AECOM

Initial Inflow Design Flood Control System Plan

Slag Settling Impoundment

Sibley Generating Station

KCP&L Greater Missouri Operations Company

October 13, 2016

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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 Combustion Residual (CCR) Rule[1] have been met for the Slag Settling Impoundment at KCP&L Greater Missouri Operations Company's (KCP&L GMO) Sibley Generating Station. The Slag Settling 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 Sibley Generating Station is a coal-fired power plant located near the City of Sibley in Jackson County, Missouri. The Station is located approximately 0.5 miles east of Sibley and is bordered to the north by the Missouri River. The Slag Settling Impoundment is located on the station property. A site Location Map showing the area surrounding the station is provided as **Figure 1** of **Appendix A**.

1.3.1 Design and Construction

The Slag Settling Impoundment was commissioned in 1986. The incised impoundment was constructed approximately 11 feet deep with a top elevation of 724.0 feet[2] (unless otherwise noted, all elevations in this plan are in the NGVD29 datum), a bottom elevation of 713.0 feet and has 3 to 1 (horizontal to vertical) side slopes. The incised impoundment has a surface area of approximately 1.1 acres at the zero freeboard elevation of 724.0 feet. The unit has a surface water area of approximately 0.4 acres at the normal operating level of 717.0 feet.

1.3.2 Inflow from Plant Operations and Stormwater Runoff

Bottom Ash (slag) is currently sluiced from the plant into the eastern side of the Slag Settling Impoundment at an approximate rate of 959,000 gallons per day (gpd) or 1.5 cubic feet per second (cfs)[3]. The water mixed with the ash flows from the eastern side of the impoundment over an in-line weir structure to a ponding area on the west side of the impoundment. Currently, an excavator removes the ash to the top of the slopes to allow water to drain. After dewatering is complete, ash material is moved by an excavator to a concrete slab where it is loaded into trucks for beneficial use or transported to the landfill for disposal. Therefore, the storage capacity of the impoundment does not significantly change from year to year.

The watershed is limited to a small watershed area surrounding the upstream plant facilities, access roads and the active impoundment.

1.3.3 Outlet Structures

Water discharges from the impoundment through an intake structure and an outlet structure located at the north side of the impoundment. The intake structure has two (2) 4-foot wide passive concrete weirs at elevation 717.0 feet and one (1) adjustable 3-foot wide stop log weir structure to control normal operating levels in the impoundment. Water is then collected in a 14-inch ductile iron pipe (DIP) pipe at an invert elevation of 712.75 feet and discharges to the permitted National Pollutant Discharge Elimination System (NPDES) Outfall 002 on the south bank of the Missouri River.

1.4 Plan Approach

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

Table 1-1 – 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 Sibley Slag Settling 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 6.8 inches for the 24-hour, 25-year 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 watershed is limited to approximately 4.7 acres of upstream plant facilities, access roads and the active impoundment. The watershed area was determined using a computer-aided design (CAD) analysis of the Black and Veatch As-Built Drawings Dated 1986[2]. See **Figure 2** in **Appendix A** for the Watershed 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[6], 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[7]. Industrial areas, access roads and water surface land covers that are located on site were determined to have a CN value of 91, 89, 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-watershed 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-watershed were performed in HydroCAD.

Stormwater runoff from the 25-year event into the impoundment has a peak inflow of 42.8 cfs and total runoff inflow volume of 2.3 acre-feet.

3 Hydraulic Analyses

3.1 Process Flows

Ash is currently sluiced from the plant into the eastern side of the impoundment at a rate of 959,000 gpd or 1.5 cfs (3.0 acre-feet per day). 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 when a unit is online.

3.2 Storage Capacity

The storage volumes for the Slag Settling Impoundment were determined using a CAD analysis of the Black and Veatch As-Built Drawings[2]. The calculated volume of the impoundment is approximately 4.5 acre-feet of available storage measured from the normal operating pool elevation of 717.0 feet to the 1-foot freeboard elevation of 723.0 feet.

3.3 Discharge Analysis

A hydraulic model was created in HydroCAD 10.00 to assess the capacity of the impoundment 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 a starting water surface elevation of 717.1 feet to pass 1.5 cfs flow through the outlet pipe. This flowrate out equals the process inflow from the plant achieving balanced water flow at the site. The process flows from the plant (1.5 cfs) and the storm water runoff from the 25-year, 24-hour storm event (42.8 cfs) are combined to produce the total inflow of (44.3 cfs) into the Slag Settling Impoundment. This total inflow is treated in the impoundment before being discharged into the Missouri River under the NPDES Permit.

4 Results

The hydrologic and hydraulic conditions of Slag Settling Impoundment were modeled with the peak discharge of the 25-year 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 the upstream watershed is added to the process flow from the plant to produce the total inflow to the Slag Settling Impoundment. Using the HydroCAD model, the total inflow was stored and routed through the outlet works of the Slag Settling Impoundment to determine the peak water surface elevations.

Table 4-1 summarizes the water surface elevations of the Slag Settling 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)	Crest Elevation[2] (feet)	Freeboard Above Peak WSE (feet)
Slag Settling Impoundment	717.1	718.4	724.0	5.6

Notes:
* WSE = Water Surface Elevation

Conclusion and Recommendation

As there is adequate storage within the Slag Settling Impoundment to manage the inflow design flood as well as the process flow from the plant, there is no anticipated overtopping of the Slag Settling 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

Runoff from the upstream watershed is added to the process flow from the plant to produce the total inflow to the Slag Settling Impoundment. Using the HydroCAD model, the total inflow was stored and routed through the outlet devices of the Slag Settling Impoundment to determine the peak water surface elevations.

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

Table 4-2 - Summary of Outlet Works[2] 25-Year, 24-Hour Storm				
Outlet Works	**Type and Size**	**Invert Elevation (feet)**	**Peak Flowrate (cfs)**	**Velocity at Peak Flowrate (fps)**
Intake Structure	4-foot wide fixed crest weir	717.0	14-inch dia. DIP barrel controls	
	3-foot stop log weir	717.0		
	4-foot wide fixed crest weir	717.0		
Outlet Pipe	14-inch dia. DIP	712.75	9.7	9.1

Conclusion and Recommendation

As the Slag Settling Impoundment outlet works manage the discharge of the inflow design flood and the process flow from the plant without the peak water surface elevation overtopping the Slag Settling embankment, 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 CCR Surface Impoundment.

Background and Assessment

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

Conclusion and Recommendation

Since the impoundment is incised, the 25 year 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 discharge from the Slag Settling Impoundment Outlet pipe enters the Missouri River. 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

Runoff discharges from the impoundment through a permitted NPDES outfall. 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 Slag Settling 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 Slag Settling 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 Slag Settling Impoundment is handled in accordance with the surface water requirements of §257.3 – 3 during the 25-year, 24-hour flood event. Therefore, the Slag Settling 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 GMO, 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 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 hydrologic and hydraulic 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 GMO Sibley Generating Station, Slag Settling 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

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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. Black & Veatch, As-Built Plans for Sibley Generating Station, dated 1986.

3. U.S. Environmental Protection Agency, Steam Electric Questionnaire - Pond/Impoundment Systems and Other Wastewater Treatment Operations for Sibley Generating Station, dated 2010.

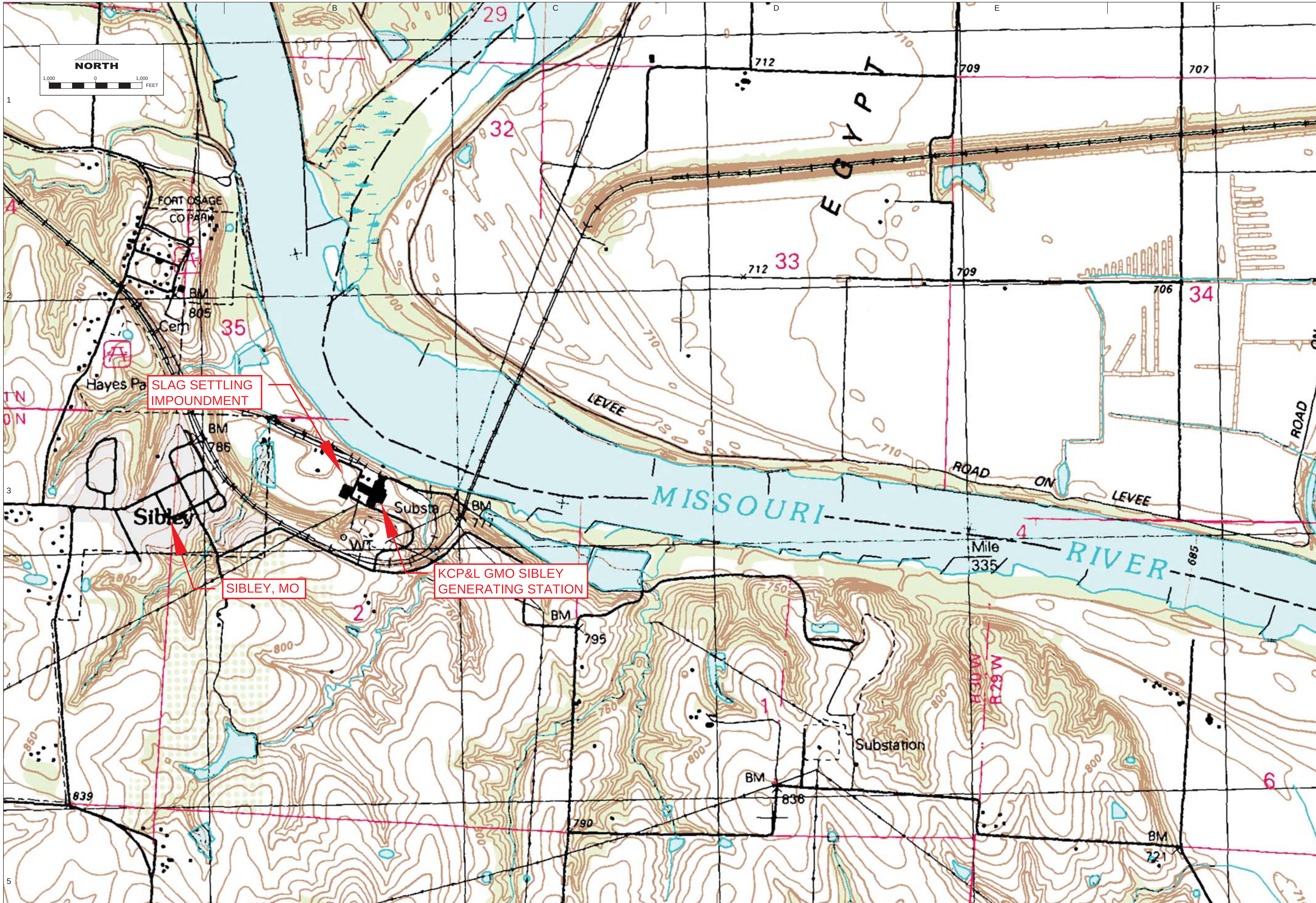
4. AECOM, Hydrologic and Hydraulic Support Calculations, Initial Inflow Design Flood Control System Plan, Slag Settling Impoundment, Sibley Generating Station, KCP&L Greater Missouri Operations Company, dated October 13, 2016.

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

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

Appendix A
Figures



QUADRANGLE SOURCE:
UNITED STATES GEOLOGICAL SURVEY SIBLEY, MISSOURI 7.5' TOPOGRAPHIC MAP, 2000

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SIBLEY GENERATING STATION
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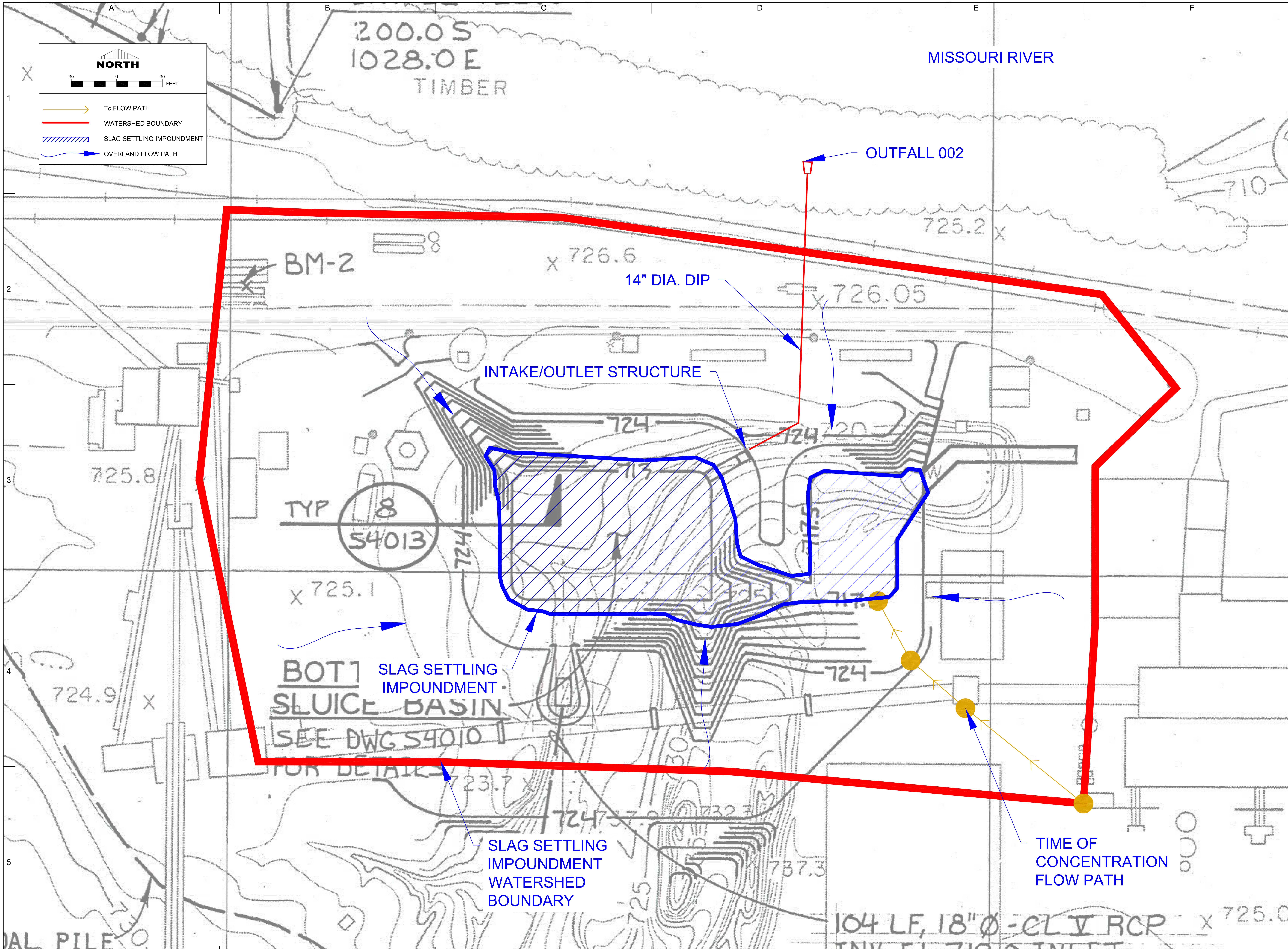
CHECKED BY:	BDL
DATE CREATED:	7/22/2016
PLOT DATE:	9/01/2016
SCALE:	AS SHOWN
ACAD VER:	2014

SHEET TITLE

Location Map

Figure 1



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Watershed Area Map

Figure 2

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