

Appendix G

Preliminary Stormwater Management Plan



PRELIMINARY STORMWATER MANAGEMENT REPORT

Cottage Grove BESS Project

Cottage Grove, Minnesota

MARCH 2026

PREPARED FOR:

LSP CG Storage, LLC

PREPARED BY:

Westwood

Preliminary Stormwater Management Report

Cottage Grove BESS Project

Cottage Grove, Minnesota

Prepared For:

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Introduction

The purpose of this report is to summarize the proposed stormwater management for the Cottage Grove BESS Project (“the project”). This report was prepared to meet stormwater management requirements of the city of Cottage Grove, South Washington Watershed District (SWWD), and the state of Minnesota, and is intended for submittal to these agencies for permitting review and approval.

The project site is proposed within a 6.8 acre property boundary. The project is located approximately 14 miles southeast of St Paul, Minnesota, and within the city of Cottage Grove, Minnesota. The landcover on the Project area is primarily grass cover and developed land as the project area is directly adjacent to the LSP-Cottage Grove, LP power station.

The proposed use of the site will be a 80 MW x 4 hour Battery Energy Storage System (BESS) consisting of approximately 1 acre of new impervious surface including BESS equipment pads, gravel access roads, and other associated infrastructure. The remainder of disturbed area on site will be restored to meadow grass cover.

Grading is proposed on site to route runoff from the proposed BESS pad to proposed stormwater facilities while maintaining the existing drainage patterns. The stormwater management practices proposed are an infiltration basin and infiltration trench to meet the requirements of the state of Minnesota, the city of Cottage Grove and the South Washington Watershed District. Culverts are proposed onsite to route water through the site and maintain existing drainage patterns.

Data Sources

TABLE 1: DATA SOURCES

Task	Format	Source	Use
Elevation	1-meter DEM	USGS	Offsite Model Elevations
Elevation	GeoTiff	Westwood Professional Services	Onsite Proposed Model Elevations
Landcover	Shapefile	USDA 2021 Crop Data Layer	Existing Landcover
Soils	Shapefile	USGS SSURGO Dataset	Curve Numbers
Precipitation	PDF File	NOAA Atlas 14	Design Storms
Site Boundary	CG_ProjectArea.shp	Panamint Capital	Define Model Extents
2014 Aerial Photography	ArcGIS Map Service	USDA FSA	Reference

Site Conditions

Site Location

The project site is proposed within a 6.8 acre property boundary. The project is located approximately 14 miles southeast of St Paul, Minnesota, within the city of Cottage Grove, Minnesota. See Exhibit 1 for a map of the project location.

Topography Description

The existing topographic information used in this analysis was USGS 1-meter DEM elevation data obtained from The National Map in October 2025. The site is generally flat with slopes less than 1%.

Drainage Patterns

Approximately 12.3 acres of offsite runoff enters the site from the north and east. Onsite runoff is split into 2 drainage areas based on discharge locations and flow paths. An existing basin and swale drains the existing site from north to south. Drainage areas are shown in Exhibits 5 & 6.

The site has one ultimate discharge location to the south. The discharge location is shown in Exhibits 5 & 6.

Soils

Soils data was obtained from SSURGO. The information was downloaded and incorporated into the analysis in October 2025.

The site consists entirely of Hydrologic Soil Group (HSG) A soils. Type A soils have low runoff potential and high infiltration rates. See Exhibit 3 for the soil distribution throughout the site.

Landcover

A review of aerial photographs and the USDA 2021 Crop Data Layer shows that the site is located adjacent to the LSP-Cottage Grove, LP power station and consists of a mix of impervious area and grass cover. See Exhibit 4 for a map of the landcover throughout the site.

Requirements and Recommendations

State, watershed district, and city requirements have been reviewed for the project. All requirements determined to be relevant to the project are summarized below. Westwood Professional Service’s recommendations will be followed where local requirements are absent.

At client request, the Authority Having Jurisdiction (AHJ) was not contacted to confirm stormwater requirements. However, a memo provided by the client summarizes the stormwater development requirements of the city (Appendix G). See Tables 2 and 3 for a summary of stormwater requirements found by Westwood.

Stormwater Management Requirements and Recommendations

The following requirements need to be met for the project.

TABLE 2: STORMWATER MANAGEMENT REQUIREMENTS

Agency	Location of Requirements	Water Quantity Requirement	Water Quality Requirement	Other
State of Minnesota	MPCA Stormwater Manual	Post Construction Runoff Rates $\leq$ Pre Construction Runoff Rates (2-, 10-, 100-year 24-hour events)	1.0" of runoff over contributing area	Infiltration within 48 hours
South Washington Watershed District	South Washington Watershed District Rules	Post Construction Runoff Rates $\leq$ Pre Construction Runoff Rates (2-, 10-, 100-year 24-hour events)	Annual total phosphorus loading rates must be $\leq$ 0.22 lb/ac. Post construction TSS discharge rates $\leq$ Pre construction TSS discharge rates	None
City of Cottage Grove	Surface Water Management Plan	Infiltration basin must discharge at 0.11 cfs/acre for the onsite area to the basin	1.0" of runoff over new and reconstructed impervious area	Time of Concentration must be $\geq$ than 8 minutes

Drainage Improvements

Proposed drainage improvements will be sized according to Westwood's recommendations as seen in Table 3 below.

TABLE 3: DRAINAGE IMPROVEMENT SIZING RECOMMENDATIONS

Drainage Improvement	Recommendation
Internal Crossings	100-year, 24-hour storm event with 1-foot allowable head

Methodology

Existing and proposed conditions are modeled in HydroCAD software. HydroCAD is a widely accepted hydrologic and hydraulic modeling package based on National Engineering Handbook (NEH) Part 630. It models stormwater runoff discharge rates and velocities from ponds, culverts, outlet control structures, and stream reaches.

Hydrology

Curve Number Methodology, based on NEH Part 630 Chapter 9, was used in the modeling for predicting direct runoff. Curve numbers were assigned by reviewing the soil and landcover for each drainage area.

Times of concentration were calculated for each drainage area in HydroCAD using methods described in Chapter 15 of NEH Part 630. If the calculated time of concentration was less than 8

minutes, the time of concentration was directly entered as 8 minutes, per the City of Cottage Grove Surface Water Management Plan.

Atlas 14 precipitation and MSE3 distribution data was used for the analysis (Appendix A).

TABLE 4: RAINFALL TABLE

Storm Event	2-year 24-hour	10-year 24-hour	100-year 24-hour
Rainfall (in)	2.79	4.15	7.39

P8 Urban Catchment Model

Program for Predicting Polluting Particle Passage Thru Pits, Puddles, and Ponds (P8) is a model that simulates the generation and transport of stormwater runoff pollutants in urban watershed areas. It models and evaluates the effectiveness of runoff treatment measures including detention ponds, infiltration basins, swales, and vegetated buffers. Runoff calculations are based off the SCS curve number method, and evapotranspiration and mass balance equations. Local precipitation and air temperature files are used as input for the analysis.

Hydraulics

Culvert sizing was completed using HydroCAD and contributing watershed properties to find runoff rates to the anticipated culvert locations. CulvertMaster was then used to size the culverts assuming 1' allowable headwater and Manning's number of 0.024 for corrugated metal culverts. CulvertMaster uses the methodologies outlined in Hydraulic Design Series Number 5 from the U.S. Federal Highway Administration to calculate capacities and end conditions. Some culverts identified are existing culverts that have been resized to account for upstream changes caused by the BESS site.

Post-Construction Stormwater Management Approach

The use of the site will be a 80 MW x 4 hour BESS project. The site will consist of BESS equipment pads, gravel access roads, and other associated infrastructure. The BESS pads and access roads will consist of compacted native soil or fill topped with crushed rock.

The proposed substation and BESS will be a raised pad and runoff from this area will sheet flow north and south to an infiltration trench and infiltration basin, respectively. As there is significant offsite runoff draining to the site (Exhibit 6), existing diversion swales divert this water around the site.

As described in the Minnesota Stormwater Manual, better site design techniques have been incorporated to ensure a site where all impervious surfaces are fully disconnected and routed over grass prior to leaving the site.

(http://stormwater.pca.state.mn.us/index.php/Better_site_design). The MPCA has developed a spreadsheet tool to calculate the volume of the stormwater that must be treated on site (Appendix H).

Infiltration practices are proposed onsite to provide rate control and treatment as needed to meet the requirements of the state, city, and watershed. An infiltration rate of 0.8 in/hour was used in the analysis of the site based on the Type A soils present in the basin location. To confirm acceptable infiltration rates, *in-situ* infiltration testing must be conducted following construction. An infiltration rate between 0.4 in/hr and 8.3 in/hr is required by the City of

Cottage Grove. The infiltration basin proposed onsite is composed of three ponds connected by equalization pipes, with one downstream outlet to the south. The outlet structures of the basin are designed to meet the runoff rate requirements of the site. A provided rate control value of 0.11 cfs/acre disturbed was provided by the City of Cottage Grove to include in the design. An infiltration trench is proposed along the northern edge of the site to infiltrate runoff from the eastern BESS pad. During large storm events overflows from this infiltration trench will flow into the existing swale and then into the infiltration basin. The proposed infiltration practices are shown in Exhibit 6 and modeled in Appendix C.

Modeling

The site is modeled in existing and proposed conditions in order to complete the water quantity analysis required.

Existing Conditions

The existing site is developed and includes an infiltration basin for runoff treatment and reduction. Offsite runoff is included in the analysis. Curve numbers were assigned based on the landcover and soil types, see Table 5 for a summary of existing conditions.

TABLE 5: EXISTING CONDITIONS COVER

Cover	CN	Area (ac)
Meadow, HSG A	30	4.7
Impervious, HSG A	98	1.7
Pond, HSG A	98	0.4
Meadow, HSG A (Offsite)	30	5.5
Impervious, HSG A (Offsite)	98	6.8
Total	62	19.1

Proposed Conditions

The use of the site will be a BESS facility. The BESS site and associated roads are considered impervious area for the purpose of this study. The proposed infiltration basin is also modeled as impervious area. Any remaining area is assumed meadow grass cover. See Table 6 below for a summary of proposed conditions.

TABLE 6: PROPOSED CONDITIONS COVER

Cover	CN	Area (ac)
Meadow, HSG A	30	3.40
BESS Site (Impervious), HSG A	98	2.70
Pond, HSG A	98	0.70
Meadow, HSG A (Offsite)	30	5.5
Impervious, HSG A (Offsite)	98	6.8
Total	66	19.1

Results

The results of the various analyses are described below.

Water Quantity Analysis

Stormwater quantity calculations for the site were prepared using HydroCAD. As indicated in the Stormwater Summary Solar Site Development Memo (Appendix G), the MSE3 rainfall distribution was used along with Atlas-14 precipitation data. The proposed site meets the rate control requirements of the City of Cottage Grove. Tables 7 and 9 show a summary of the runoff rates and volumes for the required storm events at the discharge location, which includes all contributing flow, including the runoff from the adjacent power station. Calculations are included in Appendices B & C. The allowable rate control value of 0.11 cfs/acre disturbed provided by the City of Cottage Grove was also incorporated. Table 8 shows a summary of the proposed discharge rates for the 2-year, 10-year, and 100-year storm events (Appendix D).

TABLE 7: RUNOFF RATE SUMMARY

Location	2-year Runoff (cfs)		10-year Runoff (cfs)		100-year Runoff (cfs)	
	Existing	Proposed	Existing	Proposed	Existing	Proposed
Reach 1	0.36	0.00	3.41	0.93	33.04	22.06

TABLE 8: UNIT PEAK OUTFLOW RATE CONTROL SUMMARY

Basin ID	Onsite Drainage Area (ac)	Allowable Rate Control (cfs/acre)	Allowable Discharge Rate (cfs)	2-year Discharge Rate (cfs)	10-year Discharge Rate (cfs)	100-year Discharge Rate (cfs)
1	6.8	0.11	0.75	0.00	0.00	0.67

TABLE 9: RUNOFF VOLUME SUMMARY

Location	2-year Runoff (ac-ft)		10-year Runoff (ac-ft)		100-year Runoff (ac-ft)	
	Existing	Proposed	Existing	Proposed	Existing	Proposed
Reach 1	0.15	0.00	1.12	0.54	4.34	3.80

Water Quality Analysis

Treatment of the stormwater quality volume for the site will be provided for each discharge location with the proposed infiltration facilities. The infiltration facilities have been sized to retain and infiltrate 1" of runoff over the proposed impervious surfaces, per the city requirement. The proposed basin and trench were designed to have increased storage from the existing basin, accounting for water quality storage for both the existing impervious and the new impervious surfaces. Table 10 shows the required and provided water quality storage volumes for the location. Calculations can be found in Appendices C and H.

TABLE 10: STORAGE SUMMARY

Facility ID	Proposed Impervious (ac)	Existing Impervious (ac)	Required Storage Volume (ac-ft)	Provided Storage Volume (ac-ft)	Total Provided Storage (ac-ft)
Basin 1	1.0	8.5	0.79	0.80	1.11
IT-1				0.31	

Pollutant Removal

The South Washington Watershed District requires that new development reduce the total suspended solids (TSS) load below the existing load. The SWWD also requires that the maximum annual total phosphorus (TP) loading rate for discharges to the Mississippi River be met for the site – 0.22 lbs/acre/year. Per State requirements, the TSS and TP removal from the site overland flow was calculated for the project using the P8 Urban Catchment Model program. For the existing and proposed conditions, weighted pervious curve numbers were used to represent the pervious land cover for each corresponding watershed and HSG. The fraction of impervious surface for each watershed was also input into the analysis for existing and proposed conditions. The offsite area was included in the P8 model. The results of the TSS and TP analysis can be found in Appendix E and Table 11 below.

TABLE 11: POLLUTANT REMOVAL

Pollutant	Load In (lbs/yr)	Load Out (lbs/yr)	Load Out (lbs/ac/yr)	Load Reduction (%)
TSS	23.18	3.30	0.52	85.76
TP	0.61	0.25	0.04	59.89

Stormwater Management Practices

Permanent Basin Calculations

The proposed basin must meet various city and state requirements. See Table 12 below for a summary of the basin design factors.

TABLE 12: DETAILED BASIN REQUIREMENTS

Item	Requirement
Depth	3.2' maximum infiltration depth
Primary Outlet	Orifice/Riser
Emergency Outlet	Emergency Overflow Spillway
Drawdown Time	Maximum of 48 hours
Allowable Discharge Rate	0.11 cfs/acre disturbed

The results of the MPCA spreadsheet show that the site is meeting the requirements. An infiltration basin and infiltration trench are provided to meet the water quality volume requirements. Tables 13 and 14 summarize the proposed basin on site. Calculations can be found in Appendix C.

TABLE 13: PROPOSED BASIN GEOMETRY

Basin ID	Type	Bottom Elevation (ft)	Outlet Elevation (ft)	Emergency Overflow Elevation (ft)	Top Elevation (ft)
1	Infiltration	792.3	795.5	799.0	800.0

TABLE 14: BASIN DRAWDOWN SUMMARY

Basin ID	Max Permanent Pool Depth (ft)	Infiltration Rate (in/hr)	Drawdown Time (hrs)
1	3.2	0.8	48

Infiltration Trench Sizing

An infiltration trench is proposed to increase the volume of runoff treated and decrease runoff rates. Space is limited onsite, so the proposed infiltration trench will allow for less water to need treatment from the infiltration basin. The infiltration trench was modeled and sized in HydroCAD and can be seen in Appendix C. Table 16 summarizes the proposed infiltration trench.

TABLE 16: INFILTRATION TRENCH SUMMARY

Location	Surface Area (ac)	Depth (ft)	Drawdown Time (hrs)	Infiltration Rate (in/hr)
IT-1	0.24	3.2	48	0.8

Crossing Sizing

Existing and proposed drainage crossing locations were identified onsite. Existing crossings were resized to account for changes to the drainage area caused by upstream development. The proposed crossings are proposed to connect the infiltration ponds and are sized for the 100-year storm due to the requirement that the infiltration basin must pass the 100-year, 24-hour storm event. These crossings maintain existing drainage patterns through the proposed site. See Exhibits 5 and 6 for crossing locations.

Culverts are sized for the 100-year 24-hour rain event with a 1-foot allowable head. Calculations were performed using HydroCAD and CulvertMaster and are included in Appendix F. Drainage pipe calculations and sizing are preliminary and subject to change as the design progresses.

TABLE 15: INTERNAL CROSSING SUMMARY

Location	Culvert Size	Culvert Material
DC-01	1-24"	CMP
DC-02	1-30"	CMP
DC-03	1-30"	CMP
DC-04	1-30"	CMP

Conclusion

The proposed site was designed to meet the stormwater requirements of the City of Cottage Grove, South Washington Watershed District, and the State of Minnesota. The proposed site consists of existing swales and proposed crossings in order to maintain existing drainage patterns, direct drainage to the infiltration facilities, and prevent inundation of infrastructure. Runoff rates for the proposed site are reduced to below existing conditions by the proposed infiltration facilities. The results of this report are preliminary and should be updated as design progresses.

References Cited

National Engineering Handbook, Part 630 Hydrology. Chapter 9 Hydrologic Soil-Cover Complexes. USDA. NRCS. 210-VI-NEH, December 2026

National Engineering Handbook, Part 630 Hydrology. Chapter 15 Time of Concentration. USDA. NRCS. 210-VI-NEH, December 2026

NOAA National Water Prediction Service. AHPS Precipitation Analysis. Retrieved December 2026, from <http://water.weather.gov/precip/download.php>

USGS The National Map, 1-meter DEM, Elevation data, Accessed December 2025, <https://apps.nationalmap.gov/downloader/>

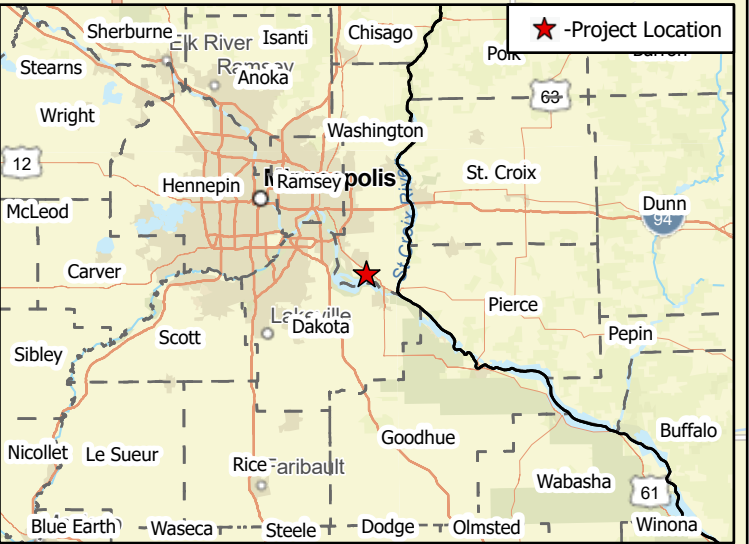
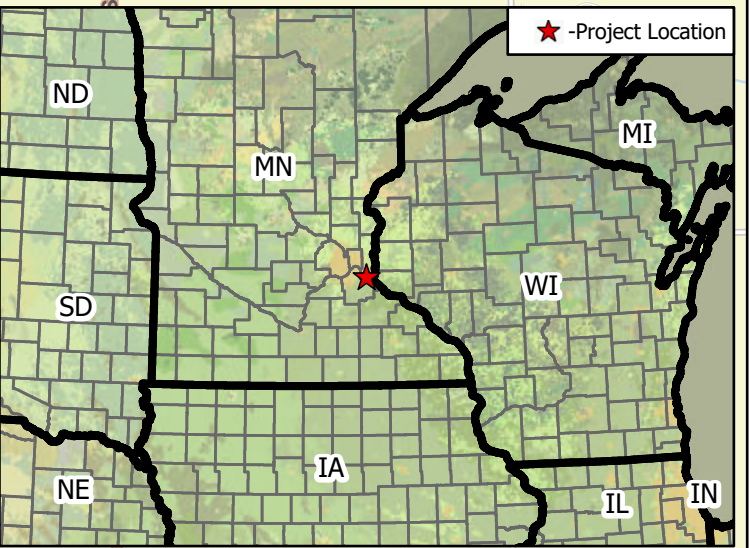
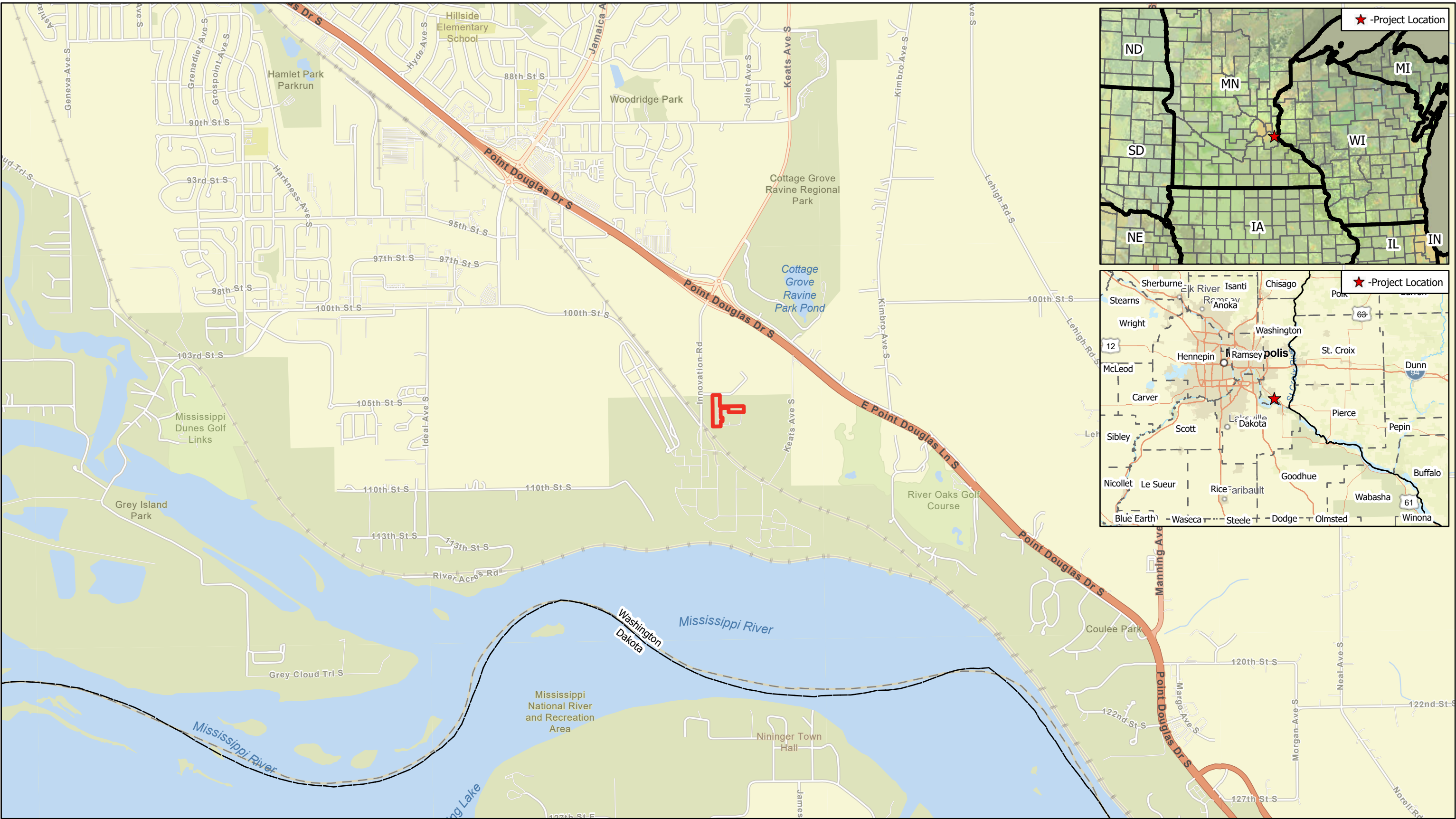
USDA 2021 Crop Data Layer, Landcover data, retrieved December 2025, from https://www.nass.usda.gov/Research_and_Science/Cropland/SARS1a.php

USGS Web Soil Survey. Retrieved December 2025, from <https://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx>

USGS Water Resources: About USGS Water Resources. Retrieved December 2025, from <https://water.usgs.gov/GIS/huc.html>

The background of the entire page is a dark red topographic map. It features intricate, swirling contour lines in a lighter red shade. A dashed red line runs diagonally from the top left towards the bottom center. An 'X' mark is placed on this dashed line in the upper-middle section. A solid red dot is located further down the dashed line, near the bottom left. The word "Exhibits" is printed in a large, white, serif font, positioned to the left of the center of the page.

Exhibits



Data Source(s): Westwood (2026); Esri WMS Basemap Imagery (Accessed 2026); USGS (2026); FEMA (2026); USDA (2026)

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Legend

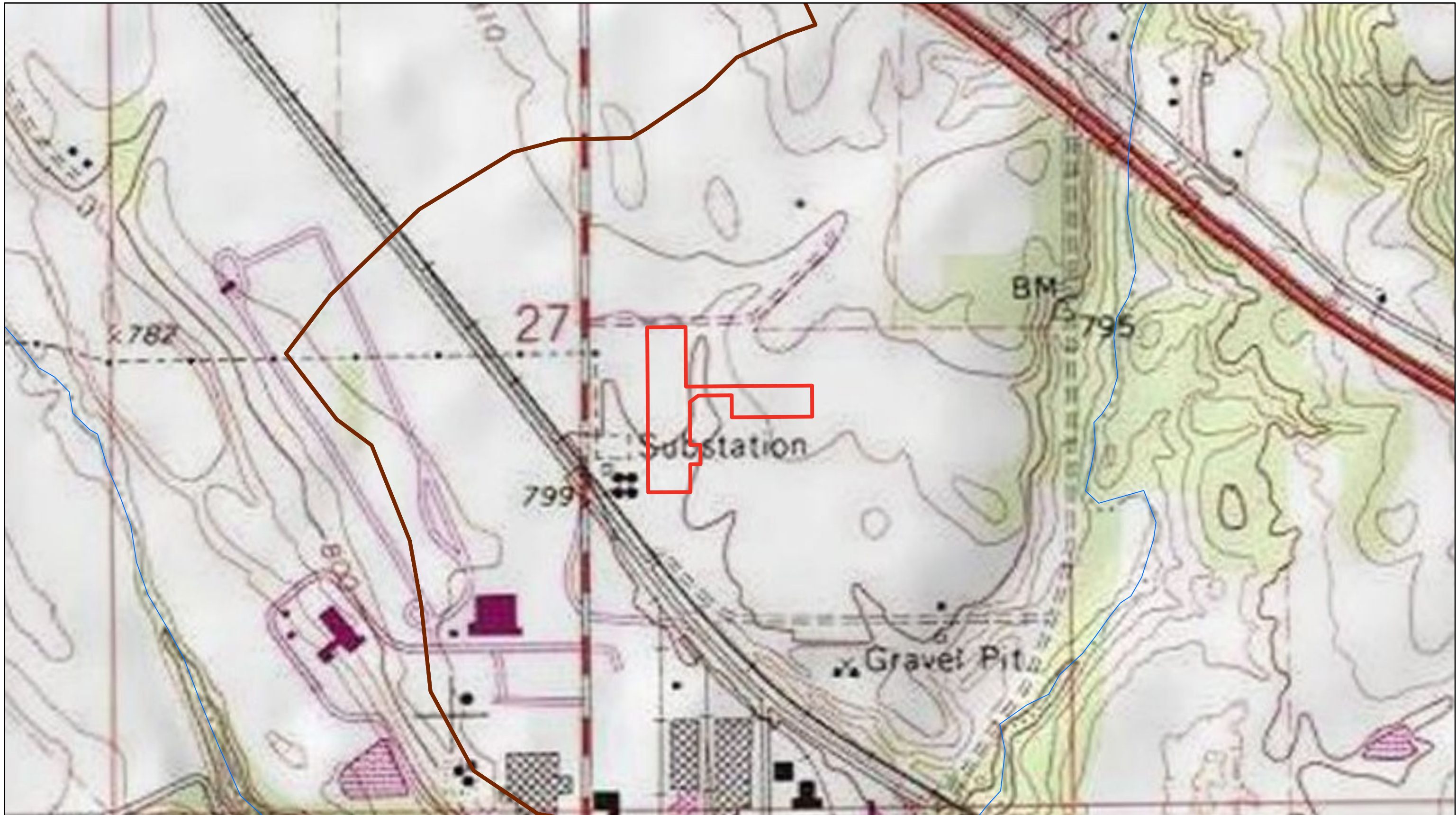
-  Project Area
-  County Boundary



Cottage Grove BESS Project

Washington County, Minnesota

Exhibit 1: Location Map
March 13, 2026



Data Source(s): Westwood (2026); Esri WMS
Basemap Imagery (Accessed 2026); USGS
(2026); FEMA (2026); USDA (2026)

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Legend

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|  | Project Area |  | County Boundary |  | NHD Flowlines |
|  | HUC-12 Boundary |  | NWI Wetlands | | |

Cottage Grove BESS Project

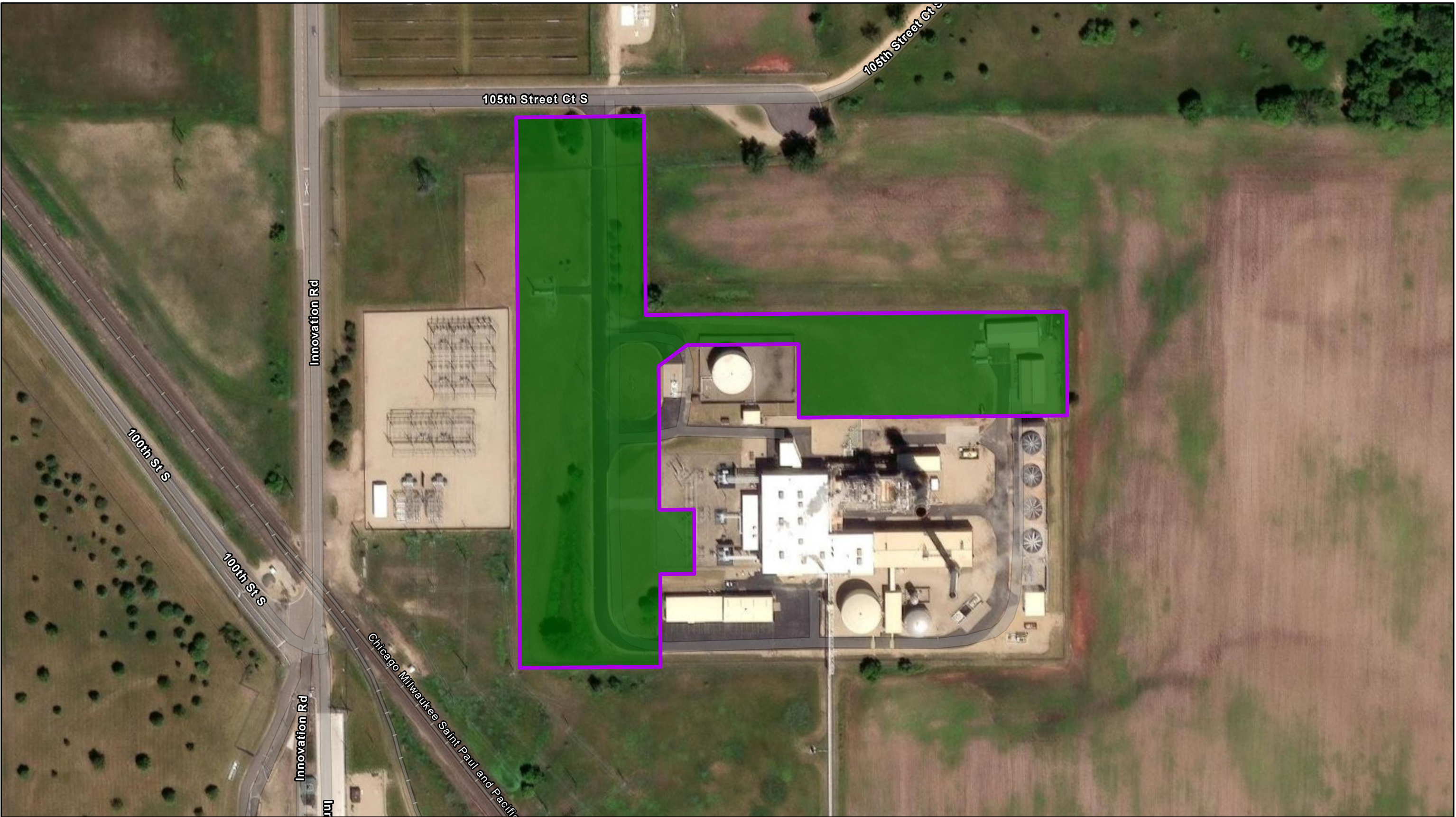
Washington County, Minnesota



0 500 Feet

Exhibit 2: Base Hydrologic Map

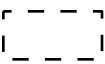
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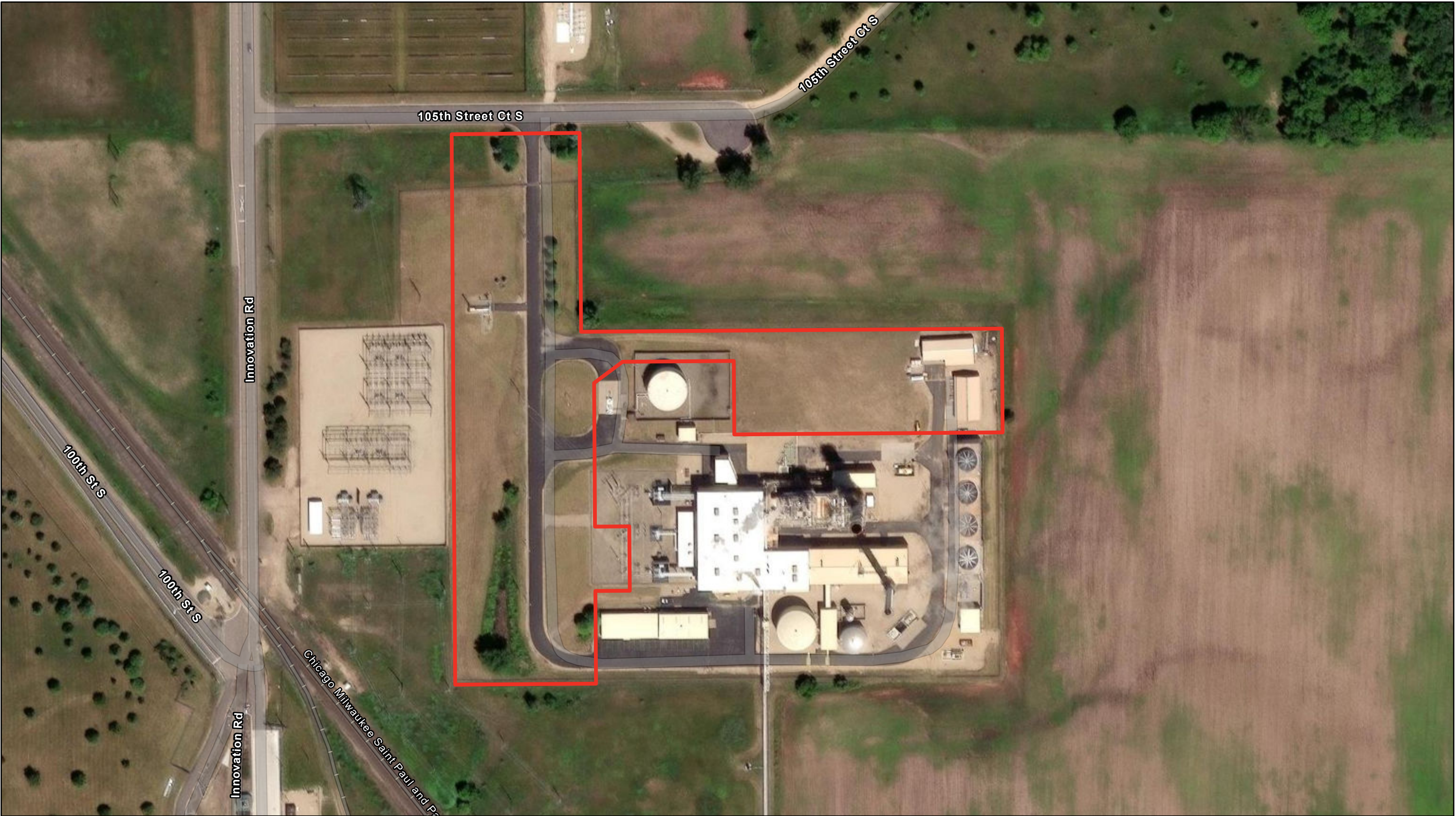
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|  Project Area | Hydrologic Soil Group |
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Cottage Grove BESS Project
Washington County, Minnesota

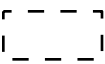
Exhibit 3: Soils Map
March 13, 2026



Data Source(s): Westwood (2026); Esri WMS Basemap Imagery (Accessed 2026); USGS (2026); FEMA (2026); USDA (2026)

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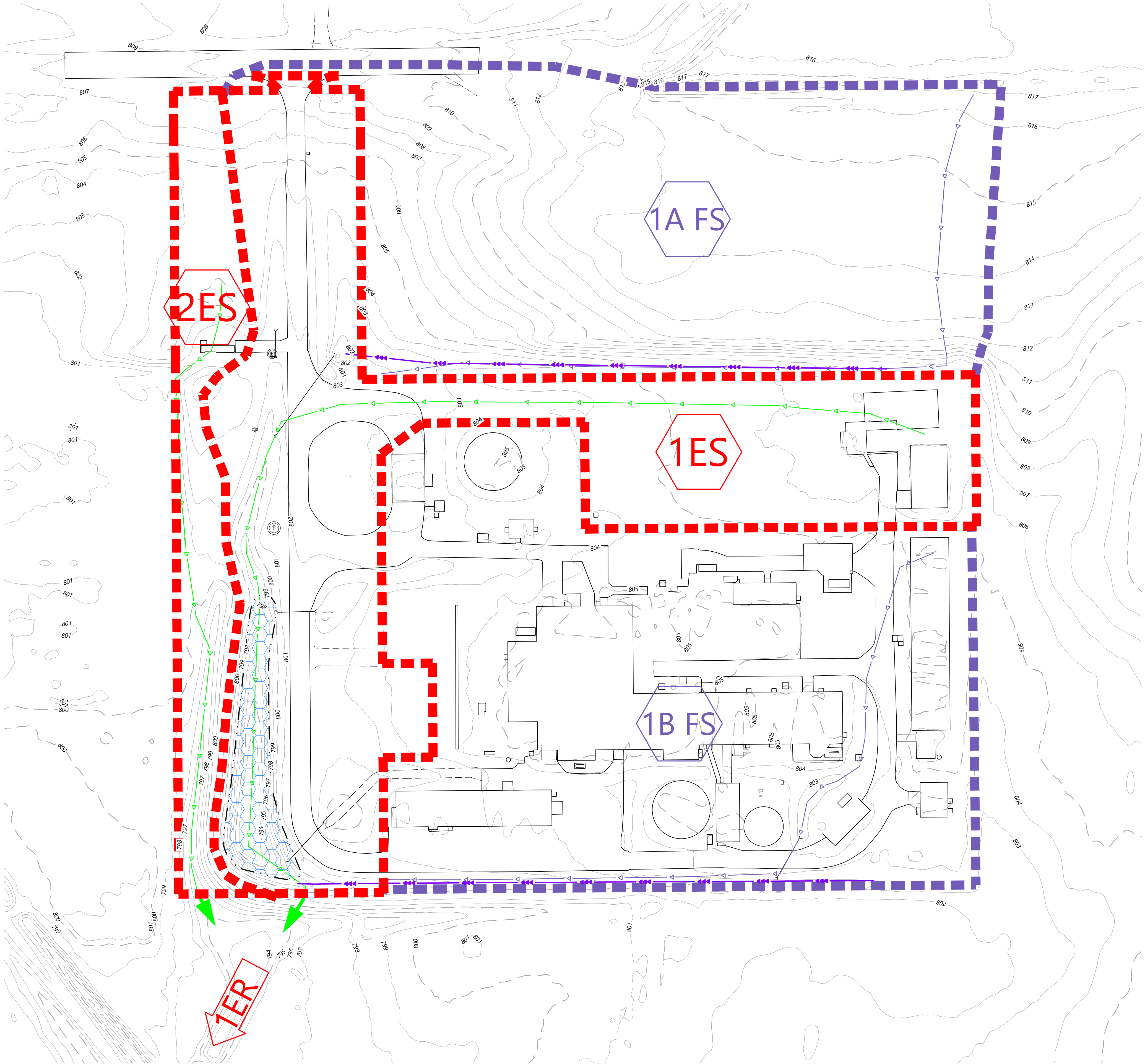
-  Project Area
-  County Boundary

Cottage Grove BESS Project
Washington County, Minnesota



Exhibit 4: Landcover Map
March 13, 2026

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- LEGEND:
- PROJECT BOUNDARY
 - EX. INDEX CONTOUR
 - EX. INTERVAL CONTOUR
 - EX. TREE LINE
 - EX. PAVED ROAD
 - EX. GRAVEL ROAD
 - EX. BUILDING
 - EX. CULVERT
 - EX. STREAM CHANNEL
 - EX. SWALE
 - EX. WETLAND
 - FEMA FLOOD ZONE
 - EX. ONSITE DRAINAGE AREA BOUNDARY
 - EX. OFFSITE DRAINAGE AREA BOUNDARY
 - EX. TIME OF CONCENTRATION LINE
 - EX. OFFSITE TIME OF CONCENTRATION LINE
 - EX. DISCHARGE LOCATION
 - EX. OFFSITE DRAINAGE AREA LABEL
 - EX. DRAINAGE AREA LABEL
 - EX. DISCHARGE AREA LABEL

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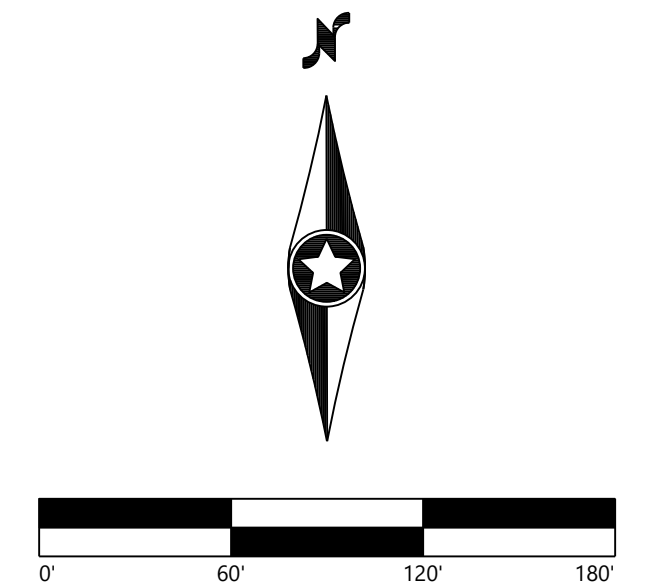
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Incline Village, NV 89451

REVISIONS:

#	DATE	COMMENT	BY	CHK	APR



**Cottage Grove
BESS**

Washington County, Minnesota

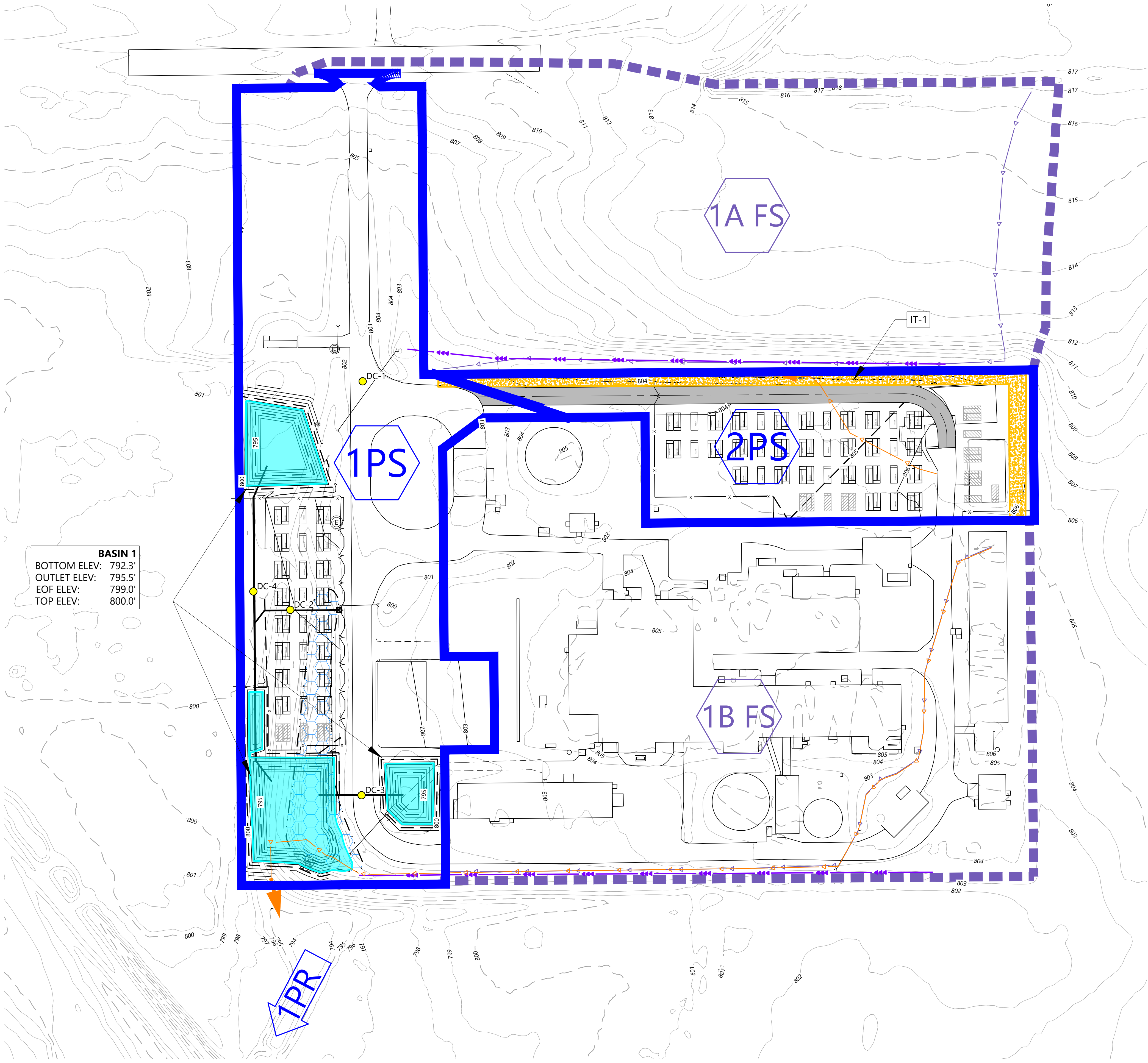
**Overall Existing
Drainage Map**

DATE: 3/13/2026

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SHEET: 5

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BASIN 1
BOTTOM ELEV: 792.3'
OUTLET ELEV: 795.5'
EOF ELEV: 799.0'
TOP ELEV: 800.0'

- LEGEND:**
- PROJECT BOUNDARY
 - EX. INDEX CONTOUR
 - EX. INTERVAL CONTOUR
 - EX. TREELINE
 - EX. PAVED ROAD
 - EX. GRAVEL ROAD
 - EX. BUILDING
 - EX. CULVERT
 - EX. STREAM CHANNEL
 - EX. SWALE
 - EX. WETLAND
 - FEMA FLOOD ZONE
 - PROPOSED ACCESS ROAD
 - PROPOSED SECURITY FENCE
 - PROPOSED ELECTRICAL EQUIPMENT
 - PROPOSED INFILTRATION TRENCH
 - PROPOSED INDEX CONTOUR
 - PROPOSED INTERVAL CONTOUR
 - PROPOSED INFILTRATION BASIN
 - PROPOSED EMERGENCY OVERFLOW OUTLET
 - PROPOSED CULVERT
 - PROPOSED ONSITE DRAINAGE AREA BOUNDARY
 - PROPOSED OFFSITE DRAINAGE AREA BOUNDARY
 - PROPOSED TIME OF CONCENTRATION LINE
 - EX. OFFSITE TIME OF CONCENTRATION LINE
 - PROPOSED DISCHARGE LOCATION
 - PROPOSED OFFSITE DRAINAGE AREA LABEL
 - PROPOSED DRAINAGE AREA LABEL
 - PROPOSED DISCHARGE AREA LABEL
 - PROPOSED CROSSING LOCATIONS

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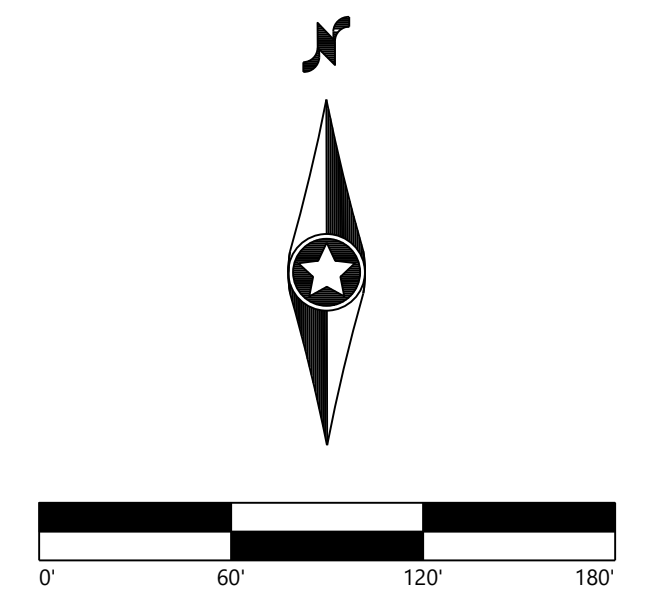
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**Cottage Grove
BESS**

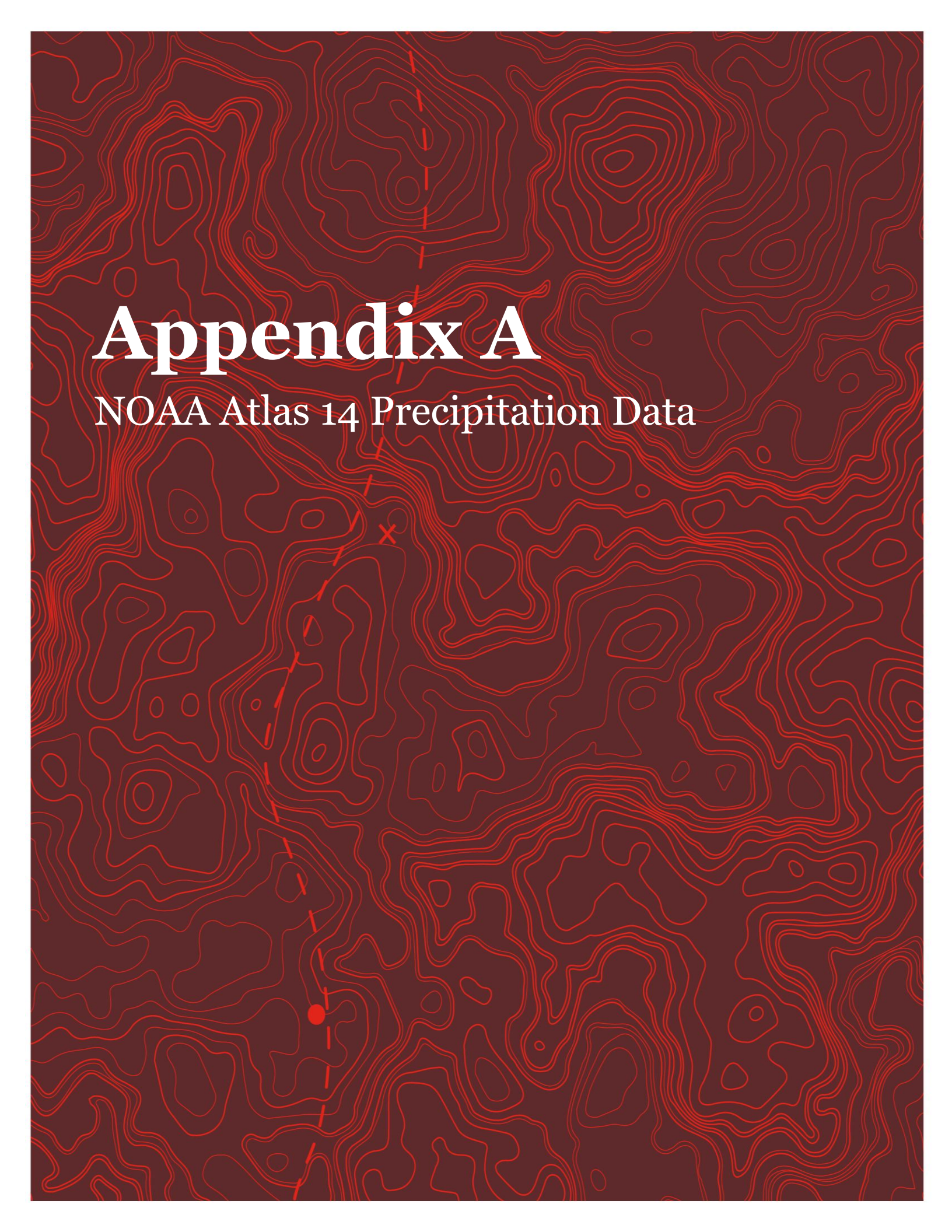
Washington County, Minnesota

**Overall Proposed
Drainage Map**

DATE: 3/13/2026

REV:

SHEET: 6



Appendix A

NOAA Atlas 14 Precipitation Data



NOAA Atlas 14, Volume 8, Version 2
Location name: Cottage Grove, Minnesota, USA*
Latitude: 44.7958°, Longitude: -92.9121°
Elevation: 802 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, Geoffrey Bonnin

NOAA, National Weather Service, Silver Spring, Maryland

[PF tabular](#) | [PF graphical](#) | [Maps & aerals](#)

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	0.357 (0.277-0.464)	0.423 (0.328-0.550)	0.536 (0.414-0.699)	0.635 (0.488-0.831)	0.778 (0.581-1.05)	0.894 (0.652-1.21)	1.02 (0.715-1.40)	1.14 (0.773-1.60)	1.32 (0.859-1.89)	1.46 (0.923-2.10)
10-min	0.522 (0.405-0.679)	0.619 (0.480-0.806)	0.786 (0.607-1.02)	0.930 (0.715-1.22)	1.14 (0.851-1.54)	1.31 (0.954-1.78)	1.49 (1.05-2.05)	1.67 (1.13-2.35)	1.93 (1.26-2.76)	2.13 (1.35-3.08)
15-min	0.637 (0.494-0.828)	0.755 (0.585-0.983)	0.958 (0.740-1.25)	1.14 (0.872-1.48)	1.39 (1.04-1.87)	1.60 (1.16-2.17)	1.81 (1.28-2.50)	2.04 (1.38-2.87)	2.35 (1.53-3.37)	2.60 (1.65-3.75)
30-min	0.891 (0.692-1.16)	1.06 (0.824-1.38)	1.36 (1.05-1.77)	1.61 (1.24-2.11)	1.98 (1.48-2.67)	2.28 (1.66-3.10)	2.59 (1.83-3.58)	2.92 (1.98-4.10)	3.37 (2.20-4.83)	3.73 (2.36-5.38)
60-min	1.16 (0.904-1.51)	1.38 (1.07-1.79)	1.76 (1.36-2.30)	2.12 (1.63-2.78)	2.67 (2.01-3.64)	3.14 (2.30-4.29)	3.64 (2.58-5.06)	4.19 (2.85-5.93)	4.98 (3.25-7.17)	5.62 (3.56-8.10)
2-hr	1.44 (1.13-1.85)	1.69 (1.33-2.17)	2.17 (1.70-2.80)	2.63 (2.05-3.40)	3.36 (2.57-4.56)	3.99 (2.97-5.43)	4.69 (3.36-6.48)	5.46 (3.76-7.68)	6.58 (4.35-9.41)	7.50 (4.80-10.7)
3-hr	1.61 (1.27-2.05)	1.88 (1.48-2.40)	2.41 (1.90-3.08)	2.94 (2.30-3.78)	3.81 (2.95-5.17)	4.58 (3.44-6.22)	5.45 (3.94-7.51)	6.42 (4.46-9.00)	7.85 (5.23-11.2)	9.04 (5.82-12.8)
6-hr	1.89 (1.51-2.38)	2.19 (1.75-2.75)	2.80 (2.23-3.53)	3.43 (2.72-4.34)	4.47 (3.52-6.02)	5.42 (4.12-7.30)	6.50 (4.76-8.89)	7.71 (5.42-10.7)	9.52 (6.42-13.5)	11.0 (7.18-15.5)
12-hr	2.12 (1.72-2.64)	2.48 (2.01-3.08)	3.18 (2.56-3.96)	3.86 (3.10-4.83)	4.96 (3.93-6.56)	5.94 (4.56-7.86)	7.02 (5.20-9.46)	8.24 (5.84-11.3)	10.0 (6.81-14.0)	11.5 (7.55-16.0)
24-hr	2.46 (2.02-3.01)	2.79 (2.29-3.42)	3.47 (2.83-4.26)	4.15 (3.37-5.12)	5.27 (4.23-6.88)	6.27 (4.87-8.21)	7.39 (5.54-9.86)	8.66 (6.21-11.8)	10.5 (7.25-14.6)	12.1 (8.03-16.7)
2-day	2.85 (2.37-3.45)	3.16 (2.63-3.83)	3.81 (3.16-4.63)	4.48 (3.69-5.46)	5.60 (4.56-7.23)	6.62 (5.21-8.57)	7.77 (5.89-10.2)	9.07 (6.59-12.2)	11.0 (7.66-15.1)	12.6 (8.48-17.3)
3-day	3.13 (2.62-3.76)	3.43 (2.87-4.13)	4.07 (3.40-4.90)	4.74 (3.93-5.72)	5.86 (4.80-7.50)	6.88 (5.46-8.85)	8.04 (6.15-10.5)	9.36 (6.85-12.5)	11.3 (7.95-15.5)	13.0 (8.78-17.7)
4-day	3.36 (2.83-4.01)	3.67 (3.09-4.38)	4.32 (3.62-5.17)	4.99 (4.16-6.00)	6.12 (5.03-7.78)	7.14 (5.69-9.12)	8.30 (6.37-10.8)	9.62 (7.07-12.8)	11.6 (8.16-15.7)	13.2 (8.98-17.9)
7-day	3.90 (3.32-4.61)	4.29 (3.65-5.07)	5.04 (4.28-5.98)	5.78 (4.86-6.87)	6.94 (5.73-8.65)	7.96 (6.38-10.0)	9.09 (7.02-11.7)	10.3 (7.65-13.6)	12.2 (8.63-16.3)	13.7 (9.38-18.4)
10-day	4.40 (3.77-5.16)	4.88 (4.17-5.72)	5.74 (4.89-6.75)	6.53 (5.54-7.71)	7.73 (6.39-9.51)	8.76 (7.04-10.9)	9.86 (7.64-12.5)	11.1 (8.20-14.4)	12.8 (9.09-17.0)	14.2 (9.76-19.0)
20-day	5.96 (5.18-6.90)	6.65 (5.77-7.69)	7.78 (6.73-9.03)	8.75 (7.52-10.2)	10.1 (8.39-12.1)	11.2 (9.04-13.6)	12.3 (9.56-15.2)	13.4 (9.98-17.0)	14.9 (10.7-19.5)	16.0 (11.2-21.3)
30-day	7.36 (6.45-8.45)	8.22 (7.19-9.43)	9.59 (8.35-11.0)	10.7 (9.27-12.4)	12.2 (10.2-14.4)	13.3 (10.8-16.0)	14.4 (11.3-17.7)	15.5 (11.6-19.6)	16.9 (12.2-21.9)	18.0 (12.6-23.7)
45-day	9.22 (8.14-10.5)	10.3 (9.07-11.7)	12.0 (10.5-13.7)	13.3 (11.6-15.2)	15.0 (12.5-17.5)	16.2 (13.3-19.2)	17.4 (13.7-21.1)	18.4 (13.9-23.0)	19.8 (14.3-25.3)	20.7 (14.6-27.1)
60-day	10.9 (9.63-12.3)	12.1 (10.7-13.7)	14.1 (12.4-16.0)	15.6 (13.7-17.7)	17.5 (14.7-20.2)	18.8 (15.4-22.1)	20.0 (15.8-24.1)	21.1 (15.9-26.1)	22.3 (16.2-28.5)	23.1 (16.4-30.2)

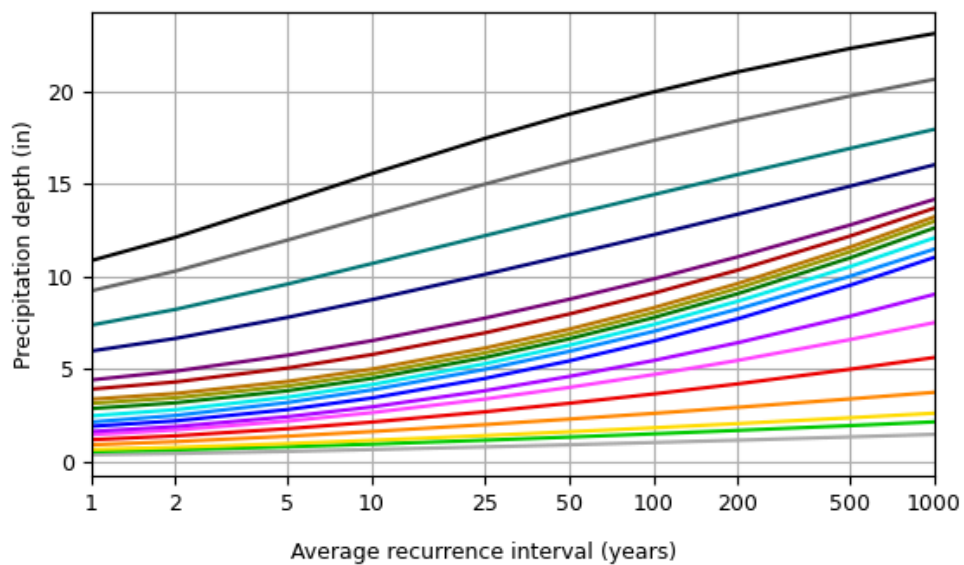
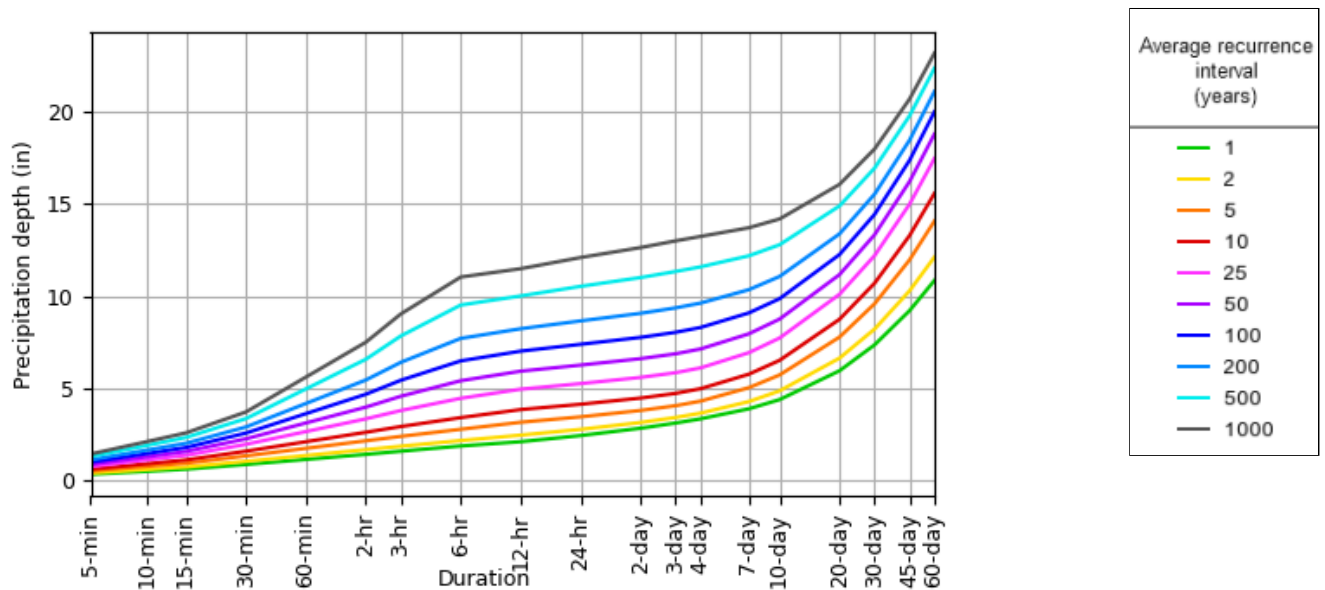
¹ Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS). Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average 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

PDS-based depth-duration-frequency (DDF) curves

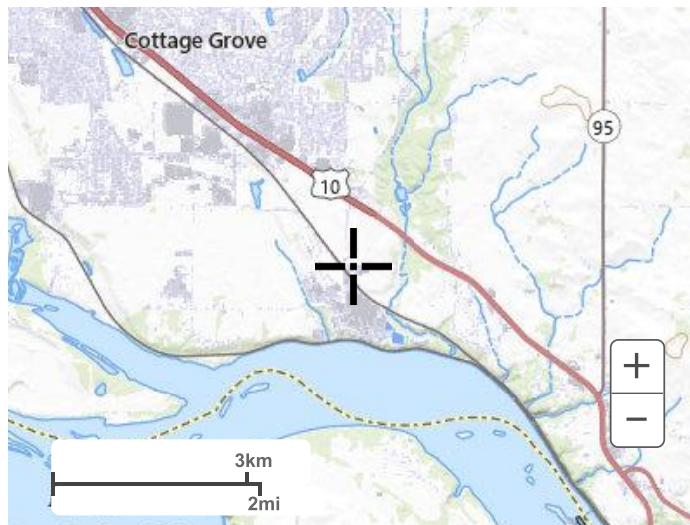
Latitude: 44.7958°, Longitude: -92.9121°



NOAA Atlas 14, Volume 8, Version 2

Created (GMT): Fri Oct 10 15:50:12 2025

[Back to Top](#)**Maps & aerials****Small scale terrain**



Large scale terrain



Large scale map



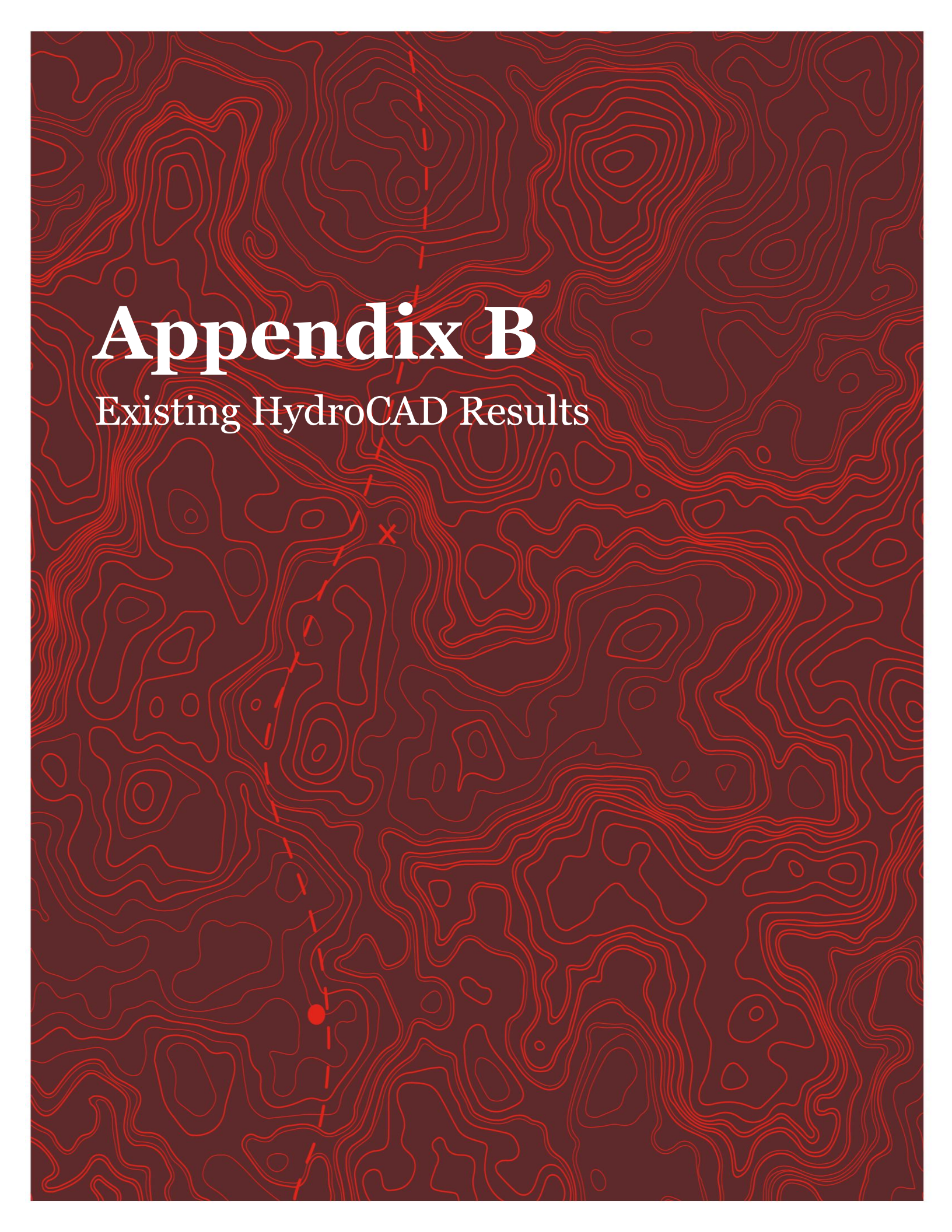
Large scale aerial



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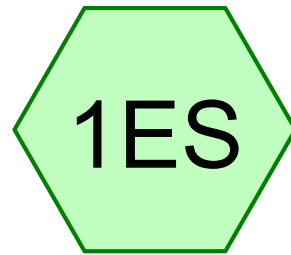
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Questions?: HDSC.Questions@noaa.gov

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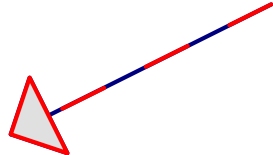
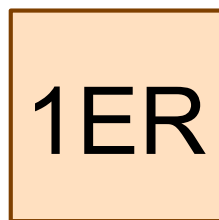
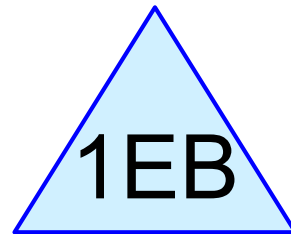
Appendix B

Existing HydroCAD Results



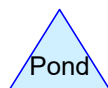
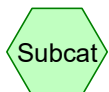
2ES

1ES



1EB

1ER



2026-03-11 Cottage Grove Pre-Post

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Page 2

Rainfall Events Listing (selected events)

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	2-yr	MSE 24-hr	3	Default	24.00	1	2.79	2
2	10-yr	MSE 24-hr	3	Default	24.00	1	4.15	2
3	100-yr	MSE 24-hr	3	Default	24.00	1	7.39	2

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Area Listing (selected nodes)

Area (acres)	CN	Description (subcatchment-numbers)
4.700	30	Meadow, non-grazed, HSG A (1ES, 2ES)
5.500	30	Offsite Meadow, non-grazed, HSG A (1ES)
6.800	98	Offsite Unconnected pavement, HSG A (1ES)
1.700	98	Unconnected pavement, HSG A (1ES)
0.400	98	Water Surface, HSG A (1ES)
19.100	62	TOTAL AREA

2026-03-11 Cottage Grove Pre-Post*MSE 24-hr 3 2-yr Rainfall=2.79"*

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Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN

Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1ES: 1ESRunoff Area=17.900 ac 49.72% Impervious Runoff Depth=0.38"
Flow Length=1,613' Tc=45.3 min CN=64 Runoff=3.38 cfs 0.567 af**Subcatchment2ES: 2ES**Runoff Area=1.200 ac 0.00% Impervious Runoff Depth=0.00"
Flow Length=718' Tc=27.0 min CN=30 Runoff=0.00 cfs 0.000 af**Reach 1ER: 1ER**Inflow=0.36 cfs 0.148 af
Outflow=0.36 cfs 0.148 af**Pond 1EB: 1EB**Peak Elev=796.84' Storage=0.329 af Inflow=3.38 cfs 0.567 af
Discarded=0.15 cfs 0.340 af Primary=0.36 cfs 0.148 af Secondary=0.00 cfs 0.000 af Outflow=0.51 cfs 0.488 af**Total Runoff Area = 19.100 ac Runoff Volume = 0.567 af Average Runoff Depth = 0.36"**
53.40% Pervious = 10.200 ac 46.60% Impervious = 8.900 ac

Summary for Subcatchment 1ES: 1ES

Runoff = 3.38 cfs @ 12.78 hrs, Volume= 0.567 af, Depth= 0.38"
 Routed to Pond 1EB : 1EB

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
 MSE 24-hr 3 2-yr Rainfall=2.79"

Area (ac)	CN	Description
* 1.700	98	Unconnected pavement, HSG A
0.400	98	Water Surface, HSG A
3.500	30	Meadow, non-grazed, HSG A
* 5.500	30	Offsite Meadow, non-grazed, HSG A
* 6.800	98	Offsite Unconnected pavement, HSG A
17.900	64	Weighted Average
9.000		50.28% Pervious Area
8.900		49.72% Impervious Area
8.500		95.51% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.9	100	0.0180	0.10		Sheet Flow, Grass: Dense n= 0.240 P2= 2.79"
29.4	1,513	0.0150	0.86		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
45.3	1,613	Total			

Summary for Subcatchment 2ES: 2ES

[45] Hint: Runoff=Zero

Runoff = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Depth= 0.00"
 Routed to Reach 1ER : 1ER

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
 MSE 24-hr 3 2-yr Rainfall=2.79"

Area (ac)	CN	Description
1.200	30	Meadow, non-grazed, HSG A
1.200		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.0	100	0.0300	0.13		Sheet Flow, Grass: Dense n= 0.240 P2= 2.79"
14.0	618	0.0110	0.73		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
27.0	718	Total			

Summary for Reach 1ER: 1ER

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 19.100 ac, 46.60% Impervious, Inflow Depth = 0.09" for 2-yr event
 Inflow = 0.36 cfs @ 15.54 hrs, Volume= 0.148 af
 Outflow = 0.36 cfs @ 15.54 hrs, Volume= 0.148 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Summary for Pond 1EB: 1EB

Inflow Area = 17.900 ac, 49.72% Impervious, Inflow Depth = 0.38" for 2-yr event
 Inflow = 3.38 cfs @ 12.78 hrs, Volume= 0.567 af
 Outflow = 0.51 cfs @ 15.54 hrs, Volume= 0.488 af, Atten= 85%, Lag= 165.2 min
 Discarded = 0.15 cfs @ 15.54 hrs, Volume= 0.340 af
 Primary = 0.36 cfs @ 15.54 hrs, Volume= 0.148 af
 Routed to Reach 1ER : 1ER
 Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
 Routed to Reach 1ER : 1ER

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
 Peak Elev= 796.84' @ 15.54 hrs Surf.Area= 0.184 ac Storage= 0.329 af

Plug-Flow detention time= 659.6 min calculated for 0.488 af (86% of inflow)
 Center-of-Mass det. time= 600.7 min (1,506.8 - 906.1)

Volume	Invert	Avail.Storage	Storage Description
#1	793.50'	1.917 af	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
793.50	0.001	0.000	0.000
794.00	0.046	0.012	0.012
795.00	0.090	0.068	0.080
796.00	0.139	0.114	0.194
797.00	0.193	0.166	0.360
798.00	0.256	0.225	0.585
799.00	0.339	0.297	0.882
800.00	0.477	0.408	1.290
801.00	0.777	0.627	1.917

Device	Routing	Invert	Outlet Devices
#1	Secondary	800.50'	10.0' long + 3.0 ' SideZ x 10.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64
#2	Discarded	793.50'	0.800 in/hr Exfiltration over Surface area
#3	Primary	796.50'	12.0" Round Culvert L= 50.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 796.50' / 794.00' S= 0.0500 ' S= 0.0500 ' Cc= 0.900 n= 0.025 Corrugated metal, Flow Area= 0.79 sf

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MSE 24-hr 3 2-yr Rainfall=2.79"

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Discarded OutFlow Max=0.15 cfs @ 15.54 hrs HW=796.84' (Free Discharge)

↑**2=Exfiltration** (Exfiltration Controls 0.15 cfs)

Primary OutFlow Max=0.36 cfs @ 15.54 hrs HW=796.84' (Free Discharge)

↑**3=Culvert** (Inlet Controls 0.36 cfs @ 1.56 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=793.50' (Free Discharge)

↑**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

2026-03-11 Cottage Grove Pre-Post*MSE 24-hr 3 10-yr Rainfall=4.15"*

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Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN

Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1ES: 1ESRunoff Area=17.900 ac 49.72% Impervious Runoff Depth=1.06"
Flow Length=1,613' Tc=45.3 min CN=64 Runoff=11.74 cfs 1.578 af**Subcatchment2ES: 2ES**Runoff Area=1.200 ac 0.00% Impervious Runoff Depth=0.00"
Flow Length=718' Tc=27.0 min CN=30 Runoff=0.00 cfs 0.000 af**Reach 1ER: 1ER**Inflow=3.41 cfs 1.117 af
Outflow=3.41 cfs 1.117 af**Pond 1EB: 1EB**Peak Elev=798.31' Storage=0.668 af Inflow=11.74 cfs 1.578 af
Discarded=0.23 cfs 0.374 af Primary=3.41 cfs 1.117 af Secondary=0.00 cfs 0.000 af Outflow=3.64 cfs 1.491 af**Total Runoff Area = 19.100 ac Runoff Volume = 1.578 af Average Runoff Depth = 0.99"**
53.40% Pervious = 10.200 ac 46.60% Impervious = 8.900 ac

Summary for Subcatchment 1ES: 1ES

Runoff = 11.74 cfs @ 12.69 hrs, Volume= 1.578 af, Depth= 1.06"
 Routed to Pond 1EB : 1EB

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
 MSE 24-hr 3 10-yr Rainfall=4.15"

Area (ac)	CN	Description
* 1.700	98	Unconnected pavement, HSG A
0.400	98	Water Surface, HSG A
3.500	30	Meadow, non-grazed, HSG A
* 5.500	30	Offsite Meadow, non-grazed, HSG A
* 6.800	98	Offsite Unconnected pavement, HSG A
17.900	64	Weighted Average
9.000		50.28% Pervious Area
8.900		49.72% Impervious Area
8.500		95.51% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.9	100	0.0180	0.10		Sheet Flow, Grass: Dense n= 0.240 P2= 2.79"
29.4	1,513	0.0150	0.86		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
45.3	1,613	Total			

Summary for Subcatchment 2ES: 2ES

[45] Hint: Runoff=Zero

Runoff = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Depth= 0.00"
 Routed to Reach 1ER : 1ER

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
 MSE 24-hr 3 10-yr Rainfall=4.15"

Area (ac)	CN	Description
1.200	30	Meadow, non-grazed, HSG A
1.200		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.0	100	0.0300	0.13		Sheet Flow, Grass: Dense n= 0.240 P2= 2.79"
14.0	618	0.0110	0.73		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
27.0	718	Total			

Summary for Reach 1ER: 1ER

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 19.100 ac, 46.60% Impervious, Inflow Depth = 0.70" for 10-yr event
 Inflow = 3.41 cfs @ 13.72 hrs, Volume= 1.117 af
 Outflow = 3.41 cfs @ 13.72 hrs, Volume= 1.117 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Summary for Pond 1EB: 1EB

Inflow Area = 17.900 ac, 49.72% Impervious, Inflow Depth = 1.06" for 10-yr event
 Inflow = 11.74 cfs @ 12.69 hrs, Volume= 1.578 af
 Outflow = 3.64 cfs @ 13.72 hrs, Volume= 1.491 af, Atten= 69%, Lag= 61.7 min
 Discarded = 0.23 cfs @ 13.72 hrs, Volume= 0.374 af
 Primary = 3.41 cfs @ 13.72 hrs, Volume= 1.117 af
 Routed to Reach 1ER : 1ER
 Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
 Routed to Reach 1ER : 1ER

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
 Peak Elev= 798.31' @ 13.72 hrs Surf.Area= 0.282 ac Storage= 0.668 af

Plug-Flow detention time= 274.6 min calculated for 1.490 af (94% of inflow)
 Center-of-Mass det. time= 247.4 min (1,123.2 - 875.8)

Volume	Invert	Avail.Storage	Storage Description
#1	793.50'	1.917 af	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
793.50	0.001	0.000	0.000
794.00	0.046	0.012	0.012
795.00	0.090	0.068	0.080
796.00	0.139	0.114	0.194
797.00	0.193	0.166	0.360
798.00	0.256	0.225	0.585
799.00	0.339	0.297	0.882
800.00	0.477	0.408	1.290
801.00	0.777	0.627	1.917

Device	Routing	Invert	Outlet Devices
#1	Secondary	800.50'	10.0' long + 3.0 ' SideZ x 10.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64
#2	Discarded	793.50'	0.800 in/hr Exfiltration over Surface area
#3	Primary	796.50'	12.0" Round Culvert L= 50.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 796.50' / 794.00' S= 0.0500 ' S= 0.0500 ' Cc= 0.900 n= 0.025 Corrugated metal, Flow Area= 0.79 sf

2026-03-11 Cottage Grove Pre-Post

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MSE 24-hr 3 10-yr Rainfall=4.15"

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Discarded OutFlow Max=0.23 cfs @ 13.72 hrs HW=798.31' (Free Discharge)

↑**2=Exfiltration** (Exfiltration Controls 0.23 cfs)

Primary OutFlow Max=3.41 cfs @ 13.72 hrs HW=798.31' (Free Discharge)

↑**3=Culvert** (Inlet Controls 3.41 cfs @ 4.35 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=793.50' (Free Discharge)

↑**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

2026-03-11 Cottage Grove Pre-Post*MSE 24-hr 3 100-yr Rainfall=7.39"*

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Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN

Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1ES: 1ESRunoff Area=17.900 ac 49.72% Impervious Runoff Depth=3.30"
Flow Length=1,613' Tc=45.3 min CN=64 Runoff=40.76 cfs 4.924 af**Subcatchment2ES: 2ES**Runoff Area=1.200 ac 0.00% Impervious Runoff Depth=0.28"
Flow Length=718' Tc=27.0 min CN=30 Runoff=0.09 cfs 0.028 af**Reach 1ER: 1ER**Inflow=33.04 cfs 4.335 af
Outflow=33.04 cfs 4.335 af**Pond 1EB: 1EB**Peak Elev=801.39' Storage=1.917 af Inflow=40.76 cfs 4.924 af
Discarded=0.63 cfs 0.523 af Primary=5.74 cfs 3.263 af Secondary=27.22 cfs 1.044 af Outflow=33.58 cfs 4.830 af**Total Runoff Area = 19.100 ac Runoff Volume = 4.953 af Average Runoff Depth = 3.11"**
53.40% Pervious = 10.200 ac 46.60% Impervious = 8.900 ac

Summary for Subcatchment 1ES: 1ES

Runoff = 40.76 cfs @ 12.64 hrs, Volume= 4.924 af, Depth= 3.30"
 Routed to Pond 1EB : 1EB

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
 MSE 24-hr 3 100-yr Rainfall=7.39"

Area (ac)	CN	Description
* 1.700	98	Unconnected pavement, HSG A
0.400	98	Water Surface, HSG A
3.500	30	Meadow, non-grazed, HSG A
* 5.500	30	Offsite Meadow, non-grazed, HSG A
* 6.800	98	Offsite Unconnected pavement, HSG A
17.900	64	Weighted Average
9.000		50.28% Pervious Area
8.900		49.72% Impervious Area
8.500		95.51% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.9	100	0.0180	0.10		Sheet Flow, Grass: Dense n= 0.240 P2= 2.79"
29.4	1,513	0.0150	0.86		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
45.3	1,613	Total			

Summary for Subcatchment 2ES: 2ES

Runoff = 0.09 cfs @ 12.81 hrs, Volume= 0.028 af, Depth= 0.28"
 Routed to Reach 1ER : 1ER

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
 MSE 24-hr 3 100-yr Rainfall=7.39"

Area (ac)	CN	Description
1.200	30	Meadow, non-grazed, HSG A
1.200		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.0	100	0.0300	0.13		Sheet Flow, Grass: Dense n= 0.240 P2= 2.79"
14.0	618	0.0110	0.73		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
27.0	718	Total			

Summary for Reach 1ER: 1ER

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 19.100 ac, 46.60% Impervious, Inflow Depth = 2.72" for 100-yr event
 Inflow = 33.04 cfs @ 12.99 hrs, Volume= 4.335 af
 Outflow = 33.04 cfs @ 12.99 hrs, Volume= 4.335 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Summary for Pond 1EB: 1EB

[93] Warning: Storage range exceeded by 0.39'

[85] Warning: Oscillations may require smaller dt or Finer Routing (severity=13)

Inflow Area = 17.900 ac, 49.72% Impervious, Inflow Depth = 3.30" for 100-yr event
 Inflow = 40.76 cfs @ 12.64 hrs, Volume= 4.924 af
 Outflow = 33.58 cfs @ 12.99 hrs, Volume= 4.830 af, Atten= 18%, Lag= 21.2 min
 Discarded = 0.63 cfs @ 12.98 hrs, Volume= 0.523 af
 Primary = 5.74 cfs @ 12.99 hrs, Volume= 3.263 af
 Routed to Reach 1ER : 1ER
 Secondary = 27.22 cfs @ 12.99 hrs, Volume= 1.044 af
 Routed to Reach 1ER : 1ER

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
 Peak Elev= 801.39' @ 12.99 hrs Surf.Area= 0.777 ac Storage= 1.917 af

Plug-Flow detention time= 162.1 min calculated for 4.829 af (98% of inflow)
 Center-of-Mass det. time= 151.6 min (1,001.4 - 849.8)

Volume	Invert	Avail.Storage	Storage Description
#1	793.50'	1.917 af	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
793.50	0.001	0.000	0.000
794.00	0.046	0.012	0.012
795.00	0.090	0.068	0.080
796.00	0.139	0.114	0.194
797.00	0.193	0.166	0.360
798.00	0.256	0.225	0.585
799.00	0.339	0.297	0.882
800.00	0.477	0.408	1.290
801.00	0.777	0.627	1.917

Device	Routing	Invert	Outlet Devices
#1	Secondary	800.50'	10.0' long + 3.0 ' SideZ x 10.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64
#2	Discarded	793.50'	0.800 in/hr Exfiltration over Surface area
#3	Primary	796.50'	12.0" Round Culvert

2026-03-11 Cottage Grove Pre-Post

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MSE 24-hr 3 100-yr Rainfall=7.39"

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L= 50.0' CMP, projecting, no headwall, Ke= 0.900
Inlet / Outlet Invert= 796.50' / 794.00' S= 0.0500 '/' Cc= 0.900
n= 0.025 Corrugated metal, Flow Area= 0.79 sf

Discarded OutFlow Max=0.63 cfs @ 12.98 hrs HW=801.12' (Free Discharge)

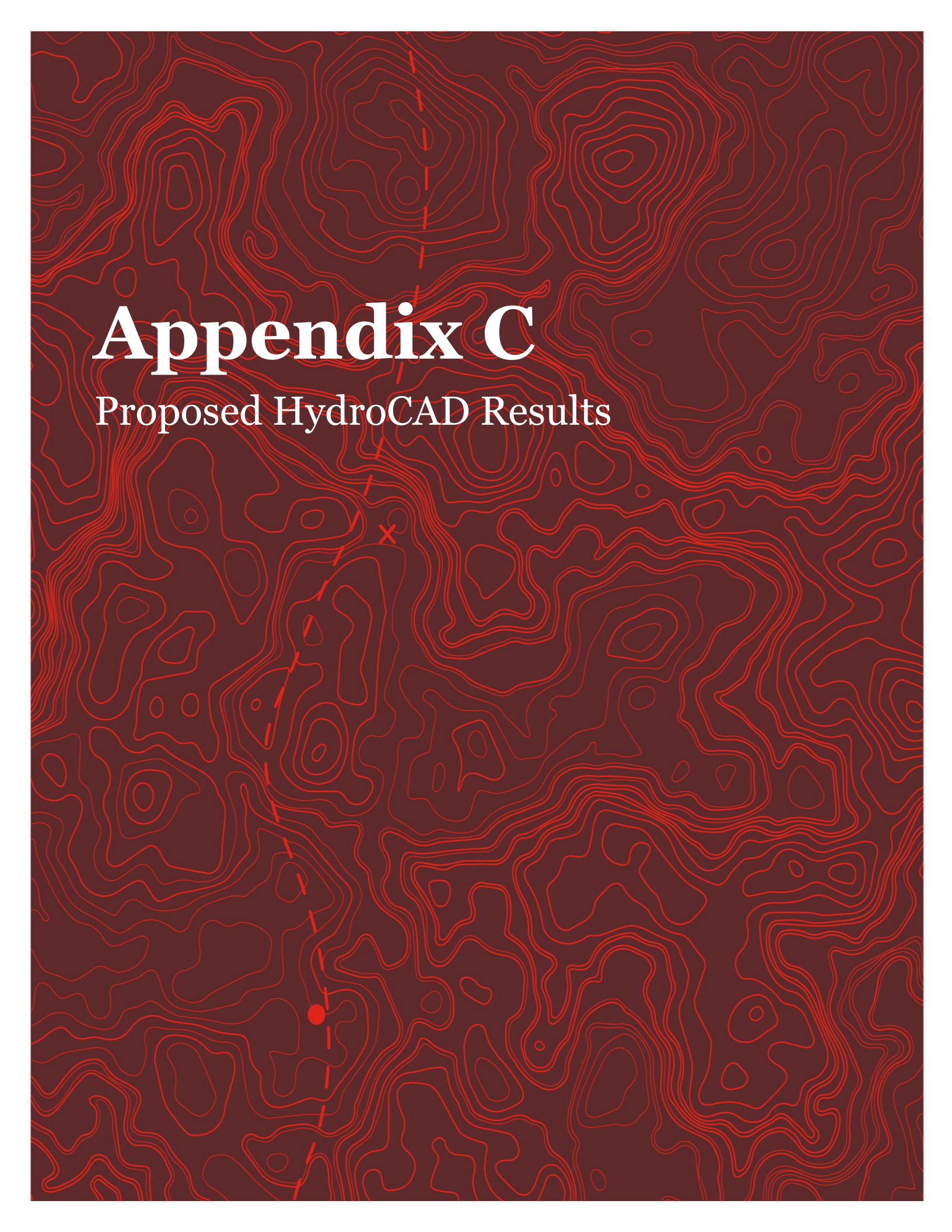
↑**2=Exfiltration** (Exfiltration Controls 0.63 cfs)

Primary OutFlow Max=5.74 cfs @ 12.99 hrs HW=801.39' (Free Discharge)

↑**3=Culvert** (Barrel Controls 5.74 cfs @ 7.31 fps)

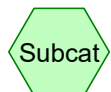
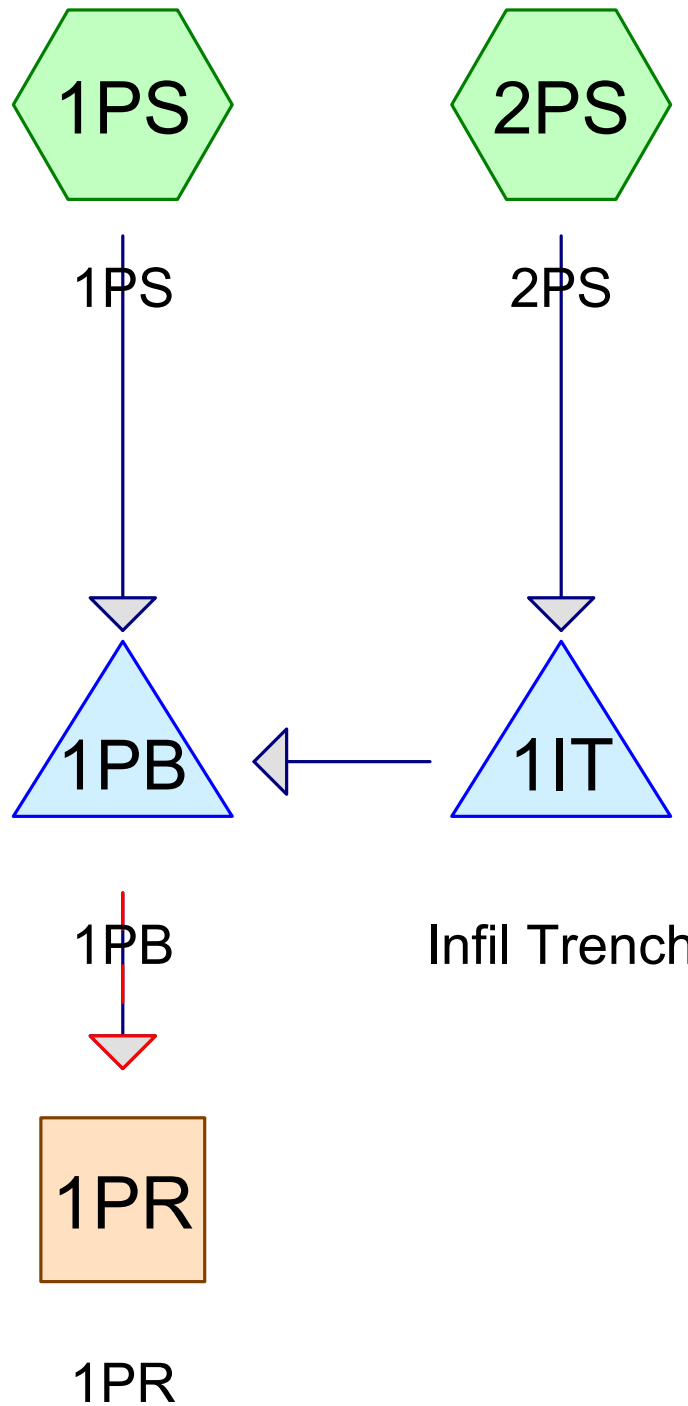
Secondary OutFlow Max=26.95 cfs @ 12.99 hrs HW=801.38' (Free Discharge)

↑**1=Broad-Crested Rectangular Weir**(Weir Controls 26.95 cfs @ 2.42 fps)



Appendix C

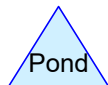
Proposed HydroCAD Results



Subcat



Reach



Pond



Link

Routing Diagram for 2026-03-11 Cottage Grove Pre-Post
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Rainfall Events Listing (selected events)

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	2-yr	MSE 24-hr	3	Default	24.00	1	2.79	2
2	10-yr	MSE 24-hr	3	Default	24.00	1	4.15	2
3	100-yr	MSE 24-hr	3	Default	24.00	1	7.39	2

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Area Listing (selected nodes)

Area (acres)	CN	Description (subcatchment-numbers)
3.400	30	Meadow, non-grazed, HSG A (1PS, 2PS)
5.500	30	Offsite Meadow, non-grazed, HSG A (1PS)
6.800	98	Offsite Unconnected pavement, HSG A (1PS)
0.700	98	Pond, HSG A (1PS)
2.700	98	Unconnected pavement, HSG A (1PS, 2PS)
19.100	66	TOTAL AREA

2026-03-11 Cottage Grove Pre-Post*MSE 24-hr 3 2-yr Rainfall=2.79"*

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Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN

Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1PS: 1PSRunoff Area=17.200 ac 52.91% Impervious Runoff Depth=0.45"
Flow Length=1,150' Tc=10.7 min CN=66 Runoff=9.08 cfs 0.642 af**Subcatchment2PS: 2PS**Runoff Area=1.900 ac 57.89% Impervious Runoff Depth=0.56"
Tc=8.0 min CN=69 Runoff=1.59 cfs 0.089 af**Reach 1PR: 1PR**Inflow=0.00 cfs 0.000 af
Outflow=0.00 cfs 0.000 af**Pond 1IT: Infil Trench**Peak Elev=799.63' Storage=0.032 af Inflow=1.59 cfs 0.089 af
Discarded=0.19 cfs 0.089 af Primary=0.00 cfs 0.000 af Outflow=0.19 cfs 0.089 af**Pond 1PB: 1PB**Peak Elev=794.36' Storage=0.457 af Inflow=9.08 cfs 0.642 af
Discarded=0.22 cfs 0.573 af Primary=0.00 cfs 0.000 af Secondary=0.00 cfs 0.000 af Outflow=0.22 cfs 0.573 af**Total Runoff Area = 19.100 ac Runoff Volume = 0.731 af Average Runoff Depth = 0.46"**
46.60% Pervious = 8.900 ac 53.40% Impervious = 10.200 ac

Summary for Subcatchment 1PS: 1PS

Runoff = 9.08 cfs @ 12.21 hrs, Volume= 0.642 af, Depth= 0.45"
Routed to Pond 1PB : 1PB

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 2-yr Rainfall=2.79"

Area (ac)	CN	Description
1.600	98	Unconnected pavement, HSG A
2.600	30	Meadow, non-grazed, HSG A
* 0.700	98	Pond, HSG A
* 5.500	30	Offsite Meadow, non-grazed, HSG A
* 6.800	98	Offsite Unconnected pavement, HSG A
17.200	66	Weighted Average
8.100		47.09% Pervious Area
9.100		52.91% Impervious Area
8.400		92.31% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.5	100	0.0040	0.67		Sheet Flow, Smooth surfaces n= 0.011 P2= 2.79"
4.7	350	0.0060	1.25		Shallow Concentrated Flow, Unpaved Kv= 16.1 fps
3.5	700	0.0100	3.35	10.04	Trap/Vee/Rect Channel Flow, S Swale Bot.W=3.50' D=0.50' Z= 5.0 ' Top.W=8.50' n= 0.022 Earth, clean & straight
10.7	1,150	Total			

Summary for Subcatchment 2PS: 2PS

Runoff = 1.59 cfs @ 12.17 hrs, Volume= 0.089 af, Depth= 0.56"
Routed to Pond 1IT : Infil Trench

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 2-yr Rainfall=2.79"

Area (ac)	CN	Description
* 1.100	98	Unconnected pavement, HSG A
0.800	30	Meadow, non-grazed, HSG A
1.900	69	Weighted Average
0.800		42.11% Pervious Area
1.100		57.89% Impervious Area
1.100		100.00% Unconnected

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MSE 24-hr 3 2-yr Rainfall=2.79"

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Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.0					Direct Entry,

Summary for Reach 1PR: 1PR

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 19.100 ac, 53.40% Impervious, Inflow Depth = 0.00" for 2-yr event
 Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
 Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Summary for Pond 1IT: Infil Trench

Inflow Area = 1.900 ac, 57.89% Impervious, Inflow Depth = 0.56" for 2-yr event
 Inflow = 1.59 cfs @ 12.17 hrs, Volume= 0.089 af
 Outflow = 0.19 cfs @ 12.09 hrs, Volume= 0.089 af, Atten= 88%, Lag= 0.0 min
 Discarded = 0.19 cfs @ 12.09 hrs, Volume= 0.089 af
 Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
 Routed to Pond 1PB : 1PB

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
 Peak Elev= 799.63' @ 13.17 hrs Surf.Area= 0.240 ac Storage= 0.032 af

Plug-Flow detention time= 64.7 min calculated for 0.089 af (100% of inflow)
 Center-of-Mass det. time= 64.7 min (917.0 - 852.3)

Volume	Invert	Avail.Storage	Storage Description
#1	799.30'	0.307 af	Custom Stage Data (Prismatic) Listed below (Recalc) 0.768 af Overall x 40.0% Voids

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
799.30	0.240	0.000	0.000
800.00	0.240	0.168	0.168
801.00	0.240	0.240	0.408
802.00	0.240	0.240	0.648
802.40	0.240	0.096	0.744
802.50	0.240	0.024	0.768

Device	Routing	Invert	Outlet Devices
#1	Primary	802.40'	20.0' long x 5.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88
#2	Discarded	799.30'	0.800 in/hr Exfiltration over Surface area

2026-03-11 Cottage Grove Pre-Post

MSE 24-hr 3 2-yr Rainfall=2.79"

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Discarded OutFlow Max=0.19 cfs @ 12.09 hrs HW=799.33' (Free Discharge)↑**2=Exfiltration** (Exfiltration Controls 0.19 cfs)**Primary OutFlow** Max=0.00 cfs @ 0.00 hrs HW=799.30' (Free Discharge)↑**1=Broad-Crested Rectangular Weir**(Controls 0.00 cfs)**Summary for Pond 1PB: 1PB**

Inflow Area = 19.100 ac, 53.40% Impervious, Inflow Depth = 0.40" for 2-yr event
 Inflow = 9.08 cfs @ 12.21 hrs, Volume= 0.642 af
 Outflow = 0.22 cfs @ 20.19 hrs, Volume= 0.573 af, Atten= 98%, Lag= 479.0 min
 Discarded = 0.22 cfs @ 20.19 hrs, Volume= 0.573 af
 Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
 Routed to Reach 1PR : 1PR
 Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
 Routed to Reach 1PR : 1PR

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
 Peak Elev= 794.36' @ 20.19 hrs Surf.Area= 0.271 ac Storage= 0.457 af

Plug-Flow detention time= 928.1 min calculated for 0.573 af (89% of inflow)
 Center-of-Mass det. time= 880.7 min (1,746.4 - 865.7)

Volume	Invert	Avail.Storage	Storage Description
#1	792.30'	1.788 af	Western Basin (Prismatic) Listed below (Recalc)
#2	792.30'	0.392 af	Eastern Basin (Prismatic) Listed below (Recalc)
#3	792.30'	0.872 af	North Basin (Prismatic) Listed below (Recalc)
		3.052 af	Total Available Storage

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
792.30	0.117	0.000	0.000
793.00	0.134	0.088	0.088
794.00	0.157	0.145	0.233
795.00	0.181	0.169	0.402
796.00	0.208	0.194	0.597
796.50	0.231	0.110	0.707
797.00	0.247	0.119	0.826
798.00	0.290	0.269	1.095
799.00	0.342	0.316	1.411
800.00	0.412	0.377	1.788

2026-03-11 Cottage Grove Pre-Post

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MSE 24-hr 3 2-yr Rainfall=2.79"

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Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
792.30	0.011	0.000	0.000
793.00	0.016	0.009	0.009
794.00	0.024	0.020	0.029
795.00	0.034	0.029	0.058
796.00	0.045	0.039	0.098
797.00	0.058	0.052	0.149
798.00	0.072	0.065	0.214
799.00	0.089	0.080	0.295
800.00	0.106	0.098	0.392

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
792.30	0.046	0.000	0.000
793.00	0.056	0.036	0.036
794.00	0.071	0.064	0.099
795.00	0.088	0.080	0.179
796.00	0.106	0.097	0.276
797.00	0.126	0.116	0.392
798.00	0.148	0.137	0.529
799.00	0.171	0.159	0.688
800.00	0.197	0.184	0.872

Device	Routing	Invert	Outlet Devices
#1	Secondary	799.00'	10.0' long + 3.0 ' SideZ x 10.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64
#2	Primary	795.50'	18.0" Round Culvert X 2.00 L= 50.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 795.50' / 795.00' S= 0.0100 ' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf
#3	Device 2	795.50'	7.0" Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads
#4	Device 2	798.00'	24.0" Horiz. Riser X 2.00 C= 0.600 Limited to weir flow at low heads
#5	Discarded	792.30'	0.800 in/hr Exfiltration over Surface area

Discarded OutFlow Max=0.22 cfs @ 20.19 hrs HW=794.36' (Free Discharge)↑**5=Exfiltration** (Exfiltration Controls 0.22 cfs)**Primary OutFlow** Max=0.00 cfs @ 0.00 hrs HW=792.30' (Free Discharge)↑**2=Culvert** (Controls 0.00 cfs)↑**3=Orifice/Grate** (Controls 0.00 cfs)↑**4=Riser** (Controls 0.00 cfs)**Secondary OutFlow** Max=0.00 cfs @ 0.00 hrs HW=792.30' (Free Discharge)↑**1=Broad-Crested Rectangular Weir**(Controls 0.00 cfs)

2026-03-11 Cottage Grove Pre-Post*MSE 24-hr 3 10-yr Rainfall=4.15"*

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Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN

Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1PS: 1PSRunoff Area=17.200 ac 52.91% Impervious Runoff Depth=1.18"
Flow Length=1,150' Tc=10.7 min CN=66 Runoff=29.12 cfs 1.687 af**Subcatchment2PS: 2PS**Runoff Area=1.900 ac 57.89% Impervious Runoff Depth=1.37"
Tc=8.0 min CN=69 Runoff=4.32 cfs 0.216 af**Reach 1PR: 1PR**Inflow=0.93 cfs 0.544 af
Outflow=0.93 cfs 0.544 af**Pond 1IT: Infil Trench**Peak Elev=800.56' Storage=0.121 af Inflow=4.32 cfs 0.216 af
Discarded=0.19 cfs 0.216 af Primary=0.00 cfs 0.000 af Outflow=0.19 cfs 0.216 af**Pond 1PB: 1PB**Peak Elev=796.31' Storage=1.086 af Inflow=29.12 cfs 1.687 af
Discarded=0.31 cfs 0.763 af Primary=0.93 cfs 0.544 af Secondary=0.00 cfs 0.000 af Outflow=1.24 cfs 1.308 af**Total Runoff Area = 19.100 ac Runoff Volume = 1.903 af Average Runoff Depth = 1.20"**
46.60% Pervious = 8.900 ac 53.40% Impervious = 10.200 ac

Summary for Subcatchment 1PS: 1PS

[47] Hint: Peak is 290% of capacity of segment #3

Runoff = 29.12 cfs @ 12.19 hrs, Volume= 1.687 af, Depth= 1.18"
 Routed to Pond 1PB : 1PB

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
 MSE 24-hr 3 10-yr Rainfall=4.15"

Area (ac)	CN	Description
1.600	98	Unconnected pavement, HSG A
2.600	30	Meadow, non-grazed, HSG A
* 0.700	98	Pond, HSG A
* 5.500	30	Offsite Meadow, non-grazed, HSG A
* 6.800	98	Offsite Unconnected pavement, HSG A
17.200	66	Weighted Average
8.100		47.09% Pervious Area
9.100		52.91% Impervious Area
8.400		92.31% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.5	100	0.0040	0.67		Sheet Flow, Smooth surfaces n= 0.011 P2= 2.79"
4.7	350	0.0060	1.25		Shallow Concentrated Flow, Unpaved Kv= 16.1 fps
3.5	700	0.0100	3.35	10.04	Trap/Vee/Rect Channel Flow, S Swale Bot.W=3.50' D=0.50' Z= 5.0 ' Top.W=8.50' n= 0.022 Earth, clean & straight
10.7	1,150	Total			

Summary for Subcatchment 2PS: 2PS

Runoff = 4.32 cfs @ 12.16 hrs, Volume= 0.216 af, Depth= 1.37"
 Routed to Pond 1IT : Infil Trench

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
 MSE 24-hr 3 10-yr Rainfall=4.15"

Area (ac)	CN	Description
* 1.100	98	Unconnected pavement, HSG A
0.800	30	Meadow, non-grazed, HSG A
1.900	69	Weighted Average
0.800		42.11% Pervious Area
1.100		57.89% Impervious Area
1.100		100.00% Unconnected

2026-03-11 Cottage Grove Pre-Post

MSE 24-hr 3 10-yr Rainfall=4.15"

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Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.0					Direct Entry,

Summary for Reach 1PR: 1PR

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 19.100 ac, 53.40% Impervious, Inflow Depth = 0.34" for 10-yr event
 Inflow = 0.93 cfs @ 15.10 hrs, Volume= 0.544 af
 Outflow = 0.93 cfs @ 15.10 hrs, Volume= 0.544 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Summary for Pond 1IT: Infil Trench

Inflow Area = 1.900 ac, 57.89% Impervious, Inflow Depth = 1.37" for 10-yr event
 Inflow = 4.32 cfs @ 12.16 hrs, Volume= 0.216 af
 Outflow = 0.19 cfs @ 11.89 hrs, Volume= 0.216 af, Atten= 96%, Lag= 0.0 min
 Discarded = 0.19 cfs @ 11.89 hrs, Volume= 0.216 af
 Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
 Routed to Pond 1PB : 1PB

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
 Peak Elev= 800.56' @ 13.70 hrs Surf.Area= 0.240 ac Storage= 0.121 af

Plug-Flow detention time= 280.7 min calculated for 0.216 af (100% of inflow)
 Center-of-Mass det. time= 280.7 min (1,110.2 - 829.6)

Volume	Invert	Avail.Storage	Storage Description
#1	799.30'	0.307 af	Custom Stage Data (Prismatic) Listed below (Recalc) 0.768 af Overall x 40.0% Voids

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
799.30	0.240	0.000	0.000
800.00	0.240	0.168	0.168
801.00	0.240	0.240	0.408
802.00	0.240	0.240	0.648
802.40	0.240	0.096	0.744
802.50	0.240	0.024	0.768

Device	Routing	Invert	Outlet Devices
#1	Primary	802.40'	20.0' long x 5.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88
#2	Discarded	799.30'	0.800 in/hr Exfiltration over Surface area

2026-03-11 Cottage Grove Pre-Post

MSE 24-hr 3 10-yr Rainfall=4.15"

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Discarded OutFlow Max=0.19 cfs @ 11.89 hrs HW=799.33' (Free Discharge)↑**2=Exfiltration** (Exfiltration Controls 0.19 cfs)**Primary OutFlow** Max=0.00 cfs @ 0.00 hrs HW=799.30' (Free Discharge)↑**1=Broad-Crested Rectangular Weir**(Controls 0.00 cfs)**Summary for Pond 1PB: 1PB**

Inflow Area = 19.100 ac, 53.40% Impervious, Inflow Depth = 1.06" for 10-yr event
 Inflow = 29.12 cfs @ 12.19 hrs, Volume= 1.687 af
 Outflow = 1.24 cfs @ 15.10 hrs, Volume= 1.308 af, Atten= 96%, Lag= 174.3 min
 Discarded = 0.31 cfs @ 15.10 hrs, Volume= 0.763 af
 Primary = 0.93 cfs @ 15.10 hrs, Volume= 0.544 af
 Routed to Reach 1PR : 1PR
 Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
 Routed to Reach 1PR : 1PR

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
 Peak Elev= 796.31' @ 15.10 hrs Surf.Area= 0.384 ac Storage= 1.086 af

Plug-Flow detention time= 676.3 min calculated for 1.307 af (78% of inflow)
 Center-of-Mass det. time= 599.8 min (1,438.6 - 838.8)

Volume	Invert	Avail.Storage	Storage Description
#1	792.30'	1.788 af	Western Basin (Prismatic) Listed below (Recalc)
#2	792.30'	0.392 af	Eastern Basin (Prismatic) Listed below (Recalc)
#3	792.30'	0.872 af	North Basin (Prismatic) Listed below (Recalc)
		3.052 af	Total Available Storage

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
792.30	0.117	0.000	0.000
793.00	0.134	0.088	0.088
794.00	0.157	0.145	0.233
795.00	0.181	0.169	0.402
796.00	0.208	0.194	0.597
796.50	0.231	0.110	0.707
797.00	0.247	0.119	0.826
798.00	0.290	0.269	1.095
799.00	0.342	0.316	1.411
800.00	0.412	0.377	1.788

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MSE 24-hr 3 10-yr Rainfall=4.15"

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Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
792.30	0.011	0.000	0.000
793.00	0.016	0.009	0.009
794.00	0.024	0.020	0.029
795.00	0.034	0.029	0.058
796.00	0.045	0.039	0.098
797.00	0.058	0.052	0.149
798.00	0.072	0.065	0.214
799.00	0.089	0.080	0.295
800.00	0.106	0.098	0.392

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
792.30	0.046	0.000	0.000
793.00	0.056	0.036	0.036
794.00	0.071	0.064	0.099
795.00	0.088	0.080	0.179
796.00	0.106	0.097	0.276
797.00	0.126	0.116	0.392
798.00	0.148	0.137	0.529
799.00	0.171	0.159	0.688
800.00	0.197	0.184	0.872

Device	Routing	Invert	Outlet Devices
#1	Secondary	799.00'	10.0' long + 3.0 ' SideZ x 10.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64
#2	Primary	795.50'	18.0" Round Culvert X 2.00 L= 50.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 795.50' / 795.00' S= 0.0100 ' S= 0.0100 ' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf
#3	Device 2	795.50'	7.0" Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads
#4	Device 2	798.00'	24.0" Horiz. Riser X 2.00 C= 0.600 Limited to weir flow at low heads
#5	Discarded	792.30'	0.800 in/hr Exfiltration over Surface area

Discarded OutFlow Max=0.31 cfs @ 15.10 hrs HW=796.31' (Free Discharge)↑ **5=Exfiltration** (Exfiltration Controls 0.31 cfs)**Primary OutFlow** Max=0.93 cfs @ 15.10 hrs HW=796.31' (Free Discharge)↑ **2=Culvert** (Passes 0.93 cfs of 4.73 cfs potential flow)↑ **3=Orifice/Grate** (Orifice Controls 0.93 cfs @ 3.47 fps)↑ **4=Riser** (Controls 0.00 cfs)**Secondary OutFlow** Max=0.00 cfs @ 0.00 hrs HW=792.30' (Free Discharge)↑ **1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

2026-03-11 Cottage Grove Pre-Post*MSE 24-hr 3 100-yr Rainfall=7.39"*

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Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN

Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1PS: 1PSRunoff Area=17.200 ac 52.91% Impervious Runoff Depth=3.51"
Flow Length=1,150' Tc=10.7 min CN=66 Runoff=91.70 cfs 5.036 af**Subcatchment2PS: 2PS**Runoff Area=1.900 ac 57.89% Impervious Runoff Depth=3.84"
Tc=8.0 min CN=69 Runoff=12.39 cfs 0.607 af**Reach 1PR: 1PR**Inflow=22.06 cfs 3.803 af
Outflow=22.06 cfs 3.803 af**Pond 1IT: Infil Trench**Peak Elev=802.58' Storage=0.307 af Inflow=12.39 cfs 0.607 af
Discarded=0.19 cfs 0.464 af Primary=3.66 cfs 0.144 af Outflow=3.85 cfs 0.607 af**Pond 1PB: 1PB**Peak Elev=798.95' Storage=2.361 af Inflow=91.70 cfs 5.180 af
Discarded=0.48 cfs 0.914 af Primary=22.06 cfs 3.803 af Secondary=0.00 cfs 0.000 af Outflow=22.54 cfs 4.717 af**Total Runoff Area = 19.100 ac Runoff Volume = 5.644 af Average Runoff Depth = 3.55"**
46.60% Pervious = 8.900 ac 53.40% Impervious = 10.200 ac

Summary for Subcatchment 1PS: 1PS

[47] Hint: Peak is 913% of capacity of segment #3

Runoff = 91.70 cfs @ 12.19 hrs, Volume= 5.036 af, Depth= 3.51"
 Routed to Pond 1PB : 1PB

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
 MSE 24-hr 3 100-yr Rainfall=7.39"

Area (ac)	CN	Description
1.600	98	Unconnected pavement, HSG A
2.600	30	Meadow, non-grazed, HSG A
* 0.700	98	Pond, HSG A
* 5.500	30	Offsite Meadow, non-grazed, HSG A
* 6.800	98	Offsite Unconnected pavement, HSG A
17.200	66	Weighted Average
8.100		47.09% Pervious Area
9.100		52.91% Impervious Area
8.400		92.31% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.5	100	0.0040	0.67		Sheet Flow, Smooth surfaces n= 0.011 P2= 2.79"
4.7	350	0.0060	1.25		Shallow Concentrated Flow, Unpaved Kv= 16.1 fps
3.5	700	0.0100	3.35	10.04	Trap/Vee/Rect Channel Flow, S Swale Bot.W=3.50' D=0.50' Z= 5.0 ' Top.W=8.50' n= 0.022 Earth, clean & straight
10.7	1,150	Total			

Summary for Subcatchment 2PS: 2PS

Runoff = 12.39 cfs @ 12.15 hrs, Volume= 0.607 af, Depth= 3.84"
 Routed to Pond 1IT : Infil Trench

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
 MSE 24-hr 3 100-yr Rainfall=7.39"

Area (ac)	CN	Description
* 1.100	98	Unconnected pavement, HSG A
0.800	30	Meadow, non-grazed, HSG A
1.900	69	Weighted Average
0.800		42.11% Pervious Area
1.100		57.89% Impervious Area
1.100		100.00% Unconnected

2026-03-11 Cottage Grove Pre-Post

MSE 24-hr 3 100-yr Rainfall=7.39"

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Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.0					Direct Entry,

Summary for Reach 1PR: 1PR

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 19.100 ac, 53.40% Impervious, Inflow Depth = 2.39" for 100-yr event
 Inflow = 22.06 cfs @ 12.56 hrs, Volume= 3.803 af
 Outflow = 22.06 cfs @ 12.56 hrs, Volume= 3.803 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Summary for Pond 1IT: Infil Trench

[93] Warning: Storage range exceeded by 0.08'

[85] Warning: Oscillations may require smaller dt or Finer Routing (severity=7)

Inflow Area = 1.900 ac, 57.89% Impervious, Inflow Depth = 3.84" for 100-yr event
 Inflow = 12.39 cfs @ 12.15 hrs, Volume= 0.607 af
 Outflow = 3.85 cfs @ 12.44 hrs, Volume= 0.607 af, Atten= 69%, Lag= 17.1 min
 Discarded = 0.19 cfs @ 11.15 hrs, Volume= 0.464 af
 Primary = 3.66 cfs @ 12.44 hrs, Volume= 0.144 af
 Routed to Pond 1PB : 1PB

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
 Peak Elev= 802.58' @ 12.44 hrs Surf.Area= 0.240 ac Storage= 0.307 af

Plug-Flow detention time= 536.4 min calculated for 0.607 af (100% of inflow)
 Center-of-Mass det. time= 536.5 min (1,344.0 - 807.5)

Volume	Invert	Avail.Storage	Storage Description
#1	799.30'	0.307 af	Custom Stage Data (Prismatic) Listed below (Recalc) 0.768 af Overall x 40.0% Voids

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
799.30	0.240	0.000	0.000
800.00	0.240	0.168	0.168
801.00	0.240	0.240	0.408
802.00	0.240	0.240	0.648
802.40	0.240	0.096	0.744
802.50	0.240	0.024	0.768

Device	Routing	Invert	Outlet Devices
#1	Primary	802.40'	20.0' long x 5.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

2026-03-11 Cottage Grove Pre-Post

MSE 24-hr 3 100-yr Rainfall=7.39"

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#2 Discarded 799.30' **0.800 in/hr Exfiltration over Surface area****Discarded OutFlow** Max=0.19 cfs @ 11.15 hrs HW=799.33' (Free Discharge)↑**2=Exfiltration** (Exfiltration Controls 0.19 cfs)**Primary OutFlow** Max=3.59 cfs @ 12.44 hrs HW=802.58' (Free Discharge)↑**1=Broad-Crested Rectangular Weir**(Weir Controls 3.59 cfs @ 0.99 fps)**Summary for Pond 1PB: 1PB**

Inflow Area = 19.100 ac, 53.40% Impervious, Inflow Depth = 3.25" for 100-yr event
 Inflow = 91.70 cfs @ 12.19 hrs, Volume= 5.180 af
 Outflow = 22.54 cfs @ 12.56 hrs, Volume= 4.717 af, Atten= 75%, Lag= 22.3 min
 Discarded = 0.48 cfs @ 12.56 hrs, Volume= 0.914 af
 Primary = 22.06 cfs @ 12.56 hrs, Volume= 3.803 af
 Routed to Reach 1PR : 1PR
 Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
 Routed to Reach 1PR : 1PR

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
 Peak Elev= 798.95' @ 12.56 hrs Surf.Area= 0.597 ac Storage= 2.361 af

Plug-Flow detention time= 316.6 min calculated for 4.717 af (91% of inflow)
 Center-of-Mass det. time= 277.0 min (1,091.0 - 814.0)

Volume	Invert	Avail.Storage	Storage Description
#1	792.30'	1.788 af	Western Basin (Prismatic) Listed below (Recalc)
#2	792.30'	0.392 af	Eastern Basin (Prismatic) Listed below (Recalc)
#3	792.30'	0.872 af	North Basin (Prismatic) Listed below (Recalc)
		3.052 af	Total Available Storage

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
792.30	0.117	0.000	0.000
793.00	0.134	0.088	0.088
794.00	0.157	0.145	0.233
795.00	0.181	0.169	0.402
796.00	0.208	0.194	0.597
796.50	0.231	0.110	0.707
797.00	0.247	0.119	0.826
798.00	0.290	0.269	1.095
799.00	0.342	0.316	1.411
800.00	0.412	0.377	1.788

2026-03-11 Cottage Grove Pre-Post

MSE 24-hr 3 100-yr Rainfall=7.39"

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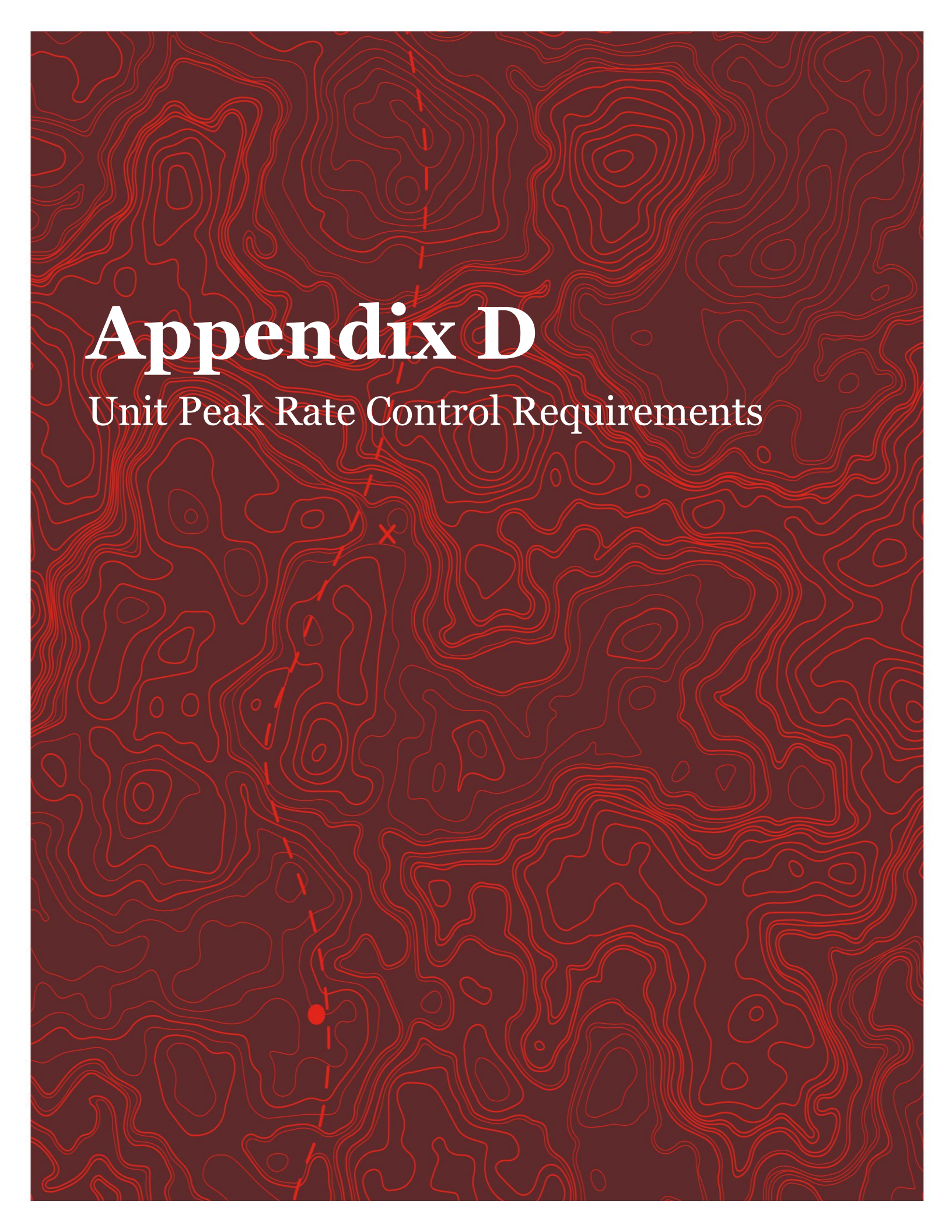
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Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
792.30	0.011	0.000	0.000
793.00	0.016	0.009	0.009
794.00	0.024	0.020	0.029
795.00	0.034	0.029	0.058
796.00	0.045	0.039	0.098
797.00	0.058	0.052	0.149
798.00	0.072	0.065	0.214
799.00	0.089	0.080	0.295
800.00	0.106	0.098	0.392

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
792.30	0.046	0.000	0.000
793.00	0.056	0.036	0.036
794.00	0.071	0.064	0.099
795.00	0.088	0.080	0.179
796.00	0.106	0.097	0.276
797.00	0.126	0.116	0.392
798.00	0.148	0.137	0.529
799.00	0.171	0.159	0.688
800.00	0.197	0.184	0.872

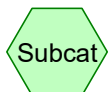
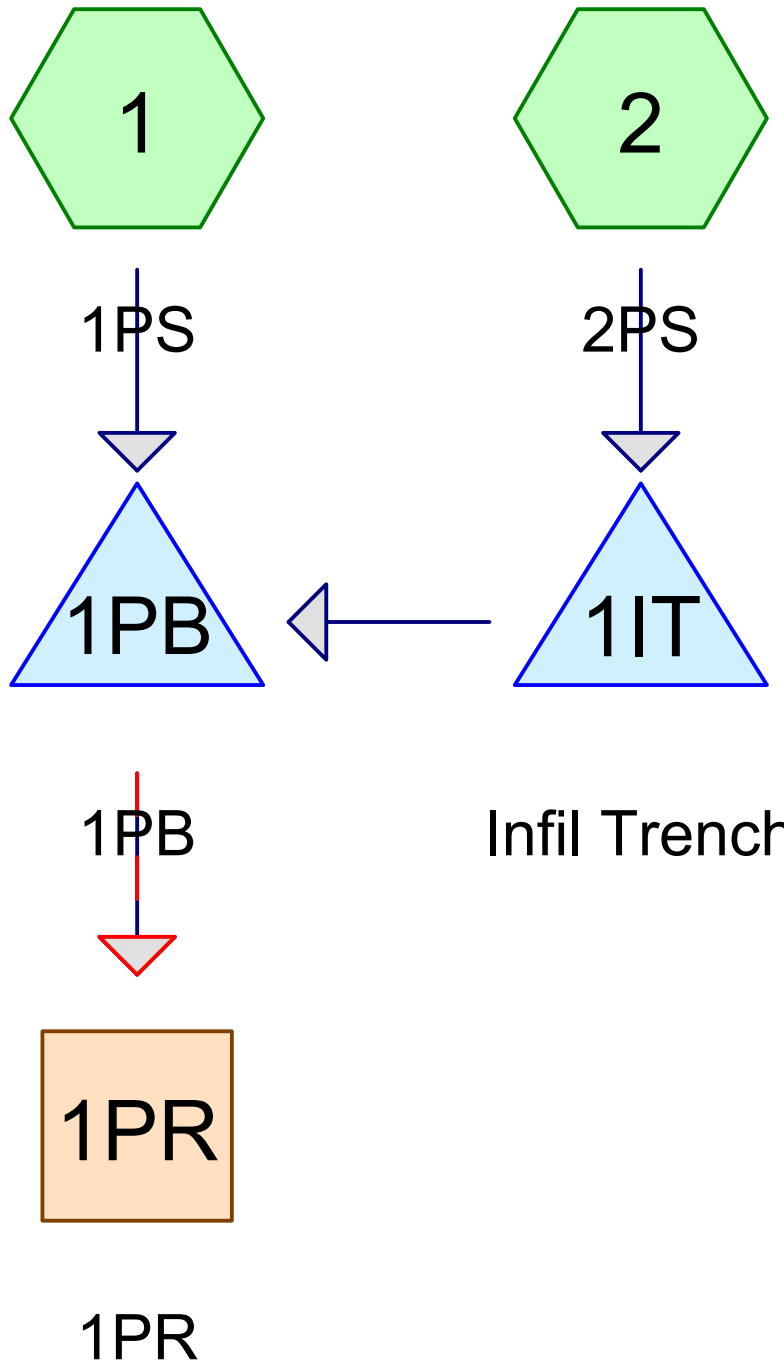
Device	Routing	Invert	Outlet Devices
#1	Secondary	799.00'	10.0' long + 3.0 ' SideZ x 10.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64
#2	Primary	795.50'	18.0" Round Culvert X 2.00 L= 50.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 795.50' / 795.00' S= 0.0100 ' S= 0.0100 ' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf
#3	Device 2	795.50'	7.0" Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads
#4	Device 2	798.00'	24.0" Horiz. Riser X 2.00 C= 0.600 Limited to weir flow at low heads
#5	Discarded	792.30'	0.800 in/hr Exfiltration over Surface area

Discarded OutFlow Max=0.48 cfs @ 12.56 hrs HW=798.95' (Free Discharge)↑ **5=Exfiltration** (Exfiltration Controls 0.48 cfs)**Primary OutFlow** Max=22.06 cfs @ 12.56 hrs HW=798.95' (Free Discharge)↑ **2=Culvert** (Inlet Controls 22.06 cfs @ 6.24 fps)↑ **3=Orifice/Grate** (Passes < 2.29 cfs potential flow)↑ **4=Riser** (Passes < 29.42 cfs potential flow)**Secondary OutFlow** Max=0.00 cfs @ 0.00 hrs HW=792.30' (Free Discharge)↑ **1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)



Appendix D

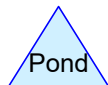
Unit Peak Rate Control Requirements



Subcat



Reach



Pond



Link

Routing Diagram for 2026-03-11 Cottage Grove Pre-Post
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2026-03-11 Cottage Grove Pre-Post

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Rainfall Events Listing (selected events)

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	2-yr	MSE 24-hr	3	Default	24.00	1	2.79	2
2	10-yr	MSE 24-hr	3	Default	24.00	1	4.15	2
3	100-yr	MSE 24-hr	3	Default	24.00	1	7.39	2

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Area Listing (selected nodes)

Area (acres)	CN	Description (subcatchment-numbers)
3.400	30	Meadow, non-grazed, HSG A (1, 2)
0.700	98	Pond, HSG A (1)
2.700	98	Unconnected pavement, HSG A (1, 2)
6.800	64	TOTAL AREA

2026-03-11 Cottage Grove Pre-Post*MSE 24-hr 3 2-yr Rainfall=2.79"*

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Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN

Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1: 1PSRunoff Area=4.900 ac 46.94% Impervious Runoff Depth=0.32"
Flow Length=1,150' Tc=10.7 min CN=62 Runoff=1.44 cfs 0.130 af**Subcatchment2: 2PS**Runoff Area=1.900 ac 57.89% Impervious Runoff Depth=0.56"
Tc=8.0 min CN=69 Runoff=1.59 cfs 0.089 af**Reach 1PR: 1PR**Inflow=0.00 cfs 0.000 af
Outflow=0.00 cfs 0.000 af**Pond 1IT: Infil Trench**Peak Elev=799.63' Storage=0.032 af Inflow=1.59 cfs 0.089 af
Discarded=0.19 cfs 0.089 af Primary=0.00 cfs 0.000 af Outflow=0.19 cfs 0.089 af**Pond 1PB: 1PB**Peak Elev=792.60' Storage=0.053 af Inflow=1.44 cfs 0.130 af
Discarded=0.15 cfs 0.130 af Primary=0.00 cfs 0.000 af Secondary=0.00 cfs 0.000 af Outflow=0.15 cfs 0.130 af**Total Runoff Area = 6.800 ac Runoff Volume = 0.219 af Average Runoff Depth = 0.39"**
50.00% Pervious = 3.400 ac 50.00% Impervious = 3.400 ac

Summary for Subcatchment 1: 1PS

Runoff = 1.44 cfs @ 12.23 hrs, Volume= 0.130 af, Depth= 0.32"
 Routed to Pond 1PB : 1PB

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
 MSE 24-hr 3 2-yr Rainfall=2.79"

Area (ac)	CN	Description
1.600	98	Unconnected pavement, HSG A
2.600	30	Meadow, non-grazed, HSG A
* 0.700	98	Pond, HSG A
4.900	62	Weighted Average
2.600		53.06% Pervious Area
2.300		46.94% Impervious Area
1.600		69.57% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.5	100	0.0040	0.67		Sheet Flow, Smooth surfaces n= 0.011 P2= 2.79"
4.7	350	0.0060	1.25		Shallow Concentrated Flow, Unpaved Kv= 16.1 fps
3.5	700	0.0100	3.35	10.04	Trap/Vee/Rect Channel Flow, S Swale Bot.W=3.50' D=0.50' Z= 5.0 ' Top.W=8.50' n= 0.022 Earth, clean & straight
10.7	1,150	Total			

Summary for Subcatchment 2: 2PS

Runoff = 1.59 cfs @ 12.17 hrs, Volume= 0.089 af, Depth= 0.56"
 Routed to Pond 1IT : Infil Trench

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
 MSE 24-hr 3 2-yr Rainfall=2.79"

Area (ac)	CN	Description
* 1.100	98	Unconnected pavement, HSG A
0.800	30	Meadow, non-grazed, HSG A
1.900	69	Weighted Average
0.800		42.11% Pervious Area
1.100		57.89% Impervious Area
1.100		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.0					Direct Entry,

Summary for Reach 1PR: 1PR

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 6.800 ac, 50.00% Impervious, Inflow Depth = 0.00" for 2-yr event
 Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
 Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Summary for Pond 1IT: Infil Trench

Inflow Area = 1.900 ac, 57.89% Impervious, Inflow Depth = 0.56" for 2-yr event
 Inflow = 1.59 cfs @ 12.17 hrs, Volume= 0.089 af
 Outflow = 0.19 cfs @ 12.09 hrs, Volume= 0.089 af, Atten= 88%, Lag= 0.0 min
 Discarded = 0.19 cfs @ 12.09 hrs, Volume= 0.089 af
 Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
 Routed to Pond 1PB : 1PB

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
 Peak Elev= 799.63' @ 13.17 hrs Surf.Area= 0.240 ac Storage= 0.032 af

Plug-Flow detention time= 64.7 min calculated for 0.089 af (100% of inflow)
 Center-of-Mass det. time= 64.7 min (917.0 - 852.3)

Volume	Invert	Avail.Storage	Storage Description
#1	799.30'	0.307 af	Custom Stage Data (Prismatic) Listed below (Recalc) 0.768 af Overall x 40.0% Voids
Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
799.30	0.240	0.000	0.000
800.00	0.240	0.168	0.168
801.00	0.240	0.240	0.408
802.00	0.240	0.240	0.648
802.40	0.240	0.096	0.744
802.50	0.240	0.024	0.768

Device	Routing	Invert	Outlet Devices
#1	Primary	802.40'	20.0' long x 5.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88
#2	Discarded	799.30'	0.800 in/hr Exfiltration over Surface area

Discarded OutFlow Max=0.19 cfs @ 12.09 hrs HW=799.33' (Free Discharge)
 ↑**2=Exfiltration** (Exfiltration Controls 0.19 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=799.30' (Free Discharge)
 ↑**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 1PB: 1PB

Inflow Area = 6.800 ac, 50.00% Impervious, Inflow Depth = 0.23" for 2-yr event
 Inflow = 1.44 cfs @ 12.23 hrs, Volume= 0.130 af
 Outflow = 0.15 cfs @ 14.05 hrs, Volume= 0.130 af, Atten= 90%, Lag= 109.1 min
 Discarded = 0.15 cfs @ 14.05 hrs, Volume= 0.130 af
 Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
 Routed to Reach 1PR : 1PR
 Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
 Routed to Reach 1PR : 1PR

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
 Peak Elev= 792.60' @ 14.05 hrs Surf.Area= 0.188 ac Storage= 0.053 af

Plug-Flow detention time= 171.0 min calculated for 0.130 af (100% of inflow)
 Center-of-Mass det. time= 171.0 min (1,054.6 - 883.6)

Volume	Invert	Avail.Storage	Storage Description
#1	792.30'	1.788 af	Western Basin (Prismatic) Listed below (Recalc)
#2	792.30'	0.392 af	Eastern Basin (Prismatic) Listed below (Recalc)
#3	792.30'	0.872 af	North Basin (Prismatic) Listed below (Recalc)
		3.052 af	Total Available Storage

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
792.30	0.117	0.000	0.000
793.00	0.134	0.088	0.088
794.00	0.157	0.145	0.233
795.00	0.181	0.169	0.402
796.00	0.208	0.194	0.597
796.50	0.231	0.110	0.707
797.00	0.247	0.119	0.826
798.00	0.290	0.269	1.095
799.00	0.342	0.316	1.411
800.00	0.412	0.377	1.788

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
792.30	0.011	0.000	0.000
793.00	0.016	0.009	0.009
794.00	0.024	0.020	0.029
795.00	0.034	0.029	0.058
796.00	0.045	0.039	0.098
797.00	0.058	0.052	0.149
798.00	0.072	0.065	0.214
799.00	0.089	0.080	0.295
800.00	0.106	0.098	0.392

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MSE 24-hr 3 2-yr Rainfall=2.79"

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Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
792.30	0.046	0.000	0.000
793.00	0.056	0.036	0.036
794.00	0.071	0.064	0.099
795.00	0.088	0.080	0.179
796.00	0.106	0.097	0.276
797.00	0.126	0.116	0.392
798.00	0.148	0.137	0.529
799.00	0.171	0.159	0.688
800.00	0.197	0.184	0.872

Device	Routing	Invert	Outlet Devices
#1	Secondary	799.00'	10.0' long + 3.0 ' SideZ x 10.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64
#2	Primary	795.50'	18.0" Round Culvert X 2.00 L= 50.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 795.50' / 795.00' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf
#3	Device 2	795.50'	7.0" Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads
#4	Device 2	798.00'	24.0" Horiz. Riser X 2.00 C= 0.600 Limited to weir flow at low heads
#5	Discarded	792.30'	0.800 in/hr Exfiltration over Surface area

Discarded OutFlow Max=0.15 cfs @ 14.05 hrs HW=792.60' (Free Discharge)↑ **5=Exfiltration** (Exfiltration Controls 0.15 cfs)**Primary OutFlow** Max=0.00 cfs @ 0.00 hrs HW=792.30' (Free Discharge)↑ **2=Culvert** (Controls 0.00 cfs)↑ **3=Orifice/Grate** (Controls 0.00 cfs)↑ **4=Riser** (Controls 0.00 cfs)**Secondary OutFlow** Max=0.00 cfs @ 0.00 hrs HW=792.30' (Free Discharge)↑ **1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

2026-03-11 Cottage Grove Pre-Post*MSE 24-hr 3 10-yr Rainfall=4.15"*

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Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN

Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1: 1PSRunoff Area=4.900 ac 46.94% Impervious Runoff Depth=0.94"
Flow Length=1,150' Tc=10.7 min CN=62 Runoff=6.30 cfs 0.386 af**Subcatchment2: 2PS**Runoff Area=1.900 ac 57.89% Impervious Runoff Depth=1.37"
Tc=8.0 min CN=69 Runoff=4.32 cfs 0.216 af**Reach 1PR: 1PR**Inflow=0.00 cfs 0.000 af
Outflow=0.00 cfs 0.000 af**Pond 1IT: Infil Trench**Peak Elev=800.56' Storage=0.121 af Inflow=4.32 cfs 0.216 af
Discarded=0.19 cfs 0.216 af Primary=0.00 cfs 0.000 af Outflow=0.19 cfs 0.216 af**Pond 1PB: 1PB**Peak Elev=793.54' Storage=0.250 af Inflow=6.30 cfs 0.386 af
Discarded=0.19 cfs 0.386 af Primary=0.00 cfs 0.000 af Secondary=0.00 cfs 0.000 af Outflow=0.19 cfs 0.386 af**Total Runoff Area = 6.800 ac Runoff Volume = 0.602 af Average Runoff Depth = 1.06"**
50.00% Pervious = 3.400 ac 50.00% Impervious = 3.400 ac

Summary for Subcatchment 1: 1PS

Runoff = 6.30 cfs @ 12.20 hrs, Volume= 0.386 af, Depth= 0.94"
 Routed to Pond 1PB : 1PB

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
 MSE 24-hr 3 10-yr Rainfall=4.15"

Area (ac)	CN	Description
1.600	98	Unconnected pavement, HSG A
2.600	30	Meadow, non-grazed, HSG A
* 0.700	98	Pond, HSG A
4.900	62	Weighted Average
2.600		53.06% Pervious Area
2.300		46.94% Impervious Area
1.600		69.57% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.5	100	0.0040	0.67		Sheet Flow, Smooth surfaces n= 0.011 P2= 2.79"
4.7	350	0.0060	1.25		Shallow Concentrated Flow, Unpaved Kv= 16.1 fps
3.5	700	0.0100	3.35	10.04	Trap/Vee/Rect Channel Flow, S Swale Bot.W=3.50' D=0.50' Z= 5.0 '/' Top.W=8.50' n= 0.022 Earth, clean & straight
10.7	1,150	Total			

Summary for Subcatchment 2: 2PS

Runoff = 4.32 cfs @ 12.16 hrs, Volume= 0.216 af, Depth= 1.37"
 Routed to Pond 1IT : Infil Trench

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
 MSE 24-hr 3 10-yr Rainfall=4.15"

Area (ac)	CN	Description
* 1.100	98	Unconnected pavement, HSG A
0.800	30	Meadow, non-grazed, HSG A
1.900	69	Weighted Average
0.800		42.11% Pervious Area
1.100		57.89% Impervious Area
1.100		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.0					Direct Entry,

Summary for Reach 1PR: 1PR

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 6.800 ac, 50.00% Impervious, Inflow Depth = 0.00" for 10-yr event
 Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
 Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Summary for Pond 1IT: Infil Trench

Inflow Area = 1.900 ac, 57.89% Impervious, Inflow Depth = 1.37" for 10-yr event
 Inflow = 4.32 cfs @ 12.16 hrs, Volume= 0.216 af
 Outflow = 0.19 cfs @ 11.89 hrs, Volume= 0.216 af, Atten= 96%, Lag= 0.0 min
 Discarded = 0.19 cfs @ 11.89 hrs, Volume= 0.216 af
 Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
 Routed to Pond 1PB : 1PB

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
 Peak Elev= 800.56' @ 13.70 hrs Surf.Area= 0.240 ac Storage= 0.121 af

Plug-Flow detention time= 280.7 min calculated for 0.216 af (100% of inflow)
 Center-of-Mass det. time= 280.7 min (1,110.2 - 829.6)

Volume	Invert	Avail.Storage	Storage Description
#1	799.30'	0.307 af	Custom Stage Data (Prismatic) Listed below (Recalc) 0.768 af Overall x 40.0% Voids
Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
799.30	0.240	0.000	0.000
800.00	0.240	0.168	0.168
801.00	0.240	0.240	0.408
802.00	0.240	0.240	0.648
802.40	0.240	0.096	0.744
802.50	0.240	0.024	0.768

Device	Routing	Invert	Outlet Devices
#1	Primary	802.40'	20.0' long x 5.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88
#2	Discarded	799.30'	0.800 in/hr Exfiltration over Surface area

Discarded OutFlow Max=0.19 cfs @ 11.89 hrs HW=799.33' (Free Discharge)
 ↑2=Exfiltration (Exfiltration Controls 0.19 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=799.30' (Free Discharge)
 ↑1=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Summary for Pond 1PB: 1PB

Inflow Area = 6.800 ac, 50.00% Impervious, Inflow Depth = 0.68" for 10-yr event
 Inflow = 6.30 cfs @ 12.20 hrs, Volume= 0.386 af
 Outflow = 0.19 cfs @ 16.37 hrs, Volume= 0.386 af, Atten= 97%, Lag= 250.4 min
 Discarded = 0.19 cfs @ 16.37 hrs, Volume= 0.386 af
 Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
 Routed to Reach 1PR : 1PR
 Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
 Routed to Reach 1PR : 1PR

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
 Peak Elev= 793.54' @ 16.37 hrs Surf.Area= 0.231 ac Storage= 0.250 af

Plug-Flow detention time= 663.5 min calculated for 0.386 af (100% of inflow)
 Center-of-Mass det. time= 663.5 min (1,512.4 - 848.9)

Volume	Invert	Avail.Storage	Storage Description
#1	792.30'	1.788 af	Western Basin (Prismatic) Listed below (Recalc)
#2	792.30'	0.392 af	Eastern Basin (Prismatic) Listed below (Recalc)
#3	792.30'	0.872 af	North Basin (Prismatic) Listed below (Recalc)
		3.052 af	Total Available Storage

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
792.30	0.117	0.000	0.000
793.00	0.134	0.088	0.088
794.00	0.157	0.145	0.233
795.00	0.181	0.169	0.402
796.00	0.208	0.194	0.597
796.50	0.231	0.110	0.707
797.00	0.247	0.119	0.826
798.00	0.290	0.269	1.095
799.00	0.342	0.316	1.411
800.00	0.412	0.377	1.788

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
792.30	0.011	0.000	0.000
793.00	0.016	0.009	0.009
794.00	0.024	0.020	0.029
795.00	0.034	0.029	0.058
796.00	0.045	0.039	0.098
797.00	0.058	0.052	0.149
798.00	0.072	0.065	0.214
799.00	0.089	0.080	0.295
800.00	0.106	0.098	0.392

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MSE 24-hr 3 10-yr Rainfall=4.15"

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Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
792.30	0.046	0.000	0.000
793.00	0.056	0.036	0.036
794.00	0.071	0.064	0.099
795.00	0.088	0.080	0.179
796.00	0.106	0.097	0.276
797.00	0.126	0.116	0.392
798.00	0.148	0.137	0.529
799.00	0.171	0.159	0.688
800.00	0.197	0.184	0.872

Device	Routing	Invert	Outlet Devices
#1	Secondary	799.00'	10.0' long + 3.0 ' SideZ x 10.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64
#2	Primary	795.50'	18.0" Round Culvert X 2.00 L= 50.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 795.50' / 795.00' S= 0.0100 ' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf
#3	Device 2	795.50'	7.0" Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads
#4	Device 2	798.00'	24.0" Horiz. Riser X 2.00 C= 0.600 Limited to weir flow at low heads
#5	Discarded	792.30'	0.800 in/hr Exfiltration over Surface area

Discarded OutFlow Max=0.19 cfs @ 16.37 hrs HW=793.54' (Free Discharge)↑ **5=Exfiltration** (Exfiltration Controls 0.19 cfs)**Primary OutFlow** Max=0.00 cfs @ 0.00 hrs HW=792.30' (Free Discharge)↑ **2=Culvert** (Controls 0.00 cfs)↑ **3=Orifice/Grate** (Controls 0.00 cfs)↑ **4=Riser** (Controls 0.00 cfs)**Secondary OutFlow** Max=0.00 cfs @ 0.00 hrs HW=792.30' (Free Discharge)↑ **1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

2026-03-11 Cottage Grove Pre-Post*MSE 24-hr 3 100-yr Rainfall=7.39"*

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Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN

Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1: 1PSRunoff Area=4.900 ac 46.94% Impervious Runoff Depth=3.09"
Flow Length=1,150' Tc=10.7 min CN=62 Runoff=22.87 cfs 1.262 af**Subcatchment2: 2PS**Runoff Area=1.900 ac 57.89% Impervious Runoff Depth=3.84"
Tc=8.0 min CN=69 Runoff=12.39 cfs 0.607 af**Reach 1PR: 1PR**Inflow=0.67 cfs 0.298 af
Outflow=0.67 cfs 0.298 af**Pond 1IT: Infil Trench**Peak Elev=802.58' Storage=0.307 af Inflow=12.39 cfs 0.607 af
Discarded=0.19 cfs 0.464 af Primary=3.66 cfs 0.144 af Outflow=3.85 cfs 0.607 af**Pond 1PB: 1PB**Peak Elev=796.06' Storage=0.993 af Inflow=22.87 cfs 1.406 af
Discarded=0.29 cfs 0.752 af Primary=0.67 cfs 0.298 af Secondary=0.00 cfs 0.000 af Outflow=0.97 cfs 1.050 af**Total Runoff Area = 6.800 ac Runoff Volume = 1.870 af Average Runoff Depth = 3.30"**
50.00% Pervious = 3.400 ac 50.00% Impervious = 3.400 ac

Summary for Subcatchment 1: 1PS

[47] Hint: Peak is 228% of capacity of segment #3

Runoff = 22.87 cfs @ 12.19 hrs, Volume= 1.262 af, Depth= 3.09"
Routed to Pond 1PB : 1PB

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-yr Rainfall=7.39"

Area (ac)	CN	Description
1.600	98	Unconnected pavement, HSG A
2.600	30	Meadow, non-grazed, HSG A
* 0.700	98	Pond, HSG A
4.900	62	Weighted Average
2.600		53.06% Pervious Area
2.300		46.94% Impervious Area
1.600		69.57% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.5	100	0.0040	0.67		Sheet Flow, Smooth surfaces n= 0.011 P2= 2.79"
4.7	350	0.0060	1.25		Shallow Concentrated Flow, Unpaved Kv= 16.1 fps
3.5	700	0.0100	3.35	10.04	Trap/Vee/Rect Channel Flow, S Swale Bot.W=3.50' D=0.50' Z= 5.0 '/' Top.W=8.50' n= 0.022 Earth, clean & straight
10.7	1,150	Total			

Summary for Subcatchment 2: 2PS

Runoff = 12.39 cfs @ 12.15 hrs, Volume= 0.607 af, Depth= 3.84"
Routed to Pond 1IT : Infil Trench

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-yr Rainfall=7.39"

Area (ac)	CN	Description
* 1.100	98	Unconnected pavement, HSG A
0.800	30	Meadow, non-grazed, HSG A
1.900	69	Weighted Average
0.800		42.11% Pervious Area
1.100		57.89% Impervious Area
1.100		100.00% Unconnected

2026-03-11 Cottage Grove Pre-Post

MSE 24-hr 3 100-yr Rainfall=7.39"

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Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.0					Direct Entry,

Summary for Reach 1PR: 1PR

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 6.800 ac, 50.00% Impervious, Inflow Depth = 0.53" for 100-yr event
 Inflow = 0.67 cfs @ 15.10 hrs, Volume= 0.298 af
 Outflow = 0.67 cfs @ 15.10 hrs, Volume= 0.298 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Summary for Pond 1IT: Infil Trench

[93] Warning: Storage range exceeded by 0.08'

[85] Warning: Oscillations may require smaller dt or Finer Routing (severity=7)

Inflow Area = 1.900 ac, 57.89% Impervious, Inflow Depth = 3.84" for 100-yr event
 Inflow = 12.39 cfs @ 12.15 hrs, Volume= 0.607 af
 Outflow = 3.85 cfs @ 12.44 hrs, Volume= 0.607 af, Atten= 69%, Lag= 17.1 min
 Discarded = 0.19 cfs @ 11.15 hrs, Volume= 0.464 af
 Primary = 3.66 cfs @ 12.44 hrs, Volume= 0.144 af
 Routed to Pond 1PB : 1PB

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
 Peak Elev= 802.58' @ 12.44 hrs Surf.Area= 0.240 ac Storage= 0.307 af

Plug-Flow detention time= 536.4 min calculated for 0.607 af (100% of inflow)
 Center-of-Mass det. time= 536.5 min (1,344.0 - 807.5)

Volume	Invert	Avail.Storage	Storage Description
#1	799.30'	0.307 af	Custom Stage Data (Prismatic) Listed below (Recalc) 0.768 af Overall x 40.0% Voids

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
799.30	0.240	0.000	0.000
800.00	0.240	0.168	0.168
801.00	0.240	0.240	0.408
802.00	0.240	0.240	0.648
802.40	0.240	0.096	0.744
802.50	0.240	0.024	0.768

Device	Routing	Invert	Outlet Devices
#1	Primary	802.40'	20.0' long x 5.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

2026-03-11 Cottage Grove Pre-Post

MSE 24-hr 3 100-yr Rainfall=7.39"

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#2 Discarded 799.30' **0.800 in/hr Exfiltration over Surface area****Discarded OutFlow** Max=0.19 cfs @ 11.15 hrs HW=799.33' (Free Discharge)↑**2=Exfiltration** (Exfiltration Controls 0.19 cfs)**Primary OutFlow** Max=3.59 cfs @ 12.44 hrs HW=802.58' (Free Discharge)↑**1=Broad-Crested Rectangular Weir**(Weir Controls 3.59 cfs @ 0.99 fps)**Summary for Pond 1PB: 1PB**

Inflow Area = 6.800 ac, 50.00% Impervious, Inflow Depth = 2.48" for 100-yr event

Inflow = 22.87 cfs @ 12.19 hrs, Volume= 1.406 af

Outflow = 0.97 cfs @ 15.10 hrs, Volume= 1.050 af, Atten= 96%, Lag= 174.5 min

Discarded = 0.29 cfs @ 15.10 hrs, Volume= 0.752 af

Primary = 0.67 cfs @ 15.10 hrs, Volume= 0.298 af

Routed to Reach 1PR : 1PR

Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routed to Reach 1PR : 1PR

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Peak Elev= 796.06' @ 15.10 hrs Surf.Area= 0.364 ac Storage= 0.993 af

Plug-Flow detention time= 772.1 min calculated for 1.050 af (75% of inflow)

Center-of-Mass det. time= 701.6 min (1,519.8 - 818.2)

Volume	Invert	Avail.Storage	Storage Description
#1	792.30'	1.788 af	Western Basin (Prismatic) Listed below (Recalc)
#2	792.30'	0.392 af	Eastern Basin (Prismatic) Listed below (Recalc)
#3	792.30'	0.872 af	North Basin (Prismatic) Listed below (Recalc)
		3.052 af	Total Available Storage

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
792.30	0.117	0.000	0.000
793.00	0.134	0.088	0.088
794.00	0.157	0.145	0.233
795.00	0.181	0.169	0.402
796.00	0.208	0.194	0.597
796.50	0.231	0.110	0.707
797.00	0.247	0.119	0.826
798.00	0.290	0.269	1.095
799.00	0.342	0.316	1.411
800.00	0.412	0.377	1.788

2026-03-11 Cottage Grove Pre-Post

MSE 24-hr 3 100-yr Rainfall=7.39"

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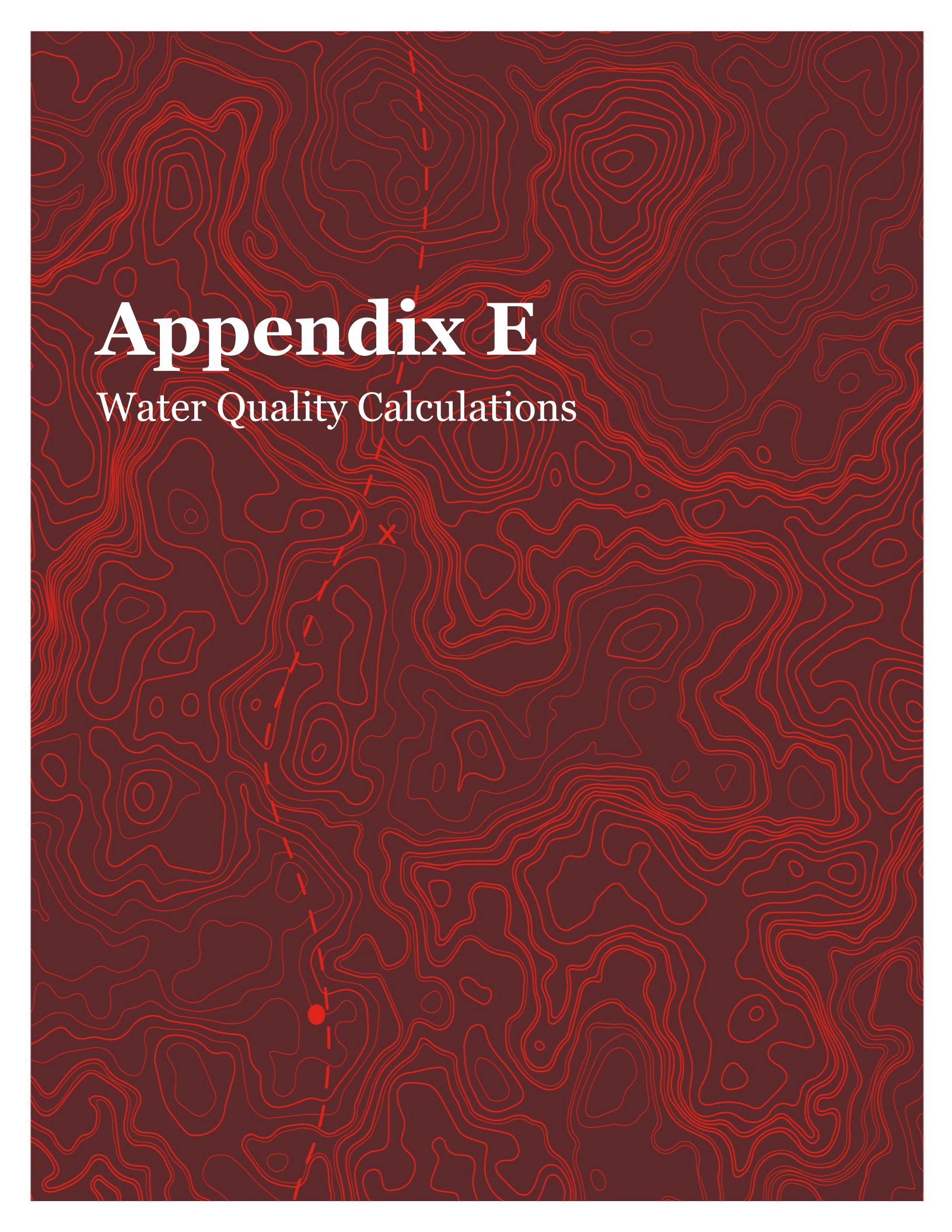
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Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
792.30	0.011	0.000	0.000
793.00	0.016	0.009	0.009
794.00	0.024	0.020	0.029
795.00	0.034	0.029	0.058
796.00	0.045	0.039	0.098
797.00	0.058	0.052	0.149
798.00	0.072	0.065	0.214
799.00	0.089	0.080	0.295
800.00	0.106	0.098	0.392

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
792.30	0.046	0.000	0.000
793.00	0.056	0.036	0.036
794.00	0.071	0.064	0.099
795.00	0.088	0.080	0.179
796.00	0.106	0.097	0.276
797.00	0.126	0.116	0.392
798.00	0.148	0.137	0.529
799.00	0.171	0.159	0.688
800.00	0.197	0.184	0.872

Device	Routing	Invert	Outlet Devices
#1	Secondary	799.00'	10.0' long + 3.0 ' SideZ x 10.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64
#2	Primary	795.50'	18.0" Round Culvert X 2.00 L= 50.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 795.50' / 795.00' S= 0.0100 ' S= 0.0100 ' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf
#3	Device 2	795.50'	7.0" Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads
#4	Device 2	798.00'	24.0" Horiz. Riser X 2.00 C= 0.600 Limited to weir flow at low heads
#5	Discarded	792.30'	0.800 in/hr Exfiltration over Surface area

Discarded OutFlow Max=0.29 cfs @ 15.10 hrs HW=796.06' (Free Discharge)↑**5=Exfiltration** (Exfiltration Controls 0.29 cfs)**Primary OutFlow** Max=0.68 cfs @ 15.10 hrs HW=796.06' (Free Discharge)↑**2=Culvert** (Passes 0.68 cfs of 2.45 cfs potential flow)↑**3=Orifice/Grate** (Orifice Controls 0.68 cfs @ 2.55 fps)↑**4=Riser** (Controls 0.00 cfs)**Secondary OutFlow** Max=0.00 cfs @ 0.00 hrs HW=792.30' (Free Discharge)↑**1=Broad-Crested Rectangular Weir**(Controls 0.00 cfs)



Appendix E

Water Quality Calculations

P8 Urban Catchment Model, Version 3.5				Run Date		01/02/26	
Case	2026-01-02_CottageGrove_ExistingP8Model.p8c		FirstDate	01/01/71	Precip(in)	870.4	
Title	Existing Conditions		LastDate	12/31/00	Rain(in)	756.51	
ProcFile	MSP_19700101-20001231.pcp		Events	2196	Snow(in)	113.84	
PartFile	nurp50.p8p		TotalHrs	261888	TotalYrs	29.88	

Mass Balances by Device

Device: OVERALL		Type:	NONE																							
		Flow	Loads(lbs)																							
Mass Balance Term		acre-ft	P0%	P10%	P30%	P50%	P80%	TSS	TP	TKN	CU	PB	ZN	HC	Concentrations (ppm)											
01 watershed inflows		402.53	7.48	6.14	6.14	6.14	12.28	30.69	0.81	4.76	0.11	0.02	0.51	2.56	0.01	0.01	0.01	0.01	0.01	0.03	0.00	0.00	0.00	0.00	0.00	0.00
03 infiltrate		281.64	4.98	2.41	0.71	0.19	0.04	3.35	0.51	3.04	0.07	0.01	0.32	1.32	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
04 exfiltrate		281.64	1.99	1.81	0.00	0.00	0.00	1.81	0.20	1.22	0.03	0.00	0.13	0.54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
05 filtered		0.00	2.99	0.60	0.71	0.19	0.04	1.54	0.30	1.82	0.04	0.01	0.19	0.78	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
06 normal outlet		120.23	2.50	2.28	1.51	0.71	0.21	4.71	0.26	1.56	0.04	0.01	0.17	0.73	0.01	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00
07 spillway outlet		0.66	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00											
08 sedimen + decay		0.00	0.00	1.45	3.91	5.24	12.03	22.63	0.04	0.16	0.01	0.00	0.02	0.51		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
09 total inflow		402.53	7.48	6.14	6.14	6.14	12.28	30.69	0.81	4.76	0.11	0.02	0.51	2.56	0.01	0.01	0.01	0.01	0.01	0.03	0.00	0.00	0.00	0.00	0.00	0.00
10 surface outflow		120.89	2.50	2.28	1.51	0.71	0.21	4.71	0.26	1.56	0.04	0.01	0.17	0.73	0.01	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00
11 groundw outflow		281.64	1.99	1.81	0.00	0.00	0.00	1.81	0.20	1.22	0.03	0.00	0.13	0.54	0.00	0.00				0.00	0.00	0.00	0.00	0.00	0.00	0.00
12 total outflow		402.54	4.49	4.08	1.51	0.71	0.21	6.52	0.47	2.79	0.06	0.01	0.30	1.27	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00
13 total trapped		0.00	2.99	2.05	4.62	5.42	12.07	24.17	0.34	1.98	0.05	0.01	0.21	1.29												
14 storage increase		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00												
15 mass balance check		-0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00												
Load Reduction (%)		0.00	39.98	33.41	75.34	88.36	98.33	78.75	42.23	41.47	43.59	50.44	41.47	50.44												

Device: WET_POND		Type:	POND																							
		Flow	Loads(lbs)																							
Mass Balance Term		acre-ft	P0%	P10%	P30%	P50%	P80%	TSS	TP	TKN	CU	PB	ZN	HC	Concentrations (ppm)											
01 watershed inflows		402.25	6.71	5.51	5.51	5.51	11.02	27.56	0.73	4.28	0.10	0.02	0.46	2.30	P0%	P10%	P30%	P50%	P80%	TSS	TP	TKN	CU	PB	ZN	HC
03 infiltrate		281.51	4.61	2.29	0.69	0.18	0.04	3.20	0.47	2.81	0.06	0.01	0.30	1.22	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
04 exfiltrate		281.51	1.84	1.72	0.00	0.00	0.00	1.72	0.19	1.13	0.03	0.00	0.12	0.50	0.00	0.00				0.00	0.00	0.00	0.00	0.00	0.00	0.00
05 filtered		0.00	2.77	0.57	0.69	0.18	0.04	1.48	0.28	1.68	0.04	0.01	0.18	0.72	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
06 normal outlet		120.09	2.11	2.15	1.49	0.71	0.20	4.55	0.23	1.33	0.03	0.01	0.14	0.63	0.01	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00
07 spillway outlet		0.66	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00											
08 sedimen + decay		0.00	0.00	1.07	3.34	4.62	10.78	19.81	0.03	0.14	0.01	0.00	0.01	0.45		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
09 total inflow		402.25	6.71	5.51	5.51	5.51	11.02	27.56	0.73	4.28	0.10	0.02	0.46	2.30	0.01	0.01	0.01	0.01	0.01	0.03	0.00	0.00	0.00	0.00	0.00	0.00
10 surface outflow		120.75	2.11	2.15	1.49	0.71	0.20	4.55	0.23	1.33	0.03	0.01	0.14	0.63	0.01	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00
11 groundw outflow		281.51	1.84	1.72	0.00	0.00	0.00	1.72	0.19	1.13	0.03	0.00	0.12	0.50	0.00	0.00				0.00	0.00	0.00	0.00	0.00	0.00	0.00
12 total outflow		402.26	3.95	3.87	1.49	0.71	0.20	6.27	0.41	2.46	0.06	0.01	0.26	1.13	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00
13 total trapped		0.00	2.77	1.64	4.02	4.80	10.82	21.29	0.31	1.82	0.04	0.01	0.19	1.17												
14 storage increase		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00												
15 mass balance check		-0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00												
Load Reduction (%)		0.00	41.19	29.76	72.98	87.15	98.15	77.24	43.12	42.47	44.54	50.91	42.47	50.91												

Device: SWALE		Type:	SWALE																						
		Flow	Loads(lbs)												Concentrations (ppm)										
Mass Balance Term	acre-ft	P0%	P10%	P30%	P50%	P80%	TSS	TP	TKN	CU	PB	ZN	HC	P0%	P10%	P30%	P50%	P80%	TSS	TP	TKN	CU	PB	ZN	HC
01 watershed inflows	0.28	0.76	0.63	0.63	0.63	1.25	3.13	0.08	0.49	0.01	0.00	0.05	0.26	1.00	0.82	0.82	0.82	1.64	4.10	0.11	0.64	0.01	0.00	0.07	0.34
03 infiltrate	0.14	0.37	0.12	0.02	0.01	0.00	0.15	0.04	0.23	0.01	0.00	0.02	0.10	1.00	0.32	0.07	0.02	0.00	0.40	0.10	0.61	0.01	0.00	0.06	0.26
04 exfiltrate	0.14	0.15	0.09	0.00	0.00	0.00	0.09	0.02	0.09	0.00	0.00	0.01	0.04	0.40	0.24				0.24	0.04	0.24	0.01	0.00	0.03	0.11
05 filtered	0.00	0.22	0.03	0.02	0.01	0.00	0.06	0.02	0.14	0.00	0.00	0.01	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
06 normal outlet	0.14	0.39	0.12	0.02	0.01	0.00	0.16	0.04	0.24	0.01	0.00	0.03	0.10	1.00	0.32	0.06	0.01	0.00	0.40	0.10	0.61	0.01	0.00	0.06	0.26
08 sedimen + decay	0.00	0.00	0.38	0.58	0.61	1.25	2.82	0.01	0.02	0.00	0.00	0.00	0.06		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
09 total inflow	0.28	0.76	0.63	0.63	0.63	1.25	3.13	0.08	0.49	0.01	0.00	0.05	0.26	1.00	0.82	0.82	0.82	1.64	4.10	0.11	0.64	0.01	0.00	0.07	0.34
10 surface outflow	0.14	0.39	0.12	0.02	0.01	0.00	0.16	0.04	0.24	0.01	0.00	0.03	0.10	1.00	0.32	0.06	0.01	0.00	0.40	0.10	0.61	0.01	0.00	0.06	0.26
11 groundw outflow	0.14	0.15	0.09	0.00	0.00	0.00	0.09	0.02	0.09	0.00	0.00	0.01	0.04	0.40	0.24				0.24	0.04	0.24	0.01	0.00	0.03	0.11
12 total outflow	0.28	0.54	0.21	0.02	0.01	0.00	0.24	0.05	0.33	0.01	0.00	0.03	0.14	0.71	0.28	0.03	0.01	0.00	0.32	0.07	0.43	0.01	0.00	0.05	0.18
13 total trapped	0.00	0.22	0.41	0.60	0.62	1.25	2.88	0.03	0.16	0.00	0.00	0.02	0.12												
14 storage increase	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00												
15 mass balance check	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00												
Load Reduction (%)	0.00	29.33	65.54	96.04	99.08	99.90	92.09	34.36	32.67	35.17	46.26	32.67	46.26												

P8 Urban Catchment Model, Version 3.5

Run Date 01/13/26

Case	2026-01-02_CottageGrove_ExistingP8Model.p8c	FirstDate	01/01/71	Precip(in)	870.4
Title	Existing Conditions	LastDate	12/31/00	Rain(in)	756.51
PrecFile	MSP_19700101-20001231.pcp	Events	2196	Snow(in)	113.84
PartFile	nurp50.p8p	TotalHrs	261888	TotalYrs	29.88

File Directory	N:\0071487.00\070_Water Resources\SWMP\P8\
Case Title	Existing Conditions
Case File	2026-01-02_CottageGrove_ExistingP8Model.p8c
Particle File	nurp50.p8p
Temperature File	MSP_19700101-20001231.tem
Storm File	MSP_19700101-20001231.pcp
Precip Scale Factor	1

Watersheds	2
Devices	2
Particles	5
WQ Components	7

Start Date	01/01/71
Keep Date	01/01/71
Stop Date	12/31/00
Storm Count	2196
Total Hours	261888
Wet Hours	28761
Precip (in)	870
Rain (in)	757
Snowfall (in)	114
Snowmelt (in)	116
EvapoTran(in)	655

Overall TSS Removal(%)	1
Water Balance Error(%)	0
TSS Mass Balance Error (%)	0

Watershed Label	Total Area	Outflow	Percol	Pervious Curve	Indirect Imperv	Pervious Load	Directly Connected UnSwept Areas-->				Directly Connected Swept Areas-->				Street Sweeping Parameters			
	acres	Device	Device	Number	Fraction	Factor	Imperv	Depress	Runoff	Imperv	Imperv	Depress	Runoff	Imperv	Start Date	Stop Date	Sweep	Sweep Freq
							Fraction	inches	Coef	Factor	Fraction	inches	Coef	Factor	MMDD	MMDD	Effic	1/week
Watershed 1	17.9	WET_POND		30	0.000	1	0.41	0.1	0.9	0	0	0.02	1	1	101	1231	1	0
Watershed 2	1.2	SWALE		30	0.000	1	0	0.1	0.9	0	0	0.02	1	1	101	1231	1	0

Case	2026-01-02_CottageGrove_ExistingP8Model.p8c	FirstDate	01/01/71	Precip(in)	870.4
Title	Existing Conditions	LastDate	12/31/00	Rain(in)	756.51
PrecFile	MSP_19700101-20001231.pcp	Events	2196	Snow(in)	113.84
PartFile	nurp50.p8p	TotalHrs	261888	TotalYrs	29.88

Case Title	Existing Conditions
Case Data File	2026-01-02_CottageGrove_ExistingP8Model.p8c
Path	N:\0071487_00070_Water_Resources\SWMP\P8
Case Notes:	simple start/stop not for use
Storm Data File	MSP_19700101-20001231.cpp
Particle File	nup50.p8p
Air Temp File File	MSP_19700101-20001231.tem

Time Steps Per Hour	4
Minimum Inter-Event Time (hrs)	10
Maximum Continuity Error %	2
Rainfall Breakpoint (inches)	0.8
Precipitation Scale Factor	1
Air Temp Offset (deg-F)	0
Loops Thru Storm File	5
Simulation Dates	
Start	1/1/1971
Keep	1/1/1971
Stop	12/31/2000

Max Snowfall Temperature (deg-F)	32.0
SnowMelt Temperature (deg-F)	32.0
Snowmelt Coef (in/degF-Day)	0.06
Soil Freeze Temp (deg-F)	32.0
Snowmelt Abstraction Factor	1.00
Evapo-Trans. Calibration Factor	1.00
Growing Season Start Month	5
Growing Season End Month	10

5-Day Antecedent Rainfall + Runoff (inches)		
CN Antecedent Moisture Condition	AMC-II	AMC-III
Growing Season	1.40	2.10
NonGrowing Season	0.50	1.10

Watershed Data																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
Watershed Name	Watershed 1	Watershed 2																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							

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P8 Urban Catchment Model, Version 3.5

Case 2026-01-02_CottageGrove_ExistngP8Model.p8c FirstDate 01/01/71
 Title Existing Conditions LastDate 12/31/00
 PrecFile MSP_19700101-20001231.pcp Events 2196
 PartFile nurp50.p8p TotalHrs 261888

Run Date 01/13/26
 Precip(in) 870.4
 Rain(in) 756.51
 Snow(in) 113.84
 TotalYrs 29.88

Particle Data					
Particle File	nurp50.p8p				
Particle Class	P0%	P10%	P30%	P50%	P80%
Filtration Efficiency (%)	60	25	100	100	100
Settling Velocity (ft/hr)	0	0.03	0.3	1.5	15
First Order Decay Rate (1/day)	0	0	0	0	0
2nd Order Decay (1/day-ppm)	0	0	0	0	0
Impervious Runoff Conc (ppm)	1	0	0	0	0
Pervious Runoff Conc (ppm)	1	100	100	100	200
Pervious Conc Exponent	0	1	1	1	1
Accum. Rate (lbs-ac-day)	0	1.75	1.75	1.75	3.5
Particle Removal Rate (1/day)	0	0.25	0.25	0.25	0.25
Washoff Coefficient	0	20	20	20	20
Washoff Exponent	0	2	2	2	2
Sweeper Efficiency	0	0	0	5	15

Water Quality Component Data										
Component Name	TSS	TP	TKN	CU	PB	ZN	HC			

Water Quality Criteria (ppm)										
Level 1	5	0.025	2	2	0.02	5	0.1			
Level 2	10	0.05	1	0.0048	0.014	0.0362	0.5			
Level 3	20	0.1	0.5	0.02	0.15	0.38	1			

Content Scale Factor	1	1	1	1	1	1	1			
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Particle Composition (mg/kg)										
P0%	0	99000	600000	13600	2000	64000	250000			
P10%	1000000	3850	15000	340	180	1600	22500			
P30%	1000000	3850	15000	340	180	1600	22500			
P50%	1000000	3850	15000	340	180	1600	22500			
P80%	1000000	0	0	340	180	0	22500			

P8 Urban Catchment Model, Version 3.5				Run Date	01/13/26
Case	2026-01-02_CottageGrove_ExisitngP8Model.p8c	FirstDate	01/01/71	Precip(in)	870.4
Title	Existing Conditions	LastDate	12/31/00	Rain(in)	756.51
PrecFile	MSP_19700101-20001231.pcp	Events	2196	Snow(in)	113.84
PartFile	nurp50.p8p	TotalHrs	261888	TotalYrs	29.88

Devices Listed in Downstream Order

Device:	WET_POND	Type:	POND
	Runoff from watershed		Watershed 1
Device:	SWALE	Type:	SWALE
	Runoff from watershed		Watershed 2

Mass Balances by Device

Under proposed conditions, annual pollutant loading is reduced below existing conditions.

The pollutant load reduction is greater under proposed conditions.

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P8 Urban Catchment Model, Version 3.5

Run Date 01/13/26

Case	2026-01-02_CottageGrove_ProposedP8Model.p8c	FirstDate	01/01/71	Precip(in)	870.4
Title	Proposed Conditions	LastDate	12/31/00	Rain(in)	756.51
PrecFile	MSP_19700101-20001231.pcp	Events	2196	Snow(in)	113.84
PartFile	nurp50.p8p	TotalHrs	261888	TotalYrs	29.88

File Directory	N:\0071487.00\070_Water Resources\SWMP\P8\
Case Title	Proposed Conditions
Case File	2026-01-02_CottageGrove_ProposedP8Model.p8c
Particle File	nurp50.p8p
Temperature File	MSP_19700101-20001231.tem
Storm File	MSP_19700101-20001231.pcp
Precip Scale Factor	1

Watersheds	2
Devices	2
Particles	5
WQ Components	7

Start Date	01/01/71
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Rain (in)	757
Snowfall (in)	114
Snowmelt (in)	116
EvapoTran(in)	655

Overall TSS Removal(%)	1
Water Balance Error(%)	0
TSS Mass Balance Error (%)	0

							Directly Connected UnSwept Areas-->				Directly Connected Swept Areas-->				Street Sweeping Parameters			
Watershed Label	Total Area	Outflow	Percol	Pervious Curve	Indirect Imperv	Pervious Load	Imperv Fraction	Depress Storage	Runoff	Imperv Load	Imperv Fraction	Depress Storage	Runoff	Imperv Load	Start Date	Stop Date	Sweep	Sweep Freq
	acres	Device	Device	Number	Fraction	Factor	Fraction	inches	Coef	Factor	Fraction	inches	Coef	Factor	MMDD	MMDD	Effic	1/week
Watershed 1	17.2	INF_POND		30	0.000	1	0.53	0.1	0.9	0	0	0.02	1	1	101	1231	1	0
Watershed 2	1.9	INF_TREN		30	0.000	1	0.58	0.1	0.9	0	0	0.02	1	1	101	1231	1	0

5-Day Antecedent Rainfall + Runoff (inches)		
CN Antecedent Moisture Condition	AMC-II	AMC-III
Growing Season	1.40	2.10
NonGrowing Season	0.50	1.10

Watershed Data																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															
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P8 Urban Catchment Model, Version 3.5

Case 2026-01-02_CottageGrove_ProposedP8Model.p8c FirstDate 01/01/71
 Title Proposed Conditions LastDate 12/31/00
 PrecFile MSP_19700101-20001231.pcp Events 2196
 PartFile nurp50.p8p TotalHrs 261888

Run Date 01/13/26
 Precip(in) 870.4
 Rain(in) 756.51
 Snow(in) 113.84
 TotalYrs 29.88

Particle Data					
Particle File	nurp50.p8p				
Particle Class	P0%	P10%	P30%	P50%	P80%
Filtration Efficiency (%)	60	25	100	100	100
Settling Velocity (ft/hr)	0	0.03	0.3	1.5	15
First Order Decay Rate (1/day)	0	0	0	0	0
2nd Order Decay (1/day-ppm)	0	0	0	0	0
Impervious Runoff Conc (ppm)	1	0	0	0	0
Pervious Runoff Conc (ppm)	1	100	100	100	200
Pervious Conc Exponent	0	1	1	1	1
Accum. Rate (lbs-ac-day)	0	1.75	1.75	1.75	3.5
Particle Removal Rate (1/day)	0	0.25	0.25	0.25	0.25
Washoff Coefficient	0	20	20	20	20
Washoff Exponent	0	2	2	2	2
Sweeper Efficiency	0	0	0	5	15

Water Quality Component Data										
Component Name	TSS	TP	TKN	CU	PB	ZN	HC			

Water Quality Criteria (ppm)										
Level 1	5	0.025	2	2	0.02	5	0.1			
Level 2	10	0.05	1	0.0048	0.014	0.0362	0.5			
Level 3	20	0.1	0.5	0.02	0.15	0.38	1			

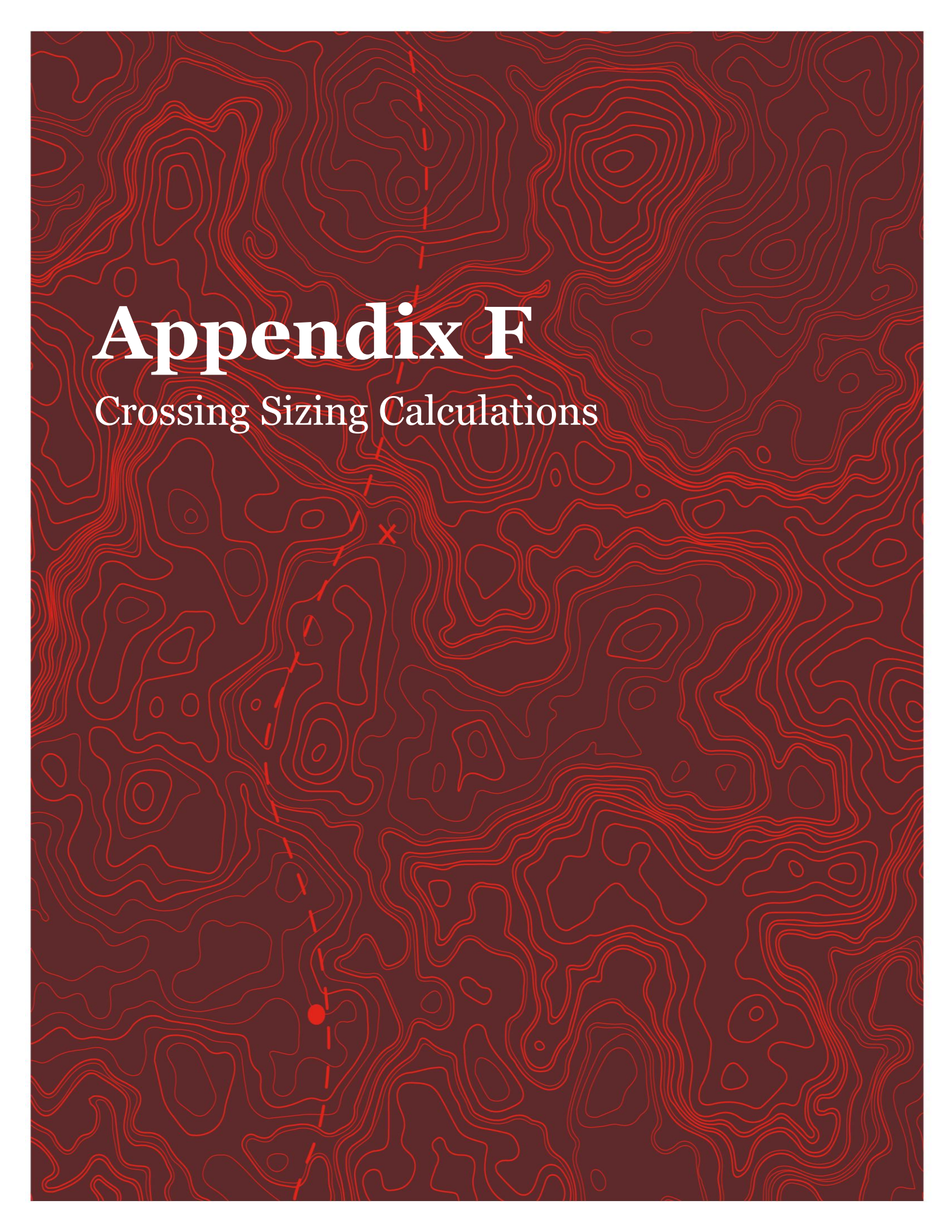
Content Scale Factor	1	1	1	1	1	1	1			
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Particle Composition (mg/kg)										
P0%	0	99000	600000	13600	2000	64000	250000			
P10%	1000000	3850	15000	340	180	1600	22500			
P30%	1000000	3850	15000	340	180	1600	22500			
P50%	1000000	3850	15000	340	180	1600	22500			
P80%	1000000	0	0	340	180	0	22500			

P8 Urban Catchment Model, Version 3.5				Run Date	01/13/26
Case	2026-01-02_CottageGrove_ProposedP8Model.p8c	FirstDate	01/01/71	Precip(in)	870.4
Title	Proposed Conditions	LastDate	12/31/00	Rain(in)	756.51
PrecFile	MSP_19700101-20001231.pcp	Events	2196	Snow(in)	113.84
PartFile	nurp50.p8p	TotalHrs	261888	TotalYrs	29.88

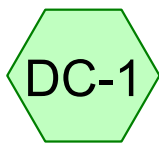
Devices Listed in Downstream Order

Device:	INF_TREN	Type:	INF_BASIN
	Discharges spillway to		INF_POND
	Runoff from watershed		Watershed 2
Device:	INF_POND	Type:	POND
	Runoff from watershed		Watershed 1

The background of the page is a dark red topographic map with intricate contour lines. A dashed red line runs diagonally from the top left towards the bottom center. A red 'x' is located near the center of the page, and a solid red dot is positioned in the lower-left quadrant.

Appendix F

Crossing Sizing Calculations



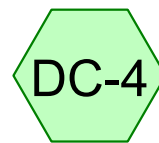
DC-1



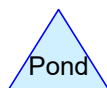
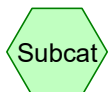
DC-2



DC-3



DC-4



2026-01-05 Cottage Grove Culvert Sizing

Prepared by Westwood Professional Services

Printed 1/12/2026

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Page 2

Rainfall Events Listing (selected events)

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	100-yr	MN-Cottage Grove 24-hr S1	100-yr	Default	24.00	1	7.39	2

2026-01-05 Cottage Grove Culvert Sizing

Prepared by Westwood Professional Services

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Printed 1/12/2026

Page 3

Area Listing (selected nodes)

Area (acres)	CN	Description (subcatchment-numbers)
12.870	30	Meadow, non-grazed, HSG A (DC-1, DC-3, DC-4)
1.500	98	Offsite Unconnected pavement, HSG A (DC-3)
0.200	98	Pond (DC-4)
0.130	98	Pond, HSG A (DC-3)
6.100	98	Unconnected pavement, HSG A (DC-1, DC-2, DC-3, DC-4)
20.800	56	TOTAL AREA

Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

SubcatchmentDC-1: DC-1 Runoff Area=7.100 ac 16.90% Impervious Runoff Depth=0.68"
Flow Length=975' Tc=30.1 min UI Adjusted CN=36 Runoff=2.23 cfs 0.403 af

SubcatchmentDC-2: DC-2 Runoff Area=2.900 ac 100.00% Impervious Runoff Depth=7.15"
Flow Length=675' Slope=0.0090 '/' Tc=8.1 min CN=98 Runoff=25.91 cfs 1.728 af

SubcatchmentDC-3: DC-3 Runoff Area=2.100 ac 96.67% Impervious Runoff Depth=6.91"
Tc=8.0 min CN=96 Runoff=18.75 cfs 1.210 af

SubcatchmentDC-4: DC-4 Runoff Area=8.700 ac 20.69% Impervious Runoff Depth=0.83"
Flow Length=1,135' Tc=30.6 min UI Adjusted CN=38 Runoff=3.61 cfs 0.604 af

Total Runoff Area = 20.800 ac Runoff Volume = 3.944 af Average Runoff Depth = 2.28"
61.87% Pervious = 12.870 ac 38.12% Impervious = 7.930 ac

Summary for Subcatchment DC-1: DC-1

Runoff = 2.23 cfs @ 12.68 hrs, Volume= 0.403 af, Depth= 0.68"
 Routed to nonexistent node 6R

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
 MN-Cottage Grove 24-hr S1 100-yr Rainfall=7.39"

Area (ac)	CN	Adj	Description
5.900	30		Meadow, non-grazed, HSG A
* 1.200	98		Unconnected pavement, HSG A
7.100	41	36	Weighted Average, UI Adjusted
5.900			83.10% Pervious Area
1.200			16.90% Impervious Area
1.200			100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.6	100	0.0270	0.12		Sheet Flow, Grass: Dense n= 0.240 P2= 2.79"
16.5	875	0.0160	0.89		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
30.1	975	Total			

Summary for Subcatchment DC-2: DC-2

Runoff = 25.91 cfs @ 12.06 hrs, Volume= 1.728 af, Depth= 7.15"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
 MN-Cottage Grove 24-hr S1 100-yr Rainfall=7.39"

Area (ac)	CN	Description
* 2.900	98	Unconnected pavement, HSG A
2.900		100.00% Impervious Area
2.900		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.8	100	0.0090	0.93		Sheet Flow, Smooth surfaces n= 0.011 P2= 2.79"
6.3	575	0.0090	1.53		Shallow Concentrated Flow, Unpaved Kv= 16.1 fps
8.1	675	Total			

Summary for Subcatchment DC-3: DC-3

Runoff = 18.75 cfs @ 12.06 hrs, Volume= 1.210 af, Depth= 6.91"
 Routed to nonexistent node 1PB

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
 MN-Cottage Grove 24-hr S1 100-yr Rainfall=7.39"

Area (ac)	CN	Description
0.070	30	Meadow, non-grazed, HSG A
* 0.400	98	Unconnected pavement, HSG A
* 0.130	98	Pond, HSG A
* 1.500	98	Offsite Unconnected pavement, HSG A
2.100	96	Weighted Average
0.070		3.33% Pervious Area
2.030		96.67% Impervious Area
1.900		93.60% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.0					Direct Entry,

Summary for Subcatchment DC-4: DC-4

Runoff = 3.61 cfs @ 12.62 hrs, Volume= 0.604 af, Depth= 0.83"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
 MN-Cottage Grove 24-hr S1 100-yr Rainfall=7.39"

Area (ac)	CN	Adj	Description
6.900	30		Meadow, non-grazed, HSG A
* 1.600	98		Unconnected pavement, HSG A
* 0.200	98		Pond
8.700	44	38	Weighted Average, UI Adjusted
6.900			79.31% Pervious Area
1.800			20.69% Impervious Area
1.600			88.89% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.6	100	0.0270	0.12		Sheet Flow, Grass: Dense n= 0.240 P2= 2.79"
16.5	875	0.0160	0.89		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
0.3	70	0.0070	3.64	17.85	Pipe Channel, 30.0" Round Area= 4.9 sf Perim= 7.9' r= 0.63' n= 0.025 Corrugated metal
0.2	90		9.83		Lake or Reservoir, Mean Depth= 3.00'
30.6	1,135	Total			

Culvert Design Report

DC-1

Peak Discharge Method: User-Specified				
Design Discharge		0.02 cfs	Check Discharge 2.23 cfs	
Grades Model: Inverts				
Invert Upstream		799.31 ft	Invert Downstream 799.24 ft	
Length		110.00 ft	Slope 0.000636 ft/ft	
Drop		0.07 ft		
Headwater Model: Unspecified				
Tailwater Conditions: Constant Tailwater				
Tailwater Elevation		N/A ft		
Name	Description	Discharge	HW Elev.	Velocity
x Trial-1	1-24 inch Circular	2.23 cfs	800.32 ft	3.45 ft/s

Culvert Design Report

DC-1

Design: Trial-1

Solve For: Headwater Elevation

Culvert Summary			
Allowable HW Elevation	N/A ft	Storm Event	Check
Computed Headwater Elevation	800.32 ft	Discharge	2.23 cfs
Headwater Depth/Height	0.51	Tailwater Elevation	N/A ft
Inlet Control HW Elev.	800.04 ft	Control Type	Outlet Control
Outlet Control HW Elev.	800.32 ft		
Grades			
Upstream Invert	799.31 ft	Downstream Invert	799.24 ft
Length	110.00 ft	Constructed Slope	0.000636 ft/ft
Hydraulic Profile			
Profile	M2	Depth, Downstream	0.52 ft
Slope Type	Mild	Normal Depth	1.26 ft
Flow Regime	Subcritical	Critical Depth	0.52 ft
Velocity Downstream	3.45 ft/s	Critical Slope	0.015255 ft/ft
Section			
Section Shape	Circular	Mannings Coefficient	0.024
Section Material	CMP	Span	2.00 ft
Section Size	24 inch	Rise	2.00 ft
Number Sections	1		
Outlet Control Properties			
Outlet Control HW Elev.	800.32 ft	Upstream Velocity Head	0.04 ft
Ke	0.90	Entrance Loss	0.03 ft
Inlet Control Properties			
Inlet Control HW Elev.	800.04 ft	Flow Control	Unsubmerged
Inlet Type	Projecting	Area Full	3.1 ft ²
K	0.03400	HDS 5 Chart	2
M	1.50000	HDS 5 Scale	3
C	0.05530	Equation Form	1
Y	0.54000		

Culvert Design Report

DC-2

Peak Discharge Method: User-Specified								
Design Discharge		15.79	cfs	Check Discharge		25.91	cfs	
Grades Model: Inverts								
Invert Upstream		797.00	ft	Invert Downstream		795.00	ft	
Length		100.00	ft	Slope		0.020000	ft/ft	
Drop		2.00	ft					
Headwater Model: Unspecified								
Tailwater Conditions: Constant Tailwater								
Tailwater Elevation		N/A						ft
Name		Description		Discharge	HW Elev.	Velocity		
x	Trial-1	1-30 inch Circular		25.91	800.23	7.15 ft/s		

Culvert Design Report

DC-2

Design: Trial-1

Solve For: Headwater Elevation

Culvert Summary			
Allowable HW Elevation	N/A ft	Storm Event	Check
Computed Headwater Elevation	800.23 ft	Discharge	25.91 cfs
Headwater Depth/Height	1.29	Tailwater Elevation	N/A ft
Inlet Control HW Elev.	800.02 ft	Control Type	Entrance Control
Outlet Control HW Elev.	800.23 ft		
Grades			
Upstream Invert	797.00 ft	Downstream Invert	795.00 ft
Length	100.00 ft	Constructed Slope	0.020000 ft/ft
Hydraulic Profile			
Profile	S2	Depth, Downstream	1.73 ft
Slope Type	Steep	Normal Depth	1.73 ft
Flow Regime	Supercritical	Critical Depth	1.74 ft
Velocity Downstream	7.15 ft/s	Critical Slope	0.019843 ft/ft
Section			
Section Shape	Circular	Mannings Coefficient	0.024
Section Material	CMP	Span	2.50 ft
Section Size	30 inch	Rise	2.50 ft
Number Sections	1		
Outlet Control Properties			
Outlet Control HW Elev.	800.23 ft	Upstream Velocity Head	0.79 ft
Ke	0.90	Entrance Loss	0.71 ft
Inlet Control Properties			
Inlet Control HW Elev.	800.02 ft	Flow Control	Unsubmerged
Inlet Type	Projecting	Area Full	4.9 ft²
K	0.03400	HDS 5 Chart	2
M	1.50000	HDS 5 Scale	3
C	0.05530	Equation Form	1
Y	0.54000		

Culvert Design Report

DC-3

Peak Discharge Method: User-Specified					
Design Discharge		11.26 cfs	Check Discharge		18.75 cfs
Grades Model: Inverts					
Invert Upstream		792.60 ft	Invert Downstream		792.30 ft
Length		90.00 ft	Slope		0.003333 ft/ft
Drop		0.30 ft			
Headwater Model: Unspecified					
Tailwater Conditions: Constant Tailwater					
Tailwater Elevation		N/A ft			
Name	Description	Discharge	HW Elev.	Velocity	
x Trial-1	1-30 inch Circular	18.75 cfs	795.32 ft	6.26 ft/s	

Culvert Design Report

DC-3

Design: Trial-1

Solve For: Headwater Elevation

Culvert Summary			
Allowable HW Elevation	N/A ft	Storm Event	Check
Computed Headwater Elevation	795.32 ft	Discharge	18.75 cfs
Headwater Depth/Height	1.09	Tailwater Elevation	N/A ft
Inlet Control HW Elev.	794.99 ft	Control Type	Outlet Control
Outlet Control HW Elev.	795.32 ft		
Grades			
Upstream Invert	792.60 ft	Downstream Invert	792.30 ft
Length	90.00 ft	Constructed Slope	0.003333 ft/ft
Hydraulic Profile			
Profile	M2	Depth, Downstream	1.47 ft
Slope Type	Mild	Normal Depth	N/A ft
Flow Regime	Subcritical	Critical Depth	1.47 ft
Velocity Downstream	6.26 ft/s	Critical Slope	0.016880 ft/ft
Section			
Section Shape	Circular	Mannings Coefficient	0.024
Section Material	CMP	Span	2.50 ft
Section Size	30 inch	Rise	2.50 ft
Number Sections	1		
Outlet Control Properties			
Outlet Control HW Elev.	795.32 ft	Upstream Velocity Head	0.25 ft
Ke	0.90	Entrance Loss	0.23 ft
Inlet Control Properties			
Inlet Control HW Elev.	794.99 ft	Flow Control	N/A
Inlet Type	Projecting	Area Full	4.9 ft²
K	0.03400	HDS 5 Chart	2
M	1.50000	HDS 5 Scale	3
C	0.05530	Equation Form	1
Y	0.54000		

Culvert Design Report

DC-4

Peak Discharge Method: User-Specified				
Design Discharge		0.56 cfs	Check Discharge 3.61 cfs	
Grades Model: Inverts				
Invert Upstream		793.00 ft	Invert Downstream 792.30 ft	
Length		350.00 ft	Slope 0.002000 ft/ft	
Drop		0.70 ft		
Headwater Model: Unspecified				
Tailwater Conditions: Constant Tailwater				
Tailwater Elevation		N/A ft		
Name	Description	Discharge	HW Elev.	Velocity
x Trial-1	1~30 inch Circular	3.61 cfs	794.14 ft	3.77 ft/s

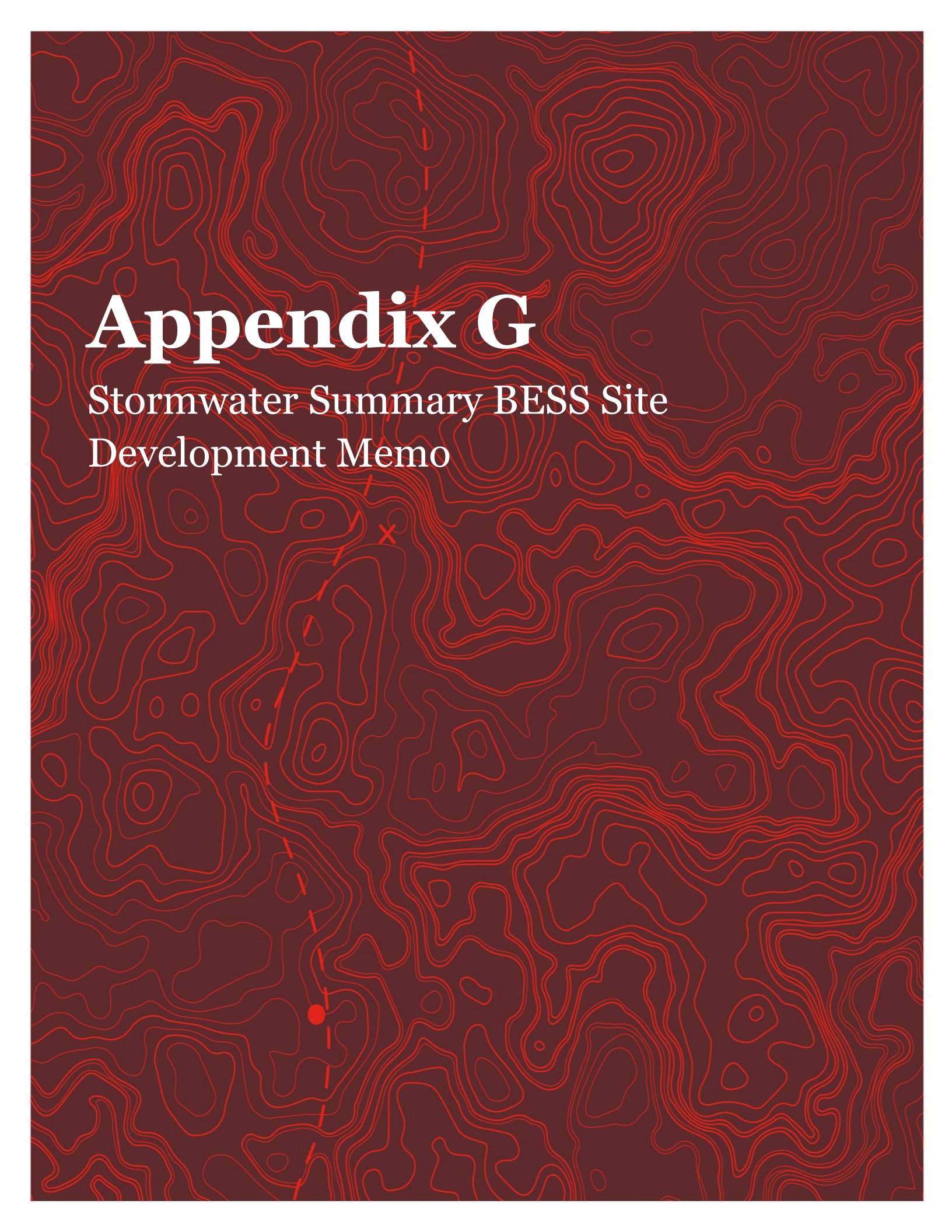
Culvert Design Report

DC-4

Design: Trial-1

Solve For: Headwater Elevation

Culvert Summary			
Allowable HW Elevation	N/A ft	Storm Event	Check
Computed Headwater Elevation	794.14 ft	Discharge	3.61 cfs
Headwater Depth/Height	0.46	Tailwater Elevation	N/A ft
Inlet Control HW Elev.	793.87 ft	Control Type	Outlet Control
Outlet Control HW Elev.	794.14 ft		
Grades			
Upstream Invert	793.00 ft	Downstream Invert	792.30 ft
Length	350.00 ft	Constructed Slope	0.002000 ft/ft
Hydraulic Profile			
Profile	M2	Depth, Downstream	0.62 ft
Slope Type	Mild	Normal Depth	1.04 ft
Flow Regime	Subcritical	Critical Depth	0.62 ft
Velocity Downstream	3.77 ft/s	Critical Slope	0.014191 ft/ft
Section			
Section Shape	Circular	Mannings Coefficient	0.024
Section Material	CMP	Span	2.50 ft
Section Size	30 inch	Rise	2.50 ft
Number Sections	1		
Outlet Control Properties			
Outlet Control HW Elev.	794.14 ft	Upstream Velocity Head	0.05 ft
Ke	0.90	Entrance Loss	0.05 ft
Inlet Control Properties			
Inlet Control HW Elev.	793.87 ft	Flow Control	N/A
Inlet Type	Projecting	Area Full	4.9 ft²
K	0.03400	HDS 5 Chart	2
M	1.50000	HDS 5 Scale	3
C	0.05530	Equation Form	1
Y	0.54000		



Appendix G

Stormwater Summary BESS Site
Development Memo



Real People. Real Solutions.

3507 High Point Drive North
Bldg. 1 Suite E130
Oakdale, MN 55128

Ph: (651) 704-9970
Bolton-Menk.com

MEMORANDUM

Date: 3-26-2025
To: Crystal Raleigh, PE
From: Brent Johnson, PE
Subject: Stormwater Rules Summary; LSP 9525 105th Street South Stormwater Summary
City of Cottage Grove
Project No.: N15.103963

Redevelopment is being planned at 9525 105th Street South on the site of the LSP (PIN 2702721420004). The following notes regarding the Cottage Grove stormwater rules and standards are excerpts from the City's Surface Water Plan and the South Washington Watershed District rules. The future land use map for this parcel indicates Industrial.

1. **If the Redeveloped Area will be less than 1 acre: Therefore**, the MS4 Permit provisions do not apply, and the NPDES Construction Stormwater Permit and associated NPDES permanent stormwater treatment are not required. Also, since the disturbed area of the proposed redevelopment project will be less than 1 acre, the South Washington Watershed District stormwater rules, including volume control and total phosphorus load limits, do not apply.

- a. **Water Quality Treatment:** For redevelopment projects of less than 1 acre, the City requires a net reduction from pre-project conditions. Therefore, on an annual average basis, reductions shall be obtained for the stormwater discharge volume and the stormwater discharges of total suspended solids (TSS) and total phosphorus (TP). The net reduction will apply to impervious areas that are redeveloped.

The proposed new impervious surfaces on redevelopment projects will need to achieve post-development reductions in TP and TSS by 50% and 80%, respectively. New impervious surfaces are defined as the difference between the total impervious area of the site before the re-development activity and total impervious area for the post-re-development condition.

Submit a water quality analysis to demonstrate compliance using a method such as the P8 or MIDS models.

2. **If the Redeveloped Area Is 1 acre or more:** Because redevelopment will involve a disturbance of 1 acre or more (including projects less than one acre that are part of a larger common plan of development or sale), the MS4 permit provisions will apply, an NPDES Construction Stormwater

Permit, SWPPP, and associated NPDES permanent stormwater treatment will be needed, and the South Washington Watershed District volume control and total phosphorus (TP) load limits will apply.

- a. **Volume Control and Water Quality Treatment:** The City requires a uniform volume control treatment equal to 1" of runoff from the sum of new and fully reconstructed impervious surfaces. The site does not lie within the Wellhead Protection Area; therefore, stormwater infiltration features are allowable by the city within this area unless prohibited by the MN Department of Health, or the MPCA Stormwater Manual (depth to bedrock, depth to groundwater, or other criteria).

Where infiltration to fully meet the volume control measure is not desirable or is impossible, an Alternative Sequencing procedure will be applied to achieve compliance. The applicant will use to the maximum extent practical filtration and biofiltration practices, using a clay liner and an underdrain sized to meet the volume control requirement for the site, or use wet sediment basins sized per the standards within the MPCA General Construction Stormwater Permit. Another alternative procedure is to use the cash dedication for off-site volume control or total phosphorus mitigation.

- b. **TP Load Limit:** South Washington Watershed District rules call for TP loading rate of 0.22 lbs./acre/year or existing loading rates, whichever is less, since the project site drains to the Mississippi River. Submit a water quality analysis of existing and proposed TP loads using a method such as the P8 or MIDS models. If on-site BMPs, such as filtration, are not sufficient to meet the water quality total phosphorus loading rates, the purchase of off-site mitigation credits is an option.

For water quality analyses using the MIDS or P8 models, the South Washington Watershed District (SWWD) Standards Manual (November 2023) includes required adjustments to the MIDS and P8 models:

<i>Model</i>	<i>Parameter</i>	<i>Required</i>
<i>MIDS</i>	<i>Retention Requirement</i>	<i>1.0 inch</i>
<i>MIDS</i>	<i>Total Phosphorus EMC, Change from Default 0.3 mg/l</i>	<i>0.31 mg/l</i>
<i>P8</i>	<i>Precipitation and Temperature Files</i>	<i>Download modified .pcp and .tmp files from District website</i>
<i>P8</i>	<i>Start Date</i>	<i>1-1-1971</i>
<i>P8</i>	<i>Keep Date</i>	<i>1-1-1971</i>
<i>P8</i>	<i>Stop Date</i>	<i>12-31-2000</i>
<i>P8</i>	<i>Number of passes through the storm file</i>	<i>5</i>
<i>P8</i>	<i>Impervious Depression Storage</i>	<i>0.1</i>
<i>P8</i>	<i>Impervious Runoff Coefficient</i>	<i>0.9</i>
<i>P8</i>	<i>Max infiltration rate</i>	<i>0.8 inch/hour</i>
<i>P8</i>	<i>Phosphorus Event Mean Concentration</i>	<i>Nurp50 particle file</i>
<i>P8</i>	<i>Total Suspended Solids Event Mean Concentration</i>	<i>Nurp50 particle file</i>

The Standards Manual is available at the link below:

[SWWD Standards-Guidance-Manual Final 11062023.pdf \(swwdmn.org\)](#)

If on-site BMPs, such as infiltration or filtration, are not sufficient to meet the water quality total phosphorus loading rates, the purchase of off-site mitigation credits is an option.

Rate Control: Peak flow rates after development shall not exceed pre-development peak flow rates for the critical 2-year, 10-year, and 100-year recurrence interval precipitation events. Use 24-hour NOAA Atlas 14 Precipitation events and MSE3 distribution for rate control analyses and pond storage design. More restrictive rate control criteria may be required to protect the integrity of downstream conveyance channels and ponds.

The project site is located within the East Ravine drainage and within the subwatershed area identified as ER-A14. The Surface Water Management Plan indicates a developed condition curve number of 85 for this area, with an average impervious percentage of 65%. Proposed condition outflow rates for lands within this subwatershed need to be at or below the unit peak outflow rate listed in **Table 1**, or existing rates, whichever is lower.

Table 1 Unit Peak Outflow Rates

Subwatershed	Unit Peak Outflow Rate (cfs/acre)
ER-A14	0.11

Curve Numbers: The South Washington Watershed District Standards Manual specifies: *Project proposers shall use runoff curve numbers (CN) based on land cover and HSG as published in the Minnesota Stormwater Manual: Stormwater runoff coefficients/curve numbers for different land uses – Minnesota Stormwater Manual (state.mn.us)*

The site soils include primarily hydrologic soil group A and we expect that proposed conditions pervious areas for urban land use types will be simulated with curve numbers of 61.

Pretreatment: The city requires adequate pretreatment of stormwater runoff from development and redevelopment activities prior to discharge into all waterbodies. The city will require that infiltration and filtration basins be constructed to be “off-line” so that the basins fill along with their pretreatment basins, but higher flood flows are not routed through the infiltration or filtration basins, to have better long-term operation and less maintenance. If wet sediment ponds are used for pretreatment, they should include equalizer pipes to carry flow into the infiltration or filtration basins.

Permanent Pools in Stormwater Ponds: In an effort to ensure that wet ponds are designed in a way to improve the probability of maintaining a normal water level, the following should be applied:

Permanent pool volume should be greater than or equal to the volume of runoff from a 2.5-inch rainstorm under full projected watershed development. This value has been derived from design criteria developed under National Urban Runoff Program (NURP), with a 25% increase in volume to allow for roughly 25 years of sediment accumulation. In the summer, this sizing rule provides a mean hydraulic residence time of about 15 days.

Additional items to help ponds achieve a normal water level:

1. 12” (minimum) of topsoil will be placed over the clay liner

2. 12" (minimum) clay liner shall be provided:
 - a. Maximum permeability of 1×10^{-6} cm/s
 - b. Liner to extend 1-foot vertically above the pond normal water level.
3. For ponds with permanent pools 1-2 times the volume of the 2.5" rain runoff:
 - a. 3:1 slopes below the NWL will be allowed per city detail STO-15
4. For ponds with permanent pools 2-4 times the volume of the 2.5" rain runoff:
 - a. 4:1 slopes below the NWL will be provided
5. No pond with a permanent pool greater than 4 times the volume of the 2.5" rain runoff will be allowed.

Wetlands: The South Washington Watershed District will act as the Local Government Unit (LGU) for administration of the Wetland Conservation Act (WCA). Please provide copies of wetland delineation and permitting correspondence to the city. The South Washington Watershed District rules call for wetland buffers and other requirements based on wetland management classification and size.

Freeboard standards: For stormwater facilities with emergency overflows, the low adjacent grade elevation for all new structures must be a minimum of 3 feet above both the peak surface water elevation for the 100-year precipitation event and 2 feet above the emergency overflow elevation of any immediately adjacent new stormwater basin. For backyard and side-yard conveyance and temporary ponding areas, there must be at least 1 foot between the overland overflow elevation and the low adjacent grade elevation of the adjacent structure.

Rational Storm Sewer Design: On-site storm sewer should be sized to a 5-year rational method design. Submit design calculations for the storm sewer system and a drainage area map showing each catchment with manholes and catch basins labeled. Include individual pipe segment velocities with calculations for review. Trunk facilities should be analyzed and designed to accommodate the 100-year ponded discharges plus 5-year rational flows from areas that enter the trunk to be carried to the next storage area downstream.

- a. Pipe sizes and slopes should be selected to provide a minimum open channel velocity of 3 feet per second.
- b. Maximum storm sewer velocities should be kept at 10 feet per second or less.
- c. When changing pipe sizes in structure, match crown of pipe elevations instead of inverts.
- d. Please show storm catch basin IDs, pipe sizes, grades, elevations, and drainage areas on the plans consistent with the rational design tables.
- e. Pipe outlets to wet ponds should be placed at the NWL and have design velocities of 6 fps or less. Pipe outlets into filtration basins or other overland discharge should have design velocities of 4 fps or less.

Soil Borings: Soil borings are required in the vicinity of proposed volume control BMPs. Borings are needed to identify soil conditions and the presence of groundwater or bedrock. Soil borings should extend a minimum of 5 feet below the lowest constructed elevation of proposed BMPs.

Control Erosion at Construction Sites:

The city requires that applications for new or redevelopment activity include in their applications

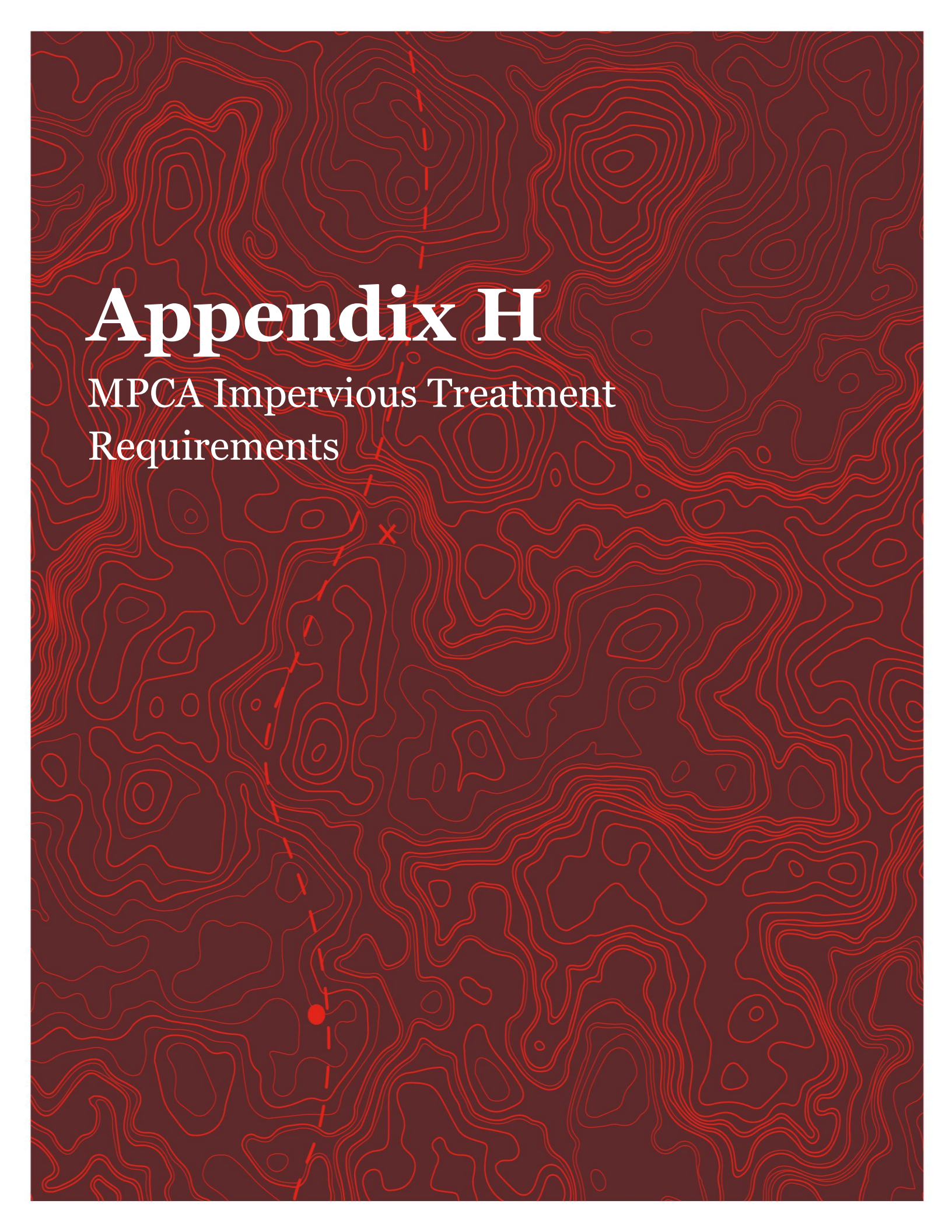
for City review, a SWPPP as required under the NPDES construction permit in effect at the time of review. Construction sites will be inspected to ensure compliance with the existing erosion and sediment control ordinance, Watershed District requirements, and with the construction site permit under NPDES Phase II MS4 rules. The city completes quality assurance inspections on all NPDES permits in the city (where the city is not the owner) twice each month. Erosion and sediment control best management practices as outlined in the Minnesota Stormwater Manual will be required and must be shown on required submittals to the City for approval. Any street sweeping conducted by the City to remove erosional debris from streets will be charged to the owner of the property.

Testing: The city will require post-construction testing to verify the filtration rates and drawdown periods of any filtration basins.

Models: Please note that digital copies of the final version stormwater models and shapefiles or CAD drawings of existing and proposed drainage areas are to be submitted to the city once the review and revision process is complete.

NPDES Construction Stormwater Permit

When the disturbed area of development exceeds 1 acre, an NPDES Construction Stormwater Permit is required.



Appendix H

MPCA Impervious Treatment Requirements

Project Title:	Cottage Grove
Project Number:	R0071487.00
Designed By:	AMC
Design Date:	1/16/2026

MPCA INFILTRATION BASIN SIZING REQUIREMENTS

Basin 1

Site Information

Total Drainage Area to Pond	19.10	ac
Impervious Surface Area	9.50	ac
Req treatment volume from MPCA sheet	0.79	ac-ft
Soil Type	SP	A
Infiltration Rate	0.80	in/hr
Required Drawdown time	48.00	hr
Required Water Quality Rainfall Event	1.00	in

Basin Storage

Contour	Distance Feet	Area (ac)	Storage (ac-ft)	Cumm. Storage (ac-ft)
792.3		0.17		
	1.7		0.36	0.36
794.0		0.25		
	2.0		0.61	0.97
796.0		0.36		
	2.0		0.87	1.84
798.0		0.51		
	2.0		1.23	3.07
800.0		0.72		

Basin Outlet Elevation 795.50

MPCA Basin Requirement Review

Max basin depth to meet required drawdown time	3.2 ft
Proposed Basin Infiltration Depth	3.2 ft
Required Water Quality Volume	0.79 ac-ft
Proposed Basin Water Quality Volume	0.80 ac-ft
Proposed Infiltration Trench Volume	0.31 ac-ft
Total Provided Water Quality Volume	1.11 ac-ft