Arizona Public Service Four Corners Power Plant

Dry Fly Ash Disposal Area Site 4

Location Restrictions Demonstration Report

Prepared for : Arizona Public Service

AECOM Job No. 60587725 October 8, 2018

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Certification Statement for Location Restrictions:

- 40 CFR § 257.60 Placement above the uppermost aquifer
- 40 CFR § 257.61 Wetlands
- 40 CFR § 257.62 Fault areas
- 40 CFR § 257.63 Seismic impact zones
- 40 CFR § 257.64 Unstable Areas

CCR Unit: Arizona Public Service Company; Four Corners Power Plant; Dry Fly Ash Disposal Area Site 4

I, Alexander Gourlay, being a Registered Professional Engineer in good standing in the State of New Mexico, do hereby certify, to the best of my knowledge, information, and belief that the information contained in this certification has been prepared in accordance with the accepted practice of engineering. I certify, for the above-referenced CCR unit, that the demonstration regarding the location of the CCR unit less than 1.52 meters (5 feet) above the upper limit of the uppermost aquifer, the demonstration regarding the location of the CCR unit in the wetlands, the demonstration regarding the location of the CCR unit within 60 meters (200 feet) of the outermost damage zone of a fault that has had a displacement in Holocene time, the demonstration regarding the location of the CCR unit is not in an unstable area, as included in the Location Restrictions Demonstration Report dated October 8, 2018 meet the requirements of 40 CFR § 257.60(a), § 257.61(a), § 257.62(a), § 257.63(a), and § 257.64(a).

Alexander W. Gourlay, P.E.

Printed Name

October 8, 2018

Date



1 Introduction

Arizona Public Service Company (APS) contracted AECOM to assist in the location restrictions demonstrations of the proposed Dry Fly Ash Disposal Area (DFADA) Site 4 coal combustion residual (CCR) landfill at the Four Corners Power Plant (FCPP, the Plant) within the Navajo Nation, near Fruitland, New Mexico. Figure 1-1 shows the proposed location for DFADA Site 4 at the FCPP. This Demonstration Report documents location-specific conditions relevant to DFADA Site 4.

1.1 Report Purpose and Description

The purpose of this report is to document the location restrictions demonstration for the proposed DFADA Site 4. DFADA Site 4 is a lateral expansion of the existing DFADA landfill complex operated by APS. In 2015, the United States Environmental Protection Agency (EPA) finalized a rule (Rule) regulating CCRs under subtitle D of the Resource Conservation and Recovery Act (RCRA). As part of this Rule, owners and operators of lateral expansions of CCR units must obtain a certification from a qualified professional engineer stating that the demonstrations for the CCR unit meet the requirements relative to the uppermost aquifer, wetlands, fault areas, seismic impact zones, and unstable areas.

1.2 EPA Regulatory Requirements

On April 17, 2015 the United States Environmental Protection Agency issued 40 CFR Part 257 Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals from Electric Utilities; Final Rule (the Rule). Sections 257.60 through 257.64 define location restriction criteria for all lateral expansions of CCR units and require the owner or operator of the CCR unit to demonstrate that the unit meets minimum requirements for:

- a) Placement above the uppermost aquifer (§ 257.60);
- b) Location outside wetlands (§ 257.61);
- c) Location more than 60 meters (200 feet) from the outermost damage zone of a fault that has had displacement in Holocene time (§ 257.62);
- d) Location outside seismic impact zones (§ 257.63);
- e) Location away from unstable areas (§ 257.64).

Lateral expansions of CCR units, such as DFADA Site 4, are required to complete the location restrictions demonstration no later than the date of initial receipt of CCR in the CCR unit. APS currently plans to begin placing CCR in DFADA Site 4 in 2019.

1.3 Report Organization

This Demonstration Report is organized into the following sections:

	Report Section	Applicable CFR 40 Part 257 Citation
	Section 1 – Introduction	
•	Section 2 – Placement Above the Uppermost Aquifer	§ 257.60 Placement above the uppermost aquifer
	Section 3 – Location Relative to Wetlands	§ 257.61 Wetlands
	Section 4 – Location Relative to Fault Areas	§ 257.62 Fault areas

- Section 5 Location Relative to Seismic Impact Zones
- § 257.63 Seismic impact zones

§ 257.64 Unstable areas

- Section 6 Location Relative to Unstable Areas
- Section 7 Conclusions
- Section 8 Limitations
- Section 9 References
- Appendix A Wetlands Map
- Appendix B Unified Hazard Tool Summary

1.4 Facility Description

The FCPP is an electric generating station located within the Navajo Nation, in Fruitland, New Mexico. The FCPP is operated by APS and owned by a consortium of utility companies. The FCPP consists of two coal-fired electrical generating units, Units 4 and 5. Units 1, 2, and 3 ceased generation in 2013 and were then decommissioned. The two generating units are cooled by water from Morgan Lake, a man-made reservoir located immediately north of the Plant. Five existing CCR units are located at the FCPP: the Combined Waste Treatment Pond (CWTP) located immediately east of the Plant, the Lined Ash Impoundment (LAI) located approximately 1 mile west of the Plant, the Lined Decant Water Pond (LDWP) located approximately 1.5 miles west of the Plant and adjacent to the LAI, the Upper Retention Sump located immediately southeast of the Plant, and the DFADA, located approximately 2 miles southwest of the Plant and south of the LAI. Figure 1-1 shows the locations of these units.

The current DFADA configuration consists of three sites – Site 1, Site 2, and Site 3 – forming one CCR unit. Site 4 will be a lateral expansion of the existing DFADA configuration (Figure 1-1). Site 4 will be constructed adjacent to the south toe of DFADA Sites 1 and 2. Site 4 will have a leachate collection system overlying a composite liner. The leachate collection system is designed to facilitate the flow of leachate and runoff to either of two geomembrane-lined leachate ponds that are contiguous to and considered to be a part of the DFADA. The east and south slopes will be constructed at 4H:1V (horizontal:vertical) and the west slope will be 2.5H:1V. The north slope will tie into Sites 1 and 2.

40 CFR § 257.60 requires that all lateral expansions of CCR units must be constructed with a base that is located no less than 1.52 meters (5 feet) above the upper limit of the uppermost aquifer, unless the owner or operator demonstrates that there will not be an intermittent, recurring, or sustained hydraulic connection between any portion of the base of the CCR unit and the uppermost aquifer due to normal fluctuations in groundwater elevation (including the seasonal high water table).

Uppermost aquifer is defined by the Rule to mean the geologic formation nearest the natural ground surface that is an aquifer, as well as lower aquifers that are hydraulically interconnected with this aquifer within the facility's property boundary.

2.1 Methodology

This Location Restrictions Demonstration Report includes an assessment of the separation between the base of the proposed DFADA Site 4 footprint and the uppermost aquifer based on available data. The following information was reviewed to assess the proposed DFADA Site 4 vertical location relative to the uppermost aquifer:

- CCR Monitoring Well Network Report and Certification (AECOM 2017)
- Annual Groundwater Monitoring and Corrective Action Report for 2017 (Amec Foster Wheeler 2018)

2.2 Discussion and Conclusion

2.2.1 Base Elevation of the CCR Unit

The bottom of DFADA Site 4 will be graded at a slope of 2 percent from the east end of the site toward the west end of the site. The natural ground surface along the proposed DFADA Site 4 footprint slopes from east to west at an overall slope of approximately 3 percent between elevations ranging from approximate EL 5220 feet on the east to approximate EL 5150 feet on the west of the footprint.

The base of the proposed DFADA Site 4 footprint ranges from approximate EL 5200 feet in the northeast to EL 5155.0 feet in the center of the west side.

2.2.2 Groundwater Elevations

The closest wells to the proposed DFADA Site 4 footprint are MW-7, MW-10, MW-13, MW-44, MW-48, and MW-55R (Figure 2-1). Well MW-7 is considered to be downgradient of Multiunit 1 (LAI and LDWP) and is included here only to indicate nearby measured groundwater elevations. Well MW-55R is designated as a background well for the weathered Lewis shale although it is consistently dry. Wells MW-10, MW-13, MW-44, and MW-48 are considered to be downgradient of the DFADA landfill complex. Amec Foster Wheeler (2018) reports that "(t)he 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."

The wells were installed to monitor for the presence of groundwater in the vicinity of existing and future CCR units. None of the wells are within the proposed footprint of DFADA Site 4. Table 1 presents well data and the water level elevations in the wells (AECOM 2017, Amec Foster Wheeler 2018).

	Well Name					
	MW-7	MW-10	MW-13	MW-44	MW-48	MW-55R
Location Relative to Site 4	Northwest	Southwest	Northwest	West	Southwest	Northeast
Surface Elevation (ft)	5148.29	5149.65	5149.52	5145.15	5163.43	5241.36
Bottom of Screen (ft)	5113.62	5116.65	5094.55	5121.65	5103.43	5148.46
Screened In	Alluvium, Weathered Shale	Weathered Shale	Unweathered, Weathered Shale	Weathered Shale	Unweathered Shale	Weathered Shale
Measurement Date	MW-7	MW-10	MW-13	MW-44	MW-48	MW-55R
11/3-11/9, 11/14/2015	5121.97	Dry	Dry	Dry	Dry	Dry
4/25/2016	5122.28	Dry	Dry	Dry	Dry	Dry
9/12/2016	5123.71	Dry	Dry	Dry	Dry	Dry
10/19-10/20/2016	5122.96	Dry	Dry	Dry	Dry	Dry
1/31-2/1/2017	5126.24	Dry	Dry	Dry	Dry	Dry
5/1/2017	5128.49	Dry	Dry	Dry	Dry	Dry
9/9/2017	5129.35	Dry	Dry	Dry	Dry	Dry
10/11/2017	5129.60	Dry	Dry	Dry	Dry	Dry
Minimum Depth to Groundwater ¹ (ft)	18.69	>53.24	>54.97	>24.13	>60	>116

Fable 1 –	Well Data	and	Groundwater	Elevations	(ft)	l
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1) Elevations are presented in NAVD88.

2) For wells reported as "Dry," the depth to groundwater is calculated as the difference between the surface elevation and the bottom of the screen.

No groundwater is detected within or directly adjacent to the footprint of the proposed DFADA Site 4. The nearest adjacent well with measureable groundwater is MW-7, not included in the DFADA CCR groundwater monitoring program. MW-7 is located approximately 500 feet west of the existing DFADA Site 1 and approximately 1,500 feet northwest of the proposed DFADA Site 4. The highest measured groundwater elevation in MW-7 is 5129.60 feet, approximately 25 feet lower than the proposed lowest base elevation, on the west edge of the proposed DFADA Site 4, at approximate EL 5155 feet.

2.2.3 Separation from the Uppermost Aquifer

The absence of groundwater detections in adjacent CCR monitoring wells indicates that groundwater is not present in the alluvium or weathered shale within the footprint of the proposed DFADA Site 4.

Conclusion: Groundwater is not present in the alluvium or weathered shale within the footprint of the proposed DFADA Site 4. Therefore, the base of DFADA Site 4 is located greater than 1.52 meters (5 feet) above the groundwater level of the uppermost aquifer.

3 Location Relative to Wetlands

40 CFR § 257.61 requires that all lateral expansions of CCR units must not be located in wetlands. Wetlands are defined in 40 CFR § 232.2 as "those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas."

3.1 Methodology

A wetland delineation was performed in April 2012 and jurisdictional determinations of the wetlands identified have been reviewed and accepted by the U.S. Army Corps of Engineers and the Environmental Protection Agency (United States Department of the Interior, Office of Surface Mining Reclamation and Enforcement 2015). A map of wetlands identified at the FCPP in this study is presented in Appendix A.

3.2 Discussion and Conclusion

The 2015 Final Environmental Impact Statement (United States Department of the Interior, Office of Surface Mining Reclamation and Enforcement 2015) identified three ephemeral drainages located near the center of the DFADA complex, that they are not jurisdictional under the Clean Water Act Section 404, and that there are no wetlands in the vicinity of the proposed location of DFADA Site 4. The nearest identified wetland is approximately 0.5 miles northwest of the proposed Site 4 location and it covers an area of 0.07 acres; the wetland drains into a concrete-lined detention pond at the pumphouse and is non-jurisdictional.

Conclusion: There are no wetlands located within the proposed DFADA Site 4 footprint.

4 Location Relative to Faults

40 CFR § 257.62 requires that all lateral expansions of CCR units not be located within 60 meters (200 feet) of the outermost damage zone of a fault that has had displacement in Holocene time (beginning 11,700 years before present) unless the owner or operator demonstrates the an alternative setback distance of less than 60 meters (200 feet) will prevent damage to the structural integrity of the CCR unit.

4.1 Methodology

AECOM reviewed the Quaternary Faults and Folds database maintained by the United States Geological Survey (USGS) as part of the Holocene fault search (USGS 2018b). The Holocene epoch is the most recent subdivision of the Quaternary period and therefore any faults that have had displacement in the Holocene would also be included in the Quaternary period database. The Quaternary Faults and Folds database is the source for the faults used in the National Seismic Hazard Maps and contains information on faults and associated folds that are believed to be sources of M > 6 earthquakes during the Quaternary Period. AECOM searched the USGS Quaternary Fault and Fold Database for Category A and Category B faults in San Juan County, New Mexico. Fault categories are defined in Table 2. Fault categories A and B relate to the Rule; fault categories C and D describe less defined or non-tectonic features.

Category	Definition
А	Geologic evidence demonstrates the existence of a Quaternary fault of tectonic origin, whether the fault is exposed by mapping or inferred from liquefaction or other deformational features.
В	Geologic evidence demonstrates the existence of Quaternary deformation, but either (1) the fault might not extend deeply enough to be a potential source of significant earthquakes; or (2) the currently available geologic evidence is too strong to confidently assign the feature to Class C, but not strong enough to assign it to Class A.
С	Geologic evidence is insufficient to demonstrate (1) the existence of tectonic faulting, or (2) Quaternary slip or deformation associated with the feature.
D	Geologic evidence demonstrates that the feature is not a tectonic fault or feature; this category includes features such as joints, landslides, erosional or fluvial scarps, or other landforms resembling scarps, but of demonstrable non-tectonic origin.

4.2 Discussion and Conclusion

The USGS Quaternary Faults and Folds Database of the United States does not contain any Class A or Class B faults in San Juan County.

Conclusion: No faults with Holocene displacement are present within 200 feet of DFADA Site 4.

5 Location Relative to Seismic Impact Zones

40 CFR § 257.63 requires that all lateral expansions of CCR units not be located in seismic impact zones unless the owner or operator demonstrates that all structural components, including liners, leachate collection and removal systems, and surface water control systems, are designed to resist the maximum horizontal acceleration in lithified earth material for the site. The Rule defines a *seismic impact zone* as an area having a 2 percent or greater probability that the maximum expected horizontal acceleration, expressed as a percentage of the earth's gravitational pull (g), will exceed 0.10 g in 50 years.

5.1 Methodology

The USGS maintains the Unified Hazard Tool website to provide access to the source and attenuation models for locations within the United States. AECOM utilized version 4.0.x of the 2014 Unified Hazard Tool to calculate the peak horizontal ground acceleration (PGA) with a 2 percent probability of exceedance in 50 years (USGS 2018a) for the proposed DFADA Site 4 location. The Unified Hazard Tool result is presented in Appendix B.

5.2 Discussion and Conclusion

The PGA with a 2 percent probability of exceedance in 50 years for DFADA Site 4 is 0.0745g. This value is less than the Rule-required threshold value of 0.10 g in 50 years.

Conclusion: DFADA Site 4 is not located in a seismic impact zone.

6-1

6 Location Relative to Unstable Areas

40 CFR § 257.64 requires that any lateral expansion of a CCR unit must not be located in an unstable area unless the owner or operator demonstrates that recognized and generally accepted good engineering practices have been incorporated into the design of the CCR unit to ensure that the integrity of the structural components of the CCR unit will not be disrupted. The owner or operator must consider the following factors when determining whether the area is unstable:

- 1) On-site or local soil conditions that may result in significant differential settling;
- 2) On-site or local geologic or geomorphologic features; and
- 3) On-site or local human-made features or events (both surface and subsurface).

Structural components mean liners, leachate collection and removal systems, final covers, run-on and run-off systems, inflow design flood control systems, and any other component used in the construction and operation of the CCR unit that is necessary to ensure the integrity of the unit and that the contents of the unit are not released into the environment.

Unstable area means a location that is susceptible to natural or human-induced events or forces capable of impairing the integrity, including structural components of some or all of the CCR unit that are responsible for preventing releases from such unit. Unstable areas can include poor foundation conditions, areas susceptible to mass movements, and karst terrains.

6.1 Methodology

The location of DFADA Site 4 relative to unstable areas was assessed by reviewing design and construction documentation, historic geological and geotechnical investigations in and near the DFADA Site 4 footprint, and engineering analyses (safety factor calculations). Information was reviewed to assess: 1) whether poor foundation conditions may exist and whether or not they could result in inadequate foundation support for Site 4; and 2) whether areas susceptible to mass movement (such as subsidence, landslides, avalanches, debris slides and flows, block sliding, or rock falls) capable of impairing the integrity of the structural components of DFADA Site 4 are present.

6.2 Discussion and Conclusion

6.2.1 Geologic Setting

The FCPP is located on the western flank of the San Juan Basin, in the Colorado Plateau physiographic province in northwestern New Mexico. The San Juan Basin is a structural basin approximately 100 miles from north to south and 90 miles from east to west underlain by laterally extensive, gently dipping to flat-lying sedimentary rocks of Late Cretaceous age. The northwestern boundary of the San Juan Basin is defined by the Hogback Monocline. The Hogback Monocline is a structural monocline where the generally horizontal to gently dipping Cretaceous sedimentary rock units in the area are uplifted into a one-sided fold which dips steeply (approximately 38 degrees) to the east. The resulting bedrock ridge approximately 3 miles west of the Plant is composed of younger rock units on the eastern flank and progressively older units exposed in the central and western portions of the Hogback.

Karst terrain is not known to be present beneath the FCPP or DFADA Site 4 footprint based on the predominance of shale and sandstone in the area.

6.2.2 Foundation Conditions

DFADA Site 4 will be constructed in a shallow excavation and founded on native soil. Site 4 is expected to be underlain by hard weathered shale. The native soils and shale within the proposed footprint appear to be competent materials based on nearby well logs (AECOM 2017). Based on knowledge of the site and available geologic information, AECOM does not believe that the presence of DFADA Site 4 would cause significant differential settling across the weathered shale underlying the site. There do not appear to be other unfavorable geologic or geomorphological features beneath the proposed DFADA Site 4 footprint, nor is AECOM aware of any unfavorable surface or subsurface human-made features or events beneath DFADA Site 4.

6.2.3 Areas Susceptible to Mass Movement

The topography surrounding the DFADA consists of steep sandstone cliffs, DFADA Site 1, and DFADA Site 2. The adjacent sandstone cliffs and underlying shale do not appear to exhibit sufficient potential for abrupt or differential movement that would compromise the performance of Site 4. Site 4 will be tied into Sites 1 and 2 as construction progresses, thereby eliminating the possibility of mass movement along the northern boundary of the cell. The east and south slopes will be constructed at 4H:1V and the west slope will be 2.5H:1V to minimize the likelihood of mass movement beyond the design footprint.

Surface water run-on is collected around the DFADA complex with an engineered diversion channel as described in the Dry Fly Ash Disposal Area Run-On and Run-Off Control System Plan (AECOM 2016). The diversion channel was designed to intercept the 24-hour, 100-year run-on storm flows from the area north and east of the DFADA.

Conclusion: DFADA Site 4 is not located in an unstable area.

7 Conclusions

Based on the findings and results of the location restrictions demonstrations, AECOM provides the following conclusions for the proposed DFADA Site 4:

- The base of DFADA Site 4 is located greater than 1.52 meters (5 feet) above the groundwater level of the uppermost aquifer.
- There are no wetlands located within the proposed DFADA Site 4 footprint.
- No faults with Holocene displacement are present within 200 feet of DFADA Site 4.
- DFADA Site 4 is not located in a seismic impact zone.
- DFADA Site 4 is not located in an unstable area.

8 Limitations

This report is for the sole use of APS on this project only and is not to be used for other projects. In the event that conclusions based upon the data obtained in this report are made by others, such conclusions are the responsibility of others. The Certification of Professional Opinion is limited to the information available to AECOM at the time this report was written. This report was written in accordance with current practice and the standard of care. Standard of care is defined as the ordinary diligence exercised by fellow practitioners in this area performing the same services under similar circumstances during the same period. Professional judgments presented herein are primarily based on information from previous reports that were assumed to be accurate partly based on knowledge of the site and partly based on our general experience with similar evaluations performed for similar structures. No warranty or guarantee, either express or implied, is applicable to this work.

The use of the words "certification" and/or "certify" in this document shall be interpreted and construed as a Statement of Professional Opinion and are not and shall not be interpreted or construed as a guarantee, warranty, or legal opinion.

9 References

- AECOM, 2016. "Four Corners Power Plant Dry Fly Ash Disposal Area Run-On and Run-Off Control System Plan."
- AECOM, 2017. "CCR Monitoring Well Network Report and Certification, Four Corners Power Plant, Fruitland, New Mexico." September 18.
- Amec Foster Wheeler, 2018, "Annual Groundwater Monitoring and Corrective Action Report for 2017," Prepared for Arizona Public Service, January 29.
- United States Geological Survey (USGS), 2018a. *Unified Hazard Tool Conterminous U.S. 2014 (v4.0.x)*. <u>https://earthquake.usgs.gov/hazards/interactive/</u>. Accessed July 31, 2018.
- United States Geological Survey (USGS), 2018b. *Quaternary Fault and Fold Database of the United States*. <u>https://earthquake.usgs.gov/hazards/qfaults/</u>. Accessed August 2, 2018.
- United States Department of the Interior Office of Surface Mining Reclamation and Enforcement, 2015. "Final Environmental Impact Statement (EIS) for the Four Corners Power Plant and Navajo Mine Energy Project." May 1.

Location Restrictions Demonstration Report Dry Fly Ash Disposal Area Site 4 Four Corners Power Plant Arizona Public Service

Figures



AECOM Figure 1-1

SITE VICINITY MAP

FOUR CORNERS POWER PLANT DFADA SITE 4 LOCATION RESTRICTIONS ARIZONA PUBLIC SERVICE Project No.: 60587725



AECOM Figure 2-1

WELL LOCATION MAP

FOUR CORNERS POWER PLANT DFADA 4 LOCATION RESTRICTIONS ARIZONA PUBLIC SERVICE Project No.: 60587725 Location Restrictions Demonstration Report Dry Fly Ash Disposal Area Site 4 Four Corners Power Plant Arizona Public Service

> Appendix A. Wetlands Map



Four Corners Power Plant and Navajo Mine Energy Project

> ENVIRONMENTAL SETTING & CONSEQUENCES

Figure 4.5-7

Jurisdictional Waters of the US in the Vicinity of the FCPP Proposed Ash Disposal Facility



*Observed Ordinary High Water Mark without jurisdiction is considered isolated.

Location Restrictions Demonstration Report Dry Fly Ash Disposal Area Site 4 Four Corners Power Plant Arizona Public Service

> Appendix B. Unified Hazard Tool Summary

Unified Hazard Tool

Please do not use this tool to obtain ground motion parameter values for the design code reference documents covered by the <u>U.S. Seismic Design Maps web tools</u> (e.g., the International Building Code and the ASCE 7 or 41 Standard). The values returned by the two applications are not identical.

↑ Input			
Edition Conterminous U.S. 2014 (v4.0.x)	Spectral Period Peak ground acceleration		
Latitude Decimal degrees	Time Horizon Return period in years		
36.675	2475		
Longitude Decimal degrees, negative values for western long -108.504			
Site Class			
760 m/s (B/C boundary)			

