Inflow Design Flood Control System Plan

For Compliance with the Coal Combustion Residuals Rule
(40 CFR Part §257)

Former Erickson Power Station –
Former CCR Surface Impoundments

Lansing Board of Water & Light
Lansing, Michigan

June 6, 2025

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Table of Abbreviations and Acronyms

Abbreviation	Definition
CCR	Coal Combustion Residuals
CFR	Code of Federal Regulations
cfs	cubic feet per second
CN	Curve Number
EPA	Environmental Protection Agency
HSG	Hydrologic Soil Group
LBWL	Lansing Board of Water and Light
MGD	Million Gallons per Day
NOAA	National Oceanic and Atmospheric Administration
RCRA	Resource Conservation and Recovery Act
SCS	Soil Conservation Service
Tc	Time of Concentration
TR-20	Technical Release 20
TR-55	Technical Release 55

1.0 Introduction

On April 17, 2015, the U.S. Environmental Protection Agency (EPA) published regulations under Subtitle D of the Resource Conservation and Recovery Act, intended to ensure the safe disposal of coal combustion residuals (CCR) generated by coal-fired electric utilities. These regulations define requirements for the disposal and handling of CCR within CCR units (categorized as either landfills or surface impoundments), including the preparation of an Inflow Design Flood (IDF) Control System Plan, in accordance with 40 CFR §257.82.

This report presents the required five-year update to the IDF Control System Plan for an impoundment system consisting of three (3) regulated former CCR surface impoundments (Former Forebay, Former Retention Basin, and Former Clear Water Pond) and one (1) former inactive surface impoundment (Former Impoundment) at the Former Erickson Power Station (Station). Since the previous report, coal-fired operations at the Station have been permanently discontinued, and the impoundment system has ceased receiving CCR waste. Additionally, the three regulated former CCR surface impoundments in the impoundment system have been physically closed via excavation of CCR materials, confirmed through analytical testing. The Former Forebay and Former Retention Basin have been filled with clean material and all former impoundments have been regraded to promote positive drainage.

Currently, the three regulated former CCR surface impoundments and the Former Impoundment are used solely to manage stormwater from direct rainfall onto the impoundment system. These areas are isolated from off-site and on-site run-on, only receiving direct precipitation and minor incidental runoff from interior berms. All collected stormwater from the impoundment system is routed to the Former Impoundment, which acts as containment for the system.

1.1 Facility Description

The Station is owned and operated by Lansing Board of Water & Light (BWL) and is located at 3725 South Canal Road in Lansing, Michigan. See Figure 1 for a Site Location Map. The Station was constructed in 1973 and previously housed one (1) coal-fired generator capable of producing 160 megawatts of electricity. Operation of the coal-fired generator ceased in 2022 and the closure of the three (3) regulated CCR surface impoundments began in February 2023. Since then, the regulated CCR units have been physically closed, and all CCR materials have been removed and appropriately managed. The Former Forebay and Former Retention Basin were then filled with clean fill material and all former impoundments were graded to direct stormwater runoff to the Former Impoundment area. Verification of CCR removal from the regulated CCR units was completed and documented in the CCR Removal Report, dated November 4, 2024.

When the Station's coal-fired generator was active, it was fitted with a bottom ash quenching and belt filter dewatering system that removed the majority of the CCR from the plant water effluent prior to being directed to the surface impoundment system. Fly ash was handled dry and collected in on-site silos. Both bottom and fly ash were hauled off-site to facilities for either beneficial use or disposal. Any CCR remaining in the plant water after the belt-filter press was directed to the active surface impoundments for further treatment.

The Station's three (3) regulated CCR surface impoundments consisted of the Forebay, Retention Basin, and Clear Water Pond which together made up a 9.5-acre system designed to separate the remaining CCR from the low-level ash plant water. The plant water was pumped directly to the Forebay from the silo sumps, hydro-bins, and coal pile runoff sump where heavy particles settled to the bottom. From the Forebay water flowed via gravity to the Retention Basin where smaller particles settled. From the Retention Basin, water finally flowed to the Clear Water Pond, where the treated water was recirculated back to the Station for reuse as plant water.

Per 40 CFR §257.53, each of the surface impoundments were defined as diked CCR surface impoundments because they were constructed using an embankment, berm, or ridge of either natural or man-made materials used to prevent the movement of liquids, sludges, solids, or other materials. The Former Forebay, Former Retention Basin, Former Clear Water Pond and the Former Impoundment were all lined. The discharges from the impoundment system were from evaporation and recirculation. The only other outlet structures from the impoundment system were emergency outfalls pipes located at the Retention Basin and Clear Water Pond. The Retention Basin emergency outfall discharged to the Former Impoundment. The Clear Water Pond emergency outfall discharges to a swale which eventually flows north to Carrier Creek and then the Grand River.

Following the decommissioning of the three (3) regulated CCR surface impoundments, the entire impoundment system (including the Former Impoundment) now collectively functions only as limited stormwater collection basins. These former impoundments form a roughly contiguous drainage system and are no longer connected to any process water discharges. Their only inflow is stormwater from direct rainfall onto the impoundment system. Figure 2 provides an aerial site view of the former CCR Surface Impoundment System.

Stormwater within the impoundment system is directed via internal grading to the Former Impoundment. The berm separating the Former Impoundment and the Former Clear Water Pond has been removed. The emergency overflow structure at the Former Clear Water Pond area was modified during the closure activities but remains intact and serves as the sole outfall from the entirety of the impoundment system. However, hydrologic modelling shows that this outfall would not spill over in a 100-year flood event (see *Attachment A – HydroCAD Model Results*).

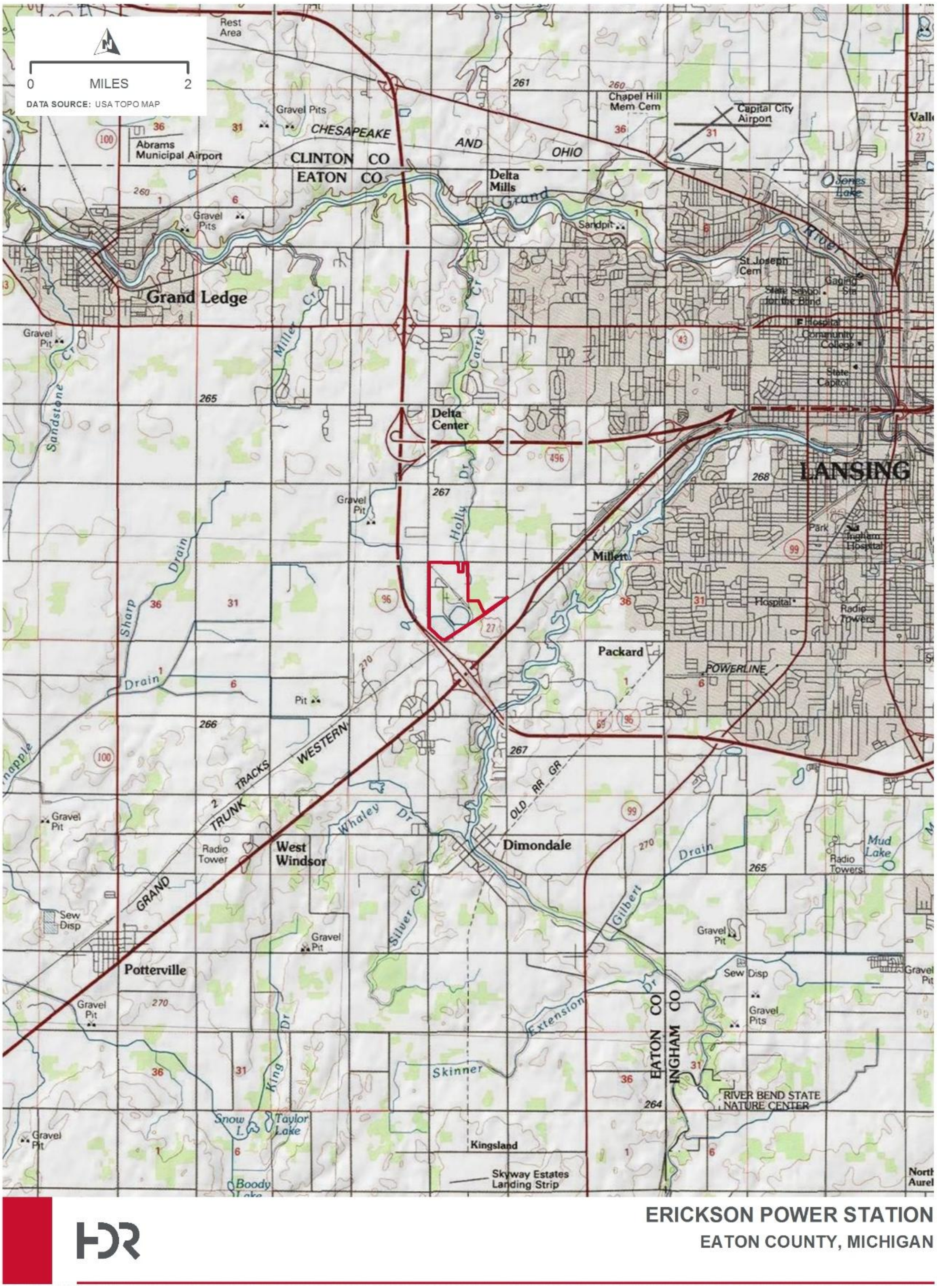


Figure 1. Site Location Map

Figure 2. Former CCR Surface Impoundment System Aerial Site View

1.2 Regulatory Requirements

Title 40 CFR §257.82 requires that an owner or operator of an existing or new CCR surface impoundment or any lateral expansion of a CCR surface impoundment to design, construct, operate, and maintain an inflow design flood control system per the requirements below:

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 item 3) below);
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 item 3) below);
3. The inflow design flood utilized in modelling the system is dictated by 40 CFR §257.82(a)(3).

   HDR has rated the three (3) regulated CCR surface impoundments as "low hazard potentials" under the EPA classification system. Therefore, according to 40 CFR §257.82(a)(3)(iii), the CCR surface impoundments at the Station must be modelled using the 100-year flood. The 100-year, 24-hour storm event for the site is 5.38-inches.

In addition, discharge from the CCR Surface Impoundments must not cause a discharge of pollutants to waters of the United States that is in violation of the requirements of the National Pollutant Discharge Elimination System under Section 402 of the Clean Water Act.

2.0 Hydrologic and Hydraulic Analysis for CCR Impoundments

A hydrologic and hydraulic analysis was completed for the three (3) regulated former CCR surface impoundments and the Former Impoundment. The evaluation was completed in accordance with 40 CFR §257.82 and identified the drainage system for each impoundment and evaluated the capacity of the outfalls to model the potential impacts of stormwater during a 100-year, 24-hour storm event.

The evaluation included preparation of a surface water run-off model using HydroCAD® 10.20-5c to determine whether existing outfalls are sufficient to manage inflow from the 100-year, 24-hour storm event.

The previous site IDF Control Plan, dated June 9, 2020, was completed based on the best available information provided by BWL at the time of that report. The most recent survey of the CCR surface impoundments at the time was completed in September 2018. Information on the decommissioned impoundment system was based on three (3) reports:

- NTH Consultants, Ltd., *"Closure Plan CCR Surface Impoundment System Erickson Power Station"* August 16, 2019;
- Mayotte Design & Engineering, P.C "*Construction Documentation Report, Ash Impoundment Reconfiguration*" May 2015; and
- GZA GeoEnvironmental, Inc., "*Final Round 10 Dam Assessment Report, Lansing Board Of Water & Light, Erickson Station Ash Pond*" August 17, 2012

This 5-year update to the IDF Control System Plan incorporates updated impoundment system information found in the following report:

- HDR Michigan, Inc. "*CCR Removal Report*" November 4, 2024

Additionally, several site changes have occurred since the submittal of the HDR *CCR Removal Report*, which have been included in the calculations herein. Those changes are discussed in Section 2.1.

All elevations identified in this report are provided in NAVD88 unless otherwise stated.

2.1 Description of CCR Surface Impoundments

A description of the CCR impoundments is presented below.

2.1.1 Former Forebay

The Former Forebay was an irregularly shaped quadrangle approximately 475 feet long by 260 feet wide that provided a storage capacity of approximately 932,837 cubic feet. The basin consisted of a clay-rich engineered fill, lined with a geosynthetic clay liner (GCL), overlain with a 40-mil thick polyvinylchloride (PVC) flexible membrane liner (FML). The Forebay was designated to capture the heaviest suspended particles allowing them to settle to the bottom of the impoundment. Plant water flowed via gravity from the Forebay to the Retention Basin through three (3) 24-inch diameter corrugate plastic pipes (CPP).

The Former Forebay has been physically closed and filled with clean fill material following CCR source removal. It no longer receives any process water, and the three inlet pipes previously used to convey water to the Former Forebay were cut back and abandoned in place. These three inlet pipes no longer connect to the Former Forebay. The three CPPs connecting the Former Forebay to the Former Retention Basin have also been removed. Due to fill grading, runoff from the Former Forebay flows towards the Former Impoundment.

2.1.2 Former Retention Basin

The second regulated CCR surface impoundment was the Former Retention Basin. The Former Retention Basin was relatively rectangular in shape approximately 560 feet long by 260 feet wide and provided a storage capacity of 1,298,407 cubic feet. Like the Former Forebay, the Former Retention Basin was constructed with a clay-rich engineered fill, lined with a GCL, overlain with a 40-mil thick PVC FML. The Former Retention Basin was designated to provide a longer retention time to allow for the settlement of smaller suspended particles.

The Former Retention Basin discharged to the Clear Water Pond through a 72-inch diameter pre-cast concrete overflow riser pipe structure at the Former Retention Basin's southern corner. At the bottom of the riser pipe structure lay a 36-inch diameter CPP that directed flow to the Clear Water Pond, which has also been decommissioned.

The secondary outlet from the Former Retention Basin was a 24-inch emergency outfall CPP that discharged to the Former Impoundment. This outfall has also been removed.

Like the Former Forebay, the Former Retention Basin has been physically closed and filled with clean fill material following CCR source removal. Due to fill grading, runoff from the Former Retention Basin flows towards the Former Impoundment.

2.1.3 Former Clear Water Pond

The last of the regulated CCR surface impoundments was the Former Clear Water Pond, which was triangular in shape with sides approximately 425 feet, 730 feet, and 640 feet in length and with an area of 189,200 square feet. The storage capacity was approximately 1,772,913 cubic feet. The Former Clear Water Pond was constructed in 1970 (prior to the Former Forebay and Former Retention Basin) with a compacted clay liner to limit infiltration. When the Station was in operation, water from the Clear Water Pond was continuously recycled back to the Erickson Power Station at a rate of 3.8 million gallons per day (MGD) where it was recycled for ash quenching, fluming, and cooling water before being re-routed back to the Forebay for treatment.

The primary discharge from the Former Clear Water Pond was the Pump Station. The Former Clear Water Pond also has an emergency outfall structure on the northeast corner that discharges to a swale that flows north and east and eventually directs flow to Carrier Creek and then to the Grand River.

Like the Former Forebay and Former Retention Basin, the Former Clear Water Pond has been physically closed, however not filled with fill material following CCR source removal. The embankment separating the Former Clear Water Pond from the Former Impoundment has been removed and the footprint of the Former Clear Water Pond was graded to drain to the Former Impoundment. It no longer serves a treatment role but directs stormwater runoff towards the Former Impoundment. While the Clear Water Pond has been decommissioned, the emergency overflow outfall remains in place, however, the invert elevation has been modified to El. 875.3.

2.1.4 Former Impoundment

The Former Impoundment was decommissioned in October of 2014 with the removal of CCR. The decommissioning provided the necessary area to construct the three regulated CCR surface impoundments. The surrounding area of the former ponds includes vegetated and paved areas with a top elevation of 886.5 feet that limits stormwater from entering into the pond system via overland flow. Following the physical closures of the Former Forebay, Former Retention Basin, and Former Clear Water Pond, the Former Impoundment now serves as the low point for stormwater collection from the three former regulated CCR units.

The berm separating the Former Impoundment and the Former Clear Water Pond has been removed. The Clear Water Pond overflow structure was modified during the closure activities but remains intact and now serves as the sole outfall from the entirety of the Former Impoundment System. However, hydrologic modelling shows that this outfall would not spill over in a 100-year flood event (see *Attachment A – HydroCAD Model Results*).

2.1.5 Lake Delta

Lake Delta is a man-made 44-acre lake that is used to supply the Station with make-up water. It is not considered a CCR Impoundment.

2.2 Existing Inflow/Outflow Design Flood Controls

2.2.1 Inlets

During decommissioning, the three force main pipes which previously fed into the Former Forebay were cut back and abandoned in place. The three CPPs leading previously conveying water from the Former Forebay to the Former Retention Basin, as well as the outfall piping from the Former Retention Basin, have been removed. The only water entering the Former Forebay, the Former Retention Basin, and the Former Clear Water Pond is from direct rainfall, which are graded to runoff towards the Former Impoundment. The only water entering the Former Impoundment is from direct rainfall and runoff from the other three former units.

2.2.2 Outflows

The only outflows from the Former Forebay, Former Retention Basin, and Former Clear Water Pond are from runoff towards the Former Impoundment.

The Former Clear Water Pond was previously equipped with an emergency overflow structure that discharges to a swale located between the Former Clear Water Pond and the Canadian National Railroad right-of way. During decommissioning, the emergency outlet steel standpipe was cut off, but the horizontal outfall pipe remains, with an invert elevation of 875.3 feet.

Following the removal of the berm separating the former Clear Water Pond and the Former Impoundment, the Clear Water Pond emergency overflow structure now serves as the sole outfall from the entirety of the Former Impoundment System. However, hydrologic modelling shows that this outfall would not spill over in a 100-year flood event.

2.2.3 Swale and Carrier Creek

The Former Clear Water Pond emergency outfall discharges to a grass swale that varies in width but is estimated to be approximately 15-feet wide at the bottom with 3H:1V side slopes that provide 3-feet of potential flow depth. The swale lies between BWL property and the Canadian National Railroad right-of-way. Any water that is received by the swale eventually flows to Carrier Creek and then to the Grand River. BWL has indicated that the Former Clear Water Pond has, to its knowledge, never discharged any water to the swale via the emergency outlet.

2.3 Hydrologic and Hydraulic Model and Results

A surface water run-off model was prepared using HydroCAD®, which utilizes procedures outlined in the Soil Conservation Service (SCS) Technical Release 55 (TR-55) for computing curve numbers and times of concentration and SCS TR-20 for calculating and generating run-off hydrographs and modeling the existing outfall structures. The HydroCAD® model report is included as **Appendix A**. A discussion of the model's input data is provided below.

2.3.1 Drainage Areas

As there are no more operational inlets into the impoundment system following the decommissioning of the three regulated CCR units, the only water entering the system is direct rainfall onto the impoundment system. Runoff is limited to the berm areas that slope into the impoundments.

Table 1 shows the Drainage Areas contributing to the CCR Impoundment System during the 100-year, 24-hour storm event.

Table 1. Inflow and Drainage Areas

Pond or Drainage Area Name	Sub-catchment Area	Peak Runoff Flow from Rainfall onto Sub-catchment
Former Forebay Sub-catchment	2.76 acres	5.16 CFS
Former Retention Basin Sub-catchment	3.73 acres	6.98 CFS
Former Clear Water Pond Sub-catchment	5.74 acres	10.74 CFS
Former Impoundment Sub-catchment	25.20 acres	70.98 CFS

2.3.2 Rainfall Data

Rainfall events for the Lansing Michigan area were available from the National Oceanic and Atmospheric Administration (NOAA) Precipitation Frequency Data Server. Rainfall data inputted into the model included the 2-year, 25-year, 50-year and 100-year 24-hour storm events. The precipitation amounts are summarized below in Table 2 and the information from the NOAA Precipitation Frequency Data Server is included as **Appendix B**.

Table 2. Rainfall Data	
24-Hour Rainfall Event	**Precipitation (inches)**
2-year	2.42
25-year	4.08
50-year	4.70
100-year	5.38

2.3.3 Weighted Curve Number

The weighted curve number (CN) is determined according to a hydrologic soil group (HSG) and ground cover for a delineated drainage basin. The majority of drainage areas were identified as having greater than 75% grass cover in good condition and underlying soils with moderate permeability (HSG B), corresponding to a CN of 61. A portion of the Former Impoundment area was identified as water surface with an impervious coverage which correlates to a CN number of 98. Based on the areas, the model calculated a weighted CN of 67 for the drainage sub-catchment areas.

The Soil Conservation District Web Soil Survey was consulted to identify the hydrologic soil groups for the native soils. The soil report for the native soils is included in **Appendix C**.

2.3.4 Time of Concentration

The time of concentration (Tc) is defined as the time required for run-off to travel from the most hydrologically distant point of a sub-catchment to the point of collection. It is determined by summing the travel time for consecutive flow segments along the sub-catchment's hydraulic path. The top of the impoundment embankment is the furthest point of travel. The time of concentration for the impoundment system sub-catchments are estimated between 16.4 and 16.8 minutes.

2.3.5 Pond Model Inputs

The evaluation was completed based on the best available information at the time of this report. Existing elevations and the outlet structure information were taken from recent construction data. A summary of the HydroCAD® model inputs is summarized in Table 3.

Table 3. Inflow/Outflow Structure Information		
Inflow/Outflow Structure and Type		**Elevation (feet) (NAVD88)**
Former Impoundment	Inlets: • Direct rainfall onto sub-catchment • Run-on from Former Forebay, Former Retention Basin, and Former Clear Water Pond	
	Outlets: • Evaporation • 36” Ductile Iron Outfall Pipe (physically located at the Former Clear Water Pond)	875.3 (invert elevation)

2.4 Evaluation of Existing Inflow/Outflow Design Controls

To comply with 40 CFR §257.82, the inflow and outflow design flood control systems must adequately manage flow into and out of the CCR unit during the 100-year, 24-hour storm event.

The HydroCAD® model was used to evaluate the inflow, outflow, and peak elevations observed for the 100-year, 24-hour storm event for the impoundments in their current conditions. Based on the model results, the outflow design control systems for both impoundments are capable of managing flows from the 100-year, 24-hour storm event and meet the requirements of 40 CFR §257.82(a)(2).

Table 4 summarizes the peak elevation of stormwater in the Former Impoundment during the 100 year, 24-hour storm event.

Table 4. Elevations during 100-year, 24-hours storm event				
Pond	**Peak Elevation (ft)**	**Peak Inflow (cfs)**	**Peak Outflow (cfs)**	**Remaining Pond Freeboard (ft)**
Former Impoundment	869.06	93.85	0.00	6.24

Note: The only discharge from Former Impoundment during the 100-year flood event is via evaporation.

The Former Impoundment is now the low point for stormwater in the system. Due to the removal of the berm separating the Former Impoundment and the Former Clear Water Pond, the Former Impoundment is hydrologically connected to the outfall located at the Former Clear Water Pond.

However, based on the modelling results, at no time during a 100-year, 24-hour storm event will water elevations rise above the decommissioned CCR Impoundment System berms, nor does the water discharge to the outfall pipe located at the Former Clear Water Pond.

2.5 Improvements to Existing Inflow/Outflow Design Controls

Based on the available information and the model results, the existing inflow design flood control systems in place for the Former Forebay, Former Retention Basin, and Former Clear Water

Pond meet the requirements of 40 CFR §257.82 and will adequately manage flow into and out of the CCR Impoundment System during the 100-year, 24-hour storm event.

3.0 Professional Engineer Certification

Erickson Power Station CCR Unit 5-Year Hydrologic and Hydraulic Capacity Requirements for CCR Surface Impoundments Compliance with the Federal Coal Combustion Residuals Rule

The undersigned Registered Professional Engineer is familiar with the requirements of Part 257 of Title 40 of the Code of Federal Regulations (40 CFR §257) and has supervised examination of the facility by appropriately qualified personnel. The undersigned Registered Professional Engineer attests that this Run-on and Run-off Controls System Plan has been prepared in accordance with good engineering practice, including consideration of applicable industry standards and the requirements of 40 CFR §257.

This Plan is valid only to the extent that the facility owner or operator maintains existing inflow design flood control systems described in this Plan.

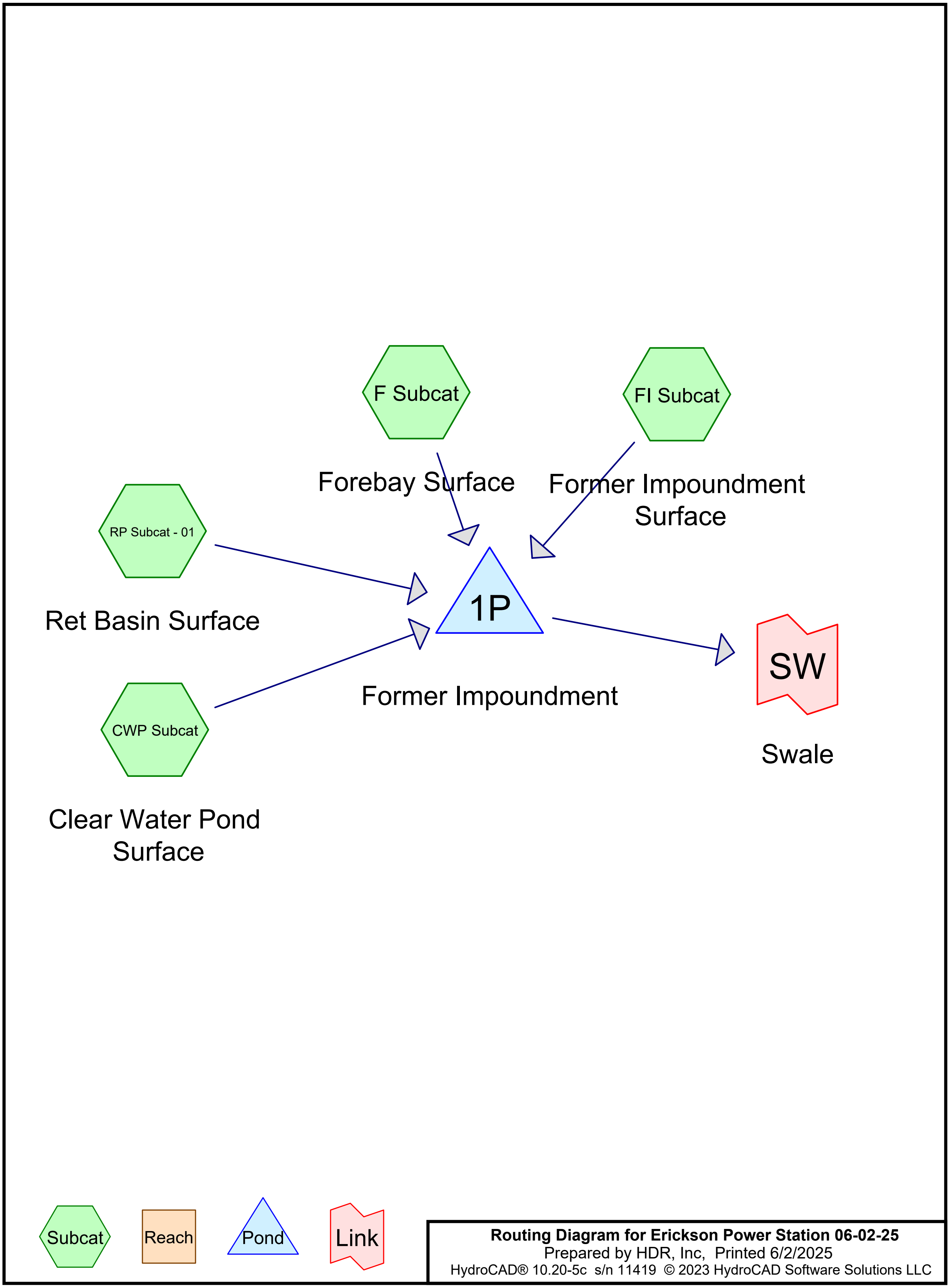
Bryce Burkett, P.E.
Senior Geotechnical Project Manager

STATE OF MICHIGAN
TERRY BRYCE BURKETT ENGINEER No. 6201066757
LICENSED PROFESSIONAL ENGINEER

6 June 2025

4.0 Appendix

APPENDIX A - HYDROCAD® MODEL RESULTS



Routing Diagram for Erickson Power Station 06-02-25
Prepared by HDR, Inc, Printed 6/2/2025
HydroCAD® 10.20-5c s/n 11419 © 2023 HydroCAD Software Solutions LLC

Project Notes

For drainage areas:

The Former Forebay receives water
from the Forebay surface area

The Former Retention Pond receives water
from Retention Pond surface area

The Former Clear Wastewater Pond receives
water from Clear Water Pond surafce area

The Former Impoundment receives water from
the Former Impoundment surface area

The swale receives water from the Former Clear
Water Pond outfall (does not spill over in 100-yr event)

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
31.249	61	>75% Grass cover, Good, HSG B (CWP Subcat, F Subcat, FI Subcat, RP Subcat - 01)
6.180	98	Impoundment (FI Subcat)
37.429	**67**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
31.249	HSG B	CWP Subcat, F Subcat, FI Subcat, RP Subcat - 01
0.000	HSG C	
0.000	HSG D	
6.180	Other	FI Subcat
37.429		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	31.249	0.000	0.000	0.000	31.249	>75% Grass cover, Good	CWP Subcat, F Subcat, FI Subcat, RP Subcat - 01
0.000	0.000	0.000	0.000	6.180	6.180	Impoundment	FI Subcat
0.000	**31.249**	**0.000**	**0.000**	**6.180**	**37.429**	**TOTAL AREA**	

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Width (inches)	Diam/Height (inches)	Inside-Fill (inches)	Node Name
1	1P	875.30	875.30	50.0	0.0000	0.011	0.0	36.0	0.0	

Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

SubcatchmentCWP Subcat: Clear Water Runoff Area=5.739 ac 0.00% Impervious Runoff Depth>1.59"
Flow Length=100' Slope=0.0200 '/' Tc=16.4 min CN=61 Runoff=10.74 cfs 0.762 af

SubcatchmentF Subcat: Forebay Surface Runoff Area=2.760 ac 0.00% Impervious Runoff Depth>1.59"
Flow Length=100' Slope=0.0200 '/' Tc=16.4 min CN=61 Runoff=5.16 cfs 0.366 af

SubcatchmentFI Subcat: Former Runoff Area=25.200 ac 24.52% Impervious Runoff Depth>2.31"
Flow Length=115' Slope=0.0200 '/' Tc=16.8 min CN=70 Runoff=70.98 cfs 4.853 af

SubcatchmentRP Subcat - 01: Ret Basin Runoff Area=3.730 ac 0.00% Impervious Runoff Depth>1.59"
Flow Length=100' Slope=0.0200 '/' Tc=16.4 min CN=61 Runoff=6.98 cfs 0.495 af

Pond 1P: Former Impoundment Peak Elev=869.06' Storage=6.476 af Inflow=93.85 cfs 6.476 af
36.0" Round Culvert n=0.011 L=50.0' S=0.0000 '/' Outflow=0.00 cfs 0.000 af

Link SW: Swale Inflow=0.00 cfs 0.000 af
Primary=0.00 cfs 0.000 af

Total Runoff Area = 37.429 ac Runoff Volume = 6.476 af Average Runoff Depth = 2.08"
83.49% Pervious = 31.249 ac 16.51% Impervious = 6.180 ac

Summary for Subcatchment CWP Subcat: Clear Water Pond Surface

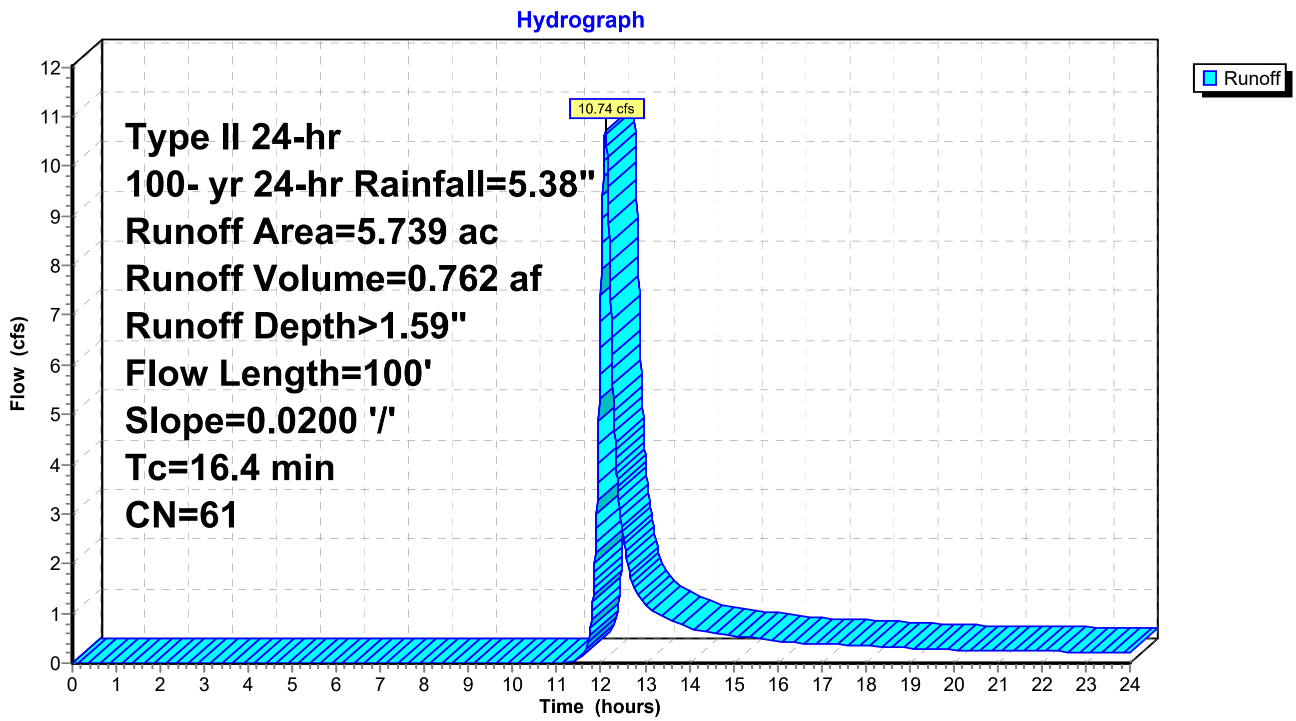
Runoff = 10.74 cfs @ 12.10 hrs, Volume= 0.762 af, Depth> 1.59"
Routed to Pond 1P : Former Impoundment

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type II 24-hr 100- yr 24-hr Rainfall=5.38"

Area (ac)	CN	Description
5.739	61	>75% Grass cover, Good, HSG B
5.739		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.4	100	0.0200	0.10		**Sheet Flow, Sheet Flow** Grass: Dense n= 0.240 P2= 2.42"

Subcatchment CWP Subcat: Clear Water Pond Surface



Summary for Subcatchment F Subcat: Forebay Surface

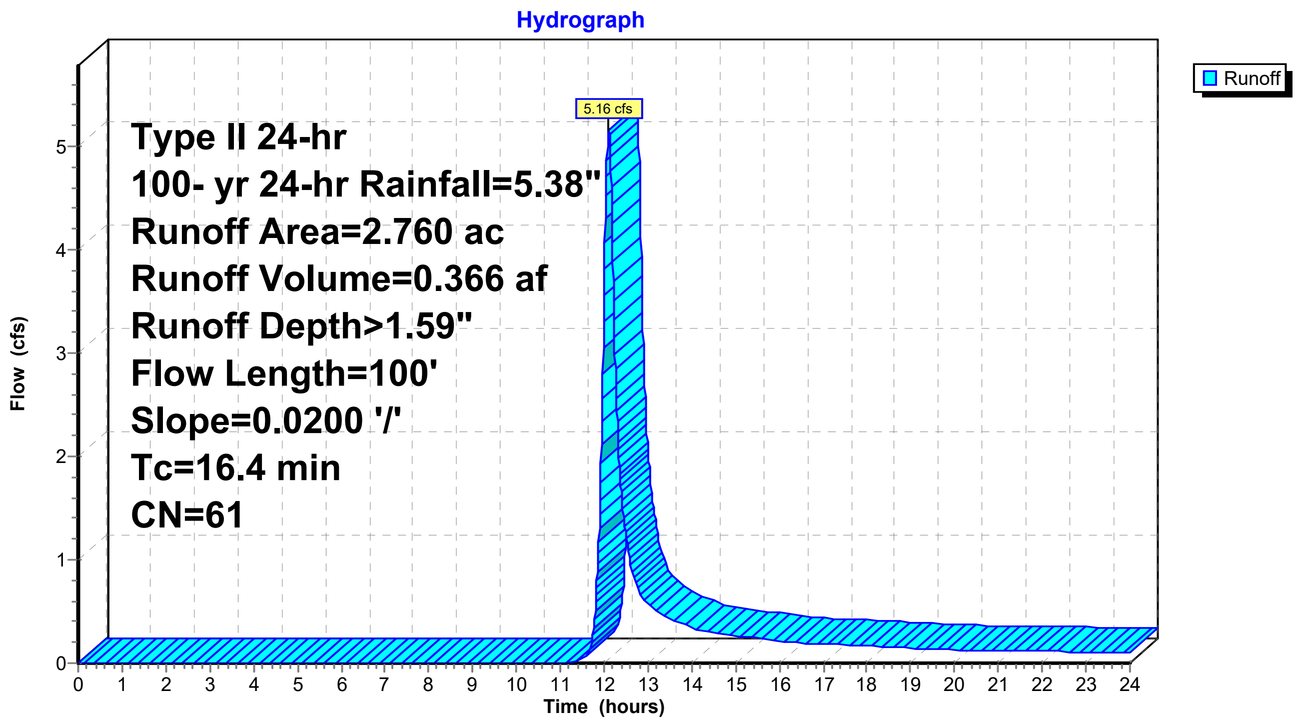
Runoff = 5.16 cfs @ 12.10 hrs, Volume= 0.366 af, Depth> 1.59"
Routed to Pond 1P : Former Impoundment

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type II 24-hr 100- yr 24-hr Rainfall=5.38"

Area (ac)	CN	Description
2.760	61	>75% Grass cover, Good, HSG B
2.760		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.4	100	0.0200	0.10		**Sheet Flow, Forebay Surface** Grass: Dense n= 0.240 P2= 2.42"

Subcatchment F Subcat: Forebay Surface



Summary for Subcatchment FI Subcat: Former Impoundment Surface

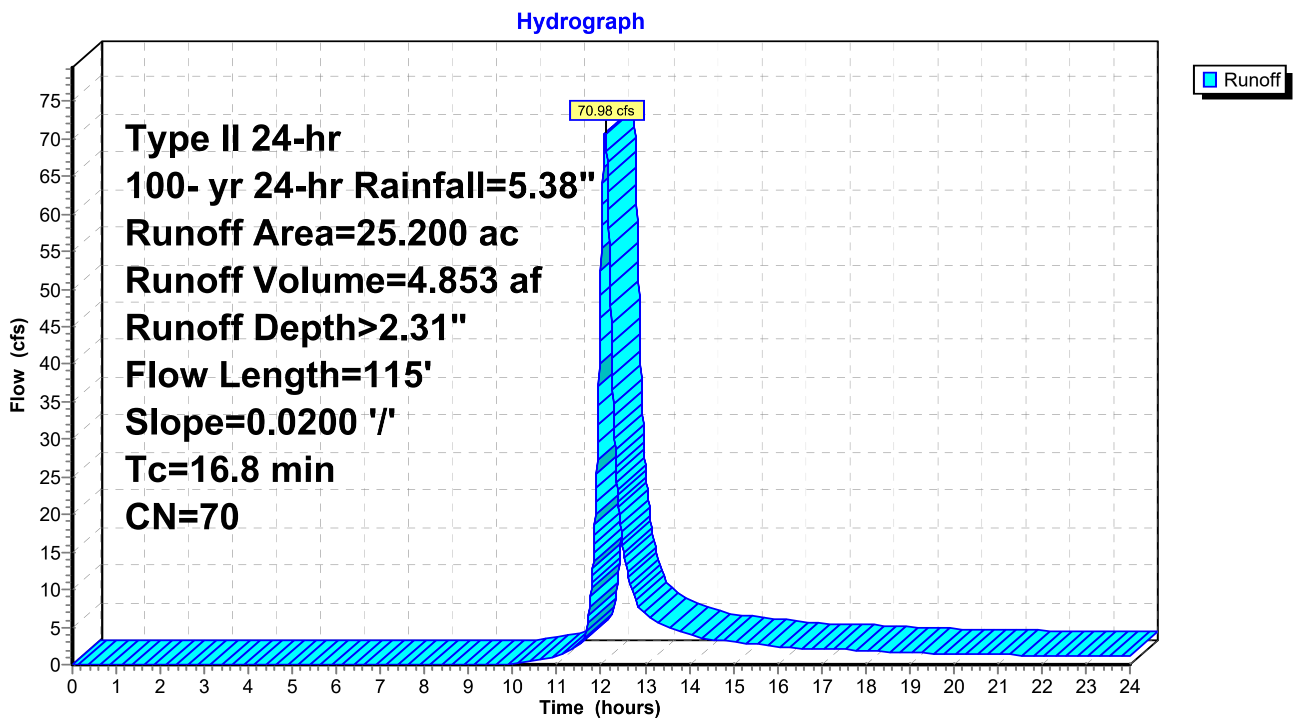
Runoff = 70.98 cfs @ 12.10 hrs, Volume= 4.853 af, Depth> 2.31"
Routed to Pond 1P : Former Impoundment

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type II 24-hr 100- yr 24-hr Rainfall=5.38"

	Area (ac)	CN	Description
*	6.180	98	Impoundment
	19.020	61	>75% Grass cover, Good, HSG B
	25.200	70	Weighted Average
	19.020		75.48% Pervious Area
	6.180		24.52% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.4	15		0.63		**Direct Entry, OAI Subcat**
16.4	100	0.0200	0.10		**Sheet Flow, Sheet Flow** Grass: Dense n= 0.240 P2= 2.42"
16.8	115	Total			

Subcatchment FI Subcat: Former Impoundment Surface



Summary for Subcatchment RP Subcat - 01: Ret Basin Surface

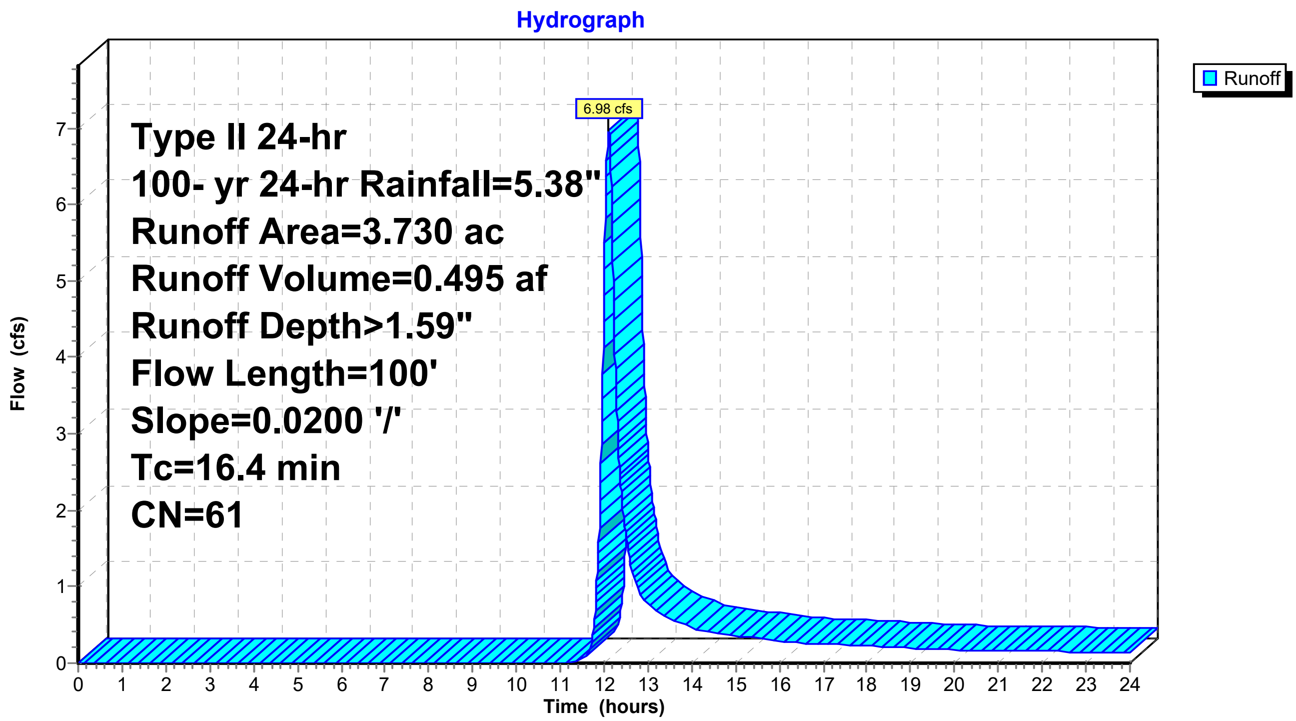
Runoff = 6.98 cfs @ 12.10 hrs, Volume= 0.495 af, Depth> 1.59"
Routed to Pond 1P : Former Impoundment

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type II 24-hr 100- yr 24-hr Rainfall=5.38"

Area (ac)	CN	Description
3.730	61	>75% Grass cover, Good, HSG B
3.730		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.4	100	0.0200	0.10		**Sheet Flow, Retention Basin - Sheet Flow** Grass: Dense n= 0.240 P2= 2.42"

Subcatchment RP Subcat - 01: Ret Basin Surface



Summary for Pond 1P: Former Impoundment

Inflow Area = 37.429 ac, 16.51% Impervious, Inflow Depth > 2.08" for 100- yr 24-hr event
Inflow = 93.85 cfs @ 12.10 hrs, Volume= 6.476 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Link SW : Swale

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 869.06' @ 24.00 hrs Surf.Area= 6.152 ac Storage= 6.476 af

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no outflow)

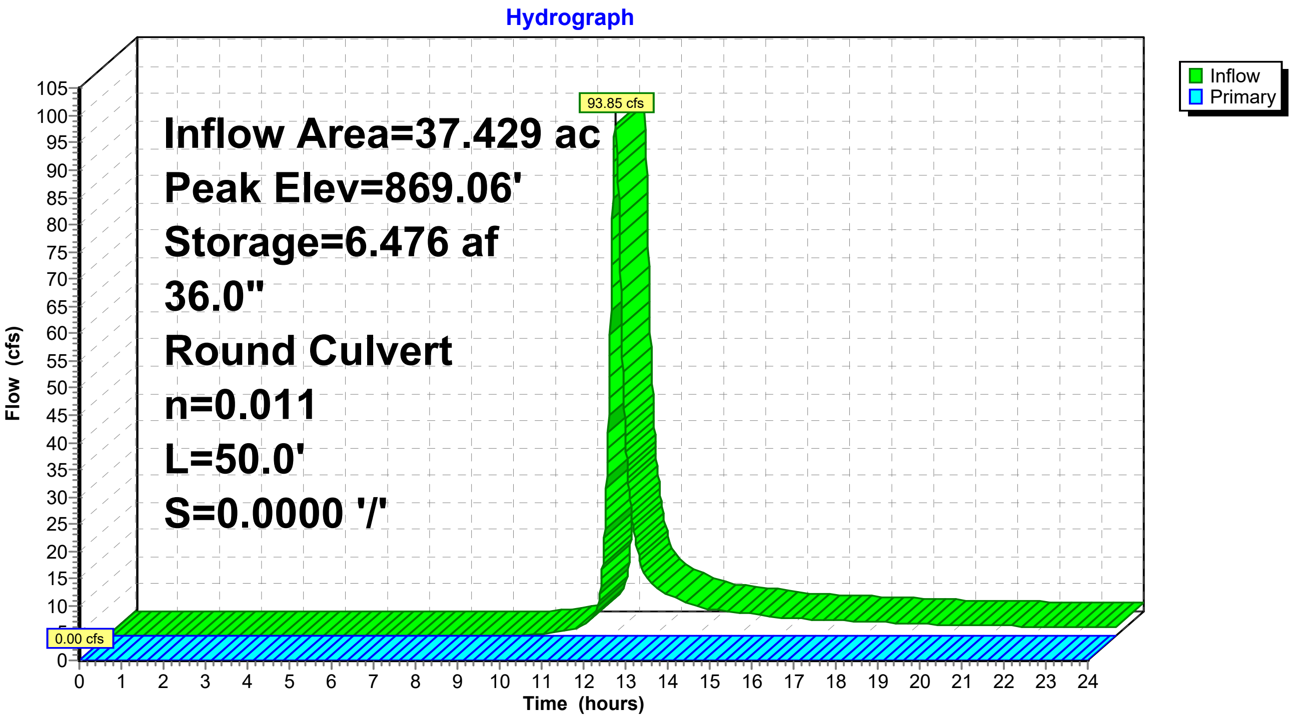
Volume	Invert	Avail.Storage	Storage Description
#1	868.00'	122.463 af	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
868.00	6.118	0.000	0.000
870.00	6.183	12.301	12.301
871.00	15.930	11.056	23.358
872.00	19.380	17.655	41.012
874.00	20.690	40.070	81.083
875.00	20.690	20.690	101.773
876.00	20.690	20.690	122.463

Device	Routing	Invert	Outlet Devices
#1	Primary	875.30'	**36.0" Round Culvert** L= 50.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 875.30' / 875.30' S= 0.0000 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 7.07 sf

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=868.00' (Free Discharge)
└─**1=Culvert** (Controls 0.00 cfs)

Pond 1P: Former Impoundment

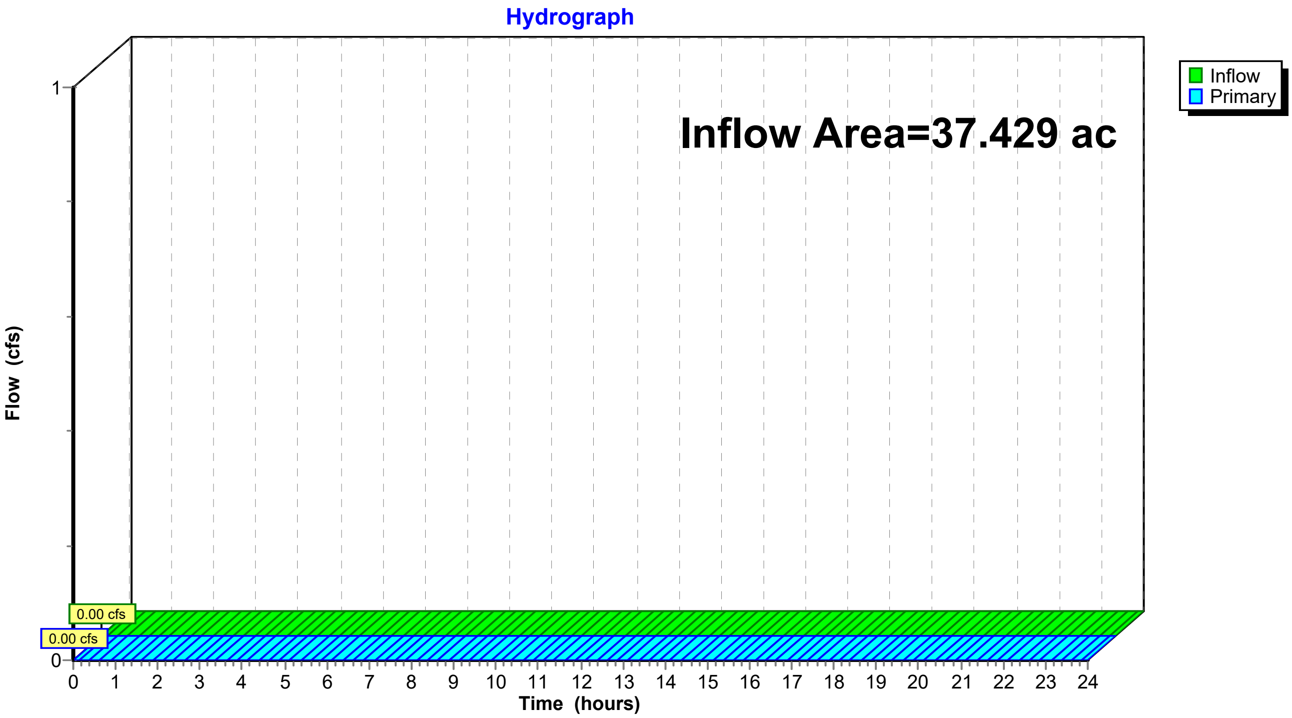


Summary for Link SW: Swale

Inflow Area = 37.429 ac, 16.51% Impervious, Inflow Depth = 0.00" for 100- yr 24-hr event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Link SW: Swale



APPENDIX B – NOAA RAINFALL DATA

NOAA Atlas 14, Volume 8, Version 2
Location name: Lansing, Michigan, USA*
Latitude: 42.6875°, Longitude: -84.6546°
Elevation: 871 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Deborah Martin, Sandra Pavlovic, Ishani Roy, Michael St. Laurent, Carl Trypaluk, Dale Unruh, Michael Yekta, Geoffery Bonnin

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

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	0.291 (0.236-0.366)	0.340 (0.274-0.427)	0.423 (0.341-0.533)	0.497 (0.398-0.628)	0.605 (0.471-0.791)	0.693 (0.526-0.913)	0.785 (0.576-1.06)	0.883 (0.622-1.21)	1.02 (0.691-1.43)	1.13 (0.743-1.59)
10-min	0.426 (0.345-0.536)	0.497 (0.402-0.625)	0.620 (0.499-0.781)	0.728 (0.583-0.920)	0.885 (0.690-1.16)	1.01 (0.770-1.34)	1.15 (0.844-1.54)	1.29 (0.911-1.77)	1.49 (1.01-2.09)	1.65 (1.09-2.33)
15-min	0.520 (0.421-0.653)	0.606 (0.490-0.762)	0.756 (0.609-0.952)	0.887 (0.711-1.12)	1.08 (0.841-1.41)	1.24 (0.940-1.63)	1.40 (1.03-1.88)	1.58 (1.11-2.16)	1.82 (1.23-2.55)	2.02 (1.33-2.84)
30-min	0.744 (0.602-0.935)	0.866 (0.700-1.09)	1.08 (0.869-1.36)	1.27 (1.02-1.60)	1.54 (1.20-2.02)	1.77 (1.34-2.33)	2.00 (1.47-2.70)	2.26 (1.59-3.10)	2.61 (1.77-3.66)	2.89 (1.90-4.08)
60-min	0.934 (0.756-1.17)	1.11 (0.898-1.40)	1.42 (1.14-1.79)	1.69 (1.35-2.13)	2.08 (1.62-2.72)	2.40 (1.82-3.16)	2.73 (2.00-3.67)	3.08 (2.17-4.23)	3.57 (2.42-5.01)	3.96 (2.61-5.60)
2-hr	1.12 (0.918-1.40)	1.36 (1.11-1.69)	1.76 (1.43-2.19)	2.11 (1.70-2.63)	2.61 (2.05-3.38)	3.02 (2.32-3.95)	3.45 (2.56-4.59)	3.91 (2.78-5.31)	4.54 (3.11-6.29)	5.04 (3.35-7.04)
3-hr	1.23 (1.01-1.52)	1.50 (1.23-1.85)	1.96 (1.60-2.42)	2.36 (1.92-2.93)	2.94 (2.33-3.79)	3.42 (2.64-4.44)	3.92 (2.92-5.18)	4.45 (3.18-6.00)	5.18 (3.57-7.14)	5.76 (3.86-8.00)
6-hr	1.47 (1.22-1.80)	1.76 (1.46-2.15)	2.26 (1.87-2.77)	2.72 (2.23-3.34)	3.39 (2.71-4.33)	3.94 (3.08-5.08)	4.53 (3.42-5.95)	5.17 (3.75-6.92)	6.06 (4.23-8.28)	6.77 (4.59-9.32)
12-hr	1.82 (1.52-2.19)	2.07 (1.73-2.50)	2.54 (2.11-3.07)	2.98 (2.46-3.62)	3.66 (2.97-4.64)	4.24 (3.36-5.42)	4.88 (3.74-6.36)	5.58 (4.10-7.42)	6.59 (4.66-8.95)	7.42 (5.09-10.1)
24-hr	2.16 (1.82-2.58)	2.42 (2.04-2.89)	2.90 (2.44-3.48)	3.36 (2.81-4.04)	4.08 (3.35-5.12)	4.70 (3.76-5.94)	5.38 (4.17-6.94)	6.13 (4.56-8.07)	7.22 (5.17-9.70)	8.11 (5.63-10.9)
2-day	2.45 (2.09-2.89)	2.81 (2.39-3.31)	3.43 (2.91-4.06)	4.00 (3.37-4.74)	4.84 (3.99-5.96)	5.54 (4.46-6.89)	6.29 (4.90-7.98)	7.09 (5.32-9.19)	8.23 (5.95-10.9)	9.14 (6.42-12.2)
3-day	2.69 (2.31-3.16)	3.07 (2.63-3.59)	3.72 (3.18-4.37)	4.31 (3.66-5.08)	5.20 (4.31-6.36)	5.93 (4.80-7.32)	6.71 (5.27-8.45)	7.55 (5.70-9.72)	8.74 (6.36-11.5)	9.69 (6.86-12.9)
4-day	2.90 (2.50-3.39)	3.28 (2.82-3.82)	3.94 (3.38-4.61)	4.54 (3.87-5.33)	5.44 (4.54-6.63)	6.20 (5.04-7.62)	7.00 (5.52-8.78)	7.87 (5.97-10.1)	9.09 (6.65-11.9)	10.1 (7.17-13.3)
7-day	3.42 (2.97-3.95)	3.81 (3.31-4.41)	4.52 (3.90-5.23)	5.15 (4.43-5.99)	6.11 (5.14-7.37)	6.91 (5.67-8.41)	7.76 (6.18-9.64)	8.68 (6.65-11.0)	9.99 (7.38-13.0)	11.0 (7.93-14.5)
10-day	3.86 (3.37-4.44)	4.29 (3.74-4.93)	5.04 (4.38-5.81)	5.72 (4.95-6.61)	6.73 (5.69-8.05)	7.57 (6.25-9.14)	8.46 (6.76-10.4)	9.41 (7.25-11.9)	10.8 (8.00-13.9)	11.8 (8.56-15.4)
20-day	5.19 (4.57-5.88)	5.72 (5.04-6.49)	6.64 (5.83-7.55)	7.43 (6.49-8.48)	8.58 (7.30-10.1)	9.50 (7.91-11.3)	10.5 (8.45-12.7)	11.5 (8.93-14.3)	12.9 (9.66-16.4)	14.0 (10.2-18.0)
30-day	6.36 (5.64-7.16)	6.99 (6.20-7.88)	8.05 (7.11-9.09)	8.94 (7.86-10.1)	10.2 (8.70-11.9)	11.2 (9.35-13.2)	12.2 (9.87-14.6)	13.2 (10.3-16.2)	14.6 (11.0-18.4)	15.6 (11.5-20.0)
45-day	7.91 (7.05-8.84)	8.68 (7.74-9.71)	9.93 (8.82-11.1)	10.9 (9.67-12.3)	12.3 (10.5-14.1)	13.3 (11.2-15.5)	14.3 (11.7-17.1)	15.3 (12.1-18.7)	16.6 (12.6-20.8)	17.6 (13.1-22.4)
60-day	9.28 (8.32-10.3)	10.2 (9.11-11.3)	11.6 (10.3-12.9)	12.7 (11.3-14.2)	14.2 (12.2-16.1)	15.2 (12.8-17.6)	16.2 (13.3-19.2)	17.2 (13.6-20.8)	18.4 (14.0-22.8)	19.2 (14.4-24.4)

[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.

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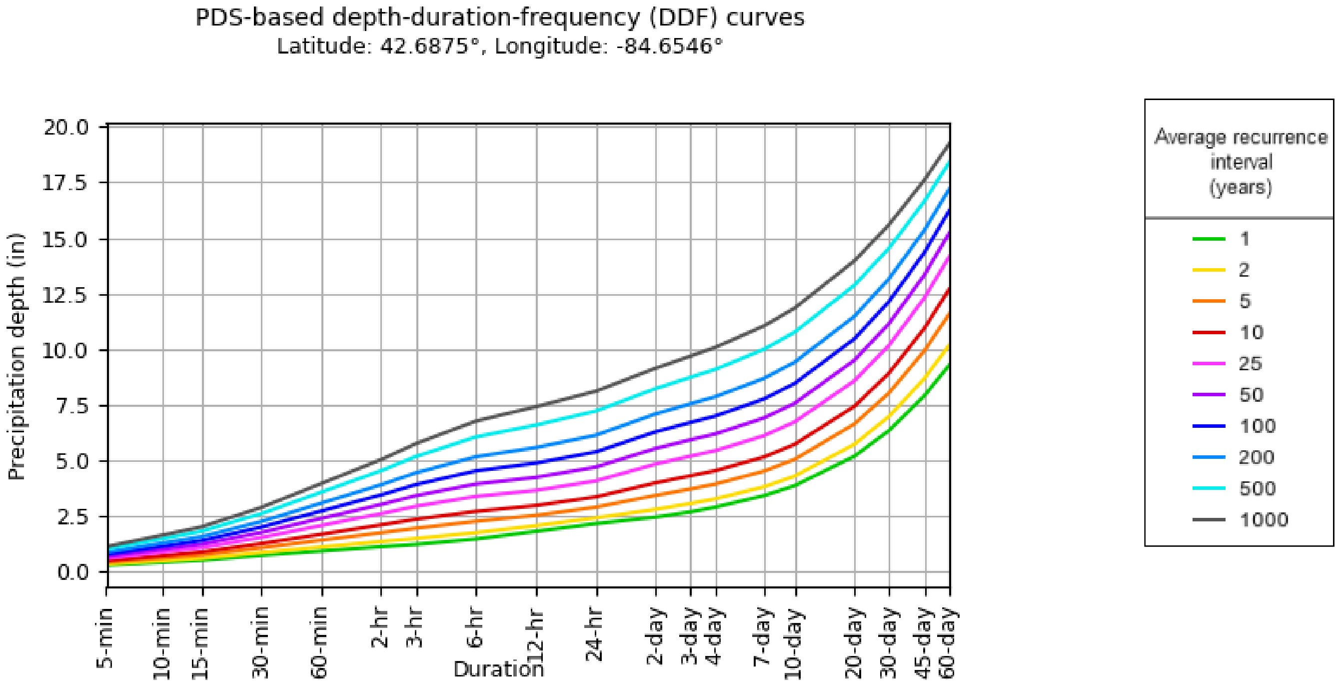
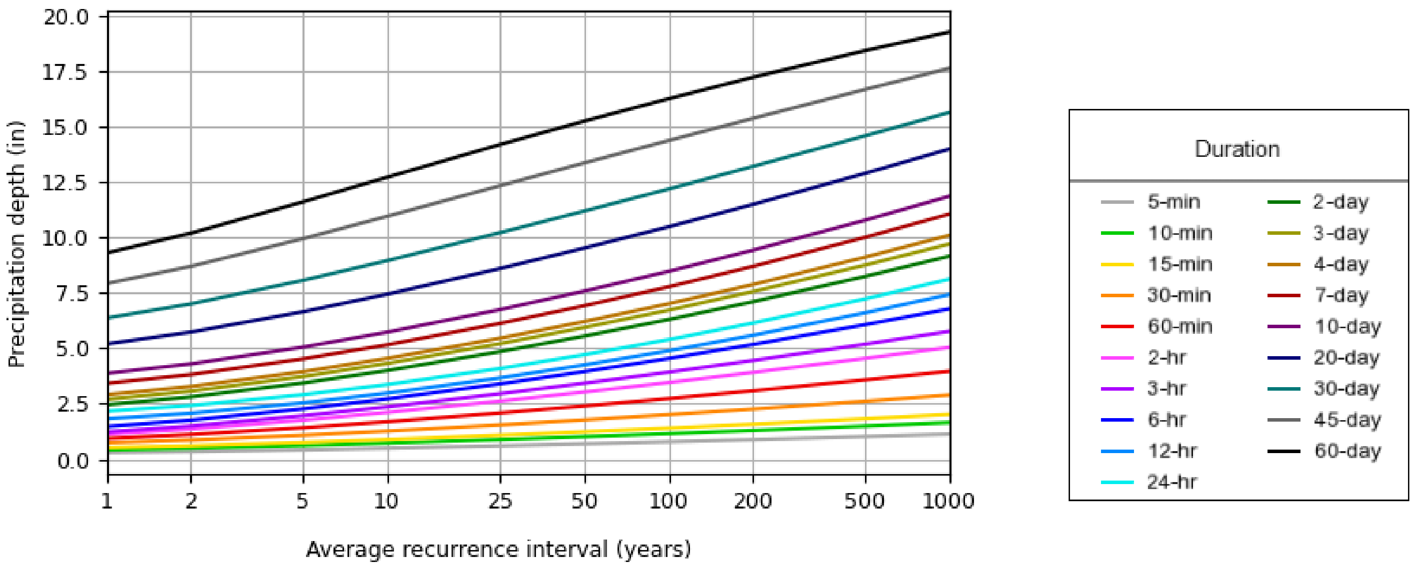
PF graphical





NOAA Atlas 14, Volume 8, Version 2 Created (GMT): Mon Jun 2 14:44:52 2025

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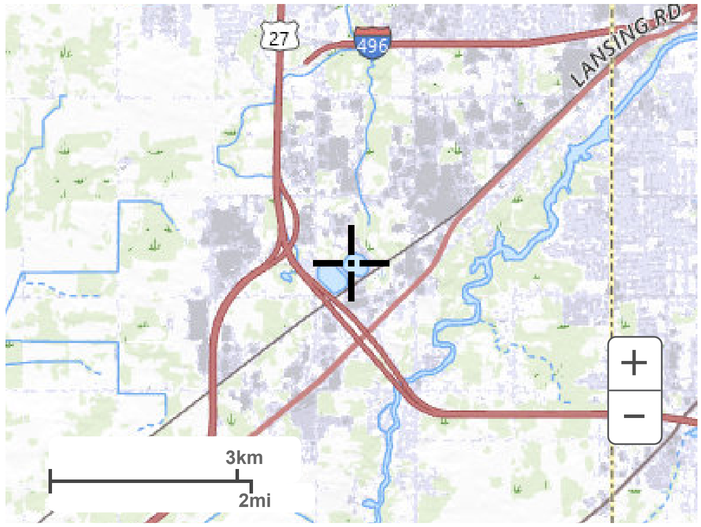
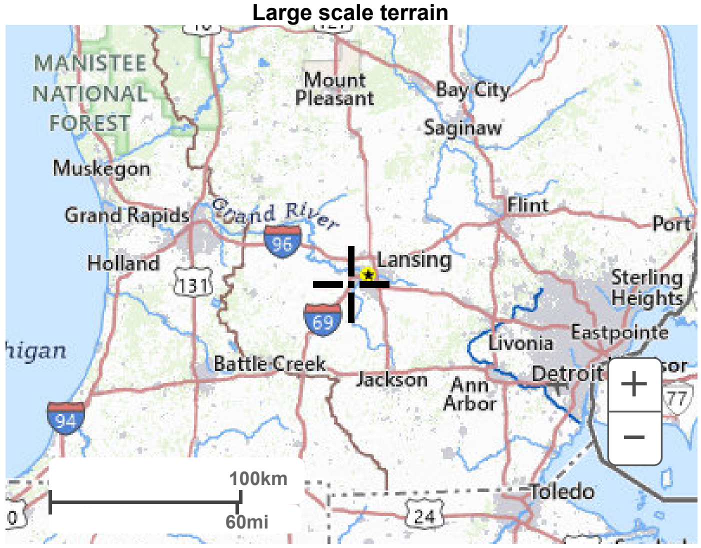
Maps & aerials

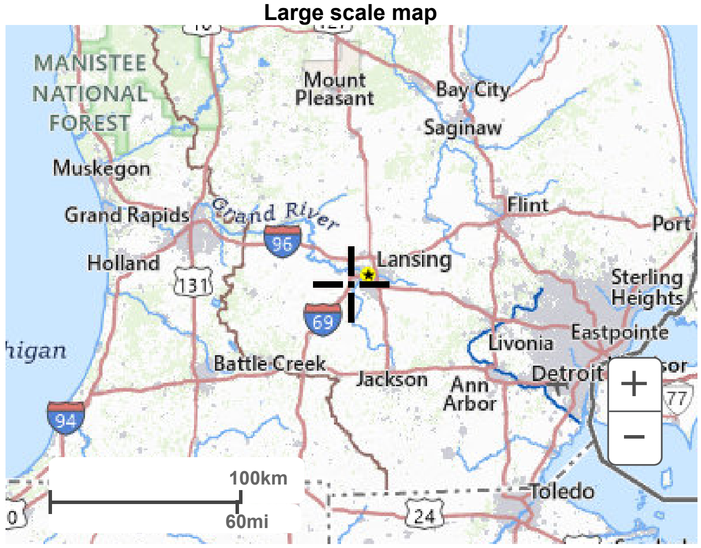
Small scale terrain



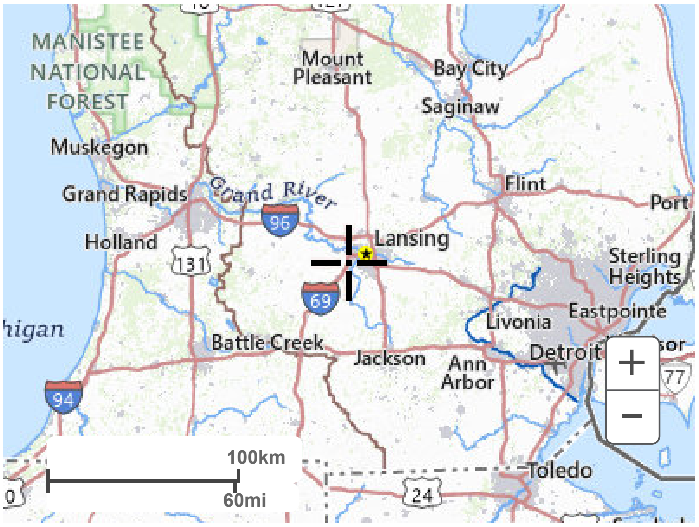
Large scale terrain



Large scale map



Large scale aerial



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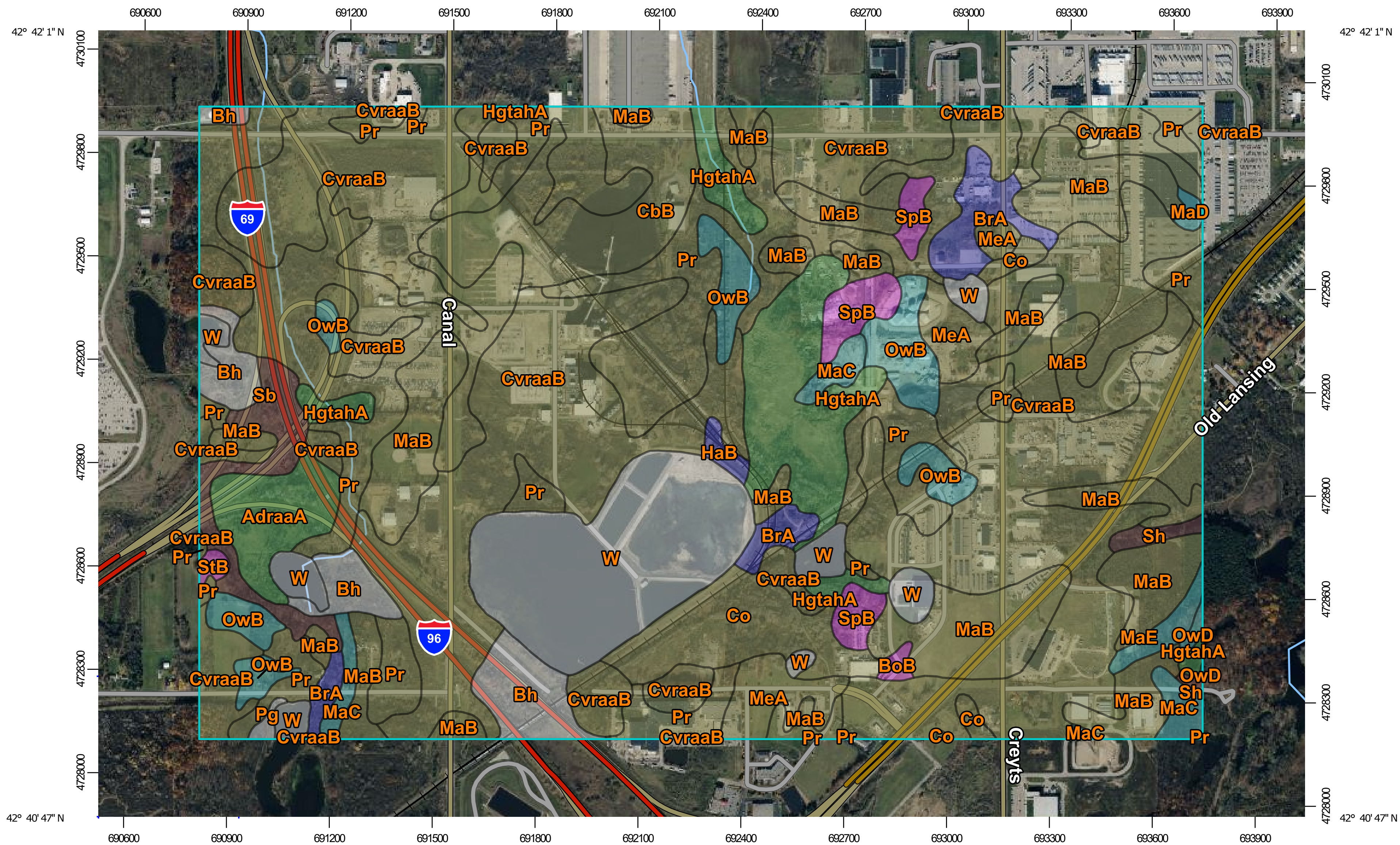
US Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

Disclaimer

APPENDIX C – NRCS SOILS REPORT

Hydrologic Soil Group—Eaton County, Michigan
(NRCS - HSG)

84° 40' 28" W
84° 37' 53" W



84° 40' 28" W
84° 37' 53" W

Map Scale: 1:16,100 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0, 200, 400, 800, 1200

Feet: 0, 500, 1000, 2000, 3000

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 16N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Water Features

Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:15,800.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Eaton County, Michigan
Survey Area Data: Version 21, Aug 26, 2024

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Oct 9, 2022—Oct 28, 2022

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
AdraaA	Adrian muck, 0 to 1 percent slopes	A/D	22.8	1.7%
Bh	Borrow land		34.2	2.6%
BoB	Boyer sandy loam, 0 to 6 percent slopes	A	1.8	0.1%
BrA	Brady-Bronson sandy loams, 0 to 3 percent slopes	B	22.5	1.7%
CbB	Capac-Marlette loams, 1 to 6 percent slopes	C/D	51.6	3.9%
Co	Colwood loam	C/D	38.8	2.9%
CvraaB	Conover loam, 0 to 4 percent slopes	C/D	460.4	34.5%
HaB	Hillsdale sandy loam, 0 to 6 percent slopes	B	2.8	0.2%
HgtahA	Houghton muck, 0 to 1 percent slopes	A/D	60.8	4.6%
MaB	Marlette loam, 2 to 6 percent slopes	C/D	164.3	12.3%
MaC	Filer loam, 6 to 12 percent slopes	C	14.0	1.0%
MaD	Filer loam, 12 to 18 percent slopes	C	1.7	0.1%
MaE	Filer loam, 18 to 35 percent slopes	C	5.5	0.4%
MeA	Metamora-Capac sandy loams, 0 to 4 percent slopes	C/D	25.1	1.9%
OwB	Owosso-Marlette sandy loams, 1 to 6 percent slopes	C	38.0	2.8%
OwD	Owosso-Marlette sandy loams, 12 to 18 percent slopes	C	1.3	0.1%
Pg	Pits, gravel		1.3	0.1%
Pr	Parkhill loam, non dense till subsoil, 0 to 2 percent slopes	C/D	240.3	18.0%
Sb	Sebewa loam, 0 to 2 percent slopes	B/D	19.7	1.5%
Sh	Shoals-Sloan loams	B/D	3.9	0.3%
SpB	Spinks loamy sand, 0 to 6 percent slopes	A	17.4	1.3%

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
StB	Spinks-Metea loamy sands, 0 to 6 percent slopes	A	1.6	0.1%
W	Water		103.0	7.7%
Totals for Area of Interest			**1,332.7**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher