Arizona Public Service
Cholla Power Plant

Bottom Ash Pond

Location Restrictions Demonstration Report

Prepared for :
Arizona Public Service

AECOM Job No. 60587726
October 8, 2018

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Certification Statement

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; Cholla Power Plant; Bottom Ash Pond

I, Alexander Gourlay, being a Registered Professional Engineer in good standing in the State of Arizona, 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 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 in a seismic impact zone, and the demonstration that the location of the CCR unit is not in an unstable area, as included in the Location Restrictions Demonstration Report dated October 8, 2018 meets the requirements of 40 CFR § 257.61(a), § 257.62(a), § 257.63(a), and § 257.64(a). 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 does not meet the requirements of 40 CFR § 257.60(a),

Alexander W. Gourlay, P.E.

Printed Name

October 8, 2018

Date

Registered Professional Engineer (Civil)
CERTIFICATE NO.
22867
ALEXANDER W.
GOURLAY
Date Signed 10-8-18
ARIZONA, U.S.A.

1 Introduction

Arizona Public Service Company (APS) contracted AECOM to assist in the location restriction demonstrations of the existing coal combustion residual (CCR) surface impoundments at the Cholla Power Plant (Cholla, the Plant) near Joseph City, in Navajo County, Arizona. Figure 1-1 shows the location of the CCR Impoundments at Cholla. This Demonstration Report documents location-specific conditions relevant to the Bottom Ash Pond.

1.1 Report Purpose and Description

The purpose of this report is to document the location restriction demonstration for the Bottom Ash Pond. The Bottom Ash Pond is an existing CCR surface impoundment owned and 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 existing surface CCR impoundments 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 existing CCR surface impoundments 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).

Existing CCR surface impoundments, such as the Bottom Ash Pond, are required to demonstrate compliance with the location restrictions by October 17, 2018. An owner or operator unable to demonstrate compliance is prohibited from placing CCR in the CCR unit under either 40 CFR § 257.60(c)(4), § 257.61(c)(4), § 257.62(c)(4), § 257.63(c)(4), or § 257.64(c)(4), as applicable unless the owner or operator complies with the alternative closure procedures specified in 40 CFR § 257.103.

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
• Section 6 – Location Relative to Unstable Areas	§ 257.64 Unstable areas
• Section 7 – Conclusions	
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• Section 9 – References	
• Appendix A – Construction Plans	
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• Appendix C – National Wetlands Inventory Map	
• Appendix D – AEIC Earthquakes	
• Appendix E – Unified Hazard Tool Summary	
• Appendix F – Karst and Land Subsidence Maps	

1.4 Facility Description

The Cholla Power Plant is an electric generating station located near Joseph City, in Navajo County, Arizona. The station consists of four coal-fired units. Units 1, 2 (decommissioned), and 3 are owned by APS and Unit 4 is owned by PacifiCorp. CCR generated at the Plant is either recycled for beneficial use or disposed at two major surface impoundments: the Fly Ash Pond located approximately 1.5 miles east of the Plant and the Bottom Ash Pond located about 1 mile north of the Plant. The Bottom Ash Monofill was constructed to dispose of bottom ash excavated from the Bottom Ash Pond. Lesser amounts of CCR, from the vehicle wash station, vacuum trucks, and Plant area runoff, are collected at the Sedimentation Pond. Figure 1-1 shows the location of the Bottom Ash Pond in relation to the Plant.

The Bottom Ash Pond is the reservoir impounded by the Bottom Ash Dam, which was constructed between 1976 and 1978. The Bottom Ash Pond has a total surface area of approximately 80 acres and a capacity of 2,300 acre-feet. The Bottom Ash Dam is approximately 73 feet high with an approximately 4,040-foot long clay core zoned earth embankment, and has a FEMA rating of intermediate size and high hazard. The maximum operating water level is EL 5117.8 feet (NGVD29).

The Bottom Ash Pond consists of a reservoir located in the southern portion of the pond and two coal combustion waste storage cells located in the northern portion of the pond. The Bottom Ash Pond receives waste water that contains water and solids from the Plant. The CCR wastes and other discharges are pumped to one of the two upstream waste storage cells, where the bottom ash is allowed to settle and the water is decanted to the reservoir for reuse at the Plant.

2 Placement Above the Uppermost Aquifer

40 CFR § 257.60 requires that existing CCR surface impoundments 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 Bottom Ash Pond and the uppermost aquifer based on available data. The following information was reviewed to assess the vertical location of the Bottom Ash Pond relative to the uppermost aquifer:

- Preconstruction topographic conditions shown on construction plans (included in Appendix A)
- Cholla Power Plant Coal Combustion Residuals Program – Design, Installation, and Evaluation of Completeness of Groundwater Monitoring Networks (Montgomery & Associates 2017)
- Annual Groundwater Monitoring and Corrective Action Report for Cholla Power Plant Coal Combustion Residuals Program, November 2015–December 2017 (Montgomery & Associates 2018)
- Historical water level data from groundwater monitoring piezometers at the Cholla Power Plant (APS and AECOM 2016, APS 2017, and APS 2018a)

2.2 Discussion and Conclusion

2.2.1 Base Elevation of the CCR Unit

The Bottom Ash Dam was constructed by building a cross-valley embankment at the downstream end of an unnamed tributary to Tanner Wash and approximately 2,500 feet north of Interstate 40 (see Figure 1-1). The preconstruction topography included on the construction plans (Appendix A) and design investigation boring logs (Ebasco 1975) indicate that the ground surface elevation beneath the Bottom Ash Pond is as low as approximate EL 5048.0 feet (NGVD29, EL 5050.6 feet NAVD88). The reservoir was constructed on top of as much as 100 feet of unconsolidated materials (alluvium).

2.2.2 Groundwater Elevations

Groundwater is present in the alluvial materials beneath the Bottom Ash Pond and in the underlying bedrock aquifer. The alluvial material beneath the Bottom Ash Pond is referred to as the Tanner Wash Alluvium. During original construction, APS installed a series of standpipe piezometers (B-200, B-201, B-202, B-204, B-206, and B-207; Figure 2-1) on the crest and at the downstream toe of the dam; these piezometers are monitored on a monthly basis. The maximum groundwater elevations for the open standpipe piezometers located downstream of the Bottom Ash Pond and in the crest of the south embankment are included in the Annual CCR Impoundment and Landfill Inspection Report (APS and AECOM 2016, APS 2017, and APS 2018a) for data since 2014. The data associated with the piezometers is presented in Table 1.

Table 1 – Piezometer Data and Groundwater Elevations (ft)[1]

	Piezometer Name					
	B-200	**B-201**	**B-202**	**B-204**	**B-206**	**B-207**
Location Relative to the Bottom Ash Pond	South	South	South	South Embankment of the Bottom Ash Dam	South	South
Reference Elevation (ft)	5063.74	5053.78	5046.29	5124.97	5052.09	5051.63
Screened In	Moqui	Moqui	Alluvium and Moqui	Alluvium and Moqui	Alluvium	Moqui
Report Year	**B-200**	**B-201**	**B-202**	**B-204**	**B-206**	**B-207**
2015	5047.89	5045.93	5041.74	5100.63	5030.15	5032.86
2016	5047.77	5045.63	5041.93	5100.15	5030.21	5033.02
2017	5048.39	5045.43	5041.92	5099.32	5029.81	5032.54
Highest Recorded Groundwater Elevation (ft)	5048.39	5045.93	5041.93	5100.63	5030.21	5033.02

1) Elevations in Table 1 are presented in the NGVD29 datum.

2.2.3 Separation from the Uppermost Aquifer

Piezometer B-204 is screened in the underlying alluvium and Moqui mudstone/siltstone. The recent piezometer readings for Piezometer B-204 shown in Table 1 have been near approximate EL 5100 feet, above the base of the Bottom Ash Pond. Prior to construction, the water elevation in a boring advanced through the alluvium near the present location of B-204 was near EL 4984.5 feet based on the Ebasco (1975) geotechnical exploration

Conclusion: The Bottom Ash Pond does not meet the location restriction requirement relative to the uppermost aquifer and is subject to closure per 40 CFR § 257.101(b)(1).

3 Location Relative to Wetlands

40 CFR § 257.61 requires that existing surface impoundments 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

The U.S. Fish and Wildlife Service (USFWS) maintains the National Wetlands Inventory mapper on the Internet (https://www.fws.gov/wetlands/data/Mapper.html). The application integrates digital map data along with other resources information to produce information on the status, extent, characteristics, and functions of wetlands and other resources. The National Wetlands Inventory, last modified on May 1, 2018, was reviewed to assess the location of the Bottom Ash Pond relative to wetlands. The results are presented in Appendix C.

3.2 Discussion and Conclusion

The USFWS Wetlands Mapper indicates four small freshwater ponds immediately south of the Bottom Ash Pond. The Mapper indicates that these ponds were photo interpreted using 1:58,000 scale, color infrared imagery from 1984. One of these mapped ponds is at the toe of the West Abutment and may be the current West Abutment Weir seepage location. The other three mapped locations are between 1,200 feet and 1,500 feet south of the Bottom Ash Pond and do not appear to be correlated to active seeps, perennially wet areas, or intermittently wet areas. Based on the age of the data in the Wetlands Mapper and the reported method of mapping, AECOM does not believe the latter three locations existed as shown.

Conclusion: The Bottom Ash Pond is not located in wetlands.

4 Location Relative to Faults

40 CFR § 257.62 requires that existing surface impoundments 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 (BP)) 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 2018). 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 Navajo County, Arizona. 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.

Table 2 – Fault Categories

Category	Definition
A	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.
B	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.
C	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.

The Arizona Earthquake Information Center (AEIC) at Northern Arizona University maintains a catalog of earthquakes in Arizona between 1830 and 2011 (AEIC 2018). The catalog was accessed via a .kmz file to review recorded earthquakes of lower magnitude than those included in the USGS database.

4.2 Discussion and Conclusion

The USGS Quaternary Faults and Folds Database of the United States did not contain any Class A or Class B faults in Navajo County. The AEIC catalog contained one earthquake within 10 miles of the Bottom Ash Pond: a Modified Mercalli intensity VI earthquake occurred near Holbrook in 1921. The earthquake location is presented in Appendix D.

Conclusion: No faults with Holocene displacement are present within 200 feet of the Bottom Ash Pond.

5 Location Relative to Seismic Impact Zones

40 CFR § 257.63 requires existing surface impoundments 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. *Seismic impact zone* is defined by the Rule 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 Bottom Ash Pond location. The Unified Hazard Tool result is presented in Appendix E.

5.2 Discussion and Conclusion

The PGA with a 2 percent probability of exceedance in 50 years for the Bottom Ash Pond is 0.0878g. This value is less than the Rule-required maximum value of 0.10 g in 50 years.

Conclusion: The Bottom Ash Pond is not located in a seismic impact zone.

6 Location Relative to Unstable Areas

40 CFR § 257.64 requires that existing surface impoundments 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 following factors must be considered when determining whether an 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 include any component used in the construction and operation of the CCR landfill or CCR surface impoundment that is necessary to ensure the integrity of the unit and to ensure that the contents will not be released to the environment, including liners, leachate collection system, embankments, spillways, outlets, final covers, inflow design flood control systems.

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 the Bottom Ash Pond relative to unstable areas was assessed by reviewing design and construction documentation, historical geologic and geotechnical investigations, and engineering analyses (safety factor calculations). Information was reviewed to assess: 1) whether poor foundation conditions may exist which could result in inadequate foundation support for structural components of the Bottom Ash Pond; and 2) whether areas susceptible to mass movement (such as landslides, avalanches, debris slides and flows, block sliding or rock falls) capable of impairing the integrity of the structural components of the Bottom Ash Pond are present.

Published geologic references documenting the Holbrook Basin salt karst subsidence features and Interferometric Synthetic Aperture Radar (InSAR) data collected by the Arizona Department of Water Resources (ADWR) Satellite Based Land Subsidence Monitoring Program to monitor the spatial extent, deformation rates, and time-series history of land subsidence features identified in the state were reviewed to assess the potential for karstic terrain in the vicinity of the Bottom Ash Pond.

6.2 Discussion and Conclusion

6.2.1 Geologic Setting

The Cholla Power Plant is located within the Navajo section of the Colorado Plateau Physiographic Province. The Colorado Plateau is characterized by wide areas of nearly flat-lying sedimentary rocks, separated by abrupt monoclinal folds formed when sedimentary rocks overly deep basement faults. The northwest-southeast trending Holbrook anticline occurs approximately 20 miles south of the Plant. The Navajo section is a somewhat poorly defined structural depression consisting of broad plateaus and wide valleys (Hendricks 1985). The plant is located approximately ½ mile north of the Little Colorado River. Exposed bedrock units in the vicinity of the Plant include the Permian-age Coconino Sandstone, the Triassic-age Moenkopi and Chinle Formations, and the Quaternary alluvial deposits of the Little Colorado River. Surficial geology at the Plant site consists of up to 200 feet of heterogeneous interbedded sand, silt, and clay layers of the Little Colorado River alluvium (Montgomery & Associates 2011).

The impoundment is surrounded on its west and north sides by natural topography consisting of rock outcrops of mudstones, siltstones, and sandstones.

6.2.2 Foundation Conditions

The Bottom Ash Dam embankment is founded on alluvium overburden associated with Tanner Wash. The abutments are founded on rock consisting of mudstone, siltstone, and sandstone associated with the Chinle and Moenkopi Formations. The Ebasco (1975) geotechnical investigation in the Bottom Ash Pond footprint indicated a surficial layer of clay and sand alluvium of variable thickness throughout the Pond footprint. The alluvium was generally less than 10 feet thick toward the north end of the Bottom Ash Pond and was observed to be up to 99 feet thick under the east half of the Bottom Ash Dam south embankment. The northern portion of the Bottom Ash Pond footprint was used as a borrow source for sandy material and weathered rock during construction. The Moqui formation was typically encountered below the alluvium throughout the Bottom Ash Pond footprint.

The as-built design drawings of the dam (Ebasco 1990) and construction inspection reports prepared by ADWR (formerly the Arizona Water Commission) indicate a cutoff trench was excavated at the abutments to extend the clay core to bedrock when the depth to bedrock was less than 20 feet. When the depth to bedrock was greater than 20 feet, a soil-bentonite slurry cutoff wall was installed to the bedrock or to a stiff clay layer found approximately 60 to 70 feet below the original ground surface. In addition, an approximately 350 ft long slurry wall was installed beyond the right abutment to help control seepage through the Moenkopi bedrock formation. The construction records indicate that where the cutoff trench was excavated to bedrock, loose rock was scaled from the foundation, dental concrete was applied to irregularities to create a relatively level surface, and a thin lift of wet cement tack coat was applied to the bedrock surface before placement of the clay core. For the shell of the dam, which is founded on alluvium overburden soils, the alluvium foundation was proof-compacted using a heavy dynamic compactor and surface stringers of sandy soils that crossed the dam foundation were removed.

6.2.3 Areas Susceptible to Mass Movement

Design and construction documentation indicate that the Bottom Ash Dam was not constructed on materials that would be susceptible to excessive settlement. Furthermore, any post-construction settlement would have occurred during the nearly 40 years since construction was completed. Safety factors calculated for the Bottom Ash Dam indicate that the embankment is not susceptible to mass movement (AECOM 2016). Topographic and geologic conditions do not indicate the potential for landslides, avalanches, debris slides and flows, block sliding, rock falls, or other mass movements which could impact the structural components of the Bottom Ash Pond.

6.2.4 Karst Areas

Collapse features (sinkholes, fissures, depressions, expanded bedrock joints and joint sets, compression ridges and buckles) associated with dissolution of evaporate deposits within the Permian-aged Supai Formation have been documented within the Holbrook Basin (see map in Appendix F). These features, collectively referred to as "salt karst," are concentrated along a roughly 60 mile long, northwest-southeast trending dissolution front near the southwestern margin of the Holbrook Basin, approximately 20 miles from the Cholla Power Plant.

The Cholla Power Plant site is within the Holbrook Basin where ADWR monitors several land subsidence features. ADWR monitors the extent and rate of land subsidence annually using InSAR data. Land subsidence maps published by ADWR for the Holbrook Basin are included in Appendix F. Three features in the Holbrook Basin are located approximately 11 miles from the Plant site and are associated with evaporite karst dissolution. A fourth land subsidence feature has been identified south of Joseph City, approximately 2 miles southwest of the Plant site. No land subsidence features have been identified at the Plant site.

6.2.5 Subsidence

Extraction of a groundwater resource can cause lowering of the regional groundwater table, consolidation of alluvial deposits, and lowering of the ground surface. In extreme circumstances, in combination with variations in the bedrock surface, earth fissures can form and express at the ground surface around the boundary of the subsidence area. The ADWR land subsidence maps (Appendix F) indicate the presence of a 1-mile wide localized subsidence area approximately 2 miles west of the Plant, 3 miles southwest of the Bottom Ash Pond and Bottom Ash Monofill, and 3.5 miles west of the Fly Ash Pond.

The InSAR data suggest subsidence rates in the range of 0 to 1 centimeters per year (cm/yr) for the most recent six-year interval (2012-2018). APS operates a wellfield south and east of the Plant, east of the subsidence area indicated on the ADWR land subsidence maps (Appendix F). APS staff report that: 1) APS groundwater extraction from its wellfield has decreased by approximately one-third since the retirement of Unit 2 in 2014 and 2) the Coconino aquifer is highly productive and groundwater levels within the wellfield have been rising since the retirement of Unit 2 in 2014 (APS Internal Communication 2018b).

The ADWR land subsidence maps suggest a cumulative subsidence of 3.9 to 5.9 inches between 2012 and 2018. The ground underlying the Bottom Ash Pond is not considered to be susceptible to the formation of earth fissures based on the distance of the CCR unit from the area of identified subsidence and the relatively small indicated total settlement.

Conclusion: The Bottom Ash Pond 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 Bottom Ash Pond.

- The Bottom Ash Pond does not meet the location restriction requirement relative to the uppermost aquifer and is subject to closure per 40 CFR § 257.101(b)(1).
- The Bottom Ash Pond is not located in wetlands.
- No faults with Holocene displacement are present within 200 feet of the Bottom Ash Pond.
- The Bottom Ash Pond is not located in a seismic impact zone.
- The Bottom Ash Pond 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 is not and shall not be interpreted or construed as a guarantee, warranty, or legal opinion.

9 References

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Figures

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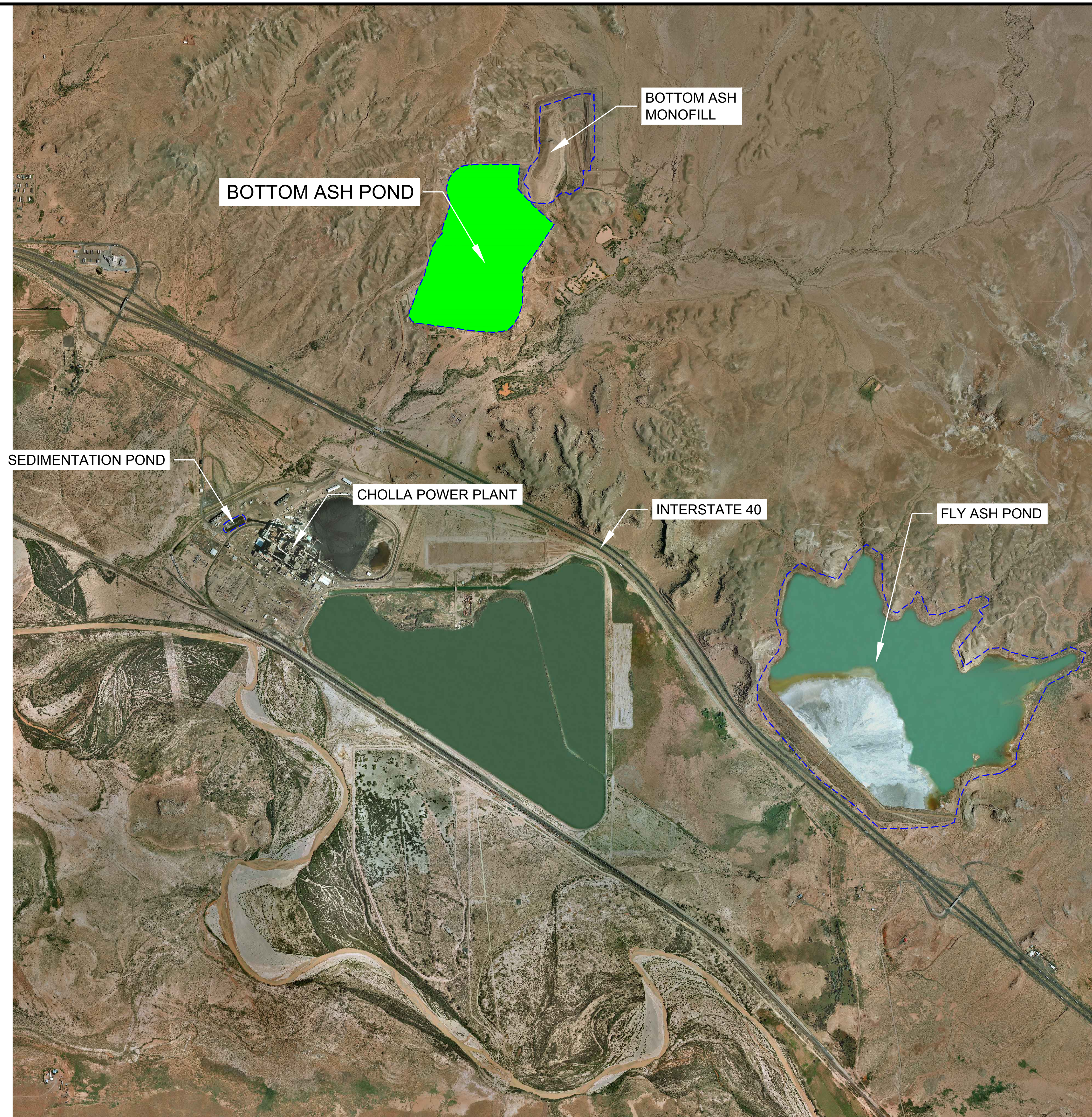
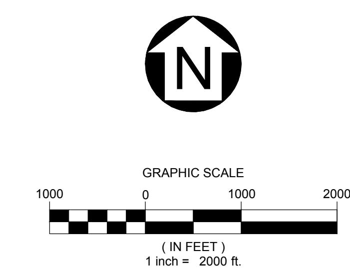


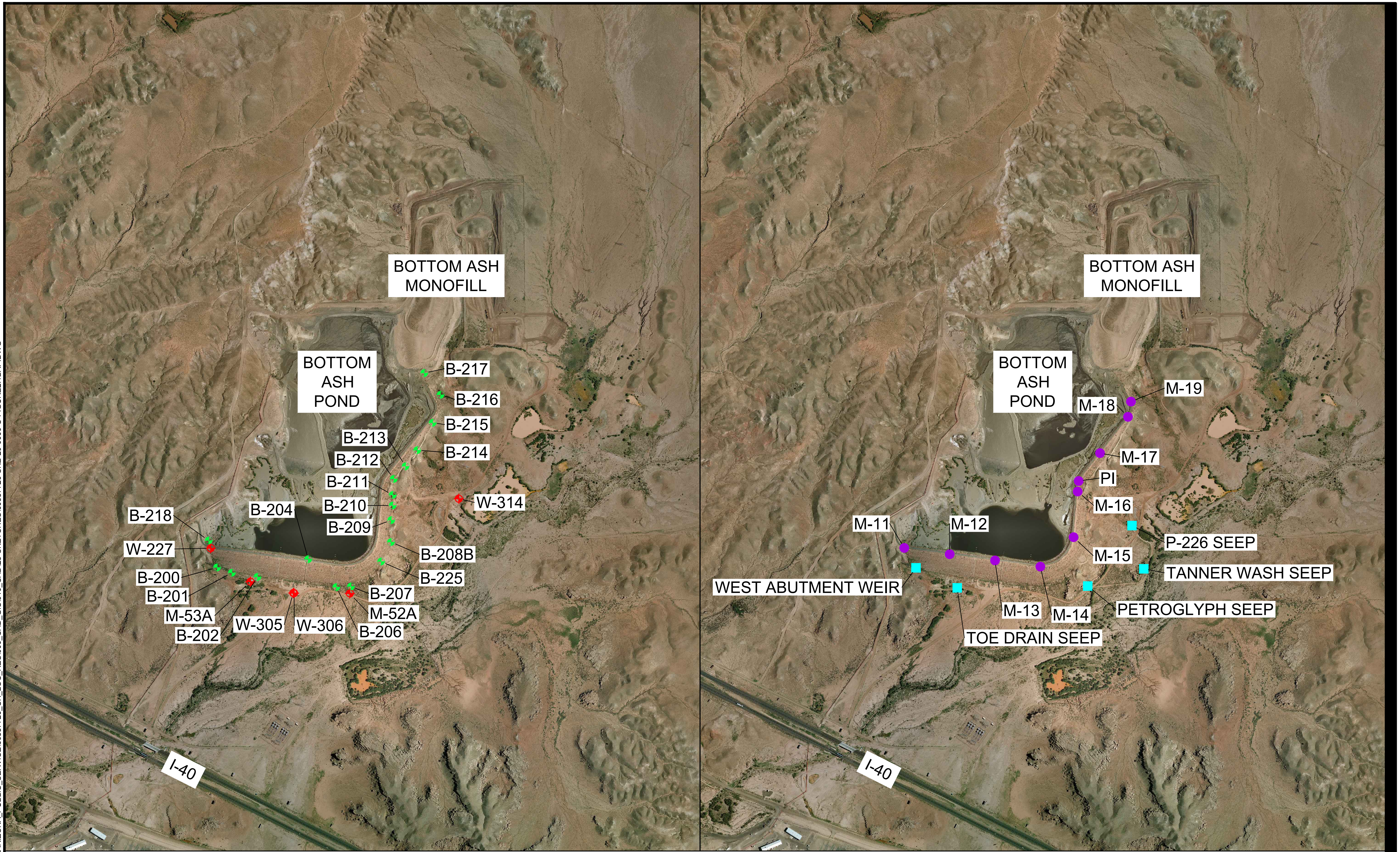


SITE VICINITY MAP

AECOM

Figure 1-1

CHOLLA POWER PLANT
BOTTOM ASH POND LOCATION RESTRICTIONS
ARIZONA PUBLIC SERVICE
Project No.: 60587726



PIEZOMETERS AND WELLS

- PIEZOMETER (B-###)
- WELL (M-## OR W-###)

N

GRAPHIC SCALE
500 0 500 1000
(IN FEET)
1 inch = 1000 ft.

SETTLEMENT MONUMENTS AND SEEPS

- SETTLEMENT MONUMENT (M-##)
- SEEPAGE LOCATION

AECOM

Figure 2-1

MONITORED INSTRUMENTATION AND SEEP LOCATION MAP

CHOLLA POWER PLANT
BOTTOM ASH POND LOCATION RESTRICTIONS
ARIZONA PUBLIC SERVICE
Project No.: 60587726

ANSI B 11" x 17"   Approved:_____   Checked:_____   Designer: LMW   Project Management Initials:
Last saved by: LEE.WRIGHT(2018-09-20) Last Plotted: 2018-09-20
Filename: P:\PROJECTS\ARIZONA_PUBLIC_SERVICE\60587726_CH_LOC_RES\900_CAD_GIS\910_CAD\25-SKETCHES\60587726-SKE-20-0000-C-FIGURE2.1BAP.DWG

Appendix A. Construction Plans

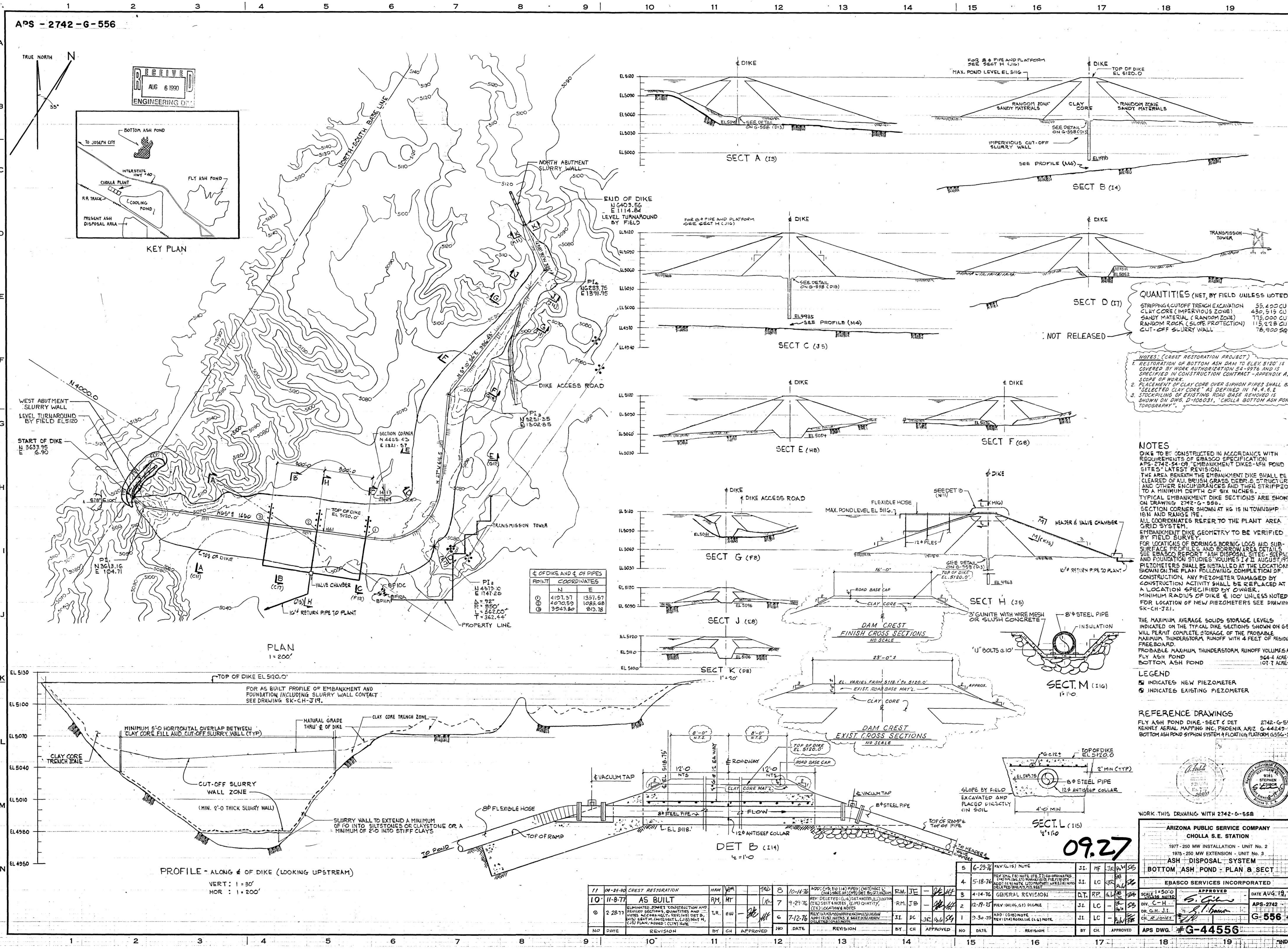

APS - 2742 - G - 556
RECEIVED AUG 6 1990 ENGINEERING
TRUE NORTH
N
KEY PLAN
BOTTOM ASH POND
TO JOSEPH CITY
INTERSTATE HWY 40
CHOLLA PLANT
FLY ASH POND
R.R. TRACK
COOLING POND
PRESENT ASH DISPOSAL AREA
NORTH-SOUTH BASE LINE
NORTH ABUTMENT SLURRY WALL
END OF DIKE N 6403.56 E 1114.84 LEVEL TURNAROUND BY FIELD
DIKE ACCESS ROAD
WEST ABUTMENT SLURRY WALL
LEVEL TURNAROUND BY FIELD EL 5120
START OF DIKE N 3633.95 E 6.90
SECTION CORNER
TRANSMISSION TOWER
VALVE CHAMBER
16" ø RETURN PIPE TO PLANT
PROPERTY LINE
PLAN 1" = 200'
SECT A (I3)
SECT B (I4)
SECT C (J5)
SECT D (I7)
SECT E (H8)
SECT F (G8)
SECT G (F8)
SECT H (J5)
SECT J (E8)
SECT K (D8)
SECT. M (I16)
SECT. L (I15)
DET B (I14)
RANDOM ZONE SANDY MATERIALS
CLAY CORE
IMPERVIOUS CUT-OFF SLURRY WALL
MAX. POND LEVEL EL 5116
TOP OF DIKE EL 5120.0
QUANTITIES (NET, BY FIELD UNLESS NOTED)
STRIPPING & CUTOFF TRENCH EXCAVATION 55,400 CU YD
CLAY CORE (IMPERVIOUS ZONE) 430,515 CU YD
SANDY MATERIAL (RANDOM ZONE) 775,000 CU YD
RANDOM ROCK (SLOPE PROTECTION) 115,228 CU YD
CUT-OFF SLURRY WALL 78,900 SQ FT
NOT RELEASED
NOTES: (CREST RESTORATION PROJECT)
1. RESTORATION OF BOTTOM ASH DAM TO ELEV. 5120' IS COVERED BY WORK AUTHORIZATION 54-9976 AND IS SPECIFIED IN CONSTRUCTION CONTRACT - APPENDIX A, SCOPE OF WORK.
2. PLACEMENT OF CLAY CORE OVER SIPHON PIPES SHALL BE "SELECTED CLAY CORE" AS DEFINED IN 14.4.6.2
3. STOCKPILING OF EXISTING ROAD BASE REMOVED IS SHOWN ON DWG. D-106031, "CHOLLA BOTTOM ASH POND TOPOGRAPHY".
NOTES
DIKE TO BE CONSTRUCTED IN ACCORDANCE WITH REQUIREMENTS OF EBASCO SPECIFICATION APS-2742-54-09 "EMBANKMENT DIKES-ASH POND SITES" LATEST REVISION.
THE AREA BENEATH THE EMBANKMENT DIKE SHALL BE CLEARED OF ALL BRUSH, GRASS, DEBRIS, STRUCTURES AND OTHER ENCUMBRANCES AND THEN STRIPPED TO A MINIMUM DEPTH OF SIX INCHES.
TYPICAL EMBANKMENT DIKE SECTIONS ARE SHOWN ON DRAWING 2742-G-556.
SECTION CORNER SHOWN AT H6 IS IN TOWNSHIP 18N AND RANGE 19E.
ALL COORDINATES REFER TO THE PLANT AREA GRID SYSTEM.
EMBANKMENT DIKE GEOMETRY TO BE VERIFIED BY FIELD SURVEY.
FOR LOCATIONS OF BORINGS, BORING LOGS AND SUB-SURFACE PROFILES AND BORROW AREA DETAILS SEE EBASCO REPORT "ASH DISPOSAL SITES - SEEPAGE AND FOUNDATION STUDIES" VOLUMES I & II AUGUST, 1975.
PIEZOMETERS SHALL BE INSTALLED AT THE LOCATIONS SHOWN ON THE PLAN FOLLOWING COMPLETION OF CONSTRUCTION. ANY PIEZOMETER DAMAGED BY CONSTRUCTION ACTIVITY SHALL BE REPLACED AT A LOCATION SPECIFIED BY OWNER.
MINIMUM RADIUS OF DIKE ¢ 100' UNLESS NOTED.
FOR LOCATION OF NEW PIEZOMETERS SEE DRAWING SK-CH-J21.
THE MAXIMUM AVERAGE SOLIDS STORAGE LEVELS INDICATED ON THE TYPICAL DIKE SECTIONS SHOWN ON G-556 WILL PERMIT COMPLETE STORAGE OF THE PROBABLE MAXIMUM THUNDERSTORM RUNOFF WITH 4 FEET OF RESIDUAL FREEBOARD.
PROBABLE MAXIMUM THUNDERSTORM RUNOFF VOLUMES ARE: FLY ASH POND 964.4 ACRE-FT BOTTOM ASH POND 107.7 ACRE-FT
LEGEND
INDICATES NEW PIEZOMETER
INDICATES EXISTING PIEZOMETER
REFERENCE DRAWINGS
FLY ASH POND DIKE - SECT & DET 2742-G-558
KENNEY AERIAL MAPPING INC, PHOENIX ARIZ. G-44249-SH1
BOTTOM ASH POND SYPHON SYSTEM & FLOATING PLATFORM G556-S02
DAM CREST FINISH CROSS SECTIONS NO SCALE
DAM CREST EXIST. CROSS SECTIONS NO SCALE
PROFILE - ALONG ¢ OF DIKE (LOOKING UPSTREAM) VERT: 1" = 30' HOR: 1" = 200'
TOP OF DIKE EL 5120.0'
FOR AS BUILT PROFILE OF EMBANKMENT AND FOUNDATION INCLUDING SLURRY WALL CONTACT SEE DRAWING SK-CH-J19.
MINIMUM 5'-0 HORIZONTAL OVERLAP BETWEEN CLAY CORE FILL AND CUT-OFF SLURRY WALL (TYP)
NATURAL GRADE THRU ¢ OF DIKE
CLAY CORE TRENCH ZONE
CUT-OFF SLURRY WALL ZONE (MIN. 2'-0 THICK SLURRY WALL)
SLURRY WALL TO EXTEND A MINIMUM OF 1'-0 INTO SILTSTONES OR CLAYSTONE OR A MINIMUM OF 2'-0 INTO STIFF CLAYS
WORK THIS DRAWING WITH 2742-G-558
09.27
ARIZONA PUBLIC SERVICE COMPANY
CHOLLA S.E. STATION
1977 - 250 MW INSTALLATION - UNIT No. 2
1978 - 250 MW EXTENSION - UNIT No. 3
ASH DISPOSAL SYSTEM
BOTTOM ASH POND - PLAN & SECT
EBASCO SERVICES INCORPORATED
DATE AUG. 19, 75
APS-2742
G-556
APS DWG. #G-44556
11 04-24-90 CREST RESTORATION
10 11-8-77 AS BUILT
6 4-14-76 GENERAL REVISION

Figure A-1

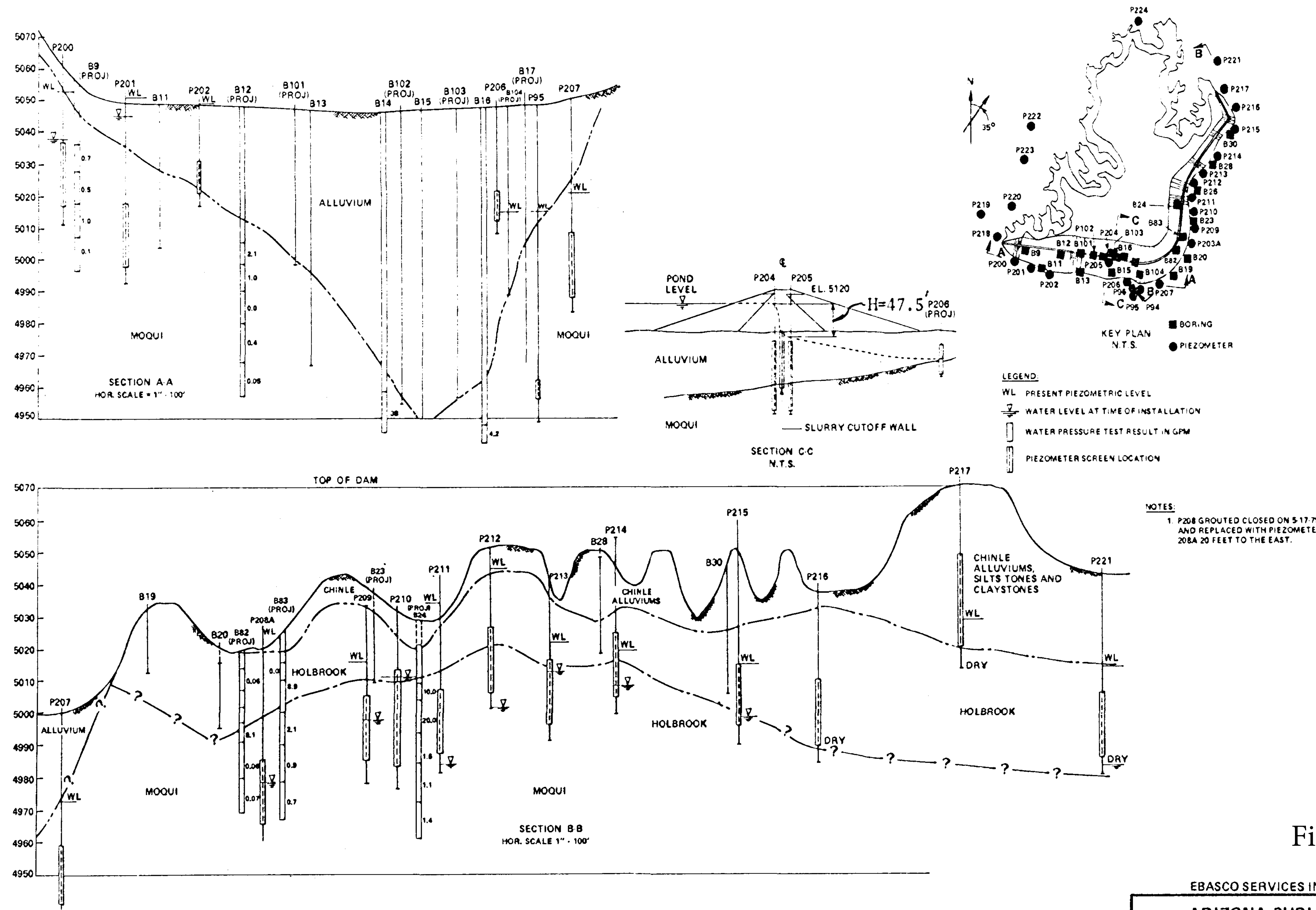


Figure A-2

EBASCO SERVICES INCORPORATED

ARIZONA PUBLIC SERVICE
CHOLLA STATION

PIEZOMETER RESPONSE – PROFILES
BOTTOM ASH DAM

FIGURE 6

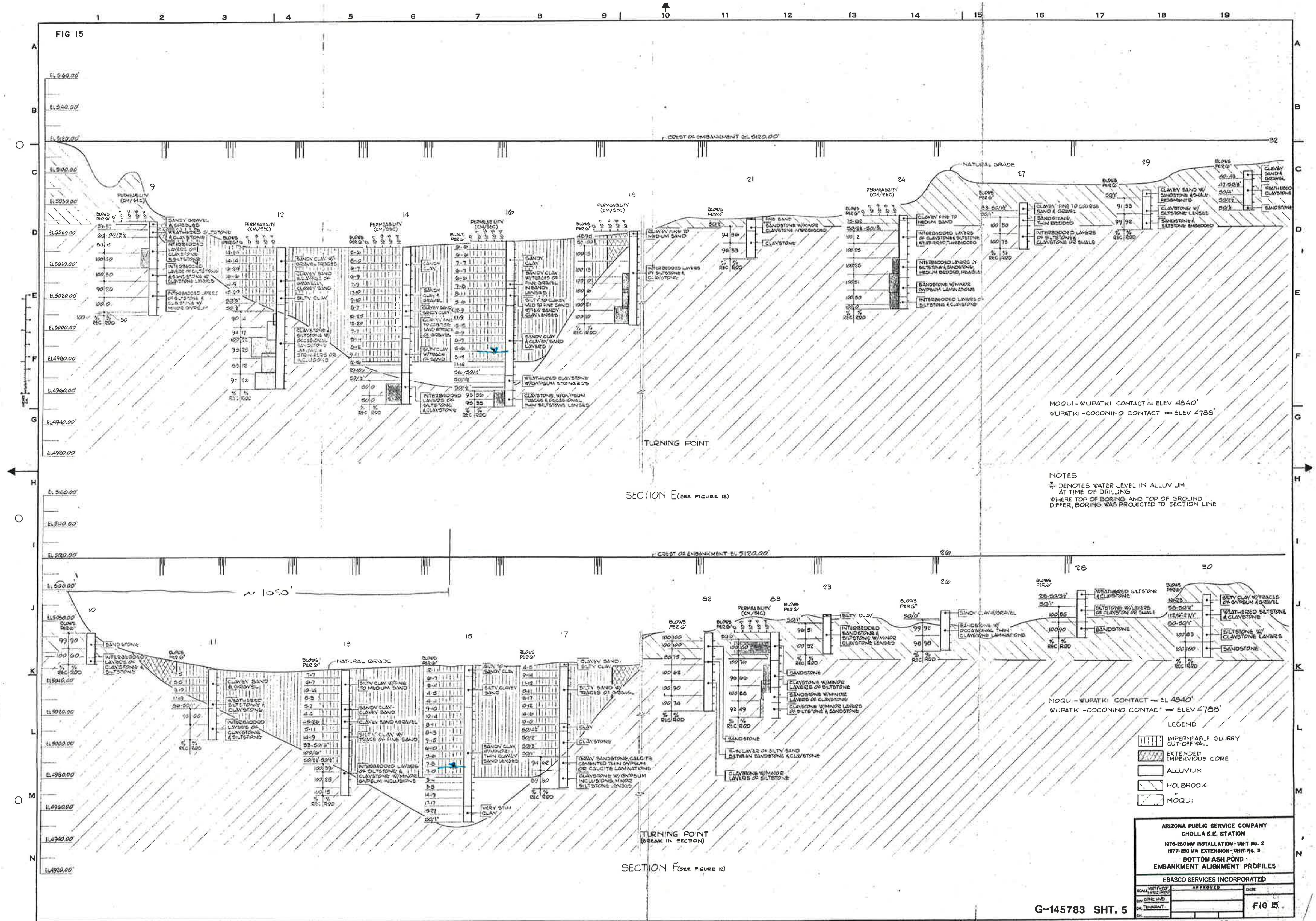
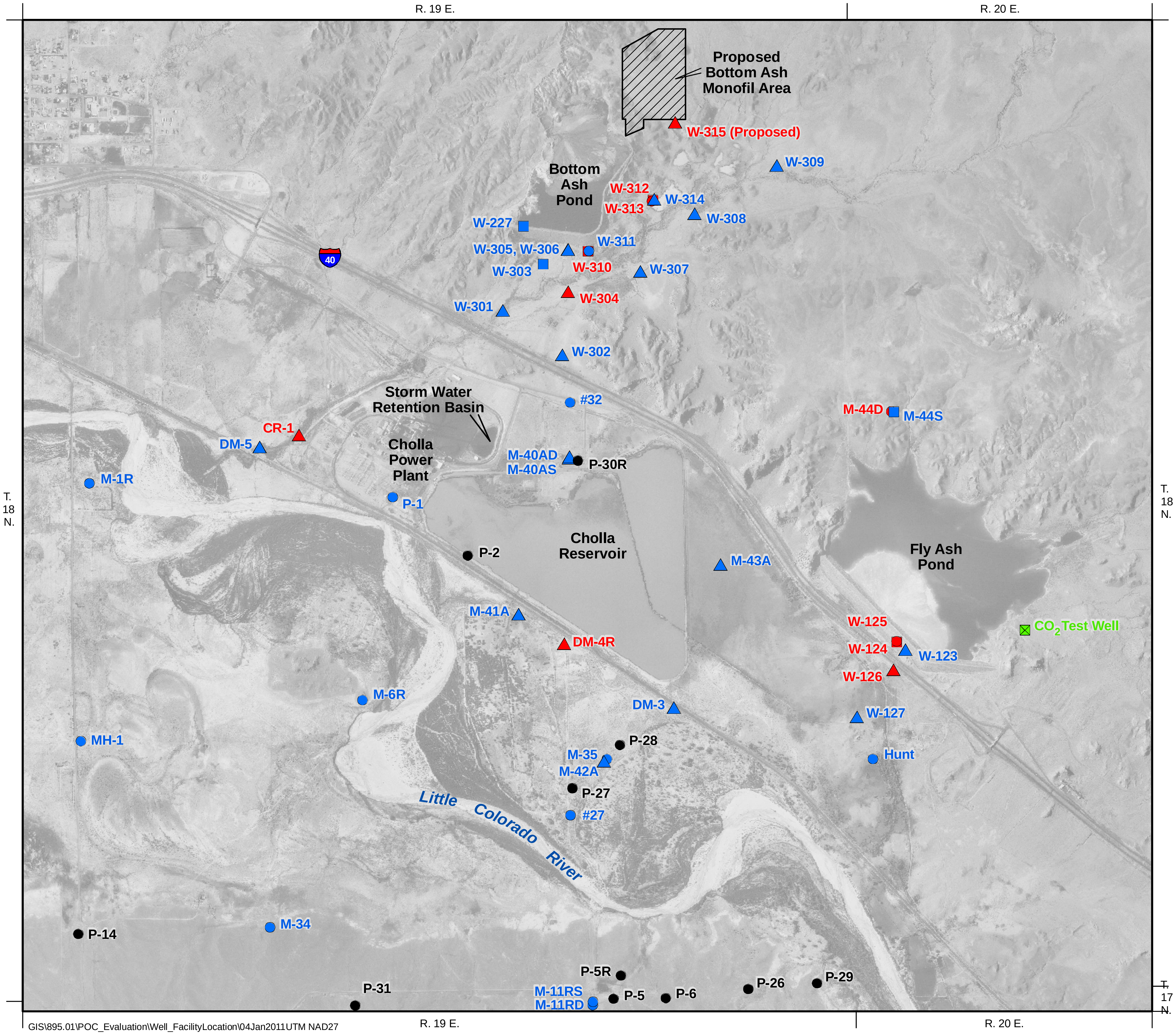


Exhibit 6

Figure A-3

Appendix B. Groundwater Elevations



EXPLANATION

DM-3	▲	Alluvial Monitor Well and Identifier
W-304	▲	Alluvial POC Well and Identifier
M-44S	■	Moenkopi Monitor Well and Identifier
W-312	■	Moenkopi POC Well and Identifier
M-34	●	Coconino Monitor Well and Identifier
M-44D	●	Coconino POC Well and Identifier
P-30R	●	Coconino Production Well and Identifier

N

0 1,000 2,000 3,000 4,000 5,000

Feet

ARIZONA PUBLIC SERVICE
CHOLLA POWER PLANT
NAVAJO COUNTY, ARIZONA

WELL AND
FACILITY LOCATIONS

MONTGOMERY & ASSOCIATES

2010

FIGURE 1

Figure B-1

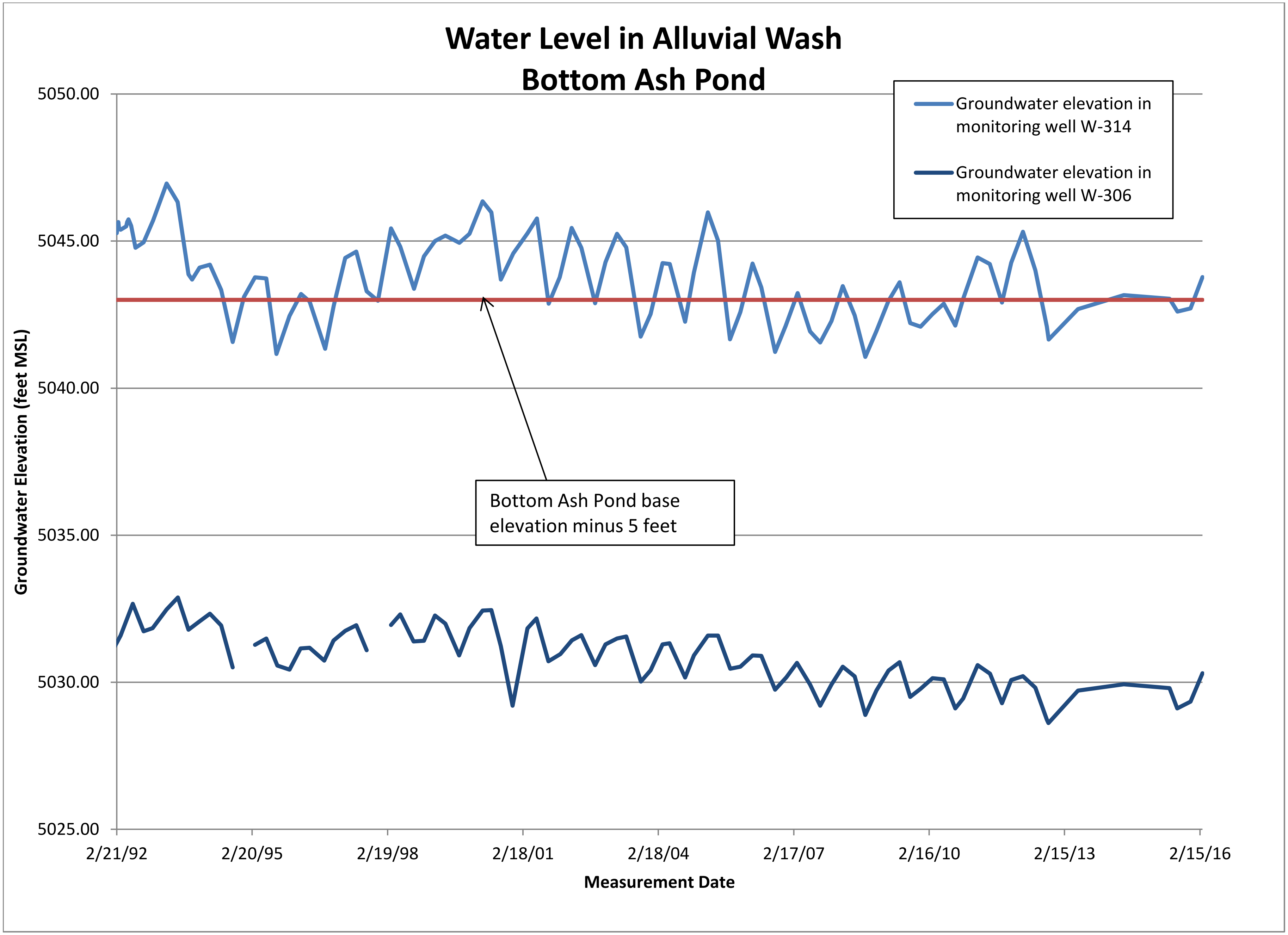

Water Level in Alluvial Wash
Bottom Ash Pond
5050.00
5045.00
5040.00
5035.00
5030.00
5025.00
Groundwater Elevation (feet MSL)
2/21/92
2/20/95
2/19/98
2/18/01
2/18/04
2/17/07
2/16/10
2/15/13
2/15/16
Measurement Date
Groundwater elevation in monitoring well W-314
Groundwater elevation in monitoring well W-306
Bottom Ash Pond base elevation minus 5 feet

Figure B-2

Appendix C. National Wetland Inventory

U.S. Fish and Wildlife Service
National Wetlands Inventory

Bottom Ash Pond

August 10, 2018

Wetlands

- Estuarine and Marine Deepwater
- Estuarine and Marine Wetland
- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond
- Lake
- Other
- Riverine

This map is for general reference only. The US Fish and Wildlife Service is not responsible for the accuracy or currentness of the base data shown on this map. All wetlands related data should be used in accordance with the layer metadata found on the Wetlands Mapper web site.

Appendix D.
AEIC Earthquakes

AEIC Earthquakes

8/10/2018 2:12:33 PM

Earthquake Epicenters

-0.2 To 1.1

> 1.1 To 2.4

> 2.4 To 3.7

> 3.7 To 4.9

> 4.9 To 6.2

> 6.2 To 7.5

Old Earthquakes

1:72,224

0 0.5 1 2 mi

0 0.75 1.5 3 km

Arizona Geological Survey:June 30, 2014, Esri, HERE, Garmin, © OpenStreetMap contributors, and the GIS user community, Source: Esri,

Web AppBuilder for ArcGIS

mber 2017 | Arizona Geological Survey: Fall, 2012 | Arizona Department of Emergency Management and Military Affairs:May, 2010 | Arizona Geological Survey:June 30, 2014 | Arizona Geological Survey: Janurary 2016 | Earthstar Geographics, CNES/Airbus DS | Esri, HERE, Garmin |

Appendix E. 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.S. Seismic Design Maps web tools (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

34.954803

Time Horizon

Return period in years

2475

Longitude

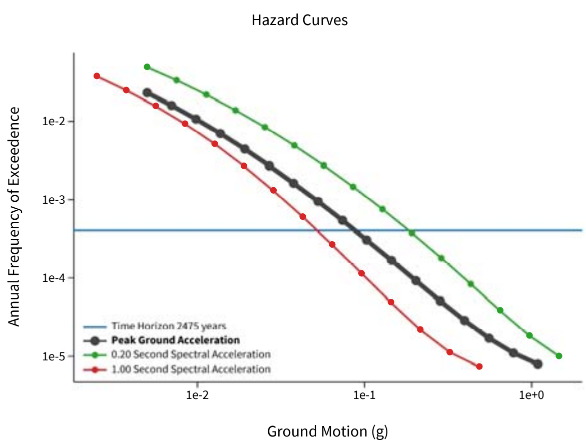
Decimal degrees, negative values for western long…

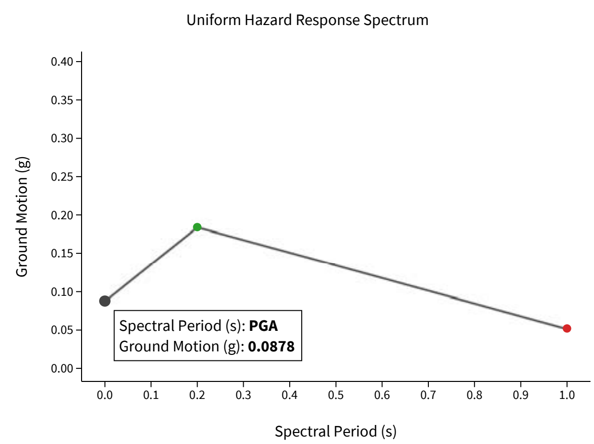
-110.28953

Site Class

760 m/s (B/C boundary)

Hazard Curve





View Raw Data

Appendix F. Karst and Land Subsidence Maps

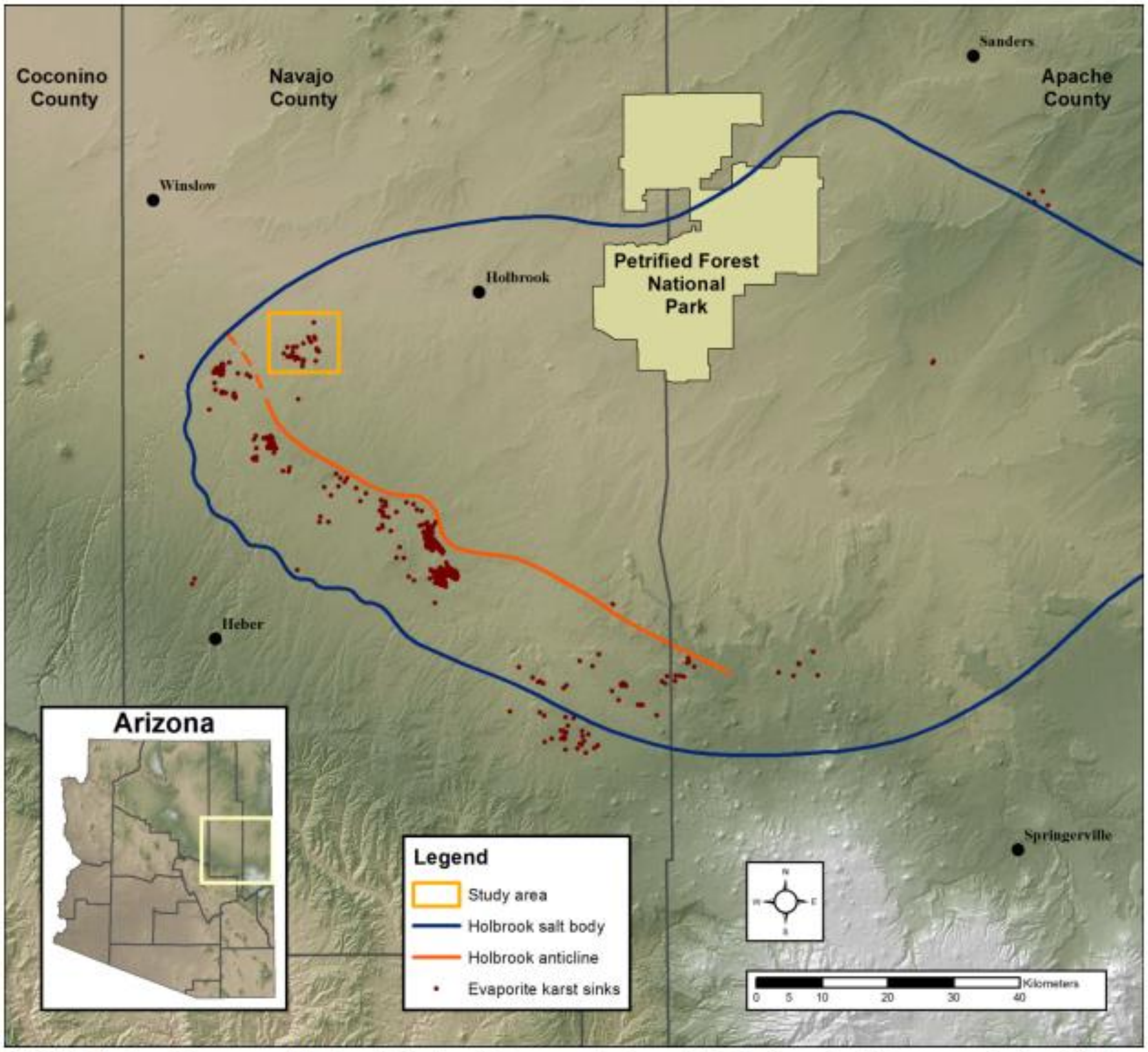
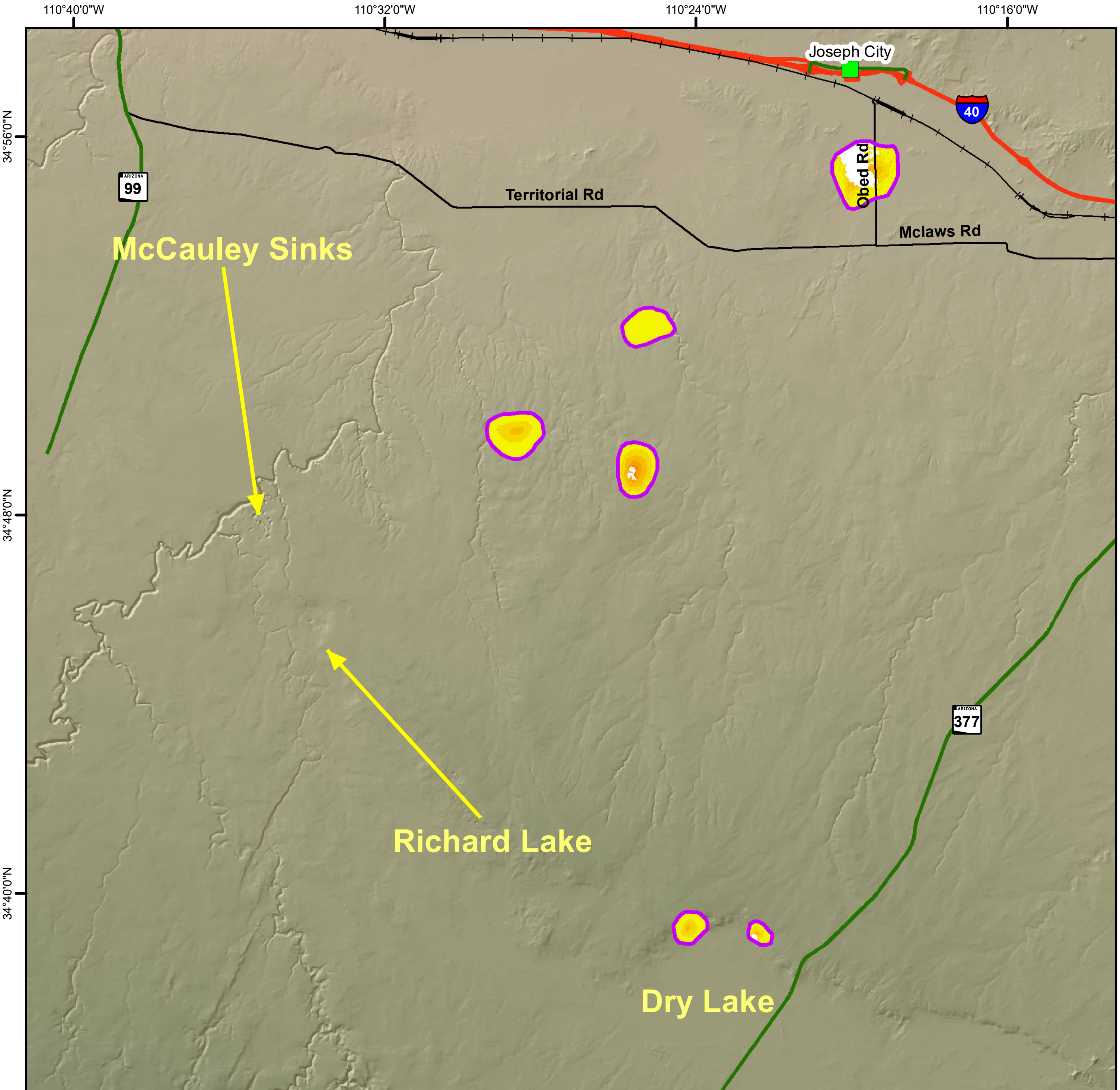


Figure 1. *Location map of Holbrook Basin, study area extent, and distribution of existing evaporite karst sinks relative to the extent of the Holbrook salt body and anticline.*



Total Land Subsidence in the Holbrook Basin, Navajo County
Based on Radarsat-2 Satellite Interferometric Synthetic Aperture Radar (InSAR) Data
Time Period of Analysis: 5.5 Years 09/22/2012 To 04/24/2018

Explanation

09/22/2012 To 04/24/2018
Total Land Subsidence

- Decorrelation/No Data
- Greater 40 cm (15.7 in)
- 25 - 40 cm (9.8 - 15.7 in)
- 15 - 25 cm (5.9 - 9.8 in)
- 10 - 15 cm (3.9 - 5.9 in)
- 6 - 10 cm (2.4 - 3.9 in)
- 4 - 6 cm (1.6 - 2.4 in)
- 2 - 4 cm (0.8 - 1.6 in)
- 1 - 2 cm (0.4 - 0.8 in)
- 0 - 1 cm (0 - 0.4 in)

- Subsidence Feature
- Hardrock
- Cities/Towns

Highways and Interstates

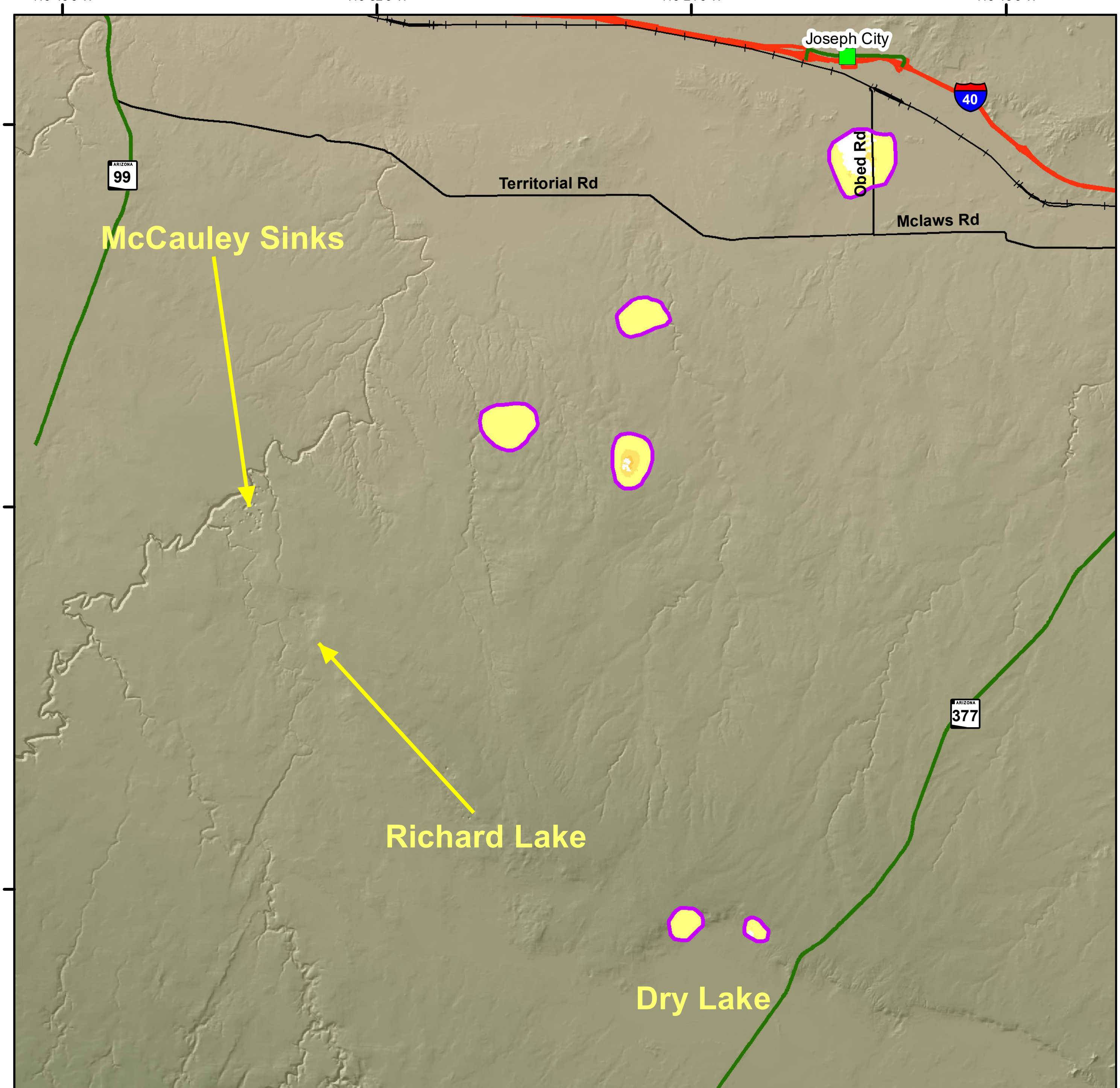
- Interstate
- US
- State
- Roads
- Railway

1:220,000

0 1 2 4 6 8 Miles

Decorrelation (white areas) are areas where the phase of the received satellite signal changed between satellite passes, causing the data to be unusable. This occurs in areas where the land surface has been disturbed (i.e. bodies of water, snow, agriculture areas, areas of development, etc).

Coordinate System: NAD 1983 UTM Zone 12N
Projection: Transverse Mercator
Datum: North American 1983
Units: Meter
Created: 5/15/2018



Land Subsidence Rate in the Holbrook Basin, Navajo County
Based on Radarsat-2 Satellite Interferometric Synthetic Aperture Radar (InSAR) Data

Time Period of Analysis: 5.5 Years 09/22/2012 To 04/24/2018

Explanation

09/22/2012 To 04/24/2018

Land Subsidence Rate

- Decorrelation/No Data
- Greater 7 cm/yr (2.8 in/yr)
- 5 - 7 cm/yr (2.0 - 2.8 in/yr)
- 3 - 5 cm/yr (1.2 - 2.0 in/yr)
- 2 - 3 cm/yr (0.8 - 1.2 in/yr)
- 1 - 2 cm/yr (0.4 - 0.8 in/yr)
- 0.5 - 1 cm/yr (0.2 - 0.4 in/yr)
- 0 - 0.5 cm/yr (0 - 0.2 in/yr)

- Subsidence Feature
- Hardrock
- Cities/Towns
- Railway

Highways and Interstates

- Interstate
- US
- State
- Roads

1:220,000

0 1 2 4 6 8 Miles

Decorrelation (white areas) are areas where the phase of the received satellite signal changed between satellite passes, causing the data to be unusable. This occurs in areas where the land surface has been disturbed (i.e. bodies of water, snow, agriculture areas, areas of development, etc).

Coordinate System: NAD 1983 UTM Zone 12N
Projection: Transverse Mercator
Datum: North American 1983
Units: Meter
Created: 6/12/2018