Inflow Design Flood Control System Plan for Walter Scott Jr. Energy Center - South Impoundment

MidAmerican Energy Company

Rev. 1
October 07, 2021

Inflow Design Flood Control System Plan for Walter Scott Jr. Energy Center - South Impoundment

Prepared for

MidAmerican Energy Company
Project No. 86617
Council Bluffs, Iowa

Rev. 1
October 07, 2021

Prepared by

Burns & McDonnell Engineering Company, Inc.
Kansas City, Missouri

INDEX AND CERTIFICATION

MidAmerican Energy Company
Inflow Design Flood Control System Plan for Walter Scott Jr. Energy Center - South Impoundment

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Certification

I hereby certify, as a Professional Engineer in the State of Iowa, that the information in this document was assembled under my direct supervisory control. This report is not intended or represented to be suitable for reuse by the MidAmerican Energy Company or others without specific verification or adaptation by the Engineer.

LICENSED PROFESSIONAL ENGINEER
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Date: 10/7/21

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License Number 23144

My license renewal date is December 31, 2022

Pages or sheets covered by this seal: As noted above.

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LIST OF ABBREVIATIONS

Abbreviation	Term/Phrase/Name
BMcD	Burns & McDonnell Engineering Company, Inc.
CCR	Coal Combustion Residual
CCR Rule	Coal Combustion Residual Rule
CFR	Code of Federal Regulations
CFS	Cubic Feet per Second
CY	Cubic Yards
EPA	Environmental Protection Agency
GIS	Geographical Information System
GPM	Gallons per Minute
IDNR	Iowa Department of Natural Resources
MEC	MidAmerican Energy Company
NAD	North American Datum
NAVD	North American Vertical Datum
PMP	Probable Maximum Precipitation
RCRA	Resource Conservations and Recovery Act
U.S.C	United States Code
WSEC	Walter Scott Jr. Energy Center

1.0 INTRODUCTION

On April 17, 2015, the Environmental Protection Agency (EPA) issued the final version of the federal Coal Combustion Residual Rule (CCR Rule) to regulate the disposal of coal combustion residual (CCR) materials generated at coal-fired units. The rule is administered as part of the Resource Conservation and Recovery Act [RCRA, 42 United States Code (U.S.C.) §6901 et seq.], using the Subtitle D approach.

The MidAmerican Energy Company (MEC) is subject to the CCR Rule and as such must meet the hydrologic and hydraulic capacity requirements per 40 Code of Federal Regulations (CFR) §257.82. This report serves as the periodic inflow design flood control system plan for an existing CCR surface impoundment, known as the South Impoundment, at the Walter Scott Jr. Energy Center (WSEC). Per §257.82, the inflow design flood control system plan must contain documentation (including supporting engineering calculations) that the inflow design flood control system has been designed and constructed to:

- Adequately manage flow into the CCR unit during and following the peak discharge of the inflow design flood;
- Adequately manage flow from the CCR unit to collect and control the peak discharge resulting from the inflow design flood; and
- Handle discharge from the CCR surface impoundment in accordance with the surface water requirements described in 40 CFR §257.3-3.

The seal on this report certified that the inflow design flood control system plan provided herein meets the requirements of 40 Code of Federal Regulations §257.82.

2.0 SITE INFORMATION

WSEC is located on the east bank of the Missouri River in Council Bluffs, Iowa and has the North & South Impoundment multi-unit system. A site plan showing the North Impoundment and South Impoundment is included in Appendix A.

The South Impoundment ceased receipt of CCR and non-CCR wastewater on July 31, 2018 and is now undergoing closure. The South Impoundment is approximately 120 acres with approximately 2,056,000 cubic yards (CY) of storage capacity. The impoundment is surrounded by a perimeter dike with varying elevations with a minimum elevation of 978.0 feet.

The impoundment currently receives flow from dewatering operations from the North Impoundment. No other plant flows are directed to the impoundment. Flowrates from these processes were obtained from the construction contractor. The impoundment also receives precipitation across its extent.

Based on available data from the High Plains Regional Climate Center, the area typically receives about 32.0 inches of precipitation and 42.7 inches of evapotranspiration occurs annually, running a precipitation deficit each year. There is no permitted overflow structure or emergency spillway present. The normal pool elevation varies, a pool elevation of 969 feet North American Vertical Datum of 1988 (NAVD 88), is assumed to be the normal pool elevation and was used on past evaluations. The current operations require that the construction contractor keep the pool elevation below 971.5. This will be used as the normal pool water elevation that will be used for the calculations within this report.

3.0 DESIGN BASIS / FLOOD CONTROL SYSTEM

3.1 Hazard Potential Classification

Per the CCR Rule compliance document titled, "Hazard Potential Classification Assessment for the North & South CCR Surface Impoundment", written in 2021, the South Impoundment is classified as having a Low Hazard Classification per §257.73(a)(2).

3.2 Inflow Design Flood System Criteria

3.2.1 Capacity Criteria

The CCR Rule requires that surface impoundments must have adequate hydrologic and hydraulic capacity to manage flows for the inflow design flood. Specifically, §257.82 (a) of the CCR regulations states the following:

> "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.
>
> (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."

For this analysis, the above criteria was interpreted to mean that the top of the surface impoundment dike should not be overtopped, with adequate freeboard, during the inflow design flood.

3.2.2 Freeboard Criteria

The CCR documentation further discusses that operating freeboard must be adequate to meet performance standards, but a specific freeboard is not defined. As stated previously, the CCR criteria is interpreted to mean that the top of the surface impoundment dike should not be overtopped during the inflow design flood; therefore, it is assumed that to meet the freeboard criteria, no additional freeboard is required.

The Iowa Department of Natural Resources, Technical Bulletin No. 16, however, does include a freeboard requirement. The bulletin states that for dams without an emergency spillway, the top of dam elevation shall be two feet higher than the peak flood elevation expected to occur during passage of the freeboard design flood of one-half of the probable maximum flood. The probable maximum flood is derived from the probable maximum precipitation (PMP). A storm duration of six hours is recommended by the state criteria.

3.3 Flood Routing Design Criteria

To evaluate the criteria discussed above, both the inflow design flood and the freeboard, 6-hour PMP event were considered.

- Per §257.82, the inflow design flood is based on the hazard potential classification of the CCR surface impoundment as required by §257.73 and §257.74. The inflow design flood for this analysis was a 100-year flood event, due to the surface impoundment's low hazard classification.
- Per Iowa Department of Natural Resources recommendations, the hydrologic criteria is one-half of the 6-hour PMP (IDNR, 1990).

3.4 Model Scenarios

Three modeling scenarios were completed as part of this evaluation. These scenarios were developed to determine normal operating conditions and to evaluate the above outlined criteria.

- Scenario 1 - Normal Operating Conditions. This scenario considered the surface impoundment conditions with no rainfall event occurring (refer to Section 5.1).
- Scenario 2 – Inflow Design Flood. The surface impoundment was analyzed under a 100-year, 24-hour event to determine peak stage and freeboard (refer to Section 5.2).
- Scenario 3 – Freeboard analysis, using IDNR state recommendations. A 6-hour PMP precipitation event was precipitated onto the watershed of the surface impoundment to evaluate peak stage in comparison to top of dike (refer to Section 5.3).

3.5 Project Mapping

Project mapping for this analysis consisted of a comprehensive inventory of stormwater assets that contribute to the surface impoundment. This included stormwater structures, piping, culverts, and drainage ditches. To develop the characterization of the existing stormwater system, two primary sources of information were utilized: a survey and field investigations.

3.5.1 Mapping Sources

Survey data utilized for this analysis was obtained from a survey performed by HGM and Associates in 2015. Furthermore, background data such as aerial images and information from the National Hydrography Dataset was obtained from the Iowa Geographic Map Server (IDNR, 2016).

3.5.2 Vertical Datum

Mapping sources referenced were in the North American Vertical Datum of 1988 (NAVD 88).

3.5.3 Horizontal Coordinate System

North American Datum (NAD) 1983 State Plane Iowa South (U.S. feet) coordinate system was utilized as the basis for mapping and modeling efforts.

4.0 HYDROLOGIC AND HYDRAULIC CAPACITY

4.1 Calculation Approach

Based upon the simplicity of the water mass balance flows into and out of the South Impoundment, the use of sophisticated modeling software was not required. A spreadsheet analysis that includes all known process inflows and outflows, was used to create a quantitative estimate of the volume and stage of the South Impoundment during design flood conditions.

4.2 Hydrology

4.2.1 Recurrence Interval and Rainfall Duration

The inflow flood design event for this study, as dictated by the hazard potential classification, was a 100-year flood event. Since a storm duration was not specified under §257.82 or other pertinent inflow flood design sections, a 24-hour storm duration was utilized. This is an industry standard duration and produces a more conservative rainfall depth than shorter duration storm events. For analyzing the freeboard requirements which are separate from the CCR requirements, one-half of the 6-hour PMP was used.

4.2.2 Rainfall Distribution and Depth

The water mass balance based spreadsheet analysis, which was used to calculate stage and storage within the South Impoundment during design flood conditions, does not require the use of rainfall distribution. The assumption is that the rainfall occurs at once, which is a more conservative approach than distributing the rainfall over a longer period of time.

The precipitation depth used for the inflow design flood event is 7.74 inches, as required per §257.82 and the assumed 24-hour duration. This precipitation data was acquired from the National Weather Service (NOAA, 2021). The point precipitation location, where the precipitation values are derived for, is shown in Figure 4-1. The table of rainfall depths for various frequencies and durations is presented in Figure 4-2. The precipitation depth used for the State of Iowa freeboard requirement is one-half of 26 inches, or 13 inches. This precipitation data was acquired from the Iowa Department of Agriculture and Land Stewardship, as specifically mandated in the State of Iowa design criteria for Iowa dams (IDALS, 1988).

Figure 4-1. Point Precipitation Location

4.2.3 Watershed Delineation and Hydrologic Characteristics

The watershed of the South Impoundment was delineated using the mapping sources as discussed in Section 3.5.1. The watershed of the South Impoundment as shown in Figure 4.3 below, was calculated to be 144.6 acres, using Geographical Information System (GIS) tools.

The simple water mass balance approach proposed in this document uses conservative assumptions when converting rainfall to total volume of runoff entering the impoundment. Therefore, there is no need to analyze land use of the watershed, to calculate the corresponding runoff curve numbers, or utilize a time of concentration. It is assumed all rainfall will be converted to runoff and immediately enter the impoundment.

Figure 4-2. NOAA Point Precipitation Frequency Estimates

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.367 (0.299-0.458)	0.436 (0.354-0.544)	0.551 (0.446-0.689)	0.650 (0.523-0.817)	0.791 (0.618-1.03)	0.904 (0.690-1.20)	1.02 (0.754-1.38)	1.14 (0.810-1.59)	1.31 (0.893-1.88)	1.44 (0.957-2.09)
10-min	0.538 (0.438-0.671)	0.638 (0.518-0.796)	0.807 (0.653-1.01)	0.952 (0.766-1.20)	1.16 (0.905-1.51)	1.32 (1.01-1.75)	1.49 (1.10-2.03)	1.67 (1.19-2.33)	1.91 (1.31-2.75)	2.10 (1.40-3.06)
15-min	0.656 (0.534-0.818)	0.778 (0.632-0.971)	0.984 (0.797-1.23)	1.16 (0.935-1.46)	1.41 (1.10-1.84)	1.61 (1.23-2.13)	1.82 (1.35-2.47)	2.04 (1.45-2.84)	2.33 (1.59-3.35)	2.56 (1.71-3.73)
30-min	0.958 (0.779-1.19)	1.14 (0.927-1.42)	1.45 (1.18-1.81)	1.72 (1.38-2.16)	2.09 (1.64-2.73)	2.39 (1.83-3.17)	2.70 (2.00-3.67)	3.02 (2.15-4.22)	3.46 (2.37-4.97)	3.81 (2.53-5.54)
60-min	1.25 (1.02-1.56)	1.51 (1.22-1.88)	1.94 (1.57-2.43)	2.32 (1.87-2.92)	2.88 (2.26-3.78)	3.34 (2.55-4.43)	3.82 (2.83-5.20)	4.33 (3.08-6.06)	5.04 (3.45-7.25)	5.60 (3.73-8.15)
2-hr	1.55 (1.27-1.92)	1.87 (1.53-2.32)	2.43 (1.98-3.02)	2.93 (2.37-3.65)	3.67 (2.90-4.80)	4.28 (3.30-5.67)	4.93 (3.68-6.69)	5.63 (4.03-7.85)	6.61 (4.56-9.47)	7.40 (4.96-10.7)
3-hr	1.73 (1.42-2.13)	2.08 (1.71-2.57)	2.71 (2.22-3.36)	3.29 (2.67-4.09)	4.17 (3.32-5.45)	4.91 (3.80-6.48)	5.70 (4.27-7.72)	6.55 (4.72-9.12)	7.77 (5.39-11.1)	8.76 (5.90-12.6)
6-hr	2.03 (1.67-2.48)	2.42 (1.99-2.96)	3.14 (2.58-3.86)	3.82 (3.12-4.71)	4.86 (3.91-6.35)	5.76 (4.50-7.59)	6.74 (5.09-9.10)	7.81 (5.67-10.8)	9.36 (6.54-13.3)	10.6 (7.20-15.2)
12-hr	2.33 (1.94-2.84)	2.74 (2.27-3.33)	3.49 (2.88-4.25)	4.20 (3.45-5.14)	5.31 (4.29-6.89)	6.26 (4.93-8.20)	7.32 (5.57-9.81)	8.47 (6.20-11.7)	10.1 (7.14-14.4)	11.5 (7.86-16.4)
24-hr	2.67 (2.23-3.23)	3.07 (2.56-3.71)	3.82 (3.18-4.63)	4.54 (3.75-5.53)	5.67 (4.62-7.31)	6.66 (5.28-8.66)	7.74 (5.93-10.3)	8.94 (6.59-12.2)	10.7 (7.58-15.0)	12.1 (8.33-17.1)
2-day	3.03 (2.55-3.64)	3.48 (2.92-4.18)	4.31 (3.60-5.18)	5.08 (4.23-6.14)	6.28 (5.13-8.00)	7.30 (5.82-9.41)	8.42 (6.49-11.1)	9.65 (7.15-13.1)	11.4 (8.15-15.9)	12.9 (8.90-18.1)
3-day	3.30 (2.78-3.94)	3.80 (3.20-4.54)	4.71 (3.95-5.64)	5.54 (4.62-6.67)	6.79 (5.56-8.59)	7.86 (6.26-10.0)	9.00 (6.95-11.8)	10.2 (7.60-13.8)	12.0 (8.59-16.6)	13.4 (9.33-18.8)
4-day	3.54 (2.99-4.22)	4.08 (3.44-4.86)	5.04 (4.24-6.02)	5.90 (4.94-7.08)	7.19 (5.88-9.04)	8.27 (6.60-10.5)	9.42 (7.28-12.3)	10.7 (7.93-14.3)	12.4 (8.90-17.1)	13.8 (9.63-19.3)
7-day	4.21 (3.58-4.99)	4.79 (4.06-5.68)	5.80 (4.90-6.89)	6.70 (5.63-7.99)	8.02 (6.59-10.0)	9.12 (7.32-11.5)	10.3 (7.99-13.3)	11.5 (8.61-15.4)	13.3 (9.56-18.2)	14.7 (10.3-20.3)
10-day	4.81 (4.10-5.67)	5.44 (4.63-6.42)	6.52 (5.53-7.71)	7.47 (6.30-8.88)	8.86 (7.29-11.0)	10.0 (8.04-12.6)	11.2 (8.72-14.4)	12.5 (9.34-16.5)	14.2 (10.3-19.4)	15.6 (11.0-21.6)
20-day	6.48 (5.55-7.59)	7.34 (6.29-8.61)	8.79 (7.50-10.3)	10.0 (8.50-11.8)	11.7 (9.67-14.3)	13.1 (10.6-16.2)	14.5 (11.3-18.4)	15.9 (12.0-20.8)	17.8 (12.9-24.0)	19.3 (13.7-26.5)
30-day	7.87 (6.77-9.18)	8.94 (7.68-10.4)	10.7 (9.16-12.5)	12.1 (10.3-14.3)	14.1 (11.6-17.1)	15.6 (12.6-19.2)	17.1 (13.4-21.7)	18.7 (14.1-24.3)	20.7 (15.1-27.7)	22.2 (15.8-30.3)
45-day	9.65 (8.33-11.2)	11.0 (9.45-12.7)	13.0 (11.2-15.2)	14.7 (12.6-17.2)	16.9 (14.0-20.4)	18.6 (15.1-22.8)	20.2 (15.9-25.4)	21.8 (16.5-28.2)	23.8 (17.4-31.8)	25.3 (18.1-34.5)
60-day	11.2 (9.69-13.0)	12.7 (10.9-14.7)	15.0 (12.9-17.4)	16.8 (14.4-19.6)	19.2 (15.9-23.0)	20.9 (17.0-25.5)	22.6 (17.8-28.2)	24.2 (18.3-31.1)	26.2 (19.1-34.7)	27.5 (19.7-37.4)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).
Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.
Please refer to NOAA Atlas 14 document for more information.

Figure 4-3. Watershed of South Impoundment

4.2.4 Process Inflows

To accurately evaluate the inflow design flood control system, both stormwater runoff flows and process flows were considered. The impoundment currently receives flow from dewatering operations from the North Impoundment closure construction. The water is then treated and discharged to the Missouri River. No other plant flows are directed to the impoundment. Flows are summarized in Table 4-1, below. All estimated inflows contributing to the surface impoundment are summarized in the table.

Table 4-1. Surface Impoundment Inflows

Source	Flow (gpm) (max)	Flow (cfs)
Dewatering from North Impoundment	4,000	8.91
Water Treatment Discharge (out)	-4,000	-8.91
Sum	0	0

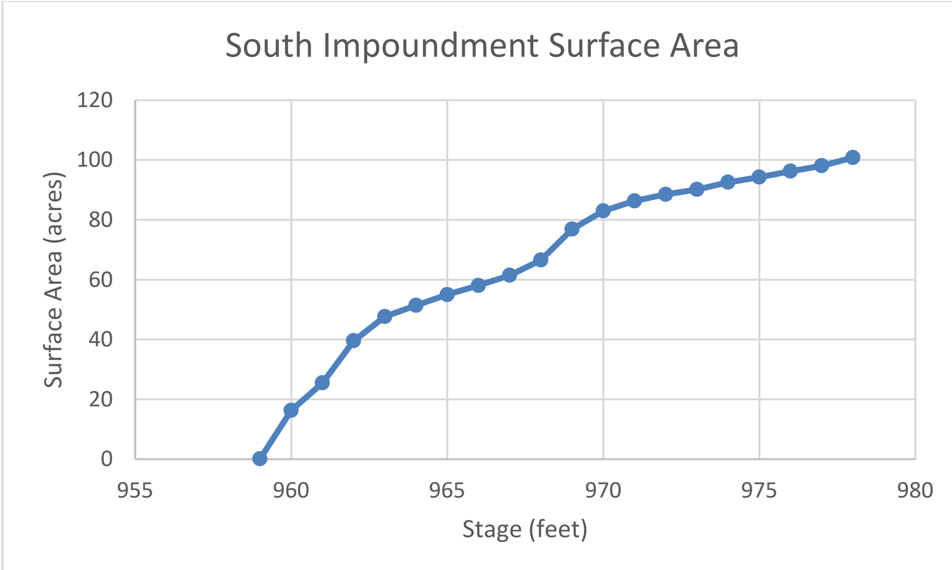
4.2.5 Hydraulic Analysis

The hydraulic component of the hydraulic analysis consisted of those elements necessary to account for all inflows to the South Impoundment. These elements, including watershed size, rainfall depth, and process inflows, are described in previous sections.

4.2.5.1 Stage / Surface Area Information

Stage and surface area information for the South Impoundment was developed from the survey data discussed in Section 3.5. A plot of the stage versus surface area relationship is shown in Figure 4-4, below.

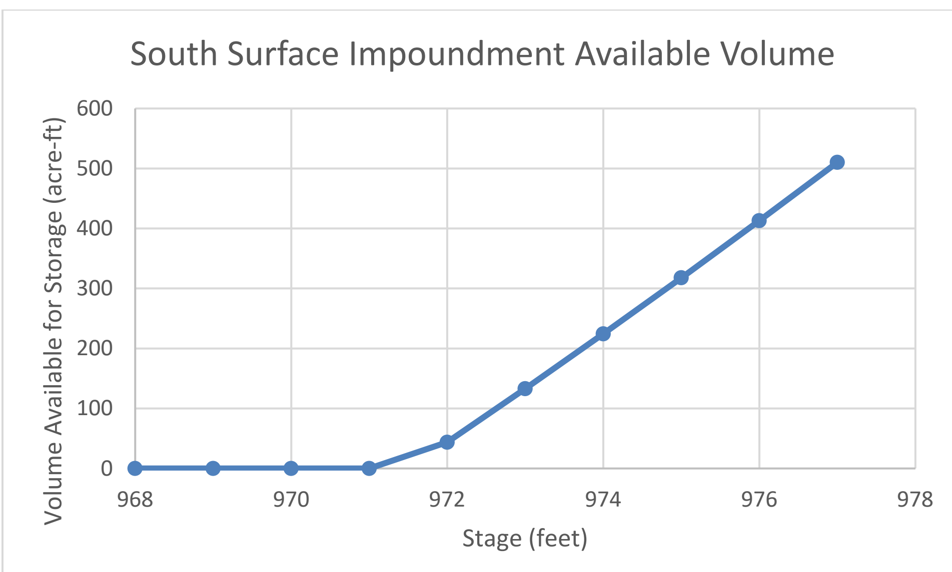
Figure 4-4. Stage and Surface Area Relationship for South Impoundment



4.2.5.2 Storage

The high-water level in the South Impoundment is maintained below 971.5 by the construction contractor. Therefore, at stages of 971.5 feet and below, the impoundment is considered to have no available storage. A plot of the stage versus surface area relationship is shown in Figure 4-5, below.

Figure 4-5. State and Storage Relationship for South Impoundment



5.0 RESULTS

5.1 Scenario 1 – Normal Operating Conditions

During normal operating conditions, the South Impoundment high water elevation will remain below 971.5. If the elevation of the water in the impoundment reaches this elevation the dewatering inflows from the North Impoundment are required to stop until the water elevation goes below 971.5.

5.2 Scenario 2 – Federal Design Flood Event

As stated in Section 4.2.2, the depth of 100-year, 24-hour storm is 7.74 inches. Given the measured watershed of 144.6 acres, this will result in a total of 93.27 acre-feet of runoff. If the dewatering flows were to continue during this 24-hour event and the discharge out of the treatment system were not active, another 17.68 acre-feet of process flow could also enter the impoundment for a combined volume of 110.94 acre-feet. Based on the stage/storage relationship shown in Figure 4-5, this volume could increase the stage of the South Impoundment from a level of 971.5 feet to 972.8. This stage increase still allows for 5.2 feet of freeboard to the top of the dike surrounding the impoundment.

5.3 Scenario 3 – Freeboard Event

As stated in Section 4.2.2, the depth of one half of the 6-hour PMP is 13 inches. This State of Iowa recommended design flood event will result in a total runoff volume of 156.65 acre-feet. If the dewatering flows were to continue during this 6-hour event and the discharge out of the treatment system were not active, another 4.41 acre-feet of process flow could also enter the impoundment for a combined volume of 161.06 acre-feet. Based on the stage/storage relationship shown in Figure 4-5, this volume could increase the stage of the South Impoundment from a level of 971.5 feet to approximately 973.3 feet. This stage increase still allows for 4.7 feet of freeboard to the top of the dike surrounding the impoundment.

5.4 Summary

Results for all three scenarios indicated that the surface impoundment was not overtopped and freeboard is provided. Freeboard is estimated to be at approximately 6.5 feet during normal operating conditions and approximately five feet during the precipitation events evaluated.

Based on these results, CCR regulations and state regulations were considered to be met for the South Impoundment.

6.0 PERIODIC ASSESSMENT AND AMENDMENT

MidAmerican Energy placed the initial inflow design flood plan in the CCR Operating Record on October 10, 2016. To date, the plan has not been amended because there has not been a change in conditions that would substantially affect the initial written plan. This report serves as the first amendment to the plan that is required, at a minimum, every five years. Each periodic plan or amendment to the written plan shall be certified by a qualified professional engineer in the State of Iowa. All amendments and revisions must be placed on the CCR public website and the facility's operating record. A record of revisions made to this document is included in Section 7.0.

7.0 RECORD OF REVISIONS AND UPDATES

Revision Number	Date	Revisions Made	By Whom
0	10/10/2016	Initial Issue	Burns & McDonnell
1	10/07/2021	Periodic update to plan	Burns & McDonnell

8.0 REFERENCES

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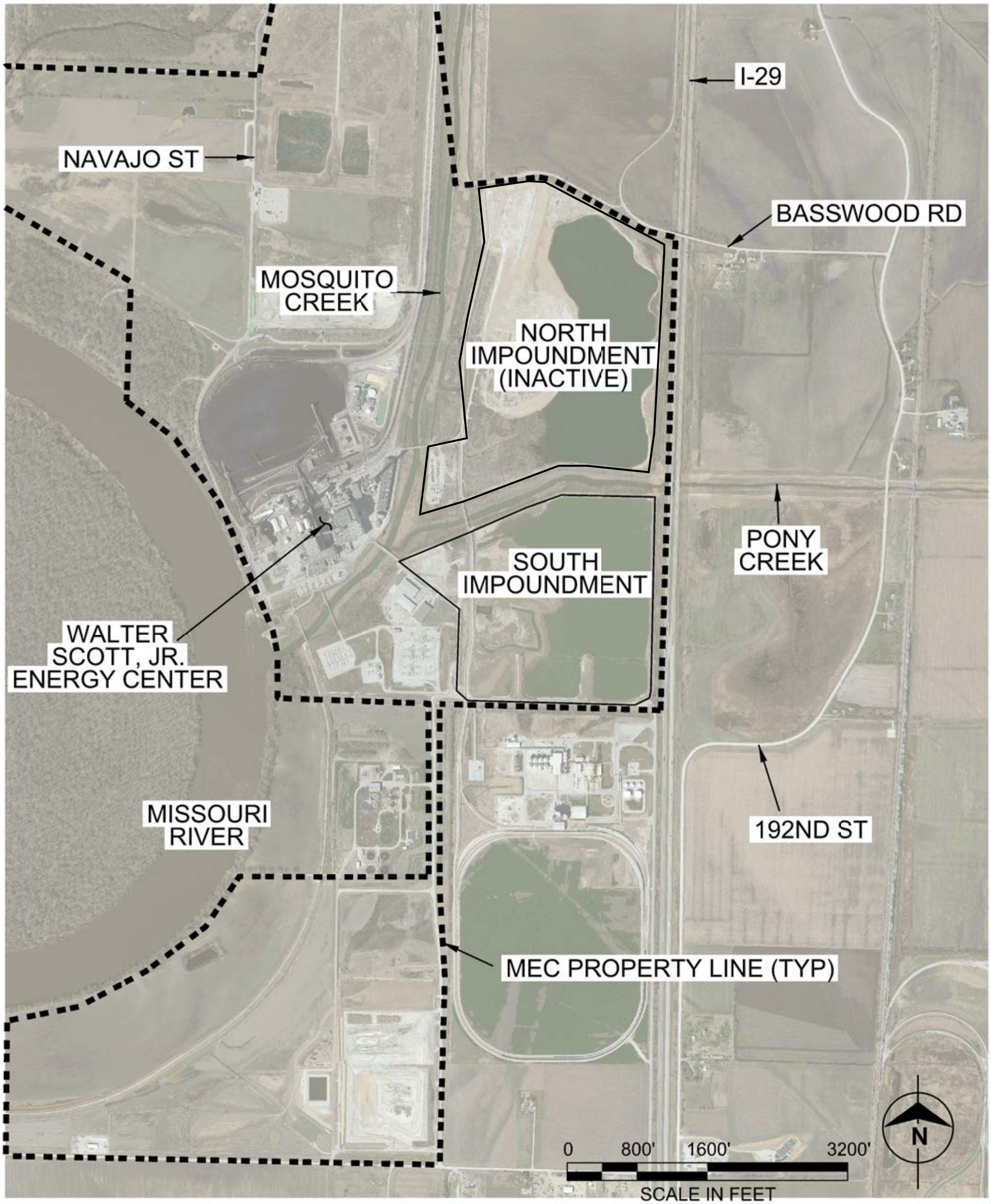
APPENDIX A – SITE PLAN



BURNS McDONNELL

date APRIL 15, 2016

designed K. WYLAM

MIDAMERICAN ENERGY COMPANY

WALTER SCOTT
HAZARD POTENTIAL ASSESSMENT
SITE PLAN

project 86617

contract

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APPENDIX B – SUMMARY OF CALCULATIONS

WALTER SCOTT JR. ENERGY CENTER
SOUTH IMPOUNDMENT CALCULATIONS
MidAmerican Energy Company

SCENARIO 2 - FEDERAL DESIGN FLOOD EVENT

Area of Watershed:	144.6 Acres
100-Year, 24-Hour Rain Depth:	7.74 inches
Volume of Runoff from Storm Event:	93.27 acre-feet
Process Inflow (24-hour):	4000 gallons/minute 17.68 acre-feet/24 hours
Combined Storage Volume:	111.78 acre-feet
Freeboard:	5.2 feet

WALTER SCOTT JR. ENERGY CENTER
SOUTH IMPOUNDMENT CALCULATIONS
MidAmerican Energy Company

SCENARIO 3 - FREEBOARD EVENT

Area of Watershed:	144.6 Acres
6-Hour PMP: 1/2 of PMP:	26 inches 13 inches
Volume of Runoff from Storm Event:	156.65 acre-feet
Process Inflow (6-hour):	4000 gallons/minute 17.68 acre-feet/6 hours
Combined Storage Volume:	161.28 acre-feet
Freeboard:	4.7 feet

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