

STORMWATER DRAINAGE STUDY

FOR

Cobey Creek – 2nd Plat Lee's Summit, Missouri

Prepared For:

Clayton Properties Group
120 SE 30th Street
Lee's Summit, MO 64082

Prepared By:

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May 11, 2022



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A3 – Detention Basin Plan and Profile

Appendix B: NRCS Soil Report

Appendix C: FEMA Flood Map

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Appendix F: Master Drainage Study

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(By Hg Consult, Inc)

F2 – As-Builts Storm Report Addendum 4 for Cobey Creek – Mixed Use
Development (By Hg Consult, Inc)

Appendix G: Phase 1 Wet Detention Basin As-Built Plans

1.0 - Introduction

This drainage study has been prepared for Clayton Properties Group to support the construction of Cobey Creek 2nd Plat, a mixed-use commercial and residential subdivision located in Lee's Summit, Missouri. The proposed construction activities consist of mass grading, roadway construction, utility installation, and a wet detention basin. The total disturbed area for all four phases of the project is 97.3-acres, with Cobey Creek 2nd Plat (Phase 2) consisting of 61.0-acres.

The location of the Project Site can further be described as the southeast quarter of Section 29, Township 49 North, Range 31 West in the City of Lee's Summit, Jackson County, Missouri. The Cobey Creek 2nd Plat Project Site map can be seen in **Figure 1** and **Figure 2** below. The land is zoned Planned Mixed Use (PMIX). Adjacent properties to the north and to the west of the land are zoned Agricultural (AG). The adjacent property to the east zoned Agricultural (A) and is located in the City of Greenwood, Missouri. The adjacent property to the south is on the other side of US Highway 150 and is zoned Agricultural (AG) and Planned Community Commercial (CP-2).

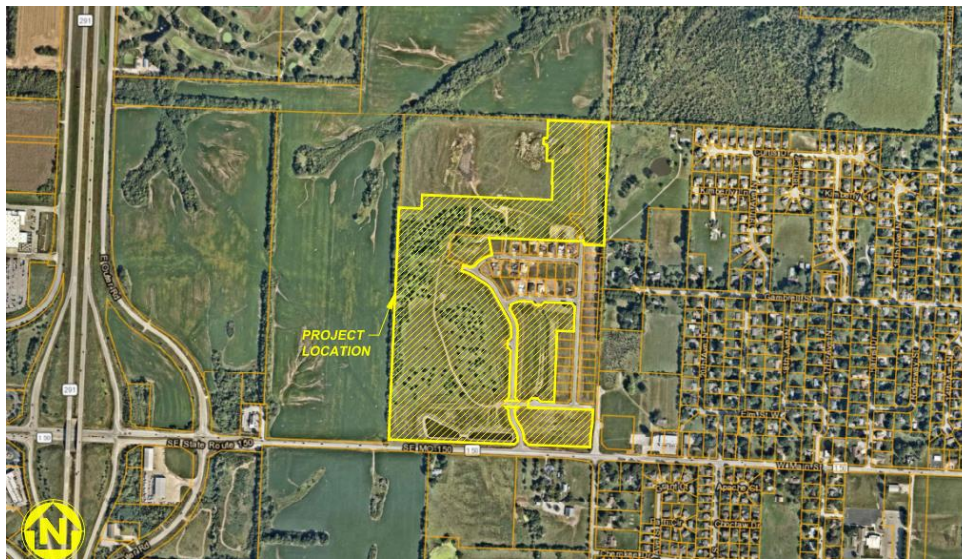


Figure 2: Project Location

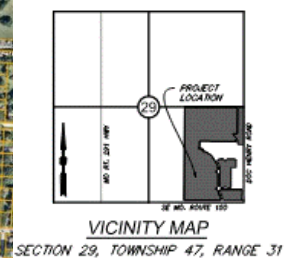


Figure 1: Vicinity Map

2.0 – Master Drainage Study

2.1 Existing Conditions

2.1.1 General

Cobey Creek 2nd Plat is the second of four phases for the mixed-use development plan. A stormwater report for all four phases of the development plan was completed by Hg Consult, Inc. in October of 2020, with a fourth and final addendum dated April 23, 2021 (together to be referred to hereon as the “Master Drainage Study”). Refer to **Appendix F** for the Master Drainage Study.

Phase 1 of Cobey Creek has been constructed and contains one dry detention basin in the northeast corner of the property and two of the three wet detentions basins that were originally approved at the south end. The wet detention basins are intended to function as a treatment train, acting in series as the upper basin(s) spill over into the lowest basin. The existing wet detention basins from Phase 1 can be seen in **Figure 3**. A third wet detention basin (referred to as “Pond 1” in the Master Drainage Study and Phase 1 Wet Detention



Figure 3: Existing Site Condition (Nov. 05, 2021)

Basin As-Built) was proposed for the Master Drainage Study that was not constructed in Phase 1. After a change in ownership of the property in 2021, Anderson Engineering Inc. was hired to finalize the design of the remaining phases of construction. After further investigation, it was concluded that the remaining wet detention basin was not constructed in Phase 1 due to a conflict with an existing 20” KCMO water main and easement that cuts across the southwest corner of the property. Upon this assessment, Anderson Engineering Inc. has re-designed the basin to avoid the existing water main conflict, while maintaining the functionality and intent of the originally approved wet detention basin.

Cobey Creek 2nd Plat (Phase 2) predominantly drains to the existing dry detention basin located at the northeast corner of the development, as intended in the Master Drainage Study and preliminary development plan. The Master Drainage Study indicates this basin was designed to

serve as the primary measure of reducing stormwater discharge from the fully developed condition of the property and provide water quality. Refer to **Appendix A** for the proposed drainage area map and Master Drainage Study drainage area map.

2.1.2 Watershed

The mixed-use development plan resides within an unnamed tributary of Big Creek Watershed. Stormwater leaves the project site in two locations. The majority of the development area drains northeast to an existing (Phase 1) dry detention basin which outflows to an unnamed tributary to Big Creek. A smaller portion of the site drains south to the two existing wet detention basins in series, which outfalls south of US Highway 150 to an unnamed tributary of Lake Winnebago.

3.0 - Objective

This report summarizes the hydrologic and hydraulic analyses of the third proposed wet detention basin, which is the fourth and final detention basin planned for the development, performed by Anderson Engineering Inc. The fourth detention basin proposed in the Master Drainage Study was not constructed in Phase 1 and therefore will be constructed in Phase 2. The design and outfall conditions for the proposed basin will meet or exceed those of the previously completed Master Drainage Study. Using the current standards and specifications set forth by the City of Lee's Summit, the objective of this report is to demonstrate that the proposed detention basin will meet the requirements of the City of Lee's Summit, Missouri, and that adequate stormwater detention and water quality measures are provided within the project limits.

4.0 – Mapping

The Project Site was surveyed by Anderson Engineering Inc. and is the source of the topographic mapping data that was utilized in this drainage analysis. This topographic information was also used in the civil engineering design of the proposed site improvements, performed by Anderson Engineering Inc. To view topographic contours of the pre-developed and post-developed site, refer to **Appendix A** of this report.

5.0 – Site Description

5.1 Existing Conditions

5.1.1 General

The existing Project Site consists of an undeveloped, open grassed space. The turf is in good condition and generally drains southeast to the proposed wet detention basin, which outfalls to the two existing wet detention basins in series. The final basin in the wet detention series (existing) outfalls south of US Highway 150 to an unnamed tributary to Lake Winnebago. The Project Site is located within an area of minimal flood hazard (Zone X) as shown of FEMA flood hazard map 29095C0551G effective 1/20/2017. Refer to Map in **Appendix B** for more information.

Based on the Soil Survey of Jackson County by the USDA Natural Resource Conservation Service, the Project Site soil type is Arisburg Silt Loam (1 to 5 percent slopes, Hydrologic Soil Group C). For more information on the existing soil conditions, refer to the Soil Report included in **Appendix C** of this report.

5.1.2 Existing Drainage

The area draining to the Project Site predominantly offsite flow. The drainage area is 2.80-acres in site and flows northwest to southeast via sheet flow and shallow concentrated flow. The existing drainage flows east to the first Phase 1 wet detention basin in series. For more information on the existing drainage conditions of the site, refer to the Drainage Map located in **Appendix A** of this report.

5.2 Proposed Development

The proposed wet detention basin volume and outfall conditions are designed to meet or exceed those of the design and capacity of the original Master Drainage Study. The wet detention basin has been designed for the 2-yr, 10-yr, and 100-yr design storm, per City of Lee's Summit, Missouri requirements. The location of the basin shifted slightly from the Master Drainage Study and Phase 1 plans due to an existing water main and easement southwest of the proposed basin.

The proposed drainage area is 2.80-acres in size and follows the drainage pattern of existing conditions, since the majority of flow is from off-site. The stormwater runoff from the west will drain eastward to the proposed wet detention basin and be collected before it reaches the

existing wet detention basins. This will provide an additional measure of water quality due to siltation, limit the peak runoff flowing from offsite, and provide a culvert for water flow under the proposed entry drive of SE Sunset Ridge. The proposed basin will outfall into the existing Phase 1 wet detention basin in series, as planned in the Master Drainage Study. Refer to **Appendix G** for the Phase 1 wet detention basin as-built plans. Stormwater flowing out of the detention basin will be controlled by an elevated 24-inch flared end section as shown in **Figure 4**. The full plan and profile of the proposed wet detention basin can be found in **Appendix A**. Additional storage was added to the bottom of the wet detention basin to allow additional volume for silt accumulation, acting as a water quality pool to enhance sedimentation and pollutant removal of dissolved nutrients and urban pollutants. For more information on the proposed development drainage patterns, refer to the Drainage Map in **Appendix A**.

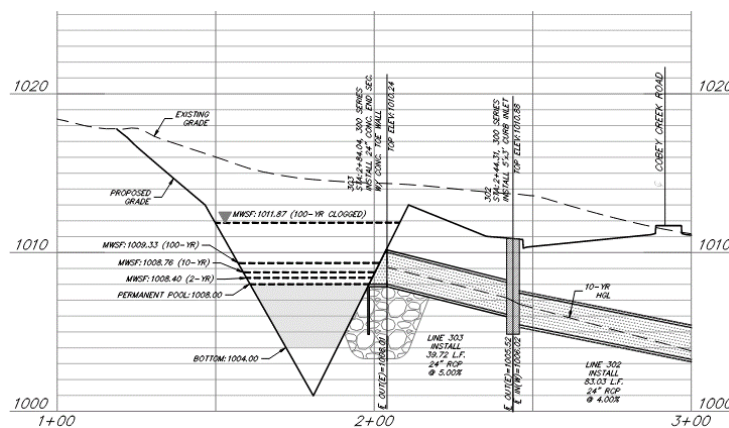


Figure 4: Detention Basin Outlet Control Structure Visual

6.0 – Hydrologic Analysis

6.1 Methodology

This study uses Section 5600 – Storm Drainage Systems & Facilities, City of Lee's Summit, Missouri, Design Criteria (July 2020) and the Kansas City Metropolitan Chapter of the American Public Works Association, Section 5600 (February 2011) as its guideline. The SCS TR-55 method was used to calculate runoff curve numbers and Hydrflow Hydragraphs software extension for AutoDesk Civil 3D was used to evaluate storm drainage and storage requirements, as well as aid in the design of the detention outlet structure. A Type II 24-hour rainfall distribution was used to determine all stormwater hydrographs. The 2-year, 10-year, and 100-year, 24-hour rainfall

depths used within the model were determined from NOAA Atlas 14, Volume 8, Version 2. To view the NOAA data, refer to **Appendix D** of this report. The following rainfall depths were used for this study:

$$P_2 = 3.68 \text{ in.}$$

$$P_{10} = 5.61 \text{ in.}$$

$$P_{100} = 9.17 \text{ in.}$$

6.2 Curve Number Calculations

Table 1 summarizes the weighted curve number calculations that were used in this drainage analysis. The surface cover type determined at the Project Site is open grassed space, good condition (CN=74). As the drainage area is primarily offsite and not being developed, the pre-development and post-development curve numbers are the same.

Table 1: SCS Curve Number Calculations

SCS CURVE NUMBER CALCUATIONS				
EXISTING & PROPOSED SUB-BASINS				
Drainage Sub-Basin	Hydrologic Soil Group	Total Area (acres)	Grass CN = 74	Composite CN
EXISTING	C	2.80	74	74
PROPOSED	C	2.80	74	74

6.3 Time of Concentration

The SCS TR-55 method was used to calculate the time of concentration for the existing and proposed drainage assessments. The Hydraflow Hydrographs extension for AutoDesk Civil 3D automatically calculates the time of concentration for sheet flow and shallow concentrated flow. **Table 2** on the next page summarizes the time of concentration results that were generated in Hydraflow. Similar to the curve number, there is no change in time of concentration between existing and proposed conditions. For more information on the time of concentration calculations, refer to the Hydraflow report located in **Appendix E**.

Table 2: Time of Concentration

TIME OF CONCENTRATION		
EXISTING SUB-BASINS		
Drainage Sub-Basin	TC (Min)	Manning's n (Sheet Flow)
EXISTING	33.5	0.24
PROPOSED	33.5	0.24

6.4 Detention Basin Performance

The wet detention basin has a capacity of 2.86 acre-feet of storage and is designed to handle a 100-year design storm with greater than 1.0-feet of freeboard. **Table 3** shows the performance of the detention basin for a 2-year, 10-year, and 100-year design storm. As shown in **Figure 4**, the elevated 24-inch outfall limits the flow of water leaving the basin, which causes water to be temporarily stored and released at a controlled rate. The permanent pool elevation of the wet detention basin is 1008.00, which is the same elevation as the outfall structure. Additional storage was added to the bottom of the wet detention basin to allow for silt accumulation, acting as a water quality pool. The additional storage allows for at least 5-years of sediment accumulation at the bottom of the basin without impact to the intended functionality of the wet detention basin. The size of proposed wet detention basin is 1.85 acre-feet for the 100-year design storm and a maximum storage capacity of 2.86 acre-feet. For more information about the proposed wet detention basin, refer to the Hydraflow report located in **Appendix E** of this report.

Table 3: Proposed Detention Basin Performance

PROPOSED DETENTION BASIN					
BASIN PERFORMANCE					
DESIGN STORM	Flow In (CFS)	Flow Out (CFS)	Peak Storage (AC-FT)	Peak Stage Over Permanent Pool (FT)	Peak Elevation (FT)
2-YEAR	3.12	0.97	1.54	0.40	1008.40
10-YEAR	6.77	3.29	1.66	0.76	1008.76
100-YEAR	14.23	8.71	1.85	1.33	1009.33

6.5 Peak Flow Rates

The City of Lee's Summit, Missouri requires post-development flow rates leaving the site be less than pre-development flow rates. **Table 4** summarizes the pre-development and post-development flow rates for a 2, 10, and 100-year design storm.

Table 4: Peak Flow Rates

PRE-DEVELOPMENT vs. POST-DEVELOPMENT	
2-YEAR PEAK FLOW RATE	
Existing (CFS)	Proposed (CFS)
3.12	7.46
10-YEAR PEAK FLOW RATE	
Existing (CFS)	Proposed (CFS)
6.77	3.29
100-YEAR PEAK FLOW RATE	
Existing (CFS)	Proposed (CFS)
14.23	8.71

7.0 – Downstream Impacts

Using the Hydraflow Hydrographs extension for AutoDesk Civil 3D, Anderson Engineering Inc. constructed a drainage model that was able to assess the peak runoff and detention release rates for a 2-yr, 10-yr, and 100-yr design storm. The results of this analysis conclude that the proposed development, if constructed per this study, will meet the requirements of the City of Lee's Summit, Missouri, since peak discharge rates leaving the post-developed site are less than pre-development peak discharge rates. The proposed wet detention basin outfalls into the first existing wet detention basin in series. Once constructed, there will be three detention basins acting in series. For more information on the drainage model, refer to the full Hydraflow report in **Appendix E**.

7.0 – Conclusion

Cobey Creek 2nd Plat is the second of four phases for the mixed-use development plan. A Master Drainage Study was completed by others and intended for a fourth detention basin to be constructed for the mixed-use development. The fourth detention basin, which was the third in a series of three wet detention basin proposed in the Master Drainage Study, was not

constructed in Phase 1 and therefore will be constructed in Phase 2. The design and outlet conditions for the proposed wet detention basin meet those of the previously completed Master Drainage Study and approved Street and Storm plans for Cobey Creek 1st Plat. The size of proposed wet detention basin is 1.85 acre-feet for the 100-year design storm and a maximum storage capacity of 2.86 acre-feet. The water collected in the detention basin will be released in a controlled manner, such that flow rates are less than those prior to construction. The design of the proposed wet detention basin meets the intent and functionality of the originally approved basin design from Cobey Creek 1st Plat Street and Storm Plans, the Master Drainage Study and the Design and Construction Manual of the City of Lee's Summit, Missouri.

9.0 – References

AutoDesk, Civil 3D, 2020

AutoDesk, Hydraflow Hydrographs Extension for AutoCAD Civil 3D, 2020

AutoDesk, Hydraflow Express Extension for AutoCAD Civil 3D, 2020

City of Lee's Summit, Section 5600 - Storm Drainage Systems & Facilities, Design Criteria, 2020

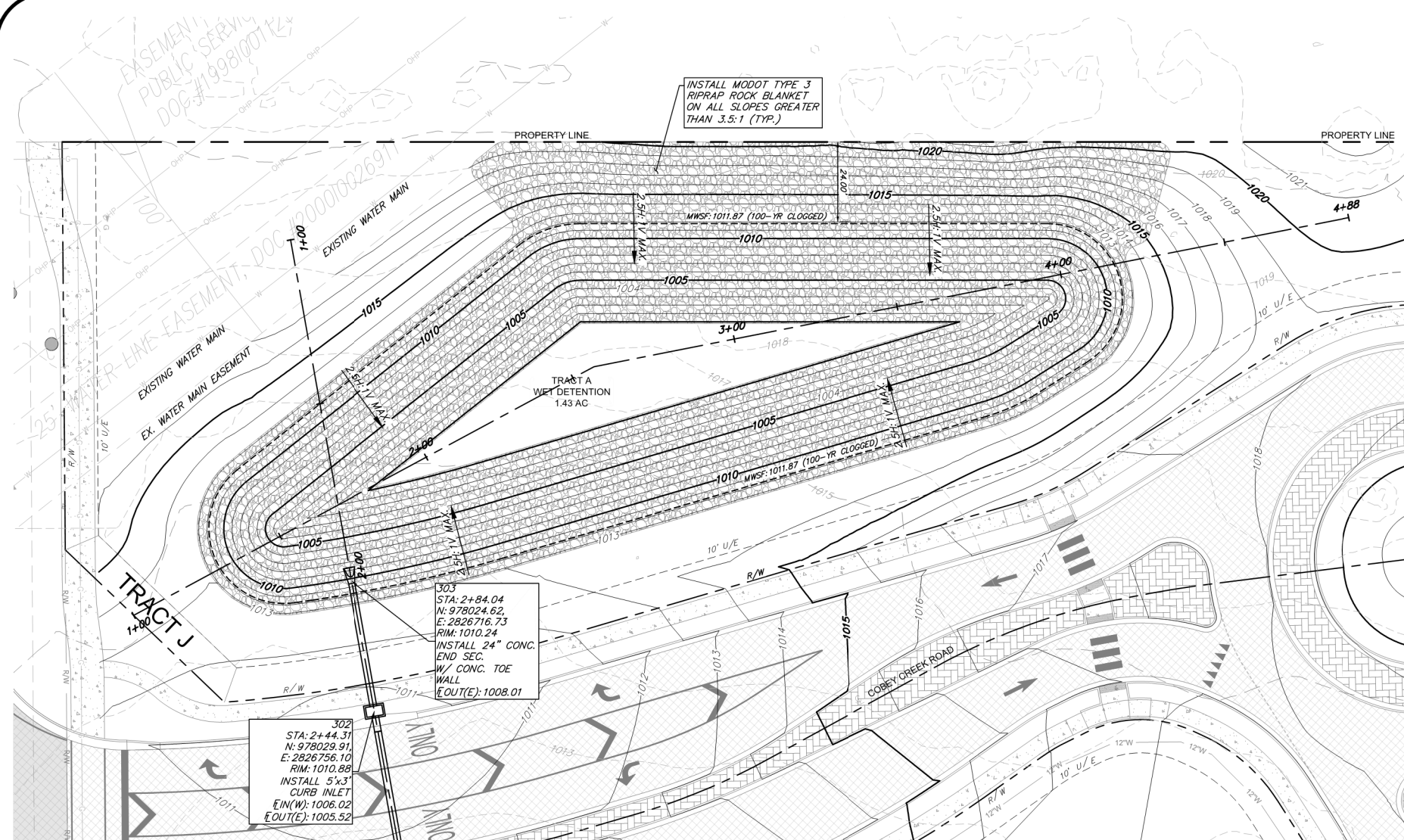
APWA, Section 5600 - Storm Drainage Systems & Facilities, 2011

Google Earth, Geographic Information System, 2022

NOAA, Atlas 14, Volume 8, Version 2, 2022

USDA, Web Soil Survey, 2022

Appendix A



WATER SURFACE ELEVATIONS:

PERM. POOL	-	1008.00
2-YR	-	1008.40
10-YR	-	1008.76
100-YR	-	1009.33
100-YR CLOGGED	-	1011.87

OUTLET DISCHARGE RATES:

2-YR	- 0.97 CFS
10-YR	- 3.29 CFS
100-YR	- 8.71 CFS
100-YR CLOGGED	- 0.00 CFS

LEGEND

 **900** PROPOSED MAJOR CONTOUR
 **90!** PROPOSED MINOR CONTOUR
 **900** EXISTING MAJOR CONTOUR
 **90!** EXISTING MINOR CONTOUR
 RIPRAP STABILIZATION
 RIGHT-OF-WAY
 ROAD CENTERLINE

WET DETENTION BASIN GENERAL NOTES:

1. CONTRACTOR TO CONSTRUCT STORMWATER MANAGEMENT FACILITIES, SPECIFICALLY THOSE FEATURES RELATED TO DETENTION, PRIOR TO ANY LAND DISTURBANCE OF THE SITE AND PRIOR TO THE CONSTRUCTION OF ANY OTHER SITE DEVELOPMENT WORK AS NOT TO EFFECT DOWNSTREAM NEIGHBORS WITH UNDETAINED STORMWATER DISCHARGE.
2. AN AS-GRADED AND AS-BUILT DRAWING SHALL BE SUBMITTED TO AND REVIEWED BY THE CITY FOR THE DETENTION BASIN. THIS SHALL BE REQUIRED PRIOR TO ISSUANCE OF A CERTIFICATE OF SUBSTANTIAL COMPLETION. PRECAUTIONS SHOULD BE TAKEN TO ENSURE DETENTION POND AND OUTLET STRUCTURE ARE CONSTRUCTED ACCORDING TO THE APPROVED PLANS; VOLUMES AND ELEVATIONS ARE CRITICAL FOR AS-BUILT APPROVAL. THE CITY SHALL BE PROVIDED WITH AN AS-BUILT SURVEY OF THE DETENTION BASIN, OUTLET STRUCTURE INCLUDING ALL WEIR ELEVATIONS AND STORM SYSTEM INCLUDING ALL THE INVERTS, STAMPED BY A MISSOURI LICENSED ENGINEER.
3. ALL SIDEWALK ADJACENT TO TRACTS SHALL BE CONSTRUCTED WITH PUBLIC IMPROVEMENTS, ALONG WITH ALL ADA ACCESSIBLE SIDEWALK RAMPS.
4. ALL SEDIMENT ACCUMULATED THROUGHOUT THE DURATION OF CONSTRUCTION SHALL BE DREDGED OR SKIMMED FROM BOTTOM OF WET POND PRIOR TO FINAL ACCEPTANCE. CONTRACTOR SHALL MAKE GREATEST EFFORT TO PREVENT SEDIMENT BUILDUP AND USE DEWATERING PRACTICES OUTLINED IN THE SWPPP UNTIL CONSTRUCTION IS COMPLETED.

EMERGENCY SPILLWAY NOTES:

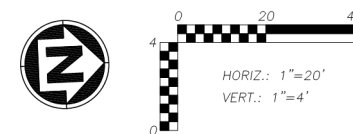
24" OUTLET PIPE SHALL FUNCTION AS EMERGENCY SPILLWAY.

STORAGE VOLUME:

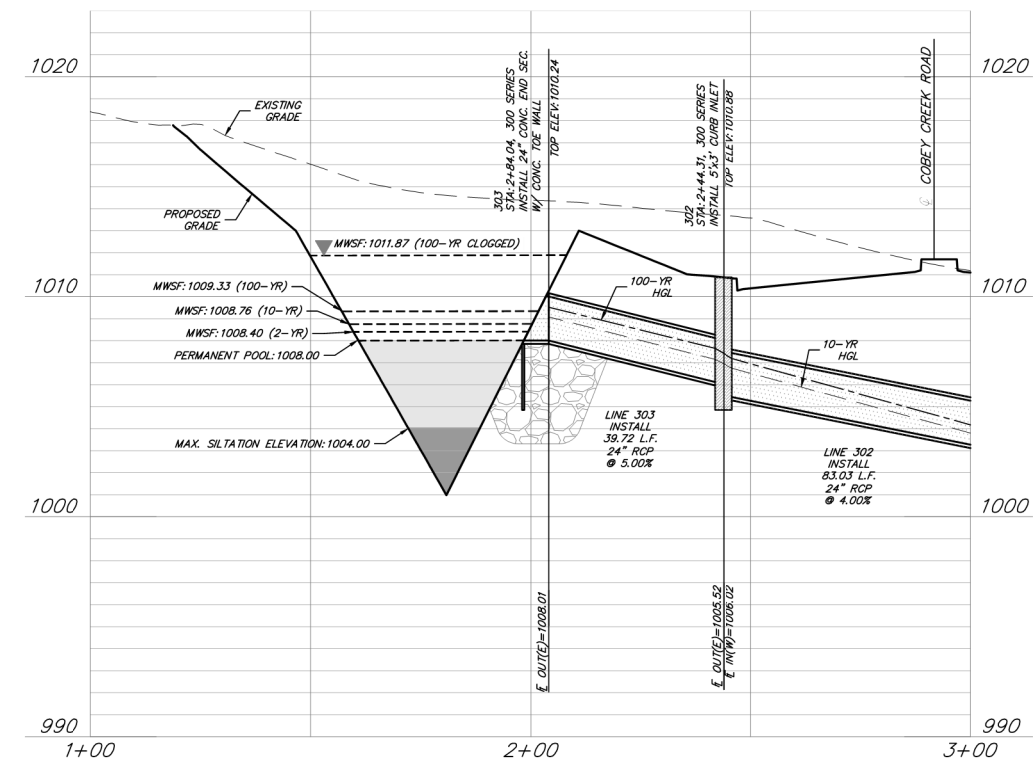
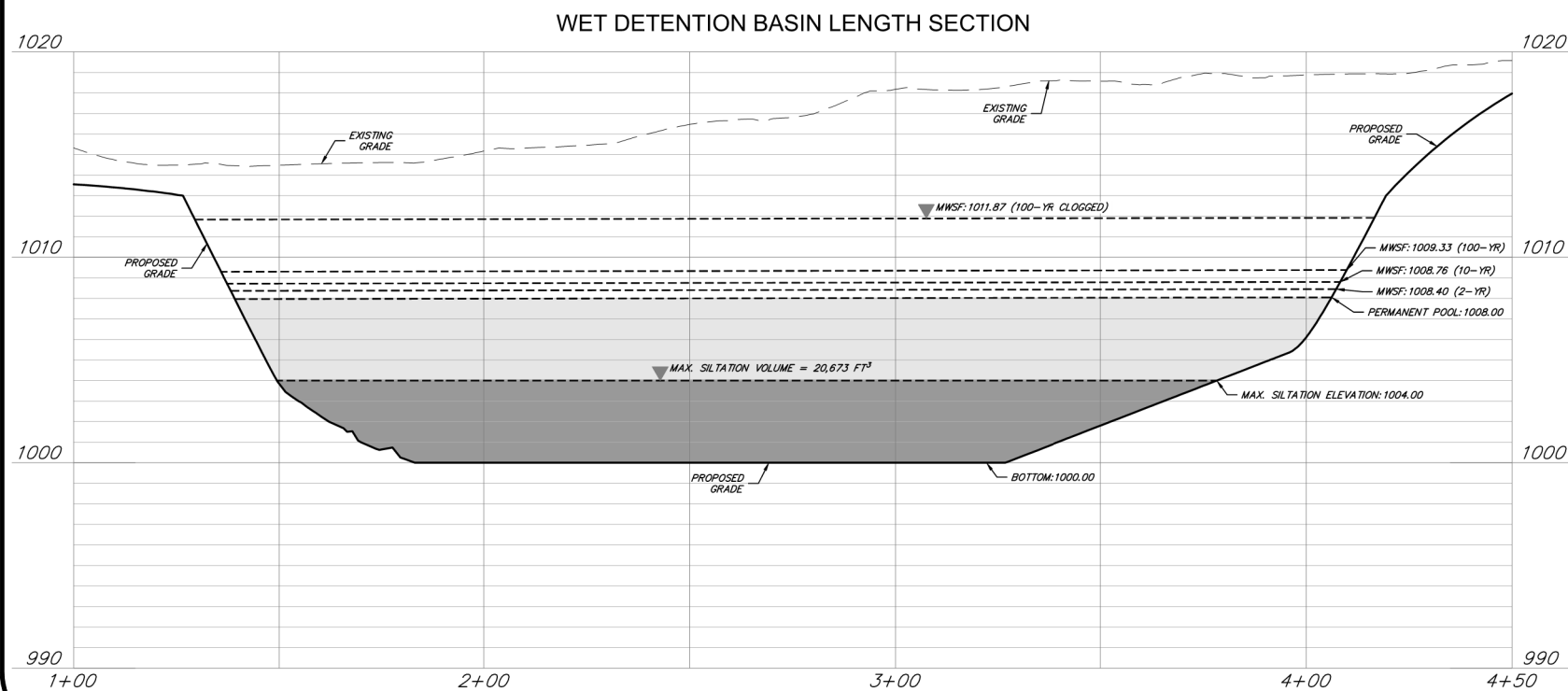
REQUIRED: 107,330 FT^3

DESIGN: 125,623 FT³

NOTE: REFER TO STORM PLAN &
PROFILE SHEET (C508) FOR STORM
LINE 300 SERIES



WET DETENTION BASIN WIDTH SECTION



**ANDERSON
ENGINEERING**
EMPLOYEE OWNED

ENGINEERS • SURVEYORS • LABORATORIES • DRILLING

REVISIONS			DRAWING INFO.	
NO.	DESCRIPTION	BY	DATE	DRAWN BY:
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				LICENSE NO. PE-2021025089
				DATE: 03/14/2022
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				JOB NUMBER: 21KC10060

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CLAYTON PROPERTIES GROUP
COBEY CREEK - 2ND PLAT - STREET, STORM, & EROSION

WET DETENTION BASIN
PLAN & PROFILE

LEE'S SUMMIT, JACKSON COUNTY, MISSOURI

SHEET NUMBER

C503
57 OF 87

Appendix B



United States
Department of
Agriculture

NRCS

Natural
Resources
Conservation
Service

A product of the National
Cooperative Soil Survey,
a joint effort of the United
States Department of
Agriculture and other
Federal agencies, State
agencies including the
Agricultural Experiment
Stations, and local
participants

Custom Soil Resource Report for **Jackson County, Missouri**



May 5, 2022

Custom Soil Resource Report Soil Map



MAP LEGEND

Area of Interest (AOI)

 Area of Interest (AOI)

Soils

 Soil Map Unit Polygons

 Soil Map Unit Lines

 Soil Map Unit Points

Special Point Features

 Blowout

 Borrow Pit

 Clay Spot

 Closed Depression

 Gravel Pit

 Gravelly Spot

 Landfill

 Lava Flow

 Marsh or swamp

 Mine or Quarry

 Miscellaneous Water

 Perennial Water

 Rock Outcrop

 Saline Spot

 Sandy Spot

 Severely Eroded Spot

 Sinkhole

 Slide or Slip

 Sodic Spot

 Spoil Area

 Stony Spot

 Very Stony Spot

 Wet Spot

 Other

 Special Line Features

Water Features

 Streams and Canals

Transportation

 Rails

 Interstate Highways

 US Routes

 Major Roads

 Local Roads

Background

 Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

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

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

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

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

Soil Survey Area: Jackson County, Missouri
Survey Area Data: Version 23, Sep 1, 2021

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

Date(s) aerial images were photographed: Sep 6, 2019—Nov 16, 2019

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

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
10000	Arisburg silt loam, 1 to 5 percent slopes	6.9	100.0%
Totals for Area of Interest		6.9	100.0%

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Custom Soil Resource Report

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Jackson County, Missouri

10000—Arisburg silt loam, 1 to 5 percent slopes

Map Unit Setting

National map unit symbol: 2w22b
Elevation: 610 to 1,130 feet
Mean annual precipitation: 39 to 43 inches
Mean annual air temperature: 50 to 55 degrees F
Frost-free period: 177 to 220 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Arisburg and similar soils: 87 percent
Minor components: 13 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Arisburg

Setting

Landform: Interfluves
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loess

Typical profile

Ap - 0 to 6 inches: silt loam
A - 6 to 13 inches: silt loam
Bt - 13 to 19 inches: silty clay loam
Btg - 19 to 56 inches: silty clay loam
BCg - 56 to 79 inches: silty clay loam

Properties and qualities

Slope: 1 to 5 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: About 18 to 30 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: High (about 11.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: C
Ecological site: R107BY007MO - Loess Upland Prairie
Hydric soil rating: No

Minor Components

Sharpsburg

Percent of map unit: 5 percent
Landform: Ridges
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R109XY002MO - Loess Upland Prairie
Hydric soil rating: No

Greenton

Percent of map unit: 5 percent
Landform: Hillslopes
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Ecological site: R109XY002MO - Loess Upland Prairie
Hydric soil rating: No

Haig

Percent of map unit: 3 percent
Landform: Flats
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Talf
Down-slope shape: Linear
Across-slope shape: Convex
Ecological site: R109XY001MO - Claypan Summit Prairie
Hydric soil rating: Yes

Soil Information for All Uses

Soil Properties and Qualities

The Soil Properties and Qualities section includes various soil properties and qualities displayed as thematic maps with a summary table for the soil map units in the selected area of interest. A single value or rating for each map unit is generated by aggregating the interpretive ratings of individual map unit components. This aggregation process is defined for each property or quality.

Soil Qualities and Features

Soil qualities are behavior and performance attributes that are not directly measured, but are inferred from observations of dynamic conditions and from soil properties. Example soil qualities include natural drainage, and frost action. Soil features are attributes that are not directly part of the soil. Example soil features include slope and depth to restrictive layer. These features can greatly impact the use and management of the soil.

Hydrologic Soil Group

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

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

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

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

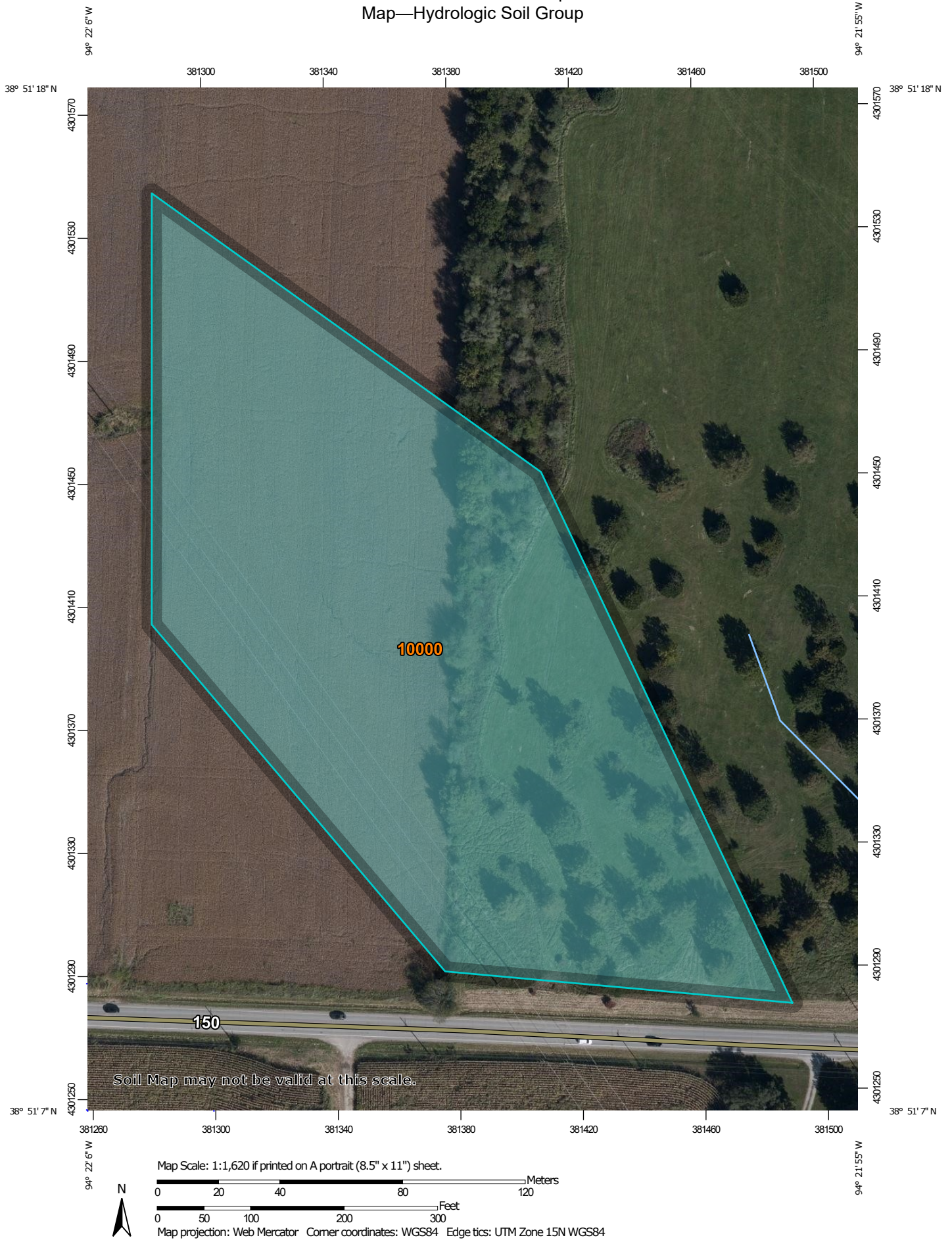
Custom Soil Resource Report

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

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

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

Custom Soil Resource Report
Map—Hydrologic Soil Group



Custom Soil Resource Report

MAP LEGEND

Area of Interest (AOI)

 Area of Interest (AOI)

Soils

Soil Rating Polygons

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

Soil Rating Lines

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

Soil Rating Points

 A
 A/D
 B
 B/D

 C
 C/D
 D
 Not rated or not available

Water Features

 Streams and Canals

Transportation

 Rails
 Interstate Highways
 US Routes
 Major Roads
 Local Roads

Background

 Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

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

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

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

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

Soil Survey Area: Jackson County, Missouri
Survey Area Data: Version 23, Sep 1, 2021

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

Date(s) aerial images were photographed: Sep 6, 2019—Nov 16, 2019

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

Table—Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
10000	Arisburg silt loam, 1 to 5 percent slopes	C	6.9	100.0%
Totals for Area of Interest			6.9	100.0%

Rating Options—Hydrologic Soil Group

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Appendix C

National Flood Hazard Layer FIRMette



94°22'12"W 38°51'35"N



0 250 500 1,000 1,500 2,000 Feet

1:6,000

94°21'35"W 38°51'7"N

Basemap: USGS National Map: Orthoimagery: Data refreshed October, 2020

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS		Without Base Flood Elevation (BFE) Zone A, V, A99
		With BFE or Depth Zone AE, AO, AH, VE, AR
		Regulatory Floodway
OTHER AREAS OF FLOOD HAZARD		0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile Zone X
		Future Conditions 1% Annual Chance Flood Hazard Zone X
		Area with Reduced Flood Risk due to Levee. See Notes. Zone X
		Area with Flood Risk due to Levee Zone D
OTHER AREAS		NO SCREEN Area of Minimal Flood Hazard Zone X
		Effective LOMRs
		Area of Undetermined Flood Hazard Zone D
GENERAL STRUCTURES		Channel, Culvert, or Storm Sewer
		Levee, Dike, or Floodwall
OTHER FEATURES		20.2 Cross Sections with 1% Annual Chance Water Surface Elevation
		17.5 Cross Sections with 1% Annual Chance Water Surface Elevation
		Coastal Transect
		Base Flood Elevation Line (BFE)
		Limit of Study
		Jurisdiction Boundary
		Coastal Transect Baseline
MAP PANELS		Digital Data Available
		No Digital Data Available
		Unmapped



The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on **5/3/2022 at 8:46 PM** and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

Appendix D



NOAA Atlas 14, Volume 8, Version 2
Location name: Lees Summit, Missouri, USA*
Latitude: 38.8534°, Longitude: -94.3651°
Elevation: 1013.58 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 & aeriels](#)

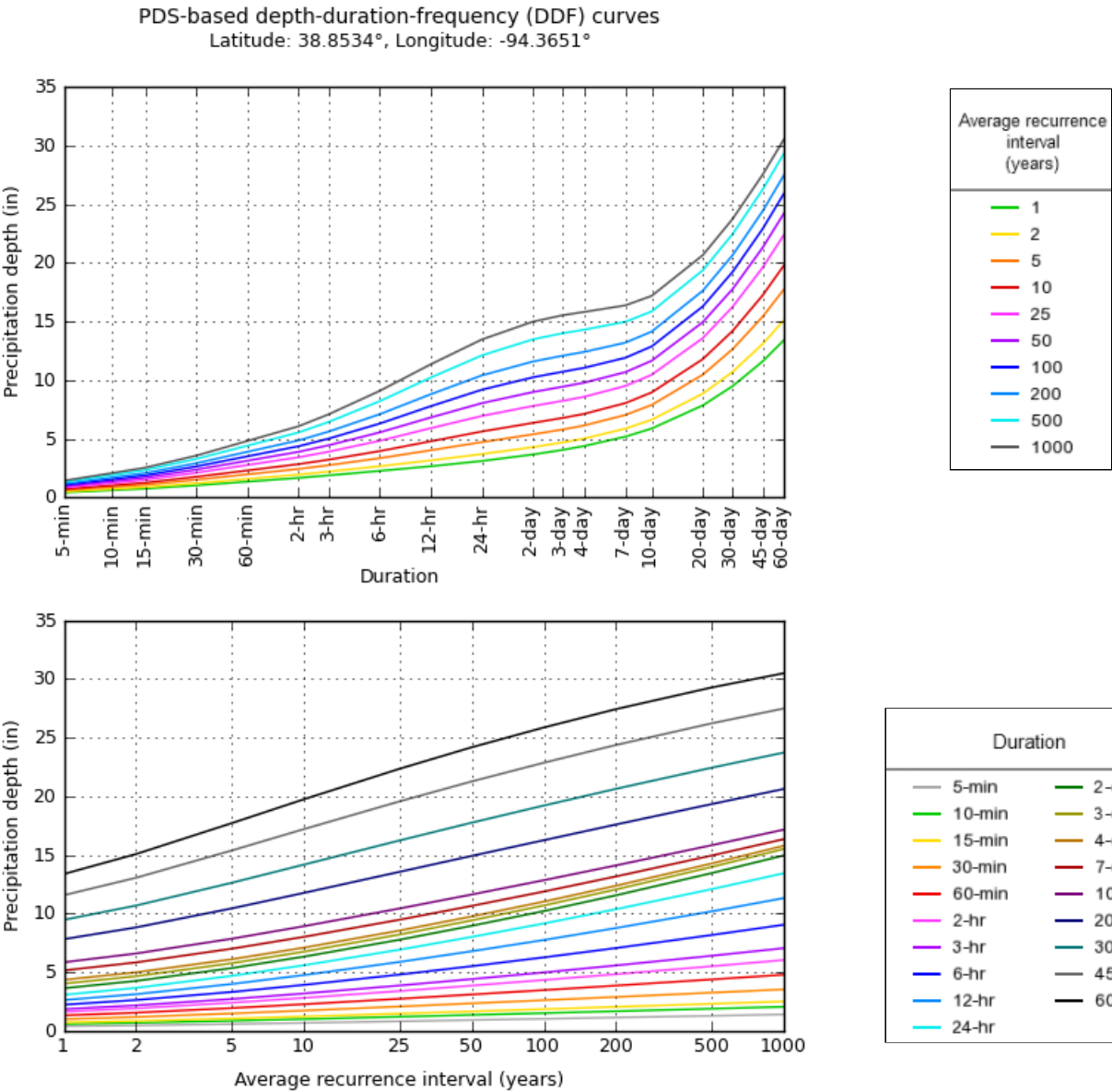
PF tabular

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	0.412 (0.326-0.522)	0.483 (0.381-0.612)	0.600 (0.472-0.762)	0.698 (0.546-0.889)	0.834 (0.632-1.09)	0.940 (0.697-1.25)	1.05 (0.752-1.42)	1.16 (0.798-1.60)	1.30 (0.867-1.85)	1.42 (0.919-2.03)
10-min	0.604 (0.477-0.765)	0.708 (0.558-0.897)	0.879 (0.691-1.12)	1.02 (0.799-1.30)	1.22 (0.925-1.60)	1.38 (1.02-1.82)	1.53 (1.10-2.07)	1.69 (1.17-2.34)	1.91 (1.27-2.70)	2.07 (1.35-2.97)
15-min	0.736 (0.581-0.933)	0.863 (0.681-1.09)	1.07 (0.842-1.36)	1.25 (0.975-1.59)	1.49 (1.13-1.95)	1.68 (1.24-2.22)	1.87 (1.34-2.53)	2.07 (1.43-2.86)	2.33 (1.55-3.29)	2.53 (1.64-3.63)
30-min	1.02 (0.805-1.29)	1.20 (0.947-1.52)	1.50 (1.18-1.90)	1.75 (1.37-2.23)	2.09 (1.59-2.74)	2.36 (1.75-3.13)	2.63 (1.89-3.56)	2.91 (2.01-4.02)	3.28 (2.18-4.64)	3.55 (2.31-5.10)
60-min	1.34 (1.06-1.69)	1.57 (1.24-1.99)	1.96 (1.54-2.49)	2.29 (1.79-2.92)	2.75 (2.09-3.61)	3.12 (2.31-4.14)	3.49 (2.51-4.73)	3.88 (2.68-5.37)	4.40 (2.93-6.24)	4.80 (3.12-6.90)
2-hr	1.65 (1.32-2.08)	1.94 (1.54-2.44)	2.42 (1.92-3.04)	2.83 (2.23-3.57)	3.41 (2.61-4.45)	3.88 (2.90-5.11)	4.35 (3.15-5.86)	4.85 (3.38-6.68)	5.53 (3.71-7.79)	6.06 (3.97-8.63)
3-hr	1.87 (1.49-2.34)	2.19 (1.75-2.74)	2.73 (2.17-3.43)	3.21 (2.54-4.03)	3.88 (2.99-5.05)	4.43 (3.33-5.82)	5.00 (3.64-6.71)	5.60 (3.92-7.69)	6.42 (4.34-9.02)	7.07 (4.65-10.0)
6-hr	2.25 (1.81-2.79)	2.65 (2.13-3.28)	3.33 (2.67-4.14)	3.94 (3.14-4.91)	4.81 (3.74-6.23)	5.53 (4.20-7.23)	6.28 (4.62-8.38)	7.08 (5.00-9.67)	8.19 (5.58-11.4)	9.07 (6.01-12.8)
12-hr	2.65 (2.15-3.25)	3.15 (2.55-3.87)	4.01 (3.24-4.94)	4.77 (3.84-5.90)	5.89 (4.62-7.57)	6.80 (5.21-8.83)	7.76 (5.75-10.3)	8.78 (6.26-11.9)	10.2 (7.01-14.2)	11.3 (7.58-15.9)
24-hr	3.09 (2.53-3.77)	3.68 (3.01-4.49)	4.70 (3.83-5.75)	5.61 (4.54-6.88)	6.94 (5.48-8.85)	8.02 (6.19-10.3)	9.17 (6.85-12.1)	10.4 (7.47-14.0)	12.1 (8.38-16.7)	13.5 (9.07-18.7)
2-day	3.65 (3.01-4.41)	4.28 (3.52-5.16)	5.37 (4.41-6.50)	6.34 (5.18-7.71)	7.78 (6.21-9.85)	8.97 (6.98-11.5)	10.2 (7.71-13.4)	11.6 (8.39-15.5)	13.5 (9.41-18.5)	15.0 (10.2-20.7)
3-day	4.04 (3.35-4.86)	4.68 (3.87-5.62)	5.78 (4.77-6.97)	6.77 (5.55-8.19)	8.23 (6.59-10.4)	9.43 (7.38-12.0)	10.7 (8.11-13.9)	12.1 (8.80-16.1)	14.0 (9.82-19.1)	15.5 (10.6-21.4)
4-day	4.37 (3.63-5.23)	5.01 (4.16-6.00)	6.12 (5.06-7.35)	7.11 (5.85-8.57)	8.57 (6.88-10.7)	9.77 (7.66-12.4)	11.0 (8.38-14.3)	12.4 (9.06-16.5)	14.3 (10.1-19.4)	15.8 (10.8-21.7)
7-day	5.17 (4.32-6.14)	5.85 (4.89-6.96)	7.02 (5.85-8.37)	8.03 (6.65-9.61)	9.49 (7.65-11.8)	10.7 (8.41-13.4)	11.9 (9.08-15.3)	13.2 (9.69-17.4)	15.0 (10.6-20.2)	16.4 (11.3-22.4)
10-day	5.86 (4.92-6.94)	6.62 (5.55-7.83)	7.87 (6.58-9.34)	8.94 (7.44-10.6)	10.4 (8.44-12.8)	11.6 (9.20-14.5)	12.9 (9.85-16.4)	14.1 (10.4-18.5)	15.8 (11.3-21.3)	17.2 (11.9-23.4)
20-day	7.83 (6.63-9.18)	8.84 (7.47-10.4)	10.5 (8.81-12.3)	11.8 (9.88-13.9)	13.6 (11.0-16.4)	14.9 (11.9-18.4)	16.3 (12.5-20.5)	17.6 (13.1-22.8)	19.3 (13.8-25.7)	20.6 (14.4-27.9)
30-day	9.48 (8.07-11.1)	10.7 (9.09-12.5)	12.6 (10.7-14.8)	14.2 (12.0-16.7)	16.2 (13.2-19.5)	17.8 (14.2-21.7)	19.2 (14.9-24.0)	20.7 (15.4-26.5)	22.4 (16.1-29.6)	23.7 (16.7-32.0)
45-day	11.6 (9.90-13.4)	13.1 (11.2-15.2)	15.4 (13.1-17.9)	17.2 (14.6-20.1)	19.6 (16.0-23.3)	21.3 (17.0-25.8)	22.9 (17.7-28.4)	24.4 (18.2-31.1)	26.2 (18.9-34.4)	27.5 (19.4-36.9)
60-day	13.4 (11.5-15.5)	15.1 (12.9-17.4)	17.7 (15.1-20.5)	19.8 (16.8-23.0)	22.4 (18.3-26.5)	24.2 (19.4-29.2)	25.9 (20.1-32.0)	27.4 (20.5-34.8)	29.3 (21.2-38.3)	30.5 (21.6-40.8)

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

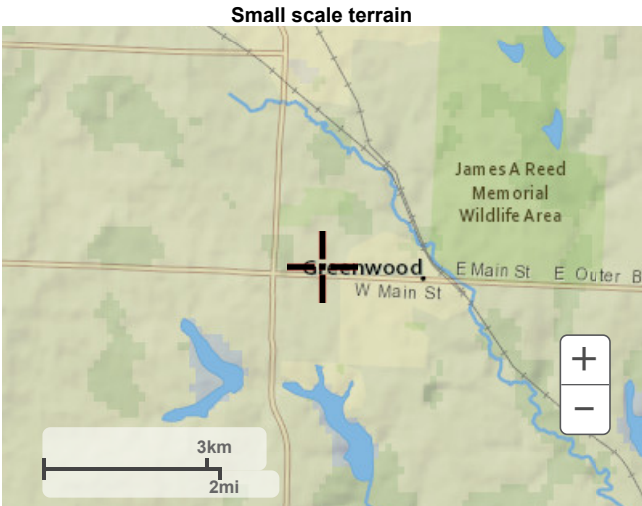


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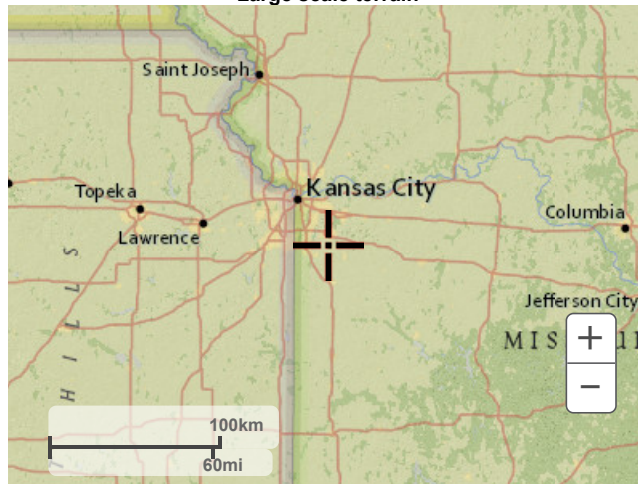
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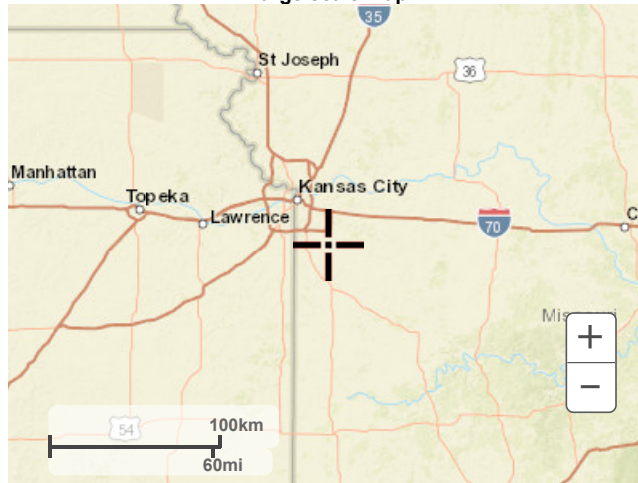
Maps & aerals



Large scale terrain



Large scale map



Large scale aerial

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Appendix E

Pond Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2020

Thursday, 05 / 5 / 2022

Pond No. 1 - SW Detention Basin

Pond Data

Contours -User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 1000.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	1000.00	2,995	0	0
1.00	1001.00	4,003	3,486	3,486
2.00	1002.00	5,112	4,546	8,032
3.00	1003.00	6,317	5,703	13,736
4.00	1004.00	7,579	6,938	20,673
5.00	1005.00	8,879	8,220	28,893
6.00	1006.00	10,220	9,541	38,434
7.00	1007.00	11,599	10,901	49,335
8.00	1008.00	13,019	12,301	61,636
9.00	1009.00	14,477	13,740	75,376
10.00	1010.00	15,975	15,218	90,594
11.00	1011.00	17,512	16,736	107,330
12.00	1012.00	19,088	18,293	125,623
13.00	1013.00	20,703	19,888	145,511

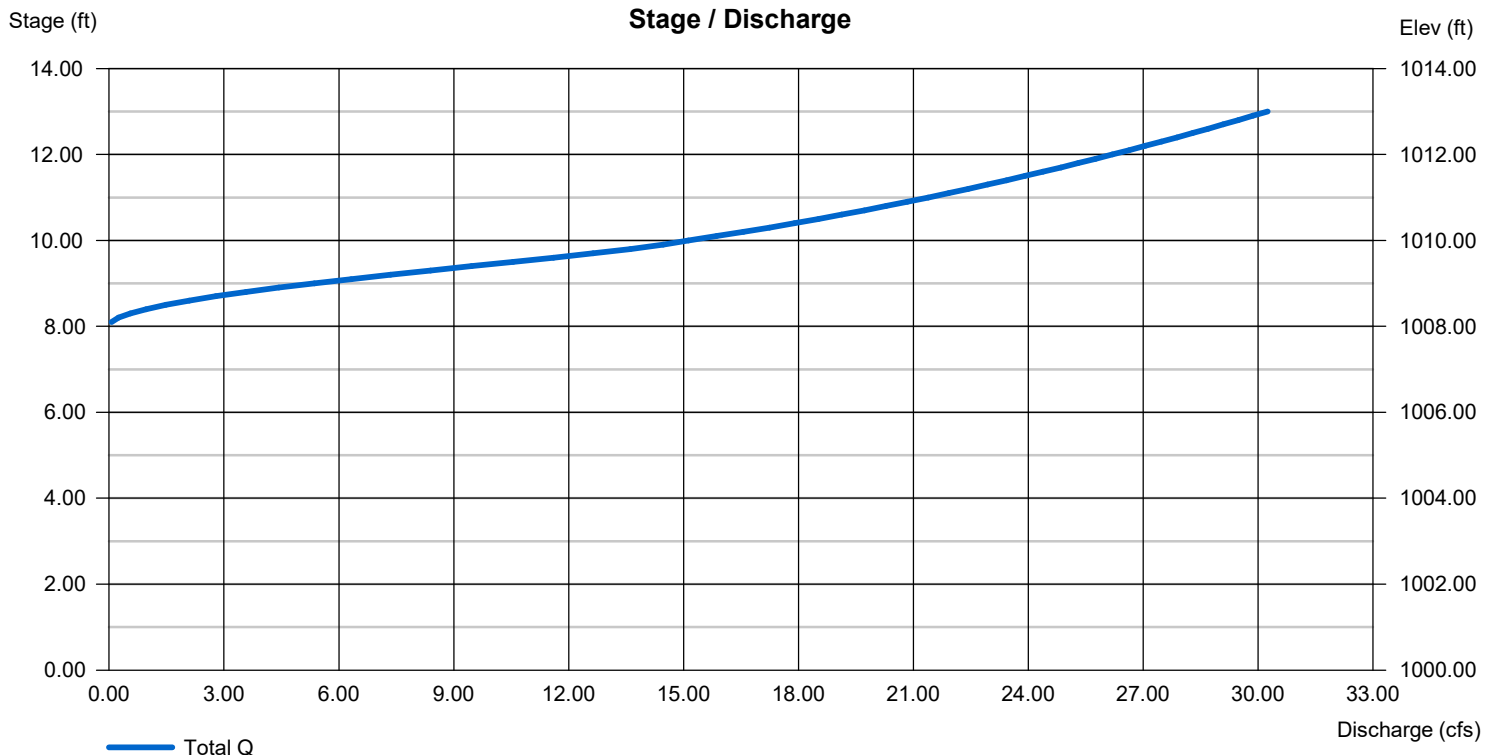
Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 24.00	0.00	0.00	0.00
Span (in)	= 24.00	0.00	0.00	0.00
No. Barrels	= 1	0	0	0
Invert El. (ft)	= 1008.00	0.00	0.00	0.00
Length (ft)	= 39.72	0.00	0.00	0.00
Slope (%)	= 5.00	0.00	0.00	n/a
N-Value	= .012	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 0.00	0.00	0.00	0.00
Crest El. (ft)	= 0.00	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= ---	---	---	---
Multi-Stage	= No	No	No	No
Exfil.(in/hr)	= 0.000 (by Contour)			
TW Elev. (ft)	= 0.00			

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).



Watershed Model Schematic

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2020



Legend

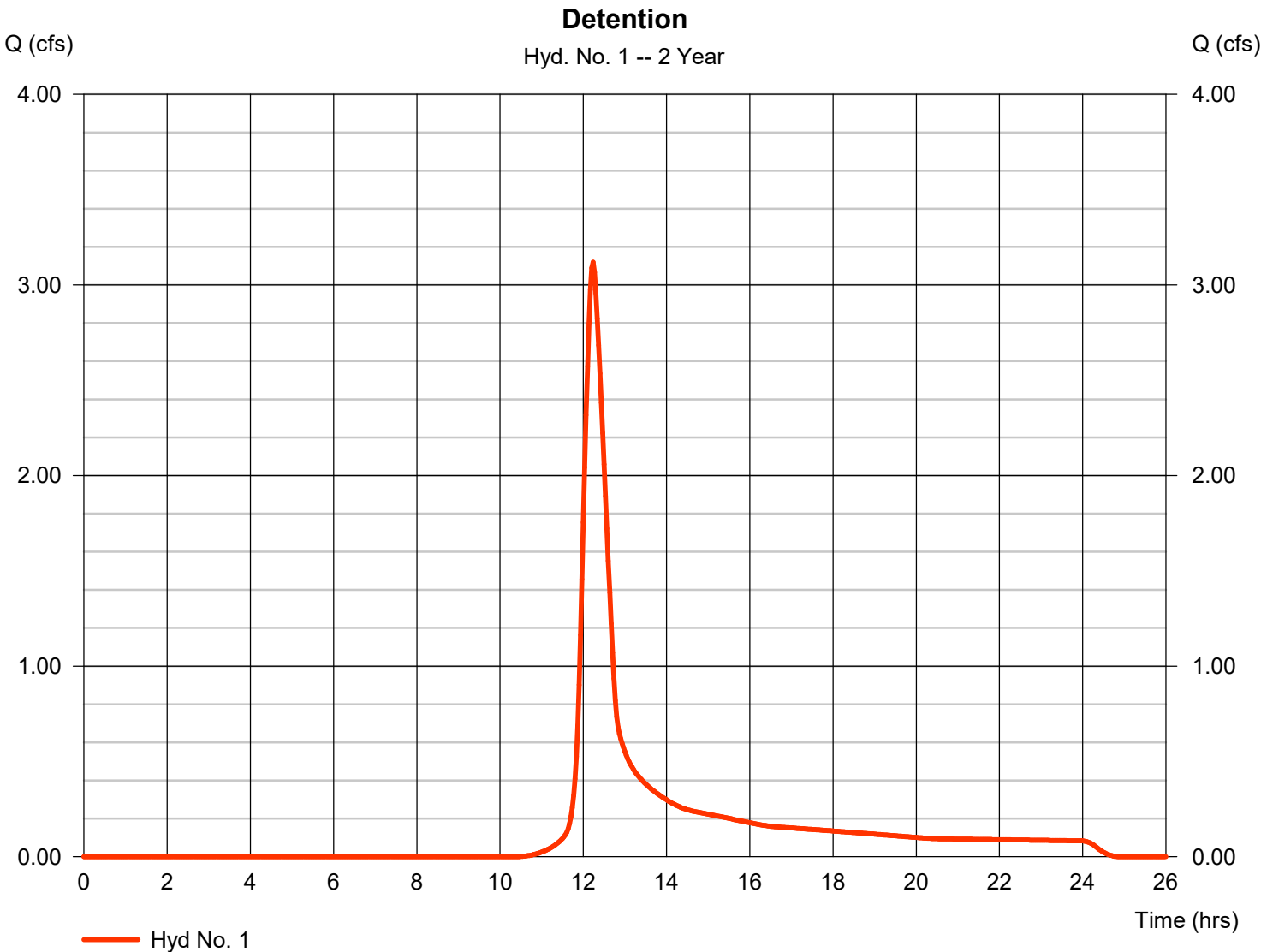
<u>Hyd.</u>	<u>Origin</u>	<u>Description</u>
1	SCS Runoff	Detention
2	Reservoir	Detention Routing

Hydrograph Report

Hyd. No. 1

Detention

Hydrograph type	=	SCS Runoff	Peak discharge	=	3.120 cfs
Storm frequency	=	2 yrs	Time to peak	=	12.23 hrs
Time interval	=	2 min	Hyd. volume	=	14,054 cuft
Drainage area	=	2.800 ac	Curve number	=	74
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	33.50 min
Total precip.	=	3.68 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484



TR55 Tc Worksheet

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2020

Hyd. No. 1

Detention

<u>Description</u>	<u>A</u>	<u>B</u>	<u>C</u>	<u>Totals</u>
Sheet Flow				
Manning's n-value	= 0.240	0.011	0.011	
Flow length (ft)	= 300.0	0.0	0.0	
Two-year 24-hr precip. (in)	= 3.87	0.00	0.00	
Land slope (%)	= 2.00	0.00	0.00	
Travel Time (min)	= 31.25	+	0.00	+
			0.00	= 31.25
Shallow Concentrated Flow				
Flow length (ft)	= 310.00	0.00	0.00	
Watercourse slope (%)	= 2.00	0.00	0.00	
Surface description	= Unpaved	Paved	Paved	
Average velocity (ft/s)	=2.28	0.00	0.00	
Travel Time (min)	= 2.26	+	0.00	+
			0.00	= 2.26
Channel Flow				
X sectional flow area (sqft)	= 0.00	0.00	0.00	
Wetted perimeter (ft)	= 0.00	0.00	0.00	
Channel slope (%)	= 0.00	0.00	0.00	
Manning's n-value	= 0.015	0.015	0.015	
Velocity (ft/s)	=0.00	0.00	0.00	
Flow length (ft)	(0)0.0	0.0	0.0	
Travel Time (min)	= 0.00	+	0.00	+
			0.00	= 0.00
Total Travel Time, Tc				33.50 min

Hydrograph Report

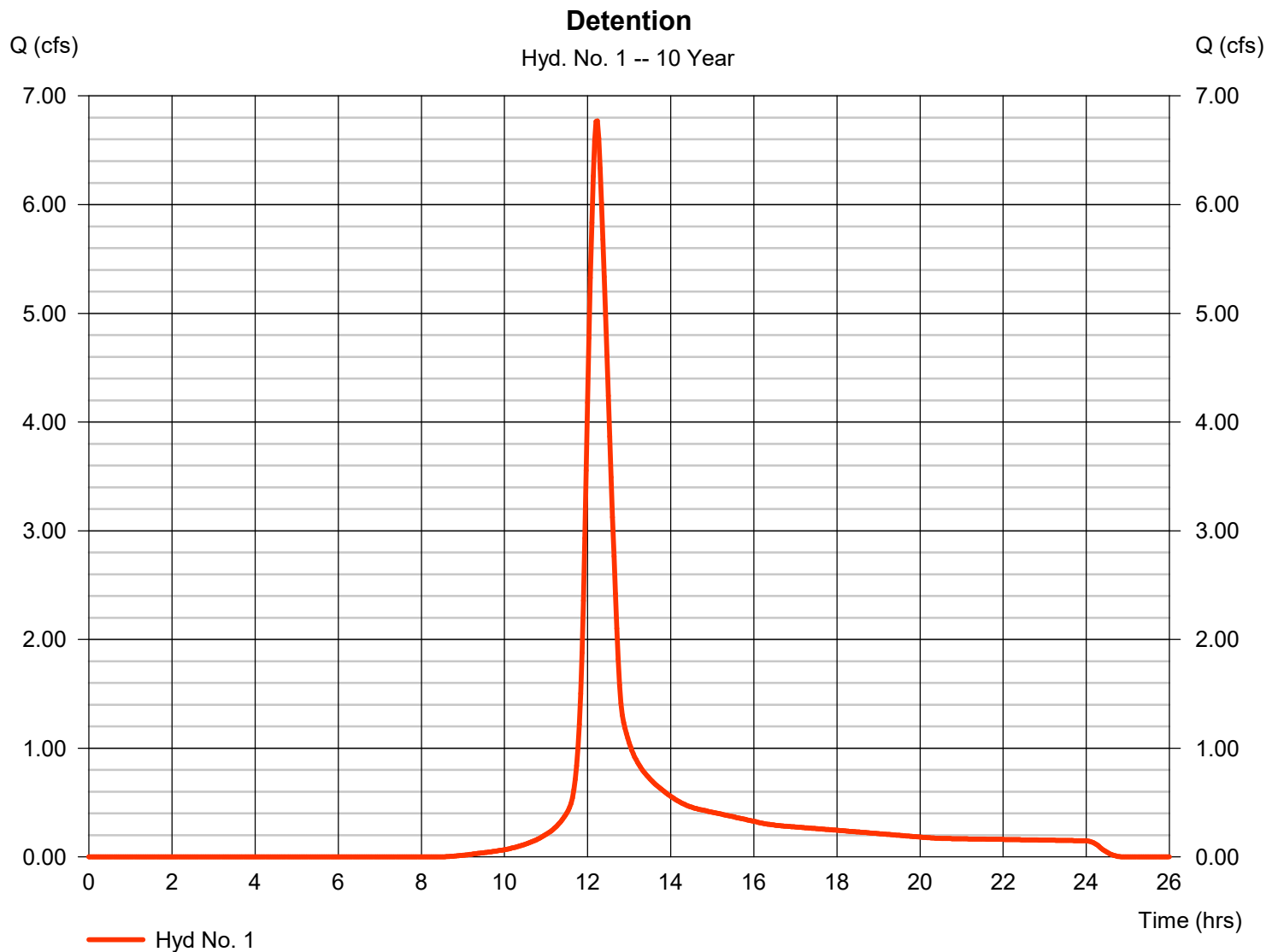
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2020

Thursday, 05 / 5 / 2022

Hyd. No. 1

Detention

Hydrograph type	= SCS Runoff	Peak discharge	= 6.771 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.23 hrs
Time interval	= 2 min	Hyd. volume	= 29,430 cuft
Drainage area	= 2.800 ac	Curve number	= 74
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 33.50 min
Total precip.	= 5.61 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2020

Thursday, 05 / 5 / 2022

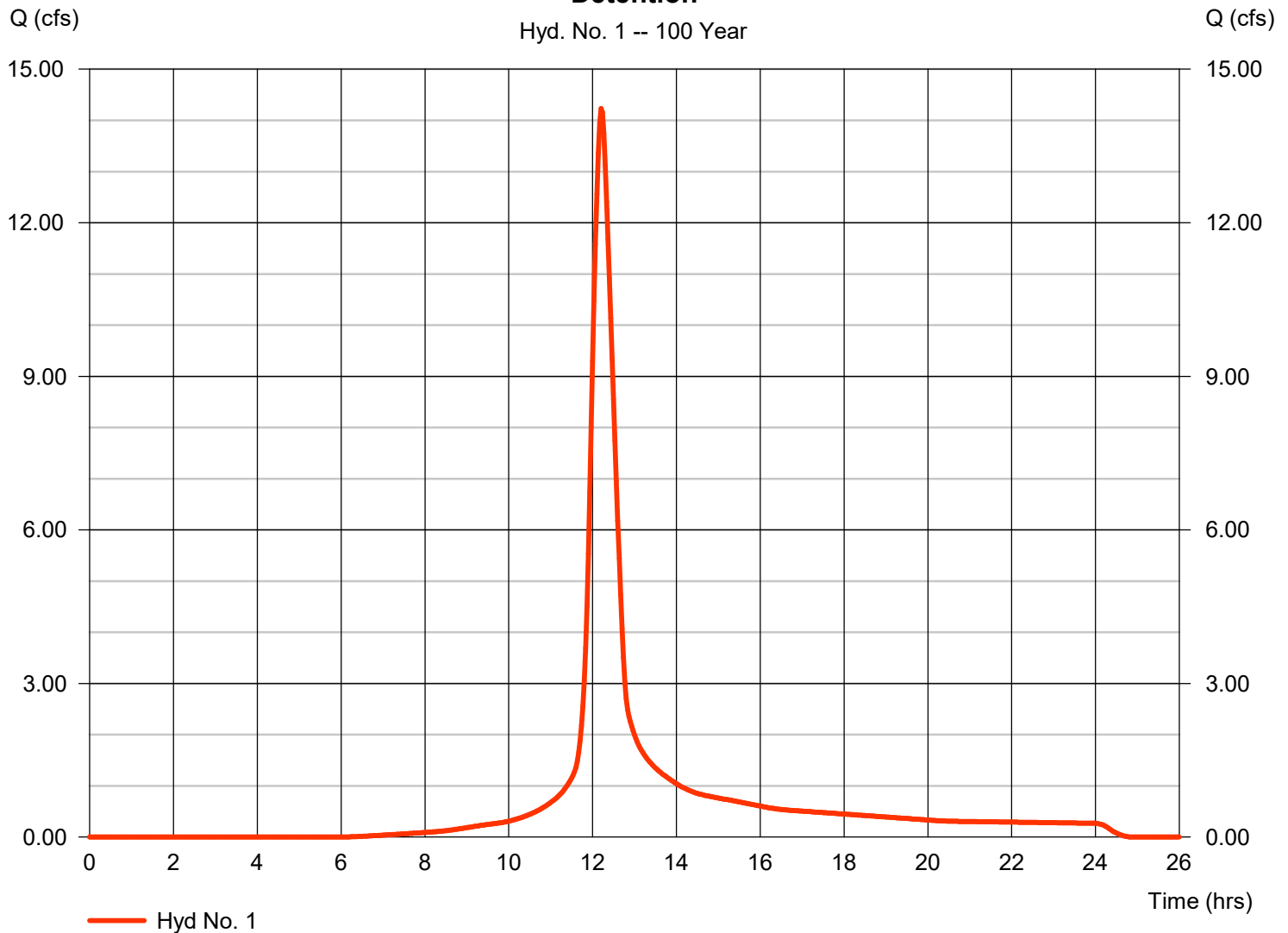
Hyd. No. 1

Detention

Hydrograph type	= SCS Runoff	Peak discharge	= 14.23 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.20 hrs
Time interval	= 2 min	Hyd. volume	= 61,583 cuft
Drainage area	= 2.800 ac	Curve number	= 74
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 33.50 min
Total precip.	= 9.17 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

Detention

Hyd. No. 1 -- 100 Year



Watershed Model Schematic..... 1

Hydrograph Return Period Recap..... 2

2 - Year

Summary Report..... 3

Hydrograph Reports..... 4

 Hydrograph No. 1, SCS Runoff, Detention..... 4

 TR-55 Tc Worksheet..... 5

10 - Year

Summary Report..... 6

Hydrograph Reports..... 7

 Hydrograph No. 1, SCS Runoff, Detention..... 7

100 - Year

Summary Report..... 8

Hydrograph Reports..... 9

 Hydrograph No. 1, SCS Runoff, Detention..... 9

IDF Report..... 10

Appendix F

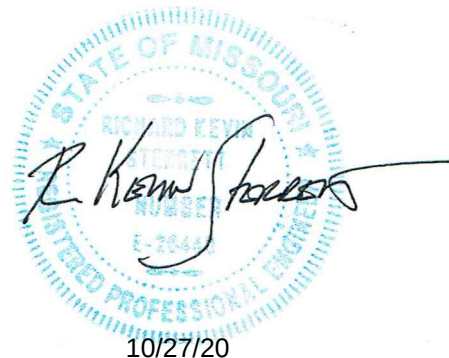
STORM WATER REPORT

Cobey Creek Mixed Use Development Lee's Summit, MO

PREPARED FOR
JCM DEVELOPMENT,LLC

PREPARED BY
Hg Consult, Inc

Condensed Version
October, 2020



10/27/20

Content

1. Original Storm Report-May 22, 2018
2. Addendum 1- July 1, 2019- Effective Height and Energy Dissipation additions to North Pond
3. Addendum 2- August 3, 2020- Updated South Pond Outlet Structure-Pond Pack Print out.
4. Addendum 3- October 8, 2020- Approved Outlet Structure Geometric Changes from Circular to Square and Rectangular

Report Summary

As requested by the City of Lee's Summit, this condensed report has been prepared to chronicle the changes to the storm system during construction of the first phase of the project and since the storm report was approved. As provided on the content page, 3 addendums have been prepared, based on the 3 changes to the plans. A summary of those addendums and changes are as follows:

Addendum 1

This addendum was prepared prior to construction to address City comments in regard to the north pond design. The addendum addressed the usage of the skimmer and the 40 hour release from the pond, effective height of the pond and the need to design the pond to TR-60 requirements and the energy dissipation design at the out of the discharge pipe from the pond.

Addendum 2

This addendum addressed the change of the geometric shape of the south detention pond outlet structure after construction began. The approved design called for a circular structure. It was found that the circular manhole could not be cast, based on the size and a square structure was to take its place. Calculations confirmed that the geometric shape change did not impact the hydraulic design or flow of the pond.

Addendum 3

This addendum addressed the change of the geometric shape of the outlet structure for the north pond after construction began. For the same reason on the change for the south pond, circular manholes couldn't be cast and a

rectangular structure was substituted for 2 side by side manholes, with again, no impact on the pond flow or hydraulic function.

STORM WATER DRAINAGE REPORT

Cobey Creek

Mixed Use Development

Lee's Summit, MO

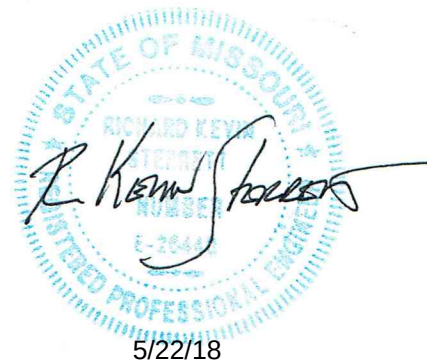
PREPARED FOR

JCM DEVELOPMENT, LLC

PREPARED BY HG

CONSULT, INC.

May 22, 2018



5/22/18

1. Project Overview

The proposed project is a mixed use development. The project will contain 12.7 acres of commercial development and 84.6 acres of mixed residential development and open space. The site is current undeveloped with a lone residential dwelling.

The topography of the site is a gentle slope south to the north, specifically to the north east corner to a creek. Some area along the highway frontage slopes to the south and drains through a culvert pipe under M-150 Highway.

2. Drainage Assessment of the Project Site

Storm drainage for the site will include a full underground system, designed for the 10-year storm event and overland routing of the higher storm events. The majority of the post development site drainage will be regulated at the north east corner of the site with a detention facility, sized for the 2-year, 10-year, and 100-year storm events with the 40-hour extended detention included.

3. Temporary Erosion and Sediment Control

During construction and prior to paving, it will be necessary to control erosion and sediment from the site during storms with in the construction timeframe. To insure that sediment does not enter the existing storm system or runs off to the existing street or creek, perimeter containment, silt fence, inlet protection, rock ditch checks will be used. The detention pond will utilized as a temporary sediment basin during construction of the early phases of the development. This will be fully addressed in the E, S&C plans with the Phase 1 construction plans. To keep construction traffic from tracking mud onto the adjacent citystreet, a stabilized rock construction entrance will need to be installed.

These erosion control devices, and their maintenance throughout the construction timeframe, are required by ordinance and the details for them are referenced by APWA 5600.

Post-development water quality will be addressed through the use a release structure sized for the 2-year, 10-year, and 100-year storm events with the 40-hour extended detention included. The owner will need to have a routine maintenance policy for the cleaning, repair and replacement of the detention release structure.

4. Soil Classifications

NRCS Web Soil Survey categorizes the soils on the Cobey Creek site below.

Table 4.1 – Soil Classification

Symbol	Name	Slopes	HSG
10000	Arisburg silt loam	1-5%	C
10082	Sampsel silty clay loam	2-5%	C/D
10117	Sampsel silty clay loam	5-9%	C/D

For this analysis, Soil group C was considered for the Cobey Creek site. Curve Numbers were used in accordance with the APWA 5600.

5. Methodology

The method for evaluating Cobey Creek was the use of a PondPack Model. Both Pre-Development and Post-Development conditions were considered:

PondPack V8i

- TR-55 Unit Hydrograph Method
 - 2-year, 10-year and 100-year Return Frequency storms
 - AMC II Soil Moisture conditions
 - 24-Hour SCS Type II Rainfall Distribution
 - SCS Runoff Curve Numbers per APWA 5600 (Table 5602-3)
 - Time of Concentration developed per TR-55

6. Pre-Development Conditions

This section of the drainage study has been prepared to evaluate the Pre-Development Conditions related to stormwater runoff. The following tables summarize the Pre-Development Conditions Analysis. Refer to the Design Calculations for details regarding the analysis.

Table 6.1 – Pre-Development Watershed Data

Name	Area (acres)	Composite CN	Tc (hrs)
EX1	17.64	75	0.217
EX2	2.43	74	0.145
EX3	89.68	75	0.419
EX4	14.70	74	0.182

Table 6.1 – Pre-Development Discharges

Name	Q2 (cfs)	Q10 (cfs)	Q100 (cfs)
EX1	29.07	61.09	107.36
EX2	4.29	9.17	16.32
EX3	105.54	226.85	403.16
EX4	23.98	51.33	91.04

Per APWA Section 5608.4 and City of Lee's Summit criteria, the post-development discharge rates from the site shall not exceed those indicated below:

- 50% storm peak rate less than or equal to 0.5 cfs per site acre
- 10% storm peak rate less than or equal to 2.0 cfs per site acre
- 1% storm peak rate less than or equal to 3.0 cfs per site acre

APWA allowable releases were calculated for the various points of discharge. Off-site flows were allowed to bypass detention. Off-site flows were calculated using a separate PondPack model. The off-site time of concentrations used the same existing time of concentrations located in Table 6.1 and the areas can be found in Table 6.3. Where detention was not possible, areas of the site were drained to the detention in P3 to reduce the outflow from EX1, EX2, and EX4. Release rates per APWA were added to the off-site discharges to produce the allowable rates.

Table 6.3 – Pre-Development Off-site Watershed Data

Name	Total Area (acres)	On-site Area (acres)	Off-site Area (acres)
EX1	17.82	13.42	4.38
EX2	2.43	2.24	0.19
EX3	89.68	68.35	21.33
EX4	14.70	14.7	0

Table 6.4 – Off-site flow rates

Name	Q2 (cfs)	Q10 (cfs)	Q100 (cfs)
EX1	8.30	16.50	28.11
EX2	0.33	0.70	1.24
EX3	32.55	63.46	106.65
EX4	0	0	0

Table 6.5 – Allowable Peak Flow Rates

Name	Allowable Q2 (cfs)	Allowable Q10 (cfs)	Allowable Q100 (cfs)
EX1	15.01	43.34	68.37
EX2	1.49	5.32	8.17
EX3	66.73	200.16	311.70
EX4	7.35	29.40	44.10

7. Post-Development Conditions

This section of the drainage study has been prepared to evaluate the Post-Development Conditions related to stormwater runoff. The following tables summarize the Post-Development Conditions Analysis. Refer to the Design Calculations for details regarding the analysis.

Table 7.1 – Post-Development Watershed Data

Name	Area (acres)	Composite CN	Tc (hrs)
P1	10.88	84	0.153
P2	0.68	81	0.112
P3	90.04	83	0.364
P4	4.40	82	0.165

Table 7.2 – Post-Development Discharges

Name	Q2 (cfs)	Q10 (cfs)	Q100 (cfs)
P1	29.29	58.87	84.76
P2	1.73	3.27	5.40
P3	56.27	194.07	282.73
P4	10.77	20.01	32.66

All storm events for Areas P2, P3, and P4 will see a decrease in the maximum release rates from Pre-Development Conditions to Post-Development Conditions. Area P1 does not meet the release requirements. This area will be a separate development that will require detention. The developer will be required to size this separate detention to meeting the allowable release rates located in Table 6.4.

P2 and P4 are fringe areas that do not contain any detention. The 2-year flows for P2 and P4 do not meet the allowable release rates located in Table 6.4. A waiver to the Design and Construction manual will be submitted to the City of Lee's Summit.

P5 on the proposed drainage map is a small fringe area on the backside of the detention pond. This area will be routed to a diversion ditch along the east side of the property and converge with the outlet of the detention pond at the Northeast corner of the property.

APWA 5608.4 also requires a 40-hour extended release of the water quality storm event (1.37"/24-hour rainfall) per Section 8.10 of the BMP Manual. The detention facility will release the water quality event over a 40-hour period. The Time vs. Volume graph is located in the Design Calculations Section.

8. Post-Development 100-year Spillway

APWA 5600 also requires a spillway in the detention pond sized for the 100-year event, assuming 100% clogging of the primary outlet works and zero available storage in the detention pond. The 100-year water surface elevation is 976.0. The spillway was set at an elevation of 976.5 and was sized to provide 1-foot of freeboard. The spillway will be 475-feet in length and riprap will be sized and placed throughout the spillway.

9. Future Conditions

The Cobey Creek site does not have any future developments planned.

10. Conclusions

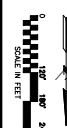
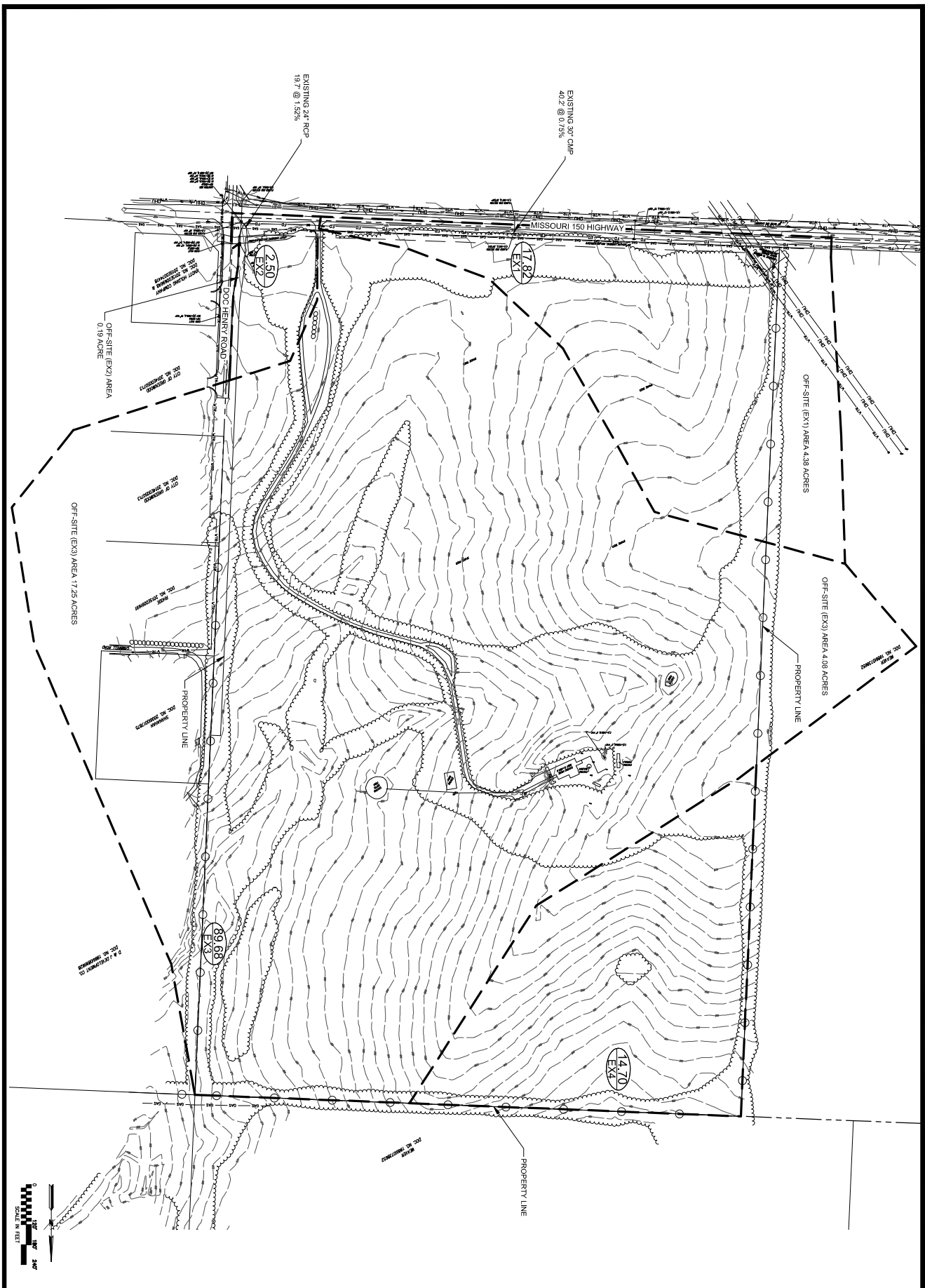
The Cobey Creek project is a mixed use development 186 single family lots, 44 multi-family lots, and 4 commercial lots. The project will contain 12.7 acres of commercial development and 84.6 acres of mixed residential development and open space. The report has been prepared to evaluate the stormwater discharge at the site to ensure the requirements of APWA 5600 are met. The detention pond and release structure was designed to not increase peak discharges from existing conditions as well as meeting the maximum releases from APWA 5600. It is not anticipated that the Cobey Creek Development will have any downstream impacts.

The 2-year flows for P2 and P4 do not meet the allowable release rates located in Table 6.4. A waiver to the Design and Construction manual will be submitted to the City of Lee's Summit.

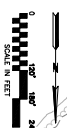
11. Design Calculations

See the attached for drainage area maps and stormwater calculations.

DRAINAGE AREA MAPS



11-000 STORM DRAINAGE May 8, 2018 18-000 1 2	STORM DRAINAGE REPORT EXISTING CONDITIONS COBEY CREEK CITY OF LEE'S SUMMIT, JACKSON COUNTY, MISSOURI	Consult Inc engineers planners 11010 Haskell Street, Suite 210, Kansas City, Kansas 66109 CORPORATE LICENSE No. E201000573 (MO.) / E-1736 (KS.)	R. KEVIN STORRETT, KS E-21889 MO E-20440 3rd 11, 2017	<table border="1"> <thead> <tr> <th>DATE</th><th>REVISION</th><th>NO.</th><th>BY</th><th>CHK/APP</th></tr> </thead> <tbody> <tr><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td></tr> </tbody> </table> IF THIS IS NOT A BLUE INK SEAL AND THE SIGNATURE IN BLUE INK, THE PLAN IS A COPY AND MAY CONTAIN UNAUTHORIZED ALTERATIONS. THE CERTIFICATION CONTAINED ON THIS DOCUMENT SHALL NOT APPLY TO ANY COPIES	DATE	REVISION	NO.	BY	CHK/APP																																																		
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SOIL CLASSIFICATIONS

Hydrologic Soil Group—Jackson County, Missouri



**Natural Resources
Conservation Service**

Web Soil Survey
National Cooperative Soil Survey

4/13/2018
Page 1 of 4

Hydrologic Soil Group—Jackson County, Missouri

MAP LEGEND

Area of Interest (AOI)

 Area of Interest (AOI)

Soils

Soil Rating Polygons

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

Soil Rating Lines

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

Soil Rating Points

 A
 A/D
 B
 B/D

 C
 C/D
 D
 Not rated or not available

Water Features

 Streams and Canals

Transportation

 Rails
 Interstate Highways
 US Routes
 Major Roads
 Local Roads

Background

 Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

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

Source of Map: Natural Resources Conservation Service
 Web Soil Survey URL:

Coordinate System: Web Mercator (EPSG:3857)

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

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

Soil Survey Area: Jackson County, Missouri
 Survey Area Data: Version 18, Sep 16, 2017

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

Date(s) aerial images were photographed: Oct 14, 2014—Oct 10, 2016

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

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
10000	Arisburg silt loam, 1 to 5 percent slopes	C	60.8	66.3%
10116	Sampsel silty clay loam, 2 to 5 percent slopes	C/D	9.0	9.8%
10117	Sampsel silty clay loam, 5 to 9 percent slopes	C/D	21.9	23.8%
Totals for Area of Interest			91.7	100.0%

Description

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

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

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

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

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

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

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

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

TIME OF CONCENTRATION CALCULATIONS

	EX1		
	Area	CN	Composite CN
Row Crop	4.4	78	19
Undeveloped	13.4	74	56
Total	17.8		75

	EX2		
	Area	CN	Composite CN
Undeveloped	0.2	74	6
Undeveloped	2.3	74	68
Total	2.5		74

	EX3		
	Area	CN	Composite CN
Row Crop	4.1	78	4
Residential/Undeveloped	17.3	80	15
Undeveloped	68.4	74	56
Total	89.7		75

	EX4		
	Area	CN	Composite CN
Undeveloped	14.7	74	74
Total	14.7		

	P1		
	Area	CN	Composite CN
Row Crop	2.5	78	18
Undeveloped	1.0	74	7
Mixed Use	7.4	88	60
Total	10.9		84

	P2		
	Area	CN	Composite CN
Undeveloped	0.2	74	16
Undeveloped	0.2	74	23
Mixed Use	0.3	88	41
Total	0.7		81

	P3		
	Area	CN	Composite CN
Row Crop	6.0	78	5
Undeveloped	3.3	74	3
Multi Family	25.8	88	25
Residential	55.0	82	50
Total	90.0		83

	P4		
	Area	CN	Composite CN
Residential	4.4	82	82
Total	4.4		

Hg

Cobey Creek
Existing
Jackson County, Missouri

Sub-Area Time of Concentration Details

Sub-Area Identifier/	Flow Length (ft)	Slope (ft/ft)	Mannings's n	End Area (sq ft)	Wetted Perimeter (ft)	Velocity (ft/sec)	Travel Time (hr)

EX3							
SHEET	100	0.0100	0.170				0.228
SHALLOW	1400	0.0330	0.050				0.133
CHANNEL	1520	0.0160	0.030	22.00	17.60	7.280	0.058
						Time of Concentration	.419
							=====
EX1							
SHEET	50	0.0140	0.170				0.114
SHALLOW	500	0.0200	0.050				0.061
CHANNEL	910	0.0200	0.030	8.00	10.00	6.019	0.042
						Time of Concentration	.217
							=====
EX2							
SHEET	50	0.0150	0.150				0.101
SHALLOW	100	0.0220	0.050				0.012
CHANNEL	350	0.0220	0.050	4.50	8.00	3.038	0.032
						Time of Concentration	.145
							=====
EX4							
SHEET	50	0.0120	0.150				0.110
SHALLOW	340	0.0300	0.050				0.034
CHANNEL	730	0.0300	0.050	16.00	15.00	5.336	0.038
						Time of Concentration	.182
							=====

Hg

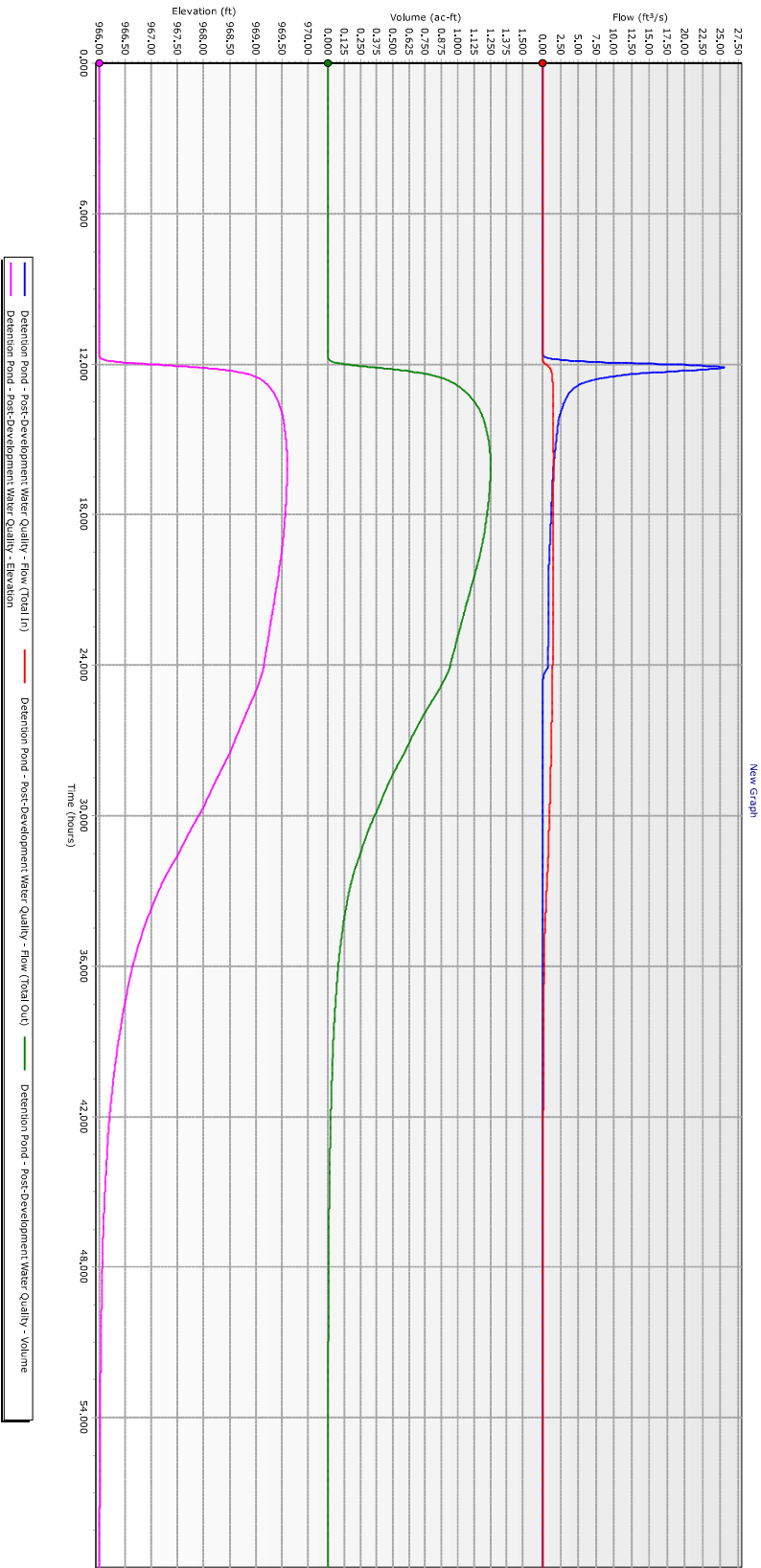
Cobey Creek
Proposed
Jackson County, Missouri

Sub-Area Time of Concentration Details

Sub-Area Identifier/	Flow Length (ft)	Slope (ft/ft)	Mannings's n	End Area (sq ft)	Wetted Perimeter (ft)	Velocity (ft/sec)	Travel Time (hr)

P3							
SHEET	100	0.0100	0.170				0.228
SHALLOW	600	0.0160	0.050				0.082
CHANNEL	2950	0.0175	0.013	12.60	12.60	15.175	0.054
						Time of Concentration	.364
							=====
P1							
SHEET	50	0.0140	0.170				0.114
SHALLOW	200	0.0200	0.025				0.019
CHANNEL	1000	0.0200	0.013	8.00	10.00	13.889	0.020
						Time of Concentration	.153
							=====
P2							
SHEET	50	0.0150	0.150				0.101
SHALLOW	50	0.0220	0.025				0.005
CHANNEL	250	0.0220	0.013	4.50	8.00	11.574	0.006
						Time of Concentration	.112
							=====
P4							
SHEET	50	0.0120	0.150				0.110
SHALLOW	100	0.0300	0.050				0.010
CHANNEL	1460	0.0300	0.030	16.00	15.00	9.012	0.045
						Time of Concentration	.165
							=====

WATER QUALITY EVENT EXTENDED RELEASE



PONDPACK OUTPUT

COBEY CREEK

Project Summary

Title	COBEY CREEK
Engineer	Kellen Huffman
Company	Hg Consult, Inc
Date	5/22/2018

Notes

COBEY CREEK

Subsection: Master Network Summary

Catchments Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft ³ /s)
P3	Pre-Development Water Quality	1	0.988	12.240	5.37
P3	Post-Development Water Quality	1	2.422	12.130	25.54
P3	Pre-Development 2 year	2	9.729	12.130	105.54
P3	Post-Development 2 year	2	13.945	12.090	169.63
P3	Pre-Development 10 year	10	20.139	12.130	226.85
P3	Post-Development 10 year	10	25.862	12.090	314.25
P3	Pre-Development 100 year	100	35.662	12.120	403.16
P3	Post-Development 100 year	100	42.704	12.090	511.44
P1	Pre-Development Water Quality	1	0.196	12.090	1.62
P1	Post-Development Water Quality	1	0.322	12.010	5.06
P1	Pre-Development 2 year	2	1.933	12.040	29.07
P1	Post-Development 2 year	2	1.756	11.980	29.29
P1	Pre-Development 10 year	10	4.002	12.030	61.09
P1	Post-Development 10 year	10	3.215	11.970	52.87
P1	Pre-Development 100 year	100	7.086	12.010	107.36
P1	Post-Development 100 year	100	5.265	11.970	84.76
P2	Pre-Development Water Quality	1	0.024	12.050	0.21
P2	Post-Development Water Quality	1	0.015	12.010	0.23
P2	Pre-Development 2 year	2	0.258	11.990	4.29
P2	Post-Development 2 year	2	0.097	11.950	1.73
P2	Pre-Development 10 year	10	0.543	11.970	9.17
P2	Post-Development 10 year	10	0.184	11.940	3.27
P2	Pre-Development 100 year	100	0.970	11.970	16.32

COBEY CREEK

Subsection: Master Network Summary

Catchments Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft ³ /s)
P2	Post-Development 100 year	100	0.309	11.940	5.40
P4	Pre-Development Water Quality	1	0.141	12.080	1.11
P4	Post-Development Water Quality	1	0.107	12.030	1.58
P4	Pre-Development 2 year	2	1.519	12.010	23.98
P4	Post-Development 2 year	2	0.654	11.990	10.77
P4	Pre-Development 10 year	10	3.192	12.010	51.33
P4	Post-Development 10 year	10	1.228	11.990	20.01
P4	Pre-Development 100 year	100	5.706	11.990	91.04
P4	Post-Development 100 year	100	2.044	11.970	32.66

Node Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft ³ /s)
O-3	Pre-Development Water Quality	1	0.988	12.240	5.37
O-3	Post-Development Water Quality	1	2.421	16.040	1.53
O-3	Pre-Development 2 year	2	9.729	12.130	105.54
O-3	Post-Development 2 year	2	13.944	12.470	56.27
O-3	Pre-Development 10 year	10	20.139	12.130	226.85
O-3	Post-Development 10 year	10	25.861	12.290	194.07
O-3	Pre-Development 100 year	100	35.662	12.120	403.16
O-3	Post-Development 100 year	100	42.703	12.310	282.73
O-1	Pre-Development Water Quality	1	0.196	12.090	1.62
O-1	Post-Development Water Quality	1	0.322	12.010	5.06
O-1	Pre-Development 2 year	2	1.933	12.040	29.07

COBEY CREEK

Subsection: Master Network Summary

Node Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft ³ /s)
O-1	Post-Development 2 year	2	1.756	11.980	29.29
O-1	Pre-Development 10 year	10	4.002	12.030	61.09
O-1	Post-Development 10 year	10	3.215	11.970	52.87
O-1	Pre-Development 100 year	100	7.086	12.010	107.36
O-1	Post-Development 100 year	100	5.265	11.970	84.76
O-2	Pre-Development Water Quality	1	0.024	12.050	0.21
O-2	Post-Development Water Quality	1	0.015	12.010	0.23
O-2	Pre-Development 2 year	2	0.258	11.990	4.29
O-2	Post-Development 2 year	2	0.097	11.950	1.73
O-2	Pre-Development 10 year	10	0.543	11.970	9.17
O-2	Post-Development 10 year	10	0.184	11.940	3.27
O-2	Pre-Development 100 year	100	0.970	11.970	16.32
O-2	Post-Development 100 year	100	0.309	11.940	5.40
O-4	Pre-Development Water Quality	1	0.141	12.080	1.11
O-4	Post-Development Water Quality	1	0.107	12.030	1.58
O-4	Pre-Development 2 year	2	1.519	12.010	23.98
O-4	Post-Development 2 year	2	0.654	11.990	10.77
O-4	Pre-Development 10 year	10	3.192	12.010	51.33
O-4	Post-Development 10 year	10	1.228	11.990	20.01
O-4	Pre-Development 100 year	100	5.706	11.990	91.04
O-4	Post-Development 100 year	100	2.044	11.970	32.66

Pond Summary

COBEY CREEK

Subsection: Master Network Summary

Pond Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft ³ /s)	Maximum Water Surface Elevation (ft)	Maximum Pond Storage (ac-ft)
Detention Pond (IN)	Post-Development Water Quality	1	2.422	12.130	25.54	(N/A)	(N/A)
Detention Pond (OUT)	Post-Development Water Quality	1	2.421	16.040	1.53	969.60	1.254
Detention Pond (IN)	Post-Development 2 year	2	13.945	12.090	169.63	(N/A)	(N/A)
Detention Pond (OUT)	Post-Development 2 year	2	13.944	12.470	56.27	972.74	5.248
Detention Pond (IN)	Post-Development 10 year	10	25.862	12.090	314.25	(N/A)	(N/A)
Detention Pond (OUT)	Post-Development 10 year	10	25.861	12.290	194.07	974.17	7.988
Detention Pond (IN)	Post-Development 100 year	100	42.704	12.090	511.44	(N/A)	(N/A)
Detention Pond (OUT)	Post-Development 100 year	100	42.703	12.310	282.73	976.00	12.018

PONDPACK SPILLWAY OUTPUT

COBEY CREEK-SPILLWAY

Project Summary

Title	COBEY CREEK- SPILLWAY
Engineer	Kellen Huffman
Company	Hg Consult, Inc
Date	5/22/2018

Notes

COBEY CREEK-SPILLWAY

Subsection: Master Network Summary

Catchments Summary

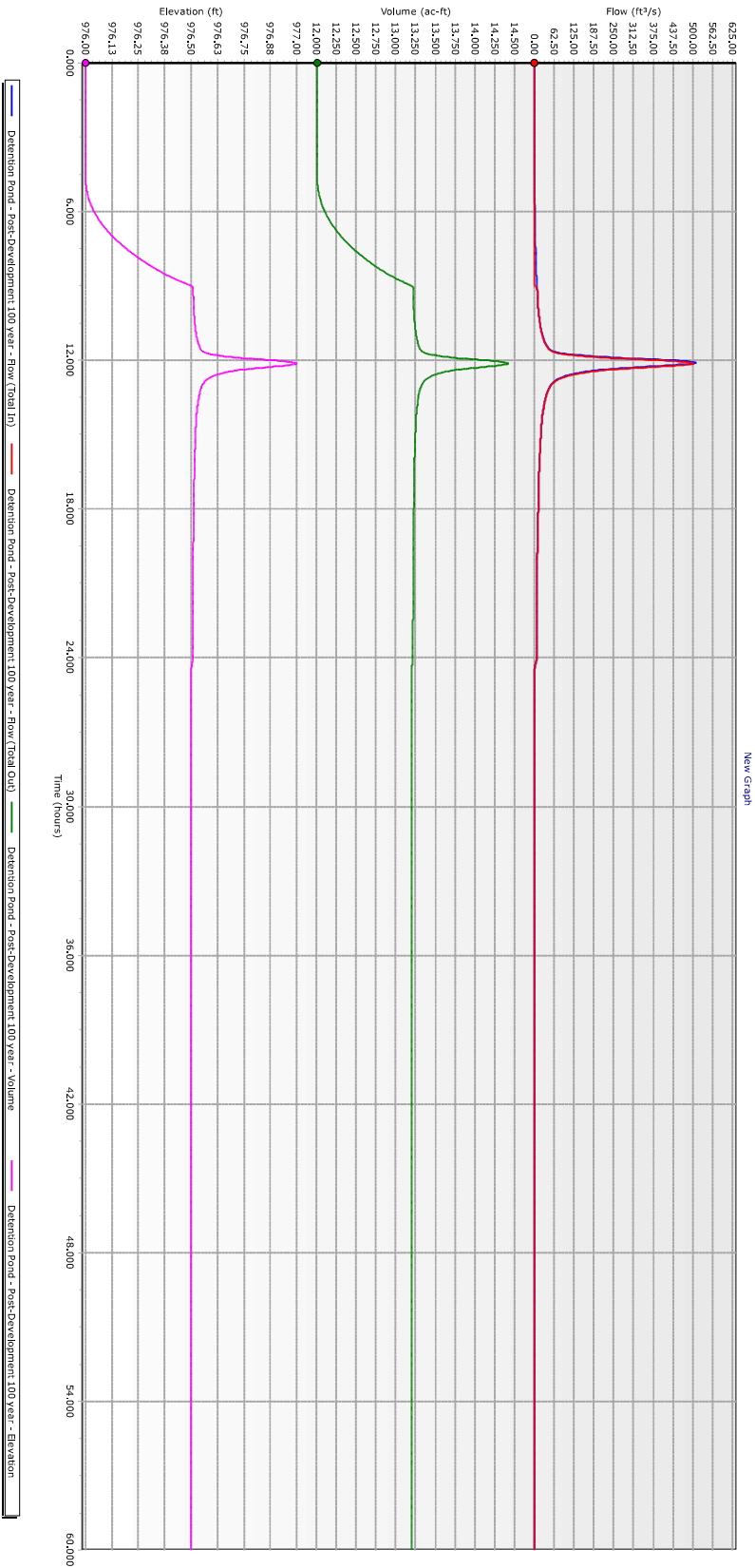
Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft ³ /s)
P3	Post-Development 100 year	100	42.704	12.090	511.44

Node Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft ³ /s)
O-3	Post-Development 100 year	100	41.518	12.130	502.73

Pond Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft ³ /s)	Maximum Water Surface Elevation (ft)	Maximum Pond Storage (ac-ft)
Detention Pond (IN)	Post-Development 100 year	100	42.704	12.090	511.44	(N/A)	(N/A)
Detention Pond (OUT)	Post-Development 100 year	100	41.518	12.130	502.73	977.00	14.420

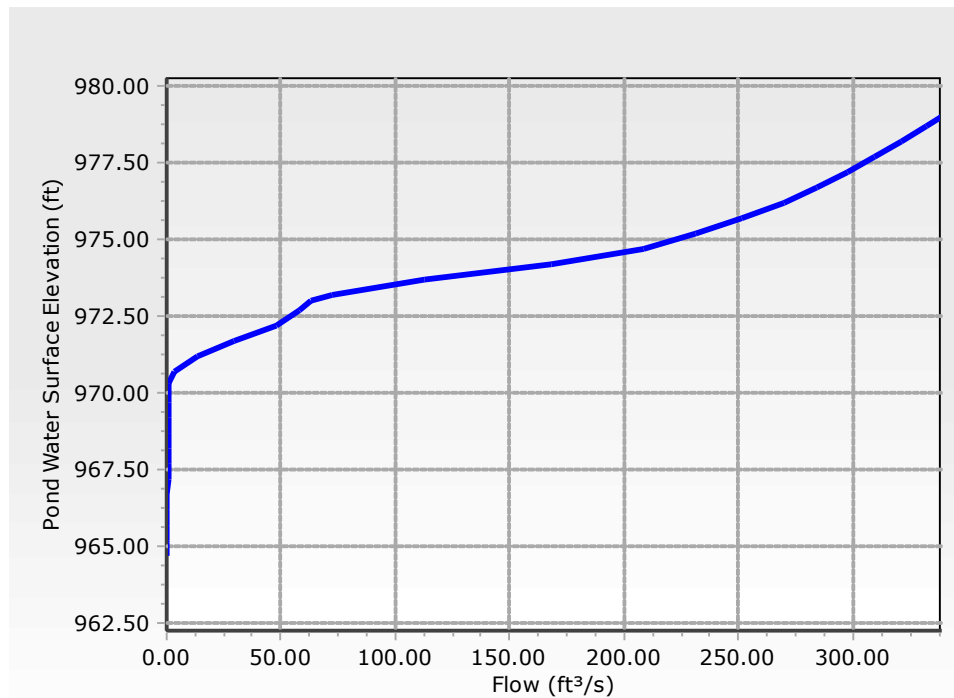


Composite Outlet Structure Detailed Report: Composite Outlet Structure - 1

Element Details			
Label	Composite Outlet Structure - 1	Notes	
Headwater Range			
Headwater Type	Use Pond for Headwater Range	Maximum (Headwater)	979.00 ft
Pond	Detention Pond	Increment (Headwater)	0.50 ft
Minimum (Headwater)	964.70 ft		
SpotElevation (ft)			
Tailwater Setup			
Tailwater Type	Free Outfall		
Tailwater Tolerances			
Maximum Iterations	30	Tailwater Tolerance (Maximum)	0.50 ft
Headwater Tolerance (Minimum)	0.01 ft	Flow Tolerance (Minimum)	0.001 ft³/s
Headwater Tolerance (Maximum)	0.50 ft	Flow Tolerance (Maximum)	10.000 ft³/s
Tailwater Tolerance (Minimum)	0.01 ft		
Outlet Structure			
Outlet Structure Type	Culvert	Culvert Type	Circular
Outlet Structure (IDs and Direction)			
Outlet ID	Culvert - 1	Downstream ID	Tailwater
Flow Direction	Forward Flow Only	Notes	
Outlet Structure (Advanced)			
Elevation (On)	0.00 ft	Elevation (Off)	0.00 ft
Culvert Data			
Number of Barrels	2	Downstream Invert	964.20 ft
Length	102.32 ft	Diameter	48.0 in
Upstream Invert	964.70 ft		
Unsubmerged->Submerged			
Specify Transitions	False	Compute Inlet Control Only	False

Composite Outlet Structure Detailed Report: Composite Outlet Structure - 1

Culvert Coefficients			
Inlet Description	Concrete - Groove end projecting	C	0.0317
Chart	Chart 1	Y	0.6900
Nomograph	Nomograph 3	Manning's n	0.011
Equation Form	Form 1	Ke	0.200
K	0.0045	Kr	0.000
M	2.0000	Slope Correction Factor	-0.500
Culvert (Advanced)			
Convergence Tolerance	0.00 ft	Specify Number of Backwater Sections	False



RATING TABLE FOR ONE OUTLET TYPE

Structure ID = Culvert - 1 (Culvert-Circular)

Mannings open channel maximum capacity: 127.65 ft³/s

Upstream ID = Orifice - 3, Riser - 2, Orifice - 1, Riser - 1, Orifice - 2

Downstream ID = Tailwater (Pond Outfall)

Water Surface Elevation (ft)	Device Flow (ft³/s)	(into) Headwater Hydraulic Grade Line (ft)	Converge Downstream Hydraulic Grade Line (ft)	Next Downstream Hydraulic Grade Line (ft)
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Composite Outlet Structure Detailed Report: Composite Outlet Structure - 1

RATING TABLE FOR ONE OUTLET TYPE

Structure ID = Culvert - 1 (Culvert-Circular)

Mannings open channel maximum capacity: 127.65 ft³/s

Upstream ID = Orifice - 3, Riser - 2, Orifice - 1, Riser - 1, Orifice - 2

Downstream ID = Tailwater (Pond Outfall)

Water Surface Elevation (ft)	Device Flow (ft ³ /s)	(into) Headwater Hydraulic Grade Line (ft)	Converge Downstream Hydraulic Grade Line (ft)	Next Downstream Hydraulic Grade Line (ft)
964.70	0.00	0.00	0.00	Free Outfall
965.10	0.12	964.80	Free Outfall	Free Outfall
965.20	0.16	964.81	Free Outfall	Free Outfall
965.70	0.30	964.85	Free Outfall	Free Outfall
966.20	0.35	964.87	Free Outfall	Free Outfall
966.70	0.41	964.88	Free Outfall	Free Outfall
967.20	0.49	964.90	Free Outfall	Free Outfall
967.70	0.52	964.90	Free Outfall	Free Outfall
968.20	0.56	964.92	Free Outfall	Free Outfall
968.70	0.62	964.92	Free Outfall	Free Outfall
969.20	0.66	964.93	Free Outfall	Free Outfall
969.70	0.68	964.93	Free Outfall	Free Outfall
970.20	0.72	964.94	Free Outfall	Free Outfall
970.30	0.72	964.94	Free Outfall	Free Outfall
970.70	3.53	965.24	Free Outfall	Free Outfall
971.20	13.78	965.78	Free Outfall	Free Outfall
971.70	29.56	966.31	Free Outfall	Free Outfall
972.20	47.61	966.78	Free Outfall	Free Outfall
972.70	57.94	967.01	Free Outfall	Free Outfall
973.00	63.26	967.13	Free Outfall	Free Outfall
973.20	72.53	967.32	Free Outfall	Free Outfall
973.70	112.93	968.07	Free Outfall	Free Outfall
974.20	167.95	969.00	Free Outfall	Free Outfall
974.70	208.39	969.66	Free Outfall	Free Outfall
975.20	230.98	970.13	Free Outfall	Free Outfall
975.70	251.77	970.63	Free Outfall	Free Outfall
976.20	270.41	971.12	Free Outfall	Free Outfall
976.70	284.48	971.51	Free Outfall	Free Outfall
977.20	297.36	971.89	Free Outfall	Free Outfall
977.70	309.66	972.26	Free Outfall	Free Outfall
978.20	321.29	972.63	Free Outfall	Free Outfall
978.70	332.45	973.00	Free Outfall	Free Outfall
979.00	338.98	973.22	Free Outfall	Free Outfall
Downstream Hydraulic Grade Line Error (ft)	Convergence Error (ft ³ /s)	Downstream Channel Tailwater (ft)	Tailwater Error (ft)	
0.00	0.00	(N/A)	0.00	
0.00	0.00	(N/A)	0.00	

Composite Outlet Structure Detailed Report: Composite Outlet Structure - 1

RATING TABLE FOR ONE OUTLET TYPE

Structure ID = Culvert - 1 (Culvert-Circular)

Mannings open channel maximum capacity: 127.65 ft³/s

Upstream ID = Orifice - 3, Riser - 2, Orifice - 1, Riser - 1, Orifice - 2

Downstream ID = Tailwater (Pond Outfall)

Message
CRIT.DEPTH CONTROL Vh= .037ft Dcr= .109ft CRIT.DEPTH Hev= .00ft
CRIT.DEPTH CONTROL Vh= .040ft Dcr= .119ft CRIT.DEPTH Hev= .00ft
CRIT.DEPTH CONTROL Vh= .044ft Dcr= .130ft CRIT.DEPTH Hev= .00ft
FLOW PRECEDENCE SET TO UPSTREAM CONTROLLING STRUCTURE
FLOW PRECEDENCE SET TO UPSTREAM CONTROLLING STRUCTURE
CRIT.DEPTH CONTROL Vh= .051ft Dcr= .151ft CRIT.DEPTH Hev= .00ft
FLOW PRECEDENCE SET TO UPSTREAM CONTROLLING STRUCTURE
FLOW PRECEDENCE SET TO UPSTREAM CONTROLLING STRUCTURE
FLOW PRECEDENCE SET TO UPSTREAM CONTROLLING STRUCTURE
CRIT.DEPTH CONTROL Vh= .058ft Dcr= .172ft CRIT.DEPTH Hev= .00ft
FLOW PRECEDENCE SET TO UPSTREAM CONTROLLING STRUCTURE
FLOW PRECEDENCE SET TO UPSTREAM CONTROLLING STRUCTURE
FLOW PRECEDENCE SET TO UPSTREAM CONTROLLING STRUCTURE
CRIT.DEPTH CONTROL Vh= .530ft Dcr= 1.440ft CRIT.DEPTH Hev= .00ft
CRIT.DEPTH CONTROL Vh= .597ft Dcr= 1.595ft CRIT.DEPTH Hev= .00ft
CRIT.DEPTH CONTROL Vh= .630ft Dcr= 1.670ft CRIT.DEPTH Hev= .00ft

Composite Outlet Structure Detailed Report: Composite Outlet Structure - 1

RATING TABLE FOR ONE OUTLET TYPE

Structure ID = Culvert - 1 (Culvert-Circular)

Mannings open channel maximum capacity: 127.65 ft³/s

Upstream ID = Orifice - 3, Riser - 2, Orifice - 1, Riser - 1, Orifice - 2

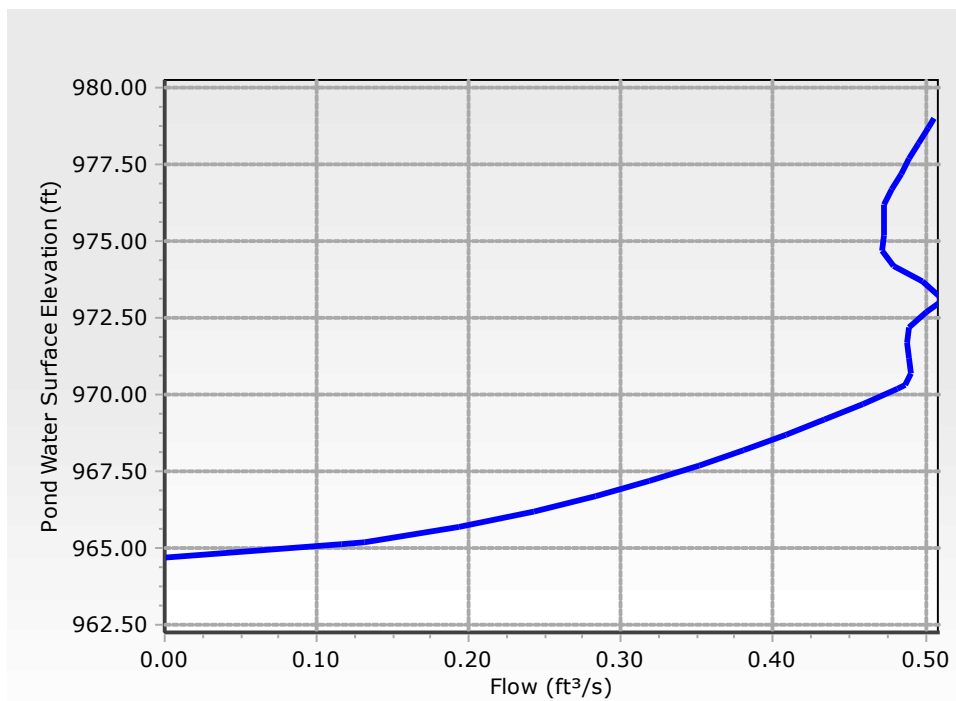
Downstream ID = Tailwater (Pond Outfall)

Message			
CRIT.DEPTH CONTROL Vh= .686ft Dcr= 1.793ft CRIT.DEPTH Hev= .00ft			
CRIT.DEPTH CONTROL Vh= .924ft Dcr= 2.261ft CRIT.DEPTH Hev= .00ft			
CRIT.DEPTH CONTROL Vh= 1.264ft Dcr= 2.778ft CRIT.DEPTH Hev= .00ft			
CRIT.DEPTH CONTROL Vh= 1.554ft Dcr= 3.091ft CRIT.DEPTH Hev= .00ft			
INLET CONTROL... Submerged: HW =5.43			
INLET CONTROL... Submerged: HW =5.93			
INLET CONTROL... Submerged: HW =6.42			
INLET CONTROL... Submerged: HW =6.81			
INLET CONTROL... Submerged: HW =7.19			
INLET CONTROL... Submerged: HW =7.56			
INLET CONTROL... Submerged: HW =7.93			
INLET CONTROL... Submerged: HW =8.30			
INLET CONTROL... Submerged: HW =8.52			

Outlet Structure			
Outlet Structure Type		Orifice	
Outlet Structure (IDs and Direction)			
Outlet ID	Orifice - 1	Downstream ID	Culvert - 1
Flow Direction	Forward Flow Only	Notes	
Outlet Structure (Advanced)			
Elevation (On)	0.00 ft	Elevation (Off)	0.00 ft
Outlet Structure (Orifice)			
Orifice	Circular Orifice	Orifice Coefficient	0.600

Composite Outlet Structure Detailed Report: Composite Outlet Structure - 1

Outlet Structure (Orifice)			
Number of Openings	2	Orifice Diameter	2.0 in
Outlet Structure (Common)			
Elevation	964.70 ft		



RATING TABLE FOR ONE OUTLET TYPE

Structure ID = Orifice - 1 (Orifice-Circular)

Upstream ID = (Pond Water Surface)

Downstream ID = Culvert - 1 (Culvert-Circular)

Water Surface Elevation (ft)	Device Flow (ft³/s)	(into) Headwater Hydraulic Grade Line (ft)	Converge Downstream Hydraulic Grade Line (ft)	Next Downstream Hydraulic Grade Line (ft)
964.70	0.00	0.00	0.00	0.00
965.10	0.12	965.10	964.80	964.80
965.20	0.13	965.20	964.81	964.81
965.70	0.19	965.70	964.85	964.85
966.20	0.24	966.20	964.87	964.87
966.70	0.28	966.70	964.88	964.88
967.20	0.32	967.20	964.90	964.90
967.70	0.35	967.70	964.90	964.90
968.20	0.38	968.20	964.91	964.92

Composite Outlet Structure Detailed Report: Composite Outlet Structure - 1

RATING TABLE FOR ONE OUTLET TYPE

Structure ID = Orifice - 1 (Orifice-Circular)

Upstream ID = (Pond Water Surface)

Downstream ID = Culvert - 1 (Culvert-Circular)

Water Surface Elevation (ft)	Device Flow (ft ³ /s)	(into) Headwater Hydraulic Grade Line (ft)	Converge Downstream Hydraulic Grade Line (ft)	Next Downstream Hydraulic Grade Line (ft)
968.70	0.41	968.70	964.92	964.92
969.20	0.43	969.20	964.93	964.93
969.70	0.46	969.70	964.93	964.93
970.20	0.48	970.20	964.94	964.94
970.30	0.49	970.30	964.94	964.94
970.70	0.49	970.70	965.24	965.24
971.20	0.49	971.20	965.78	965.78
971.70	0.49	971.70	966.31	966.31
972.20	0.49	972.20	966.78	966.78
972.70	0.50	972.70	967.01	967.01
973.00	0.51	973.00	967.13	967.13
973.20	0.51	973.20	967.32	967.32
973.70	0.50	973.70	968.07	968.07
974.20	0.48	974.20	968.99	969.00
974.70	0.47	974.70	969.66	969.66
975.20	0.47	975.20	970.13	970.13
975.70	0.47	975.70	970.63	970.63
976.20	0.47	976.20	971.12	971.12
976.70	0.48	976.70	971.51	971.51
977.20	0.48	977.20	971.89	971.89
977.70	0.49	977.70	972.26	972.26
978.20	0.50	978.20	972.63	972.63
978.70	0.50	978.70	973.00	973.00
979.00	0.51	979.00	973.22	973.22
Downstream Hydraulic Grade Line Error (ft)	Convergence Error (ft ³ /s)	Downstream Channel Tailwater (ft)	Tailwater Error (ft)	
0.00	0.00	(N/A)	0.00	
0.00	0.00	(N/A)	0.00	
0.00	0.00	(N/A)	0.00	
0.00	0.00	(N/A)	0.00	
0.00	0.00	(N/A)	0.00	
0.00	0.00	(N/A)	0.00	
0.00	0.00	(N/A)	0.00	
0.00	0.00	(N/A)	0.00	
0.00	0.00	(N/A)	0.00	
0.00	0.00	(N/A)	0.00	
0.00	0.00	(N/A)	0.00	
0.00	0.00	(N/A)	0.00	
0.00	0.00	(N/A)	0.00	

Composite Outlet Structure Detailed Report: Composite Outlet Structure - 1

RATING TABLE FOR ONE OUTLET TYPE

Structure ID = Orifice - 1 (Orifice-Circular)

Upstream ID = (Pond Water Surface)

Downstream ID = Culvert - 1 (Culvert-Circular)

Downstream Hydraulic Grade Line Error (ft)	Convergence Error (ft ³ /s)	Downstream Channel Tailwater (ft)	Tailwater Error (ft)
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00

Message

WS below an invert; no flow.

H =.30
H =.39
H =.85
H =1.33
H =1.82
H =2.30
H =2.80
H =3.29
H =3.78
H =4.27
H =4.77
H =5.26
H =5.36
H =5.46
H =5.42
H =5.39

Composite Outlet Structure Detailed Report: Composite Outlet Structure - 1

RATING TABLE FOR ONE OUTLET TYPE

Structure ID = Orifice - 1 (Orifice-Circular)

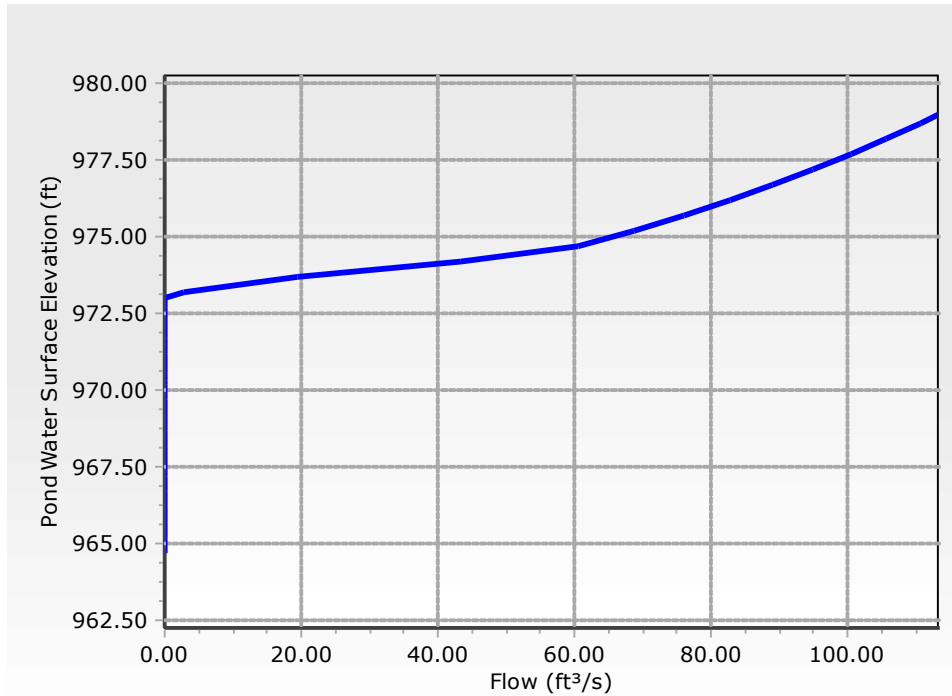
Upstream ID = (Pond Water Surface)

Downstream ID = Culvert - 1 (Culvert-Circular)

Message			
H =5.42 H =5.69 H =5.87 H =5.88 H =5.63 H =5.21 H =5.04 H =5.07 H =5.07 H =5.08 H =5.19 H =5.31 H =5.44 H =5.57 H =5.70 H =5.78			
Outlet Structure			
Outlet Structure Type		Riser	
Outlet Structure (IDs and Direction)			
Outlet ID	Riser - 1	Downstream ID	Culvert - 1
Flow Direction	Forward Flow Only	Notes	
Outlet Structure (Advanced)			
Elevation (On)	0.00 ft	Elevation (Off)	0.00 ft
Outlet Structure (Riser)			
Riser	Stand Pipe	Transition Elevation	0.00 ft
Diameter	42.0 in	Transition Height	0.00 ft
Weir Coefficient	3.00 (ft^0.5)/s	K Reverse	1.000
Orifice Coefficient	0.600		
Outlet Structure (Common)			
Elevation	973.00 ft		
Outlet Structure (Riser, Advanced)			
Use Orifice Depth to Crest?	True	Use Submerged Weir Equation?	False

Composite Outlet Structure Detailed Report: Composite Outlet Structure - 1

Outlet Structure (Riser, Advanced)



RATING TABLE FOR ONE OUTLET TYPE

Structure ID = Riser - 1 (Stand Pipe)

Upstream ID = (Pond Water Surface)

Downstream ID = Culvert - 1 (Culvert-Circular)

Water Surface Elevation (ft)	Device Flow (ft³/s)	(into) Headwater Hydraulic Grade Line (ft)	Converge Downstream Hydraulic Grade Line (ft)	Next Downstream Hydraulic Grade Line (ft)
964.70	0.00	0.00	0.00	0.00
965.10	0.00	0.00	0.00	964.80
965.20	0.00	0.00	0.00	964.81
965.70	0.00	0.00	0.00	964.85
966.20	0.00	0.00	0.00	964.87
966.70	0.00	0.00	0.00	964.88
967.20	0.00	0.00	0.00	964.90
967.70	0.00	0.00	0.00	964.90
968.20	0.00	0.00	0.00	964.92
968.70	0.00	0.00	0.00	964.92
969.20	0.00	0.00	0.00	964.93
969.70	0.00	0.00	0.00	964.93
970.20	0.00	0.00	0.00	964.94

Composite Outlet Structure Detailed Report: Composite Outlet Structure - 1

RATING TABLE FOR ONE OUTLET TYPE

Structure ID = Riser - 1 (Stand Pipe)

Upstream ID = (Pond Water Surface)

Downstream ID = Culvert - 1 (Culvert-Circular)

Water Surface Elevation (ft)	Device Flow (ft ³ /s)	(into) Headwater Hydraulic Grade Line (ft)	Converge Downstream Hydraulic Grade Line (ft)	Next Downstream Hydraulic Grade Line (ft)
970.30	0.00	0.00	0.00	964.94
970.70	0.00	0.00	0.00	965.24
971.20	0.00	0.00	0.00	965.78
971.70	0.00	0.00	0.00	966.31
972.20	0.00	0.00	0.00	966.78
972.70	0.00	0.00	0.00	967.01
973.00	0.00	0.00	0.00	967.13
973.20	2.95	973.20	Free Outfall	967.32
973.70	19.32	973.70	Free Outfall	968.07
974.20	43.36	974.20	Free Outfall	969.00
974.70	60.38	974.70	Free Outfall	969.66
975.20	68.68	975.20	Free Outfall	970.13
975.70	76.09	975.70	Free Outfall	970.63
976.20	82.84	976.20	Free Outfall	971.12
976.70	89.07	976.70	Free Outfall	971.51
977.20	94.90	977.20	Free Outfall	971.89
977.70	100.39	977.70	Free Outfall	972.26
978.20	105.60	978.20	Free Outfall	972.63
978.70	110.56	978.70	Free Outfall	973.00
979.00	113.43	979.00	973.22	973.22
Downstream Hydraulic Grade Line Error (ft)	Convergence Error (ft ³ /s)	Downstream Channel Tailwater (ft)	Tailwater Error (ft)	
0.00	0.00	(N/A)	0.00	
0.00	0.00	(N/A)	0.00	
0.00	0.00	(N/A)	0.00	
0.00	0.00	(N/A)	0.00	
0.00	0.00	(N/A)	0.00	
0.00	0.00	(N/A)	0.00	
0.00	0.00	(N/A)	0.00	
0.00	0.00	(N/A)	0.00	
0.00	0.00	(N/A)	0.00	
0.00	0.00	(N/A)	0.00	
0.00	0.00	(N/A)	0.00	
0.00	0.00	(N/A)	0.00	
0.00	0.00	(N/A)	0.00	
0.00	0.00	(N/A)	0.00	
0.00	0.00	(N/A)	0.00	
0.00	0.00	(N/A)	0.00	
0.00	0.00	(N/A)	0.00	

Composite Outlet Structure Detailed Report: Composite Outlet Structure - 1

RATING TABLE FOR ONE OUTLET TYPE

Structure ID = Riser - 1 (Stand Pipe)

Upstream ID = (Pond Water Surface)

Downstream ID = Culvert - 1 (Culvert-Circular)

Downstream Hydraulic Grade Line Error (ft)	Convergence Error (ft ³ /s)	Downstream Channel Tailwater (ft)	Tailwater Error (ft)
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00

Message

WS below an invert; no flow.
 WS below an invert; no flow.
 WS below an invert; no flow.
 WS below an invert; no flow.
 WS below an invert; no flow.
 WS below an invert; no flow.
 WS below an invert; no flow.
 WS below an invert; no flow.
 WS below an invert; no flow.
 WS below an invert; no flow.
 WS below an invert; no flow.
 WS below an invert; no flow.
 WS below an invert; no flow.
 WS below an invert; no flow.
 WS below an invert; no flow.
 WS below an invert; no flow.
 WS below an invert; no flow.
 WS below an invert; no flow.
 WS below an invert; no flow.
 WS below an invert; no flow.
 Weir: H =0.2ft

Composite Outlet Structure Detailed Report: Composite Outlet Structure - 1

RATING TABLE FOR ONE OUTLET TYPE

Structure ID = Riser - 1 (Stand Pipe)

Upstream ID = (Pond Water Surface)

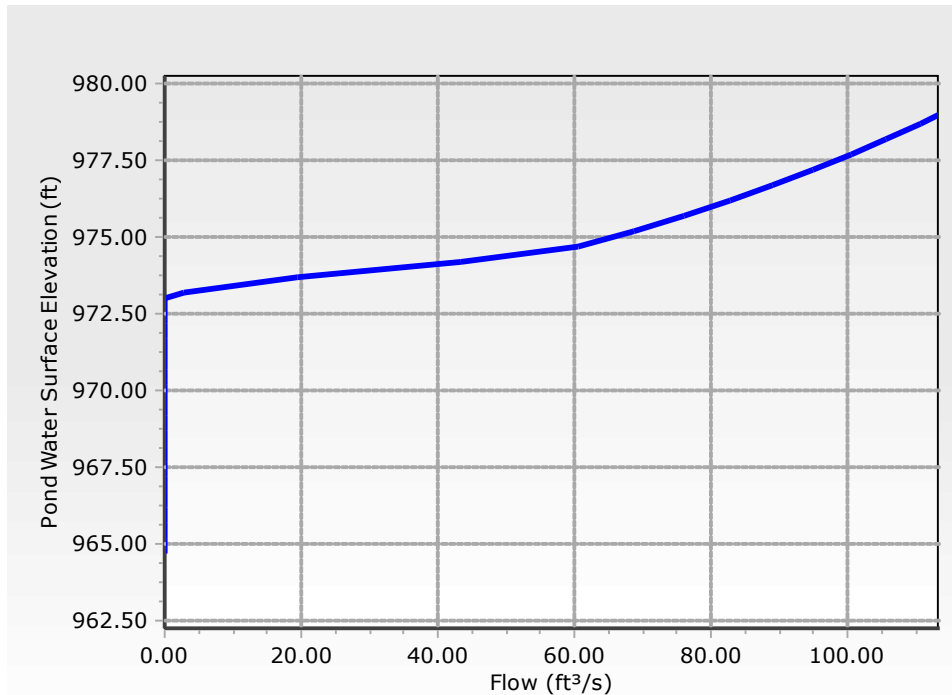
Downstream ID = Culvert - 1 (Culvert-Circular)

Message			
Weir: H =0.7ft			
Weir: H =1.2ft			
Orifice: H =1.70; Riser orifice equation controlling.			
Orifice: H =2.20; Riser orifice equation controlling.			
Orifice: H =2.70; Riser orifice equation controlling.			
Orifice: H =3.20; Riser orifice equation controlling.			
Orifice: H =3.70; Riser orifice equation controlling.			
Orifice: H =4.20; Riser orifice equation controlling.			
Orifice: H =4.70; Riser orifice equation controlling.			
Orifice: H =5.20; Riser orifice equation controlling.			
Orifice: H =5.70; Riser orifice equation controlling.			
FULLY CHARGED RISER: Orifice Equation Control to Crest; H=6.00			

Outlet Structure			
Outlet Structure Type		Riser	
Outlet Structure (IDs and Direction)			
Outlet ID	Riser - 2	Downstream ID	Culvert - 1
Flow Direction	Forward Flow Only	Notes	
Outlet Structure (Advanced)			
Elevation (On)	0.00 ft	Elevation (Off)	0.00 ft
Outlet Structure (Riser)			
Riser	Stand Pipe	Transition Elevation	0.00 ft
Diameter	42.0 in	Transition Height	0.00 ft
Weir Coefficient	3.00 (ft^0.5)/s	K Reverse	1.000
Orifice Coefficient	0.600		
Outlet Structure (Common)			

Composite Outlet Structure Detailed Report: Composite Outlet Structure - 1

Outlet Structure (Common)			
Elevation	973.00 ft		
Outlet Structure (Riser, Advanced)			
Use Orifice Depth to Crest?	True	Use Submerged Weir Equation?	False



RATING TABLE FOR ONE OUTLET TYPE

Structure ID = Riser - 2 (Stand Pipe)

Upstream ID = (Pond Water Surface)

Downstream ID = Culvert - 1 (Culvert-Circular)

Water Surface Elevation (ft)	Device Flow (ft³/s)	(into) Headwater Hydraulic Grade Line (ft)	Converge Downstream Hydraulic Grade Line (ft)	Next Downstream Hydraulic Grade Line (ft)
964.70	0.00	0.00	0.00	0.00
965.10	0.00	0.00	0.00	964.80
965.20	0.00	0.00	0.00	964.81
965.70	0.00	0.00	0.00	964.85
966.20	0.00	0.00	0.00	964.87
966.70	0.00	0.00	0.00	964.88
967.20	0.00	0.00	0.00	964.90
967.70	0.00	0.00	0.00	964.90

Composite Outlet Structure Detailed Report: Composite Outlet Structure - 1

RATING TABLE FOR ONE OUTLET TYPE

Structure ID = Riser - 2 (Stand Pipe)

Upstream ID = (Pond Water Surface)

Downstream ID = Culvert - 1 (Culvert-Circular)

Water Surface Elevation (ft)	Device Flow (ft ³ /s)	(into) Headwater Hydraulic Grade Line (ft)	Converge Downstream Hydraulic Grade Line (ft)	Next Downstream Hydraulic Grade Line (ft)
968.20	0.00	0.00	0.00	964.92
968.70	0.00	0.00	0.00	964.92
969.20	0.00	0.00	0.00	964.93
969.70	0.00	0.00	0.00	964.93
970.20	0.00	0.00	0.00	964.94
970.30	0.00	0.00	0.00	964.94
970.70	0.00	0.00	0.00	965.24
971.20	0.00	0.00	0.00	965.78
971.70	0.00	0.00	0.00	966.31
972.20	0.00	0.00	0.00	966.78
972.70	0.00	0.00	0.00	967.01
973.00	0.00	0.00	0.00	967.13
973.20	2.95	973.20	Free Outfall	967.32
973.70	19.32	973.70	Free Outfall	968.07
974.20	43.36	974.20	Free Outfall	969.00
974.70	60.38	974.70	Free Outfall	969.66
975.20	68.68	975.20	Free Outfall	970.13
975.70	76.09	975.70	Free Outfall	970.63
976.20	82.84	976.20	Free Outfall	971.12
976.70	89.07	976.70	Free Outfall	971.51
977.20	94.90	977.20	Free Outfall	971.89
977.70	100.39	977.70	Free Outfall	972.26
978.20	105.60	978.20	Free Outfall	972.63
978.70	110.56	978.70	Free Outfall	973.00
979.00	113.43	979.00	973.22	973.22
Downstream Hydraulic Grade Line Error (ft)	Convergence Error (ft ³ /s)	Downstream Channel Tailwater (ft)	Tailwater Error (ft)	
0.00	0.00	(N/A)	0.00	
0.00	0.00	(N/A)	0.00	
0.00	0.00	(N/A)	0.00	
0.00	0.00	(N/A)	0.00	
0.00	0.00	(N/A)	0.00	
0.00	0.00	(N/A)	0.00	
0.00	0.00	(N/A)	0.00	
0.00	0.00	(N/A)	0.00	
0.00	0.00	(N/A)	0.00	
0.00	0.00	(N/A)	0.00	
0.00	0.00	(N/A)	0.00	

Composite Outlet Structure Detailed Report: Composite Outlet Structure - 1

RATING TABLE FOR ONE OUTLET TYPE

Structure ID = Riser - 2 (Stand Pipe)

Upstream ID = (Pond Water Surface)

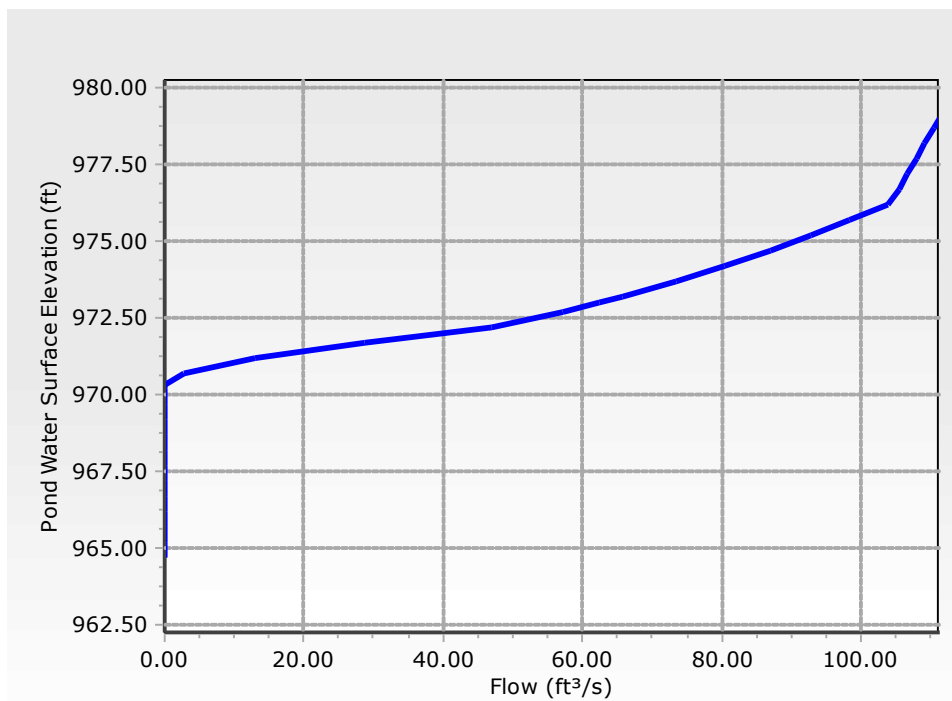
Downstream ID = Culvert - 1 (Culvert-Circular)

Message			
WS below an invert; no flow.			
WS below an invert; no flow.			
WS below an invert; no flow.			
WS below an invert; no flow.			
Weir: H =0.2ft			
Weir: H =0.7ft			
Weir: H =1.2ft			
Orifice: H =1.70; Riser orifice equation controlling.			
Orifice: H =2.20; Riser orifice equation controlling.			
Orifice: H =2.70; Riser orifice equation controlling.			
Orifice: H =3.20; Riser orifice equation controlling.			
Orifice: H =3.70; Riser orifice equation controlling.			
Orifice: H =4.20; Riser orifice equation controlling.			
Orifice: H =4.70; Riser orifice equation controlling.			
Orifice: H =5.20; Riser orifice equation controlling.			
Orifice: H =5.70; Riser orifice equation controlling.			
FULLY CHARGED RISER: Orifice Equation Control to Crest; H=6.00			

Outlet Structure			
Outlet Structure Type		Orifice	
Outlet Structure (IDs and Direction)			
Outlet ID	Orifice - 3	Downstream ID	Culvert - 1
Flow Direction	Forward Flow Only	Notes	
Outlet Structure (Advanced)			
Elevation (On)	0.00 ft	Elevation (Off)	0.00 ft
Outlet Structure (Orifice)			
Orifice	Circular Orifice	Orifice Coefficient	0.600

Composite Outlet Structure Detailed Report: Composite Outlet Structure - 1

Outlet Structure (Orifice)			
Number of Openings	4	Orifice Diameter	21.0 in
Outlet Structure (Common)			
Elevation	970.30 ft		



RATING TABLE FOR ONE OUTLET TYPE

Structure ID = Orifice - 3 (Orifice-Circular)

Upstream ID = (Pond Water Surface)

Downstream ID = Culvert - 1 (Culvert-Circular)

Water Surface Elevation (ft)	Device Flow (ft³/s)	(into) Headwater Hydraulic Grade Line (ft)	Converge Downstream Hydraulic Grade Line (ft)	Next Downstream Hydraulic Grade Line (ft)
964.70	0.00	0.00	0.00	0.00
965.10	0.00	0.00	0.00	964.80
965.20	0.00	0.00	0.00	964.81
965.70	0.00	0.00	0.00	964.85
966.20	0.00	0.00	0.00	964.87
966.70	0.00	0.00	0.00	964.88
967.20	0.00	0.00	0.00	964.90
967.70	0.00	0.00	0.00	964.90
968.20	0.00	0.00	0.00	964.92

Composite Outlet Structure Detailed Report: Composite Outlet Structure - 1

RATING TABLE FOR ONE OUTLET TYPE

Structure ID = Orifice - 3 (Orifice-Circular)

Upstream ID = (Pond Water Surface)

Downstream ID = Culvert - 1 (Culvert-Circular)

Water Surface Elevation (ft)	Device Flow (ft ³ /s)	(into) Headwater Hydraulic Grade Line (ft)	Converge Downstream Hydraulic Grade Line (ft)	Next Downstream Hydraulic Grade Line (ft)
968.70	0.00	0.00	0.00	964.92
969.20	0.00	0.00	0.00	964.93
969.70	0.00	0.00	0.00	964.93
970.20	0.00	0.00	0.00	964.94
970.30	0.00	0.00	0.00	964.94
970.70	2.79	970.70	Free Outfall	965.24
971.20	13.03	971.20	Free Outfall	965.78
971.70	28.85	971.70	Free Outfall	966.31
972.20	46.88	972.20	Free Outfall	966.78
972.70	57.18	972.70	Free Outfall	967.01
973.00	62.56	973.00	Free Outfall	967.13
973.20	65.90	973.20	Free Outfall	967.32
973.70	73.58	973.70	Free Outfall	968.07
974.20	80.54	974.20	Free Outfall	969.00
974.70	86.94	974.70	Free Outfall	969.66
975.20	92.90	975.20	Free Outfall	970.13
975.70	98.50	975.70	970.63	970.63
976.20	103.80	976.20	971.12	971.12
976.70	105.48	976.70	971.51	971.51
977.20	106.72	977.20	971.89	971.89
977.70	107.99	977.70	972.26	972.26
978.20	109.27	978.20	972.63	972.63
978.70	110.59	978.70	973.00	973.00
979.00	111.36	979.00	973.22	973.22
Downstream Hydraulic Grade Line Error (ft)	Convergence Error (ft ³ /s)	Downstream Channel Tailwater (ft)	Tailwater Error (ft)	
0.00	0.00	(N/A)	0.00	
0.00	0.00	(N/A)	0.00	
0.00	0.00	(N/A)	0.00	
0.00	0.00	(N/A)	0.00	
0.00	0.00	(N/A)	0.00	
0.00	0.00	(N/A)	0.00	
0.00	0.00	(N/A)	0.00	
0.00	0.00	(N/A)	0.00	
0.00	0.00	(N/A)	0.00	
0.00	0.00	(N/A)	0.00	
0.00	0.00	(N/A)	0.00	
0.00	0.00	(N/A)	0.00	
0.00	0.00	(N/A)	0.00	

Composite Outlet Structure Detailed Report: Composite Outlet Structure - 1

RATING TABLE FOR ONE OUTLET TYPE

Structure ID = Orifice - 3 (Orifice-Circular)

Upstream ID = (Pond Water Surface)

Downstream ID = Culvert - 1 (Culvert-Circular)

Downstream Hydraulic Grade Line Error (ft)	Convergence Error (ft ³ /s)	Downstream Channel Tailwater (ft)	Tailwater Error (ft)
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00

Message

WS below an invert; no flow.
 WS below an invert; no flow.
 WS below an invert; no flow.
 WS below an invert; no flow.
 WS below an invert; no flow.
 WS below an invert; no flow.
 WS below an invert; no flow.
 WS below an invert; no flow.
 WS below an invert; no flow.
 WS below an invert; no flow.
 WS below an invert; no flow.
 WS below an invert; no flow.
 WS below an invert; no flow.
 CRIT.DEPTH CONTROL Vh= .103ft
 Dcr= .297ft CRIT.DEPTH Hev= .00ft

Composite Outlet Structure Detailed Report: Composite Outlet Structure - 1

RATING TABLE FOR ONE OUTLET TYPE

Structure ID = Orifice - 3 (Orifice-Circular)

Upstream ID = (Pond Water Surface)

Downstream ID = Culvert - 1 (Culvert-Circular)

Message			
CRIT.DEPTH CONTROL Vh= .243ft			
Dcr= .656ft CRIT.DEPTH Hev= .00ft			
CRIT.DEPTH CONTROL Vh= .407ft			
Dcr= .994ft CRIT.DEPTH Hev= .00ft			
H =1.03			
H =1.53			
H =1.83			
H =2.03			
H =2.53			
H =3.03			
H =3.53			
H =4.03			
H =4.53			
H =5.03			
H =5.19			
H =5.31			
H =5.44			
H =5.57			
H =5.70			
H =5.78			

Outlet Structure			
Outlet Structure Type		Orifice	

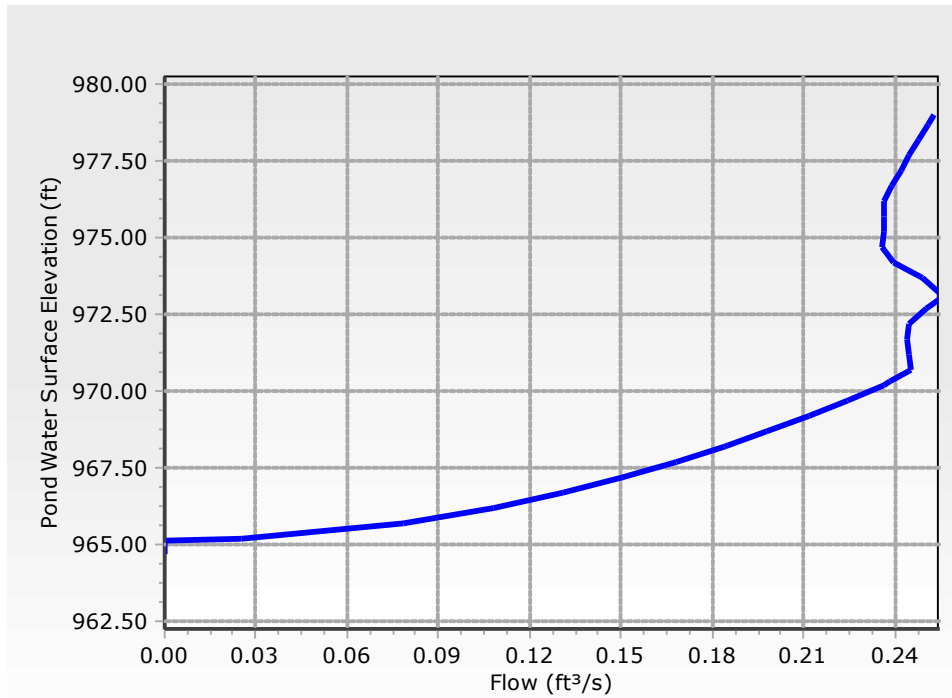
Outlet Structure (IDs and Direction)			
Outlet ID	Orifice - 2	Downstream ID	Culvert - 1
Flow Direction	Forward Flow Only	Notes	

Outlet Structure (Advanced)			
Elevation (On)	0.00 ft	Elevation (Off)	0.00 ft

Outlet Structure (Orifice)			
Orifice	Circular Orifice	Orifice Coefficient	0.600
Number of Openings	4	Orifice Diameter	1.0 in

Outlet Structure (Common)	
Elevation	965.10 ft

Composite Outlet Structure Detailed Report: Composite Outlet Structure - 1



RATING TABLE FOR ONE OUTLET TYPE

Structure ID = Orifice - 2 (Orifice-Circular)

Upstream ID = (Pond Water Surface)

Downstream ID = Culvert - 1 (Culvert-Circular)

Water Surface Elevation (ft)	Device Flow (ft³/s)	(into) Headwater Hydraulic Grade Line (ft)	Converge Downstream Hydraulic Grade Line (ft)	Next Downstream Hydraulic Grade Line (ft)
964.70	0.00	0.00	0.00	0.00
965.10	0.00	0.00	0.00	964.80
965.20	0.03	965.20	Free Outfall	964.81
965.70	0.08	965.70	Free Outfall	964.85
966.20	0.11	966.20	Free Outfall	964.87
966.70	0.13	966.70	Free Outfall	964.88
967.20	0.15	967.20	Free Outfall	964.90
967.70	0.17	967.70	Free Outfall	964.90
968.20	0.18	968.20	Free Outfall	964.92
968.70	0.20	968.70	Free Outfall	964.92
969.20	0.21	969.20	Free Outfall	964.93
969.70	0.22	969.70	Free Outfall	964.93
970.20	0.24	970.20	Free Outfall	964.94
970.30	0.24	970.30	Free Outfall	964.94
970.70	0.25	970.70	965.24	965.24
971.20	0.24	971.20	965.78	965.78

Composite Outlet Structure Detailed Report: Composite Outlet Structure - 1

RATING TABLE FOR ONE OUTLET TYPE

Structure ID = Orifice - 2 (Orifice-Circular)

Upstream ID = (Pond Water Surface)

Downstream ID = Culvert - 1 (Culvert-Circular)

Downstream Hydraulic Grade Line Error (ft)	Convergence Error (ft ³ /s)	Downstream Channel Tailwater (ft)	Tailwater Error (ft)
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00

Message

WS below an invert; no flow.

WS below an invert; no flow.

H =.06

H =.56

H =1.06

H =1.56

H =2.06

H =2.56

H =3.06

H =3.56

H =4.06

H =4.56

H =5.06

H =5.16

H =5.46

H =5.42

H =5.39

H =5.42

H =5.69

H =5.87

H =5.88

H =5.63

H =5.21

H =5.04

Composite Outlet Structure Detailed Report: Composite Outlet Structure - 1

RATING TABLE FOR ONE OUTLET TYPE

Structure ID = Orifice - 2 (Orifice-Circular)

Upstream ID = (Pond Water Surface)

Downstream ID = Culvert - 1 (Culvert-Circular)

Message
H =5.07
H =5.07
H =5.08
H =5.19
H =5.31
H =5.44
H =5.57
H =5.70
H =5.78

Composite Outlet Structure Detailed Report: Composite Outlet Structure - 1

Composite Rating Table

Tailwater Elevation = Free Outfall (Composite Outlet Structure - 1)

Water Surface Elevation (ft)	Flow (ft ³ /s)	Tailwater Elevation (ft)	Convergence Error (ft)
964.70	0.00	(N/A)	0.00
965.10	0.12	(N/A)	0.00
965.20	0.16	(N/A)	0.00
965.70	0.27	(N/A)	0.00
966.20	0.35	(N/A)	0.00
966.70	0.41	(N/A)	0.00
967.20	0.47	(N/A)	0.00
967.70	0.52	(N/A)	0.00
968.20	0.56	(N/A)	0.00
968.70	0.61	(N/A)	0.00
969.20	0.65	(N/A)	0.00
969.70	0.68	(N/A)	0.00
970.20	0.72	(N/A)	0.00
970.30	0.72	(N/A)	0.00
970.70	3.53	(N/A)	0.00
971.20	13.76	(N/A)	0.00
971.70	29.58	(N/A)	0.00
972.20	47.61	(N/A)	0.00
972.70	57.94	(N/A)	0.00
973.00	63.26	(N/A)	0.00
973.20	72.53	(N/A)	0.00
973.70	112.95	(N/A)	0.00
974.20	167.97	(N/A)	0.00
974.70	208.40	(N/A)	0.00
975.20	230.98	(N/A)	0.00
975.70	251.39	(N/A)	0.00
976.20	270.19	(N/A)	0.00
976.70	284.34	(N/A)	0.00
977.20	297.25	(N/A)	0.00
977.70	309.51	(N/A)	0.00
978.20	321.21	(N/A)	0.00
978.70	332.45	(N/A)	0.00
979.00	338.97	(N/A)	0.00

Contributing Structures

(no Q: Orifice - 3,Riser - 2,Orifice - 1,Riser - 1,Orifice - 2,Culvert - 1)
Orifice - 1,Culvert - 1
(no Q: Orifice - 3,Riser - 2,Riser - 1,Orifice - 2)
Orifice - 1,Orifice - 2,Culvert - 1 (no Q: Orifice - 3,Riser - 2,Riser - 1)

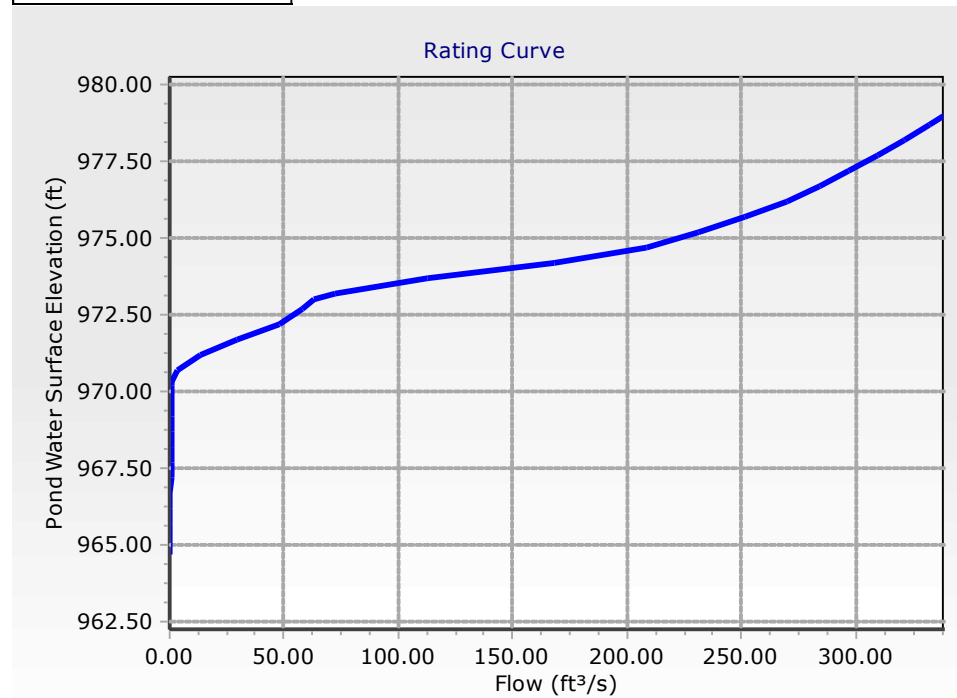
Composite Outlet Structure Detailed Report: Composite Outlet Structure - 1

Composite Rating Table

Tailwater Elevation = Free Outfall (Composite Outlet Structure - 1)

Contributing Structures

Orifice - 3,Riser - 2,Orifice - 1,Riser - 1,Orifice - 2,Culvert - 1



FINAL STORM REPORT

ADDENDUM 1

Cobey Creek, Phase 1

Mixed Use Development

Lee's Summit, MO

PREPARED FOR

JCM DEVELOPMENT, LLC

PREPARED BY

HG CONSULT, INC.

July 1, 2019



7/1/19

Contents

1.	40 Hour Extended Detention.....	3
2.	Effective Height.....	3
3.	Energy Dissipation	3

This addendum to the final storm report for Cobey Creek, Phase 1, is prepared to address comments from the City of Lee's Summit staff from a letter dated May 25th, 2019 in regard to specific stormwater issues. The three sections are intended to provide additional information to the first three comments of said letter.

1. 40 Hour Extended Detention

The 8" skimmer used for erosion control will be permanent and the coupling will be capped. After final construction, if it is determined the North Detention Pond does not drain in 48 hours; the cap will be removed to drain the detention pond.

2. Effective Height

TR-60 states the following for the effective height of the dam.

"Effective height of dam. The difference in elevation in feet between the lowest open channel auxiliary spillway crest and the lowest point in the original cross section on the centerline of the dam. If there is no open channel auxiliary spillway, the top of the dam becomes the upper limit."

The top of the auxiliary spillway is at El. 977.0. The lowest point in the original cross section on the centerline of the dam is El. 968.0. Therefore, TR-60 does not apply to this detention pond.

3. Energy Dissipation

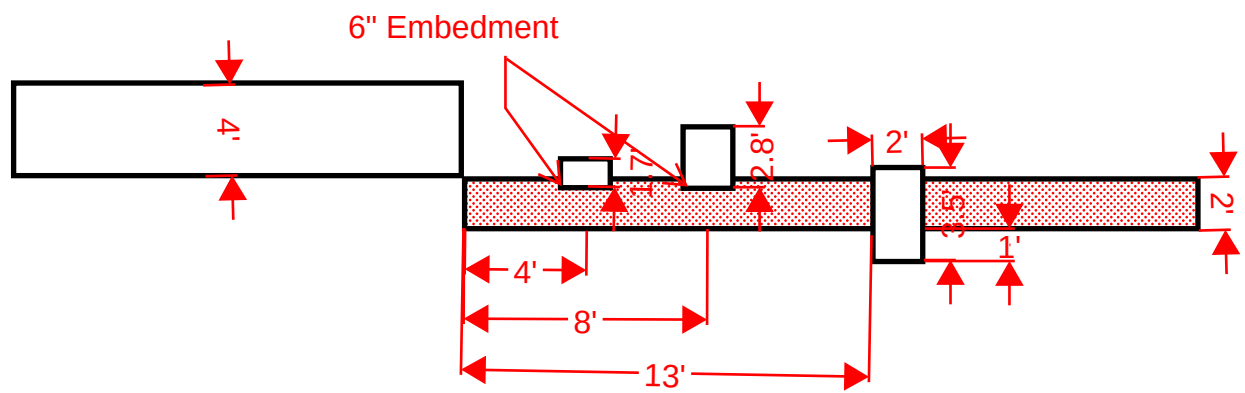
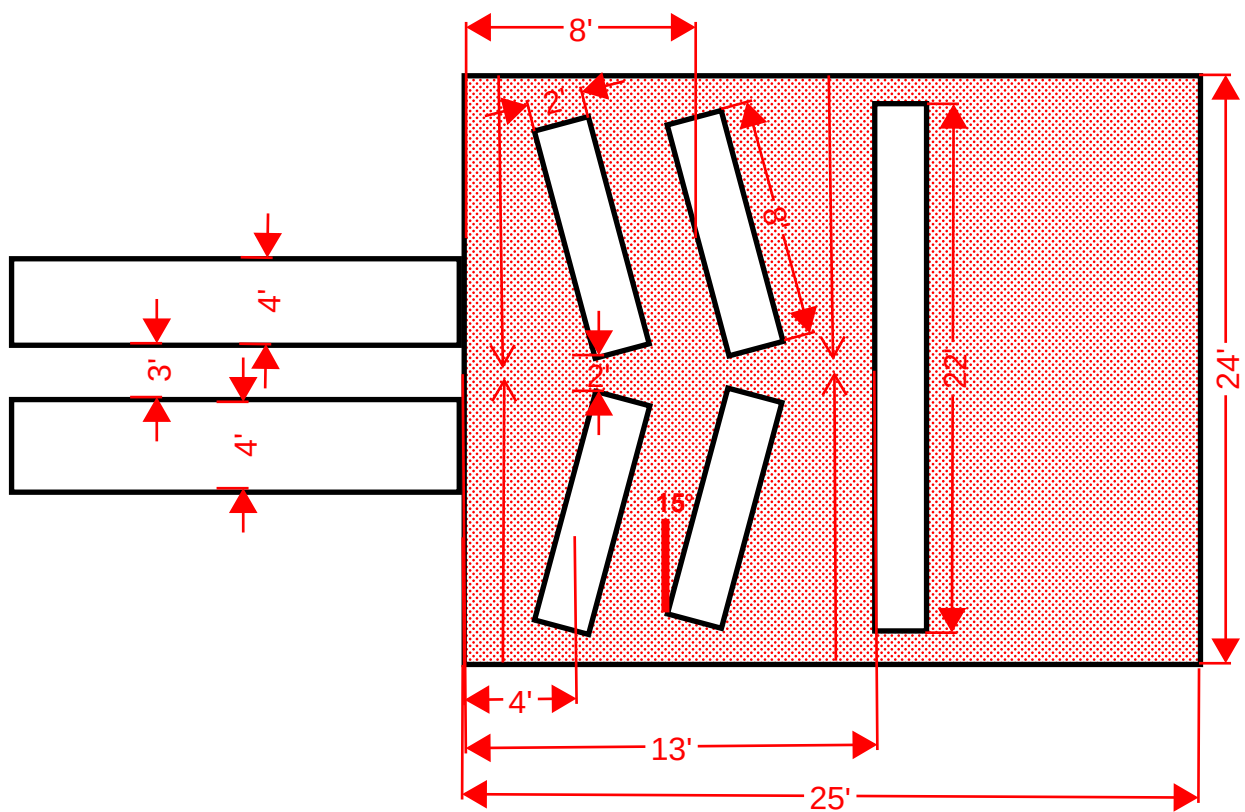
Additional energy dissipation has been added to the outlet structure at the request of the City of Lee's Summit. The outlet rip rap pad is fitted with a Contra Costa Design from HEC 14. The design details are included in the plans. The original 100-year outlet velocity is ~12.0 ft/s and the proposed 100-year outlet velocity is expected to be ~8.7 ft/s. Calculations are included in this Addendum.

HY-8 Energy Dissipation Report

External Energy Dissipator

Parameter	Value	Units
Select Culvert and Flow		
Crossing	Crossing 1	
Culvert	Culvert 1	
Flow	280.00	cfs
Culvert Data		
Culvert Width (including multiple barrels)	8.0	ft
Culvert Height	4.0	ft
Outlet Depth	3.51	ft
Outlet Velocity	11.98	ft/s
Froude Number	1.13	
Tailwater Depth	0.00	ft
Tailwater Velocity	0.00	ft/s
Tailwater Slope (SO)	0.0049	
External Dissipator Data		
External Dissipator Category	Streambed Level Structures	
External Dissipator Type	Contra Costa	
Restrictions		
Froude Number	<3	
TailWater	<.5D	
Input Data		
Baffle Block Height Ratio		
Note:	$2.5 < \text{Baffle Block Height Ratio} < 7$	
Note:	Optimum Baffle Block Height Ratio = 3.5	
Ratio of Baffle Block Height to Block Distance from the Culvert	3.500	
End Sill Height to Maximum Depth Ratio		
Note:	Maximum Depth in the Dissipator is 4.794 feet	
Note:	$0.06 < \text{End Sill Height to Max Depth Ratio} < 0.1$	
Note:	0.1 is Recommended for End Sill Height to Max Depth Ratio	
Ratio to Determine End Sill Height from Maximum Depth	0.100	
Basin Width		
Note:	Channel Width is 8.000 feet	ft
Note:	$4.000 < \text{Basin Width} < 12.000$	ft
Note:	Channel Width is Recommended for Basin Width	
Basin Width	8.000	ft
Results		
Basin Depth (Y2)	4.794	ft
Basin Length (LB)	21.373	ft
Basin Width (WB)	8.000	ft
Exit Width (W3)	8.000	ft
Exit Depth (YC)	2.954	ft

Exit Velocity (VB=VC)	8.653	ft/s
First Baffle		
Height (H1)	1.174	ft
Width (WB)	8.000	ft
Space (L1)	4.111	ft
Second Baffle		
Height (H2)	2.349	ft
Width (WB)	8.000	ft
Space (L2)	8.221	ft
End Sill		
Height (H3)	0.479	ft
Top Width (W3)	8.000	ft
Location (L3)	13.152	ft



STORM WATER REPORT

Addendum 2

Cobey Creek

Mixed Use Development

Lee's Summit, MO

PREPARED FOR

JCM DEVELOPMENT,LLC

PREPARED BY

Hg Consult, Inc

August 3, 2020

This addendum to the final storm report for Cobey Creek, Phase 1, is prepared to address the updating of the Pond Pack information for the south pond outlet structure. The attached Pondpack print out addresses the flow characteristics associated with six- 12inch diameter holes shown on the new square outlet structure detail, also attached.

The structure was changed to square from a circular manhole due to the unavailability of the manhole in a 6 foot diameter, as designed and approved in the original plans. The Pond pack information is provided as confirmation that original release orifices (12" holes) on the circular manhole when placed on the square version, shows no changes to the hydraulic function of the outlet structure within the pond.

STORM WATER REPORT

Addendum 3

Cobey Creek

Mixed Use Development

Lee's Summit, MO

PREPARED FOR

JCM DEVELOPMENT,LLC

PREPARED BY

Hg Consult, Inc

October 8, 2020

This addendum to the Final Storm Report for Cobey Creek, Phase 1 is prepared for addressing the change to the geometric shape of the outlet structure in the north pond from circular to rectangular, due to the unavailability of a six foot diameter manhole.

This change is the same as the change at the south pond, except that the north pond design called for 2 circular manholes side by side. The shape of the outlet structure has been redesigned to incorporate the 2 manholes into one larger and rectangular structure. All orifices that were shown for the manholes have been incorporated into the rectangular structure at the same elevations to provide the same hydraulic flows at the various storm events as originally designed. Details of the new and approved structure are attached.

AS-BUILTS STORM REPORT

ADDENDUM 4

Cobey Creek, Phase 1

Mixed Use Development Lee's

Summit, MO

PREPARED FOR

JCM DEVELOPMENT, LLC

PREPARED BY

HG CONSULT, INC.

April 23, 2021



4/23/21

This addendum to the final storm report for Cobey Creek, Phase 1, is prepared for the North Detention Pond for the as-built conditions.

Proposed orifices/risers were designed to handle the WQ, 2, 10, and 100 year events. The table below summarizes the proposed vs. the as-built orifice elevations.

Table 1– Design Water Surface Elevations

Name	Design Elevation	As-Built Elevation
2 – 48" Pipes	964.70	965.40
2 – 2" Orifices (WQ)	964.70	965.35
4 – 1" Orifices (WQ)	965.10	965.75
4 – 21" Orifices (2-Year and 10-Year)	970.30	970.45
2 – 42" Risers (10-Year and 100-Year)	973.00	972.90
165' Emergency Spillway	977.00	977.05

The North Detention Pond was designed with adequate storage volume to discharge the design storm events. The as-built storage volumes closely match the design storage volumes and are summarized below.

Table 2– North Detention Pond Volumes

Elevation	Design Volume (CF)	As-Built Volume (CF)
964.70	0.00	---
965.00	91.14	---
965.66	1078.69	0.00
966.00	1587.43	96.91
967.00	5221.71	2224.13
968.00	11887.61	7480.39
969.00	16284.71	11378.48
970.00	22239.80	17002.99
971.00	34243.52	27237.46
972.00	67231.45	57187.14
973.00	138511.05	124762.26
974.00	218096.48	201239.95
975.00	304146.11	285267.17
976.00	396454.77	376940.76
977.00	495081.75	476368.06
978.00	600087.34	583653.32
979.00	711528.98	698910.02
979.07	---	707297.84

APWA 5608.4 requires a 40-hour extended release of the water quality storm event (1.37"/24-hour rainfall) per Section 8.10 of the BMP Manual. The detention facility was designed with the 1" and 2" orifices to release the water quality event over a 40-hour period. Because the 1" and 2" orifices were constructed 0.65' higher the water quality event was slightly impacted. Below is a summary of those results.

Table 3 – Water Quality

Name	Max WSE (ft)	Max Pond Storage (ac-ft)	Peak Flow (cf/s)	Release Duration (hr)
Design	970.40	1.431	1.42	40.96
As-Built	970.74	1.114	2.72	34.24

As indicated in table the water quality event will discharge through the 21" orifices at a maximum depth of 0.29' (3.5") therefore slightly increasing the discharge for a short amount of time and thus reducing the maximum pond storage and the release duration. Although there is a slight impact the detention pond is able to release the water quality event for 34.24 hours. See water quality hydrographs in Appendix.

Per APWA Section 5608.4 and City of Lee's Summit criteria, the post-development discharge rates from the site shall not exceed those indicated below:

- 50% storm peak rate less than or equal to 0.5 cfs per site acre
- 10% storm peak rate less than or equal to 2.0 cfs per site acre
- 1% storm peak rate less than or equal to 3.0 cfs per site acre

The table below summarizes the allowable, designed, and as-built discharge rates for the North Detention Pond.

Table 4 – North Detention Release Rates

Name	2-Year	10-Year	100-Year
Allowable Discharge (cfs)	66.73	200.16	311.70
Design Discharge (cfs)	65.08	194.74	278.44
As-Built Discharge 9cfs)	85.52	204.93	277.47

The highlighted items above indicate where the allowable flow rates were exceeded in the as-built conditions. The 2-year had a significant increase because the 2-Year WSE = 973.33 and therefore is discharging into the 42" risers. In order to get the 2-Year closer to the allowable we propose adding 0.6' risers to the 42" domes therefore raising the 42" domes to an elevation of 973.50. The additional riser lengths keep the 2-Year below the 42" risers and therefore discharging through 21" orifices. This proposed change has the following flow rates:

Table 5: Proposed North Detention Discharge Values

Name	2-Year	10-Year	100-Year
Allowable Discharge (cfs)	66.73	200.16	311.70
Proposed Discharge (cfs)	68.55	194.57	272.78

By making the aforementioned revision to the risers we exceed the allowable 2-Year by 3% and meet the 10 and 100-Year.

The proposed change increases the proposed 100-Year WSE from 976.50 to 976.82. The new WSE would be within 0.23' of the Spillway. In order to accommodate the 0.5' of freeboard the spillway would need to be raised an additional 4" which appears to be in a very limited section of the spillway based on the as-built information. The subsequent 100-Year WSE with the aforementioned changes is 978.31. The as-built top of dam elevation is very close to 979.00.

Table 6: Subsequent 100 Year Spillway Discharge Values and Elevations

Name	100-Year WSE	Subsequent 100-Year WSE	Spillway Elevation	Top of Dam Elevation
Designed	976.50	977.99	977.00	979.00
Proposed	976.82	978.31	977.32	978.99

In summary we propose adding a 7" extension to the 42" domes (ELEV = 973.50). Additionally we proposed raising the spillway elevation by 0.32' (ELEV = 977.32). By doing so the WQ, 2, 10, 100, and subsequent 100-Year events are within a close tolerance to the allowable. The PondPack results are contained within.

Table 7: Summary of Changes

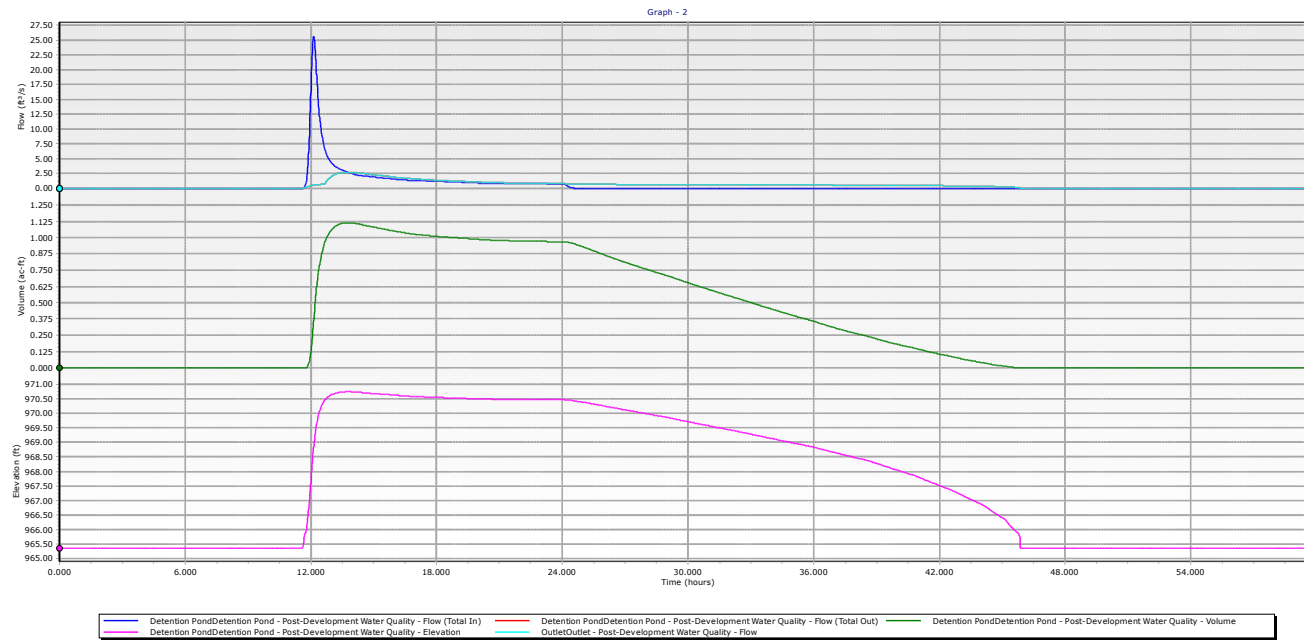
Name	42" Risers Elevation	Spillway Elevation
As-Built	972.90	977.00
Proposed	973.50	977.32

The upstream pipes were analyzed to determine if the increased 10-Year WSE had an effect on the HGL in pipe systems 1 and 12. The 10-Year WSE elevation was used as the tailwater condition. The tailwater increased from 974.53 to 974.91 for the 10-Year event. Pipe system 1 has an invert into north pond of 973.12. Because the tailwater is only 1.79 deep inside the 60" diameter pipe (pipe HGL is above tailwater) the pipe system remains inlet controlled and therefore the HGL is not affected. The invert elevation into the pond for pipe system 12 is 971.10 therefore has a tailwater depth of 3.81. Because the tailwater depth is higher than the HGL in a free outfall condition the system is outlet controlled. Therefore the HGL changes by 0.38' at the outfall (12-A) and dissipates to "no-change" three structures upstream (structure 12-D – 245' upstream). In summary the increased 10-Year WSE had no-effect on system 1 and had minimal effect on system 12. System 12 continues to contain the HGL within the pipe.

Appendix

WATER QUALITY EVENT EXTENDED RELEASE.....	5
PONDPACK OUTPUT	7
PONDPACK SPILLWAY OUTPUT	44

WATER QUALITY EVENT EXTENDED RELEASE



PONDPACK OUTPUT

COBEY CREEK - 2, 10, 100 YEAR (AS-BUILTS)

Project Summary

Title	COBEY CREEK
Engineer	Matthew Castor
Company	Hg Consult, Inc
Date	4/6/2021

Notes

Table of Contents

Master Network Summary

2

COBEY CREEK - 2, 10, 100 YEAR (AS-BUILTS)

Subsection: Master Network Summary

Catchments Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft ³ /s)
P3	Post-Development 2 year	2	13.945	12.090	169.63
P3	Post-Development 10 year	10	25.862	12.090	314.25
P3	Post-Development 100 year	100	42.704	12.090	511.44
P1	Post-Development 2 year	2	1.756	11.980	29.29
P1	Post-Development 10 year	10	3.215	11.970	52.87
P1	Post-Development 100 year	100	5.265	11.970	84.76
P2	Post-Development 2 year	2	0.097	11.950	1.73
P2	Post-Development 10 year	10	0.184	11.940	3.27
P2	Post-Development 100 year	100	0.309	11.940	5.40
P4	Post-Development 2 year	2	0.654	11.990	10.77
P4	Post-Development 10 year	10	1.228	11.990	20.01
P4	Post-Development 100 year	100	2.044	11.970	32.66

Node Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft ³ /s)
O-3	Post-Development 2 year	2	13.945	12.410	68.55
O-3	Post-Development 10 year	10	25.862	12.290	194.57
O-3	Post-Development 100 year	100	42.704	12.320	272.78
O-1	Post-Development 2 year	2	1.756	11.980	29.29
O-1	Post-Development 10 year	10	3.215	11.970	52.87
O-1	Post-Development 100 year	100	5.265	11.970	84.76
O-2	Post-Development 2 year	2	0.097	11.950	1.73
O-2	Post-Development 10 year	10	0.184	11.940	3.27

COBEY CREEK - 2, 10, 100 YEAR (AS-BUILTS)

Subsection: Master Network Summary

Node Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft ³ /s)
O-2	Post-Development 100 year	100	0.309	11.940	5.40
O-4	Post-Development 2 year	2	0.654	11.990	10.77
O-4	Post-Development 10 year	10	1.228	11.990	20.01
O-4	Post-Development 100 year	100	2.044	11.970	32.66

Pond Summary

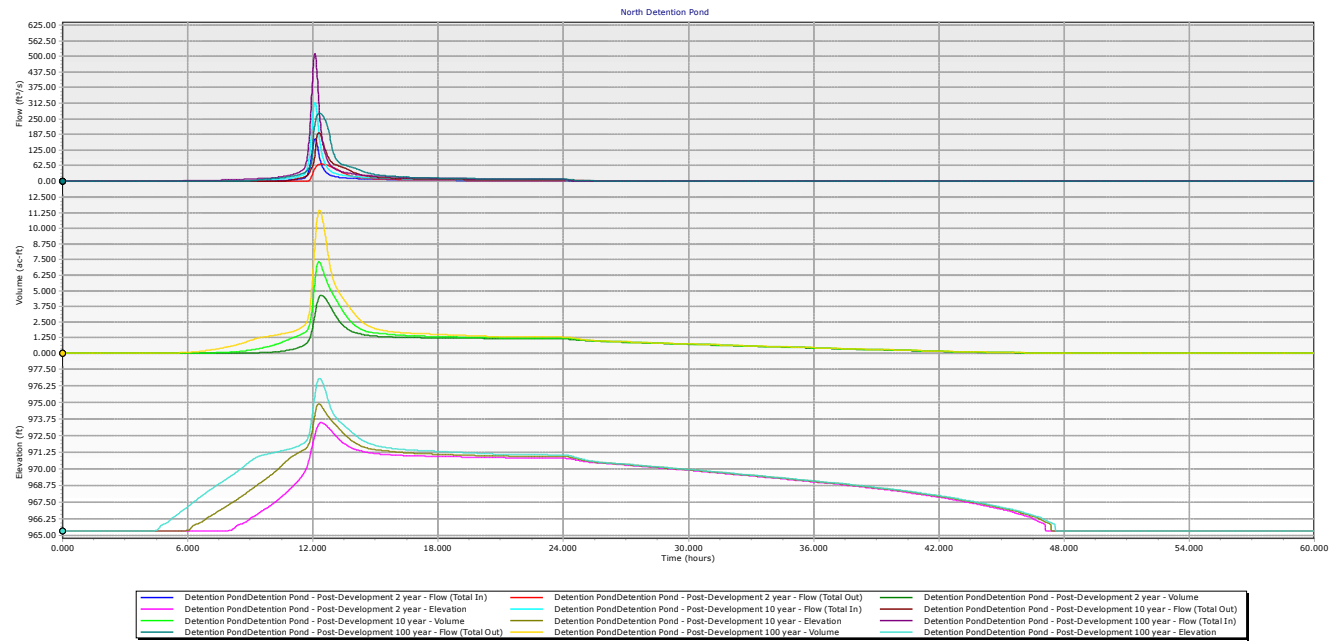
Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft ³ /s)	Maximum Water Surface Elevation (ft)	Maximum Pond Storage (ac-ft)
Detention Pond (IN)	Post-Development 2 year	2	13.945	12.090	169.63	(N/A)	(N/A)
Detention Pond (OUT)	Post-Development 2 year	2	13.945	12.410	68.55	973.47	4.636
Detention Pond (IN)	Post-Development 10 year	10	25.862	12.090	314.25	(N/A)	(N/A)
Detention Pond (OUT)	Post-Development 10 year	10	25.862	12.290	194.57	974.91	7.336
Detention Pond (IN)	Post-Development 100 year	100	42.704	12.090	511.44	(N/A)	(N/A)
Detention Pond (OUT)	Post-Development 100 year	100	42.704	12.320	272.78	976.82	11.475

COBEY CREEK - 2, 10, 100 YEAR (AS-BUILTS)

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M

Master Network Summary...2, 3

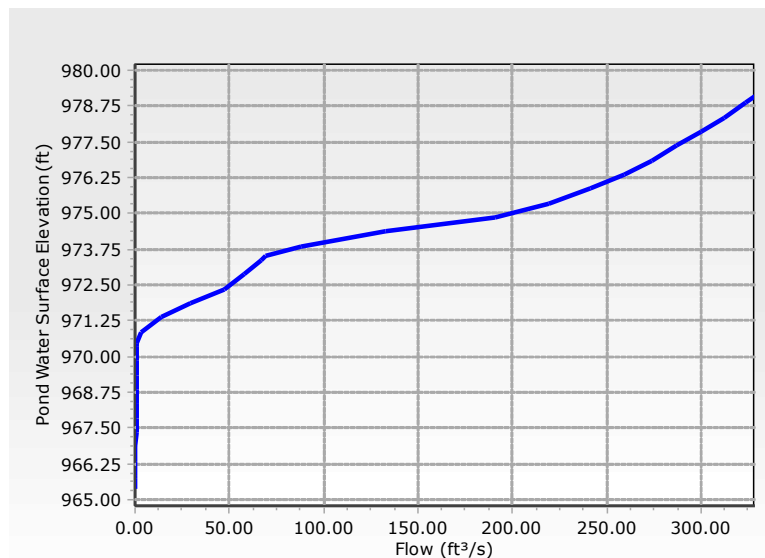


Composite Outlet Structure Detailed Report: Composite Outlet Structure - 1

Element Details			
Label	Composite Outlet Structure - 1	Notes	
Headwater Range			
Headwater Type	Use Pond for Headwater Range	Maximum (Headwater)	979.07 ft
Pond	Detention Pond	Increment (Headwater)	0.50 ft
Minimum (Headwater)	965.35 ft		
SpotElevation (ft)			
Tailwater Setup			
Tailwater Type	Free Outfall		
Tailwater Tolerances			
Maximum Iterations	30	Tailwater Tolerance (Maximum)	0.50 ft
Headwater Tolerance (Minimum)	0.01 ft	Flow Tolerance (Minimum)	0.001 ft³/s
Headwater Tolerance (Maximum)	0.50 ft	Flow Tolerance (Maximum)	10.000 ft³/s
Tailwater Tolerance (Minimum)	0.01 ft		
Outlet Structure			
Outlet Structure Type	Culvert	Culvert Type	Circular
Outlet Structure (IDs and Direction)			
Outlet ID	Culvert - 1	Downstream ID	Tailwater
Flow Direction	Forward Flow Only	Notes	
Outlet Structure (Advanced)			
Elevation (On)	0.00 ft	Elevation (Off)	0.00 ft
Culvert Data			
Number of Barrels	2	Downstream Invert	964.80 ft
Length	102.32 ft	Diameter	48.0 in
Upstream Invert	965.35 ft		
Unsubmerged->Submerged			
Specify Transitions	False	Compute Inlet Control Only	False

Composite Outlet Structure Detailed Report: Composite Outlet Structure - 1

Culvert Coefficients			
Inlet Description	Concrete - Groove end projecting	C	0.0317
Chart	Chart 1	Y	0.6900
Nomograph	Nomograph 3	Manning's n	0.011
Equation Form	Form 1	Ke	0.200
K	0.0045	Kr	0.000
M	2.0000	Slope Correction Factor	-0.500
Culvert (Advanced)			
Convergence Tolerance	0.00 ft	Specify Number of Backwater Sections	False



RATING TABLE FOR ONE OUTLET TYPE

Structure ID = Culvert - 1 (Culvert-Circular)

Mannings open channel maximum capacity: 133.88 ft³/s

Upstream ID = Orifice - 2, Riser - 2, Orifice - 1, Riser - 1, Copy of Orifice - 1

Downstream ID = Tailwater (Pond Outfall)

Water Surface Elevation (ft)	Device Flow (ft³/s)	(into) Headwater Hydraulic Grade Line (ft)	Converge Downstream Hydraulic Grade Line (ft)	Next Downstream Hydraulic Grade Line (ft)
------------------------------	---------------------	--	---	---

Composite Outlet Structure Detailed Report: Composite Outlet Structure - 1

RATING TABLE FOR ONE OUTLET TYPE

Structure ID = Culvert - 1 (Culvert-Circular)

Mannings open channel maximum capacity: 133.88 ft³/s

Upstream ID = Orifice - 2, Riser - 2, Orifice - 1, Riser - 1, Copy of Orifice - 1

Downstream ID = Tailwater (Pond Outfall)

Water Surface Elevation (ft)	Device Flow (ft ³ /s)	(into) Headwater Hydraulic Grade Line (ft)	Converge Downstream Hydraulic Grade Line (ft)	Next Downstream Hydraulic Grade Line (ft)
965.35	0.00	0.00	0.00	Free Outfall
965.75	0.12	965.45	Free Outfall	Free Outfall
965.85	0.16	965.46	Free Outfall	Free Outfall
966.35	0.30	965.50	Free Outfall	Free Outfall
966.85	0.37	965.52	Free Outfall	Free Outfall
967.35	0.42	965.53	Free Outfall	Free Outfall
967.85	0.48	965.55	Free Outfall	Free Outfall
968.35	0.52	965.55	Free Outfall	Free Outfall
968.85	0.58	965.57	Free Outfall	Free Outfall
969.35	0.62	965.57	Free Outfall	Free Outfall
969.85	0.65	965.58	Free Outfall	Free Outfall
970.35	0.68	965.59	Free Outfall	Free Outfall
970.45	0.69	965.59	Free Outfall	Free Outfall
970.85	3.49	965.89	Free Outfall	Free Outfall
971.35	13.73	966.43	Free Outfall	Free Outfall
971.85	29.54	966.96	Free Outfall	Free Outfall
972.35	47.56	967.43	Free Outfall	Free Outfall
972.85	57.90	967.66	Free Outfall	Free Outfall
973.35	66.57	967.84	Free Outfall	Free Outfall
973.50	69.03	967.90	Free Outfall	Free Outfall
973.85	87.98	968.27	Free Outfall	Free Outfall
974.35	133.02	969.06	Free Outfall	Free Outfall
974.85	191.12	970.02	Free Outfall	Free Outfall
975.35	219.54	970.52	Free Outfall	Free Outfall
975.85	241.18	971.02	Free Outfall	Free Outfall
976.35	259.30	971.47	Free Outfall	Free Outfall
976.85	273.70	971.86	Free Outfall	Free Outfall
977.35	287.15	972.24	Free Outfall	Free Outfall
977.85	299.93	972.61	Free Outfall	Free Outfall
978.35	312.04	972.99	Free Outfall	Free Outfall
978.85	323.63	973.36	Free Outfall	Free Outfall
979.07	328.45	973.51	Free Outfall	Free Outfall
Downstream Hydraulic Grade Line Error (ft)	Convergence Error (ft ³ /s)	Downstream Channel Tailwater (ft)	Tailwater Error (ft)	
0.00	0.00	(N/A)	0.00	
0.00	0.00	(N/A)	0.00	
0.00	0.00	(N/A)	0.00	

Composite Outlet Structure Detailed Report: Composite Outlet Structure - 1

RATING TABLE FOR ONE OUTLET TYPE

Structure ID = Culvert - 1 (Culvert-Circular)

Mannings open channel maximum capacity: 133.88 ft³/s

Upstream ID = Orifice - 2, Riser - 2, Orifice - 1, Riser - 1, Copy of Orifice - 1

Downstream ID = Tailwater (Pond Outfall)

Downstream Hydraulic Grade Line Error (ft)	Convergence Error (ft ³ /s)	Downstream Channel Tailwater (ft)	Tailwater Error (ft)
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.01	(N/A)	0.00
0.00	0.01	(N/A)	0.00
0.00	0.02	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.06	(N/A)	0.00
0.00	0.01	(N/A)	0.00
0.00	0.01	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.01	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.01	(N/A)	0.00

Message

WS below an invert; no flow.
 CRIT.DEPTH CONTROL Vh= .023ft
 Dcr= .068ft CRIT.DEPTH Hev= .00ft
 CRIT.DEPTH CONTROL Vh= .026ft
 Dcr= .079ft CRIT.DEPTH Hev= .00ft
 CRIT.DEPTH CONTROL Vh= .037ft
 Dcr= .109ft CRIT.DEPTH Hev= .00ft

Composite Outlet Structure Detailed Report: Composite Outlet Structure - 1

RATING TABLE FOR ONE OUTLET TYPE

Structure ID = Culvert - 1 (Culvert-Circular)

Mannings open channel maximum capacity: 133.88 ft³/s

Upstream ID = Orifice - 2, Riser - 2, Orifice - 1, Riser - 1, Copy of Orifice - 1

Downstream ID = Tailwater (Pond Outfall)

Message
FLOW PRECEDENCE SET TO UPSTREAM CONTROLLING STRUCTURE
FLOW PRECEDENCE SET TO UPSTREAM CONTROLLING STRUCTURE
FLOW PRECEDENCE SET TO UPSTREAM CONTROLLING STRUCTURE
FLOW PRECEDENCE SET TO UPSTREAM CONTROLLING STRUCTURE
FLOW PRECEDENCE SET TO UPSTREAM CONTROLLING STRUCTURE
FLOW PRECEDENCE SET TO UPSTREAM CONTROLLING STRUCTURE
FLOW PRECEDENCE SET TO UPSTREAM CONTROLLING STRUCTURE
CRIT.DEPTH CONTROL Vh= .056ft Dcr= .167ft CRIT.DEPTH Hev= .00ft
FLOW PRECEDENCE SET TO UPSTREAM CONTROLLING STRUCTURE
CRIT.DEPTH CONTROL Vh= .129ft Dcr= .379ft CRIT.DEPTH Hev= .00ft
CRIT.DEPTH CONTROL Vh= .265ft Dcr= .760ft CRIT.DEPTH Hev= .00ft
CRIT.DEPTH CONTROL Vh= .403ft Dcr= 1.125ft CRIT.DEPTH Hev= .00ft
CRIT.DEPTH CONTROL Vh= .530ft Dcr= 1.440ft CRIT.DEPTH Hev= .00ft
CRIT.DEPTH CONTROL Vh= .597ft Dcr= 1.595ft CRIT.DEPTH Hev= .00ft
CRIT.DEPTH CONTROL Vh= .650ft Dcr= 1.715ft CRIT.DEPTH Hev= .00ft
CRIT.DEPTH CONTROL Vh= .665ft Dcr= 1.748ft CRIT.DEPTH Hev= .00ft
CRIT.DEPTH CONTROL Vh= .777ft Dcr= 1.984ft CRIT.DEPTH Hev= .00ft

Composite Outlet Structure Detailed Report: Composite Outlet Structure - 1

RATING TABLE FOR ONE OUTLET TYPE

Structure ID = Culvert - 1 (Culvert-Circular)

Mannings open channel maximum capacity: 133.88 ft³/s

Upstream ID = Orifice - 2, Riser - 2, Orifice - 1, Riser - 1, Copy of Orifice - 1

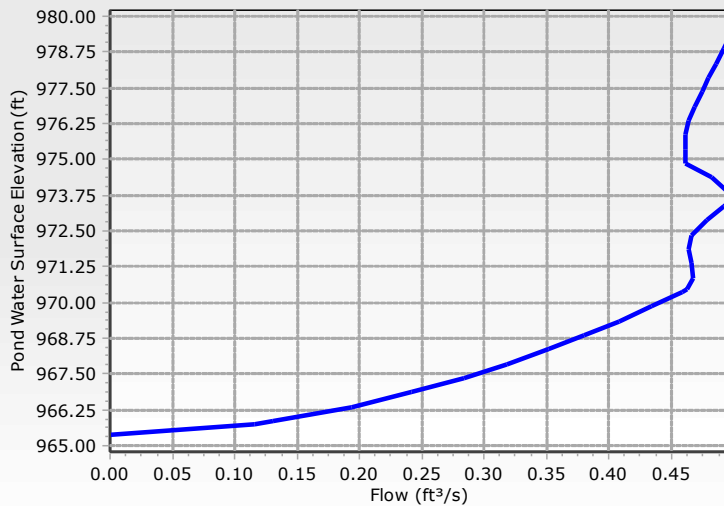
Downstream ID = Tailwater (Pond Outfall)

Message			
CRIT.DEPTH CONTROL Vh= 1.043ft Dcr= 2.463ft CRIT.DEPTH Hev= .00ft CRIT.DEPTH CONTROL Vh= 1.424ft Dcr= 2.964ft CRIT.DEPTH Hev= .00ft INLET CONTROL... Submerged: HW =5.17 INLET CONTROL... Submerged: HW =5.67 INLET CONTROL... Submerged: HW =6.12 INLET CONTROL... Submerged: HW =6.51 INLET CONTROL... Submerged: HW =6.89 INLET CONTROL... Submerged: HW =7.26 INLET CONTROL... Submerged: HW =7.64 INLET CONTROL... Submerged: HW =8.01 INLET CONTROL... Submerged: HW =8.16			
Outlet Structure			
Outlet Structure Type		Orifice	
Outlet Structure (IDs and Direction)			
Outlet ID	Orifice - 1	Downstream ID	Culvert - 1
Flow Direction	Forward Flow Only	Notes	
Outlet Structure (Advanced)			
Elevation (On)	0.00 ft	Elevation (Off)	0.00 ft
Outlet Structure (Orifice)			
Orifice	Circular Orifice	Orifice Coefficient	0.600
Number of Openings	2	Orifice Diameter	2.0 in
Outlet Structure (Common)			

Composite Outlet Structure Detailed Report: Composite Outlet Structure - 1

Outlet Structure (Common)

Elevation 965.35 ft



RATING TABLE FOR ONE OUTLET TYPE

Structure ID = Orifice - 1 (Orifice-Circular)

Upstream ID = (Pond Water Surface)

Downstream ID = Culvert - 1 (Culvert-Circular)

Water Surface Elevation (ft)	Device Flow (ft³/s)	(into) Headwater Hydraulic Grade Line (ft)	Converge Downstream Hydraulic Grade Line (ft)	Next Downstream Hydraulic Grade Line (ft)
965.35	0.00	0.00	0.00	0.00
965.75	0.12	965.75	965.45	965.45
965.85	0.13	965.85	965.46	965.46
966.35	0.19	966.35	965.50	965.50
966.85	0.24	966.85	965.52	965.52
967.35	0.28	967.35	965.53	965.53
967.85	0.32	967.85	965.55	965.55
968.35	0.35	968.35	965.55	965.55
968.85	0.38	968.85	965.57	965.57
969.35	0.41	969.35	965.57	965.57
969.85	0.43	969.85	965.58	965.58
970.35	0.46	970.35	965.58	965.59

Composite Outlet Structure Detailed Report: Composite Outlet Structure - 1

RATING TABLE FOR ONE OUTLET TYPE

Structure ID = Orifice - 1 (Orifice-Circular)

Upstream ID = (Pond Water Surface)

Downstream ID = Culvert - 1 (Culvert-Circular)

Water Surface Elevation (ft)	Device Flow (ft ³ /s)	(into) Headwater Hydraulic Grade Line (ft)	Converge Downstream Hydraulic Grade Line (ft)	Next Downstream Hydraulic Grade Line (ft)
970.45	0.46	970.45	965.59	965.59
970.85	0.47	970.85	965.88	965.89
971.35	0.47	971.35	966.43	966.43
971.85	0.46	971.85	966.96	966.96
972.35	0.47	972.35	967.43	967.43
972.85	0.48	972.85	967.66	967.66
973.35	0.49	973.35	967.84	967.84
973.50	0.50	973.50	967.90	967.90
973.85	0.50	973.85	968.27	968.27
974.35	0.48	974.35	969.06	969.06
974.85	0.46	974.85	970.02	970.02
975.35	0.46	975.35	970.52	970.52
975.85	0.46	975.85	971.02	971.02
976.35	0.46	976.35	971.47	971.47
976.85	0.47	976.85	971.86	971.86
977.35	0.47	977.35	972.24	972.24
977.85	0.48	977.85	972.61	972.61
978.35	0.49	978.35	972.99	972.99
978.85	0.49	978.85	973.36	973.36
979.07	0.50	979.07	973.51	973.51
Downstream Hydraulic Grade Line Error (ft)	Convergence Error (ft ³ /s)	Downstream Channel Tailwater (ft)	Tailwater Error (ft)	
0.00	0.00	(N/A)	0.00	
0.00	0.00	(N/A)	0.00	
0.00	0.00	(N/A)	0.00	
0.00	0.00	(N/A)	0.00	
0.00	0.00	(N/A)	0.00	
0.00	0.00	(N/A)	0.00	
0.00	0.00	(N/A)	0.00	
0.00	0.00	(N/A)	0.00	
0.00	0.00	(N/A)	0.00	
0.00	0.00	(N/A)	0.00	
0.00	0.00	(N/A)	0.00	
0.00	0.00	(N/A)	0.00	
0.00	0.00	(N/A)	0.00	
0.00	0.00	(N/A)	0.00	
0.00	0.00	(N/A)	0.00	
0.00	0.00	(N/A)	0.00	
0.00	0.00	(N/A)	0.00	
0.00	0.00	(N/A)	0.00	

Composite Outlet Structure Detailed Report: Composite Outlet Structure - 1

RATING TABLE FOR ONE OUTLET TYPE

Structure ID = Orifice - 1 (Orifice-Circular)

Upstream ID = (Pond Water Surface)

Downstream ID = Culvert - 1 (Culvert-Circular)

Downstream Hydraulic Grade Line Error (ft)	Convergence Error (ft ³ /s)	Downstream Channel Tailwater (ft)	Tailwater Error (ft)
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00

Message

WS below an invert; no flow.

H =.30
H =.39
H =.85
H =1.33
H =1.82
H =2.30
H =2.80
H =3.28
H =3.78
H =4.27
H =4.77
H =4.86
H =4.97
H =4.92
H =4.89
H =4.92
H =5.19
H =5.51
H =5.60
H =5.58
H =5.29

Composite Outlet Structure Detailed Report: Composite Outlet Structure - 1

RATING TABLE FOR ONE OUTLET TYPE

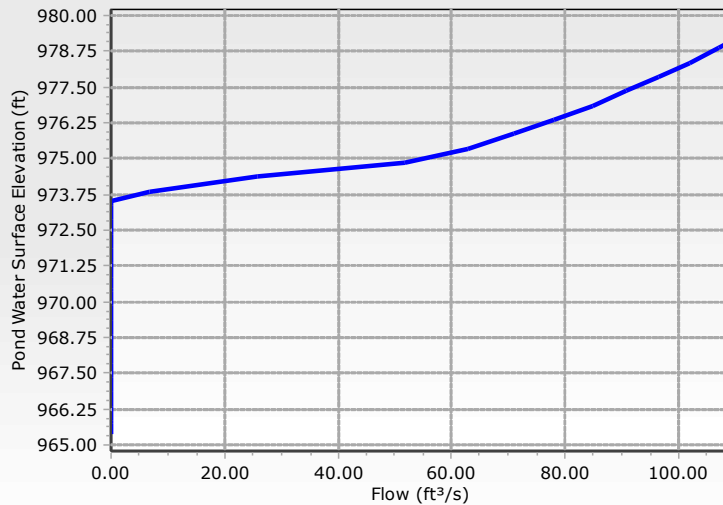
Structure ID = Orifice - 1 (Orifice-Circular)

Upstream ID = (Pond Water Surface)

Downstream ID = Culvert - 1 (Culvert-Circular)

Message			
H =4.83			
H =4.83			
H =4.83			
H =4.88			
H =4.99			
H =5.11			
H =5.24			
H =5.36			
H =5.49			
H =5.56			
Outlet Structure			
Outlet Structure Type		Riser	
Outlet Structure (IDs and Direction)			
Outlet ID	Riser - 1	Downstream ID	Culvert - 1
Flow Direction	Forward Flow Only	Notes	
Outlet Structure (Advanced)			
Elevation (On)	0.00 ft	Elevation (Off)	0.00 ft
Outlet Structure (Riser)			
Riser	Stand Pipe	Transition Elevation	0.00 ft
Diameter	42.0 in	Transition Height	0.00 ft
Weir Coefficient	3.00 (ft^0.5)/s	K Reverse	1.000
Orifice Coefficient	0.600		
Outlet Structure (Common)			
Elevation	973.50 ft		
Outlet Structure (Riser, Advanced)			
Use Orifice Depth to Crest?	True	Use Submerged Weir Equation?	False

Composite Outlet Structure Detailed Report: Composite Outlet Structure - 1



RATING TABLE FOR ONE OUTLET TYPE

Structure ID = Riser - 1 (Stand Pipe)

Upstream ID = (Pond Water Surface)

Downstream ID = Culvert - 1 (Culvert-Circular)

Water Surface Elevation (ft)	Device Flow (ft³/s)	(into) Headwater Hydraulic Grade Line (ft)	Converge Downstream Hydraulic Grade Line (ft)	Next Downstream Hydraulic Grade Line (ft)
965.35	0.00	0.00	0.00	0.00
965.75	0.00	0.00	0.00	965.45
965.85	0.00	0.00	0.00	965.46
966.35	0.00	0.00	0.00	965.50
966.85	0.00	0.00	0.00	965.52
967.35	0.00	0.00	0.00	965.53
967.85	0.00	0.00	0.00	965.55
968.35	0.00	0.00	0.00	965.55
968.85	0.00	0.00	0.00	965.57
969.35	0.00	0.00	0.00	965.57
969.85	0.00	0.00	0.00	965.58
970.35	0.00	0.00	0.00	965.59
970.45	0.00	0.00	0.00	965.59
970.85	0.00	0.00	0.00	965.89
971.35	0.00	0.00	0.00	966.43
971.85	0.00	0.00	0.00	966.96

Composite Outlet Structure Detailed Report: Composite Outlet Structure - 1

RATING TABLE FOR ONE OUTLET TYPE

Structure ID = Riser - 1 (Stand Pipe)

Upstream ID = (Pond Water Surface)

Downstream ID = Culvert - 1 (Culvert-Circular)

Downstream Hydraulic Grade Line Error (ft)	Convergence Error (ft ³ /s)	Downstream Channel Tailwater (ft)	Tailwater Error (ft)
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00

Message

WS below an invert; no flow.
 WS below an invert; no flow.
 WS below an invert; no flow.
 WS below an invert; no flow.
 WS below an invert; no flow.
 WS below an invert; no flow.
 WS below an invert; no flow.
 WS below an invert; no flow.
 WS below an invert; no flow.
 WS below an invert; no flow.
 WS below an invert; no flow.
 WS below an invert; no flow.
 WS below an invert; no flow.
 WS below an invert; no flow.
 WS below an invert; no flow.
 WS below an invert; no flow.
 WS below an invert; no flow.
 WS below an invert; no flow.
 Weir: H =0.35ft
 Weir: H =0.85ft
 Weir: H =1.35ft
 Orifice: H =1.85; Riser orifice equation
 controlling.

Composite Outlet Structure Detailed Report: Composite Outlet Structure - 1

RATING TABLE FOR ONE OUTLET TYPE

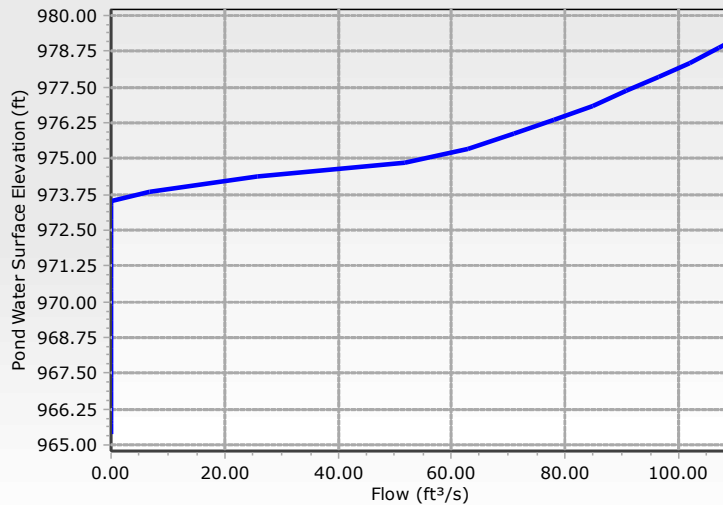
Structure ID = Riser - 1 (Stand Pipe)

Upstream ID = (Pond Water Surface)

Downstream ID = Culvert - 1 (Culvert-Circular)

Message			
Orifice: H =2.35; Riser orifice equation controlling.			
Orifice: H =2.85; Riser orifice equation controlling.			
Orifice: H =3.35; Riser orifice equation controlling.			
Orifice: H =3.85; Riser orifice equation controlling.			
Orifice: H =4.35; Riser orifice equation controlling.			
Orifice: H =4.85; Riser orifice equation controlling.			
Orifice: H =5.35; Riser orifice equation controlling.			
FULLY CHARGED RISER: Orifice Equation Control to Crest; H=5.57			
Outlet Structure			
Outlet Structure Type		Riser	
Outlet Structure (IDs and Direction)			
Outlet ID	Riser - 2	Downstream ID	Culvert - 1
Flow Direction	Forward Flow Only	Notes	
Outlet Structure (Advanced)			
Elevation (On)	0.00 ft	Elevation (Off)	0.00 ft
Outlet Structure (Riser)			
Riser	Stand Pipe	Transition Elevation	0.00 ft
Diameter	42.0 in	Transition Height	0.00 ft
Weir Coefficient	3.00 (ft^0.5)/s	K Reverse	1.000
Orifice Coefficient	0.600		
Outlet Structure (Common)			
Elevation	973.50 ft		
Outlet Structure (Riser, Advanced)			
Use Orifice Depth to Crest?	True	Use Submerged Weir Equation?	False

Composite Outlet Structure Detailed Report: Composite Outlet Structure - 1



RATING TABLE FOR ONE OUTLET TYPE

Structure ID = Riser - 2 (Stand Pipe)

Upstream ID = (Pond Water Surface)

Downstream ID = Culvert - 1 (Culvert-Circular)

Water Surface Elevation (ft)	Device Flow (ft³/s)	(into) Headwater Hydraulic Grade Line (ft)	Converge Downstream Hydraulic Grade Line (ft)	Next Downstream Hydraulic Grade Line (ft)
965.35	0.00	0.00	0.00	0.00
965.75	0.00	0.00	0.00	965.45
965.85	0.00	0.00	0.00	965.46
966.35	0.00	0.00	0.00	965.50
966.85	0.00	0.00	0.00	965.52
967.35	0.00	0.00	0.00	965.53
967.85	0.00	0.00	0.00	965.55
968.35	0.00	0.00	0.00	965.55
968.85	0.00	0.00	0.00	965.57
969.35	0.00	0.00	0.00	965.57
969.85	0.00	0.00	0.00	965.58
970.35	0.00	0.00	0.00	965.59
970.45	0.00	0.00	0.00	965.59
970.85	0.00	0.00	0.00	965.89
971.35	0.00	0.00	0.00	966.43
971.85	0.00	0.00	0.00	966.96

Composite Outlet Structure Detailed Report: Composite Outlet Structure - 1

RATING TABLE FOR ONE OUTLET TYPE

Structure ID = Riser - 2 (Stand Pipe)

Upstream ID = (Pond Water Surface)

Downstream ID = Culvert - 1 (Culvert-Circular)

Downstream Hydraulic Grade Line Error (ft)	Convergence Error (ft ³ /s)	Downstream Channel Tailwater (ft)	Tailwater Error (ft)
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00

Message

WS below an invert; no flow.
 WS below an invert; no flow.
 WS below an invert; no flow.
 WS below an invert; no flow.
 WS below an invert; no flow.
 WS below an invert; no flow.
 WS below an invert; no flow.
 WS below an invert; no flow.
 WS below an invert; no flow.
 WS below an invert; no flow.
 WS below an invert; no flow.
 WS below an invert; no flow.
 WS below an invert; no flow.
 WS below an invert; no flow.
 WS below an invert; no flow.
 WS below an invert; no flow.
 WS below an invert; no flow.
 WS below an invert; no flow.
 Weir: H =0.35ft
 Weir: H =0.85ft
 Weir: H =1.35ft
 Orifice: H =1.85; Riser orifice equation
 controlling.

Composite Outlet Structure Detailed Report: Composite Outlet Structure - 1

RATING TABLE FOR ONE OUTLET TYPE

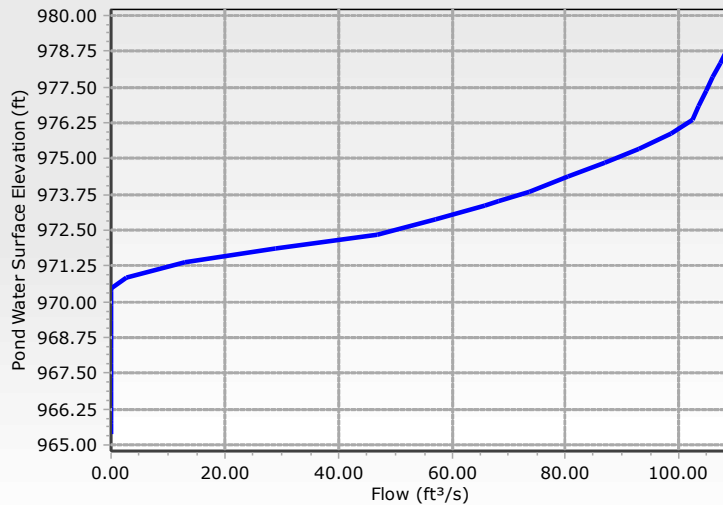
Structure ID = Riser - 2 (Stand Pipe)

Upstream ID = (Pond Water Surface)

Downstream ID = Culvert - 1 (Culvert-Circular)

Message			
Orifice: H =2.35; Riser orifice equation controlling.			
Orifice: H =2.85; Riser orifice equation controlling.			
Orifice: H =3.35; Riser orifice equation controlling.			
Orifice: H =3.85; Riser orifice equation controlling.			
Orifice: H =4.35; Riser orifice equation controlling.			
Orifice: H =4.85; Riser orifice equation controlling.			
Orifice: H =5.35; Riser orifice equation controlling.			
FULLY CHARGED RISER: Orifice Equation Control to Crest; H=5.57			
Outlet Structure			
Outlet Structure Type		Orifice	
Outlet Structure (IDs and Direction)			
Outlet ID	Orifice - 2	Downstream ID	Culvert - 1
Flow Direction	Forward Flow Only	Notes	
Outlet Structure (Advanced)			
Elevation (On)	0.00 ft	Elevation (Off)	0.00 ft
Outlet Structure (Orifice)			
Orifice	Circular Orifice	Orifice Coefficient	0.600
Number of Openings	4	Orifice Diameter	21.0 in
Outlet Structure (Common)			
Elevation	970.45 ft		

Composite Outlet Structure Detailed Report: Composite Outlet Structure - 1



RATING TABLE FOR ONE OUTLET TYPE

Structure ID = Orifice - 2 (Orifice-Circular)

Upstream ID = (Pond Water Surface)

Downstream ID = Culvert - 1 (Culvert-Circular)

Water Surface Elevation (ft)	Device Flow (ft³/s)	(into) Headwater Hydraulic Grade Line (ft)	Converge Downstream Hydraulic Grade Line (ft)	Next Downstream Hydraulic Grade Line (ft)
965.35	0.00	0.00	0.00	0.00
965.75	0.00	0.00	0.00	965.45
965.85	0.00	0.00	0.00	965.46
966.35	0.00	0.00	0.00	965.50
966.85	0.00	0.00	0.00	965.52
967.35	0.00	0.00	0.00	965.53
967.85	0.00	0.00	0.00	965.55
968.35	0.00	0.00	0.00	965.55
968.85	0.00	0.00	0.00	965.57
969.35	0.00	0.00	0.00	965.57
969.85	0.00	0.00	0.00	965.58
970.35	0.00	0.00	0.00	965.59
970.45	0.00	0.00	0.00	965.59
970.85	2.79	970.85	Free Outfall	965.89
971.35	13.03	971.35	Free Outfall	966.43
971.85	28.85	971.85	Free Outfall	966.96

Composite Outlet Structure Detailed Report: Composite Outlet Structure - 1

RATING TABLE FOR ONE OUTLET TYPE

Structure ID = Orifice - 2 (Orifice-Circular)

Upstream ID = (Pond Water Surface)

Downstream ID = Culvert - 1 (Culvert-Circular)

Downstream Hydraulic Grade Line Error (ft)	Convergence Error (ft ³ /s)	Downstream Channel Tailwater (ft)	Tailwater Error (ft)
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00

Message

WS below an invert; no flow.
 WS below an invert; no flow.
 WS below an invert; no flow.
 WS below an invert; no flow.
 WS below an invert; no flow.
 WS below an invert; no flow.
 WS below an invert; no flow.
 WS below an invert; no flow.
 WS below an invert; no flow.
 WS below an invert; no flow.
 WS below an invert; no flow.
 WS below an invert; no flow.
 WS below an invert; no flow.
 CRIT.DEPTH CONTROL Vh= .103ft
 Dcr= .297ft CRIT.DEPTH Hev= .00ft
 CRIT.DEPTH CONTROL Vh= .243ft
 Dcr= .656ft CRIT.DEPTH Hev= .00ft
 CRIT.DEPTH CONTROL Vh= .407ft
 Dcr= .994ft CRIT.DEPTH Hev= .00ft
 H =1.03
 H =1.53
 H =2.03
 H =2.18
 H =2.53
 H =3.03
 H =3.53

Composite Outlet Structure Detailed Report: Composite Outlet Structure - 1

RATING TABLE FOR ONE OUTLET TYPE

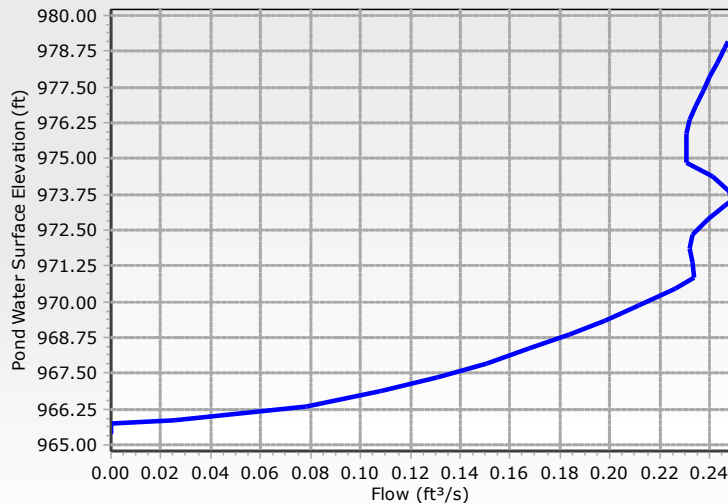
Structure ID = Orifice - 2 (Orifice-Circular)

Upstream ID = (Pond Water Surface)

Downstream ID = Culvert - 1 (Culvert-Circular)

Message			
H =4.03			
H =4.53			
H =4.88			
H =4.99			
H =5.11			
H =5.24			
H =5.36			
H =5.49			
H =5.56			
Outlet Structure			
Outlet Structure Type		Orifice	
Outlet Structure (IDs and Direction)			
Outlet ID	Copy of Orifice - 1	Downstream ID	Culvert - 1
Flow Direction	Forward Flow Only	Notes	
Outlet Structure (Advanced)			
Elevation (On)	0.00 ft	Elevation (Off)	0.00 ft
Outlet Structure (Orifice)			
Orifice	Circular Orifice	Orifice Coefficient	0.600
Number of Openings	4	Orifice Diameter	1.0 in
Outlet Structure (Common)			
Elevation	965.75 ft		

Composite Outlet Structure Detailed Report: Composite Outlet Structure - 1



RATING TABLE FOR ONE OUTLET TYPE

Structure ID = Copy of Orifice - 1 (Orifice-Circular)

Upstream ID = (Pond Water Surface)

Downstream ID = Culvert - 1 (Culvert-Circular)

Water Surface Elevation (ft)	Device Flow (ft³/s)	(into) Headwater Hydraulic Grade Line (ft)	Converge Downstream Hydraulic Grade Line (ft)	Next Downstream Hydraulic Grade Line (ft)
965.35	0.00	0.00	0.00	0.00
965.75	0.00	0.00	0.00	965.45
965.85	0.03	965.85	Free Outfall	965.46
966.35	0.08	966.35	Free Outfall	965.50
966.85	0.11	966.85	Free Outfall	965.52
967.35	0.13	967.35	Free Outfall	965.53
967.85	0.15	967.85	Free Outfall	965.55
968.35	0.17	968.35	Free Outfall	965.55
968.85	0.18	968.85	Free Outfall	965.57
969.35	0.20	969.35	Free Outfall	965.57
969.85	0.21	969.85	Free Outfall	965.58
970.35	0.22	970.35	Free Outfall	965.59
970.45	0.23	970.45	Free Outfall	965.59
970.85	0.23	970.85	965.88	965.89
971.35	0.23	971.35	966.43	966.43
971.85	0.23	971.85	966.96	966.96

Composite Outlet Structure Detailed Report: Composite Outlet Structure - 1

RATING TABLE FOR ONE OUTLET TYPE

Structure ID = Copy of Orifice - 1 (Orifice-Circular)

Upstream ID = (Pond Water Surface)

Downstream ID = Culvert - 1 (Culvert-Circular)

Downstream Hydraulic Grade Line Error (ft)	Convergence Error (ft ³ /s)	Downstream Channel Tailwater (ft)	Tailwater Error (ft)
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00

Message

WS below an invert; no flow.

WS below an invert; no flow.

H =.06

H =.56

H =1.06

H =1.56

H =2.06

H =2.56

H =3.06

H =3.56

H =4.06

H =4.56

H =4.66

H =4.97

H =4.92

H =4.89

H =4.92

H =5.19

H =5.51

H =5.60

H =5.58

H =5.29

H =4.83

H =4.83

H =4.83

H =4.88

Composite Outlet Structure Detailed Report: Composite Outlet Structure - 1

RATING TABLE FOR ONE OUTLET TYPE

Structure ID = Copy of Orifice - 1 (Orifice-Circular)

Upstream ID = (Pond Water Surface)

Downstream ID = Culvert - 1 (Culvert-Circular)

Message
H =4.99
H =5.11
H =5.24
H =5.36
H =5.49
H =5.56

Composite Outlet Structure Detailed Report: Composite Outlet Structure - 1

Composite Rating Table

Tailwater Elevation = Free Outfall (Composite Outlet Structure - 1)

Water Surface Elevation (ft)	Flow (ft ³ /s)	Tailwater Elevation (ft)	Convergence Error (ft)
965.35	0.00	(N/A)	0.00
965.75	0.12	(N/A)	0.00
965.85	0.16	(N/A)	0.00
966.35	0.27	(N/A)	0.00
966.85	0.35	(N/A)	0.00
967.35	0.41	(N/A)	0.00
967.85	0.47	(N/A)	0.00
968.35	0.52	(N/A)	0.00
968.85	0.56	(N/A)	0.00
969.35	0.61	(N/A)	0.00
969.85	0.65	(N/A)	0.00
970.35	0.68	(N/A)	0.00
970.45	0.69	(N/A)	0.00
970.85	3.49	(N/A)	0.00
971.35	13.73	(N/A)	0.00
971.85	29.54	(N/A)	0.00
972.35	47.56	(N/A)	0.00
972.85	57.90	(N/A)	0.00
973.35	66.57	(N/A)	0.00
973.50	69.03	(N/A)	0.00
973.85	87.98	(N/A)	0.00
974.35	132.96	(N/A)	0.00
974.85	191.12	(N/A)	0.00
975.35	219.55	(N/A)	0.00
975.85	241.17	(N/A)	0.00
976.35	259.30	(N/A)	0.00
976.85	273.68	(N/A)	0.00
977.35	287.14	(N/A)	0.00
977.85	299.84	(N/A)	0.00
978.35	311.94	(N/A)	0.00
978.85	323.50	(N/A)	0.00
979.07	328.46	(N/A)	0.00

Contributing Structures

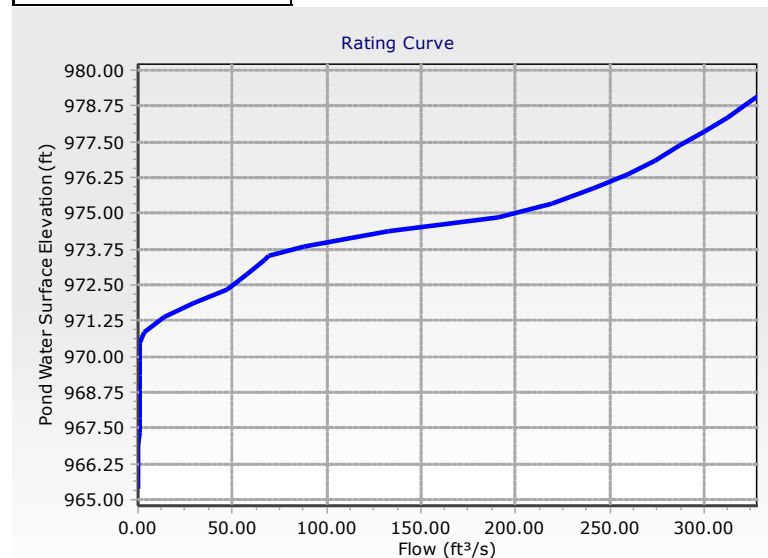
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 Orifice - 1,Culvert - 1
 (no Q: Orifice - 2,Riser - 2,Riser - 1,Copy of Orifice - 1)
 Orifice - 1,Copy of Orifice - 1,Culvert - 1 (no Q: Orifice - 2,Riser - 2,Riser - 1)

Composite Outlet Structure Detailed Report: Composite Outlet Structure - 1

Composite Rating Table

Tailwater Elevation = Free Outfall (Composite Outlet Structure - 1)

Contributing Structures
Orifice - 2,Riser - 2,Orifice - 1,Riser - 1,Copy of Orifice - 1,Culvert - 1
Orifice - 2,Riser - 2,Orifice - 1,Riser - 1,Copy of Orifice - 1,Culvert - 1
Orifice - 2,Riser - 2,Orifice - 1,Riser - 1,Copy of Orifice - 1,Culvert - 1
Orifice - 2,Riser - 2,Orifice - 1,Riser - 1,Copy of Orifice - 1,Culvert - 1
Orifice - 2,Riser - 2,Orifice - 1,Riser - 1,Copy of Orifice - 1,Culvert - 1



PONDPACK SPILLWAY OUTPUT

COBEY CREEK - SPILLWAY (AS-BUILTS)

Project Summary

Title	COBEY CREEK
Engineer	Matthew Castor
Company	Hg Consult, Inc
Date	4/6/2021

Notes

Table of Contents

Master Network Summary

2

COBEY CREEK - SPILLWAY (AS-BUILTS)

Subsection: Master Network Summary

Catchments Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft ³ /s)
P1	Post-Development 100 year	100	5.265	11.970	84.76
P2	Post-Development 100 year	100	0.309	11.940	5.40
P3	Post-Development 100 year	100	42.704	12.090	511.44
P4	Post-Development 100 year	100	2.044	11.970	32.66

Node Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft ³ /s)
O-1	Post-Development 100 year	100	5.265	11.970	84.76
O-2	Post-Development 100 year	100	0.309	11.940	5.40
O-3	Post-Development 100 year	100	41.512	12.140	493.13
O-4	Post-Development 100 year	100	2.044	11.970	32.66

Pond Summary

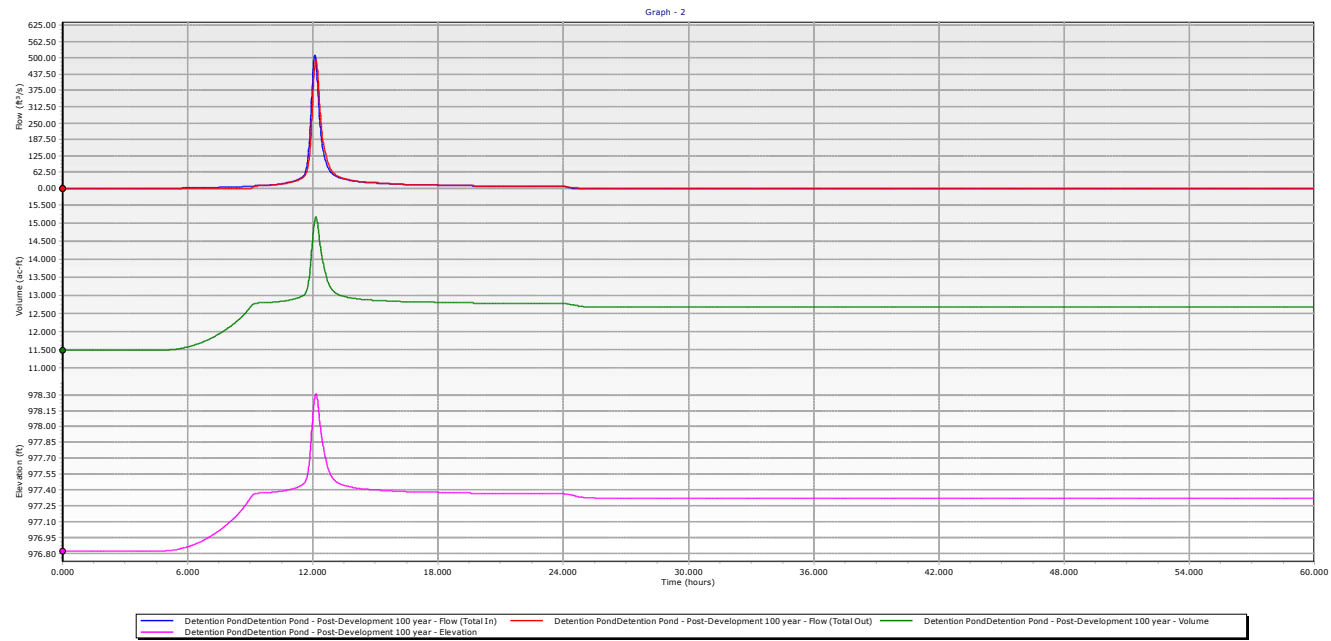
Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft ³ /s)	Maximum Water Surface Elevation (ft)	Maximum Pond Storage (ac-ft)
Detention Pond (IN)	Post-Development 100 year	100	42.704	12.090	511.44	(N/A)	(N/A)
Detention Pond (OUT)	Post-Development 100 year	100	41.512	12.140	493.13	978.31	15.173

COBEY CREEK - SPILLWAY (AS-BUILTS)

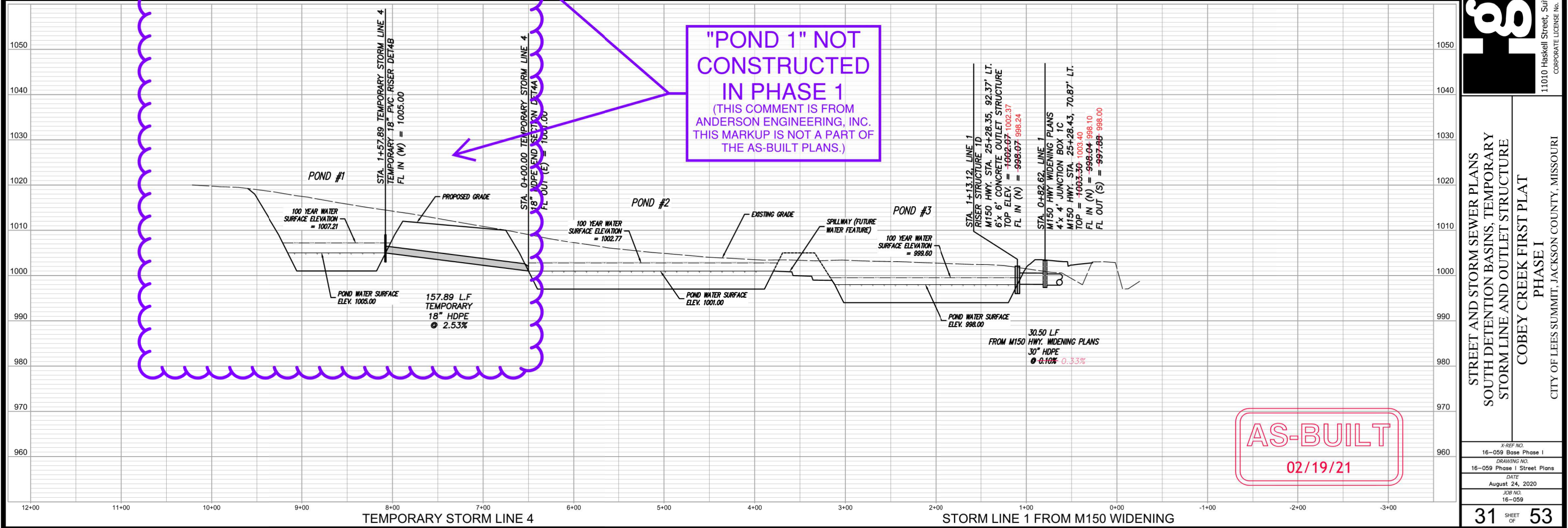
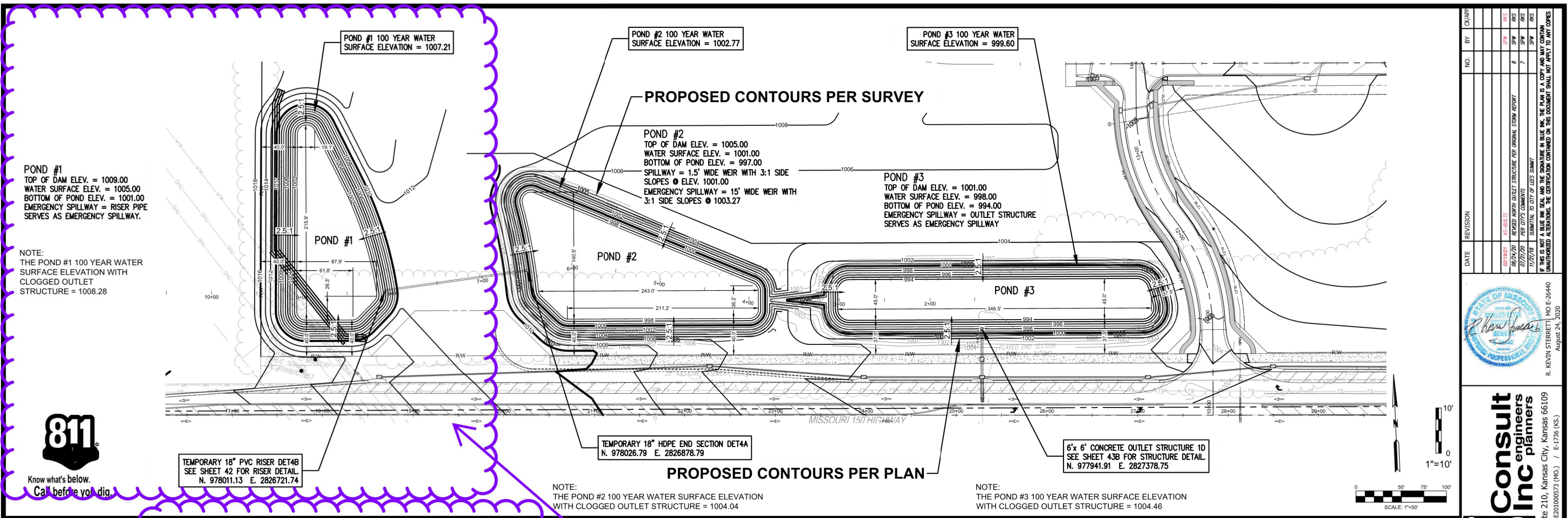
Index

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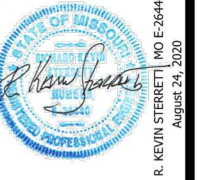
Master Network Summary...2



Appendix G



NO.	BY	DATE	REVISION
1	SW	02/19/21	AS-BUILT
2	SW	08/24/20	REVISED NORTH OUTLET STRUCTURE PER ORIGINAL STORM REPORT
3	SW	07/21/20	PER CITY COMMENTS
4	SW	11/27/18	SUBMITTAL TO CITY OF LEES SUMMIT
5	SW		IF THIS IS NOT A BLUE INK SEAL AND THE SIGNATURE IN BLUE INK, THE PLAN IS A COPY AND MAY CONTAIN UNAUTHORIZED ALTERATIONS. THE CERTIFICATION CONTAINED ON THIS DOCUMENT SHALL NOT APPLY TO ANY COPIES



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STREET AND STORM SEWER PLANS
SOUTH DETENTION BASINS, TEMPORARY
STORM LINE AND OUTLET STRUCTURE
COBEY CREEK FIRST PLAT
PHASE I
CITY OF LEES SUMMIT, JACKSON COUNTY, MISSOURI