Initial Inflow Design Flood Control System Plan

South Ash Impoundment

Montrose Generating Station

Kansas City Power & Light Company

October 13, 2016

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Appendices

1 Introduction

1.1 Purpose

The purpose of this Initial Inflow Design Flood Control System Plan is to document that the requirements specified in 40 CFR §257.82 of the Coal Combusting Residual (CCR) Rule[1] have been met for the South Ash Impoundment at Kansas City Power & Light Company's (KCP&L) Montrose Generating Station. The South Ash Impoundment is an existing CCR surface impoundment as defined by 40 CFR §257.53.

1.2 Regulatory Requirements

In accordance with the CCR Rule, this plan documents how the inflow design flood control system has been designed and constructed to meet the requirements of 40 CFR §257.82 referenced below and is supported by appropriate engineering calculations. This Initial Inflow Design Flood Control System Plan shall be completed no later than October 17, 2016. Periodic inflow design flood control system plans shall be prepared every five years. The date of completing the initial plan is the basis for establishing the deadline to complete the first periodic plan. This plan shall be amended whenever there is a change in conditions that would substantially affect the written plan in effect.

Regulatory Citation: 40 CFR §257.82 (a); Design, construct, operate, and maintain an inflow design flood control system as specified:

- *(1) 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 (3);*
- *(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 (3);*
- *(3) The inflow design flood is: (i) For a high hazard potential CCR surface impoundment, the probable maximum flood; (ii) For a significant hazard potential CCR surface impoundment, the 1,000-year flood; (iii) For a low hazard potential CCR surface impoundment, the 100-year flood; or (iv) For an incised CCR surface impoundment, the 25-year flood.*

Regulatory Citation: 40 CFR §257.82 (b); Discharge from the CCR unit must be handled in accordance with the surface water requirements under: §257.3 – 3.

1.3 Brief Description of Impoundment

The Montrose Generating Station is a coal-fired power plant located near the City of Montrose in Henry County, Missouri. The Station is located approximately 4.5 miles north of Montrose and is bordered to the south by Montrose Lake. The South Ash Impoundment is located on plant property. A site Location Map showing the area surrounding the station is in **Figure 1** of **Appendix A**. The South Ash Impoundment is adjacent to the North Ash Impoundment and the two impoundments are separated by a splitter berm. The South Ash Impoundment is the primary ash facility that receives process flow most of the year. During maintenance and dredging activities on the South Ash Impoundment, the process flow is diverted to the North Ash Impoundment.

1.3.1 Design and Construction

The impoundment was commissioned in 1958 and was constructed as an incised CCR earthen impoundment in natural ground. The South Ash Impoundment consists of two cells separated by a splitter berm but hydraulically connected by a series of culverts. Design drawings prepared by Harden & Associates[2] show that the interior splitter berms have crest elevations of 757.0 feet (unless otherwise noted, all elevations in this plan are in the NAVD88 datum), while the perimeter access road that encompasses both impoundments has a minimum crest elevation of 760.0 feet. The North Impoundment has a water surface area of approximately 1.6 acres at the normal operating level of 756.5 feet, and provides additional storage capacity if needed. Cell 1 of the South Impoundment has a water surface area of approximately 1.8 acres at the normal operating level of 754.7 feet while Cell 2 of the South Impoundment has a water surface area of approximately 0.5 acres at the normal operating level of 751.4 feet.

1.3.2 Inflow from Plant Operations and Stormwater Runoff

When the South Ash Impoundment receives process flow, CCR is sluiced into the east side of the South Ash Impoundment Cell 1 at an approximate rate of 1.81 million gallons per day (MGD) or 2.82 cubic feet per second (cfs) for initial particle settling. Water flows to the west portion of Cell 1 where it drains through two culverts into the South Ash Impoundment Cell 2. Water then flows east to a 4-foot box culvert that discharges into the canal that leads to Montrose Lake.

In addition to rain that falls directly into the pond, there are upstream areas that contribute runoff to the impoundments. Approximately 14.1 acres drain to the North Ash Impoundment from upstream areas. When the upstream area is added to the 3.0 acres within the impoundment, the total drainage area of the North Ash Impoundment is 17.1 acres. Approximately 9.0 acres drain to the South Impoundment Cell 1 from upstream areas. When the upstream area is added to the 3.2 acres within the South Ash Impoundment Cell 1 and the 1.4 acres within the South Ash Impoundment Cell 2, the total drainage area of the South Ash Impoundment 13.6 acres.

1.3.3 Outlet Structures

Water typically discharges from the South Ash Impoundment Cell 1 through two 24-inch corrugated metal pipe (CMP) culverts which are located on the southwest side of the impoundment. The outlet pipes have upstream invert elevations, as shown on the Western Air Maps 2001 Topographic Survey[3], of 753.7 feet and 754.3 feet and discharge into the South Ash Impoundment Cell 2. The outlet structure from Cell 2 is a 48-inch concrete box culvert that is located on the southeast corner of the impoundment. The invert elevation of 751.0 feet was obtained from the Harden and Associates drawing[2]. The impoundment discharges through the permitted National Pollutant Discharge Elimination System (NPDES) outfall into the discharge canal which ultimately leads to Montrose Lake.

During large rain events, water also discharges from the North Ash Impoundment through two 24-inch diameter reinforced concrete pipe (RCP) culverts. The culverts are located on the northwest portion of the impoundment. The outlet pipes have an upstream invert elevation of 756.0 feet[2]. The outlet pipes daylight on the exterior slope and discharges through the permitted National Pollutant Discharge Elimination System (NPDES) outfall into the discharge canal which ultimately leads to Montrose Lake.

1.4 Plan Approach

Analyses and calculations completed for the hydrologic and hydraulic assessments of the South Ash Impoundment[4] are described in this plan. Data and analyses results are based on information shown on design drawings, topographic surveys, information about operational and maintenance procedures provided by KCP&L, and limited field measurements collected by AECOM. The analysis approach and results of the hydrologic and hydraulic analyses are presented in following sections. The results of these analyses will be used by AECOM to confirm that the South Ash Impoundment meets the hydrologic and hydraulic capacity requirements of the rule referenced above for CCR surface impoundments. **Table 1-1** cross references the Plan sections to the applicable CCR Rule requirements.

Table 2-1 – CCR Rule Cross Reference Table		
Plan Section	**Title**	**CCR Rule Reference**
4.1	Inflow Analysis	§257.82 (a)(1)
4.2	Outflow Analysis	§257.82 (a)(2)
4.3	Inflow Design Flood	§257.82 (a)(3)
4.4	Discharge handled in accordance with *§257.3 – 3*	§257.82 (b)

2 Hydrologic Analysis

2.1 Design Storm

The inflow design flood for the South Ash Impoundment is the 25-year return frequency design storm event since the impoundment is incised.

2.2 Rainfall Data

The rainfall information used in the analysis was based on the National Oceanic and Atmospheric Administration (NOAA) Atlas 14, Volume 8, Version 2[5] which provides rainfall data for storm events with average recurrence intervals ranging from 1 to 1,000 years and durations ranging from 5 minutes to 60 days. The design storm rainfall depth, obtained from the NOAA website, is 6.49 in for the 25-year, 24-hour storm. The Soil Conservation Service (SCS) Type II rainfall distribution used by AECOM is appropriate to use for storms up to the 1,000-year flood at the project site.

2.3 Runoff Computations

The drainage area for the North and South Ash Impoundment was determined using a computer-aided design (CAD) analysis of the 2001 Topographic Survey by Western Air Maps[3] and the 2013 Topographic Survey by Whitehead Consultants, Inc[6]. The total drainage area to the North Ash Impoundment and the South Ash Impoundment is approximately 17.1 acres and 13.6 acres, respectively. See **Figure 2** in **Appendix A** for the Drainage Area Map.

Runoff was calculated using the SCS Curve Number Method, where curve numbers (CN) were assigned to each sub-catchment based on the type of land cover and soil type present. Using the USDA Natural Resources Conservation Service (NRCS) Web Soil Survey[7], the soil type of the site was determined to be hydrologic soil group C. CN values for the land cover were selected from the CN Table available in HydroCAD. This data was obtained from the SCS NRCS Technical Release-55 publication[8]. The land cover types identified for the site were <50% Grass Cover and Water Surface and were determined to have a CN value of 86 and 98, respectively. A composite CN was calculated for each sub-catchment area by summing the products of each CN multiplied by its percentage of the total area. Calculations for the weighted runoff curve numbers for each sub-catchment area were performed in HydroCAD.

The time of concentration is commonly defined as the time required for runoff to travel from the most hydrologically distant point to the point of collection. Calculations for the time of concentration for each sub-catchment area were performed in HydroCAD.

Stormwater runoff from the 25-year event into the North Ash Impoundment has a peak inflow of 71.7 cubic feet per second (cfs) and total inflow volume of 7.1 acre-feet. The South Ash Impoundment Cell 1 has a peak stormwater runoff inflow of 64.0 cfs and a total inflow volume of 5.2 acre-feet, while the South Ash Impoundment Cell 2 has a peak stormwater runoff inflow of 14.9 cfs and total inflow volume of 0.6 acre-feet.

3 Hydraulic Analyses

3.1 Process Flows

Ash is currently sluiced from the plant into the east portion of the South Ash Impoundment at a rate of 1.81 million gallons per day (MGD) or 2.82 cfs. These plant flows were added as constant inflow into the impoundment during and after the IDF. Due to the process flow into the impoundment from the plant, there is typically a discharge through the outlet structure.

3.2 Storage Capacity

The storage volumes for the South Ash Impoundment was determined using a CAD analysis of the of the 2001 Topographic Survey by Western Air Maps[3]. The calculated volume of the North Ash Impoundment is approximately 0.9 acre-feet of available storage measured from the normal operating pool elevation of 756.5 feet to the zero freeboard elevation of 757.0 feet at the crest of the splitter berm. The calculated volume of Cell 1 of the South Ash Impoundment is approximately 5.1 acre-feet of available storage measured from the normal operating pool elevation of 754.7 feet to the zero freeboard elevation of 757.0 feet at the crest of the splitter berm. The calculated volume of Cell 2 of the South Ash Impoundment is approximately 4.3 acre-feet of available storage measured from the normal operating pool elevation of 751.4 feet to the zero freeboard elevation of 757.0 feet at the crest of the splitter berm. The perimeter access road of the impoundment has a minimum crest elevation of 760.0 feet, so additional storage is available above the top of the splitter berm.

3.3 Discharge Analysis

A hydraulic model was created in HydroCAD 10.00 to assess the capacity of the impoundments to store and convey the storm flows. HydroCAD has the capability to evaluate each Impoundment within the network, to respond to variable tailwater, pumping rates, and reversing flows. HydroCAD routing calculations reevaluate the impoundment’s discharge capability at each time increment, making the program an efficient and dynamic tool for this evaluation.

The analyzed scenario assumes the starting water surface elevation of the South Ash Impoundment Cell 1 is 754.7 feet, while the starting water surface elevations of Cell 2 is 751.4 feet. At these elevations, a steady-state (beginning) flow of 2.82 cfs discharges through the outlet culverts. The analyzed scenario assumes the starting water surface elevation of the North Ash Impoundment is 756.0 feet. The flowrate out of the culverts equals the process inflow from the plant achieving balanced water flow in the impoundment. The process flows and storm water runoff collected and stored in the impoundment discharge through the site’s NPDES permitted outfall into a hot water canal which ultimately leads to the Montrose Lake. Therefore, the facility does not cause a discharge of pollutants into waters of the United States that is in violation of the requirements of the NPDES under Section 402 of the Clean Water Act.

4 Results

The hydrologic and hydraulic conditions of the South Ash Impoundment were modeled with the peak discharge of the 25-year, 24-hour storm event and the current process flow from the plant.

4.1 Inflow Analysis – §257.82 (a)(1)

Adequately manage flow into the CCR unit during and following the peak discharge of the inflow design flood

Background and Assessment

Runoff from upstream areas and rain that falls directly within the perimeter access road is stored within the impoundment. Rainfall within the access road and adjacent drainage areas is added to the process flow from the plant to produce the total inflow to the South Ash Impoundment. Using the HydroCAD model, the total inflow was stored and routed through the outlet pipes of the South Ash Impoundment to determine the peak water surface elevations.

Table 4-1 summarizes the water surface elevations of the South Ash Impoundment prior to and after the inflow design flood.

Table 4-1 - Summary of Hydrologic and Hydraulic Analysis 25-Year, 24-Hour Storm				
CCR Unit	Beginning WSE* (feet)	Peak WSE (feet)	Min. Crest Elevation[3] (feet)	Freeboard Above Peak WSE (feet)
North Ash Impoundment	756.5	757.1	760.0	2.9
South Ash Impoundment Cell 1	754.7	756.4	760.0	3.6
South Ash Impoundment Cell 2	751.4	752.5	760.0	7.5
Notes: * WSE = Water Surface Elevation				

Conclusion and Recommendation

The runoff from the inflow design storm is initially stored in the both the North and South Ash Impoundments. When the water level in the North Ash Impoundment rises above the top of the interior splitter berm, the overflow is then stored in the South Ash Impoundment, which is also storing the process flow from the plant. As there is adequate storage within the perimeter access road of the North Ash Impoundment and South Ash Impoundment to manage the inflow design flood as well as the process flow from the plant, there is no anticipated overtopping of the impoundment, which meets the requirements in §257.82 (a)(1).

4.2 Outflow Analysis – §257.82 (a)(2)

Adequately manage flow from the CCR unit to collect and control the peak discharge resulting from the inflow design flood.

Background and Assessment

Rainfall and process flow from the plant is stored within the South Ash Impoundment. Using the HydroCAD model, the total inflow was routed through the outlet pipes of the South Ash Impoundment to determine the peak flowrate and velocity through the outlet devices.

Table 4-2 summarizes the peak flowrates and velocities through each of the outlet devices.

Table 4-2 - Summary of Outlet Pipes
25-Year, 24-Hour Storm

Outlet Device	Type and Size	Invert Elevation[2,3] (feet)	Peak Flowrate (cfs)	Velocity at Peak Flowrate (fps)
North Ash Impoundment Outlet Pipes	2 – 24-inch dia. RCP Culvert	756.0	12.9	3.6
North Ash Impoundment Splitter Berm	Broad Crested Weir	757.0	57.7	0.9
South Ash Impoundment Cell 1 Outlet Pipes	2 – 24-inch dia. CMP Culvert	753.7 754.3	14.5 11.0	4.6 4.1
South Ash Impoundment Cell 2 Outlet Pipes	48-inch Concrete Box Culvert	751.0	24.0	4.0

Conclusion and Recommendation

As the South Ash Impoundment outlets manage the discharge of the inflow design flood and the process flow from the plant without the peak water surface elevation overtopping the perimeter access road, the impoundment meets the requirements in §257.82 (a)(2).

4.3 Inflow Design Flood – §257.82 (a)(3)

Required Inflow design flood for Incised Impoundment.

Background and Assessment

The calculations for the inflow design flood are based on the impoundment being incised.

Conclusion and Recommendation

Since the impoundment is incised, the 25-year, 24-hour design storm was utilized in the analysis, which meets the requirements in §257.82 (a)(3).

4.4 Discharge – §257.82 (b)

Discharge from the CCR unit handled in accordance with the surface water requirements under: §257.3 – 3.

Background and Assessment

The typical discharge from the South Ash Impoundment outlets to the discharge canal that leads to Montrose Lake. During the inflow design storm event, a portion of the discharge from the North Ash Impoundment is partially contained in the South Ash Impoundment and is discharged via outlet pipes to the discharge canal that leads to Montrose Lake. The discharge must meet the requirements of the NDPES under Section 402 of the Clean Water Act to meet the CCR Rule.

Conclusion and Recommendation

Discharge from the South Ash Impoundment is through permitted NPDES outfalls. As per the current NPDES permit all discharged water is tested for pollutants and the discharge meets the minimum regulatory requirements of the permit. Therefore, the facility does not cause a discharge of pollutants into waters of the United States that is in violation of the requirements of the NPDES under Section 402 of the Clean Water Act, and thereby meets the requirements in §257.82 (b).

5 Conclusions

The inflow design flood control system of the South Ash Impoundment adequately manages flow into the CCR unit during and following the peak discharge of the 25-year, 24-hour frequency storm event inflow design flood. The inflow design flood control system of the South Ash Impoundment adequately manages flow from the CCR unit to collect and control the peak discharge resulting from the 25-year, 24-hour frequency storm event inflow design flood. Discharge from the South Ash Impoundment is handled in accordance with the surface water requirements of §257.3 – 3 during the 25-year flood event. Therefore, the South Ash Impoundment meets the requirements for certification.

The contents of this plan, specifically **Sections 1** through **5**, represent the Initial Inflow Design Flood Control System Plan for this unit.

6 Limitations

Background information, design basis, and other data have been furnished to AECOM by KCP&L, which AECOM has used in preparing this plan. AECOM has relied on this information as furnished, and is not responsible for the accuracy of this information. Our recommendations are based on available information from previous and current investigations. These recommendations may be updated as future investigations are performed.

The conclusions presented in this plan are intended only for the purpose, site location, and project indicated. The recommendations presented in this plan should not be used for other projects or purposes. Conclusions or recommendations made from these data by others are their responsibility. The conclusions and recommendations are based on AECOM's understanding of current plant operations, maintenance, stormwater handling, and ash handling procedures at the station, as observed by AECOM and/or as provided by KCP&L. Changes in any of these operations or procedures may invalidate the findings in this plan until AECOM has had the opportunity to review the findings, and revise the plan if necessary.

This hydrologic and hydraulic analysis was performed in accordance with the standard of care commonly used as state-of-practice in our profession. Specifically, our services have been performed in accordance with accepted principles and practices of the civil engineering profession. The conclusions presented in this plan are professional opinions based on the indicated project criteria and data available at the time this plan was prepared. Our services were provided in a manner consistent with the level of care and skill ordinarily exercised by other professional consultants under similar circumstances. No other representation is intended.

7 Certification Statement

CCR Unit: KCP&L Montrose Generating Station, South Ash Impoundment

I, Brian D. Linnan, being a Registered Professional Engineer in good standing in the State of Missouri, 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 Initial Inflow Design Flood Control System Plan dated October 13, 2016, which includes all pages in Sections 1 through 5, meets the requirements of 40 CFR § 257.82.

_________Brian D. Linnan__________
Printed Name

_________October 13, 2016_________
Date

Brian D. Linnan
Digitally signed by Brian D. Linnan
Date: 2016.10.13 15:37:08 -05'00'

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8 References

1. U.S. Environmental Protection Agency, Standards for the Disposal of Coal Combustion Residuals in Landfills and Surface Impoundments, 40 CFR §257, Federal Register 80, Subpart D, April 17, 2015.

2. Harden & Associates, Montrose Station Solid Waste Disposal Area Drawings D32 and D33, dated 1986/1987.

3. Western Air Maps, Topographic Survey Plans for the Montrose Generating Station, dated 2001.

4. AECOM, Hydrologic and Hydraulic Support Calculations, Initial Inflow Design Flood Control System Plan, South Ash Impoundment, Montrose Generating Station, Kansas City Power & Light Company, dated October 13, 2016.

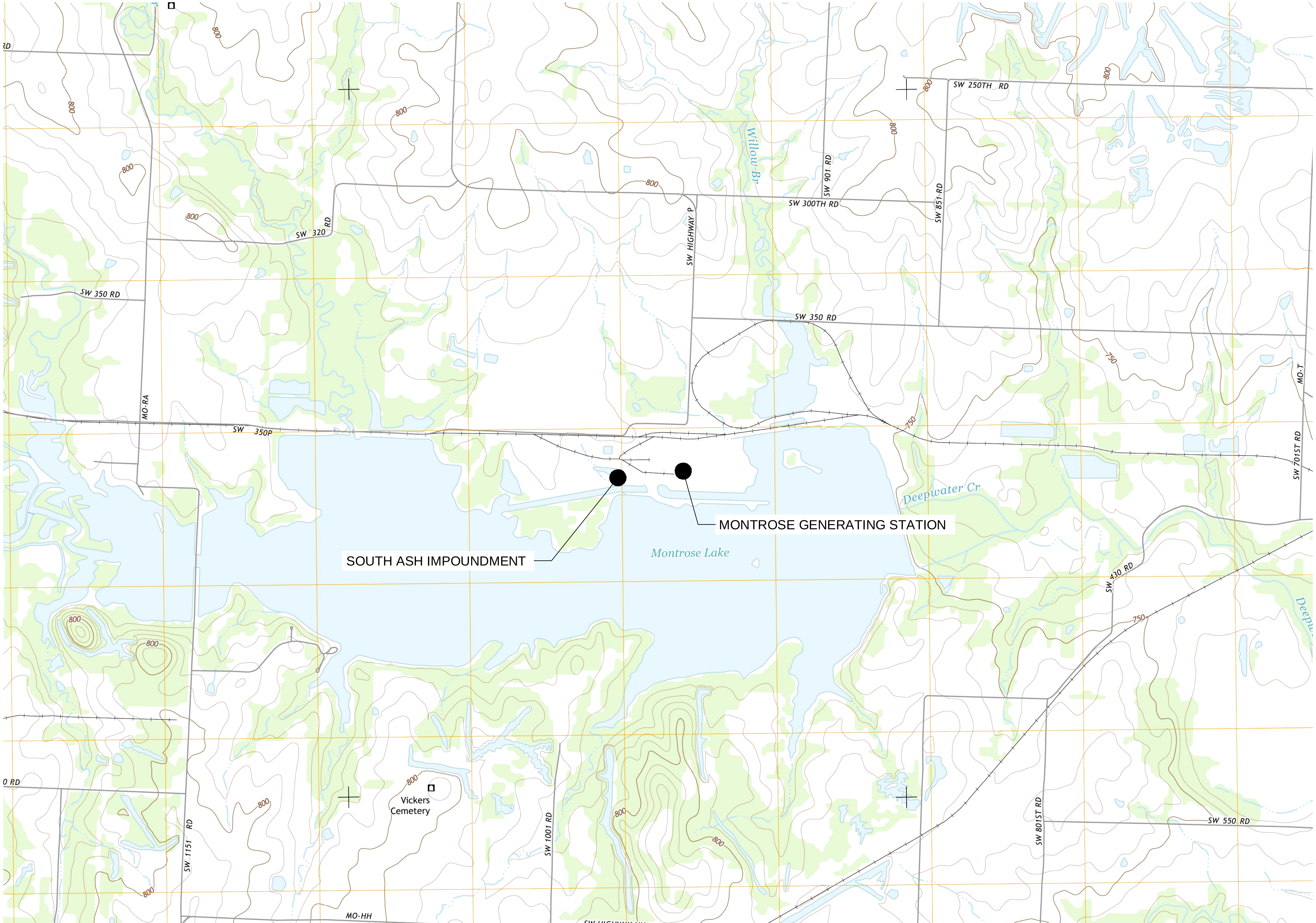
5. National Oceanic and Atmospheric Administration, NOAA Atlas 14 Point Precipitation Frequency Estimates, Volume 8, Version 2, http://hdsc.nws.noaa.gov/hdsc/pfds/pfds_map_cont.html?bkmrk=il, dated 2016.

6. Whitehead Consultants, Inc., Topographic Survey, dated January 30, 2013.

7. USDA Natural Resources Conservation Service, Web Soil Survey, http://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm, dated 2016.

8. USDA Natural Resources Conservation Service, Technical Release 55, dated June 1986.

Appendix A
Figures



MAP SOURCE:
US GEOLOGICAL SURVEY - MONTROSE QUADRANGLE 7.5 MINUTE SERIES 2014

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MONTROSE
GENERATING STATION
CLINTON, MO

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NO.	DESCRIPTION	DATE
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DESIGNED BY:	MJC
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DATE CREATED:	8/8/2016
PLOT DATE:	9/23/2016
SCALE:	1" = 500'
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LOCATION MAP

FIGURE 1

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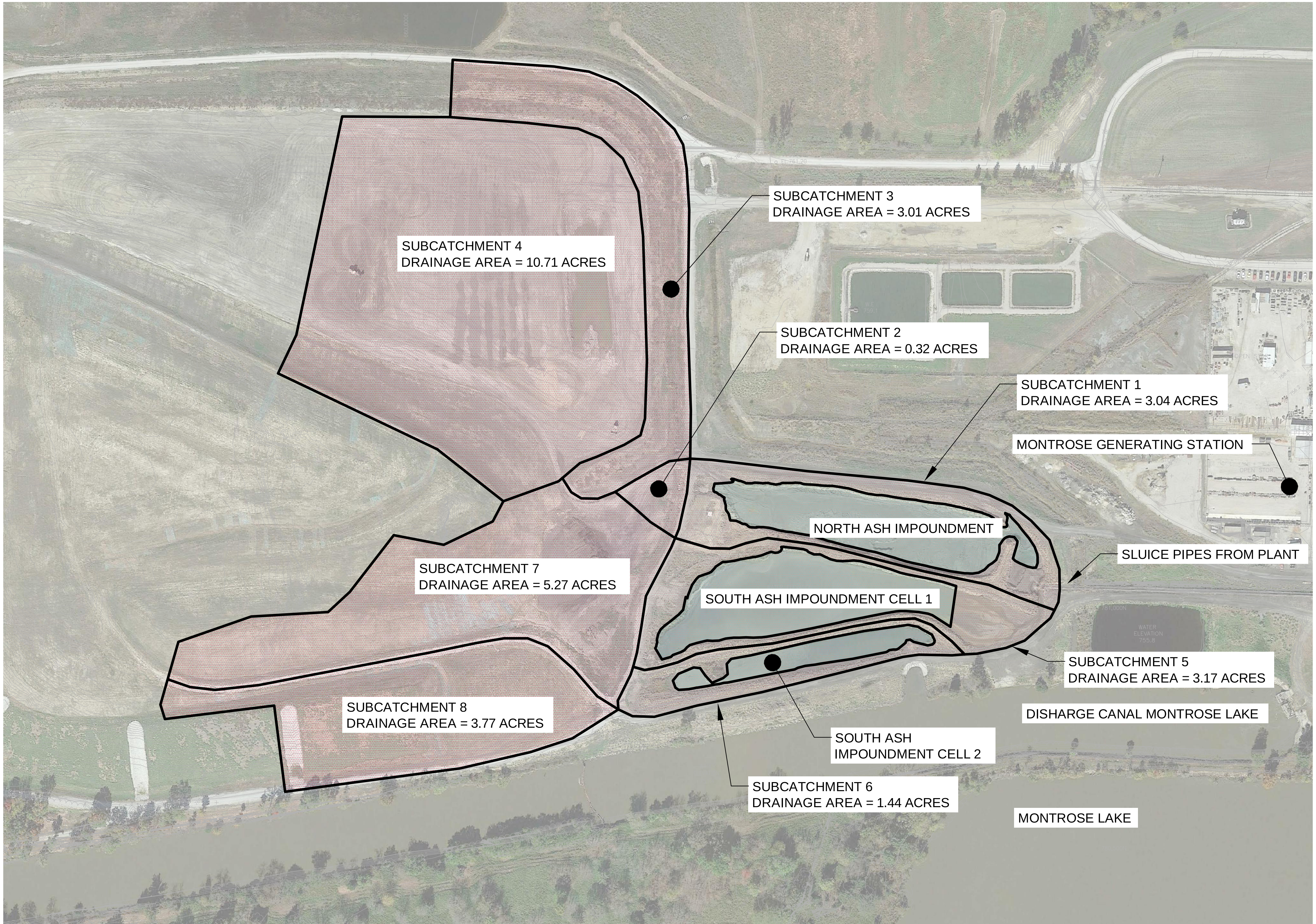

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WATERSHED AREA MAP

FIGURE 2

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