Preliminary Stormwater Management Plan

Orchard Woods

NE Lakewood Way & NE Woods Chapel Road
Section: SW ¼ Sec. 9-48-31
Lee's Summit, Missouri

Prepared by:

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PEI #211142
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1. INTRODUCTION

This report is a Preliminary Stormwater Management plan for the proposed Orchard Woods development located northeast of the intersection of NE Lakewood Way & NE Woods Chapel Road in the City of Lee's Summit, Jackson County, Missouri. This report has been prepared by Phelps Engineering, Inc. (PEI) and McMullen Stormwater Engineering LLC (MSE) on behalf of the developer – Entres' Hive.

The proposed site is bounded by NE Chapel Road (public) to the south, NE Lakewood Way (public) and commercial development to the west, commercial development to the north, and single-family residential development to the east. The proposed development is approximately 18.80 acres and consists of 34 single-family residential lots and a collector road which will bisect the site.

The property lies within Zone X, defined as areas determined to be outside the 0.2% annual chance floodplain, as shown on the flood insurance rate map prepared by the Federal Emergency Management Agency for the City of Lee's Summit, Community No. 290174, Jackson County, Missouri, Map No. 29095C0430G, and dated January 20, 2017.

See the Vicinity Map below.

Figure 1 - Vicinity Map

2. STORMWATER REQUIREMENTS

Stormwater design criteria are in accordance with City of Lee's Summit Technical Specifications and Design Criteria and APWA 5600.

Onsite detention will be provided for the increase in impervious area with the development, to reduce the proposed peak runoff rates in the 2-year, 10-yr, and 100-year rainfall events to under the existing peak runoff rates for the respective storm event. The detention system shall also be designed to drawdown over a minimum of 40-hours during the 90% mean annual event (Water Quality storm).

All storm sewers shall be sized to convey the 10-year design storm. The 100-year overflow will be conveyed in the street system in conjunction with overflow path swales where necessary. The lowest opening of any building adjacent to the 100-year overflow path will be set a minimum of one-foot above the 100-year energy grade line (EGL).

3. EXISTING SITE CONDITIONS

The existing site consists of three watersheds which discharge to the northwest, west, and southeast.

A total of 13.37 acres of onsite drainage area and 19.01 acres of offsite drainage area discharges the site in the northwest watershed into an existing enclosed storm sewer system located just west of the site.

A total of 3.82 acres of onsite drainage area discharges the site in the west watershed via an existing storm sewer system along NE Lakewood Drive.

A total of 1.61 acres of onsite drainage area discharges the site in the southeast watershed via overland flow to the unplatted property to the east.

The existing site is a large majority undeveloped and consists of Hydrologic Soil Group (HSG) Type "C" and "D" soils. Based off aerial photography and site visit, the land cover type is considered to be woods/grass combination in fair condition, corresponding to a CN value of 76 for the HSG Type "C" soils and 82 for the HSG Type "D" soils. See Appendix A of this report for the NRCS Web Soil Survey and the Existing Drainage Map for the site.

4. PROPOSED SITE CONDITIONS

The proposed site will contain 34 single-family residential lots on approximately 13.55 acres of the site located north of the proposed collector road which bisects the site. The portion of the site located south of the collector road will remain undisturbed. The proposed site will approximately maintain the existing drainage pattern. See Appendix "A" of this report for Proposed Drainage Map A2.

5. STORMWATER DETENTION

An existing conditions site runoff model determined the pre-developed 2, 10 and 100-year Allowable Release Rates for the northwest watershed. The onsite west and southeast watersheds will be undisturbed with this phase of development, and therefore detention is not required with the current phase, but a detention analysis for the west and southeast watershed shall be required in the future if developed. The existing release rates for the 2, 10 and 100-year storm events for the west and southeast watershed are shown in Table 2 below.

Detention in the northwest watershed will be provided per APWA Section 5601.5.A.4.a, the "Default Strategy – Comprehensive Protection". The onsite allowable release rates are shown per Table 1 below for each respective recurrence interval in the northwest watershed. The offsite peak release rates for the northwest watershed are shown in Table 2, along with the total combined allowable release rates for the northwest watershed which includes the onsite and offsite areas. The northwest watershed will also be required to drawdown the 90% mean annual storm event over a minimum of 40-hours for the onsite area.

A total of 8.53 acres of the offsite northwest watershed is developed single-family residential, while 10.48 acres is currently undeveloped. In the future, if the 10.48 acres of offsite area is developed, the site would need to provide detention per APWA's Comprehensive Protection strategy as outlined above.

All detention analyses were completed using the HydroCAD V10 storm modeling software, using SCS Unit Hydrograph detention modeling with SCS Type II 24-hr storm duration.

Table 1 – APWA Onsite Allowable Discharge – Northwest Watershed

Storm Event	Allowable Discharge (cfs)		
	Onsite Area (acres)	Discharge Rate (cfs)	Discharge (cfs)
2-Year	13.37	0.5	6.69
10-Year	13.37	2.0	26.74
100-Year	13.37	3.0	40.11

Table 2 - Existing Runoff Conditions

Watershed Area	Drainage Area (acres)	Time of Conc. (minutes)	Composite Curve Number (CN)	2-Year Allowable Discharge (cfs)	10-Year Allowable Discharge (cfs)	100-Year Allowable Discharge (cfs)
Northwest Onsite	13.37	13.7	81	6.69	26.74	40.11
Northwest Offsite	19.01	13.7	83	47.80	87.59	141.67
NORTHWEST TOTAL	**32.38**	**-**	**-**	**54.49**	**114.33**	**181.78**
WEST ONSITE (TOTAL)	**3.82**	**11.8**	**76**	**7.47**	**15.36**	**26.64**
SOUTHEAST ONSITE (TOTAL)	**28.07**	**1.61**	**76**	**3.17**	**6.52**	**11.31**

Northwest Watershed

One extended dry detention basin is proposed for the northwest watershed of the proposed development. The proposed drainage to the northwest extended dry detention basin totals 32.87 acres (13.86 acres onsite area, 19.01 acres offsite area). The outlet control system for the detention basin will consist of a V-notch weir on the east face of the proposed 7'x4' outlet structure with a 20 degree notch angle. The outlet structure will have an open top and trash rack set at an elevation of 1004.30. The V-notch weir will have a bottom elevation of 996.00 (bottom of basin) and extend up to the top elevation of the structure (1004.30) for a top width of 2.93 feet. The outlet pipe from the outlet control structure will be a 48" RCP which will tie into the existing storm sewer system located west of the basin.

Using HydroCAD, the proposed 2-year, 10-year, and 100-year peak discharges for the northwest watershed were determined and are shown in Table 3 below. See Appendix "B" of this report for proposed PondPack calculations.

Table 3: Summary of Northwest Watershed Discharges

		Existing Condition	Proposed Condition			
Storm	Discharge Pt.	*Allowable Release Rate, cfs*	Inflow Rate, cfs	Outflow Rate, cfs	WSE, ft	Storage, ac-ft
2-year	NW Onsite - Bypass	*NA*	NA	0.79	NA	NA
	NW Onsite - Detained	*NA*	47.80	NA	NA	NA
	NW Offsite - Detained	*NA*	44.21	NA	NA	NA
	Extended Dry Detention	*NA*	90.81	52.41	1002.57	1.280
	NORTHWEST TOTAL	*54.49*	**NA**	**52.53**	**NA**	**NA**
10-year	NW Onsite - Bypass	*NA*	NA	1.50	NA	NA
	NW Onsite - Detained	*NA*	77.20	NA	NA	NA
	NW Offsite - Detained	*NA*	87.59	NA	NA	NA
	Extended Dry Detention	*NA*	162.81	113.71	1004.61	2.106
	NORTHWEST TOTAL	*114.33*	**NA**	**113.96**	**NA**	**NA**

100-year	NW Onsite - Bypass	*NA*	NA	2.47	NA	NA
	NW Onsite - Detained	*NA*	121.22	NA	NA	NA
	NW Offsite - Detained	*NA*	141.67	NA	NA	NA
	Extended Dry Detention	*NA*	259.87	117.48	1006.40	2.992
	NORTHWEST TOTAL	*181.78*	**NA**	**177.88**	**NA**	**NA**

The 100-year water surface elevation (WSE) in the basin is 1006.40. The emergency spillway is 150 feet wide with a flowline elevation of 1006.90. The emergency spillway conveys the peak inflows for the 100-year (259.87 cfs) at WSE of 1007.66. The top of dam elevation is at 1008.66 providing a minimum freeboard of one foot over the 100-year WSE through the emergency spillway.

As seen in Table 2 above, the proposed peak release rates in the 2, 10, and 100-year storm events are under the allowable release rates for the respective storm events. The water quality V-notch weir in the basin was designed using the 2012 MARC BMP Manual spreadsheet for extended dry detention, which is sized to drawdown the 90% mean annual event (water quality storm) in a minimum of 40 hours. See Appendix “B” for the Extended Dry Detention Design Details.

6. STORMWATER TREATMENT

A Level of Service analysis according to the MARC Manual of Best Management Practices for Stormwater Quality has been completed for the proposed development. The treatment analysis was completed solely for the 13.55 acres of the site which is being developed as single-family residential and associated collector road with this current phase associated with this report. The portion of the site south of the proposed collector road will remain undisturbed with this phase of development and will require a separate treatment analysis if/when it is being developed in a future phase.

Level of Service (LOS) Worksheet 1 calculated a composite predevelopment CN of 81, based upon existing land cover and hydrologic soil type covering the site. The existing land cover type for the development consists of woods/grass combination in fair condition. According to the NRCS Soil Report for Jackson County, Kansas, the existing onsite soils consist of Hydrologic Soil Group (HSG) Type “C” and Type “D” soils.

The proposed 13.55-acres of the development will consist of 34 lots, or 1/3 acre lots. The post-development CN calculated in Worksheet 1 is 86, an increase in CN value by 5, therefore requiring a level of service of 5.7 in accordance with APWA Best Management Practices for Stormwater Quality. See Appendix “B” for LOS Worksheet 1 for the proposed development.

The proposed mitigation required to provide a LOS of 5.7 for the development is achieved by constructing one extended dry detention basin with signage in the northwest watershed. The basin will be sized to treat the entire 32.87 acres of onsite and offsite drainage areas draining to the basin as fully developed single-family residential (13.86 acres onsite drainage area, 19.01 offsite drainage area), but only portions of the offsite area will be allowed to be counted towards the proposed treatment calculation. A total of 4.97 acres of developed single-family residential located east of the site discharges onto the proposed Orchard Woods site and does not have any stormwater treatment associated with the drainage area. This area will be collected and treated by the proposed extended dry detention basin and will be included in the proposed LOS treatment calculation.

The remaining 14.04 acres of offsite area will not be included in the proposed LOS treatment calculation for this development. A total of 10.48 acres of the 14.04 acres of offsite drainage area is currently undeveloped, but will potentially be developed in the future. In the event of future development, the property can take 44.54 Value Rating points (4.25 LOS for EDD multiplied by 10.48 acres) towards the proposed development's LOS treatment calculation as the extended dry detention basin being constructed with the current Orchard Woods development phase has been sized for the water quality event to include 10.48 acres.

The proposed 13.55-acre analyzed portion of the site provides a LOS of 5.91, therefore exceeding the required LOS of 5.7 and meeting the requirements set forth in the MARC Manual. See Level of Service Worksheet 2 in Appendix "B" for the above calculations.

Preliminary sizing and calculations for the proposed extended dry detention basin have been provided in Appendix "B" of this report. Final design and detailing of the extended dry detention basin will be provided with submittal of the Final Stormwater Study. See Appendix "A" for the Stormwater Treatment Plan A3.

7. CONCLUSION

This report and attached appendices complete Phelps Engineering Inc. and McMullen Stormwater Engineering LLC's submittal of the Preliminary Stormwater Management plan for the proposed Orchard Woods development located northeast of the intersection of NE Lakewood Way & NE Woods Chapel Road in the City of Lee's Summit, Jackson County, Missouri. Please feel free to contact MSE at (913) 221-4055 if you require additional information.

Sincerely,

PHELPS ENGINEERING, INC. & MCMULLEN STORMWATER ENGINEERING LLC

Doug Ubben, Jr., P.E.
(Phelps Engineering, Inc.)

Daniel McMullen, P.E., CFM
(McMullen Stormwater Engineering LLC)

Enclosures

APPENDIX A

Stormwater Treatment & Detention Exhibits

- NRCS Web Soil Survey
- Existing Drainage Map A1
- Proposed Drainage Map A2
- Stormwater Treatment Map A3

United States Department of Agriculture

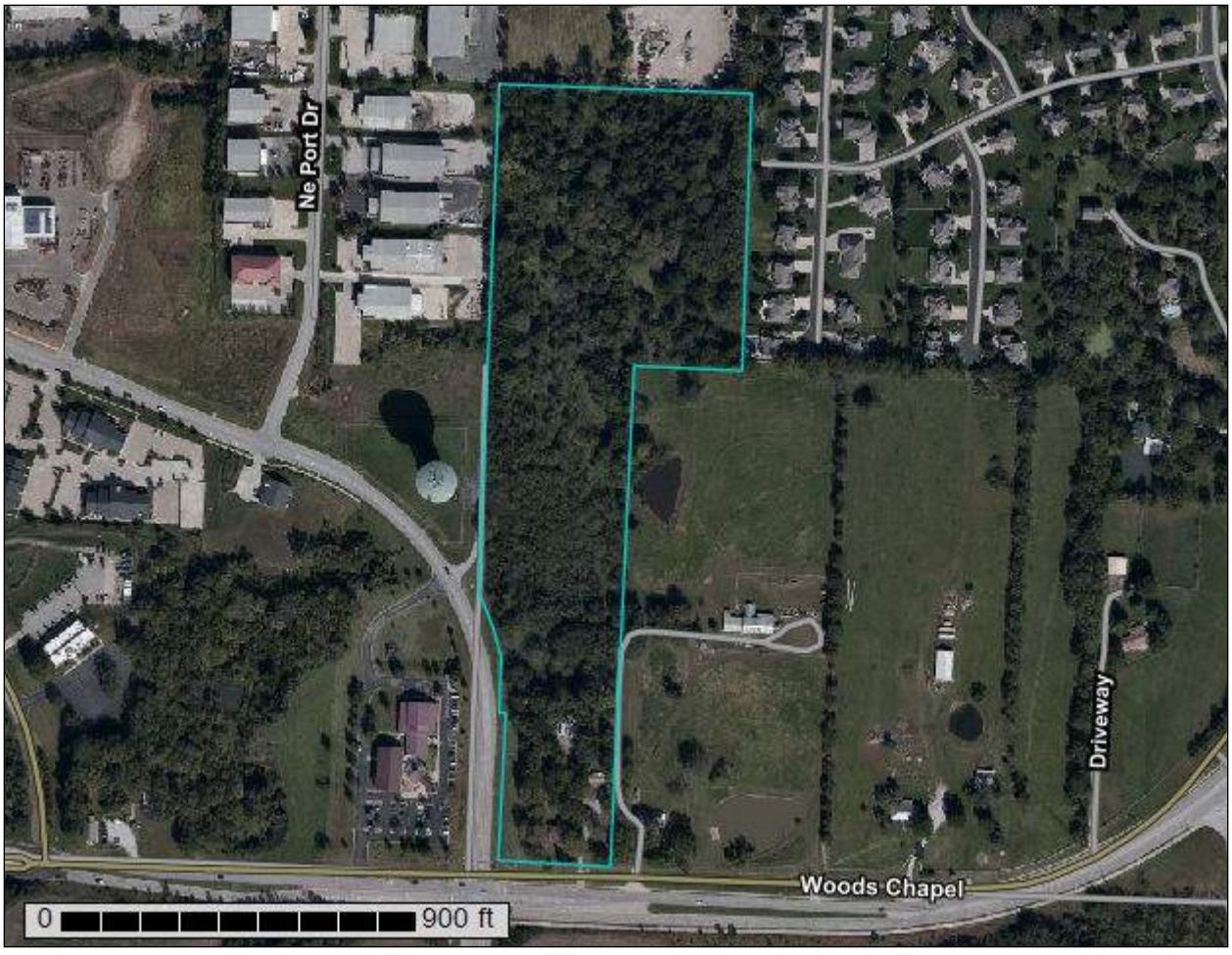
NRCS

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

Orchard Woods



May 12, 2022

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.

Hydrologic Soil Group—Jackson County, Missouri
(Orchard Woods)

Map Scale: 1:3,540 if printed on A portrait (8.5" x 11") sheet.

N

Meters
0 50 100 200 300

Feet
0 150 300 600 900

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 15N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

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

Soil Rating Lines

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

Soil Rating Points

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

Water Features

- Streams and Canals

Transportation

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

Background

- Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

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

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

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

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

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
10024	Greenton-Urban land complex, 5 to 9 percent slopes	D	12.0	60.0%
10128	Sharpsburg-Urban land complex, 2 to 5 percent slopes	D	0.8	3.8%
10132	Sibley silt loam, 2 to 5 percent slopes	C	7.3	36.2%
Totals for Area of Interest			**20.1**	**100.0%**

Description

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

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

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

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

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

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

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

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Jackson County, Missouri

10024—Greenton-Urban land complex, 5 to 9 percent slopes

Map Unit Setting

National map unit symbol: 2qky4
Elevation: 800 to 1,100 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: Prime farmland if drained

Map Unit Composition

Greenton and similar soils: 60 percent
Urban land: 35 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): Side slope
Down-slope shape: Convex
Across-slope shape: Concave, convex
Parent material: Loess over residuum weathered from limestone and shale

Typical profile

A - 0 to 16 inches: silty clay loam
Bt1 - 16 to 26 inches: silty clay loam
2Bt2 - 26 to 80 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
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 3.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
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: Hills
Landform position (two-dimensional): Backslope
Across-slope shape: Concave, convex

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
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 1,300 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: 60 percent
Urban land: 35 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

10132—Sibley silt loam, 2 to 5 percent slopes

Map Unit Setting

National map unit symbol: 2ql0d
Elevation: 850 to 950 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

Sibley and similar soils: 95 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Sibley

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

Ap1 - 0 to 11 inches: silt loam

Ap2 - 11 to 18 inches: silt loam
Bt - 18 to 49 inches: silty clay loam
C - 49 to 72 inches: silty clay loam

Properties and qualities

Slope: 2 to 5 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 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: High (about 11.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: C
Ecological site: R107BY002MO - Deep Loess Upland Prairie
Other vegetative classification: Grass/Prairie (Herbaceous Vegetation)
Hydric soil rating: No

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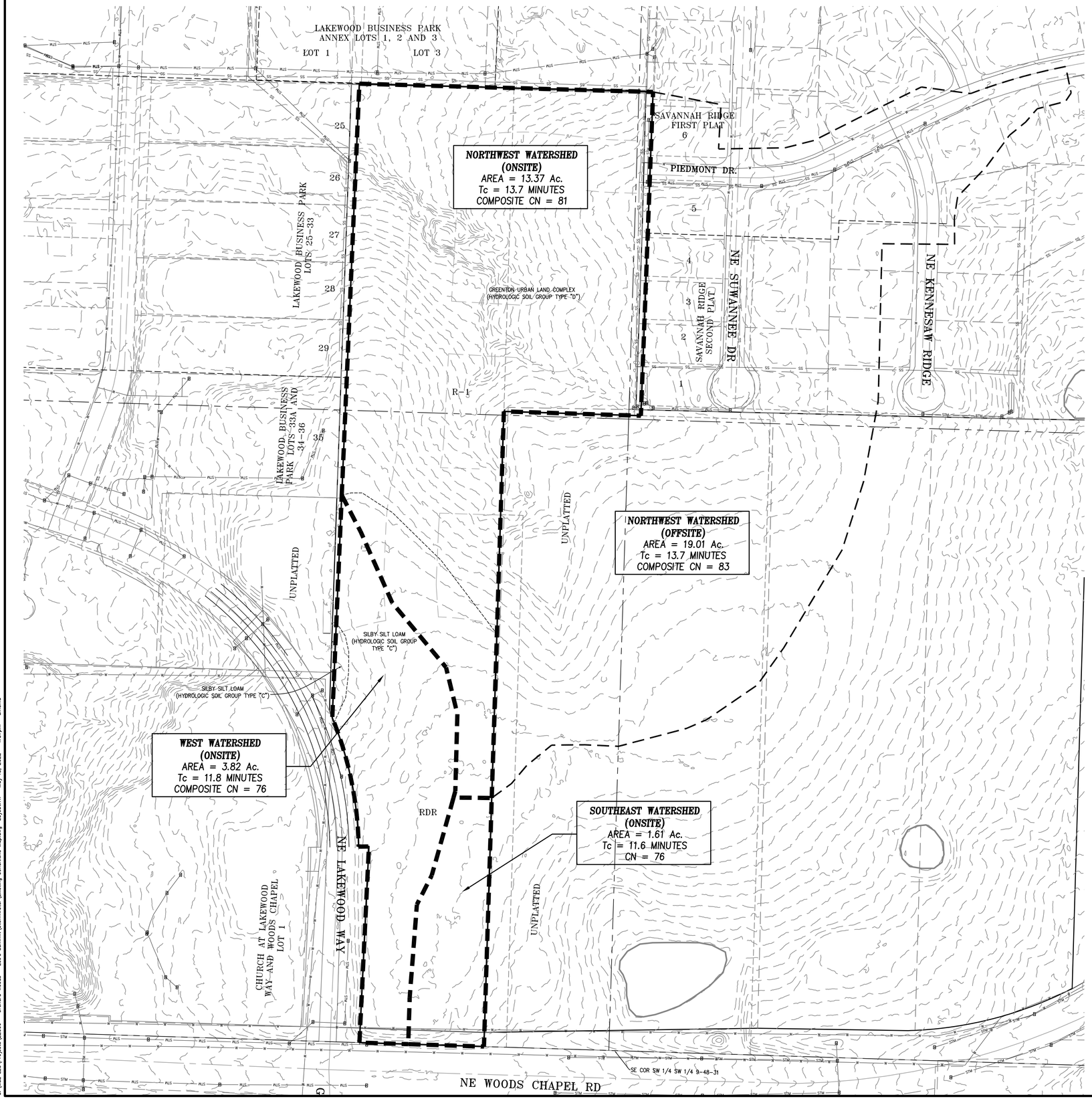
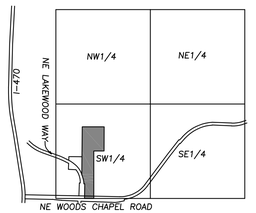


LEGEND

- EXISTING CONTOURS
- SOIL TYPE BOUNDARY
- DRAINAGE BOUNDARY

FLOOD NOTE:

THIS PROPERTY LIES WITHIN ZONE X, DEFINED AS AREAS DETERMINED TO BE OUTSIDE THE 0.2% ANNUAL CHANCE FLOODPLAIN, AS SHOWN ON THE FLOOD INSURANCE RATE MAP PREPARED BY THE FEDERAL EMERGENCY MANAGEMENT AGENCY FOR THE CITY OF LEE'S SUMMIT, COMMUNITY NO. 290174, JACKSON COUNTY, MISSOURI, PANEL NO. 29095C0430G, AND DATED JANUARY 20, 2017.



VICINITY MAP
SEC. 9-48-31

SCALE: 1"=100'
0' 100' 200'

1" = 2000'

EXISTING DRAINAGE MAP

ORCHARD WOODS
LEE'S SUMMIT, MISSOURI

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PLANNING
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IMPLEMENTATION

No.	Date	Revisions:	By	App.

PROJECT NO. 211142
DATE: 5-13-22
DRAWN: DLM
CERTIFICATE OF AUTHORIZATION
LAND SURVEYING - LS-82
ENGINEERING - E-361

CERTIFICATE OF AUTHORIZATION
LAND SURVEYING- 2007001128
ENGINEERING-2007000208

SHEET
A1

LAKEWOOD BUSINESS PARK
ANNEX LOTS 1, 2 AND 3

LOT 1

LOT 3

EXTENDED DRY DETENTION BASIN

TRACT D

SAVANNAH RIDGE FIRST PLAT

PIEDMONT DR.

NORTHWEST WATERSHED BYPASS (ONSITE)
AREA = 0.26 Ac.
Tc = 5.0 MINUTES
CN = 80

NORTHWEST WATERSHED DETAINED (ONSITE)
AREA = 13.86 Ac.
Tc = 10.7 MINUTES
COMPOSITE CN = 86

LAKEWOOD BUSINESS PARK LOTS 25-33

NE SUWANNEE DR

SAVANNAH RIDGE SECOND PLAT

NE KENNESAW RIDGE

R-1

LAKEWOOD BUSINESS PARK LOTS 33A AND 34-36

TRACT C

TRACT B

UNPLATTED

NORTHWEST WATERSHED DETAINED (OFFSITE)
AREA = 19.01 Ac.
Tc = 13.7 MINUTES
COMPOSITE CN = 83

TRACT A

WEST WATERSHED (ONSITE)
AREA = 3.07 Ac.
Tc = 11.8 MINUTES
COMPOSITE CN = 76

RDR

SOUTHEAST WATERSHED (ONSITE)
AREA = 1.61 Ac.
Tc = 11.6 MINUTES
CN = 76

NE LAKEWOOD WAY

CHURCH AT LAKEWOOD WAY-AND WOODS CHAPEL LOT 1

SE COR SW 1/4 SW 1/4 9-48-31

NE WOODS CHAPEL RD

LEGEND

- EXISTING CONTOURS
- PROPOSED CONTOURS
- DRAINAGE BOUNDARY

FLOOD NOTE:

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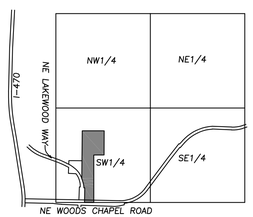
N

SCALE: 1"=100'
0' 100' 200'



VICINITY MAP
SEC. 9-48-31

N

1" = 2000'
0' 1000' 2000'

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PROPOSED DRAINAGE MAP

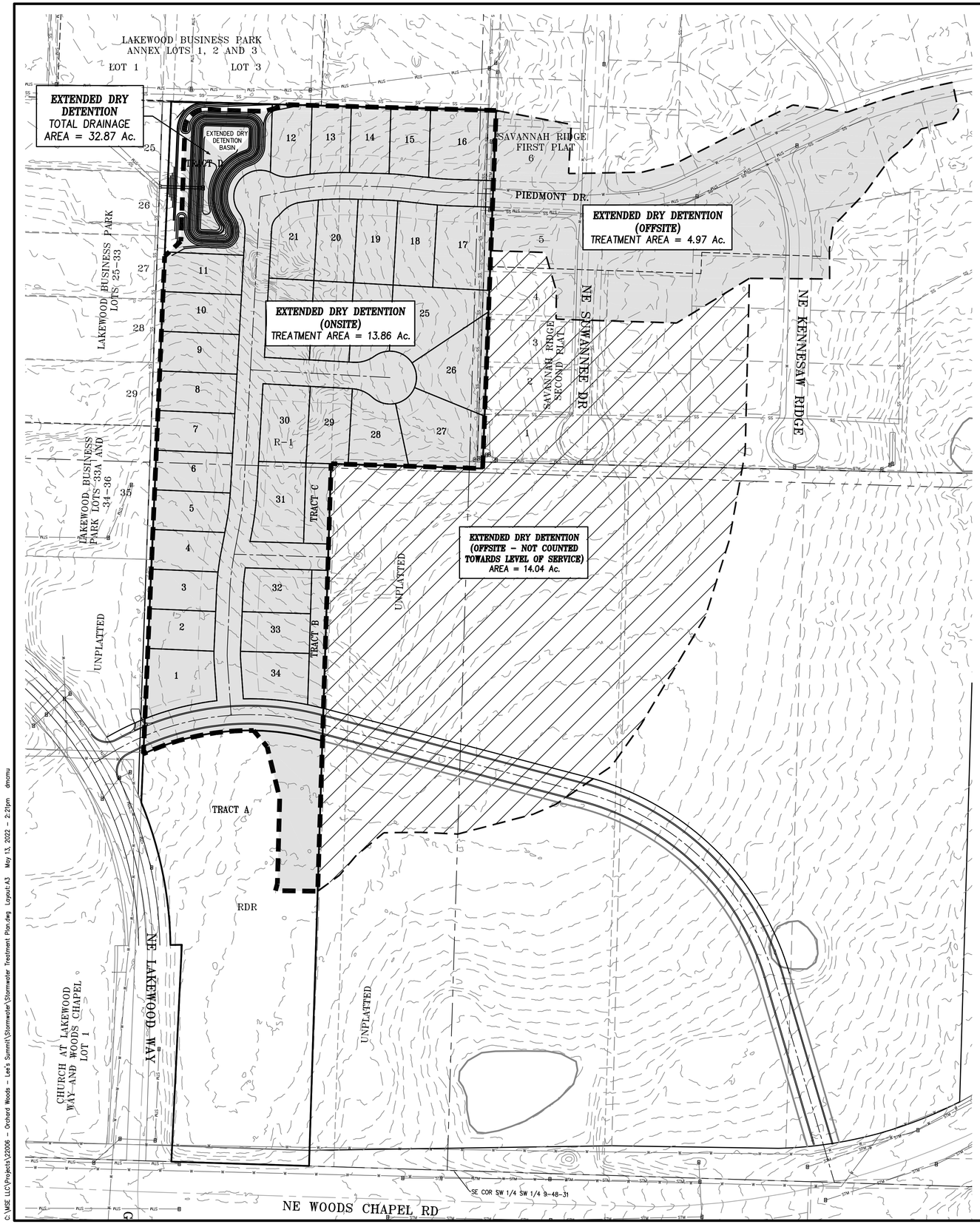
ORCHARD WOODS
LEE'S SUMMIT, MISSOURI

No.	Date	Revisions:	By	App.

PROJECT NO. 211142
DATE: 5-13-22
DRAWN: DLM
CERTIFICATE OF AUTHORIZATION LAND SURVEYING - LS-82
ENGINEERING - E-361
CERTIFICATE OF AUTHORIZATION LAND SURVEYING-2007030128
ENGINEERING-2007002308

SHEET
A2

C:\MSE LLC\Projects\22006 - Orchard Woods - Lee's Summit\Stormwater\Proposed Conditions Map.dwg Layout:A2 May 13, 2022 - 2:23pm dmcmu



WORKSHEET 1: REQUIRED LEVEL OF SERVICE - UNDEVELOPED SITE

Project: Orchard Woods — **By:** DLM — **Date:** 5/13/2022
Location: Lee's Summit — **Checked:** DEU — **Date:** 5/13/2022

1. **Runoff Curve Number**

A. **Predevelopment CN**

Cover Description	Soil HSG	CN	Area (ac.)	Product of CN x Area
Woods/Grass Combination (Fair)	C	76	1.8	136.8
Woods/Grass Combination (Fair)	D	82	11.75	963.5
			Totals:	13.55	1100.3

Area-Weighted CN = total product/total area = 81 (Round)

B. **Postdevelopment CN**

Cover Description	Soil HSG[1]	CN	Area (ac.)	Product of CN x Area
Single-Family Residential (1/3 acre/lot)	D	86	13.55	1165.3
			Totals:	13.55	1165.3

[1] Postdevelopment CN is one HSG higher for all cover types except preserved vegetation, absent documentation showing how postdevelopment soil structure will be preserved.

Area-Weighted CN = total product/total area = 86 (Round)

C. **Level of Service (LOS) Calculation**

Predevelopment CN:	81
Postdevelopment CN:	86
Difference:	5
LOS Requirec:	5.7

WORKSHEET 2: DEVELOP MITIGATION PACKAGE(S) THAT MEETS REQUIRED LOS

Project: Orchard Woods — **By:** DLM — **Date:** 5/13/2022
Location: Lee's Summit — **Checked:** DEU — **Date:** 5/13/2022
Sheet 1 of 1

1. **Required LOS (from Table 1 or 1A or Worksheet 1 or 1A, as appropriate):** 5.7

Note: Various BMPs may alter CN of proposed development, and LS; recalculate both if applicable.

2. **Proposed BMP Option Package No.** 1

ID	BMP / Cover Description	Treatment Area, ac.	VR[1]	Product of VR x Area
EDD-1	Extended Dry Detention or Equiva	18.83 (13.86 acres in-site, 4.97 acres offsite)	4.25	80.03
	Total[2]	18.83	Total VRs	80.03
			Proposed LOS	5.81	= total product/total area

[1] VR calculated for final BMP only in Treatment Train.
[2] Total treatment area cannot exceed 100 percent of the actual site area.

2) **Meets required LOS (Yes/No)?** YES (If No, or if additional options are being tested, move to next sheet.)

LEGEND

- EXISTING CONTOURS
- PROPOSED CONTOURS
- DRAINAGE BOUNDARY
- EXTENDED DRY DETENTION TREATMENT AREA (COUNTED TOWARDS LEVEL OF SERVICE CALCULATION)
- EXTENDED DRY DETENTION TREATMENT AREA (NOT COUNTED TOWARDS PROPOSED LEVEL OF SERVICE CALCULATION)

FLOOD NOTE:

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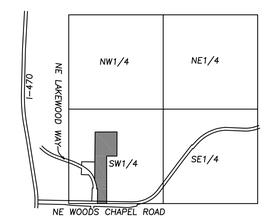
N

SCALE: 1"=100'
0' 100' 200'



VICINITY MAP
SEC. 9-48-31

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1" = 2000'

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STORMWATER TREATMENT PLAN

ORCHARD WOODS
LEE'S SUMMIT, MISSOURI

No.	Revisions:	Date	By	App.

PROJECT NO. 211142
DATE: 5-13-22
DRAWN: DLM
CERTIFICATE OF AUTHORIZATION LAND SURVEYING - LS-82
ENGINEERING - E-391

CERTIFICATE OF AUTHORIZATION
LAND SURVEYING-2007001128
ENGINEERING-2007000308

SHEET
A3

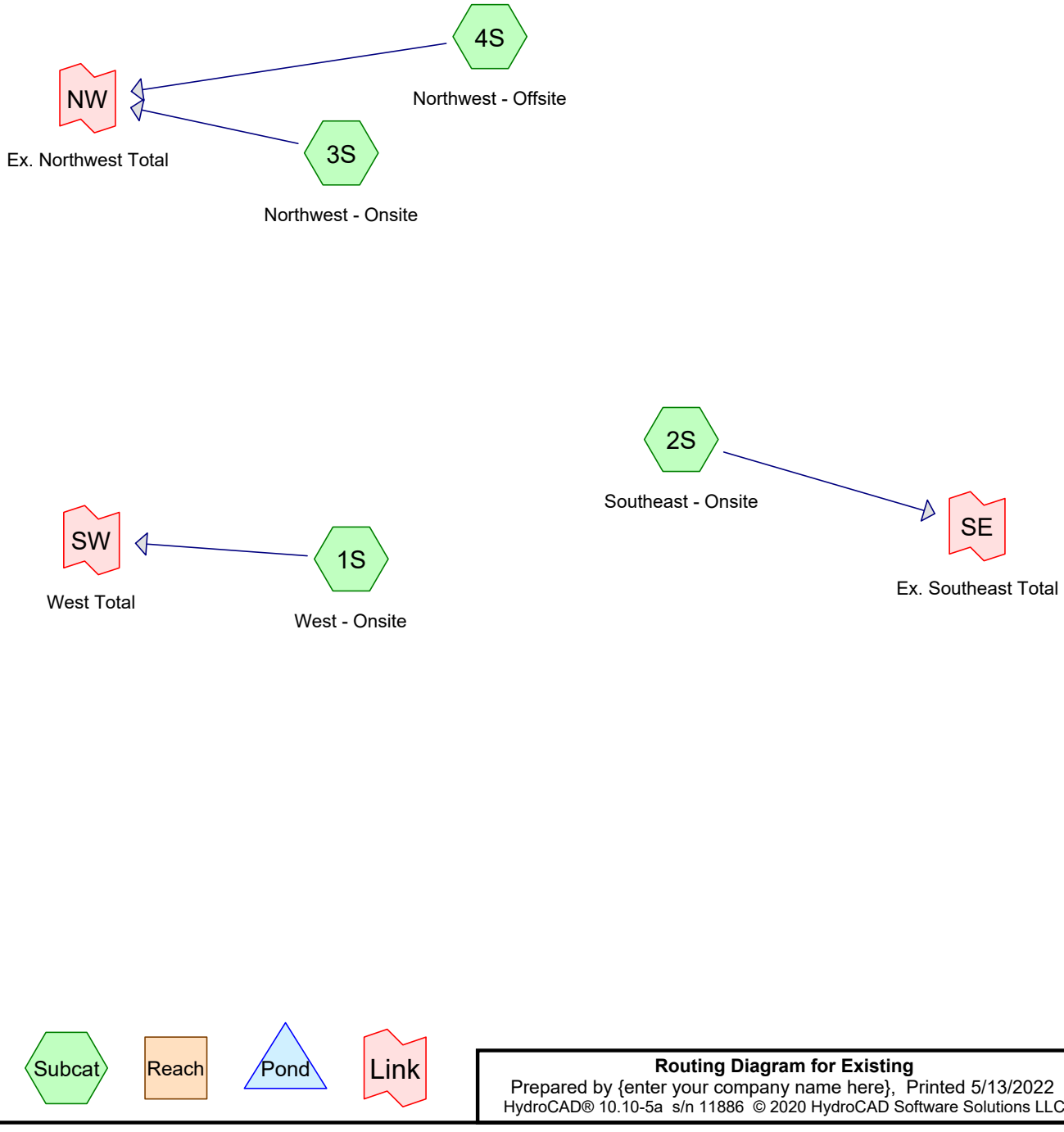
APPENDIX B

Details & Calculations

- Time of Concentration Calculations
- Existing HydroCAD Model Results
- Proposed HydroCAD Model Results
- Emergency Spillway Sizing
- Level of Service Worksheets 1 & 2
- Extended Dry Detention Sizing Calculations
- Extended Dry Detention

Time of Concentration Calculations								
Orchard Woods - EXISTING CONDITIONS								
	Overland Flow				Concentrated Flow			Total
Watershed	C	Distance (100' Max)	Slope (%)	T_I (min.)	Distance (feet)	Vel. (ft/sec)	T_T (min)	T_C (min)
Ex - NW	0.30	100	2.0	11.4	1400	10.0	2.3	13.7
Ex - NW (Off)	0.30	100	2.0	11.4	1400	10.0	2.3	13.7
Ex - W	0.30	100	2.0	11.4	230	10.0	0.4	11.8
Ex - SE	0.30	100	2.0	11.4	105	10.0	0.2	11.6

Time of Concentration Calculations								
Orchard Woods - PROPOSED CONDITIONS								
	Overland Flow				Concentrated Flow			Total
Watershed	C	Distance (100' Max)	Slope (%)	T_I (min.)	Distance (feet)	Vel. (ft/sec)	T_T (min)	T_C (min)
Prop - NW	0.51	100	2.0	8.4	1400	10.0	2.3	10.7
Prop - NW (Off)	0.30	100	2.0	11.4	1400	10.0	2.3	13.7
Prop - W	0.30	100	2.0	11.4	230	10.0	0.4	11.8
Prop - SE	0.30	100	2.0	11.4	105	10.0	0.2	11.6



Routing Diagram for Existing

Prepared by {enter your company name here}, Printed 5/13/2022

Rainfall Events Listing (selected events)

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	Jackson - 002 YR	Type II 24-hr		Default	24.00	1	3.50	2
2	Jackson - 10 YR	Type II 24-hr		Default	24.00	1	5.30	2
3	Jackson - 100 YR	Type II 24-hr		Default	24.00	1	7.70	2

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
8.530	86	1/3 acre lots, 30% imp, HSG D (4S)
10.480	80	>75% Grass cover, Good, HSG D (4S)
6.940	76	Woods/grass comb., Fair, HSG C (1S, 2S, 3S)
11.860	82	Woods/grass comb., Fair, HSG D (1S, 3S)
37.810	**81**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
6.940	HSG C	1S, 2S, 3S
30.870	HSG D	1S, 3S, 4S
0.000	Other	
37.810		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	0.000	0.000	8.530	0.000	8.530	1/3 acre lots, 30% imp	4S
0.000	0.000	0.000	10.480	0.000	10.480	>75% Grass cover, Good	4S
0.000	0.000	6.940	11.860	0.000	18.800	Woods/grass comb., Fair	1S, 2S, 3S
0.000	**0.000**	**6.940**	**30.870**	**0.000**	**37.810**	**TOTAL AREA**	

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

Subcatchment1S: West - Onsite Runoff Area=3.820 ac 0.00% Impervious Runoff Depth=1.37"
Tc=11.8 min CN=76 Runoff=7.47 cfs 0.435 af

Subcatchment2S: Southeast - Onsite Runoff Area=1.610 ac 0.00% Impervious Runoff Depth=1.37"
Tc=11.6 min CN=76 Runoff=3.17 cfs 0.183 af

Subcatchment3S: Northwest - Onsite Runoff Area=13.370 ac 0.00% Impervious Runoff Depth=1.71"
Tc=13.7 min CN=81 Runoff=30.90 cfs 1.904 af

Subcatchment4S: Northwest - Offsite Runoff Area=19.010 ac 13.46% Impervious Runoff Depth=1.86"
Tc=13.7 min CN=83 Runoff=47.80 cfs 2.944 af

Link NW: Ex. Northwest Total Inflow=78.70 cfs 4.848 af
Primary=78.70 cfs 4.848 af

Link SE: Ex. Southeast Total Inflow=3.17 cfs 0.183 af
Primary=3.17 cfs 0.183 af

Link SW: West Total Inflow=7.47 cfs 0.435 af
Primary=7.47 cfs 0.435 af

Total Runoff Area = 37.810 ac Runoff Volume = 5.466 af Average Runoff Depth = 1.73"
93.23% Pervious = 35.251 ac 6.77% Impervious = 2.559 ac

Summary for Subcatchment 1S: West - Onsite

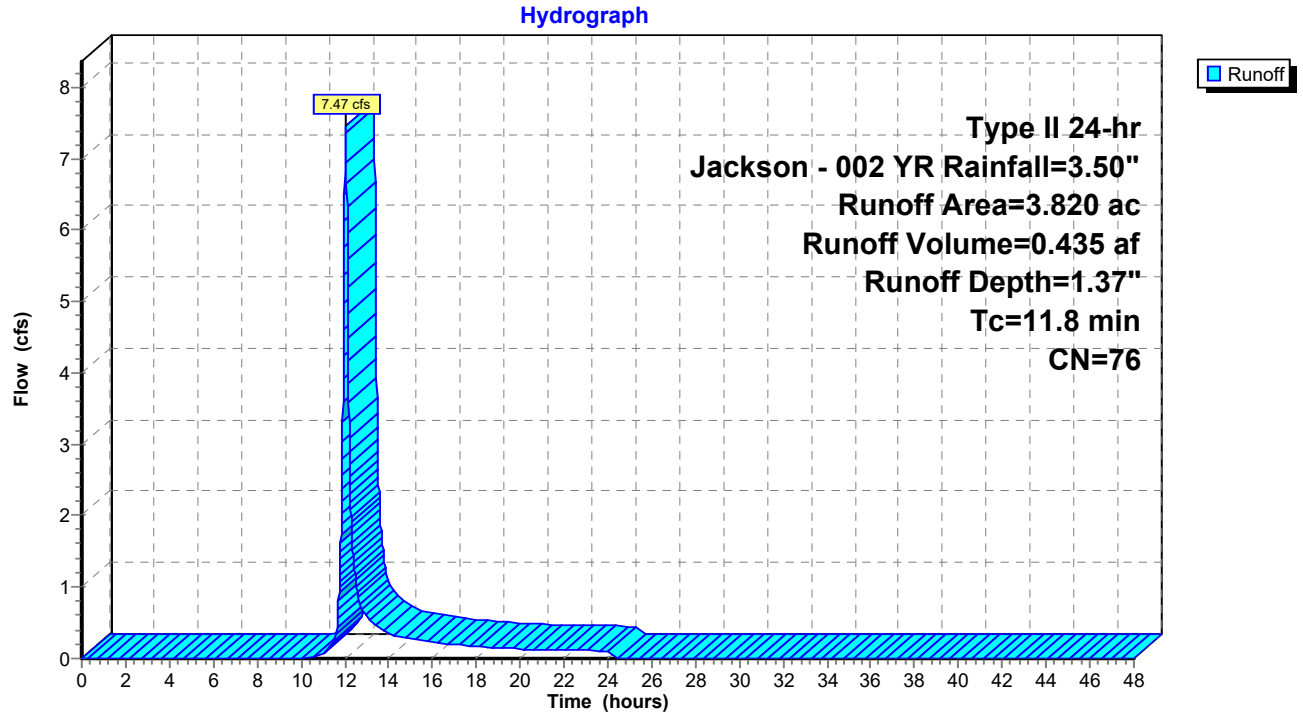
Runoff = 7.47 cfs @ 12.04 hrs, Volume= 0.435 af, Depth= 1.37"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type II 24-hr Jackson - 002 YR Rainfall=3.50"

Area (ac)	CN	Description
3.720	76	Woods/grass comb., Fair, HSG C
0.100	82	Woods/grass comb., Fair, HSG D
3.820	76	Weighted Average
3.820		100.00% Pervious Area

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

Subcatchment 1S: West - Onsite



Summary for Subcatchment 2S: Southeast - Onsite

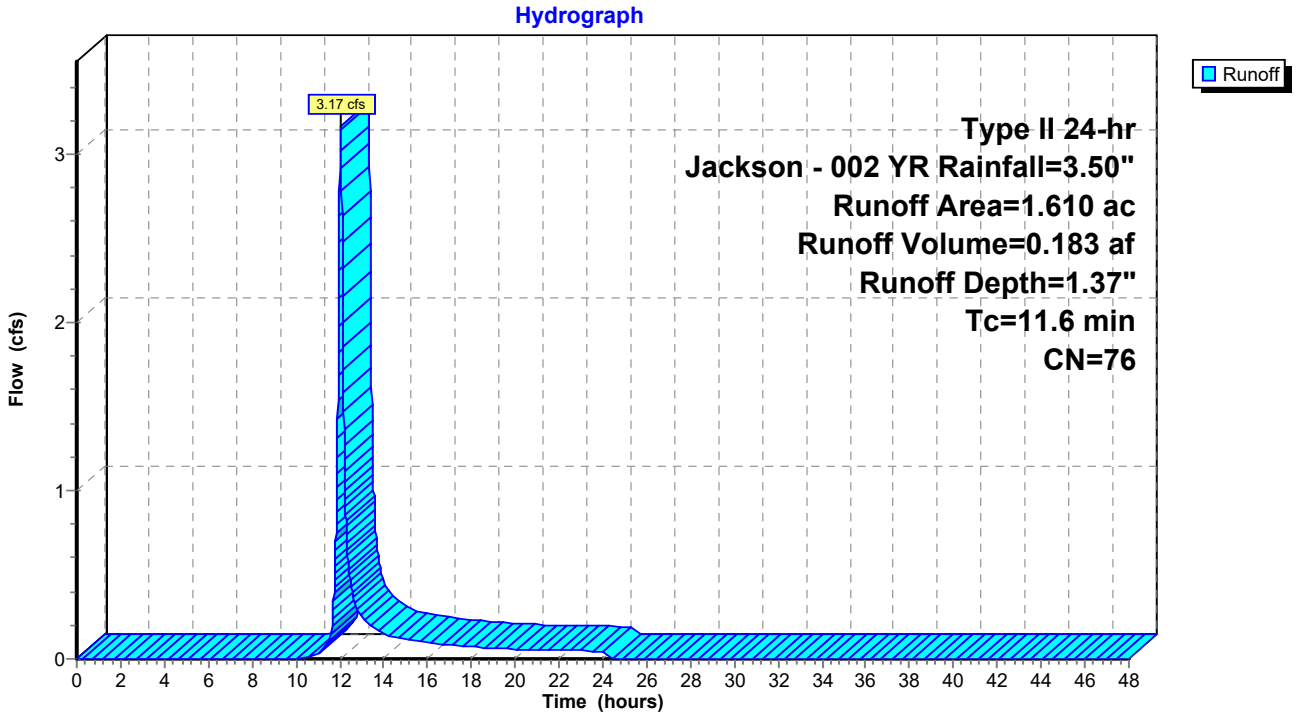
Runoff = 3.17 cfs @ 12.04 hrs, Volume= 0.183 af, Depth= 1.37"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type II 24-hr Jackson - 002 YR Rainfall=3.50"

Area (ac)	CN	Description
1.610	76	Woods/grass comb., Fair, HSG C
1.610		100.00% Pervious Area

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

Subcatchment 2S: Southeast - Onsite



Summary for Subcatchment 3S: Northwest - Onsite

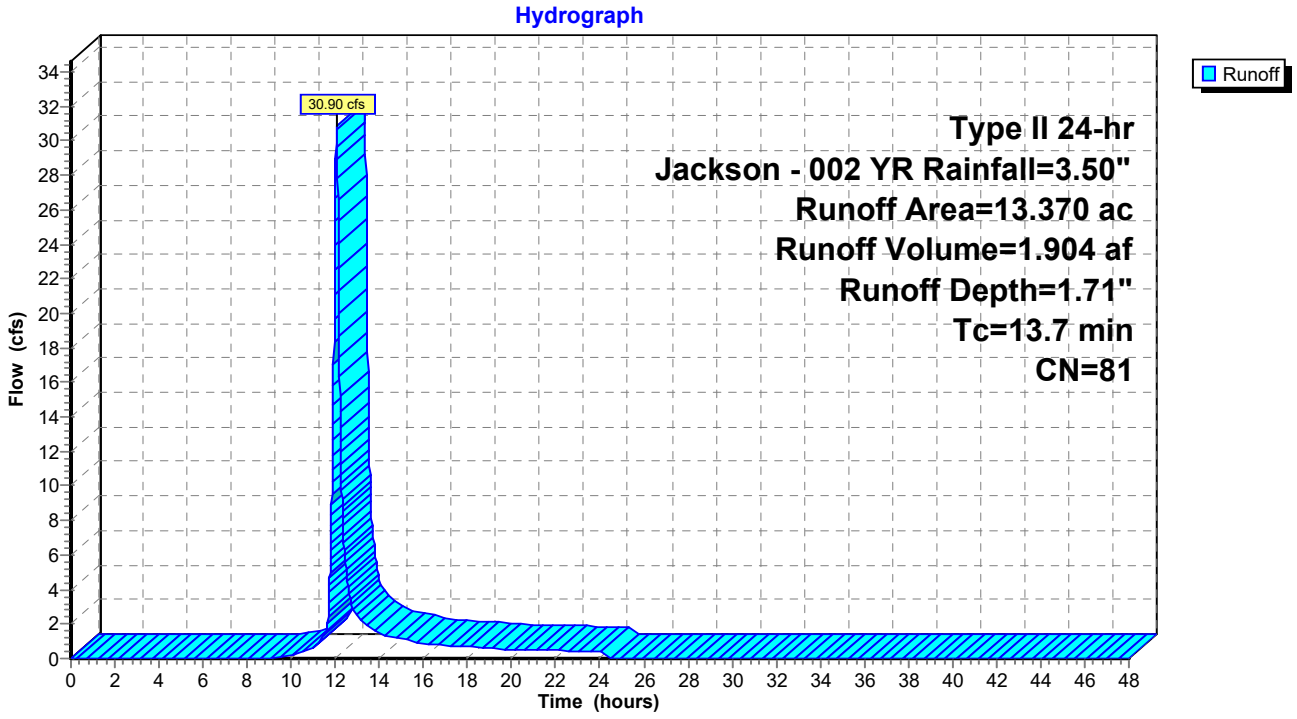
Runoff = 30.90 cfs @ 12.06 hrs, Volume= 1.904 af, Depth= 1.71"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type II 24-hr Jackson - 002 YR Rainfall=3.50"

Area (ac)	CN	Description
1.610	76	Woods/grass comb., Fair, HSG C
11.760	82	Woods/grass comb., Fair, HSG D
13.370	81	Weighted Average
13.370		100.00% Pervious Area

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

Subcatchment 3S: Northwest - Onsite



Summary for Subcatchment 4S: Northwest - Offsite

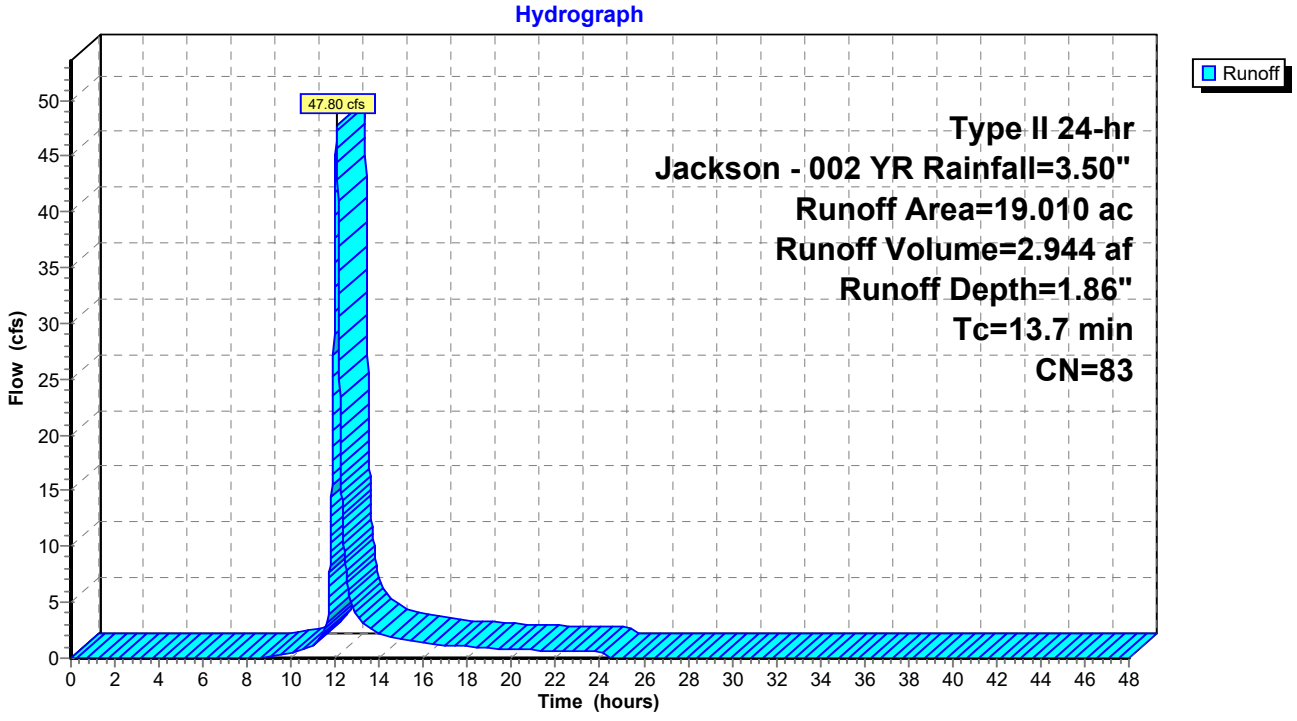
Runoff = 47.80 cfs @ 12.06 hrs, Volume= 2.944 af, Depth= 1.86"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type II 24-hr Jackson - 002 YR Rainfall=3.50"

Area (ac)	CN	Description
10.480	80	>75% Grass cover, Good, HSG D
8.530	86	1/3 acre lots, 30% imp, HSG D
19.010	83	Weighted Average
16.451		86.54% Pervious Area
2.559		13.46% Impervious Area

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

Subcatchment 4S: Northwest - Offsite

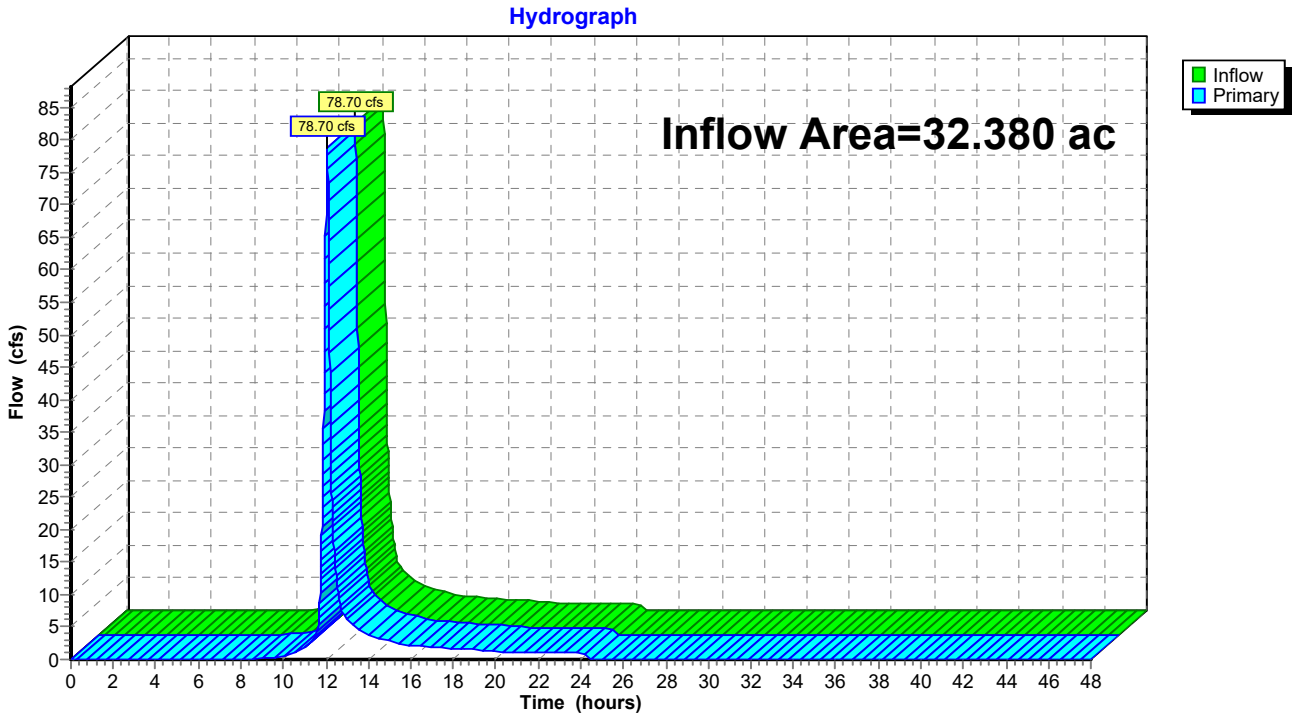


Summary for Link NW: Ex. Northwest Total

Inflow Area = 32.380 ac, 7.90% Impervious, Inflow Depth = 1.80" for Jackson - 002 YR event
Inflow = 78.70 cfs @ 12.06 hrs, Volume= 4.848 af
Primary = 78.70 cfs @ 12.06 hrs, Volume= 4.848 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link NW: Ex. Northwest Total

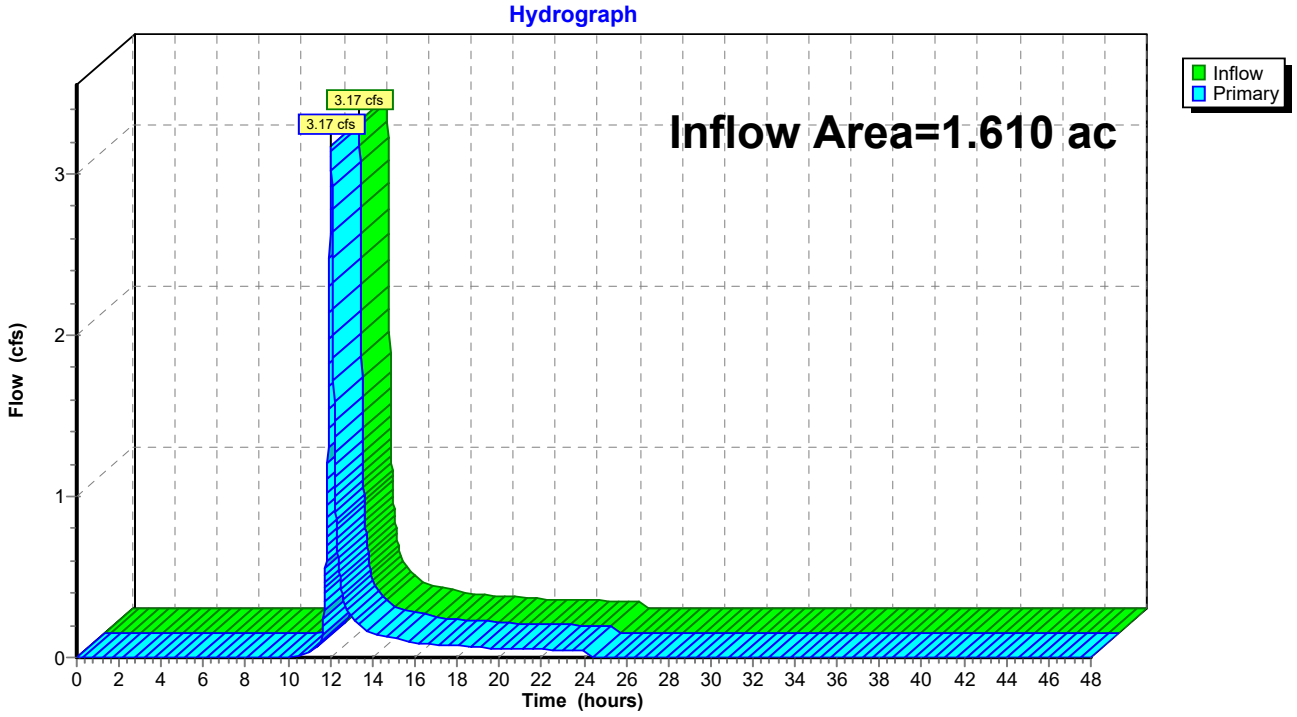


Summary for Link SE: Ex. Southeast Total

Inflow Area = 1.610 ac, 0.00% Impervious, Inflow Depth = 1.37" for Jackson - 002 YR event
Inflow = 3.17 cfs @ 12.04 hrs, Volume= 0.183 af
Primary = 3.17 cfs @ 12.04 hrs, Volume= 0.183 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link SE: Ex. Southeast Total

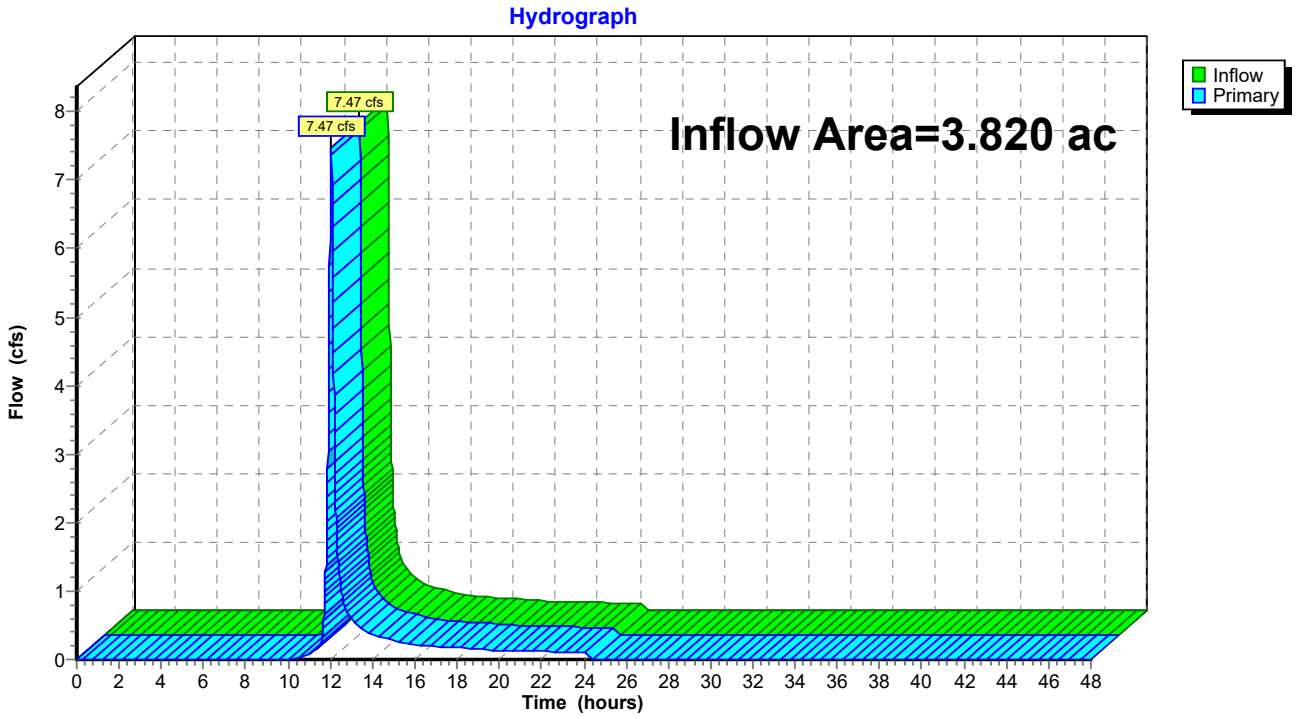


Summary for Link SW: West Total

Inflow Area = 3.820 ac, 0.00% Impervious, Inflow Depth = 1.37" for Jackson - 002 YR event
Inflow = 7.47 cfs @ 12.04 hrs, Volume= 0.435 af
Primary = 7.47 cfs @ 12.04 hrs, Volume= 0.435 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link SW: West Total



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

Subcatchment1S: West - Onsite Runoff Area=3.820 ac 0.00% Impervious Runoff Depth=2.78"
Tc=11.8 min CN=76 Runoff=15.36 cfs 0.886 af

Subcatchment2S: Southeast - Onsite Runoff Area=1.610 ac 0.00% Impervious Runoff Depth=2.78"
Tc=11.6 min CN=76 Runoff=6.52 cfs 0.374 af

Subcatchment3S: Northwest - Onsite Runoff Area=13.370 ac 0.00% Impervious Runoff Depth=3.25"
Tc=13.7 min CN=81 Runoff=58.45 cfs 3.623 af

Subcatchment4S: Northwest - Offsite Runoff Area=19.010 ac 13.46% Impervious Runoff Depth=3.45"
Tc=13.7 min CN=83 Runoff=87.59 cfs 5.460 af

Link NW: Ex. Northwest Total Inflow=146.03 cfs 9.083 af
Primary=146.03 cfs 9.083 af

Link SE: Ex. Southeast Total Inflow=6.52 cfs 0.374 af
Primary=6.52 cfs 0.374 af

Link SW: West Total Inflow=15.36 cfs 0.886 af
Primary=15.36 cfs 0.886 af

Total Runoff Area = 37.810 ac Runoff Volume = 10.343 af Average Runoff Depth = 3.28"
93.23% Pervious = 35.251 ac 6.77% Impervious = 2.559 ac

Summary for Subcatchment 1S: West - Onsite

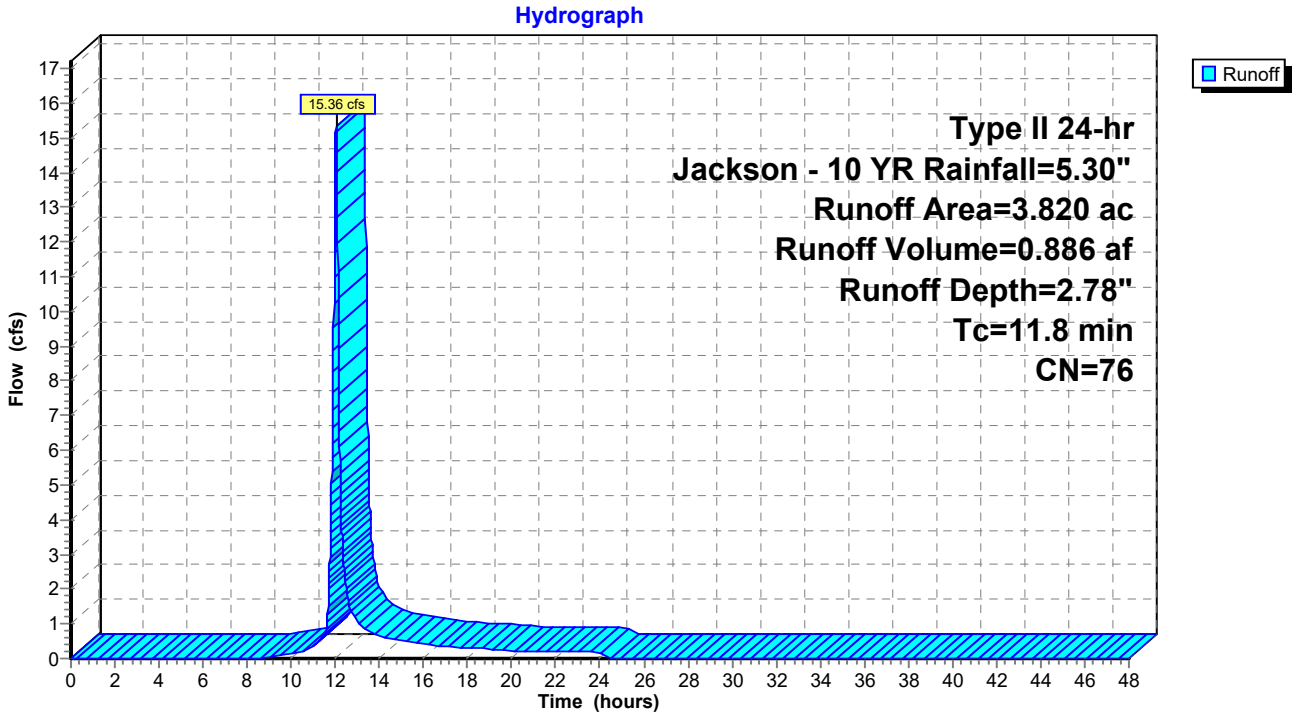
Runoff = 15.36 cfs @ 12.04 hrs, Volume= 0.886 af, Depth= 2.78"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type II 24-hr Jackson - 10 YR Rainfall=5.30"

Area (ac)	CN	Description
3.720	76	Woods/grass comb., Fair, HSG C
0.100	82	Woods/grass comb., Fair, HSG D
3.820	76	Weighted Average
3.820		100.00% Pervious Area

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

Subcatchment 1S: West - Onsite



Summary for Subcatchment 2S: Southeast - Onsite

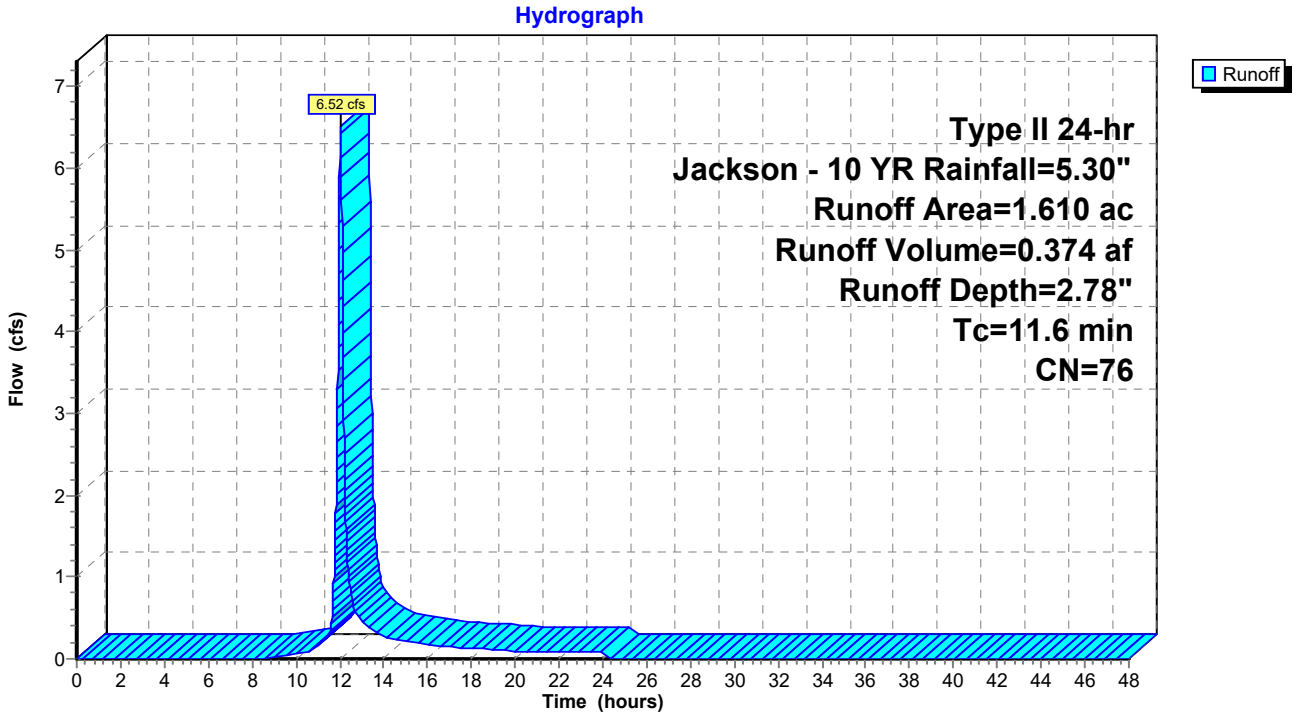
Runoff = 6.52 cfs @ 12.03 hrs, Volume= 0.374 af, Depth= 2.78"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type II 24-hr Jackson - 10 YR Rainfall=5.30"

Area (ac)	CN	Description
1.610	76	Woods/grass comb., Fair, HSG C
1.610		100.00% Pervious Area

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

Subcatchment 2S: Southeast - Onsite



Summary for Subcatchment 3S: Northwest - Onsite

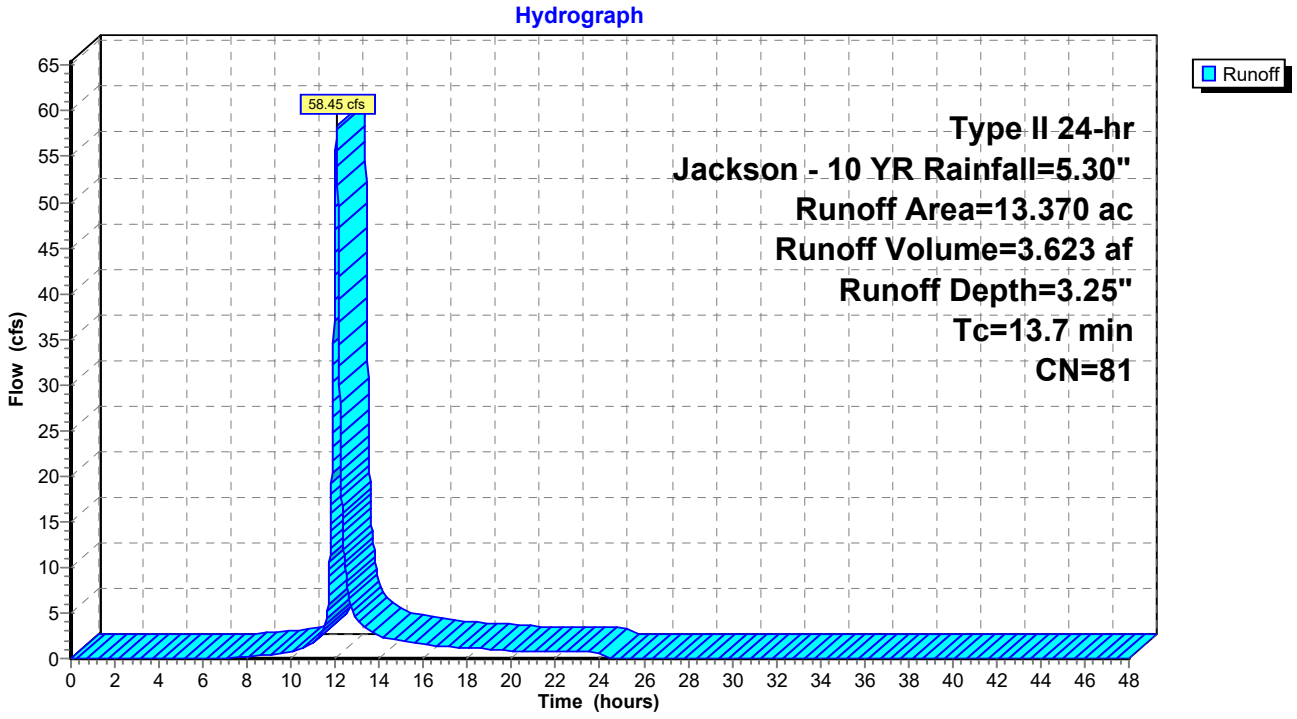
Runoff = 58.45 cfs @ 12.06 hrs, Volume= 3.623 af, Depth= 3.25"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type II 24-hr Jackson - 10 YR Rainfall=5.30"

Area (ac)	CN	Description
1.610	76	Woods/grass comb., Fair, HSG C
11.760	82	Woods/grass comb., Fair, HSG D
13.370	81	Weighted Average
13.370		100.00% Pervious Area

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

Subcatchment 3S: Northwest - Onsite



Summary for Subcatchment 4S: Northwest - Offsite

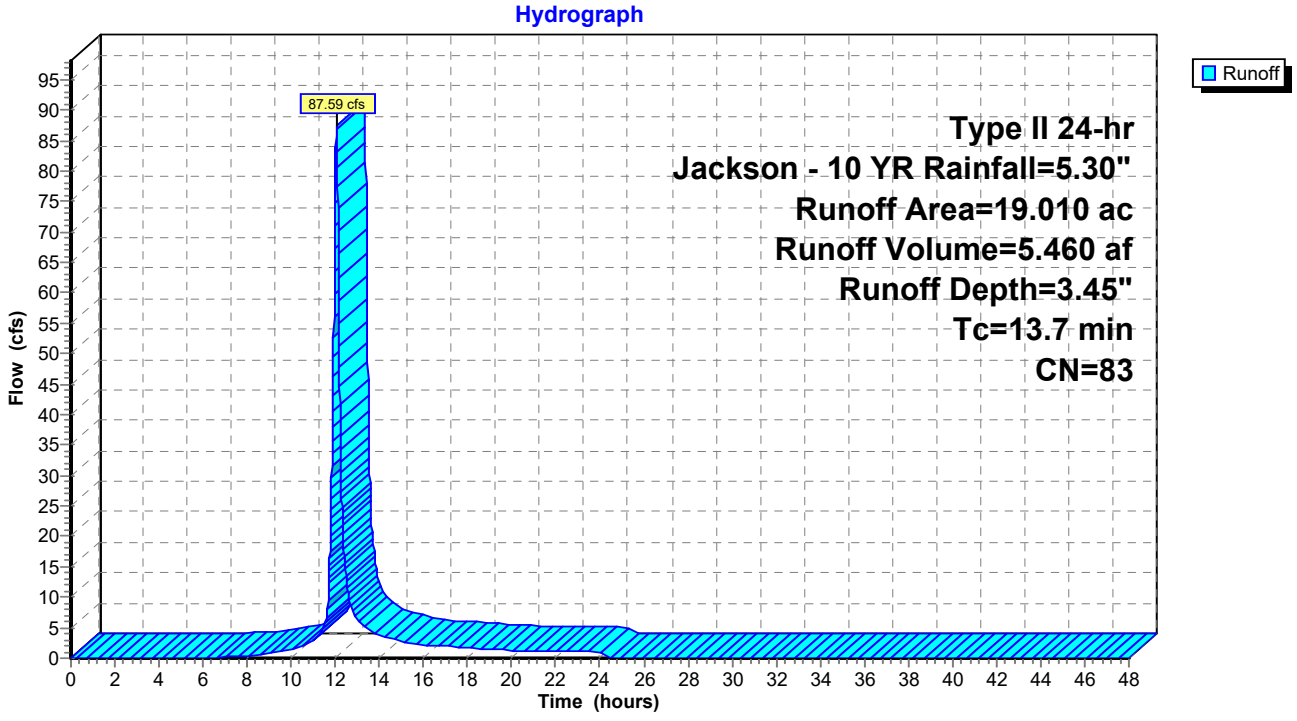
Runoff = 87.59 cfs @ 12.05 hrs, Volume= 5.460 af, Depth= 3.45"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type II 24-hr Jackson - 10 YR Rainfall=5.30"

Area (ac)	CN	Description
10.480	80	>75% Grass cover, Good, HSG D
8.530	86	1/3 acre lots, 30% imp, HSG D
19.010	83	Weighted Average
16.451		86.54% Pervious Area
2.559		13.46% Impervious Area

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

Subcatchment 4S: Northwest - Offsite

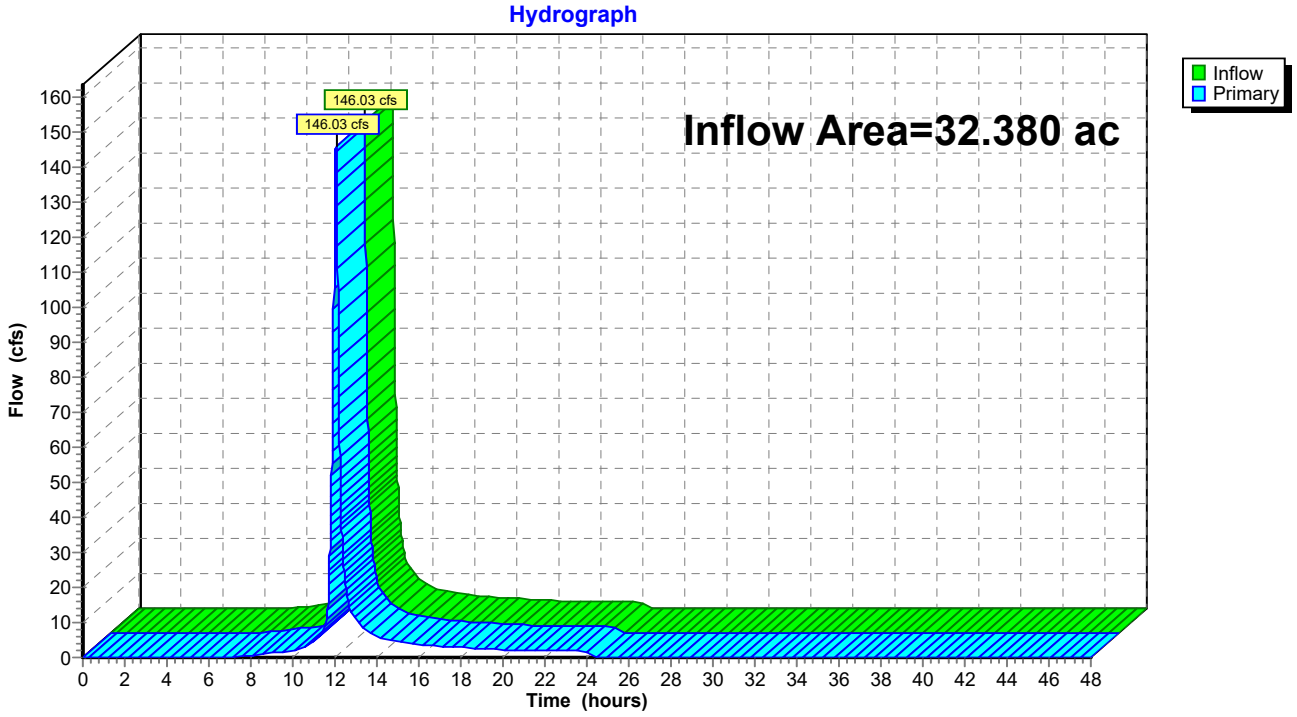


Summary for Link NW: Ex. Northwest Total

Inflow Area = 32.380 ac, 7.90% Impervious, Inflow Depth = 3.37" for Jackson - 10 YR event
Inflow = 146.03 cfs @ 12.05 hrs, Volume= 9.083 af
Primary = 146.03 cfs @ 12.05 hrs, Volume= 9.083 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link NW: Ex. Northwest Total

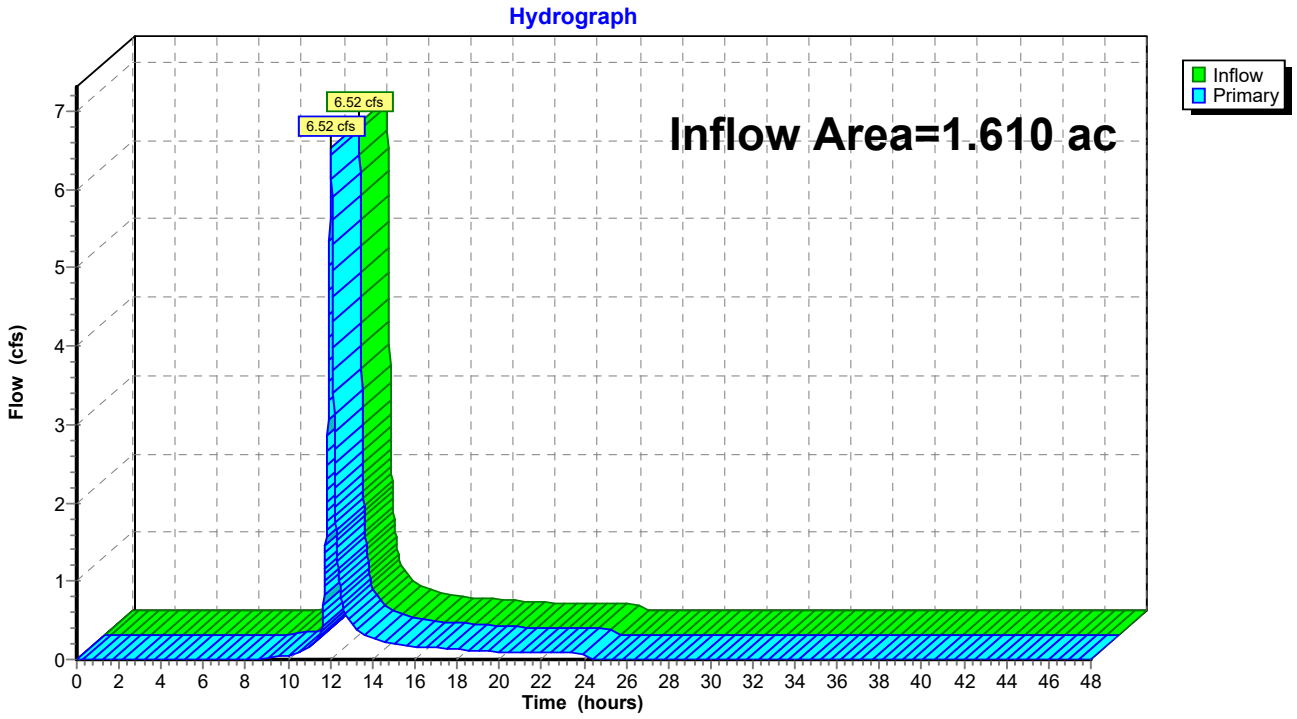


Summary for Link SE: Ex. Southeast Total

Inflow Area = 1.610 ac, 0.00% Impervious, Inflow Depth = 2.78" for Jackson - 10 YR event
Inflow = 6.52 cfs @ 12.03 hrs, Volume= 0.374 af
Primary = 6.52 cfs @ 12.03 hrs, Volume= 0.374 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link SE: Ex. Southeast Total

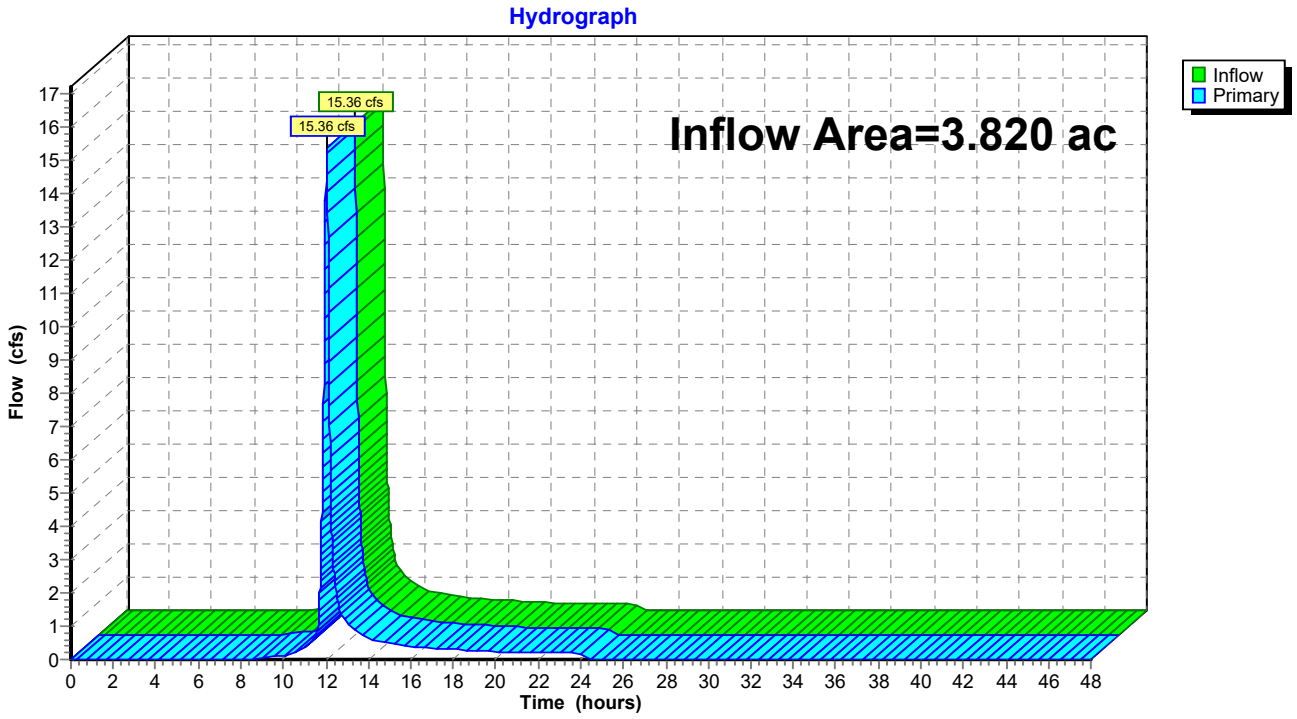


Summary for Link SW: West Total

Inflow Area = 3.820 ac, 0.00% Impervious, Inflow Depth = 2.78" for Jackson - 10 YR event
Inflow = 15.36 cfs @ 12.04 hrs, Volume= 0.886 af
Primary = 15.36 cfs @ 12.04 hrs, Volume= 0.886 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link SW: West Total



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

Subcatchment1S: West - Onsite Runoff Area=3.820 ac 0.00% Impervious Runoff Depth=4.89"
Tc=11.8 min CN=76 Runoff=26.64 cfs 1.555 af

Subcatchment2S: Southeast - Onsite Runoff Area=1.610 ac 0.00% Impervious Runoff Depth=4.89"
Tc=11.6 min CN=76 Runoff=11.31 cfs 0.655 af

Subcatchment3S: Northwest - Onsite Runoff Area=13.370 ac 0.00% Impervious Runoff Depth=5.46"
Tc=13.7 min CN=81 Runoff=96.37 cfs 6.083 af

Subcatchment4S: Northwest - Offsite Runoff Area=19.010 ac 13.46% Impervious Runoff Depth=5.69"
Tc=13.7 min CN=83 Runoff=141.67 cfs 9.016 af

Link NW: Ex. Northwest Total Inflow=238.04 cfs 15.099 af
Primary=238.04 cfs 15.099 af

Link SE: Ex. Southeast Total Inflow=11.31 cfs 0.655 af
Primary=11.31 cfs 0.655 af

Link SW: West Total Inflow=26.64 cfs 1.555 af
Primary=26.64 cfs 1.555 af

Total Runoff Area = 37.810 ac Runoff Volume = 17.310 af Average Runoff Depth = 5.49"
93.23% Pervious = 35.251 ac 6.77% Impervious = 2.559 ac

Summary for Subcatchment 1S: West - Onsite

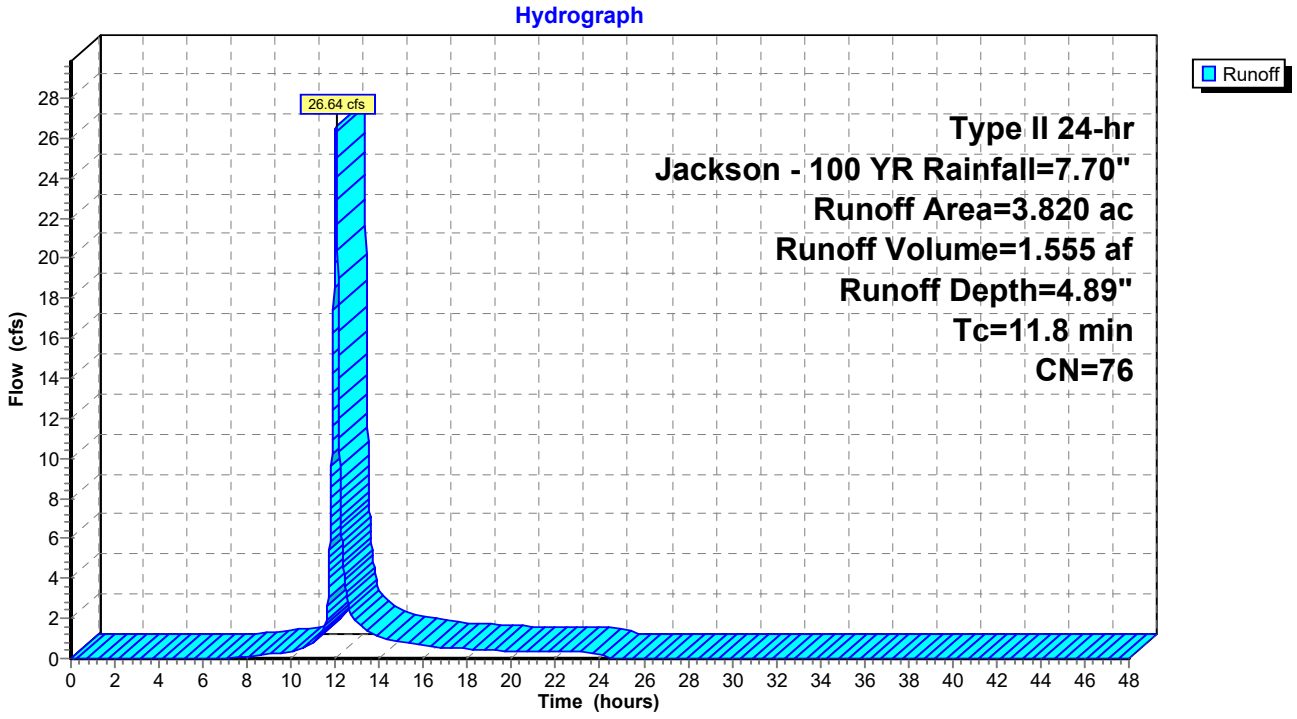
Runoff = 26.64 cfs @ 12.03 hrs, Volume= 1.555 af, Depth= 4.89"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type II 24-hr Jackson - 100 YR Rainfall=7.70"

Area (ac)	CN	Description
3.720	76	Woods/grass comb., Fair, HSG C
0.100	82	Woods/grass comb., Fair, HSG D
3.820	76	Weighted Average
3.820		100.00% Pervious Area

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

Subcatchment 1S: West - Onsite



Summary for Subcatchment 2S: Southeast - Onsite

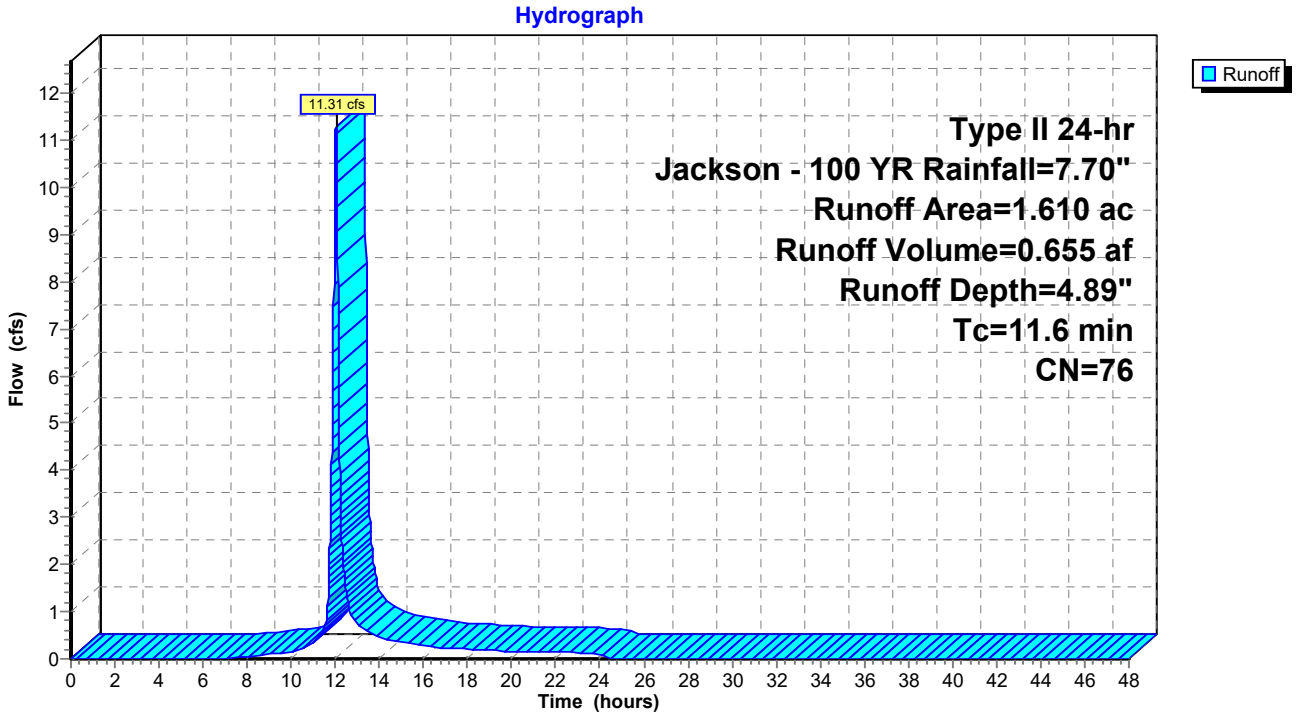
Runoff = 11.31 cfs @ 12.03 hrs, Volume= 0.655 af, Depth= 4.89"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type II 24-hr Jackson - 100 YR Rainfall=7.70"

Area (ac)	CN	Description
1.610	76	Woods/grass comb., Fair, HSG C
1.610		100.00% Pervious Area

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

Subcatchment 2S: Southeast - Onsite



Summary for Subcatchment 3S: Northwest - Onsite

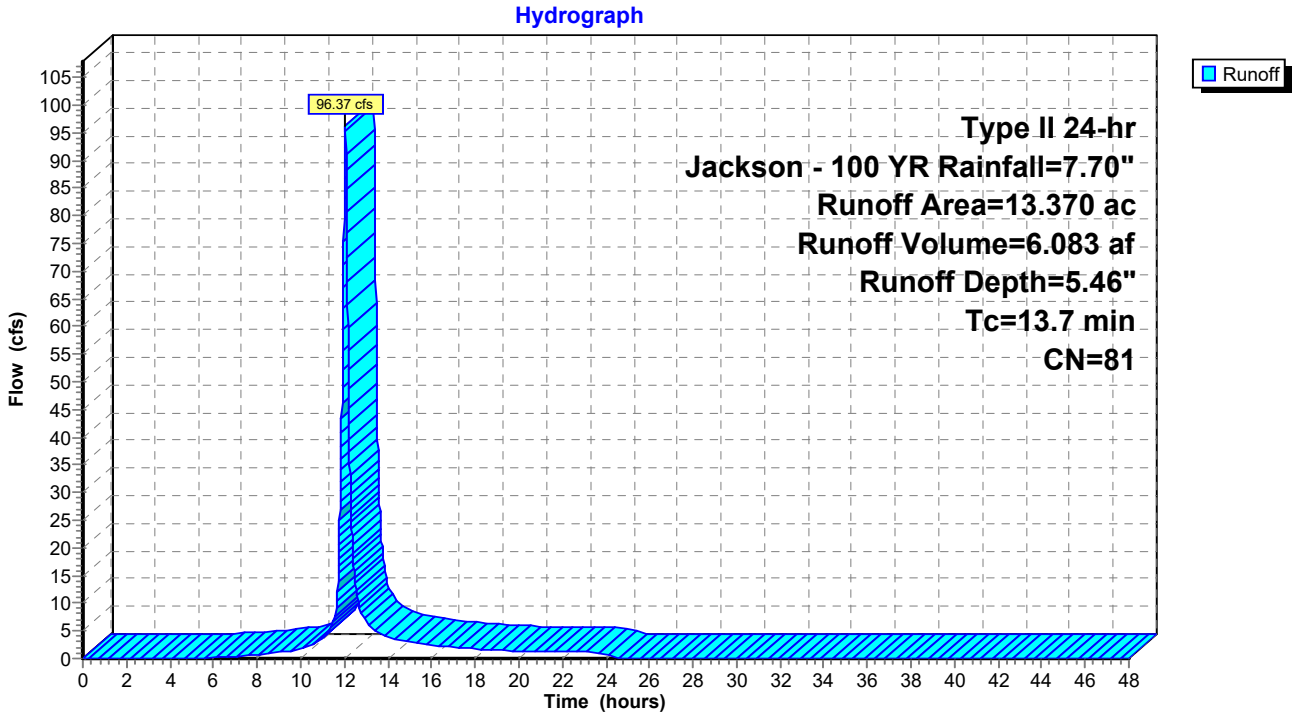
Runoff = 96.37 cfs @ 12.05 hrs, Volume= 6.083 af, Depth= 5.46"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type II 24-hr Jackson - 100 YR Rainfall=7.70"

Area (ac)	CN	Description
1.610	76	Woods/grass comb., Fair, HSG C
11.760	82	Woods/grass comb., Fair, HSG D
13.370	81	Weighted Average
13.370		100.00% Pervious Area

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

Subcatchment 3S: Northwest - Onsite



Summary for Subcatchment 4S: Northwest - Offsite

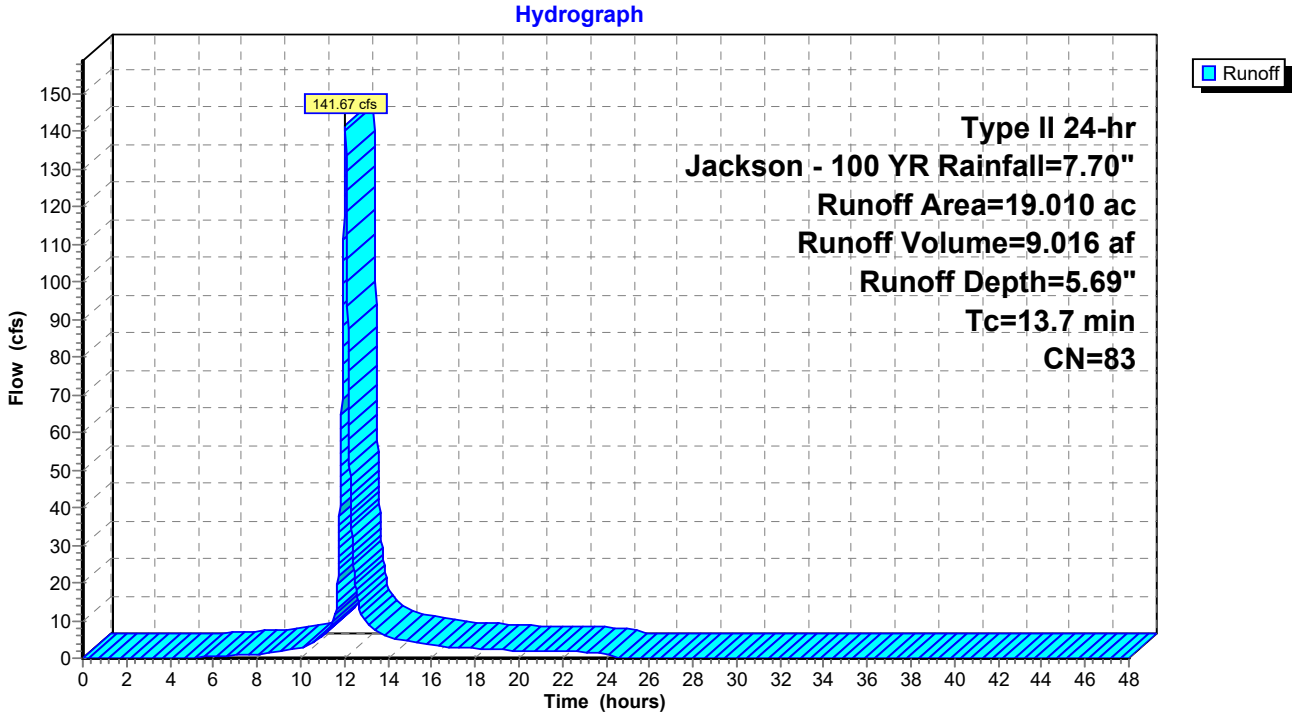
Runoff = 141.67 cfs @ 12.05 hrs, Volume= 9.016 af, Depth= 5.69"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type II 24-hr Jackson - 100 YR Rainfall=7.70"

Area (ac)	CN	Description
10.480	80	>75% Grass cover, Good, HSG D
8.530	86	1/3 acre lots, 30% imp, HSG D
19.010	83	Weighted Average
16.451		86.54% Pervious Area
2.559		13.46% Impervious Area

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

Subcatchment 4S: Northwest - Offsite

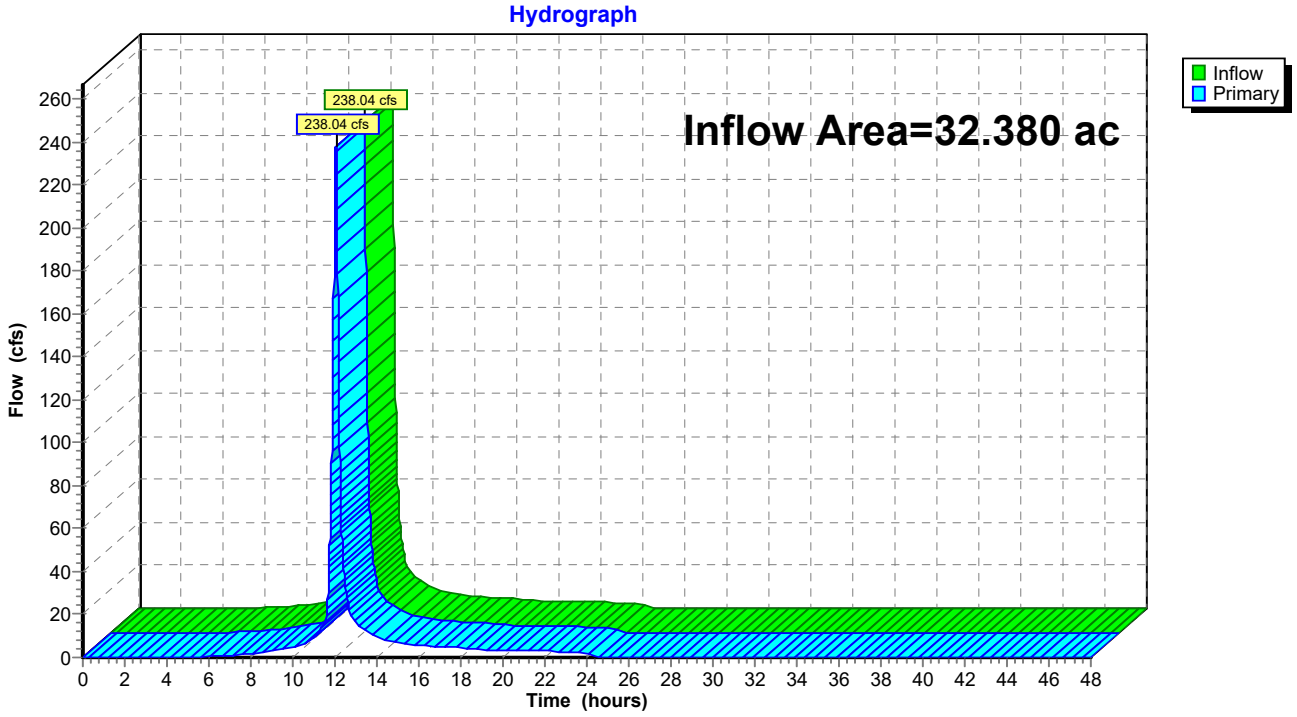


Summary for Link NW: Ex. Northwest Total

Inflow Area = 32.380 ac, 7.90% Impervious, Inflow Depth = 5.60" for Jackson - 100 YR event
Inflow = 238.04 cfs @ 12.05 hrs, Volume= 15.099 af
Primary = 238.04 cfs @ 12.05 hrs, Volume= 15.099 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link NW: Ex. Northwest Total

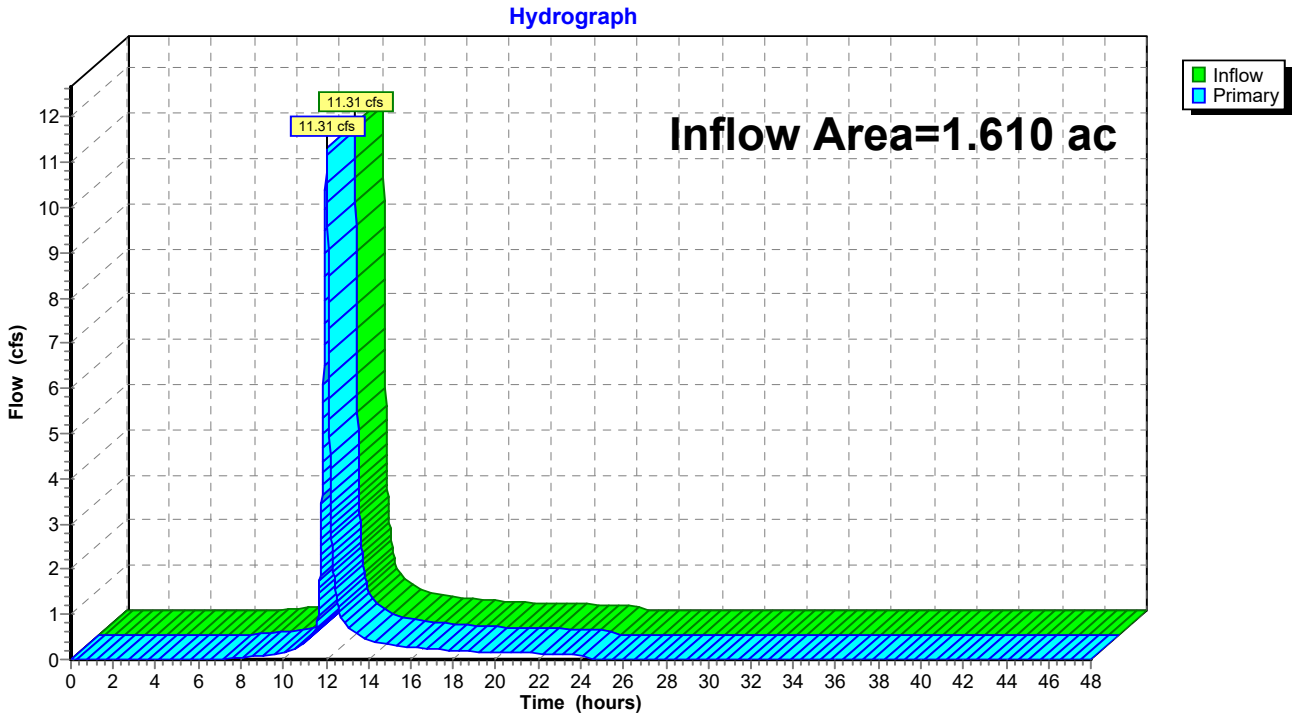


Summary for Link SE: Ex. Southeast Total

Inflow Area = 1.610 ac, 0.00% Impervious, Inflow Depth = 4.89" for Jackson - 100 YR event
Inflow = 11.31 cfs @ 12.03 hrs, Volume= 0.655 af
Primary = 11.31 cfs @ 12.03 hrs, Volume= 0.655 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link SE: Ex. Southeast Total

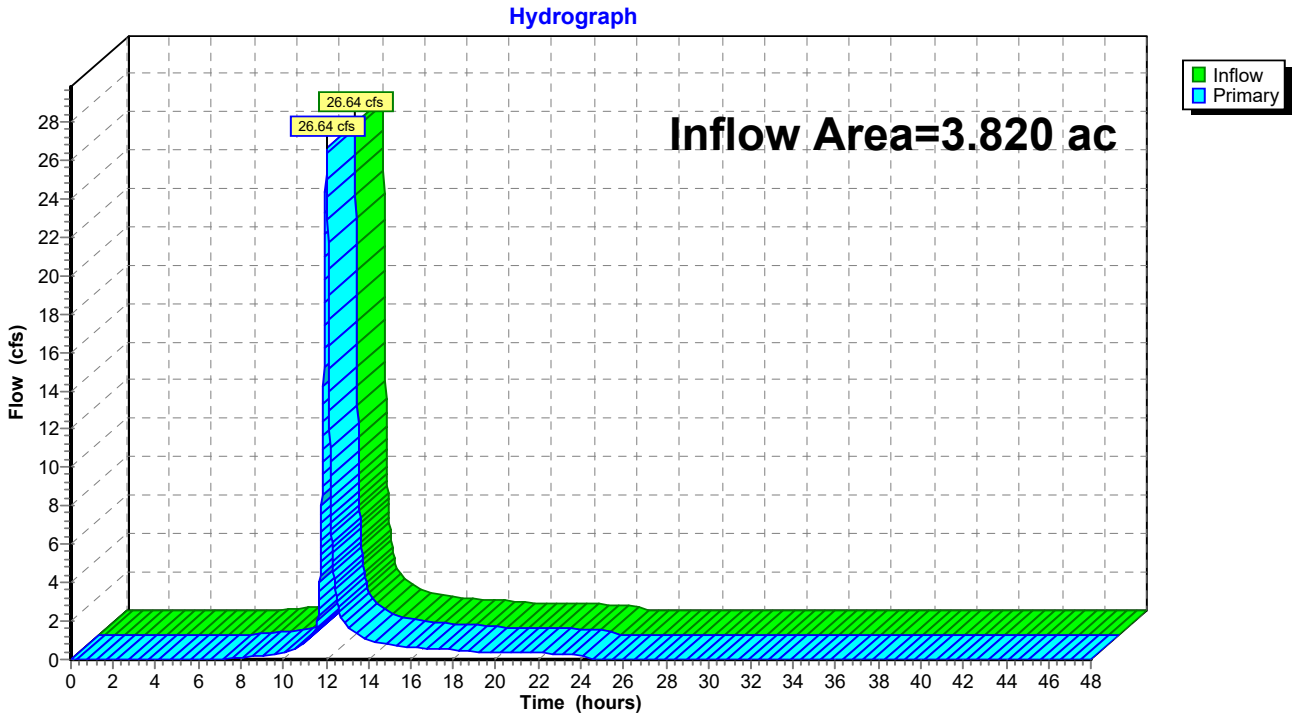


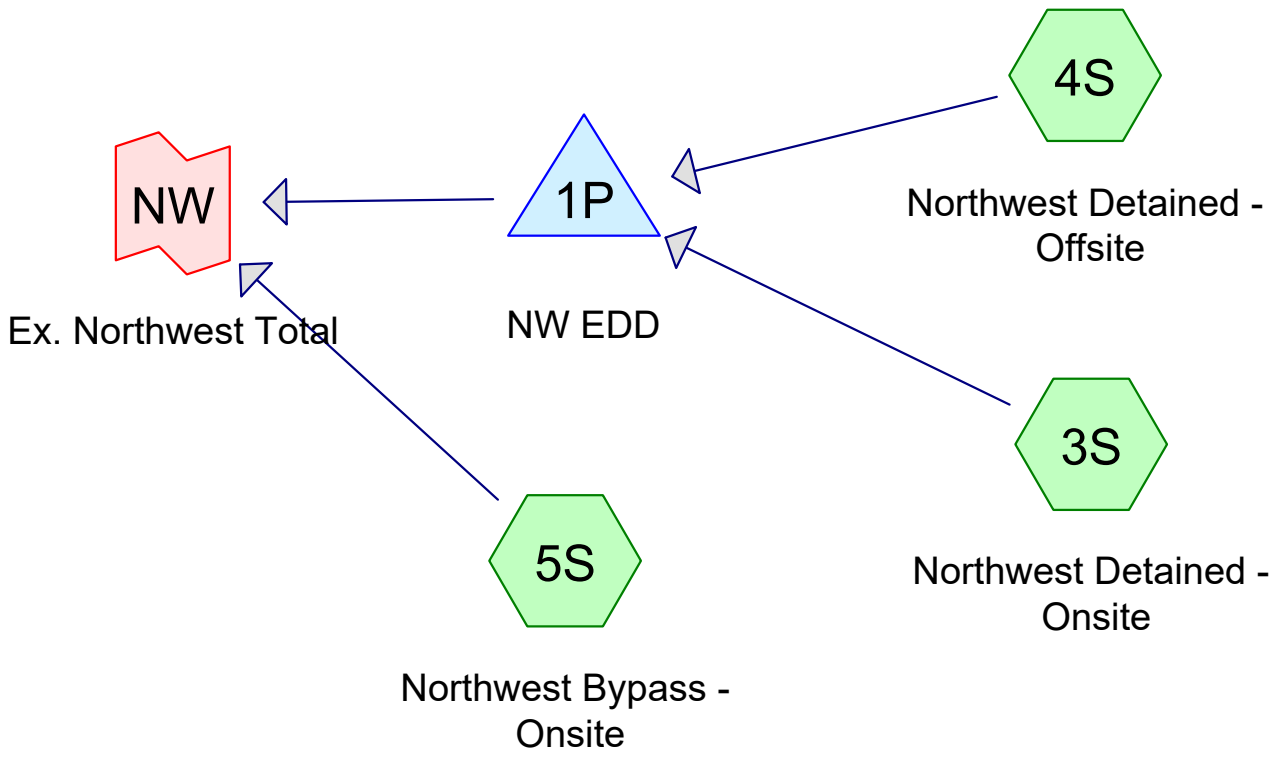
Summary for Link SW: West Total

Inflow Area = 3.820 ac, 0.00% Impervious, Inflow Depth = 4.89" for Jackson - 100 YR event
Inflow = 26.64 cfs @ 12.03 hrs, Volume= 1.555 af
Primary = 26.64 cfs @ 12.03 hrs, Volume= 1.555 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link SW: West Total





Subcat Reach Pond Link

Routing Diagram for Proposed - Orchard Woods
Prepared by {enter your company name here}, Printed 6/14/2022

Rainfall Events Listing (selected events)

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	Jackson - 002 YR	Type II 24-hr		Default	24.00	1	3.50	2
2	Jackson - 10 YR	Type II 24-hr		Default	24.00	1	5.30	2
3	Jackson - 100 YR	Type II 24-hr		Default	24.00	1	7.70	2

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
22.080	86	1/3 acre lots, 30% imp, HSG D (3S, 4S)
0.260	80	>75% Grass cover, Good, HSG D (5S)
10.480	80	Pasture/grassland/range, Good, HSG D (4S)
0.570	76	Woods/grass comb., Fair, HSG C (3S)
33.390	**84**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
0.570	HSG C	3S
32.820	HSG D	3S, 4S, 5S
0.000	Other	
33.390		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	0.000	0.000	22.080	0.000	22.080	1/3 acre lots, 30% imp	3S , 4S
0.000	0.000	0.000	0.260	0.000	0.260	>75% Grass cover, Good	5S
0.000	0.000	0.000	10.480	0.000	10.480	Pasture/grassland/range, Good	4S
0.000	0.000	0.570	0.000	0.000	0.570	Woods/grass comb., Fair	3S
0.000	**0.000**	**0.570**	**32.820**	**0.000**	**33.390**	**TOTAL AREA**	

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Width (inches)	Diam/Height (inches)	Inside-Fill (inches)
1	1P	995.80	993.50	80.0	0.0287	0.013	0.0	48.0	0.0

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

Subcatchment3S: Northwest Detained - Runoff Area=14.120 ac 28.79% Impervious Runoff Depth=2.10"
Tc=10.7 min CN=86 Runoff=44.21 cfs 2.469 af

Subcatchment4S: Northwest Detained - Runoff Area=19.010 ac 13.46% Impervious Runoff Depth=1.86"
Tc=13.7 min CN=83 Runoff=47.80 cfs 2.944 af

Subcatchment5S: Northwest Bypass - Runoff Area=0.260 ac 0.00% Impervious Runoff Depth=1.64"
Tc=5.0 min CN=80 Runoff=0.79 cfs 0.035 af

Pond 1P: NW EDD Peak Elev=1,002.57' Storage=1.280 af Inflow=90.81 cfs 5.413 af
Outflow=52.41 cfs 5.413 af

Link NW: Ex. Northwest Total Inflow=52.53 cfs 5.449 af
Primary=52.53 cfs 5.449 af

Total Runoff Area = 33.390 ac Runoff Volume = 5.449 af Average Runoff Depth = 1.96"
80.16% Pervious = 26.766 ac 19.84% Impervious = 6.624 ac

Summary for Subcatchment 3S: Northwest Detained - Onsite

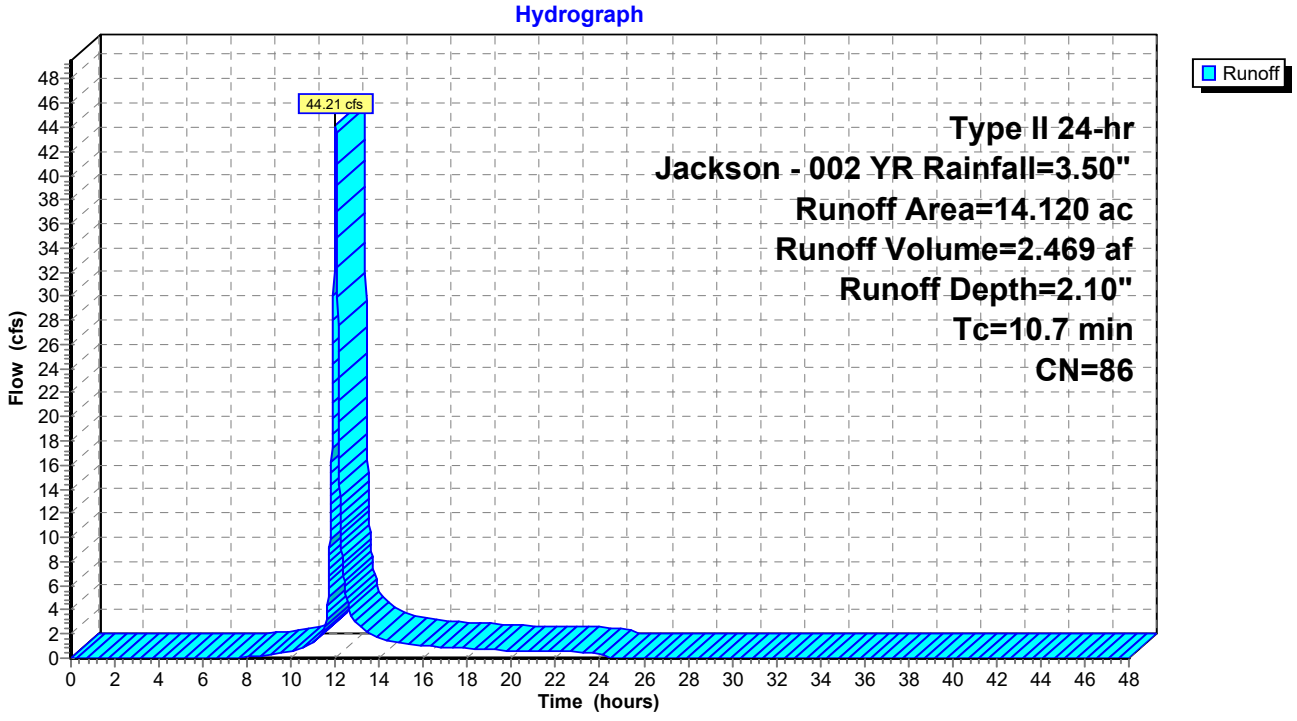
Runoff = 44.21 cfs @ 12.02 hrs, Volume= 2.469 af, Depth= 2.10"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type II 24-hr Jackson - 002 YR Rainfall=3.50"

Area (ac)	CN	Description
0.570	76	Woods/grass comb., Fair, HSG C
13.550	86	1/3 acre lots, 30% imp, HSG D
14.120	86	Weighted Average
10.055		71.21% Pervious Area
4.065		28.79% Impervious Area

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

Subcatchment 3S: Northwest Detained - Onsite



Summary for Subcatchment 4S: Northwest Detained - Offsite

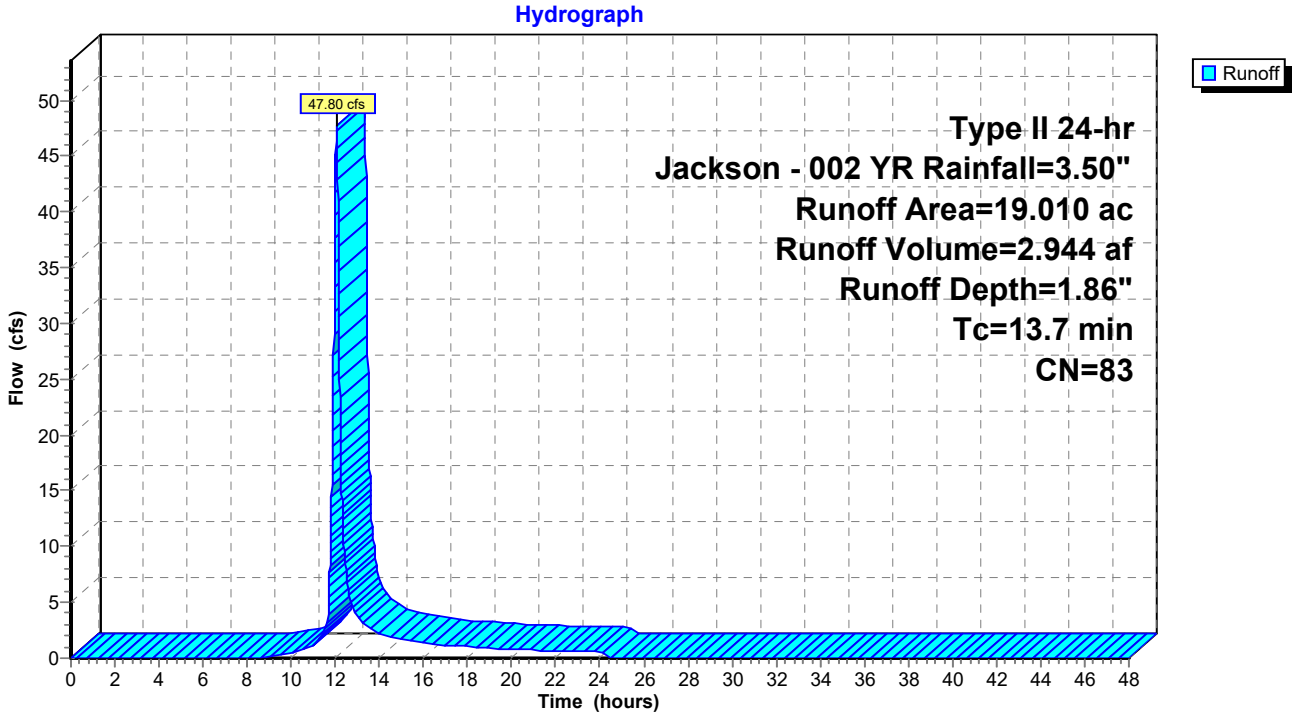
Runoff = 47.80 cfs @ 12.06 hrs, Volume= 2.944 af, Depth= 1.86"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type II 24-hr Jackson - 002 YR Rainfall=3.50"

Area (ac)	CN	Description
8.530	86	1/3 acre lots, 30% imp, HSG D
10.480	80	Pasture/grassland/range, Good, HSG D
19.010	83	Weighted Average
16.451		86.54% Pervious Area
2.559		13.46% Impervious Area

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

Subcatchment 4S: Northwest Detained - Offsite



Summary for Subcatchment 5S: Northwest Bypass - Onsite

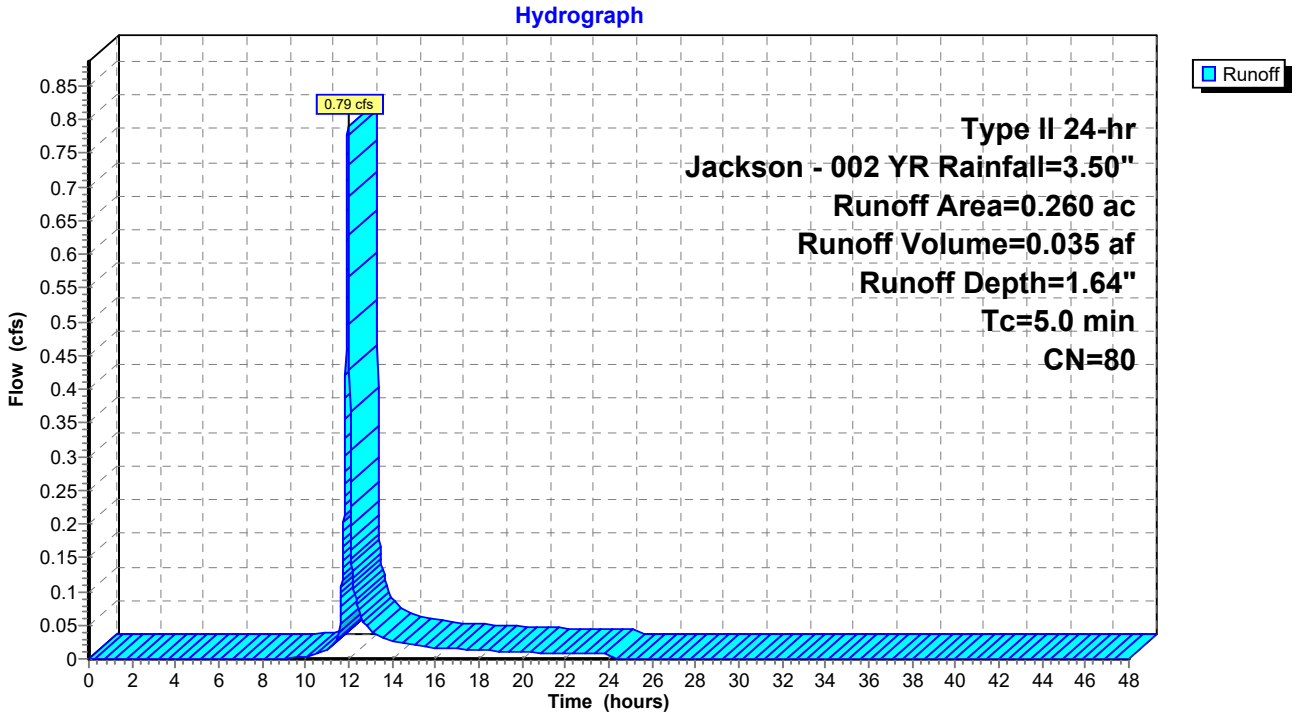
Runoff = 0.79 cfs @ 11.96 hrs, Volume= 0.035 af, Depth= 1.64"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type II 24-hr Jackson - 002 YR Rainfall=3.50"

Area (ac)	CN	Description
0.260	80	>75% Grass cover, Good, HSG D
0.260		100.00% Pervious Area

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

Subcatchment 5S: Northwest Bypass - Onsite



Summary for Pond 1P: NW EDD

Inflow Area = 33.130 ac, 19.99% Impervious, Inflow Depth = 1.96" for Jackson - 002 YR event
Inflow = 90.81 cfs @ 12.04 hrs, Volume= 5.413 af
Outflow = 52.41 cfs @ 12.16 hrs, Volume= 5.413 af, Atten= 42%, Lag= 7.2 min
Primary = 52.41 cfs @ 12.16 hrs, Volume= 5.413 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 1,002.57' @ 12.16 hrs Surf.Area= 0.360 ac Storage= 1.280 af

Plug-Flow detention time= 22.9 min calculated for 5.413 af (100% of inflow)
Center-of-Mass det. time= 22.7 min (849.7 - 826.9)

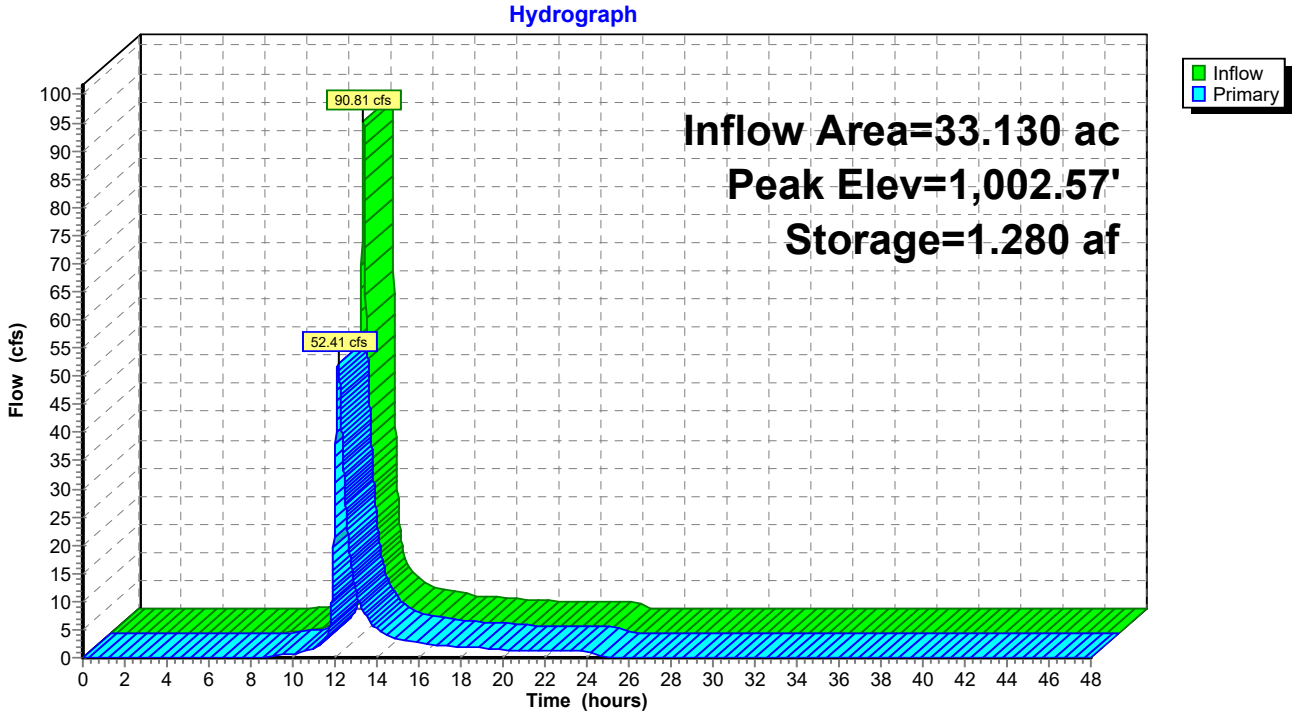
Volume	Invert	Avail.Storage	Storage Description
#1	996.00'	3.910 af	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
996.00	0.001	0.000	0.000
997.00	0.031	0.016	0.016
998.00	0.126	0.078	0.094
999.00	0.213	0.169	0.264
1,000.00	0.252	0.233	0.497
1,001.00	0.293	0.272	0.769
1,002.00	0.335	0.314	1.083
1,003.00	0.379	0.357	1.440
1,004.00	0.423	0.401	1.841
1,005.00	0.469	0.446	2.287
1,006.00	0.516	0.492	2.779
1,007.00	0.565	0.540	3.320
1,008.00	0.614	0.590	3.910

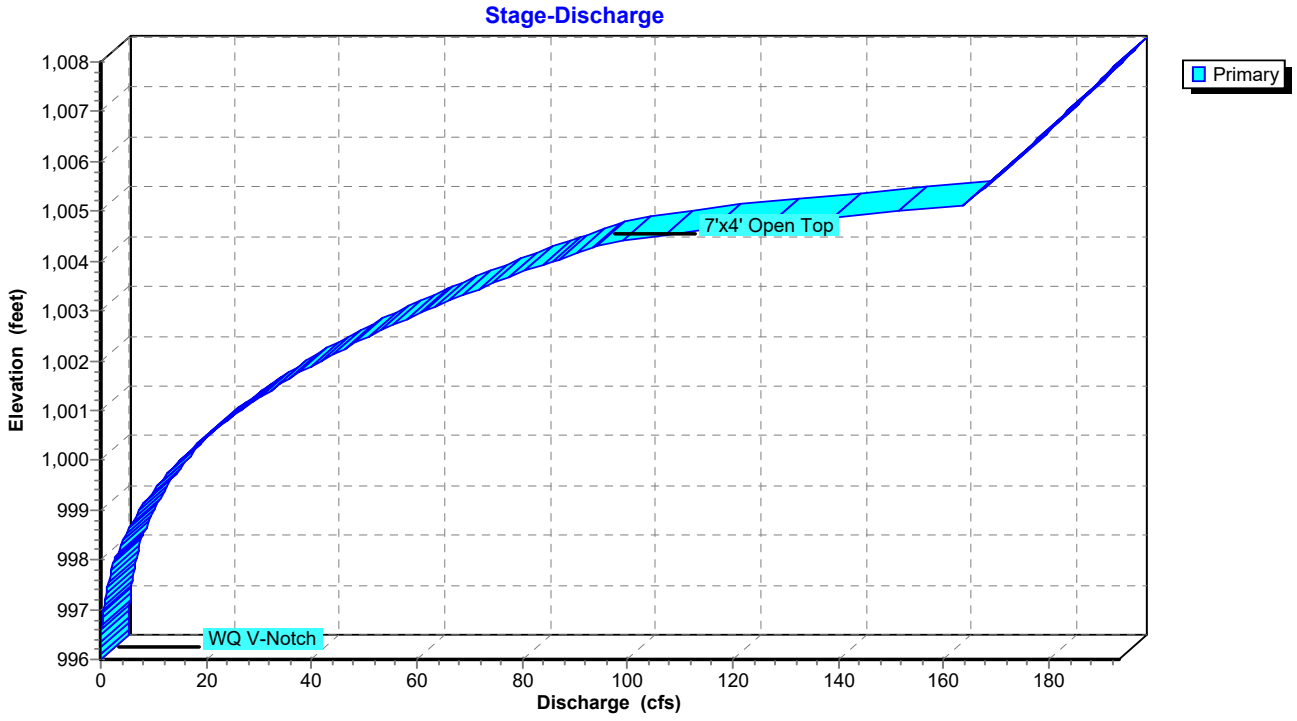
Device	Routing	Invert	Outlet Devices
#1	Primary	995.80'	**48.0" Round 48" RCP** L= 80.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 995.80' / 993.50' S= 0.0287 '/' Cc= 0.900 n= 0.013, Flow Area= 12.57 sf
#2	Device 1	996.00'	**20.0 deg x 8.30' rise WQ V-Notch** Cv= 2.69 (C= 3.36)
#3	Device 1	1,004.30'	**84.0" x 48.0" Horiz. 7'x4' Open Top** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=52.40 cfs @ 12.16 hrs HW=1,002.57' (Free Discharge)
└**1=48" RCP** (Passes 52.40 cfs of 132.09 cfs potential flow)
  ├**2=WQ V-Notch** (Weir Controls 52.40 cfs @ 6.89 fps)
  └**3=7'x4' Open Top** (Controls 0.00 cfs)

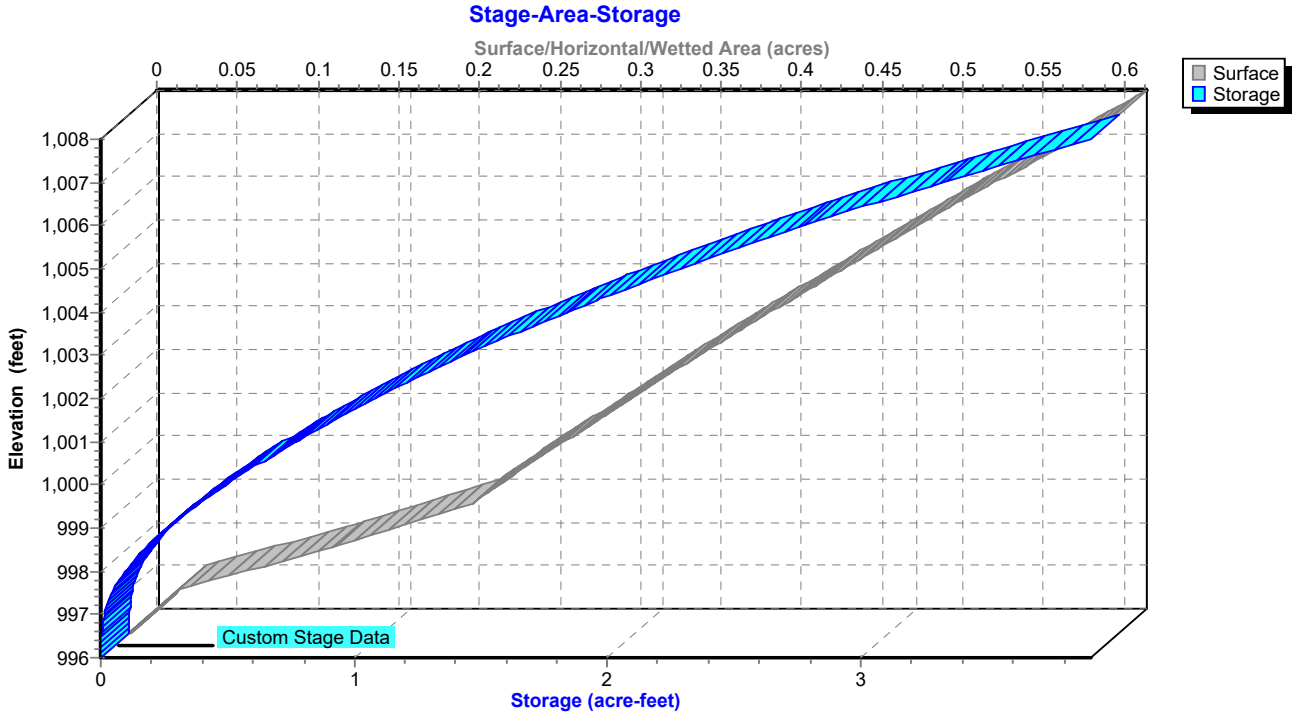
Pond 1P: NW EDD



Pond 1P: NW EDD



Pond 1P: NW EDD

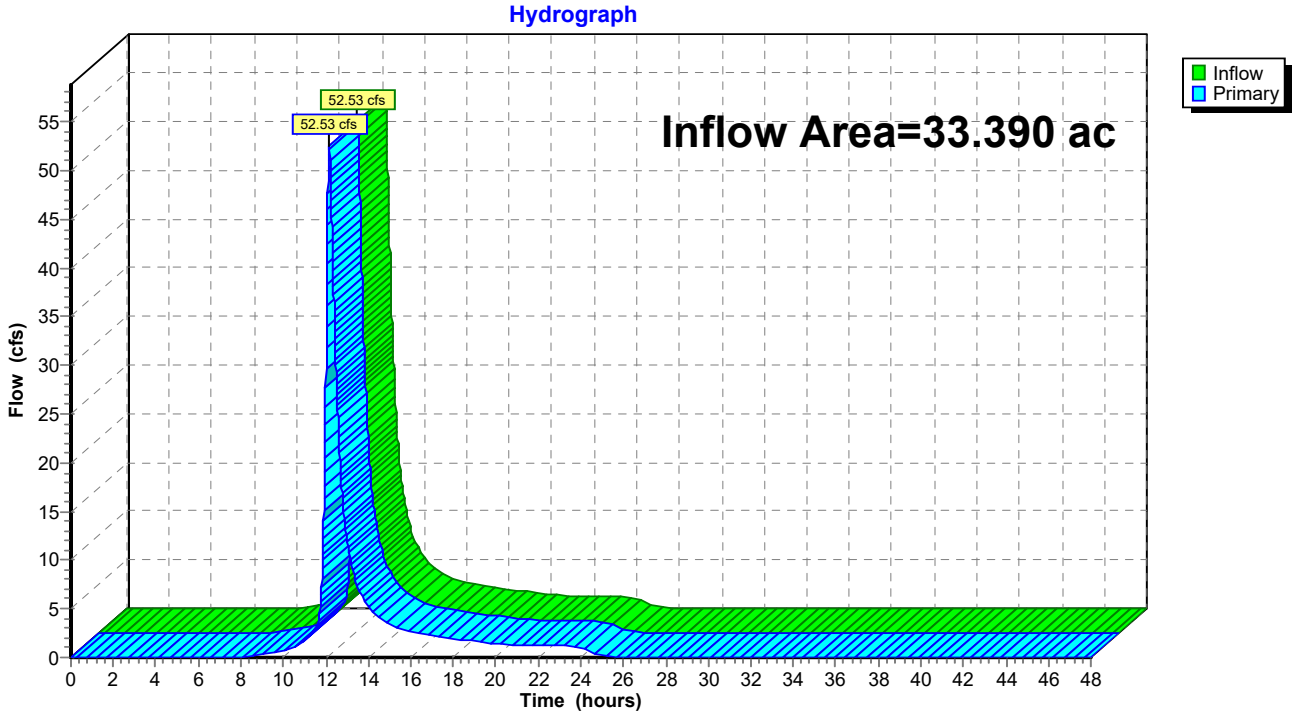


Summary for Link NW: Ex. Northwest Total

Inflow Area = 33.390 ac, 19.84% Impervious, Inflow Depth = 1.96" for Jackson - 002 YR event
Inflow = 52.53 cfs @ 12.16 hrs, Volume= 5.449 af
Primary = 52.53 cfs @ 12.16 hrs, Volume= 5.449 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link NW: Ex. Northwest Total



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

Subcatchment3S: Northwest Detained - Runoff Area=14.120 ac 28.79% Impervious Runoff Depth=3.75"
Tc=10.7 min CN=86 Runoff=77.20 cfs 4.410 af

Subcatchment4S: Northwest Detained - Runoff Area=19.010 ac 13.46% Impervious Runoff Depth=3.45"
Tc=13.7 min CN=83 Runoff=87.59 cfs 5.460 af

Subcatchment5S: Northwest Bypass - Runoff Area=0.260 ac 0.00% Impervious Runoff Depth=3.16"
Tc=5.0 min CN=80 Runoff=1.50 cfs 0.068 af

Pond 1P: NW EDD Peak Elev=1,004.61' Storage=2.106 af Inflow=162.81 cfs 9.870 af
Outflow=113.71 cfs 9.870 af

Link NW: Ex. Northwest Total Inflow=113.96 cfs 9.939 af
Primary=113.96 cfs 9.939 af

Total Runoff Area = 33.390 ac Runoff Volume = 9.939 af Average Runoff Depth = 3.57"
80.16% Pervious = 26.766 ac 19.84% Impervious = 6.624 ac

Summary for Subcatchment 3S: Northwest Detained - Onsite

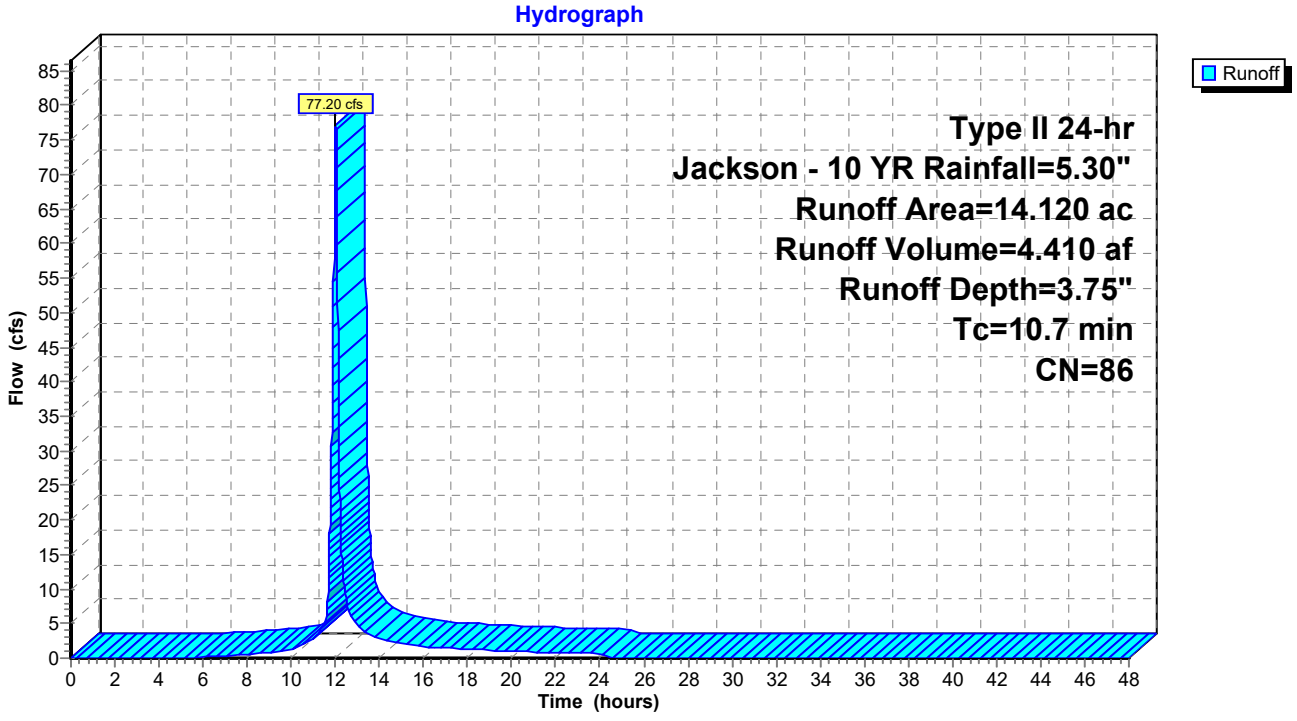
Runoff = 77.20 cfs @ 12.02 hrs, Volume= 4.410 af, Depth= 3.75"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type II 24-hr Jackson - 10 YR Rainfall=5.30"

Area (ac)	CN	Description
0.570	76	Woods/grass comb., Fair, HSG C
13.550	86	1/3 acre lots, 30% imp, HSG D
14.120	86	Weighted Average
10.055		71.21% Pervious Area
4.065		28.79% Impervious Area

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

Subcatchment 3S: Northwest Detained - Onsite



Summary for Subcatchment 4S: Northwest Detained - Offsite

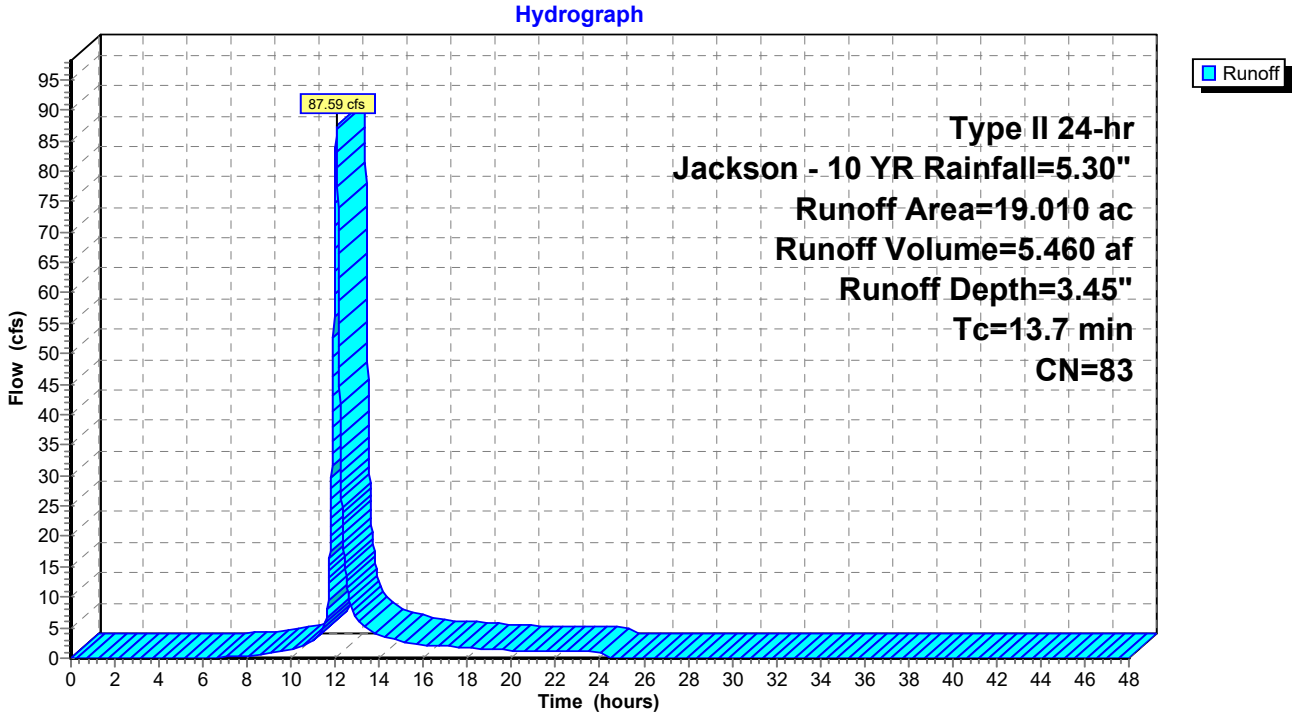
Runoff = 87.59 cfs @ 12.05 hrs, Volume= 5.460 af, Depth= 3.45"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type II 24-hr Jackson - 10 YR Rainfall=5.30"

Area (ac)	CN	Description
8.530	86	1/3 acre lots, 30% imp, HSG D
10.480	80	Pasture/grassland/range, Good, HSG D
19.010	83	Weighted Average
16.451		86.54% Pervious Area
2.559		13.46% Impervious Area

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

Subcatchment 4S: Northwest Detained - Offsite



Summary for Subcatchment 5S: Northwest Bypass - Onsite

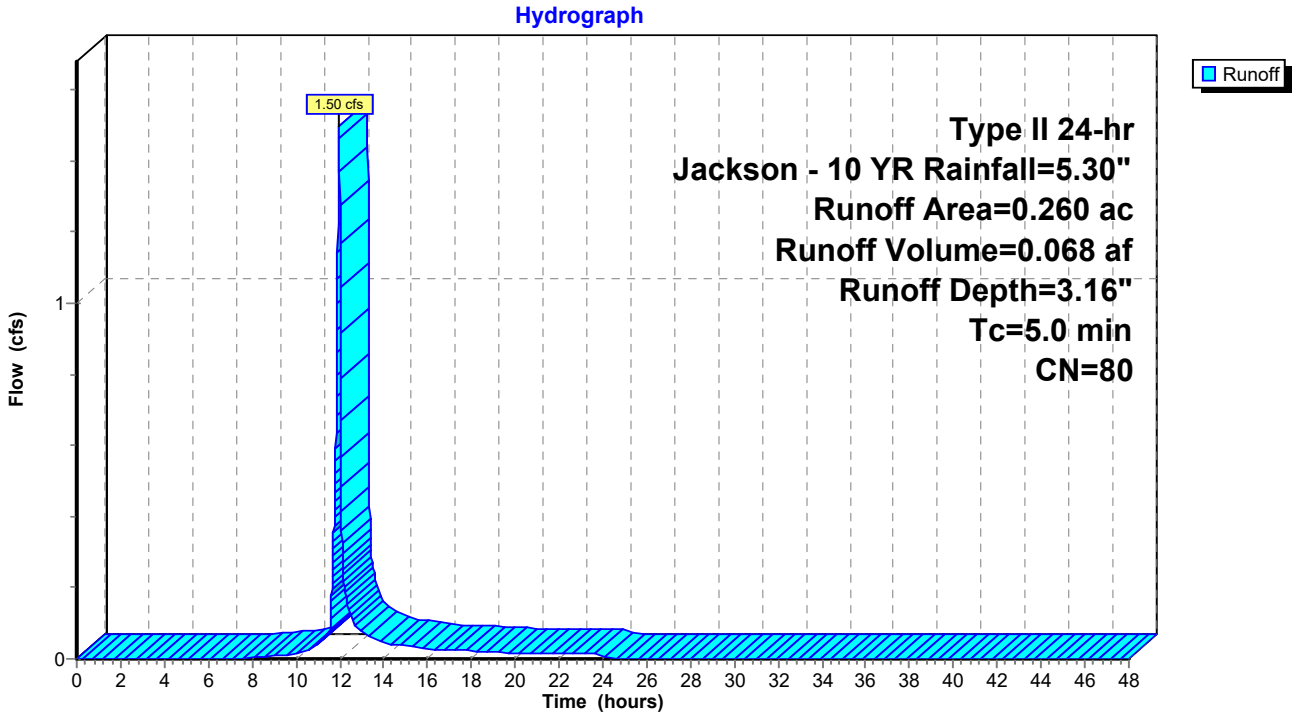
Runoff = 1.50 cfs @ 11.96 hrs, Volume= 0.068 af, Depth= 3.16"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type II 24-hr Jackson - 10 YR Rainfall=5.30"

Area (ac)	CN	Description
0.260	80	>75% Grass cover, Good, HSG D
0.260		100.00% Pervious Area

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

Subcatchment 5S: Northwest Bypass - Onsite



Summary for Pond 1P: NW EDD

Inflow Area = 33.130 ac, 19.99% Impervious, Inflow Depth = 3.58" for Jackson - 10 YR event
Inflow = 162.81 cfs @ 12.04 hrs, Volume= 9.870 af
Outflow = 113.71 cfs @ 12.13 hrs, Volume= 9.870 af, Atten= 30%, Lag= 5.6 min
Primary = 113.71 cfs @ 12.13 hrs, Volume= 9.870 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 1,004.61' @ 12.13 hrs Surf.Area= 0.451 ac Storage= 2.106 af

Plug-Flow detention time= 21.1 min calculated for 9.868 af (100% of inflow)
Center-of-Mass det. time= 21.1 min (831.0 - 810.0)

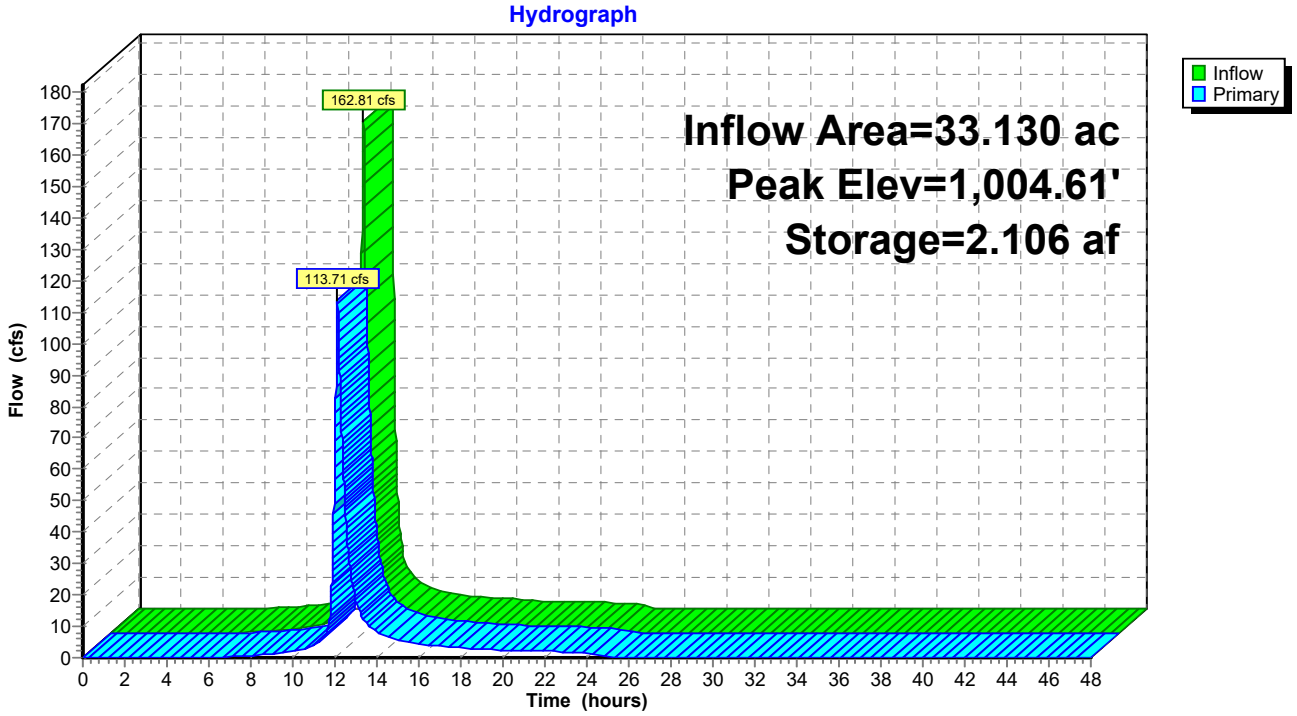
Volume	Invert	Avail.Storage	Storage Description
#1	996.00'	3.910 af	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
996.00	0.001	0.000	0.000
997.00	0.031	0.016	0.016
998.00	0.126	0.078	0.094
999.00	0.213	0.169	0.264
1,000.00	0.252	0.233	0.497
1,001.00	0.293	0.272	0.769
1,002.00	0.335	0.314	1.083
1,003.00	0.379	0.357	1.440
1,004.00	0.423	0.401	1.841
1,005.00	0.469	0.446	2.287
1,006.00	0.516	0.492	2.779
1,007.00	0.565	0.540	3.320
1,008.00	0.614	0.590	3.910

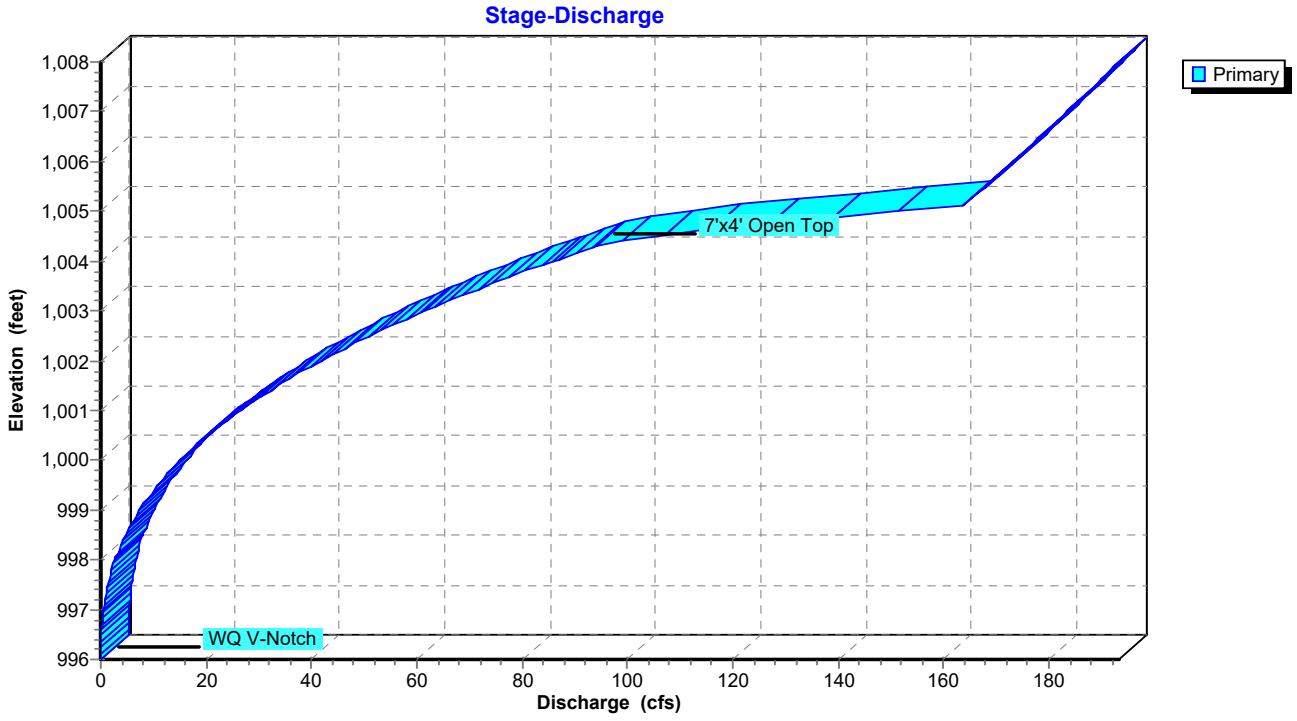
Device	Routing	Invert	Outlet Devices
#1	Primary	995.80'	**48.0" Round 48" RCP** L= 80.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 995.80' / 993.50' S= 0.0287 '/' Cc= 0.900 n= 0.013, Flow Area= 12.57 sf
#2	Device 1	996.00'	**20.0 deg x 8.30' rise WQ V-Notch** Cv= 2.69 (C= 3.36)
#3	Device 1	1,004.30'	**84.0" x 48.0" Horiz. 7'x4' Open Top** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=113.56 cfs @ 12.13 hrs HW=1,004.61' (Free Discharge)
└**1=48" RCP** (Passes 113.56 cfs of 157.85 cfs potential flow)
  ├**2=WQ V-Notch** (Orifice Controls 101.37 cfs @ 8.35 fps)
  └**3=7'x4' Open Top** (Weir Controls 12.19 cfs @ 1.81 fps)

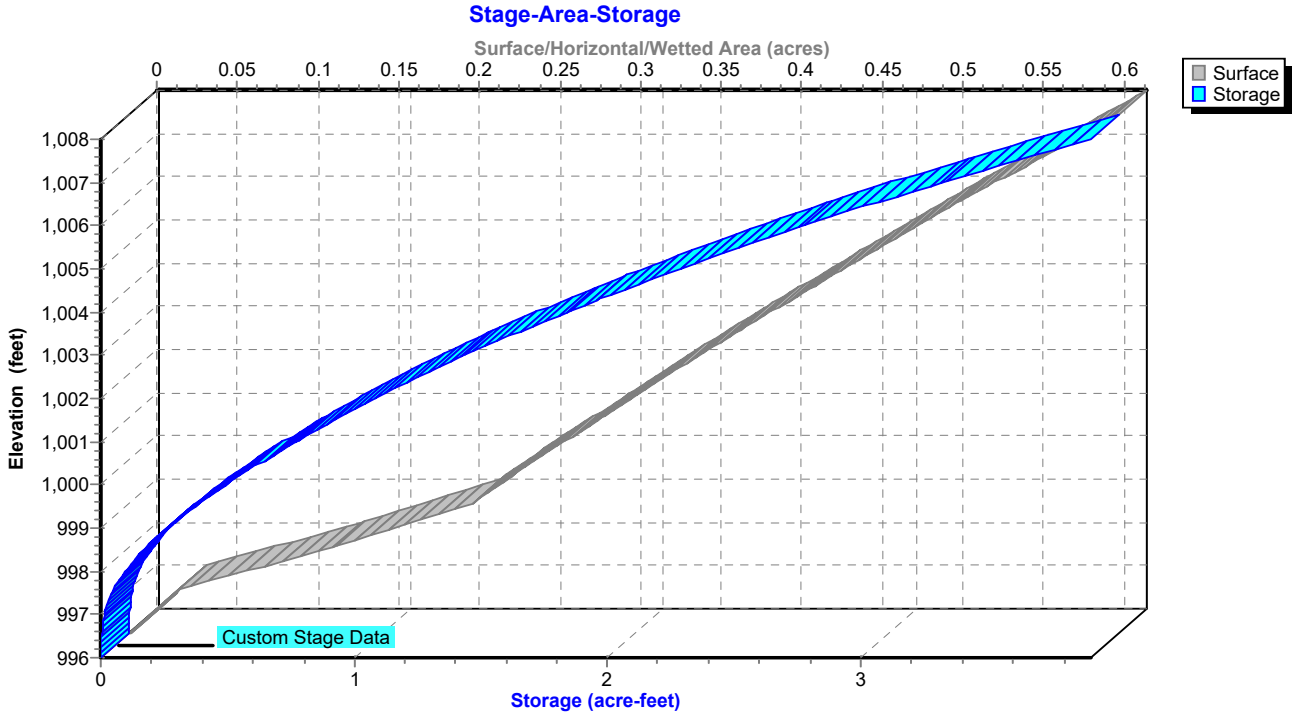
Pond 1P: NW EDD



Pond 1P: NW EDD



Pond 1P: NW EDD

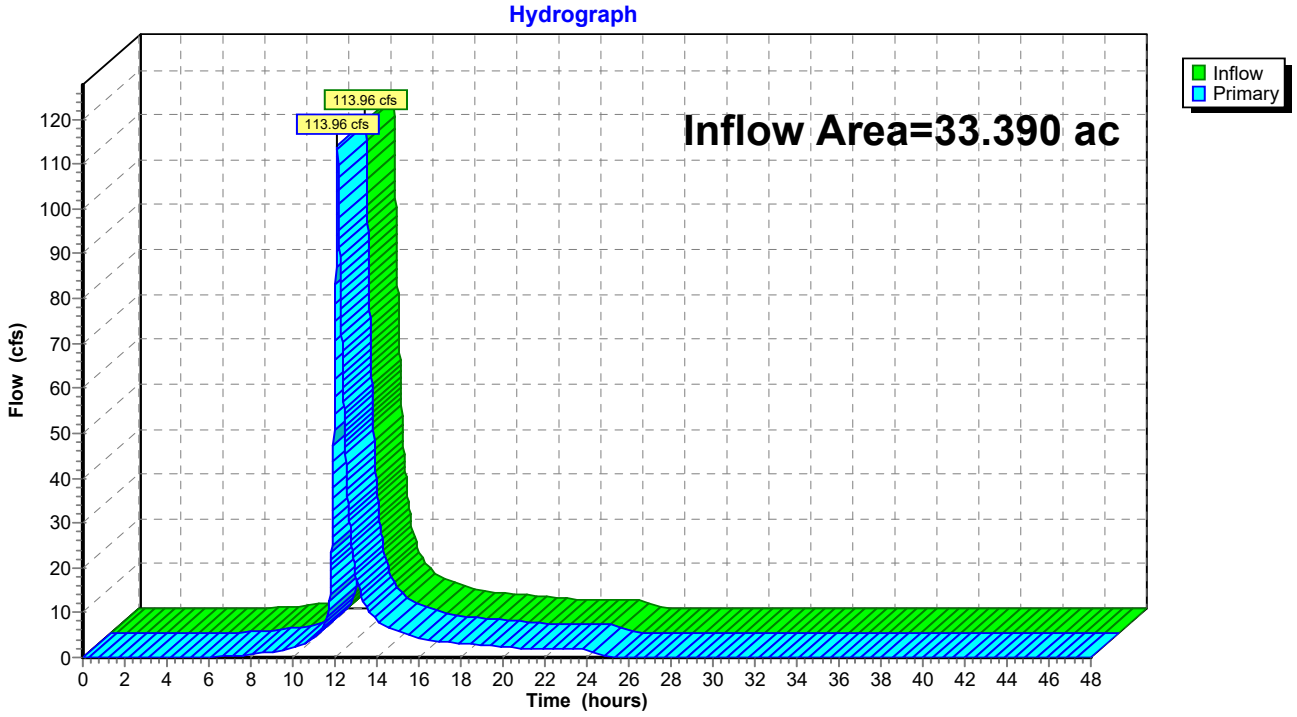


Summary for Link NW: Ex. Northwest Total

Inflow Area = 33.390 ac, 19.84% Impervious, Inflow Depth = 3.57" for Jackson - 10 YR event
Inflow = 113.96 cfs @ 12.13 hrs, Volume= 9.939 af
Primary = 113.96 cfs @ 12.13 hrs, Volume= 9.939 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link NW: Ex. Northwest Total



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

Subcatchment3S: Northwest Detained - Runoff Area=14.120 ac 28.79% Impervious Runoff Depth=6.04"
Tc=10.7 min CN=86 Runoff=121.22 cfs 7.108 af

Subcatchment4S: Northwest Detained - Runoff Area=19.010 ac 13.46% Impervious Runoff Depth=5.69"
Tc=13.7 min CN=83 Runoff=141.67 cfs 9.016 af

Subcatchment5S: Northwest Bypass - Runoff Area=0.260 ac 0.00% Impervious Runoff Depth=5.34"
Tc=5.0 min CN=80 Runoff=2.47 cfs 0.116 af

Pond 1P: NW EDD Peak Elev=1,006.40' Storage=2.992 af Inflow=259.87 cfs 16.124 af
Outflow=177.48 cfs 16.124 af

Link NW: Ex. Northwest Total Inflow=177.88 cfs 16.240 af
Primary=177.88 cfs 16.240 af

Total Runoff Area = 33.390 ac Runoff Volume = 16.240 af Average Runoff Depth = 5.84"
80.16% Pervious = 26.766 ac 19.84% Impervious = 6.624 ac

Summary for Subcatchment 3S: Northwest Detained - Onsite

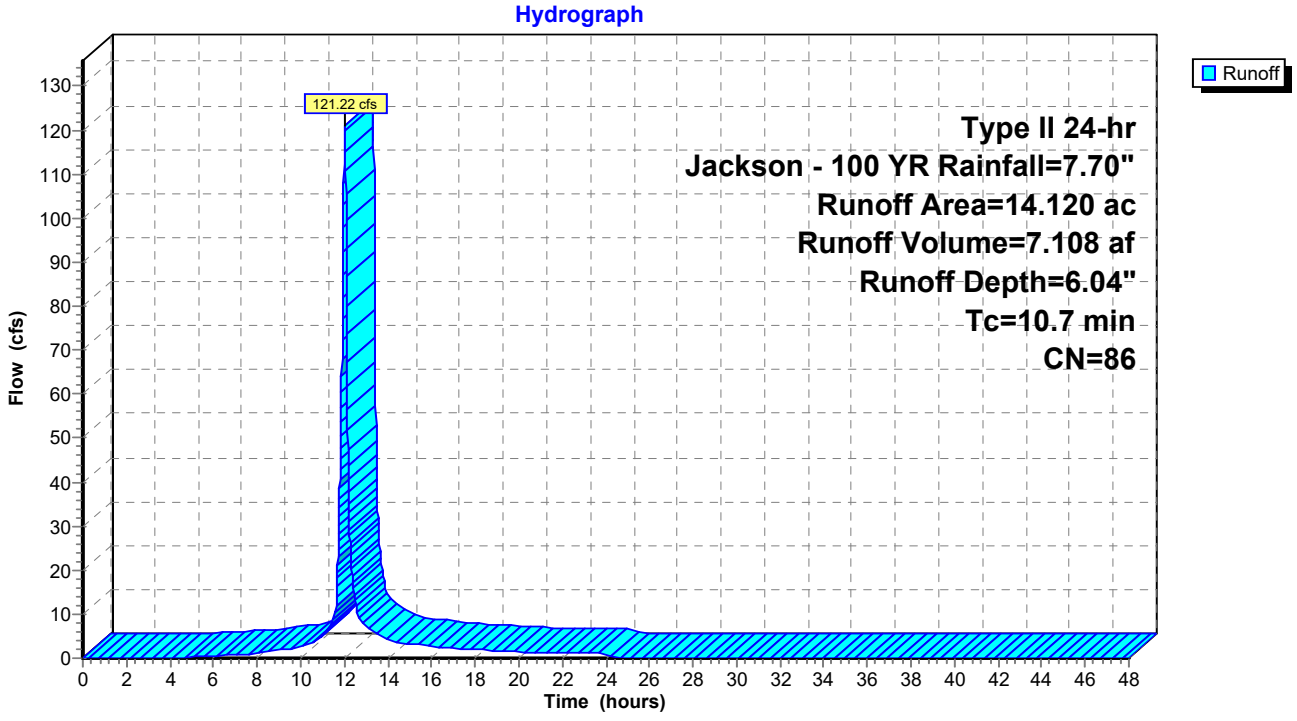
Runoff = 121.22 cfs @ 12.02 hrs, Volume= 7.108 af, Depth= 6.04"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type II 24-hr Jackson - 100 YR Rainfall=7.70"

Area (ac)	CN	Description
0.570	76	Woods/grass comb., Fair, HSG C
13.550	86	1/3 acre lots, 30% imp, HSG D
14.120	86	Weighted Average
10.055		71.21% Pervious Area
4.065		28.79% Impervious Area

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

Subcatchment 3S: Northwest Detained - Onsite



Summary for Subcatchment 4S: Northwest Detained - Offsite

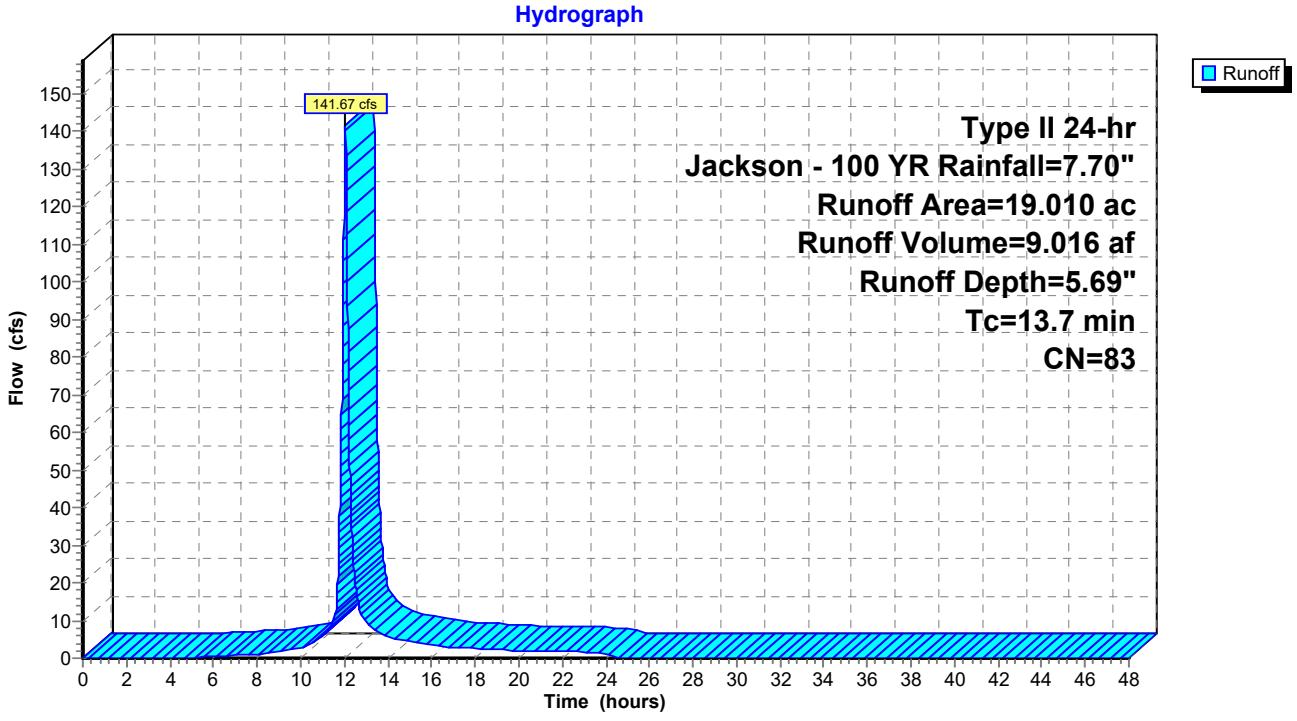
Runoff = 141.67 cfs @ 12.05 hrs, Volume= 9.016 af, Depth= 5.69"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type II 24-hr Jackson - 100 YR Rainfall=7.70"

Area (ac)	CN	Description
8.530	86	1/3 acre lots, 30% imp, HSG D
10.480	80	Pasture/grassland/range, Good, HSG D
19.010	83	Weighted Average
16.451		86.54% Pervious Area
2.559		13.46% Impervious Area

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

Subcatchment 4S: Northwest Detained - Offsite



Summary for Subcatchment 5S: Northwest Bypass - Onsite

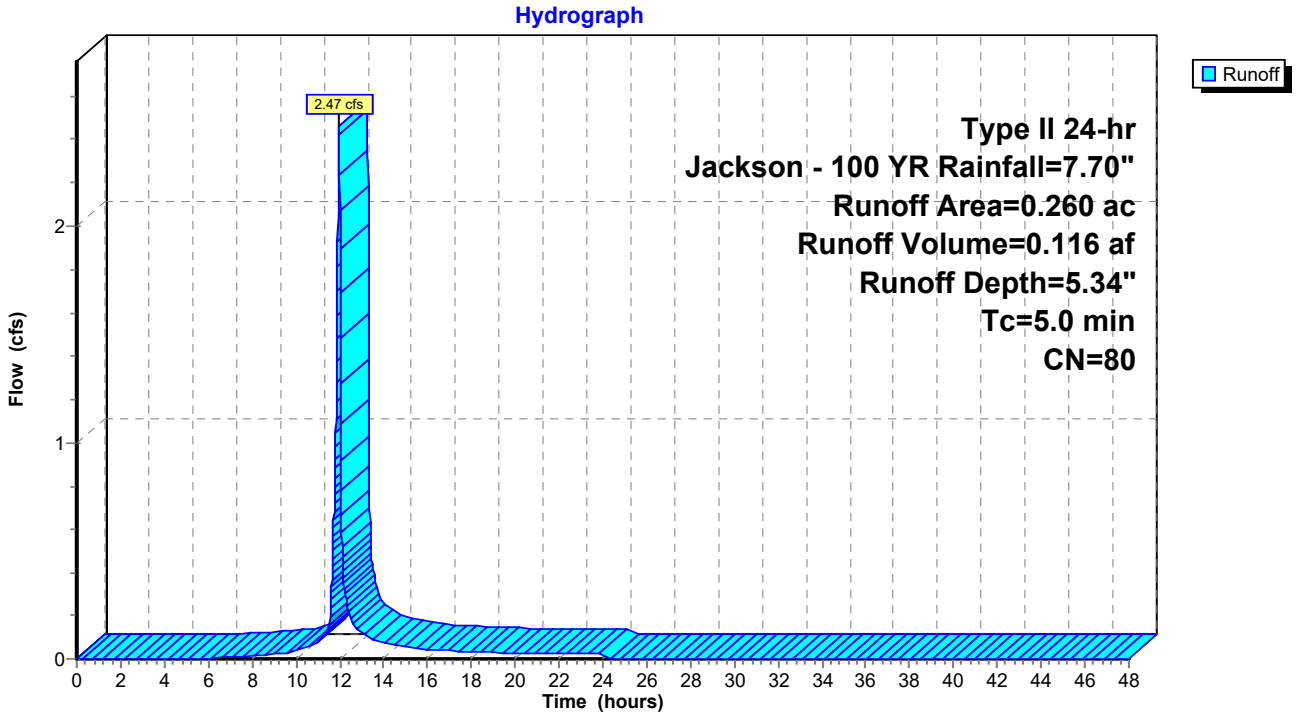
Runoff = 2.47 cfs @ 11.96 hrs, Volume= 0.116 af, Depth= 5.34"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type II 24-hr Jackson - 100 YR Rainfall=7.70"

Area (ac)	CN	Description
0.260	80	>75% Grass cover, Good, HSG D
0.260		100.00% Pervious Area

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

Subcatchment 5S: Northwest Bypass - Onsite



Summary for Pond 1P: NW EDD

Inflow Area = 33.130 ac, 19.99% Impervious, Inflow Depth = 5.84" for Jackson - 100 YR event
Inflow = 259.87 cfs @ 12.04 hrs, Volume= 16.124 af
Outflow = 177.48 cfs @ 12.13 hrs, Volume= 16.124 af, Atten= 32%, Lag= 5.8 min
Primary = 177.48 cfs @ 12.13 hrs, Volume= 16.124 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 1,006.40' @ 12.13 hrs Surf.Area= 0.536 ac Storage= 2.992 af

Plug-Flow detention time= 19.4 min calculated for 16.121 af (100% of inflow)
Center-of-Mass det. time= 19.4 min (815.6 - 796.2)

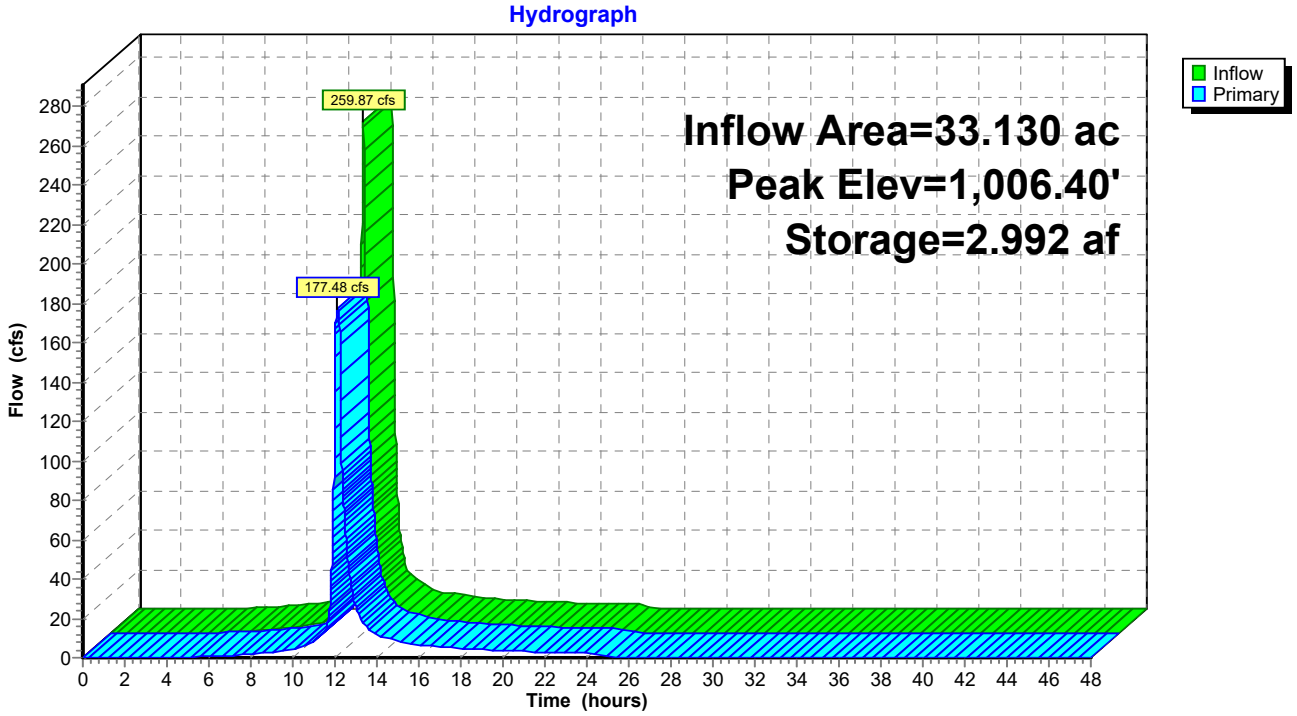
Volume	Invert	Avail.Storage	Storage Description
#1	996.00'	3.910 af	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
996.00	0.001	0.000	0.000
997.00	0.031	0.016	0.016
998.00	0.126	0.078	0.094
999.00	0.213	0.169	0.264
1,000.00	0.252	0.233	0.497
1,001.00	0.293	0.272	0.769
1,002.00	0.335	0.314	1.083
1,003.00	0.379	0.357	1.440
1,004.00	0.423	0.401	1.841
1,005.00	0.469	0.446	2.287
1,006.00	0.516	0.492	2.779
1,007.00	0.565	0.540	3.320
1,008.00	0.614	0.590	3.910

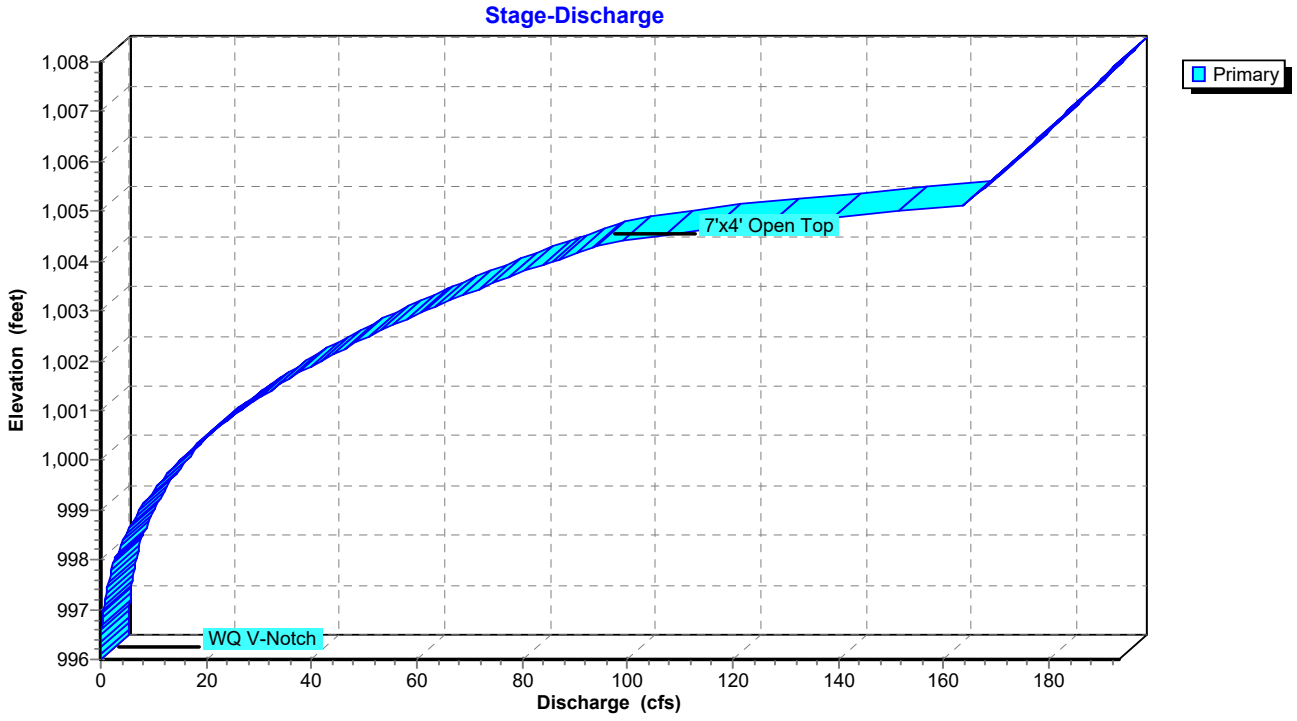
Device	Routing	Invert	Outlet Devices
#1	Primary	995.80'	**48.0" Round 48" RCP** L= 80.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 995.80' / 993.50' S= 0.0287 '/' Cc= 0.900 n= 0.013, Flow Area= 12.57 sf
#2	Device 1	996.00'	**20.0 deg x 8.30' rise WQ V-Notch** Cv= 2.69 (C= 3.36)
#3	Device 1	1,004.30'	**84.0" x 48.0" Horiz. 7'x4' Open Top** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=177.46 cfs @ 12.13 hrs HW=1,006.40' (Free Discharge)
└**1=48" RCP** (Inlet Controls 177.46 cfs @ 14.12 fps)
  ├**2=WQ V-Notch** (Passes < 132.49 cfs potential flow)
  └**3=7'x4' Open Top** (Passes < 195.46 cfs potential flow)

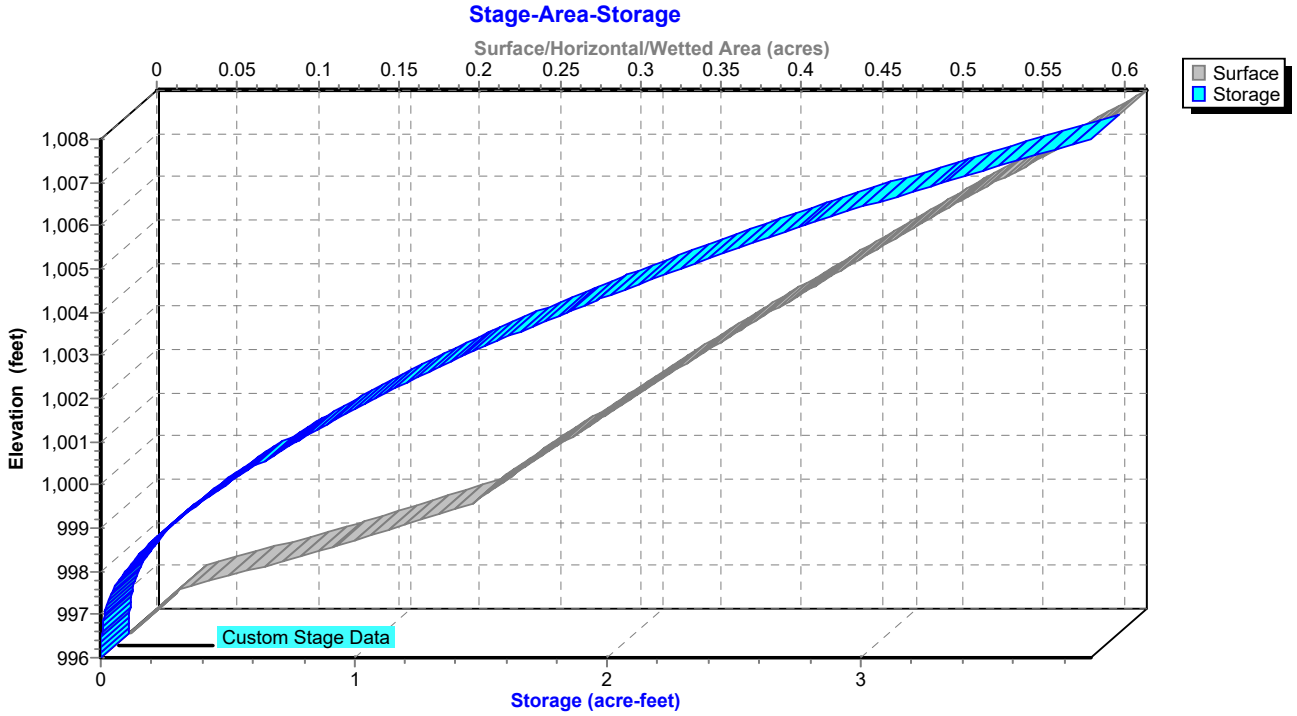
Pond 1P: NW EDD



Pond 1P: NW EDD



Pond 1P: NW EDD

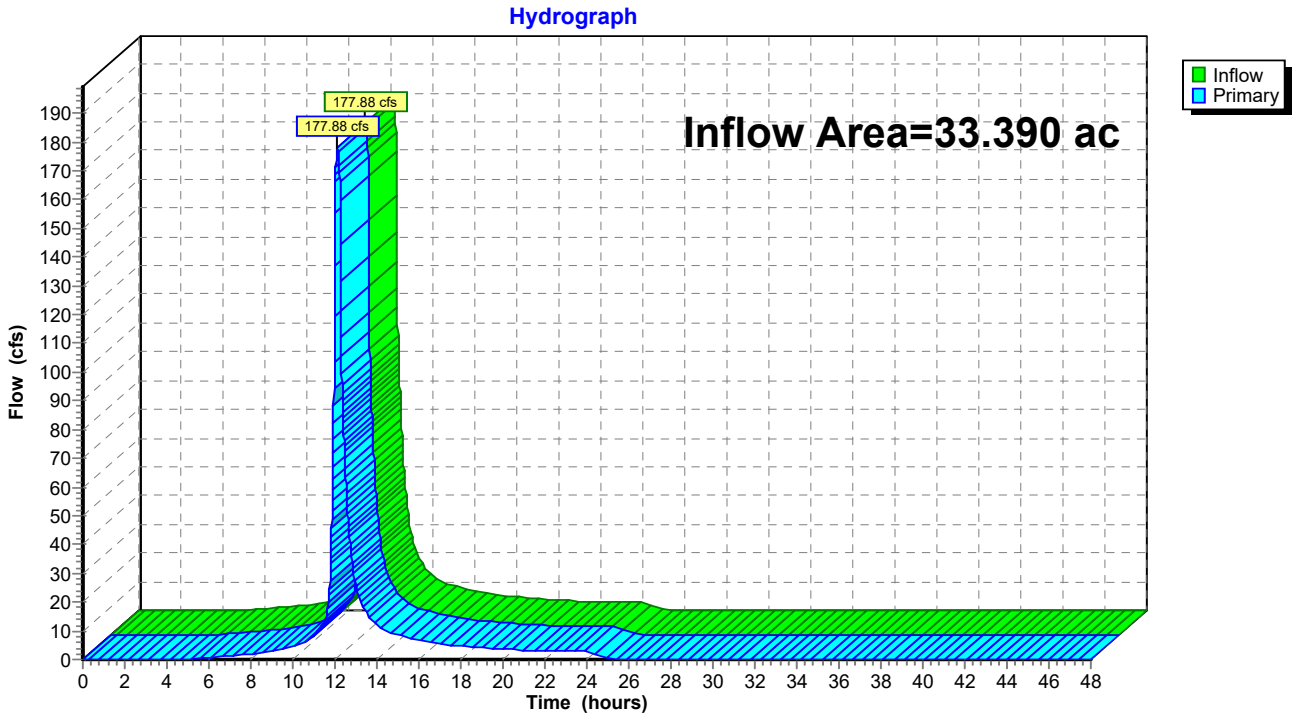


Summary for Link NW: Ex. Northwest Total

Inflow Area = 33.390 ac, 19.84% Impervious, Inflow Depth = 5.84" for Jackson - 100 YR event
Inflow = 177.88 cfs @ 12.13 hrs, Volume= 16.240 af
Primary = 177.88 cfs @ 12.13 hrs, Volume= 16.240 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link NW: Ex. Northwest Total



Weir Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Tuesday, Jun 14 2022

Orchard Woods - Emergency Spillway

Trapezoidal Weir

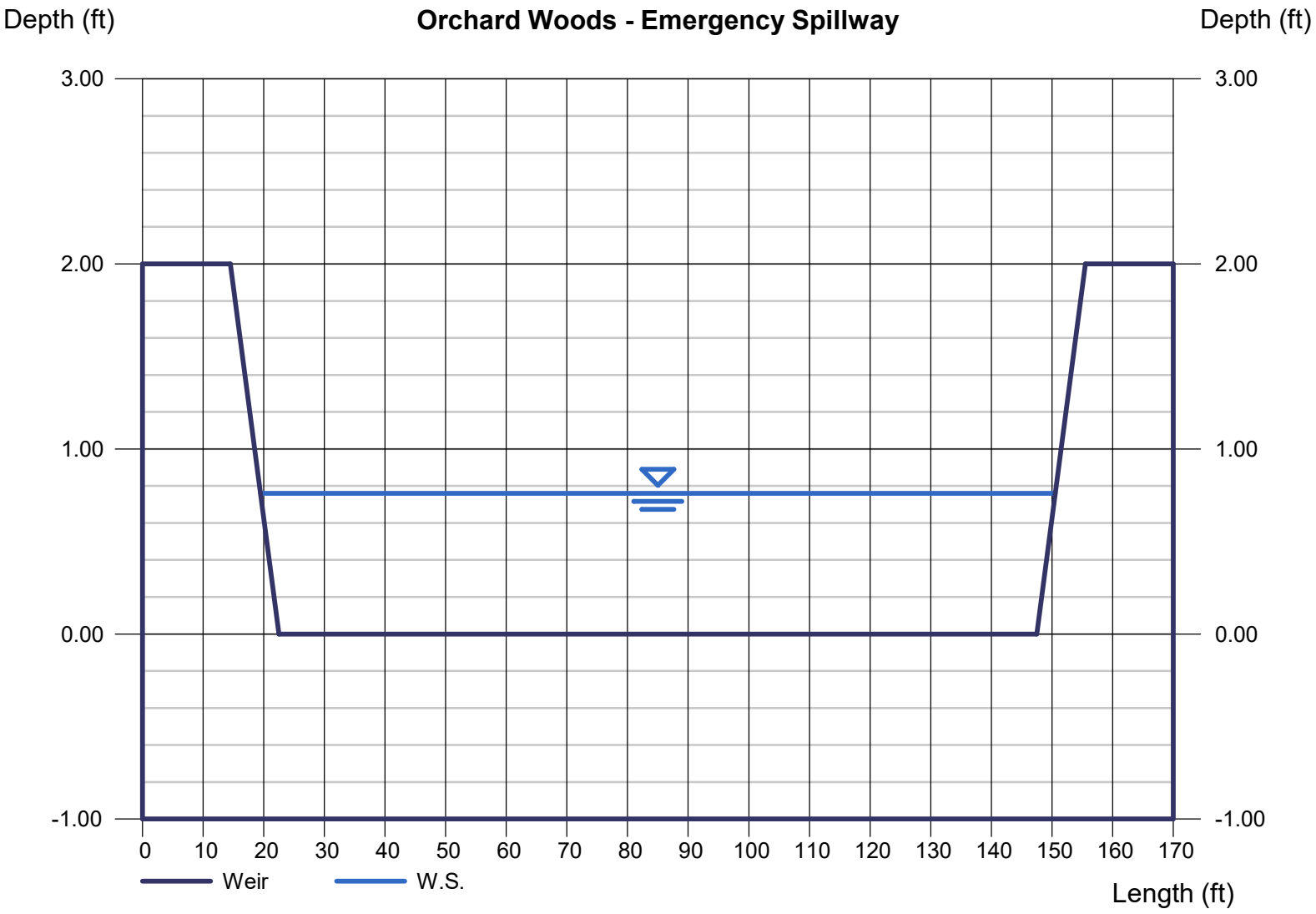
Crest	= Sharp
Bottom Length (ft)	= 125.00
Total Depth (ft)	= 2.00
Side Slope (z:1)	= 4.00

Calculations

Weir Coeff. Cw	= 3.10
Compute by:	Known Q
Known Q (cfs)	= 259.87

Highlighted

Depth (ft)	= 0.76
Q (cfs)	= 259.87
Area (sqft)	= 97.31
Velocity (ft/s)	= 2.67
Top Width (ft)	= 131.08



WORKSHEET 1: REQUIRED LEVEL OF SERVICE - UNDEVELOPED SITE

Project:	**Orchard Woods**	**By:**	**DLM**	**Date:**	**5/13/2022**
Location:	**Lee's Summit**	**Checked:**	**DEU**	**Date:**	**5/13/2022**

1. Runoff Curve Number

A. Predevelopment CN

Cover Description	Soil HSG	CN	Area (ac.)	Product of CN x Area
Woods/Grass Combination (Fair)	C	76	1.8	136.8
Woods/Grass Combination (Fair)	D	82	11.75	963.5
		Totals:	13.55	1100.3

Area-Weighted CN = total product/total area = 81 (Round)

B. Postdevelopment CN

Cover Description	Soil HSG[1]	CN	Area (ac.)	Product of CN x Area
Single-Family Residential (1/3 acre/lot)	D	86	13.55	1165.3
		Totals:	13.55	1165.3

[1] Postdevelopment CN is one HSG higher for all cover types except preserved vegetation, absent documentation showing how postdevelopment soil structure will be preserved.

Area-Weighted CN = total product/total area = 86 (Round)

C. Level of Service (LOS) Calculation

Predevelopment CN:	81
Postdevelopment CN:	86
Difference:	5
LOS Required:	5.7

WORKSHEET 2: DEVELOP MITGATION PACKAGE(S) THAT MEETS REQUIRED LOS

Project:	**Orchard Woods**	**By:**	**DLM**	**Date:**	**5/13/2022**
Location:	**Lee's Summit**	**Checked:**	**DEU**	**Date:**	**5/13/2022**
Sheet:	**1 of 1**				

1. Required LOS (from Table 1 or 1A or Worksheet 1 or 1A, as appropriate): **5.7**

Note: Various BMPs may alter CN of proposed development, and LS; recalculate both if applicable.

2. Proposed BMP Option Package No. **1**

ID	BMP / Cover Description	Treatment Area, ac.	VR[1]	Product of VR x Area
EDD-1	Extended Dry Detention w/ Signage	18.83 (13.86 acres onsite, 4.97 acres offsite)	4.25	80.03
	Total[2]:	18.83	**Total VR:**	80.03
			Proposed LOS:	**5.91** = total product/total area

[1] VR calculated for final BMP only in Treatment Train.

[2] Total treatment area cannot exceed 100 percent of the actual site area.

2) Meets required LOS (Yes/No)? **YES** (If No, or if additional options are being tested, move to next sheet.)

Design Procedure Form: Extended Dry Detention Basin (EDDB)
Main Worksheet

Designer: DLM
Checked By: DLM
Company: MCMULLEN STORMWATER ENGINEERING LLC

Date: 5/13/2022
Project: ORCHARD WOODS
Location: CITY OF LEE'S SUMMIT
Page: 1 of 3

I. Basin Water Quality Storage Volume

Step 1) Tributary area to EDDB, A_T (ac) — A_T (ac) = 32.87

Step 2) Calculate WQv using methodology in Section 6 — WQv (ac-ft) = 1.20

Step 3) Add 20 percent to account for silt and sediment deposition in the basir — V_{design} (ac-ft) = 1.44

IIa. Water Quality Outlet Type

Step 1) Set water quality outlet type — Outlet Type = 3
Type 1 = single orifice
Type 2 = perforated riser or plate
Type 3 = v-notch weir

Step 2) Proceed to Step IIb, IIc, or IId based on water quality outlet type slecte

IIb. Water Quality Outlet, Single Orifice

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

Step 2) Average head of water quality volume over invert of orifice, H_{WQ} (ft)
$H_{WQ} = 0.5 * Z_{WQ}$ — H_{WQ} (ft) = _____

Step 3) Average water quality outflow rate, Q_{WQ} (cfs)
$Q_{WQ} = (WQ_v * 43{,}560)/(40 * 3{,}600)$ — Q_{WQ} (cfs) = _____

Step 4) Set value of orifice discharge coefficient, C_o
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 — C_o = _____

Step 5) Water quality otulet orifice diameter (minimum of 4 inches), D_o (in)
$D_o = 12 * 2 * (Q_{WQ}/(C_o * \pi * (2 * g * H)^{0.5}))^{0.5}$ — D_o (in) = _____
(if orifice diameter < 4 inches, us outlet type 2 or 3)

Step 6) To size outlet orifice for EDDB with an irregular stage-volume relationship, use the Single Orifice Worksheet

IIc. Water Quality Outlet, Perforated Riser

Step 1) Depth at outlet above lowest perforation, Z_{WQ} (ft) — Z_{WQ} (ft) = _____

Step 2) Recommended maximum outlet area per row, A_o (in^2)
$A_o = (WQv)/(0.013 * Z_{WQ}^2 + 0.22 * Z_{WQ} - 0.10)$ — A_o (in^2) = _____

Step 3) Circular perforation diameter per row assuming a single column, D_1 (in) — D_1 (in) = _____

Step 4) Number of columns, n_c — n_c = _____

Step 5) Design circular perforation diameter (should be between 1 and 2 inches), D_{perf} (in) — D_{perf} (in) = _____

Step 6) Horizontal perforation column spacing when $n_c > 1$, center to center, S_c — S_c (in) = _____
If $D_{perf} \geq 1.0$ inch, $S_c = 4$

Step 7) Number of rows (4" vertical spacing between perforations, center to center), r_r — n_r = _____

Design Procedure Form: Extended Dry Detention Basin (EDDB)
Main Worksheet

Designer: DLM
Checked By: DLM
Company: MCMULLEN STORMWATER ENGINEERING LLC
Date: 10/25/2021
Project: RIVERBEND
Location: CITY OF LENEXA
Page: 2 of 3

IId. Water Quality Outlet, V-notch Weir

Step 1) Depth of water quality volume above permanent pool, Z_{WQ} (ft) — Z_{WQ} (ft) = 7.0

Step 2) Average head of water quality pool volume over invert of v-notch, H_{WQ} (ft)
$H_{WQ} = 0.5*Z_{WQ}$ — H_{WQ} (ft) = 3.5

Step 3) Average water quality pool outflow rate, Q_{WQ} (cfs)
$Q_{WQ} = (WQv*43,560)/(40*3,600)$ — Q_{WQ} (cfs) = 0.36

Step 4) V-notch weir coefficient, C_v — C_v = 2.5

Step 5) V-notch weir angle, θ (deg)
$\theta = 2*(180/\pi)*\arctan(Q_{WQ}/(C_v*H_{WQ}^{5/2}))$
V-notch angle should be at least 20 degrees. Set to 20 degrees if calculated angle is smaller. — θ (deg) = 20

Step 6) Top width of V-notch weir, W_v (ft)
$W_v = 2*Z_{WQ}*TAN(\theta/2)$ — W_v (ft) = 2.47

Step 7) To calculate v-notch angle for EDDB with an irregular stage-volume relationship, use the V-notch Weir Worksheet

III. Flood Control

Refer to APWA Secifications Section 5608

IV. Trash Racks

Step 1) Total outlet area, A_{ot} (in^2) — A_{ot} (in^2) = _____

Step 2) Required trash rack open area, A_t (in^2)
$A_t = A_{ot}*77*e^{(-0.124*D)}$ for single orifice outlet
$A_t = (A_{ot}/2)*77*e^{(-0.124*D)}$ for orifice plate outlet
$A_t = 4*A_{ot}$ for v-notch weir outlet — A_t (in^2) = _____

V. Basin Shape

Step 1) Length to width ratio should be at least 3:1 (L:W) wherever practicable — (L:W) = _____

Step 2) Low flow channel side lining
Concrete: _____
Soil / riprap: _____
No low flow channel: _____

Step 3) Top stage floor drainage slope (toward low flow channel), S_{ts} (%) — S_{ts} (%) = _____
Top stage depth, D_{ts} (ft) — D_{ts} (ft) = _____

Step 4) Bottom stage volume, V_{bs} (ac-ft)
V_{bs} (% of WQv) = _____
V_{bs} (ac-ft) = _____

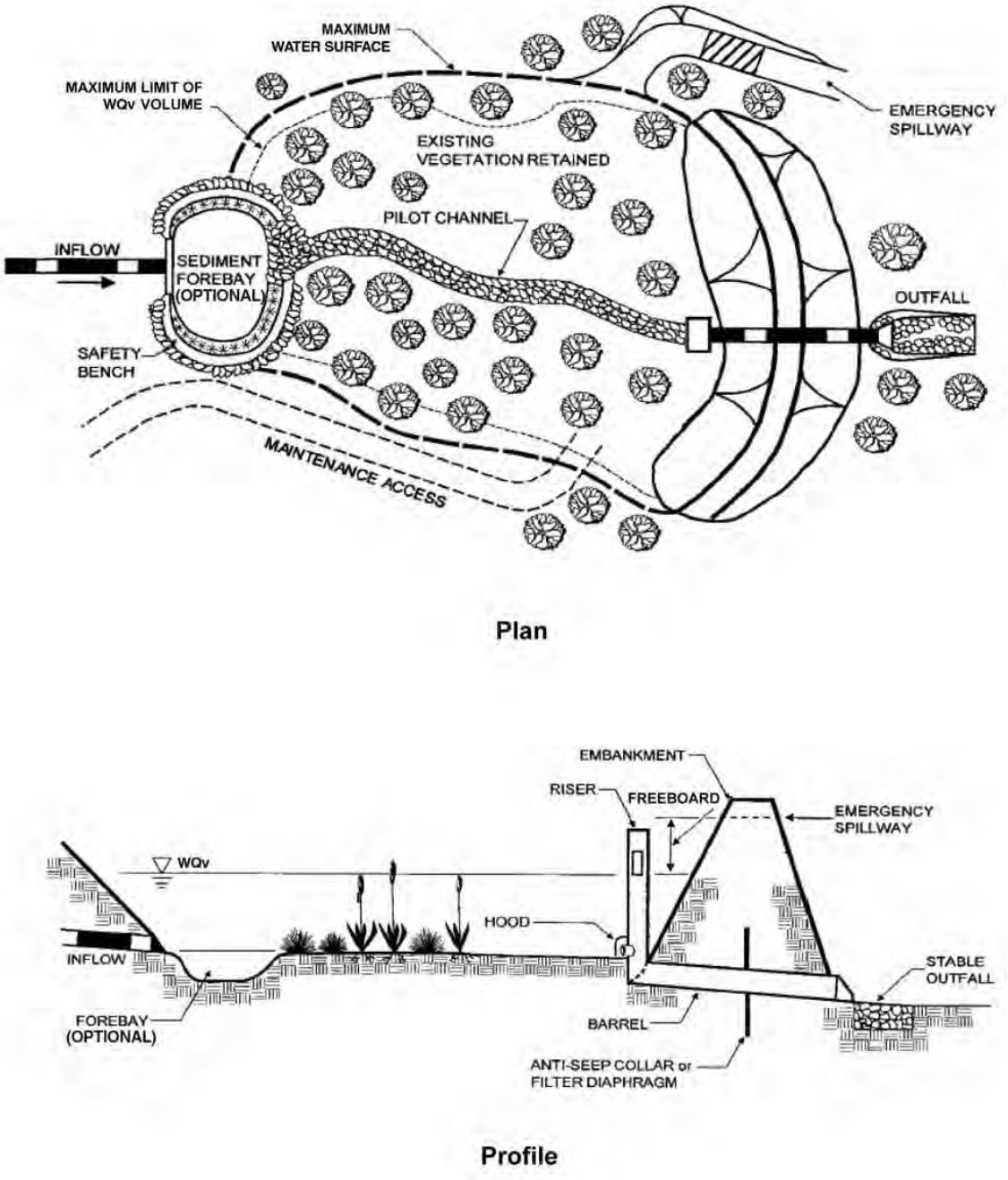


Figure 8.18 - Schematic of an Extended Dry Detention Basin

(Adapted from Maryland Department of Environment, 2000)

8.10.7 Design Example

The following sections present an example for designing an EDDB. These procedures follow the steps outlined in the Design Procedure Form: Extended Dry Detention Basin (EDDB) Main Worksheet. When using the worksheet in electronic form, manually enter values in green.