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June 20, 2024

Preliminary Stormwater Management & Drainage Report

Client

Intrinsic Development
3622 Endeavor Ave, Ste. 101
Columbia, MO 65201

Project

Discovery Crossing
SW Corner of Douglas St and Colbern Rd
Lee's Summit, MO

P.N. 24KC10015

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Project Description and General Information

The proposed project is a 268 acre mixed use development located at the intersection of Colbern Road and Douglas Street in Lee's Summit, Missouri. Discovery Crossing is the second phase of the Discovery Park project located on the south side of Colbern Road.

The purpose of this report is to analyze the stormwater impacts of the proposed mixed use development and show that the post-development conditions meet the regulations established by the City of Lee's Summit. This phase of the development is located on the southwest corner of Douglas Street and Colbern Road in Lee's Summit, Missouri. The full site is bounded by Cobern Road to the north, Douglas Street to the east, Interstate 470 to the south, and Main Street to the west. This phase is the easternmost portion encompassing approximately 18 acres of the overall site. The existing site is undeveloped, consisting mostly of grass and farmland.

The existing soil characteristics as published in the Soil Survey for Jackson County, Missouri are summarized in the table below. Additional information on the existing soil is provided in the Web Soil Survey located in the Appendix.

Table 1: Soil Classifications

Map Unit Symbol	Map Unit Name	Slopes	Hydrologic Soil Group
10113	Oska Silty Clay Loam	5 to 9%	D
10120	Sharpsburg Silty Loam	2 to 5%	C
10128	Sharpsburg-Urban Land Complex	2 to 5%	D
10180	Udarents-Urban Land-Sampsel Complex	2 to 5%	C
30080	Greenton Silty Clay Loam	5 to 9%	C/D
40107	Snead-Rock Outcrop Complex	5 to 14%	D

According to FEMA flood maps (FIRM Panel 29095C0409G), the site is located in zone X, an area of minimal flood hazard. No amendments or revisions to the map are being proposed.

Methodology

The Discovery Crossing site was analyzed in both the pre-development and post-development conditions. The analysis was conducted utilizing HydroCAD which uses an SCS Type-II 24 hr. rainfall distribution data in computing unit hydrographs for varying conditions. Precipitation depths used in the analysis have been interpolated from the "Technical Paper No. 40 Rainfall Frequency Atlas of the United States" (TP-40).

Table 2: Rainfall Precipitation

Annual Exceedance Probability (AEP)	Rainfall Depth (inches)
90% (Water Quality Event)	1.37
50% (2 year)	3.50
10% (10 year)	5.34
1% (100 year)	7.71

The post-development rates were determined utilizing the APWA 5600 Comprehensive Protection Strategy in accordance with the City of Lee's Summit regulations. Under this strategy, peak runoff control is provided for the 1%, 10%, and 50% chance storms and volumetric and/or extended detention control (≥40 hr.) of the 90% mean annual event storm. The maximum allowable release rates for the design storm events are established for the 2-year (0.50 cfs/acre), 10-year (2.0 cfs/acre), 100-year (3.0 cfs/acre).

Existing Conditions Analysis

The site generally drains to the north and west. The north watershed drains to the existing storm sewer network along Colbern Road and the first phase of Discovery Park, and ultimately into the regional detention basin. The west and south watersheds drain into the stream located west of the site that crosses under Colbern Road into Unity Lake Number One on the north side of Colbern Road. Refer to the Pre-Development Plan in the Appendix. A summary of the existing conditions design parameters is in the table below.

Table 3: Existing Conditions Parameters

Subarea	Total Area (ac)	Onsite Area (ac)	Offsite Area (ac)	NRCS Weighted CN	Time of Concentration (min)
North	13.45	9.21	4.24	83	6.2
West	9.32	9.32	0	79	10.3

The portion draining to the north has been included in the previous drainage study titled "Discovery Park Macro Stormwater Report" prepared by Olsson dated October 24, 2023 and the drainage study titled "Stormwater Management and Drainage Report" prepared by OWN, Inc. dated June 20, 2024. The previous studies determined the allowable release rates and calculated the required detention for The Village at Discovery Park, Aria Apartments, and a portion of Discovery Crossing. A portion of Discovery Crossing will drain into the existing basin constructed as part of the Village at Discovery Park. Water quality treatment for Discovery Crossing was not provided and has been included in the proposed improvements. The existing peak runoff rates were calculated for the design storms and summarized below.

Table 4: Existing Peak Flow Summary

Watershed	Peak Flow 2-yr Event (cfs)	Peak Flow 10-yr Event (cfs)	Peak Flow 100-yr Event (cfs)
North	42.80	77.55	123.66
West	21.83	42.99	71.48

Proposed Conditions Analysis

The proposed development for this phase consists of 9 lots containing retail and restaurant buildings and associated surface parking. The proposed site has 3 watersheds; north (lots 1-5), west (lot 9), and south (lots 6-8). The west and south watershed ultimately drain into the same creek and should be combined when compared to the existing west watershed. Refer to the Post-Development Plan in the Appendix. The allowable release rates were determined using the Comprehensive Control Strategy as defined in APWA 5608.4. A summary of the allowable release rates is provided in the table below:

Table 5: Allowable Release Rates

Design Storm	Allowable Release Rate (cfs/acre)	South (6.29 ac.) (cfs)	West (2.24 ac.) (cfs)
50% (2 year)	0.5	3.15	1.14
10% (10 year)	2.0	12.58	4.58
1% (100 year)	3.0	18.87	6.87

*Note: The north watershed (Lots 1-5) is not included in the allowable release rate calculations as detention has been previously provided.

A summary of the proposed design parameters is in the table below.

Table 6: Proposed Conditions Parameters

Subarea	Total Area (ac)	Onsite Area (ac)	Offsite Area (ac)	NRCS Weighted CN	Time of Concentration (min)
North	11.27	8.71	2.56	94	6
South	6.41	6.29	0.12	94	6
West	2.29	2.29	0	94	6

To mitigate the impact of the proposed increase in impervious area associated with the development and to satisfy the requirement for detention, two above ground detention basins are proposed to capture stormwater and release at rates at or below the allowable release rates as established above. The proposed basins will receive stormwater from enclosed pipe systems that collect water from the streets and parking lots.

Outlet control structures with multiple stage release controls are proposed to provide controlled release over the design storms. Specific detail of each outlet control structure is provided in the associated watershed review below.

North Watershed

The proposed improvements in the north watershed are consistent with the previously approved drainage studies. Below is a comparison summary of the previously assumed parameters for the sizing of the regional detention basin and the proposed improvements.

Table 7: Existing Basin Design Comparison Summary

	Previous Studies	Proposed
Total Area (ac.)	13.42	11.27
Onsite Area (ac.)	9.88	8.71
NRCS CN	94	94

The proposed total area is smaller due to the inclusion of the Colbern Road right-of-way in the original study. The proposed condition onsite area shows a reduction in the area originally proposed and therefore no additional detention is required.

The storm sewer network was also analyzed to confirm the proposed site can be served by the existing storm crossings under Colbern Road. Design of the pipe crossings to convey the 100-year flows without overtopping was provided in the approved Public Storm Sewer Plans prepared by Olsson dated 9/8/2023.

Per the previous studies, water quality treatment was not provided for the area within Discovery Crossing. As such, water quality treatment is proposed to treat the storm drainage prior to leaving the site for the north watershed. Two hydrodynamic separators are proposed to provide the required water quality treatment. The hydrodynamic separators will be sized to treat the flow resulting from the APWA Water Quality Storm. Final design and sizing will be provided with the Final Development Plans for the associated lots.

South Watershed

The south watershed is approximately 6.41 acres located on Lots 6-8 and consists of three commercial buildings and associated parking lots. The calculated CN for this area is 94, which is consistent with urban commercial development.

An above ground extended dry detention basin is proposed to provide the volume needed to meet the allowable release rate for this development. The basin will have a 6'x6' outlet control structure to control the release rates for the 2-yr, 10-yr, and 100-yr design storms and to provide a controlled release of the water quality storm. A 2-inch diameter orifice is proposed to drain the water quality storm over the required 40 hour period. The associated water quality volume and sizing calculations are provided in the Appendix. A 42-inch by 6-inch rectangular opening and 72-inch by 72-inch open top will provide the controlled release of the 2-yr, 10-yr, and 100-yr design storms. The peak release rates are summarized in the table below:

Table 9: South Watershed Release Rate Summary

Storm Event	Allowable Release Rate (cfs)	Proposed Peak Release Rates (cfs)
2 year	3.15	2.92
10 year	12.58	12.03
100 year	18.87	17.46

West Watershed

The west watershed is approximately 2.29 acres located on Lot 9 and consists of a commercial building and associated parking lot. The calculated CN for this area is 94, which is consistent with urban commercial development.

An above ground extended dry detention basin is proposed to provide the volume needed to meet the allowable release rate for this development. The basin will have a 5'x5' outlet control structure to control the release rates for the 2-yr, 10-yr, and 100-yr design storms and to provide a controlled release of the water quality storm. A 1.25-inch diameter orifice is proposed to drain the water quality storm over the required 40 hour period. The associated water quality volume and sizing calculations are provided in the Appendix. A 24-inch by 5-inch rectangular opening and 60-inch by 60-inch open top and 9.5-inch orifice will provide the controlled release of the 2-yr, 10-yr, and 100-yr design storms. The peak release rates are summarized in the table below:

Table 10: West Watershed Release Rate Summary

Storm Event	Allowable Release Rate (cfs)	Proposed Peak Release Rates (cfs)
2 year	1.14	0.99
10 year	4.58	4.25
100 year	6.87	6.03

The peak flows were also compared to the existing flows and summarized in the table below. The proposed west and south watershed peak flows were combined to compare to the existing west watershed.

Table 11: Peak Flow Comparison

Watershed	Existing Peak Flow 2-yr Event (cfs)	Proposed Peak Flow 2-yr Event (cfs)	Existing Peak Flow 10-yr Event (cfs)	Proposed Peak Flow 10-yr Event (cfs)	Existing Peak Flow 100-yr Event (cfs)	Proposed Peak Flow 100-yr Event (cfs)
North	42.80	63.79	77.55	101.22	123.66	148.82
West	21.83	6.76	42.99	20.80	71.48	30.14

The north watershed shows an increase in the peak flow rates as a result of the development. This increase has already been mitigated with the detention basin previously provided in the first phase of the project.

Summary and Recommendations

The existing site is undeveloped, consisting mostly of grass and farmland. The proposed development for this phase consists of 9 lots containing retail and restaurant buildings and associated surface parking. To mitigate the increase in runoff release rates due to the increase in impervious area, an enclosed pipe network in conjunction with above ground detention basins with an outlet control structure was designed. As stated previously, approximately 13 acres of the north watershed was included in the design of the first phase of Discovery Park and the proposed changes in this phase still meet the assumed parameters set for its design. Peak runoff control is provided for the 1%, 10%, and 50% chance storms and volumetric and/or extended detention control (≥40 hr.) of the 90% mean annual event storm. Post-development site conditions and detention basins were modeled and analyzed using HydroCAD. Detailed calculations are presented in the Appendix to support the presented release rate summaries, detention volumes, and maximum water surface elevations.

Appendix

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Pre-Development Plan

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DISOVERY CROSSING PRELIMINARY STORMWATER REPORT

SW CORNER OF DOUGLAS ST
AND COLBERN RD
LEE'S SUMMIT, MO

REVISIONS

NO.	DESCRIPTION	DATE
1	INITIAL SUBMISSION	06/20/2024

DRAWING INFORMATION

PROJECT NO: 24KC10025
DRAWN BY: JGD
CHECK BY: JWB
ISSUED DATE: 06/20/2024
FIELD BOOK:

ISSUED BY:
LICENSE NO: ____

SHEET TITLE

PRE-DEVELOPMENT PLAN

SHEET NUMBER

1

1 OF 2

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Post-Development Plan

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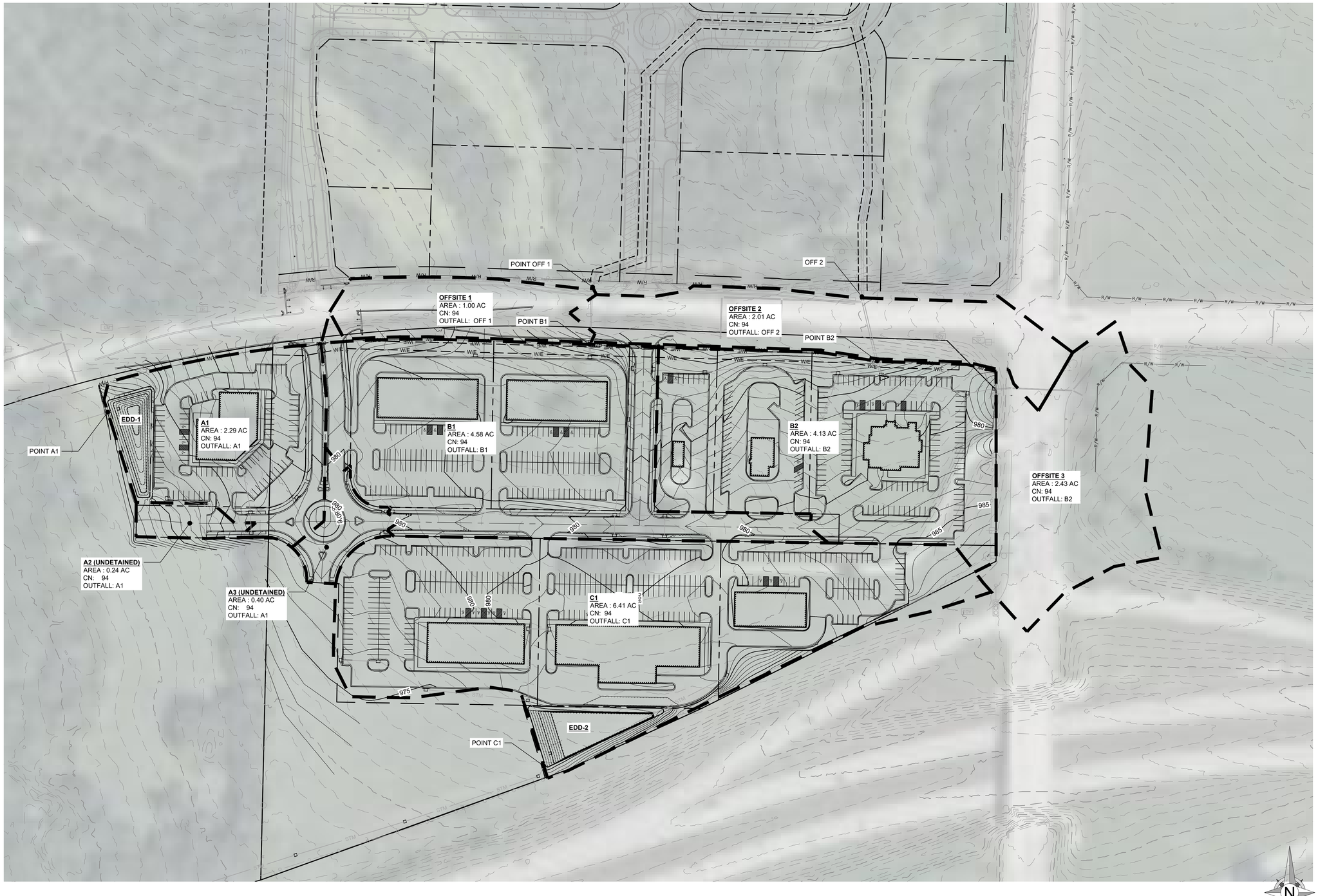

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DISOVERY CROSSING PRELIMINARY STORMWATER REPORT

SW CORNER OF DOUGLAS ST
AND COLBERN RD
LEE'S SUMMIT, MO

REVISIONS

NO.	DESCRIPTION	DATE
1	INITIAL SUBMISSION	06/20/2024

DRAWING INFORMATION

PROJECT NO: 24KC10025
DRAWN BY: JGD
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ISSUED DATE: 06/20/2024
FIELD BOOK:

ISSUED BY:
LICENSE NO: ____

SHEET TITLE

POST-DEVELOPMENT PLAN

SHEET NUMBER

2

2 OF 2

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Soil Report

Engineering beyond.™

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

Discovery Crossing

June 11, 2024

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

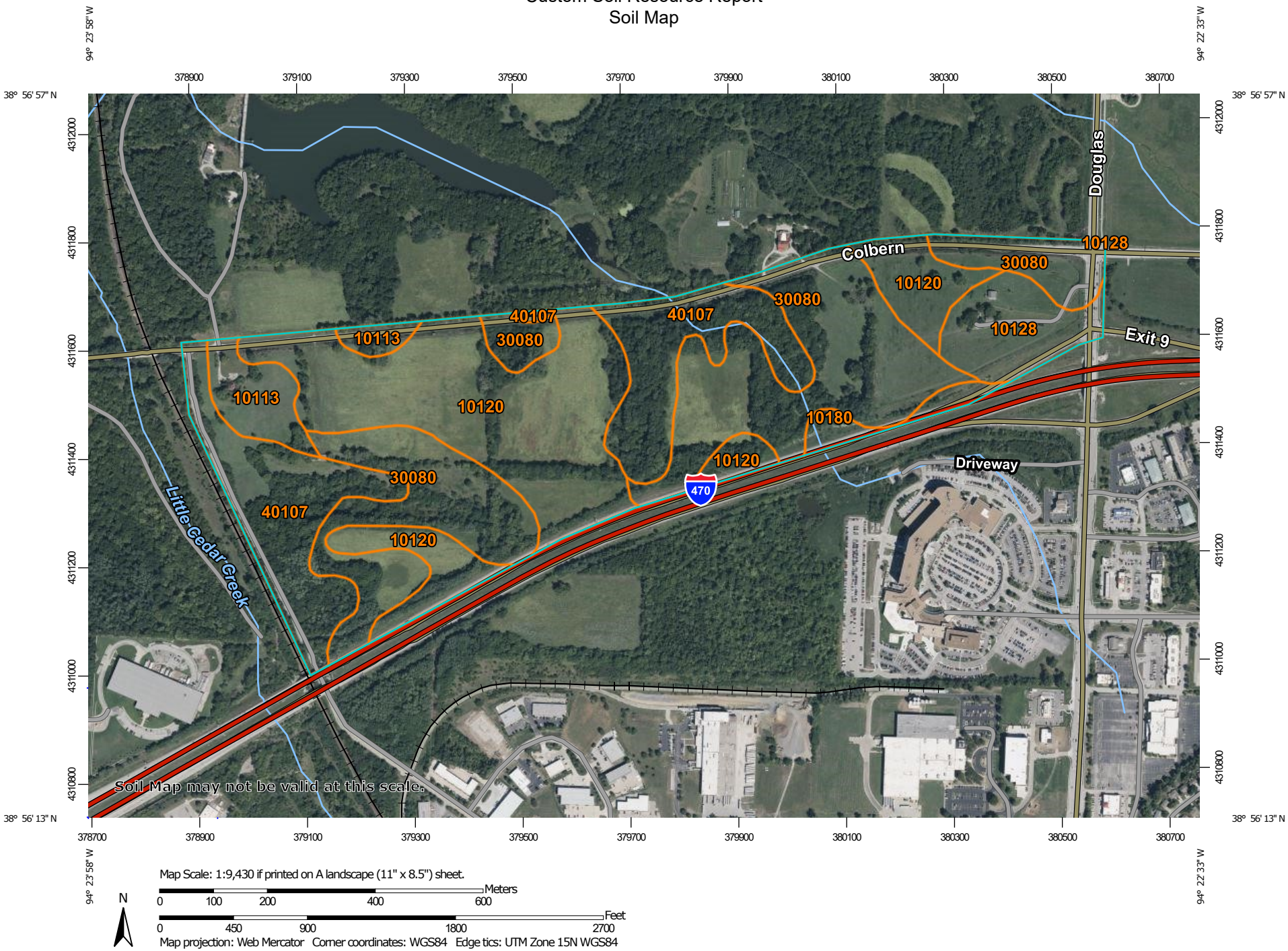
After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

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 25, Aug 22, 2023

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

Date(s) aerial images were photographed: Aug 30, 2022—Sep 8, 2022

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

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
10113	Oska silty clay loam, 5 to 9 percent slopes, eroded	7.8	4.7%
10120	Sharpsburg silt loam, 2 to 5 percent slopes	52.9	31.7%
10128	Sharpsburg-Urban land complex, 2 to 5 percent slopes	10.1	6.1%
10180	Udarents-Urban land-Sampsel complex, 2 to 5 percent slopes	3.1	1.8%
30080	Greenton silty clay loam, 5 to 9 percent slopes	58.6	35.1%
40107	Snead-Rock outcrop complex, warm, 5 to 14 percent slopes	34.4	20.6%
Totals for Area of Interest		**166.8**	**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.

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

10113—Oska silty clay loam, 5 to 9 percent slopes, eroded

Map Unit Setting

National map unit symbol: yrm7
Elevation: 600 to 1,200 feet
Mean annual precipitation: 33 to 43 inches
Mean annual air temperature: 50 to 57 degrees F
Frost-free period: 177 to 220 days
Farmland classification: Not prime farmland

Map Unit Composition

Oska and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Oska

Setting

Landform: Ridges
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Crest
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Residuum

Typical profile

A - 0 to 7 inches: silty clay loam
Bt - 7 to 34 inches: silty clay loam
R - 34 to 80 inches: bedrock

Properties and qualities

Slope: 5 to 9 percent
Depth to restrictive feature: 20 to 40 inches to lithic bedrock
Drainage class: Well drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately high (0.00 to 0.20 in/hr)
Depth to water table: More than 80 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: Low (about 5.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: D
Ecological site: R106XY015KS - Loamy Upland (PE 30-37)
Other vegetative classification: Grass/Prairie (Herbaceous Vegetation)
Hydric soil rating: No

Minor Components

Sampsel

Percent of map unit: 5 percent
Landform: Hillslopes
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Concave
Ecological site: R109XY010MO - Interbedded Sedimentary Upland Savanna
Other vegetative classification: Grass/Prairie (Herbaceous Vegetation)
Hydric soil rating: No

Snead, eroded, warm

Percent of map unit: 5 percent
Landform: Hillslopes
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Ecological site: R109XY010MO - Interbedded Sedimentary Upland Savanna
Hydric soil rating: No

10120—Sharpsburg silt loam, 2 to 5 percent slopes

Map Unit Setting

National map unit symbol: 2yy7v
Elevation: 1,000 to 1,300 feet
Mean annual precipitation: 33 to 41 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

Sharpsburg and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Sharpsburg

Setting

Landform: Hillslopes
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Interfluve
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Loess

Typical profile

Ap - 0 to 6 inches: silt loam

A - 6 to 16 inches: silty clay loam
Bt1 - 16 to 22 inches: silty clay loam
Bt2 - 22 to 46 inches: silty clay loam
BC - 46 to 58 inches: silty clay loam
C - 58 to 79 inches: silty clay loam

Properties and qualities

Slope: 2 to 5 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Moderately well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately high (0.00 to 0.20 in/hr)
Depth to water table: About 45 to 50 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: Moderate (about 7.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3s
Hydrologic Soil Group: C
Ecological site: R109XY002MO - Loess Upland Prairie
Hydric soil rating: No

Minor Components

Sibley

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

Higginsville, eroded

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

10128—Sharpsburg-Urban land complex, 2 to 5 percent slopes

Map Unit Setting

National map unit symbol: 2ql09
Elevation: 1,000 to 1,320 feet
Mean annual precipitation: 33 to 41 inches
Mean annual air temperature: 50 to 55 degrees F
Frost-free period: 155 to 220 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Sharpsburg and similar soils: 60 percent
Urban land: 35 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Sharpsburg

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

A - 0 to 17 inches: silt loam
Bt - 17 to 55 inches: silty clay loam
C - 55 to 60 inches: silty clay loam

Properties and qualities

Slope: 2 to 5 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Moderately well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 24 to 35 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: Very high (about 12.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: D
Ecological site: R109XY002MO - Loess Upland Prairie
Other vegetative classification: Grass/Prairie (Herbaceous Vegetation)

Hydric soil rating: No

Description of Urban Land

Setting

Landform: Interfluves
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydric soil rating: No

Minor Components

Macksburg

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: R108XD860IA - Loess Upland Prairie
Hydric soil rating: No

10180—Udarents-Urban land-Sampsel complex, 2 to 5 percent slopes

Map Unit Setting

National map unit symbol: 1n85h
Elevation: 600 to 900 feet
Mean annual precipitation: 33 to 43 inches
Mean annual air temperature: 50 to 57 degrees F
Frost-free period: 175 to 220 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Udarents and similar soils: 46 percent
Urban land: 39 percent
Sampsel and similar soils: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Udarents

Setting

Landform position (two-dimensional): Summit
Landform position (three-dimensional): Crest
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Mine spoil or earthy fill

Typical profile

C1 - 0 to 5 inches: silt loam
C2 - 5 to 80 inches: silty clay loam

Properties and qualities

Slope: 2 to 5 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.14 to 0.57 in/hr)
Depth to water table: More than 80 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: Moderate (about 9.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: C
Ecological site: R107XB002MO - Deep Loess Upland Prairie
Other vegetative classification: Mixed/Transitional (Mixed Native Vegetation)
Hydric soil rating: No

Description of Urban Land

Setting

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

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydric soil rating: No

Description of Sampsel

Setting

Landform: Hillslopes
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Convex
Parent material: Residuum weathered from shale

Typical profile

Ap - 0 to 13 inches: silty clay loam
Bt - 13 to 80 inches: silty clay

Properties and qualities

Slope: 2 to 5 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat poorly drained
Runoff class: Very high

Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 0 to 18 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: Moderate (about 8.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: C/D
Ecological site: R109XY010MO - Interbedded Sedimentary Upland Savanna
Other vegetative classification: Grass/Prairie (Herbaceous Vegetation)
Hydric soil rating: No

30080—Greenton silty clay loam, 5 to 9 percent slopes

Map Unit Setting

National map unit symbol: 2xjd9
Elevation: 640 to 1,120 feet
Mean annual precipitation: 35 to 41 inches
Mean annual air temperature: 50 to 57 degrees F
Frost-free period: 177 to 209 days
Farmland classification: Not prime farmland

Map Unit Composition

Greenton and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Greenton

Setting

Landform: Hillslopes
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Interfluve
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loess over residuum weathered from limestone and shale

Typical profile

Ap - 0 to 12 inches: silty clay loam
Bt - 12 to 28 inches: silty clay
2Bt - 28 to 30 inches: silty clay
2C - 30 to 79 inches: silty clay

Properties and qualities

Slope: 5 to 9 percent
Depth to restrictive feature: More than 80 inches

Drainage class: Somewhat poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 12 to 30 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 10 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: High (about 9.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C/D
Ecological site: R109XY002MO - Loess Upland Prairie
Hydric soil rating: No

Minor Components

Sampsel

Percent of map unit: 10 percent
Landform: Hillslopes
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Ecological site: R109XY002MO - Loess Upland Prairie
Hydric soil rating: Yes

40107—Snead-Rock outcrop complex, warm, 5 to 14 percent slopes

Map Unit Setting

National map unit symbol: 2zccr
Elevation: 660 to 1,130 feet
Mean annual precipitation: 39 to 43 inches
Mean annual air temperature: 54 to 57 degrees F
Frost-free period: 185 to 220 days
Farmland classification: Not prime farmland

Map Unit Composition

Snead, warm, and similar soils: 70 percent
Rock outcrop: 20 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Snead, Warm

Setting

Landform: Hillslopes

Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Residuum weathered from limestone and shale

Typical profile

A - 0 to 10 inches: silty clay loam
Bw - 10 to 20 inches: silty clay
BC - 20 to 24 inches: silty clay
C - 24 to 35 inches: silty clay
Cr - 35 to 45 inches: bedrock

Properties and qualities

Slope: 5 to 14 percent
Depth to restrictive feature: 20 to 40 inches to paralithic bedrock
Drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 24 to 30 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 10 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 4.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: D
Ecological site: R109XY010MO - Interbedded Sedimentary Upland Savanna
Hydric soil rating: No

Description of Rock Outcrop

Typical profile

R - 0 to 79 inches: bedrock

Properties and qualities

Slope: 5 to 14 percent
Depth to restrictive feature: 0 inches to lithic bedrock
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately high (0.00 to 0.20 in/hr)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8s
Hydric soil rating: No

Minor Components

Oska

Percent of map unit: 4 percent
Landform: Hillslopes
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Linear

Ecological site: R106XY015KS - Loamy Upland (PE 30-37)
Hydric soil rating: No

Sampsel

Percent of map unit: 3 percent
Landform: Hillslopes
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Concave
Ecological site: R109XY010MO - Interbedded Sedimentary Upland Savanna
Hydric soil rating: Yes

Kennebec, occasionally flooded

Percent of map unit: 3 percent
Landform: Drainageways
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Talf
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R109XY028MO - Loamy Upland Drainageway Savanna
Hydric soil rating: No

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.

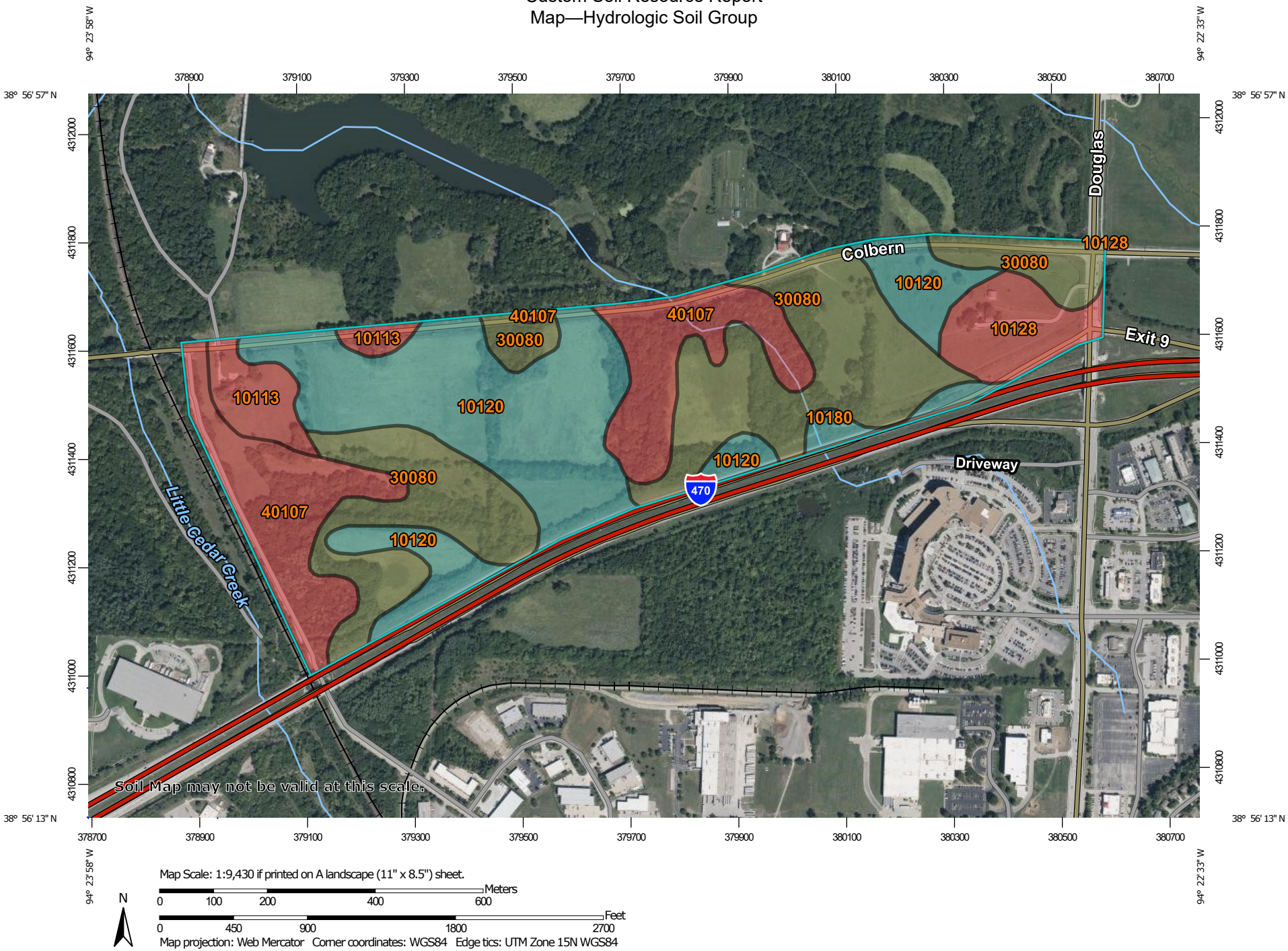
Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

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



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 25, Aug 22, 2023

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

Date(s) aerial images were photographed: Aug 30, 2022—Sep 8, 2022

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

Table—Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
10113	Oska silty clay loam, 5 to 9 percent slopes, eroded	D	7.8	4.7%
10120	Sharpsburg silt loam, 2 to 5 percent slopes	C	52.9	31.7%
10128	Sharpsburg-Urban land complex, 2 to 5 percent slopes	D	10.1	6.1%
10180	Udarents-Urban land-Sampsel complex, 2 to 5 percent slopes	C	3.1	1.8%
30080	Greenton silty clay loam, 5 to 9 percent slopes	C/D	58.6	35.1%
40107	Snead-Rock outcrop complex, warm, 5 to 14 percent slopes	D	34.4	20.6%
Totals for Area of Interest			**166.8**	**100.0%**

Rating Options—Hydrologic Soil Group

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

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FEMA Floodplain Map

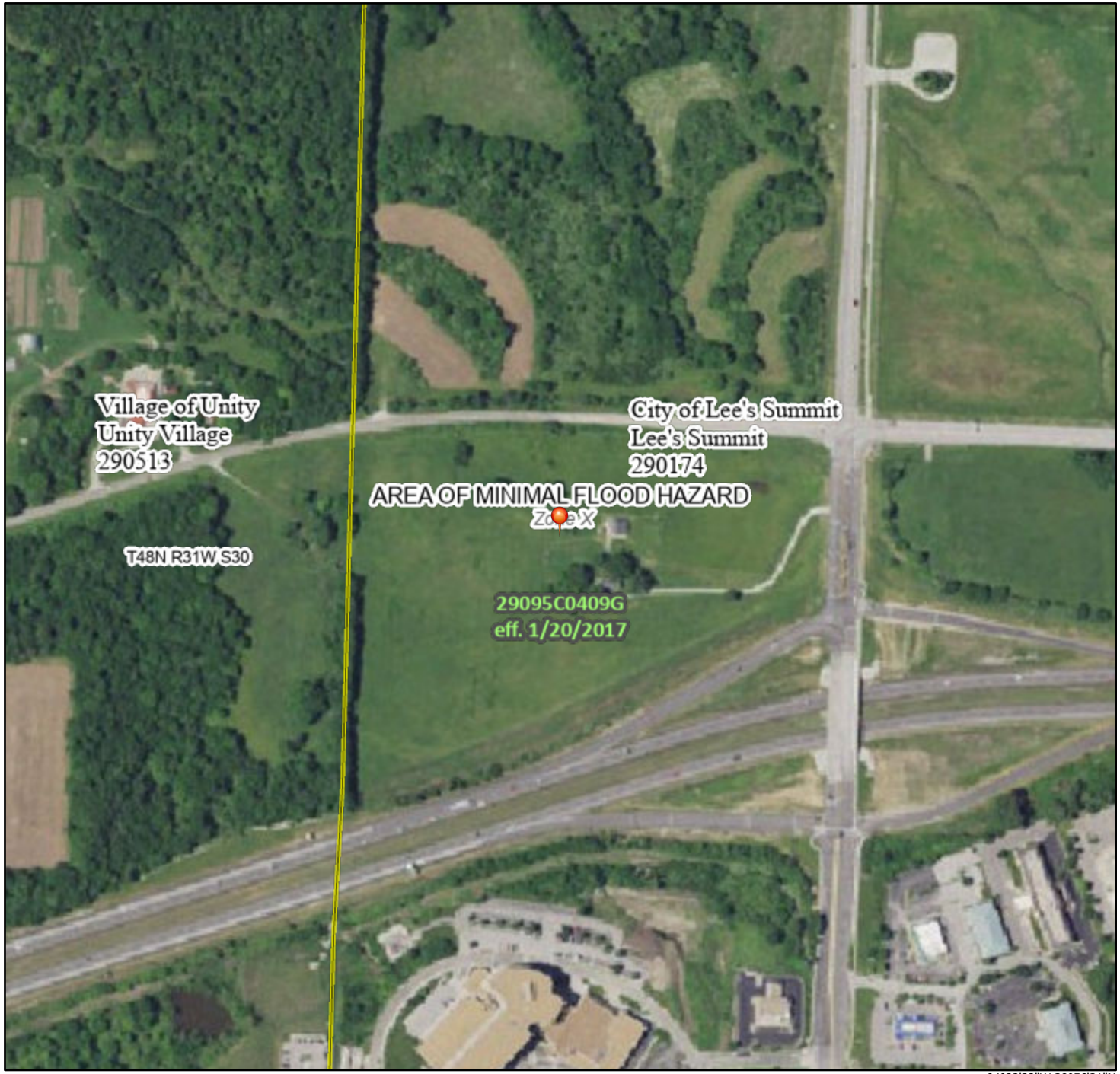
OWN

Engineering beyond.™

National Flood Hazard Layer FIRMette

FEMA

94°23'10"W 38°56'59"N



94°22'32"W 38°56'31"N

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

1:6,000

Basemap Imagery Source: USGS National Map 2023

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
- 17.5 — Water Surface Elevation
- Coastal Transect
- 513 — Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

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 6/20/2024 at 9:36 AM 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.

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) Report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS Report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study Report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study Report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Missouri State Plane West Zone (FIPS zone 2403). The **horizontal datum** was NAD 83, GRS 1980 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at **(301) 713- 3242**, or visit its website at http://www.ngs.noaa.gov.

Base map information shown on this FIRM was derived from the U.S.D.A Farm Service National Agriculture ImageryProgram (NAIP) dated 2014. Produced at scale of 1:24,000.

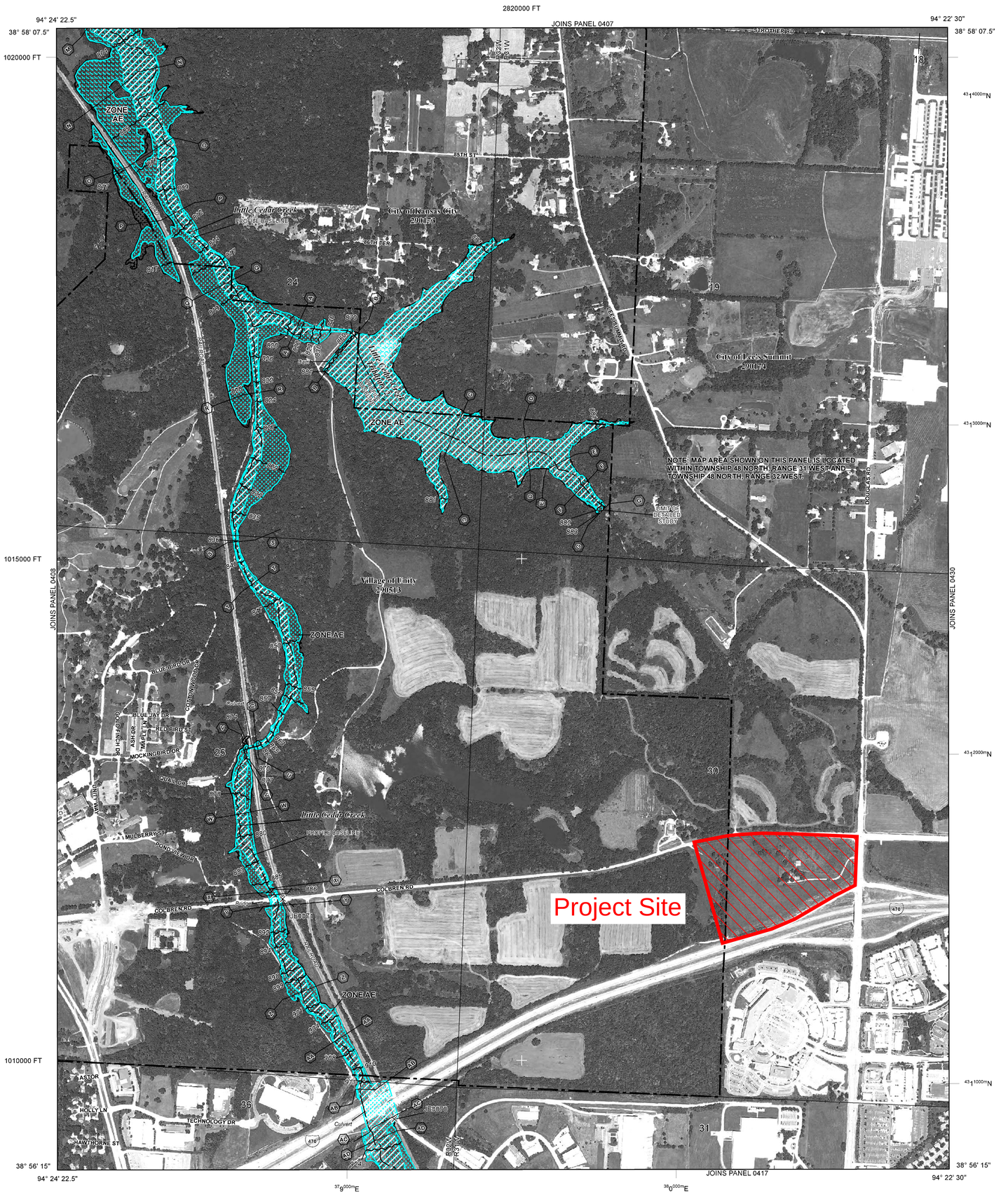
The **profile baselines** depicted on this map represent the hydraulic modeling baselines that match the flood profiles in the FIS report. As a result of improved topographic data, the **profile baseline**, in some cases, may deviate significantly from the channel centerline or appear outside the SFHA.

Based on updated topographic information, this map reflects more detailed and up-to-date **stream channel configurations and floodplain delineations** than those shown on the previous FIRM for this jurisdiction. As a result, the Flood Profiles and Floodway Data tables for multiple streams in the Flood Insurance Study Report (which contains authoritative hydraulic data) may reflect stream channel distances that differ from what is shown on the map. Also, the road to floodplain relationships for unrevised streams may differ from what is shown on previous maps.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

For information on available products associated with this FIRM visit the **Map Service Center (MSC)** website at http://msc.fema.gov. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the MSC website.



LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A No Base Flood Elevations determined.

ZONE AE Base Flood Elevations determined.

ZONE AH Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.

ZONE AO Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.

ZONE AR Special Flood Hazard Areas formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.

ZONE A99 Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.

ZONE V Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.

ZONE VE Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X Areas determined to be outside the 0.2% annual chance floodplain.

ZONE D Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

- 1% Annual Chance Floodplain Boundary
- 0.2% Annual Chance Floodplain Boundary
- Floodway boundary
- Zone D boundary
- CBRS and OPA boundary
- Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths, or flood velocities.
- 513 — Base Flood Elevation line and value; elevation in feet*
- (EL 987) — Base Flood Elevation value where uniform within zone; elevation in feet*

*Referenced to the North American Vertical Datum of 1988

- A — A — Cross section line
- 23 — 23 — Transect line
- Culvert
- Bridge
- 45° 02' 08", 93° 02' 12" — Geographic coordinates referenced to the North American Datum of 1983 (NAD 83) Western Hemisphere
- 3100000 FT — 5000-foot ticks: Missouri State Plane West Zone (FIPS Zone 2403), Transverse Mercator projection
- DX5510 — Bench mark (see explanation in Notes to Users section of this FIRM panel)
- M1.5 — River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP
September 29, 2006

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL
January 20, 2017 - to change Special Flood Hazard Areas.

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 500'

250 0 500 1000 FEET
150 0 150 300 METERS

NFIP
NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0409G

FIRM

FLOOD INSURANCE RATE MAP

JACKSON COUNTY, MISSOURI
AND INCORPORATED AREAS

PANEL 409 OF 625
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
KANSAS CITY, CITY OF	290173	0409	G
LEE'S SUMMIT, CITY OF	290174	0409	G
UNITY, VILLAGE OF	290513	0409	G

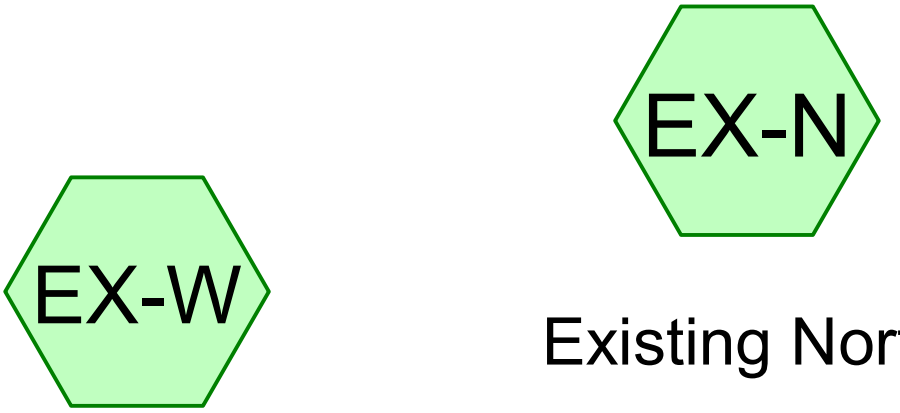
Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
29095C0409G
MAP REVISED
JANUARY 20, 2017

Federal Emergency Management Agency

HydroCAD Report

Engineering beyond.™



Subcat Reach Pond Link

Routing Diagram for Discovery Crossing Existing
Prepared by OWN Inc, Printed 6/18/2024
HydroCAD® 10.20-5a s/n 09171 © 2023 HydroCAD Software Solutions LLC

Rainfall Events Listing (selected events)

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	2-Year	Type II 24-hr		Default	24.00	1	3.50	2
2	10-Year	Type II 24-hr		Default	24.00	1	5.34	2
3	100-Year	Type II 24-hr		Default	24.00	1	7.71	2

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment EX-N: Existing North Runoff Area=13.450 ac 0.00% Impervious Runoff Depth>1.72"
Tc=6.4 min CN=83 Runoff=42.80 cfs 1.923 af

Subcatchment EX-W: Existing West Runoff Area=9.318 ac 0.00% Impervious Runoff Depth>1.43"
Flow Length=900' Slope=0.0200 '/' Tc=10.3 min CN=79 Runoff=21.83 cfs 1.112 af

Total Runoff Area = 22.768 ac Runoff Volume = 3.034 af Average Runoff Depth = 1.60"
100.00% Pervious = 22.768 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment EX-N: Existing North

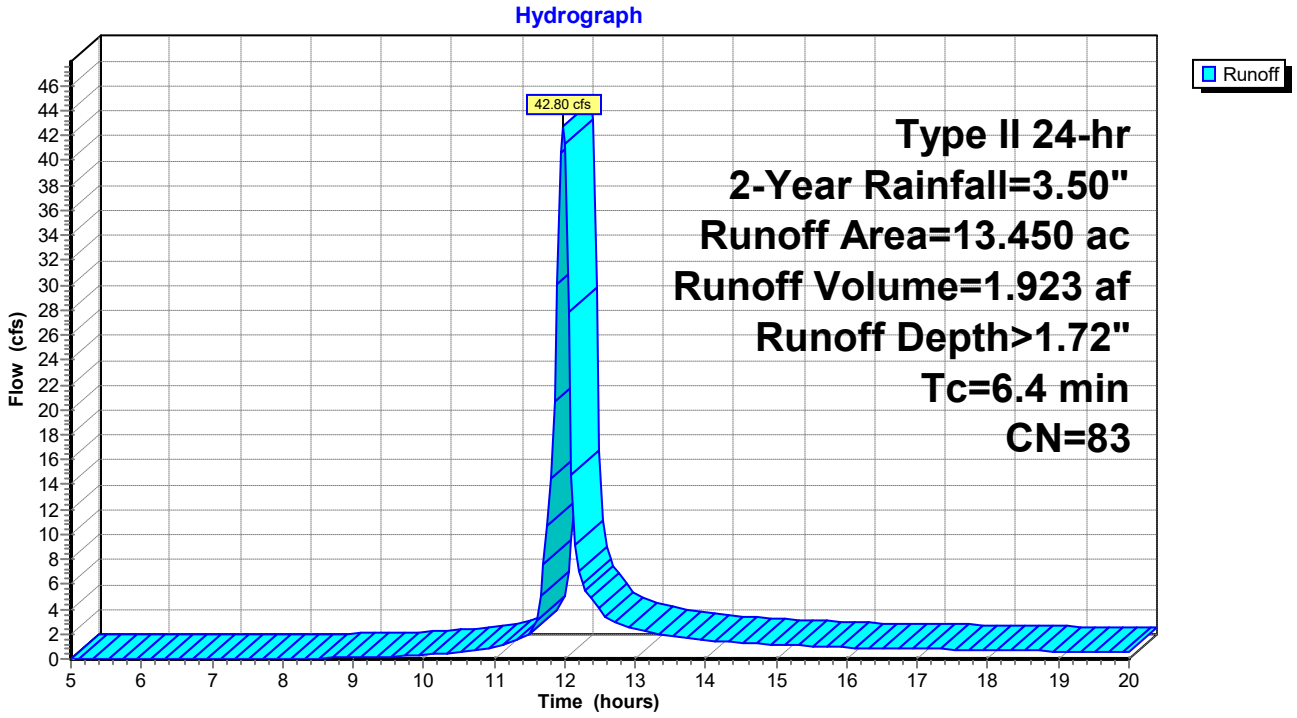
Runoff = 42.80 cfs @ 11.98 hrs, Volume= 1.923 af, Depth> 1.72"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-Year Rainfall=3.50"

	Area (ac)	CN	Description
*	13.450	83	
	13.450		100.00% Pervious Area

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

Subcatchment EX-N: Existing North



Summary for Subcatchment EX-W: Existing West

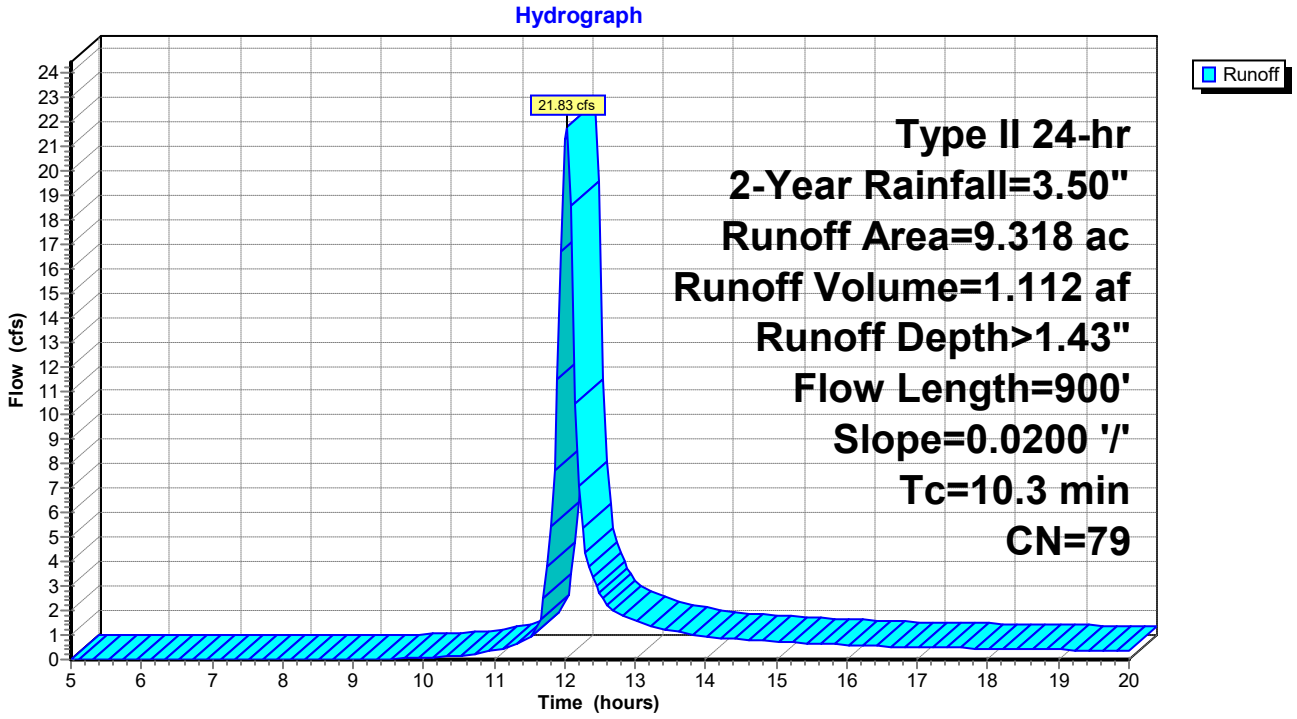
Runoff = 21.83 cfs @ 12.02 hrs, Volume= 1.112 af, Depth> 1.43"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-Year Rainfall=3.50"

	Area (ac)	CN	Description
*	9.318	79	
	9.318		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.4	100	0.0200	0.20		**Sheet Flow,** Range n= 0.130 P2= 3.50"
1.9	800		7.00		**Direct Entry,**
10.3	900	Total			

Subcatchment EX-W: Existing West



Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment EX-N: Existing North Runoff Area=13.450 ac 0.00% Impervious Runoff Depth>3.25"
Tc=6.4 min CN=83 Runoff=77.55 cfs 3.637 af

Subcatchment EX-W: Existing West Runoff Area=9.318 ac 0.00% Impervious Runoff Depth>2.87"
Flow Length=900' Slope=0.0200 '/' Tc=10.3 min CN=79 Runoff=42.99 cfs 2.225 af

Total Runoff Area = 22.768 ac Runoff Volume = 5.863 af Average Runoff Depth = 3.09"
100.00% Pervious = 22.768 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment EX-N: Existing North

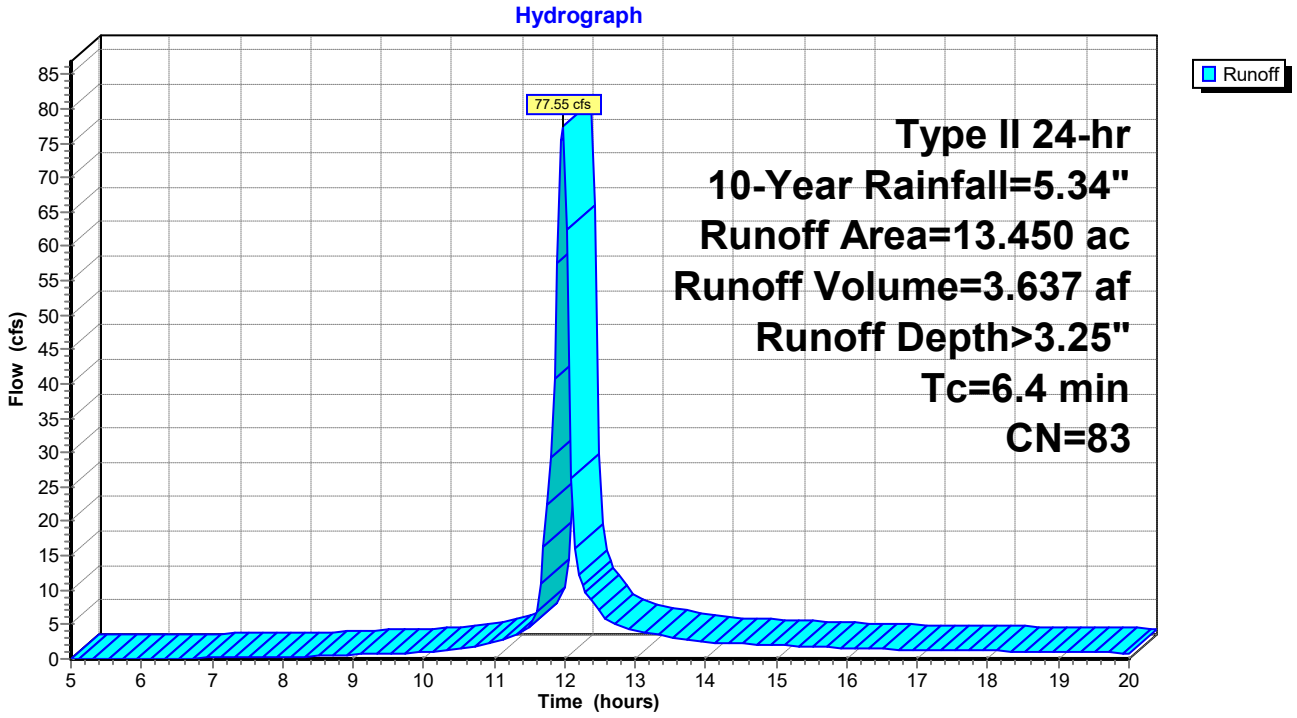
Runoff = 77.55 cfs @ 11.97 hrs, Volume= 3.637 af, Depth> 3.25"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-Year Rainfall=5.34"

	Area (ac)	CN	Description
*	13.450	83	
	13.450		100.00% Pervious Area

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

Subcatchment EX-N: Existing North



Summary for Subcatchment EX-W: Existing West

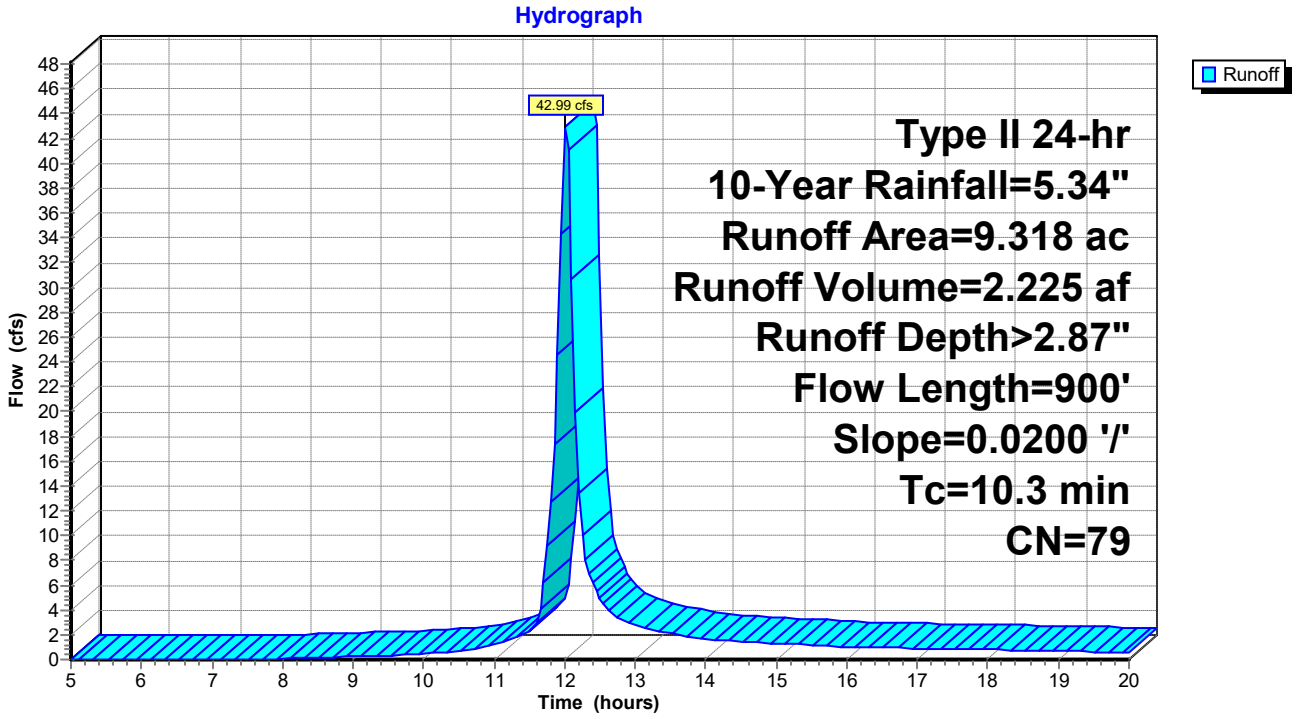
Runoff = 42.99 cfs @ 12.02 hrs, Volume= 2.225 af, Depth> 2.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-Year Rainfall=5.34"

	Area (ac)	CN	Description
*	9.318	79	
	9.318		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.4	100	0.0200	0.20		**Sheet Flow,** Range n= 0.130 P2= 3.50"
1.9	800		7.00		**Direct Entry,**
10.3	900	Total			

Subcatchment EX-W: Existing West



Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment EX-N: Existing North Runoff Area=13.450 ac 0.00% Impervious Runoff Depth>5.34"
Tc=6.4 min CN=83 Runoff=123.66 cfs 5.986 af

Subcatchment EX-W: Existing West Runoff Area=9.318 ac 0.00% Impervious Runoff Depth>4.88"
Flow Length=900' Slope=0.0200 '/' Tc=10.3 min CN=79 Runoff=71.48 cfs 3.792 af

Total Runoff Area = 22.768 ac Runoff Volume = 9.778 af Average Runoff Depth = 5.15"
100.00% Pervious = 22.768 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment EX-N: Existing North

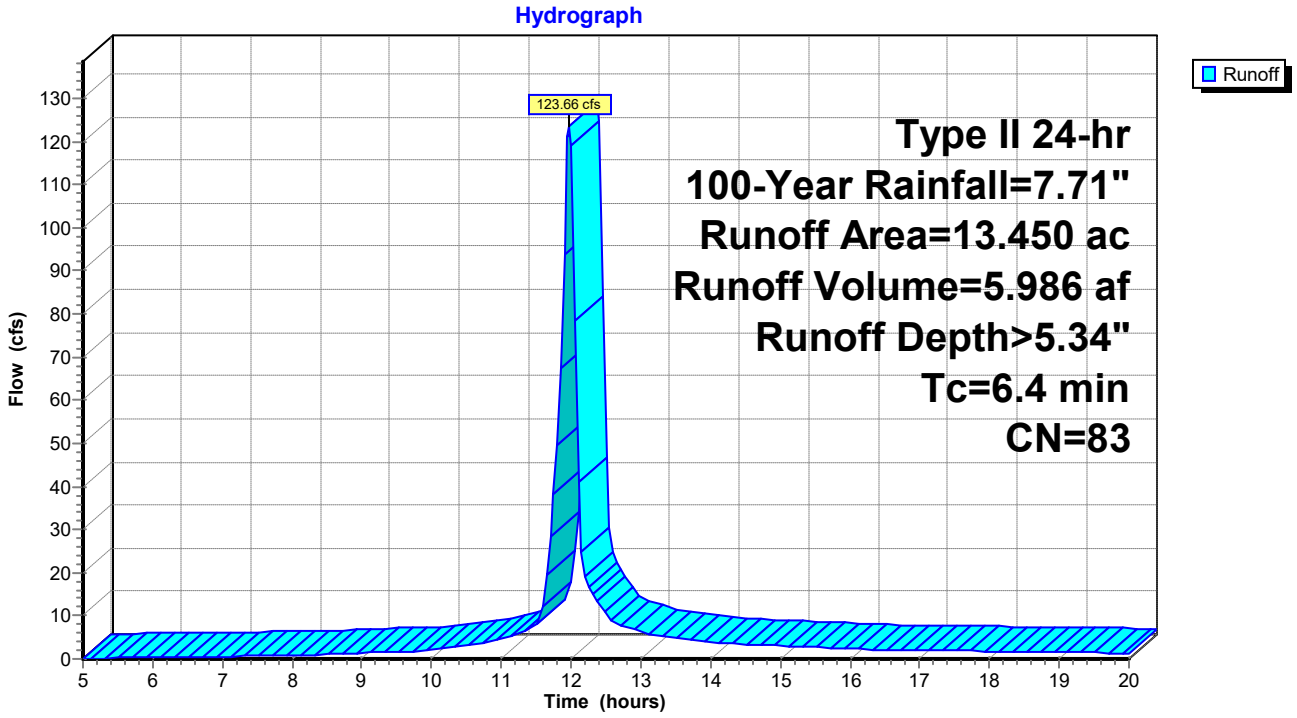
Runoff = 123.66 cfs @ 11.97 hrs, Volume= 5.986 af, Depth> 5.34"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-Year Rainfall=7.71"

	Area (ac)	CN	Description
*	13.450	83	
	13.450		100.00% Pervious Area

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

Subcatchment EX-N: Existing North



Summary for Subcatchment EX-W: Existing West

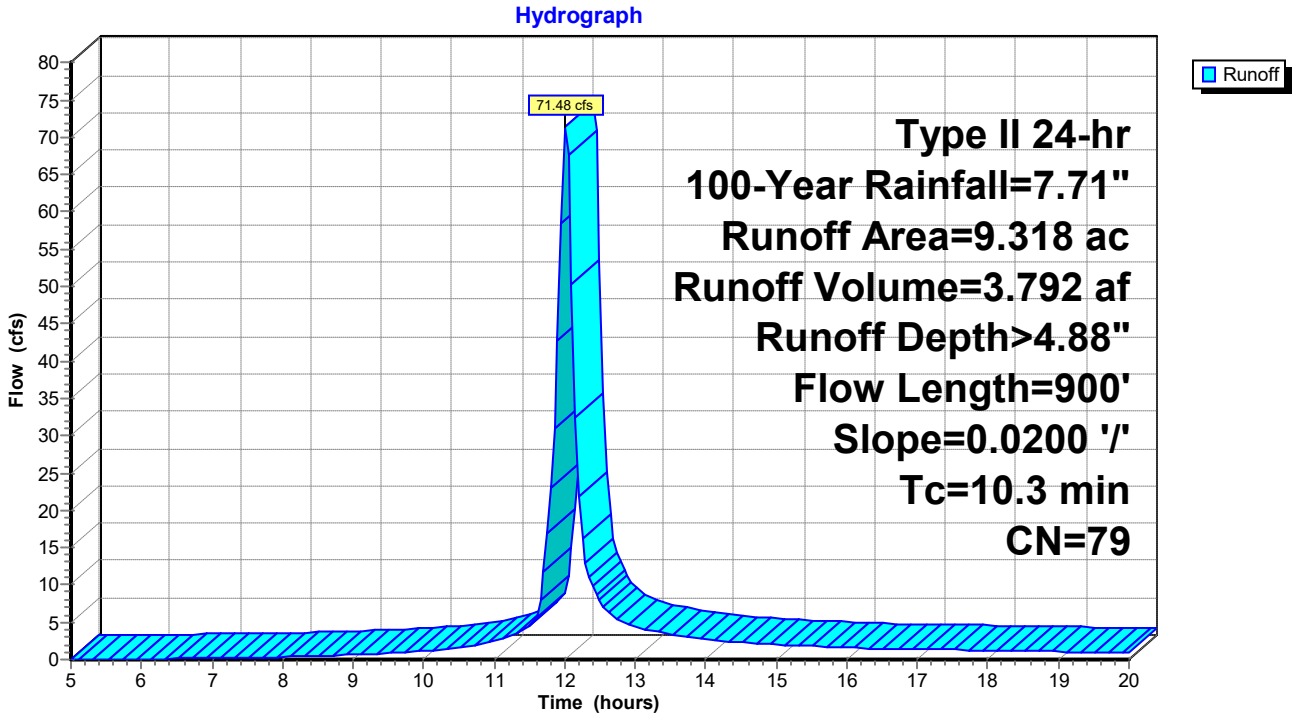
Runoff = 71.48 cfs @ 12.02 hrs, Volume= 3.792 af, Depth> 4.88"

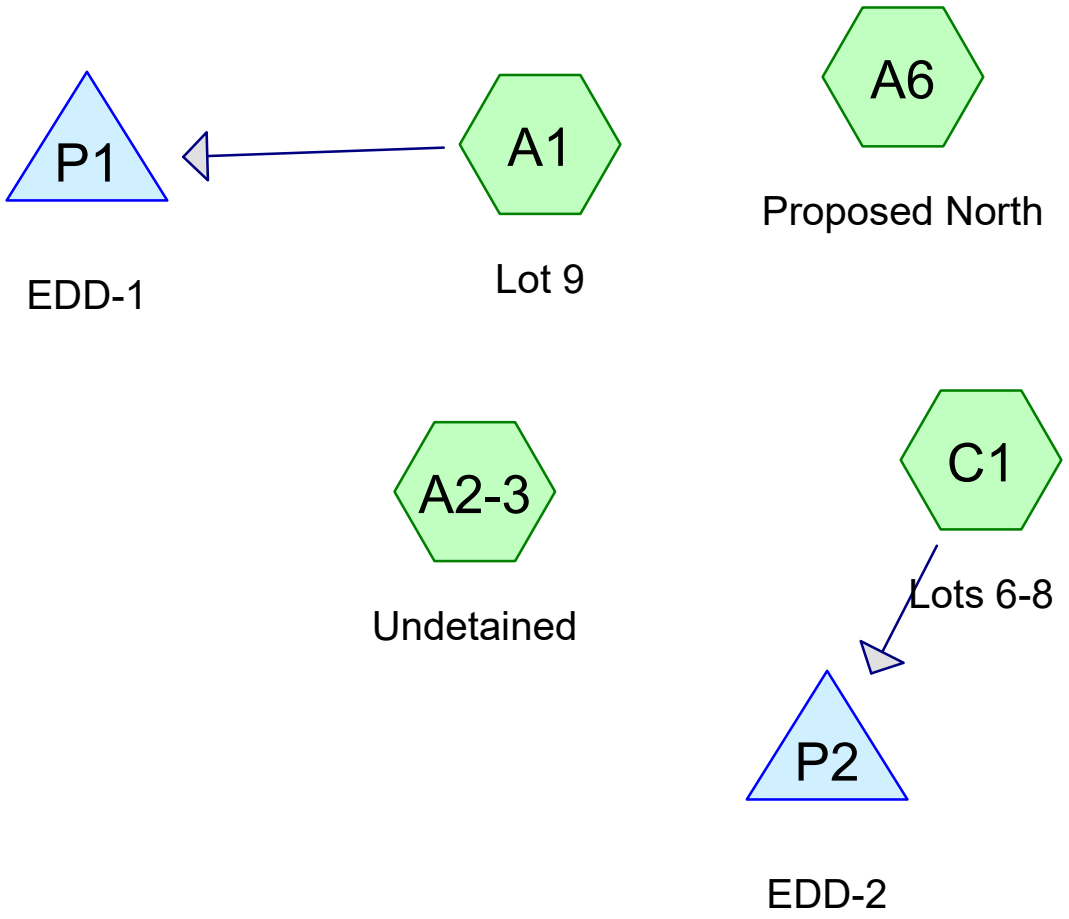
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-Year Rainfall=7.71"

	Area (ac)	CN	Description
*	9.318	79	
	9.318		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.4	100	0.0200	0.20		**Sheet Flow,** Range n= 0.130 P2= 3.50"
1.9	800		7.00		**Direct Entry,**
10.3	900	Total			

Subcatchment EX-W: Existing West





Subcat Reach Pond Link

Routing Diagram for Discovery Park Crossing
Prepared by OWN Inc, Printed 6/18/2024
HydroCAD® 10.20-5a s/n 09171 © 2023 HydroCAD Software Solutions LLC

Rainfall Events Listing (selected events)

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	2-Year	Type II 24-hr		Default	24.00	1	3.50	2
2	10-Year	Type II 24-hr		Default	24.00	1	5.34	2
3	100-Year	Type II 24-hr		Default	24.00	1	7.71	2

Time span=0.00-48.00 hrs, dt=0.05 hrs, 961 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment A1: Lot 9 Runoff Area=2.288 ac 0.00% Impervious Runoff Depth=2.84"
Tc=6.0 min CN=94 Runoff=10.31 cfs 0.541 af

Subcatchment A2-3: Undetained Runoff Area=0.633 ac 0.00% Impervious Runoff Depth=2.84"
Tc=6.0 min CN=94 Runoff=2.85 cfs 0.150 af

Subcatchment A6: Proposed North Runoff Area=14.150 ac 0.00% Impervious Runoff Depth=2.84"
Tc=6.0 min CN=94 Runoff=63.79 cfs 3.344 af

Subcatchment C1: Lots 6-8 Runoff Area=6.411 ac 0.00% Impervious Runoff Depth=2.84"
Tc=6.0 min CN=94 Runoff=28.90 cfs 1.515 af

Pond P1: EDD-1 Peak Elev=964.77' Storage=13,711 cf Inflow=10.31 cfs 0.541 af
Outflow=0.99 cfs 0.404 af

Pond P2: EDD-2 Peak Elev=969.69' Storage=39,199 cf Inflow=28.90 cfs 1.515 af
Outflow=2.92 cfs 1.069 af

Total Runoff Area = 23.482 ac Runoff Volume = 5.549 af Average Runoff Depth = 2.84"
100.00% Pervious = 23.482 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment A1: Lot 9

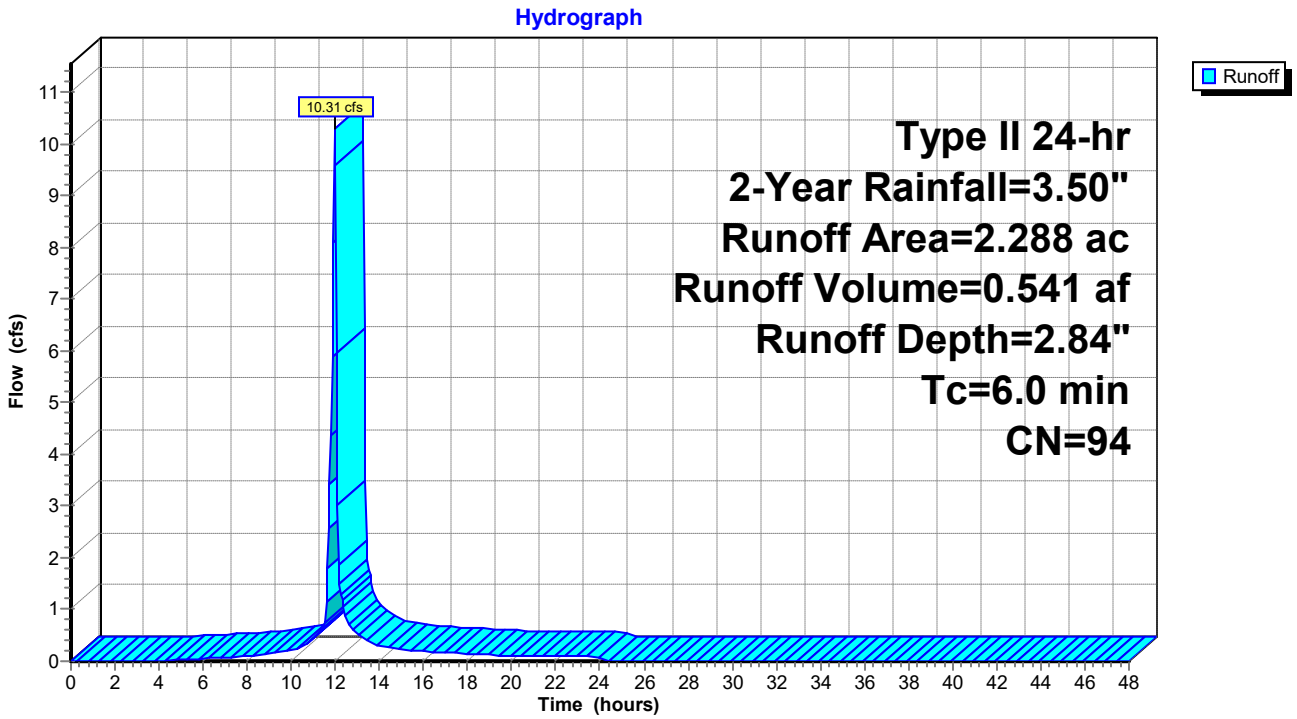
Runoff = 10.31 cfs @ 11.96 hrs, Volume= 0.541 af, Depth= 2.84"
Routed to Pond P1 : EDD-1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-Year Rainfall=3.50"

	Area (ac)	CN	Description
*	2.288	94	
	2.288		100.00% Pervious Area

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

Subcatchment A1: Lot 9



Summary for Subcatchment A2-3: Undetained

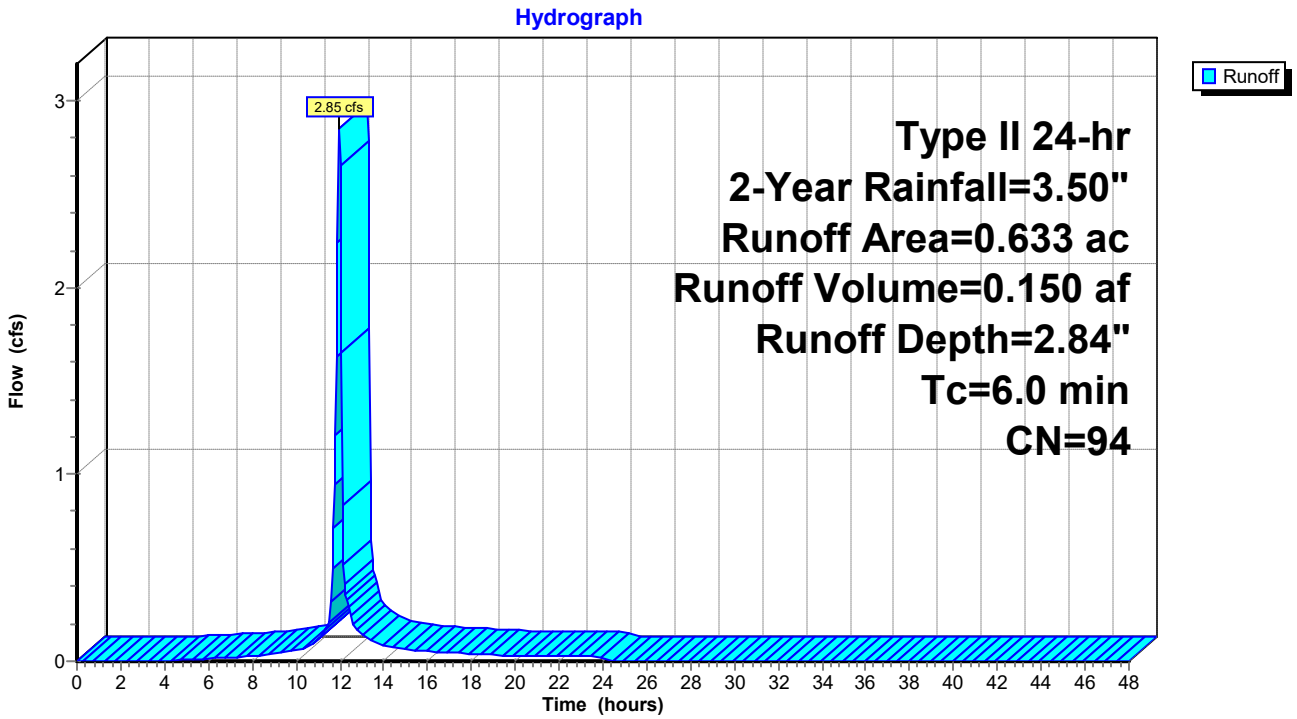
Runoff = 2.85 cfs @ 11.96 hrs, Volume= 0.150 af, Depth= 2.84"
Routed to nonexistent node 1L

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-Year Rainfall=3.50"

	Area (ac)	CN	Description
*	0.633	94	
	0.633		100.00% Pervious Area

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

Subcatchment A2-3: Undetained



Summary for Subcatchment A6: Proposed North

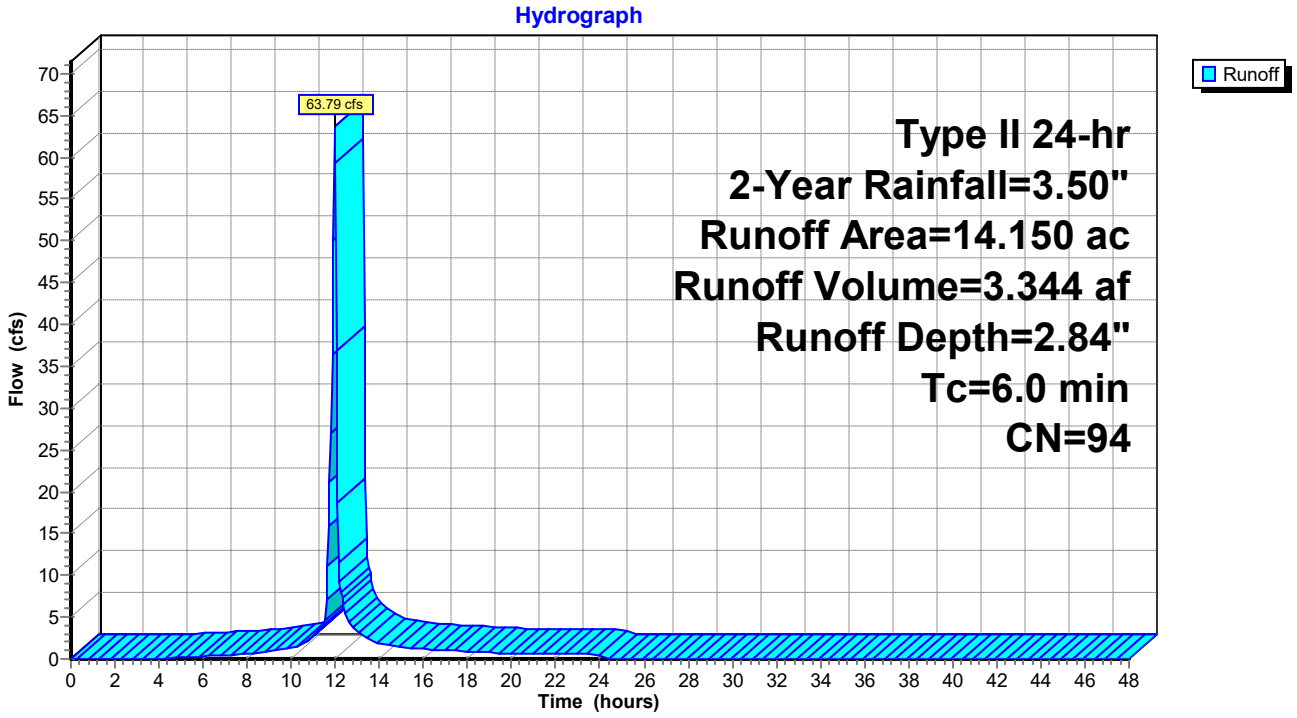
Runoff = 63.79 cfs @ 11.96 hrs, Volume= 3.344 af, Depth= 2.84"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-Year Rainfall=3.50"

	Area (ac)	CN	Description
*	14.150	94	
	14.150		100.00% Pervious Area

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

Subcatchment A6: Proposed North



Summary for Subcatchment C1: Lots 6-8

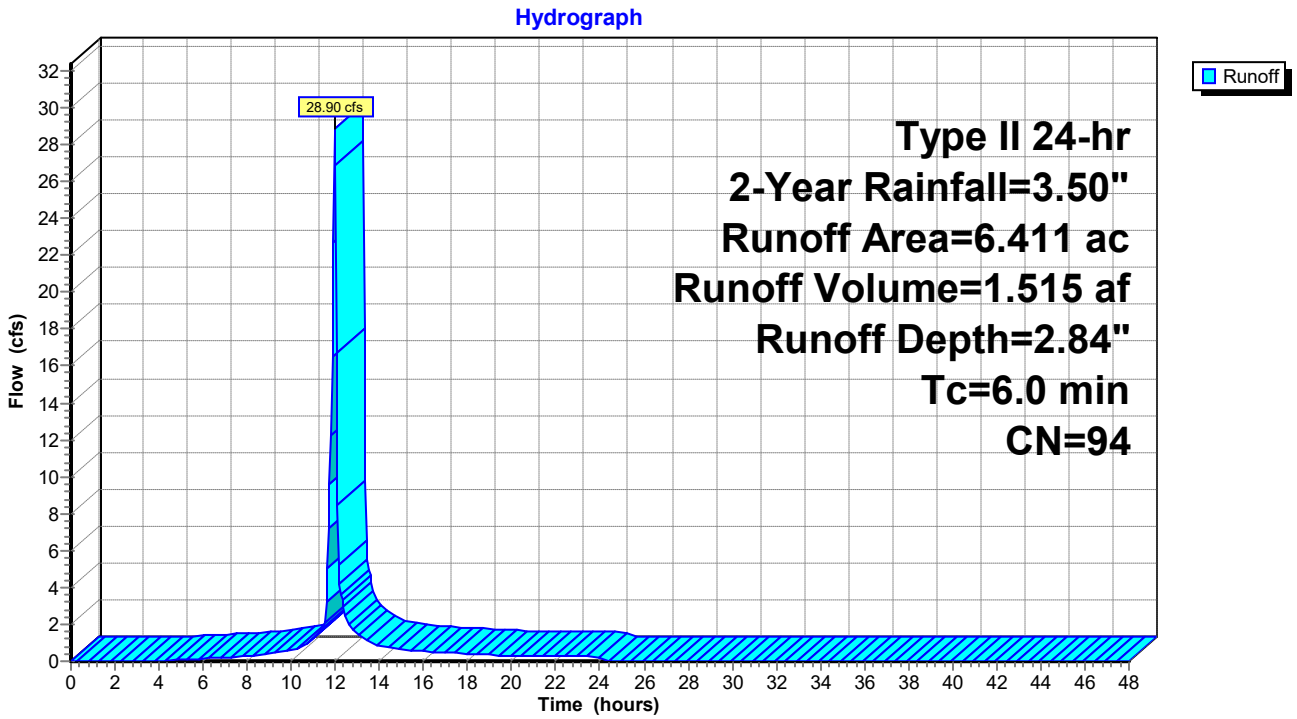
Runoff = 28.90 cfs @ 11.96 hrs, Volume= 1.515 af, Depth= 2.84"
Routed to Pond P2 : EDD-2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-Year Rainfall=3.50"

	Area (ac)	CN	Description
*	6.411	94	
	6.411		100.00% Pervious Area

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

Subcatchment C1: Lots 6-8



Summary for Pond P1: EDD-1

Inflow Area = 2.288 ac, 0.00% Impervious, Inflow Depth = 2.84" for 2-Year event
Inflow = 10.31 cfs @ 11.96 hrs, Volume= 0.541 af
Outflow = 0.99 cfs @ 12.41 hrs, Volume= 0.404 af, Atten= 90%, Lag= 26.8 min
Primary = 0.99 cfs @ 12.41 hrs, Volume= 0.404 af
Routed to nonexistent node 1L

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Starting Elev= 928.00' Storage= 0 cf
Peak Elev= 964.77' @ 12.41 hrs Surf.Area= 5,720 sf Storage= 13,711 cf

Plug-Flow detention time= 661.0 min calculated for 0.404 af (75% of inflow)
Center-of-Mass det. time= 571.8 min (1,352.7 - 780.9)

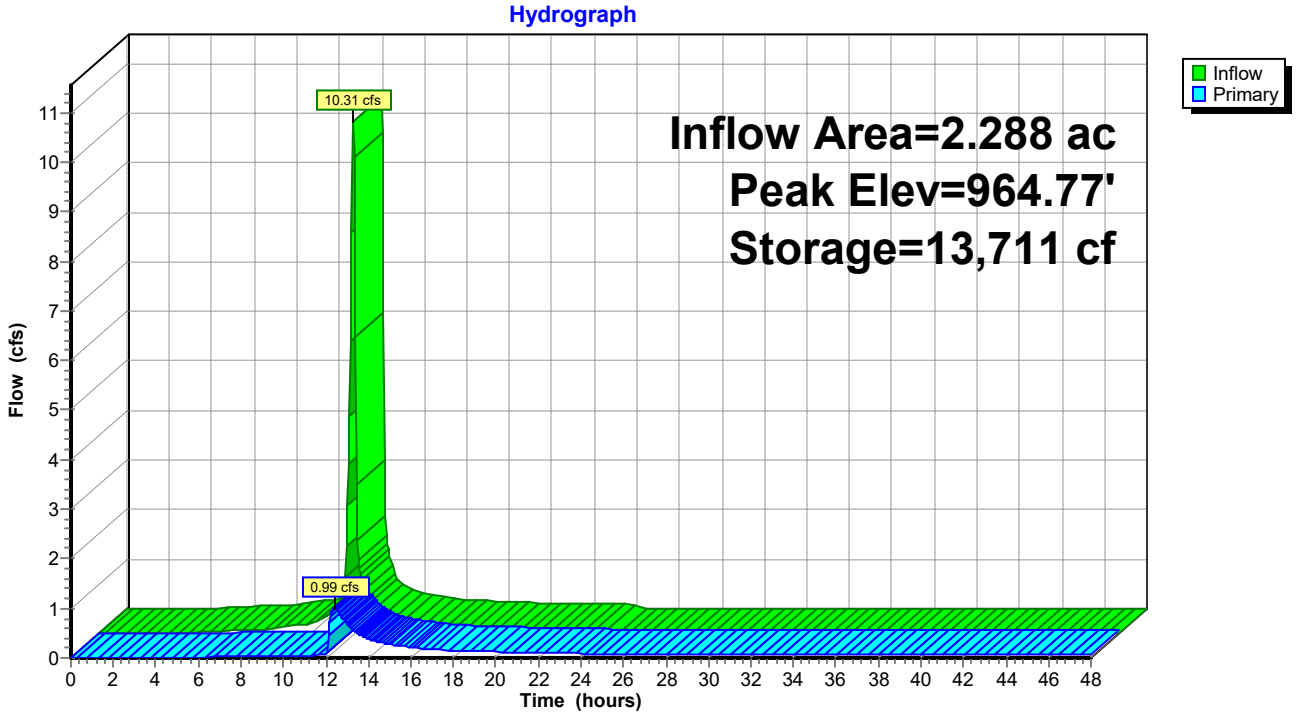
Volume	Invert	Avail.Storage	Storage Description
#1	960.00'	30,108 cf	**Custom Stage Data (Conic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
960.00	745	0	0	745
961.00	1,422	1,065	1,065	1,432
962.00	2,297	1,842	2,908	2,320
963.00	3,373	2,818	5,725	3,412
964.00	4,648	3,994	9,719	4,707
965.00	6,059	5,338	15,057	6,141
966.00	7,514	6,773	21,830	7,625
967.00	9,065	8,277	30,108	9,209

Device	Routing	Invert	Outlet Devices
#1	Primary	960.00'	**15.0" Round Culvert** L= 100.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 960.00' / 958.50' S= 0.0150 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.23 sf
#2	Device 1	960.00'	**9.5" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 2	960.00'	**1.2" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Device 2	964.50'	**24.0" W x 5.0" H Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#5	Device 2	965.75'	**60.0" x 60.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.99 cfs @ 12.41 hrs HW=964.77' (Free Discharge)
- **1=Culvert** (Passes 0.99 cfs of 11.27 cfs potential flow)
  - **2=Orifice/Grate** (Passes 0.99 cfs of 4.96 cfs potential flow)
    - **3=Orifice/Grate** (Orifice Controls 0.08 cfs @ 10.46 fps)
    - **4=Orifice/Grate** (Orifice Controls 0.91 cfs @ 1.67 fps)
    - **5=Orifice/Grate** (Controls 0.00 cfs)

Pond P1: EDD-1


Hydrograph
Inflow
Primary
10.31 cfs
0.99 cfs
Inflow Area=2.288 ac
Peak Elev=964.77'
Storage=13,711 cf
Flow (cfs)
Time (hours)
0 1 2 3 4 5 6 7 8 9 10 11
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48

Stage-Area-Storage for Pond P1: EDD-1

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
960.00	745	0
960.10	803	77
960.20	863	161
960.30	925	250
960.40	990	346
960.50	1,056	448
960.60	1,125	557
960.70	1,196	673
960.80	1,269	796
960.90	1,345	927
961.00	1,422	1,065
961.10	1,500	1,212
961.20	1,580	1,366
961.30	1,663	1,528
961.40	1,747	1,698
961.50	1,833	1,877
961.60	1,922	2,065
961.70	2,013	2,262
961.80	2,105	2,467
961.90	2,200	2,683
962.00	2,297	2,908
962.10	2,395	3,142
962.20	2,496	3,387
962.30	2,598	3,641
962.40	2,703	3,906
962.50	2,809	4,182
962.60	2,918	4,468
962.70	3,029	4,766
962.80	3,141	5,074
962.90	3,256	5,394
963.00	3,373	5,725
963.10	3,491	6,069
963.20	3,612	6,424
963.30	3,734	6,791
963.40	3,859	7,171
963.50	3,985	7,563
963.60	4,114	7,968
963.70	4,244	8,385
963.80	4,377	8,817
963.90	4,511	9,261
964.00	4,648	9,719
964.10	4,781	10,190
964.20	4,915	10,675
964.30	5,052	11,173
964.40	5,190	11,685
964.50	5,330	12,211
964.60	5,472	12,752
964.70	5,616	13,306
964.80	5,762	13,875
964.90	5,909	14,458
965.00	6,059	15,057
965.10	6,197	15,670
965.20	6,337	16,296
965.30	6,479	16,937
965.40	6,622	17,592
965.50	6,767	18,262
965.60	6,913	18,946
965.70	7,061	19,644
965.80	7,210	20,358
965.90	7,361	21,086
966.00	7,514	21,830
966.10	7,663	22,589
966.20	7,813	23,363
966.30	7,964	24,152
966.40	8,117	24,956
966.50	8,271	25,775
966.60	8,427	26,610
966.70	8,584	27,461
966.80	8,743	28,327
966.90	8,903	29,209
967.00	**9,065**	**30,108**

Summary for Pond P2: EDD-2

Inflow Area = 6.411 ac, 0.00% Impervious, Inflow Depth = 2.84" for 2-Year event
Inflow = 28.90 cfs @ 11.96 hrs, Volume= 1.515 af
Outflow = 2.92 cfs @ 12.38 hrs, Volume= 1.069 af, Atten= 90%, Lag= 25.2 min
Primary = 2.92 cfs @ 12.38 hrs, Volume= 1.069 af
Routed to nonexistent node 1L

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 969.69' @ 12.38 hrs Surf.Area= 9,433 sf Storage= 39,199 cf

Plug-Flow detention time= 658.3 min calculated for 1.068 af (70% of inflow)
Center-of-Mass det. time= 565.0 min (1,345.9 - 780.9)

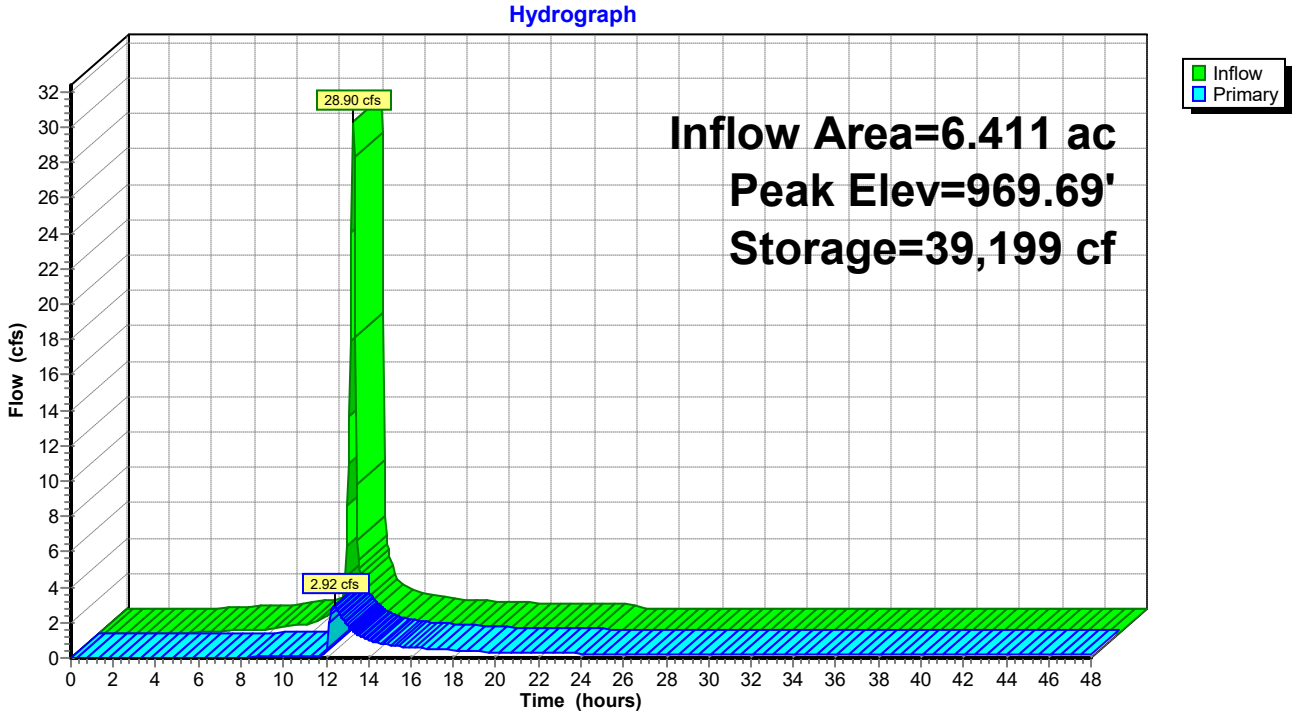
Volume	Invert	Avail.Storage	Storage Description
#1	965.00'	84,469 cf	**Custom Stage Data (Conic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
965.00	7,341	0	0	7,341
966.00	7,765	7,552	7,552	7,865
967.00	8,202	7,983	15,535	8,405
968.00	8,651	8,426	23,960	8,959
969.00	9,111	8,880	32,840	9,528
970.00	9,583	9,346	42,186	10,111
971.00	10,067	9,824	52,010	10,709
972.00	10,563	10,314	62,324	11,322
973.00	11,070	10,816	73,140	11,949
974.00	11,590	11,329	84,469	12,591

Device	Routing	Invert	Outlet Devices
#1	Primary	965.00'	**18.0" Round Culvert** L= 280.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 965.00' / 962.20' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf
#2	Device 1	965.00'	**2.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	969.30'	**42.0" W x 6.0" H Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Device 1	971.50'	**72.0" x 72.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=2.91 cfs @ 12.38 hrs HW=969.69' (Free Discharge)
└**1=Culvert** (Passes 2.91 cfs of 13.48 cfs potential flow)
  ├**2=Orifice/Grate** (Orifice Controls 0.23 cfs @ 10.33 fps)
  ├**3=Orifice/Grate** (Orifice Controls 2.69 cfs @ 1.99 fps)
  └**4=Orifice/Grate** (Controls 0.00 cfs)

Pond P2: EDD-2


Hydrograph
Inflow
Primary
28.90 cfs
2.92 cfs
Inflow Area=6.411 ac
Peak Elev=969.69'
Storage=39,199 cf
Flow (cfs)
Time (hours)
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32

Stage-Area-Storage for Pond P2: EDD-2

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
965.00	7,341	0
965.10	7,383	736
965.20	7,425	1,477
965.30	7,467	2,221
965.40	7,509	2,970
965.50	7,552	3,723
965.60	7,594	4,480
965.70	7,637	5,242
965.80	7,679	6,008
965.90	7,722	6,778
966.00	7,765	7,552
966.10	7,808	8,331
966.20	7,851	9,114
966.30	7,895	9,901
966.40	7,938	10,693
966.50	7,982	11,489
966.60	8,026	12,289
966.70	8,070	13,094
966.80	8,114	13,903
966.90	8,158	14,717
967.00	8,202	15,535
967.10	8,246	16,357
967.20	8,291	17,184
967.30	8,335	18,015
967.40	8,380	18,851
967.50	8,425	19,691
967.60	8,470	20,536
967.70	8,515	21,385
967.80	8,560	22,239
967.90	8,606	23,097
968.00	8,651	23,960
968.10	8,696	24,827
968.20	8,742	25,699
968.30	8,788	26,576
968.40	8,834	27,457
968.50	8,880	28,343
968.60	8,926	29,233
968.70	8,972	30,128
968.80	9,018	31,027
968.90	9,064	31,931
969.00	9,111	32,840
969.10	9,158	33,753
969.20	9,204	34,672
969.30	9,251	35,594
969.40	9,298	36,522
969.50	9,346	37,454
969.60	9,393	38,391
969.70	9,440	39,333
969.80	9,488	40,279
969.90	9,535	41,230
970.00	9,583	42,186
970.10	9,631	43,147
970.20	9,679	44,112
970.30	9,727	45,082
970.40	9,775	46,058
970.50	9,824	47,038
970.60	9,872	48,022
970.70	9,921	49,012
970.80	9,969	50,006
970.90	10,018	51,006
971.00	10,067	52,010
971.10	10,116	53,019
971.20	10,165	54,033
971.30	10,215	55,052
971.40	10,264	56,076
971.50	10,314	57,105
971.60	10,363	58,139
971.70	10,413	59,178
971.80	10,463	60,221
971.90	10,513	61,270
972.00	10,563	62,324
972.10	10,613	63,383
972.20	10,663	64,447
972.30	10,714	65,516
972.40	10,764	66,589
972.50	10,815	67,668
972.60	10,866	68,752
972.70	10,917	69,842
972.80	10,968	70,936
972.90	11,019	72,035
973.00	11,070	73,140
973.10	11,121	74,249
973.20	11,173	75,364
973.30	11,225	76,484
973.40	11,277	77,609
973.50	11,329	78,739
973.60	11,381	79,875
973.70	11,433	81,015
973.80	11,485	82,161
973.90	11,537	83,312
974.00	**11,590**	**84,469**

Time span=0.00-48.00 hrs, dt=0.05 hrs, 961 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment A1: Lot 9 Runoff Area=2.288 ac 0.00% Impervious Runoff Depth=4.64"
Tc=6.0 min CN=94 Runoff=16.37 cfs 0.885 af

Subcatchment A2-3: Undetained Runoff Area=0.633 ac 0.00% Impervious Runoff Depth=4.64"
Tc=6.0 min CN=94 Runoff=4.53 cfs 0.245 af

Subcatchment A6: Proposed North Runoff Area=14.150 ac 0.00% Impervious Runoff Depth=4.64"
Tc=6.0 min CN=94 Runoff=101.22 cfs 5.476 af

Subcatchment C1: Lots 6-8 Runoff Area=6.411 ac 0.00% Impervious Runoff Depth=4.64"
Tc=6.0 min CN=94 Runoff=45.86 cfs 2.481 af

Pond P1: EDD-1 Peak Elev=965.76' Storage=20,071 cf Inflow=16.37 cfs 0.885 af
Outflow=4.25 cfs 0.747 af

Pond P2: EDD-2 Peak Elev=971.50' Storage=57,128 cf Inflow=45.86 cfs 2.481 af
Outflow=12.03 cfs 2.031 af

Total Runoff Area = 23.482 ac Runoff Volume = 9.087 af Average Runoff Depth = 4.64"
100.00% Pervious = 23.482 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment A1: Lot 9

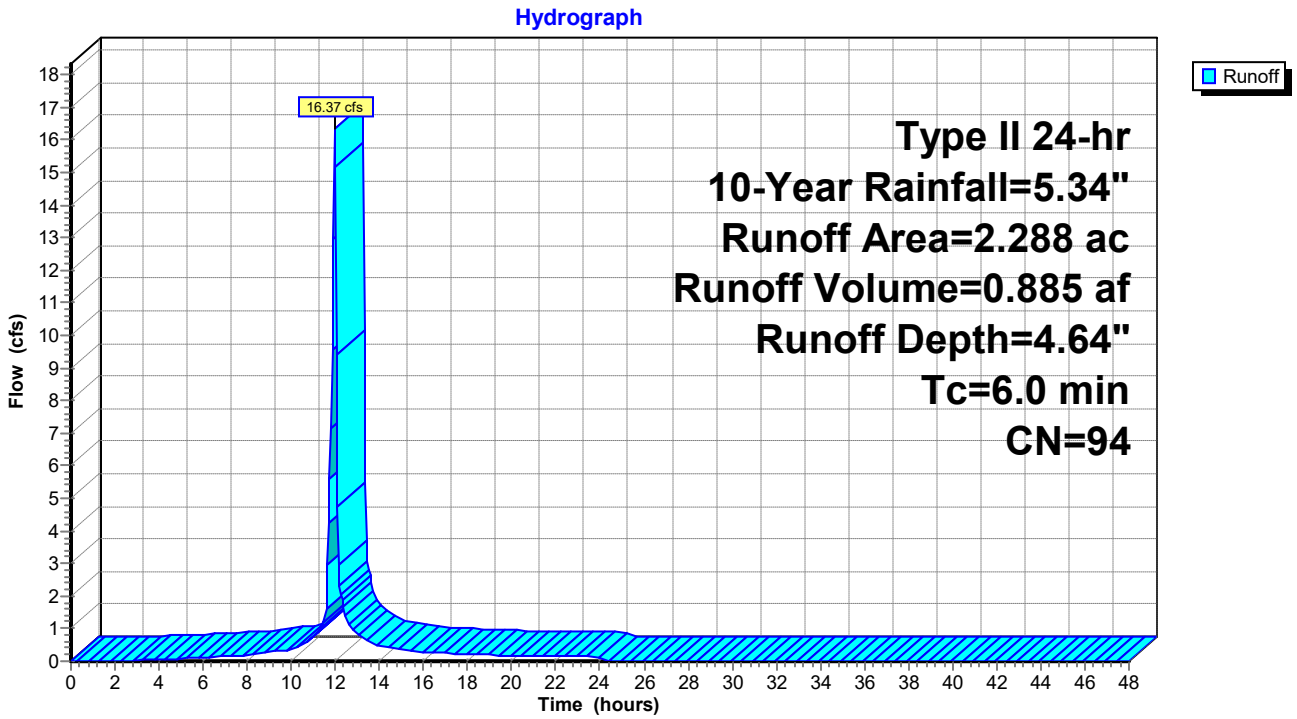
Runoff = 16.37 cfs @ 11.96 hrs, Volume= 0.885 af, Depth= 4.64"
Routed to Pond P1 : EDD-1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-Year Rainfall=5.34"

	Area (ac)	CN	Description
*	2.288	94	
	2.288		100.00% Pervious Area

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

Subcatchment A1: Lot 9



Summary for Subcatchment A2-3: Undetained

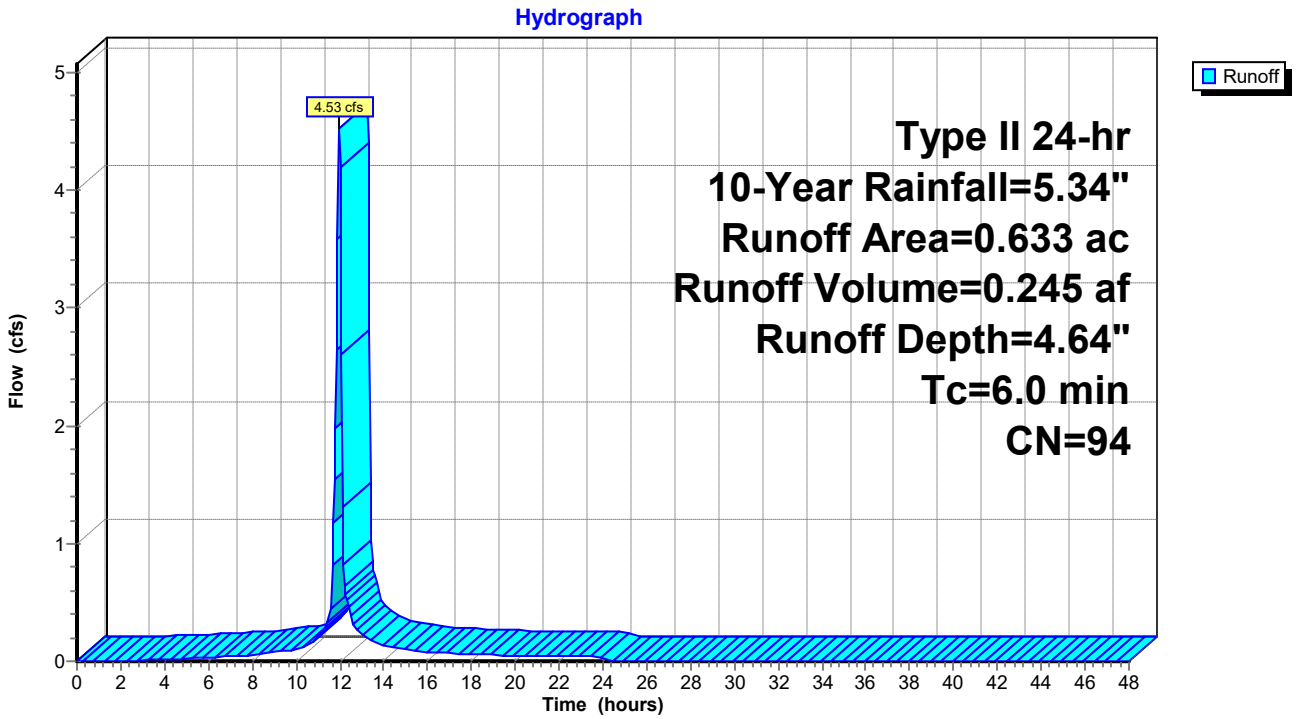
Runoff = 4.53 cfs @ 11.96 hrs, Volume= 0.245 af, Depth= 4.64"
Routed to nonexistent node 1L

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-Year Rainfall=5.34"

	Area (ac)	CN	Description
*	0.633	94	
	0.633		100.00% Pervious Area

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

Subcatchment A2-3: Undetained



Summary for Subcatchment A6: Proposed North

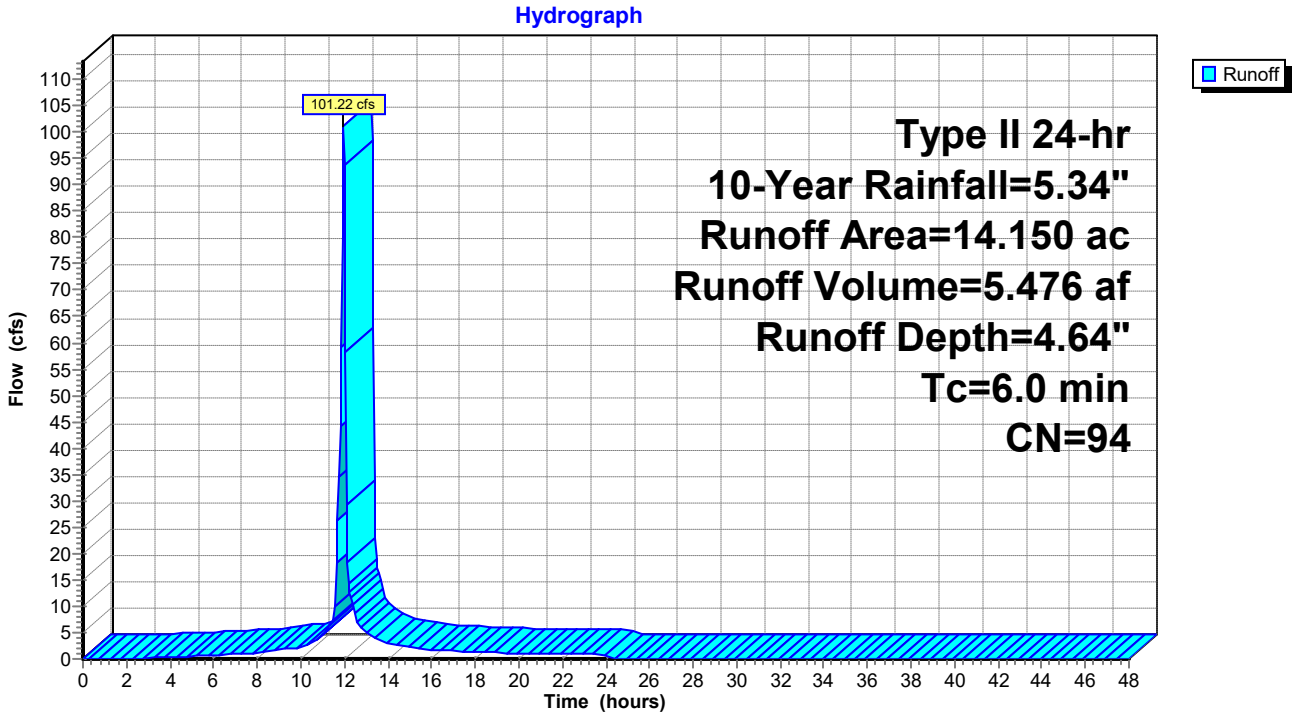
Runoff = 101.22 cfs @ 11.96 hrs, Volume= 5.476 af, Depth= 4.64"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-Year Rainfall=5.34"

	Area (ac)	CN	Description
*	14.150	94	
	14.150		100.00% Pervious Area

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

Subcatchment A6: Proposed North



Summary for Subcatchment C1: Lots 6-8

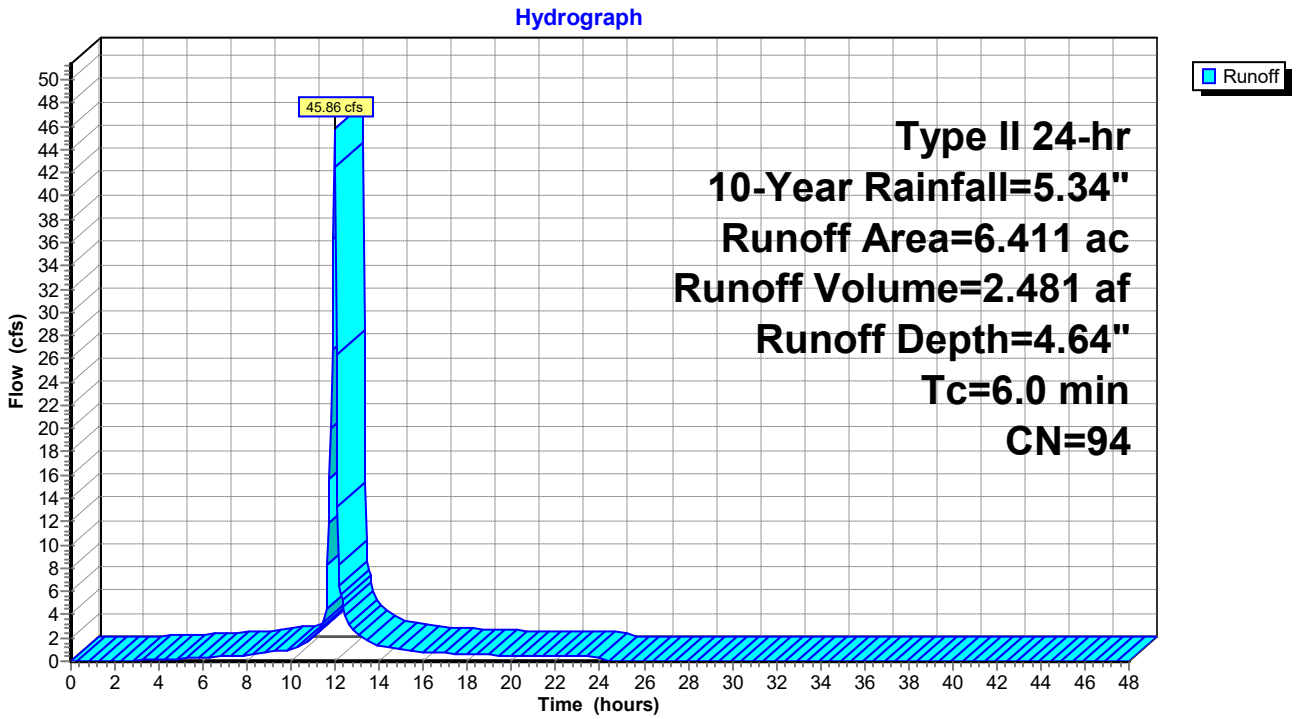
Runoff = 45.86 cfs @ 11.96 hrs, Volume= 2.481 af, Depth= 4.64"
Routed to Pond P2 : EDD-2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-Year Rainfall=5.34"

	Area (ac)	CN	Description
*	6.411	94	
	6.411		100.00% Pervious Area

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

Subcatchment C1: Lots 6-8



Summary for Pond P1: EDD-1

Inflow Area = 2.288 ac, 0.00% Impervious, Inflow Depth = 4.64" for 10-Year event
Inflow = 16.37 cfs @ 11.96 hrs, Volume= 0.885 af
Outflow = 4.25 cfs @ 12.11 hrs, Volume= 0.747 af, Atten= 74%, Lag= 8.9 min
Primary = 4.25 cfs @ 12.11 hrs, Volume= 0.747 af
Routed to nonexistent node 1L

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Starting Elev= 928.00' Storage= 0 cf
Peak Elev= 965.76' @ 12.12 hrs Surf.Area= 7,151 sf Storage= 20,071 cf

Plug-Flow detention time= 406.1 min calculated for 0.747 af (84% of inflow)
Center-of-Mass det. time= 336.4 min (1,104.5 - 768.1)

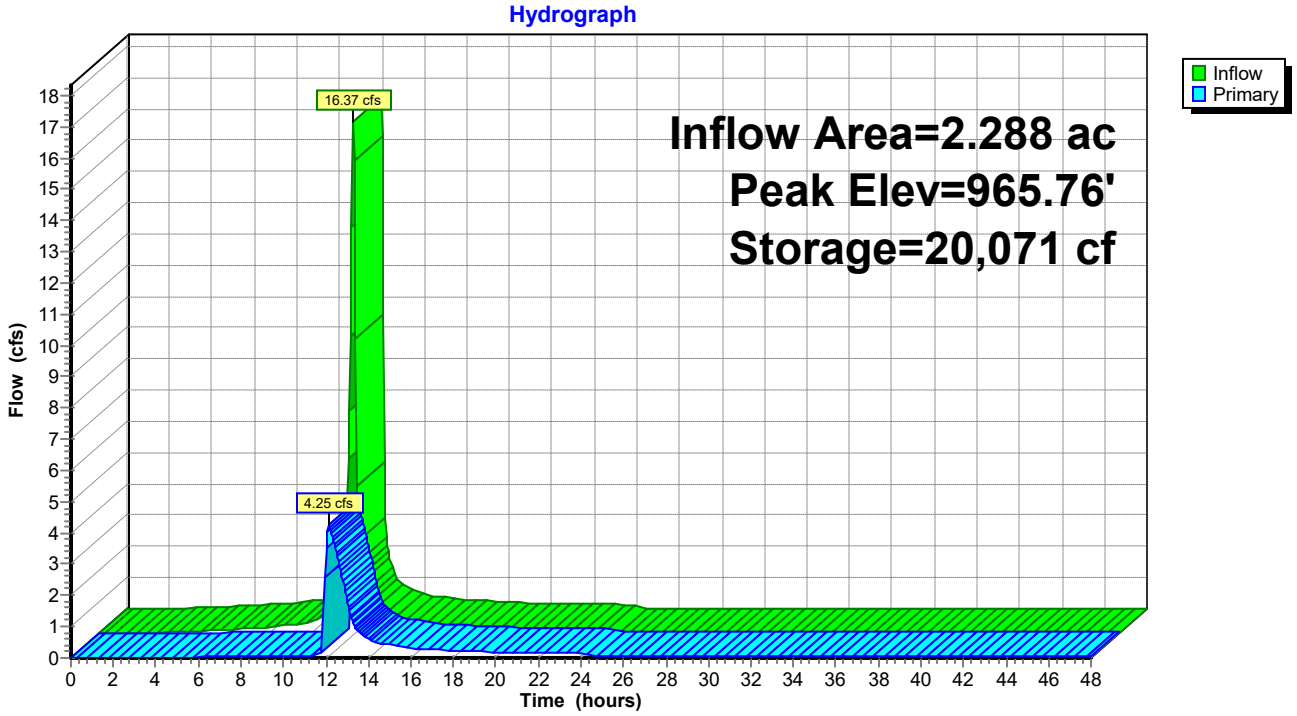
Volume	Invert	Avail.Storage	Storage Description
#1	960.00'	30,108 cf	**Custom Stage Data (Conic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
960.00	745	0	0	745
961.00	1,422	1,065	1,065	1,432
962.00	2,297	1,842	2,908	2,320
963.00	3,373	2,818	5,725	3,412
964.00	4,648	3,994	9,719	4,707
965.00	6,059	5,338	15,057	6,141
966.00	7,514	6,773	21,830	7,625
967.00	9,065	8,277	30,108	9,209

Device	Routing	Invert	Outlet Devices
#1	Primary	960.00'	**15.0" Round Culvert** L= 100.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 960.00' / 958.50' S= 0.0150 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.23 sf
#2	Device 1	960.00'	**9.5" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 2	960.00'	**1.2" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Device 2	964.50'	**24.0" W x 5.0" H Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#5	Device 2	965.75'	**60.0" x 60.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=4.19 cfs @ 12.11 hrs HW=965.75' (Free Discharge)
- **1=Culvert** (Passes 4.19 cfs of 12.32 cfs potential flow)
  - **2=Orifice/Grate** (Passes 4.19 cfs of 5.49 cfs potential flow)
    - **3=Orifice/Grate** (Orifice Controls 0.09 cfs @ 11.50 fps)
    - **4=Orifice/Grate** (Orifice Controls 4.09 cfs @ 4.91 fps)
    - **5=Orifice/Grate** (Weir Controls 0.00 cfs @ 0.13 fps)

Pond P1: EDD-1


Hydrograph
Inflow
Primary
16.37 cfs
4.25 cfs
Inflow Area=2.288 ac
Peak Elev=965.76'
Storage=20,071 cf
Flow (cfs)
Time (hours)
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48

Stage-Area-Storage for Pond P1: EDD-1

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
960.00	745	0
960.10	803	77
960.20	863	161
960.30	925	250
960.40	990	346
960.50	1,056	448
960.60	1,125	557
960.70	1,196	673
960.80	1,269	796
960.90	1,345	927
961.00	1,422	1,065
961.10	1,500	1,212
961.20	1,580	1,366
961.30	1,663	1,528
961.40	1,747	1,698
961.50	1,833	1,877
961.60	1,922	2,065
961.70	2,013	2,262
961.80	2,105	2,467
961.90	2,200	2,683
962.00	2,297	2,908
962.10	2,395	3,142
962.20	2,496	3,387
962.30	2,598	3,641
962.40	2,703	3,906
962.50	2,809	4,182
962.60	2,918	4,468
962.70	3,029	4,766
962.80	3,141	5,074
962.90	3,256	5,394
963.00	3,373	5,725
963.10	3,491	6,069
963.20	3,612	6,424
963.30	3,734	6,791
963.40	3,859	7,171
963.50	3,985	7,563
963.60	4,114	7,968
963.70	4,244	8,385
963.80	4,377	8,817
963.90	4,511	9,261
964.00	4,648	9,719
964.10	4,781	10,190
964.20	4,915	10,675
964.30	5,052	11,173
964.40	5,190	11,685
964.50	5,330	12,211
964.60	5,472	12,752
964.70	5,616	13,306
964.80	5,762	13,875
964.90	5,909	14,458
965.00	6,059	15,057
965.10	6,197	15,670
965.20	6,337	16,296
965.30	6,479	16,937
965.40	6,622	17,592
965.50	6,767	18,262
965.60	6,913	18,946
965.70	7,061	19,644
965.80	7,210	20,358
965.90	7,361	21,086
966.00	7,514	21,830
966.10	7,663	22,589
966.20	7,813	23,363
966.30	7,964	24,152
966.40	8,117	24,956
966.50	8,271	25,775
966.60	8,427	26,610
966.70	8,584	27,461
966.80	8,743	28,327
966.90	8,903	29,209
967.00	**9,065**	**30,108**

Summary for Pond P2: EDD-2

Inflow Area = 6.411 ac, 0.00% Impervious, Inflow Depth = 4.64" for 10-Year event
Inflow = 45.86 cfs @ 11.96 hrs, Volume= 2.481 af
Outflow = 12.03 cfs @ 12.12 hrs, Volume= 2.031 af, Atten= 74%, Lag= 9.4 min
Primary = 12.03 cfs @ 12.12 hrs, Volume= 2.031 af
Routed to nonexistent node 1L

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 971.50' @ 12.12 hrs Surf.Area= 10,315 sf Storage= 57,128 cf

Plug-Flow detention time= 399.6 min calculated for 2.029 af (82% of inflow)
Center-of-Mass det. time= 325.5 min (1,093.6 - 768.1)

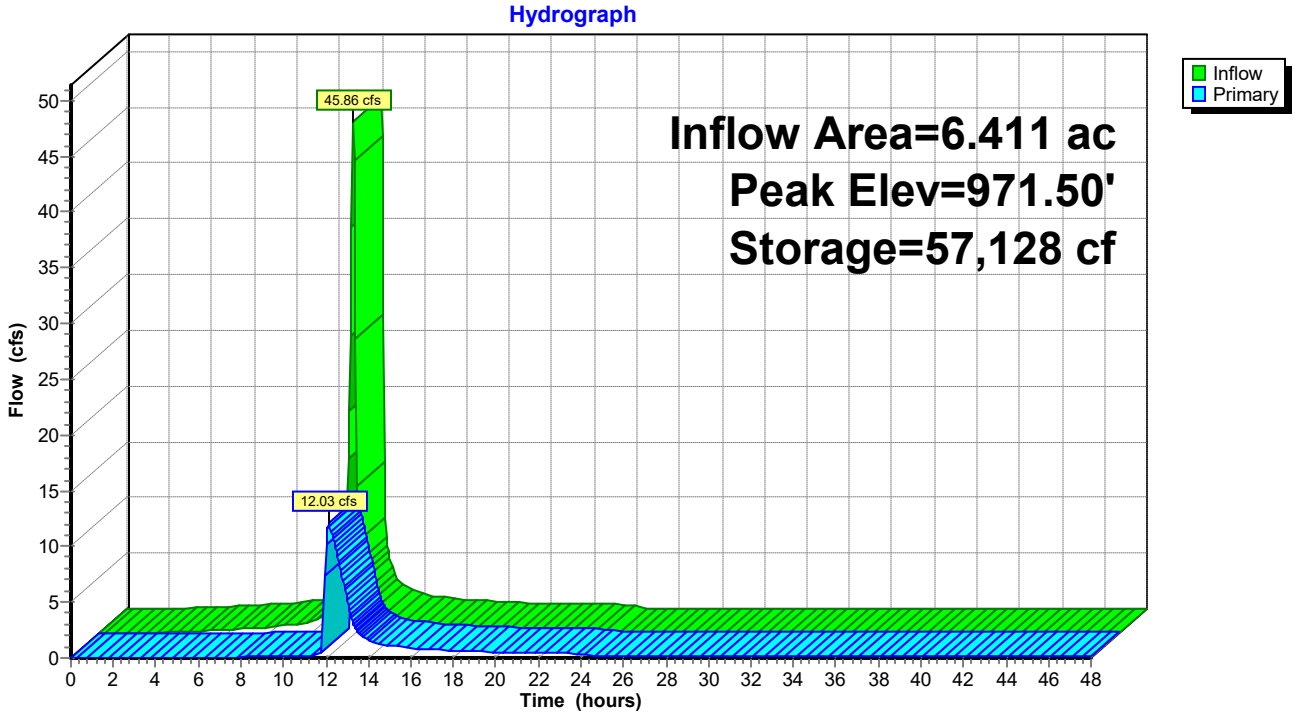
Volume	Invert	Avail.Storage	Storage Description
#1	965.00'	84,469 cf	**Custom Stage Data (Conic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
965.00	7,341	0	0	7,341
966.00	7,765	7,552	7,552	7,865
967.00	8,202	7,983	15,535	8,405
968.00	8,651	8,426	23,960	8,959
969.00	9,111	8,880	32,840	9,528
970.00	9,583	9,346	42,186	10,111
971.00	10,067	9,824	52,010	10,709
972.00	10,563	10,314	62,324	11,322
973.00	11,070	10,816	73,140	11,949
974.00	11,590	11,329	84,469	12,591

Device	Routing	Invert	Outlet Devices
#1	Primary	965.00'	**18.0" Round Culvert** L= 280.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 965.00' / 962.20' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf
#2	Device 1	965.00'	**2.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	969.30'	**42.0" W x 6.0" H Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Device 1	971.50'	**72.0" x 72.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=11.97 cfs @ 12.12 hrs HW=971.48' (Free Discharge)
↑—**1=Culvert** (Passes 11.97 cfs of 15.38 cfs potential flow)
↑—**2=Orifice/Grate** (Orifice Controls 0.27 cfs @ 12.18 fps)
—**3=Orifice/Grate** (Orifice Controls 11.71 cfs @ 6.69 fps)
—**4=Orifice/Grate** (Controls 0.00 cfs)

Pond P2: EDD-2


Hydrograph
Inflow
Primary
45.86 cfs
12.03 cfs
Inflow Area=6.411 ac
Peak Elev=971.50'
Storage=57,128 cf
Flow (cfs)
Time (hours)
0
5
10
15
20
25
30
35
40
45
50
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48

Stage-Area-Storage for Pond P2: EDD-2

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
965.00	7,341	0
965.10	7,383	736
965.20	7,425	1,477
965.30	7,467	2,221
965.40	7,509	2,970
965.50	7,552	3,723
965.60	7,594	4,480
965.70	7,637	5,242
965.80	7,679	6,008
965.90	7,722	6,778
966.00	7,765	7,552
966.10	7,808	8,331
966.20	7,851	9,114
966.30	7,895	9,901
966.40	7,938	10,693
966.50	7,982	11,489
966.60	8,026	12,289
966.70	8,070	13,094
966.80	8,114	13,903
966.90	8,158	14,717
967.00	8,202	15,535
967.10	8,246	16,357
967.20	8,291	17,184
967.30	8,335	18,015
967.40	8,380	18,851
967.50	8,425	19,691
967.60	8,470	20,536
967.70	8,515	21,385
967.80	8,560	22,239
967.90	8,606	23,097
968.00	8,651	23,960
968.10	8,696	24,827
968.20	8,742	25,699
968.30	8,788	26,576
968.40	8,834	27,457
968.50	8,880	28,343
968.60	8,926	29,233
968.70	8,972	30,128
968.80	9,018	31,027
968.90	9,064	31,931
969.00	9,111	32,840
969.10	9,158	33,753
969.20	9,204	34,672
969.30	9,251	35,594
969.40	9,298	36,522
969.50	9,346	37,454
969.60	9,393	38,391
969.70	9,440	39,333
969.80	9,488	40,279
969.90	9,535	41,230
970.00	9,583	42,186
970.10	9,631	43,147
970.20	9,679	44,112
970.30	9,727	45,082
970.40	9,775	46,058
970.50	9,824	47,038
970.60	9,872	48,022
970.70	9,921	49,012
970.80	9,969	50,006
970.90	10,018	51,006
971.00	10,067	52,010
971.10	10,116	53,019
971.20	10,165	54,033
971.30	10,215	55,052
971.40	10,264	56,076
971.50	10,314	57,105
971.60	10,363	58,139
971.70	10,413	59,178
971.80	10,463	60,221
971.90	10,513	61,270
972.00	10,563	62,324
972.10	10,613	63,383
972.20	10,663	64,447
972.30	10,714	65,516
972.40	10,764	66,589
972.50	10,815	67,668
972.60	10,866	68,752
972.70	10,917	69,842
972.80	10,968	70,936
972.90	11,019	72,035
973.00	11,070	73,140
973.10	11,121	74,249
973.20	11,173	75,364
973.30	11,225	76,484
973.40	11,277	77,609
973.50	11,329	78,739
973.60	11,381	79,875
973.70	11,433	81,015
973.80	11,485	82,161
973.90	11,537	83,312
974.00	**11,590**	**84,469**

Time span=0.00-48.00 hrs, dt=0.05 hrs, 961 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment A1: Lot 9 Runoff Area=2.288 ac 0.00% Impervious Runoff Depth=6.99"
Tc=6.0 min CN=94 Runoff=24.06 cfs 1.333 af

Subcatchment A2-3: Undetained Runoff Area=0.633 ac 0.00% Impervious Runoff Depth=6.99"
Tc=6.0 min CN=94 Runoff=6.66 cfs 0.369 af

Subcatchment A6: Proposed North Runoff Area=14.150 ac 0.00% Impervious Runoff Depth=6.99"
Tc=6.0 min CN=94 Runoff=148.82 cfs 8.247 af

Subcatchment C1: Lots 6-8 Runoff Area=6.411 ac 0.00% Impervious Runoff Depth=6.99"
Tc=6.0 min CN=94 Runoff=67.43 cfs 3.736 af

Pond P1: EDD-1 Peak Elev=966.86' Storage=28,870 cf Inflow=24.06 cfs 1.333 af
Outflow=6.03 cfs 1.193 af

Pond P2: EDD-2 Peak Elev=973.74' Storage=81,479 cf Inflow=67.43 cfs 3.736 af
Outflow=17.46 cfs 3.284 af

Total Runoff Area = 23.482 ac Runoff Volume = 13.685 af Average Runoff Depth = 6.99"
100.00% Pervious = 23.482 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment A1: Lot 9

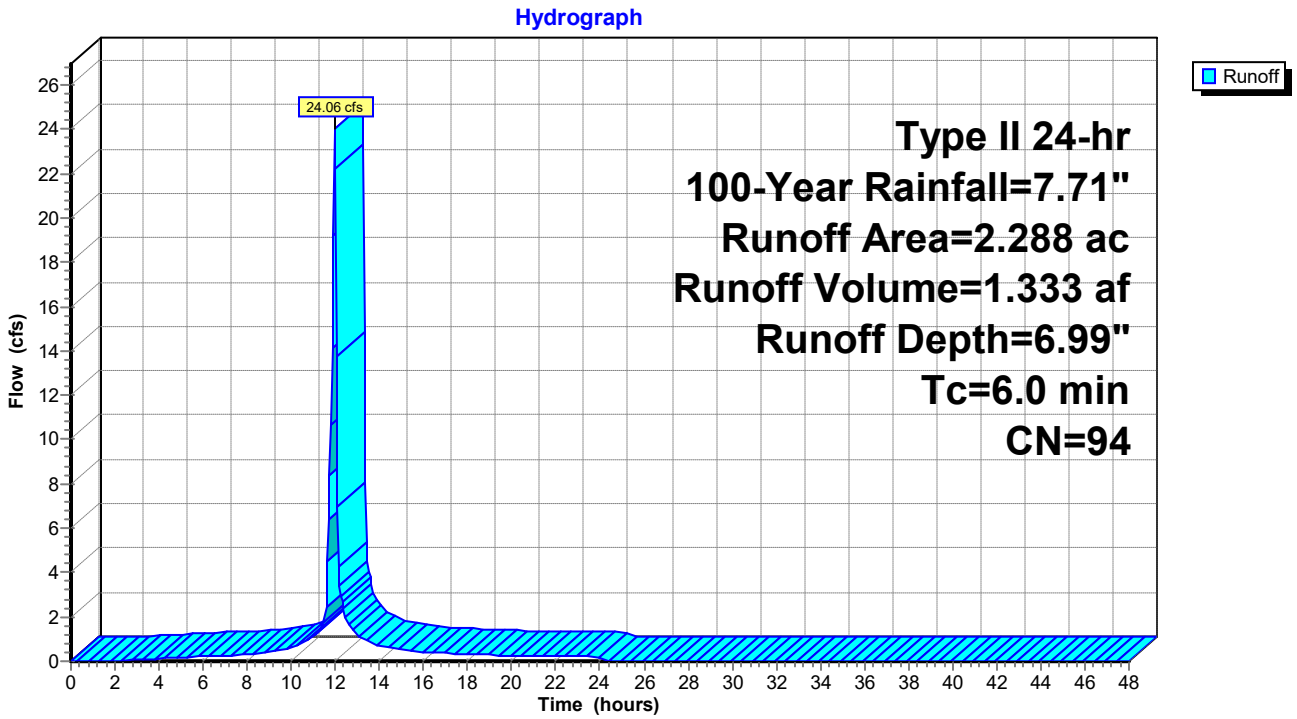
Runoff = 24.06 cfs @ 11.96 hrs, Volume= 1.333 af, Depth= 6.99"
Routed to Pond P1 : EDD-1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-Year Rainfall=7.71"

	Area (ac)	CN	Description
*	2.288	94	
	2.288		100.00% Pervious Area

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

Subcatchment A1: Lot 9



Summary for Subcatchment A2-3: Undetained

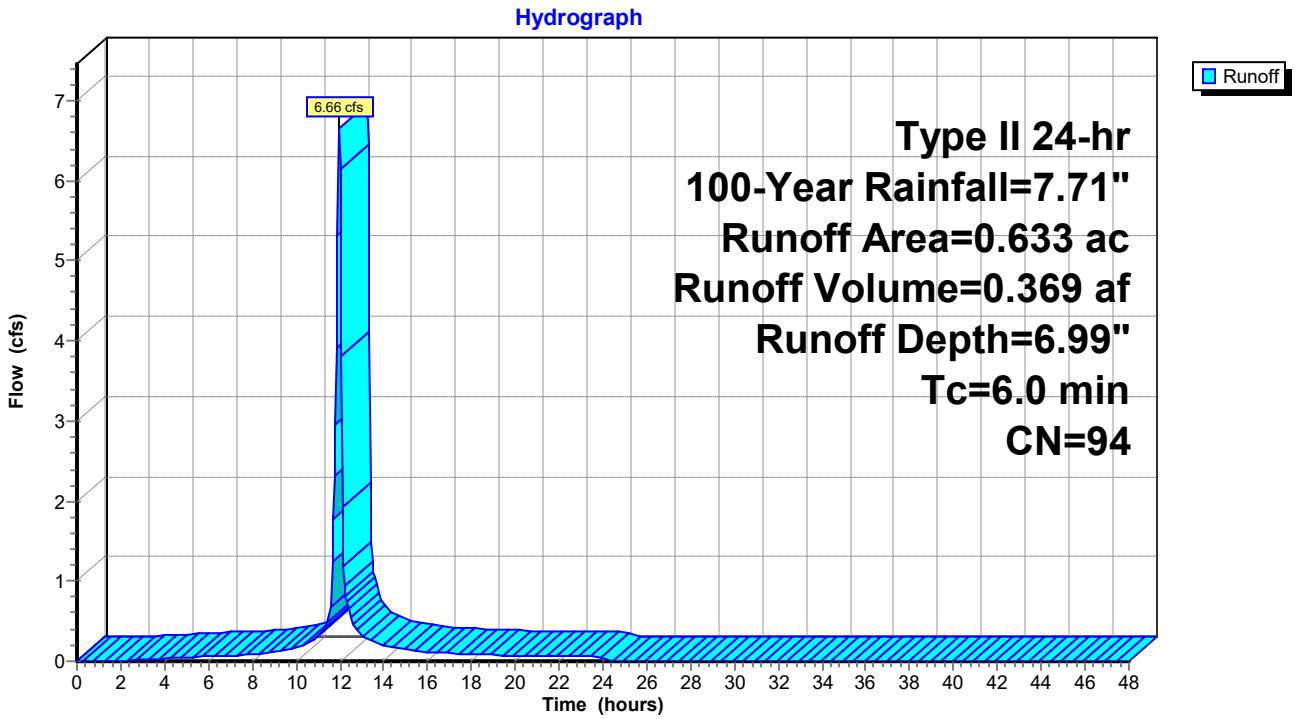
Runoff = 6.66 cfs @ 11.96 hrs, Volume= 0.369 af, Depth= 6.99"
Routed to nonexistent node 1L

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-Year Rainfall=7.71"

	Area (ac)	CN	Description
*	0.633	94	
	0.633		100.00% Pervious Area

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

Subcatchment A2-3: Undetained



Summary for Subcatchment A6: Proposed North

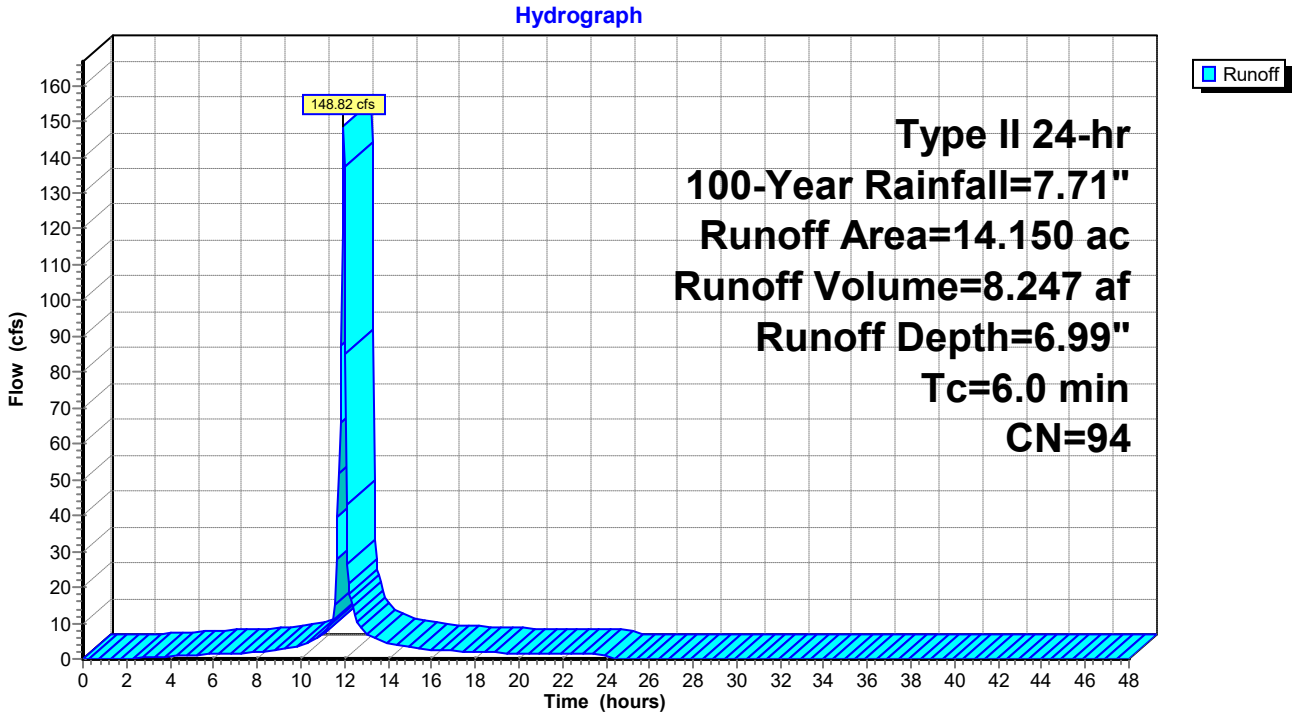
Runoff = 148.82 cfs @ 11.96 hrs, Volume= 8.247 af, Depth= 6.99"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-Year Rainfall=7.71"

	Area (ac)	CN	Description
*	14.150	94	
	14.150		100.00% Pervious Area

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

Subcatchment A6: Proposed North



Summary for Subcatchment C1: Lots 6-8

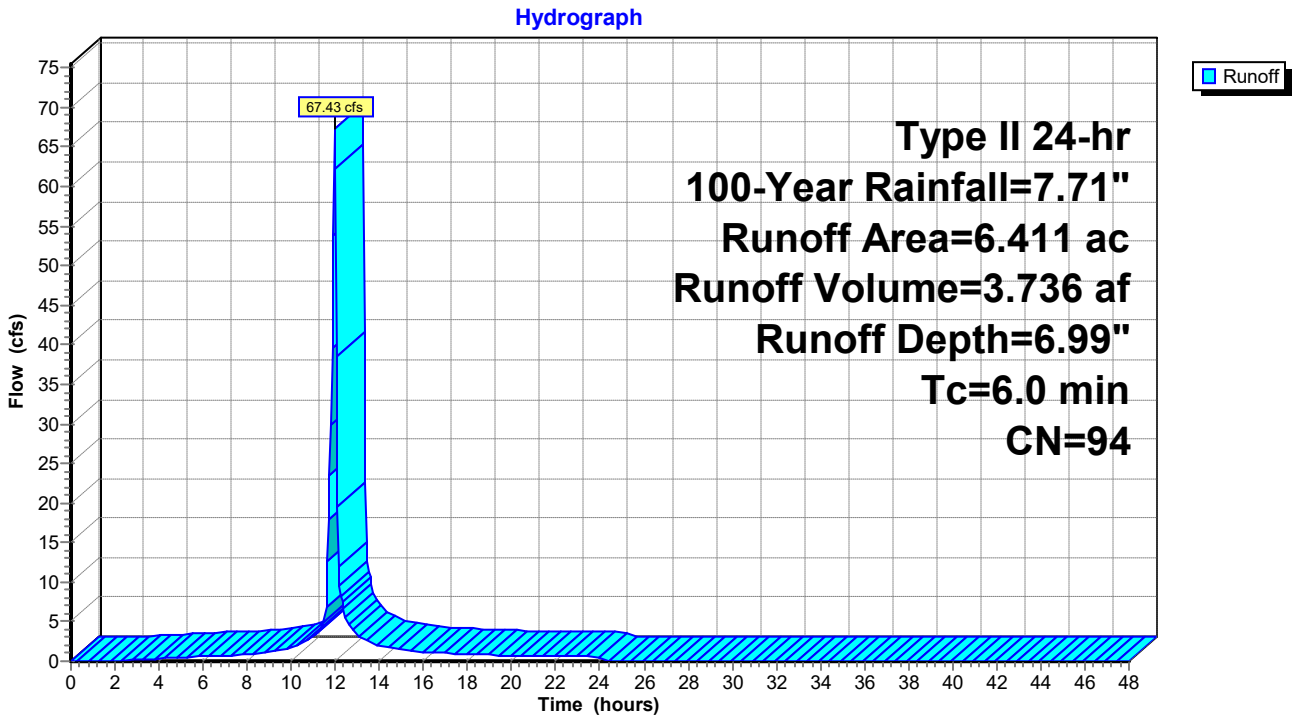
Runoff = 67.43 cfs @ 11.96 hrs, Volume= 3.736 af, Depth= 6.99"
Routed to Pond P2 : EDD-2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-Year Rainfall=7.71"

	Area (ac)	CN	Description
*	6.411	94	
	6.411		100.00% Pervious Area

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

Subcatchment C1: Lots 6-8



Summary for Pond P1: EDD-1

Inflow Area = 2.288 ac, 0.00% Impervious, Inflow Depth = 6.99" for 100-Year event
Inflow = 24.06 cfs @ 11.96 hrs, Volume= 1.333 af
Outflow = 6.03 cfs @ 12.12 hrs, Volume= 1.193 af, Atten= 75%, Lag= 9.5 min
Primary = 6.03 cfs @ 12.12 hrs, Volume= 1.193 af
Routed to nonexistent node 1L

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Starting Elev= 928.00' Storage= 0 cf
Peak Elev= 966.86' @ 12.12 hrs Surf.Area= 8,842 sf Storage= 28,870 cf

Plug-Flow detention time= 290.9 min calculated for 1.192 af (89% of inflow)
Center-of-Mass det. time= 238.7 min (997.2 - 758.5)

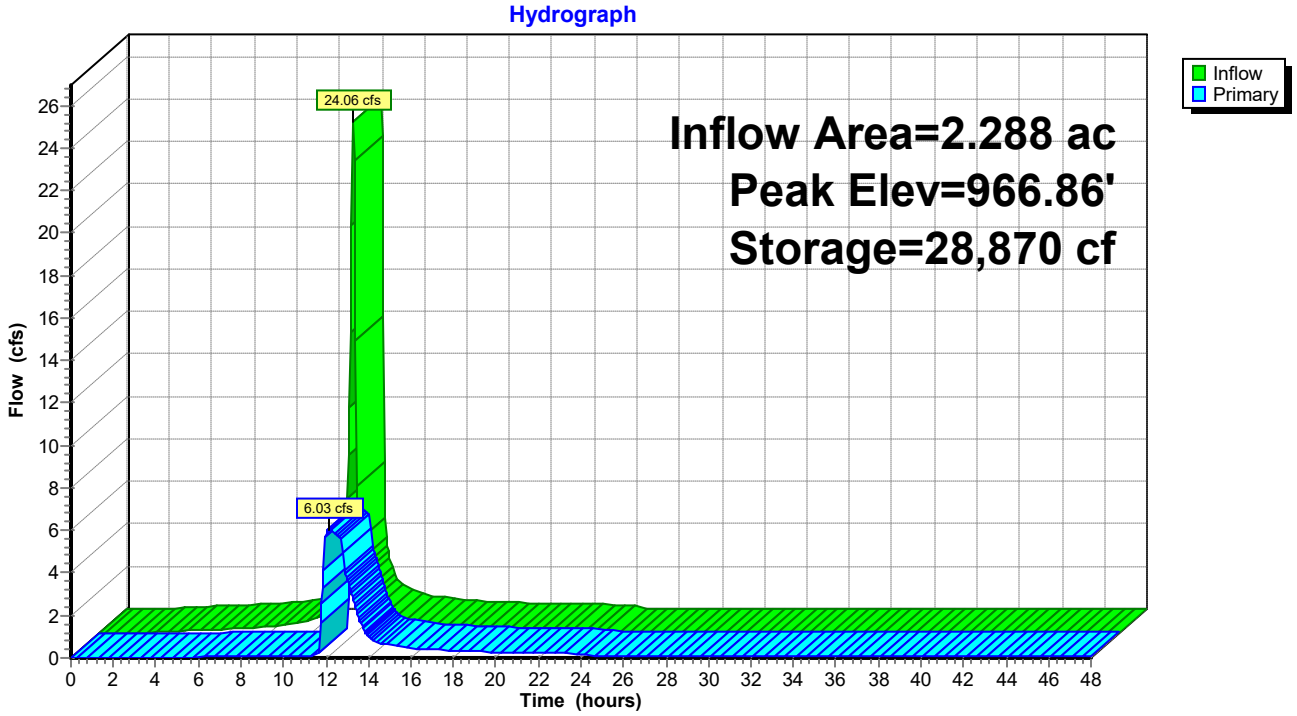
Volume	Invert	Avail.Storage	Storage Description
#1	960.00'	30,108 cf	**Custom Stage Data (Conic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
960.00	745	0	0	745
961.00	1,422	1,065	1,065	1,432
962.00	2,297	1,842	2,908	2,320
963.00	3,373	2,818	5,725	3,412
964.00	4,648	3,994	9,719	4,707
965.00	6,059	5,338	15,057	6,141
966.00	7,514	6,773	21,830	7,625
967.00	9,065	8,277	30,108	9,209

Device	Routing	Invert	Outlet Devices
#1	Primary	960.00'	**15.0" Round Culvert** L= 100.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 960.00' / 958.50' S= 0.0150 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.23 sf
#2	Device 1	960.00'	**9.5" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 2	960.00'	**1.2" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Device 2	964.50'	**24.0" W x 5.0" H Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#5	Device 2	965.75'	**60.0" x 60.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=6.02 cfs @ 12.12 hrs HW=966.85' (Free Discharge)
- **1=Culvert** (Passes 6.02 cfs of 13.41 cfs potential flow)
  - **2=Orifice/Grate** (Orifice Controls 6.02 cfs @ 12.23 fps)
    - **3=Orifice/Grate** (Passes < 0.10 cfs potential flow)
    - **4=Orifice/Grate** (Passes < 5.87 cfs potential flow)
    - **5=Orifice/Grate** (Passes < 75.44 cfs potential flow)

Pond P1: EDD-1


Hydrograph
Inflow
Primary
24.06 cfs
6.03 cfs
Inflow Area=2.288 ac
Peak Elev=966.86'
Storage=28,870 cf
Flow (cfs)
Time (hours)
0 2 4 6 8 10 12 14 16 18 20 22 24 26
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48

Stage-Area-Storage for Pond P1: EDD-1

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
960.00	745	0
960.10	803	77
960.20	863	161
960.30	925	250
960.40	990	346
960.50	1,056	448
960.60	1,125	557
960.70	1,196	673
960.80	1,269	796
960.90	1,345	927
961.00	1,422	1,065
961.10	1,500	1,212
961.20	1,580	1,366
961.30	1,663	1,528
961.40	1,747	1,698
961.50	1,833	1,877
961.60	1,922	2,065
961.70	2,013	2,262
961.80	2,105	2,467
961.90	2,200	2,683
962.00	2,297	2,908
962.10	2,395	3,142
962.20	2,496	3,387
962.30	2,598	3,641
962.40	2,703	3,906
962.50	2,809	4,182
962.60	2,918	4,468
962.70	3,029	4,766
962.80	3,141	5,074
962.90	3,256	5,394
963.00	3,373	5,725
963.10	3,491	6,069
963.20	3,612	6,424
963.30	3,734	6,791
963.40	3,859	7,171
963.50	3,985	7,563
963.60	4,114	7,968
963.70	4,244	8,385
963.80	4,377	8,817
963.90	4,511	9,261
964.00	4,648	9,719
964.10	4,781	10,190
964.20	4,915	10,675
964.30	5,052	11,173
964.40	5,190	11,685
964.50	5,330	12,211
964.60	5,472	12,752
964.70	5,616	13,306
964.80	5,762	13,875
964.90	5,909	14,458
965.00	6,059	15,057
965.10	6,197	15,670
965.20	6,337	16,296
965.30	6,479	16,937
965.40	6,622	17,592
965.50	6,767	18,262
965.60	6,913	18,946
965.70	7,061	19,644
965.80	7,210	20,358
965.90	7,361	21,086
966.00	7,514	21,830
966.10	7,663	22,589
966.20	7,813	23,363
966.30	7,964	24,152
966.40	8,117	24,956
966.50	8,271	25,775
966.60	8,427	26,610
966.70	8,584	27,461
966.80	8,743	28,327
966.90	8,903	29,209
967.00	**9,065**	**30,108**

Summary for Pond P2: EDD-2

Inflow Area = 6.411 ac, 0.00% Impervious, Inflow Depth = 6.99" for 100-Year event
Inflow = 67.43 cfs @ 11.96 hrs, Volume= 3.736 af
Outflow = 17.46 cfs @ 12.12 hrs, Volume= 3.284 af, Atten= 74%, Lag= 9.4 min
Primary = 17.46 cfs @ 12.12 hrs, Volume= 3.284 af
Routed to nonexistent node 1L

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 973.74' @ 12.12 hrs Surf.Area= 11,454 sf Storage= 81,479 cf

Plug-Flow detention time= 289.4 min calculated for 3.284 af (88% of inflow)
Center-of-Mass det. time= 229.9 min (988.4 - 758.5)

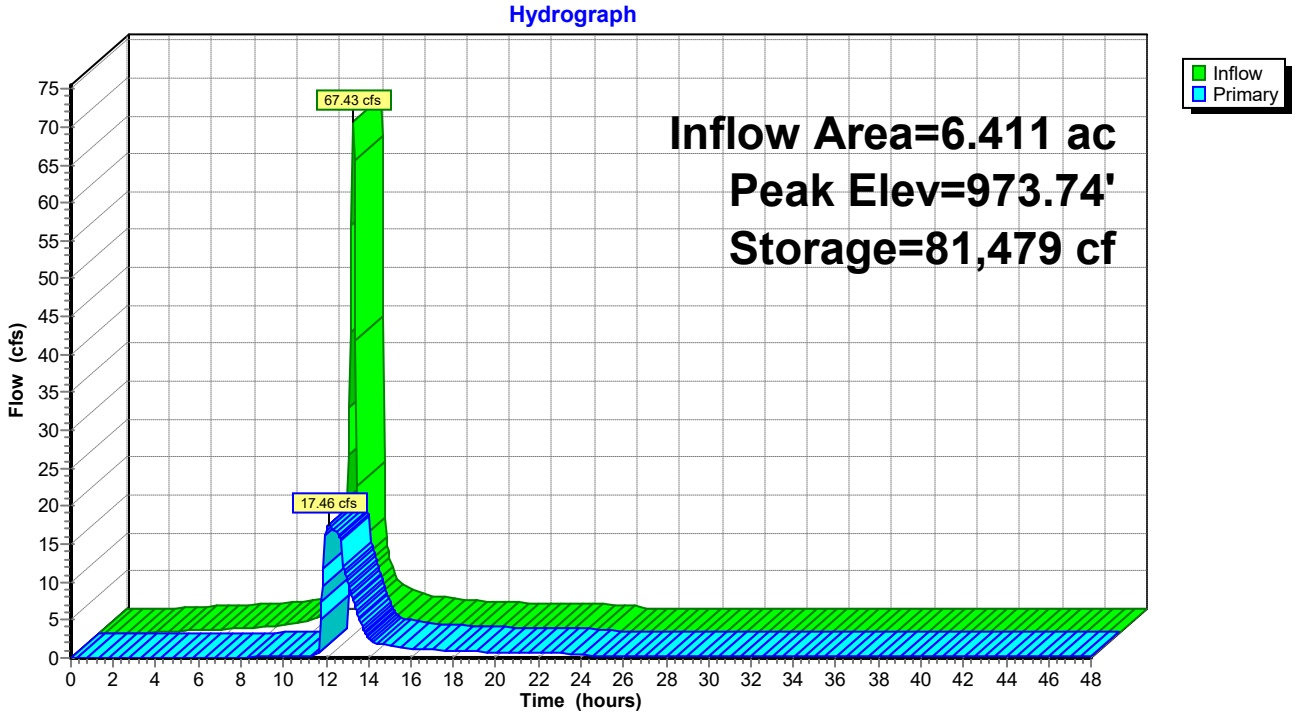
Volume	Invert	Avail.Storage	Storage Description
#1	965.00'	84,469 cf	**Custom Stage Data (Conic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
965.00	7,341	0	0	7,341
966.00	7,765	7,552	7,552	7,865
967.00	8,202	7,983	15,535	8,405
968.00	8,651	8,426	23,960	8,959
969.00	9,111	8,880	32,840	9,528
970.00	9,583	9,346	42,186	10,111
971.00	10,067	9,824	52,010	10,709
972.00	10,563	10,314	62,324	11,322
973.00	11,070	10,816	73,140	11,949
974.00	11,590	11,329	84,469	12,591

Device	Routing	Invert	Outlet Devices
#1	Primary	965.00'	**18.0" Round Culvert** L= 280.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 965.00' / 962.20' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf
#2	Device 1	965.00'	**2.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	969.30'	**42.0" W x 6.0" H Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Device 1	971.50'	**72.0" x 72.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=17.44 cfs @ 12.12 hrs HW=973.72' (Free Discharge)
└**1=Culvert** (Barrel Controls 17.44 cfs @ 9.87 fps)
  ├**2=Orifice/Grate** (Passes < 0.31 cfs potential flow)
  ├**3=Orifice/Grate** (Passes < 17.20 cfs potential flow)
  └**4=Orifice/Grate** (Passes < 258.03 cfs potential flow)

Pond P2: EDD-2


Hydrograph
Inflow
Primary
67.43 cfs
17.46 cfs
Inflow Area=6.411 ac
Peak Elev=973.74'
Storage=81,479 cf
Flow (cfs)
Time (hours)
0
5
10
15
20
25
30
35
40
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Stage-Area-Storage for Pond P2: EDD-2

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
965.00	7,341	0
965.10	7,383	736
965.20	7,425	1,477
965.30	7,467	2,221
965.40	7,509	2,970
965.50	7,552	3,723
965.60	7,594	4,480
965.70	7,637	5,242
965.80	7,679	6,008
965.90	7,722	6,778
966.00	7,765	7,552
966.10	7,808	8,331
966.20	7,851	9,114
966.30	7,895	9,901
966.40	7,938	10,693
966.50	7,982	11,489
966.60	8,026	12,289
966.70	8,070	13,094
966.80	8,114	13,903
966.90	8,158	14,717
967.00	8,202	15,535
967.10	8,246	16,357
967.20	8,291	17,184
967.30	8,335	18,015
967.40	8,380	18,851
967.50	8,425	19,691
967.60	8,470	20,536
967.70	8,515	21,385
967.80	8,560	22,239
967.90	8,606	23,097
968.00	8,651	23,960
968.10	8,696	24,827
968.20	8,742	25,699
968.30	8,788	26,576
968.40	8,834	27,457
968.50	8,880	28,343
968.60	8,926	29,233
968.70	8,972	30,128
968.80	9,018	31,027
968.90	9,064	31,931
969.00	9,111	32,840
969.10	9,158	33,753
969.20	9,204	34,672
969.30	9,251	35,594
969.40	9,298	36,522
969.50	9,346	37,454
969.60	9,393	38,391
969.70	9,440	39,333
969.80	9,488	40,279
969.90	9,535	41,230
970.00	9,583	42,186
970.10	9,631	43,147
970.20	9,679	44,112
970.30	9,727	45,082
970.40	9,775	46,058
970.50	9,824	47,038
970.60	9,872	48,022
970.70	9,921	49,012
970.80	9,969	50,006
970.90	10,018	51,006
971.00	10,067	52,010
971.10	10,116	53,019
971.20	10,165	54,033
971.30	10,215	55,052
971.40	10,264	56,076
971.50	10,314	57,105
971.60	10,363	58,139
971.70	10,413	59,178
971.80	10,463	60,221
971.90	10,513	61,270
972.00	10,563	62,324
972.10	10,613	63,383
972.20	10,663	64,447
972.30	10,714	65,516
972.40	10,764	66,589
972.50	10,815	67,668
972.60	10,866	68,752
972.70	10,917	69,842
972.80	10,968	70,936
972.90	11,019	72,035
973.00	11,070	73,140
973.10	11,121	74,249
973.20	11,173	75,364
973.30	11,225	76,484
973.40	11,277	77,609
973.50	11,329	78,739
973.60	11,381	79,875
973.70	11,433	81,015
973.80	11,485	82,161
973.90	11,537	83,312
974.00	**11,590**	**84,469**

Water Quality Computations

Engineering beyond.™

WORKSHEET: EXTENDED DRY DETENTION BASIN (EDD) DESIGN

Project: ***Discovery Crossing***
Location: Lee's Summit, MO

By: JWB 6/20/2024
Checked:

Basin ID:	**EDD-1**

Required Volume Calculation

*WQ_V = P * Rv * A / 12 (ac-ft)*
P = Water Quality Storm rainfall depth = 1.37 in.
A = Local Treatment Drainage Area (acres)
*Rv = Volumetric Runoff Coefficient = 0.05 + 0.009 * I*
I = Percent Site Imperviousness (%)

Drainage Area:	2.29 acres
% Impervious:	75.0 %

WQ_V (required): 0.19 ac-ft
8,257 cu ft

Water Quality Outlet Type

Step 1) Set water quality outlet type — Outlet Type: 1

Type 1 = single orifice
Type 2 = perforated riser or plate
Type 3 = v-notch weir

Water Quality Outlet, Single Orifice

Step 1) Depth of water quality volume at outlet, Z_{WQ} (ft) — Z_{WQ}: 3.7 ft

Step 2) Average head of water quality volume over invert of orifice, H_{WQ} (ft)

$H_{WQ} = 0.5 * Z_{WQ}$ — H_{WQ}: 1.84 ft

Step 3) Average water quality outflow rate, Q_{WQ} (cfs) — Q_{WQ}: 0.06 cfs

$Q_{WQ} = (WQ_V * 43{,}560) / (40 * 3{,}600)$

Step 4) Set value of orifice discharge coefficient, C_O — C_O: 0.66

$C_O = 0.66$ when thickness of riser/weir plate is ≤ orifice diameter
$C_O = 0.80$ when thickness of riser/weir plate is > orifice diameter

Step 5) Water quality outlet orifice diameter (minimum of 4 inches), D_O (in) — D_O: 1.2 in

$D_O = 12 * 2 * (Q_{WQ} / (C_O * \pi * (2 * g * H)^{0.5}))^{0.5}$

WQv (proposed): 0.28 ac-ft

40-Hour WQv Outlet

Outlet Elevation:	960.00
Outlet Type:	Orifice
Outlet Size:	1.25" Diameter
Outlet Protection:	Submerged Well-screen

WORKSHEET: EXTENDED DRY DETENTION BASIN (EDD) DESIGN

Project: ***Discovery Crossing***
Location: Lee's Summit, MO

By: JWB 6/20/2024
Checked:

Basin ID:	**EDD-2**

Required Volume Calculation

*WQ_V = P * Rv * A / 12 (ac-ft)*

P = Water Quality Storm rainfall depth = 1.37 in.
A = Local Treatment Drainage Area (acres)
*Rv = Volumetric Runoff Coefficient = 0.05 + 0.009 * I*
I = Percent Site Imperviousness (%)

Drainage Area:	6.41 acres
% Impervious:	75.0 %

WQ_V (required): 0.53 ac-ft
23,111 cu ft

Water Quality Outlet Type

Step 1) Set water quality outlet type — Outlet Type: 1

Type 1 = single orifice
Type 2 = perforated riser or plate
Type 3 = v-notch weir

Water Quality Outlet, Single Orifice

Step 1) Depth of water quality volume at outlet, Z_{WQ} (ft) — Z_{WQ}: 2.9 ft

Step 2) Average head of water quality volume over invert of orifice, H_{WQ} (ft)

$H_{WQ} = 0.5 * Z_{WQ}$ — H_{WQ}: 1.46 ft

Step 3) Average water quality outflow rate, Q_{WQ} (cfs) — Q_{WQ}: 0.16 cfs

$Q_{WQ} = (WQ_V * 43{,}560) / (40 * 3{,}600)$

Step 4) Set value of orifice discharge coefficient, C_O — C_O: 0.66

$C_O = 0.66$ when thickness of riser/weir plate is ≤ orifice diameter
$C_O = 0.80$ when thickness of riser/weir plate is > orifice diameter

Step 5) Water quality outlet orifice diameter (minimum of 4 inches), D_O (in) — D_O: 2.1 in

$D_O = 12 * 2 * (Q_{WQ} / (C_O * \pi * (2 * g * H)^{0.5}))^{0.5}$

WQv (proposed): 0.82 ac-ft

40-Hour WQv Outlet

Outlet Elevation:	965.00
Outlet Type:	Orifice
Outlet Size:	2.0" Diameter
Outlet Protection:	Submerged Well-screen