed the current Health and Safety Plan (HASP) for FCPP to establish protocols to minimize hazards to personnel performing field activities and to the environment. The updated HASP described the Site and included a description of the scope of work, site control practices, potential chemical and physical hazards, personal protective equipment, emergency response procedures, communications, and decontamination procedures. Although this work is not considered hazardous waste operations, the HASP met the requirements of 29 CFR 1910.120.

APS staff will use Human Performance tools, understand the hazards of the work, wear proper personal protective equipment, use the corrective action program, and hold regular pre-job briefings. Staff know and understand the APS Accident Prevention Manual and Safe Working Rules.

5.2 Groundwater Elevations

Prior to purging and sampling, depth-to-water (DTW) will be measured in the wells using an electronic water level meter. DTW measurements for each event will be collected in a single day to avoid temporal and operations-induced variations in the water table. Static water level will be measured to the nearest 0.01-foot from the designated measuring point, usually the north side of the top of the inner well casing. The water level meter will be decontaminated with distilled water prior to and following use at each well.

Depth-to-water measurements and total well depth measurements will be recorded in a field logbook, on field sheets, or electronically at the time of measurement.

5.3 Sample Collection

At the conclusion of water level measurements, the monitor wells will be purged and sampled using low-flow purging methodology. Each well will be purged using either a peristaltic pump or bladder pump with dedicated disposable tubing until field parameters [pH, temperature, turbidity, dissolved oxygen, oxidation reduction potential, and conductivity] have stabilized. Stabilization will be conducted with a flow-through cell. Readings will be taken at a rate commensurate for the flow involved, usually no sooner than every three minutes. Low-flow purging rates on the order of 0.1 to 0.5 liters per minute (L/min) will be used depending on the site-specific hydrogeology. The tubing will be set to a point in the middle of the screened interval, 5 feet below the water table, or in instances where the screen is submerged, 5 feet below the top of the screen. The depth to the pump inlet or the bottom of tubing will be recorded on field sheets. The maximum allowable drawdown during low-flow purging is 0.3 feet. If the maximum allowable drawdown limit of 0.3 feet is exceeded and cannot be achieved, then either Total Volume Purge or HydraSleeve™ methods will be used. Field notes will reflect any deviation from the low flow purging methodology. Although turbidity goals for non-background and background samples are 15 and 10 nephelometric turbidity units (NTU), respectively, samples with higher turbidity are acceptable if turbidity readings are stabilized and the other conditions of low-flow purging have been met. Refer to AECOM SOP 005a, Groundwater Purging and Sampling (Appendix C).

Samples will be collected directly from the tubing immediately following purging. Samples will be placed in laboratory-provided containers, labeled and placed immediately in a cooler with ice in preparation for shipping or delivery to the analytical laboratory. If insufficient water is available for sampling, the well will be allowed to recharge, if possible. An inadequate water column may result in a skipped sample from that well during the sampling event.

QA/QC samples to be collected include one field duplicate sample for every 10 samples and one MS/MSD sample for every 20 samples. Equipment rinsate samples will be collected if any non-dedicated equipment is used during sampling.

5.4 Purge Water

Any equipment decontamination water will be containerized at the well head during well drilling, development, or testing. It is anticipated that small volumes of purge water associated with sampling will be disposed on the ground surface at the monitoring wells located away from the plant area. Within the plant area, purge water will be containerized for later disposal to the Upper Retention Sump (URS) or another area approved by APS.

6 Sample Labels, Preservation, and Custody

Sample handling, labeling, preservation, and custody documentation will be conducted in accordance with the AECOM SOPs. Refer to AECOM SOP 018, Packing and Shipping Environmental Samples and SOP 017, Chain-of Custody (Appendix C).

6.1 Containers And Preservation

Samples will be placed in certified clean, pre-preserved sample containers specified and supplied by TestAmerica Laboratories, Inc. of Phoenix, Arizona (TestAmerica). Sample media, analytical methods, sample containers, preservation, and hold times are summarized in Table 2.

TABLE 2 - CCR ANALYTICAL METHODS, SAMPLE CONTAINERS AND PRESERVATION

PARAMETER	ANALYTICAL METHOD	LABORATORY REPORTING LIMIT (mg/L)	HOLDING TIME	CONTAINER AND SIZE	PRESERVATION METHOD
Appendix III - Detection Monitoring Constituents					
Boron (total recoverable)	EPA 200.8[2]	0.050	180 days	Plastic - 500 mL	Nitric Acid (HNO_3) to pH <2, cool, < 6° C
Calcium (total recoverable)	EPA 200.8[2]	2.000	180 days		
Chloride	EPA 300.0	2.00	28 days	Plastic - 500 mL	Cool, < 6° C
Fluoride	EPA 300.0	0.400	28 days		
Sulfate	EPA 300.0	2.00	28 days		
Total Dissolved Solids	SM 2540 C	20.0	7 days		
pH[1]	SM 4500-H B	1.68 (SU)	15 minutes		
Appendix IV - Assessment Monitoring Constituents					
Beryllium (total recoverable)	EPA 200.8[2]	0.00100	180 days	Plastic - 500 mL	Nitric Acid (HNO_3) to pH<2,cool, <6° C
Lithium (total recoverable)	EPA 200.8[2]	0.200	180 days		
Antimony (total recoverable)	EPA 200.8[2]	0.00300	180 days	Plastic - 500 mL	Nitric Acid (HNO_3) to pH<2,cool, <6° C
Arsenic (total recoverable)	EPA 200.8[2]	0.00300	180 days		
Barium (total recoverable)	EPA 200.8[2]	0.00100	180 days		
Cadmium (total recoverable)	EPA 200.8[2]	0.00100	180 days		
Chromium (total recoverable)	EPA 200.8[2]	0.00200	180 days		
Cobalt (total recoverable)	EPA 200.8[2]	0.00100	180 days		
Lead (total recoverable)	EPA 200.8[2]	0.00100	180 days		
Molybdenum (total recoverable)	EPA 200.8[2]	0.00300	180 days		
Selenium (total recoverable)	EPA 200.8[2]	0.00200	180 days		
Thallium (total recoverable)	EPA 200.8[2]	0.00100	180 days		
Mercury (total recoverable)	EPA 245.1	0.000200	180 days	Plastic - 500 mL	Nitric Acid (HNO_3) to pH <2, cool, < 6° C
Radium 226 & 228 combined	EPA 9320	1 (pCi/L)	180 days	Plastic - 1 L	Nitric Acid (HNO_3) to pH <2, cool, < 6° C
Fluoride[3]	EPA 300.0	0.400	28 days	Plastic - 500 mL	Cool, < 6° C

[1] pH is measured in the field at the time of sample collection and checked in the laboratory

[2] EPA Method 200.8 with collision cell

[3] included in both constituent lists - analyze with Appendix III constituents

6.2 Sample Identification

Each sample will be labeled with a unique identifier and recorded in the field logbook as it is collected. Sample identification, location, time and date will be recorded on field data sheets (Appendix D). Each analytical sample will be assigned a unique number of the following format:

The sample identification system will include:

- Site Identification, Four Corners CCR (FC-CCR);
- Sample Location, Monitoring Well Number (e.g. MW-48); and
- Date sampled (MMYY).

6.3 Chain-Of-Custody and Shipping

Samples will be labeled, placed into a cooler with ice and stored at approximately 4ºC pending transportation to TestAmerica. A Chain of Custody (CoC) form provided by the laboratory (see Appendix D for a sample CoC) will accompany each shipping container or cooler. Samples will be shipped using overnight delivery to TestAmerica.

Upon receipt of the samples, the laboratory will immediately notify the Project Manager if conditions or problems are identified that require immediate resolution. Such conditions include container breakage, missing or improper CoC, exceeded holding times, temperature deviations, and missing or improper sample labeling.

7 Analytical Methods

7.1 Groundwater Samples

Groundwater samples will be delivered to Test America for quantification of total recoverable analytes consistent with § 257.93 (h) (2)(i). In addition general chemistry parameters sodium, potassium, magnesium and nitrate/nitrite may be analyzed to provide a more complete geochemical characterization consistent with past sampling. Samples will be analyzed for Appendix III and Appendix IV as required by the Rule using EPA Methods or Standard Methods as in Table 2.

8 Record Keeping

AECOM maintained a field log book with lined, consecutively numbered pages. All pages were numbered prior to initial use of the logbook. The primary document used to by AECOM to record site data was the field logbook.

After APS assumed sampling responsibilities, field sheets were developed for each monitor well. An example field sheet is included in Appendix D.

Additional written field records for this project include the chain-of-custody records. Other records that may be associated with field sampling activities include Laboratory EDDs in Locus™ format as wells as site photographs.

9 Quality Assurance And Quality Control

9.1 Equipment Decontamination

The general decontamination procedures for equipment include (1) an initial wash in a solution of Alconox® and water, (2) a thorough rinse with tap water, and (3) a final rinse with deionized water. Gloves and other personal protective equipment and equipment used for sampling (e.g., tubing) will be double bagged, placed in plastic trash bags and disposed of as municipal solid waste. Refer to AECOM SOP 021, Equipment Decontamination Procedures (Appendix C).

Low flow purge and sampling methods will be completed using either a peristaltic pump with disposable tubing or a bladder pump. The peristaltic pump allows for water to be removed from the well without coming in contact with the pump; therefore decontaminating the pump between each well is not needed. The tubing used for sampling will be dedicated to each well and be kept individually packaged and labeled for use in future sampling.

When using a bladder pump, the bladders are dedicated and will be disposed after each sample is collected. The stainless steel bladder pump housing is non-dedicated and will be decontaminated between each well.

9.2 Equipment Blanks

Field equipment blanks are samples that are prepared in the field by pouring distilled water over decontaminated sampling equipment (bladder pump housing) and collecting the water in laboratory provided sampling containers. For the peristaltic pump distilled water is pumped thought the tubing. The water is then collected and analyzed as a sample. Field equipment blanks will be labeled using the nomenclature on Table 5. The field equipment blank gives an indication of contamination from field procedures (e.g., improperly cleaned sampling equipment, cross-contamination).

9.3 Field Duplicate Samples

Duplicate samples will be collected during the groundwater sampling and will be analyzed for the same parameters as the primary sample in order to evaluate sampling and analytical precision. Field duplicate samples will be numbered in a manner such that it will not be obvious to the laboratory from which well the duplicate was collected. The well number for the field duplicate will be recorded on the field sheet or in the project field logbook. Each sample (primary and field duplicate) will have a unique sampling time.

Agreement between duplicate sample results will indicate good sampling and analytical precision. Field duplicates are collected at a frequency of 10 percent of the primary samples collected, with a minimum of one duplicate collected. The precision goal for field duplicate analyses will be plus or minus a 20 relative percent difference (RPD).

9.4 Temperature Blanks

Temperature Blanks will be provided by the laboratory and will accompany each sample container. Temperature blanks will be used to evaluate the temperature of the samples that were stored in the cooler between sample collection and delivery to the laboratory. The temperature of the blanks will be measured upon receipt of the sample cooler at the laboratory and the temperature will be noted on the CoC.

9.5 Matrix Spike/ Matrix Spike Duplicates

Matrix Spike/ Matrix spike duplicate (MS/MSD) samples will be collected, prepared, and analyzed at a frequency of 5 percent. MS/MSD samples will be analyzed for all analytes except radionuclides. MS/MSD recoveries will be evaluated against the method requirements and laboratory SOPs in the data verification review.

9.6 Data Validation

The laboratory will provide a USEPA Level II quality control laboratory data package for all laboratory analysis, which includes all documentation required by the QAPP. Following receipt of the Level II data package from the laboratory, data validation evaluates the reliability and defensibility of the analytical data. This process involves reviewing the data against a known set of criteria to verify data validity. The data validation criteria will follow the procedures outlined in the QAPP.

10 Reporting

The well network certification report was completed September 17, 2017. This report certified, in accordance with § 257.91(f), that the monitoring well network was designed and constructed to meet the requirements of § 257.91 considering the hydrogeologic setting, site history, number, spacing and orientation of each CCR unit, engineering design of each CCR unit, basis for the well installation, justification for the location and number of monitor wells, and the designation of multiunits as defined in the Rule. This SAP may be amended based on future sampling and a revised SAP will be developed.

Annual reporting will begin no later than January 2018 (reflecting the 2017 monitoring period) as required by the Rules § 257.90 (e) and January 31 for each subsequent year. The Rules require, at a minimum, that the annual groundwater monitoring report contain the following information, to the extent available:

"*(1) A map, aerial image, or diagram showing the CCR unit and all background (or upgradient) and downgradient monitoring wells, to include the well identification numbers, that are part of the groundwater monitoring program for the CCR unit;*

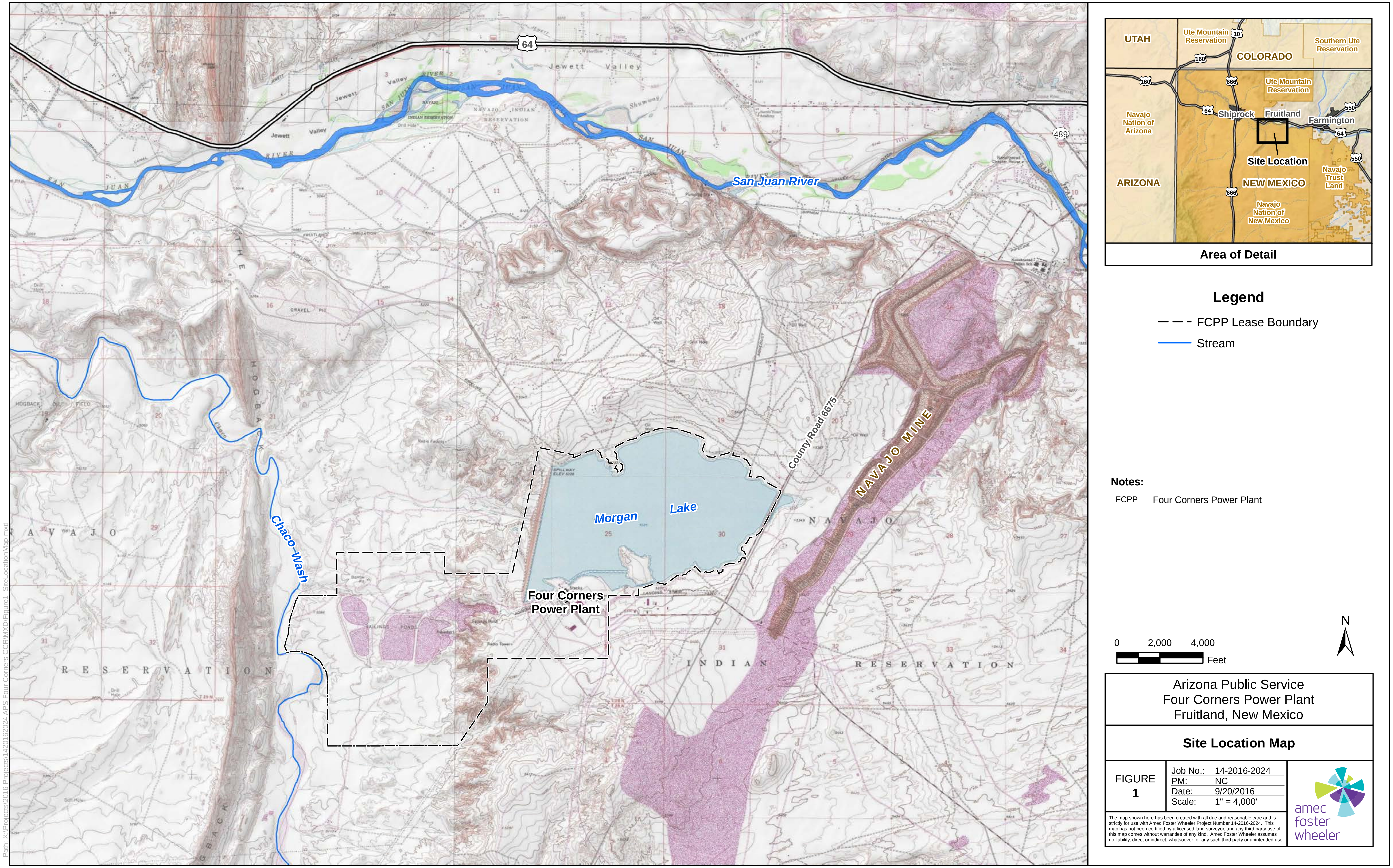
(2) Identification of any monitoring wells that were installed or decommissioned during the preceding year, along with a narrative description of why those actions were taken;

(3) In addition to all the monitoring data obtained under §§ 257.90 through 257.98, a summary including the number of groundwater samples that were collected for analysis for each background and downgradient well, the dates the samples were collected, and whether the sample was required by the detection monitoring or assessment monitoring programs;

(4) A narrative discussion of any transition between monitoring programs (e.g., the date and circumstances for transitioning from detection monitoring to assessment monitoring in addition to identifying the constituent(s) detected at a statistically significant increase over background levels); and

*(5) Other information required to be included in the annual report as specified in (*the Rules*) § 257.90 through 257.98.*"

Figures



Legend

- - - FCPP Lease Boundary

— Stream

Notes:

FCPP	Four Corners Power Plant

Arizona Public Service
Four Corners Power Plant
Fruitland, New Mexico

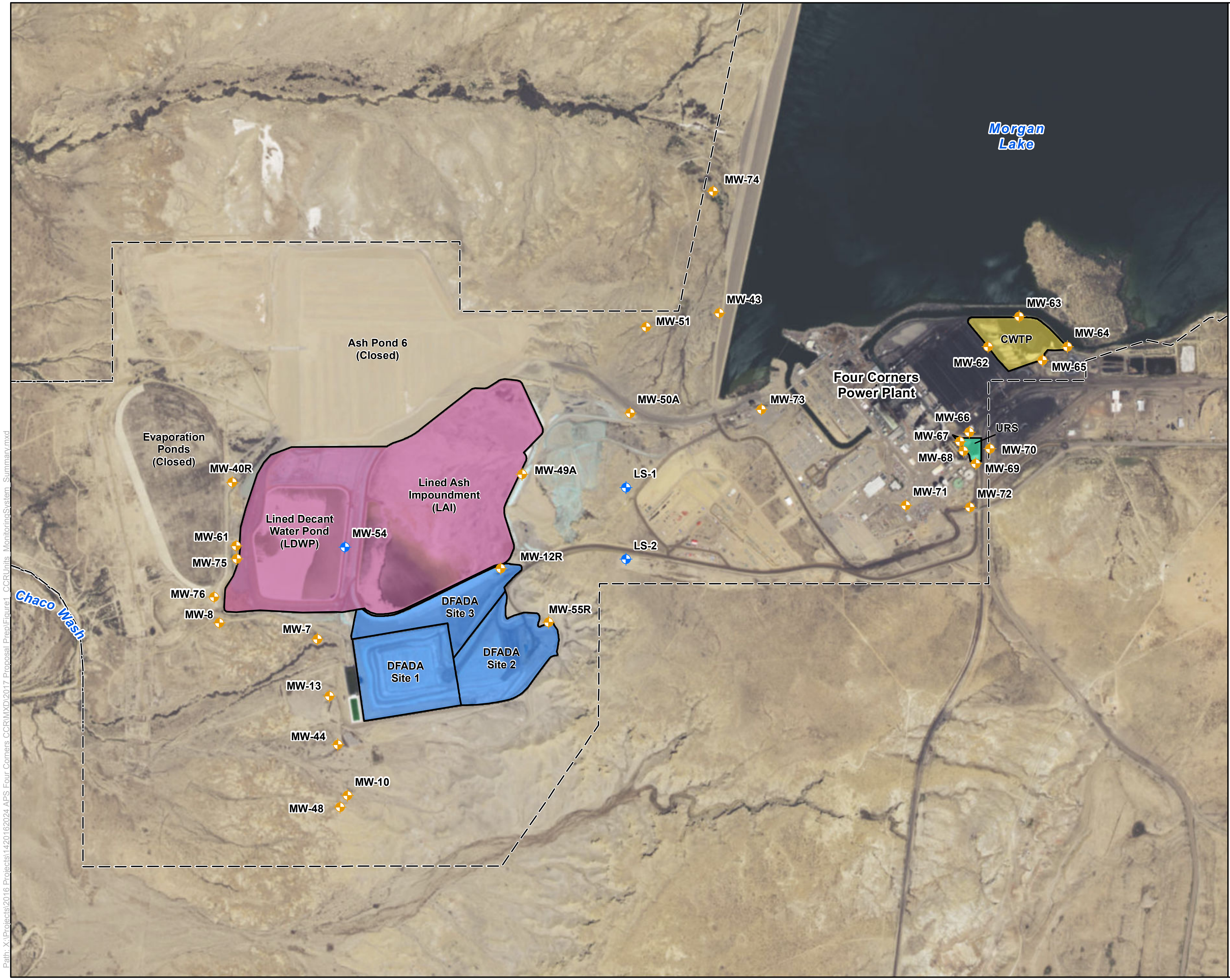
Site Location Map

FIGURE
1

Job No.:	14-2016-2024
PM:	NC
Date:	9/20/2016
Scale:	1" = 4,000'

amec foster wheeler

Path: X:\Projects\2016 Projects\1420162024 APS Four Corners CCR\MXD\Figure1_SiteLocationMap.mxd



Legend

◆ CCR Monitoring Well Location

◆ Supplementary Site Monitoring Well Location

— — FCPP Lease Boundary

CCR Units

🟪 Multiunit 1 (LAI and LDWP)

🟦 Dry Fly Ash Disposal Area (DFADA)

🟨 Combined Waste Treatment Pond (CWTP)

🟩 Upper Retention Sump (URS)

Notes:

CCR	Coal Combustion Residuals
CWTP	Combined Waste Treatment Pond
DFADA	Dry Fly Ash Disposal Area
FCPP	Four Corners Power Plant
LAI	Lined Ash Impoundment
LDWP	Lined Decant Water Pond
URS	Upper Retention Sump

0 350 700 1,400
Feet

N

Arizona Public Service
Four Corners Power Plant
Fruitland, New Mexico

CCR Units and Monitoring System Summary

FIGURE
2

Job No.: 14-2016-2024
PM: NC
Date: 10/5/2017
Scale: 1" = 1400'

amec foster wheeler

Appendix A
Arizona Public Service Quality Assurance Project Plan

Final

Arizona Public Service
Quality Assurance Project Plan

Prepared for

Arizona Public Service

August 2012

CH2M HILL
1501 W. Fountainhead Pkwy
Suite 401
Tempe, AZ 85282
480.966.8188

Title Page

Document Title: Arizona Public Service Quality Assurance Project Plan

Site Name: MGP and Non-MGP Sites

Site Location: Various Sites in Arizona

Anticipated Sampling Dates: Ongoing

Prepared By: CH2M HILL

Date: Original Date: 11/30/1999; Latest Revision: August 22, 2012;
Produced -

Address: 1501 W. Fountainhead Pkwy, Suite 401

City/State/Zip: Tempe, AZ 85282-3397

Telephone: (480) 966-8188

APS Project Manager: Judy Heywood Phone: (602) 250-3850

Quality Assurance Project Plan Approvals

Date:

Judy Heywood, Remediation Project Manager, APS

Phone No.: 602-250-3850

Allard

August 31, 2012

Date:

Dave Allard, Project Manager, CH2M HILL

Phone No.: 480-295-3913

Davis

August 31, 2012

Date:

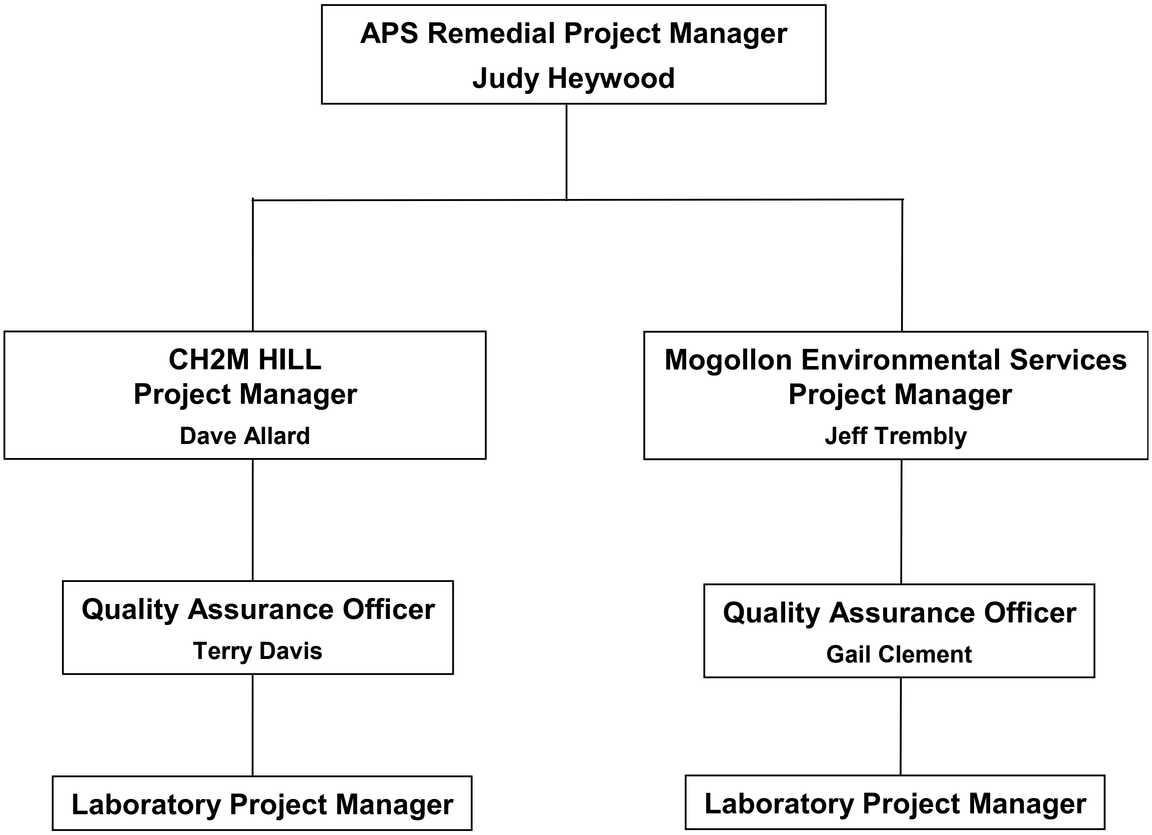
Terry Davis, Quality Assurance Officer/CH2M HILL

Phone No: 530-243-5831 x3375

Date:

Arizona Department of Environmental Quality

Organization Chart



Contents

Tables

Appendixes

Acronyms and Abbreviations

%R	percent recovery
°C	degrees Celsius
µg/kg	microgram(s) per kilogram
ADEQ	Arizona Department of Environmental Quality
ADHS	Arizona Department of Health Services
APS	Arizona Public Service
AWQS	Aquifer Water Quality Standard
BOD	biochemical oxygen demand
BTEX	benzene, toluene, ethylbenzene, and xylenes
CA	corrective action
CLP	Contract Laboratory Program
COC	chain of custody
CCV	continuing calibration verification
DO	dissolved oxygen
DQO	data quality objectives
EDD	electronic data deliverables
Exposure Duration-adult	EDa
Exposure Duration-child	EDc
GC/MS	Gas chromatography/mass spectrometry
GPL	groundwater protection level(s)
HPLC	high-performance liquid chromatography
ICP	inductively coupled plasma
LCS	laboratory control sample
LFB/LFBD	Laboratory fortified blank/laboratory fortified blank duplicate
$MeCl_2$	methylene chloride
MDL	method detection limit

MGP	manufactured gas plants
MRL	minimum reporting level
MS/MSD	matrix spike/matrix spike duplicate
NIOSH	National Institute for Occupational Safety and Health
OEHHA	Office of Environmental Health Hazard Assessment
PAH	polynuclear aromatic hydrocarbons
PCB	polychlorinated biphenyls
PL	groundwater protection levels
PQL	practical quantitation limit
PRG	Preliminary Remediation Goals
QA/QC	quality assurance and quality control
QAPP	Quality Assurance Project Plan
RAP	remedial action plan
RCRA	Total Resource Conservation and Recovery Act
REL	inhalation reference value
RPD	relative percent difference
RSD	relative standard deviation
SAP	sampling and analysis plan
SM	standard methods
SRL	soil remediation levels
SWQS	Surface Water Quality Standards
TCLP	Toxicity Characteristic Leaching Procedure
TPH	total petroleum hydrocarbons
USEPA	United States Environmental Protection Agency
VOC	volatile organic compounds
VRP	Voluntary Remediation Program

SECTION 1.0

Introduction

This Quality Assurance Project Plan (QAPP) is intended to serve as a guide to APS, its consultants, and analytical laboratory personnel for sample analysis and laboratory performance evaluations at both former APS manufactured gas plants (MGP) and non-MGP related projects in Arizona. The sites covered by this QAPP include the former MGPs located at 300 North Granite Street in Prescott, Arizona (Prescott MGP); 501/505 South 2nd Avenue (501/505 MGP) and 331 West Grant Street (Grant Street Yard), Phoenix, Arizona; 2919 Latham Boulevard, Miami, Arizona (Miami MGP); Northwest corner of intersection of Mesquite and Pine Streets, Globe, Arizona (Globe MGP); 175 North Main Street, Yuma, Arizona (Yuma MGP); Washington Street and 5th Avenue, Phoenix, Arizona; Douglas, Arizona; and other sites that Arizona Public Service (APS) deems appropriate. These additional APS sites are projects that are currently enrolled or anticipated to be enrolled in the Arizona Department of Environmental Quality (ADEQ) Voluntary Remediation Program (VRP). The current list of non-MGP APS sites in the ADEQ VRP that are utilizing this QAPP include Cholla Power Plant, Joseph City, Arizona, Yucca Power Plant, Yuma, Arizona, and West Phoenix Power Plant, Phoenix, Arizona. In addition, this QAPP may be utilized for projects related to Energy Delivery operations and during property assessments investigations associated with real estate transactions.

This QAPP details specific quality assurance and quality control (QA/QC) requirements that apply to the APS sites. These QA/QC requirements are designed to assist in achieving the project data quality objectives (DQO) and analytical DQOs for all sampling activities, remedial actions, and periodic groundwater and surface water monitoring that will be performed at the former MGPs and additional APS sites. This document should be used as a foundation from which to build site-specific work plans that address each phase of work to be performed at the former MGPs and additional APS projects.

The guidelines for preparing this QAPP are presented in the United States Environmental Protection Agency (USEPA) document *USEPA Requirement for Quality Assurance Project Plans for Environmental Data Operations; USEPA QA/R-5*, dated October 1997.

The intended purpose of this QAPP is to provide program QA/QC consistency throughout APS site monitoring and remedial activities. Additional information on the data quality review process is described in the *Guidance for Data Quality Assessment: Practical Methods for Data Analysis; USEPA QA/G-9,* dated January 1998. This document provides the guidance to perform the scientific and statistical evaluation of the data to ensure the project data objectives of quality and quantity are met to support project needs and their intended use.

This QAPP presents the guidelines for monitoring the performance of the analytical laboratory and is not intended to supersede the laboratory's QAPP. All project personnel will be required to read the QAPP. A copy of the QAPP will be maintained at the field sites during every sampling event at each site.

A program QAPP is a living document and will be updated as required. An environmental consulting firm under contract with APS will be responsible for the QAPP updates and ensuring that the QAPP is kept current. Any questions or comments on the QAPP, or suggestions for future revisions should be presented to the APS project manager.

The attached table of contents form (Table 1.0) will be used to track changes to the QAPP by page number, section number, revision number, and revision date. Following an update to the QAPP, the associated QAPP document text and/or table requiring amendments will be modified to reflect the revision number and revision date to correspond with Table 1.0. When the update is final, all users will be issued a copy of the revised Table 1.0 and corresponding amendments.

SECTION 2.0

Project Management

2.1 Project Description

2.1.1 Problem Definition/Background

This section describes the historical background and activities that were conducted at the APS sites. A detailed background information about each site and description of the task being undertaken, including the specific problems(s) to be solved, and decisions to be made, can be found in the site-specific work plan or remedial action plan (RAP).

2.1.2 Manufactured Gas Plant-Related Projects

Once at the forefront of industrial technology, MGPs provided fuel for streetlights, reading lamps, heating, and cooking throughout the United States from the early 1800s through the middle of the 20th Century. It has been estimated that, at their peak, more than 1,500 MGPs provided manufactured gas to U.S. customers. Manufactured gas was produced by three primary processes: coal carbonization, carbureted water gas, and oil gas. MGP sites often vary significantly in the specific types and quantities of residual wastes present, depending on the types of processes used and the era in which the plant operated. In general, the compounds of interest, which could be present at MGP sites, can be divided into five chemical types: inorganics, metals, volatile aromatics, phenolics, and polynuclear aromatic hydrocarbons (PAH). PAH-containing soils represent the largest waste type at most MGP sites. A complete description of each specific MGP site and constituents of concern for that process will be presented in the site work plan or RAP(s).

A description of each project site is presented in the following documents:

- Additional Site Investigation Former APS Manufactured Gas Plant Site Prescott, Arizona. ARCADIS Geraghty & Miller. June 8, 1998.
- Remedial Action Closure Report for the APS Former Manufactured Gas Plant, Prescott, Arizona. CH2M HILL. August 2002.
- Groundwater and Surface Water Field Sampling Plan Former Prescott Manufactured Gas Plant. CH2M HILL. June 2002.
- Site Investigation Report, Former MGP at 505 South 2nd Avenue, Phoenix, Arizona, Volumes I and II. Brown and Caldwell. December 29, 1998.
- Final Focused Remedial Investigation Report, APS 501, 502 and 505 South 2nd Avenue Properties, Motorola 52nd Street Superfund Site, OU3. AMEC. May 2010.
- Site Investigation Report at the Former Grant Street Yard Manufactured Gas Plant, 331 West Grant Street, Phoenix, Arizona. Brown and Caldwell. October 1, 1998.
- Site Investigation Report at the Former Manufactured Gas Plant, 2919 Latham Blvd., Miami, Arizona. Brown and Caldwell. September 2, 1999.

- Additional Site Investigation Former Globe Manufactured Gas Plant Site, Globe, Arizona. ARCADIS Geraghty & Miller. May 26, 1999.
- Remedial Action Plan for the APS Former Manufactured Gas Plant, Globe, Arizona. CH2M HILL. April 2007.
- Site Investigation Report Former Manufactured Gas Plant, 175 North Main Street, Yuma, Arizona. Brown and Caldwell. September 30, 1999.
- Remedial Action Closure Report for the APS Former Manufactured Gas Plant, Yuma, Arizona. CH2M HILL. February 2004.
- Groundwater Field Sampling Plan for the APS Former Manufactured Gas Plant, Yuma, Arizona. CH2M HILL. February 2004.
- Former APS Manufactured Gas Plant Site Material Removal and Groundwater Investigation Washington Street and 5th Avenue, Phoenix, Arizona. ARCADIS Geraghty & Miller. April 8, 1998.
- Material Removal Activities Former APS Manufactured Gas Plant Site Douglas, Arizona. ARCADIS Geraghty & Miller. June 5, 1998.

2.1.3 Non-Manufactured Gas Plant-Related Projects

The APS non-MGP-related sites that will use this QAPP are sites that are related to the generation, transmission, and distribution of electricity. These sites include power generation facilities, substations, service centers, construction yards, and parcels acquired by APS. The sites are either in or candidates for the ADEQ VRP Program.

A description of each project site currently using this QAPP is presented in the following documents:

- Cholla Power Plant—ADEQ VRP—Site Codes 090050-00, 090050-02, and 090050-03
- Groundwater Monitoring Report , November 2010 through October 2011,VRP No. 090050-00 and 090050-03,, Cholla Power Plant, Joseph City, Arizona, prepared by Mogollon Environmental Services LLC and dated March 2012.
- Groundwater Monitoring Report, March 2011 through October 2011, ADEQ VRP No. 070932-00, West Phoenix Power Plant, Phoenix, Arizona, prepared by Mogollon Environmental Services LLC and dated March 2012..

As APS sites using this QAPP are identified, the project descriptions will be added to Appendix A.

2.2 Purpose

The QAPP is intended to provide field and laboratory personnel with guidance for the field activities as well as sample handling activities within the laboratory for each sampling event. The QAPP contains general and specific guidance on sample collection methodology, sample handling, sample containers, and laboratory procedures. The guidelines will be followed by project personnel during each sampling event.

2.3 Scope and Objectives

This QAPP is intended to provide guidance for APS, its consultant, and analytical laboratory personnel performing remedial actions, periodic water sampling, and other applicable activities at APS sites. This QAPP is not intended to replace the laboratory's QAPP. It is intended to provide guidance for field QC collection, method selection, DQOs, and program specific validation guidelines. All participating parties provided input during the preparation of this QAPP.

2.4 Project Management Responsibilities

This section describes the organizational structure of personnel involved with this program. This description defines the lines of authority and identifies key personnel assigned to various activities for the program. The organization is essentially a hierarchical structure. The project manager will be the key operational manager for project execution and will be primarily responsible for project plan development and implementation of the project tasks. The QAPP-related tasks for which the consultant and contracted laboratory personnel are responsible are described in the following sections.

2.4.1 Arizona Public Service Personnel

The APS project manager will be the primary contact at APS. Ms. Heywood will be responsible for coordinating onsite activities described in the various program work plans and RAPs. All project-related activities will be managed by APS project manager. Any recommended updates or revisions to the QAPP should be presented to the APS project manager.

APS Project Manager:	Judy Heywood
Title:	Remediation Project Manager
Address:	Mail Station 9303 Post Office Box 53999 Phoenix, Arizona 85072-3999
Office:	(602) 250-3850
Fax:	(602) 250-3872
Cell:	(602) 818-0259

2.4.2 Consultant

The consultant will appoint a project manager that will be responsible for the overall project implementation. The consultant project manager will have the authority to commit the necessary resources to ensure timely completion of project tasks. The consultant project manager reports directly to the APS project manager and is responsible for reviewing project progress, and all documents, plans, and drawings before they are sent to the APS project manager.

Consulting firm: CH2M HILL
Project Manager: Dave Allard
Title: Project Manager
Address: 1501 W. Fountainhead Pkwy, Suite 401,
Tempe, Arizona 85282
Office: (480) 295-3913
Fax: (480) 966-9450

Consulting firm: Mogollon Environmental Services
Project Manager: Jeff Trembly
Title: Project Manager
Address: 2905 East Flower Street,
Phoenix, Arizona 85016
Office: (602) 778-6810
Fax: (602) 778-6815

The consultant quality assurance officer will be responsible for oversight of the subcontracted laboratories for all projects contracted to their consulting firm. Other responsibilities for the consultant quality assurance officer may include management of field and laboratory audits, review of field QC sample collection and analytical program designs, validation of field and analytical data, and documentation of the field and analytical results.

Consulting firm: CH2M HILL
Quality Assurance Officer: Terry Davis
Address: 523 South Louisiana Suite 304
Little Rock, AR 72201
Office: (530) 243-5831 x3375

Consulting firm: Mogollon Environmental Services/
G.M. Clement and Assoc., Inc.
Quality Assurance Officer: Gail Clement
Address: 301 Baron Drive
Sedona, AZ 86336
Office: (928) 282-3630
Fax:

2.4.3 Analytical Laboratory

The analytical laboratory project manager will act as the primary liaison to the consultant during implementation of project activities and will be responsible for the review of the final analytical reports submitted for this project. The analytical laboratory project manager will also be responsible for coordination with the laboratory QA officer to implement the DQOs established in this program QAPP and alerting the consultant to DQO and method updates before analysis and data submittal. The analytical laboratory project manager is responsible for the oversight and deliverables submitted by laboratories subcontracted by the originating laboratory.

Mobile/Fixed-base

Laboratory: TestAmerica Analytical Testing Corporation
(formerly Del Mar Analytical Lab and Aerotech
Environmental Lab): AZ0426, AZ0610
Project Manager: Kylie Emily
Title: Project Manager
Address: 4645 E. Cotton Center Blvd., Building 3, Suite 189,
Phoenix, Arizona 85040
Office: (602) 659-7622
Fax: (602)-454-9303

Mobile/Fixed-base
Laboratory: Xenco Laboratories (formerly Columbia Analytical Services
Inc.,): AZM133
Project Manager: Skip Harden
Title: Project Manager
Address: 3725 E. Atlanta Avenue, Suite 2,
Phoenix, Arizona 85040
Office: (602) 437-0330
Fax: (602) 437-0660

Mobile/Fixed-base
Laboratory: Orange Coast Analytical: AZM499, AZ0558, AZ0646
Project Manager: Patrick Freeman
Title: Project Manager
Address: 4620 E. Elwood, Suite 4,
Phoenix, Arizona 85040
Office: (480) 736-0960
Fax: (480) 736-0970

Air Laboratory: American Environmental Testing Laboratory (AETL) (not
ADHS certified)
Project Manager: Cyrus Razmara
Title: Laboratory Director
Address: 2834 North Naomi Street
Burbank, California 91504
Office: (818) 845-8200
Fax: (818) 845-8840

Air Laboratory: H&P Mobile Geochemistry (not ADHS certified)
Project Manager: Suzie Reed and Louise Adams
Title: Project Manager
Address: 2470 Impala Drive
Carlsbad, CA 92010
Office: (760) 804-9678
Fax: (760) 804-9159

Air Laboratory: Air Toxics LTD: AZ0719
Project Manager: Kyle Vagadori
Title: Project Manager
Address: 180 Blue Ravine Road
Folsom, CA 95630
Office: (916) 985-1000
Fax: (916) 605-3339

2.5 Project Goals

2.5.1 Quality Objectives and Criteria for Measurement Data

The DQOs for each project are discussed in the site-specific work plan. The DQOs are the basis for the design of the data collection plan and, as such, they specify the type, quality, and quantity of data to be collected and how the data are to be used to make the appropriate decisions for the project. The DQOs are developed through a seven-step process, each step of which derives valuable criteria that are used to establish the final data collection design. The first five steps of the process identify mostly qualitative criteria, such as what problem initiated the project and what issue needs to be resolved. These steps also define the type of data to be collected, where and when the data will be collected, and how the decision should be made. The sixth step defines quantitative criteria expressed as limits on decision errors that can be tolerated by the decision maker. The final step is the development of the data collection design using the criteria developed in the previous six steps. The final output of the process is a data collection design that meets the qualitative and quantitative needs of the project.

The general regulatory standards that will be applied to the various APS sites are discussed below. The specific regulatory standards, as well as other standards, that will be used at each site will be a function of the site-specific project DQOs. The sites-specific QAPP, work plan, remedial action plan, or equivalent document should discuss which specific standards will be used, and how these standards will be applied to meet the DQOs.

Table 2.1 and 2.2 summarize the 1996 Soil Remediation Standards (or soil remediation levels [SRLs]) last amended on December 4, 1997, and the revised rule and new standards promulgated on May 5, 2007.

The 1996 Soil Remediation Standards were revised and updated to be consistent with current scientific data and statues. The revised rule requires the use of 1×10^{-6} excess lifetime cancer risk level for remediation at sites if the current or intended future use is a school or child care facility where children are reasonably expected to be in frequent and repeated contact with the soil. In addition, petroleum hydrocarbons (C10-C32) no longer have a SRL (residential or non-residential). The revised rule does not set a single numeric SRL value for petroleum hydrocarbons (ADEQ, 2006); instead the revised rule provides a cleanup of petroleum hydrocarbons by requiring cleanup of all individual petroleum constituents detected in soil which have a SRL (ADEQ, 2006). These include BTEX and PAHs, which are present at some of the APS sites.

Sites which have already been characterized and have initiated remediation and/or completed a risk assessment prior to the promulgation of the new rule on May 5, 2007, can continue to apply the 1996 SRLs but the site must receive closure within three years (that is, May 5, 2010). If the 1996 SRLs cannot be met within the 3-year period, the new SRLs would apply. These new SRLs apply to all sites not conducting remediation or risk assessment as of May 5, 2007.

In addition to the SRLs, groundwater protection levels (GPL) may be used to protect water quality based on soil that has been affected site-related constituents of concern at each site as presented in Table 2.1. Three of the compounds listed on Table 2.1 and 2.2 have residential SRLs that are lower than the analytical laboratory can reliably achieve. However, these compounds (1,2,3-trichloropropane, 1,2-dibromoethane, and vinyl chloride) are not expected to be indicator compounds at the MGP sites. Laboratory flags will be added to any data in which the method detection limit (MDL) or practical quantitation limit (PQL) exceeds the SRLs. Additionally, the ADEQ has approved the laboratory reporting limits, acknowledging the discrepancy. The non-MGP related sites may also use the GPL. The GPL table will be updated to include additional compounds as they are identified.

Groundwater that has been or has the potential to be affected by residual MGP by-products or non-MGP related compounds will be monitored by periodic sampling. Any constituents detected in groundwater will be compared with their respective Aquifer Water Quality Standard (AWQS). The AWQS are presented in Table 2.3. One of the compounds listed on Table 2.3 has an AWQS that is lower than the analytical laboratory can reliably achieve. However, this compound (1,2-dibromoethane) is not expected to be indicator compounds at the MGP sites. Additionally, the ADEQ has approved the laboratory reporting limits, acknowledging the discrepancy.

The ADEQ has established numeric water quality standards, hereafter referred to as Arizona's Numeric Surface Water Quality Standards (SWQS), for designated uses of the state's surface waters. Surface water sampling will be conducted to determine if target analytes exceed the SWQS listed in Table 2.4. Concentrations established as the SWQS for several compounds are lower than the laboratory can reliably achieve during routine operations. In these cases, the regulations state that the water quality standard is enforceable at the PQL. Section 3 provides a detailed discussion on PQLs.

Selected soil samples may be analyzed at the fixed-base laboratory to determine whether the soil is considered to be a hazardous waste. Table 2.5 provides EPA-established concentrations for soil leachate for comparison in the Toxicity Characteristic Leaching Procedure (TCLP) analysis. If the concentrations in Table 2.5 are exceeded, the soil would be considered a hazardous waste.

Air samples may be collected periodically as part of remedial activities at each of the former MGP sites. Air monitoring performed for health and safety purposes will be addressed in a site-specific health and safety plan. Air samples collected in conjunction with remediation system emissions will be compared with permit requirements or the Arizona Ambient Air Quality Guidelines as they apply to each site. Air samples collected for laboratory analysis in conjunction with perimeter monitoring during excavation activities will be compared with the pre-determined allowable community air monitoring concentrations listed in Table 2.6.

USEPA Region 9 Ambient Air Preliminary Remediation Goals (PRG) are risk-based tools for evaluating and remediating contaminated sites. The USEPA Region 9 PRGs combine the current USEPA toxicity values with "standard" exposure factors to estimate contaminant concentrations in environmental media (i.e., soil, air, and water). The USEPA Region 9 PRGs for polynuclear aromatic hydrocarbons (PAH) and benzene presented in Table 2.6 are non-site-specific.

The standard USEPA Region 9 PRG concentrations include the residential exposure duration to calculate the age-adjusted carcinogen PRG concentration assuming a child exposure of 6 years and an adult exposure of 24 years (EDc [Exposure Duration-child] = 6 years and EDa [Exposure Duration-adult] = 24 years). To account for exposure scenarios related to limited-duration field activities (i.e., excavation), alternate ambient air PRG concentrations for PAHs have also been determined. To calculate the alternate values, the EDc and EDa have been changed to 1 year. The calculated 1-year values are presented in Table 2.6. These alternate PRGs apply to any APS sites where the excavation activities will be completed within one year.

The pre-determined allowable community air monitoring concentration for benzene at former MGP excavations is based on the USEPA Office of Environmental Health Hazard Assessment (OEHHA) "Technical Support Document for the Determination of Noncancer Reference Exposure Levels." This document identifies the chronic (long-term) inhalation reference value (REL) for benzene at 60 micrograms per cubic meter (19 ppbv [parts per billion by volume]), as specified in Table 2.6.

Because there is no PRG ambient air value for lead, the Occupational Safety and Health Administration Permissible Exposure Level of 0.05 milligram per cubic meter will be used to evaluate the allowable concentration of lead in the air samples.

2.6 Project Documentation

The following is a list of required documents for sites that are undergoing remedial activities or periodic water sampling:

- Copies of all appropriate permits to complete the scope of work
- Field notebook
- Periodic water level measurement, as and where appropriate
- Field sampling records for perimeter air monitoring, soil, and groundwater sampling, where appropriate, including the sample name, sample location, and purpose of sample

- Sample chain of custody (COC) records from onsite mobile laboratory
- Sample COC records with the sample temperature at time of receipt at laboratory (for samples that are submitted to fixed-base laboratory) noted
- Final analytical data packages from the analyzing laboratory, completed as required in the site-specific work plan for the requested data deliverable level as described in Section 7.3
- Soil volatile organic compound (VOC) methanol preservation logs
- Data validation report
- Work Plan, QAPP, and all other-site-specific documents

These documents will be included, as appropriate, in the remedial action report following remedial activities, or in periodic water monitoring reports. These documents will be kept on file by the consultant for the duration of the project. The files will be transferred to the APS project manager at the completion of the project.

2.7 Data Report to the Arizona Department of Environmental Quality

The site-specific work plan or equivalent document will specify the reports required by ADEQ, the frequency for submission of such reports, and the required information to be included the reports. The length of retention for these reports will also be addressed.

2.8 Special Training Requirements and Certification

Special training and certification required for personnel to complete tasks for each project will be identified and described in the site-specific work plan or equivalent document. Appropriate personnel will be designated to oversee the implementation and documentation of training and certification.

SECTION 3.0

Field Measurement and Data Acquisition

3.1 Analytical Method Requirements

The general categories of data that may be collected will include field screening data, confirmational data, health and safety monitoring, and monitoring data for soil, water, soil vapor, and air samples. The QAPP presents a comprehensive list of the potential measurements and analyses that will be performed at the various APS sites over the course of the project. The methods to be used are summarized in Tables 3.1, 3.2, and 3.3. Specific methods and analyte lists to be used at each site will be included in the site-specific QAPP, work plan, or equivalent document. The site-specific document(s) should also address the work schedule, special personnel training and certification requirements, equipment requirements, and assessment techniques to be used to ensure that all procedures are followed. Laboratory personnel must meet the requirements specified for each method used. Contingency plans must be accessible in the laboratory in the event the analytical system fails. The laboratory project manager is responsible for initiating timely corrective action and ensuring its effectiveness. Any system failures or deviations from method requirements that have the potential to affect data quality must be properly documented in the case narrative to be included in the data package.

3.1.1 Soil Sample Analysis

3.1.1.1 Mobile Laboratory Soil Analysis

Field screening data will include analyses performed by the mobile laboratory. The mobile laboratory will generate quantitative analytical data for soils using the methods listed below and the analytical DQOs presented in Table 3.4. If additional analytical parameters are required, the consultant will define the parameter DQOs, and submit associated DQOs for the annual QAPP update. Soil samples may be submitted to the mobile laboratory for the following field screening analyses:

- Total petroleum hydrocarbons (TPH) using Arizona Department of Health Services (ADHS) by Method 8015AZR1
- Benzene, toluene, ethylbenzene, and xylenes (BTEX) using USEPA Method 8021B
- PAHs using USEPA Modified Method 8100
- Any other analytes as necessary or appropriate

3.1.1.2 Fixed-base Laboratory Soil Analysis

At APS sites undergoing soil investigation or remedial activities, supplemental data will be obtained by submitting soil samples to the fixed-base laboratory to perform sample analysis that cannot be performed by the mobile laboratory or to confirm screening data acquired by the mobile laboratory. The fixed-base analytical laboratory will generate quantitative analytical data for soils using the methods listed below and the DQOs presented in

Table 3.5. If additional analytical parameters are required, the consultant will define the parameter DQOs, and submit associated DQOs for the annual QAPP update. Soil samples may be submitted to the fixed-base laboratory for the following analyses:

- VOCs using USEPA GC Method 8021B or GC/MS Method 8260B
- SVOCs using USEPA GC/MS Method 8270D
- PAH using USEPA GC/MS Method 8270D SIM
- Total Resource Conservation and Recovery Act (RCRA) 8 metals: arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver using USEPA Methods 6010C/7471B
- TPH for extractable and volatile fuel groups using ADHS Method 8015AZR1 or 8015D GRO
- Total cyanide using USEPA Method 9014
- Toxic Characteristic Leachate Procedure (TCLP) volatile organic compounds (VOCs) using USEPA Method 1311/8021B or 8260B
- TCLP metals using USEPA Method 1311/6010C/7470A
- Polychlorinated biphenyls (PCB) using USEPA Method 8082A
- Ignitability as defined in SW846 Chapter 7.1.2
- pH using USEPA Method 9045D
- Paint filter using USEPA Method 9095B
- Hexavalent chromium using USEPA Method 7196A or 7199
- Organochlorine pesticides using USEPA Method 8081B
- Chlorinated herbicides using EPA Method 8151A
- Sulfides using USEPA Method 9031

3.1.2 Water Sample Analysis

Water samples may be collected periodically at each of the sites. The water sample analysis is project-specific and may not include all of the methods listed. The fixed-base analytical laboratory will generate quantitative analytical data for water samples using the methods listed below and the DQOs presented in Table 3.6. If additional analytical parameters are required, the consultant will define the parameter DQOs, and submit associated DQOs for the annual QAPP update. Water samples may be submitted to the fixed-base laboratory for the following analyses:

- VOCs using USEPA GC Methods 601/602, 8021B, or GC/MS Method 8260B
- SVOCs using USEPA GC/MS Method 8270D
- PAHs using USEPA GC/MS Method 8270D SIM

- TPH using USEPA Method 8015D
- Total RCRA 8 metals : arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver using USEPA Methods 6010C/7470A or USEPA Methods 245.1/200.7/200.9/206.2/213.2/239.2/ 270.2/272.2
- Total cyanide using standard methods (SM) 4500 CN-E or USEPA Method 9014
- Amenable cyanide using SM4500 CN-G
- Weak acid dissociable cyanide using SM4500 CN-I
- Nitrate/nitrite using combined USEPA Methods 353.2 or SM4500NO3.
- Nitrate and nitrite by USEPA 300.0.
- Sulfate by USEPA 300.0
- Ammonia by SM4500-NH3 B, D, E
- Hexavalent chromium using USEPA Method 7196A or 7199
- PCBs using USEPA Method 8082A
- Organochlorine pesticides using USEPA Method 8081B
- Chlorinated herbicides using USEPA Method 8151A
- Sulfides using USEPA Method 9034

3.1.3 Air and Soil Vapor Analyses

3.1.3.1 Mobile Laboratory Air and Soil Vapor Analyses

Air or soil vapor samples may be collected periodically and screened for VOCs by the mobile laboratory using USEPA method TO-15 or 8260B for the analytes listed in Table 3.7. The analyte lists are project-specific and may differ from those listed in the table. If additional analytical parameters are required, the consultant will define the analytical DQOs for these parameters and submit them for the annual QAPP update.

3.1.3.2 Fixed-base Laboratory Air and Soil Vapor Analyses

Air or soil vapor samples may be collected periodically as part of characterization or remedial activities at APS sites. The air or soil vapor sample analysis is project specific and may not include all of the methods listed. The fixed-base analytical laboratory will generate quantitative analytical data for air or soil vapor samples using the methods listed below and the DQOs presented in Table 3.8. If additional analytical parameters are required, the consultant will define the parameter DQOs, and submit associated DQOs for the annual QAPP update. Air or soil vapor samples may be submitted to the fixed-base laboratory for the following analyses:

- VOCs using USEPA Method TO-15 or 8260B
- Oxygen, carbon dioxide, methane, and nitrogen using USEPA Method 3C

- BTEX using USEPA Method TO-15 and/or National Institute of Occupational Safety and Health (NIOSH) 1501
- PAHs using USEPA Method TO-13A by HPLC
- Lead using SM 7300

3.2 Sampling Design and Procedures

The sampling design for each site is discussed in the site-specific work plan or RAP. The design addresses the number and location of samples, sampling frequency, sample matrices, and measurement parameters of interest for each sample. Samples will be classified as either critical (i.e., required to achieve project objectives) or non-critical (i.e., for information only). The rationale for the sampling design is also described in the site-specific work plan or RAP. The sampling design is a function of the medium sampled, information about the sampling site, the type of data to be collected, and how the data are to be used.

The soil and groundwater samples will be collected for each site as described in the applicable work plan or RAP. Sampling procedures for perimeter air sampling and soil vapor sampling are provided in Appendix B. The Work Plan or RAP describes the sampling procedures and equipment, the sample containers, sample handling and storage, sampling equipment decontamination, and handling of any investigation-derived waste. The work plan or RAP should also discuss corrective actions to be taken in the event the sampling system fails, and include names of individuals responsible for implementing those corrective actions.

3.3 Sample Handling and Custody

General sample handling and custody procedures are described in the following sections. They may be superseded by procedures specified in site-specific documents.

3.3.1 Containers and Preservatives

The contracted laboratories will provide the required sample containers for all environmental and associated quality control samples. All containers will be certified free of the analytes of concern for this project. No sample containers will be reused. The contracted laboratory will add preservatives, if required, before shipping the sample containers to the field. The laboratory, upon receipt of the samples, will verify the adequacy of preservation and will add preservative, if necessary. Samples received by the laboratory will be at a temperature of 4 ^{0}C +/-2 ^{0}C. The containers, minimum sample quantities, required preservatives, and maximum holding times for soil, water, soil vapor, and air samples are listed in Tables 3.9, 3.10, and 3.11.

3.3.2 Chain of Custody

Collecting data of known quality begins at the point of sample collection. Legally defensible data are generated by adhering to proven evidentiary procedures. These procedures are outlined in the following sections and must be followed to preserve and ensure the integrity of all samples from the time of collection through analysis. Sample custody records must be maintained both in the field and in the subcontractor laboratory. A sample is considered to be in someone's custody if it is either in his or her physical possession or view, locked up, or kept in a secured and restricted area. Until shipment, the sample team leader is responsible for the sample in custody. COC records document sample collection and shipment to the laboratory. A COC form will be completed for each sampling event. The original copy will be provided to the laboratory with the sample shipping cooler, and a copy will be retained in the field documentation files. The COC form will identify the contents of each shipment and maintain the custodial integrity of the samples. All COC forms will be signed and dated by the responsible sampling team personnel. The "relinquished by" box will be signed by the responsible sampling team personnel, and the date, time, and airbill number will be noted on the COC form. The laboratory will return the executed copy of the COC with the hardcopy report.

The shipping coolers containing the samples will be sealed with a custody seal any time the coolers are not in an individual's possession or view before shipping. All custody seals will be signed and dated by the responsible sampling team personnel.

At a minimum, the COC form must contain the following information:

- Site name
- Project manager, project chemist, and data manager names, and telephone and fax numbers
- Unique sample identification
- Date and time of sample collection
- Source of sample (including name, location, sample type, and matrix)
- Number of containers
- Designation of matrix spike/matrix spike duplicate (MS/MSD)
- Preservative used
- Analyses required
- Name of sampler
- Custody transfer signatures and dates and times of sample transfer from the field to transporters and to the laboratories
- Bill of lading or transporter tracking number (if applicable)
- Turnaround time
- Laboratory name, address, and contact information
- Any special instructions

Erroneous entries on COC records will be corrected by drawing a line through the error and entering the corrected information. The person performing the correction will date and initial each change made on the COC form.

3.3.3 Laboratory Responsibilities

When the samples reach the laboratory, they will be checked against information on the COC form for anomalies. The condition, temperature, and appropriate preservation of samples will be checked and documented on the COC form. Checking an aliquot of the sample using pH paper is an acceptable procedure (precautions must be taken to avoid contamination of the sample). Samples requiring VOC analyses should not undergo preservation verification until the time of analysis. The occurrence of any anomalies in the received samples and their resolution will be documented in laboratory records. All sample information will then be entered into a tracking system, and will be assigned unique analytical sample identifiers. A copy of this information will be reviewed by the laboratory for accuracy. Sample holding time tracking begins with the collection of samples and continues until the analysis is complete. **Samples not preserved or analyzed in accordance with the requirements in this QAPP will be resampled and analyzed at no additional cost to APS.** Laboratory analyses will be documented on the COC form. Procedures ensuring internal laboratory COC will also be implemented and documented by the laboratory. Ideally, sample custody will be maintained using an internal custody system that requires samples to be kept in a secured and restricted area when not in use and to be checked out and checked back in by the analysts who use the samples. Internal custody records must be maintained by the laboratory as part of the documentation file for each sample. Specific instructions concerning the analysis specified for each sample will be communicated to the analysts. Analytical batches will be created, and laboratory quality control samples will be introduced into each batch.

While samples are stored in the laboratory, they will be stored in limited-access, temperature-controlled areas. Refrigerators, coolers, and freezers will be monitored for temperature 7 days a week. Acceptance criterion for the temperatures of the refrigerators and coolers is 4±2 degrees Celsius (°C). Acceptance criterion for the temperatures of the freezers will be less than 0°C. All of the cold storage areas will be monitored by thermometers that have been calibrated with a NIST-traceable thermometer. As indicated by the findings of the calibration, correction factors will be applied to each thermometer. Records that include acceptance criteria will be maintained. Samples for VOC determination will be stored separately from other samples, standards, and sample extracts. Samples will be stored after analysis until disposed of in accordance with applicable local, state, and federal regulations. Disposal records will be maintained by the laboratory.

Along with sample receipt documentation, the following information will be documented on sample receipt forms by the sample custodian:

- Date samples received
- Field sample identification number
- Laboratory sample identification number
- Analytical tests requested for the sample batch
- Sample matrix
- Number of samples in the batch
- Container description and location in the laboratory
- Verification of sample preservation

The laboratory should have a system and procedures for maintaining sample control and custody when the samples are received.

3.3.4 Sample Packaging and Transport

3.3.4.1 Sample Container Preparation

- Labels will be secured to each container with clear tape, if not previously done.

- Container lids will be checked for tightness, and if the container is not full, the outside of the container will be marked with indelible ink at the sample volume level.
- Sample bottles will be double-bagged in heavy-duty plastic. Glass containers will be covered with bubble wrap to prevent breakage.

3.3.4.2 Shipping Cooler Preparation

- All previous labels used on the shipping cooler will be removed.
- The drain plugs will be sealed with fiberglass tape (outside and inside) to prevent melting ice from leaking.
- A cushioning layer of packing material such as bubble wrap will be placed at the bottom of the cooler (approximately 1 inch thick) to prevent breakage during shipment.
- The cooler will be lined with a large plastic bag (same type used to contain samples).
- All ice will be double-bagged in a resealable plastic bag.

3.3.4.3 Placing Samples in the Cooler

- The COC form will be placed in a resealable plastic bag.
- Samples will be placed in an upright position in the cooler.
- Ice will be placed on top of and between samples. Ideally, ice will be double bagged in resealable plastic bags to minimize leakage of ice melt into the cooler.
- Void space between samples will be filled with packing material.

3.3.4.4 Closing the Cooler

- The cooler lid will be taped with strapping tape, encircling the cooler several times.
- Custody seals may also be affixed to the cooler lid to further ensure the integrity of the samples.

3.3.4.5 Transport

- Sample coolers will be transported to the laboratory (an overnight courier may be used) immediately after sample collection. Intermediate stops will be avoided with the exception of emergencies only, in which case, the situation will be noted in the field notebooks.
- The laboratory will be notified that samples are being shipped.

3.4 Measurement Performance Criteria

The PQL is the lowest concentration of a specific analyte that can be reasonably achieved within the specified limits of precision and accuracy during routine laboratory operations. Analytes that have a concentration greater than or equal to its respective PQL will be reported. The PQLs for the mobile and the fixed-base laboratories are presented in Tables 3.4 through 3.8.

Soil samples collected for VOC analyses (Method 8021B and Method 8260B) will be field-preserved with methanol , or sub-cored using an EnCore or equivalent sampler, and preserved with methanol in the laboratory within 48 hours of collection (Method 5035). The methanol preservation requires a 50X dilution before sample analysis, resulting in elevated PQLs for all target analytes. The PQLs presented in Table 3.5 reflect the elevated values.

3.5 Field Quality Control Sampling

Quality control samples will be collected in the field to evaluate laboratory precision (sample duplicates), the effectiveness of sampling equipment decontamination (equipment blanks and field blanks), and sample shipping procedures (trip blanks and temperature blanks). A general description of required quality control samples is presented below along with recommended minimum sampling frequencies. The sampling plan should be flexible enough to allow collection of field QC samples at lesser or greater frequencies based on the data collected over time. For example, if equipment blank results have repeatedly demonstrated effectiveness of the equipment decontamination procedure, relaxing the frequency of equipment blank collection will not likely compromise data quality. Likewise, unnecessary expense can be avoided by minimizing the frequency of field duplicates when data from an ongoing water monitoring program have continually indicated non-detection of the contaminants of concern. Specific field QC sampling requirements, including frequency of collection, will be addressed in site-specific work plans.

- **Field Blanks**. Field blanks are samples containing analyte-free water, and are collected and processed in the same manner as equivalent environmental samples (i.e., clean water is poured into a sample container in the same physical location where the environmental sample is collected, and is subsequently handled, processed and analyzed exactly as an equivalent environmental sample). The field blank is used to identify contamination resulting from field sample collection techniques. Sampling procedures that do not involve the likelihood of contamination from field conditions do not require collection of field blanks. The source of the water used for field and equipment blanks will be identified in the field sampling logs or field notes. Field blanks will be designated as "FB" followed by the sample date (e.g., FB081799), or per designation stated in site-specific field sampling plan and analyzed for the identical parameter set as the field samples.

- **Equipment Blanks.** At a minimum, one equipment blank will be collected before sampling during each sampling event where decontamination of sampling equipment is required. Ideally, two equipment blanks (one collected before sampling and one collected at the completion of sampling) will be collected during each sampling event where decontamination of sampling equipment is required. (Note: A specific case where decontamination may not be required would include groundwater sampling with dedicated or disposable tubing.) The equipment blank samples will be collected by pouring distilled or de-ionized water through sampling equipment, such as a split-spoon sampler or a hand sampler containing brass sleeve inserts, or a submersible groundwater sampling pump, into the appropriate sample bottles. The equipment blank will be designated as "EB" followed by the sample date (e.g., EB081799), or per designation stated in site-specific field sampling plan and analyzed for the identical parameter set as the field samples.

- **Trip Blanks.** Trip blanks will be provided by the fixed-base laboratory and will accompany each sample cooler containing VOCs (EPA Method 8021B, 601/602 and 8260B), and TPH as gasoline (EPA Method 8015D and ADHS 8015 AZR1 Appendix 1). Trip blanks will be prepared in a clean environment and will consist of organic-free water submitted during groundwater and surface water sampling; and purge and trap grade methanol submitted during soil sampling. The trip blanks will be transported to the sampling site, handled as an environmental sample, and returned to the laboratory for analysis. Trip blanks will be analyzed for the same volatile constituents as requested for the field samples.

- **Temperature Blanks.** Temperature blanks will be provided by the laboratory or made in the field by the field personnel and will accompany each sample container. The temperature blanks will be used to evaluate the temperature of the samples that were stored in the cooler between sample collection and delivery to the laboratory. The temperature of the blanks will be measured upon receipt of the sample cooler at the laboratory and the temperature will be noted on the COC form. If temperature blanks are not used, the laboratory may measure the temperature of the sample bottles upon receipt of the samples.

- **Field Duplicates.** Blind field duplicate samples will be collected at a minimum frequency of one duplicate sample per sampling event or a minimum of 1 per 10 samples (10 percent) to assess field precision unless otherwise specified in the site-specific work plan. The blind duplicate will be collected from a sample point most likely to contain elevated concentrations of the constituents of concern. Duplicate subsurface soil samples will be collected from a second brass sleeve insert within the split-spoon sampler. Duplicate surface soil samples will be collected from a location adjacent to the original sample location. Duplicate groundwater samples will be collected at the same time the primary sample is collected. Field duplicate samples will be analyzed for parameters of concern specified in the site-specific work plan. Specific labeling designation will be outlined in the site-specific work plan.

- **MS/MSD Samples.** MS/MSD samples, or enough sample volume to perform MS/MSD analyses, will be collected to evaluate the effect of the sample matrix on the analytical method. The MS/MSD samples will be collected at the same time the primary sample is collected and should be collected from a sampling location not likely to contain elevated concentrations of the constituents of concern. Equipment, field, and trip blanks must not be assigned for MS/MSD analysis. Additional sample volume will be collected for MS/MSD analysis from an APS field sample location during confirmation sampling, compliance sampling, or sampling events for site closure. MS/MSD samples will be collected at a frequency of one pair per sample batch or at least one per 20 samples during each sampling events. In addition, MS/MSD samples may also be collected during routine sampling events on an as-needed basis. MS/MSD samples will be analyzed for parameters of concern specified in the site-specific work plan.

SECTION 4.0

Instrument Calibration and Frequency

4.1 Field Instrument Calibration

Field equipment will be calibrated before the start of work and at the end of the sampling day. Any instrument drift from before calibration will be recorded in the field notebook. Calibration will be performed according to procedures and schedules outlined in the particular instrument's operations manual, and information in the site-specific closure plan or equivalent document. Calibrated equipment will be uniquely identified by using either the manufacturer's serial number or other types of identification. A label with the identification number and the date when the next calibration is due will be placed on the equipment. If this is not possible, records traceable to the equipment (e.g., showing the equipment identification) will be readily available for reference. In addition, the results of calibrations and records of repairs will be recorded in the field notebook. Scheduled periodic calibration of testing equipment does not relieve field personnel of the responsibility of using properly functioning equipment. If an individual suspects an equipment malfunction, the equipment will be removed from service, tagged so that it is not inadvertently used, and the appropriate personnel will be notified so that a recalibration can be performed or substitute equipment can be obtained.

Equipment that fails calibration or becomes inoperable during use will be removed from service and either segregated to prevent inadvertent use, or tagged to indicate that it is out of calibration. Such equipment will be repaired and satisfactorily recalibrated. Equipment that cannot be repaired will be replaced.

4.2 Laboratory Instrument calibration

Qualified personnel will appropriately calibrate laboratory instruments before sample analysis. The requirements specified in each analytical method will be followed. Only certified standards of known purity may be used for calibration. Calibration will be verified at specified intervals throughout the analysis. Calibration records will become part of the analytical documentation. The frequency and acceptance criteria for calibration are specified for each analytical method in Tables 4.1 through 4.17. When multi-point calibration is specified, the concentrations of the calibration standards should bracket those expected in the samples. Samples must be diluted, if necessary, to bring analyte responses within the calibration range. The laboratory may only report those data that result from quantitation within the demonstrated working calibration range. Quantitation based on extrapolation is not acceptable.

SECTION 5.0

Instrument/Equipment Testing Inspection and Maintenance

The field instruments that will be used at each site will be identified in the site-specific work plan or equivalent document. The document should include procedures for inspecting and testing these instruments. The procedures should also discuss preventive and corrective maintenance to ensure the instruments' availability and performance at all times.

The contracted laboratories must have procedures in place to ensure that all analytical instrumentation is maintained according to the manufacturer's recommendations. Critical spare parts must be available onsite to minimize downtime. All maintenance activities must be documented in a maintenance logbook.

SECTION 6.0

Requirements for Supplies and Consumables

Standard materials and reagents must be of known high purity and traceable to an approved source. Pure standards must not exceed the manufacturer's expiration date or one year following receipt, whichever comes first. Each laboratory must assign an expiration date to each solution prepared from the pure standards. All such solutions must be used within the expiration date. All other supplies and consumables must be inspected before use to ensure that they meet purity standards based on their intended use. The laboratory's inventory and storage system should ensure their use within the manufacturer's expiration date and storage under proper conditions.

The designated contracted laboratory project manager will have the responsibility for meeting the above requirements.

SECTION 7.0

Analytical Data Quality Assessment

This section of the QAPP presents the established procedures and criteria for assuring data quality and consistency for laboratory QA/QC, laboratory reporting, data evaluation, and database management. This is of particular importance when using more than one analytical laboratory. The analytical DQOs discussed in the following sections will provide guidance for the consultant project manager, the consultant quality assurance officer, and the analytical laboratory personnel.

7.1 Analytical Data Quality Objectives

Analytical DQOs, as a minimum, are used as the basis for data quality assessment. The DQOs are precision, accuracy, representativeness, completeness, and comparability. These qualitative and quantitative objectives ensure the data generated during these investigations are scientifically valid, defensible, and meet the needs of each project. As discussed in *USEPA Guidance for the Data Quality Objectives Process; USEPA QA/G-4*, dated September 1994 and *USEPA Guidance for Quality Assurance Project Plans; USEPA QA/G-5*, dated February 1998, the DQOs depend on the intended data usage and are based on the premise that the ultimate use(s) of a particular data set should determine the quantity and quality of these data. A summary of the APS program-specific analytical DQOs for soil, aqueous, air, and soil vapor matrices are presented in Tables 3.4, 3.5, 3.6, 3.7 and 3.8. The precision and accuracy limits for spiked target analytes are to be applied to both laboratory control samples and matrix spikes, unless otherwise specified in the tables.

Precision is a measure of the reproducibility of concentrations reported for duplicate analyses, calculated by determining the relative percent difference (RPD) between the two values. Precision will be reviewed for the following analysis: laboratory control sample (LCS)/Laboratory Control Sample Data (LCSD), MS/MSD, and field duplicate (soil or groundwater samples collected from the same location). The proposed precision objectives for field duplicates are specified in Section 7.4.2.4. Precision objectives for LCS/LCSD and MS/MSD are presented in Tables 3.4 through 3.8.

RPD is calculated as follows:

$$RPD = \frac{D_1 - D_2}{(D_1 + D_2)/2} \cdot 100$$

Where:

D_1 = MS (or LCS) spiked sample concentration
D_2 = MSD (or LCSD) spiked sample concentration

When the RPD between duplicate sample results is calculated, D_1 and D_2 represent the original and duplicate sample concentrations.

Accuracy is the degree to which the measurement data approaches the "true" value for each analyte. For soil samples, accuracy is assessed by calculating the percent recovery (%R) for a sample spiked with the analyte of concern (e.g., LCS, surrogates, matrix spike). For soil, water, soil gas, and air samples, the accuracy objectives are in Tables 3.4 through 3.8.

Percent recovery (%R) is calculated as follows:

$$\%R = \left(Q_d / Q_a\right) \cdot 100$$

Where:

Qd = Spiked sample concentration minus unspiked sample concentration
Qa = True value of the spike

Representativeness refers to the comparability of the sample collection procedures to those delineated in the sampling and analysis plan (SAP) or RAP, and to the degree which the analytical data represents the subsurface contaminant concentrations. Representativeness will be accomplished by adhering to consistent field sampling and analytical procedures for soil samples.

Completeness is defined as the ratio of usable (i.e., non-rejected) laboratory measurements to the total number of planned measurements for this investigation.

It is calculated as follows:

$$\text{Percent Completeness} = \frac{\text{Number of Usable Results (i.e., Non-rejected Results)}}{\text{Total Number of Possible Results}} \times 100$$

Comparability is an evaluation of the relative consistency of the laboratory measurement data. Because comparability cannot be measured quantitatively, professional judgment is relied upon. Internal comparability will be achieved for soil by adhering to consistent sample collection procedures and analyses methods throughout each investigation.

7.2 Laboratory Quality Assurance/Quality Control Procedures

QA/QC procedures will be implemented using methods that ensure each project's data needs for completeness, comparability, representativeness, accuracy, and precision are met. Based on these QA/QC objectives, sample analyses will be completed in accordance with USEPA-approved methodologies.

A preparation batch is a group of samples (not to exceed 20 samples) similar in composition (matrix) and are extracted or digested at the same time with the same lot of reagents. The laboratory QC samples will not count as a part of the 20 samples, but will be prepared with each preparation batch. The QC samples will also be employed for samples that do not need separate extraction or digestion, such as VOC analysis by purge and trap.

The laboratory will use QC samples to assess the validity of the analytical results of field samples following the method requirements. The laboratory QC samples will include: method blank, LCS, surrogate spikes, MS/MSD (or laboratory duplicate), and all method-specific quality control samples. When the acceptance criteria established for the QC samples are not met, the affected sample results are qualified using the Arizona Laboratory Data Qualifiers in Appendix C. The following paragraphs describe the types of laboratory QC samples and/or tests that should be performed to assess the validity of the analytical results of the field samples:

- A method blank is an analyte-free matrix similar to the field samples (solid or liquid), in which all of the reagents are added in the same proportion or concentration as used to process the field samples. Method blank analysis is performed to assess possible laboratory contamination each day of analysis, for each method of analysis and at a frequency of at least one per 20 samples analyzed. Both a methanol and purge water method blank will be analyzed and reported for solid matrix VOC analysis. If compounds of interest are detected in the trip blank, the raw data from the method blanks will be submitted with the analytical data package to determine the source of contamination. If concentrations of constituents of concern are found to be greater than the PQL in the method blank, corrective action will be performed to identify and eliminate the source of contamination before proceeding with the analyses. The analytical data will not be corrected based on the presence of an analyte in the method blank, and corrective action is not necessary in the event that the analyte is detected in the method blank but not in the sample. If an analyte continues to be found in the method blank and in the sample, and corrective actions are not implemented, the affected result will be flagged with the appropriate qualifier.

- The LCS or blank spikes are analyte-free samples, either water or Ottawa sand, which are spiked with a known concentration of specific analytes. The spiking standard must be from a source independent of that used for calibration standards. The LCS is used to evaluate each preparation sample and to assess the statistical control of the method at a frequency of at least one per 20 samples. Corrective action will be implemented in the event that the LCS is found to be outside of the recovery acceptance limits.

- Surrogate spike analysis is used to evaluate the efficiency of the analytical procedure in recovering the true amount of a known compound. The surrogates are organic compounds similar to the target analyte(s) in chemical composition and behavior in the analytical process, but do not normally occur in environmental samples. Surrogate spikes are added to all samples, including QC samples. Percent recovery values are provided along with the sample results. Corrective action will be implemented in the event that the surrogate recovery is found to be outside acceptable limits, and the sample will be prepared and analyzed again. If the surrogate continues to be found outside the acceptable QC limits, the affected result will be flagged with the appropriate qualifier.

- MS/MSD samples are used to evaluate the effect of the sample matrix on the analytical method. The spiking standard must be from a source independent of that used for calibration standards. MS/MSD samples are analyzed at a frequency of one pair per sample batch or at least one pair per 20 samples. The MS/MSD sample analysis will be performed on an APS project sample. Samples designated as field blanks, equipment blanks, and trip blanks must not be used for MS/MSD analyses. The MS/MSD is intended to evaluate the matrix effect on the instrument, not to control the analytical process. If the MS/ MSD is found to be outside the acceptable QC limits, the affected result will be flagged with the appropriate qualifier.

- A sample duplicate selected by the laboratory is called a laboratory sample duplicate. It is subjected to the same preparation and analytical procedures as the native sample. The RPD between the results of the original sample and laboratory sample duplicate measures the precision of sample results. The data collected could also yield information regarding the homogeneity of the sample matrix. A laboratory duplicate will be analyzed with each analytical batch in which no sample has been designated for matrix spiking, when only a single spike can be analyzed because of limited sample quantity, or when the analytical method requires it.
- Some methods, such as those for VOCs, require the use of internal standards to compensate for losses during injection or purging. Internal standards are compounds that have similar properties as the analytes of interest but are not expected to occur naturally in the samples. A measured amount of the internal standard is added to the standards, samples, and quality control samples following preparation. When the internal standard results are outside the control limits, corrective action must be taken, including sample reanalysis, if appropriate.
- Retention time windows for PAH, pesticide, PCB, and herbicide analyses must be established by replicate injections of the calibration standard over multiple days. The absolute retention time of the calibration verification standard at the start of each analytical sequence will be used as the centerline of the window. For a target analyte to be reported as positive, its elution time must be within the retention time window.
- The interference check samples are used in inductively coupled plasma (ICP) analyses to verify background and inter-element correction factors. They consist of two solutions: A and B. Solution A contains the interfering analytes, and Solution B contains both the analytes of interest and the interfering analytes. Both solutions are analyzed at the beginning of each analytical sequence. When the interference check samples results are outside the control limits, corrective action must be taken, including sample reanalysis, if appropriate.
- The dilution test in metals analysis consists of analyzing a 1:5 dilution of a sample. The results of the 1:5 dilution are compared with the original sample results. When the original sample concentration is sufficiently high (at least 10 times the method detection limit for ICP, or at least 25 times the method detection limit for cold-vapor atomic absorption) , the result of the 1:5 dilution should agree within ±10% of the original sample result. If this criterion is not met, chemical or physical interferences may be indicated for that particular sample matrix.
- When the metal analyte concentrations are not sufficiently high to perform the dilution test, or when the dilution test results are not acceptable, a post-digestion spike analysis (also called recovery test) should be performed. It consists of adding an analyte spike to an aliquot of the prepared sample. The spike addition should result in 2 to 5 times the original sample concentration, or 10 to 20 times the method detection limit. If the spike is not recovered within the acceptable range (i.e., 75 to 125 percent for ICP; 85 to 115 percent for cold-vapor atomic absorption), a matrix effect should be suspected.

7.3 Quality Assurance/Quality Control Data Packages

Data package documentation will be as specified by the APS laboratory contract and the site-specific needs. Three levels of data deliverables are detailed below. The level of deliverables required for a specific project will depend on the extent of the data evaluation effort specified for the project. The deliverables will consist primarily of summary forms in USEPA Contract Laboratory Program (CLP)-like format containing the information specified for each level. In addition, level III deliverables will also include all raw data. Regardless of the level of deliverables requested, the laboratory must maintain all required documentation associated with each data acquisition to allow re-creation of the sample preparation and analysis, and submittal of more extensive deliverables upon request for specific sample delivery groups. In addition to hardcopy, electronic deliverables will be expected for each level of documentation.

7.3.1 Level I Data Deliverables

Examples of use of level I data documentation would be for data generated by the mobile laboratory, and analytical data generated by a fixed-base laboratory for continued surface and groundwater monitoring. Data for these examples are usually used for screening, or for recurrent monitoring multiple times each year. Level I documentation will include the following information:

- Case narrative – the case narrative will address any QC deficiencies associated with the data set in the associated report and provide a cross reference field and laboratory sample identification
- Analytical results for each parameter requested
- Laboratory established precision and accuracy limits
- Dates of sample collection, preparation, analysis
- Method blank (matrix-specific) results
- LCS recoveries
- MS/MSD recoveries (or laboratory duplicate results), and calculated RPDs
- Surrogate recoveries

7.3.2 Level II Data Deliverables

Level II data documentation will be requested according to site-specific needs and mostly applies to data collected during confirmation sampling, compliance sampling, and closure sampling. Data documentation for level II reports will include the following information:

- Case narrative – the case narrative will address any QC deficiencies associated with the data set in the associated report and provide a cross reference field and laboratory sample identification
- Analytical results for each parameter requested
- Laboratory established precision and accuracy limits

- Dates of sample collection, preparation, analysis
- Extraction logs, including methanol preservation logs (sample weight/extraction volume)
- Instrument run logs
- Method blank (matrix-specific) results
- Calibration blank results for inorganic analyses
- LCS recoveries
- MS/MSD recoveries and calculated RPDs (or results and percent differences for laboratory duplicates); provide concentrations of all spike solutions
- Serial dilution results and percent differences for inorganics (if applicable)
- Analytical spike recoveries for graphite furnace atomic absorption
- Surrogate recoveries
- Initial and continuing calibration data summaries, including response factors, average response factors, percent relative standard deviations (or regression equations and correlation coefficients); response factors, percent recoveries, percent differences or percent drifts, for continuing calibration
- Interference check standard recoveries for ICP
- Method of standard addition results (if applicable)
- Tuning summary, including ion abundances and acceptance criteria (if applicable)
- Internal standard summary showing areas and retention times, or recoveries (if applicable)
- Retention times and windows for chromatography methods
- Pesticide breakdown products for pesticides analysis by gas chromatography
- Confirmation results and relative percent differences for chromatography methods
- Analytical sequence log, including analysis dates and times
- All other method-specific quality controls

7.3.3 Level III Data Deliverables

Level III deliverables will enable full data validation when required by the project. The deliverables will include all items listed under level II and the raw data. The laboratory will be contacted in advance when level III deliverables are required for a subset of data. Data documentation for level III reports will include the following information:

- Raw data
  - Organics—chromatograms and quantitation reports for all standards, samples, and QC samples; sample and reference spectra for gas chromatography (GC)/mass spectrometry (MS)
  - Inorganics (metals or wet chemistry)—instrument printouts for standards, samples, and QC samples, and analytical worksheets where printouts are not available
- Method Detection Limit (MDL) for all metals 200/6000/7000

7.4 Data Evaluation

The effectiveness of the implementation of the QAPP and the QA/QC procedures will be assessed at various times during each project to ensure that the data needs of each project continue to be met. This evaluation will include conducting data quality assessments on the data as they are received. If the data fall outside the parameters of the DQOs, additional assessments and corrective actions will be taken. The additional assessments may include a review of the sampling method, sample handling and storage methods, a laboratory audit, a review of the laboratory management system, and/or a performance evaluation.

7.4.1 Data Quality Assessment by the Laboratory

The laboratory personnel should conduct an initial quality assessment of the data to ensure that the analytical DQOs are achieved. The assessment will include ensuring that the sample preparation and analyses were performed within the specified holding times for each analysis, identifying any source of contamination, and performing a review for both internal laboratory quality control and the APS program DQOs. The laboratory personnel will note any QC deficiencies in the final laboratory report.

Hold time criteria begin at the time of sample collection. To remain in compliance with each analytical method, the sample extraction or preparation process must be completed as described by each analytical method before any necessary extract cleanup or volume reduction procedures, and must be completed within the specified timeframe as presented in Tables 3.9, 3.10, and 3.11. The analysis is considered finished when all analytical runs, including dilutions and any required re-analyses, are completed.

7.4.2 Third Party Data Quality Evaluation

Data evaluation will be performed by a qualified chemist or data validation consultant as prescribed for each site-specific program. The evaluation will consist of a review of the supplied data documentation to determine if the data satisfy the project's DQOs and the data use requirements.

The data evaluation strategies can range from a verification of the batch-related QC performance using summary reports, to a validation of the complete analytical run using raw data. The level of effort for data evaluation will be a function of the project's DQOs, familiarity with the laboratory's data quality, analytical techniques employed, nature of the contamination and sample matrix, historical information about the investigation site, and budget and time constraints. For example, definitive data will require a much higher level of effort than screening data. A higher level of effort is usually required when using a laboratory that has not had any experience with the project, or when a site with no historical information is being investigated. Data generated using analytical techniques that require a significant amount of analyst interpretation (such as gas and liquid chromatographies) will require more intense evaluation than those generated using more specific instrumentation (such as ICP and GC/MS). This applies to samples that could have significantly high interfering background. A review of batch-related QC alone would be inadequate in identifying data quality problems when measuring low-level PAHs in samples with high background petroleum fuel contamination.

Three levels of data evaluation are presented in this QAPP. These levels collectively encompass the checks recommended by ADEQ in its data verification and data validation checklists found at its website at http://www.azdeq.gov/function/business/data.html and included in Appendix D. The data evaluation strategy can be limited to one particular level, or can be a combination of two or more levels for pre-determined subsets of data. Full data validation can be focused on data subsets expected to be most complicated or problematic. The strategy should be flexible enough to allow switching to a lower or higher level of effort based on the findings from the initial evaluation. The data evaluation strategy for each project must be addressed in the site-specific QAPP or equivalent document.

The data evaluation at each level will be limited to the data provided at the corresponding level of deliverables. The data will be reviewed and evaluated according to the criteria established in this QAPP, and summarized in Tables 4.1 through 4.17. In the case of parameters for which no criteria have been established in this QAPP, the laboratory's control limits will be used.

Issues requiring resolution will be brought to the laboratory project manager's attention by the data Quality Assurance Manager or designate.

Data qualification will be documented in the validation reports and in the database for access by the data users. Professional judgment assessments will be clearly documented in the data validation reports.

7.4.2.1 Level I

Only batch-related QC will be evaluated at this level. Instrument performance will be assumed to be in-control or out-of-control in a manner that is consistent with the batch-related QC performance.

The following will be evaluated using the summary reports in the data package:

- Case narrative
- Holding time
- Method blank results
- Sample results and reporting limits
- Field duplicate results
- MS/MSD recoveries and RPDs
- Laboratory duplicate percent differences
- LCS recoveries
- Surrogate recoveries

7.4.2.2 Level II

Data evaluation at this level will include batch-related QC, as well as calibration and other instrument QC performance.

The following will be evaluated using the summary reports in the data package:

- Case narrative
- Holding time
- Method blank results
- Calibration blank results for inorganic analyses
- Sample results and reporting limits
- Field duplicate results
- MS/MSD recoveries and RPDs (or results and percent differences for laboratory duplicates)
- LCS recoveries
- Serial dilution results and percent differences for inorganics (if applicable)
- Analytical spike recoveries for graphite furnace atomic absorption
- Surrogate recoveries
- Initial and continuing calibration results
- Interference check standard recoveries for ICP
- Method of standard addition results (if applicable)
- Tuning results (GC/MS only)
- Internal standard results (if applicable)
- Retention times and windows for chromatography methods
- Pesticide breakdown products for pesticides analysis by GC
- Confirmation results and relative percent differences for chromatography methods.
- Analytical sequence log, including analysis dates and times
- All other method-specific quality controls

7.4.2.3 Level III

This level validates the performance of the analytical methodology specific to the samples analyzed to the level of the raw data.

All the items evaluated under level II will be evaluated. The accuracy of a representative amount of raw data, including sample identification and quantitation, will be verified.

7.4.2.4 Primary and Field Duplicate Comparisons

The validator will compare primary and field duplicate sample analysis results to evaluate whether the precision criteria for each analyte have been achieved. This evaluation will be accomplished by comparing the results with criteria listed below. Data qualifier codes will be assigned based on the results of this comparison. If the primary and field duplicate results do not meet the applicable criteria listed below, the results for both the primary and field duplicate samples for that analyte will be qualified as estimated (“UJ or J”).

- A control limit of ±20 percent for water and 35 percent for soil for the RPD should be used when both the sample and field duplicate results are greater than or equal to 5 times the PQL.

- A control limit of ±PQL for water and ±2 times the PQL for soil should be used when at least one of the results is less than 5 times the PQL.

7.4.2.5 Evaluations of Detections in Blanks

When an analyte has been detected in a blank sample at a concentration above the PQLs (or above the MDL but below the PQL) the associated sample data must be assessed to evaluate the contamination of the impact of the blank. Blank contamination will be evaluated using the *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review* (USEPA, 1994) five times rule or the ten times rule. The five times rule is applied to blank samples that are affected by compounds that are not considered to be common laboratory contaminants. The ten times rule is applied to the following compounds recognized by USEPA as common laboratory contaminants: acetone, 2-butanone, methylene chloride, and each of the common phthalate contaminants. The ten times rule may also be applied to additional contaminants that are shown to be specific to a particular laboratory. In cases where a field sample requires dilution, the five times or ten times blank detection rule will be evaluated against the field sample concentration before adjustment for dilution (see example below). Values determined to be less than the blank concentration will be qualified as "U/Not Detected."

In some cases, samples other than blanks may be used to evaluate contaminants detected in laboratory QA/QC samples. For instance, methylene chloride could be detected in the LCS when it is not an expected analyte. The methylene chloride in the LCS sample would indicate that the methylene chloride is a result of laboratory contamination and could be used in the same manner as a blank to qualify the associated groundwater or soil samples.

Example of Blank Detection Comparison
Detected compound methylene chloride ($MeCl_2$).

USEPA recognizes $MeCl_2$ as a common laboratory contaminant; therefore, the ten times rule is applied to any blank (e.g., field, equipment, trip, or method) concentration detected. The highest concentration detected in any associated blank should be used for evaluation.

Highest Blank detection		USEPA rule		*Value used to evaluate field results*
5 µg/kg	X	10	=	*50 µg/kg*

Field sample was diluted 50X and the reported result is 600 µg/kg

Reported Sample Result		Dilution Factor		*Sample concentration before adjustment for dilution*
600 µg/kg	÷	50	=	*12 µg/kg*

- If sample concentration before adjustment for dilution is less than the value used to evaluate the field result, the sample result is qualified as “U/Not Detected”
- In this example 12 is less than 50; therefore, the field sample result of 600 micrograms per kilogram (µg/kg) is qualified “**U/** not detected.”
- This rule applies to all analytes and parameters

NOTE: Field preservation of soil volatile samples with methanol results in a dilution factor of 50X, which might not be indicated in the laboratory report. In these cases, the reported sample result should be divided by 50 to determine the sample concentration before adjustment for dilution, which will then be used in the blank comparison. The effect of methanol preservation on the PQL is discussed further in Section 3.4.

7.4.3 Alternative to Data Validation

As an alternative to data validation for small projects, ADEQ recommends that split samples be collected and analyzed by another laboratory. To employ this approach, it must be previously approved by ADEQ on a case-by-case basis.

7.4.4 Corrective Action

Problems identified by the analytical laboratory or data evaluator requiring corrective action in the laboratory will be documented in a corrective action report. If a corrective action (CA) form is necessary, a laboratory-signed CA will be placed in the associated analytical data package and the validator will document the CA issue in the final validation report. Depending on the significance of the problem, corrective actions may include re-analysis of the affected sample, re-sampling and analysis, or a change in procedure or analytical method.

7.4.5 Data Management

Data from all phases of the data collection effort will be stored in a relational project repository database for each site. The database structure must accommodate soil analytical data, surface water data (where applicable), hydropunch data (where applicable), air/soil gas data (where applicable), laboratory data qualifiers, and data validation qualifiers. The project database structure established for each site should adequately meet the minimum ADEQ requirements.

Field measurements are collected and catalogued for loading into the database. The analytical data will be submitted as hardcopy and electronic data deliverables, and delivered to the data manager in the agreed-upon format. The hardcopy and electronic data are entered into their respective physical and electronic placeholders and are tracked, imported, and catalogued, as appropriate. The electronic data are checked for completeness and consistency with the hardcopy. Manual or semi-automated data validation is performed using hardcopy and electronic data, and all flags and findings are recorded electronically. Data may be exported to one or more exterior applications for generating summary statistics, required electronic deliverables, or reports.

SECTION 8.0

Assessments and Response Actions

The assessment activities for this project will consist of laboratory technical systems audits and data quality audits.

Laboratory audits may be performed to evaluate a laboratory before contract award or to provide surveillance when the contract has been awarded. In pre-award audits, the laboratory's capabilities will be evaluated against the project's requirements. Surveillance audits will focus on the laboratory's continued compliance with project requirements. These audits will be unannounced and will be performed at random frequencies, depending on the laboratory's performance.

Data quality audits will take the form of data quality evaluation as discussed in Section 7.4. A surveillance audit of the laboratory may be performed as a consequence of the data quality audit.

The consultant quality assurance officer or his designee will be responsible for performing the assessments and initiating any required corrective action. He or she will have the authority to order work stoppage, with the concurrence of the APS remedial project manager, if necessary.

SECTION 9.0

Reports to Management

The types of reports that will be submitted to management will vary with the different sites. These reports will be a function of the environmental effort being undertaken at the site. They may include regularly scheduled post-remediation surface and groundwater monitoring reports, and periodic technical status reports summarizing project activities and any problems encountered. Significant problems identified during laboratory and data quality audits and associated actions taken to remedy the problem will also be reported to management. They should be addressed in the site-specific closure plan or equivalent document. The frequency, information to be included, and personnel charged with the responsibility for preparing, reviewing, and approving each report should be discussed.

SECTION 10.0

Reconciliation with User Requirements

Reconciliation of the collected environmental data with the project objectives will be addressed in the site-specific closure plan or equivalent document. Use of statistical approaches may be discussed if applicable. The documentation should also include how limitations on the use of the data will be communicated to the data users.

SECTION 11.0

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TABLE 2.1

Summary of Groundwater Protection Levels and 1996 Soil Remediation Levels

APS Quality Assurance Project Plan

Analyte	Residential SRLs (mg/kg)	Non-Residential SRLs (mg/kg)	Minimum GPL (mg/kg)
Total Petroleum Hydrocarbons			
Total Petroleum Hydrocarbons (C_{10} to C_{32})	4,100	18,000	NE
Volatile Organic Compounds			
1,1,1,2-Tetrachloroethane	23	54	NE
1,1,1-Trichloroethane	1,200	4,800	1.0
1,1,2,2-Tetrachloroethane	4.4	11	NE
1,1,2-Trichloroethane	6.5	15	NE
1,1-Dichloroethane	500	1,700	NE
1,1-Dichloroethene	0.36	0.8	0.81
1,1-Dichloropropene	NE	NE	NE
1,2,3-Trichlorobenzene	NE	NE	NE
1,2,3-Trichloropropane	0.014[a]	0.03	NE
1,2,4-Trichlorobenzene	570	4,700	NE
1,2,4-Trimethylbenzene	NE	NE	NE
1,2-Dibromo-3-chloropropane	3.2	14	NE
1,2-Dibromoethane (EDB)	0.049[a]	0.2	0.0033
1,2-Dichlorobenzene	1,100	3,900	72
1,2-Dichloroethane	2.5	5.5	0.21
1,2-Dichloropropane	3.1	6.8	0.28
1,3,5-Trimethylbenzene	NE	NE	NE
1,3-Dichlorobenzene	500	2,000	NE
1,3-Dichloropropane	NE	NE	NE
1,4-Dichlorobenzene	190	790	9.3
2,2-Dichloropropane	NE	NE	NE
2-Butanone	NE	NE	NE
2-Chloroethylvinyl ether	NE	NE	NE
2-Chlorotoluene	160	550	NE
2-Hexanone	NE	NE	NE
4-Chlorotoluene	NE	NE	NE

TABLE 2.1

Summary of Groundwater Protection Levels and 1996 Soil Remediation Levels

APS Quality Assurance Project Plan

Analyte	Residential SRLs (mg/kg)	Non-Residential SRLs (mg/kg)	Minimum GPL (mg/kg)
4-Methyl-2-pentanone	NE	NE	NE
Acetone	2,100	8,800	NE
Benzene	0.62	1.40	0.71
Bromobenzene	NE	NE	NE
Bromochloromethane	NE	NE	NE
Bromodichloromethane	6.3	14	NE
Bromoform	560	2,400	NE
Bromomethane	6.8	23	NE
Carbon Disulfide	7.5	24	NE
Carbon Tetrachloride	1.6	5	1.6
Chlorobenzene	65	220	22
Chloroethane	NE	NE	NE
Chloroform	2.5	5.3	6.8
Chloromethane	12	26	NE
cis-1,2-Dichloroethene	31	100	4.9
cis-1,3-Dichloropropene	NE	NE	NE
Dibromochloromethane	53	230	NE
Dibromomethane	NE	NE	NE
Dichlorodifluoromethane	94	310	NE
Ethylbenzene	1,500	2,700	120
Hexachlorobutadiene	13	140	NE
Iodomethane	NE	NE	NE
Isopropylbenzene	NE	NE	NE
Methylene chloride	77	180	NE
Methyl-tert-butyl- ether	320	3,300	NE
N-Butylbenzene	NE	NE	NE
N-Propylbenzene	NE	NE	NE
Naphthalene	2,600	27,000	NE
p-Isopropyltoluene	NE	NE	NE
sec-Butylbenzene	NE	NE	NE

TABLE 2.1
Summary of Groundwater Protection Levels and 1996 Soil Remediation Levels
APS Quality Assurance Project Plan

Analyte	**Residential SRLs (mg/kg)**	**Non-Residential SRLs (mg/kg)**	**Minimum GPL (mg/kg)**
Styrene	3,300	3,300	36
tert-Butylbenzene	NE	NE	NE
Tetrachloroethene	53	170	1.3
Toluene	790	2,700	400
trans-1,2-Dichloroethene	78	270	8.4
trans-1,3-Dichloropropene	NE	NE	NE
Trichloroethene	27	70	0.61
Trichlorofluoromethane	380	1,300	NE
Vinyl acetate	780	2,600	NE
Vinyl chloride	0.016[a]	0.035	NE
Total xylenes	2,800	2,800	2,200
Polynuclear Aromatic Hydrocarbons			
2-Methylnaphthalene	NE	NE	NE
Acenaphthene	3,900	41,000	NE
Acenaphthylene	NE	NE	NE
Anthracene	20,000	200,000	NE
Benz(a)anthracene	6.1	26	NE
Benzo(a)pyrene	0.61	2.6	NE
Benzo(b)fluoranthene	6.1	26	NE
Benzo(g,h,i)perylene	NE	NE	NE
Benzo(k)fluoranthene	61	260	NE
Chrysene	610	2,600	NE
Dibenz(a,h)anthracene	0.61	2.6	NE
Fluoranthene	2,600	27,000	NE
Fluorene	2,600	27,000	NE
Indeno(1,2,3-cd)pyrene	6.1	26	NE
Naphthalene	2,600	27,000	NE
Phenanthrene	NE	NE	NE
Pyrene	2,000	20,000	NE

TABLE 2.1
Summary of Groundwater Protection Levels and 1996 Soil Remediation Levels
APS Quality Assurance Project Plan

Analyte	Residential SRLs (mg/kg)	Non-Residential SRLs (mg/kg)	Minimum GPL (mg/kg)
Metals			
Arsenic	10	10	290
Barium	5,300	110,000	12,000
Cadmium	38	850	29
Chromium	2,100	4,500	590
Lead	400	2,000	290
Mercury	6.7	180	12
Selenium	380	8,500	290
Silver	380	8,500	NE
Cyanide			
Total Cyanide*	1,300	14,000	NE
Free Cyanide	1,300	14,000	NE

Notes: SRL = Soil Remediation Level[1]
GPL = Groundwater Protection Level[2]
NE = Not Established
mg/Kg = milligrams per kilogram
*There is no established SRL for total cyanide. The SRL for free cyanide is presented.
[a] Laboratory cannot report to this level. The associated PQL is the laboratory established reporting limit.
Sources:
[1] A.A.C., Title 18, Chapter 7, Article 2, Appendix A. Soil Remediation Levels, adopted December 4, 1997.
[2] ADEQ, A Screening Method to Determine Soil Concentrations Protective of Groundwater Quality, Minimum GPLs, September 1996.

TABLE 2.2
2007 Soil Remediation Levels (SRLS)
APS Quality Assurance Project Plan

			Residential (mg/kg)[a]			**Non-residential (mg/kg)[a]**
			Carcinogen			
Compound	**CASRN**	**Class**	**10^{-6} Risk**	**10^{-5} Risk**	**Non-carcinogen**	
Acephate	30560-19-1	ca, nc	63	630	240	2,000
Acetaldehyde	75-07-0	ca, nc	11	110	50	160
Acetochlor	34256-82-1	nc			1,200	12,000
Acetone	67-64-1	nc			14,000	54,000
Acetone cyanohydrin	75-86-5	nc			49	490
Acetonitrile	75-05-8	nc			420	1,800
Acrolein	107-02-8	nc			0.1	0.34
Acrylamide	79-06-1	ca, nc	0.12	1.2		3.8
Acrylic acid	79-10-7	nc			29,000	270,000
Acrylonitrile	107-13-1	ca, nc	0.21	2.1		4.9
Alachlor	15972-60-8	ca, nc	6.8	68		210
Alar	1596-84-5	nc			9,200	92,000
Aldicarb	116-06-3	nc			61	620
Aldicarb sulfone	1646-88-4	nc			61	620
Aldrin	309-00-2	ca, nc	0.032	0.32		1
Ally	74223-64-6	nc			15,000	150,000
Allyl alcohol	107-18-6	nc			310	3,100
Allyl chloride	107-05-1	nc			18	180
Aluminum	7429-90-5	nc			76,000	920,000
Aluminum phosphide	20859-73-8	nc			31	410

TABLE 2.2
2007 Soil Remediation Levels (SRLS)
APS Quality Assurance Project Plan

			Residential (mg/kg)[a]			**Non-residential (mg/kg)[a]**
			Carcinogen			
Compound	**CASRN**	**Class**	**10^{-6} Risk**	**10^{-5} Risk**	**Non-carcinogen**	
Amdro	67485-29-4	nc			18	180
Ametryn	834-12-8	nc			550	5,500
Aminodinitrotoluene	1321-12-6	nc			12	120
m-Aminophenol	591-27-5	nc			4,300	43,000
4-Aminopyridine	504-24-5	nc			1.2	12
Amitraz	33089-61-1	nc			150	1,500
Ammonium sulfamate	7773-06-0	nc			12,000	120,000
Aniline	62-53-3	ca, nc	96	960	430	3,000
Antimony and compounds	7440-36-0	nc			31	410
Apollo	74115-24-5	nc			790	8,000
Aramite	140-57-8	ca, nc	22	220		690
Arsenic1	7440-38-2	ca, nc	10	10	10	10
Assure	76578-12-6	nc			550	5,500
Asulam	3337-71-1	nc			3,100	31,000
Atrazine	1912-24-9	ca, nc	2.5	25		78
Avermectin B1	71751-41-2	nc			24	250
Azobenzene	103-33-3	ca	5	50		160
Barium and compounds	7440-39-3	nc			15,000	170,000
Baygon	114-26-1	nc			240	2,500

TABLE 2.2
2007 Soil Remediation Levels (SRLS)
APS Quality Assurance Project Plan

			Residential (mg/kg)[a]			Non-residential (mg/kg)[a]
			Carcinogen			
Compound	**CASRN**	**Class**	**10^{-6} Risk**	**10^{-5} Risk**	**Non-carcinogen**	
Bayleton	43121-43-3	nc			1,800	18,000
Baythroid	68359-37-5	nc			1,500	15,000
Benefin	1861-40-1	nc			18,000	180,000
Benomyl	17804-35-2	nc			3,100	31,000
Bentazon	25057-89-0	nc			1,800	18,000
Benzaldehyde	100-52-7	nc			6,100	62,000
Benzene	71-43-2	ca, nc	0.65	NA		1.4
Benzidine	92-87-5	ca, nc	0.0024	NA		0.0075
Benzoic acid	65-85-0	nc			240,000	1,000,000
Benzotrichloride	98-07-7	ca	0.042	0.42		1.3
Benzyl alcohol	100-51-6	nc			18,000	180,000
Benzyl chloride	100-44-7	ca, nc	0.92	9.2		22
Beryllium and compounds	7440-41-7	ca, nc			150	1,900
Bidrin	141-66-2	nc			6.1	62
Biphenthrin (Talstar)	82657-04-3	nc			920	9,200
1,1-Biphenyl	92-52-4	nc			350	350
Bis(2-chloroethyl)ether	111-44-4	ca	0.23	2.3		5.8
Bis(2-chloroisopropyl)ether	39638-32-9	nc			790	790
Bis(chloromethyl)ether	542-88-1	ca	0.0002	NA		0.00043

TABLE 2.2
2007 Soil Remediation Levels (SRLS)
APS Quality Assurance Project Plan

			Residential (mg/kg)^{a}			**Non-residential (mg/kg)^{a}**
			Carcinogen			
Compound	**CASRN**	**Class**	**10^{-6} Risk**	**10^{-5} Risk**	**Non-carcinogen**	
Bis(2-chloro-1-methylethyl)ether	108-60-1	ca, nc	3	30		74
Bis(2-ethylhexyl)phthalate (DEHP)	117-81-7	ca, nc	39	390		1200
Bisphenol A	80-05-7	nc			3,100	31,000
Boron	7440-42-8	nc			16,000	200,000
Bromate	15541-45-4	ca, nc	0.78	7.8		25
Bromobenzene	108-86-1	nc			28	92
Bromodichloromethane	75-27-4	ca, nc	0.83	8.3		18
Bromoform (tribromomethane)	75-25-2	ca, nc	69	690		2,200
Bromomethane (methyl bromide)	74-83-9	nc			3.9	13
Bromophos	2104-96-3	nc			310	3,100
Bromoxynil	1689-84-5	nc			1,200	12,000
Bromoxynil octanoate	1689-99-2	nc			1,200	12,000
1,3-Butadiene	106-99-0	ca, nc	0.058	0.58		1.2
1-Butanol	71-36-3	nc			6,100	61,000
Butylate	2008-41-5	nc			3,100	31,000
n-Butylbenzene	104-51-8	nc			240	240
sec-Butylbenzene	135-98-8	nc			220	220
tert-Butylbenzene	98-06-6	nc			390	390
Butyl benzyl phthalate	85-68-7	nc			12,000	120,000

TABLE 2.2
2007 Soil Remediation Levels (SRLS)
APS Quality Assurance Project Plan

			Residential (mg/kg)[a]			**Non-residential (mg/kg)[a]**
			Carcinogen			
Compound	**CASRN**	**Class**	**10^{-6} Risk**	**10^{-5} Risk**	**Non-carcinogen**	
Butylphthalyl butylglycolate	85-70-1	nc			61,000	620,000
Cadmium and compounds	7440-43-9	ca, nc			39	510
Caprolactam	105-60-2	nc			31,000	310,000
Captafol	191906	ca, nc	64	640	120	1,200
Captan	133-06-2	ca, nc	160	1,600		4,900
Carbaryl	63-25-2	nc			6,100	62,000
Carbazole	86-74-8	ca	27	270		860
Carbofuran	1563-66-2	nc			310	3,100
Carbon disulfide	75-15-0	nc			360	720
Carbon tetrachloride	56-23-5	ca, nc	0.25	2.5	2.2	5.5
Carbosulfan	55285-14-8	nc			610	6,200
Carboxin	5234-68-4	nc			6,100	62,000
Chloral hydrate	302-17-0	nc			6,100	62,000
Chloramben	133-90-4	nc			920	9,200
Chloranil	118-75-2	ca	1.4	14		43
Chlordane	12789-03-6	ca, nc	1.9	19		65
Chlorimuron-ethyl	90982-32-4	nc			1,200	12,000
Chloroacetic acid	79-11-8	nc			120	1,200
2-Chloroacetophenone	532-27-4	nc			0.033	0.11

			Residential (mg/kg)[a]			**Non-residential (mg/kg)[a]**
			Carcinogen			
Compound	**CASRN**	**Class**	**10^{-6} Risk**	**10^{-5} Risk**	**Non-carcinogen**	
4-Chloroaniline	106-47-8	nc			240	2,500
Chlorobenzene	108-90-7	nc			150	530
Chlorobenzilate	510-15-6	ca, nc	2	20		64
p-Chlorobenzoic acid	74-11-3	nc			12,000	120,000
4-Chlorobenzotrifluoride	98-56-6	nc			1,200	12,000
2-Chloro-1,3-butadiene	126-99-8	nc			3.6	12
1-Chlorobutane	109-69-3	nc			480	480
1-Chloro-1,1-difluoroethane	75-68-3	nc			340	340
Chlorodifluoromethane	75-45-6	nc			340	340
Chloroethane	75-00-3	ca, nc	3	30		65
Chloroform	67-66-3	ca, nc	0.94	9.4		20
Chloromethane	74-87-3	nc			48	160
4-Chloro-2-methylaniline	95-69-2	ca	0.94	9.4		30
4-Chloro-2-methylaniline hydrochloride	3165-93-3	ca	1.2	12		37
beta-Chloronaphthalene	91-58-7	nc			110	110
o-Chloronitrobenzene	88-73-3	ca, nc			1.4	4.5
p-Chloronitrobenzene	100-00-5	ca, nc			10	37
2-Chlorophenol	95-57-8	nc			63	240
2-Chloropropane	75-29-6	nc			170	590

TABLE 2.2
2007 Soil Remediation Levels (SRLS)
APS Quality Assurance Project Plan

			Residential (mg/kg)[a]			**Non-residential (mg/kg)[a]**
			Carcinogen			
Compound	**CASRN**	**Class**	**10^{-6} Risk**	**10^{-5} Risk**	**Non-carcinogen**	
Chlorothalonil	1897-45-6	ca, nc	50	500		1600
o-Chlorotoluene	95-49-8	nc			160	510
Chlorpropham	101-21-3	nc			12,000	120,000
Chlorpyrifos	2921-88-2	nc			180	1,800
Chlorpyrifos-methyl	5598-13-0	nc			610	6,200
Chlorsulfuron	64902-72-3	nc			3,100	31,000
Chlorthiophos	60238-56-4	nc			49	490
Chromium III	16065-83-1	nc			120,000	1,000,000
Chromium VI	18540-29-9	ca, nc	30	NA		65
Cobalt	7440-48-4	ca, nc	900	9,000	1,400	13,000
Copper and compounds	7440-50-8	nc			3,100	41,000
Crotonaldehyde	123-73-9	ca	0.0053	0.053		0.11
Cumene (isopropylbenzene)	98-82-8	nc			92	92
Cyanazine	21725-46-2	ca, nc	0.65	6.5		21
Cyanide (free)2	57-12-5	nc			1,200	12,000
Cyanide (hydrogen)3	74-90-8	nc			11	35
Cyanogen	460-19-5	nc			130	430
Cyanogen bromide	506-68-3	nc			290	970
Cyanogen chloride	506-77-4	nc			160	540

TABLE 2.2
2007 Soil Remediation Levels (SRLS)
APS Quality Assurance Project Plan

			Residential (mg/kg)[a]			Non-residential (mg/kg)[a]
			Carcinogen			
Compound	**CASRN**	**Class**	**10^{-6} Risk**	**10^{-5} Risk**	**Non-carcinogen**	
Cyclohexane	110-82-7	nc			140	140
Cyclohexanone	108-94-1	nc			310,000	1,000,000
Cyclohexylamine	108-91-8	nc			12,000	120,000
Cyhalothrin/Karate	68085-85-8	nc			310	3,100
Cypermethrin	52315-07-8	nc			610	6,200
Cyromazine	66215-27-8	nc			460	4,600
Dacthal	1861-32-1	nc			610	6,200
Dalapon	75-99-0	nc			1,800	18,000
Danitol	39515-41-8	nc			1,500	15,000
DDD	72-54-8	ca	2.8	28		100
DDE	72-55-9	ca	2	20		70
DDT	50-29-3	ca, nc	2	20		70
Decabromodiphenyl ether	1163-19-5	nc			610	6,200
Demeton	8065-48-3	nc			2.4	25
Diallate	2303-16-4	ca	9	90		280
Diazinon	333-41-5	nc			55	550
Dibenzofuran	132-64-9	nc			140	140
1,4-Dibromobenzene	106-37-6	nc			610	6,200
Dibromochloromethane	124-48-1	ca, nc	1.1	11		26

TABLE 2.2
2007 Soil Remediation Levels (SRLS)
APS Quality Assurance Project Plan

			Residential (mg/kg)[a]			**Non-residential (mg/kg)[a]**
			Carcinogen			
Compound	**CASRN**	**Class**	**10^{-6} Risk**	**10^{-5} Risk**	**Non-carcinogen**	
1,2-Dibromo-3-chloropropane	96-12-8	ca, nc	0.53	5.3	1.5	6.5
1,2-Dibromoethane	106-93-4	ca, nc	0.029	0.29		0.63
Dibutyl phthalate	84-74-2	nc			6,100	62,000
Dicamba	1918-00-9	nc			1,800	18,000
1,2-Dichlorobenzene	95-50-1	nc			600	600
1,3-Dichlorobenzene	541-73-1	nc			530	600
1,4-Dichlorobenzene	106-46-7	ca, nc	3.5	35		79
3,3-Dichlorobenzidine	91-94-1	ca	1.2	12		38
4,4'-Dichlorobenzophenone	90-98-2	nc			1,800	18,000
1,4-Dichloro-2-butene	764-41-0	ca	0.008	0.08		0.18
Dichlorodifluoromethane	75-71-8	nc			94	310
1,1-Dichloroethane	75-34-3	nc			510	1,700
1,2-Dichloroethane (DCA)	107-06-2	ca, nc	0.28	2.8		6
1,1-Dichloroethylene (DCE)	75-35-4	nc			120	410
1,2-Dichloroethylene (cis)	156-59-2	nc			43	150
1,2-Dichloroethylene (trans)	156-60-5	nc			69	230
2,4-Dichlorophenol	120-83-2	nc			180	1,800
4-(2,4-Dichlorophenoxy)butyric acid	94-82-6	nc			490	4,900
2,4-Dichlorophenoxyacetic Acid (2,4-D)	94-75-7	nc			690	7,700

TABLE 2.2
2007 Soil Remediation Levels (SRLS)
APS Quality Assurance Project Plan

			Residential (mg/kg)[a]			
			Carcinogen			
Compound	**CASRN**	**Class**	**10^{-6} Risk**	**10^{-5} Risk**	**Non-carcinogen**	**Non-residential (mg/kg)[a]**
1,2-Dichloropropane	78-87-5	ca, nc	0.34	3.4		7.4
1,3-Dichloropropane	142-28-9	nc			100	360
1,3-Dichloropropene	542-75-6	ca, nc	0.79	7.9		18
2,3-Dichloropropanol	616-23-9	nc			180	1,800
Dichlorvos	62-73-7	ca, nc	1.9	19		59
Dicofol	115-32-2	ca	1.2	12		39
Dicyclopentadiene	77-73-6	nc			0.54	1.8
Dieldrin	60-57-1	ca, nc	0.034	0.34		1.1
Diethylene glycol, monobutyl ether	112-34-5	nc			610	6,200
Diethylene glycol, monomethyl ether	111-90-0	nc			3,700	37,000
Diethylformamide	617-84-5	nc			24	250
Di(2-ethylhexyl)adipate	103-23-1	ca, nc	460	4,600		14,000
Diethyl phthalate	84-66-2	nc			49,000	490,000
Diethylstilbestrol	56-53-1	ca	0.00012	NA		0.0037
Difenzoquat (Avenge)	43222-48-6	nc			4,900	49,000
Diflubenzuron	35367-38-5	nc			1,200	12,000
Diisononyl phthalate	28553-12-0	nc			1,200	12,000
Diisopropyl methylphosphonate	1445-75-6	nc			4,900	49,000
Dimethipin	55290-64-7	nc			1,200	12,000

TABLE 2.2
2007 Soil Remediation Levels (SRLS)
APS Quality Assurance Project Plan

			Residential (mg/kg)[a]			Non-residential (mg/kg)[a]
			Carcinogen			
Compound	**CASRN**	**Class**	**10^{-6} Risk**	**10^{-5} Risk**	**Non-carcinogen**	
Dimethoate	60-51-5	nc			12	120
3,3'-Dimethoxybenzidine	119-90-4	ca	39	390		1,200
Dimethylamine	124-40-3	nc			0.067	0.25
N-N-Dimethylaniline	121-69-7	nc			120	1,200
2,4-Dimethylaniline	95-68-1	ca	0.73	7.3		23
2,4-Dimethylaniline hydrochloride	21436-96-4	ca	0.94	9.4		30
3,3'-Dimethylbenzidine	119-93-7	ca	0.24	2.4		7.5
N,N-Dimethylformamide	68-12-2	nc			6,100	62,000
Dimethylphenethylamine	122-09-8	nc			61	620
2,4-Dimethylphenol	105-67-9	nc			1,200	12,000
2,6-Dimethylphenol	576-26-1	nc			37	370
3,4-Dimethylphenol	95-65-8	nc			61	620
Dimethyl phthalate	131-11-3	nc			610,000	1,000,000
Dimethyl terephthalate	120-61-6	nc			6,100	62,000
4,6-Dinitro-o-cyclohexyl phenol	131-89-5	nc			120	1,200
1,2-Dinitrobenzene	528-29-0	nc			6.1	62
1,3-Dinitrobenzene	99-65-0	nc			6.1	62
1,4-Dinitrobenzene	100-25-4	nc			6.1	62
2,4-Dinitrophenol	51-28-5	nc			120	1,200

TABLE 2.2
2007 Soil Remediation Levels (SRLS)
APS Quality Assurance Project Plan

			Residential (mg/kg)[a]			**Non-residential (mg/kg)[a]**
			Carcinogen			
Compound	**CASRN**	**Class**	**10^{-6} Risk**	**10^{-5} Risk**	**Non-carcinogen**	
Dinitrotoluene mixture	25321-14-6	ca	0.81	8.1		25
2,4-Dinitrotoluene	121-14-2	nc			120	1,200
2,6-Dinitrotoluene	606-20-2	nc			61	620
Dinoseb	88-85-7	nc			61	620
di-n-Octyl phthalate	117-84-0	nc			2,400	25,000
1,4-Dioxane	123-91-1	ca	50	500		1,600
Dioxin (2,3,7,8-TCDD)	1746-01-6	ca	0.0000045	0.000045		0.00016
Diphenamid	957-51-7	nc			1,800	18,000
Diphenylamine	122-39-4	nc			1,500	15,000
N,N-Diphenyl-1,4 benzenediamine (DPPD)	74-31-7	nc			18	180
1,2-Diphenylhydrazine	122-66-7	ca	0.68	6.8		22
Diphenyl sulfone	127-63-9	nc			180	1,800
Diquat	85-00-7	nc			130	1,400
Direct black 38	1937-37-7	ca	0.064	NA		0.2
Direct blue 6	2602-46-2	ca	0.068	NA		0.21
Direct brown 95	16071-86-6	ca	0.059	NA		0.19
Disulfoton	298-04-4	nc			2.4	25
1,4-Dithiane	505-29-3	nc			610	6,200
Diuron	330-54-1	nc			120	1,200

TABLE 2.2
2007 Soil Remediation Levels (SRLS)
APS Quality Assurance Project Plan

			Residential (mg/kg)[a]			Non-residential (mg/kg)[a]
			Carcinogen			
Compound	**CASRN**	**Class**	**10^{-6} Risk**	**10^{-5} Risk**	**Non-carcinogen**	
Dodine	2439-10-3	nc			240	2,500
Dysprosium	7429-91-6	nc			7,800	102,000
Endosulfan	115-29-7	nc			370	3,700
Endothall	145-73-3	nc			1,200	12,000
Endrin	72-20-8	nc			18	180
Epichlorohydrin	106-89-8	ca, nc			7.6	26
1,2-Epoxybutane	106-88-7	nc			350	3,500
EPTC (S-Ethyl dipropylthiocarbamate)	759-94-4	nc			1,500	15,000
Ethephon (2-chloroethyl phosphonic acid)	16672-87-0	nc			310	3,100
Ethion	563-12-2	nc			31	310
2-Ethoxyethanol	110-80-5	nc			24,000	250,000
2-Ethoxyethanol acetate	111-15-9	nc			18,000	180,000
Ethyl acetate	141-78-6	nc			19,000	37,000
Ethyl acrylate	140-88-5	ca	0.21	2.1		4.5
Ethylbenzene	100-41-4	nc			400	400
Ethyl chloride	75-00-3	ca, nc	3	30		65
Ethylene cyanohydrin	109-78-4	nc			18,000	180,000
Ethylene diamine	107-15-3	nc			5,500	55,000
Ethylene glycol	107-21-1	nc			120,000	1,000,000

			Residential (mg/kg)[a]			Non-residential (mg/kg)[a]
			Carcinogen			
Compound	**CASRN**	**Class**	**10^{-6} Risk**	**10^{-5} Risk**	**Non-carcinogen**	
Ethylene glycol, monobutyl ether	111-76-2	nc			31,000	310,000
Ethylene oxide	75-21-8	ca	0.14	1.4		3.4
Ethylene thiourea (ETU)	96-45-7	ca, nc			4.9	49
Ethyl ether	60-29-7	nc			1,800	1,800
Ethyl methacrylate	97-63-2	nc			140	140
Ethyl p-nitrophenyl phenylphosphorothioate	2104-64-5	nc			0.61	6.2
Ethylphthalyl ethyl glycolate	84-72-0	nc			180,000	1,000,000
Express	101200-48-0	nc			490	4,900
Fenamiphos	22224-92-6	nc			15	150
Fluometuron	2164-17-2	nc			790	8,000
Fluoride	16984-48-8	nc			3,700	37,000
Fluoridone	59756-60-4	nc			4,900	49,000
Flurprimidol	56425-91-3	nc			1,200	12,000
Flutolanil	66332-96-5	nc			3,700	37,000
Fluvalinate	69409-94-5	nc			610	6,200
Folpet	133-07-3	ca, nc	160	1,600		4,900
Fomesafen	72178-02-0	ca	2.9	29		91
Fonofos	944-22-9	nc			120	1,200
Formaldehyde	50-00-0	ca, nc			9,200	92,000

TABLE 2.2
2007 Soil Remediation Levels (SRLS)
APS Quality Assurance Project Plan

			Residential (mg/kg)[a]			**Non-residential (mg/kg)[a]**
			Carcinogen			
Compound	**CASRN**	**Class**	**10^{-6} Risk**	**10^{-5} Risk**	**Non-carcinogen**	
Formic Acid	64-18-6	nc			110,000	1,000,000
Fosetyl-al	39148-24-8	nc			180,000	1,000,000
Furan	110-00-9	nc			2.5	8.5
Furazolidone	67-45-8	ca	0.14	1.4		4.5
Furfural	98-01-1	nc			180	1,800
Furium	531-82-8	ca	0.011	0.11		0.34
Furmecyclox	60568-05-0	ca	18	180		570
Glufosinate-ammonium	77182-82-2	nc			24	250
Glycidaldehyde	765-34-4	nc			24	250
Glyphosate	1071-83-6	nc			6,100	62,000
Haloxyfop-methyl	69806-40-2	nc			3.1	31
Harmony	79277-27-3	nc			790	8,003
Heptachlor	76-44-8	ca, nc	0.12	1.2		3.8
Heptachlor epoxide	1024-57-3	ca, nc	0.06	0.6		1.9
Hexabromobenzene	87-82-1	nc			120	1,200
Hexachlorobenzene	118-74-1	ca, nc	0.34	3.4		11
Hexachlorobutadiene	87-68-3	ca, nc	7	70	18	180
HCH (alpha)	319-84-6	ca, nc	0.1	1		3.6
HCH (beta)	319-85-7	ca, nc	0.36	3.6		13

TABLE 2.2
2007 Soil Remediation Levels (SRLS)
APS Quality Assurance Project Plan

			Residential (mg/kg)[a]			**Non-residential (mg/kg)[a]**
			Carcinogen			
Compound	**CASRN**	**Class**	**10^{-6} Risk**	**10^{-5} Risk**	**Non-carcinogen**	
HCH (gamma) Lindane	58-89-9	ca, nc	0.5	5		17
HCH-technical	608-73-1	ca	0.36	3.6		13
Hexachlorocyclopentadiene	77-47-4	nc			370	3,700
Hexachloroethane	67-72-1	ca, nc	39	390	61	620
Hexachlorophene	70-30-4	nc			18	180
Hexahydro-1,3,5-trinitro-1,3,5-triazine	121-82-4	ca, nc	5	50		160
1,6-Hexamethylene diisocyanate	822-06-0	nc			0.17	1.8
n-Hexane	110-54-3	nc			110	110
Hexazinone	51235-04-2	nc			2,020	20,000
Hydrazine, hydrazine sulfate	302-01-2	ca	0.18	1.8		5.7
Hydrazine, monomethyl	60-34-4	ca	0.18	1.8		5.7
Hydrazine, dimethyl	57-14-7	ca	0.18	1.8		5.7
p-Hydroquinone	123-31-9	ca, nc	9.8	98		310
Imazalil	35554-44-0	nc			790	8,000
Imazaquin	81335-37-7	nc			15,000	150,000
Iprodione	36734-19-7	nc			2,400	25,000
Isobutanol	78-83-1	nc			13,000	40,000
Isophorone	78-59-1	ca, nc	580	5,800		18,000
Isopropalin	33820-53-0	nc			920	9,200

TABLE 2.2
2007 Soil Remediation Levels (SRLS)
APS Quality Assurance Project Plan

			Residential (mg/kg)[a]			Non-residential (mg/kg)[a]
			Carcinogen			
Compound	**CASRN**	**Class**	**10^{-6} Risk**	**10^{-5} Risk**	**Non-carcinogen**	
Isopropyl methyl phosphonic acid	1832-54-8	nc			6,100	62,000
Isoxaben	82558-50-7	nc			3,100	31,000
Kepone	143-50-0	ca, nc	0.068	0.68		2.2
Lactofen	77501-63-4	nc			120	1,200
Lead	7439-92-1	ca, nc			400	800
Lead (tetraethyl)	78-00-2	nc			0.0061	0.062
Linuron	330-55-2	nc			120	1,200
Lithium	7439-93-2	nc			1,600	20,000
Londax	83055-99-6	nc			12,000	120,000
Malathion	121-75-5	nc			1,200	12,000
Maleic anhydride	108-31-6	nc			6,100	62,000
Maleic hydrazide	123-33-1	nc			1,700	2,400
Malononitrile	109-77-3	nc			6.1	62
Mancozeb	8018-01-7	nc			1,800	18,000
Maneb	12427-38-2	ca, nc	9.1	91		290
Manganese	7439-96-5	nc			3,300	32,000
Mephosfolan	950-10-7	nc			5.5	55
Mepiquat	24307-26-4	nc			1,800	18,000
2-Mercaptobenzothiazole	149-30-4	ca, nc	19	190		590

			Residential (mg/kg)[a]			**Non-residential (mg/kg)[a]**
			Carcinogen			
Compound	**CASRN**	**Class**	**10^{-6} Risk**	**10^{-5} Risk**	**Non-carcinogen**	
Mercury and compounds	7487-94-7	nc			23	310
Mercury (methyl)	22967-92-6	nc			6.1	62
Merphos	150-50-5	nc			1.8	18
Merphos oxide	78-48-8	nc			1.8	18
Metalaxyl	57837-19-1	nc			3,700	37,000
Methacrylonitrile	126-98-7	nc			2.1	8.4
Methamidophos	10265-92-6	nc			3.1	31
Methanol	67-56-1	nc			31,000	310,000
Methidathion	950-37-8	nc			61	620
Methomyl	16752-77-5	nc			44	150
Methoxychlor	72-43-5	nc			310	3,100
2-Methoxyethanol	109-86-4	nc			61	620
2-Methoxyethanol acetate	110-49-6	nc			120	1,200
2-Methoxy-5-nitroaniline	99-59-2	ca	12	120		370
Methyl acetate	79-20-9	nc			22,000	92,000
Methyl acrylate	96-33-3	nc			70	230
2-Methylaniline (o-toluidine)	95-53-4	ca	2.3	23		72
2-Methylaniline hydrochloride	636-21-5	ca	3	30		96
2-Methyl-4-chlorophenoxyacetic acid	94-74-6	nc			31	310

			Residential (mg/kg)[a]			Non-residential (mg/kg)[a]
			Carcinogen			
Compound	**CASRN**	**Class**	**10^{-6} Risk**	**10^{-5} Risk**	**Non-carcinogen**	
4-(2-Methyl-4-chlorophenoxy) butyric acid (MCPB)	94-81-5	nc			610	6,200
2-(2-Methyl-4-chlorophenoxy) propionic acid	93-65-2	nc			61	620
2-(2-Methyl-1,4-chlorophenoxy) propionic acid (MCPP)	16484-77-8	nc			61	620
Methylcyclohexane	108-87-2	nc			230	230
4,4'-Methylenebisbenzeneamine	101-77-9	ca	2.2	22		69
4,4'-Methylene bis(2-chloroaniline)	101-14-4	ca, nc	4.2	42		130
4,4'-Methylene bis(N,N'-dimethyl) aniline	101-61-1	ca	12	120		370
Methylene bromide	74-95-3	nc			67	230
Methylene chloride	75-09-2	ca, nc	9.3	93		210
4,4'-Methylenediphenyl diisocyanate	101-68-8	nc			10	110
Methyl ethyl ketone (MEK)	78-93-3	nc			23,000	34,000
Methyl isobutyl ketone (MIBK)	108-10-1	nc			5,300	17,000
Methyl mercaptan	74-93-1	nc			35	350
Methyl methacrylate	80-62-6	nc			2,200	2,700
2-Methyl-5-nitroaniline	99-55-8	ca	17	170		520
Methyl parathion	298-00-0	nc			15	150
2-Methylphenol	95-48-7	nc			3,100	31,000
3-Methylphenol	108-39-4	nc			3,100	31,000

TABLE 2.2
2007 Soil Remediation Levels (SRLS)
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			Residential (mg/kg)[a]			Non-residential (mg/kg)[a]
			Carcinogen			
Compound	**CASRN**	**Class**	**10^{-6} Risk**	**10^{-5} Risk**	**Non-carcinogen**	
4-Methylphenol	106-44-5	nc			310	3,100
Methyl phosphonic acid	993-13-5	nc			1,200	12,000
Methyl styrene (mixture)	25013-15-4	nc			130	540
Methyl styrene (alpha)	98-83-9	nc			680	680
Methyl tertbutyl ether (MTBE)	1634-04-4	ca, nc	32	320		710
Metolaclor (Dual)	51218-45-2	nc			9,200	92,000
Metribuzin	21087-64-9	nc			1,500	15,000
Mirex	2385-85-5	ca, nc	0.3	3		9.6
Molinate	2212-67-1	nc			120	1,200
Molybdenum	7439-98-7	nc			390	5,100
Monochloramine	10599-90-3	nc			6,100	62,000
Naled	300-76-5	nc			120	1,200
Napropamide	15299-99-7	nc			6,100	62,000
Nickel and compounds	7440-02-0	nc			1,600	20,000
Nickel subsulfide	12035-72-2	ca	5,200	NA		11,000
2-Nitroaniline	88-74-4	nc			180	1,800
3-Nitroaniline	99-09-2	ca, nc			18	180
4-Nitroaniline	100-01-6	ca, nc	26	260	180	820
Nitrobenzene	98-95-3	nc			20	100

			Residential (mg/kg)[a]			Non-residential (mg/kg)[a]
			Carcinogen			
Compound	**CASRN**	**Class**	**10^{-6} Risk**	**10^{-5} Risk**	**Non-carcinogen**	
Nitrofurantoin	67-20-9	nc			4,300	43,000
Nitrofurazone	59-87-0	ca	0.37	3.7		11
Nitroglycerin	55-63-0	ca	39	390		1,200
Nitroguanidine	556-88-7	nc			6,100	62,000
2-Nitropropane	79-46-9	ca, nc	0.0028	0.028		0.061
N-Nitrosodi-n-butylamine	924-16-3	ca	0.025	0.25		0.58
N-Nitrosodiethanolamine	1116-54-7	ca	0.2	2		6.2
N-Nitrosodiethylamine	55-18-5	ca	0.0037	0.037		0.11
N-Nitrosodimethylamine	62-75-9	ca, nc	0.011	0.11		0.34
N-Nitrosodiphenylamine	86-30-6	ca, nc	110	1,100		3,500
N-Nitroso di-n-propylamine	621-64-7	ca	0.078	0.78		2.5
N-Nitroso-N-methylethylamine	10595-95-6	ca	0.025	0.25		0.78
N-Nitrosopyrrolidine	930-55-2	ca	0.26	2.6		8.2
m-Nitrotoluene	99-08-1	nc			730	1,000
o-Nitrotoluene	88-72-2	ca, nc	0.93	9.3		22
p-Nitrotoluene	99-99-0	ca, nc	13	130		300
Norflurazon	27314-13-2	nc			2,400	25,000
NuStar	85509-19-9	nc			43	430
Octabromodiphenyl ether	32536-52-0	nc			180	1,800

			Residential (mg/kg)[a]			Non-residential (mg/kg)[a]
			Carcinogen			
Compound	**CASRN**	**Class**	**10^{-6} Risk**	**10^{-5} Risk**	**Non-carcinogen**	
Octahydro-1357-tetranitro-1357-tetrazocine (HMX)	2691-41-0	nc			3,100	31,000
Octamethylpyrophosphoramide	152-16-9	nc			120	1,200
Oryzalin	19044-88-3	nc			3,100	31,000
Oxadiazon	19666-30-9	nc			310	3,100
Oxamyl	23135-22-0	nc			1,500	15,000
Oxyfluorfen	42874-03-3	nc			180	1,800
Paclobutrazol	76738-62-0	nc			790	8,000
Paraquat	4685-14-7	nc			270	2,800
Parathion	56-38-2	nc			370	3,700
Pebulate	1114-71-2	nc			3,100	31,000
Pendimethalin	40487-42-1	nc			2,400	25,000
Pentabromo-6-chloro cyclohexane	87-84-3	ca	24	240		750
Pentabromodiphenyl ether	32534-81-9	nc			120	1,200
Pentachlorobenzene	608-93-5	nc			49	490
Pentachloronitrobenzene	82-68-8	ca, nc	2.1	21		66
Pentachlorophenol	87-86-5	ca, nc	3.2	32		90
Perchlorate	7601-90-3	nc			55	720
Permethrin	52645-53-1	nc			3,100	31,000
Phenmedipham	13684-63-4	nc			15,000	150,000

TABLE 2.2
2007 Soil Remediation Levels (SRLS)
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			Residential (mg/kg)[a]			Non-residential (mg/kg)[a]
			Carcinogen			
Compound	**CASRN**	**Class**	**10^{-6} Risk**	**10^{-5} Risk**	**Non-carcinogen**	
Phenol	108-95-2	nc			18,000	180,000
Phenothiazine	92-84-2	nc			120	1,200
m-Phenylenediamine	108-45-2	nc			370	3,700
o-Phenylenediamine	95-54-5	ca	12	120		370
p-Phenylenediamine	106-50-3	nc			12,000	120,000
Phenylmercuric acetate	62-38-4	nc			4.9	49
2-Phenylphenol	90-43-7	ca	280	2,800		8,900
Phorate	298-02-2	nc			12	120
Phosmet	732-11-6	nc			1,200	12,000
Phosphine	7803-51-2	nc			18	180
Phosphorus (white)	7723-14-0	nc			1.6	20
p-Phthalic acid	100-21-0	nc			61,000	620,000
Phthalic anhydride	85-44-9	nc			120,000	1,000,000
Picloram	1918-02-1	nc			4,300	43,000
Pirimiphos-methyl	29232-93-7	nc			610	6,200
Polybrominated biphenyls (PBBs)	NA	ca, nc	0.062	0.62	0.43	1.9
Polychlorinated biphenyls (PCBs), low-risk mixture4	12674-11-2	ca, nc			3.9	37
Polychlorinated biphenyls (PCBs), high-risk mixture5	11097-69-1	ca, nc	0.25	2.5	1.1	7.4

TABLE 2.2
2007 Soil Remediation Levels (SRLS)
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			Residential (mg/kg)[a]			**Non-residential (mg/kg)[a]**
			Carcinogen			
Compound	**CASRN**	**Class**	**10^{-6} Risk**	**10^{-5} Risk**	**Non-carcinogen**	
Polychlorinated terphenyls	61788-33-8	ca	0.12	1.2		3.8
Polynuclear aromatic hydrocarbons						
Acenaphthene	83-32-9	nc			3,700	29,000
Anthracene	120-12-7	nc			22,000	240,000
Benz[a]anthracene	56-55-3	ca	0.69	6.9		21
Benzo[b]fluoranthene	205-99-2	ca	0.69	6.9		21
Benzo[k]fluoranthene	207-08-9	ca	6.9	69		210
Benzo[a]pyrene	50-32-8	ca	0.069	0.69		2.1
Chrysene	218-01-9	ca	68	680		2,000
Dibenz[ah]anthracene	53-70-3	ca	0.069	0.69		2.1
Fluoranthene	206-44-0	nc			2,300	22,000
Fluorene	86-73-7	nc			2,700	26,000
Indeno[1,2,3-cd]pyrene	193-39-5	ca	0.69	6.9		21
Naphthalene	91-20-3	nc			56	190
Pyrene	129-00-0	nc			2,300	29,000
Prochloraz	67747-09-5	ca, nc	3.7	37		110
Profluralin	26399-36-0	nc			370	3,700
Prometon	1610-18-0	nc			920	9,200
Prometryn	7287-19-6	nc			240	2,500

TABLE 2.2
2007 Soil Remediation Levels (SRLS)
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			Residential (mg/kg)[a]			Non-residential (mg/kg)[a]
			Carcinogen			
Compound	**CASRN**	**Class**	**10^{-6} Risk**	**10^{-5} Risk**	**Non-carcinogen**	
Pronamide	23950-58-5	nc			4,600	46,000
Propachlor	1918-16-7	nc			790	8,000
Propanil	709-98-8	nc			310	3,100
Propargite	2312-35-8	nc			1,200	12,000
Propargyl alcohol	107-19-7	nc			120	1,200
Propazine	139-40-2	nc			1,200	12,000
Propham	122-42-9	nc			1,200	12,000
Propiconazole	60207-90-1	nc			790	8,000
n-Propylbenzene	103-65-1	nc			240	240
Propylene glycol	57-55-6	nc			30,000	290,000
Propylene glycol, monoethyl ether	52125-53-8	nc			43,000	430,000
Propylene glycol, monomethyl ether	107-98-2	nc			43,000	430,000
Propylene oxide	75-56-9	ca, nc	2.2	22		66
Pursuit	81335-77-5	nc			15,000	150,000
Pydrin	51630-58-1	nc			1,500	15,000
Pyridine	110-86-1	nc			61	620
Quinalphos	13593-03-8	nc			31	310
Quinoline	91-22-5	ca	0.18	1.8		5.7
RDX (Cyclonite)	121-82-4	ca, nc	5	50		160

TABLE 2.2
2007 Soil Remediation Levels (SRLS)
APS Quality Assurance Project Plan

			Residential (mg/kg)[a]			**Non-residential (mg/kg)[a]**
			Carcinogen			
Compound	**CASRN**	**Class**	**10^{-6} Risk**	**10^{-5} Risk**	**Non-carcinogen**	
Resmethrin	10453-86-8	nc			1,800	18,000
Ronnel	299-84-3	nc			3,100	31,000
Rotenone	83-79-4	nc			240	2,500
Savey	78587-05-0	nc			1,500	15,000
Selenious Acid	7783-00-8	nc			310	3,100
Selenium	7782-49-2	nc			390	5,100
Selenourea	630-10-4	nc			310	3,100
Sethoxydim	74051-80-2	nc			5,500	55,000
Silver and compounds	7440-22-4	nc			390	5,100
Simazine	122-34-9	ca, nc	4.6	46		140
Sodium azide	26628-22-8	nc			310	4,100
Sodium diethyldithiocarbamate	148-18-5	ca, nc	2	20		64
Sodium fluoroacetate	62-74-8	nc			1.2	12
Sodium metavanadate	13718-26-8	nc			61	620
Strontium, stable	7440-24-6	nc			47,000	610,000
Strychnine	57-24-9	nc			18	180
Styrene	100-42-5	nc			1,500	1,500
1,1'-Sulfonylbis-(4-chlorobenzene)	80-07-9	nc			310	3,100
Systhane	88671-89-0	nc			1,500	15,000

TABLE 2.2
2007 Soil Remediation Levels (SRLS)
APS Quality Assurance Project Plan

			Residential (mg/kg)[a]			Non-residential (mg/kg)[a]
			Carcinogen			
Compound	**CASRN**	**Class**	**10^{-6} Risk**	**10^{-5} Risk**	**Non-carcinogen**	
Tebuthiuron	34014-18-1	nc			4,300	43,000
Temephos	3383-96-8	nc			1,200	12,000
Terbacil	5902-51-2	nc			790	8,000
Terbufos	13071-79-9	nc			1.5	15
Terbutryn	886-50-0	nc			61	620
1,2,4,5-Tetrachlorobenzene	95-94-3	nc			18	180
1,1,1,2-Tetrachloroethane	630-20-6	ca, nc	3.2	32		73
1,1,2,2-Tetrachloroethane	79-34-5	ca, nc	0.42	4.2		9.3
Tetrachloroethylene (PCE)	127-18-4	ca, nc	0.51	5.1		13
2,3,4,6-Tetrachlorophenol	58-90-2	nc			1,800	18,000
p,a,a,a-Tetrachlorotoluene	5216-25-1	ca	0.027	0.27		0.86
Tetrachlorovinphos	961-11-5	ca, nc	23	230		720
Tetraethyldithiopyrophosphate	3689-24-5	nc			31	310
Tetrahydrofuran	109-99-9	ca, nc	9.5	95		210
Thallium and compounds	7440-28-0	nc			5.2	67
Thiobencarb	28249-77-6	nc			610	6,200
Thiocyanate	NA	nc			3,100	31,000
Thiofanox	39196-18-4	nc			18	180
Thiophanate-methyl	23564-05-8	nc			4,900	49,000

TABLE 2.2
2007 Soil Remediation Levels (SRLS)
APS Quality Assurance Project Plan

			Residential (mg/kg)[a]			**Non-residential (mg/kg)[a]**
			Carcinogen			
Compound	**CASRN**	**Class**	**10^{-6} Risk**	**10^{-5} Risk**	**Non-carcinogen**	
Thiram	137-26-8	nc			310	3,100
Tin	7440-31-5	nc			47,000	610,000
Titanium	7440-32-6	nc			310,000	1,000,000
Toluene	108-88-3	nc			650	650
Toluene-2,4-diamine	95-80-7	ca	0.17	1.7		5.4
Toluene-2,5-diamine	95-70-5	nc			37,000	370,000
Toluene-2,6-diamine	823-40-5	nc			12,000	120,000
p-Toluidine	106-49-0	ca	2.9	29		91
Toxaphene	8001-35-2	ca	0.5	5		16
Tralomethrin	66841-25-6	nc			460	4,600
Triallate	2303-17-5	nc			790	8,000
Triasulfuron	82097-50-5	nc			610	6,200
1,2,4-Tribromobenzene	615-54-3	nc			310	3,100
Tributyl phosphate	126-73-8	ca, nc	60	600		1,900
Tributyltin oxide (TBTO)	56-35-9	nc			18	180
2,4,6-Trichloroaniline	634-93-5	ca	16	160		510
2,4,6-Trichloroaniline hydrochloride	33663-50-2	ca	19	190		590
1,2,4-Trichlorobenzene	120-82-1	nc			62	220
1,1,1-Trichloroethane	71-55-6	nc			1,200	1,200

TABLE 2.2
2007 Soil Remediation Levels (SRLS)
APS Quality Assurance Project Plan

			Residential (mg/kg)[a]			Non-residential (mg/kg)[a]
			Carcinogen			
Compound	**CASRN**	**Class**	**10^{-6} Risk**	**10^{-5} Risk**	**Non-carcinogen**	
1,1,2-Trichloroethane	79-00-5	ca, nc	0.74	7.4		16
Trichloroethylene (TCE)	79-01-6	ca, nc	3	30	17	65
Trichlorofluoromethane	75-69-4	nc			390	1,300
2,4,5-Trichlorophenol	95-95-4	nc			6,100	62,000
2,4,6-Trichlorophenol	88-06-2	ca, nc			6.1	62
2,4,5-Trichlorophenoxyacetic acid	93-76-5	nc			610	6,200
2-(2,4,5-Trichlorophenoxy) propionic acid	93-72-1	nc			490	4,900
1,1,2-Trichloropropane	598-77-6	nc			15	51
1,2,3-Trichloropropane	96-18-4	ca, nc	0.005	0.05		0.11
1,2,3-Trichloropropene	96-19-5	nc			0.71	2.3
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	76-13-1	nc			5,600	5,600
Tridiphane	58138-08-2	nc			180	1,800
Triethylamine	121-44-8	nc			23	86
Trifluralin	1582-09-8	ca, nc	71	710	460	2,200
Trimellitic Anhydride (TMAN)	552-30-7	nc			8.6	86
1,2,4-Trimethylbenzene	95-63-6	nc			52	170
1,3,5-Trimethylbenzene	108-67-8	nc			21	70
Trimethyl phosphate	512-56-1	ca	15	150		470
1,3,5-Trinitrobenzene	99-35-4	nc			1,800	18,000

TABLE 2.2
2007 Soil Remediation Levels (SRLS)
APS Quality Assurance Project Plan

			Residential (mg/kg)[a]			Non-residential (mg/kg)[a]
			Carcinogen			
Compound	**CASRN**	**Class**	**10^{-6} Risk**	**10^{-5} Risk**	**Non-carcinogen**	
Trinitrophenylmethylnitramine	479-45-8	nc			610	6,200
2,4,6-Trinitrotoluene	118-96-7	ca, nc	18	180	31	310
Triphenylphosphine oxide	791-28-6	nc			1,200	12,000
Tris(2-chloroethyl) phosphate	115-96-8	ca, nc	39	390		1,200
Tris(2-ethylhexyl) phosphate	78-42-2	ca, nc	170	1,700		5,400
Uranium (chemical toxicity only)	7440-61-0	nc			16	200
Vanadium and compounds	7440-62-2	nc			78	1,000
Vernam	1929-77-7	nc			61	620
Vinclozolin	50471-44-8	nc			1,500	15,000
Vinyl acetate	108-05-4	nc			430	1,400
Vinyl bromide	593-60-2	ca, nc	0.19	1.9		4.2
Vinyl chloride	75-01-4	ca, nc	0.085	NA		0.75
Warfarin	81-81-2	nc			18	180
Xylenes	1330-20-7	nc			270	420
Zinc	7440-66-6	nc			23,000	310,000
Zinc phosphide	1314-84-7	nc			23	310
Zineb	12122-67-7	nc			3,100	31,000

TABLE 2.2

2007 Soil Remediation Levels (SRLS)

APS Quality Assurance Project Plan

			Residential (mg/kg)[a]			Non-residential (mg/kg)[a]
			Carcinogen			
Compound	**CASRN**	**Class**	**10^{-6} Risk**	**10^{-5} Risk**	**Non-carcinogen**	

Notes:

[a] The revised rule has eliminated the SRL listing for petroleum hydrocarbon mixtures, range C10 - C32, and does not set a single numeric SRL for total petroleum hydrocarbons. Instead, the revised rule provides for the cleanup of petroleum hydrocarbons by requiring cleanup for individual petroleum constituents detected in soil which have an SRL. For example, depending on the product released, this may include PAHs, trimethyl benzenes, and MTBE.

Class is the classification of the chemical. Chemicals may be either ca or nc, or both.

ca = carcinogenic

nc = non-carcinogenic

NA = non applicable

CASRN = Chemical Abstract System Registry Number

mg/kg = milligram per kilogram

TABLE 2.3

Summary of Regulatory Clean-up Levels for Groundwater

APS Quality Assurance Project Plan

Analyte	Aquifer Water Quality Standards (μg/L)
Total Petroleum Hydrocarbons	
Total Petroleum Hydrocarbons	NE
Volatile Organic Compounds	
1,1,1,2-Tetrachloroethane	NE
1,1,1-Trichloroethane	200
1,1,2,2-Tetrachloroethane	NE
1,1,2-Trichloroethane	5
1,1-Dichloroethane	NE
1,1-Dichloroethene	7
1,1-Dichloropropene	NE
1,2,3-Trichlorobenzene	NE
1,2,3-Trichloropropane	NE
1,2,4-Trichlorobenzene	70
1,2,4-Trimethylbenzene	NE
1,2-Dibromo-3-chloropropane	0.2
1,2-Dibromoethane (EDB)	0.05[a]
1,2-Dichlorobenzene	600
1,2-Dichloroethane	5
1,2-Dichloropropane	5
1,3,5-Trimethylbenzene	NE
1,3-Dichlorobenzene	NE
1,3-Dichloropropane	NE
1,4-Dichlorobenzene	75
2,2-Dichloropropane	NE
2-Butanone	NE
2-Chloroethylvinyl ether	NE
2-Chlorotoluene	NE
2-Hexanone	NE
4-Chlorotoluene	NE
4-Methyl-2-pentanone	NE

TABLE 2.3

Summary of Regulatory Clean-up Levels for Groundwater

APS Quality Assurance Project Plan

Analyte	**Aquifer Water Quality Standards (μg/L)**
Acetone	NE
Benzene	5
Bromobenzene	NE
Bromochloromethane	NE
Bromodichloromethane	NE
Bromoform	NE
Bromomethane	NE
Carbon Disulfide	NE
Carbon Tetrachloride	5
Chlorobenzene	100
Volatile Organic Compounds	
Chloroethane	NE
Chloroform*	100
Chloromethane	NE
cis-1,2-Dichloroethene	70
cis-1,3-Dichloropropene	NE
Dibromochloromethane	NE
Dibromomethane	NE
Dichlorodifluoromethane	NE
Ethylbenzene	700
Hexachlorobutadiene	NE
Iodomethane	NE
Isopropylbenzene	NE
Methylene chloride	NE
Methyl-tert-butyl- ether	NE
N-Butylbenzene	NE
N-Propylbenzene	NE
Naphthalene	NE
p-Isopropyltoluene	NE
sec-Butylbenzene	NE

TABLE 2.3

Summary of Regulatory Clean-up Levels for Groundwater

APS Quality Assurance Project Plan

Analyte	**Aquifer Water Quality Standards (μg/L)**
Styrene	100
tert-Butylbenzene	NE
Tetrachloroethene	5
Toluene	1,000
trans-1,2-Dichloroethene	100
trans-1,3-Dichloropropene	NE
Trichloroethene	5
Trichlorofluoromethane	NE
Vinyl acetate	NE
Vinyl chloride	2
Total xylenes	10,000
Polynuclear Aromatic Hydrocarbons	
2-Methylnaphthalene	NE
Acenaphthene	NE
Acenaphthylene	NE
Anthracene	NE
Benz(a)anthracene	NE
Benzo(a)pyrene	0.2[b]
Polynuclear Aromatic Hydrocarbons	
Benzo(b)fluoranthene	NE
Benzo(g,h,I)perylene	NE
Benzo(k)fluoranthene	NE
Chrysene	NE
Dibenz(a,h)anthracene	NE
Fluoranthene	NE
Fluorene	NE
Indeno(1,2,3-cd)pyrene	NE
Naphthalene	NE
Phenanthrene	NE
Pyrene	NE

TABLE 2.3
Summary of Regulatory Clean-up Levels for Groundwater
APS Quality Assurance Project Plan

Analyte	**Aquifer Water Quality Standards (μg/L)**
Metals	
Arsenic	50
Barium	2,000
Cadmium	5
Chromium	100
Lead	50
Mercury	2
Selenium	50
Silver	NE
Cyanide	
Total Cyanide	NE
Free Cyanide[c]	200
Ammonia	
Ammonia	NE
Nitrate/Nitrite	
Nitrate/nitrite	10,000
Nitrate	10,000
Nitrite	1000

Notes:

NE = Not Established

μg/L = micrograms per liter

* The AWQS for total trihalomethanes is presented for chloroform.

[a] Laboratory cannot report to this level. The associated PQL is the laboratory established reporting limit.

[b] Level achievable with analysis by Method 8310 but not by Method 8270C.

[c] "Free" = Amenable

Source: A.A.C., Title 18, Chapter 11, Article 4, R18-11-406 Numeric Aquifer Water Quality Standards: Drinking Water Protected Use, adopted May 25, 1994.

TABLE 2.4
Summary of Regulatory Clean-Up Levels for Surface Water
APS Quality Assurance Project Plan

Analyte	DWS(1) (µg/L)	FC(1) (µg/L)	FBC(1) (µg/L)	PCB(1) (µg/L)	AgI(1) (µg/L)	AgL(1) (µg/L)	A&Wc		A&Ww		A&Wedw		A&We	
							Acute(2) (µg/L)	Chronic(3) (µg/L)	Acute(2) (µg/L)	Chronic(3) (µg/L)	Acute(2) (µg/L)	Chronic(3) (µg/L)	Acute(2) (µg/L)	Chronic(3) (µg/L)
Acenaphthene	420	2600	8400	8400	NE	NE	850	550	850	550	850	550	NE	NE
Acenaphthylene	NSS	NSS	NSS	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Anthracene	2100	6300	42000	42000	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Arsenic (as As)	50 T	1450 T	50 T	50 T	2000 T	200 T	360 D	190 D	360 D	190 D	360 D	190 D	440 D	230 D
Barium (as Ba)	2000 T	NE	9800 D	9800 D	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Benzene	5	120	48	NE	NE	NE	2700	180	2700	180	11000	700	NE	NE
Benzo (a) anthracene	0.003	0.00008	0.12	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Benzo (a) pyrene	0.2	0.002	0.2	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Benzo (ghi) perylene	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Benzo (k) fluoranthene	0.003	0.00001	0.12	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Bromodichloromethane	TTHM	22	100	2800	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Bromoform	TTHM	80	180	2800	NE	NE	15000	10000	15000	10000	15000	10000	NE	NE
Bromomethane	9.8	7500	200	200	NE	NE	5500	360	5500	360	5500	360	NE	NE
Cadmium (as Cd)	5 T	41 T	70 T	70 T	50 T	50 T	D	D	D	D	D	D	D	D
Carbon tetrachloride	5	5.5	11	98	NE	NE	18000	1100	18000	1100	18000	1100	NE	NE
Chlorobenzene	100	500	2800	2800	NE	NE	9800	620	9800	620	NE	NE	NE	NE
2-Chloroethyl vinyl ether	NE	NE	NE	NE	NE	NE	180000	9800	180000	9800	180000	9800	NE	NE
Chloroform	TTHM	590	230	1400	NE	NE	14000	900	14000	900	14000	900	NE	NE
Chloromethane	NE	NE	NE	NE	NE	NE	270000	15000	270000	15000	270000	15000	NE	NE
Chromium (Total as Cr)	100 T	NE	NE	NE	1000 T	1000 T	NE	NE	NE	NE	NE	NE	NE	NE
Chrysene	0.003	0.0001	0.12	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Cyanide	200 T	210000 T	2800 T	2800 T	NE	200 T	22 T	5.2 T	41 T	9.7 T	41 T	9.7 T	84 T	19 T
Dibenzo (ah) anthracene	0.003	0.00003	0.12	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Dibromochloromethane	TTHM	12	17	2800	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
1,2-Dibromo-3-chloropropane (DBCP)	0.2	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
1,2-Dibromoethane (EDB)	0.05	NE	1.6	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
1,2-Dichlorobenzene	600	2800	13000	13000	NE	NE	790	300	1200	470	1200	470	5900	2300
1,3-Dichlorobenzene	94	2000	1880	1880	NE	NE	2500	970	2500	970	2500	970	NE	NE
1,4-Dichlorobenzene	75	1200	1880	1880	NE	NE	560	210	2000	780	2000	780	6500	2500
1,1-Dichloroethane	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
1,2-Dichloroethane	5	120	15	NE	NE	NE	59000	41000	59000	41000	59000	41000	NE	NE
1,1-Dichloroethylene	7	4.5	7	1300	NE	NE	15000	950	15000	950	15000	950	NE	NE
1,2-cis-Dichloroethylene	70	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
1,2-trans-Dichloroethylene	100	13000	2800	2800	NE	NE	68000	3900	68000	3900	68000	3900	NE	NE
Dichloromethane	5	480	190	8400	NE	NE	97000	5500	97000	5500	97000	5500	NE	NE
1,2-Dichloropropane	5	NE	NE	NE	NE	NE	26000	9200	26000	9200	26000	9200	NE	NE
1,3-Dichloropropene	0.2	6.6	7.8	42	NE	NE	3000	1100	3000	1100	3000	1100	NE	NE
Ethlybenzene	700	110000	14000	14000	NE	NE	23000	1400	23000	1400	23000	1400	NE	NE
Fluoranthene	280	130	5600	5600	NE	NE	2000	1600	2000	1600	2000	1600	NE	NE
Fluorene	280	580	5600	5600	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE

TABLE 2.4
Summary of Regulatory Clean-Up Levels for Surface Water
APS Quality Assurance Project Plan

Analyte	**DWS(1) (µg/L)**	**FC(1) (µg/L)**	**FBC(1) (µg/L)**	**PCB(1) (µg/L)**	**AgI(1) (µg/L)**	**AgL(1) (µg/L)**	**A&Wc**		**A&Ww**		**A&Wedw**		**A&We**	
							Acute(2) (µg/L)	**Chronic(3) (µg/L)**	**Acute(2) (µg/L)**	**Chronic(3) (µg/L)**	**Acute(2) (µg/L)**	**Chronic(3) (µg/L)**	**Acute(2) (µg/L)**	**Chronic(3) (µg/L)**
Fluorine	4000	NE	8400	8400	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Hexachlorobutadiene	0.45	0.52	18	NE	NE	NE	45	8.2	45	8.2	45	8.2	NE	NE
Indeno (1,2,3-cd) pyrene	0.003	3E-06	0.12	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Lead (as Pb)	50 T	NE	NE	NE	10000 T	100 T	D	D	D	D	D	D	D	D
Mercury (as Hg)	2 T	0.6 T	42 T	42 T	NE	10 T	2.4 D	0.01 D	2.4 D	0.01 D	2.6 D	0.2 D	5.0 D	2.7 D
Naphthalene	NE	NE	NE	NE	NE	NE	1100	210	3300	600	3300	600	NE	NE
Phenanthrene	NE	NE	NE	NE	NE	NE	30	6.3	30	6.3	54	6.3	NE	NE
Pyrene	210	1100	4200	4200	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Selenium (as Se)	50 T	9000 T	700 T	700 T	20 T	50 T	20 T	2.0 T	20 T	2.0 T	50 T	2.0 T	33 T	2.0 T
Silver (as Ag)	NE	NE	NE	NE	NE	NE	D	NE	D	NE	D	NE	D	NE
Styrene	100	NE	28000	28000	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
1,1,2,2-Tetrachloroethane	0.17	11	7	NE	NE	NE	4700	3200	4700	3200	4700	3200	NE	NE
Tetrachloroethylene	5	11	35	1400	NE	NE	2600	280	6500	680	6500	680	15000	1600
Toluene	1000	90000	28000	28000	NE	NE	8700	180	8700	180	8700	180	NE	NE
1,2,4-Trichlorobenzene	70	155	1400	1400	NE	NE	750	130	1700	300	NE	NE	NE	NE
1,1,1-Trichloroethane	200	NE	NE	NE	NE	NE	2600	1600	2600	1600	2600	1600	NE	NE
1,1,2-Trichloroethane	5	31	25	560	NE	NE	18000	12000	18000	12000	18000	12000	NE	NE
Trichloroethylene	5	NE	NE	NE	NE	NE	20000	1300	20000	1300	20000	1300	NE	NE
Trihalomethanes, Total	100	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Vinyl chloride	2	620	80	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Xylenes (Total)	10000	NE	280000	280000	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE

Notes:

(1) The numeric standards to protect this use shall not be exceede
(2) Determination of compliance with acute standards shall be as presecribed in R18-11-120C.
(3) Determination of compliance with chronic standards shall be as presecribed in R18-11-120C.
DWS = Domestic water source
FC = Fish consumption
FBC = Full body contact
PBC = Partial body contact
AgI = Agricultural irrigation
AgL = Agricultural livestock watering
TTHM = Indicates that the chemical is a trihalomethane. See trihalomethanes for DWS standard
T = Total recoverable

A&Wc Acute = aquatic and wildlife (cold water fishery)
A&Wc Chronic = aquatic and wildlife (cold water fishery)
A&Ww Acute = aquatic and wildlife (warm water fishery)
A&Ww Chronic = aquatic and wildlife (warm water fishery)
A&Wedw Acute = aquatic and wildlife (effluent dependent water)
A&Wedw Chronic = aquatic and wildlife (effluent dependent water)
A&We Acute = aquatic and wildlife (ephemeral)
A&We Chronic = aquatic and wildlife (ephemeral)
ug/L = micrograms per liter
NE = Not established
D = Dissolved

Source: Arizona Administrative Code, Title 18, Chapter 11, Article 1, Appendix A. Numeric Water Quality Standards, adopted April 23, 1996.

TABLE 2.5

Maximum Concentration of Contaminants for the Toxicity Characteristic Leaching Procedure

APS Quality Assurance Project Plan

Analyte	EPA Hazardous waste Number	CAS Number	Regulatory Level (mg/L)
TCLP Metals			
Arsenic	D004	7440-38-2	5.0
Barium	D005	7440-39-3	100.0
Cadmium	D006	7440-43-9	1.0
Chromium	D007	7440-47-3	5.0
Lead	D008	7439-92-1	5.0
Mercury	D009	7439-97-6	0.2
Selenium	D010	7782-49-2	1.0
Silver	D011	7440-22-4	5.0
TCLP Volatile Organic Compounds EPA 8260B			
1,1-Dichloroethene	D029	75-35-4	0.7
1,2-Dichloroethane	D028	107-06-2	0.5
2-Butanone (Methylethyl ketone [MEK])	D035	78-93-3	200.0
Benzene	D018	71-43-2	0.5
Carbon Tetrachloride	D019	56-23-5	0.5
Chlorobenzene	D021	108-90-7	100.0
Chloroform	D022	67-66-3	6.0
Tetrachloroethene	D039	127-18-4	0.7
Trichloroethene	D040	79-01-6	0.5
Vinyl chloride	D043	75-01-4	0.2

Notes:

Source: 40 CFR Sec. 261.24

TCLP - Toxicity Characteristic Leachate Procedure

TABLE 2.6
Pre-determined Allowable Community Air Monitoring Concentrations
APS Quality Assurance Project Plan

Test Method/Equipment	Analyte	Action Level USEPA Region IX Preliminary Remediation Goals (PRGs) (ng/m^3)	Maximum Allowable Concentrations Based on a Community Exposure Duration of 1-year (ng/m^3)
Polynuclear Aromatic Hydrocarbons (PAHs)			
EPA Method TO-13A by HPLC with high volume PUF tube (PUF/XAD-2/PUF)	Acenaphthene	220,000	220,000
	Acenaphthylene	NA	NA
	Anthracene	1,100,000	1,100,000
	Benzo(a)anthracene	9.2	105
	Benzo(a)pyrene	0.92	10.5
	Benzo(b)fluoranthene	9.2	105
	Benzo(g,h,i)perylene	NA	NA
	Benzo(k)fluoranthene	92	1,045
	Chrysene	920	25,000
	Dibenzo(a,h) anthracene	0.92	10.5
	Fluoranthene	150,000	150,000
	Fluorene	150,000	150,000
	Indeno(1,2,3-cd)pyrene	9.2	105
	Naphthalene	3,100	3,100
	Phenanthrene	NA	NA
	Pyrene	110,000	110,000
Volatile Organics			
EPA Method TO-15 with SUMMA canister or NIOSH Method 1501 with air monitoring pumps and sorbent tubes	Benzene	250	2,800
Metals			
Filter Cassette NIOSH Method 7300	Arsenic	0.45	5.1
Filter Cassette NIOSH Method 7300	Lead	NA	NA

TABLE 3.1

Soil Analytical Methods

APS Quality Assurance Project Plan

Analyses	Preparation Method	Test Method
Soil Samples - Mobile Laboratory		
TPH	ADHS 8015 AZR1	ADHS 8015 AZR1
BTEX	EPA 5035	EPA 8021B
PAHs	EPA 3550C	Modified EPA 8100
Soil Samples - Fixed Base Laboratory		
VOCs	EPA 5035	EPA 8021B or 8260B
TCLP VOCs	EPA 1311 and 5030B	EPA 8021B or 8260B
SVOCs	EPA 3550C	EPA 8270D
PAHs	EPA 3550C	EPA 8270D SIM
Organochlorine Pesticides	EPA 3550C	EPA 8081B
PCBs	EPA 3550C and EPA 3665A (acid cleanup)	EPA 8082A
Chlorinated herbicides	-	EPA 8151A
TPHg (GRO – C_6 to C_{10})	ADHS 8015 (Appendix 1)	ADHS 8015 AZR1 (Appendix 1)
TPHd as (DRO – C_{10} to C_{22})	ADHS 8015 AZR1	ADHS 8015 AZR1
TPHo as (ORO – C_{22} to C_{32})	ADHS 8015 AZR1	ADHS 8015 AZR1
RCRA-8 Metals	EPA 3050B	EPA 6010C/7471B
TCLP Metals	EPA 1311 and 3005A	EPA 6010C/7471B
Hexavalent Chromium	EPA 3060A	EPA 7196A or EPA 7199
Total Cyanide	EPA 9013 (extraction) and EPA 9010C (distillation)	EPA 9014
Sulfide	-	EPA 9031
Sulfide	EPA 9030B	EPA 9034
Ignitability	-	SW-846 7.1.2
pH	-	EPA 9045D
Paint Filter	-	EPA 9095B

Notes:

TPH = Total Petroleum Hydrocarbons

EPA = Environmental Protection Agency

ADHS = Arizona Department of Health Services

BTEX = Benzene, Toluene, Ethylbenzene, and total Xylenes

PAHs = Polynuclear Aromatic Hydrocarbons

PCB = Polychlorobiphenyls

VOCs = Volatile Organic Compounds

GRO = Gasoline Range Organics

DRO = Diesel Range Organics

ORO = Oil Range Organics

RCRA = Resource Conservation and Recovery Act

TCLP = Toxicity Characteristic Leaching Procedure

TABLE 3.2
Aqueous Analytical Methods
APS Quality Assurance Project Plan

Analyses	Preparation Method	Test Method
Aqueous Samples - Fixed Base Laboratory		
VOCs	EPA 5030B	EPA 8021B, 601/602, or 8260B
SVOCs	EPA 3510C or 3520C	EPA 8270D
PAHs	EPA 3510C or 3520C	EPA 8270D SIM
TPHg (GRO – C_6 to C_{10})	EPA 5030B	Modified EPA 8015D
TPHd as (DRO – C_{10} to C_{22})	EPA 3510C	Modified EPA 8015D
TPHo as (ORO – C_{22} to C_{32})	EPA 3510C	Modified EPA 8015D
Organochlorine Pesticides	EPA 3510C or 3520C	EPA 8081B
PCBs	EPA 3510C or 3520C and EPA 3665A (sulfuric acid cleanup)	EPA 8082A
Chlorinated Herbicides	-	EPA 8151A
RCRA-8 Metals using Wastewater Methods	EPA 3005A	EPA 200.7/200.9/206.2/213.2/239.2/ 270.2/272.2/245.1
RCRA-8 Metals for using Groundwater Methods	EPA 3005A	EPA 6010C/7470A
Hexavalent Chromium	-	EPA 7196A or EPA 7199
Sulfide	EPA 9030B	EPA 9034
Total Cyanide	-	SM4500-CN-E
Total Cyanide	EPA 9010C	EPA 9014
Amenable Cyanide	-	SM4500 CN-G
Weak Acid Dissociable Cyanide	-	SM4500 CN-I
Ammonia	-	SM4500-NH3 B, D, E
Nitrate	-	300.0
Nitrite	-	300.0
Nitrate/nitrite combined methods	-	SM4500NO3, 353.2
Sulfate	-	300.0

Notes:
VOCs = Volatile Organic Compounds
EPA = United States Environmental Protection Agency
TPH = Total Petroleum Hydrocarbons
GRO = Gasoline Range Organics
DRO = Diesel Range Organics
ORO = Oil Range Organics
PAHs = Polynuclear Aromatic Hydrocarbons
PCBs = Polychlorinated Biphenyls
RCRA = Resource Conservation and Recovery Act

TABLE 3.3

Air and Soil Vapor Analytical Methods

APS Quality Assurance Project Plan

Analyses	Preparation Method	Test Method
Air Samples and Soil Vapor - Fixed Base Laboratory		
VOCs	EPA TO-15 or NIOSH 1501	EPA TO-15 or NIOSH 1501
VOCs	-	EPA 8260B
Oxygen, Carbon Dioxide, Methane, and Nitrogen	-	EPA 3C
PAHs	EPA 3540C	EPA TO-13A by HPLC
Lead	NIOSH 7300	NIOSH 7300/EPA 6010C

Notes:

VOCs = Volatile Organic Compounds

EPA = United States Environmental Protection Agency

PAHs = Polynuclear Aromatic Hydrocarbons

NIOSH = National Institute for Occupational Safety and Health

TABLE 3.4
Summary of Analytes and QAPP Objectives for Mobile Laboratory Soil Analyses
APS Quality Assurance Project Plan

Analyte	PQLs (mg/kg)	Lower Control Limit (percent)	Upper Control Limit (percent)	Relative Percent Difference Limit
ADHS 8015 AZR1 (LCS/LCSD)				
Total TPH	130	70	130	30
ADHS 8015 AZR1 (MS/MSD)				
Total TPH	130	44	171	30
8015AZR1 surrogate				
GRO) 2-bromofluorobenzene		23	174	
DRO) o-terphenyl		23	174	
DRO) n-docosane		23	174	
BTEX by EPA 8021B (LCS/LCSD)				
Benzene	0.5	70	130	30
Toluene	0.1	70	130	30
Ethylbenzene	0.1	70	130	30
Total xylenes	0.15	70	130	30
BTEX by EPA 8021B (MS/MSD)				
Benzene	0.5	79	167	30
Toluene	0.1	77	164	30
Ethylbenzene	0.1	80	158	30
Total xylenes	0.15	66	209	30
8021B surrogate				
bromochlorobenzene		48	156	
PAHs by EPA 8100 Modified (LCS/LCSD)				
Acenaphthene	0.5	70	130	30
Acenaphthylene	0.5			
Anthracene	0.5			
Benz(a)anthracene	0.5			
Benzo(a)pyrene	0.5	70	130	30
Benzo(b)fluoranthene	0.5			
Benzo(g,h,i)perylene	0.5			
Benzo(k)fluoranthene	0.5			
Chrysene	0.5			

TABLE 3.4
Summary of Analytes and QAPP Objectives for Mobile Laboratory Soil Analyses
APS Quality Assurance Project Plan

Analyte	PQLs (mg/kg)	Lower Control Limit (percent)	Upper Control Limit (percent)	Relative Percent Difference Limit
Dibenz(a,h)anthracene	0.5			
Fluoranthene	0.5			
Fluorene	0.5			
Indeno(1,2,3-cd)pyrene	0.5			
Naphthalene	0.5			
Phenanthrene	0.5			
Pyrene	0.5	70	130	30
PAHs by EPA 8100 Modified (MS/MSD)				
Acenaphthene	0.5	38	200	30
Acenaphthylene	0.5			
Anthracene	0.5			
Benz(a)anthracene	0.5			
Benzo(a)pyrene	0.5	16	223	30
Benzo(b)fluoranthene	0.5			
Benzo(g,h,i)perylene	0.5			
Benzo(k)fluoranthene	0.5			
Chrysene	0.5			
Dibenz(a,h)anthracene	0.5			
Fluoranthene	0.5			
Fluorene	0.5			
Indeno(1,2,3-cd)pyrene	0.5			
Naphthalene	0.5			
Phenanthrene	0.5			
Pyrene	0.5	59	243	30
8100 Surrogate				
o-terphenyl		23	174	

Notes:
QAPP = Quality Assurance Project Plan
PQL = Practical Quantitation Limit
TPH = Total Petroleum Hydrocarbons
BTEX = Benzene, Toluene, Ethylbenzene, and total Xylenes
PAHs = Polynuclear Aromatic Hydrocarbons
mg/kg = milligrams per kilogram
Source of 8100 spiking compounds: Orange Coast Analytical, Inc.
All values presented are the method control limits (LCS/LCSD, MS/MSD, Surrogates)

TABLE 3.5

Summary of Analytes and QAPP Objectives for Fixed-Base Laboratory Analyses of Soil Samples

APS Quality Assurance Project Plan

Analyte	PQL	Units	Lower Control Limit (percent)	Upper Control Limit (percent)	Relative Percent Difference Limit
Volatile Organic Compounds by EPA 8021B					
1,1,1-Trichloroethane	0.05	mg/kg			
1,1,2,2-Tetrachloroethane	0.1	mg/kg			
1,1,2-Trichloroethane	0.05	mg/kg			
1,1-Dichloroethane	0.05	mg/kg	70	130	30
1,1-Dichloroethene	0.1	mg/kg	70	130	30
1,2-Dichlorobenzene	0.1	mg/kg			
1,2-Dichloroethane	0.05	mg/kg	70	130	30
1,2-Dichloropropane	0.05	mg/kg			
1,3-Dichlorobenzene	0.1	mg/kg			
1,4-Dichlorobenzene	0.1	mg/kg			
Benzene	0.05	mg/kg	70	130	30
Bromodichloromethane	0.05	mg/kg			
Bromoform	0.1	mg/kg			
Bromomethane	0.2	mg/kg			
Carbon Tetrachloride	0.05	mg/kg			
Chlorobenzene	0.1	mg/kg			
Chloroethane	0.2	mg/kg			
Chloroform	0.05	mg/kg	70	130	30
Chloromethane	0.2	mg/kg			
cis-1,2-Dichloroethene	0.05	mg/kg			
cis-1,3-Dichloropropene	0.05	mg/kg			
Dibromochloromethane	0.05	mg/kg			
Dichlorodifluoromethane	0.2	mg/kg			
Ethylbenzene	0.1	mg/kg			
Methylene chloride	0.2	mg/kg			
Tetrachloroethene	0.05	mg/kg	70	130	30
Toluene	0.1	mg/kg	70	130	30
trans-1,2-Dichloroethene	0.05	mg/kg			

TABLE 3.5

Summary of Analytes and QAPP Objectives for Fixed-Base Laboratory Analyses of Soil Samples

APS Quality Assurance Project Plan

Analyte	PQL	Units	Lower Control Limit (percent)	Upper Control Limit (percent)	Relative Percent Difference Limit
trans-1,3-Dichloropropene	0.05	mg/kg			
Trichloroethene	0.05	mg/kg	70	130	30
Trichlorofluoromethane	0.2	mg/kg			
Vinyl chloride	0.1	mg/kg			
Xylenes, total	0.15	mg/kg			
8021B Surrogates					
aaa- trifluorotoluene *1-chloro-3-fluorobenzene*			70 70	130 130	
Volatile Organic Compounds by EPA 8260B					
1,1,1,2-Tetrachloroethane	0.25	mg/kg			
1,1,1-Trichloroethane	0.1	mg/kg			
1,1,2,2-Tetrachloroethane	0.1	mg/kg			
1,1,2-Trichloroethane	0.1	mg/kg			
1,1-Dichloroethane	0.1	mg/kg			
1,1-Dichloroethene	0.25	mg/kg	70	130	30
1,1-Dichloropropene	0.1	mg/kg			
1,2,3-Trichlorobenzene	0.25	mg/kg			
1,2,3-Trichloropropane	0.5	mg/kg			
1,2,4-Trichlorobenzene	0.25	mg/kg			
1,2,4-Trimethylbenzene	0.1	mg/kg			
1,2-Dibromo-3-chloropropane	0.25	mg/kg			
1,2-Dibromoethane	0.1	mg/kg			
1,2-Dichlorobenzene	0.1	mg/kg			
1,2-Dichloroethane	0.1	mg/kg			
1,2-Dichloropropane	0.1	mg/kg			
1,3,5-Trimethylbenzene	0.1	mg/kg			
1,3-Dichlorobenzene	0.1	mg/kg			
1,3-Dichloropropane	0.1	mg/kg			
1,4-Dichlorobenzene	0.1	mg/kg			

TABLE 3.5
Summary of Analytes and QAPP Objectives for Fixed-Base Laboratory Analyses of Soil Samples
APS Quality Assurance Project Plan

Analyte	PQL	Units	Lower Control Limit (percent)	Upper Control Limit (percent)	Relative Percent Difference Limit
2,2-Dichloropropane	0.1	mg/kg			
2-Butanone (Methylethyl ketone [MEK])	0.5	mg/kg			
2-Chloroethylvinyl ether	0.25	mg/kg			
2-Chlorotoluene	0.25	mg/kg			
2-Hexanone	0.5	mg/kg			
4-Chlorotoluene	0.25	mg/kg			
4-Methyl-2-pentanone	0.25	mg/kg			
Acetone	0.5	mg/kg			
Benzene	0.1	mg/kg	70	130	30
Bromobenzene	0.25	mg/kg			
Bromochloromethane	0.25	mg/kg			
Bromodichloromethane	0.1	mg/kg			
Bromoform	0.25	mg/kg			
Bromomethane	0.25	mg/kg			
Carbon Disulfide	0.25	mg/kg			
Carbon Tetrachloride	0.25	mg/kg			
Chlorobenzene	0.1	mg/kg	70	130	30
Chloroethane	0.25	mg/kg			
Chloroform	0.1	mg/kg			
Chloromethane	0.25	mg/kg			
cis-1,2-Dichloroethene	0.1	mg/kg			
cis-1,3-Dichloropropene	0.1	mg/kg			
Dibromochloromethane	0.1	mg/kg			
Dibromomethane	0.1	mg/kg			
Dichlorodifluoromethane	0.25	mg/kg			
Ethylbenzene	0.1	mg/kg			
Hexachlorobutadiene	0.25	mg/kg			
Iodomethane	0.1	mg/kg			
Isopropylbenzene	0.1	mg/kg			

TABLE 3.5

Summary of Analytes and QAPP Objectives for Fixed-Base Laboratory Analyses of Soil Samples

APS Quality Assurance Project Plan

Analyte	PQL	Units	Lower Control Limit (percent)	Upper Control Limit (percent)	Relative Percent Difference Limit
Methylene chloride	0.5	mg/kg			
Methyl-tert-butyl- ether	0.25	mg/kg			
N-Butylbenzene	0.25	mg/kg			
N-Propylbenzene	0.1	mg/kg			
Naphthalene	0.25	mg/kg			
p-Isopropyltoluene	0.1	mg/kg			
sec-Butylbenzene	0.25	mg/kg			
Styrene	0.1	mg/kg			
tert-Butylbenzene	0.25	mg/kg			
Tetrachloroethene	0.1	mg/kg			
Toluene	0.1	mg/kg	70	130	30
trans-1,2-Dichloroethene	0.1	mg/kg			
trans-1,3-Dichloropropene	0.1	mg/kg			
Trichloroethene	0.1	mg/kg	70	130	30
Trichlorofluoromethane	0.25	mg/kg			
Vinyl acetate	0.25	mg/kg			
Vinyl chloride	0.25	mg/kg			
Total xylenes	0.3	mg/kg			
8260B Surrogates					
Toluene-D8			70	130	
4-Bromofluorobenzene			70	130	
Dibromofluoromethane			70	130	
SVOCs by 8270D					
Acenaphthene	0.33	mg/kg	70	130	30
Acenaphthylene	0.33	mg/kg			
Anthracene	0.33	mg/kg			
Benz(a)anthracene	0.33	mg/kg			
Benzo(a)pyrene	0.33	mg/kg			
Benzo(b)fluoranthene	0.33	mg/kg			

TABLE 3.5

Summary of Analytes and QAPP Objectives for Fixed-Base Laboratory Analyses of Soil Samples

APS Quality Assurance Project Plan

Analyte	PQL	Units	Lower Control Limit (percent)	Upper Control Limit (percent)	Relative Percent Difference Limit
Benzo(g,h,i)perylene	0.33	mg/kg			
Benzo(k)fluoranthene	0.33	mg/kg			
Chrysene	0.33	mg/kg			
Dibenz(a,h)anthracene	0.33	mg/kg			
Fluoranthene	0.33	mg/kg			
Fluorene	0.33	mg/kg			
Indeno(1,2,3-cd)pyrene	0.33	mg/kg			
2-Methylnaphthalene	0.33	mg/kg			
Naphthalene	0.33	mg/kg			
Phenanthrene	0.33	mg/kg			
Pyrene	0.33	mg/kg	70	130	30
1,2,4-trichlorobenzene	0.33	mg/kg	44	125	30
1,2-dichlorobenzene	0.33	mg/kg	45	125	30
1,3-dichlorobenzene	0.33	mg/kg	39	125	30
1,4-dichlorobenzene	0.33	mg/kg	35	125	30
2,4-Dinitrotoluene	0.33	mg/kg	48	125	30
2,6-dinitrotoluene	0.33	mg/kg	48	125	30
2,4,5-Trichlorophenol	1.6	mg/kg	25	175	30
2,4,6-Trichlorophenol	0.33	mg/kg	39	138	30
2,4-Dichlorophenol	0.33	mg/kg	36	135	30
2,4-Dimethylphenol	0.33	mg/kg	35	149	30
2,4-Dinitrophenol	1.6	mg/kg	25	161	30
2-Chloronaphthalene	0.33	mg/kg	50	135	30
2-Chlorophenol	0.33	mg/kg	31	135	30
2-Methylphenol	0.33	mg/kg	25	135	30
2-Nitroaniline	1.6	mg/kg	40	135	30
3-Nitroaniline	1.6	mg/kg	27	125	30
2-Methyl-4,6-Dinitrophenol	1.6	mg/kg	25	144	30
3,3'-Dichlorobenzidine	0.33	mg/kg	25	175	30
4-Chloroaniline	0.33	mg/kg	35	146	30

TABLE 3.5
Summary of Analytes and QAPP Objectives for Fixed-Base Laboratory Analyses of Soil Samples
APS Quality Assurance Project Plan

Analyte	PQL	Units	Lower Control Limit (percent)	Upper Control Limit (percent)	Relative Percent Difference Limit
4-Methylphenol	0.33	mg/kg	25	135	30
4-Nitroaniline	1.6	mg/kg	34	125	30
4-Nitrophenol	1.6	mg/kg	25	141	30
Benzoic Acid	1.6	mg/kg	25	125	30
Benzyl Alcohol	1.6	mg/kg	25	125	30
Bis(2-Chloroethyl)Ether	0.33	mg/kg	34	135	30
Bis(2-Chloroisopropyl)Ether	0.33	mg/kg	26	175	30
Bis(2-Ethylhexyl)Phthalate	0.33	mg/kg	25	139	30
Butylbenzylphthalate	0.33	mg/kg	25	135	30
Dibenzofuran	0.33	mg/kg	25	135	30
Diethylphthalate	0.33	mg/kg	27	135	30
Dimethylphthalate	0.33	mg/kg	25	175	30
Di-n-Butylphthalate	0.33	mg/kg	25	136	30
Di-n-Octylphthalate	0.33	mg/kg	28	137	30
Hexachlorobenzene	0.33	mg/kg	36	143	30
Hexachlorobutadiene	0.33	mg/kg	25	135	30
Hexachloroethane	0.33	mg/kg	25	163	30
Isophorone	0.33	mg/kg	25	175	30
Nitrobenzene	0.33	mg/kg	36	143	30
N-Nitroso-di-n-Propylamine	0.33	mg/kg	27	135	30
N-Nitrosodiphenylamine	0.33	mg/kg	25	135	30
Pentachlorophenol	1.6	mg/kg	38	146	30
Phenol	0.33	mg/kg	25	135	30
8270D Surrogates					
2,4,6-Tribromophenol			25	144	
Phenol-d5			25	135	
2-Fluorobiphenyl			34	135	
Nitrobenzene-d5			70	130	
2-fluorobiphenol			70	130	

TABLE 3.5
Summary of Analytes and QAPP Objectives for Fixed-Base Laboratory Analyses of Soil Samples
APS Quality Assurance Project Plan

Analyte	PQL	Units	Lower Control Limit (percent)	Upper Control Limit (percent)	Relative Percent Difference Limit
Terphenyl-d14			70	130	
Polynuclear Aromatic Hydrocarbons by EPA 8310/EPA 8270DSIM					
Acenaphthene	0.1/0.005	mg/kg			
Acenaphthylene	0.1/0.005	mg/kg			
Anthracene	0.01/0/005	mg/kg			
Benz(a)anthracene	0.01/0.005	mg/kg	12/Lab limit	135/Lab limit	30
Benzo(a)pyrene	0.005/0.005	mg/kg	D/Lab limit	128/Lab limit	30
Benzo(b)fluoranthene	0.01/0.005	mg/kg			
Benzo(g,h,i)perylene	0.01/0.005	mg/kg			
Benzo(k)fluoranthene	0.01/0.005	mg/kg			
Chrysene	0.01/0.005	mg/kg			
Dibenz(a,h)anthracene	0.005/0.005	mg/kg			
Fluoranthene	0.01/0.005	mg/kg			
Fluorene	0.01/0.005	mg/kg			
Indeno(1,2,3-cd)pyrene	0.01/0.006	mg/kg			
Naphthalene	0.1/0.005	mg/kg	D/Lab limit	122/Lab limit	30
Phenanthrene	0.01/0.005	mg/kg			
Pyrene	0.010.005	mg/kg			
8310 Surrogate					
2-methylanthracene			70	130	
8270DSIM Surrogates					
Lab surrogates			Lab limit	Lab limit	
TPH by ADHS 8015AZR1					
Volatile TPH					
GRO (C_6 – C_{10})	20	mg/kg	70	130	30
Volatile Surrogate					
2-bromofluorobenzene			70	130	
Extractable TPH					
DRO (C10 – C22)	30	mg/kg	70	130	30

TABLE 3.5
Summary of Analytes and QAPP Objectives for Fixed-Base Laboratory Analyses of Soil Samples
APS Quality Assurance Project Plan

Analyte	PQL	Units	Lower Control Limit (percent)	Upper Control Limit (percent)	Relative Percent Difference Limit
ORO (C22 – C32)	100	mg/kg	70	130	30
Extractable Surrogate					
Docosane			70	30	
Organochlorine Pesticides by EPA 8081B					
4,4’-DDD	3.3	µg/kg	38	146	50
4,4’-DDE	3.3	µg/kg	35	149	50
4,4’-DDT	3.3	µg/kg	25	153	50
Aldrin	1.7	µg/kg	37	126	50
alpha-BHC	1.7	µg/kg	65	135	50
beta-BHC	1.7	µg/kg	41	133	50
delta-BHC	1.7	µg/kg	57	130	50
gamma-BHC	1.7	µg/kg	63	130	50
alpha-Chlordane	1.7	µg/kg	63	121	50
gamma-Chlordane	1.7	µg/kg	31	133	50
Dieldrin	3.3	µg/kg	32	142	50
Endosulfan I	3.3	µg/kg	41	147	50
Endosulfan II	3.3	µg/kg	37	141	50
Endosulfan Sulfate	3.3	µg/kg	62	135	50
Endrin	3.3	µg/kg	33	144	50
Endrin Aldehyde	3.3	µg/kg	37	147	50
Endrin Ketone	3.3	µg/kg	60	125	50
Heptachlor	1.7	µg/kg	35	138	50
Heptachlor Epoxide	1.7	µg/kg	43	144	50
Methoxychlor	17	µg/kg	63	152	50
Toxaphene	170	µg/kg	31	136	50
8081B Surrogates					
DCBP			25	143	
TCMX			35	135	

TABLE 3.5

Summary of Analytes and QAPP Objectives for Fixed-Base Laboratory Analyses of Soil Samples

APS Quality Assurance Project Plan

Analyte	PQL	Units	Lower Control Limit (percent)	Upper Control Limit (percent)	Relative Percent Difference Limit
PCBs by EPA 8082A					
Aroclor-1016	33	µg/kg	44	127	50
Aroclor-1221	67	µg/kg	31	136	50
Aroclor-1232	33	µg/kg	31	136	50
Aroclor-1242	33	µg/kg	29	160	50
Aroclor-1248	33	µg/kg	31	136	50
Aroclor-1254	33	µg/kg	25	141	50
Aroclor-1260	33	µg/kg	31	136	50
8082A Surrogate					
DCBP			25	143	
Chlorinated Herbicides by EPA 8151A					
2,4-D	0.2	mg/kg	32	121	50
2,4-DB	0.5	mg/kg	42	145	50
2,4,5-T	0.5	mg/kg	43	139	50
2,4,5-TP	0.2	mg/kg	46	128	50
Dalapon	0.8	mg/kg	22	125	50
Dicamba	0.5	mg/kg	56	120	50
Dichloroprop	0.5	mg/kg	72	142	50
Dinoseb	0.1	mg/kg	20	131	50
MCPA	10	mg/kg	65	120	50
MCPP	15	mg/kg	60	118	50
8151A Surrogate					
2,4-Dichlorophenylacetic acid			51	146	
RCRA 8 Metals by EPA 6010C/7471B (LCS/LCSD)					
Arsenic by 6010C	5.0	mg/kg	80	120	20
Barium by 6010C	1.0	mg/kg	80	120	20
Cadmium by 6010C	0.5	mg/kg	80	120	20
Chromium by 6010C	2.0	mg/kg	80	120	20
Lead by 6010C	2.5	mg/kg	80	120	20

TABLE 3.5
Summary of Analytes and QAPP Objectives for Fixed-Base Laboratory Analyses of Soil Samples
APS Quality Assurance Project Plan

Analyte	PQL	Units	Lower Control Limit (percent)	Upper Control Limit (percent)	Relative Percent Difference Limit
Mercury by 7471B	0.02	mg/kg	80	120	20
Selenium by 6010C	10	mg/kg	80	120	20
Silver by 6010C	2.5	mg/kg	80	120	20
RCRA 8 Metals by EPA 6010C/7471B (MS/MSD)					
Arsenic by 6010C	5.0	mg/kg	75	125	20
Barium by 6010C	1.0	mg/kg	75	125	20
Cadmium by 6010C	0.5	mg/kg	75	125	20
Chromium by 6010C	2.0	mg/kg	75	125	20
Lead by 6010C	2.5	mg/kg	75	125	20
Mercury by 7471B	0.02	mg/kg	75	125	20
Selenium by 6010C	10	mg/kg	75	125	20
Silver by 6010C	2.5	mg/kg	75	125	20
Hexavalent Chromium by EPA 7196A/7199 (LCS/LCSD)					
Hexavalent Chromium by 7196A	1	mg/kg	80	120	20
Hexavalent Chromium by 7199	0.1	mg/kg	80	120	20
Hexavalent Chromium by EPA 7196A/7199 (MS/MSD)					
Hexavalent Chromium by 7196A	1	mg/kg	75	125	20
Hexavalent Chromium by 7199	0.1	mg/kg	75	125	20
Sulfide by EPA 9031/9034 (LCS/LCSD)					
Sulfide	1	mg/kg	80	120	20
Sulfide by EPA 9031/9034 (MS/MSD)					
Sulfide	1	mg/kg	75	125	20
EPA 9014, SM4500 CN-G, and SM4500 CN-I					
Total cyanide (EPA 9014)	0.5	mg/kg	70	130	30
Amenable cyanide (SM4500 CN-G)	NA				
WAD cyanide (SM4500 CN-I)	NA				
SW-846 7.1.2, EPA 9045D, and EPA 9095B					
Ignitability (SW-846 7.1.2)	NA				
pH (EPA9045D)	NA				

TABLE 3.5

Summary of Analytes and QAPP Objectives for Fixed-Base Laboratory Analyses of Soil Samples

APS Quality Assurance Project Plan

Analyte	PQL	Units	Lower Control Limit (percent)	Upper Control Limit (percent)	Relative Percent Difference Limit
Paint Filter Free Liquid Test (EPA 9095B)	NA				
TCLP Volatile Organic Compounds EPA 1311/8021B					
1,1-Dichloroethene	0.0025	mg/L	70	130	30
1,2-Dichloroethane	0.0025	mg/L	70	130	30
Benzene	0.0025	mg/L	70	130	30
Carbon Tetrachloride	0.0025	mg/L	70	130	30
Chlorobenzene	0.0025	mg/L	70	130	30
Chloroform	0.0025	mg/L	70	130	30
Tetrachloroethene	0.0025	mg/L	70	130	30
Trichloroethene	0.0025	mg/L	70	130	30
Vinyl chloride	0.005	mg/L	70	130	30
8021B Leachate Surrogates					
aaa- trifluorotoluene			70	130	
1-chloro-3-fluorobenzene			70	130	
TCLP Volatile Organic Compounds EPA 1311/8260B					
1,1-Dichloroethene	0.025	mg/L	70	130	30
1,2-Dichloroethane	0.01	mg/L			
2-Butanone (Methylethyl ketone [MEK])	0.05	mg/L			
Benzene	0.01	mg/L	70	130	30
Carbon Tetrachloride	0.025	mg/L			
Chlorobenzene	0.01	mg/L			
Chloroform	0.01	mg/L	70	130	30
Tetrachloroethene	0.01	mg/L	70	130	30
Trichloroethene	0.01	mg/L	70	130	30
Vinyl chloride	0.025	mg/L			
8260B Leachate Surrogates					
Toluene-D8			70	130	
4-Bromofluorobenzene			70	130	

TABLE 3.5

Summary of Analytes and QAPP Objectives for Fixed-Base Laboratory Analyses of Soil Samples

APS Quality Assurance Project Plan

Analyte	**PQL**	**Units**	**Lower Control Limit (percent)**	**Upper Control Limit (percent)**	**Relative Percent Difference Limit**
Dibromofluoromethane			70	130	
TCLP Metals EPA 1311, 6010C/7470A (LCS/LCSD)					
Arsenic by 6010C	0.5	mg/L	80	120	20
Barium by 6010C	10	mg/L	80	120	20
Cadmium by 6010C	0.05	mg/L	80	120	20
Chromium by 6010C	0.1	mg/L	80	120	20
Lead by 6010C	0.5	mg/L	80	120	20
Mercury by 7470A	0.002	mg/L	80	120	20
Selenium by 6010C	0.6	mg/L	80	120	20
Silver by 6010C	0.5	mg/L	80	120	20
TCLP Metals EPA 1311, 6010C/7470A (MS/MSD)					
Arsenic by 6010C	0.5	mg/L	75	125	20
Barium by 6010C	10	mg/L	75	125	20
Cadmium by 6010C	0.05	mg/L	75	125	20
Chromium by 6010C	0.1	mg/L	75	125	20
Lead by 6010C	0.5	mg/L	75	125	20
Mercury by 7470A	0.002	mg/L	75	125	20
Selenium by 6010C	0.6	mg/L	75	125	20
Silver by 6010C	0.5	mg/L	75	125	20

Notes:

QAPP = Quality Assurance Project Plan
% = percent
PQL = Practical Quantitation Limit
RCRA = Resource Conservation and Recovery Act
mg/kg = milligrams per kilogram
mg/L = milligram per liter
MS/MSD = Matrix spike/ Matrix Spike Duplicate
D = Detected; result must be greater than zero
LCS/LCSD = Lab control sample/lab control sample duplicate
GRO – Gasoline range organic
DRO – Diesel range organic
ORO – Oil range organic
NA = Not applicable
TCLP = Toxicity Characteristic Leaching Procedure

The PQLs presented for VOCs assume soil samples are preserved in the field with methanol or are collected using Encore^{TM} or equivalent sampling equipment.

All values presented are the method control limits (LCS/LCSD, MS/MSD, Surrogates)

TABLE 3.6

Summary of Analytes and QAPP Objectives for Fixed-Base Laboratory Analyses of Aqueous Samples

APS Quality Assurance Project Plan

Analyte	PQL	Units	Lower Control Limit (percent)	Upper Control Limit (percent)	Relative Percent Difference Limit
Volatile Organic Compounds by EPA 8021B					
1,1,1-Trichloroethane	1.0	μg/L			
1,1,2,2-Tetrachloroethane	2.0	μg/L			
1,1,2-Trichloroethane	1.0	μg/L			
1,1-Dichloroethane	1.0	μg/L	70	130	30
1,1-Dichloroethene	2.0	μg/L	70	130	30
1,2-Dichlorobenzene	1.0	μg/L			
1,2-Dichloroethane	1.0	μg/L	70	130	30
1,2-Dichloropropane	1.0	μg/L			
1,3-Dichlorobenzene	1.0	μg/L			
1,4-Dichlorobenzene	1.0	μg/L			
Benzene	1.0	μg/L	70	130	30
Bromodichloromethane	1.0	μg/L			
Bromoform	2.0	μg/L			
Bromomethane	4.0	μg/L			
Carbon Tetrachloride	1.0	μg/L			
Chlorobenzene	1.0	μg/L			
Chloroethane	4.0	μg/L			
Chloroform	1.0	μg/L	70	130	30
Chloromethane	4.0	μg/L			
cis-1,2-Dichloroethene	1.0	μg/L			
cis-1,3-Dichloropropene	1.0	μg/L			
Dibromochloromethane	1.0	μg/L			
Dichlorodifluoromethane	4.0	μg/L			
Ethylbenzene	2.0	μg/L			
Methylene chloride	5.0	μg/L			
Methyl-tert-butyl- ether(1)	5.0	μg/L			
Tetrachloroethene	1.0	μg/L	70	130	30
Toluene	2.0	μg/L	70	130	30
trans-1,2-Dichloroethene	1.0	μg/L			

TABLE 3.6

Summary of Analytes and QAPP Objectives for Fixed-Base Laboratory Analyses of Aqueous Samples

APS Quality Assurance Project Plan

Analyte	PQL	Units	Lower Control Limit (percent)	Upper Control Limit (percent)	Relative Percent Difference Limit
trans-1,3-Dichloropropene	1.0	μg/L			
Trichloroethene	1.0	μg/L	70	130	30
Trichlorofluoromethane	4.0	μg/L			
Vinyl chloride	2.0	μg/L			
Xylenes, total	3.0	μg/L			
8021B surrogates					
aaa-trifluorotoluene			*70*	*130*	
1-chloro-3-fluorobenzene			*70*	*130*	
Volatile Organic Compounds by EPA 601/602					
1,1,1-Trichloroethane	0.5	μg/L	41	138	30
1,1,2,2-Tetrachloroethane	0.5	μg/L	8	184	30
1,1,2-Trichloroethane	0.5	μg/L	39	136	30
1,1-Dichloroethane	0.5	μg/L	47	132	30
1,1-Dichloroethene	0.5	μg/L	28	167	30
1,2-Dichlorobenzene	1.0	μg/L	D	208	30
1,2-Dichloroethane	0.5	μg/L	51	147	30
1,2-Dichloropropane	0.5	μg/L	44	156	30
1,3-Dichlorobenzene	1.0	μg/L	50	152	30
1,4-Dichlorobenzene	1.0	μg/L	42	143	30
Benzene	0.5	μg/L	39	150	30
Bromodichloromethane	0.5	μg/L	42	172	30
Bromoform	0.5	μg/L	13	159	30
Bromomethane	1.0	μg/L	D	144	30
Carbon Tetrachloride	0.5	μg/L	43	143	30
Chlorobenzene	0.5	μg/L	38	150	30
Chloroethane	2.5	μg/L	46	137	30
Chloroform	0.5	μg/L	49	133	30
Chloromethane	1.0	μg/L	D	193	30
cis-1,2-Dichloroethene	0.5	μg/L			
cis-1,3-Dichloropropene	0.5	μg/L	22	178	30

TABLE 3.6

Summary of Analytes and QAPP Objectives for Fixed-Base Laboratory Analyses of Aqueous Samples

APS Quality Assurance Project Plan

Analyte	PQL	Units	Lower Control Limit (percent)	Upper Control Limit (percent)	Relative Percent Difference Limit
Dibromochloromethane	0.5	µg/L	24	191	30
Ethylbenzene	0.5	µg/L	32	160	30
Methylene chloride	5.0	µg/L	25	162	30
Tetrachloroethene	0.5	µg/L	26	162	30
Toluene	0.5	µg/L	46	148	30
Total Xylenes	3.0	µg/L			
trans-1,2-Dichloroethene	0.5	µg/L	38	155	30
trans-1,3-Dichloropropene	0.5	µg/L	22	178	30
Trichloroethene	0.5	µg/L	35	146	30
Trichlorofluoromethane	1.0	µg/L	21	156	30
Vinyl chloride	2.0	µg/L	28	163	30
601/602 surrogates					
aaa-trifluorotoluene			*NE*	*NE*	
1-chloro-3-fluorobenzene			*NE*	*NE*	
Volatile Organic Compounds by EPA 8260B					
1,1,1,2-Tetrachloroethane	5	µg/L			
1,1,1-Trichloroethane	2	µg/L			
1,1,2,2-Tetrachloroethane	2	µg/L			
1,1,2-Trichloroethane	2	µg/L			
1,1-Dichloroethane	2	µg/L			
1,1-Dichloroethene	5	µg/L	70	130	30
1,1-Dichloropropene	2	µg/L			
1,2,3-Trichlorobenzene	5	µg/L			
1,2,3-Trichloropropane	10	µg/L			
1,2,4-Trichlorobenzene	5	µg/L			
1,2,4-Trimethylbenzene	2	µg/L			
1,2-Dibromo-3-chloropropane	5	µg/L			
1,2-Dibromoethane	2	µg/L			
1,2-Dichlorobenzene	2	µg/L			
1,2-Dichloroethane	2	µg/L			

TABLE 3.6

Summary of Analytes and QAPP Objectives for Fixed-Base Laboratory Analyses of Aqueous Samples

APS Quality Assurance Project Plan

Analyte	PQL	Units	Lower Control Limit (percent)	Upper Control Limit (percent)	Relative Percent Difference Limit
1,2-Dichloropropane	2	μg/L			
1,3,5-Trimethylbenzene	2	μg/L			
1,3-Dichlorobenzene	2	μg/L			
1,3-Dichloropropane	2	μg/L			
1,4-Dichlorobenzene	2	μg/L			
2,2-Dichloropropane	2	μg/L			
2-Butanone (Methylethyl ketone [MEK])	10	μg/L			
2-Chloroethylvinyl ether	5	μg/L			
2-Chlorotoluene	5	μg/L			
2-Hexanone	10	μg/L			
4-Chlorotoluene	5	μg/L			
4-Methyl-2-pentanone	5	μg/L			
Acetone	20	μg/L			
Benzene	2	μg/L	70	130	30
Bromobenzene	5	μg/L			
Bromochloromethane	5	μg/L			
Bromodichloromethane	2	μg/L			
Bromoform	5	μg/L			
Bromomethane	5	μg/L			
Carbon Disulfide	5	μg/L			
Carbon Tetrachloride	5	μg/L			
Chlorobenzene	2	μg/L	70	130	30
Chloroethane	5	μg/L			
Chloroform	2	μg/L			
Chloromethane	5	μg/L			
cis-1,2-Dichloroethene	2	μg/L			
cis-1,3-Dichloropropene	2	μg/L			
Dibromochloromethane	2	μg/L			
Dibromomethane	2	μg/L			

TABLE 3.6
Summary of Analytes and QAPP Objectives for Fixed-Base Laboratory Analyses of Aqueous Samples
APS Quality Assurance Project Plan

Analyte	PQL	Units	Lower Control Limit (percent)	Upper Control Limit (percent)	Relative Percent Difference Limit
Dichlorodifluoromethane	5	µg/L			
Ethylbenzene	2	µg/L			
Hexachlorobutadiene	5	µg/L			
Iodomethane	2	µg/L			
Isopropylbenzene	2	µg/L			
Methylene chloride	5	µg/L			
Methyl-tert-butyl- ether	5	µg/L			
N-Butylbenzene	5	µg/L			
N-Propylbenzene	2	µg/L			
Naphthalene	5	µg/L			
p-Isopropyltoluene	2	µg/L			
sec-Butylbenzene	5	µg/L			
Styrene	2	µg/L			
tert-Butylbenzene	5	µg/L			
Tetrachloroethene	2	µg/L			
Toluene	2	µg/L	70	130	30
trans-1,2-Dichloroethene	2	µg/L			
trans-1,3-Dichloropropene	2	µg/L			
Trichloroethene	2	µg/L	70	130	30
Trichlorofluoromethane	5	µg/L			
Vinyl acetate	5	µg/L			
Vinyl chloride	2	µg/L			
Total xylenes	10	µg/L			
8260B surrogates					
Toluene-D8		µg/L	*70*	*130*	
4-Bromofluorobenzene		µg/L	*70*	*130*	
Dibromofluoromethane		µg/L	*70*	*130*	
SVOCs by EPA 8270D					
Acenaphthene	10	µg/L	70	130	30
Acenaphthylene	10	µg/L			

TABLE 3.6
Summary of Analytes and QAPP Objectives for Fixed-Base Laboratory Analyses of Aqueous Samples
APS Quality Assurance Project Plan

Analyte	PQL	Units	Lower Control Limit (percent)	Upper Control Limit (percent)	Relative Percent Difference Limit
Anthracene	10	µg/L			
Benz(a)anthracene	10	µg/L			
Benzo(a)pyrene	10	µg/L			
Benzo(b)fluoranthene	10	µg/L			
Benzo(g,h,i)perylene	10	µg/L			
Benzo(k)fluoranthene	10	µg/L			
Chrysene	10	µg/L			
Dibenz(a,h)anthracene	20	µg/L			
Fluoranthene	10	µg/L			
Fluorene	10	µg/L			
Indeno(1,2,3-cd)pyrene	20	µg/L			
2-Methylnaphthalene	10	µg/L			
Naphthalene	10	µg/L			
Phenanthrene	10	µg/L			
Pyrene	10	µg/L	70	130	30
1,2,4-trichlorobenzene	10	µg/L	37	120	20
1,2-dichlorobenzene	10	µg/L	33	120	20
1,3-dichlorobenzene	10	µg/L	32	120	20
1,4-dichlorobenzene	10	µg/L	32	120	20
2,4-Dinitrotoluene	10	µg/L	51	120	20
2,6-dinitrotoluene	10	µg/L	49	120	20
2,4,5-Trichlorophenol	50	µg/L	49	120	20
2,4,6-Trichlorophenol	10	µg/L	39	128	20
2,4-Dichlorophenol	10	µg/L	46	120	20
2,4-Dimethylphenol	10	µg/L	45	139	20
2,4-Dinitrophenol	20	µg/L	30	30	20
2-Chloronaphthalene	10	µg/L	49	151	20
2-Chlorophenol	10	µg/L	41	125	20
2-Methylphenol	50	µg/L	38	120	20
2-Nitroaniline	50	µg/L	48	120	20

TABLE 3.6

Summary of Analytes and QAPP Objectives for Fixed-Base Laboratory Analyses of Aqueous Samples

APS Quality Assurance Project Plan

Analyte	PQL	Units	Lower Control Limit (percent)	Upper Control Limit (percent)	Relative Percent Difference Limit
3-Nitroaniline	50	μg/L	20	126	20
2-Methyl-4,6-Dinitrophenol	20	μg/L	126	130	20
3,3'-Dichlorobenzidine	10	μg/L	29	174	20
4-Chloroaniline	10	μg/L	20	120	20
4-Methylphenol	50	μg/L	32	120	20
4-Nitroaniline	50	μg/L	36	120	20
4-Nitrophenol	50	μg/L	20	120	20
Benzoic Acid	100	μg/L	20	120	20
Benzyl Alcohol	20	μg/L	30	120	20
Bis(2-Chloroethyl)Ether	10	μg/L	44	125	20
Bis(2-Chloroisopropyl)Ether	10	μg/L	26	131	20
Bis(2-Ethylhexyl)Phthalate	10	μg/L	33	129	20
Butyl benzyl phthalate	20	μg/L	26	125	20
Dibenzofuran	10	μg/L	54	120	20
Diethyl phthalate	20	μg/L	37	125	20
Dimethyl phthalate	10	μg/L	27	175	20
Di-n-Butylphthalate	20	μg/L	34	126	20
Di-n-Octylphthalate	10	μg/L	37	137	20
Hexachlorobenzene	10	μg/L	46	133	20
Hexachlorobutadiene	10	μg/L	25	125	20
Hexachloroethane	10	μg/L	25	153	20
Isophorone	10	μg/L	26	175	20
Nitrobenzene	10	μg/L	46	133	20
N-Nitroso-di-n-Propylamine	10	μg/L	37	125	20
N-Nitrosodiphenylamine	10	μg/L	27	125	20
Pentachlorophenol	20	μg/L	28	136	20
Phenol	10	μg/L	25	125	20
8270D Surrogates					
2,4,6-Tribromophenol			*25*	*134*	
2-Fluorobiphenyl			*43*	*125*	

TABLE 3.6

Summary of Analytes and QAPP Objectives for Fixed-Base Laboratory Analyses of Aqueous Samples

APS Quality Assurance Project Plan

Analyte	PQL	Units	Lower Control Limit (percent)	Upper Control Limit (percent)	Relative Percent Difference Limit
2-Fluorophenol			*25*	*125*	
Nitrobenzene-d5			*32*	*125*	
Phenol-d5			*25*	*125*	
Terphenyl-d14			*42*	*126*	
Polynuclear Aromatic Hydrocarbons by EPA 8310/ EPA 8270DSIM					
Acenaphthene	3.0/0.02	µg/L			
Acenaphthylene	3.0/0.02	µg/L			
Anthracene	0.3/0.02	µg/L			
Benz(a)anthracene	0.3/0.02	µg/L	12/Lab limit	135/Lab limit	30
Benzo(a)pyrene	0.15/0.02	µg/L	D/Lab limit	128/Lab limit	30
Benzo(b)fluoranthene	0.3/0.02	µg/L			
Benzo(g,h,i)perylene	0.3/0.02	µg/L			
Benzo(k)fluoranthene	0.3/0.02	µg/L			
Chrysene	0.3/0.02	µg/L			
Dibenz(a,h)anthracene	0.15/0.02	µg/L			
Fluoranthene	0.3/0.02	µg/L			
Fluorene	0.3/0.02	µg/L			
Indeno(1,2,3-cd)pyrene	0.3/0.02	µg/L			
Naphthalene	3.0/0.02	µg/L	D/Lab limit	122/Lab limit	30
Phenanthrene	0.3/0.02	µg/L			
Pyrene	0.3/0.02	µg/L			
8310 Surrogate					
2-methylanthracene			*70*	*130*	
8270DSIM Surrogates					
Lab surrogates			Lab limit	Lab limit	
Total Petroleum Hydrocarbons by Modified EPA 8015C					
Extractable Fuel Hydrocarbons (C_{10} to C_{32})	5.0	mg/L	70	130	30
Extractable Fuel Hydrocarbons Diesel range (C_{10} to C_{22})	5.0	mg/L	70	130	30

TABLE 3.6

Summary of Analytes and QAPP Objectives for Fixed-Base Laboratory Analyses of Aqueous Samples

APS Quality Assurance Project Plan

Analyte	PQL	Units	Lower Control Limit (percent)	Upper Control Limit (percent)	Relative Percent Difference Limit
Extractable Fuel Hydrocarbons Oil range (C_{22} to C_{32})	5.0	mg/L	70	130	30
8015C surrogates					
GRO) 2-bromofluorobenzene			*70*	*130*	
DRO) n-docosane			*70*	*130*	
Organochlorine Pesticides by EPA 8081B					
4,4'-DDD	0.1	µg/L	48	136	50
4,4'-DDE	0.1	µg/L	45	139	50
4,4'-DDT	0.1	µg/L	34	143	50
Aldrin	0.05	µg/L	47	125	50
alpha-BHC	0.05	µg/L	75	125	50
beta-BHC	0.05	µg/L	51	125	50
delta-BHC	0.05	µg/L	46	136	50
gamma-BHC	0.05	µg/L	73	125	50
alpha-Chlordane	0.05	µg/L	63	123	50
gamma-Chlordane	0.05	µg/L	67	120	50
Dieldrin	0.1	µg/L	42	132	50
Endosulfan I	0.1	µg/L	49	120	50
Endosulfan II	0.1	µg/L	42	130	50
Endosulfan Sulfate	0.1	µg/L	46	141	50
Endrin	0.1	µg/L	43	134	50
Endrin Aldehyde	0.1	µg/L	56	137	50
Endrin Ketone	0.1	µg/L	60	125	50
Heptachlor	0.05	µg/L	45	128	50
Heptachlor Epoxide	0.05	µg/L	53	134	50
Methoxychlor	0.5	µg/L	73	142	50
Toxaphene	5	µg/L	41	126	50
Surrogates					
DCBP			34	133	
TCMX			45	125	
PCBs by EPA 8082A					

TABLE 3.6
Summary of Analytes and QAPP Objectives for Fixed-Base Laboratory Analyses of Aqueous Samples
APS Quality Assurance Project Plan

Analyte	PQL	Units	Lower Control Limit (percent)	Upper Control Limit (percent)	Relative Percent Difference Limit
Aroclor-1016	0.5	µg/L	54	125	50
Aroclor-1221	1	µg/L	41	126	50
Aroclor-1232	0.5	µg/L	41	126	50
Aroclor-1242	0.5	µg/L	39	150	50
Aroclor-1248	0.5	µg/L	41	126	50
Aroclor-1254	0.5	µg/L	29	131	50
Aroclor-1260	0.5	µg/L	41	126	50
Surrogate					
DCBP			34	133	
Chlorinated Herbicides by EPA 8151A					
2,4-D	10	µg/L	39	120	50
2,4-DB	20	µg/L	44	120	50
2,4,5-T	20	µg/L	44	122	50
2,4,5-TP	10	µg/L	49	126	50
Dalapon	30	µg/L	40	120	50
Dicamba	20	µg/L	60	120	50
Dichloroprop	20	µg/L	68	122	50
Dinoseb	3	µg/L	28	115	50
MCPA	100	µg/L	62	144	50
MCPP	150	µg/L	60	133	50
Surrogate					
2*,4-Dichlorophenylacetic acid*			50	130	
RCRA 8 Metals for Groundwater (LCS/LCSD) – Analysis by EPA Methods as Indicated					
Arsenic by 200.7	0.05	mg/L	80	120	20
Arsenic by 200.9	0.003	mg/L	80	120	20
Arsenic by 206.2	0.003	mg/L	80	120	20
Arsenic by 6010C	0.05	mg/L	80	120	20
Barium by 200.7	0.01	mg/L	80	120	20
Barium by 6010C	0.01	mg/L	80	120	20
Cadmium by 200.7	0.005	mg/L	80	120	20
Cadmium by 213.2	0.001	mg/L	80	120	20

TABLE 3.6
Summary of Analytes and QAPP Objectives for Fixed-Base Laboratory Analyses of Aqueous Samples
APS Quality Assurance Project Plan

Analyte	PQL	Units	Lower Control Limit (percent)	Upper Control Limit (percent)	Relative Percent Difference Limit
Cadmium by 6010C	0.005	mg/L	80	120	20
Chromium by 200.7	0.01	mg/L	80	120	20
Chromium by 6010C	0.01	mg/L	80	120	20
Lead by 200.7	0.05	mg/L	80	120	20
Lead by 200.9	0.002	mg/L	80	120	20
Lead by 239.2	0.002	mg/L	80	120	20
Lead by 6010C	0.05	mg/L	80	120	20
Mercury by 245.1	0.0002	mg/L	80	120	20
Mercury by 7470A	0.0002	mg/L	80	120	20
Selenium by 200.7	0.06	mg/L	80	120	20
Selenium by 270.2	0.004	mg/L	80	120	20
Selenium by 6010C	0.06	mg/L	80	120	20
Silver by 200.7	0.05	mg/L	80	120	20
Silver by 272.2	0.005	mg/L	80	120	20
Silver by 6010C	0.05	mg/L	80	120	20
RCRA 8 Metals for Groundwater (MS/MSD) – Analysis by EPA Methods as Indicated					
Arsenic by 200.7	0.05	mg/L	70	130	20
Arsenic by 200.9	0.003	mg/L	85	115	20
Arsenic by 206.2	0.003	mg/L	85	115	20
Arsenic by 6010C	0.05	mg/L	75	125	20
Barium by 200.7	0.01	mg/L	70	130	20
Barium by 6010C	0.01	mg/L	75	125	20
Cadmium by 200.7	0.005	mg/L	70	130	20
Cadmium by 213.2	0.001	mg/L	85	115	20
Cadmium by 6010C	0.005	mg/L	75	125	20
Chromium by 200.7	0.01	mg/L	70	130	20
Chromium by 6010C	0.01	mg/L	75	125	20
Lead by 200.7	0.05	mg/L	70	130	20
Lead by 200.9	0.002	mg/L	85	115	20
Lead by 239.2	0.002	mg/L	85	115	20
Lead by 6010C	0.05	mg/L	75	125	20

TABLE 3.6
Summary of Analytes and QAPP Objectives for Fixed-Base Laboratory Analyses of Aqueous Samples
APS Quality Assurance Project Plan

Analyte	PQL	Units	Lower Control Limit (percent)	Upper Control Limit (percent)	Relative Percent Difference Limit
Mercury by 245.1	0.0002	mg/L	85	115	20
Mercury by 7470A	0.0002	mg/L	75	125	20
Selenium by 200.7	0.06	mg/L	70	130	20
Selenium by 270.2	0.004	mg/L	85	115	20
Selenium by 6010C	0.06	mg/L	75	125	20
Silver by 200.7	0.05	mg/L	70	130	20
Silver by 272.2	0.005	mg/L	85	115	20
Silver by 6010C	0.05	mg/L	75	125	20
Hexavalent Chromium by EPA 7196A/7199 (LCS/LCSD)					
Hexavalent Chromium by 7196A	0.01	mg/L	80	120	20
Hexavalent Chromium by 7199	0.001	mg/L	80	120	20
Hexavalent Chromium by EPA 7196A/7199 (MS/MSD)					
Hexavalent Chromium by 7196A	0.01	mg/L	75	125	20
Hexavalent Chromium by 7199	0.001	mg/L	75	125	20
Sulfide by EPA 9034 (LCS/LCSD)					
Sulfide	1	mg/L	80	120	20
Sulfide by EPA 9034 (MS/MSD)					
Sulfide	1	mg/L	75	125	20
SM 4500-CN-E					
Total Cyanide (LCS)	0.02	mg/L	90	110	20
Total Cyanide (MS/MSD)	0.02	mg/L	70	130	20
SM 4500-CN-G					
Amenable Cyanide (LCS)	0.02	mg/L	90	110	20
Amenable Cyanide (MS/MSD)	0.02	mg/L	70	130	20
SM 4500-CN-I					
Weak Acid Dissociable Cyanide (LCS)	0.02	mg/L	90	110	20
Weak Acid Dissociable Cyanide (MS/MSD)	0.02	mg/L	70	130	20

TABLE 3.6

Summary of Analytes and QAPP Objectives for Fixed-Base Laboratory Analyses of Aqueous Samples

APS Quality Assurance Project Plan

Analyte	PQL	Units	Lower Control Limit (percent)	Upper Control Limit (percent)	Relative Percent Difference Limit
Ammonia EPA 350.3					
Ammonia (LCS)	0.50	mg/L	80	120	20
Ammonia (MS/MSD)	0.50	mg/L	70	130	20
Nitrate/nitrite SM4500NO3					
Nitrate/nitrite (LCS)	0.01	mg/L	80	120	20
Nitrate/nitrite (MS/MSD)	0.01	mg/L	70	130	20
Nitrate/nitrite EPA 353.2					
Nitrate/nitrite by 353.2 (LCS)	0.05	mg/L	80	120	20
Nitrate/nitrite by 353.2 (MS/MSD)	0.05	mg/L	70	130	20
EPA 300.0					
Nitrate by 300.0 (LCS)	0.1	mg/L	80	120	20
Nitrite by 300.0 (LCS)	0.1	mg/L	80	120	20
Nitrite by 300.0 (MS/MSD)	0.1	mg/L	70	130	20
Nitrate by 300.0 (MS/MSD)	0.1	mg/L	70	130	20

Notes:

(1) – Methly-tert-butyl-ether may be reported under Method 8021B for screening purposes only. Concentrations reported by Method 8021B may not be used for compliance purposes and should be confirmed by Method 8260.

QAPP = Quality Assurance Project Plan

PQL = Practical Quantitation Limit

% = percent

µg/L = micrograms per Liter

mg/L = milligrams per Liter

MS/MSD = Matrix spike/ Matrix Spike Duplicate

LCS/LCSD = Lab control sample/lab control sample duplicate

SM = Standard Method

RCRA = Resource Conservation and Recovery Act

D = Detected; result must be greater than zero

NE = not established, see laboratory established guidelines

All values presented are the method control limits (LCS/LCSD, MS/MSD, Surrogates)

TABLE 3.7

Summary of Analytes and QAPP Objectives for Mobile Laboratory Analyses of Air and Soil Vapor Screening Samples

APS Quality Assurance Project Plan

Analyte	PQL	Units	Lower Control Limit (percent)	Upper Control Limit (percent)	RPD (percent)
Volatile Organic Compounds 8260B					
1,1,1-Trichloroethane*	1	µg/L			
1,1,2,2-Tetrachloroethane*	1	µg/L	70	130	30
1,1,2-Trichloroethane*	1	µg/L			
1,1-Dichloroethane*	1	µg/L			
1,1-Dichloroethene*	1	µg/L	70	130	30
1,1,2-Trichlorotrifluoroethane	1	µg/L			
1,2,4-Trichlorobenzene	1	µg/L			
1,2,4-Trimethylbenzene	1	µg/L			
1,2-Dibromoethane (EDB)	1	µg/L			
1,2-Dichlorobenzene	1	µg/L			
1,2-Dichloroethane*	1	µg/L			
1,2-Dichloropropane	1	µg/L			
1,3-Dichlorobenzene	1	µg/L			
1,3,5-Trimethylbenzene	1	µg/L			
1,4-Dichlorobenzene	1	µg/L			
Benzene*	1	µg/L			
Bromomethane	1	µg/L			
Carbon Tetrachloride*	1	µg/L			
Chlorobenzene	1	µg/L			
Chloroethane*	1	µg/L			
Chloroform*	1	µg/L			
Chloromethane	1	µg/L			
cis-1,2-Dichloroethene*	1	µg/L			
cis-1,3-Dichloropropene	1	µg/L			
Dichlorodifluoromethane*	1	µg/L			
Dichlorotetrafluoroethane	1	µg/L			
Ethylbenzene*	1	µg/L			
Hexachlorobutadiene	1	µg/L			
m,p-Xylenes*	2	µg/L			

TABLE 3.7

Summary of Analytes and QAPP Objectives for Mobile Laboratory Analyses of Air and Soil Vapor Screening Samples

APS Quality Assurance Project Plan

Analyte	PQL	Units	Lower Control Limit (percent)	Upper Control Limit (percent)	RPD (percent)
Methylene chloride*	1	μg/L	70	130	
o-Xylene*	1	μg/L			
Styrene	1	μg/L			
Tetrachloroethene*	1	μg/L			
Toluene*	1	μg/L			
trans-1,2 -Dichloroethene	1	μg/L			
trans-1,3 -Dichloropropene	1	μg/L			
Trichloroethene*	1	μg/L	70	130	30
Trichlorofluoromethane*	1	μg/L			
Vinyl chloride*	1	μg/L			
Diisopropyl ether (DIPE)	1	μg/L			
Ethyl-t-butyl ether (ETBE)	1	μg/L			
t-Amyl-methyl ether (TAME)	1	μg/L			
t-butanol (TBA)	5	μg/L			
Leak Check Compound					
1,1-Difluoroethane	10	μg/L			

Notes:

* Primary Target Compounds; California Regional Water Quality Control Board Los Angeles Region Interim Guidance for Active Soil Gas Investigation, February 25, 1997

QAPP = Quality Assurance Project Plan

PQL = Practical Quantitation Limit

ug/L = micrograms per liter

All values presented are the method control limits (LCS, MS, Surrogates)

TABLE 3.8

Summary of Analytes and QAPP Objectives for Fixed-Base Laboratory Analyses of Air and Soil Vapor Samples

APS Quality Assurance Project Plan

Analyte	PQL	Units	Lower Control Limit (percent)	Upper Control Limit (percent)	RPD (percent)
Volatile Organic Compounds by EPA TO-15 (Air Samples)					
1,1,1-Trichloroethane	2.0	PPB V/V			
1,1,2,2-Tetrachloroethane	2.0	PPB V/V	70	130	30
1,1,2-Trichloroethane	2.0	PPB V/V			
1,1-Dichloroethane	2.0	PPB V/V			
1,1-Dichloroethene	2.0	PPB V/V	70	130	30
1,1,2-Trichlorotrifluoroethane	2.0	PPB V/V			
1,2,4-Trichlorobenzene	4.0	PPB V/V			
1,2,4-Trimethylbenzene	2.0	PPB V/V			
1,2-Dibromoethane (EDB)	2.0	PPB V/V			
1,2-Dichlorobenzene	2.0	PPB V/V			
1,2-Dichloroethane	2.0	PPB V/V			
1,2-Dichloropropane	2.0	PPB V/V			
1,3-Butadiene	2.0	PPB V/V			
1,3-Dichlorobenzene	2.0	PPB V/V			
1,3,5-Trimethylbenzene	2.0	PPB V/V			
1,4-Dichlorobenzene	2.0	PPB V/V			
1,4-Dioxane	10.0	PPB V/V			
2,2,4-Trimethylpentane	2.0	PPB V/V			
4-Ethyltoluene	2.0	PPB V/V			
Allyl Chloride	2.0	PPB V/V			
Benzene	2.0	PPB V/V			
Benzyl Chloride	2.0	PPB V/V			
Bromoethene	2.0	PPB V/V			
Bromoform	2.0	PPB V/V			
Bromodichloromethane	2.0	PPB V/V			
Bromomethane	2.0	PPB V/V			
Carbon Disulfide	10.0	PPB V/V			
Carbon Tetrachloride	2.0	PPB V/V			
Chlorobenzene	2.0	PPB V/V			
Chloroethane	4.0	PPB V/V			

TABLE 3.8

Summary of Analytes and QAPP Objectives for Fixed-Base Laboratory Analyses of Air and Soil Vapor Samples

APS Quality Assurance Project Plan

Analyte	PQL	Units	Lower Control Limit (percent)	Upper Control Limit (percent)	RPD (percent)
Chloroform	2.0	PPB V/V			
Chloromethane	4.0	PPB V/V			
cis-1,2-Dichloroethene	2.0	PPB V/V			
cis-1,3-Dichloropropene	2.0	PPB V/V			
Cyclohexane	2.0	PPB V/V			
Dibromochloromethane	2.0	PPB V/V			
Dichlorodifluoromethane	2.0	PPB V/V			
Ethyl Acetate	2.0	PPB V/V			
Ethylbenzene	2.0	PPB V/V			
Hexachlorobutadiene	4.0	PPB V/V			
m,p-Xylenes	2.0	PPB V/V			
Methylene chloride	2.0	PPB V/V	70	130	30
Methyl Butyl Ketone (2-Hexanone)	4.0	PPB V/V			
Methyl Ethyl Ketone (2-Butanone)	10.0	PPB V/V			
Methyl Isobutyl Ketone (4-Methyl-2-pentanone)	4.0	PPB V/V			
n-Hexane	2.0	PPB V/V			
n-Heptane	2.0	PPB V/V			
o-Xylene	2.0	PPB V/V			
Propylene	2.0	PPB V/V			
Styrene	2.0	PPB V/V			
Tetrachloroethene	2.0	PPB V/V			
Tetrahydrofuran	2.0	PPB V/V			
Toluene	2.0	PPB V/V			
trans-1,2-Dichloroethene	2.0	PPB V/V			
trans-1,3-Dichloropropene	2.0	PPB V/V			
Trichloroethene	2.0	PPB V/V	70	130	30
Trichlorofluoromethane	2.0	PPB V/V			
Vinyl acetate	10.0	PPB V/V			
Vinyl chloride	2.0	PPB V/V			
Methyl-tert-butyl ether (MTBE)	2.0	PPB V/V			

TABLE 3.8

Summary of Analytes and QAPP Objectives for Fixed-Base Laboratory Analyses of Air and Soil Vapor Samples

APS Quality Assurance Project Plan

Analyte	PQL	Units	Lower Control Limit (percent)	Upper Control Limit (percent)	RPD (percent)
Surrogate compound monitoring is not required by method TO-15, however it is recommended that laboratories analyze surrogates with each field and QC sample, and provide the results with each analytical data packet.					
Volatile Organic Compounds by NIOSH 1501 (Air Samples)					
1,1,1-Trichloroethane	0.25	µg/L			
1,1,2,2-Tetrachloroethane	0.25	µg/L	80	120	20
1,1-Dichloroethane	0.25	µg/L			
1,1-Dichloroethene	0.25	µg/L	80	120	20
1,2,4-Trichlorobenzene	0.25	µg/L			
1,2-Dibromoethane	0.25	µg/L			
1,2-Dichloroethane	0.25	µg/L			
1,2-Dichloropropane	0.25	µg/L			
2-Butanone (Methylethyl ketone [MEK])	0.25	µg/L			
2-Hexanone	0.25	µg/L			
4-Methyl-2-pentanone	0.25	µg/L			
Acetone	0.25	µg/L			
Benzene	0.25	µg/L			
Bromobenzene	0.25	µg/L			
Bromochloromethane	0.25	µg/L			
Bromodichloromethane	0.25	µg/L			
Bromoform	0.25	µg/L			
Bromomethane	0.25	µg/L			
Carbon Disulfide	0.25	µg/L			
Carbon Tetrachloride	0.25	µg/L			
Chlorobenzene	0.25	µg/L			
Chloroethane	0.25	µg/L			
Chloroform	0.25	µg/L			
Chloromethane	0.25	µg/L			
cis-1,2-Dichloroethene	0.25	µg/L			
Dibromochloromethane	0.25	µg/L			

TABLE 3.8

Summary of Analytes and QAPP Objectives for Fixed-Base Laboratory Analyses of Air and Soil Vapor Samples

APS Quality Assurance Project Plan

Analyte	PQL	Units	Lower Control Limit (percent)	Upper Control Limit (percent)	RPD (percent)
Dichlorodifluoromethane	0.25	μg/L			
Ethylbenzene	0.25	μg/L			
Hexachlorobutadiene	0.25	μg/L			
Methylene chloride	0.25	μg/L	80	120	20
Styrene	0.25	μg/L			
Tetrachloroethene	0.25	μg/L			
Toluene	0.25	μg/L			
trans-1,2-Dichloroethene	0.25	μg/L			
trans-1,3-Dichloropropene	0.25	μg/L			
Trichloroethene	0.25	μg/L	80	120	20
Vinyl acetate	0.25	μg/L			
Vinyl chloride	0.25	μg/L			
Total xylenes	0.25	μg/L			
Polycyclic Aromatic Hydrocarbons by USEPA TO-13A by HPLC (Air Samples)					
Acenaphthene	10.0	ng /sample	75	125	25
Acenaphthylene	5.0	ng /sample	75	125	25
Anthracene	20.0	ng /sample	75	125	25
Benz(a)anthracene	5.0	ng /sample			
Benzo(a)pyrene	5.0	ng /sample			
Benzo(b)fluoranthene	5.0	ng /sample	75	125	25
Benzo(g,h,i)perylene	5.0	ng /sample	75	125	25
Benzo(k)fluoranthene	10.0	ng /sample	75	125	25
Chrysene	5.0	ng /sample	75	125	25
Dibenz(a,h)anthracene	5.0	ng /sample	75	125	25
Fluoranthene	5.0	ng /sample	75	125	25
Fluorene	5.0	ng /sample	75	125	25
Indeno(1,2,3-cd)pyrene	10.0	ng /sample	75	125	25
Naphthalene	20.0	ng /sample			
Phenanthrene	5.0	ng /sample	75	125	25
Pyrene	5.0	ng /sample	75	125	25

TABLE 3.8

Summary of Analytes and QAPP Objectives for Fixed-Base Laboratory Analyses of Air and Soil Vapor Samples

APS Quality Assurance Project Plan

Analyte	PQL	Units	Lower Control Limit (percent)	Upper Control Limit (percent)	RPD (percent)
TO-13A surrogates					
p-terphenyl-d-14			75	125	25
NIOSH 7300 (Air Samples)					
Lead	5	µg/sample	80	120	20
Volatile Organic Compounds Method TO-15 (Soil Vapor)					
1,1,1-Trichloroethane*	0.005	µg/L			
1,1,2,2-Tetrachloroethane*	0.005	µg/L	70	130	30
1,1,2-Trichloroethane*	0.005	µg/L			
1,1,2-Trichlorotrifluoroethane	0.01	µg/L			
1,1-Dichloroethane*	0.005	µg/L			
1,1-Dichloroethene*	0.005	µg/L	70	130	30
1,2,4-Trichlorobenzene	0.01	µg/L			
1,2,4-Trimethylbenzene	0.005	µg/L			
1,2-Dibromoethane (EDB)	0.01	µg/L			
1,2-Dichlorobenzene	0.01	µg/L			
1,2-Dichloroethane*	0.005	µg/L			
1,2-Dichloropropane	0.005	µg/L			
1,3,5-Trimethylbenzene	0.005	µg/L			
1,3-Butadiene	0.005	µg/L			
1,3-Dichlorobenzene	0.01	µg/L			
1,4-Dichlorobenzene	0.01	µg/L			
Methyl Ethyl Ketone (2-Butanone)	0.005	µg/L			
Methyl Butyl Ketone (2-Hexanone)	0.01	µg/L			
4-Ethyltoluene	0.005	µg/L			
Methyl Isobutyl Ketone (4-Methyl-2-Pentanone)	0.005	µg/L			
Acetone	0.012	µg/L			
Benzene*	0.005	µg/L			
Benzyl Chloride	0.005	µg/L			
Bromodichloromethane	0.005	µg/L			
Bromoform	0.005	µg/L			

TABLE 3.8

Summary of Analytes and QAPP Objectives for Fixed-Base Laboratory Analyses of Air and Soil Vapor Samples

APS Quality Assurance Project Plan

Analyte	PQL	Units	Lower Control Limit (percent)	Upper Control Limit (percent)	RPD (percent)
Bromomethane	0.005	µg/L			
Carbon Disulfide	0.005	µg/L			
Carbon Tetrachloride*	0.005	µg/L			
Chlorobenzene	0.005	µg/L			
Chloroethane*	0.005	µg/L			
Chloroform*	0.005	µg/L			
Chloromethane	0.005	µg/L			
cis-1,2-Dichloroethene*	0.005	µg/L			
cis-1,3-Dichloropropene	0.005	µg/L			
Cyclohexane	0.005	µg/L			
Dibromochloromethane	0.005	µg/L			
Dichlorodifluoromethane*	0.01	µg/L			
Dichlorotetrafluoroethane	0.01	µg/L			
Ethyl Acetate	0.005	µg/L			
Ethylbenzene*	0.005	µg/L			
N-Heptane	0.005	µg/L			
Hexachlorobutadiene	0.01	µg/L			
N-Hexane	0.005	µg/L			
m,p-Xylene*	0.005	µg/L			
MTBE	0.005	µg/L			
Methylene Chloride*	0.005	µg/L	70	130	30
o-Xylene*	0.005	µg/L			
Propylene	0.01	µg/L			
Styrene	0.005	µg/L			
Tetrachloroethene*	0.005	µg/L			
Tetrahydrofuran	0.005	µg/L			
Toluene*	0.005	µg/L			
trans-1,2-Dichloroethene	0.005	µg/L			
trans-1,3-Dichloropropene	0.005	µg/L			
Trichloroethene*	0.005	µg/L	70	130	30

TABLE 3.8

Summary of Analytes and QAPP Objectives for Fixed-Base Laboratory Analyses of Air and Soil Vapor Samples

APS Quality Assurance Project Plan

Analyte	PQL	Units	Lower Control Limit (percent)	Upper Control Limit (percent)	RPD (percent)
Trichlorofluoromethane*	0.005	µg/L			
Vinyl Acetate	0.005	µg/L			
Vinyl Chloride*	0.005	µg/L			
Leak Check Compound					
1,1-Difluoroethane	10	µg/L			
Volatile Organic Compounds by EPA 8260B (Soil Vapor)					
1,1,1-Trichloroethane*	0.01	µg/L			
1,1,2,2-Tetrachloroethane*	0.014	µg/L	70	130	30
1,1,2-Trichloroethane*	0.01	µg/L			
1,1-Dichloroethane*	0.008	µg/L			
1,1-Dichloroethene*	0.008	µg/L	70	130	30
1,1,2-Trichlorotrifluoroethane	0.015	µg/L			
1,2,4-Trichlorobenzene	0.015	µg/L			
1,2,4-Trimethylbenzene	0.01	µg/L			
1,2-Dibromoethane (EDB)	0.015	µg/L			
1,2-Dichlorobenzene	0.012	µg/L			
1,2-Dichloroethane*	0.008	µg/L			
1,2-Dichloropropane	0.009	µg/L			
1,3-Dichlorobenzene	0.012	µg/L			
1,3,5-Trimethylbenzene	0.01	µg/L			
1,4-Dichlorobenzene	0.012	µg/L			
Benzene*	0.006	µg/L			
Bromomethane	0.008	µg/L			
Carbon Tetrachloride*	0.013	µg/L			
Chlorobenzene	0.009	µg/L			
Chloroethane*	0.005	µg/L			
Chloroform*	0.01	µg/L			
Chloromethane	0.004	µg/L			
cis-1,2-Dichloroethene*	0.008	µg/L			
cis-1,3-Dichloropropene	0.009	µg/L			

TABLE 3.8

Summary of Analytes and QAPP Objectives for Fixed-Base Laboratory Analyses of Air and Soil Vapor Samples

APS Quality Assurance Project Plan

Analyte	PQL	Units	Lower Control Limit (percent)	Upper Control Limit (percent)	RPD (percent)
Dichlorodifluoromethane*	0.01	µg/L			
Dichlorotetrafluoroethane	0.014	µg/L			
Ethylbenzene*	0.009	µg/L			
Hexachlorobutadiene	0.021	µg/L			
m,p-Xylenes*	0.009	µg/L			
Methylene chloride*	0.007	µg/L	70	130	30
o-Xylene*	0.009	µg/L			
Styrene	0.008	µg/L			
Tetrachloroethene*	0.013	µg/L			
Toluene*	0.007	µg/L			
trans-1,3 -Dichloropropene	0.009	µg/L			
Trichloroethene*	0.01	µg/L	70	130	30
Trichlorofluoromethane*	0.011	µg/L			
Vinyl chloride*	0.005	µg/L			
Leak Check Compound					
1,1-Difluoroethane	10	µg/L			
EPA 3C (Soil Vapor)					
Oxygen	100	PPM V/V	30	130	70
Carbon Dioxide	100	PPM V/V	30	130	70
Methane	100	PPM V/V	30	130	70
Nitrogen	100	PPM V/V	30	130	70

Notes:

*Primary Target Compounds; California Regional Water Quality Control Board Los Angeles Region, *Interim Guidance for Active Soil Gas Investigation* (February 25, 1997)

QAPP = Quality Assurance Project Plan

PQL = Practical Quantitation Limit

PPB V/V = Parts per billion volume per volume

PPM V/V = Parts per million volume per volume

µg/L = micrograms per Liter

NIOSH = National Institute of Occupational Health and Safety

ng/sample = nanograms per sample

All values presented are the method control limits (LCS, MS, Surrogates)

TABLE 3.9

Summary of Sample Containers, Preservation, Volumes, and Holding Times for Soil Sample Analyses

APS Quality Assurance Project Plan

Analytical Method	Container	Preservation	Minimum Sample Weight or Volume	Holding Time
VOCs by EPA 8021B	Brass sleeve or Encore^{TM} sampler	MeOH, Chill to 4 °C	10 g / 10 mL MeOH or 20g / 20 mL MeOH 5 g for Encore^{TM}	2 hrs – extraction for brass sleeves, 48 hrs – extraction for Encore^{TM}, 14 days – analysis for brass sleeves and Encore^{TM}
VOCs by EPA 8260B	Brass sleeve or Encore^{TM} sampler	MeOH, Chill to 4 °C	10 g / 10 mL MeOH or 20 g / 20 mL MeOH 5 g for Encore^{TM}	2 hrs – extraction for brass sleeves, 48 hrs – extraction for Encore^{TM}, 14 days – analysis for brass sleeves and Encore^{TM}
PAHs by EPA 8270D	9 ounce glass with Teflon^{TM} lined cap or brass sleeve	Chill to 4 °C	100 g	14 days - extraction, 40 days - analysis
TPH by ADHS 8015 AZR1 (C_6 to C_{10})	Brass sleeve or Encore	MeOH, Chill to 4 °C	10 g / 10 mL MeOH or 20 g / 20 mL MeOH	14 days - analysis
TPH by ADHS 8015 AZR1 (C_{10} to C_{32})	9 ounce glass with Teflon^{TM} lined cap or brass sleeve	Chill to 4 °C	100 g	14 days – both extraction and analysis
Organochlorine Pesticides by EPA 8081B	9 ounce glass with Teflon^{TM} lined cap or brass sleeve	Chill to 4 °C	100 g	14 days - extraction, 40 days - analysis
PCBs by EPA 8082A	9 ounce glass with Teflon^{TM} lined cap or brass sleeve	Chill to 4 °C	100 g	14 days - extraction, 40 days - analysis
Chlorinated Herbicides by EPA 8151A	9 ounce glass with Teflon^{TM} lined cap or brass sleeve	Chill to 4 °C	100 g	14 days - extraction, 40 days - analysis
RCRA 8 Total Metals by EPA EPA 6010C/7471B	9 ounce glass with Teflon^{TM} lined cap or brass sleeve	Chill to 4 °C	50 g	6 months
TCLP Metals by EPA 1311/6010C	9 ounce glass with Teflon^{TM} lined cap or brass sleeve	Chill to 4 °C	100 g	6 months to extract 6 months to analyze
Hexavalent Chromium by EPA 7196A/7199	9 ounce glass with Teflon^{TM} lined cap or brass sleeve	Chill to 4 °C	10 g	30 days to extract; 24 hours to analyze extract
Sulfide by EPA 9031/9034	9 ounce glass with Teflon^{TM} lined cap or brass sleeve	Add 2N Zinc acetate until sample is moistened; chill to 4 °C	10 g	7 days
Total Cyanide by EPA 9014	9 ounce glass with Teflon^{TM} lined cap or brass sleeve	Chill to 4 °C	10 g	14 days

TABLE 3.9

Summary of Sample Containers, Preservation, Volumes, and Holding Times for Soil Sample Analyses

APS Quality Assurance Project Plan

Analytical Method	Container	Preservation	Minimum Sample Weight or Volume	Holding Time
Flash Point by SW-846 Article 7.1.2.	9 ounce glass with Teflon^{TM} lined cap or brass sleeve	Chill to 4 °C	200 g	None
Paint Filter by EPA 9095B	9 ounce glass with Teflon^{TM} lined cap or brass sleeve	Chill to 4 °C	100 g	None
pH by EPA 9045D	9 ounce glass with Teflon^{TM} lined cap or brass sleeve	Chill to 4 °C	50 g	Immediate

Notes:

VOCs = Volatile Organic Compounds

EPA = Environmental Protection Agency

Encore^{TM} = Sampling device sold by En Novative Technologies, Inc. approved by EPA.

g = grams

PAHs = Polynuclear Aromatic Hydrocarbons

ADHS = Arizona Department of Health Services

TPH = Total Petroleum Hydrocarbons

TRPH = Total Recoverable Petroleum Hydrocarbons

GRO = Gasoline Range Organics

DRO = Diesel Range Organics

SM = Standard Method

MeOH = Methanol

mL = milliliter

°C = Degrees Celsius

TABLE 3.10

Summary of Sample Containers, Preservation, Volumes, and Holding Times for Aqueous Sample Analyses

APS Quality Assurance Project Plan

Analytical Method	Container	Preservation	Minimum Sample Weight or Volume	Holding Time
VOCs by EPA 8021B VOCs by EPA601/602 VOCs by EPA 8260B	2 x 40 ml VOA with Teflon^{TM} lined septum	HCl to pH<2, Chill to 4 °C	2 x 40 ml	14 days - analysis
PAHs by EPA 8270D SIM	2 x 1 L amber glass, Teflon^{TM} lined cap	Chill to 4 °C	2 x 1 L	7 days - extraction, 40 days - analysis
TPH by EPA 8015D Modified (C_6 to C_{10})	2 x 40 ml VOA with Teflon^{TM} lined septum	HCl to pH<2, Chill to 4 °C	2 x 40 ml	14 days - analysis
TPH by EPA 8015D Modified (C_{10} to C_{32})	2 x 500 ml amber glass, Teflon^{TM} lined cap	Chill to 4 °C	2 x 500 ml	7 days - extraction, 40 days - analysis
Organochlorine Pesticides by EPA 8081B	2 x 1 L amber glass, Teflon^{TM} lined cap	Chill to 4 °C	2 x 1 L	7 days - extraction, 40 days - analysis
PCBs by EPA 8082A	2 x 1 L amber glass, Teflon^{TM} lined cap	Chill to 4 °C	2 x 1 L	7 days - extraction, 40 days - analysis
Chlorinated Herbicides by EPA 8151A	2 x 1 L amber glass, Teflon^{TM} lined cap	Chill to 4 °C	2 x 1 L	7 days - extraction, 40 days - analysis
RCRA 8 Total Metals	plastic	HNO_3 to pH <2, Chill to 4 °C	500 ml	6 months
Hexavalent Chromium by EPA 7196A/7199	250 ml amber glass, Teflon^{TM} lined cap	NaOH to pH >12, Chill to 4 °C	250 ml	24 hours
Total Cyanide by SM 4500-CN,C-E; Amenable Cyanide by SM 4500 CN-G; Weak Acid Dissociable Cyanide by SM 4500 CN-I	1 L amber glass, Teflon^{TM} lined cap	NaOH to pH >12, Chill to 4 °C	1 L	14 days
Ammonia by SM4500-NH3 B, D, E	glass or HDPE	H_2SO_4 to pH <2 Chill to 4 °C	500 ml	28 days
Nitrate/ Nitrate by EPA 353.2, SM4500NO3	glass or HDPE	H_2SO_4 to pH <2 Chill to 4 °C	500 ml	28 days
Nitrate/ Nitrate by EPA 300.0	glass or HDPE	Chill to 4 °C	500 ml	48 hours
Sulfide by EPA 9034	Glass or HDPE	Add 2N Zinc Acetate and 6N NaOH to pH>9; chill to 4 °C	1 L	7 days

TABLE 3.10

Summary of Sample Containers, Preservation, Volumes, and Holding Times for Aqueous Sample Analyses

APS Quality Assurance Project Plan

Analytical Method	Container	Preservation	Minimum Sample Weight or Volume	Holding Time
Sulfate by EPA 300.0	Glass or HDPE	Chill to 4 °C	500 ml	28 days

Notes:

HDPE=High Density Poly Ethylene

VOCs = Volatile Organic Compounds

EPA = Environmental Protection Agency

PAHs = Polynuclear Aromatic Hydrocarbons

ADHS = Arizona Department of Health Services

TPH = Total Petroleum Hydrocarbons

GRO = Gasoline Range Organics

DRO = Diesel Range Organics

ORO = Oil Range Organics

SM = Standard Method

ml = milliliter, L = liter

4 °C = Degrees Celsius

NaOH = Sodium Hydroxide

HCL = Hydrochloric acid

HNO_3 = Nitric Acid

RCRA = Resource Conservation and Recovery Act

SM = Standard Method

TABLE 3.11
Summary of Sample Containers, Preservation, Volumes, and Holding Times for Air and Soil Vapor Sample Analyses
APS Quality Assurance Project Plan

Analytical Method	**Container**	**Preservation**	**Minimum Sample Weight or Volume**	**Holding Time**
VOCs by EPA TO-15	SUMMA canister with fused silica liner	N/A	1 L or 6 L	72 hours
PAHs by EPA TO-13A by HPLC	High volume PUF tube (PUF/XAD-2/PUF)	N/A	300 m^3	7 days to extract, 40 days to analyze
VOCs by NIOSH 1501	Sorbent tubes	N/A	20 L	14 days to extract and analyze
Lead by NIOSH 7300	Filter cassette	N/A	960 L	6 months
Carbon Dioxide, Oxygen, Methane, and Nitrogen by EPA 3C	SUMMA canister with fused silica liner (Gas-tight glass syringe or glass bulb wrapped in aluminum foil may also be used.)	N/A	1 L or 6 L	24 hours

Notes:

VOCs = Volatile Organic Compounds

EPA = Environmental Protection Agency

PAHs = Polynuclear Aromatic Hydrocarbons

NIOSH – National Institute of Occupational Safety and Health

m^3 = cubic meter

L = liter

HPLC – High Pressure Liquid Chromatography

N/A – Not Applicable

TABLE 4.1
Data Evaluation Summary for USEPA Method 8021B, Aromatic and Halogenated Volatile Organic Compounds
APS Quality Assurance Project Plan

QC Check	Minimum Frequency	Acceptance Criteria	Flagging Criteria
Hold Time	All field samples and the associated field QC	Table 3.9 – Soils Table 3.10 - Aqueous	If the samples were not properly preserved within the specified hold time (HT) qualify detected values J and non-detected values UJ. If the proper preservation is exceeded by twice that specified qualify detected values as J and non-detected values as R. If samples were properly preserved and the analytical HT time is exceeded qualify detected values as J and non-detected values as UJ. If the analytical HT is exceeded by more than 5 days qualify all positive values as J and non-detected values as R.
Minimum five-point initial calibration	Initial calibration prior to sample analysis, after instrument changes, or when calibration verification fails.	Correlation coefficient or coefficient of determination (r) ≥0.990 (if using calibration curves) or %RSD ≤ 20% (if using average RRF).	If using calibration curves and correlation coefficient or coefficient of determination < 0.990, qualify positive values J, and non-detected values R. If using average RF and %RSD >20%, qualify positive values J, and non-detects as UJ. Non-detected values with a %RSD > 35 % will be qualified as R.
Calibration verification	Initially to verify the curve, and after every 10 samples.	≤±20%D (using average RF) or %Drift (using calibration curves) for all analytes	If %D or %Drift is > ±20%, qualify positive results as J. If the %D or %Drift is > -20%, qualify non-detects UJ.
Second column confirmation	All samples analyzed for method 8021B by fixed base laboratories	≤25% RPD between primary and second column results. Second column must meet all calibration criteria required on primary column	For >25% RPD, qualify the result from the primary column as J.
LCS for all analytes specified in Tables 3.4 through 3.6	One LCS sample pair per every 20 samples per matrix	QC acceptance criteria as presented in Tables 3.4 through 3.6.	Batch qualification will be applied as follows: %R for LCS/LCSD >UCL qualify positive values as J. %R for LCS/LCSD <LCL qualify positive values as J and non-detected values as UJ. If the %R is < 10% qualify positive values as J and non-detected values as R qualify positive results J if the RPD is > UCL. Use professional judgment for analytes other than spiking analytes.
Surrogate spike	Every sample, spiked sample, standard, and method blank	QC acceptance criteria as presented in Tables 3.4 through 3.6.	If one surrogate fails apply the following qualification to all analyte(s) in the affected sample: %R >UCL or <LCL apply J for detected analytes, %R < LCL but > 10% apply UJ for non-detected analytes. If surrogate %R is < 10% qualify non-detected analytes R.

TABLE 4.1
Data Evaluation Summary for USEPA Method 8021B, Aromatic and Halogenated Volatile Organic Compounds
APS Quality Assurance Project Plan

QC Check	Minimum Frequency	Acceptance Criteria	Flagging Criteria
MS/MSD	One MS/MSD sample pair per every 20 samples per matrix	Meet or exceed QC acceptance criteria as presented in Tables 3.4 through 3.6.	If the MS or MSD recovery is >UCL or <LCL, qualify positive results J. Qualify non-detected analytes UJ if the MS or MSD recovery is <LCL. Qualify positive Results J if the RPD is >UCL.
Field duplicate comparison	One duplicate pair per sampling event	Per Section 7.4.2.4	If the criteria specified in Section 7.4.2.4 are not met, qualify the primary and field duplicate sample only as J for detected results and UJ for non-detects.
Method blank	One per analytical batch per matrix	No analytes detected > PQL	Apply U to all contaminant compound results detected at <5X the amount found in highest blank, and <10X the amount in blank if a common laboratory contaminant is detected (methylene chloride, toluene), for all samples in the associated analytical batch. The reviewer will consider blank detected values > MDL < PQL during level III qualification.
Additional blank samples (Trip blank, field blank, equipment blank)	As defined in the QAPP	No analytes detected > PQL	Apply U to all contaminant compound results detected at <5X the amount found in highest blank, and <10X the amount in blank if a common laboratory contaminant is detected (methylene chloride, toluene), for all samples associated with the affected blank sample. The reviewer will consider blank detected values > MDL < PQL during level III qualification.
Results reported between MDL and PQL	none	Data values will **not** be reported below the PQLs presented in tables 3.4 through 3.6.	The lab report will be amended and resubmitted

Notes:

U- not detected	LCL-lower control limit	RPD-relative percent difference	LCS/LCSD-lab control sample/ lab control sample duplicate
UJ- estimated, not detected	UCL-upper control limit	%D-percent difference	
J- estimated, detected	%R-percent recovery	MDL-method detection limit	MS/MSD-matrix spike/matrix spike duplicate
R-unusable, rejected	%RSD-percent relative standard deviation	PQL-practical quantitation limit	QC-quality control

The method requires a LCS; there are instances when the laboratory does not have sufficient sample volume to perform MS/MSD analyses and will report an LCS/LCSD for the batch.

TABLE 4.2

Data Evaluation Summary For USEPA Method 601/602, Aromatic and Halogenated Volatile Organic Compounds

APS Quality Assurance Project Plan

QC Check	Minimum Frequency	Acceptance Criteria	Flagging Criteria
Hold Time	All field samples and the associated field QC	Table 3.10 - Aqueous	If the samples were not properly preserved within the specified hold time (HT) qualify detected values J and non-detected values UJ. If the proper preservation is exceeded by twice that specified qualify detected values as J and non-detected values as R. If samples were properly preserved and the analytical HT time is exceeded qualify detected values as J and non-detected values as UJ. If the analytical HT is exceeded by more than 5 days qualify all positive values as J and non-detected values as R.
Minimum three-point initial calibration	Initial calibration prior to sample analysis, after instrument changes, or when calibration verification fails	%RSD ≤ 10% (if using average RRF), or correlation coefficient or coefficient of determination ≥0.990 (if using calibration curves).	If using calibration curves and correlation coefficient or coefficient of determination < 0.990, qualify positive values J, and non-detected values R. If using average RRF and %RSD >10%, qualify positive values J, and non-detects as UJ. Non-detected values with a %RSD > 35 % will be qualified as R.
Second column confirmation	All samples analyzed for method 601/602 by fixed base laboratories	≤25% RPD between primary and second column results. Second column must meet all calibration criteria required on primary column.	For >25% RPD, qualify the result from the primary column as J.
LCS for all analytes specified in Table 3.6; must be from second source independent of that used for calibration standards.	At beginning of run, after every 20 samples, and at end of run.	QC acceptance criteria, Table 3.6.	Batch qualification will be applied as follows: %R for LCS/LCSD >UCL qualify positive values as J. %R for LCS/LCSD <LCL qualify positive values as J and non-detected values as UJ. If the %R is < 10% qualify positive values as J and non-detected values as R qualify positive results J if the RPD is > UCL. Use laboratory control limits and professional judgment for analytes for which there are no limits in the QAPP.

TABLE 4.2
Data Evaluation Summary For USEPA Method 601/602, Aromatic and Halogenated Volatile Organic Compounds
APS Quality Assurance Project Plan

QC Check	Minimum Frequency	Acceptance Criteria	Flagging Criteria
Surrogate spike	Every sample, spiked sample, standard, and method blank	QC acceptance criteria as presented in Table 3.6	If one surrogate fails apply the following qualification to all analyte(s) in the affected sample: %R >UCL or <LCL apply J for detected analytes, %R < LCL but > 10% apply UJ for non-detected analytes If surrogate %R is < 10% qualify non-detected analytes R.
MS/MSD	One MS/MSD sample pair per every 20 samples per matrix	QC acceptance criteria as presented in Table 3.6	If the MS or MSD recovery is >UCL or <LCL, qualify positive results J. Qualify non-detected analytes UJ if the MS or MSD recovery is <LCL. Qualify positive results J if the RPD is >UCL.
Field duplicate comparison	One duplicate pair per sampling event	Per Section 7.4.2.4	If the criteria specified in Section 7.4.2.4 are not met, qualify the primary and field duplicate sample only as J for detected results and UJ for ND results.
Method blank	One per analytical batch per matrix	No analytes detected > PQL	Apply U to all contaminant compound results detected at <5X the amount found in highest blank, and <10X the amount in blank if a common laboratory contaminant is detected, for all samples in the associated analytical batch. The reviewer will consider blank detected values > MDL < PQL during level III qualification.
Additional blank samples (Trip blank, field blank, equipment blank)	As outlined in the QAPP	No analytes detected > PQL	Apply U to all contaminant compound results detected at <5X the amount found in highest blank, and <10X the amount in blank if a common laboratory contaminant is detected, for all samples associated with the affected blank sample. The reviewer will consider blank detected values > MDL < PQL during level III qualification.
Results reported between MDL and PQL	none	Results will **not** be reported below the PQL for any analyte in Table 3.6.	The lab report will be amended and resubmitted.

Notes:

U- not detected	LCL-lower control limit	LCS/LCSD-lab control sample/
UJ- estimated, not detected	%R-percent recovery	lab control sample duplicate
J- estimated, detected	RPD-relative percent difference	MS/MSD-matrix spike/matrix duplicate
R-unusable, rejected	%RSD-percent relative standard deviation	MDL-method detection limit
UCL-upper control limit	QC-quality control	PQL-practical quantitation limit

The method requires a LCS; there are instances when the laboratory does not have sufficient sample volume to perform MS/MSD analyses and will report an LCS/LCSD for the batch

TABLE 4.3

Data Evaluation Summary for USEPA Methods 8015C and Arizona Method 8015AZR1; Gasoline, Diesel, and Oil Range Organics for Total Petroleum Hydrocarbons

APS Quality Assurance Project Plan

QC Check	Minimum Frequency	Acceptance Criteria	Flagging Criteria
Hold Time	All field samples and the associated field QC	Table 3.9 – Soils Table 3.10 - Aqueous	If the samples were not properly preserved within the specified hold time (HT) qualify detected values J and non-detected values UJ. If the proper preservation is exceeded by twice that specified qualify detected values as J and non-detected values as R. If samples were properly preserved and the analytical HT time is exceeded qualify detected values as J and non-detected values as UJ. If the analytical HT is exceeded by more than 5 days qualify all positive values as J and non-detected values as R.
Minimum five-point initial calibration (Methods 8015B and 8015AZR1)	Initial calibration prior to sample analysis, after instrument changes, or when calibration verification fails.	Correlation coefficient or coefficient of determination (r) ≥0.995, (if using calibration curves) or %RSD ≤ 20% (if using average RF.	If using calibration curves and correlation coefficient or coefficient of determination < 0.995, qualify positive values J, and non-detected values R. If using average RF and %RSD >20%, qualify positive values J, and non-detects as UJ. Non-detected values with a %RSD > 35 % will be qualified as R.
Calibration verification (8015B)	Initially to verify the initial calibration and every 12 hours of analysis time	≤±15%D (using average RF) or %Drift (using calibration curves) for all analytes	If %D or %Drift is > ±15%, qualify positive results as J. If the %D or %Drift is > -15%, qualify non-detects UJ.
Calibration verification (8015AZR1)	Initially to verify the curve, and as the closing standard	≤±30%D (using average RF) or %Drift (using calibration curves) for all analytes	If %D or %Drift is > ±30%, qualify positive results as J. If the %D or %Drift is > -30%, qualify non-detects UJ.
LCS for all analytes specified in Tables 3.4 through 3.6	One LCS sample pair per every 20 samples per matrix	QC acceptance criteria as presented in Tables 3.4 through 3.6	Batch qualification will be applied as follows: %R for LCS/LCSD >UCL qualify positive values as J. %R for LCS/LCSD <LCL qualify positive values as J and non-detected values as UJ. If the %R is < 10% qualify positive values as J and non-detect values as R qualify positive results J if the RPD is > UCL. Use professional judgment for analytes other than spiking analytes.

TABLE 4.3
Data Evaluation Summary for USEPA Methods 8015C and Arizona Method 8015AZR1; Gasoline, Diesel, and Oil Range Organics for Total Petroleum Hydrocarbons
APS Quality Assurance Project Plan

QC Check	Minimum Frequency	Acceptance Criteria	Flagging Criteria
Surrogate spike (all methods)	Every sample, spiked sample, standard, and method blank	QC acceptance criteria as presented in Tables 3.4 through 3.6	If one surrogate fails apply the following qualification to all analyte(s) in the affected sample: %R >UCL or <LCL apply J for detected analytes, %R < LCL but > 10% apply UJ for non-detected analytes If surrogate %R is < 10% qualify non-detects R.
MS/MSD	One MS/MSD sample pair per every 20 samples per matrix	Meet or exceed QC acceptance criteria as presented in Tables 3.4 through 3.6.	If the MS or MSD recovery is >UCL or <LCL, qualify positive results J qualify non-detected analytes UJ if the MS or MSD recovery is <LCL qualify positive Results J if the RPD is >UCL.
Field duplicate comparison	One duplicate pair per sampling event	Per Section 7.4.2.4	If the criteria specified in Section 7.4.2.4 are not met, qualify the primary and field duplicate sample only as J for detected results and UJ for non-detects.
Method blank	One per analytical batch	No analytes detected > PQL	Apply U to all contaminant compound results detected at <5X the amount found in highest blank, for all samples in the associated analytical batch. The reviewer will consider blank detected values > MDL < PQL during level III qualification.
Additional blank samples (Trip blank, field blank, equipment blank)	As defined in the QAPP	No analytes detected > PQL	Apply U to all contaminant compound results detected at <5X the amount found in highest blank for all samples associated with the affected blank sample. The reviewer will consider blank detected values > MDL < PQL during level III qualification.
Results reported between MDL and PQL	none	Data values will **not** be reported below the PQL for any analyte in Tables 3.4 through 3.6.	The lab report will be amended and resubmitted.

TABLE 4.3

Data Validation Summary for USEPA Methods 8015B and Arizona Method 8015AZR1; Gasoline, Diesel, and Oil Range Organics for Total Petroleum Hydrocarbons

APS Quality Assurance Project Plan

Notes:

U- not detected
UJ- estimated, not detected
J- estimated, detected
R-unusable, rejected

MDL-method detection limit
PQL-practical quantitation limit
%R-percent recovery
RPD-relative percent difference

ICB-initial calibration blank
ICV-initial calibration verification
CCB-continuing calibration blank
CCV-continuing calibration verification

LCS/LCSD-lab control sample/ lab control sample duplicate
MS/MSD-matrix spike/matrix spike duplicate

The method requires a LCS; there are instances when the laboratory does not have sufficient sample volume to perform MS/MSD analyses and will report an LCS/LCSD for the batch.

TABLE 4.4

Data Evaluation Summary for USEPA Methods 8310 and 8100, Polynuclear Aromatic Hydrocarbons; USEPA Method 8081B, Organochlorine Pesticides; USEPA Method 8082A, PCBs; USEPA Method 8151A, Chlorinated Herbicides

APS Quality Assurance Project Plan

QC Check	Minimum Frequency	Acceptance Criteria	Flagging Criteria
Hold Time	All field samples and the associated field QC	Table 3.9 – Soils Table 3.10 - Aqueous	If the samples were not properly preserved within the specified hold time (HT) qualify detected values J and non-detected values UJ. If the proper preservation is exceeded by twice that specified qualify detected values as J and non-detected values as R. If samples were properly preserved and the analytical HT time is exceeded qualify detected values as J and non-detected values as UJ. If the analytical HT is exceeded by more than 5 days qualify all positive values as J and non-detected values as R.
Five-point initial calibration for all PAHs, single-response Organochlorine Pesticides, and Aroclors 1016 and 1260; include mid-level standard of all other Aroclors for pattern recognition; if a specific Aroclor is found in any sample, quantitation for that Aroclor must be done using 5-point calibration; single-point calibration for multi-response organochlorine Pesticides.	Initial calibration prior to sample analysis, after instrument changes, or when calibration verification fails.	Correlation coefficient or coefficient of determination (r) ≥0.990 (if using calibration curves) or %RSD ≤ 20% (if using average RRF). Both detectors must pass calibration requirements.	If using calibration curves and correlation coefficient or coefficient of determination < 0.990, qualify positive values J, and non-detected values R If using average RF and %RSD >20% , qualify positive values J, and non-detects as UJ. If the %RSD > 35 %, non-detects will be qualified as R.
Calibration verification (for all analytes used in initial calibration; if specific Aroclor is found in any sample, calibration for that Aroclor must be verified.	Daily, at beginning of sequence and every 12 hours of analysis time	≤±15%D (using average RF) or %Drift (using calibration curves) for all analytes	If %D or %Drift is > ±15%, qualify positive results as J. If the %D or %Drift is > -15%, qualify non-detects UJ.
Endrin/DDT Breakdown (method 8081A only)	At start of each 12 hour period	Breakdown of either Endrin or DDT >15%	For breakdown>15%, qualify the positive results of Endrin, DDT and derivatives J, qualify non-detects UJ.

TABLE 4.4
Data Evaluation Summary for USEPA Methods 8310 and 8100, Polynuclear Aromatic Hydrocarbons; USEPA Method 8081B, Organochlorine Pesticides; USEPA Method 8082A, PCBs; USEPA Method 8151A, Chlorinated Herbicides
APS Quality Assurance Project Plan

QC Check	Minimum Frequency	Acceptance Criteria	Flagging Criteria
Second column confirmation (8310)	All positive PAH results from fixed base laboratories	Second column must meet all calibration criteria required on primary column. <25% RPD between primary and second column results.	For >25% RPD, qualify the result from the primary column as J.
LCS for all analytes specified in Tables 3.4 through 3.6	One LCS per every 20 samples per matrix	Meet or exceed QC acceptance criteria or as presented in Tables 3.4 through 3.6.	Batch qualification will be applied as follows: %R for LCS/LCSD >UCL qualify positive values as J. %R for LCS/LCSD <LCL qualify positive values as J and non-detected values as UJ. If the %R is < 10% qualify positive values as J and non-detected values as R. Qualify positive results J if the RPD is > UCL. Use professional judgment for analytes other than spiking analytes.
Surrogate spike	Every sample, spiked sample, standard, and method blank	Meet or exceed QC acceptance criteria or as presented in Tables 3.4 through 3.6.	For all analyte(s) in the affected sample, apply J for detected compounds if surrogate %R is > UCL, or < LCL. Apply UJ for non- detects if surrogate %R is < LCL, and apply R for non-detects if surrogate %R is <10%
MS/MSD	One MS/MSD sample pair per every 20 samples per matrix	Meet or exceed QC acceptance criteria as presented in Tables 3.4 through 3.6.	If the MS or MSD recovery is >UCL or <LCL, qualify positive results J. Qualify non-detected analytes UJ if the MS or MSD recovery is <LCL. Qualify positive Results J if the RPD is >UCL.
Field duplicate comparison	One duplicate pair per sampling event	Per Section 7.4.2.4	If the criteria specified in Section 7.4.2.4 are not met, qualify the primary and field duplicate sample only as J for detected results and UJ for non-detects.

TABLE 4.4

Data Evaluation Summary for USEPA Methods 8310 and 8100, Polynuclear Aromatic Hydrocarbons; USEPA Method 8081B, Organochlorine Pesticides; USEPA Method 8082A, PCBs; USEPA Method 8151A, Chlorinated Herbicides

APS Quality Assurance Project Plan

QC Check	Minimum Frequency	Acceptance Criteria	Flagging Criteria
Method blank	One per analytical batch per matrix	No analytes detected > PQL	Apply U to all contaminant compound results detected at <5X the amount found in highest blank for all samples in the associated analytical batch. The reviewer will consider blank detected values > MDL < PQL during level III qualification.
Additional blank samples (field blank, equipment blank)	As defined in the QAPP	No analytes detected > PQL	Apply U to all contaminant compound results detected at <5X the amount found in highest blank for all samples associated with the affected blank sample. The reviewer will consider blank detected values > MDL < PQL during level III qualification.
Results reported between MDL and PQL	none	Data values will **not** be reported below the PQL for any analyte in Tables 3.4 through 3.6.	The lab report will be amended and resubmitted.

Notes:

U- not detected
UJ- estimated, not detected
J- estimated, detected
R-unusable, rejected
UCL-upper control limit
LCL-lower control limit
%R-percent recovery
RPD-relative percent difference
%D-percent difference
%RSD-percent relative standard deviation
MDL-method detection limit
PQL-practical quantitation limit
RRF-relative response factor
RF-response factor
QC-quality control
LCS/LCSD-lab control sample/ lab control sample duplicate
MS/MSD-matrix spike/matrix spike duplicate
CCC- calibration check compounds
SPCC-system performance check compounds

The method requires a LCS; there are instances when the laboratory does not have sufficient sample volume to perform MS/MSD analyses and will report an LCS/LCSD for the batch.

TABLE 4.5
Data Evaluation Summary For USEPA Method 8260B, Volatile Organic Compounds
APS Quality Assurance Project Plan

QC Check	**Minimum Frequency**	**Acceptance Criteria**	**Flagging Criteria**
Hold Time	All field samples and the associated field QC	Table 3.9 – Soils Table 3.10 – Aqueous	If the samples were not properly preserved within the specified hold time (HT) qualify detected values J and non-detected values UJ. If the proper preservation is exceeded by twice that specified qualify detected values as J and non-detected values as R. If samples were properly preserved and the analytical HT time is exceeded qualify detected values as J and non-detected values as UJ. If the analytical HT is exceeded by more than 5 days qualify all positive values as J and non-detected values as R.
Five-point initial calibration for all analytes	Initial calibration prior to sample analysis and when calibration verification fails	SPCCs average RF ≥ 0.30 (except >0.100 for bromoform, chloromethane, and 1,1-DCA); all CCC ≤ 30% RSD To use average RRF for quantitation, RSD for alll analytes must be ≤15%; otherwise use calibration curve with correlation coefficient or coefficient of determination ≥ 0.99	If %RSD for any CCC is > than the criteria specified, qualify positive results as J and non-detects UJ. If RRF for any SPCC is < the criteria specified, qualify positive results as J and non-detects as R. f SPCC and CCC analytes do not meet the specified criteria (regardless of calibration option) results will be qualified as specified above. If average RRF is used for quantitation, and the RSD is > 15%, qualify positive results J and non-detects UJ. If calibration curves are used and the correlation coefficient or coefficient of determination is < 0.99 qualify positive values as J and non-detected values as R.
Calibration verification	Daily, before sample analysis, and every 12 hours of analysis time	SPCCs average RF ≥ 0.30 (except ≥0.10 for bromoform, chloromethane, and 1,1-DCA); %D (if using average RRFs) or % Drift (if using calibration curves) must be ≤ ± 20%.	If %D or %Drift > ±20%, qualify positive results as J. If the %D or %Drift is > -20%, qualify non-detects UJ. If RRF for any SPCC is < the criteria specified, qualify positive results as J, and non-detects as R.
Instrument tune mass spectral ion intensities of BFB.	Every 12 hours of analysis time.	Refer to Method 8260B.	Qualify all of the associated results of a failed tune as R.

TABLE 4.5
Data Evaluation Summary For USEPA Method 8260B, Volatile Organic Compounds
APS Quality Assurance Project Plan

QC Check	Minimum Frequency	Acceptance Criteria	Flagging Criteria
Internal standards	Every sample, spiked sample, standard, and method blank	Retention time ±30 seconds: EICP area within -50% to +100% of last calibration verification (12 hours)	If the EICP area is < 50% or > 200%, qualify positive results as J. EICP area >30% but <50%, qualify non-detected analytes UJ. If the EICP area is <30% non-detected analytes will be qualified R.
LCS for all analytes specified in Tables 3.4 and 3.6	One LCS sample per every 20 samples per matrix	Meet or exceed QC acceptance criteria as presented in Tables 3.4 and 3.6	Batch qualification will be applied as follows: %R for LCS/LCSD >UCL qualify positive values as J. %R for LCS/LCSD <LCL qualify positive values as J and non-detected values as UJ. If the %R is < 10% qualify positive values as J and non-detected values as R qualify positive results J if the RPD is > UCL. Use professional judgment for analytes other than spiking analytes.
Surrogate spike	Every sample, spiked sample, standard, and method blank	Meet or exceed QC acceptance criteria as presented in Tables 3.5 and 3.6.	If one surrogate fails apply the following qualification to all analyte(s) in the affected sample: %R >UCL or <LCL apply J for detected analytes, %R < LCL but > 10% R apply UJ for non-detected analytes. If surrogate %R is < 10% qualify non-detected analytes R.
MS/MSD	One MS/MSD sample pair per every 20 samples per matrix	Meet or exceed QC acceptance criteria as presented in Tables 3.4 through 3.6.	If the MS or MSD recovery is >UCL or <LCL, qualify positive results J. Qualify non-detected analytes UJ if the MS or MSD recovery is <LCL. Qualify positive Results J if the RPD is >UCL.
Field duplicate comparison	One duplicate pair per sampling event	Per section 7.4.2.4	If the criteria specified in Section 7.4.2.4 are not met, qualify the primary and field duplicate sample only as J for detected results and UJ for ND results.
Method blank	One per analytical batch, per matrix	No analytes detected > PQL	Apply U to all contaminant compound results detected at <5X the amount found in highest blank, and <10X the amount in blank if a common laboratory contaminant is detected (methylene chloride, acetone, toluene, or 2-butanone), for all samples in the associated analytical batch. The reviewer will consider blank detected values > MDL < PQL during level III qualification.

TABLE 4.5
Data Evaluation Summary For USEPA Method 8260B, Volatile Organic Compounds
APS Quality Assurance Project Plan

QC Check	**Minimum Frequency**	**Acceptance Criteria**	**Flagging Criteria**
Additional blank samples (Trip blank, field blank, equipment blank)	As defined in the QAPP	No analytes detected > PQL	Apply U to all contaminant compound results detected at <5X the amount found in highest blank, and <10X the amount in blank if a common laboratory contaminant is detected (methylene chloride, acetone, toluene, or 2-butanone), for all samples associated with the affected blank sample. The reviewer will consider blank detected values > MDL < PQL during level III qualification.
Results reported between MDL and PQL	none	Data values will not be reported below the PQLs presented in Tables 3.4 through 3.6.	The lab report will be amended and resubmitted.

Notes:

U- not detected

UJ- estimated, not detected

J- estimated, detected

R-unusable, rejected

MDL-method detection limit

PQL-practical quantitation limit

%R-percent recovery

RPD-relative percent difference

ICB-initial calibration blank

ICV-initial calibration verification

CCB-continuing calibration blank

CCV-continuing calibration verification

LCS/LCSD-lab control sample/ lab control sample duplicate

MS/MSD-matrix spike/matrix spike duplicate

The method requires a LCS; there are instances when the laboratory does not have sufficient sample volume to perform MS/MSD analyses and will report an LCS/LCSD for the batch.

TABLE 4.6

Data Evaluation Summary For USEPA Methods 8270D, Semi-Volatile Organic Compounds and 8270DSIM, Polynuclear Aromatic Hydrocarbons

APS Quality Assurance Project Plan

QC Check	Minimum Frequency	Acceptance Criteria	Flagging Criteria
Hold Time	All field samples and the associated field QC	Table 3.9 – Soils Table 3.10 - Aqueous	If the samples were not properly preserved within the specified hold time (HT) qualify detected values J and non detected values UJ. If the proper preservation is exceeded by twice that specified qualify detected values as J and non detected values as R. If samples were properly preserved and the analytical HT time is exceeded qualify detected values as J and non detected values as UJ. If the analytical HT is exceeded by more than 5 days qualify all positive values as J and non detected values as R.
Five-point initial calibration for all analytes	Initial calibration prior to sample analysis and when calibration verification fails.	SPCCs average RRF ≥ 0.05, and all CCC ≤30% RSD. To use average RRF for quantitation, RSD for all analytes must be ≤15%; otherwise use calibration curve with correlation coefficient or coefficient of determination ≥ 0.99	If %RSD for any CCC is > than the criteria specified, qualify positive results as J and non-detects UJ. If RRF for any SPCC is < the criteria specified, qualify positive results as J and non detects as R. If SPCC and CCC analytes do not meet the specified criteria (regardless of calibration option) results will be qualified as specified above. If average RRF is used for quantitation, and the RSD is > 15%, qualify positive results J and non-detects UJ. If calibration curves are used and the correlation coefficient or coefficient of determination is < 0.99 qualify positive values as J and non detected values as R.
Calibration verification	Daily, before sample analysis, and every 12 hours of analysis time	SPCCs average RF ≥ 0.05; %D (If using average RRFs) or % Drift (if using calibration curves) must be ≤ ± 20%.	If %D or %Drift > ±20%, qualify positive results as J. If the %D or %Drift is > -20%, qualify non-detects UJ. If RRF for any SPCC is < the criteria specified, qualify positive results as J, and non detects as R.

TABLE 4.6
Data Evaluation Summary For USEPA Methods 8270D, Semi-Volatile Organic Compounds and 8270DSIM, Polynuclear Aromatic Hydrocarbons
APS Quality Assurance Project Plan

QC Check	Minimum Frequency	Acceptance Criteria	Flagging Criteria
Instrument tune mass spectral ion intensities of DFTPP	Every 12 hours of analysis time.	Refer to Method 8270D.	Qualify all of the associated results of a failed tune as R.
Internal standards	Every sample, spiked sample, standard, and method blank	Retention time ±30 seconds: EICP area within -50% to +100% of last calibration verification (12 hours)	If the EICP area is < 50% or > 200%, qualify positive results as J. EICP area >30% but <50%, qualify non-detected analytes UJ. If the EICP area is <30% non-detected analytes will be qualified R.
LCS for all analytes specified in Tables 3.4 through 3.6	One LCS sample per every 20 samples per matrix	Meet or exceed QC acceptance criteria as presented in Tables 3.4 through 3.6	Batch qualification will be applied as follows: %R for LCS/LCSD >UCL qualify positive values as J. %R for LCS/LCSD <LCL qualify positive values as J and non detected values as UJ. If the %R is < 10% qualify positive values as J and non detected values as R. Qualify positive results J if the RPD is > UCL. Use professional judgment for analytes other than spiking analytes.
Surrogate spike	Every sample, spiked sample, standard, and method blank	Meet or exceed QC acceptance criteria as presented in Tables 3.5 through 3.6.	If two surrogate in the same fraction (acid or base neutral) fail to meet the established criteria apply the following qualification to all analyte(s) in the affected sample fraction: %R >UCL or <LCL apply J for detected analytes, %R < LCL but > 10%R apply UJ for non detected analytes If surrogate %R is < 10% qualify no detected analytes R.
MS/MSD	One MS/MSD sample pair per every 20 samples per matrix	Meet or exceed QC acceptance criteria as presented in Tables 3.5 through 3.6.	If the MS or MSD recovery is >UCL or <LCL, qualify positive results J. Qualify non-detected analytes UJ if the MS or MSD recovery is <LCL.

TABLE 4.6

Data Evaluation Summary For USEPA Methods 8270D, Semi-Volatile Organic Compounds and 8270DSIM, Polynuclear Aromatic Hydrocarbons

APS Quality Assurance Project Plan

QC Check	Minimum Frequency	Acceptance Criteria	Flagging Criteria
Field duplicate comparison	One duplicate pair per sampling event	Per Section 7.4.2.4	If the criteria specified in Section 7.4.2.4 are not met, qualify the primary and field duplicate sample only as J for detected results and UJ for ND results.
Method blank	One per analytical batch, per matrix	No analytes detected > PQL	Apply U to all contaminant compound results detected at <5X the amount found in highest blank, and <10X the amount in blank if a common laboratory contaminant is detected (common phthalate esters), for all samples in the associated analytical batch. The reviewer will consider blank detected values > MDL < PQL during level III qualification
Additional blank samples (Trip blank, field blank, equipment blank)	As defined in the QAPP	No analytes detected > PQL	Apply U to all contaminant compound results detected at <5X the amount found in highest blank, and <10X the amount in blank if a common laboratory contaminant is detected (common phthalate esters), for all samples associated with the affected blank sample. The reviewer will consider blank detected values > MDL < PQL during level III qualification.
Results reported between MDL and PQL	None	Data values will **not** be reported below the PQLs presented in Tables 3.5 through 3.6.	The lab report will be amended and resubmitted.

Notes:

U- not detected

UJ- estimated, not detected

J- estimated, detected

R-unusable, rejected

UCL-upper control limit

LCL-lower control limit

%R-percent recovery

RPD-relative percent difference

%D-percent difference

%RSD-percent relative standard deviation

MDL-method detection limit

PQL-practical quantitation limit

RRF-relative response factor

RF-response factor

QC-quality control

LCS/LCSD-lab control sample/Lab control sample duplicate

MS/MSD-matrix spike/matrix spike duplicate

CCC- calibration check compounds

SPCC-system performance check compounds

The method requires a LCS; there are instances when the laboratory does not have sufficient sample volume to perform MS/MSD analyses and will report an LCS/LCSD for the batch.

TABLE 4.7

Data Evaluation Summary For USEPA Methods 200.7, 200.9, 206.2, 213.2, 239.2, 245.1, 270.2, and 272.2, Metals Analyzed as Wastewater

APS Quality Assurance Project Plan

QC Check	Minimum Frequency	Acceptance Criteria	Flagging Criteria
Hold Time	All field samples and the associated field QC	Table 3.10 - Aqueous	If the technical hold time (HT) and preservation requirements are not met, qualify detected values J and non-detected values UJ. If the proper preservation is exceeded by twice that specified qualify detected values as J and non-detected values as R.
Initial calibration (5-point; blank + 4 standards)	Daily, before sample analysis	Correlation coefficient (r) ≥ 0.995	Analytes with a r < 0.995 will be qualified as J for detected values and R for non-detected values.
Calibration verification	Daily, ICB and ICV following initial calibration. CCB and CCV once every ten samples and a CCV at the end of run	ICV; within ≤ ±5%R CCV; within ≤ ±5%R ICB and CCB < MDL	ICV/CCV recoveries <95% or >105%, qualify positive results J. ICV/CCV recovery is 75-94%, qualify non-detected analytes UJ. ICV/CCV recovery is <75%, qualify non-detected analytes R. ICB and CCB values > MDL will be qualified as described in the method blank section below.
Interference check sample (ICP only)	Beginning of each run	Within ±20% of true value	For samples with concentrations of Al, Ca, Fe, and Mg comparable or > the levels found in the ICS apply the following; If the ICS recovery is > 120%, qualify positive values as J and no action is taken for non-detected values. If the ICS recovery is 50-79% qualify positive values as J, and non-detected values as UJ. If the ICS recovery is < 50%, qualify all affected data as R for that analyte.
Method blank	One per analytical batch, per matrix	No analytes detected > PQL	Apply U to all contaminant analyte results detected at <5X the amount found in highest blank for all samples in the associated analytical batch. The reviewer will consider blank detected values > MDL < PQL during level III qualification.
Additional blank samples (field blank, equipment blank)	As defined in the QAPP	No analytes detected > PQL	Apply U to all contaminant analyte results detected at <5X the amount found in highest blank for all samples associated with the contaminated blank. The reviewer will consider blank detected values > MDL < PQL during level III qualification.

TABLE 4.7
Data Evaluation Summary For USEPA Methods 200.7, 200.9, 206.2, 213.2, 239.2, 245.1, 270.2, and 272.2, Metals Analyzed as Wastewater
APS Quality Assurance Project Plan

QC Check	Minimum Frequency	Acceptance Criteria	Flagging Criteria
Dilution check	As necessary, for each new and unusual matrix	≤ ±10% of original determination; criteria apply only when the concentration is at least a factor of 10 above the instrument detection limit (IDL) after dilution; otherwise perform post-digestion spike instead of dilution check.	When the dilution check is > ±10% of original determination, qualify positive values as J or perform the method of standard additions (MSA)
Post-digestion spike	In lieu of dilution check when the sample concentration is not high enough	Within ± 25% recovery (for ICP) or ± 15% recovery (for non-ICP)	If recovery is not within 75-125% (for ICP) or not within 85-115% (non-ICP), qualify positive results J, or perform MSA. If recovery is less than 75% (ICP) or less than 85% (non-ICP), qualify non-detected analytes UJ, or perform MSA.
Method of Standard Additions (MSA)	As necessary, or in lieu of the dilution check or post-digestion spike, or if dilution check or post-digestion spike fails	For multi-point MSA the correlation coefficient (r) > 0.995.	If the r value is < 0.995 qualify the associated results as J. Professional judgment should be used to qualify any result as R.
LCS for all analytes specified in Table 3.6.	One LCS sample per every 20 samples per matrix	Meet or exceed QC acceptance criteria as presented in Table 3.6.	Qualify all associated analytical batch results for the specific LCS/LCSD analyte(s) outside the established control limits as follows: If the LCS recovery is > 120%, qualify positive values as J, and no action is taken for non-detected values. If the LCS recovery is 50-79% qualify positive values as J, and non-detected values as UJ. If the LCS is < 50%, qualify positive values J and non-detects R. Qualify positive results J if the RPD is > UCL.

TABLE 4.7

Data Evaluation Summary For USEPA Methods 200.7, 200.9, 206.2, 213.2, 239.2, 245.1, 270.2, and 272.2, Metals Analyzed as Wastewater

APS Quality Assurance Project Plan

QC Check	Minimum Frequency	Acceptance Criteria	Flagging Criteria
MS/MSD	One MS/MSD sample pair per every 20 samples per matrix	Meet or exceed QC acceptance criteria as presented in Table 3.6. QC criteria does not apply if sample concentration exceeds the spike concentration by 4X	Qualify all associated analytical batch results for the specific MS/MSD analyte(s) outside the established control limits as follows: If the MS or MSD recovery is <LCL or >UCL, qualify positive values as J. If the MS or MSD recovery is < LCL, qualify non-detected values as UJ. If the MS or MSD recovery is < 50% qualify non-detected values as R. Apply qualifiers UJ and J when % RPD value exceeds the established control limit.
Field duplicate comparison	One duplicate pair per sampling event	Per Section 7.4.2.4	If the criteria specified in Section 7.4.2.4 are not met, qualify the primary and field duplicate sample only as J for detected values and UJ for non-detected values.
Results reported between MDL and PQL	none	Data values will **not** be reported below the PQLs presented in Table 3.6.	The lab report will be amended and resubmitted.

Notes:

U- not detected

UJ- estimated, not detected

J- estimated, detected

R-unusable, rejected

MDL-method detection limit

PQL-practical quantitation limit

%R-percent recovery

RPD-relative percent difference

ICB-initial calibration blank

ICV-initial calibration verification

CCB-continuing calibration blank

CCV-continuing calibration verification

LCS/LCSD-lab control sample/ lab control sample duplicate

MS/MSD-matrix spike/matrix spike duplicate

The method requires a LCS; there are instances when the laboratory does not have sufficient sample volume to perform MS/MSD analyses and will report an LCS/LCSD for the batch.

TABLE 4.8

Data Evaluation Summary For USEPA Method 6010C, Metals Analyzed by ICP

APS Quality Assurance Project Plan

QC Check	Minimum Frequency	Acceptance Criteria	Flagging Criteria
Hold Time	All field samples and the associated field QC	Table 3.9 – Solid Table 3.10 - Aqueous	If the technical hold time (HT) and preservation requirements are not met, qualify detected values J and non- detected values UJ. If the proper preservation is exceeded by twice that specified qualify detected values as J and non-detected values as R.
Initial calibration (Minimum of blank plus one standard)	Daily, before sample analysis	Correlation coefficient ≥ 0.995 when a multi-point calibration is used	Analytes with a r < 0.995 will be qualified as J for detected values and R for non-detected values.
Calibration verification	Daily, ICB and ICV following initial calibration. CCB and CCV once every ten samples and a CCV at the end of run	ICV; within ≤ ± 10%R CCV; within ≤ ± 10%R ICB and CCB < MDL	ICV/CCV recoveries <90% or >110%, qualify positive results J. ICV/CCV recovery is 75-90%, qualify non-detected analytes UJ. ICV/CCV recovery is <75%, qualify non-detected analytes R. ICB and CCB values > MDL will be qualified as described in the method blank section below.
Method blank	One per analytical batch, per matrix	No analytes detected > PQL	Apply U to all contaminant analyte results detected at <5X the amount found in highest blank for all samples in the associated analytical batch. The reviewer will consider blank detected values > MDL < PQL during level III qualification.
Additional blank samples (field blank, equipment blank)	As defined in the QAPP	No analytes detected > PQL	Apply U to all contaminant analyte results detected at <5X the amount found in highest blank for all samples associated with the contaminated blank. The reviewer will consider blank detected values > MDL < PQL during level III qualification.
Interference check sample	Beginning of each run	≤ ±20% of true value	For samples with concentrations of Al, Ca, Fe, and Mg comparable or > the levels found in the ICS apply the following; If the ICS recovery is> 120%, qualify positive values as J and no action is taken for non-detected values.

TABLE 4.8

Data Evaluation Summary For USEPA Method 6010C, Metals Analyzed by ICP

APS Quality Assurance Project Plan

QC Check	Minimum Frequency	Acceptance Criteria	Flagging Criteria
			If the ICS recovery is 50-79%, qualify positive values as J, and non-detected values as UJ. If the ICS recovery is < 50%, qualify all affected data as R for that analyte.
Dilution check	As necessary, for each new and unusual matrix	< ±10% of original determination; criteria apply only when the concentration is at least a factor of 10 above the instrument detection limit (IDL) after dilution; otherwise perform post-digestion spike instead of dilution check.	> ±10% of original determination, qualify result as J or perform the method of standard additions (MSA)
Post digestion spike	In lieu of dilution check when the sample concentration is not high enough	Within ±25% of known value	If recovery is not within 75-125%,, qualify positive results J, or perform MSA. If recovery is less than 75%, qualify non-detected analytes UJ, or perform MSA.
Method of standard additions (MSA)	As necessary , or in lieu of the dilution check or post-digestion spike, or if dilution check or post-digestion spike fails	For multi-point MSA the correlation coefficient (r) > 0.995.	If the r value is < 0.995 qualify the associated results as estimated J. Professional judgment should be used to qualify any result as R.
LCS for all analytes specified in Tables 3.5 through 3.6.	One LCS sample per every 20 samples per matrix	Meet or exceed QC acceptance criteria as presented in Tables 3.5 through 3.6.	Qualify all associated analytical batch results for the specific LCS/LCSD analyte(s) outside the established control limits as follows: If the LCS recovery is > 120%, qualify positive values as J, and no action is taken for non-detected values. If the LCS recovery is 50-79% qualify positive values as J, and non-detected values as UJ. If the LCS recovery is < 50%, qualify positive values J and non-detects R.

TABLE 4.8

Data Evaluation Summary For USEPA Method 6010C, Metals Analyzed by ICP

APS Quality Assurance Project Plan

QC Check	Minimum Frequency	Acceptance Criteria	Flagging Criteria
			Qualify positive results J if the RPD is > UCL.
MS/MSD	One MS/MSD sample pair per every 20 samples per matrix	Meet or exceed QC acceptance criteria as presented in Tables 3.5 through 3.6. QC criteria does not apply if sample concentration exceeds the spike concentration by 4X.	Qualify all associated analytical batch results for the specific MS/MSD analyte(s) outside the established control limits as follows: If the MS or MSD recovery is <LCL or >UCL, qualify positive values as J. If the MS or MSD recovery is < LCL, qualify non-detected values as UJ. When the MS or MSD recovery is < 50% qualify non-detected values as R. Apply qualifiers UJ and J when % RPD value exceeds the established control limit.
Field duplicate comparison	One duplicate pair per sampling event	Per Section 7.4.2.4	If the criteria specified in Section 7.4.2.4 are not met, qualify the primary and field duplicate sample only as J for detected values and UJ for non- detected values.
Results reported between MDL and PQL	none	Data values will **not** be reported below the PQLs presented in Tables 3.5 through 3.6	The lab report will be amended and resubmitted.

Notes:

U- not detected	MDL-method detection limit	ICB-initial calibration blank	LCS/LCSD-lab control sample/lab control sample duplicate
UJ- estimated, not detected	PQL-practical quantitation limit	ICV-initial calibration verification	
J- estimated, detected	%R-percent recovery	CCB-continuing calibration blank	MS/MSD-matrix spike/matrix spike duplicate
R-unusable, rejected	RPD-relative percent difference	CCV-continuing calibration verification	

The method requires a LCS; there are instances when the laboratory does not have sufficient sample volume to perform MS/MSD analyses and will report an LCS/LCSD for the batch.

TABLE 4.9
Data Evaluation Summary For USEPA Methods 7470A/7471B, Mercury Analyzed by Cold Vapor AA
APS Quality Assurance Project Plan

QC Check	Minimum Frequency	Acceptance Criteria	Flagging Criteria
Hold Time	All field samples and the associated field QC	Table 3.9 – Solid Table 3.10 – Aqueous	If the technical hold time (HT) and preservation requirements are not met, qualify detected values J and non-detected values UJ. If the proper preservation is exceeded by twice that specified qualify detected values as J and non-detected values as R.
Initial calibration (Minimum of a blank and 3 standards)	Daily, before sample analysis	Correlation coefficient ≥ 0.995	Analytes with a r < 0.995 will be qualified as J for detected values and R for non-detected values.
Calibration verification (second source standard)	Immediately following initial calibration	ICV; within ≤ ±10%R CCB < MDL	ICV/CCV recoveries <90% or >110%, qualify positive results J. ICV/CCV recovery is 75-90%, qualify non-detected analytes UJ. ICV/CCV recovery is <75%, qualify non-detected analytes R. CCB values > MDL will be qualified as described in the method blank section below.
Continuing Calibration verification	CCV once every ten samples and at the end of run	Reference standard must be ≤ ±20%R	If CCV recovery is <80% or >120%, qualify positive results J. If CCV recovery is 50-79%R, qualify non-detected analytes UJ. When the CCV recovery is <50%R, qualify non-detected analytes R.
Method blank	One per analytical batch, per matrix	No analytes detected > PQL	Apply U to all contaminant analyte results detected at <5X the amount found in highest blank for all samples in the associated analytical batch. The reviewer will consider blank detected values > MDL < PQL during level III qualification.
Additional blank samples (field blank, equipment blank)	As defined in the QAPP	No analytes detected > PQL	Apply U to all contaminant analyte results detected at <5X the amount found in highest blank for all samples in the associated analytical batch. The reviewer will consider blank detected values > MDL < PQL during level III qualification.
Dilution check	As necessary, for each new and unusual matrix	≤ ±10% of original determination; criteria apply only when the	> ±10% of original determination, qualify result as J, or perform the method of standard additions (MSA)

TABLE 4.9

Data Evaluation Summary For USEPA Methods 7470A/7471B, Mercury Analyzed by Cold Vapor AA

APS Quality Assurance Project Plan

QC Check	Minimum Frequency	Acceptance Criteria	Flagging Criteria
		concentration is at least a factor of 10 above the instrument detection limit (IDL) after dilution; otherwise perform post-digestion spike instead of dilution check.	
Post-digestion spike	In lieu of dilution check when the sample concentration is not high enough	Within ± 15% recovery	If recovery is not within 85-115%, qualify positive results J, or perform MSA. If recovery is less than 85%, qualify non-detected analytes UJ, or perform MSA.
Method of standard additions (MSA)	As necessary, in lieu of the dilution check or post-digestion spike, or if dilution check or post-digestion spike fails	For multi-point MSA the correlation coefficient (r) ≥ 0.995.	If the r value is < 0.995 qualify the associated results as estimated J. Professional judgment should be used to qualify any result as R.
LCS for all analytes specified in Tables 3.5 and 3.6	One LCS sample per every 20 samples per matrix	Meet or exceed QC acceptance criteria as presented in Tables 3.5 and 3.6.	Qualify all associated analytical batch results for the specific LCS/LCSD analyte(s) outside the established control limits as follows: If the LCS is > 120% R, qualify positive values as J, and no action is taken for non-detected values. If the LCS is 50-79%R qualify positive values as J, and non-detected values as UJ. If the LCS is < 50%, qualify all affected data as R. Qualify positive results J if the RPD is > UCL.
MS/MSD	One MS/MSD sample pair per every 20 samples per matrix	Meet or exceed QC acceptance criteria as presented in Tables 3.5 through 3.6. QC criteria does not apply if sample concentration exceeds the spike concentration by 4X.	If the MS or MSD recovery is >UCL or <LCL, qualify positive results J. Qualify non-detected analytes UJ if the MS or MSD recovery is <LCL. Qualify positive Results J if the RPD is >UCL.
Field duplicate comparison	One duplicate pair per sampling event	Per section 7.4.2.4	If the criteria specified in Section 7.4.2.4 are not met, qualify the primary and field duplicate sample only as J for detected values and UJ

TABLE 4.9

Data Evaluation Summary For USEPA Methods 7470A/7471B, Mercury Analyzed by Cold Vapor AA

APS Quality Assurance Project Plan

QC Check	Minimum Frequency	Acceptance Criteria	Flagging Criteria
			for non-detected values.
Results reported between MDL and PQL	none	Data values will **not** be reported below the PQLs presented in Tables 3.5 and 3.6.	The lab report will be amended and resubmitted.

Notes:

U- not detected

UJ- estimated, not detected

J- estimated, detected

R-unusable, rejected

MDL-method detection limit

PQL-practical quantitation limit

%R-percent recovery

RPD-relative percent difference

ICB-initial calibration blank

ICV-initial calibration verification

CCB-continuing calibration blank

CCV-continuing calibration verification

LCS/LCSD-lab control sample/lab control sample duplicate

MS/MSD-matrix spike/matrix spike duplicate

The method requires a LCS; there are instances when the laboratory does not have sufficient sample volume to perform MS/MSD analyses and will report an LCS/LCSD for the batch.

TABLE 4.10

Data Evaluation Summary for Standard Methods SM4500-CN-E or USEPA 9014 (total cyanide), SM4500-CN-G (amenable cyanide)[1] and SM4500-CN-I (WAD cyanide), Cyanide Analysis

APS Quality Assurance Project Plan

QC Check	Minimum Frequency	Acceptance Criteria	Flagging Criteria
Hold Time	All field samples and the associated field QC	Table 3.10 - Aqueous	If the technical hold time (HT) and preservation requirements are not met, qualify detected values J and non-detected values UJ. If the proper preservation is exceeded by twice that specified qualify detected values as J and non-detected values as R.
Initial calibration (5 point; blank plus 4 standards)	Daily, before sample analysis	Correlation coefficient ≥ 0.995	Analytes with a r < 0.995 will be qualified as J for detected values and R for non-detected values.
Continuing Calibration verification	CCV once every ten samples and at the end of run	CCV must be ≤ ±20%R	If CCV recovery is <80% or >120%, qualify positive results J. If CCV recovery is 50-79%, qualify non-detected analytes UJ. When the CCV recovery is <50%, qualify non-detected analytes R.
Method blank	One per analytical batch, per matrix	No analytes detected > PQL	Apply U to all contaminant analyte results detected at <5X the amount found in highest blank for all samples in the associated analytical batch. The reviewer will consider blank detected values > MDL < PQL during level III qualification.
Additional blank samples (field blank, equipment blank)	As defined in the QAPP	No analytes detected > PQL	Apply U to all contaminant analyte results detected at <5X the amount found in highest blank for all samples associated with the contaminated blank. The reviewer will consider blank detected values > MDL < PQL during level III qualification.
LCS for all analytes specified in Table 3.6.	One LCS sample per every 20 samples per matrix	Meet or exceed QC acceptance criteria as presented in Table 3.6.	Qualify all associated analytical batch results for the specific LCS/LCSD analyte(s) outside the established control limits as follows: If the LCS recovery is <90% or > 110%, qualify positive values J. If the LCS recovery is 50-89%, qualify non-detected values as UJ. When the LCS recovery is < 50% qualify non-detected values as R. When RPD is > UCL, qualify positive results J.

TABLE 4.10
Data Evaluation Summary for Standard Methods SM4500-CN-E or USEPA 9014 (total cyanide), SM4500-CN-G (amenable cyanide)[1] and SM4500-CN-I (WAD cyanide), Cyanide Analysis

APS Quality Assurance Project Plan

QC Check	Minimum Frequency	Acceptance Criteria	Flagging Criteria
MS/MSD	One MS/MSD sample pair per every 20 samples per matrix	Meet or exceed QC acceptance criteria as presented in Table 3.6.	If the MS or MSD recovery is <LCL or >UCL, qualify positive values as J. If the MS or MSD recovery is < LCL, qualify non-detected values as UJ. When the MS or MSD recovery is < 50% qualify non-detected values as R. Apply qualifiers UJ and J when % RPD value exceeds the established control limit. When RPD is > UCL, qualify positive results J.
Field duplicate comparison	One duplicate pair per sampling event	Per Section 7.4.2.4	If the criteria specified in Section 7.4.2.4 are not met, qualify the primary and field duplicate sample only as J for detected values and UJ for non-detected values.
Results reported between MDL and PQL	none	Data values will **not** be reported below the PQLs presented in Table 3.6.	The lab report will be amended and resubmitted.

Notes:

[1] Interference resulting from chlorination may lead to negative results for cyanides amenable to chlorination. When this occurs, the method recommends using method SM4500-CN-I. The laboratory must report both values.

U- not detected
UJ- estimated, not detected
J- estimated, detected
R-unusable, rejected
MDL-method detection limit
PQL-practical quantitation limit
%R-percent recovery
RPD-relative percent difference
ICB-initial calibration blank
CCB-continuing calibration blank
CCV-continuing calibration verification
LCS/LCSD-lab control sample/ lab control sample duplicate
MS/MSD-matrix spike/matrix spike duplicate

The method requires a LCS; there are instances when the laboratory does not have sufficient sample volume to perform MS/MSD analyses and will report an LCS/LCSD for the batch.

TABLE 4.11

Data Evaluation Summary For Standard Method SM4500-NO_3 (nitrate/nitrite), and EPA Methods 350.3 (ammonia), 353.2 (nitrate/nitrite), and 300.0 (nitrate and nitrite)

APS Quality Assurance Project Plan

QC Check	Minimum Frequency	Acceptance Criteria	Flagging Criteria
Hold Time	All field samples and the associated field QC	Table 3.10 – Aqueous	If the technical hold time (HT) and preservation requirements are not met, qualify detected values J and non-detected values UJ. If the proper preservation is exceeded by twice that specified qualify detected values as J and non-detected values as R.
Initial calibration (5point; blank plus 4 standards)	Daily, before sample analysis	Correlation coefficient > 0.995	Analytes with a r < 0.995 will be qualified as J for detected values and R for non-detected values.
Continuing Calibration verification	CCV once every ten samples and at the end of run	CCV < ±20%R	If CCV recovery is <80% or >120%, qualify positive results J. If CCV recovery is 50-79%, qualify non-detected analytes UJ. When the CCV recovery is <50%, qualify non-detected analytes R.
Method blank	One per analytical batch, per matrix	No analytes detected > PQL	Apply U to all contaminant analyte results detected at <5X the amount found in highest blank for all samples in the associated analytical batch. The reviewer will consider blank detected values > MDL < PQL during level III qualification.
Additional blank samples (field blank, equipment blank)	As defined in the QAPP	No analytes detected > PQL	Apply U to all contaminant analyte results detected at <5X the amount found in highest blank for all samples e associated with the contaminated blank. The reviewer will consider blank detected values > MDL < PQL during level III qualification.
LCS for all analytes specified in Tables 3.6	One LCS sample per every 20 samples per matrix	Meet or exceed QC acceptance criteria as presented in Table 3.6 (80-120% Rec)	Qualify all associated analytical batch results for the specific LCS/LCSD analyte(s) outside the established control limits as follows: If the LCS recovery is > 120%, qualify positive values as J, and no action is taken for non-detected values. If the LCS recovery is 50-79% qualify positive values as J, and non-detected values as UJ. If the LCS recovery is < 50%, qualify positive values J and the non-detects R. Qualify positive results J if the RPD is > UCL.

TABLE 4.11
Data Evaluation Summary For Standard Method SM4500-NO_3 (nitrate/nitrite), and EPA Methods 350.3 (ammonia), 353.2 (nitrate/nitrite), and 300.0 (nitrate and nitrite)
APS Quality Assurance Project Plan

QC Check	Minimum Frequency	Acceptance Criteria	Flagging Criteria
Field duplicate comparison	One duplicate pair per sampling event	Per Section 7.4.2.4	If the criteria specified in Section 7.4.2.4 are not met, qualify the primary and field duplicate sample only as J for detected values and UJ for non-detected values.
Results reported between MDL and PQL	none	Data values will **not** be reported below the PQLs presented in Table 3.6.	The lab report will be amended and resubmitted.

Notes:

U- not detected	MDL-method detection limit	ICB-initial calibration blank	LCS/LCSD-lab control sample/ lab control sample duplicate
UJ- estimated, not detected	PQL-practical quantitation limit	CCB-continuing calibration blank	
J- estimated, detected	%R-percent recovery	CCV-continuing calibration verification	MS/MSD-matrix spike/matrix spike duplicate
R-unusable, rejected	RPD-relative percent difference		

The method requires a LCS; there are instances when the laboratory does not have sufficient sample volume to perform MS/MSD analyses and will report an LCS/LCSD for the batch.

TABLE 4.12
Data Evaluation Summary For Air and Soil Vapor Parameters By Methods TO-15 or 8260B (VOCs), NIOSH 1501 (VOCs), and TO-13A (PAH) by HPLC
APS Quality Assurance Project Plan

QC Check	Minimum Frequency	Acceptance Criteria	Flagging Criteria
Hold Time	All field samples and the associated field QC	Table 3.11 – Air and Soil Vapor	TO-13A by HPLC - If the technical hold time (HT) exceeds 7 days but not more than 20 days qualify detected values J and non-detected values UJ. If the HT exceeds 20 days, qualify detected values as J and non-detected values as R. TO-15 and NIOSH 1501 - If the technical hold time (HT) requirements are not met, qualify detected values J and non-detected values UJ. If the HT exceeds 2 times that specified qualify detected values as J and non-detected values as R.
Five-point initial calibration for all analytes	8260B and TO-15 by GC/MS Initial calibration Prior to sample analysis	The RRT of each analyte at each calibration level within 0.06 RRT units of the average RRT. ≤30%RSD for each analyte.	If %RSD > than the criteria specified, qualify positive results J, and non-detects UJ. If the RRT criterion is not met, the reviewer may consider partial or total rejection of the associated sample results. The chromatographic profile for each sample must be examined to determine if false positives or negatives exist.
	NIOSH 1501 by GC/FID Initial calibration prior to sample analysis, every three months or after instrument changes	Correlation coefficient (r) ≥0.990, or %RSD ≤ 20%	If the correlation coefficient is < 0.990, qualify positive values J, and non-detected values R. If the %RSD >20%, qualify positive values J, and non-detects UJ. Non-detected values with a %RSD > 35 % will be qualified R.
	TO-13A by HPLC Initial calibration prior to sample analysis, after instrument changes, or when calibration verification fails.	Correlation coefficient or coefficient of determination (r) ≥0.990 (if using calibration curves) or %RSD ≤ 20% (if using average RRF). Both detectors must pass calibration requirements.	If using calibration curves and correlation coefficient or coefficient of determination is < 0.990, qualify positive values J, and non-detects R If using average RF and %RSD >20%, qualify positive values J, and non- detects UJ. If the %RSD > 35 % qualify non-detects R.
Calibration verification	8260B and TO-15 by GC/MS Daily, before sample analysis, and every 12 hours of analysis time.	≤ ±30%D for all analytes reported.	If %D> ±30%, qualify positive results J and non-detects UJ

TABLE 4.12
Data Evaluation Summary For Air and Soil Vapor Parameters By Methods TO-15 or 8260B (VOCs), NIOSH 1501 (VOCs), and TO-13A (PAH) by HPLC
APS Quality Assurance Project Plan

QC Check	Minimum Frequency	Acceptance Criteria	Flagging Criteria
	NIOSH 1501 by GC/FID Initially to verify the curve, and one as a closing standard.	≤±20%D for all analytes	%D outside of the ± 20%, qualify positive results J and non-detects UJ.
	TO-13A by HPLC Daily, at beginning of sequence and every 12 hours of analysis time.	≤±15%D (using average RF) or %Drift (using calibration curves) for all analytes	If %D or %Drift is > ±15%, qualify positive results J. If the %D or %Drift is > ±15%, qualify non-detects UJ.
Instrument tune mass spectral ion intensities of BFB	8260B and TO-15 by GC/MS Every 12 hours during which analysis is performed.	Refer to Method TO-15	Qualify all of the associated results of a failed tune R.
Internal standards	8260B and TO-15 by GC/MS Every sample, spiked sample, standard, and method blank.	Retention time ±20 seconds: EICP area within -40% to +40% of last calibration verification (12 hours)	If the EICP area is >140%, (TO-15), or <50% of the last calibration verification standard, qualify positive results J. If the EICP area >30% but <60% qualify non-detects UJ. If the EICP area is <30% (TO-15) non-detects will be qualified R.
Method blank	One per analytical batch, per matrix.	No analytes detected > PQL	Apply U to all contaminant compound results detected at <5X the amount found in highest blank, and <10X the amount in blank if a common laboratory contaminant is detected (methylene chloride, acetone, toluene, or 2-butanone), for all samples in the associated analytical batch. The reviewer will consider blank detected values > MDL < PQL during level III qualification.

TABLE 4.12

Data Evaluation Summary For Air and Soil Vapor Parameters By Methods TO-15 or 8260B (VOCs), NIOSH 1501 (VOCs), and TO-13A (PAH) by HPLC

APS Quality Assurance Project Plan

QC Check	Minimum Frequency	Acceptance Criteria	Flagging Criteria
LCS	One LCS sample per every 20 samples per matrix	Meet acceptance criteria presented in Table 3.7 and 3.8.	Batch qualification will be applied as follows: %R for LCS/LCSD >UCL qualify positive values as J. %R for LCS/LCSD <LCL qualify positive values as J and non-detected values as UJ. If the %R is < 10% qualify positive values as J and non-detected values as R. Qualify positive results J if the RPD is > UCL. Use professional judgment for analytes other than spiking analytes.
Matrix spike	NIOSH 1501 and TO-13A One MS sample per every 20 samples per matrix	Meet or exceed QC acceptance criteria or as presented in Tables 3.7 and 3.8	If the MS recovery is >UCL or <LCL, qualify positive results J. Qualify non-detected analytes UJ if the MS recovery is <LCL. Qualify positive results J if the RPD is >UCL.
Surrogate spike	Only required for TO-13A Every sample, spiked sample, standard, and method blank	Between 75-125% recovery.	For all analyte(s) in the affected sample, apply J for detected compounds if surrogate %R is > UCL, or < LCL. Apply UJ for non-detects if surrogate %R is < LCL, and apply R for non-detects if surrogate %R is <10%.
Field duplicate comparison	One duplicate pair per sampling event	Per Section 7.4.2.4	If the criteria specified in Section 7.4.2.4 are not met, qualify the primary and field duplicate sample only as J for detected values and UJ for non-detected values.
Results reported between MDL and PQL	None	Data values will not be reported below the PQLs presented in Table 3.7 and 3.8.	The lab report will be amended and resubmitted.

TABLE 4.12
Data Evaluation Summary For Air and Soil Vapor Parameters By Methods TO-15 or 8260B (VOCs), NIOSH 1501 (VOCs), and TO-13A (PAH) by HPLC
APS Quality Assurance Project Plan

Notes:

U- not detected
UJ- estimated, not detected
J- estimated, detected
R-unusable, rejected
QC-quality control
RPD-relative percent difference
%D-percent difference
%RSD-percent relative standard deviation
%R-percent recovery
MDL-method detection limit
PQL-practical quantitation limit
RRF-relative response factor
RF-response factor
BFB- bromofluorobenzene
DFTPP- decafluortriphenylphosphine
UCL-upper control limit
LCL-lower control limit

The method requires a LCS; there are instances when the laboratory does not have sufficient sample volume to perform MS/MSD analyses and will report an LCS/LCSD for the batch.

TABLE 4.13

Data Evaluation Summary For Air Parameters by NIOSH 7300 (Lead). Analyzed by ICP Method 6010C

APS Quality Assurance Project Plan

QC Check	Minimum Frequency	Acceptance Criteria	Flagging Criteria
Hold Time	All field samples and the associated field QC	Table 3.11 - Air	If the technical hold time (HT) and preservation requirements are not met, qualify detected values J and non-detected values UJ. If the HT is exceeded by half the HT specified, qualify detected values as J and non-detected values as R.
Initial calibration (Minimum of one acid blank plus one standard)	Daily, before sample analysis	Correlation coefficient ≥ 0.995 when a multi-point calibration is used	Analytes with a r < 0.995 will be qualified as J for detected values and R for non-detected values.
Calibration verification	Daily, ICB and ICV following initial calibration. CCB and CCV once every ten samples and a CCV at the end of run	ICV; within ≤ ± 10%R CCV; within ≤ ± 10%R ICB and CCB < PQL	ICV/CCV recoveries <90% or >110%, qualify positive results J. ICV/CCV recovery is 75-90%, qualify non-detected analytes UJ. ICV/CCV recovery is <75%, qualify non-detected analytes R. ICB and CCB values > MDL will be qualified as described in the method blank section below.
Method blank	One per analytical batch, per matrix	No analytes detected > PQL	Apply U to all contaminant analyte results detected at <5X the amount found in highest blank for all samples in the associated analytical batch. The reviewer will consider blank detected values > MDL < PQL during qualification.
Additional blank samples (field blank, equipment blank)	As defined in the QAPP	No analytes detected > PQL	Apply U to all contaminant analyte results detected at <5X the amount found in highest blank for all samples associated with the contaminated blank. The reviewer will consider blank detected values > MDL < PQL during qualification.
Interference check sample	Beginning of each run	≤ ±20% of true value	For samples with concentrations of Al, Ca, Fe, and Mg comparable or > the levels found in the ICS apply the following; If the ICS recovery is > 120%, qualify positive values as J and no action is taken for non-detected values. If the ICS recovery is ICS 50-79% qualify positive values as J, and non-detected values as UJ. If the ICS recovery is < 50%, qualify all

TABLE 4.13

Data Evaluation Summary For Air Parameters by NIOSH 7300 (Lead). Analyzed by ICP Method 6010C

APS Quality Assurance Project Plan

QC Check	Minimum Frequency	Acceptance Criteria	Flagging Criteria
			affected data as R for that analyte.
Dilution check	As necessary, for each new and unusual matrix	< ±10% of original determination; criteria apply only when the concentration is at least a factor of 10 above the instrument detection limit (IDL) after dilution; otherwise perform post-digestion spike instead of dilution check.	> ±10% of original determination, qualify result as J or perform the method of standard additions (MSA)
Post digestion spike	In lieu of dilution check when the sample concentration is not high enough	Within ±25% of known value	If recovery is not within 75-125%, qualify positive results J, or perform MSA. If recovery is less than 75%, qualify non-detected analytes UJ, or perform MSA.
Laboratory Control Sample	One LCS sample per every 10 samples per matrix	Meet or exceed QC acceptance criteria as presented in Tables 3.7 through 3.8.	Qualify all associated analytical batch results for the specific LCS/LCSD analyte(s) outside the established control limits as follows: If the LCS recovery is > 120%, qualify positive values as J, and no action is taken for non-detected values. If the LCS recovery is 50-79% qualify positive values as J, and non-detected values as UJ. If the LCS recovery is < 50%, qualify positive values J and non-detects R. Qualify positive results J if the RPD is > UCL.
Matrix Spike	One MS sample per every 10 samples per matrix	Meet or exceed QC acceptance criteria as presented in Tables 3.7 through 3.8. QC criteria does not apply if sample concentration exceeds the spike concentration by 4X.	Qualify all associated analytical batch results for the specific MS analyte(s) outside the established control limits as follows: If the MS recovery is <LCL or >UCL, qualify positive values as J. If the MS recovery is < LCL, qualify non-detected values as UJ. If the MS recovery is < 50% qualify non detected values as R.
Field duplicate comparison	One duplicate pair per sampling event	Per Section 7.4.2.4.	If the criteria specified in Section 7.4.2.4 are not met, qualify the primary and field duplicate sample only as J for detected

TABLE 4.13

Data Evaluation Summary For Air Parameters by NIOSH 7300 (Lead). Analyzed by ICP Method 6010C

APS Quality Assurance Project Plan

QC Check	Minimum Frequency	Acceptance Criteria	Flagging Criteria
			values and UJ for non-detected values.
Results reported between MDL and PQL	none	Data values will **not** be reported below the PQLs presented in Tables 3.7 and 3.8.	The lab report will be amended and resubmitted.

Notes:

U- not detected	MDL-method detection limit	ICB-initial calibration blank	LCS/LCSD-lab control sample/lab control sample duplicate
UJ- estimated, not detected	PQL-practical quantitation limit	ICV-initial calibration verification	
J- estimated, detected	%R-percent recovery	CCB-continuing calibration blank	MS/MSD-matrix spike/matrix spike duplicate
R-unusable, rejected	RPD-relative percent difference	CCV-continuing calibration verification	

TABLE 4.14
Data Evaluation Summary For Soil Vapor By USEPA Method 3C
APS Quality Assurance Project Plan

QC Check	Minimum Frequency	Acceptance Criteria	Flagging Criteria
Hold Time	All field samples and the associated field QC	Table 3.11 – Soil Vapor	If the technical hold time (HT) requirement is not met, qualify detects J and non-detects UJ. If the HT is exceeded by twice that specified qualify detects J and non-detects R.
Five-point initial calibration for all analytes	Initial calibration prior to sample analysis, when calibration verification fails, or after instrument changes	Correlation coefficient (r) ≥0.990, or %RSD ≤ 20% (if using average RRF).	If the correlation coefficient is < 0.990, qualify positive results J, and non-detects R. If the %RSD is >20%, qualify positive results J, and non-detects UJ. If the %RSD is > 35 % non-detects will be qualified R.
Calibration verification	Daily, at beginning of sequence and every 12 hours of analysis time.	≤±15%D (using average RF) or %Drift (using calibration curves) for all analytes	If %D or %Drift is > ±15%, qualify positive results J. If the %D or %Drift is > +15%, qualify non-detects UJ.
Method blank	One per analytical batch, per matrix	No analytes detected > PQL	Apply U to all results <5X the amount found in highest blank for all samples in the associated analytical batch. The reviewer will consider blank detected values > MDL < PQL during level III qualification.
LCS	One LCS sample per every 20 samples per matrix	Meet acceptance criteria presented in Table 3.7 and 3.8.	Batch qualification will be applied as follows: %R for LCS/LCSD >UCL qualify positive results J. %R for LCS/LCSD <LCL qualify positive results J and non-detects UJ. If %R is < 10% qualify positive results J and non-detects R.
Field duplicate comparison	One duplicate pair per sampling event	Per Section 7.4.2.4	If the criteria specified in Section 7.4.2.4 are not met, qualify the primary and field duplicate sample only as J for detected values and UJ for non-detected values.
Duplicate sample injection	Each sample	RPD of duplicate injections >5%	If the RPD is >5%, qualify positive results J; qualify non-detects UJ.
Results reported between MDL and PQL	None	Data values will **not** be reported below the PQLs presented in Table 3-7 and 3-8.	The lab report will be amended and resubmitted.

TABLE 4.14
Data Evaluation Summary For Soil Vapor By USEPA Method 3C
APS Quality Assurance Project Plan

Notes:
U- not detected
UJ- estimated, not detected
J- estimated, detected
R-unusable, rejected
MDL-method detection limit
%D-percent difference
%RSD-percent relative standard deviation
%R-percent recovery
LCL-lower control limit
UCL-upper control limit
QC-quality control
RPD-relative percent difference

TABLE 4.15
Data Evaluation Summary for Hexavalent Chromium by USEPA Method 7196A
APS Quality Assurance Project Plan

QC Check	Minimum Frequency	Acceptance Criteria	Flagging Criteria
Hold Time	All field samples and the associated field QC	Table 3.9 – Soil Table 3.10 - Aqueous	If the technical hold time (HT) and preservation requirements are not met, qualify detects J and non-detects UJ. If the HT is exceeded by twice that specified qualify detects J and non-detects R.
Initial calibration (5 point; blank plus 4 standards)	Daily, before sample analysis	Correlation coefficient $\geq$ 0.995	If r < 0.995 qualify detects J and non-detects R.
Continuing Calibration verification	CCV once every ten samples and at the end of run	CCV must be $\leq$ ±10%R	If CCV recovery is <90% or >110%, qualify positive results J. If CCV recovery is 50-89%, qualify non-detects UJ. If the CCV recovery is <50%, qualify non-detects R.
Method blank	One per analytical batch, per matrix	No analytes detected > PQL	Apply U to all results <5X the amount found in highest blank for all samples in the associated analytical batch. The reviewer will consider blank detected values > MDL < PQL during level III qualification.
Additional blank samples (field blank, equipment blank)	As defined in the QAPP	No analytes detected > PQL	Apply U to all results <5X the amount found in highest blank for all samples in the associated analytical batch. The reviewer will consider blank detected values > MDL < PQL during level III qualification.
LCS for all analytes specified in Table 3.5 and 3.6.	One LCS sample per every 20 samples per matrix	Meet or exceed QC acceptance criteria as presented in Tables 3.5 and 3.6.	Qualify all associated analytical batch results outside the established control limits as follows: If the LCS recovery is <80% or > 120%, qualify positive results J. If the LCS recovery is 50-79% qualify non-detects UJ. If the LCS recovery is < 50%, qualify the non-detects R.
MS/MSD	One MS/MSD sample pair per every 20 samples per matrix	Meet or exceed QC acceptance criteria as presented in Tables 3.5 and 3.6.	If the MS or MSD recovery is >UCL or <LCL, qualify positive results J. Qualify non-detected analytes UJ if the MS or MSD recovery is <LCL. Qualify positive results J if the RPD is >UCL.

TABLE 4.15
Data Evaluation Summary for Hexavalent Chromium by USEPA Method 7196A
APS Quality Assurance Project Plan

QC Check	Minimum Frequency	Acceptance Criteria	Flagging Criteria
Post-Spike Addition	One for every sample matrix analyzed to verify that neither a reducing condition nor chemical interference is affecting color development	85-115%R	If the post-spike recovery is <LCL or >UCL, qualify positive results J. If the post-spike recovery is < LCL, qualify non-detects UJ.
Field duplicate comparison	One duplicate pair per sampling event	Per Section 7.4.2.4.	If the criteria specified in Section 7.4.2.4 are not met, qualify positive results in the primary and field duplicate samples J and the non-detects UJ
Results reported between MDL and PQL	none	Data values will **not** be reported below the PQLs presented in Tables 3.5 and 3.6.	The lab report will be amended and resubmitted.

Notes:

U- not detected
UJ- estimated, not detected
J- estimated, detected
R-unusable, rejected

MDL-method detection limit
PQL-practical quantitation limit
%R-percent recovery
RPD-relative percent difference

ICB-initial calibration blank
CCB-continuing calibration blank
CCV-continuing calibration verification

LCS/LCSD-lab control sample/ lab control sample duplicate
MS/MSD-matrix spike/matrix spike duplicate

The method requires a LCS; there are instances when the laboratory does not have sufficient sample volume to perform MS/MSD analyses and will report an LCS/LCSD for the batch.

TABLE 4.16

Data Evaluation Summary for Hexavalent Chromium by USEPA Method 7199

APS Quality Assurance Project Plan

QC Check	Minimum Frequency	Acceptance Criteria	Flagging Criteria
Hold Time	All field samples and the associated field QC	Table 3.9 – Soil Table 3.10 – Aqueous	If the technical hold time (HT) and preservation requirements are not met, qualify detects J and non-detects UJ. If the HT is exceeded by twice that specified qualify detects J and non-detects R.
Initial calibration (5point; blank plus 4 standards)	Daily, before sample analysis	Correlation coefficient ≥ 0.995	If r < 0.995 qualify detects J and non-detects R.
Continuing Calibration verification	CCV once every ten samples and at the end of run	CCV ≤ ±10%R	If CCV recovery is <90% or >110%, qualify positive results J. If CCV recovery is 50-89%, qualify non-detects UJ. When the CCV recovery is <50%, qualify non-detects R.
ICB and CCB	Before first sample, every ten samples, and at the end of run	No analytes detected > PQL	Apply U to all results <5X the amount found in highest blank for all samples in the associated analytical batch. The reviewer will consider blank detected values > MDL < PQL during level III qualification.
Method blank	One per analytical batch, per matrix	No analytes detected > PQL	Apply U to all results <5X the amount found in highest blank for all samples in the associated analytical batch. The reviewer will consider blank detected values > MDL < PQL during level III qualification.
Additional blank samples (field blank, equipment blank)	As defined in the QAPP	No analytes detected > PQL	Apply U to all results <5X the amount found in highest blank for all samples in the associated analytical batch. The reviewer will consider blank detected values > MDL < PQL during level III qualification.
LCS	One LCS sample per every 20 samples per matrix	Meet or exceed QC acceptance criteria as presented in Tables 3.5 and 3.6	Qualify all associated analytical batch results outside the established control limits as follows: If the LCS recovery is <80% or > 120%, qualify positive results J. If the LCS recovery is 50-79% qualify non-detects UJ. If the LCS recovery is < 50%, qualify the non-detects R.
MS/MSD	One MS/MSD sample pair per every 20 samples per matrix	Meet or exceed QC acceptance criteria as presented in Tables 3.5 and 3.6	If the MS or MSD recovery is >UCL or <LCL, qualify positive results J. Qualify non-detected analytes UJ if the MS or MSD recovery is <LCL. Qualify positive results J if the RPD is >UCL.

TABLE 4.16
Data Evaluation Summary for Hexavalent Chromium by USEPA Method 7199
APS Quality Assurance Project Plan

QC Check	Minimum Frequency	Acceptance Criteria	Flagging Criteria
Field duplicate comparison	One duplicate pair per sampling event	Per Section 7.4.2.4	If the criteria specified in Section 7.4.2.4 are not met, qualify positive results in the primary and field duplicate samples J and the non-detects UJ.
Duplicate sample injection	Each sample	RPD of duplicate injections >20%	If the RPD is >20%, qualify positive results J and the non-detects UJ.
Results reported between MDL and PQL	none	Data values will **not** be reported below the PQLs presented in Tables 3.5 and 3.6.	The lab report will be amended and resubmitted.

Notes:

U- not detected

UJ- estimated, not detected

J- estimated, detected

R-unusable, rejected

MDL-method detection limit

PQL-practical quantitation limit

%R-percent recovery

RPD-relative percent difference

ICB-initial calibration blank

CCB-continuing calibration blank

CCV-continuing calibration verification

LCS/LCSD-lab control sample/ lab control sample duplicate

MS/MSD-matrix spike/matrix spike duplicate

The method requires a LCS; there are instances when the laboratory does not have sufficient sample volume to perform MS/MSD analyses and will report an LCS/LCSD for the batch.

TABLE 4.17
Data Evaluation Summary For Sulfide by USEPA Method 9031/9034
APS Quality Assurance Project Plan

QC Check	Minimum Frequency	Acceptance Criteria	Flagging Criteria
Hold Time	All field samples and the associated field QC	Table 3.9 – Soil Table 3.10 - Aqueous	If the technical hold time (HT) and preservation requirements are not met, qualify detects J and non-detects UJ. If the HT is exceeded by twice that specified qualify detects J and non-detects R.
Method blank	One per analytical batch, per matrix	No analytes detected > PQL	Apply U to all results <5X the amount found in highest blank for all samples in the associated analytical batch. The reviewer will consider blank detected values > MDL < PQL during level III qualification.
LCS for all analytes specified in Table 3.5 and 3.6.	One LCS sample per every 20 samples per matrix	Meet or exceed QC acceptance criteria as presented in Tables 3.5 and 3.6.	Qualify all associated analytical batch results outside the established control limits as follows: If the LCS recovery is <80% or > 120%, qualify positive results J. If the LCS recovery is 50-79% qualify non-detects UJ. If the LCS recovery is < 50%, qualify the non-detects R.
MS/MSD	One MS/MSD sample pair per every 20 samples per matrix	Meet or exceed QC acceptance criteria as presented in Tables 3.5 and 3.6.	If the MS or MSD recovery is >UCL or <LCL, qualify positive results J. Qualify non-detected analytes UJ if the MS or MSD recovery is <LCL. Qualify positive results J if the RPD is >UCL.
Field duplicate comparison	One duplicate pair per sampling event	Per Section 7.4.2.4.	If the criteria specified in Section 7.4.2.4 are not met, qualify positive results in the primary and field duplicate samples J and the non-detects UJ.
Results reported between MDL and PQL	none	Data values will **not** be reported below the PQLs presented in Tables 3.5 and 3.6.	The lab report will be amended and resubmitted.

Notes:

U- not detected	MDL-method detection limit	LCS/LCSD-lab control sample/
UJ- estimated, not detected	PQL-practical quantitation limit	lab control sample duplicate
J- estimated, detected	%R-percent recovery	MS/MSD-matrix spike/matrix spike duplicate
R-unusable, rejected	RPD-relative percent difference	

The method requires a LCS; there are instances when the laboratory does not have sufficient sample volume to perform MS/MSD analyses and will report an LCS/LCSD for the batch.

Appendix A
APS Project Descriptions

Site Name	**West Phoenix Power Plant – ADEQ VRP Site Code No. 070932-00**	**Yucca Power Plant**		**Cholla Power Plant – ADEQ VRP Site Code No. 090050-00, 090050-02, & 090050-03**	
Short Description	Releases of petroleum products are known to have occurred at four separate areas within the West Phoenix Power Plant. Groundwater monitoring is on-going while the extent of petroleum impacted soils is defined. Remedial action will be initiated if appropriate.	Petroleum odors emanating from a cathodic protection anode at the Yucca Power Plant prompted a soil and groundwater investigation which has identified diesel impacted soil and groundwater. Reported concentrations of petroleum-related constituents have not exceeded the AWQS in groundwater nor the residential SRL in soil.		VOCs at concentrations exceeding the AWQS were discovered in groundwater at the Cholla Power Plant during the investigation of an unrelated diesel pipeline release. Investigations to determine the extent and degree of VOC impacted groundwater are on-going. Remedial action will be initiated if appropriate.	
Planned Activities and Objectives	Activities: Groundwater monitoring, soil sampling, soil gas sampling Objectives: Monitor potentially impacted groundwater, investigate extent of petroleum impacted soil, and plan remedial action, if appropriate	Activities: Groundwater monitoring Objectives: Monitor potentially impacted groundwater and plan remedial action, if appropriate		Activities: Groundwater monitoring, monitor well installation Objectives: Define extent of impacted groundwater and plan remedial action, if appropriate	
Site APS PM	Judy Heywood Remediation Project Manager, Environmental Policy & Programs 400 North 5th Street, Phoenix, AZ 85004-3902, Mail Station (MS) 9303 Tel 602 250 3850 Cell 602 818 0259 judith.heywood@aps.com	Judy Heywood Remediation Project Manager, Environmental Policy & Programs 400 North 5th Street, Phoenix, AZ 85004-3902, Mail Station (MS) 9303 Tel 602 250 3850 Cell 602 818 0259 judith.heywood@aps.com		Judy Heywood Remediation Project Manager, Environmental Policy & Programs 400 North 5th Street, Phoenix, AZ 85004-3902, Mail Station (MS) 9303 Tel 602 250 3850 Cell 602 818 0259 judith.heywood@aps.com	
Consultant PM	Jeff Trembly Mogollon Environmental Services LLC 2905 East Flower Street Phoenix, AZ 85016 602-778-6810 jeff@mogollonenv.com	Jeff Trembly Mogollon Environmental Services LLC 2905 East Flower Street Phoenix, AZ 85016 602-778-6810 jeff@mogollonenv.com		Jeff Trembly Mogollon Environmental Services LLC 2905 East Flower Street Phoenix, AZ 85016 602-778-6810 jeff@mogollonenv.com	
Consultant QA Officer with Contact Information	Gail Clement G. M. Clement & Assoc., Inc. 301 Baron Drive Sedona, AZ 86336 928-282-3630 gailclement@earthlink.net	Gail Clement G. M. Clement & Assoc., Inc. 301 Baron Drive Sedona, AZ 86336 928-282-3630 gailclement@earthlink.net		Gail Clement G. M. Clement & Assoc., Inc. 301 Baron Drive Sedona, AZ 86336 928-282-3630 gailclement@earthlink.net	
Analytical Labs with Contact Information	TestAmerica Kylie Emily 4625 E. Cotton Center Blvd., Suite 189 Phoenix, AZ 85040 Tel 602-437-3340 | Dir 602-659-7622 Kylie.emily@testamericainc.com	TestAmerica Kylie Emily 4625 E. Cotton Center Blvd., Suite 189 Phoenix, AZ 85040 Tel 602-437-3340 | Dir 602-659-7622 Kylie.emily@testamericainc.com	Xenco Laboratories Skip Harden 3725 East Atlanta Ave Phoenix AZ 85040 602-437-0330 Skip.harden@xenco.com	TestAmerica Kylie Emily 4625 E. Cotton Center Blvd., Suite 189 Phoenix, AZ 85040 Tel 602-437-3340 | Dir 602-659-7622 Kylie.emily@testamericainc.com	Xenco Laboratories Skip Harden 3725 East Atlanta Ave Phoenix AZ 85040 602-437-0330 Skip.harden@xenco.com
Required Analysis	8260, 8310	8260, 8310, 8015AZ		8260	
QC Levels Required	Level II	Level II		Level II	
Regulatory Agencies	ADEQ VRP	ADEQ		ADEQ VRP	
Regulatory Standards or Limits	AWQS, SRL	AWQS, SRL		AWQS	
Any Special Project QC, Field Measurements, or Regulatory Standards.	NA	NA		NA	

Appendix B

Standard Operating Procedures for Collection of Ambient Air Samples using Summa Canisters, PUF HIVOL or Dawson HIVOL Air Samplers

Standard Operating Procedures for Collection of VOCs in Ambient Air Samples with Summa Canisters

SUMMA Canister Sampling Description

Sample canisters consist of stainless steel that has been treated by the SUMMA passivation process. Valves are fitted with special "valve saver" handles that allow the valve to be closed to a sufficient torque but then slip to prevent over-tightening and damage to the valve.

For time composite samples, a vacuum flow regulator is mounted on the side valve. This regulator is preset at a rate corresponding to the total sample time. Attached to the regulator is a particulate filter to prevent clogging of the fine passages in the vacuum flow regulator.

Canisters are shipped under high vacuum and are leaked checked and batch analyzed for contamination before leaving the laboratory.

Vacuum flow regulators and particulate filters are purged with Ultra High Purity Nitrogen or Air for a minimum of 20 to 30 minutes to ensure that they are clean.

Vacuum Check

Immediately before sampling, the vacuum integrity of all the canisters should be checked. There are two styles of canisters.

"Style A" has a gauge permanently attached to the canister and shows the vacuum of the canister continually. For this style, simply read the already attached gauge before and after sampling. "Style B" has no gauge attached to it. For this style, a separate gauge is included with the shipment for use in checking the canister vacuum. While in a relatively clean atmosphere, remove the dust cap on the top valve (use 9/16 wrench) and attach the supplied gauge to the canister (finger tight plus 1/8 turn with 9/16 wrench). Open the top valve (turn counter clockwise two turns max) and note the gauge reading. Close valve (turn clockwise at least three full turns) and remove gauge. Replace dust cap.

Vacuum should be approximately 30 inches Hg. If vacuum shows less than 28 inches, careful consideration should be performed before use of the canister. Record vacuum on field sample sheet.

Flow Check

To verify correct sample flow, a "practice" (evacuated) canister is used in the sampling system. The flow meter and practice canister are needed. A flow meter is attached to the inlet line, just in front of the filter. The canister is opened. The sampler is turned on and the reading of the bubble meter is compared to the required sample flow rate. The valves should be within ± 10 percent of the desired flow rate. If not, the sampler flow controller needs to be adjusted or there is a leak in the system. This should be investigated and corrected. The flow check should be performed before placing sample canister at sampling location, and initially at the beginning of sample collection, and at the end of the sampling collection period.

Sampling

Start sampling period by opening the side valve on the SUMMA canister with the regulator/filter attached to it (2 turns clockwise max). When sample period is over, close the valve (at least 3 turns clockwise). Canister can then be vacuum checked again to confirm that the equipment functioned properly. (Caution: For Style B canisters, care should be taken not to cross-contaminate samples by using gauge on "clean" or low level samples. The gauge can be rinsed with a clean air or nitrogen source between samples to minimize this problem. The gauge should be used to check the initial vacuum of all canisters before it is used to check the final pressure of any canister – this will avoid contamination).

Final pressures should be between 10 and 5 inches of mercury vacuum. There will likely be some variation in final vacuum reading between cans. This is due to flow rates that change slightly due to rough handling during shipment. This will not affect analytical results in any way. The accuracy of the regulators decrease slightly while sampling between 10 and 5 inches of mercury vacuum, but should still be within ± 10 percent. Record final vacuum readings on the sample sheet and on tags. Replace dust caps and return canister for analysis.

DO NOT ATTACH ADHESIVE LABELS DIRECTLY TO CANISTERS. USE THE TAGS PROVIDED – OR ATTACH LABELS TO THE TAGS PROVIDED.

Sample Canister Integrity

The lab supplying the canisters tracks the integrity of whole air samples in SUMMA passivated canisters by using a canister Chain of Custody (COC) form. This form allows for the tracking of canister vacuum and pressure readings from the lab to the client and back to the lab.

Prior to shipment of canister to the field, the canister vacuum is checked and recorded on the COC form. Once received in the field, the sampling person checks the vacuum of the canister and records it on a log sheet. After sampling, read the vacuum again and record prior to shipment back to the lab. Upon receipt at the lab, the sample receiving person checks and records the canister vacuum or pressure reading and records it on the COC form.

Once the canister COC form is completed, it contains the information needed to assure that the canister did not leak during shipment, prior to and after sampling, and during shipment back to the lab. In this way, the end data user can determine whether the sample integrity has been maintained by reviewing the canister COC form.

Sample Packaging and Shipment

Each collected SUMMA canister (whether for soil gas or ambient air) will be appropriately labeled, packaged along with the appropriate chain of custody forms, and sent to the analytical laboratory with overnight delivery. If possible, this will be done on the same day as sample pick-up, or on the following day at the latest. No special preservatives are required. Custody seals will be placed on each package prior to shipping. No special preservation methods or temperature are required.

Standard Operating Procedure for Collection of PAH Ambient Air Samples with High-Volume Sampler

Sampling System

The sampling pump system consists of a high volume sampler with flow range greater than 20 liters per minute (lpm), pressure transducer recorder to document continuous flow rate, a PUF sample module which includes a TSP (total suspended particulate) filter and holder and a PUF sampling module filtering media. The high volume sampler is housed in an aluminum box structure of approximately four feet in height and 21 inches square. The equipment will require calibration prior to sampling. Dust free sampling gloves, Teflon tipped forceps, and a clean area for sample preparation will be required for sampling.

Calibration

The air flow rate must be verified prior to initiation of the sampling. Calibration is performed by the following (General Metal Works PUF Sampler):

1. Calibration of the PUF Sampler is performed without a foam slug or filter paper in the sampling module. However, the empty glass cartridge must remain in the module to insure a good seal through the module.
2. Install the GMW-40 Calibrator on top of the 4″ filter holder.
3. Connect an 8″ water manometer to the Calibrator.
4. Open the ball valve fully.
5. Turn the system on by tripping the manual switch on the timer. Allow a few minutes to warm-up.
6. Adjust the voltage control screw to obtain a reading of 70 inches on the dial gauge (Magnehelic Gauge).
7. With 70 inches on the dial gage as your first calibration point, record it and the manometer reading on the data sheet.
8. Close the ball valve slightly to readjust the dial gauge down to 60, 50, 40, and 30 inches and record on the data sheet.
9. Using these two sets of readings, plot a curve on the data sheet. This curve will be used to calibrate actual flow rate.
10. Readjust the voltage control fully clockwise to its maximum setting. Open ball valve fully.

Sample Collection

After the sampling system has been assembled and flow checked as described previously, it can be used to collect air samples.

1. The samples should be located in an unobstructed area, at least two meters from any obstacle to air flow. The exhaust hose should be stretched out in the down wind direction to prevent recycling of air into the sample head.
2. With the empty sample module removed from the sampler, rinse all sample contact areas using reagent grade hexane in a Teflon® squeeze bottle. Allow the hexane to evaporate from the module before loading the samples.
3. Detach the lower chamber of the rinsed sampling module. While wearing disposable clean lint-free nylon or powder-free surgical gloves, remove a clean glass cartridge/sorbent from its container (wide mouthed glass jar with a Teflon®-lined lid) and unwrap its aluminum foil covering. The foil should be replaced back in the sample container to be reused after the samples have been collected.
4. Insert the cartridge into the lower chamber and tightly reattach it to the module.
5. Using clean Teflon® tipped forceps, carefully place a clean filter atop the filter holder and secure in place by clamping the filter holder ring over the filter using the three screw clamps. Insure that all module connections are tightly assembled. [Note: Failure to do so could result in air leaks at poorly sealed locations which could affect sample representativeness.] Ideally, sample module loading and unloading would be conducted in a controlled environment or at least a centralized sample processing area so that the sample handling variables can be minimized.
6. With the module removed from the sampler and the flow control valve fully open, turn the pump on and allow it to warm-up for approximately 5 minutes.
7. Install the sampling module after five minutes. Ambient temperature, barometric pressure, sampler serial numbers and filter number are recorded on the Field Test Data Sheet.
8. The start time is recorded. The flow rate has been determined previously during calibration.
9. At the end of the desired sampling period, the power is turned off. Carefully remove the sampling head contain the filter and adsorbent cartridge to a clean area.
10. While wearing disposable lint-free nylon or surgical gloves, remove the sorbent cartridge from the lower module chamber and lay it on the retained aluminum foil in which the sample was originally wrapped.
11. Carefully remove the glass fiber filter from the upper chamber using clean Teflon® tipped forceps.
12. Fold the filter in half twice (sample side inward) and place it in the glass cartridge atop the sorbent.
13. Wrap the combined samples in aluminum foil and place them in their original glass sample container. Chain-of-custody should be maintained for all samples.
14. If conditions warrant, one field filter/adsorbent blank may be returned to the laboratory with each group of samples. A field blank is treated exactly as a sample except that no air is drawn through the filter/adsorbent cartridge assembly.

Sample Preservation & Shipping

The glass containers should be stored in a cool area and protected from light to prevent possible photo-decomposition of collected analytes. If the time span between sample collection and laboratory analysis is to exceed 24 hours, sample must be kept refrigerated. The sample holding time prior to extraction may not exceed 7 days.

Chain-of-custody forms should be sent with the samples to the laboratory. Field data sheets and sampling logs should be kept to maintain clear records of field sampling activities.

Standard Operating Procedures for Collection of Lead Ambient Air Samples with Dawson High-Volume Air Sampler

Sampling System

The sampling pump system consists of a Dawson High Volume Air Sampler with an adjustable, tamper-proof flow regulator which provides a variable flow setting between 3 to 20 liters per minute (lpm), a 37 mm sample cassette with a 0.8μm cellulose ester membrane, and a fully independent cassette stand able to extend to a height of 6 feet. The equipment will require calibration prior to sampling.

Calibration

The air flow rate must be verified prior to initiation of the sampling. Calibration is performed by the following procedures (Dawson Hi-Vol Air Sampler):

1. Attach Tygon™ tubing to the inlet port of sampling pump.
2. Attach tubing to top port of Dwyer rotometer and turn on air sampling pump.
3. Adjust flow regulator to desired air flow (approximately 3 lpm) and lock flow regulator.
4. Remove rotometer and attach sample cassette.

Sample Collection

After sampling system has been assembled, and flow checked as described previously, it can be used to collect air samples.

1. The air samples should be located in an unobstructed area. The sampler should be located approximately 4 feet above ground surface on the adjustable cassette stand. The sampling motor is not self-contained therefore needs to be protected from adverse weather conditions (rain, snow, etc.).
2. The sample cassette is supplied with two ports, the blue plug designates the input, and the red plug designates the output. Both plugs should be removed from the sampling cassette and saved for final shipment. The Tygon™ tubing should be attached to the output side of the cassette and the cassette should be secured to the stand.
3. The sampling pump should be started and the start time recorded in the field book. The flow rate has been determined previously during calibration.
4. At the end of desired sampling period (at least 8 hours), the power should be turned off and finish time recorded. Carefully remove the sample cassette and plug the two ports with the supplied plugs.
5. The sample cassette should be labeled and placed in a Ziplock™ bag to ensure the cleanliness of the sample. Chain of Custody should be maintained for all samples.

Sample Preservation & Shipping

The air sample cassettes should be stored in a cool place and packed carefully for shipment to avoid damage to the cassette during transit. The sample holding time should not exceed 6 months.

Chain-of-custody forms should be sent with the samples to the laboratory. Field data sheets and sampling logs should be kept to maintain clear records of the field sampling activities.

Appendix C
Arizona Laboratory Data Qualifiers

APPENDIX C

Arizona Laboratory Data Qualifiers

Revision 1.0 – March 3, 2002

(Developed by the Technical Subcommittee of the Arizona Environmental Laboratory Advisory Committee. This is a revised list with additional qualifiers added to the original list dated 12/11/2000)

Microbiology

A1 = Too numerous to count.

A2 = Sample incubation period exceeded method requirement.

A3 = Sample incubation period was shorter than method requirement.

A4 = Target organism detected in associated method blank.

A5 = Incubator/water bath temperature was outside method requirements.

A6 = Target organism not detected in associated positive control.

A7 = Micro sample received without adequate headspace.

Method blank

B1 = Target analyte detected in method blank at or above the method reporting limit.

B2 = Non-target analyte detected in method blank and sample, producing interference.

B3 = Target analyte detected in calibration blank at or above the method reporting limit.

B4 = Target analyte detected in blank at/above method acceptance criteria.

B5 = Target analyte detected in method blank at or above the method reporting limit, but below trigger level or MCL.

B6 = Target analyte detected in calibration blank at or above the method reporting limit, but below trigger level or MCL.

B7 = Target analyte detected in method blank at or above the method reporting limit. Concentration found in the sample was 10 times above the concentration found in the method blank.

Confirmation:

C1 = Confirmatory analysis not performed as required by the method.

C2 = Confirmatory analysis not performed. Confirmation of analyte presence established by site historical data.

C3 = Qualitative confirmation performed. See case narrative.

C4 = Confirmatory analysis was past holding time.

C5 = Confirmatory analysis was past holding time. Original result not confirmed.

Dilution:

D1 = Sample required dilution as a result of matrix interference. See case narrative.

D2 = Sample required dilution as a result of high concentration of target analyte.

D3 = Sample dilution required as a result of insufficient sample.

D4 = Minimum reporting level (MRL) adjusted to reflect sample amount received and analyzed.

Estimated concentration:

E1 = Concentration estimated. Analyte exceeded calibration range. Re-analysis is not possible as a result of insufficient sample.

E2 = Concentration estimated. Analyte exceeded calibration range. Re-analysis not performed as a result of sample matrix.

E3 = Concentration estimated. Analyte exceeded calibration range. Re-analysis not performed because of holding time requirements.

E4 = Concentration estimated. Analyte was detected below laboratory MRL.

E5 = Concentration estimated. Analyte was detected below laboratory MRL, but not confirmed by alternate analysis.

E6 = Concentration estimated. Internal standard recoveries did not meet method acceptance criteria.

E7 = Concentration estimated. Internal standard recoveries did not meet laboratory acceptance criteria.

Hold time:

H1 = Sample analysis performed past holding time. See case narrative.

H2 = Initial analysis within holding time. Re-analysis for the required dilution was past holding time.

H3 = Sample was received and analyzed past holding time.

H4 = Sample was extracted past required extraction holding time, but analyzed within analysis holding time. See case narrative.

Biochemical oxygen demand:

K1 = Sample dilutions set up for the biochemical oxygen demand (BOD) analysis did not meet the oxygen depletion criteria of at least 2 mg/L. Any reported result is an estimated value.

K2 = Sample dilutions set up for the BOD analysis did not meet the criteria of a residual dissolved oxygen of at least 1 mg/L. Any reported result is an estimated value.

K3 = Seed depletion was outside the method acceptance limits.

K4 = Seed depletion was outside the method and laboratory acceptance limits. The reported result is an estimated value.

K5 = Dilution water dissolved oxygen (DO) depletion was > 0.2 mg/L.

K6 = Glucose/glutamic acid BOD was below method acceptance criteria.

K7 = A discrepancy between the BOD and chemical oxygen demand (COD) results has been verified by reanalysis of the sample for COD.

K8 = Glucose/glutamic acid BOD was above method acceptance levels.

Laboratory fortified blank/blank spike:

L1 = Associated blank spike recovery was above laboratory acceptance limits. See case narrative.

L2 = Associated blank spike recovery was below laboratory acceptance limits. See case narrative.

L3 = Associated blank spike recovery was above method acceptance limits. See case narrative.

L4 = Associated blank spike recovery was below method acceptance limits. See case narrative.

Note: The L1, L2, L3 & L4 footnotes need to be added to all corresponding analytes for a sample.

Matrix spike:

M1 = Matrix spike recovery was high; method control sample recovery was acceptable.

M2 = Matrix spike recovery was low; method control sample recovery was acceptable.

M3 = Accuracy of the spike recovery value is reduced because the analyte concentration in the sample is disproportionate to spike level. The method control sample recovery was acceptable.

M4 = Analysis of the spiked sample required a dilution such that the spike concentration was diluted below the reporting limit. The method control sample recovery was acceptable.

M5 = Analyte concentration was determined by the method of standard addition.

M6 = Matrix spike recovery was high. Data reported per ADEQ policy 0154.000.

M7 = Matrix spike recovery was low. Data reported per ADEQ policy 0154.000.

General:

N1 = See case narrative.

N2 = See corrective action report.

Sample quality:

Q1 = Sample integrity was not maintained. See case narrative.

Q2 = Sample received with head space.

Q3 = Sample received with improper chemical preservation.

Q4 = Sample received and analyzed without chemical preservation.

Q5 = Sample received with inadequate chemical preservation, but preserved by the laboratory.

Q6 = Sample was received above recommended temperature.

Q7 = Sample inadequately dechlorinated.

Q8 = Insufficient sample received to meet method QC requirements. QC requirements satisfy ADEQ policies 0154 and 0155.

Q9 = Insufficient sample received to meet method QC requirements.

Q10= Sample received in inappropriate sample container.

Q11= Sample is heterogeneous. Sample homogeneity could not be readily achieved using routine laboratory practices.

Duplicates:

R1 = RPD exceeded the method control limit. See case narrative.

R2 = RPD exceeded the laboratory control limit. See case narrative.

R3 = Sample RPD between the primary and confirmatory analysis exceeded 40%. Per EPA Method 8000B, the higher value was reported.

R4 = MS/MSD RPD exceeded the method control limit. Recovery met acceptance criteria.

R5 = MS/MSD RPD exceeded the laboratory control limit. Recovery met acceptance criteria.

R6 = LFB/LFBD RPD exceeded the method control limit. Recovery met acceptance criteria.

R7 = LFB/LFBD RPD exceeded the laboratory control limit. Recovery met acceptance criteria.

R8 = Sample RPD exceeded the method control limit.

R9 = Sample RPD exceeded the laboratory control limit.

Surrogate:

S1 = Surrogate recovery was above laboratory acceptance limits, but within method acceptance limits.

S2 = Surrogate recovery was above laboratory and method acceptance limits.

S3 = Surrogate recovery was above laboratory acceptance limits, but within method acceptance limits. No target analytes were detected in the sample.

S4 = Surrogate recovery was above laboratory and method acceptance limits. No target analytes were detected in the sample.

S5 = Surrogate recovery was below laboratory acceptance limits, but within method acceptance limits.

S6 = Surrogate recovery was below laboratory and method acceptance limits. Re-extraction and/or re-analysis confirms low recovery caused by matrix effect.

S7 = Surrogate recovery was below laboratory and method acceptance limits. Unable to confirm matrix effect.

S8 = Analysis of the sample required a dilution such that the surrogate concentration was diluted below the method acceptance criteria. The method control sample recovery was acceptable.

S9 = Analysis of the sample required a dilution such that the surrogate concentration was diluted below the laboratory acceptance criteria. The method control sample recovery was acceptable.

S10 = Surrogate recovery was above laboratory and method acceptance limits. See case narrative.

S11 = Surrogate recovery was high. Data reported per ADEQ policy 0154.000.

S12 = Surrogate recovery was low. Data reported per ADEQ policy 0154.000.

Method/analyte discrepancies:

T1 = Method promulgated by USEPA, but not by ADHS at this time.

T2 = Cited ADHS licensed method does not contain this analyte as part of method compound list.

T3 = Method not promulgated either by EPA or ADHS.

T4 = Tentatively identified compound. Concentration is estimated and based on the closest internal standard.

Calibration verification:

V1 = CCV (continuing calibration verification) recovery was above method acceptance limits. This target analyte was not detected in the sample.

V2 = CCV recovery was above method acceptance limits. This target analyte was detected in the sample. The sample could not be reanalyzed due to insufficient sample.

V3 = CCV recovery was above method acceptance limits. This target analyte was detected in the sample, but the sample was not reanalyzed. See case narrative.

V4 = CCV recovery was below method acceptance limits. The sample could not be reanalyzed due to insufficient sample.

V5 = CCV recovery after a group of samples was above acceptance limits. This target analyte was not detected in the sample. Acceptable per USEPA Method 8000B.

V6 = Data reported from one-point calibration criteria per ADEQ policy 0155.000.

V7 = Calibration verification recovery was above the method control limit for this analyte; however, the average percent difference or percent drift for all the analytes met method criteria.

V8 = Calibration verification recovery was below the method control limit for this analyte; however, the average percent difference or percent drift for all the analytes met method criteria.

Calibration:

W1 = The percent RSD (relative standard deviation) for this compound was above 15%. The average percent RSD for all compounds in the calibration met the 15 percent criteria as specified in USEPA Method 8000B.

Appendix D
ADEQ Data Verification and Validation Checklists

Checklist 1
LABORATORY REPORT GOAL: DATA VERIFICATION

Perform data verification on all samples collected to characterize the site, including quarterly groundwater monitoring samples and soil investigation samples. Data verification will be performed by a chemist or other professional with knowledge or experience generating analytical laboratory data. The professional should be familiar with the QC requirements specified for the analytical methods being reviewed. Data verification precedes data validation and is a systematic process for evaluating whether data has been generated with acceptable quality control, as defined in the Project QAPP.

At a minimum, the items listed below must be evaluated as well as completeness of supporting documentation. This is a cursory review of the laboratory's quality control and may suggest that a more thorough validation is needed.

Completed	Review Item
	1. Case Narrative Have any anomalies, deficiencies, and QC problems been identified in the case narrative? What corrective action, if any, was taken?
	2. Chain-of-Custody Documentation Are the original Chain-of-Custody forms with ID numbers and laboratory receipt signatures present?
	Are there copies of internal tracking documents, as applicable?
	3. Sample Analysis Results Are sample analysis results included for environmental samples, with quantitation limits (include dilutions and reanalyses)?
	4. QC Summary Is the following information included? Initial and continuing calibrations
	Method blanks, continuing calibration blanks, and preparation blanks
	Surrogate percent recoveries
	Internal standard percent recoveries

Completed	Review Item
	Matrix spike percent recoveries
	Laboratory duplicate relative percent differences
	Laboratory QC check sample, laboratory control sample recoveries
	Field duplicates, if identified, reproducibility will be evaluated
	Acceptance criteria, if not already established by the method/DQO
	Definitions for any laboratory data qualifiers used
	Method of standard additions (INORGANIC)
	ICP serial dilution (INORGANIC)
	5. Specifically review the following: Was a check for timeliness and errors conducted, including requested deliverables, preservation, holding times, and Chain-of-Custody?
	Was a duplicate sample/matrix spike/matrix spike duplicate/postdigest spike reviewed against precision and accuracy criteria specified by the method or by project DQOs?
	Were compound quantitation and reported detection limits reviewed, checking reporting limits against contract required limits, verifying dry weights, calculations, and dilutions?
	6. Does the Verification Report include the following information?: Case narrative including, but not limited to, an overall summary of data acceptability and comparison to DQOs and DQIs (PARCC), a list of recommended changes, a summary of all laboratory contacts, in which communications with the laboratory, if any, would be identified, and any other problems associated with the actual analysis which might impact the sample integrity or data quality
	Marking of recommended changes directly on copies of the laboratory reports for the client’s ease in performing data entry

Completed	Review Item
	Tabulated summary of all data results supplied electronically by email or on 3.5-inch floppy disks in a commonly used software format

Checklist 2
LABORATORY REPORT GOAL: DATA VALIDATION

Experienced chemists will perform full data validation on a data package(s) selected by the contractor Project Manager at the beginning of the project. The package(s) should be a full sample batch (approximately 20 samples), and should be typical of the type of samples expected for the project decision-making. For long-term projects, each analytical method used during the life of the project should be initially validated prior to proceeding with performing data verification on the bulk of the laboratory results. Additionally, during each six-month period that the project is ongoing, the Project Manager will select additional data packages for validation that are representative of the matrix and analyses being performed.

Data validation will consist of a review of sample and QC results, and all accompanying raw data. The ADEQ Project Manager will identify the compounds of concern, and the data validation will include a review of 100% of the QC data and sample data for these compounds in the laboratory report for a sample delivery group. Compounds not identified as contaminants of interest will not be validated unless requested by ADEQ's Project Manager. Data validation will be conducted by the either the consultant's QA officer or an independent data validation contractor. The ADEQ QA Unit will validate a portion of that data previously validated at the ADEQ Project Manager's request to confirm the findings and conclusions regarding the usability of the data. Validation includes all of the following items listed as validation deliverables.

The percentage of data that undergoes full validation may be increased if substantial data quality issues are raised during the initial or subsequent assessments. ADEQ may also require that a larger percent of the data be fully validated for various reasons including, but not limited to, determining the extent of the issue and/or if the issue has been corrected in subsequent analyses, or that additional data be made available for review, besides the validation deliverables mentioned below.

Completed	Review Item
	1. Case Narrative Have any anomalies, deficiencies, and QC problems been identified in the case narrative? What corrective action, if any, was taken?
	2. Chain-of-Custody Documentation Are the original Chain-of-Custody forms with ID numbers and laboratory receipt signatures present?
	Are there copies of internal tracking documents, as

Completed	Review Item
	applicable?
	3. Sample Analysis Results Are sample analysis results included for environmental samples, with quantitation limits (include dilutions and reanalyses)?
	4. QC Summary Is the following information included? Initial and continuing calibrations
	Method blanks, continuing calibration blanks, and preparation blanks
	Surrogate percent recoveries
	Internal standard percent recoveries
	Matrix spike percent recoveries
	Laboratory duplicate relative percent differences
	Laboratory QC check sample, laboratory control sample recoveries
	Field duplicates, if identified, reproducibility will be evaluated
	Acceptance criteria, if not already established by the method/DQO
	Definitions for any laboratory data qualifiers used
	Gas chromatograph breakdown products
	Retention times and acceptance windows (ORGANIC)
	ICP interference check sample (INORGANIC)
	Method of standard additions (INORGANIC)
	ICP serial dilution (INORGANIC)
	5. Raw data, chromatograms, and area quantitation reports (ORGANIC), sequential measurement readout records for ICP, graphite furnace atomic absorption (AA), flame AA, cold vapor mercury, cyanide, and/or other inorganic analyses (INORGANIC), including but not limited to the following: Environmental samples (include dilutions and reanalyses)
	Instrument tuning, for analyses of gas chromatography/mass spectrometry (GC/MS)

Completed	Review Item
	Initial calibration and continuing calibrations
	Method blanks, continuing calibration, and preparation blanks
	Surrogate recoveries and internal standard recoveries, where applicable
	Matrix spike (MS)
	Laboratory duplicate or matrix spike duplicate (MSD)
	Laboratory QC check sample, or laboratory control samples, as applicable
	Retention time windows
	Percent moisture for soil samples
	Sample extraction and cleanup logs (ORGANIC)
	Enhanced spectra of target analytes and tentatively identified compounds (TICs) with the associated best match spectra for MS data
	Sample digestion and/or sample preparation logs (INORGANIC)
	Instrument analysis log for each instrument used (INORGANIC)
	Postdigest spikes (INORGANIC)
	Method of standard additions when applicable (INORGANIC)
	ICP serial dilution (INORGANIC)
	Instrument tuning for ICP/MS, when applicable (INORGANIC)
	6. Specifically review the following: Was a check for timeliness and errors conducted, including requested deliverables, preservation, holding times, and Chain-of-Custody?
	Was a duplicate sample/matrix spike/matrix spike duplicate/post-digest spike reviewed against precision and accuracy criteria specified by the method or by project DQOs?
	Was compound quantitation and reported detection limits reviewed, checking reporting limits against contract required

Completed	Review Item
	limits, verifying dry weights, calculations, and dilutions?
	Was target list compounds identified, indicating proper identification of analytes?
	Was sample result verification conducted, in which the final reports are reviewed against all raw instrumental data and logs and all applicable worksheets to check anomalies, data reduction/calculations, transcription, linear ranges, and dilutions?
	7. OPTIONAL **(as requested by ADEQ for data validation on a case-by-case basis)** Method detection limits (MDLs)
	Instrument detection limits (IDLs)
	ICP linear range (INORGANIC)
	8. Does the Validation Report include the following information?: Case narrative including, but not limited to, an overall summary of data acceptability and comparison to DQOs (PARCC), a list of recommended changes, a summary of all laboratory contacts, in which communications with the laboratory, if any, would be identified, and any other problems associated with the actual analysis which might impact the sample integrity or data quality
	Marking of recommended changes directly on copies of the laboratory reports for the client's ease in performing data entry
	Tabulated summary of all data results supplied electronically by email or on 3.5-inch floppy disks in a commonly used software format

SPLIT SAMPLING AS AN ACCEPTABLE ALTERNATIVE TO PERFORMING DATA VALIDATION

In the absence of performing data validation (which can be cost prohibitive for small numbers of samples analyzed) a percentage of split samples can be collected and analyzed at another laboratory to confirm accuracy. ***This, however, should be approved by ADEQ in advance to ensure that project requirements can still be achieved****. The decision to allow split sampling as an alternative to data validation must be made on a case-by-case basis. The Agency stresses that analyzing split samples should not be viewed as an equivalent substitution for performing data validation. There are, however, conceivably various sites in which the data quality objectives (DQOs) would not be seriously compromised if split samples were analyzed either in lieu of or in conjunction with performing data validation.*

As the number of samples collected increases, the rationale for analyzing split samples as an alternative to performing data validation must also become more compelling.

With prior approval from ADEQ, the QAPP must document the number of samples to be collected and the percentage of split samples anticipated for the project. State the rationale if the percentage of split samples recommended differs from the number of samples collected. Recommended percentages are as follows:

- *1-10 samples collected (100% splits)*
- *11-20 samples collected (50% splits)*
- *21-35 samples collected (35% splits)*
- *36-50 samples collected (25% splits)*

Appendix B
Updated Quality Assurance Project Plan Table 2.8

Table 2.8 Summary of CCR Analytes and Maximum Contaminant Levels

Analyte	Maximum Contaminant Level (MCL) (mg/L)
Antimony	0.006
Arsenic	0.010
Barium	2
Beryllium	0.004
Boron	N/A
Cadmium	0.005
Calcium	N/A
Chloride	N/A
Chromium	0.1
Cobalt	N/A
Fluoride	4.0
Lead	AL=0.15
Lithium	N/A
Mercury	0.002
Molybdenum	N/A
pH	N/A
Radium 226 + 228, combined	5 pCi/L
Selenium	0.05
Sulfate	N/A
Thallium	0.002
Total Dissolved Solids	N/A

Appendix C
AECOM Standard Operating Procedures

Field measurements for temperature, pH, turbidity, conductivity, DO, and ORP will be made in accordance with procedures outlined in SOP-024, *Water Quality Measurements Using a Multiple Parameter Water Quality Meter*, along with the manufacturer's instructions.

3.3.3 Well Purging

The purpose of well purging is to remove stagnant water in the well casing and obtain a representative water sample from the geologic formation being sampled while minimizing disturbance of the water column during sample collection.

3.3.3.1 Low-Flow Purge Methodology

Using the low-flow purging methodology, the well will be purged until field parameters (pH, temperature, turbidity, DO, ORP, and conductivity) have stabilized. Readings will be taken at a rate commensurate for the flow involved, but no sooner than every three minutes. Low-flow purging rates on the order of 0.1 - 1.0 L/min will be used depending on the site-specific hydrogeology. The maximum allowable drawdown during low-flow purging is 0.3 feet. If the maximum allowable drawdown limit of 0.3 feet is exceeded and cannot be achieved, then the Total Volume Purge Method described in Section 3.3.3.2 will be followed.

Background wells being sampled for metals must attain a turbidity of 10 Nephelometric Turbidity Units (NTUs) or less before sample collection unless a written variance (on a well-specific basis) is acquired. The turbidity goal for non-background samples is 15 NTU, but samples with higher turbidity are acceptable if turbidity readings are stabilized and the other conditions of low-flow purging have been met. See *EPA/540/S-95/504, Low-Flow (Minimal Drawdown) Ground-water Sampling Procedures (April 1996).*

For standard low-flow well purging, the following procedures will be performed at each well:

- The condition of the well completion (outer well casing, concrete well pad, protective posts, well label) and any unusual conditions of the area around the well will be noted in the field logbook. The well may also be photographed. Any deficiencies encountered will be reported to the Field Manager on the same working day.

- Don personal protective equipment (PPE) as specified in the Health and Safety Plan (HSP).

- Note if the reference point (measuring point) on the well is present. This is usually an indelible mark or V-notch cut in the top of the well casing. If this point is missing, make one on the north side of the well casing.

- The depth of the static water level will be measured with a water level indicator (to the nearest 0.01 foot) in accordance with SOP-006, *Static Water Level and Total Depth Measurement*.

- The total depth of well will be measured from the same measuring point on the casing with a water level indicator and recorded. It is critical that the distance between the water sensor (zero point) and the end of the water level indicator probe be measured independently and added to each total depth measurement.

- Slowly lower the pump or pump tubing into the well casing to a point in the middle of the screened interval, 5 feet below the water table, or in instances where the well screen is submerged, 5 feet below the top of the screen. Reinsert the water level indicator and repeat measurements until the water level reaches static. Leave water level indicator in the well to monitor water levels during purging.

- Start the pump. As soon as water is discharging, adjust the pump speed to a rate suitable to create minimal drawdown. During purging and sampling, the maximum allowable drawdown is 0.3 feet.

- Using a stopwatch and some type of graduated cylinder, measure the pumping rate. Monitor the water level, pumping rate, cumulative volume withdrawn, and field parameters approximately every three to five minutes.

- When the field parameters have stabilized, disconnect the flow cell from the water path before collecting samples. Water samples for laboratory analyses must be collected before the water has passed through the cell to prevent cross-contamination or chemistry changes. Stabilization is achieved when three consecutive readings show the following:

    - Temperature - ± 1 degree Celsius
    - pH - ± 0.1 pH unit
    - Turbidity - ≤ 10 NTU or ± 10%
    - Conductivity - ± 3%
    - Dissolved Oxygen - ± 10%
    - Oxidation-Reduction Potential - ± 10 millivolts

3.3.3.2 Total Well Volume Purge Methodology

At a minimum, three total volumes must be purged for this method if the well is not purged dry with a pumping rate less than 2 L/min. If the well is purged dry with a flow rate of less than 2 L/min, it will be sampled as soon as possible after the minimum sample volume of groundwater has recharged into the well. The requirements of a minimum of three well volumes purged and stabilization of field parameters will not be applied to sampling a well that has been purged dry if the pumping rate was less than 2 L/min.

The volume of water in the well will be calculated based on the length of the saturated thickness in the well and the screen diameter (see below for calculation of volumes).

The well volume can be calculated in gallons using the following equation:

Well Volume V (in gallons) = H x F

where V = one well volume
H = the difference between the depth of the well and depth of water (ft)
F = factor for volume of one foot section of casing (gallons) from the table below.

Diameter of Casing (inches)	F Factor (gallons)
1.5	0.09
2.0	0.16
3.0	0.37
4.0	0.65
6.0	1.47

F can also be calculated from the following equation:

$$F=\Pi (D/2)^2 \text{ X } 7.48 \text{ gal/ft}^3$$

where D = the inside diameter of the well casing (ft)

For total well volume purging, the following procedures will be performed at each well:

- The condition of the well completion (outer well casing, concrete well pad, protective posts, well label) and any unusual conditions of the area around the well will be noted in the field logbook. The well may also be photographed. Any deficiencies encountered will be reported to the Site Manager on the same working day.

- Don PPE as specified in the HSP.

- Note if the reference point (measuring point) on the well is present. This is usually an indelible mark or V-notch cut in the top of the well casing. If this point is missing, make one on the north side of the well casing.

- The depth of the static water level will be measured with a water level indicator (to the nearest 0.01 foot) in accordance with SOP-006, *Static Water Level and Total Depth Measurement*.

- The total depth of well will be measured from the same measuring point on the casing with a water level indicator and recorded. It is critical that the distance between the water sensor (zero point) and the end of the water level indicator probe be measured independently and added to each total depth measurement.

- Slowly lower the pump or pump tubing into the well casing to a point in the middle of the screened interval. Reinsert the water level indicator to monitor water levels during purging.

- Start the pump. As soon as water is discharging, adjust the pump speed. The pumping rate should never exceed 2 L/min.

- Using a stopwatch and some type of graduated cylinder, measure the pumping rate. Monitor the water level, pumping rate, cumulative withdrawal, and field parameters every ten minutes and/or per well volume. Field parameters including temperature, pH, turbidity, conductivity, DO, and/or ORP will be monitored.

- At a minimum, three total volumes must be purged for this method if the well is not purged dry with a pumping rate less than 2 L/min. If the well is purged dry with a pumping rate less than 2 L/min then the sample will be collected after a sufficient volume of water has recharged the well regardless of total volume purged and field parameter stabilization.

- Purging is complete only when all required field parameters have stabilized (temperature, pH, turbidity, conductivity, DO, and ORP) or six WCVs have been removed, whichever comes first. Water parameters will be measured after removal of each volume and approximately every five minutes after the first 2 WCVs. Stabilization is achieved when two consecutive readings show the following:

    - Temperature - ± 1 degree Celsius
    - pH - ± 0.1 pH unit
    - Turbidity - ≤ 10 NTU or ± 10%
    - Conductivity - ± 5%
    - Dissolved Oxygen - ± 10%
    - Oxidation-Reduction Potential - ± 10 millivolts

3.3.4 Sample Collection (Low Flow & Total Well Volume)

Using low-flow or total well volume sampling procedures, samples for chemical analysis will be collected immediately following purging. For wells that were purged dry, samples will be collected as soon as possible after a sufficient volume of groundwater is available in the well.

The water quality samples will be taken from within the well screen interval. The following sampling procedure will be used at each well:

- Immediately following purging, use the pump to collect the groundwater sample. The pump should not be moved between purging and sampling.

- Identification labels for sample bottles will be filled out for each well.

- The individual sample bottles should be filled in the order given below:

  - Metals (inorganics),
  - Inorganic anions,
  - Radionuclides and other parameters, and
  - Field test parameters (e.g., pH, conductivity, and temperature).

- Fill containers for inorganics, inorganic anions, and other parameter analyses until almost full. When collecting samples using preservatives, the pH should be periodically checked. For non-VOC samples, a small amount of the preserved sample should be poured from the sample container directly onto the pH strip (rather than dipping the strip into the sample container, which can contaminate the sample).

- After the samples have been collected, they should immediately be placed in an ice-filled cooler for transport to the analytical laboratory in accordance with SOP-018, *Packing and Shipping Environmental Samples*.

- Complete all chain-of-custody information in accordance with SOP-17, *Chain of Custody*.

- After removing the pump and equipment from the well, replace and lock the well cap.

3.3.5 Sample Collection (HydraSleeve)

HydraSleeve™ samplers will be used in wells known to have very slow recharge and that are unable to be sampled using other low flow methods. The HydraSleeve™ Standard Operating Procedure, *Sampling Groundwater with a HydraSleeve*, will be followed for deployment and sample collection. Refer to Attachment 2 of this SOP.

The Standard 4-inch diameter, 30-inch long HydraSleeve will collect 1.6-Liters of sample volume. The total volume required for laboratory (CCR program) analyses is 2 liters. Depending on the amount of water column in the well, is may be necessary to deploy two HydraSleeve samplers at once, or return and deploy a second HydraSleeve after the water level has stabilized.

- Inspect the well and surrounding area for security, damage, and evidence of tampering.

- Don personal protective equipment as specified in the project-specific Health and Safety Plan or Safe Work Plan, as applicable.

- Locate the well survey reference point. This is usually an indelible mark or V-notch cut in the top of the well casing. If this point is missing, make one on the north side of the well casing.

- Measure the static water level and total depth in accordance with SOP-006, *Static Water Level and Total Depth Measurement.*

- Remove the HydraSleeve from its packaging, unfold it, and hold by its top.

- Crimp the top of the HydraSleeve by folding the hard polyethylene reinforcing strips at the holes.

- Attach the spring clip to the holes to ensure that the top will remain open until the sampler is retrieved.

- Attach the tether to the spring clip by tying a knot in the tether.

- Fold the flaps with the two holes at the bottom of the HydraSleeve together and slide the weight clip through the holes.

- Attach a weight to the bottom of the weight clip to ensure that the HydraSleeve will descend to the desired sampling depth

- Using the tether, carefully lower the HydraSleeve to preferred depth.

- Secure the tether at the top of the well by placing the well cap on the top of the well casing and over the tether.

- Allow time for equilibration. In most cases the HydraSleeve can be recovered immediately (with no equilibration time) or within a few hours.

- In one smooth motion, pull the tether up the full length of the sleeve (30-60”) at a rate of about 1’ per second (or faster). The motion will open the top check valve and allow the HydraSleeve to fill.

- When the HydraSleeve is full, the top check valve will close and the weight of the HydraSleeve sample will be felt on the tether. Continue pulling upward until the HydraSleeve is at the top of the well.

- Decant and discard the small volume of water trapped in the HydraSleeve above the check valve by turning the sleeve over.

- Remove the discharge tube from its sleeve.
- Hold the HydraSleeve at the check valve.
- Puncture the HydraSleeve just below the check valve with the pointed end of the discharge tube.
- Discharge water from the HydraSleeve into sample containers.
- Record the sampling information in the field logbook and/or the field data sheets.
- After the samples have been collected, they should immediately be placed in an ice-filled cooler for transport to the analytical laboratory in accordance with SOP-018, *Packing and Shipping Environmental Samples*.
- Complete all chain-of-custody information in accordance with SOP-17, *Chain of Custody*.
- After removing the pump and equipment from the well, replace and lock the well cap.

4.0 REFERENCES

Ground Water Issue, Low-Flow (Minimal Drawdown) Ground-Water Sampling Procedures, April 1996 (EPA/540/S-95/504).

5.0 RECORDS

Field notes will be kept in a bound field logbook or Monitoring Well Purging Form (Attachment 1) as required by SOP-019, *Field Activity Records*. The following information will be recorded using waterproof ink:

- Names of sampling personnel;
- Weather conditions;
- Project title;
- Location and well number;
- Date and time of sampling;
- Condition of the well;
- Decontamination information;
- Initial and final static water level, total well depth;
- Equipment calibration information;
- Method of purging;
- Volume of water purged before sampling;
- Purge start/stop times;

- Pumping rate, if applicable;
- Field parameter measurements during purging;
- Method of sample collection;
- Sample identification numbers;
- Photo documentation, if applicable;
- QA/QC samples collected; and
- Irregularities or problems.

In addition to the logbook, the Monitoring Well Purging Form located in Attachment 1 will be completed.

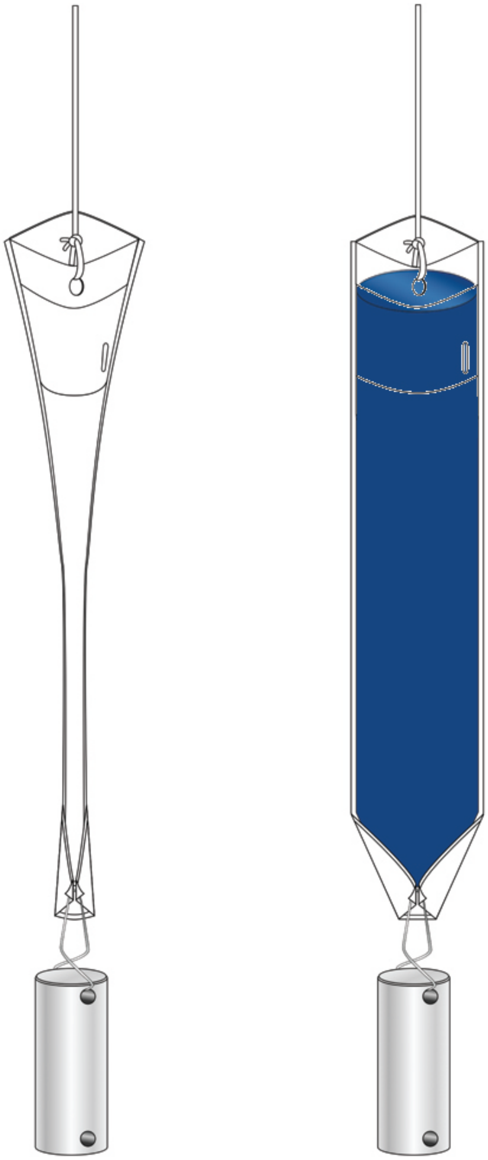
6.0 ATTACHMENTS

Attachment 1 – Monitoring Well Purging Form
Attachment 2 – HydraSleeve™ SOP, Sampling Groundwater with a HydraSleeve

HYDRASleeve™

Simple by Design US Patent No. 6,481,300; No. 6,837,120 others pending

Standard Operating Procedure:
Sampling Ground Water with a HydraSleeve



This Guide should be used in addition to field manuals appropriate to sampling device (i.e., HydraSleeve or Super Sleeve).

Find the appropriate field manual on the HydraSleeve website at http://www.hydrasleeve.com.

For more information about the HydraSleeve, or if you have questions, contact:
GeoInsight, 2007 Glass Road, Las Cruces, NM 88005, 1-800-996-2225,
info@hydrasleeve.com.

Table of Contents

Introduction

The HydraSleeve is classified as a no-purge (passive) grab sampling device, meaning that it is used to collect ground-water samples directly from the screened interval of a well without having to purge the well prior to sample collection. When it is used as described in this Standard Operating Procedure (SOP), the HydraSleeve causes no drawdown in the well (until the sample is withdrawn from the water column) and only minimal disturbance of the water column, because it has a very thin cross section and it displaces very little water (<100 ml) during deployment in the well. The HydraSleeve collects a sample from within the screen only, and it excludes water from any other part of the water column in the well through the use of a self-sealing check valve at the top of the sampler. It is a single-use (disposable) sampler that is not intended for reuse, so there are no decontamination requirements for the sampler itself.

The use of no-purge sampling as a means of collecting representative ground-water samples depends on the natural movement of ground water (under ambient hydraulic head) from the formation adjacent to the well screen through the screen. Robin and Gillham (1987) demonstrated the existence of a dynamic equilibrium between the water in a formation and the water in a well screen installed in that formation, which results in formation-quality water being available in the well screen for sampling at all times. No-purge sampling devices like the HydraSleeve collect this formation-quality water as the sample, under undisturbed (non-pumping) natural flow conditions. Samples collected in this manner generally provide more conservative (i.e., higher concentration) values than samples collected using well-volume purging, and values equivalent to samples collected using low-flow purging and sampling (Parsons, 2005).

Applications of the HydraSleeve

The HydraSleeve can be used to collect representative samples of ground water for all analytes (volatile organic compounds [VOCs], semi-volatile organic compounds [SVOCs], common metals, trace metals, major cations and anions, dissolved gases, total dissolved solids, radionuclides, pesticides, PCBs, explosive compounds, and all other analytical parameters). Designs are available to collect samples from wells from 1” inside diameter and larger. The HydraSleeve can collect samples from wells of any yield, but it is especially well-suited to collecting samples from low-yield wells, where other sampling methods can’t be used reliably because their use results in dewatering of the well screen and alteration of sample chemistry (McAlary and Barker, 1987).

The HydraSleeve can collect samples from wells of any depth, and it can be used for single-event sampling or long-term ground-water monitoring programs. Because of its thin cross section and flexible construction, it can be used in narrow, constricted or damaged wells where rigid sampling devices may not fit. Using multiple HydraSleeves deployed in series along a single suspension line or tether, it is also possible to conduct in-well vertical profiling in wells in which contaminant concentrations are thought to be stratified.

As with all groundwater sampling devices, HydraSleeves should not be used to collect groundwater samples from wells in which separate (non-aqueous) phase hydrocarbons (i.e., gasoline, diesel fuel or jet fuel) are present because of the possibility of incorporating some of the separate-phase hydrocarbon into the sample.

Description of the HydraSleeve

The HydraSleeve (Figure 1) consists of the following basic components:

- A suspension line or tether (A.), attached to the spring clip or directly to the top of the sleeve to deploy the device into and recover the device from the well. Tethers with depth indicators marked in 1-foot intervals are available from the manufacturer.
- A long, flexible, 4-mil thick lay-flat polyethylene sample sleeve (C.) sealed at the bottom (this is the sample chamber), which comes in different sizes, as discussed below with a self-sealing reed-type flexible polyethylene check valve built into the top of the sleeve (B.) to prevent water from entering or exiting the sampler except during sample acquisition.
- A reusable stainless-steel weight with clip (D.), which is attached to the bottom of the sleeve to carry it down the well to its intended depth in the water column. Bottom weights available from the manufacturer are 0.75” OD and are available in three sizes: 5 oz. (2.5” long); 8 oz. (4” long); and 16 oz. (8” long). In lieu of a bottom weight, an optional top weight may be attached to the top of the HydraSleeve to carry it to depth and to compress it at the bottom of the well (not shown in Figure 1);
- A discharge tube that is used to puncture the HydraSleeve after it is recovered from the well so the sample can be decanted into sample bottles (not shown).
- Just above the self-sealing check valve at the top of the sleeve are two holes which provide attachment points for the spring clip and/or suspension line or tether. At the bottom of the sample sleeve are two holes which provide attachment points for the weight clip and weight.

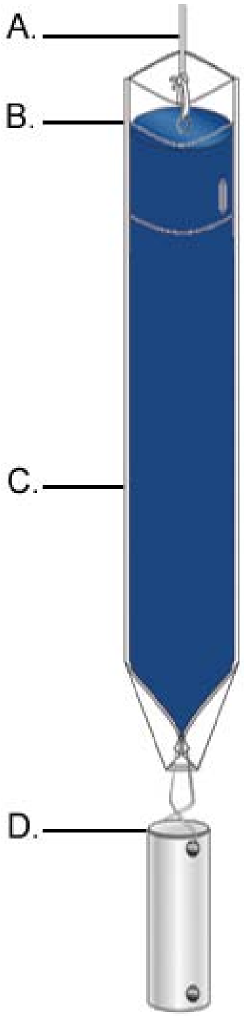


Figure 1. HydraSleeve components.

Note: The sample sleeve and the discharge tube are designed for one-time use and are disposable. The spring clip, weight and weight clip may be reused after thorough cleaning. Suspension cord is generally disposed after one use although, if it is dedicated to the well, it may be reused at the discretion of the sampling personnel.

Selecting the HydraSleeve Size to Meet Site-Specific Sampling Objectives

It is important to understand that each HydraSleeve is able to collect a finite volume of sample because, after the HydraSleeve is deployed, you only get one chance to collect an undisturbed sample. Thus, the volume of sample required to meet your site-specific sampling and analytical requirements will dictate the size of HydraSleeve you need to meet these requirements.

The volume of sample collected by the HydraSleeve varies with the diameter and length of the HydraSleeve. Dimensions and volumes of available HydraSleeve models are detailed in Table 1.

Table 1. Dimensions and volumes of HydraSleeve models.

Diameter	Volume	Length	Lay-Flat Width	Filled Dia.
2-Inch HydraSleeves				
Standard 625-ml HydraSleeve	625 ml	< 30”	2.5”	1.4”
Standard 1-Liter HydraSleeve	1 Liter	38”	3”	1.9”
1-Liter HydraSleeve SS	1 Liter	36”	3”	1.9”
2-Liter HydraSleeve SS	2 Liters	60”	3”	1.9”
4-Inch HydraSleeves				
Standard 1.6-Liter HydraSleeve	1.6 Liters	30”	3.8”	2.3”
Custom 2-Liter HydraSleeve	2 Liters	36”	4”	2.7”

HydraSleeves can be custom-fabricated by the manufacturer in varying diameters and lengths to meet specific volume requirements. HydraSleeves can also be deployed in series (i.e., multiple HydraSleeves attached to one tether) to collect additional sample to meet specific volume requirements, as described below.

If you have questions regarding the availability of sufficient volume of sample to satisfy laboratory requirements for analysis, it is recommended that you contact the laboratory to discuss the minimum volumes needed for each suite of analytes. Laboratories often require only 10% to 25% of the volume they specify to complete analysis for specific suites of analytes, so they can often work with much smaller sample volumes that can easily be supplied by a HydraSleeve.

HydraSleeve Deployment

Information Required Before Deploying a HydraSleeve

Before installing a HydraSleeve in any well, you will need to know the following:

- The inside diameter of the well
- The length of the well screen
- The water level in the well
- The position of the well screen in the well
- The total depth of the well

The inside diameter of the well is used to determine the appropriate HydraSleeve diameter for use in the well. The other information is used to determine the proper placement of the HydraSleeve in the well to collect a representative sample from the screen (see HydraSleeve Placement, below), and to determine the appropriate length of tether to attach to the HydraSleeve to deploy it at the appropriate position in the well.

Most of this information (with the exception of the water level) should be available from the well log; if not, it will have to be collected by some other means. The inside diameter of the well can be measured at the top of the well casing, and the total depth of the well can be measured by sounding the bottom of the well with a weighted tape. The position and length of the well screen may have to be determined using a down-hole camera if a well log is not available. The water level in the well can be measured using any commonly available water-level gauge.

HydraSleeve Placement

The HydraSleeve is designed to collect a sample directly from the well screen, and it fills by pulling it up through the screen a distance equivalent to 1 to 1.5 times its length. This upward motion causes the top check valve to open, which allows the device to fill. To optimize sample recovery, it is recommended that the HydraSleeve be placed in the well so that the bottom weight rests on the bottom of the well and the top of the HydraSleeve is as close to the bottom of the well screen as possible. This should allow the sampler to fill before the top of the device reaches the top of the screen as it is pulled up through the water column, and ensure that only water from the screen is collected as the sample. In short-screen wells, or wells with a short water column, it may be necessary to use a top-weight on the HydraSleeve to compress it in the bottom of the well so that, when it is recovered, it has room to fill before it reaches the top of the screen.

Example

2" ID PVC well, 50' total depth, 10' screen at the bottom of the well, with water level above the screen (the entire screen contains water).

Correct Placement (figure 2): Using a standard HydraSleeve for a 2" well (2.6" flat width/1.5" filled OD x 30" long, 650 ml volume), deploy the sampler so the weight (an 8 oz., 4"-long weight with a 2"-long clip) rests at the bottom of the well. The top of the sleeve is thus set at about 36" above the bottom of the well. When the sampler is recovered, it will be pulled upward approximately 30" to 45" before it is filled; therefore, it is full (and the top check valve closes) at approximately 66" (5 ½ feet) to 81" (6 ¾ feet) above the bottom of the well, which is well before the sampler reaches the top of the screen. In this example, only water from the screen is collected as a sample.

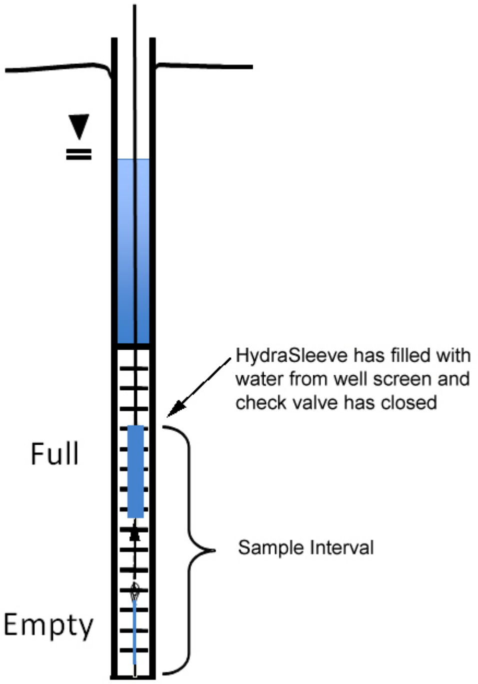


Figure 2. Correct placement of HydraSleeve.

Incorrect Placement (figure 3): If the well screen in this example was only 5' long, and the HydraSleeve was placed as above, it would not fill before the top of the device reached the top of the well screen, so the sample would include water from above the screen, which may not have the same chemistry.

The solution? Deploy the HydraSleeve with a top weight, so that it is collapsed to within 6" to 9" of the bottom of the well. When the HydraSleeve is recovered, it will fill within 39" (3 ¼ feet) to 54" (4 ½ feet) above the bottom of the well, or just before the sampler reaches the top of the screen, so it collects only water from the screen as the sample.

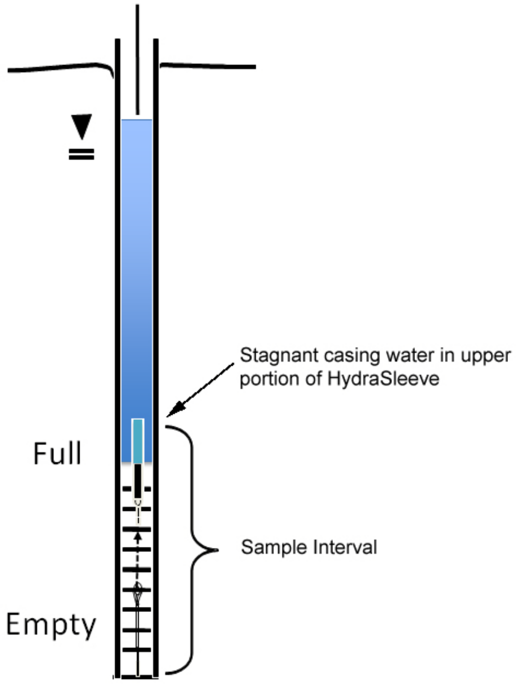


Figure 3. Incorrect placement of HydraSleeve.

This example illustrates one of many types of HydraSleeve placements. More complex placements are discussed in a later section.

Procedures for Sampling with the HydraSleeve

Collecting a ground-water sample with a HydraSleeve is a simple one-person operation.

Note: Before deploying the HydraSleeve in the well, collect the depth-to-water measurement that you will use to determine the preferred position of the HydraSleeve in the well. This measurement may also be used with measurements from other wells to create a ground-water contour map. If necessary, also measure the depth to the bottom of the well to verify actual well depth to confirm your decision on placement of the HydraSleeve in the water column.

Measure the correct amount of tether needed to suspend the HydraSleeve in the well so that the weight will rest on the bottom of the well (or at your preferred position in the well). Make sure to account for the need to leave a few feet of tether at the top of the well to allow recovery of the sleeve

Note: Always wear sterile gloves when handling and discharging the HydraSleeve.

I. Assembling the HydraSleeve

1. Remove the HydraSleeve from its packaging, unfold it, and hold it by its top.
2. Crimp the top of the HydraSleeve by folding the hard polyethylene reinforcing strips at the holes.
3. Attach the spring clip to the holes to ensure that the top will remain open until the sampler is retrieved.
4. Attach the tether to the spring clip by tying a knot in the tether.

Note: Alternatively, attach the tether to one (NOT both) of the holes at the top of the Hydrasleeve by tying a knot in the tether.

5. Fold the flaps with the two holes at the bottom of the HydraSleeve together and slide the weight clip through the holes.
6. Attach a weight to the bottom of the weight clip to ensure that the HydraSleeve will descend to the bottom of the well.

II. Deploying the HydraSleeve

1. Using the tether, carefully lower the HydraSleeve to the bottom of the well, or to your preferred depth in the water column

   During installation, hydrostatic pressure in the water column will keep the self-sealing check valve at the top of the HydraSleeve closed, and ensure that it retains its flat, empty profile for an indefinite period prior to recovery.

Note: Make sure that it is not pulled upward at any time during its descent. If the HydraSleeve is pulled upward at a rate greater than 0.5'/second at any time prior to recovery, the top check valve will open and water will enter the HydraSleeve prematurely.

2. Secure the tether at the top of the well by placing the well cap on the top of the well casing and over the tether.

Note: Alternatively, you can tie the tether to a hook on the bottom of the well cap (you will need to leave a few inches of slack in the line to avoid pulling the sampler up as the cap is removed at the next sampling event).

III. Equilibrating the Well

The equilibration time is the time it takes for conditions in the water column (primarily flow dynamics and contaminant distribution) to restabilize after vertical mixing occurs (caused by installation of a sampling device in the well).

- Situation: The HydraSleeve is deployed for the first time or for only one time in a well

  The HydraSleeve is very thin in cross section and displaces very little water (<100 ml) during deployment so, unlike most other sampling devices, it does not disturb the water column to the point at which long equilibration times are necessary to ensure recovery of a representative sample.

  In most cases, the HydraSleeve can be recovered immediately (with no equilibration time) or within a few hours. In regulatory jurisdictions that impose specific requirements for equilibration times prior to recovery of no-purge sampling devices, these requirements should be followed.

- Situation: The HydraSleeve is being deployed for recovery during a future sampling event

  In periodic (i.e., quarterly or semi-annual) sampling programs, the sampler for the current sampling event can be recovered and a new sampler (for the next sampling event) deployed immediately thereafter, so the new sampler remains in the well until the next sampling event.

Thus, a long equilibration time is ensured and, at the next sampling event, the sampler can be recovered immediately. This means that separate mobilizations, to deploy and then to recover the sampler, are not required. HydraSleeves can be left in a well for an indefinite period of time without concern.

IV. HydraSleeve Recovery and Sample Collection

1. Hold on to the tether while removing the well cap.

2. Secure the tether at the top of the well while maintaining tension on the tether (but without pulling the tether upwards)

3. Measure the water level in the well.

4. In one smooth motion, pull the tether up between 30” to 45” (36” to 54” for the longer HydraSleeve) at a rate of about 1’ per second (or faster).

   The motion will open the top check valve and allow the HydraSleeve to fill (it should fill in about 1 to 1.5 times the length of the HydraSleeve). This is analogous to coring the water column in the well from the bottom up.

   When the HydraSleeve is full, the top check valve will close. You should begin to feel the weight of the HydraSleeve on the tether and it will begin to displace water. The closed check valve prevents loss of sample and entry of water from zones above the well screen as the HydraSleeve is recovered.

5. Continue pulling the tether upward until the HydraSleeve is at the top of the well.

6. Decant and discard the small volume of water trapped in the Hydrasleeve above the check valve by turning the sleeve over.

V. Sample Collection

Note: Sample collection should be done immediately after the HydraSleeve has been brought to the surface to preserve sample integrity.

1. Remove the discharge tube from its sleeve.

2. Hold the HydraSleeve at the check valve.

3. Puncture the HydraSleeve just below the check valve with the pointed end of the discharge tube

4. Discharge water from the HydraSleeve into your sample containers.

Control the discharge from the HydraSleeve by either raising the bottom of the sleeve, by squeezing it like a tube of toothpaste, or both.

5. Continue filling sample containers until all are full.

Measurement of Field Indicator Parameters

Field indicator parameter measurement is generally done during well purging and sampling to confirm when parameters are stable and sampling can begin. Because no-purge sampling does not require purging, field indicator parameter measurement is not necessary for the purpose of confirming when purging is complete.

If field indicator parameter measurement is required to meet a specific non-purging regulatory requirement, it can be done by taking measurements from water within a HydraSleeve that is not used for collecting a sample to submit for laboratory analysis (i.e., a second HydraSleeve installed in conjunction with the primary sample collection HydraSleeve [see Multiple Sampler Deployment below]).

Alternate Deployment Strategies

Deployment in Wells with Limited Water Columns

For wells in which only a limited water column exists to be sampled, the HydraSleeve can be deployed with an optional top weight instead of a bottom weight, which collapses the HydraSleeve to a very short (approximately 6” to 9”) length, and allows the HydraSleeve to fill in a water column only 36” to 45” in height.

Multiple Sampler Deployment

Multiple sampler deployment in a single well screen can accomplish two purposes:

- It can collect additional sample volume to satisfy site or laboratory-specific sample volume requirements.
- It can accommodate the need for collecting field indicator parameter measurements.
- It can be used to collect samples from multiple intervals in the screen to allow identification of possible contaminant stratification.

It is possible to use up to 3 standard 30” HydraSleeves deployed in series along a single tether to collect samples from a 10’ long well screen without collecting water from the interval above the screen.

The samplers must be attached to the tether at both the top and bottom of the sleeve. Attach the tether at the top with a stainless-steel clip (available from the manufacturer). Attach the tether at the bottom using a cable tie. The samplers must be attached as follows (figure 4):

- The first (attached to the tether as described above, with the weight at the bottom) at the bottom of the screen
- The second attached immediately above the first
- The third (attached the same as the second) immediately above the second

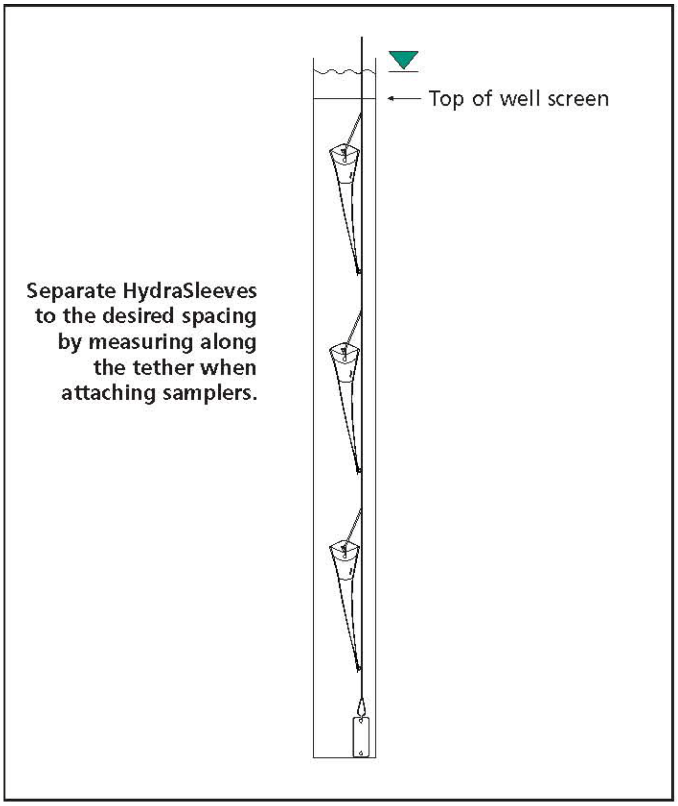


Figure 4. Multiple HydraSleeve deployment.

Alternately, the first sampler can be attached to the tether as described above, a second attached to the bottom of the first using a short length of tether (in place of the weight), and the third attached to the bottom of the second in the same manner, with the weight attached to the bottom of the third sampler (figure 5).

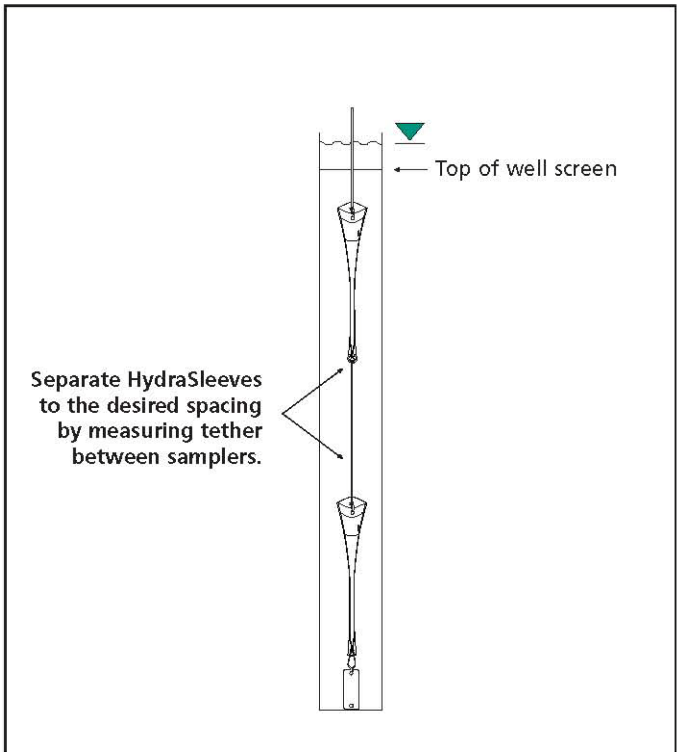


Figure 5. Alternative method for deploying multiple HydraSleeves.

In either case, when attaching multiple HydraSleeves in series, more weight may be required to hold the samplers in place in the well than would be required with a single sampler. Recovery of multiple samplers and collection of samples is done in the same manner as for single sampler deployments.

Post-Sampling Activities

The recovered HydraSleeve and the sample discharge tubing should be disposed as per the solid waste management plan for the site. To prepare for the next sampling event, a new HydraSleeve can be deployed in the well (as described previously) and left in the well until the next sampling event, at which time it can be recovered.

The weight and weight clip can be reused on this sampler after they have been thoroughly cleaned as per the site equipment decontamination plan. The tether may be dedicated to the well and reused or discarded at the discretion of sampling personnel.

References

McAlary, T. A. and J. F. Barker, 1987, Volatilization Losses of Organics During Ground-Water Sampling From Low-Permeability Materials, Ground-Water Monitoring Review, Vol. 7, No. 4, pp. 63-68

Parsons, 2005, Results Report for the Demonstration of No-Purge Ground-Water Sampling Devices at Former McClellan Air Force Base, California; Contract F44650-99-D-0005, Delivery Order DKO1, U.S. Army Corps of Engineers (Omaha District), U.S. Air Force Center for Environmental Excellence, and U.S. Air Force Real Property Agency

Robin, M. J. L. and R. W. Gillham, 1987, Field Evaluation of Well Purging Procedures, Ground-Water Monitoring Review, Vol. 7, No. 4, pp. 85-93

1.0 PURPOSE

The purpose of this Standard Operating Procedure is to describe the equipment and methods used to accurately determine static water level and total depth in a groundwater monitoring well, pumping well, or piezometer.

2.0 SCOPE

This Standard Operating Procedure applies to all personnel who measure water levels and total depths in wells. The procedure is applicable to the sampling of monitoring wells and must be performed prior to any activities which may disturb the water level, such as purging or aquifer testing.

3.0 METHOD

3.1 General

This procedure requires the use of an electronic water level device that employs a battery-powered probe assembly attached to a cable marked in 0.01-foot increments. When the probe makes contact with the water surface, a circuit is closed and energy is transmitted through the cable to sound an audible alarm. This equipment will have a sensitivity adjustment switch that enables the operator to distinguish between actual and false readings. The manufacturer's operating manual should be consulted for instructions on use of the sensitivity adjustment.

3.2 Procedures

3.2.1 Equipment

- Water level indicator with an audible alarm and a cable marked in 0.01-foot increments. The point on the probe that triggers the alarm corresponds to the zero point.

- If free-phase product is present on the water surface, then an interface probe capable of distinguishing between product and water will be used.

3.2.2 Calibration

The water level indicator or interface probe should be calibrated before use. The end of a probe should be placed in a bucket of water to ensure that the audible alarm is in working condition and responds when the electrical contacts encounter water. The marked length units on the probe line should be verified for accuracy by comparing to a standard steel tape measure. If there is any noted discrepancy between the water level indicator and the measuring tape, the difference in length will be noted on the field log and identified on the water level indicator. All subsequent water level measurements will be corrected as necessary.

3.2.3 Static Water Level Measurement

Before water level measurements are collected, all equipment will be thoroughly decontaminated as detailed in SOP-021, *Equipment Decontamination Procedures.* The static water level will be measured each time a well is sampled. This must be done before any fluids are withdrawn and before any purging or sampling equipment enters a well.

The measurements of static water level and total depth must be taken at an established reference point, generally from the top of the well casing at the surveyor's mark. The mark should be permanent, such as a notch or mark on the top of the casing. If the surveyor's point is not marked at the time of water level measurement, the north side of the casing should be used and marked. All equipment will be decontaminated before and after introduction of the equipment to the well following procedures in SOP-021, *Equipment Decontamination Procedures.*

If the well is sealed with an air-tight cap, allow time for equilibration of pressures after the cap is removed before water level measurement. Air-tight caps should be replaced by ventilated caps or a hole drilled in the well casing, where feasible, to allow the water to equilibrate to barometric changes.

With the water level indicator switched on, slowly lower the probe until it contacts the water surface as indicated by the audible alarm. Raise the probe out of the water until the alarm turns off. Three or more measurements will be taken on three minute intervals at each well until two measurements agree to within +/- 0.01 feet. Record the reading on the cable at the established reference point to the nearest 0.01 foot.

3.2.4 Total Depth Measurement

Slowly lower the water level indicator, with weight attached if necessary, until the cable goes slack. Raise and lower the probe until the precise location of the bottom is determined. Record the reading on the cable at the established reference point to the nearest 0.01 foot. Depending on the type of instrument used, the total depth measurement may need to be adjusted for the offset between the bottom of the probe and the water level sensor. Some instruments have the sensor at the bottom of the probe so the depth reading is accurate without an adjustment. However, the water indicator sensor on some probes is not located at the bottom of the probe. To get a true total depth reading, the distance from the water indicator sensors to the bottom of the probe housing must be added to the depth reading.

If it is not possible to measure the depth of a well in which pumping equipment is installed, then the as-built well construction diagram will provide the total depth.

3.2.5 Interface Probe Measurement

If there is the potential for free-phase product to be present on the surface of the water table in a well, then an oil-water interface probe will be used to collect water level measurements. Interface probes are used in the same manner as a water level indicator. The difference is that the interface probes have two different audible signals to differentiate between water and oil. If a layer of free-phase product is present, the probe will emit a different signal than for water. Most probes emit an intermittent beep when product is encountered, as opposed to a constant tone for water. The alarm codes for individual probes are marked on the reel casing. If product is encountered, continue to raise and lower the probe until a precise level (within 0.01 foot) is determined. Record the measurement in the field log and identify it as a product measurement.

Next, slowly lower the probe until the water interface is encountered. Repeat the level measurement process and record the depth to water in the field logbook. Care should be taken during the measurement process to minimize disturbance of the product layer.

4.0 REFERENCES

Driscoll, F.G., 1986. *Groundwater and Wells*, 2nd Edition, Johnson Division, St. Paul, MN, pp. 1089.

Thornhill, J.T., 1989. *Accuracy of Depth to Ground Water Measurements*, from U.S. Environmental Protection Agency (USEPA) Superfund Ground Water Issue, USEPA/540/4-89/002.

U.S. Department of the Interior, 1981. *Groundwater Manual, A Water Resource Technical Publication*, Water and Power Resources Services, U.S. Government Printing Office, Denver, CO, pp. 480.

5.0 RECORDS

All field notes for water level and well depth measurements will be recorded in accordance with SOP-019, *Field Activity Records*.

1.0 PURPOSE

The purpose of this Standard Operating Procedure is to delineate protocols for use of the chain-of-custody (COC) form.

2.0 SCOPE

This Standard Operating Procedure applies to all personnel responsible for collecting, shipping and analyzing environmental samples.

3.0 METHOD

3.1 General

COC forms are used to legally track samples from time of collection through completion of laboratory analysis.

3.2 Procedures

The following information will be preprinted on the COC form when possible:

- Project name;
- Name and address of laboratory; and
- Potential analysis and method numbers.

The following information will be written on the COC form by the sample controller/shipper:

- Site name;
- Name of receiving laboratory;
- Sample IDs for all samples in a particular cooler/shipping container;
- Sample matrix or matrix code (e.g., SO for soil);
- Sample type (environmental, trip blank, equipment blank, etc.), which is encrypted in the sample ID code;
- Analysis requested by method number unless other arrangements are made with the receiving laboratory;
- Number of containers;
- Quality Control (QC) required (to indicate the sample is to be used for matrix spike/matrix spike duplicate analyses);
- Date of collection (mm/dd/yy or m/dd/yy: 04/03/98 or 4/3/98 is April 3, 1998);
- Time of collection (military format);
- Signature of individual who prepares the COC form;
- Cooler identification (ID);
- Carrier service and airbill number; and

- Signature of individual relinquishing samples along with the date and time of relinquishment.

Upon completion of the form, retain two copies and affix the original and one copy to the inside of the sample cooler (in a Ziploc® bag to protect from moisture), to be sent to the designated laboratory.

4.0 REFERENCES

U.S. Environmental Protection Agency (EPA), December 1990. *Sampler's Guide to the Contract Laboratory Program*, USEPA/540/P-90/006, Directive 9240.0-06, Office of Emergency and Remedial Response, Washington, D.C.

EPA, January 1991. *User's Guide to the Contract Laboratory Program*, USEPA/540/0-91/002, Directive 9240.0-01D, Office of Emergency and Remedial Response, Washington, D.C.

EPA, *Guidelines and Specifications for Preparing Quality Assurance Project Plans.*

5.0 RECORDS

Distribution of the COC record will be:

- Original and one copy - sealed in plastic bag with a custody seal (initialed and dated) and taped inside the top of the shipping container;
- One copy - file in Project File; and
- One copy - submit to URS Database Manager.

6.0 ATTACHMENTS

A sample of a chain-of-custody form is attached.

1.0 PURPOSE

The purpose of this Standard Operating Procedure is to provide guidance for the packing and shipping of environmental samples with the appropriate chain-of-custody (COC) forms. This is in accordance with all applicable transportation regulations, analytical requirements, and proper COC forms.

2.0 SCOPE

This Standard Operating Procedure applies to all personnel involved in the packing and shipping of environmental samples. Samples determined to be hazardous will be managed in accordance with the requirements of the U.S. Department of Transportation (DOT) and the International Air Transportation Association (IATA) for shipping hazardous/dangerous goods by land or air.

3.0 METHOD

3.1 General

Environmental samples and quality control samples are collected, labeled, and sealed in the field, and COC is maintained, as defined in SOP-015, *Field Sample Management.*

40 Code of Federal Regulations (CFR) Part 261.4 describes sample shipping requirements. It states that:

> "... a sample of solid waste or a sample of water, soil, or air, which is collected for the sole purpose of testing its characteristics or composition, is not subject to any requirements of this part (hazardous materials shipping requirements)... when:
>
> (i) The sample is being transported to a laboratory for the purpose of testing; or
>
> (ii) The sample is being transported back to the sample collector after testing.
>
> In order to qualify for the(se) exemption(s)..., a sample collector shipping samples to a laboratory and a laboratory returning samples to a sample collector must:
>
> (i) Comply with DOT, U.S. Postal Service (USPS), or any other applicable shipping requirements; or
>
> (ii) Comply with the following requirements if the sample collector determines that DOT, USPS, or other shipping requirements do not apply to the shipment of the sample:
>
> (A) Assure that the following information accompanies the sample:
>
> (1) The sample collector's name, mailing address, and telephone number;

(2) The laboratory's name, mailing address, and telephone number;

(3) The quantity of the sample;

(4) The date of shipment; and

(5) A description of the sample.

(B) Package the sample so that it does not leak, spill, or vaporize from its packaging. The URS Hazardous Materials Shipping Hotline can be reached at 1.800.381.0664. Shipping experts are available via the hotline to answer any shipping questions you may have.

Samples will be assessed to determine potential hazard. Potentially hazardous samples are required by law to be properly handled and labeled.

PID readings greater than 1,000 parts per million will be used to identify a sample as hazardous. These measurements should be made on the sample headspace or directly over the sample as it is being collected. Good judgement on the part of the sample coordinator is also necessary to identify hazardous samples. Samples collected from chemical or fuel drums and tanks, stained or otherwise obviously contaminated soil, free product from a well, leachates, sludges, and samples with headspace readings noted above are all hazardous samples. Hazardous waste samples will be shipped according to DOT and IATA regulations.

Samples determined to be non-hazardous by the Sample Coordinator are environmental samples. They are to be labeled, packaged, documented, and shipped as described in Section 4.3.

3.2 Procedures

Determine the maximum allowable weight of each cooler (Federal Express limit for Priority Overnight shipping is 150 pounds).

Place each container in a Ziploc® bag and seal, squeezing as much air as possible from the bag before closing. Glass bottles and jars will be wrapped in bubble wrap.

Tape the cooler's drain plug shut on the inside and the outside.

Place a large size plastic bag (trash bag) in the cooler to contain samples.

Place the bottles upright in the plastic bag, with enough room for ice bags to be placed among and around the containers, and insulate with enough bubble wrap to deter breakage.

Place ice (double-bagged) among the containers along the walls and top of each cooler in a manner to ensure uniform cooling. For water samples, it is possible to place the bottles upright in absorbent material to provide additional stability. Do not use Blue Ice, as its heat capacity is lower than regular ice. If the Sample Shipper/Controller is informed by the laboratory that the samples are not being chilled sufficiently, additional ice may be required. Note that in summer months, more ice may be needed to ensure the samples arrive cold at the laboratory.

If shipping via commercial carrier (e.g., Federal Express), write the carrier's airbill number on the COC form, place the appropriate pages of the COC form inside a Ziploc® bag, and seal the bag with a signed, dated custody seal. The COC form has three pages. The original and one copy are sealed inside the Ziploc® bag and placed inside the cooler. One copy goes to project data management, and one copy (made by the Field Manager) is placed in field files. The COC form sent to the laboratory must be completed with all designated information, the pages must be originals (not photocopies), and the COC must be unique to the samples contained in the cooler.

If a courier from the laboratory is collecting the samples and delivering them to the laboratory, have the courier confirm that all samples listed are present and then sign the COC form.

Tape the Ziploc® bag with the COC form to the inside lid of the cooler, and close and latch the cooler.

Wrap strapping tape completely around the cooler on both sides of the latch.

Affix the shipping label with the address and telephone number of the laboratory and the contractor.

Affix signed custody seals on the front right and back left of the cooler across the lid, so as to tear if the cooler is opened during shipping.

The laboratory should be notified if the samples are being delivered via courier. They should be prepared to receive and check the samples and sign the COC form as the sample receiver.

4.0 REFERENCES

40 CFR 261.4, July 1990, Identification and Listing of Hazardous Waste, Federal Register, Chapter 1, p. 35.

Environmental Resource Center, 1992. *Hazardous Waste Management Compliance Handbook*, Van Nostrand Reinhold, New York.

EPA, 1987. *A Compendium of Superfund Field Operation Methods*, Office of Solid Waste and Emergency Response, Directive 9355.0-14.

USEPA, 1985. *Characterization of Hazardous Waste Sites: A Method Manual*, Vol. I, Site Investigation.

USEPA, 1986. *RCRA Groundwater Monitoring Technical Enforcement Guidance Document*.

5.0 RECORDS

Completed COC form.

1.0 PURPOSE

The purpose of this Standard Operating Procedure is to provide the step-by-step procedures for field decontamination of equipment. Decontamination of equipment and personal protective equipment (PPE) is designed to ensure that the introduction and transfer of contamination is minimized.

2.0 SCOPE

This Standard Operating Procedure applies to all personnel collecting environmental samples or operating in environments in which hazardous or contaminating substances are expected to be present.

3.0 METHOD

3.1 General

Decontamination consists of physically removing contaminants. To prevent the transfer of harmful materials and unwanted cross contamination, decontamination procedures continue throughout site operations.

A decontamination plan should be based on the worst-case scenario (if information about the site is limited). The plan can be modified if justified by supplemental information obtained as the field program evolves. Initially, the decontamination plan assumes all protective clothing and equipment that leave the exclusion zone are contaminated. Based on this assumption, a system is established to wash and rinse all non-disposable equipment. This Standard Operating Procedure will serve as the site decontamination plan.

The type of decontamination procedures and solutions needed at each site should be determined after considering the following project-specific conditions:

- The type of equipment to be decontaminated;
- The type of contaminant(s) present; and
- Extent of contamination.

3.2 Procedures

All sampling equipment used at the site must be decontaminated both before activities begin and after each sample is collected. All drilling equipment must be decontaminated both before activities begin and between each location.

3.2.1 Decontamination Site

Central decontamination areas for drill rigs and other large equipment may be established onsite. A decontamination area will be chosen so that decontamination fluids and soil wastes can be easily discarded or discharged into controlled areas of accumulation. A full-scale decontamination pad will be constructed. At a minimum, the pad must consist of a bermed liner large enough for equipment, have a nearby source of potable water, have a containment system for rinse water, and be equipped with a steam cleaner. After completion of drilling at a site, signs of gross contamination (if any) will be removed from the drill rig prior to moving the rig.

Smaller decontamination tasks, such as for groundwater, soil, and surface water/sediment sampling equipment, may take place at the sampling locations. In this case all required decontamination supplies and equipment will be mobilized to the site and all decontamination wastes containerized. Decontamination fluids will be disposed of according to WI-020, *Investigation-Derived Wastes.*

3.2.2 Decontamination Equipment

The following is a list of equipment that may be needed to perform decontamination:

- Bermed concrete or synthetic material-lined decontamination pad;
- Brushes (including long-handled brushes), garden-type water sprayers (without oil-lubricated moving parts), rinse bottles, flat-bladed scrapers;
- Portable steam cleaner;
- Sump or collection system for contaminated liquid;
- Wash tubs and buckets;
- Drums or tanks for containing decontamination fluids and solids; and
- Non-phosphate detergent,
- American Society for Testing and Materials (ASTM) Type II reagent grade water, isopropanol, methanol, hexane, or nitric acid.

3.2.3 Decontamination Procedure

3.2.3.1 Sample Bottles and Jars

At the completion of each sampling activity the outside of each sample bottle or jar must be decontaminated as follows:

- Be sure that the bottle or jar lids are snug.
- Wipe the outside of the bottle with a paper towel, if necessary to remove visible sample material from the bottle or jar.

3.2.3.2 Personnel and Personal Protective Equipment

Review the project HSP for appropriate personnel decontamination requirements.

3.2.3.3 Sampling Equipment

Note: See Section 4.3.3.6 for groundwater sampling pump decontamination.

The following steps will be used to decontaminate small sampling equipment:

- Decontamination personnel will wear the appropriate personal protective equipment as required by the contractor specific HASP.
- The sequence of actual decontamination will be as follows:

  – Gross contamination on equipment will be scraped off at the sampling site.

  – Water-resistant equipment is placed in a wash tub containing Liquinox, or equivalent laboratory-grade detergent with potable water, and scrubbed with a bristle brush or similar utensil.

  – Equipment will be thoroughly rinsed with potable water in a second wash tub, and then rinsed using an deionized water.

- Depending on site conditions and the number of samples collected at each location, rinse and detergent water may be replaced with new solutions between boreholes or sample locations.
- Following decontamination, equipment will be placed in a clean area to prevent contact with contaminated soil. All equipment should be allowed time to dry before re-use. If the equipment is not used immediately, it will be covered or wrapped in aluminum foil after drying to minimize potential airborne contamination.

3.2.3.4 Measurement Devices/Monitoring Equipment

Any delicate instrument that cannot be decontaminated easily should be protected while it is being used. These instruments can be covered with plastic sheeting, plastic bags, or aluminum foil to minimize contamination of the instrument. Openings can be made in the wrapping for sample intake.

3.2.3.5 Bailers

3.2.3.6 Groundwater Sampling Pumps

Proper pump decontamination between wells is essential for the integrity of samples. The following steps will be adhered to during decontamination:

- Potable water with a non-phosphate detergent such as Liquinox will be flushed through the pump and over the outside of the hoses. A minimum of three pump tubing volumes of soapy water will be purged through the pump.

- Potable water will then be flushed through the pump and over the outside of the hoses. A minimum of three pump tubing volumes of potable water will be purged through the pump to assure that all of the detergent solution has been removed.

- At least two pump tubing volumes of deionized water will then be flushed through the pump. When applicable, the pump may then be used for the collection of an equipment blank.

- The pump is then allowed to dry and stored in the equipment area.

3.2.3.7 Drilling and Subsurface Soil Sampling Equipment

Drilling equipment, including the rig, augers, drill rods, and split-spoon samplers will be decontaminated by the drilling contractor prior to any drilling operations and between borings. Decontamination will take place at the fixed decontamination pad. All external surfaces of all drilling equipment, rigs, tools, drill bits, drilling stem, hoses, and all other appurtenant equipment will be thoroughly cleaned after each hole is completed. All tools used for soil sampling (i.e., split-spoon, split-barrel, Hydropunch samplers) will be decontaminated as specified in Section 4.3.3.3 prior to the collection of each sample. When collecting samples for geotechnical analysis only, soil sampling equipment will be decontaminated in the same manner as other drilling tools.

All drilling rigs and tools will be steam cleaned prior to commencement of drilling activities. All fluids will be contained and managed. Decontamination begins by completely removing all soil and visible contamination (i.e., soil, mud, hydraulic fluid) from the equipment with a high pressure steam cleaner, and thoroughly flushing the interior and exterior of all downhole tools, including drill pipes, collars, bits and tremie pipe with fresh, clean, potable water. Decontamination will take place at the decontamination pad where all rinse water will be containerized for disposition.

3.2.3.8 Decontamination of Heavy Equipment

Heavy equipment (e.g., drill rigs, bulldozers, backhoes, and trucks) is generally washed with water under pressure, if possible. Portable steam cleaners and handwashing with a brush and detergent, followed by a potable water rinse, can also be used. Decontamination of heavy equipment will be conducted at the decontamination pad where all rinse water can be containerized for treatment. Particular care must be given to the components in direct contact with contaminants, such as tires and buckets. Wipe sampling may be utilized to establish effectiveness of decontamination procedures.

3.3 Investigative Derived Material

All materials and wastes generated during decontamination will be managed as described in SOP-020, *Investigation-Derived Waste*.

4.0 REFERENCES

U.S. Environmental Protection Agency (EPA). *A Compendium of Superfund Field Operations Methods,* Vols. I and II, USEPA/540/P 87/001a&b.

5.0 RECORDS

Sampling personnel will be responsible for documenting the decontamination of sampling and drilling equipment. The documentation will be recorded in the field logbooks as per SOP-019, *Field Activity Records*. The information entered in the field logbook concerning decontamination should include the following:

- Date, start and end times;
- Decontamination personnel;
- Decontamination solutions used;
- Equipment identification numbers; and
- General decontamination methods and observations.

6.0 ATTACHMENTS

Not applicable.

1.0 PURPOSE

The purpose of this Standard Operating Procedure is to establish guidelines for the use of a multiple parameter water quality meter such as the Horiba or U-52 or equivalent. Multiple parameter meters measure water quality parameters including pH, temperature, salinity, turbidity, dissolved oxygen (DO), oxidation reduction potential (ORP), and specific conductance (conductivity) in water during well purging, well development, and surface water sampling for chemical analysis.

2.0 SCOPE

This Standard Operating Procedure applies to all personnel who measure water quality parameters using a multiple parameter water quality meter.

3.0 METHOD

3.1 General

Water quality parameters such as pH, temperature, turbidity, DO, conductivity, ORP, and salinity are collected to determine conditions in surface or groundwater at a given location. A series of such determinations can be used to evaluate a variety of situations, from the performance of a groundwater treatment system to the spread of contaminant plume in groundwater. A multiple parameter water quality meter measures each of these parameters digitally. The pH is a primary parameter measured in the field to determine hydrogen-ion activity. It is measured using a glass electrode in combination with a reference potential. Temperature is measured because many water quality parameters vary with temperature. The solubility of oxygen is temperature dependent, as are all electrochemically determined water quality parameters (pH, conductivity).

Turbidity serves as a measure of suspended solids in a water sample. Since these suspended solids might result in elevated apparent concentrations of some contaminants (especially metals) to above levels of concern, the measurement of turbidity is a critical determination before collection of groundwater samples. Turbidity above acceptable levels will typically result in additional efforts to reduce the turbidity of the well water before collecting samples, since samples will be collected unfiltered unless otherwise approved.

DO is an indicator of the oxygen-consuming and oxygen-providing process taking place. It is an indicator of the biochemical processes occurring in the water and is related to the ORP. The most common membrane electrode (ME) meters for determining the DO in water are dependent upon electrochemical reactions. Under steady-state conditions, the current or potential can be correlated with DO concentration. Interfacial dynamics at the ME/sample interface are a factor in probe response and a significant degree of interfacial turbulence is necessary to avoid a “stagnant layer” at the interface and resulting biased determinations. For acceptable precision to be obtained, flow over the DO membrane should be constant, as in the case of a flow-through cell used for groundwater sampling or a flowing stream for stream sampling.

Specific conductance is the ability of a volume of a solution to conduct an electrical current as compared to the same volume of pure water. Chemically pure water has a very low electrical conductance, indicating that it is a good insulator. However, minute amounts of dissolved mineral matter (total dissolved solids, TDS) in water increase the electrical conductance of water. In dilute solutions, the specific conductance varies almost directly with the TDS content of the samples. Salinity of the sample is computed from conductivity data.

3.2 Procedures

3.2.1 Field Determinations Using a Multiple Parameter Water Quality Meter

3.2.1.1 Equipment

Equipment that will be used to collect water quality measurements using a multiple parameter water quality meter includes, but is not limited to, the following items:

- Multiple parameter water quality meter with power supply;
- Calibration solutions, as specified by the manufacturer;
- Calibration log form and field logbook for recording calibration;
- Clean sample containers (glass, plastic);
- Distilled or deionized water in wash bottle; and
- Operating manual for the multiple parameter water quality meter.

3.2.2.2 Calibration

The multiple parameter water quality meter may be calibrated in the field by using calibration solutions supplied by a commercial laboratory supply house. The specific calibration procedures in the owner's manual for the multiple parameter water quality meter should be followed. Generally, the calibration procedure involves measuring the value of a specific parameter in a standard calibration solution of a known value. The meter is typically calibrated to read the known value to within the acceptance criteria. The instrument should be calibrated prior to each workday of use. The initial instrument response and the final (calibrated) response will be recorded on the calibration log, along with the date and time of calibration. Calibration will be performed in accordance with the manufacturers' instructions..

3.2.2.3 Taking Measurements

After the unit is calibrated, it is ready for use. To take measurements, turn the unit on and gently place the probe in the water sample or connect to the flow cell. Typically, a select button can be pressed to toggle between the different parameters, if they are not all displayed on screen simultaneously.

Care should be exercised when handling the probes. The multiple parameter water quality meter should be lowered gently into the sample. The water quality meter should be allowed to stabilize for at least several seconds before collecting water quality parameter data. When conducting groundwater sampling, a flow-through cell should be used whenever possible to minimize wear and tear on the probes, eliminate the need for stabilization (since the electrode is constantly immersed in groundwater flowing over the probes), and improve the consistency of the readings. Multiple determinations as an indication of field precision should be conducted more frequently than every tenth reading if precision problems are apparent.

3.2.2.4 Storage

After using the water quality meter, thoroughly wash all probes with analyte free water. The turbidity sensor tube should be periodically washed out with a test tube brush and analyte free water, or according to the manufacturer’s instructions. The conductivity guard should be periodically removed to brush away any dirt from the sensor unit. If storing the unit for a week or less, fill the calibration cup with tap water (*not distilled or deionized water, which can damage the probes*) and fit the cap over it. For long-term storage, follow the manufacturer’s instructions.

3.2.2.5 Additional Considerations

Operators of field equipment should refer to the manufacturer’s instructions for step-by-step calibration and usage guidelines. Additional considerations of a general nature include:

- The water quality meter must be checked for mechanical and electrical failures, weak batteries, and cracked or fouled electrodes before field activities.

- Perform calibration using the appropriate solutions as described in the manufacturer’s instructions.

- Clean and rinse probes thoroughly using distilled or deionized water in a wash bottle between all samples and at the end of the day. Each time the electrodes are cleaned, they should be examined for damage.

- Some electrodes (e.g., pH and DO electrodes) must NOT be allowed to dry completely, as this may permanently alter the physical or electrochemical properties of the electrode surface.

- Note that oily samples are likely to result in fouling of the electrodes and more aggressive cleaning procedures (such as mild acid washing) will be required, as described in the manufacturer’s instruction manual. After such cleaning, a calibration check must be performed; typically such cleaning will necessitate recalibration.

4.0 REFERENCES

American Society for Testing and Materials (ASTM). *Tests for Dissolved Oxygen in Water,* Annual Book of ASTM Standards; Part 31, “Water,” Standard D888-92(A). Philadelphia, PA.

Instruction Manual, Horiba U-10 Water Quality Checker, Horiba Instruments, Inc.

USEPA, 1991. *Environmental Branch Standard Operating Procedures and Quality Assurance Manual*. EPA Region IV, Athens, GA.

USEPA, 1983. *Methods for Chemical Analyses of Water and Wastes.* Environmental Monitoring and Support Laboratory, Cincinnati, OH.

5.0 RECORDS

All field notes will be recorded in accordance with SOP-019, *Field Activity Records.*

6.0 ATTACHMENTS

Not applicable.

Appendix D
Field Forms

APS – FOUR CORNERS POWER PLANT GROUNDWATER SAMLING RECORD FOR CCR

Sample Year:

Well ID: ______________

Sample date:

Sampler(s):

WELL DATA

Weather conditions:

Well Depth (BMPT): _____ft. Screen Interval (BMPT): ____ – ____ ft.

MP Elevation: _________ ft. (Ground Surface)

Well Depth (BGS): _____ ft. Screen Interval: ____ – ____ ft.

Depth to Water:____________ ft. *BMPT* Total Depth ft BMPT:________

Pump set @: _____ ft. BMPT. Well Dia.: ____"

PURGE METHOD & VOLUME CALCULATION

Purge Method: Low/Flow______

No Purge _______

Available Sample: Pump Set BMPT: ____' - DTW (BMPT)________ x ___ L/ft = ______________Liters

Minimum Liters needed for Low/Flow Sample: ___ liters

L/ft = ((3.14 x Well Radius squared)x12) /61.02 " / L = L/ft

Volume of Purge Required**:**

1 System Volume = Tubing Length: ___'___" x Tubing ID Multiplier: 10 ml/ft = _____ plus Bladder: 125 ml = ____**ml /** ____ **liters**

Time:	Criteria								
Flow Rate (L):	50-500 ml/m								
Turbidity (NTU):	+/- 10%								
pH (SU):	+/- 0.1 SU								
Temperature (ºC):	+/- 3%								
Conductivity (µS/cm):	+/- 3%								
DO (mg/l):	+/- 10%								
ORP (mv):	+/- 20 mV								
Depth to Water ft:									
Volume Removed (L):									

Comments:

WELL WATER SAMPLE DISTRIBUTION FOR ANALYSIS

Sample ID / Time	Sample Bottles Required	Comments
________________________________	2 ea 250 ml/HNO3 1 ea 500 ml non preserve 1 ea 250 ml non preserve 2 ea 1L Pols	
Field Blank:___________________	Equipment Blank_______________________	

TestAmerica Phoenix
4625 E Cotton Center Blvd
Suite 189
Phoenix, AZ 85040
phone 602.437.3340 fax 602.454.9303

Chain of Custody Record

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Regulatory Program: ☐ DW ☐ NPDES ☐ RCRA ☑ Other: **CCR**

TestAmerica Laboratories, Inc.

Client Contact	**Doug Lavarnway**	**Doug Lavarnway**	**Date:**	COC No:
APS Cholla	**928-587-0319**	**Lab Contact:**	**Carrier:**	______ of ______ COCs
4801 Cholla Lake Rd	**Analysis Turnaround Time**			Sampler:
Joseph City, AZ 86032	☐ CALENDAR DAYS ☐ WORKING DAYS			**For Lab Use Only:**
(928) 587-0319 Phone	TAT if different from Below ________			Walk-in Client:
(xxx) xxx-xxxx FAX	☐ 2 weeks			Lab Sampling:
Project Name:	☐ 1 week			
Site:	☐ 2 days			Job / SDG No.:
P O #	☐ 1 day			

Sample Identification	Sample Date	Sample Time	Sample Type (C=Comp, G=Grab)	Matrix	# of Cont.	Filtered Sample (Y / N)	Perform MS / MSD (Y / N)	EPA 200.7 (B, Ca)	EPA 300.0 (Cl, F, SO4)	SM 2540C (TDS)	SM 4500-HB (pH)														Sample Specific Notes:
			G	W		N																			

Preservation Used: 1= Ice, 2= HCl; 3= H2SO4; 4=HNO3; 5=NaOH; 6= Other ____________

Possible Hazard Identification:
Are any samples from a listed EPA Hazardous Waste? Please List any EPA Waste Codes for the sample in the Comments Section if the lab is to dispose of the sample.

☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)

☐ Return to Client ☐ Disposal by Lab ☐ Archive for__________ Months

Special Instructions/QC Requirements & Comments:

Custody Seals Intact: ☐ Yes ☐ No

Custody Seal No.:

Cooler Temp. (°C): Obs'd:_________ Corr'd:__________ Therm ID No.:____________

Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received in Laboratory by:	Company:	Date/Time:

Form No. CA-C-WI-002, Rev. 4.2, dated 04/02/2013

TestAmerica Phoenix
4625 E Cotton Center Blvd
Suite 189
Phoenix, AZ 85040
phone 602.437.3340 fax 602.454.9303

Chain of Custody Record

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Regulatory Program: ☐ DW ☐ NPDES ☐ RCRA ☑ Other: **CCR**

TestAmerica Laboratories, Inc.

Client Contact	**Doug Lavarnway**	**Doug Lavarnway**	**Date:**	COC No:
APS Cholla	**928-587-0319**	**Lab Contact:**	**Carrier:**	_______ of ______ COCs

APS Cholla
4801 Cholla Lake Rd
Joseph City, AZ 86032
(928) 587-0319 Phone
(xxx) xxx-xxxx FAX
Project Name:
Site:
P O #

Analysis Turnaround Time
☐ CALENDAR DAYS ☐ WORKING DAYS
TAT if different from Below __________
☐ 2 weeks
☐ 1 week
☐ 2 days
☐ 1 day

Sampler:
For Lab Use Only:
Walk-in Client:
Lab Sampling:
Job / SDG No.:

Sample Identification	Sample Date	Sample Time	Sample Type (C=Comp, G=Grab)	Matrix	# of Cont.	Filtered Sample (Y / N)	Perform MS / MSD (Y / N)	EPA 200.7 (Be, Li)	200.8 (Sb, As, Ba, Cd, Cr, Co, Pb, Mo, Se, Tl)	932.0 Radium 226 and 228	EPA 245.1 (Hg)	EPA 300.0 (F)												Sample Specific Notes:
			G	W		N																		

Preservation Used: 1= Ice, 2= HCl; 3= H2SO4; 4=HNO3; 5=NaOH; 6= Other _____________

Possible Hazard Identification:
Are any samples from a listed EPA Hazardous Waste? Please List any EPA Waste Codes for the sample in the Comments Section if the lab is to dispose of the sample.

☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)

☐ Return to Client ☐ Disposal by Lab ☐ Archive for__________ Months

Special Instructions/QC Requirements & Comments:

Method 200.8 with collision cell

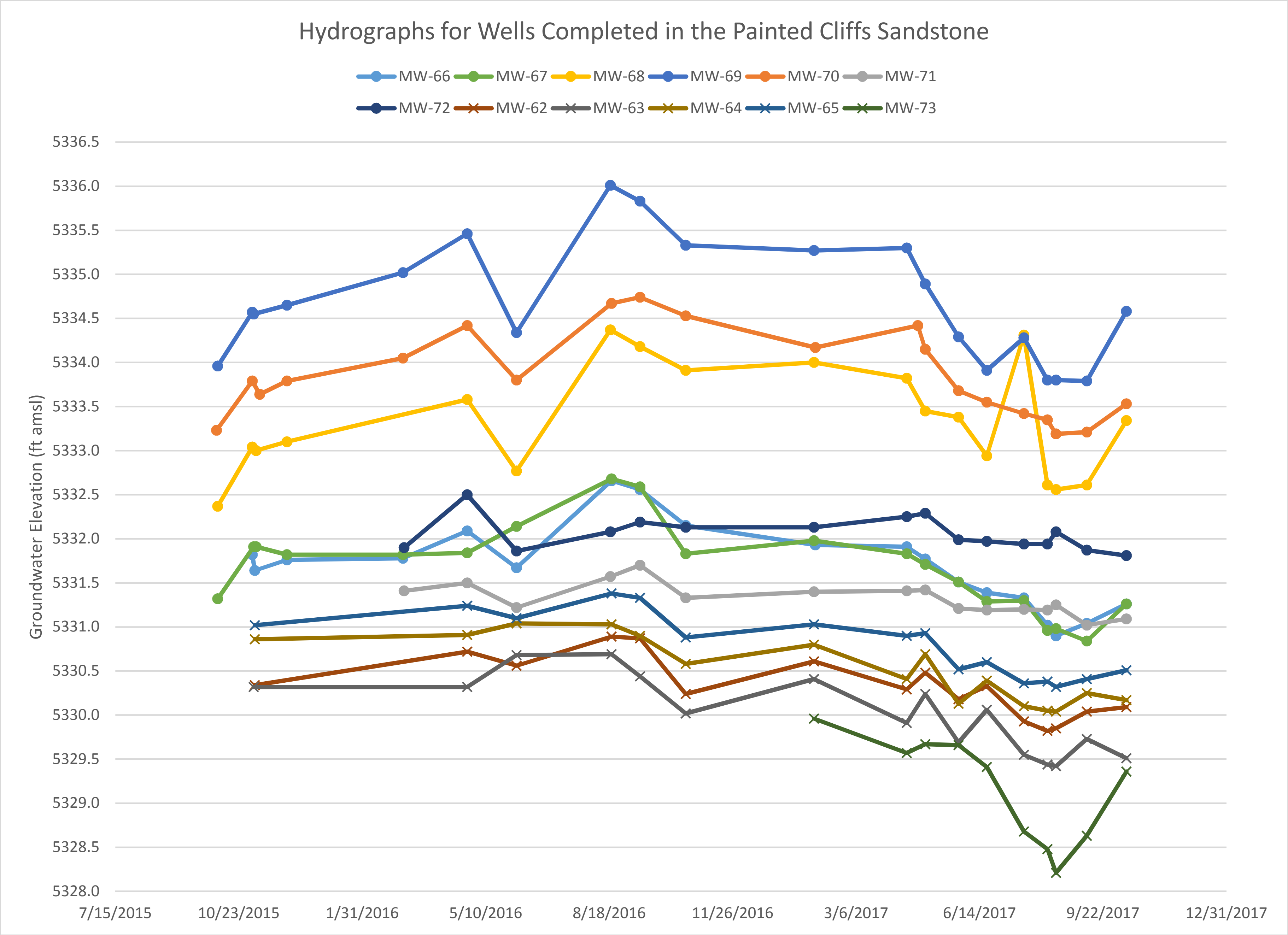
Custody Seals Intact: ☐ Yes ☐ No
Custody Seal No.:
Cooler Temp. (°C): Obs'd:_________ Corr'd:__________ Therm ID No.:____________

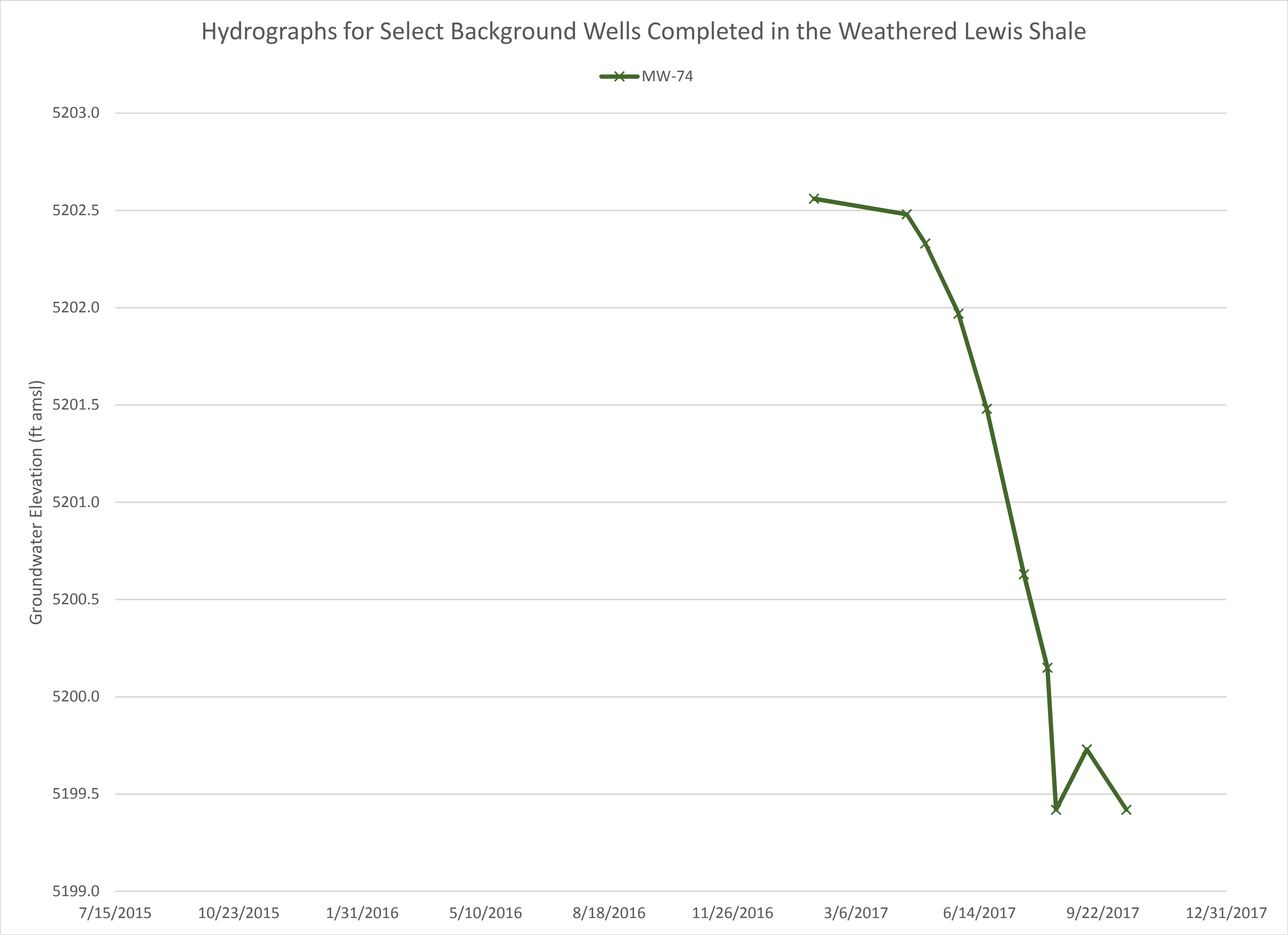
Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received in Laboratory by:	Company:	Date/Time:

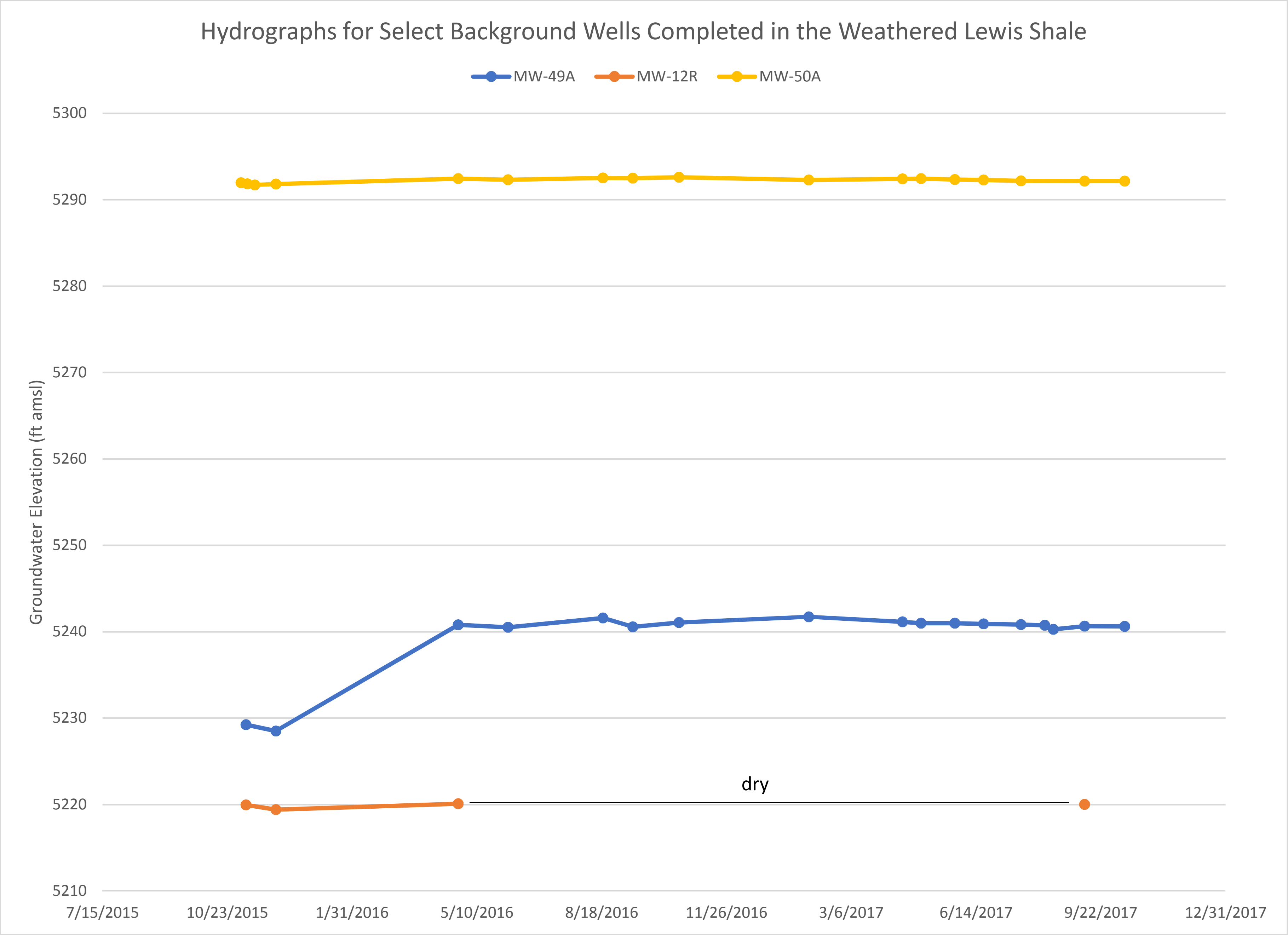
Form No. CA-C-WI-002, Rev. 4.2, dated 04/02/2013

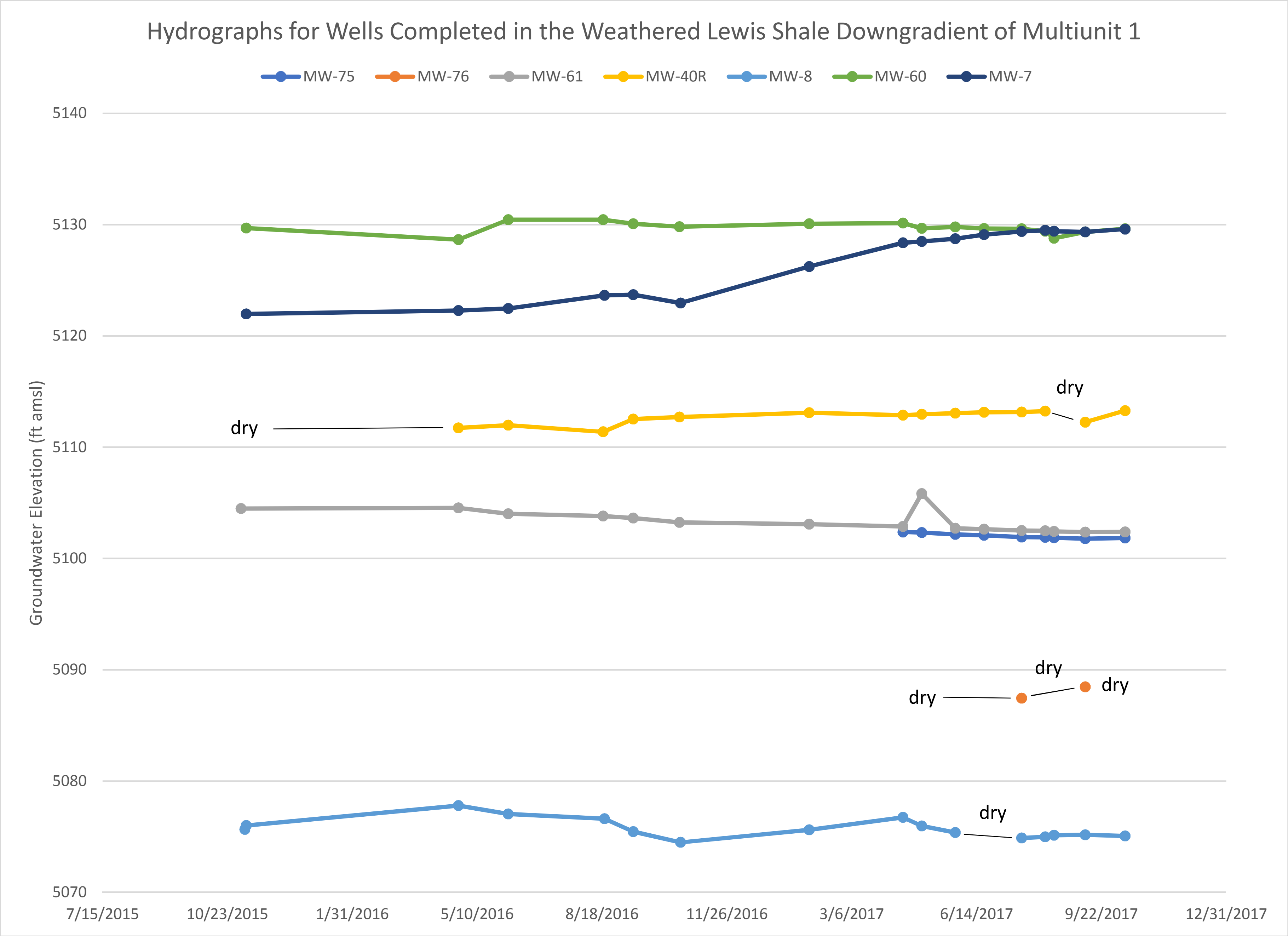
APPENDIX B

GROUNDWATER ELEVATION DATA AND HYDROGRAPHS


Hydrographs for Wells Completed in the Painted Cliffs Sandstone
MW-66
MW-67
MW-68
MW-69
MW-70
MW-71
MW-72
MW-62
MW-63
MW-64
MW-65
MW-73
Groundwater Elevation (ft amsl)
5336.5
5336.0
5335.5
5335.0
5334.5
5334.0
5333.5
5333.0
5332.5
5332.0
5331.5
5331.0
5330.5
5330.0
5329.5
5329.0
5328.5
5328.0
7/15/2015
10/23/2015
1/31/2016
5/10/2016
8/18/2016
11/26/2016
3/6/2017
6/14/2017
9/22/2017
12/31/2017


Hydrographs for Select Background Wells Completed in the Weathered Lewis Shale
MW-74
Groundwater Elevation (ft amsl)
5203.0
5202.5
5202.0
5201.5
5201.0
5200.5
5200.0
5199.5
5199.0
7/15/2015
10/23/2015
1/31/2016
5/10/2016
8/18/2016
11/26/2016
3/6/2017
6/14/2017
9/22/2017
12/31/2017


Hydrographs for Select Background Wells Completed in the Weathered Lewis Shale
MW-49A
MW-12R
MW-50A
Groundwater Elevation (ft amsl)
5300
5290
5280
5270
5260
5250
5240
5230
5220
5210
7/15/2015
10/23/2015
1/31/2016
5/10/2016
8/18/2016
11/26/2016
3/6/2017
6/14/2017
9/22/2017
12/31/2017
dry


Hydrographs for Wells Completed in the Weathered Lewis Shale Downgradient of Multiunit 1
MW-75
MW-76
MW-61
MW-40R
MW-8
MW-60
MW-7
Groundwater Elevation (ft amsl)
5140
5130
5120
5110
5100
5090
5080
5070
7/15/2015
10/23/2015
1/31/2016
5/10/2016
8/18/2016
11/26/2016
3/6/2017
6/14/2017
9/22/2017
12/31/2017
dry
dry
dry
dry
dry
dry

MW-7				
Date of Measurement	**Measuring Pt Elevation**	**Water Level**	**GW Elevation**	**Well TD**
11/7/2015	5149.32	27.35	5121.97	
4/25/2016	5149.32	27.04	5122.28	
6/4/2016	5149.32	26.85	5122.47	
8/20/2016	5149.32	25.68	5123.64	
9/12/2016	5149.32	25.61	5123.71	
10/20/2016	5149.32	26.36	5122.96	
1/31/2017	5149.32	23.08	5126.24	36.04
4/16/2017	5149.32	20.95	5128.37	
5/1/2017	5149.32	20.83	5128.49	
5/28/2017	5149.32	20.59	5128.73	
6/20/2017	5149.32	20.21	5129.11	
7/20/2017	5149.32	19.93	5129.39	
8/8/2017	5149.32	19.83	5129.49	
8/15/2017	5149.32	19.91	5129.41	
9/9/2017	5149.32	19.97	5129.35	
10/11/2017	5149.32	19.72	5129.6	

MW-8				
Date of Measurement	**Measuring Pt Elevation**	**Water Level**	**GW Elevation**	**Well TD**
11/6/2015	5122.56	46.9	5075.66	
11/7/2015	5122.56	46.56	5076	
4/25/2016	5122.56	44.76	5077.8	
6/4/2016	5122.56	45.52	5077.04	
8/20/2016	5122.56	45.95	5076.61	
9/12/2016	5122.56	47.11	5075.45	
10/20/2016	5122.56	48.07	5074.49	
1/31/2017	5122.56	46.94	5075.62	
4/16/2017	5122.56	45.82	5076.74	
5/1/2017	5122.56	46.59	5075.97	
5/28/2017	5122.56	47.19	5075.37	
6/20/2017	5122.56	Dry		
7/20/2017	5122.56	47.68	5074.88	
8/8/2017	5122.56	47.57	5074.99	
8/15/2017	5122.56	47.44	5075.12	
9/9/2017	5122.56	47.39	5075.17	
10/11/2017	5122.56	47.49	5075.07	

MW-12R				
Date of Measurement	**Measuring Pt Elevation**	**Water Level**	**GW Elevation**	**Well TD**
11/7/2015	5264.70	44.75	5219.95	
12/1/2015	5264.70	45.29	5219.41	
4/25/2016	5264.70	44.6	5220.10	
6/4/2016	5264.70	DRY		
8/20/2016	5264.70	DRY		
9/12/2016	5264.70	DRY		
10/19/2016	5264.70	DRY		
1/31/2017	5264.70	DRY		
4/16/2017	5264.70	DRY		
5/1/2017	5264.70	DRY		
5/28/2017	5264.70	DRY		
6/20/2017	5264.70	DRY		
7/20/2017	5264.70	DRY		
8/8/2017	5264.70	DRY		
8/15/2017	5264.70	DRY		
9/9/2017	5264.70	44.68		
10/11/2017	5264.70	DRY		

MW-40R				
Date of Measurement	**Measuring Pt Elevation**	**Water Level**	**GW Elevation**	**Well TD**
11/7/2015	5137.43	DRY		
4/25/2016	5137.43	25.7	5111.73	
6/4/2016	5137.43	25.46	5111.97	
8/19/2016	5137.43	26.05	5111.38	
9/12/2016	5137.43	24.9	5112.53	
10/19/2016	5137.43	24.72	5112.71	
1/31/2017	5137.43	24.34	5113.09	
4/16/2017	5137.43	24.56	5112.87	
5/1/2017	5137.43	24.47	5112.96	
5/28/2017	5137.43	24.38	5113.05	
6/20/2017	5137.43	24.29	5113.14	
7/20/2017	5137.43	24.26	5113.17	
8/8/2017	5137.43	24.19	5113.24	
8/15/2017	5137.43	Dry		
9/9/2017	5137.43	25.18	5112.25	
10/11/2017	5137.43	24.14	5113.29	

MW-49A		
Date of Measurement	**GW Elevation**	**Well TD**
11/7/2015	5229.25	
12/1/2015	5228.51	
4/25/2016	5240.79	
6/4/2016	5240.52	
8/19/2016	5241.58	
9/12/2016	5240.56	
10/19/2016	5241.06	
1/31/2017	5241.73	
4/16/2017	5241.14	
5/1/2017	5240.98	
5/28/2017	5240.98	
6/20/2017	5240.9	
7/20/2017	5240.83	
8/8/2017	5240.74	
8/15/2017	5240.28	
9/9/2017	5240.64	
10/11/2017	5240.62	

MW-50A				
Date of Measurement	**Measuring Pt Elevation**	**Water Level**	**GW Elevation**	**Well TD**
11/3/2015	5335.67	43.69	5291.98	
11/8/2015	5335.67	43.84	5291.83	
11/14/2015	5335.67	43.95	5291.72	
12/1/2015	5335.67	43.85	5291.82	
4/25/2016	5335.67	43.23	5292.44	
6/4/2016	5335.67	43.36	5292.31	
8/19/2016	5335.67	43.16	5292.51	
9/12/2016	5335.67	43.18	5292.49	
10/19/2016	5335.67	43.07	5292.6	
1/31/2017	5335.67	43.38	5292.29	
4/16/2017	5335.67	43.25	5292.42	
5/1/2017	5335.67	43.24	5292.43	
5/28/2017	5335.67	43.33	5292.34	
6/20/2017	5335.67	43.39	5292.28	
7/20/2017	5335.67	43.49	5292.18	
8/8/2017	5335.67	Dry		
8/15/2017	5335.67	Dry		
9/9/2017	5335.67	43.51	5292.16	
10/11/2017	5335.67	43.52	5292.15	

MW-60				
Date of Measurement	**Measuring Pt Elevation**	**Water Level**	**GW Elevation**	**Well TD**
11/7/2015	5144.10	14.41	5129.69	
4/25/2016	5144.10	15.45	5128.65	
6/4/2016	5144.10	13.66	5130.44	
8/19/2016	5144.10	13.66	5130.44	
9/12/2016	5144.10	14.02	5130.08	
10/19/2016	5144.10	14.28	5129.82	
1/31/2017	5144.10	14.03	5130.07	
4/16/2017	5144.10	13.96	5130.14	
5/1/2017	5144.10	14.43	5129.67	
5/28/2017	5144.10	14.30	5129.80	
6/20/2017	5144.10	14.45	5129.65	
7/20/2017	5144.10	14.47	5129.63	
8/8/2017	5144.10	14.69	5129.41	
8/15/2017	5144.10	15.33	5128.77	
9/9/2017	5144.10	14.76	5129.34	
10/11/2017	5144.10	14.47	5129.63	

MW-61				
Date of Measurement	**Measuring Pt Elevation**	**Water Level**	**GW Elevation**	**Well TD**
11/3/2015	5129.19	24.70	5104.49	
4/25/2016	5129.19	24.64	5104.55	
6/4/2016	5129.19	25.18	5104.01	
8/19/2016	5129.19	25.38	5103.81	
9/12/2016	5129.19	25.55	5103.64	
10/19/2016	5129.19	25.94	5103.25	
1/31/2017	5129.19	26.1	5103.09	
4/16/2017	5129.19	26.32	5102.87	
5/1/2017	5129.19	23.36	5105.83	
5/28/2017	5129.19	26.48	5102.71	
6/20/2017	5129.19	26.56	5102.63	
7/20/2017	5129.19	26.67	5102.52	
8/8/2017	5129.19	26.69	5102.50	
8/15/2017	5129.19	26.75	5102.44	
9/9/2017	5129.19	26.81	5102.38	
10/11/2017	5129.19	26.79	5102.40	

MW-62				
Date of Measurement	**Measuring Pt Elevation**	**Water Level**	**GW Elevation**	**Well TD**
11/5/2015	5341.87	11.53	5330.34	
4/25/2016	5341.87	11.15	5330.72	
6/4/2016	5341.87	11.31	5330.56	
8/20/2016	5341.87	10.98	5330.89	
9/12/2016	5341.87	11.00	5330.87	
10/19/2016	5341.87	11.63	5330.24	
1/31/2017	5341.87	11.26	5330.61	
4/16/2017	5341.87	11.58	5330.29	
5/1/2017	5341.87	11.39	5330.48	
5/28/2017	5341.87	11.69	5330.18	
6/20/2017	5341.87	11.54	5330.33	
7/20/2017	5341.87	11.94	5329.93	
8/8/2017	5341.87	12.05	5329.82	
8/15/2017	5341.87	12.02	5329.85	
9/9/2017	5341.87	11.83	5330.04	
10/11/2017	5341.87	11.78	5330.09	

MW-63				
Date of Measurement	**Measuring Pt Elevation**	**Water Level**	**GW Elevation**	**Well TD**
11/4/2015	5337.02	6.70	5330.32	
4/25/2016	5337.02	6.7	5330.32	
6/4/2016	5337.02	6.34	5330.68	
8/20/2016	5337.02	6.33	5330.69	
9/12/2016	5337.02	6.58	5330.44	
10/19/2016	5337.02	7.0	5330.02	
1/31/2017	5337.02	6.61	5330.41	
4/16/2017	5337.02	7.11	5329.91	
5/1/2017	5337.02	6.78	5330.24	
5/28/2017	5337.02	7.33	5329.69	
6/20/2017	5337.02	6.96	5330.06	
7/20/2017	5337.02	7.47	5329.55	
8/8/2017	5337.02	7.58	5329.44	
8/15/2017	5337.02	7.6	5329.42	
9/9/2017	5337.02	7.29	5329.73	
10/11/2017	5337.02	7.51	5329.51	

MW-64				
Date of Measurement	**Measuring Pt Elevation**	**Water Level**	**GW Elevation**	**Well TD**
11/5/2015	5337.66	6.80	5330.86	
4/25/2016	5337.66	6.75	5330.91	
6/4/2016	5337.66	6.62	5331.04	
8/20/2016	5337.66	6.63	5331.03	
9/12/2016	5337.66	6.76	5330.90	
10/19/2016	5337.66	7.08	5330.58	
1/31/2017	5337.66	6.86	5330.80	
4/16/2017	5337.66	7.25	5330.41	
5/1/2017	5337.66	6.97	5330.69	
5/28/2017	5337.66	7.53	5330.13	
6/20/2017	5337.66	7.27	5330.39	
7/20/2017	5337.66	7.56	5330.10	
8/8/2017	5337.66	7.61	5330.05	
8/15/2017	5337.66	7.62	5330.04	
9/9/2017	5337.66	7.41	5330.25	
10/11/2017	5337.66	7.49	5330.17	

MW-65				
Date of Measurement	**Measuring Pt Elevation**	**Water Level**	**GW Elevation**	**Well TD**
11/5/2015	5339.74	8.72	5331.02	
4/25/2016	5339.74	8.5	5331.24	
6/4/2016	5339.74	8.64	5331.10	
8/20/2016	5339.74	8.36	5331.38	
9/12/2016	5339.74	8.41	5331.33	
10/19/2016	5339.74	8.86	5330.88	
1/31/2017	5339.74	8.71	5331.03	
4/16/2017	5339.74	8.84	5330.90	
5/1/2017	5339.74	8.81	5330.93	
5/28/2017	5339.74	9.22	5330.52	
6/20/2017	5339.74	9.14	5330.60	
7/20/2017	5339.74	9.38	5330.36	
8/8/2017	5339.74	9.36	5330.38	
8/15/2017	5339.74	9.42	5330.32	
9/9/2017	5339.74	9.33	5330.41	
10/11/2017	5339.74	9.23	5330.51	

MW-66				
Date of Measurement	**Measuring Pt Elevation**	**Water Level**	**GW Elevation**	**Well TD**
11/3/2015	5344.69	12.87	5331.82	
11/5/2015	5344.69	13.05	5331.64	
12/1/2015	5344.69	12.93	5331.76	
3/4/2016	5344.69	12.91	5331.78	
4/25/2016	5344.69	12.6	5332.09	
6/4/2016	5344.69	13.02	5331.67	
8/20/2016	5344.69	12.03	5332.66	
9/12/2016	5344.69	12.13	5332.56	
10/19/2016	5344.69	12.54	5332.15	
2/1/2017	5344.69	12.76	5331.93	
4/16/2017	5344.69	12.78	5331.91	
5/1/2017	5344.69	12.92	5331.77	
5/28/2017	5344.69	13.18	5331.51	
6/20/2017	5344.69	13.3	5331.39	
7/20/2017	5344.69	13.36	5331.33	
8/8/2017	5344.69	13.67	5331.02	
8/15/2017	5344.69	13.79	5330.90	
9/9/2017	5344.69	13.65	5331.04	
10/11/2017	5344.69	13.43	5331.26	

MW-67				
Date of Measurement	**Measuring Pt Elevation**	**Water Level**	**GW Elevation**	**Well TD**
10/6/2015	5356.42	25.1	5331.32	
11/4/2015	5356.42	24.51	5331.91	
11/6/2015	5356.42	24.51	5331.91	
12/1/2015	5356.42	24.6	5331.82	
3/4/2016	5356.42	24.6	5331.82	
4/25/2016	5356.42	24.58	5331.84	
6/4/2016	5356.42	24.28	5332.14	
8/20/2016	5356.42	23.74	5332.68	
9/12/2016	5356.42	23.83	5332.59	
10/19/2016	5356.42	24.59	5331.83	
1/31/2017	5356.42	24.44	5331.98	
4/16/2017	5356.42	24.59	5331.83	
5/1/2017	5356.42	24.71	5331.71	
5/28/2017	5356.42	24.91	5331.51	
6/20/2017	5356.42	25.13	5331.29	
7/20/2017	5356.42	25.12	5331.3	
8/8/2017	5356.42	25.46	5330.96	
8/15/2017	5356.42	25.44	5330.98	
9/9/2017	5356.42	25.58	5330.84	
10/11/2017	5356.42	25.16	5331.26	

MW-68				
Date of Measurement	**Measuring Pt Elevation**	**Water Level**	**GW Elevation**	**Well TD**
10/6/2015	5353.58	21.21	5332.37	
11/3/2015	5353.58	20.54	5333.04	
11/6/2015	5353.58	20.58	5333	
12/1/2015	5353.58	20.48	5333.1	
4/25/2016	5353.58	20.0	5333.58	
6/4/2016	5353.58	20.81	5332.77	
8/19/2016	5353.58	19.21	5334.37	
9/12/2016	5353.58	19.4	5334.18	
10/19/2016	5353.58	19.67	5333.91	
1/31/2017	5353.58	19.58	5334	
4/16/2017	5353.58	19.76	5333.82	
5/1/2017	5353.58	20.13	5333.45	
5/28/2017	5353.58	20.20	5333.38	
6/20/2017	5353.58	20.64	5332.94	
7/20/2017	5353.58	19.27	5334.31	
8/8/2017	5353.58	20.97	5332.61	
8/15/2017	5353.58	21.02	5332.56	
9/9/2017	5353.58	20.97	5332.61	
10/11/2017	5353.58	20.24	5333.34	

MW-69				
Date of Measurement	**Measuring Pt Elevation**	**Water Level**	**GW Elevation**	**Well TD**
10/6/2015	5357.66	23.7	5333.96	
11/3/2015	5357.66	23.09	5334.57	
11/4/2015	5357.66	23.11	5334.55	
12/1/2015	5357.66	23.01	5334.65	
3/4/2016	5357.66	22.64	5335.02	
4/25/2016	5357.66	22.2	5335.46	
6/4/2016	5357.66	23.32	5334.34	
8/19/2016	5357.66	21.65	5336.01	
9/12/2016	5357.66	21.83	5335.83	
10/19/2016	5357.66	22.33	5335.33	
1/31/2017	5357.66	22.39	5335.27	
4/16/2017	5357.66	22.36	5335.3	
5/1/2017	5357.66	22.77	5334.89	
5/28/2017	5357.66	23.37	5334.29	
6/20/2017	5357.66	23.75	5333.91	
7/20/2017	5357.66	23.38	5334.28	
8/8/2017	5357.66	23.86	5333.8	
8/15/2017	5357.66	23.86	5333.8	
9/9/2017	5357.66	23.87	5333.79	
10/11/2017	5357.66	23.08	5334.58	

MW-70				
Date of Measurement	**Measuring Pt Elevation**	**Water Level**	**GW Elevation**	**Well TD**
10/5/2015	5371.12	37.89	5333.23	
11/3/2015	5371.12	37.33	5333.79	
11/9/2015	5371.12	37.48	5333.64	
12/1/2015	5371.12	37.33	5333.79	
3/4/2016	5371.12	37.07	5334.05	
4/25/2016	5371.12	36.7	5334.42	
6/4/2016	5371.12	37.32	5333.8	
8/20/2016	5371.12	36.45	5334.67	
9/12/2016	5371.12	36.38	5334.74	
10/19/2016	5371.12	36.59	5334.53	
2/1/2017	5371.12	36.95	5334.17	
4/25/2017	5371.12	36.7	5334.42	
5/1/2017	5371.12	36.97	5334.15	
5/28/2017	5371.12	37.44	5333.68	
6/20/2017	5371.12	37.57	5333.55	
7/20/2017	5371.12	37.7	5333.42	
8/8/2017	5371.12	37.77	5333.35	
8/15/2017	5371.12	37.93	5333.19	
9/9/2017	5371.12	37.91	5333.21	
10/11/2017	5371.12	37.59	5333.53	

MW-71				
Date of Measurement	**Measuring Pt Elevation**	**Water Level**	**GW Elevation**	**Well TD**
3/5/2016	5362.91	31.5	5331.41	
4/25/2016	5362.91	31.41	5331.5	
6/4/2016	5362.91	31.69	5331.22	
8/19/2016	5362.91	31.34	5331.57	
9/12/2016	5362.91	31.21	5331.7	
10/19/2016	5362.91	31.58	5331.33	
1/31/2017	5362.91	31.51	5331.4	
4/16/2017	5362.91	31.50	5331.41	
5/1/2017	5362.91	31.49	5331.42	
5/28/2017	5362.91	31.70	5331.21	
6/20/2017	5362.91	31.72	5331.19	
7/20/2017	5362.91	31.71	5331.2	
8/8/2017	5362.91	31.72	5331.19	
8/15/2017	5362.91	31.66	5331.25	
9/9/2017	5362.91	31.89	5331.02	
10/11/2017	5362.91	31.82	5331.09	

MW-72				
Date of Measurement	**Measuring Pt Elevation**	**Water Level**	**GW Elevation**	**Well TD**
3/5/2016	5381.62	49.72	5331.9	
4/25/2016	5381.62	49.12	5332.5	
6/4/2016	5381.62	49.76	5331.86	
8/19/2016	5381.62	49.54	5332.08	
9/12/2016	5381.62	49.43	5332.19	
10/19/2016	5381.62	49.49	5332.13	
1/31/2014	5381.62	49.49	5332.13	
4/16/2017	5381.62	49.37	5332.25	
5/1/2017	5381.62	49.33	5332.29	
5/28/2017	5381.62	49.63	5331.99	
6/20/2017	5381.62	49.65	5331.97	
7/20/2017	5381.62	49.68	5331.94	
8/8/2017	5381.62	49.68	5331.94	
8/15/2017	5381.62	49.54	5332.08	
9/9/2017	5381.62	49.75	5331.87	
10/11/2017	5381.62	49.81	5331.81	

MW-73				
Date of Measurement	**Measuring Pt Elevation**	**Water Level**	**GW Elevation**	**Well TD**
1/31/2017	5353.95	23.99	5329.96	
4/16/2017	5353.95	24.38	5329.57	
5/1/2017	5353.95	24.28	5329.67	
5/28/2017	5353.95	24.29	5329.66	
6/20/2017	5353.95	24.54	5329.41	
7/20/2017	5353.95	25.27	5328.68	
8/8/2017	5353.95	25.47	5328.48	
8/15/2017	5353.95	25.74	5328.21	
9/9/2017	5353.95	25.32	5328.63	
10/11/2017	5353.95	24.59	5329.36	

MW-74				
Date of Measurement	**Measuring Pt Elevation**	**Water Level**	**GW Elevation**	**Well TD**
1/31/2017	5219.09	16.53	5202.56	
4/16/2017	5219.09	16.61	5202.48	20.86
5/1/2017	5219.09	16.76	5202.33	
5/28/2017	5219.09	17.12	5201.97	
6/20/2017	5219.09	17.61	5201.48	
7/20/2017	5219.09	18.46	5200.63	
8/8/2017	5219.09	18.94	5200.15	
8/15/2017	5219.09	19.67	5199.42	
9/9/2017	5219.09	19.36	5199.73	
10/11/2017	5219.09	19.67	5199.42	

MW-75				
Date of Measurement	**Measuring Pt Elevation**	**Water Level**	**GW Elevation**	**Well TD**
4/16/2017	5126.80	24.42	5102.38	41.85
5/1/2017	5126.80	24.48	5102.32	
5/28/2017	5126.80	24.64	5102.16	
6/20/2017	5126.80	24.71	5102.09	
7/20/2017	5126.80	24.88	5101.92	
8/8/2017	5126.80	24.89	5101.91	
8/15/2017	5126.80	24.93	5101.87	
9/9/2017	5126.80	25.02	5101.78	
10/11/2017	5126.80	24.95	5101.85	

MW-76				
Date of Measurement	**Measuring Pt Elevation**	**Water Level**	**GW Elevation**	**Well TD**
4/16/2017	5116.23	DRY		29.34
5/1/2017	5116.23	DRY		
5/28/2017	5116.23	DRY		
6/20/2017	5116.23	DRY		
7/20/2017	5116.23	28.78	5087.45	
8/8/2017	5116.23	DRY		
8/15/2017	5116.23	DRY		
9/9/2017	5116.23	27.76	5088.47	
10/11/2017	5116.23	DRY		

APPENDIX C

ANALYTICAL LABORATORY REPORTS AND DATA VALIDATION REPORTS

This appendix is a separate file included with this submittal.