AECOM

CHOLLA POWER PLANT
FLY ASH POND

Periodic Inflow Design Flood Control System Plan

October 2021
AECOM Project 60664605

Delivering a better world

Prepared for:

Arizona Public Service
400 North 5th Street
Phoenix, AZ 85004

Prepared by:

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Phoenix, AZ 85020
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Table of Contents

Attachment

1. Introduction

This Periodic Inflow Design Flood Control System Plan for the Fly Ash Pond at Cholla Power Plant, operated by Arizona Public Service (APS), has been prepared in accordance with the requirements of Title 40 of the Code of Federal Regulations Part 257 (40 CFR 257) ("the Coal Combustion Residuals [CCR] Rule", or "the Rule") and the specific requirement of 40 CFR § 257.82(c)(4) that "(t)he owner or operator of the CCR unit must prepare periodic inflow design flood control system plans required by paragraph (c)(1) of this section every five years."

2. Methodology

The methodology used to prepare this 2021 Periodic Inflow Design Flood Control System Plan for the Fly Ash Pond (FAP) at the Cholla Power Plant is for the certifying Qualified Professional Engineer (QPE) to:

1. Identify and review the hydrologic design basis references used for the 2016 Plan and verify applicability for use in 2021.
2. Perform a documented review of each major component of the contributing technical information from:
    a. AECOM, 2016, Cholla Power Plant, Fly Ash Pond, Inflow Design Flood Control System Plan, CH_InflowFlood_002_20161017, August 31, 2016 (hereafter referred to as the "2016 Plan" and incorporated and referenced directly as Attachment A to this document).
3. Consider and document whether the 2016 Plan and its conclusions:
    a. Meet the current reporting requirements of the Rule;
    b. Reflect the current condition of the structure, as known to the QPE and documented in the annual inspections;
    c. Are compromised by any identified issues of concern; and
    d. Are consistent with the standard of care of professionals performing similar evaluations in this region of the country; and
4. Identify any additional analyses, investigations, inspections, and/or repairs that should be completed in order to complete this 2021 Recertification.

This plan documents the results of these considerations, incorporates the 2016 Plan as an Appendix, identifies any additional technical investigation or evaluations (if needed), and presents an updated certification by the QPE.

3. Applicability of 2016 Plan Hydrologic Design Basis

The 2016 Plan reported flood routing for an inflow design flood runoff volume from a Probable Maximum Precipitation (PMP) thunderstorm depth of 10.1 inches based on “Flood Routing Studies for Bottom Ash and Fly Ash Ponds” (Ebasco, 1976). The 2016 Plan concluded that the 10.1-inch PMP would produce 964.4 acre-feet of runoff that could be stored easily within the 7,400 acre-feet of storage available between the 2016 average operating level (Elevation 5,097 feet) and the maximum flood level (Elevation 5,116 feet), four feet below the crest elevation.

The 2016 Plan also reported that the 10.1-inches depth exceeds estimates of Probable Maximum Precipitation (PMP) depth using methods prescribed at that time by the Arizona Department of Water Resources (ADWR) and developed by Applied Weather Associates (AWA 2013). The AWA PMP tool evaluates precipitation for the 72-hour general, 72-hour tropical, and the 6-hour local distribution; at the FAP site, the 6-hour local storm yields the largest runoff volume of the three distributions, a rainfall depth of 7.75 inches.

The relevant page of the ADWR website (https://new.azwater.gov/dam-safety/az-pmp) provides hyperlinks to the technical studies supporting the PMP tool, and the PMP tool itself, and includes a statement that “(t)he most recent version of the Statewide Probable Maximum Precipitation Study was published in 2013.”

AECOM concludes that the hydrologic design basis provided by Ebasco (1976) provides PMP depths that are significantly higher than produced by more current PMP depth estimation tools (AWA 2013) and therefore this section of the 2016 Plan adequately represent current conditions and satisfy the requirements of the Rule.

4. 2016 Plan – Review by Section

Other than as described in the remainder of this section, the details presented in this section of the 2016 Plan adequately represent current conditions and satisfy the requirements of the Rule.

4.1 “§257.82 Hydrologic and Hydraulic capacity requirements for CCR surface impoundments”

The details presented in this section of the 2016 Plan accurately describe the requirements of the Rule.

4.2 “Overview”

The details presented in this section of the 2016 Plan adequately represent current conditions and satisfy the requirements of the Rule.

4.3 "§257.82 (a)(1)(2)(3) Hydrologic and Hydraulic capacity requirements for CCR surface impoundments"

A separate 2021 Periodic Hazard Potential Study confirms the assignment of the most severe classification, High Hazard, to the FAP. Therefore, this aspect of the 2016 Plan adequately represents current conditions and satisfies the requirements of the Rule.

As described in Section "3. Applicability of 2016 Plan Hydrologic Design Basis" of this 2021 Plan, the methodology of the 2016 Plan for PMP depth estimation, based on Ebasco (1976), is significantly more conservative (10.1 inches) than the equivalent result (7.75 inches) from the PMP depth estimation tool that ADWR recommends for use in 2021. Therefore, this aspect of the 2016 Plan adequately represents current conditions and satisfies the requirements of the Rule.

The FAP free water level has continued to lower, from approximate Elevations 5,095 feet in mid-2016 to 5,085 feet in mid-2021. The lowering is believed primarily to be a response to ongoing Plant operational improvements to decrease discharge volumes, the closure of Unit 4 at the end of 2020, and a more limited seasonal Plant operating schedule.

The characterization of the flood storage volume capacity available within the FAP that was reported in the 2016 Plan is unchanged and therefore adequately represents current conditions and satisfies the requirements of the Rule.

4.4 "§257.82 (b) Hydrologic and Hydraulic capacity requirements for CCR surface impoundments"

The details presented in this section of the 2016 Plan adequately represent current conditions and satisfy the requirements of the Rule.

4.5 "§257.82 (c)(1)(2)(3)(4)(5) Hydrologic and Hydraulic capacity requirements for CCR surface impoundments"

The owner or operator continues to acknowledge and will comply with these requirements.

Per the requirement of §257.82 (c)(4), this document constitutes the "every five years" Periodic Inflow Design Flood Control System Plan.

A certification of this Periodic Inflow Design Flood Control System Plan by a QPE is included in this document per the requirement of §257.82(c)(5).

4.6 "§257.82 (d) Hydrologic and Hydraulic capacity requirements for CCR surface impoundments"

The owner or operator continues to acknowledge and will comply with these requirements.

5. Recommended Additional Technical Investigations or Evaluations

None identified and none recommended.

6. Limitations

This document 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 presented in this document are made by others, such conclusions are the responsibility of others.

The Periodic Inflow Design Flood Control System Plan presented in this report is based on the 2016 Plan and relies and incorporates any Limitations expressed in that document.

The Certification of Professional Opinion in this report is limited to the information available to AECOM at the time this Assessment was performed 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 have been assumed to be accurate, knowledge of the site, and partly on our general experience with dam safety evaluations performed on other dams.

No warranty or guarantee, either written or implied, is applicable to this work. The use of the word “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.

7. Conclusion

The 2016 Plan and its conclusions meet the current reporting requirements of the Rule, reflect the current condition of the structure as known to the QPE and documented in the annual inspections, are not compromised by any identified issues of concern, and are consistent with the standard of care of professionals performing similar evaluations in this region of the country.

8. Certification Statement

Certification Statement for:

- Certification Statement 40 CFR § 257.82(c)(5) – Periodic Inflow Design Flood Control System Plan for an Existing CCR Surface Impoundment.
- CCR Unit: Arizona Public Service; Cholla Power Plant; Fly Ash Pond

I, Alexander W. 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 information contained in this Periodic Inflow Design Flood Control System Plan dated October 2021, including the technical content in Attachment A, meets the requirements of 40 CFR § 257.81.

Alexander W. Gourlay, P.E.
Printed Name

October 11, 2021
Date

Attachment A:

AECOM, 2016, *Cholla Power Plant, Fly Ash Pond, Inflow Design Flood Control System Plan, CH_InflowFlood_002_20161017,* August 31, 2016.

ATTACHMENT A

AECOM, 2016. ***Cholla Power Plant, Fly Ash Pond, Inflow Design Flood Control System Plan, CH_InflowFlood_002_20161017,*** **August 31, 2016.**

CHOLLA POWER PLANT
FLY ASH POND
INFLOW DESIGN FLOOD CONTROL SYSTEM PLAN
CH_InflowFlood_002_20161017

This *Inflow Design Flood Control System Plan* (Plan) document has been prepared specifically for the Fly Ash Pond at the Cholla Power Plant. This Plan has been prepared in accordance with our understanding of the requirements prescribed in §257.82 of the Federal Register, Volume 80, Number 74, dated April 17, 2015 (U. S. Government, 2015) for hydrologic and hydraulic capacity requirements for CCR surface impoundments associated with existing Coal Combustion Residual (CCR) surface impoundments. Section §257.82 is reproduced below for reference purposes. This document serves as the initial plan described in §257.82.

The Fly Ash Pond is an existing CCR surface impoundment facility. Calculations prepared previously in support of the facility operation have been referenced and reproduced herein to address the requirements listed.

§257.82 Hydrologic and Hydraulic capacity requirements for CCR surface impoundments

(a) The owner or operator of an existing or new CCR surface impoundment or any lateral expansion of a CCR surface impoundment must design, construct, operate, and maintain an inflow design flood control system as specified in paragraphs (a)(1) and (2) of this section.

(1) The inflow design flood control system must adequately manage flow into the CCR unit during and following the peak discharge of the inflow design flood specified in paragraph (a)(3) of this section.

(2) The inflow design flood control system must adequately manage flow from the CCR unit to collect and control the peak discharge resulting from the inflow design flood specified in paragraph (a)(3) of this section.

(3) The inflow design flood is:

(i) For a high hazard potential CCR surface impoundment, as determined under §257.73(a)(2) or §257.74(a)(2), the probable maximum flood;

(ii) For a significant hazard potential CCR surface impoundment, as determined under §257.73(a)(2) or §257.74(a)(2) , the 1,000-year flood;

(iii) For a low hazard potential CCR surface impoundment, as determined under §257.73(a)(2) or §257.74(a)(2), the 100-year flood; or

(iv) For an incised CCR surface impoundment, the 25-year flood.

(b) Discharge from the CCR unit must be handled in accordance with the surface water requirements under §257.3-3.

(c) *Inflow design flood control system plan* –

(1) *Content of the Plan*. The owner or operator must prepare initial and periodic inflow design flood control system plans for the CCR unit according to the timeframes specified in paragraphs (c)(3) and (4) of this section. These plans must document how the inflow design flood control system has been

designed and constructed to meet the requirements of this section. Each plan must be supported by appropriate engineering calculations. The owner or operator of the CCR unit has completed the inflow design flood control system plan when the plan has been placed in the facility's operating record as required by §257.105(g)(4).

(2) *Amendment of the Plan*. The owner or operator of the CCR unit may amend the written inflow design flood control system plan at any time provided the revised plan is placed in the facility's operating record as required by §257.105(g)(4). The owner or operator must amend the written inflow design flood control system plan whenever there is a change in conditions that would substantially affect the written plan in effect.

(3) *Timeframes for preparing the initial plan* -

(i) *Existing CCR surface impoundments*. The owner or operator must prepare the initial inflow design flood control system plan no later than October 17, 2016.

(ii) New CCR surface impoundments and any lateral expansion of a CCR surface impoundment. The owner of operator must prepare the initial inflow design flood control system plan no later than the date of initial receipt of CCR in the CCR unit.

(4) *Frequency for revising the plan*. The owner or operator must prepare periodic inflow design flood control system plans required by paragraph (c)(1) of this section every five years. The date of completing the initial plan is the basis for establishing the deadline to complete the first periodic plan. The owner or operator may complete any required plan prior to the required deadline provided the owner or operator places the completed plan into the facility's operating record within a reasonable amount of time. In all cases, the deadline for completing a subsequent plan is based on the date of completing the previous plan. For purposes of this paragraph (c)(4), the owner or operator has completed an inflow design flood control system plan when the plan has been placed in the facility's operating record as required by §257.105(g)(4).

(5) The owner or operator must obtain a certification from a qualified engineer stating that the initial and periodic inflow design flood control system plans meet the requirements of this section.

(d) The owner or operator of the CCR unit must comply with the record keeping requirements specified in §257.105(g), the notification requirements specified in §257.106(g), and the internet requirements specified in §257.107(g).

SITE INFORMATION	
Site Name / Address	Cholla Power Plant / 4801 Frontage Road, Joseph City, AZ 86032
Owner Name / Address	Arizona Public Service / 400 North 5th Street, Phoenix, AZ 85004
CCR Unit	Fly Ash Pond

OVERVIEW

The Fly Ash Pond is an existing surface impoundment that receives fly ash generated by the Cholla Power Plant. This Inflow/flood control plan describes the contributing flow rates, runoff volumes, and storage capacities estimated previously as part of the design. The Fly Ash Pond has been classified as a high hazard dam which is required to accommodate the Probable Maximum Precipitation (PMP) event inflow. The Fly Ash Pond provides sufficient storage volume to accommodate the PMP runoff volume of 964.4 acre-feet.

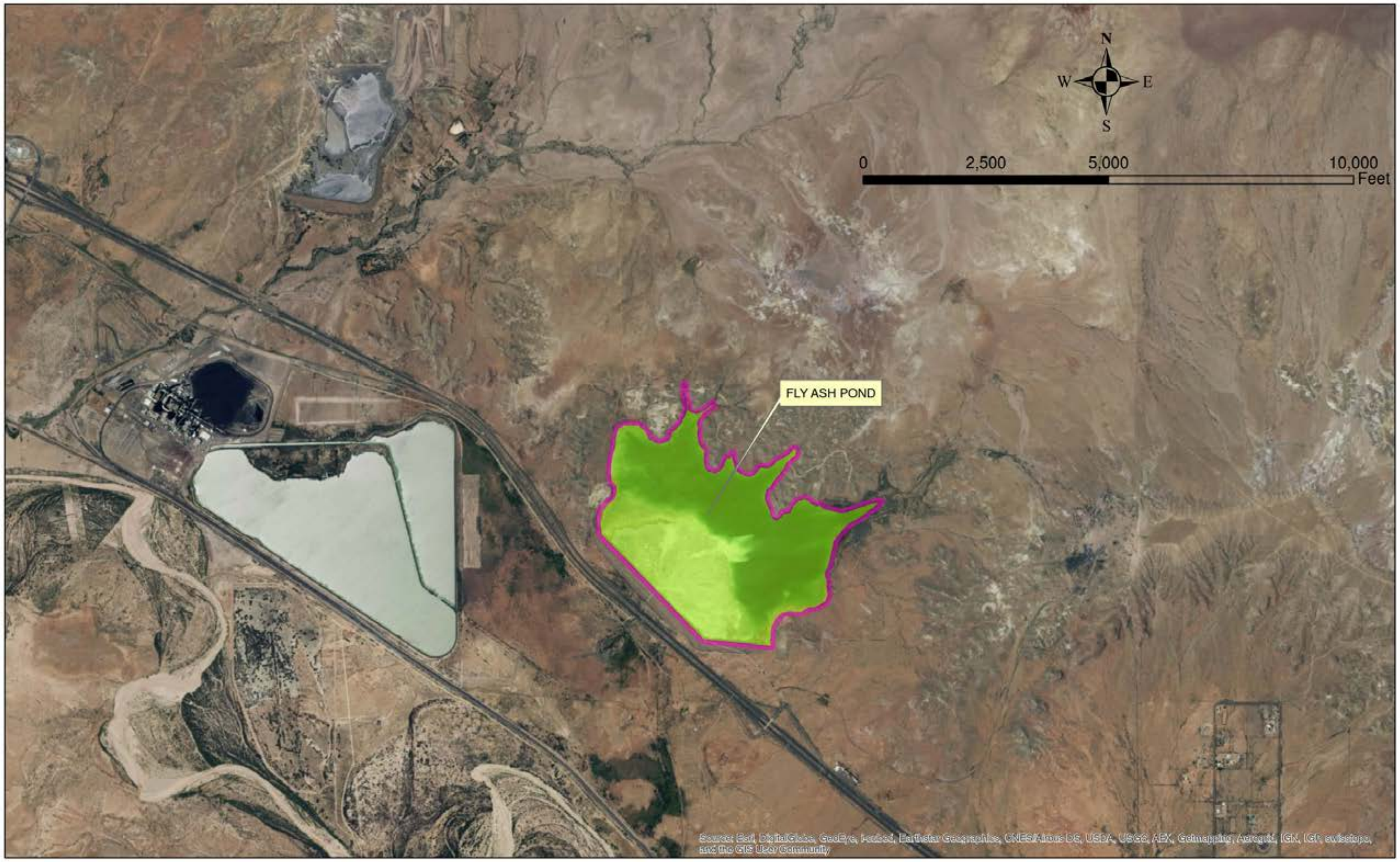


Exhibit 1 – Fly Ash Pond at Cholla Power Plant Facility

§257.82 (a)(1)(2)(3) Hydrologic and Hydraulic capacity requirements for CCR surface impoundments	
(a) The owner or operator of an existing or new CCR surface impoundment or any lateral expansion of a CCR surface impoundment must design, construct, operate, and maintain an inflow design flood control system as specified in paragraphs (a)(1) and (2) of this section. (1) The inflow design flood control system must adequately manage flow into the CCR unit during and following the peak discharge of the inflow design flood specified in paragraph (a)(3) of this section.	The Fly Ash Pond has a high hazard classification which requires accommodation of the Probable Maximum Precipitation (PMP) inflow runoff volume. The Fly Ash Pond was designed with for probable maximum thunderstorm depth of 10.1-inches. The 10.1 inch depth exceeds PMP requirement. The Arizona Department of Water Resource's more recent local 6-hour PMP Depth is 7.75 inches which is based on methodology developed by Applied Weather Associates (AWA 2013). Using this methodology the local 6-hour PMP depth is greater that the tropical 72-hour PMP. **Flood Routing Studies for Bottom Ash and Fly Ash Ponds** (Ebasco 1976), indicates that the Fly Ash Pond provides sufficient storage volume to accommodate the probable maximum thunderstorm precipitation runoff volume of 964.4 acre-feet produced by the 1230-acre contributing watershed with a minimum of four feet of freeboard. The Fly Ash Pond embankment is constructed to elevation 5120 feet. Recorded water levels at the Fly Ash Pond from January 2016 to May 2016 yielded an average normal operating water level of approximately 5097. The water level records are included in Appendix 3 – Fly Ash Dam Settlement Program Records. **Arizona Public Service Company, Cholla Generating Station, Ash Disposal Sites, Seepage and Foundation Studies Engineering Report** (Ebasco 1975) indicates that the Fly Ash Pond storage capacity at stage 5097 and 5116 (4 feet below top of embankment stage 5120) is 9,000 and 16,400 acre-feet, respectively. This yields a storage capacity of 7,400 acre-feet for storm water

	which exceeds the PMP runoff volume of 964.4 acre-feet. A freeboard value of over 4 feet is provided below the Fly Ash Pond embankment elevation of 5120 feet.
(a) The owner or operator of an existing or new CCR surface impoundment or any lateral expansion of a CCR surface impoundment must design, construct, operate, and maintain an inflow design flood control system as specified in paragraphs (a)(1) and (2) of this section. (2) The inflow design flood control system must adequately manage flow from the CCR unit to collect and control the peak discharge resulting from the inflow design flood specified in paragraph (a)(3) of this section.	**Flood Routing Studies for Bottom Ash and Fly Ash Ponds** (Ebasco 1976) indicates that the Fly Ash Pond provides storage volume to accommodate the PMP runoff volume of 964.4 acre-feet produced by the 1230-acre contributing watershed with over four feet of freeboard. No flow from the Fly Ash Pond is anticipated and no emergency spillways are provided as part of the Fly Ash Pond.
(a)(3) The inflow design flood is: (i) For a high hazard potential CCR surface impoundment, as determined under §257.73(a)(2) or §257.74(a)(2), the probable maximum flood; (ii) For a significant hazard potential CCR surface impoundment, as determined under §257.73(a)(2) or §257.74(a)(2) , the 1,000-year flood; (iii) For a low hazard potential CCR surface impoundment, as determined under §257.73(a)(2) or §257.74(a)(2), the 100-year flood; or (iv) For an incised CCR surface impoundment, the 25-year flood.	The hazard classification for the Bottom Ash Pond is high based on the **Final Summary Report Structural Integrity Assessment, Fly Ash Pond, Cholla Power Plant**, prepared by AECOM in August 2016 (AECOM 2016).
§257.82 (b) Hydrologic and Hydraulic capacity requirements for CCR surface impoundments	
(b) Discharge from the CCR unit must be handled in accordance with the surface water requirements under §257.3-3.	The Fly Ash Pond is designed and operated as a disposal facility and is intended for use as an impoundment with storage volume in excess of the PMP runoff volume and no spillway.

§257.82 (c)(1)(2)(3)(4)(5) Hydrologic and Hydraulic capacity requirements for CCR surface impoundments	
(c)(1) *Content of the plan.* The owner or operator must prepare initial and periodic inflow design flood control system plans for the CCR unit according to the timeframes specified in paragraphs (c)(3) and (4) of this section. These plans must document how the inflow design flood control system has been designed and constructed to meet the requirements of this section. Each plan must be supported by appropriate engineering calculations. The owner or operator of the CCR unit has completed the inflow design flood control system plan when the plan has been placed in the facility's operating record as required by §257.105(g)(4).	This *Inflow Design Flood Control Plan* serves as the initial plan prescribed herein.
(c)(2) *Amendment of the Plan*. The owner or operator of the CCR unit may amend the written inflow design flood control system plan at any time provided the revised plan is placed in the facility's operating record as required by §257.105(g)(4). The owner or operator must amend the written inflow design flood control system plan whenever there is a change in conditions that would substantially affect the written plan in effect.	The owner or operator acknowledges and will comply with this requirement.
(c)(3*) Timeframes for preparing the initial plan –* (i) Existing CCR impoundments. The owner or operator must prepare the initial inflow design flood control system plan no later than October 17, 2016. (ii) New CCR surface impoundments and any lateral expansion of a CCR surface impoundment. The owner or operator must prepare the initial inflow design flood control system plan no later than the date of initial receipt of CCR in the CCR Unit	The Fly Ash Pond is an existing CCR impoundment at Cholla Power Plant. The inflow design flood control system plan is included herein. The owner or operator acknowledges and will comply with this requirement.

(c)(4) *Frequency for revising the plan*. The owner or operator must prepare periodic inflow design flood control system plans required by paragraph (c)(1) of this section every five years. The date of completing the initial plan is the basis for establishing the deadline to complete the first periodic plan. The owner or operator may complete any required plan prior to the required deadline provided the owner or operator places the completed plan into the facility's operating record within a reasonable amount of time. In all cases, the deadline for completing a subsequent plan is based on the date of completing the previous plan. For purposes of this paragraph (c)(4), the owner or operator has completed an inflow design flood control system plan when the plan has been placed in the facility's operating record as required by §257.105(g)(4).	The owner or operator acknowledges and will comply with this requirement.
(c)(5) The owner or operator must obtain a certification from a qualified professional engineer stating that the initial and periodic inflow design flood control system plans meet the requirements of this section.	Certification by a professional engineer is included as an attachment to this document.
§257.82 (d) Hydrologic and Hydraulic capacity requirements for CCR surface impoundments	
(d) The owner or operator of the CCR unit must comply with the recordkeeping requirements specified in §257.105(g), the notification requirements specified in §257.106(g), and the internet requirements specified in §257.107(g).	The owner or operator acknowledges and will comply with this requirement.

References

AECOM, August 2016, **Final Summary Report Structural Integrity Assessment, Fly Ash Pond, Cholla Power *Plant*.**

Applied Weather Associates, 2013, **Probable Maximum Precipitation Study for Arizona, prepared for the Arizona Department of Water Resources.**

Ebasco Services Incorporated, May 1976, ***Flood Routing Studies for Bottom Ash and Fly Ash Ponds***.

Ebasco Services Incorporated, September 1975, ***Arizona Public Service Company, Cholla Generating Station, Ash Disposal Sites, Seepage and Foundation Studies Engineering Report***.

U.S. Government, April 2015, ***Federal Register, Volume 80, Number 74, Rules and Regulations***.

Certification Statement 40 CFR § 257.82(c)(5) – Initial Inflow Design Flood Control System Plan for an Existing CCR Surface Impoundment

CCR Unit: Arizona Public Service; Cholla Power Plant; Fly Ash Pond

I, Alexander W. 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 information contained in the initial inflow design flood control system plan dated August, 31, 2016 meets the requirements of 40 CFR § 257.82.

Alexander W. Gourlay, P.E.

Printed Name

August 31, 2016

Date

APPENDIX 1 - CHOLLA FLY ASH POND PMP INFLOW RUNOFF VOLUME

ARIZONA PUBLIC SERVICE

CHOLLA STEAM ELECTRIC STATION

FLOOD ROUTING STUDIES
FOR
BOTTOM ASH AND FLY ASH PONDS

EBASCO SERVICES INCORPORATED

MAY 1976

INTRODUCTION

Bottom Ash and Fly Ash produced as waste products from the operation of the electric generating units at the Cholla Site will be disposed of separately in two ponds to be constructed just north of Route 40 as indicated on Figure 1. The pond areas will be formed by constructing embankment dikes across low areas between ridges at each location. The Fly Ash Pond and Bottom Ash Pond embankment dikes will be approximately 4400 and 4000 feet long respectively. Both embankment dikes will be constructed to a final top elevation of 5120.0. As described in the Ebasco report "Seepage and Foundation Studies", service spillways or other release structures are not necessary during the life of the installation. Sufficient storage volumes are available over and above that required for the ash products to store process waters and normal storm waters while maintaining more than four feet of freeboard. Such waters are continuously being dissipated through evaporation throughout any given year. Following the useful life of the installation, there will still be adequate residual storage in the ponds to fully contain runoff waters from a probable maximum thunderstorm with four feet of freeboard. These waters can also be dissipated through evaporation without resorting to emergency spillways.

PURPOSE AND SCOPE

This report describes the detailed assumptions and procedures used to establish both the magnitude of the probable maximum design storm applicable to the site area and the inflow hydrograph for each pond associated with the design storm. Plots of the inflow hydrographs with time are provided.

ESTABLISHMENT OF PROBABLE MAXIMUM DESIGN STORM

In establishing the probable maximum design storm applicable to the site area the procedures given in Chapter III of the 1973 edition of Design of Small Dams by the Bureau of Reclamation were used.

The site area is located west of the 105th meridian and therefore two types of storm were studied, a probable maximum general storm of 48 hours duration and a probable maximum thunderstorm of 1-hour duration. Figures 2 and 3 reproduced from Design of Small Dams indicate that at the site the probable maximum thunderstorm 1-hour rainfall is 10.1 inches and the probable maximum general storm 6-hour point rainfall is 4.0 inches. The probable maximum general storm was extended to a 48-hour storm by multiplying by a recommended factor of 2.41 to yield a total rainfall of 9.64 inches. No extension of the probable maximum thunderstorm rainfall is required.

The rainfall values given in the previous paragraph are point values that should be converted to an area value depending on the size of the drainage basin. The Fly Ash Pond has a total drainage basin area of 1230 acres or 1.92 square miles. The Bottom Ash Pond has a drainage basin area of 128 acres or 0.2 square miles. Due to the very small size of the Bottom Ash Pond Basin, no reduction in the total rainfall was made. For the Fly Ash Pond, the area rainfall was taken as 96% of the 48-hour point value using Figure 21 of Design of Small Dams for a basin size of 1.92 sq mi. The total rainfalls for each basin are then as follows:

Pond	Drainage Area	Probable Maximum 1-hour Thunderstorm Rainfall	Probable Maximum 48-hour General Storm Rainfall
Fly Ash	1.92 sq mi	9.7 inches	9.25 inches
Bottom Ash	0.20 sq mi	10.1 inches	9.64 inches

Although both storms have roughly the same rainfall and will contribute similar volumes of water to the ponds, the thunderstorm is much more critical since all the rainfall occurs within a one hour time period. This causes more rapid pond water level build-ups than does the general storm where the total rainfall is spread out over 48 hours. For this reason, inflow hydrographs for both ponds were constructed for only the probable maximum thunderstorm.

ESTABLISHMENT OF INFLOW FLOOR HYDROGRAPHS

Using the procedures outlined in Chapter III and Appendix-A of Design of Small Dams, the thunderstorm was defined by breaking it up into a series of 15-minute increments and assigning to each a percentage of the total rainfall in inches. The resulting storm is as follows:

Duration	Accumulative Rainfall	Incremental Rainfall	Rainfall Intensity
15 min.	1.65 inches	1.65 inches	6.6 inches/hour
30 min.	3.88 inches	2.23 inches	8.9 inches/hour
45 min.	8.54 inches	4.66 inches	18.6 inches/hour
60 min.	9.70 inches	1.16 inches	4.6 inches/hour

Due to the very small size of the Bottom Ash Pond drainage basin and since the pond itself covers most of the basin, it was assumed that the inflow was equivalent to the incremental rainfall over the basin area with no reductions for losses or lag times for overland flow. The inflow hydrograph is then simply equal to the individual incremental rainfall values multiplied by the drainage basin area and converted to acre feet. The inflow hydrograph for the Bottom Ash Pond during a probable maximum thunderstorm is shown on Figure 4. The total volume of water reaching the pond is 107.7 acre feet.

The Fly Ash Pond at elevation +5116.0 covers an area of roughly 440 acres or approximately one-third the total drainage basin. The quantity of overland runoff from the remaining basin area resulting from the design rainfall was calculated using the Soil Conservation Service method using a runoff curve number of 95. Appendix-A of Design of Small Dams outlines the method and provides plots of direct runoff versus rainfall for various runoff curve numbers. The following table summarizes storm rainfall and direct runoff for the Fly Ash Pond basin above pond level.

Time	Incremental Rainfall	Accumulative Rainfall	Accumulative Runoff	Incremental Runoff
15 min.	1.65 in.	1.65 in.	1.15 in.	1.15 in.
30 min.	2.23 in.	3.88 in.	3.34 in.	2.19 in.
45 min.	4.66 in.	8.54 in.	7.93 in.	4.59 in.
60 min.	1.16 in.	9.70 in.	9.07 in.	1.14 in.

For each 15 minute increment of runoff listed above, a triangular hydrograph of flow rate versus time was constructed using 10 minutes as the average time of concentration for basin overland flow to the pond. The individual hydrographs were then graphically added to yield a total inflow hydrograph for overland flow.

From this hydrograph and using 15 minute time steps, the volume of water reaching the pond in each increment was calculated. To these volumes was added the volume of rainfall falling directly on the pond surface for each 15-minute increment of the storm. The total design inflow hydrography for the Fly Ash Pond during a probable maximum thunderstorm is shown on Figure 5. The total volume of water reaching the pond is 964.4 acre feet.

CONCLUSIONS

The Bottom Ash Pond and Fly Ash Pond embankment dikes will both be constructed in two stages. Stage I - top of dike will be at Elevation +5095 and Stage II

CONCLUSIONS (Continued)

- or completed top of dike will be at Elevation +5120. Emergency spillways will not be provided in connection with either pond. Adequate storage volumes are available in both ponds to hold the Fly Ash and Bottom Ash waste products as well as the storm water from a probable maximum thunderstorm while maintaining a minimum of 4 feet of freeboard. If it becomes evident that less than 4 feet of freeboard will remain following a probable maximum thunderstorm either due to increased bottom ash or fly ash production or extended plant life, then the dikes will be raised, spillways added, or other steps taken to provide the required minimum freeboard.

LOCATION PLAN
FLY ASH AND BOTTOM ASH PONDS

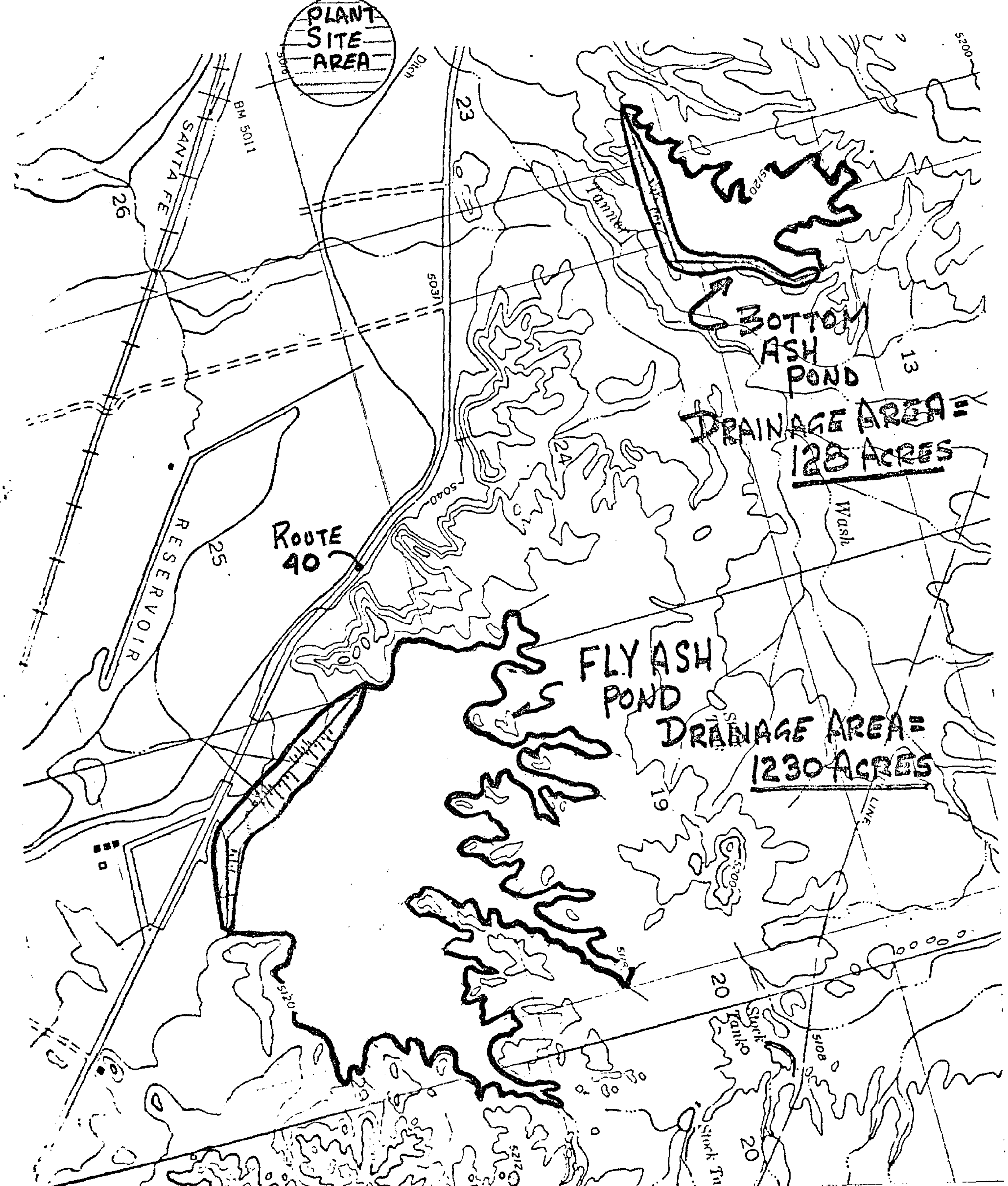


FIGURE-1

PROBABLE MAXIMUM THUNDERSTORM

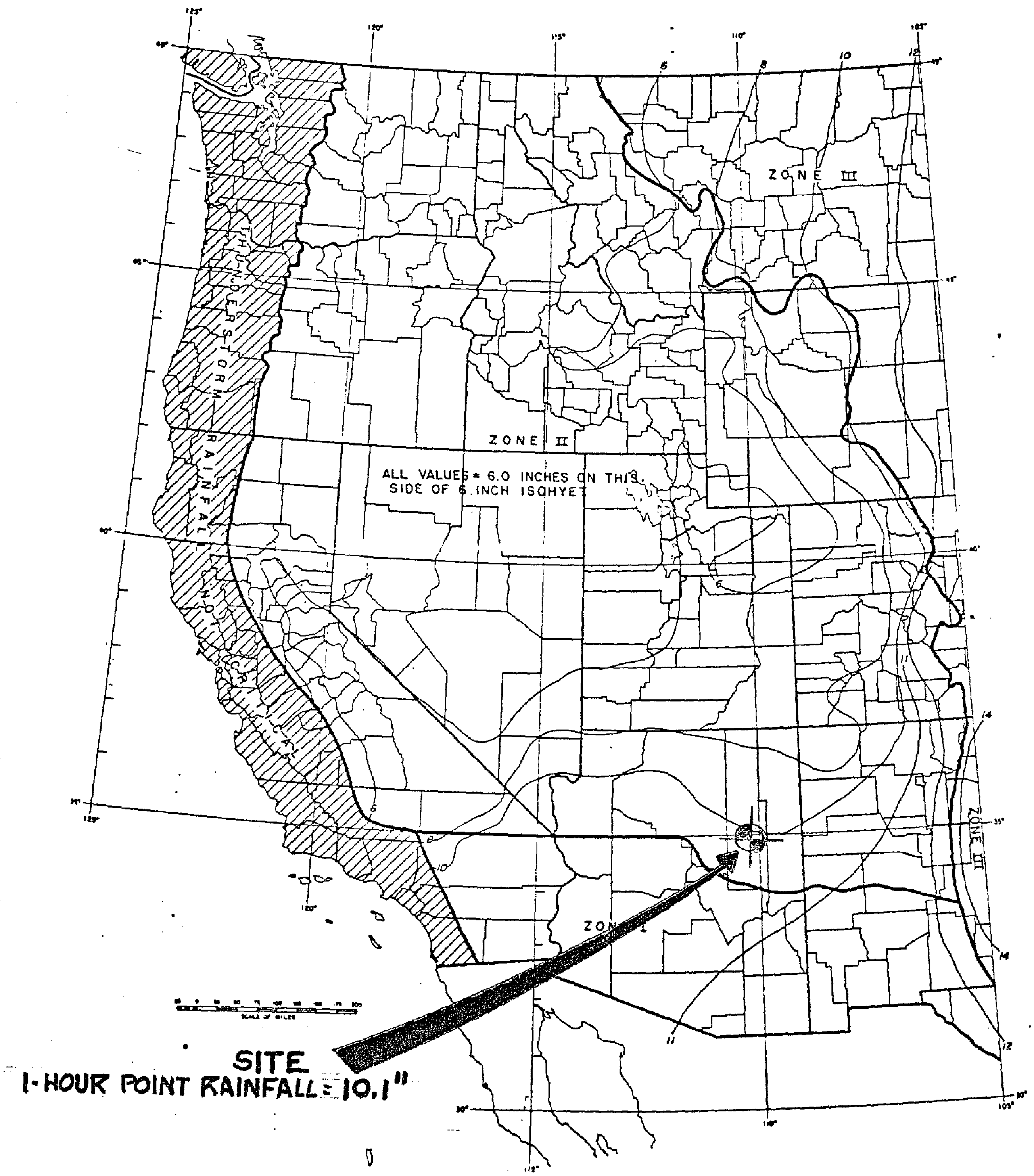


Figure 20. Probable maximum thunderstorm 1-hour rainfall (point values in inches) for area west of 105° meridian. 288-D-2760, 288-D-2761.

FIGURE-2

PROBABLE MAXIMUM GENERAL STORM

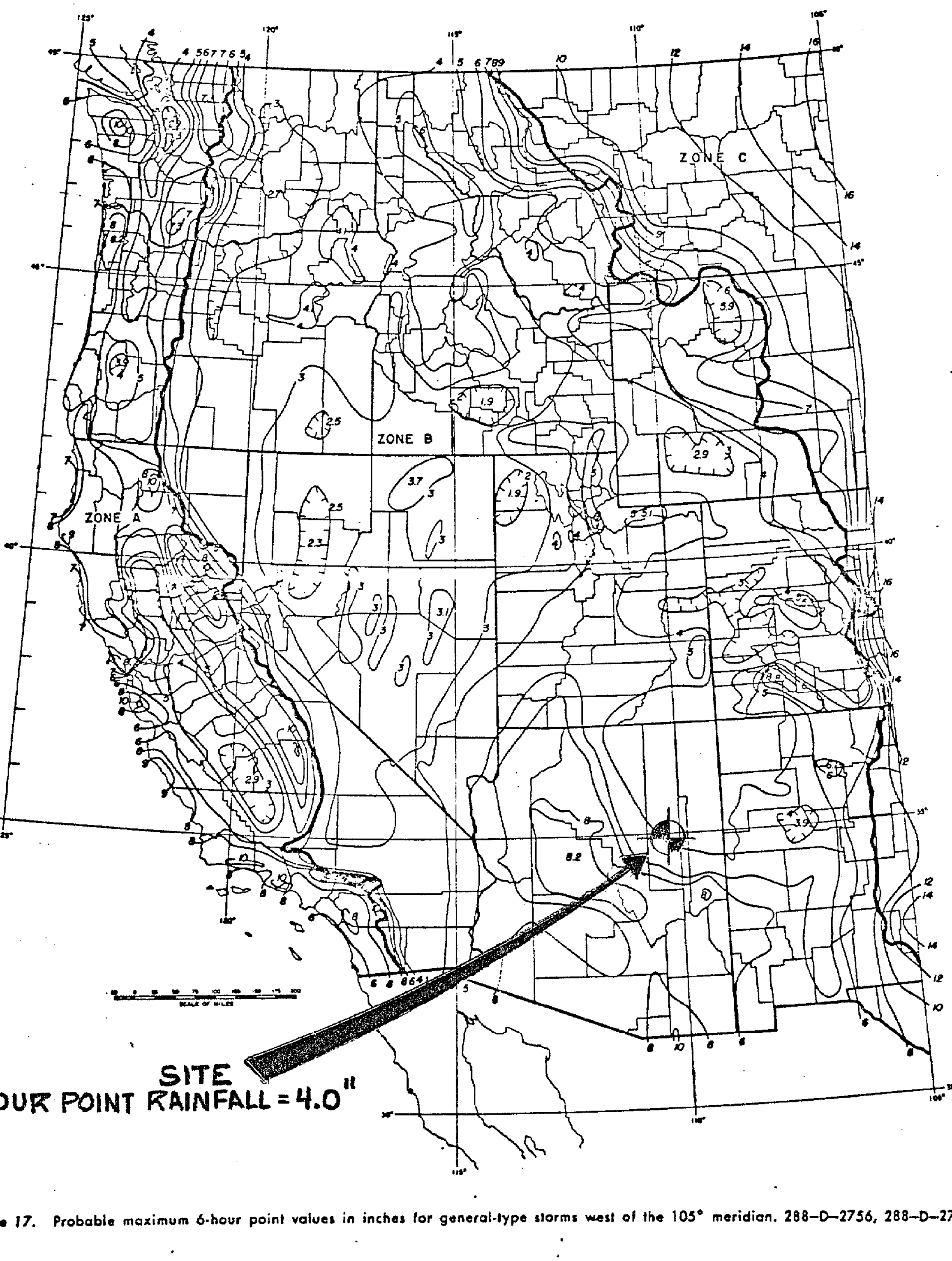
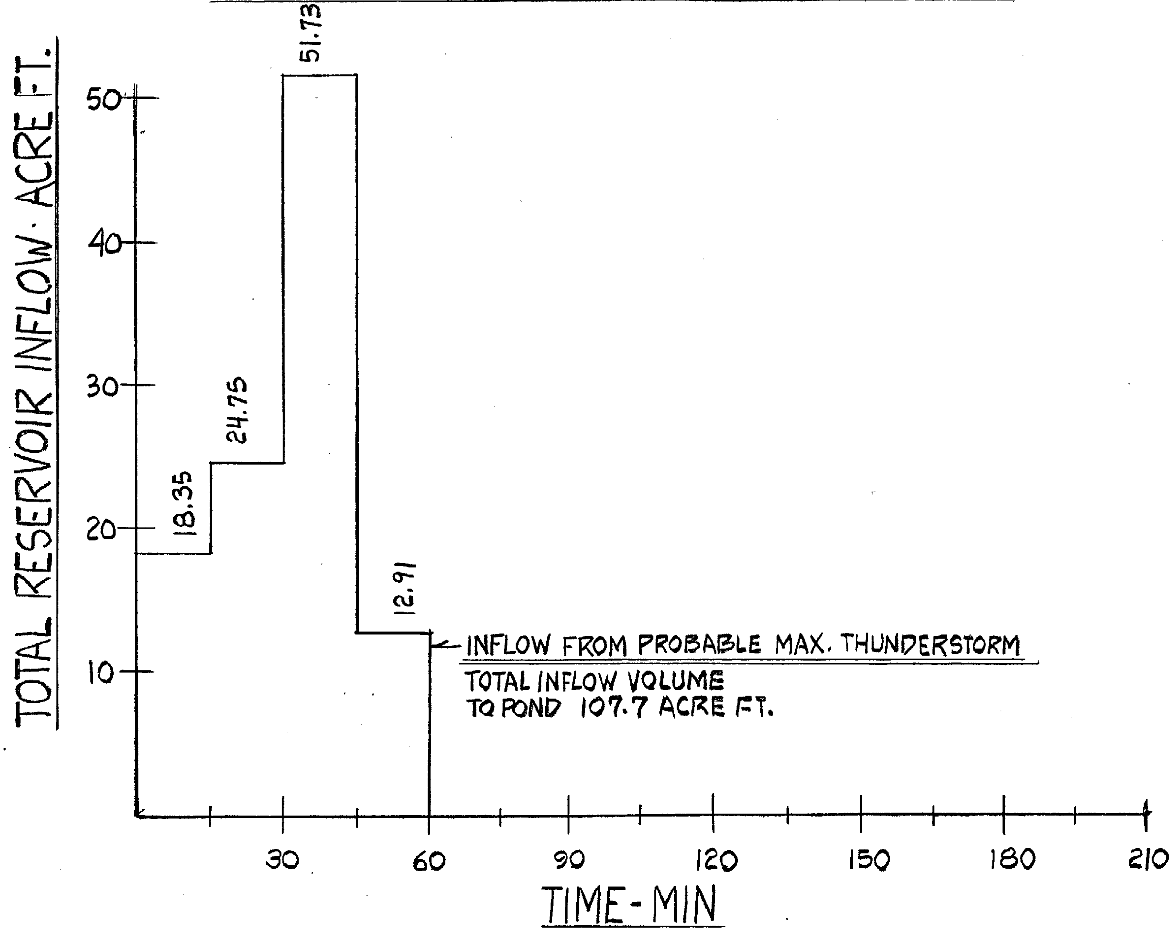


Figure 17. Probable maximum 6-hour point values in inches for general-type storms west of the 105° meridian. 288–D–2756, 288–D–2757.

FIGURE- 3

BOTTOM ASH POND INFLOW HYDROGRAPH



EBASCO SERVICES INCORPORATED

DIV. C.H. DR. JB
SCALE ___ CH. ___
DATE ___

APPROVED

REV. NO. DATE

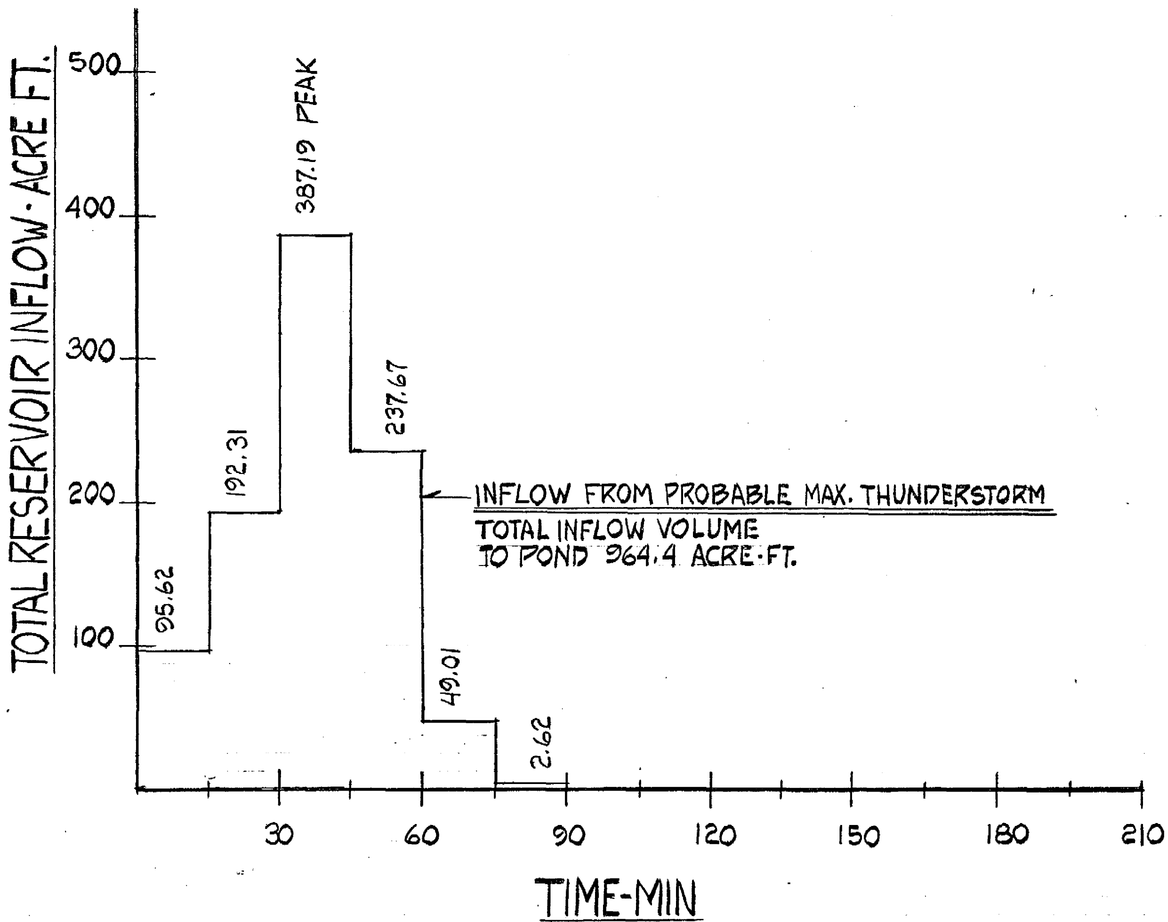
CHOLLA S.E.S.
FLOOD ROUTING STUDY

FIGURE 4

EBASCO SERVICES INCORPORATED

DIV. C.H. DR. J.B.
SCALE CH
DATE
APPROVED

FLYASH POND INFLOW HYDROGRAPH



REV. NO. DATE

CHOLLA S.E.S.
FLOOD ROUTING STUDY

FIGURE 5

APPENDIX 2 - CHOLLA FLY ASH POND STORAGE VOLUME

ARIZONA PUBLIC SERVICE COMPANY

CHOLLA GENERATING STATION

ASH DISPOSAL SITES

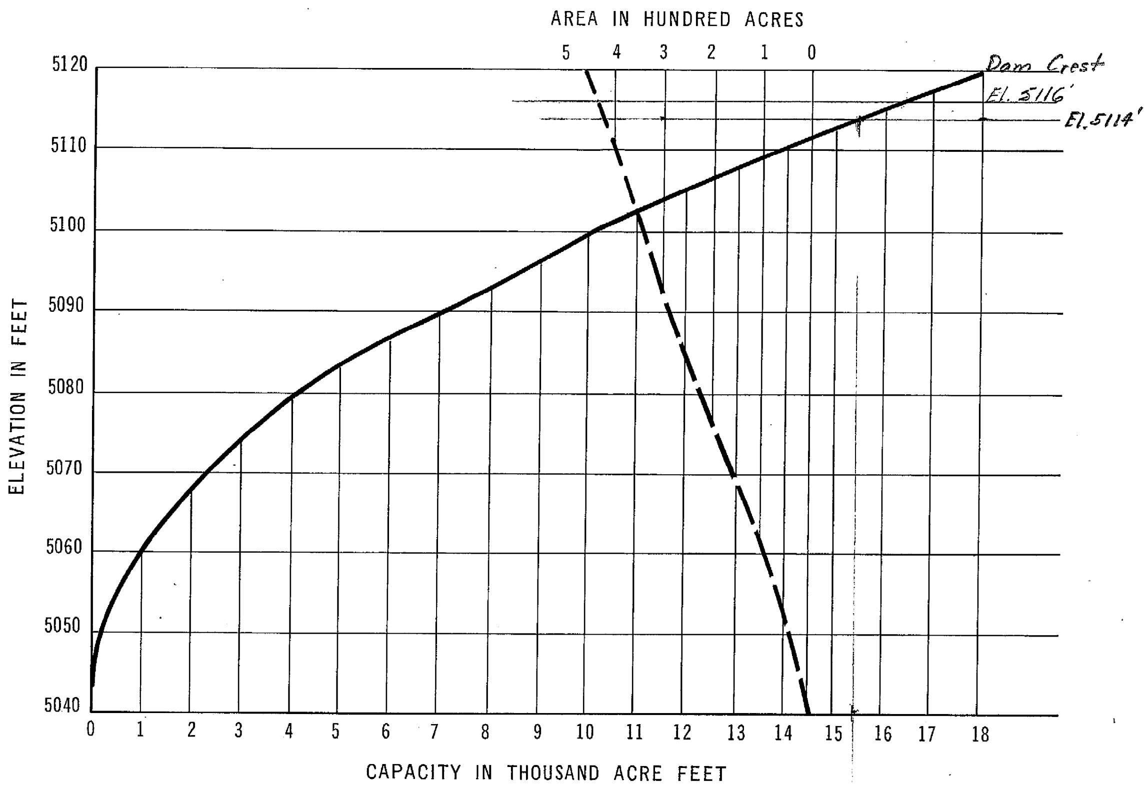
SEEPAGE AND FOUNDATION STUDIES

VOLUME I OF II

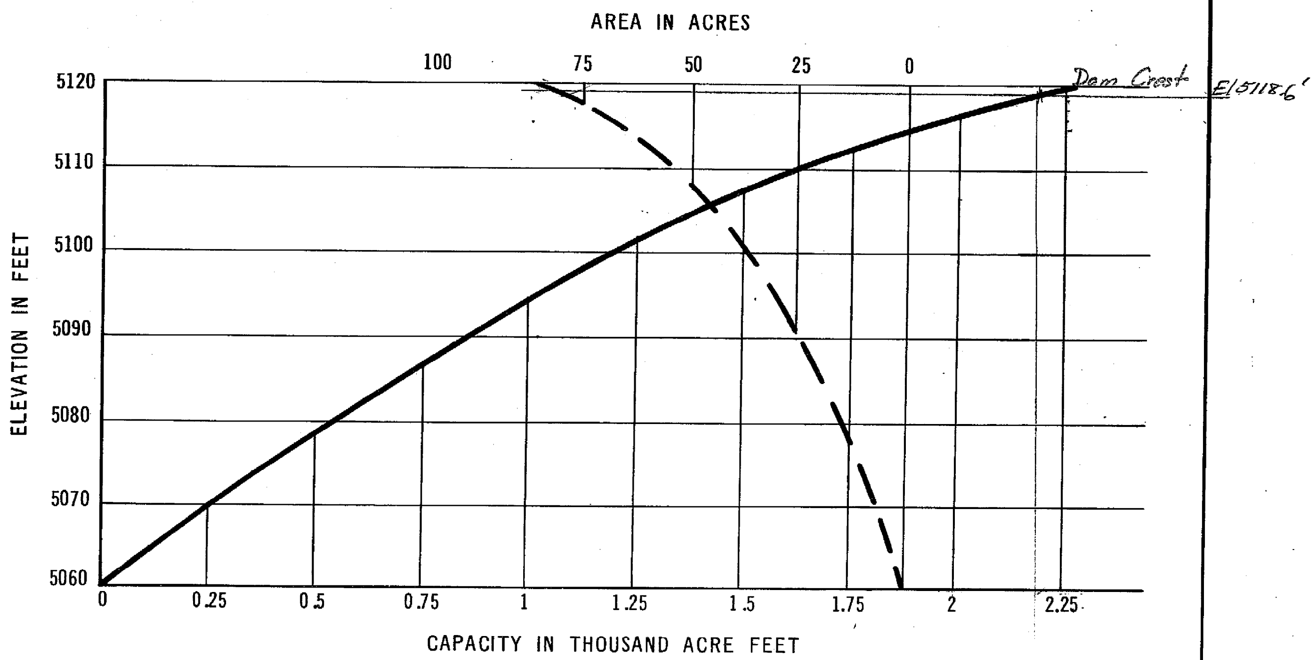
ENGINEERING REPORT

CONTENTS

LIST OF FIGURES



ARIZONA PUBLIC SERVICE CHOLLA S.E. STATION	AREA AND CAPACITY CURVES FOR FLY ASH POND SITE FIGURE 3



ARIZONA PUBLIC SERVICE CHOLLA S.E. STATION	AREA AND CAPACITY CURVES FOR BOTTOM ASH POND SITE FIGURE 4

APPENDIX 3 – FLY ASH DAM SETTLEMENT PROGRAM RECORDS

CHOLLA

FLY ASH POND

AVERAGE OPERATING WATER SURFACE ELEVATION AND STORAGE VOLUME CAPACITY

7/13/2016

MONITORING DATE	OPERATING WATER LEVEL	STORAGE CAPACITY [acre-feet]		
		STAGE 5097	STAGE 5116	STAGE 5120
January 26, 2016	5096.989	9000	16400	18000
February 29, 2016	5097.843	9000	16400	18000
March 22, 2016	5096.873	9000	16400	18000
April 23, 2016	5096.561	9000	16400	18000
May 24, 2016	5096.217	9000	16400	18000
AVERAGE -->	5097			

FLY-ASH DAM SETTLEMENT PROGRAM

CREW: JIM EDWARDS DATE: January 26 - 2016

* = NEW MONUMENTS INSTALLED AUG.2001 GPS METHODS

MONUMENT NUMBER	ORIGINAL DISTANCE	LATEST DISTANCE	ORIGINAL ELEVATION	LATEST ELEVATION	HORIZ. MOVEMENT	REMARKS
CONTROL				5175.220'		CP-21
	211.43	212.322'				
M-1			5121.549	5120.977'	.070'	DOWN STREAM
	500.00'	499.844'				
M-2			5121.515	5120.480'	.189'	DOWN STREAM
	500.00'	499.830'				
M-3			5121.418	5119.844'	.086'	DOWN STREAM
	500.00'	499.844'				
M-4			5120.676	5119.049'	.310'	DOWN STREAM
	500.00'	499.828'				
M-5			5120.122	5118.068'	.368'	DOWN STREAM
	124.89	124.913'				
* M-5A			5118.409	5117.838'	.237'	DOWN STREAM
	125.44	125.401'				
* M-5B			5118.235	5117.673'	.196'	DOWN STREAM
	123.36	123.413'				
* M-5C			5118.729	5118.007'	.034'	UP STREAM
	125.68	125.623'				
M-6			5120.721	5119.100'	.151'	UP STREAM
	127.78	127.863'				
* M-6A			5119.277	5118.714'	.129'	UP STREAM
	127.94	128.082'				
* M-6B			5120.249	5119.721	.083'	UP STREAM
	127.93	127.922'				
* M-6C			5120.523	5120.083'	.087'	UP STREAM
	127.92	127.963'				
M-7			5120.159	5119.573'	.154'	UP STREAM
	488.36'	488.263'				
M-8			5120.674	5119.863'	.241'	UP STREAM
	500.00'	499.792'				
M-9			5120.852	5120.048'	.173'	UP-STREAM
	400.00'	399.804'				
M-10			5120.283	5119.963'	.047'	UP-STREAM
	177.47'	178.576'				
CONTROL			5153.455'			CP-2

WATER LEVEL = 5096.989'

The bottom ash base pt.1000 that was set in 1999 and the fly ash base pt. 2000 that was set 20+ years ago were re-calibrated from the NGS RANDELL in June of 2010. It appears that pt. 1000 has settled .10' and pt. 2000 has settled .16'. The elevations on the monuments at each dam reflect this settlement, assuming that RANDELL has not settled.

FLY-ASH DAM SETTLEMENT PROGRAM

CREW: JIM EDWARDS DATE: 2-29-16

* = NEW MONUMENTS INSTALLED AUG.2001 GPS METHODS

MONUMENT NUMBER	ORIGINAL DISTANCE	LATEST DISTANCE	ORIGINAL ELEVATION	LATEST ELEVATION	HORIZ. MOVEMENT	REMARKS
CONTROL				5175.214'		CP.21
	211.43	212.366'				
M-1			5121.549	5120.966'	.013'	DOWN STREAM
	500.00'	499.883'				
M-2			5121.515	5120.480'	.128'	DOWN STREAM
	500.00'	499.812'				
M-3			5121.418	5119.861'	.090'	DOWN STREAM
	500.00'	499.848'				
M-4			5120.676	5119.061'	.061'	DOWN STREAM
	500.00'	499.801'				
M-5			5120.122	5117.971'	.364'	DOWN STREAM
	124.89	124.909'				
* M-5A			5118.409	5117.803	.255'	DOWN STREAM
	125.44	125.482'				
* M-5B			5118.235	5117.627'	.213'	DOWN STREAM
	123.36	123.364'				
* M-5C			5118.729	5117.993'	.033'	UP-STREAM
	125.68	125.656'				
M-6			5120.721	5119.074'	.190'	UP STREAM
	127.78	127.849'				
* M-6A			5119.277	5118.704'	.145'	UP STREAM
	127.94	128.093'				
* M-6B			5120.249	5119.710	.106'	UP STREAM
	127.93	127.937'				
* M-6C			5120.523	5120.061'	.062'	UP STREAM
	127.92	127.943'				
M-7			5120.159	5119.513'	.144'	UP STREAM
	488.36'	488.251'				
M-8			5120.674	5119.644'	.240'	UP STREAM
	500.00'	499.794'				
M-9			5120.852	5120.052'	.189'	UP STREAM
	400.00'	399.818'				
M-10			5120.283	5119.967'	.102'	UP STREAM
	177.47'	178.501'				
CONTROL			5153.493'			CP.2

WATER LEVEL = 5097.043'

The bottom ash base pt.1000 that was set in 1999 and the fly ash base pt. 2000 that was set 20+ years ago were re-calibrated from the NGS RANDELL in June of 2010. It appears that pt. 1000 has settled .10' and pt. 2000 has settled .16'. The elevations on the monuments at each dam reflect this settlement, assuming that RANDELL has not settled.

FLY-ASH DAM SETTLEMENT PROGRAM

CREW: JIM EDWARDS DATE: 3-22-16

* = NEW MONUMENTS INSTALLED AUG.2001 GPS METHODS

MONUMENT NUMBER	ORIGINAL DISTANCE	LATEST DISTANCE	ORIGINAL ELEVATION	LATEST ELEVATION	HORIZ. MOVEMENT	REMARKS
CONTROL				5175.239'		CP-21
	211.43	212.325'				
M-1			5121.549	5120.968'	.027'	DOWN STREAM
	500.00'	499.834'				
M-2			5121.515	5120.469'	.171'	DOWN STREAM
	500.00'	499.829'				
M-3			5121.418	5119.851'	.125'	DOWN STREAM
	500.00'	499.835'				
M-4			5120.676	5119.029'	.270'	DOWN STREAM
	500.00'	499.818'				
M-5			5120.122	5117.988'	.389'	DOWN STREAM
	124.89	124.945'				
* M-5A			5118.409	5117.813'	.260'	DOWN STREAM
	125.44	125.414'				
* M-5B			5118.235	5117.679'	.196'	DOWN STREAM
	123.36	123.416'				
* M-5C			5118.729	5118.013'	.023'	UP STREAM
	125.68	125.650'				
M-6			5120.721	5119.118'	.131'	UP STREAM
	127.78	127.843'				
* M-6A			5119.277	5118.720'	.109'	UP STREAM
	127.94	128.059'				
* M-6B			5120.249	5119.751'	.043'	UP STREAM
	127.93	127.950'				
* M-6C			5120.523	5120.116'	.073'	UP STREAM
	127.92	127.956'				
M-7			5120.159	5119.544'	.188'	UP STREAM
	488.36'	488.247'				
M-8			5120.674	5119.722'	.250'	UP STREAM
	500.00'	499.813'				
M-9			5120.852	5120.107'	.172'	UP STREAM
	400.00'	399.811'				
M-10			5120.283	5120.000'	.084'	UP STREAM
	177.47'	178.489'				
CONTROL			5153.489'			CP-2

WATER LEVEL = 5096.873

The bottom ash base pt.1000 that was set in 1999 and the fly ash base pt. 2000 that was set 20+ years ago were re-calibrated from the NGS RANDELL in June of 2010. It appears that pt. 1000 has settled .10' and pt. 2000 has settled .16'. The elevations on the monuments at each dam reflect this settlement, assuming that RANDELL has not settled.

FLY-ASH DAM SETTLEMENT PROGRAM

CREW: EDWARDS — DATE: 4-23-16

* = NEW MONUMENTS INSTALLED AUG.2001 — GPS METHODS

MONUMENT NUMBER	ORIGINAL DISTANCE	LATEST DISTANCE	ORIGINAL ELEVATION	LATEST ELEVATION	HORIZ. MOVEMENT	REMARKS
CONTROL				5175.232'		CP-21
	211.43	212.334'				
M-1			5121.549	5120.962'	.020'	DOWN STREAM
	500.00'	499.807'				
M-2			5121.515	5120.486'	.162'	DOWN STREAM
	500.00'	499.808'				
M-3			5121.418	5119.848'	.090'	DOWN STREAM
	500.00'	499.851'				
M-4			5120.676	5119.054'	.264'	DOWN STREAM
	500.00'	499.803'				
M-5			5120.122	5118.018	.354'	DOWN STREAM
	124.89	124.919'				
* M-5A			5118.409	5117.796'	.211'	DOWN STREAM
	125.44	125.413'				
* M-5B			5118.235	5117.643'	.182'	DOWN STREAM
	123.36	123.413'				
* M-5C			5118.729	5117.982'	.077	UP STREAM
	125.68	125.653'				
M-6			5120.721	5119.096'	.166'	UP STREAM
	127.78	127.827'				
* M-6A			5119.277	5118.725	.123'	UP STREAM
	127.94	128.103'				
* M-6B			5120.249	5119.739'	.097'	UP STREAM
	127.93	127.937'				
* M-6C			5120.523	5120.067'	.093'	UP STREAM
	127.92	127.963'				
M-7			5120.159	5119.543'	.159'	UP STREAM
	488.36'	488.260'				
M-8			5120.674	5119.668'	.234'	UP STREAM
	500.00'	499.780'				
M-9			5120.852	5120.044'	.177'	UP STREAM
	400.00'	399.844'				
M-10			5120.283	5119.994'	.064'	UP STREAM
	177.47'	178.561				
CONTROL			5153.476'			CP-2

WATER LEVEL = 5096.561'

The bottom ash base pt.1000 that was set in 1999 and the fly ash base pt. 2000 that was set 20+ years ago were re-calibrated from the NGS RANDELL in June of 2010. It appears that pt. 1000 has settled .10' and pt. 2000 has settled .16'. The elevations on the monuments at each dam reflect this settlement, assuming that RANDELL has not settled.

FLY-ASH DAM SETTLEMENT PROGRAM

CREW: EDWARDS **DATE:** 5-24-16

* = NEW MONUMENTS INSTALLED AUG.2001 GPS METHODS

MONUMENT NUMBER	ORIGINAL DISTANCE	LATEST DISTANCE	ORIGINAL ELEVATION	LATEST ELEVATION	HORIZ. MOVEMENT	REMARKS
CONTROL				5175.253		CP.21
	211.43	212.361'				
M-1			5121.549	5121.002'	.054'	DOWN STREAM
	500.00'	499.826'				
M-2			5121.515	5120.493'	.189	DOWN STREAM
	500.00'	499.831'				
M-3			5121.418	5119.852'	.134'	DOWN STREAM
	500.00'	499.860'				
M-4			5120.676	5119.062'	.276'	DOWN STREAM
	500.00'	499.781'				
M-5			5120.122	5118.042'	.361'	DOWN STREAM
	124.89	124.951'				
* M-5A			5118.409	5117.812	.225'	DOWN STREAM
	125.44	125.386'				
* M-5B			5118.235	5117.651	.154'	DOWN STREAM
	123.36	123.405'				
* M-5C			5118.729	5118.014'	.050'	UP STREAM
	125.68	125.653'				
M-6			5120.721	5119.092'	.188'	UP STREAM
	127.78	127.833'				
* M-6A			5119.277	5118.731	.135'	UP STREAM
	127.94	128.079'				
* M-6B			5120.249	5119.728'	.127'	UP STREAM
	127.93	127.946'				
* M-6C			5120.523	5120.068	.108'	UP STREAM
	127.92	127.966'				
M-7			5120.159	5119.550	.199'	UP STREAM
	488.36'	488.224'				
M-8			5120.674	5119.675'	.270'	UP STREAM
	500.00'	499.790'				
M-9			5120.852	5120.063'	.199'	UP STREAM
	400.00'	399.803'				
M-10			5120.283	5119.994'	.098'	UP STREAM
	177.47'	178.521'				
CONTROL			5159.493'			CP.2

WATER LEVEL = 5096.217'

The bottom ash base pt.1000 that was set in 1999 and the fly ash base pt. 2000 that was set 20+ years ago were re-calibrated from the NGS RANDELL in June of 2010. It appears that pt. 1000 has settled .10' and pt. 2000 has settled .16'. The elevations on the monuments at each dam reflect this settlement, assuming that RANDELL has not settled.

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