Preliminary Stormwater Management Plan

prepared for

Pryor Mixed-Use Development
Griffin Riley Property Group

MO-150 Highway & Pryor Road
Lee's Summit, Missouri
City of Lee's Summit Project

June 9, 2023

SCHLAGEL PROJECT: 23-013

prepared by

SCHLAGEL
ENGINEERS PLANNERS SURVEYORS LANDSCAPE ARCHITECTS
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Executive Summary

June 9, 2023

Gene Williams, P.E.,
Senior Civil Engineer
City of Lee's Summit
220 Southeast Green Street
Lee's Summit, Missouri 64063

RE: Pryor Mixed-Use Development
MO-150 Highway & Pryor Road
Lee's Summit, Missouri

Dear Mr. Williams,

We are submitting the enclosed preliminary stormwater management study in support of the preliminary development plan application for Pryor Mixed-Use. This report has been prepared to address permitting requirements and provides preliminary design calculations for the required storm events. We have modeled the existing site conditions as they existed at the time this report was prepared.

The proposed development has been analyzed and designed to meet the APWA Comprehensive Control Strategy, which entails limiting post-development peak discharge rates from the site for the 2-Year, 10-Year, and 100-Year design storm events. An Extended Wet Detention Basin has been designed to detain the mentioned events as well as provide 40-hour detention of runoff from the local 90% mean annual event. All elements of the enclosed drainage system will be designed and constructed in accordance with all City of Lee's Summit, Missouri, requirements.

Sincerely,

SCHLAGEL

Paul Woodard
Design Engineer

06.13.2023

Mark Breuer, P.E.
Project Engineer

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1.0 GENERAL INFORMATION

Pryor Mixed-Use is located on the southeast corner of MO-150 Highway and Pryor Road in the northwest quarter of Section 36, Township 47, Range 32, in the City of Lee's Summit, Jackson County, Missouri. This is vacant agricultural land proposed as future residential zoning.

The property is bounded on the north by MO-150 Highway, on the west by Pryor Road, on the east by low residential development and on the south by single-family residential development.

The Owner is proposing to develop approximately 19.37 acres of vacant agricultural land as multi-family development that will consist of associated infrastructure, pool amenity area, and landscaping.

1.1 OBJECTIVE

The intent of this report is to provide information pertaining to the existing and proposed watersheds, identify and address any downstream drainage issues, determine and address any detention requirements, determine and address any water quality requirements, and address permitting requirements. This study provides the preliminary design calculations for the development of the facility and associated infrastructure.

1.2 METHODOLOGY

The following were utilized in the assessment, preparation, and analysis of watersheds in this design plan: *Section 5600, 2011, Storm Drainage Systems & Facilities* of the Standard Specifications & Design Criteria of the Kansas City Metropolitan Chapter of the American Public Works Association; *Storm Drainage Systems & Facilities,* Design Criteria (July 2020), prepared by the City of Lee's Summit, Missouri, Public Works Department.

Watersheds for the site were defined according to soil cover and type, tributary area, and runoff times of concentration. Soil cover was determined from inspection of the site and aerial photography. A soil survey for the project area was obtained from the NRCS website and was utilized in determining soil type, and can be found in Appendix B. Watershed size was determined from both aerial topography and topographical survey, and by the proposed grading plan. Times of concentration were compiled according to *NRCS TR-55 Urban Hydrology for Small Watersheds (1986)* methodology for sheet flow, shallow concentrated flow, and channel flow. Travel times for channel flows were determined using the length and velocity of the open channel. *HydroCAD-10* was utilized to model the runoff. Please reference the HydroCAD Model Output Report, in Appendix B, for time of concentration input/output values for calculations. All storm events were modeled using SCS 24-hour Type II distributions and were modeled for the 2-Year, 10-Year and 100-Year storm events.

* * * * *

2.0 EXISTING CONDITIONS ANALYSIS

The parcel lies within the Headwater Big Creek watershed in Lee's Summit, Missouri. The property consists of mostly contoured small grain rows in poor condition with patches of existing trees/brush in fair condition. There are three water ponds located on site no bigger than 7,000 square feet.

Aside from a 12" sewer main interceptor installed along the north side of the south property boundary, there is no additional infrastructure or improvements made to the site.

2.1 TRIBUTARY AREAS

The site was modeled into two watersheds each with its own Release Point (RP) as identified on Figure A.3, in Appendix A. The areas were delineated with respect to its topographical characteristics.

The following approximate areas were determined with these delineations: 0.78 acres to the northeast and 18.59 acres to the southeast. Stormwater from approximately 148.67 offsite acres enters the site from the west and south. This offsite watershed can be seen in Figure A.2, in Appendix A. All offsite stormwater drainage exits the Pryor Mixed-Use property at the southeast release point, RP2.

2.2 CURVE NUMBER AND TIME OF CONCENTRATION

The existing curve numbers and time of concentrations for each sub-area have been established based on the procedures outlined in *NRCS TR-55 Urban Hydrology for Small Watersheds (1986)*. Existing curve numbers were based upon aerial photography, site inspection, and the soil types present on site. An existing ground cover of trees/brush and agricultural contoured small grain rows were found to be in fair and poor condition, respectively. A Hydrologic Soil Group (HSG) of C and C/D were present on site. Hydrologically poor conditions indicate a state of land use that will provide higher runoff compared to good conditions.

However, for the purposes of developmental impact, a maximum curve number of 74 was utilized for undeveloped agricultural areas in accordance with APWA 5602.3.E.1. Water ponds were assigned a curve number of 98 to account for impervious surface. The existing condition runoff calculations are provided for informational and comparison purposes only, as the proposed post-development peak discharge rates will need to comply with the reduced allowed runoff rates as outlined in the APWA Comprehensive Control Strategy.

A current aerial photograph depicting the existing cover conditions, Figure A.1, can be found in Appendix A. For reference, a copy of the NRCS soil report can be found in Appendix B.

Time of concentration flow paths were based upon sheet flow and shallow concentrated flow for the existing conditions. Sheet flow lengths were limited to where a grade break occurred. Flow was then considered shallow concentrated flow until a channel was visible either from the USGS topographic map or the aerial photograph, and then from that point was considered channel flow determined by the length of the channel and the velocity of flow. Table 2-1 below summarizes the time of concentration for Drainage Area 1 (D1), Drainage Area 2 (DA2), and Offsite Drainage Area 2 (OFF2).

2.3 EXISTING FLOW RATES

Existing flow rates were determined for the 2-Year, 10-Year and 100-Year design storms. Runoff coefficient curve numbers were based on APWA 5602.3.E.1 for undeveloped agricultural land. Detailed calculations can be found in Appendix B.

Table 2-1 - Existing Flow Rates

Drainage Sub-Basin	Area (acres)	Time of Concentration (minutes)	Runoff Coeff. (CN)	2-Year Peak Flow (cfs)	10-Year Peak Flow (cfs)	100-Year Peak Flow (cfs)
DA1	0.78	17.4	74	1.12	2.44	4.36
DA2	18.59	41.2	74	15.23	33.61	60.63
OFF2	148.67	18.7	83	319.70	589.07	955.78

Table 2-2, below, reflects the runoff rates for the release points identified in Figure A.3 in Appendix A.

Table 2-2 - Existing Runoff Evaluation

Drainage Sub-Basin Release Points	2-Year Peak Flow (cfs)	10-Year Peak Flow (cfs)	100-Year Peak Flow (cfs)
RP1	1.12	2.44	4.36
RP2	326.79	606.56	989.18

2.4 DOWNSTREAM DRAINAGE ISSUES

The project lies outside of the identified FEMA floodplain, per map number 29095C0531G. This FEMA FIRMette is included in Appendix A, Figure A.5. The southeast corner of Pryor Mixed-Use is approximately 130 LF from the from the 1% annual chance floodplain, in Zone A. This flooding area is based on future conditions hydrology. No current base flood elevations have been established for Zone A. Nonetheless, any future development to the east near Zone A is to be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

2.5 AGENCY REVIEW

Permitting requirements of the following agencies were reviewed as part of the existing conditions analysis.

2.5.1 Corps of Engineers Review

The National Wetlands Inventory map was reviewed for the site and there are no identified wetlands located within the project site. The map can be found in Appendix A, Figure A.6. Nonetheless, it might be beneficial to assess the state of the three existing water ponds, located on site, to determine what, if any, jurisdictional needs might be required if U.S. Army Corps of Engineers documentation is indeed warranted.

2.5.2 FEMA Requirements

No FEMA identified floodplain is located on the proposed property, per Flood Insurance Rate Map Panel No. 29095C0531G. There is currently no work proposed in the regulated floodplain. Please see the attached FEMA FIRMette in Appendix A, Figure A. 4.

2.5.3 Missouri Department of Natural Resources

All disturbance activities will be permitted in accordance with the City of Lee's Summit, MO specification as well as the Missouri Department of Water Pollution Control general permit under the National Pollution Elimination System (NPDES) and an authorized Notice of Intent (NOI) application form. The disturbance of the site is more than one acre, therefore NPDES and NOI applications are required with the future permitting of the site in compliance with local, State and Federal guidelines. The permit will be kept open until the completion of the project.

* * * * *

3.0 PROPOSED CONDITIONS ANALYSIS

Proposed renovations for Pryor Mixed-Use will include public infrastructure, a pool tract, and associated landscaping. A designated stream corridor will be proposed.

Stormwater runoff will be conveyed through the site via open sheet flow, shallow concentrated flow, it's associated underground storm sewer system, an extended wet detention basin, and a dedicated stream corridor.

All components of the overland and enclosed storm sewer systems will meet or exceed the specifications provided in *Section 5600, 2011, Storm Drainage Systems & Facilities* of the Standard Specifications & Design Criteria of the Kansas City Metropolitan Chapter of the American Public Works Association; *Storm Drainage Systems & Facilities,* Design Criteria (July 2020), prepared by the City of Lee's Summit, Missouri, Public Works Department.

3.1 TRIBUTARY AREAS

The proposed tributaries are provided in Appendix A, Figure A.4. The site release points will remain unchanged from the existing conditions.

Stormwater runoff for Drainage Area 1 (DA1) will be reduced to limit stormwater discharge to the northeast. Drainage Area 2 will be divided into two drainage areas, Drainage Area 2.A (DA2.A) and Drainage Area 2.B (DA2.B); with DA2.B bypassing detention. DA2.B will include offsite peak discharge rates from Osage Development from the east and Napa Valley Development from the south. Again, detention will not be provided for these offsite peak rates. DA2.B will include the use of a dedicated stream corridor.

3.2 STREAM CORRIDIOR REQUIREMENTS

We reviewed the approved Final Stormwater Management Drainage Study, dated June 15, 2020, by Olsson & Associates, for Osage Development located west of our project.

Osage is a proposed single-family residential development on approximately 36 acres and includes a pool area, amenity tract for open space and stormwater detention. The final design for this development includes stormwater retention for approximately 28.82 acres draining east. The delineated area, in the Osage study, bypassing the detention basin is 5.59 acres. The combined total drainage area from Osage to Pryor Mixed-Use development is 34.41 acres.

Along the south side of the project, runoff is conveyed, traveling eastbound, through an engineered swale sloped at 2.25%. The 34.41 acre discharged from Osage enters Pryor Mixed-Use on the west side through three parallel 15” CMP pipes and is conveyed along the engineered swale. In addition to the Osage 34.41 acre drainage area, additional runoff enters the project from Pryor Road and the Napa Valley development. This additional 2.37 acre drainage area, from Pryor Road and Napa Valley, is also conveyed through the engineered swale. Approximately 210 LF west of the southeast corner of the property, the engineered swale exits the site and enters the Napa Valley, First Plat development. Stormwater is then conveyed southeast approximately 110 LF at which point it connects with the predominant stream channel which then re-enters the Pryor Mixed-Use development approximately 62 LF west of the southeast corner of the property.

A field survey was conducted on the existing stream features located on site. The ordinary high water mark (OHM) for the predominant stream discharging to RP2 had an average width of 8 feet. The OHM is shown on Figure A.4, in Appendix A.

In accordance with APWA 5605.3.B.1 and 5605.3.B.2, streams having a tributary area in excess of 40 acres shall be preserved with a dedicated stream buffer zone around the stream. Per our proposed delineation, Figure A.4 in Appendix A, Drainage Area 2.A (DA2.A), Drainage Area 2.B and Offsite Drainage Area 2 (OFF2) contribute a total combined area of 167.79 acres to the existing predominant stream that discharges to RP2. The required stream buffer width, measured from the OHM outward in each direction, according to APWA Table 5605.1, for contributing areas between 160 acres

and 5,000 acres is 100 feet. This would require the absolute minimum total corridor width to be 200 feet. Figure A.4, in Appendix A, has been annotated with 2 different width dimensions, the minimum being 104 feet from the OHM.

We do not propose providing a stream corridor buffer zone on the existing engineered swale, that runs eastbound from Osage, since the combined tributary area of 36.78 acres is less than 40 acres. We do, however, propose leaving the existing engineered swale features as-is.

Therefore, the stream corridor requirements needed for this project will be satisfied by the proposed stream buffer zone area located southeast of the property.

3.3 CURVE NUMBER AND TIME OF CONCENTRATION

Curve numbers for the proposed development were developed in a similar manner as the existing conditions. A Hydrologic Soil Group of D is proposed for post-development conditions. Cover types for the proposed condition were considered to be impervious surface areas and woods/grass.

Time of concentration was established in a similar manner as the existing conditions. Shallow concentrated flow lengths were shortened and considered paved. Pipe lengths were calculated by proposed pipe alignment lengths with an assumed velocity of 9 feet per second. Detailed calculations of the composite curve number and time of concentration can be found in the HydroCAD Model Output in Appendix B. Figure A.4, in Appendix A, depicts the proposed drainage conditions.

3.4 PROPOSED FLOW RATES

Proposed flow rates were determined for the 2-Year, 10-Year and 100-Year design storms. Detailed calculations can be found in the HydroCAD Model Output Report in Appendix B.

Table 3-1 - Proposed HydroCAD Runoff Calculations

Drainage Sub-Basin	Area (acres)	Time of Concentration (minutes)	Runoff Coeff. (CN)	2-Year Peak Flow (cfs)	10-Year Peak Flow (cfs)	100-Year Peak Flow (cfs)
DA1	0.25	5.0	81	0.79	1.48	2.41
DA2.A	17.45	5.0	92	79.91	128.32	191.96
DA2.B	1.67	5.0	81	5.30	9.86	16.11
OFF2	148.67	18.7	83	319.70	589.07	955.78

3.5 DETENTION ANALYSIS

The site will need to provide detention that meets the requirements of the APWA Comprehensive Control Strategy. This entails limiting post-development peak discharge rates from the site for the 2-Year, 10-Year, and 100-Year design storm events, as well as providing 40-hour extended detention of runoff from the local 90% mean annual event. The post-development peak discharge rate from the site shall not exceed the following:

- 2-Year storm peak rate less than or equal to 0.5 cfs per site acre
- 10-Year storm peak rate less than or equal to 2.0 cfs per site acre
- 100-Year storm peak rate less than or equal to 3.0 cfs per site acre

An Extended Wet Detention Basin (EWDB) is proposed to mitigate post-development discharge rates from the site. This EWDB will provide 40-hour extended detention runoff from the local 90% mean annual event (1.37 inches/24-hours). The EWDB is proposed for Drainage Area 2.A (DA2.A).

Drainage Area 1 (DA1), Drainage Area 2.B (DA2.B), and the existing 148.67 acres of offsite drainage entering the site from the west and from the south will bypass the EWDB and will not be detained.

Table 3-2, below, summarizes the proposed maximum post-development peak discharge rates based on a 19.37-acre drainage area. This table does not include the offsite drainage mentioned above.

Table 3-2 - Required & Proposed Runoff Comparison

Site Release Information for Pryor Mixed-Use					
2-Year (cfs)		10-Year (cfs)		100-Year (cfs)	
Required	Proposed	Required	Proposed	Required	Proposed
9.69	9.53	38.74	20.11	58.11	56.45

The runoff hydrographs utilized to determine the peak flow volumes for each tributary area were determined using *TR-55* methodology and *HydroCAD-10*. For the 2-Year, 10-Year and 100-Year storm events, the complete hydrograph routing and model output can be found in the HydroCAD Model Output Report in Appendix B.

Table 3-3, below, summarizes the proposed flow rates for DA1, DA2.A, and DA2.B with the utilization of an EWDB.

Table 3-3 – Proposed HydroCAD Runoff Calculations with EWDB

Total Site Release w/ Extended Detention			
	2-Year (cfs)	10-Year (cfs)	100-Year (cfs)
DA1	*0.79*	*1.48*	*2.41*
DA2.A	*3.44*	*8.77*	*37.93*
DA2.B	*5.30*	*9.86*	*16.11*
Total	**9.53**	**20.11**	**56.45**

Finally, Table 3-4, below, reflects the post-development runoff rates for the release points identified in Figure A.4, in Appendix A.

Table 3-4 – Proposed Runoff Evaluation

Drainage Sub-Basin Release Points	2-Year Peak Flow (cfs)	10-Year Peak Flow (cfs)	100-Year Peak Flow (cfs)
RP1	0.79	1.48	2.41
RP2	324.04	597.37	996.83

* * * * *

4.0 SUMMARY AND RECOMMENDATIONS

The proposed development is a 19.37-acre, multi-family mix-use residential district, currently zoned as rural property, within the City of Lee's Summit with associated landscape/amenities and infrastructure.

The proposed development has been analyzed and designed to meet the APWA Comprehensive Control Strategy, which entails limiting the post-development peak discharge rates from the site for the 2-Year, 10-Year, and 100-Year design storm events. An Extended Wet Detention Basin has been designed to detain the mentioned events as well as provide 40-hour detention of runoff from the local 90% mean annual event.

All elements of the enclosed drainage system will be designed and constructed in accordance with all City of Lee's Summit, Missouri, requirements.

* * * *

APPENDIX A

- Figure A.1 Existing Site Aerial Photograph
- Figure A.2 Existing Offsite Drainage Map
- Figure A.3 Existing Drainage Map
- Figure A.4 Proposed Drainage Map
- Extended Wet Detention Basin Calculations
- Figure A.5 FEMA FIRMette
- Figure A.6 National Wetlands Inventory

23-013

4/18/2023

Tax Parcels

Address Points

Nearmap

Red: Band_1

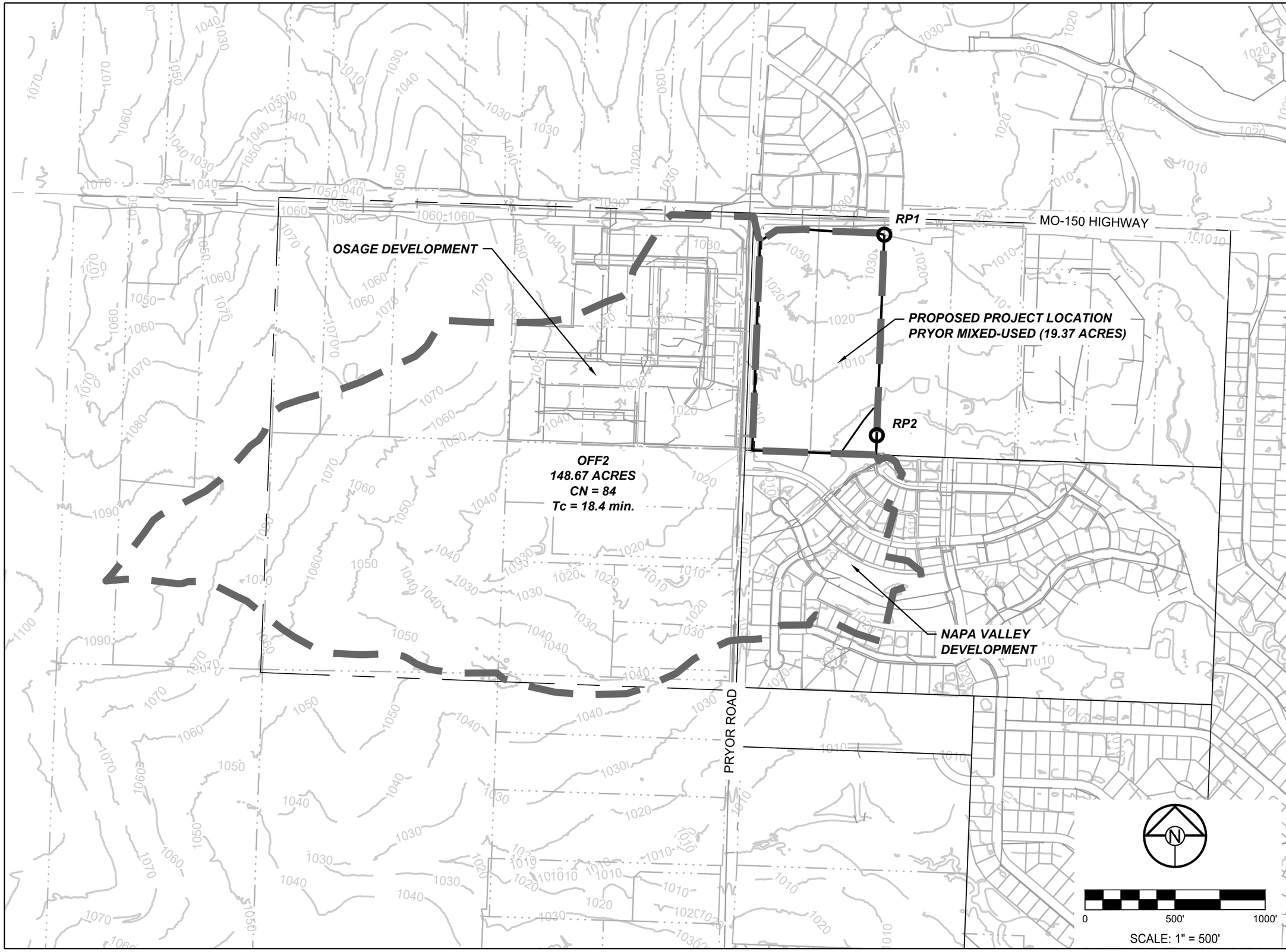
Green: Band_2

Blue: Band_3

1:4,514

0 0.03 0.06 0.12 mi

0 0.05 0.1 0.19 km



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PRYOR MIXED-USE PRELIMINARY STORMWATER MANAGMENT PLAN

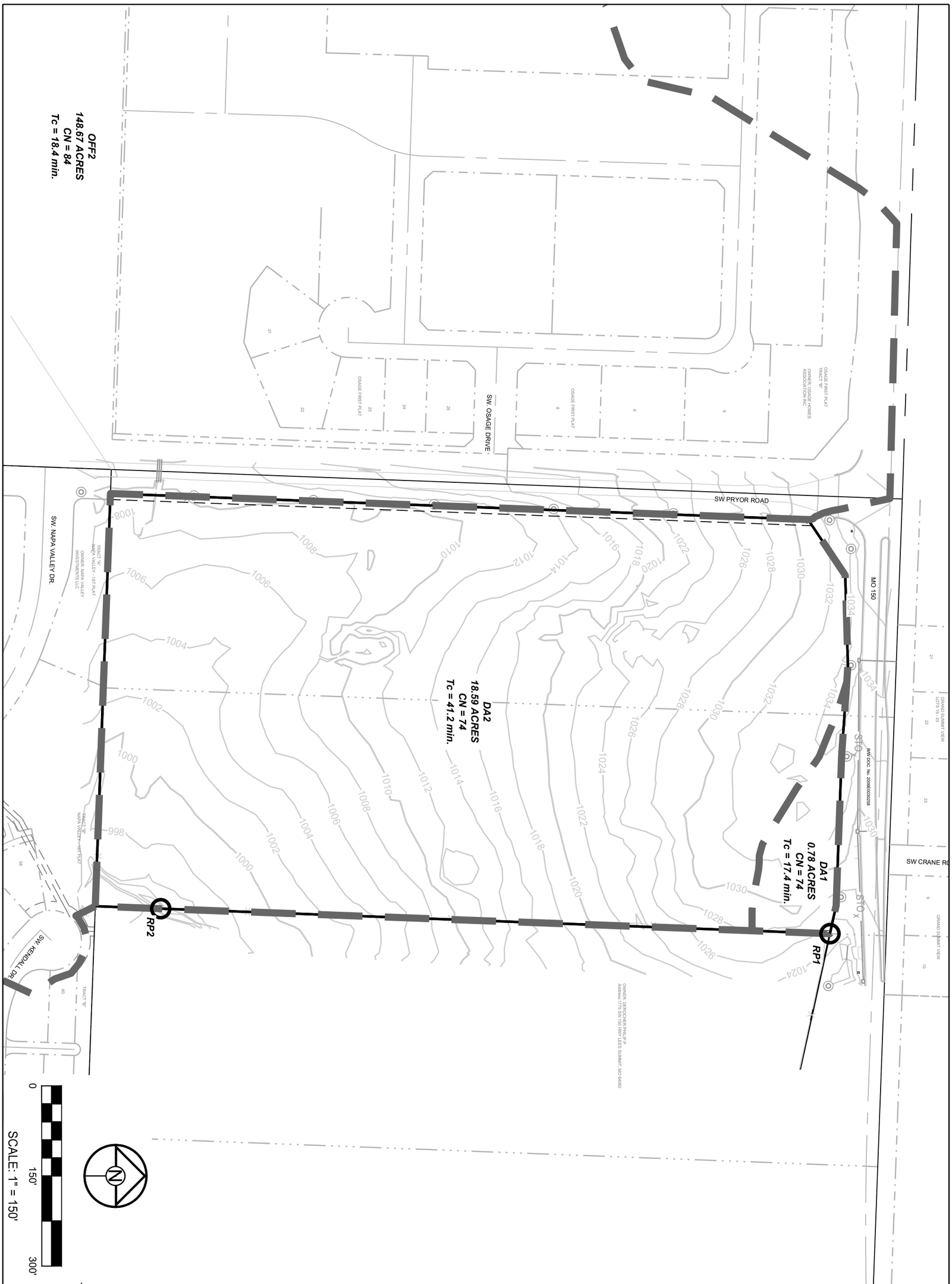
MO-150 & PRYOR ROAD LEE'S SUMMIT, MO

DRAWN BY:	DATE PREPARED:	PROJ. NUMBER:
P.WOODARD	6/9/2023	23-013

EXISTING OFFSITE DRAINAGE MAP

SHEET

A.2



SHEET
A.3

EXISTING DRAINAGE MAP

DRAWN BY:
P.WOODARD
DATE PREPARED:
6/9/2023
PROJ. NUMBER:
23-013

PRYOR MIXED-USE
PRELIMINARY STORMWATER MANAGMENT PLAN

MO-150 & PRYOR ROAD LEE'S SUMMIT, MO

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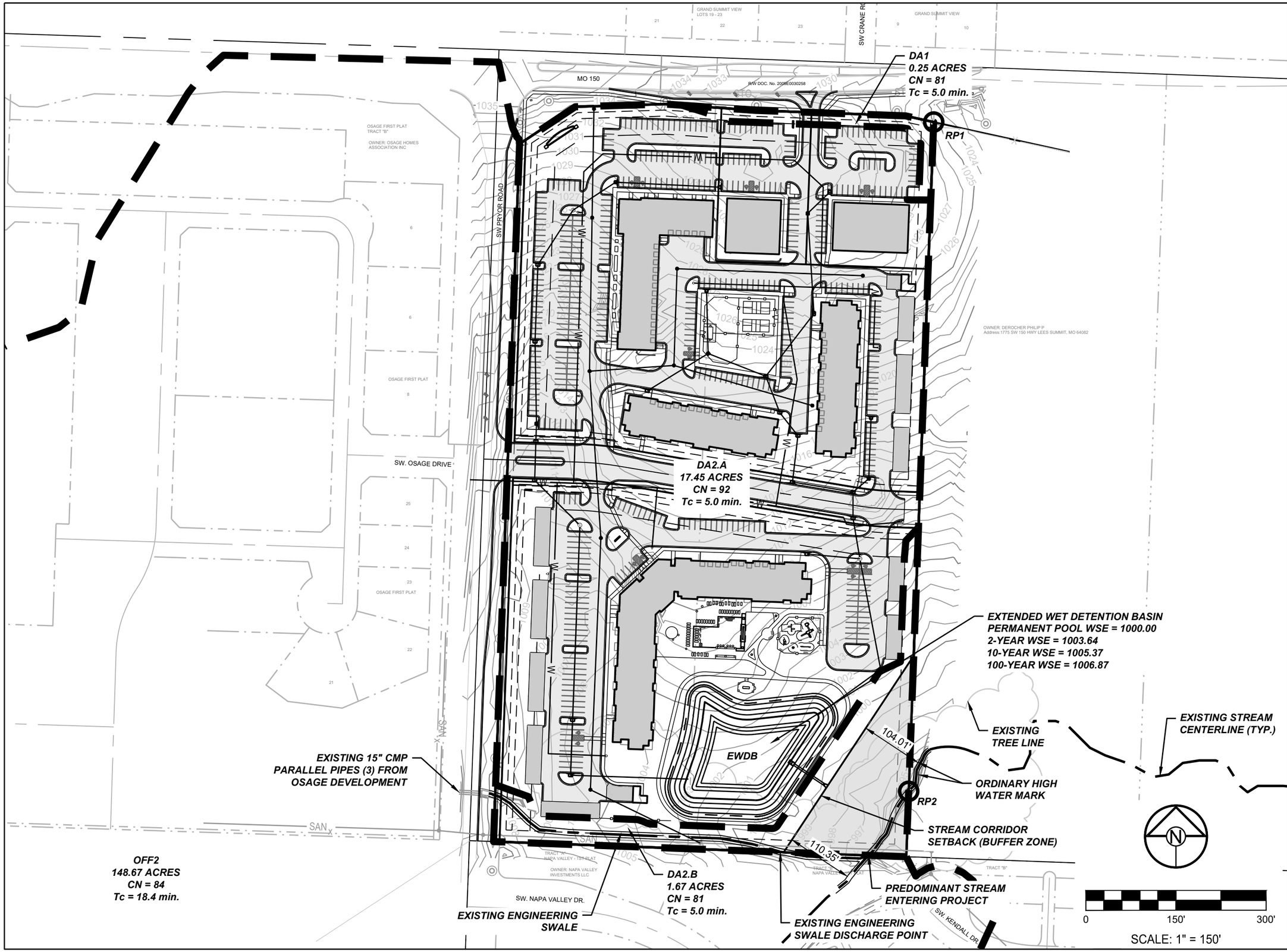

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PRYOR MIXED-USE
PRELIMINARY STORMWATER MANAGMENT PLAN

MO-150 & PRYOR ROAD LEE'S SUMMIT, MO

DRAWN BY:	DATE PREPARED:	PROJ. NUMBER:
P.WOODARD	6/9/2023	23-013

PROPOSED DRAINAGE MAP

SHEET
A.4

Extended Wet Detention Basin 1 Location: M-150 & Pryor Road

Water Quality Volume Calculation

WQV - Water Quality Volume (watershed-inches)
P - Rainfall Event (1.37 inches in Kansas City)
RV - Volumetric Runoff Coefficient
I - Percent Site Imperviousness (%)

WQV = P * Weighted RV
RV = 0.05 + 0.009(I)
C=0.3+0.6(I)

I. Determine Weighted RV & Weighted Rational C Coefficient

Cover Type	% Impervious	Area (Ac.)	Total Impervious Area (Ac.)	Rational Runoff Coefficient	RV	C * Area	RV * Area
ROOF	98	2.92	2.86	0.89	0.93	2.59	2.72
PAVEMENT	98	7.64	7.49	0.89	0.93	6.78	7.12
GRASS/OPEN	0	5.33	0.00	0.30	0.05	1.60	0.27
POND	100	0.50	0.50	0.90	0.95	0.45	0.48
PLAYGROUND/POOL	88	1.06	0.93	0.83	0.84	0.88	0.89
Total		**17.45**	**11.78**			**12.30**	**11.48**

Rv = Sum(Rv*A)/Total Area = 11.47 / 17.45 = 0.658

C = Sum(C*A)/Total Area = 12.3 / 17.45 = 0.705

II. Determine Water Quality Volume

WQV = P * Rv = 1.37 * 0.658 = **0.901 in**

III. Determine Total Water Quality Volume

Total Watershed Area (AT) = 17.45 acres
WQV = 0.901 in

WQV = (17.45 * 0.901)/12 = **1.31 ac-ft** (+20%)= 1.57 ac-ft

Extended Wet Detention Basin

Design Worksheet

Pryor Mixed-Use

PRELIMINARY STORMWATER MANAGEMENT PLAN

6/9/2023

I. Basin Water Quality Volume			
Tributary Area to EWDB, A_T	A_T =	17.45	acres
Water Qualtity Volume, WQ_V - See Attached Calculations	WQ_V =	1.310	ac-ft
IIa. Permanent Pool Volume - Method 1			
Average 14 Day Wet Season Rainfal, R_{14}	R_{14} =	2.2	in
Rational Runoff Coefficient, C	C =	0.76	
Permanent Pool Volume by Method 1, V_{P1} $V_{P1} = (C*A_T*R_{14})/12$	V_{P1} =	**2.43**	ac-ft
IIb. Permanent Pool Volume - Method 2			
Ratio of Basin Volume to Runoff Volume, $V_{B/R}$ (From Figure 8.6; $V_{B/R}$ should be >= 4.0)	$V_{B/R}$ =	4	
Mean Storm Depth, Sd	Sd =	0.6	in
Impervious Tributary Area, Ai	Ai =	11.78	acres
Permanent Pool Volume by Method 2, V_{P2} $V_{P2} = (V_{B/R}*Sd*Ai)/12$	V_{P2} =	**2.36**	ac-ft
IIc. Permanent Pool Design Volume			
Design Permanent Pool Volume, V_P (Larger of V_{P1} and V_{P2} plus 20%)	V_P =	**2.92**	ac-ft
Average Permanent Pool Depth, Z_P	Z_P =	6	ft
Permanent Pool Surface Area, A_P	A_P =	0.49	ac
IIId. Water Quality Outlet - V-Notch Weir			
Depth of Water Quality Volume Above Permanent Pool, Z_{WQ}	Z_{WQ} =	2.34	ft
Average Head of Water Quality Pool Volume Over Invert of V-Notch, H_{WQ} $H_{WQ} = 0.50 * Z_{WQ}$	H_{WQ} =	1.2	ft
Average Water Quality Pool Outflow Rate, Q_{WQ} $Q_{WQ} = (WQ_V * 43560)/(40*3600)$	Q_{WQ} =	0.40	cfs
V-Notch Weir Coefficient, Cv	Cv	2.5	
V-Notch Weir Angle $\Theta = 2*(180/\Pi)*\arctan(Q_{WQ}/(Cv*H_{QW}\text{^}5/2))$ - Not < 20 degrees	Θ =	20.0	deg
V-Notch Weir Top Width, WV $Wv = 2*Z_{WQ}*\tan(\Theta/2)$	Wv =	0.83	ft

National Flood Hazard Layer FIRMette

FEMA

94°25'14"W 38°51'20"N

94°24'37"W 38°50'52"N

Feet

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

1:6,000

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

Legend

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

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 Cross Sections with 1% Annual Chance
- 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.

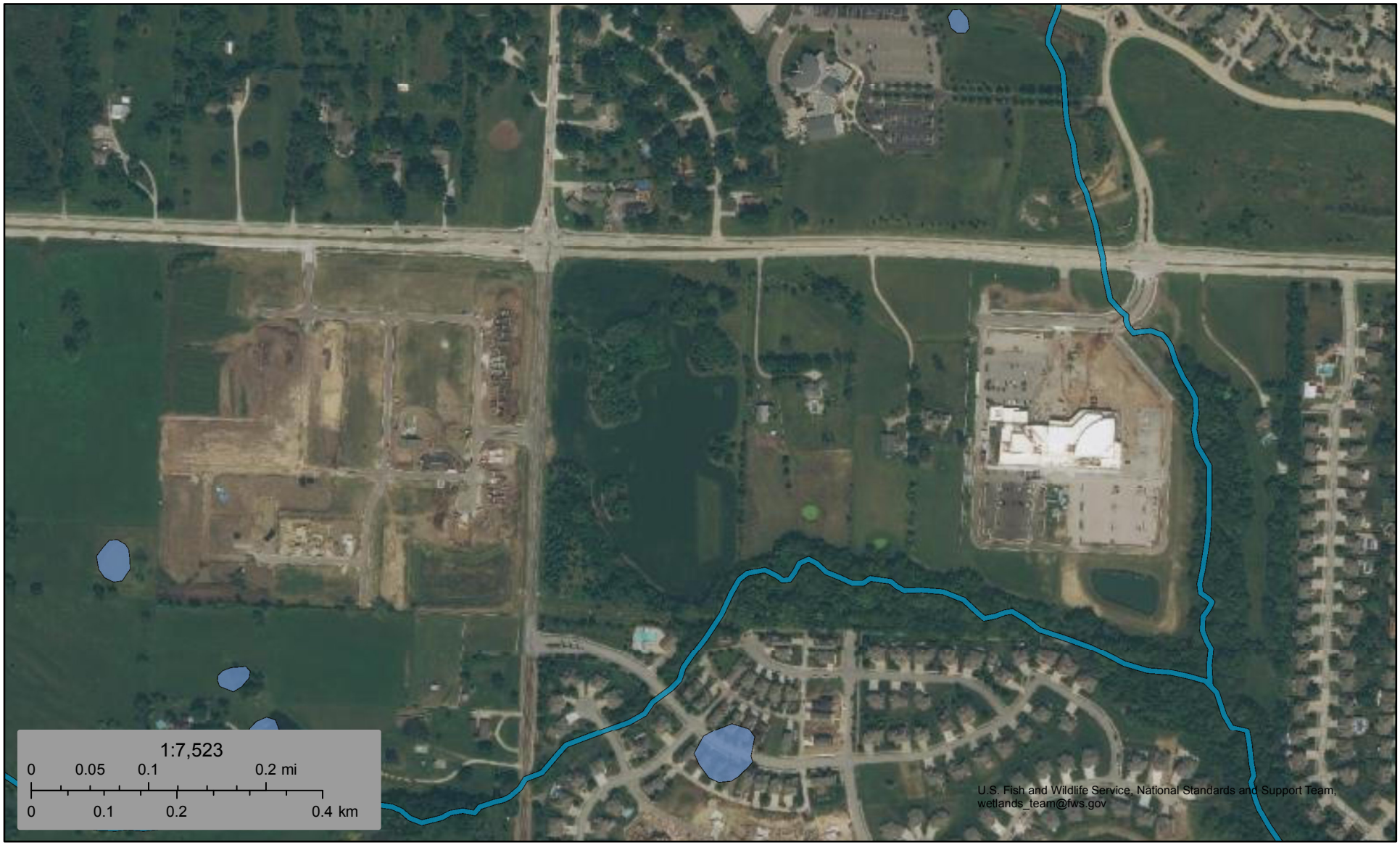
This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 10/11/2022 at 4:00 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

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

U.S. Fish and Wildlife Service
National Wetlands Inventory

23-013



April 19, 2023

Wetlands

- Estuarine and Marine Deepwater
- Estuarine and Marine Wetland
- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond
- Lake
- Other
- Riverine

This map is for general reference only. The US Fish and Wildlife Service is not responsible for the accuracy or currentness of the base data shown on this map. All wetlands related data should be used in accordance with the layer metadata found on the Wetlands Mapper web site.

APPENDIX B

- NRCS Soil Survey Report
- HydroCAD Model Output Reports

United States Department of Agriculture

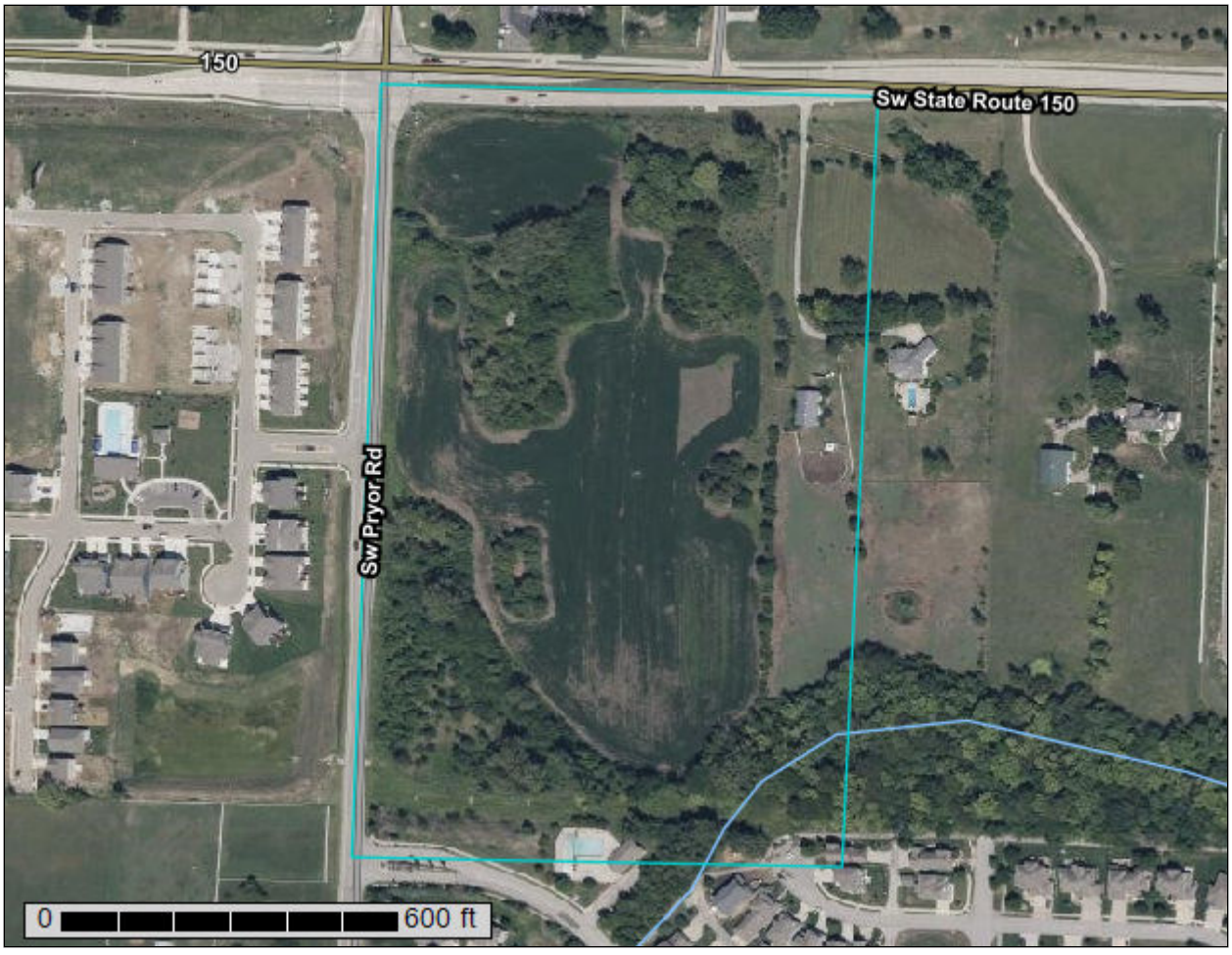
NRCS

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

23-013



April 19, 2023

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.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require

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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 Scale: 1:2,480 if printed on A portrait (8.5" x 11") sheet.

N

Meters
0 35 70 140 210

Feet
0 100 200 400 600

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 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 24, Aug 31, 2022

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
10082	Arisburg-Urban land complex, 1 to 5 percent slopes	18.1	65.4%
10116	Sampsel silty clay loam, 2 to 5 percent slopes	9.6	34.6%
Totals for Area of Interest		**27.7**	**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

10082—Arisburg-Urban land complex, 1 to 5 percent slopes

Map Unit Setting

National map unit symbol: 2w7ld
Elevation: 750 to 1,130 feet
Mean annual precipitation: 39 to 45 inches
Mean annual air temperature: 50 to 55 degrees F
Frost-free period: 177 to 220 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Arisburg and similar soils: 61 percent
Urban land: 30 percent
Minor components: 9 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Arisburg

Setting

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

Typical profile

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

Properties and qualities

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

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: C
Ecological site: R107XB007MO - Loess Upland Prairie
Hydric soil rating: No

Description of Urban Land

Interpretive groups

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

Minor Components

Sampsel

Percent of map unit: 3 percent
Landform: Hills
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

Greenton

Percent of map unit: 3 percent
Landform: Hillslopes
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Ecological site: R109XY002MO - Loess Upland Prairie
Hydric soil rating: No

Sharpsburg

Percent of map unit: 3 percent
Landform: Ridges
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R109XY002MO - Loess Upland Prairie
Hydric soil rating: No

10116—Sampsel silty clay loam, 2 to 5 percent slopes

Map Unit Setting

National map unit symbol: 2qkzy
Elevation: 600 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: Prime farmland if drained

Map Unit Composition

Sampsel and similar soils: 95 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Sampsel

Setting

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

Typical profile

Ap - 0 to 11 inches: silty clay loam
Bt - 11 to 80 inches: silty clay

Properties and qualities

Slope: 2 to 5 percent
Depth to restrictive feature: More than 80 inches
Drainage class: 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 8.4 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

Minor Components

Grundy

Percent of map unit: 3 percent
Landform: Hillslopes
Landform position (two-dimensional): Shoulder, backslope
Landform position (three-dimensional): Head slope, side slope
Down-slope shape: Concave
Across-slope shape: Concave
Ecological site: R109XY002MO - Loess Upland Prairie
Hydric soil rating: No

Snead

Percent of map unit: 2 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

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 (23-013)

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 (23-013)

Map Scale: 1:2,480 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 35 70 140 210

Feet: 0 100 200 400 600

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)

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Soil Survey Area: Jackson County, Missouri
Survey Area Data: Version 24, Aug 31, 2022

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 (23-013)

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
10082	Arisburg-Urban land complex, 1 to 5 percent slopes	C	18.1	65.4%
10116	Sampsel silty clay loam, 2 to 5 percent slopes	C/D	9.6	34.6%
Totals for Area of Interest			**27.7**	**100.0%**

Rating Options—Hydrologic Soil Group (23-013)

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

References

American Association of State Highway and Transportation Officials (AASHTO). 2004. Standard specifications for transportation materials and methods of sampling and testing. 24th edition.

American Society for Testing and Materials (ASTM). 2005. Standard classification of soils for engineering purposes. ASTM Standard D2487-00.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deep-water habitats of the United States. U.S. Fish and Wildlife Service FWS/OBS-79/31.

Federal Register. July 13, 1994. Changes in hydric soils of the United States.

Federal Register. September 18, 2002. Hydric soils of the United States.

Hurt, G.W., and L.M. Vasilas, editors. Version 6.0, 2006. Field indicators of hydric soils in the United States.

National Research Council. 1995. Wetlands: Characteristics and boundaries.

Soil Survey Division Staff. 1993. Soil survey manual. Soil Conservation Service. U.S. Department of Agriculture Handbook 18. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_054262

Soil Survey Staff. 1999. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. 2nd edition. Natural Resources Conservation Service, U.S. Department of Agriculture Handbook 436. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053577

Soil Survey Staff. 2010. Keys to soil taxonomy. 11th edition. U.S. Department of Agriculture, Natural Resources Conservation Service. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053580

Tiner, R.W., Jr. 1985. Wetlands of Delaware. U.S. Fish and Wildlife Service and Delaware Department of Natural Resources and Environmental Control, Wetlands Section.

United States Army Corps of Engineers, Environmental Laboratory. 1987. Corps of Engineers wetlands delineation manual. Waterways Experiment Station Technical Report Y-87-1.

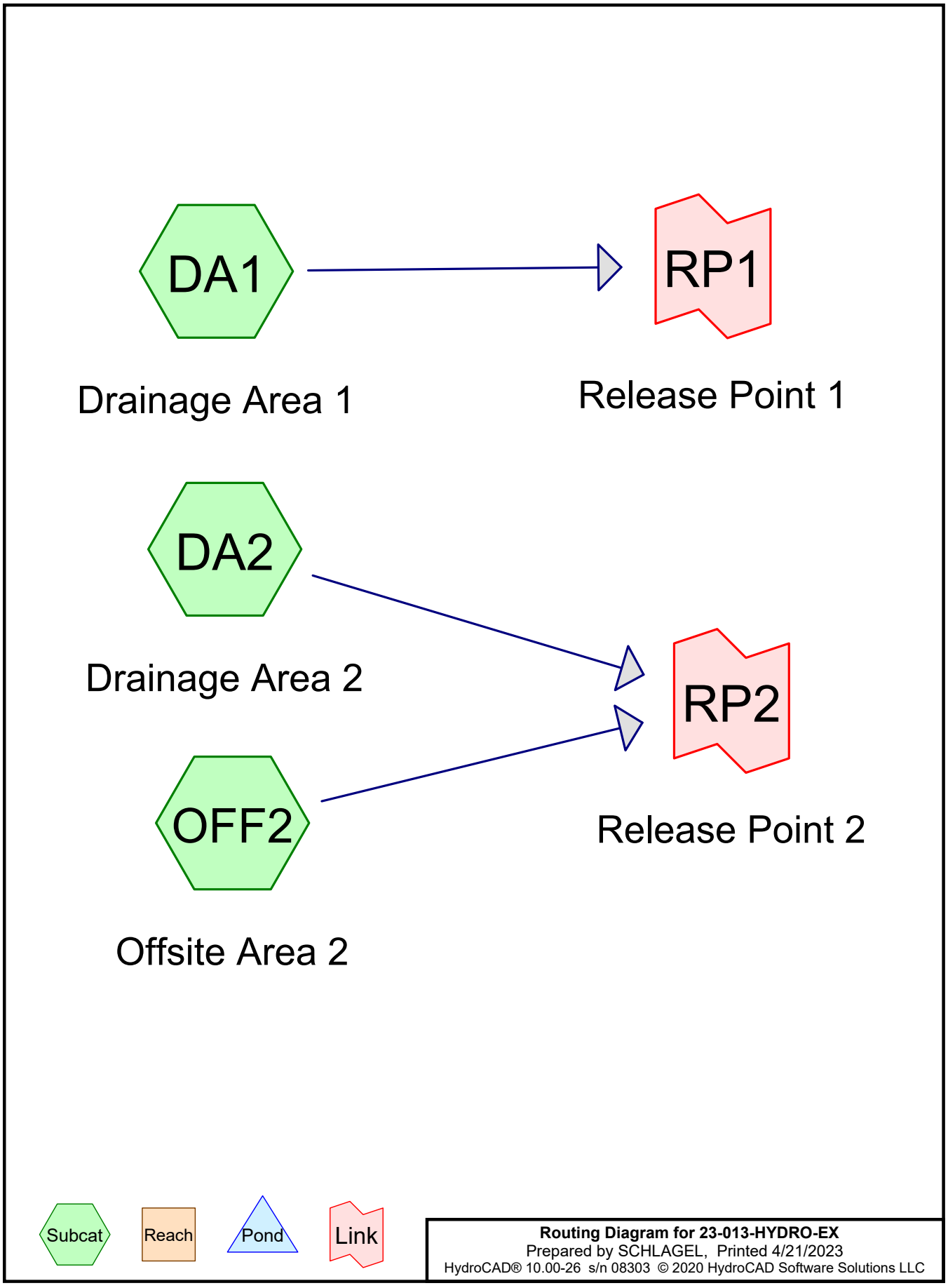
United States Department of Agriculture, Natural Resources Conservation Service. National forestry manual. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/home/?cid=nrcs142p2_053374

United States Department of Agriculture, Natural Resources Conservation Service. National range and pasture handbook. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/landuse/rangepasture/?cid=stelprdb1043084

United States Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook, title 430-VI. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/scientists/?cid=nrcs142p2_054242

United States Department of Agriculture, Natural Resources Conservation Service. 2006. Land resource regions and major land resource areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053624

United States Department of Agriculture, Soil Conservation Service. 1961. Land capability classification. U.S. Department of Agriculture Handbook 210. http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_052290.pdf



Routing Diagram for 23-013-HYDRO-EX
Prepared by SCHLAGEL, Printed 4/21/2023

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
51.270	87	1/4 acre lots, 38% imp, HSG D (OFF2)
0.780	74	50-75% Grass cover, Fair, HSG C (DA1, DA2)
49.030	80	>75% Grass cover, Good, HSG D (OFF2)
38.450	80	Pasture/grassland/range, Good, HSG D (OFF2)
6.400	89	Row crops, straight row, Good, HSG D (OFF2)
11.340	74	Small grain, contoured, Poor, HSG C (DA1, DA2)
0.200	98	Water Surface, HSG D (DA2)
3.520	77	Woods, Good, HSG D (OFF2)
7.050	74	Woods/grass comb., Fair, HSG C (DA1, DA2)
168.040	**82**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
19.170	HSG C	DA1, DA2
148.870	HSG D	DA2, OFF2
0.000	Other	
168.040		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover
0.000	0.000	0.000	51.270	0.000	51.270	1/4 acre lots, 38% imp
0.000	0.000	0.780	0.000	0.000	0.780	50-75% Grass cover, Fair
0.000	0.000	0.000	49.030	0.000	49.030	>75% Grass cover, Good
0.000	0.000	0.000	38.450	0.000	38.450	Pasture/grassland/ range, Good
0.000	0.000	0.000	6.400	0.000	6.400	Row crops, straight row, Good
0.000	0.000	11.340	0.000	0.000	11.340	Small grain, contoured, Poor
0.000	0.000	0.000	0.200	0.000	0.200	Water Surface
0.000	0.000	0.000	3.520	0.000	3.520	Woods, Good
0.000	0.000	7.050	0.000	0.000	7.050	Woods/grass comb., Fair
0.000	**0.000**	**19.170**	**148.870**	**0.000**	**168.040**	**TOTAL AREA**

Time span=0.00-60.00 hrs, dt=0.01 hrs, 6001 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 DA1: Drainage Runoff Area=0.780 ac 0.00% Impervious Runoff Depth=1.24"
Flow Length=244' Tc=17.4 min CN=74 Runoff=1.12 cfs 0.081 af

Subcatchment DA2: Runoff Area=18.590 ac 1.08% Impervious Runoff Depth=1.24"
Flow Length=1,285' Tc=41.2 min CN=74 Runoff=15.23 cfs 1.921 af

Subcatchment OFF2: Runoff Area=148.670 ac 13.10% Impervious Runoff Depth=1.86"
Flow Length=5,079' Tc=18.7 min CN=83 Runoff=319.70 cfs 23.026 af

Link RP1: Release Point 1 Inflow=1.12 cfs 0.081 af
Primary=1.12 cfs 0.081 af

Link RP2: Release Point 2 Inflow=326.79 cfs 24.947 af
Primary=326.79 cfs 24.947 af

Total Runoff Area = 168.040 ac Runoff Volume = 25.027 af Average Runoff Depth = 1.79"
88.29% Pervious = 148.357 ac 11.71% Impervious = 19.683 ac

Summary for Subcatchment DA1: Drainage Area 1

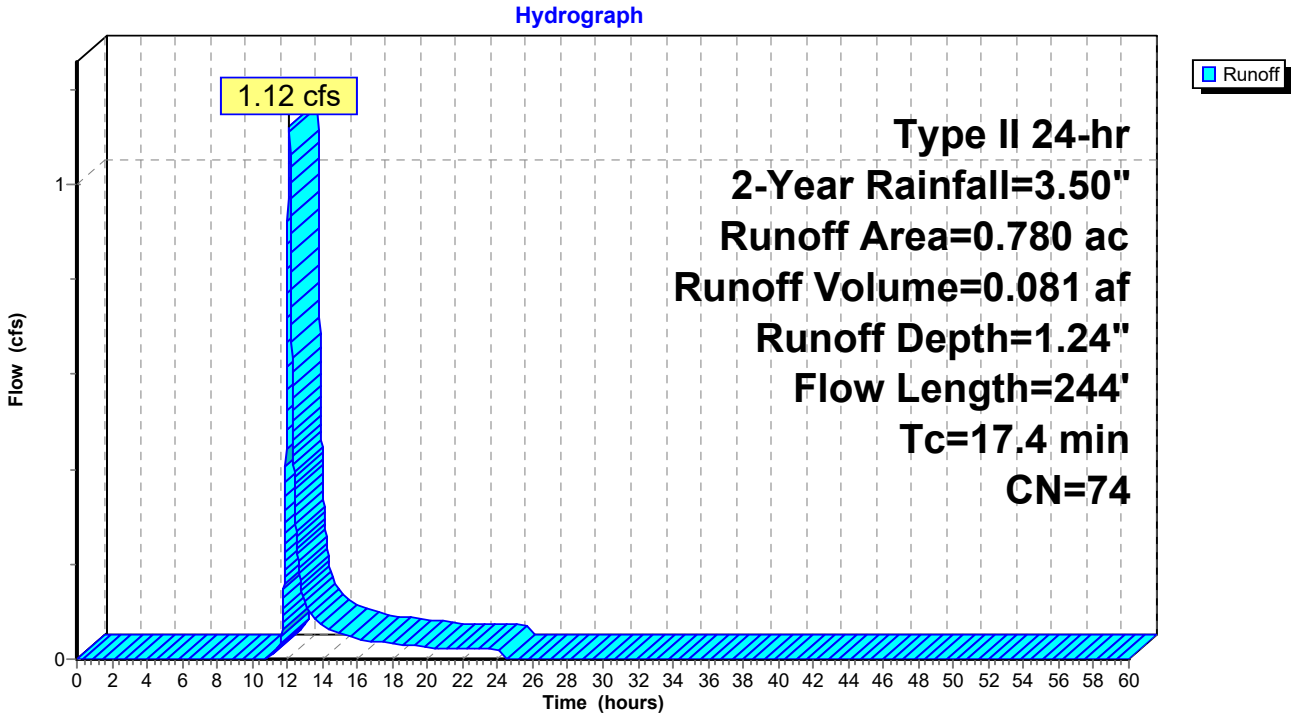
Runoff = 1.12 cfs @ 12.11 hrs, Volume= 0.081 af, Depth= 1.24"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-60.00 hrs, dt= 0.01 hrs
Type II 24-hr 2-Year Rainfall=3.50"

	Area (ac)	CN	Description
*	0.250	74	Woods/grass comb., Fair, HSG C
*	0.050	74	Small grain, contoured, Poor, HSG C
*	0.480	74	50-75% Grass cover, Fair, HSG C
	0.780	74	Weighted Average
	0.780		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.7	100	0.0121	0.10		**Sheet Flow, SHEET** Grass: Dense n= 0.240 P2= 3.50"
0.7	144	0.0522	3.68		**Shallow Concentrated Flow, SHALLOW** Unpaved Kv= 16.1 fps
17.4	244	Total			

Subcatchment DA1: Drainage Area 1



Summary for Subcatchment DA2: Drainage Area 2

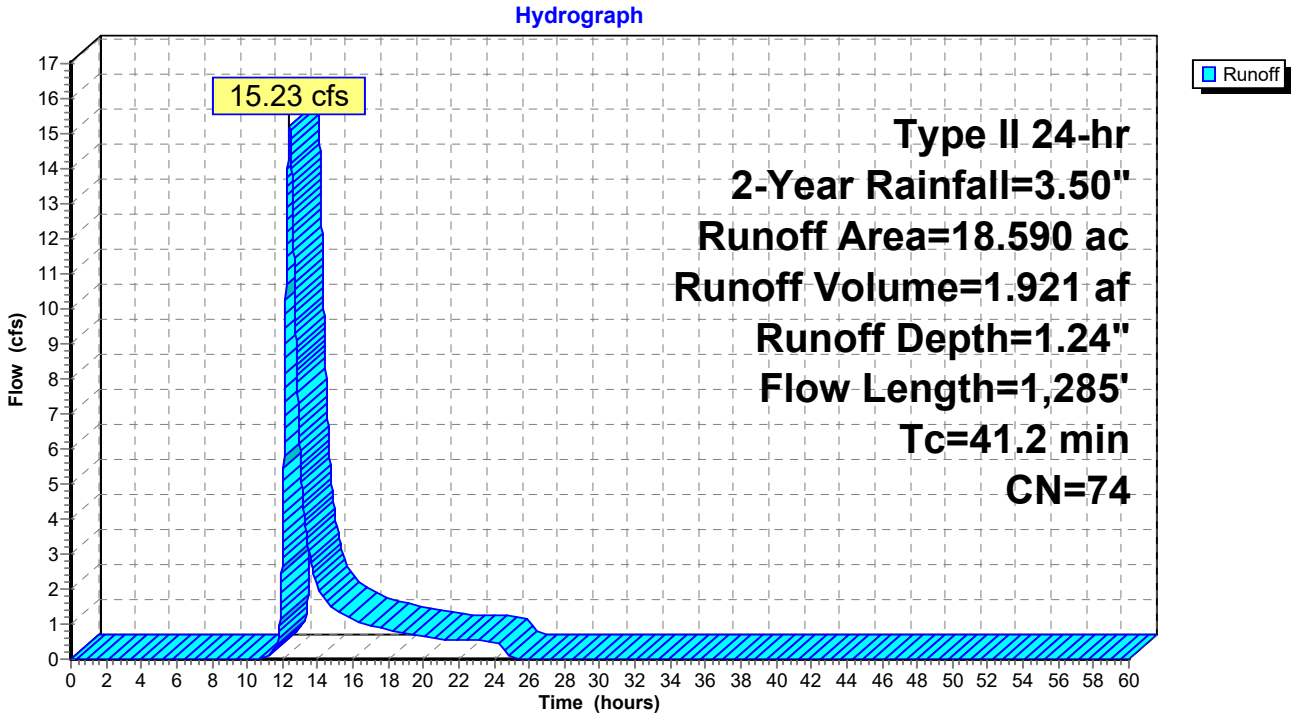
Runoff = 15.23 cfs @ 12.41 hrs, Volume= 1.921 af, Depth= 1.24"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-60.00 hrs, dt= 0.01 hrs
Type II 24-hr 2-Year Rainfall=3.50"

	Area (ac)	CN	Description
*	1.950	74	Woods/grass comb., Fair, HSG C
*	1.000	74	Woods/grass comb., Fair, HSG C
*	3.850	74	Woods/grass comb., Fair, HSG C
	0.110	98	Water Surface, HSG D
	0.030	98	Water Surface, HSG D
	0.060	98	Water Surface, HSG D
*	11.290	74	Small grain, contoured, Poor, HSG C
*	0.300	74	50-75% Grass cover, Fair, HSG C
	18.590	74	Weighted Average
	18.390		98.92% Pervious Area
	0.200		1.08% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
29.1	100	0.0084	0.06		**Sheet Flow, SHEET** Woods: Light underbrush n= 0.400 P2= 3.50"
12.1	1,180	0.0327	1.63		**Shallow Concentrated Flow, SHALLOW** Cultivated Straight Rows Kv= 9.0 fps
0.0	5	0.0208	14.30	364.75	**Channel Flow, CHANNEL** Area= 25.5 sf Perim= 9.0' r= 2.83' n= 0.030 Earth, clean & winding
41.2	1,285	Total			

Subcatchment DA2: Drainage Area 2



Summary for Subcatchment OFF2: Offsite Area 2

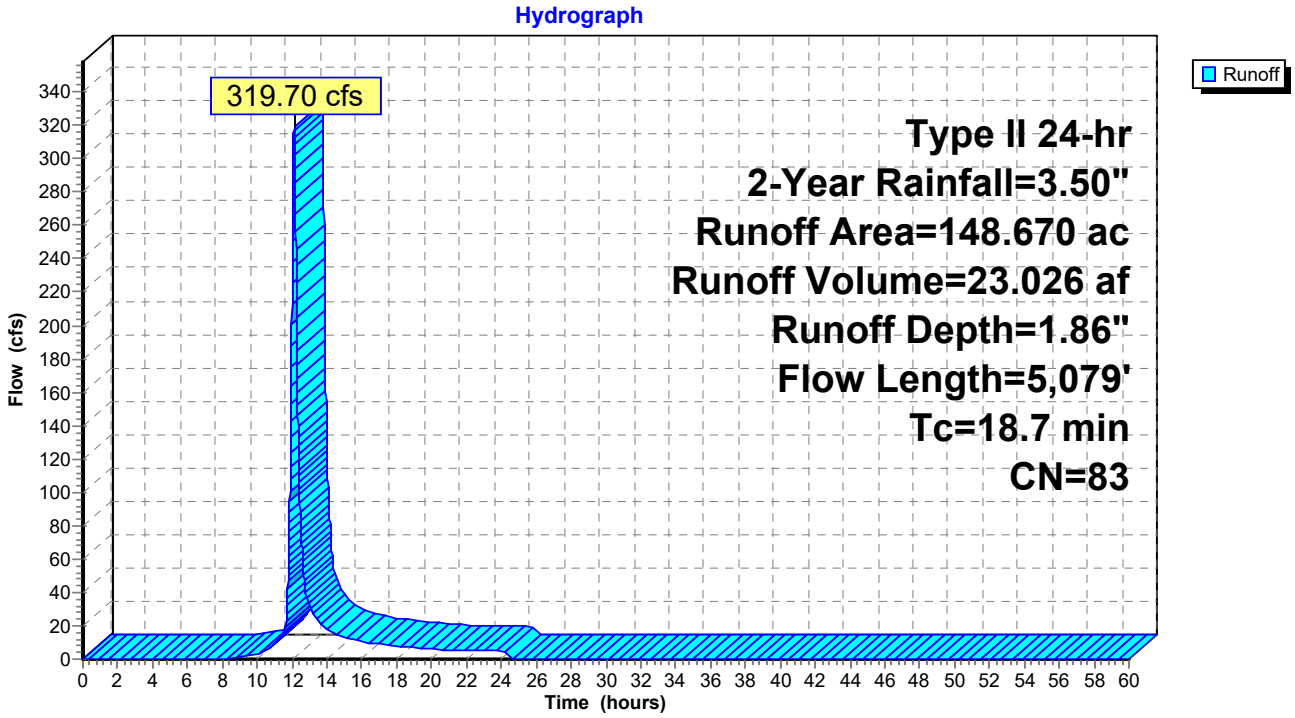
Runoff = 319.70 cfs @ 12.11 hrs, Volume= 23.026 af, Depth= 1.86"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-60.00 hrs, dt= 0.01 hrs
Type II 24-hr 2-Year Rainfall=3.50"

Area (ac)	CN	Description
6.400	89	Row crops, straight row, Good, HSG D
3.520	77	Woods, Good, HSG D
49.030	80	>75% Grass cover, Good, HSG D
38.450	80	Pasture/grassland/range, Good, HSG D
20.210	87	1/4 acre lots, 38% imp, HSG D
31.060	87	1/4 acre lots, 38% imp, HSG D
148.670	83	Weighted Average
129.187		86.90% Pervious Area
19.483		13.10% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.6	100	0.0940	0.30		**Sheet Flow, SHEET** Cultivated: Residue>20% n= 0.170 P2= 3.50"
3.4	410	0.0506	2.02		**Shallow Concentrated Flow, SHALLOW** Cultivated Straight Rows Kv= 9.0 fps
3.6	216	0.0400	1.00		**Shallow Concentrated Flow, SHALLOW** Woodland Kv= 5.0 fps
2.4	1,261	0.0327	8.67	104.04	**Channel Flow, CHANNEL** Area= 12.0 sf Perim= 10.0' r= 1.20' n= 0.035 High grass
1.3	1,985	0.1450	26.29	670.29	**Channel Flow, CHANNEL** Area= 25.5 sf Perim= 15.5' r= 1.65' n= 0.030 Earth, clean & winding
2.2	980	0.0114	7.43	223.03	**Channel Flow, CHANNEL** Area= 30.0 sf Perim= 18.0' r= 1.67' n= 0.030
0.2	127	0.0265	11.24	286.55	**Channel Flow, CHANNEL** Area= 25.5 sf Perim= 15.5' r= 1.65' n= 0.030
18.7	5,079	Total			

Subcatchment OFF2: Offsite Area 2

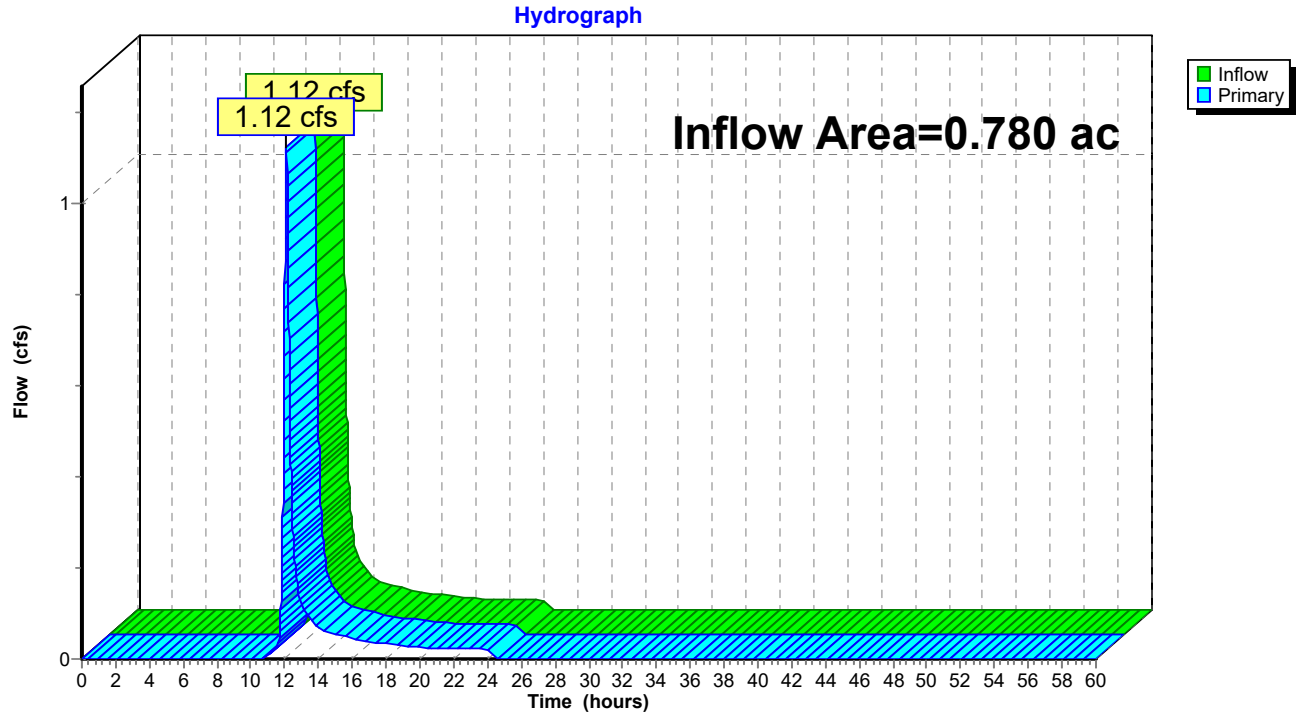


Summary for Link RP1: Release Point 1

Inflow Area = 0.780 ac, 0.00% Impervious, Inflow Depth = 1.24" for 2-Year event
Inflow = 1.12 cfs @ 12.11 hrs, Volume= 0.081 af
Primary = 1.12 cfs @ 12.11 hrs, Volume= 0.081 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-60.00 hrs, dt= 0.01 hrs

Link RP1: Release Point 1

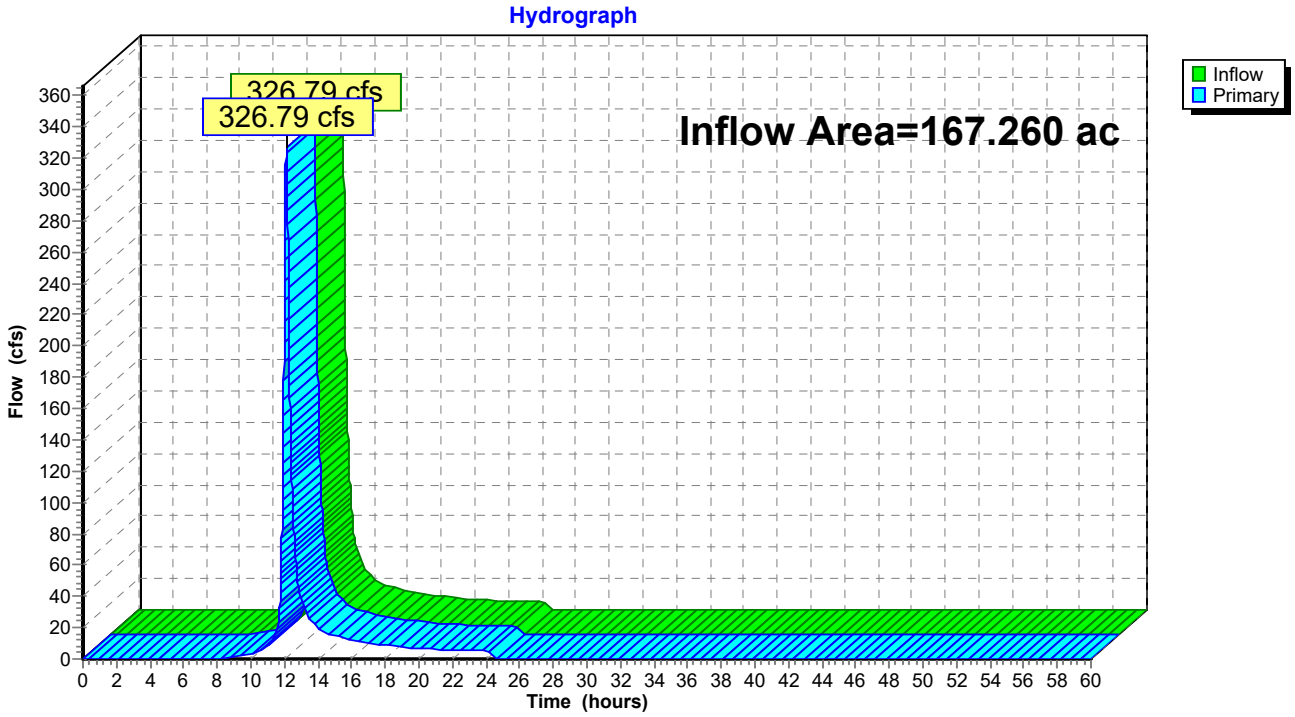


Summary for Link RP2: Release Point 2

Inflow Area = 167.260 ac, 11.77% Impervious, Inflow Depth = 1.79" for 2-Year event
Inflow = 326.79 cfs @ 12.11 hrs, Volume= 24.947 af
Primary = 326.79 cfs @ 12.11 hrs, Volume= 24.947 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-60.00 hrs, dt= 0.01 hrs

Link RP2: Release Point 2



Time span=0.00-60.00 hrs, dt=0.01 hrs, 6001 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 DA1: Drainage Runoff Area=0.780 ac 0.00% Impervious Runoff Depth=2.61"
Flow Length=244' Tc=17.4 min CN=74 Runoff=2.44 cfs 0.169 af

Subcatchment DA2: Runoff Area=18.590 ac 1.08% Impervious Runoff Depth=2.61"
Flow Length=1,285' Tc=41.2 min CN=74 Runoff=33.61 cfs 4.037 af

Subcatchment OFF2: Runoff Area=148.670 ac 13.10% Impervious Runoff Depth=3.45"
Flow Length=5,079' Tc=18.7 min CN=83 Runoff=589.07 cfs 42.703 af

Link RP1: Release Point 1 Inflow=2.44 cfs 0.169 af
Primary=2.44 cfs 0.169 af

Link RP2: Release Point 2 Inflow=606.56 cfs 46.739 af
Primary=606.56 cfs 46.739 af

Total Runoff Area = 168.040 ac Runoff Volume = 46.909 af Average Runoff Depth = 3.35"
88.29% Pervious = 148.357 ac 11.71% Impervious = 19.683 ac

Summary for Subcatchment DA1: Drainage Area 1

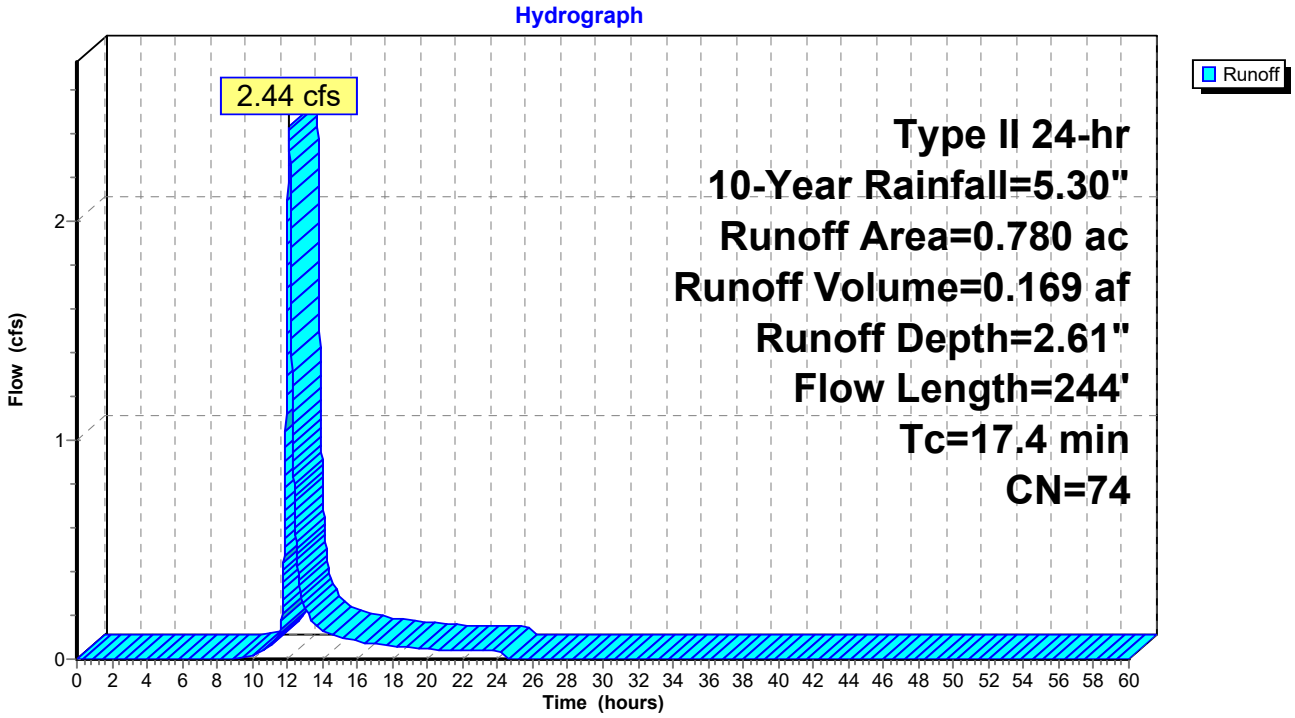
Runoff = 2.44 cfs @ 12.10 hrs, Volume= 0.169 af, Depth= 2.61"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-60.00 hrs, dt= 0.01 hrs
Type II 24-hr 10-Year Rainfall=5.30"

	Area (ac)	CN	Description
*	0.250	74	Woods/grass comb., Fair, HSG C
*	0.050	74	Small grain, contoured, Poor, HSG C
*	0.480	74	50-75% Grass cover, Fair, HSG C
	0.780	74	Weighted Average
	0.780		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.7	100	0.0121	0.10		**Sheet Flow, SHEET** Grass: Dense n= 0.240 P2= 3.50"
0.7	144	0.0522	3.68		**Shallow Concentrated Flow, SHALLOW** Unpaved Kv= 16.1 fps
17.4	244	Total			

Subcatchment DA1: Drainage Area 1



Summary for Subcatchment DA2: Drainage Area 2

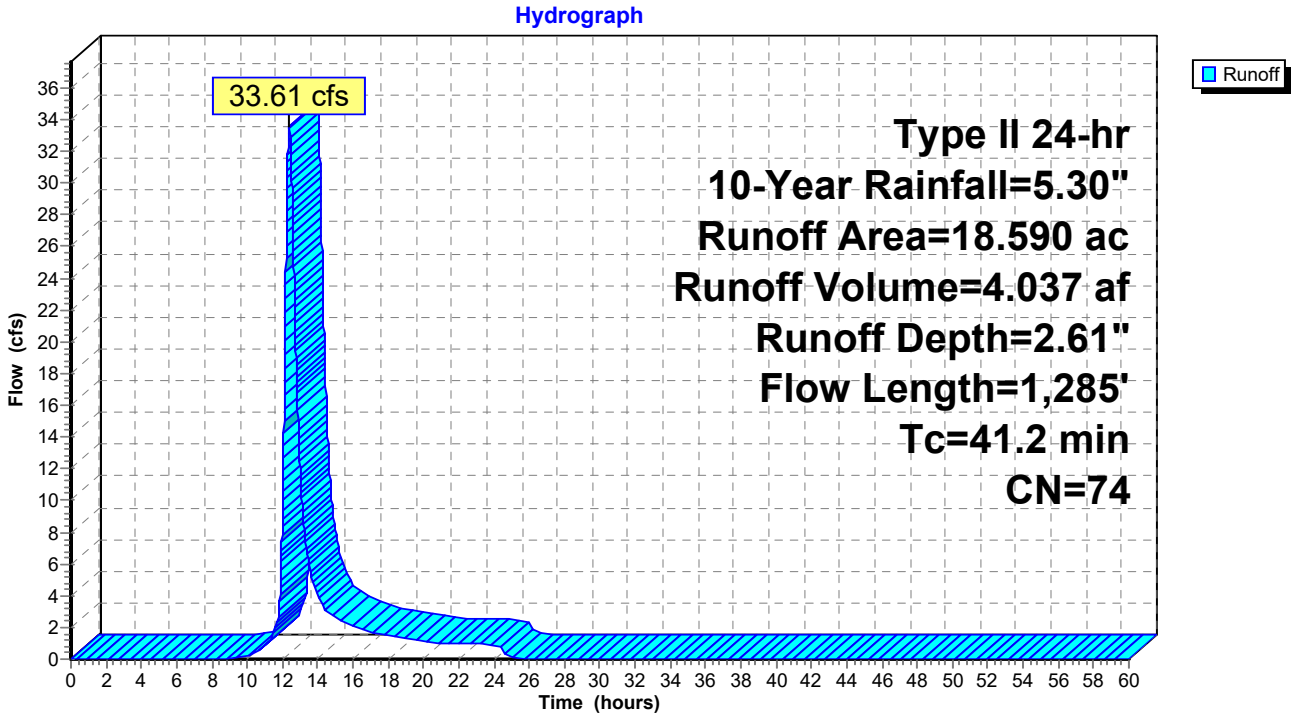
Runoff = 33.61 cfs @ 12.40 hrs, Volume= 4.037 af, Depth= 2.61"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-60.00 hrs, dt= 0.01 hrs
Type II 24-hr 10-Year Rainfall=5.30"

	Area (ac)	CN	Description
*	1.950	74	Woods/grass comb., Fair, HSG C
*	1.000	74	Woods/grass comb., Fair, HSG C
*	3.850	74	Woods/grass comb., Fair, HSG C
	0.110	98	Water Surface, HSG D
	0.030	98	Water Surface, HSG D
	0.060	98	Water Surface, HSG D
*	11.290	74	Small grain, contoured, Poor, HSG C
*	0.300	74	50-75% Grass cover, Fair, HSG C
	18.590	74	Weighted Average
	18.390		98.92% Pervious Area
	0.200		1.08% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
29.1	100	0.0084	0.06		**Sheet Flow, SHEET** Woods: Light underbrush n= 0.400 P2= 3.50"
12.1	1,180	0.0327	1.63		**Shallow Concentrated Flow, SHALLOW** Cultivated Straight Rows Kv= 9.0 fps
0.0	5	0.0208	14.30	364.75	**Channel Flow, CHANNEL** Area= 25.5 sf Perim= 9.0' r= 2.83' n= 0.030 Earth, clean & winding
41.2	1,285	Total			

Subcatchment DA2: Drainage Area 2



Summary for Subcatchment OFF2: Offsite Area 2

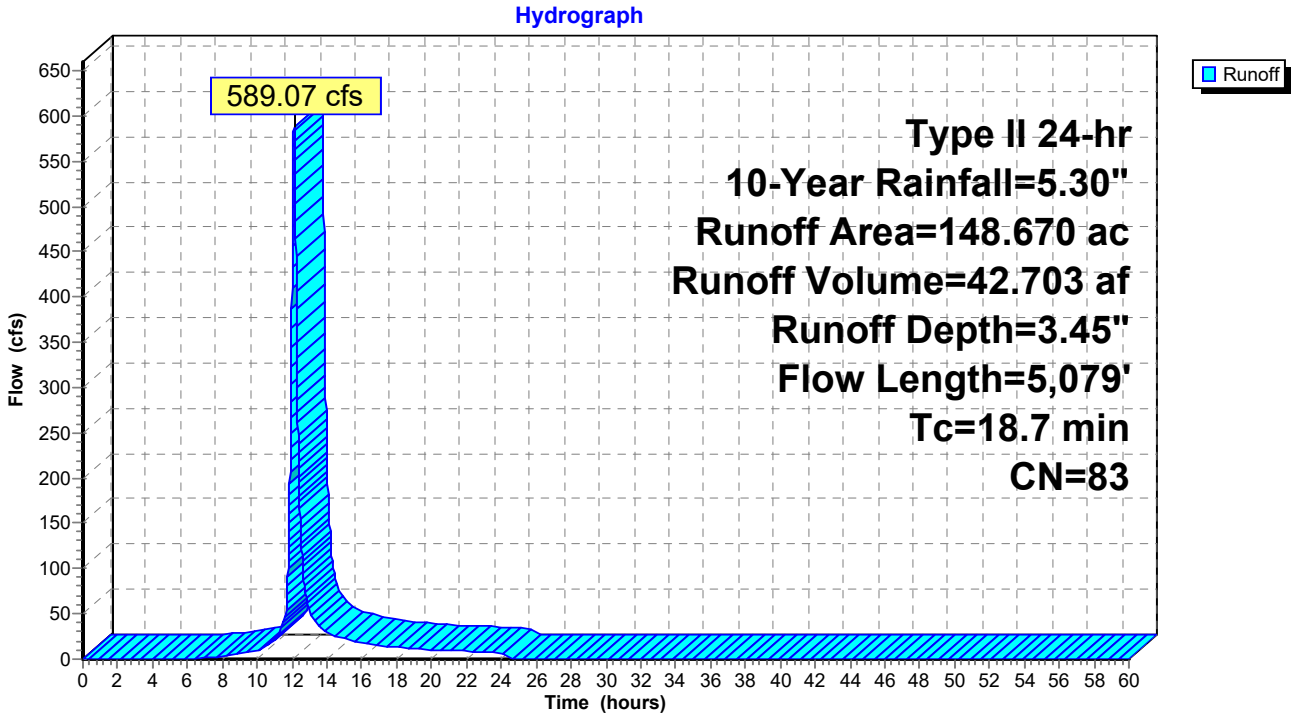
Runoff = 589.07 cfs @ 12.11 hrs, Volume= 42.703 af, Depth= 3.45"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-60.00 hrs, dt= 0.01 hrs
Type II 24-hr 10-Year Rainfall=5.30"

Area (ac)	CN	Description
6.400	89	Row crops, straight row, Good, HSG D
3.520	77	Woods, Good, HSG D
49.030	80	>75% Grass cover, Good, HSG D
38.450	80	Pasture/grassland/range, Good, HSG D
20.210	87	1/4 acre lots, 38% imp, HSG D
31.060	87	1/4 acre lots, 38% imp, HSG D
148.670	83	Weighted Average
129.187		86.90% Pervious Area
19.483		13.10% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.6	100	0.0940	0.30		**Sheet Flow, SHEET** Cultivated: Residue>20% n= 0.170 P2= 3.50"
3.4	410	0.0506	2.02		**Shallow Concentrated Flow, SHALLOW** Cultivated Straight Rows Kv= 9.0 fps
3.6	216	0.0400	1.00		**Shallow Concentrated Flow, SHALLOW** Woodland Kv= 5.0 fps
2.4	1,261	0.0327	8.67	104.04	**Channel Flow, CHANNEL** Area= 12.0 sf Perim= 10.0' r= 1.20' n= 0.035 High grass
1.3	1,985	0.1450	26.29	670.29	**Channel Flow, CHANNEL** Area= 25.5 sf Perim= 15.5' r= 1.65' n= 0.030 Earth, clean & winding
2.2	980	0.0114	7.43	223.03	**Channel Flow, CHANNEL** Area= 30.0 sf Perim= 18.0' r= 1.67' n= 0.030
0.2	127	0.0265	11.24	286.55	**Channel Flow, CHANNEL** Area= 25.5 sf Perim= 15.5' r= 1.65' n= 0.030
18.7	5,079	Total			

Subcatchment OFF2: Offsite Area 2

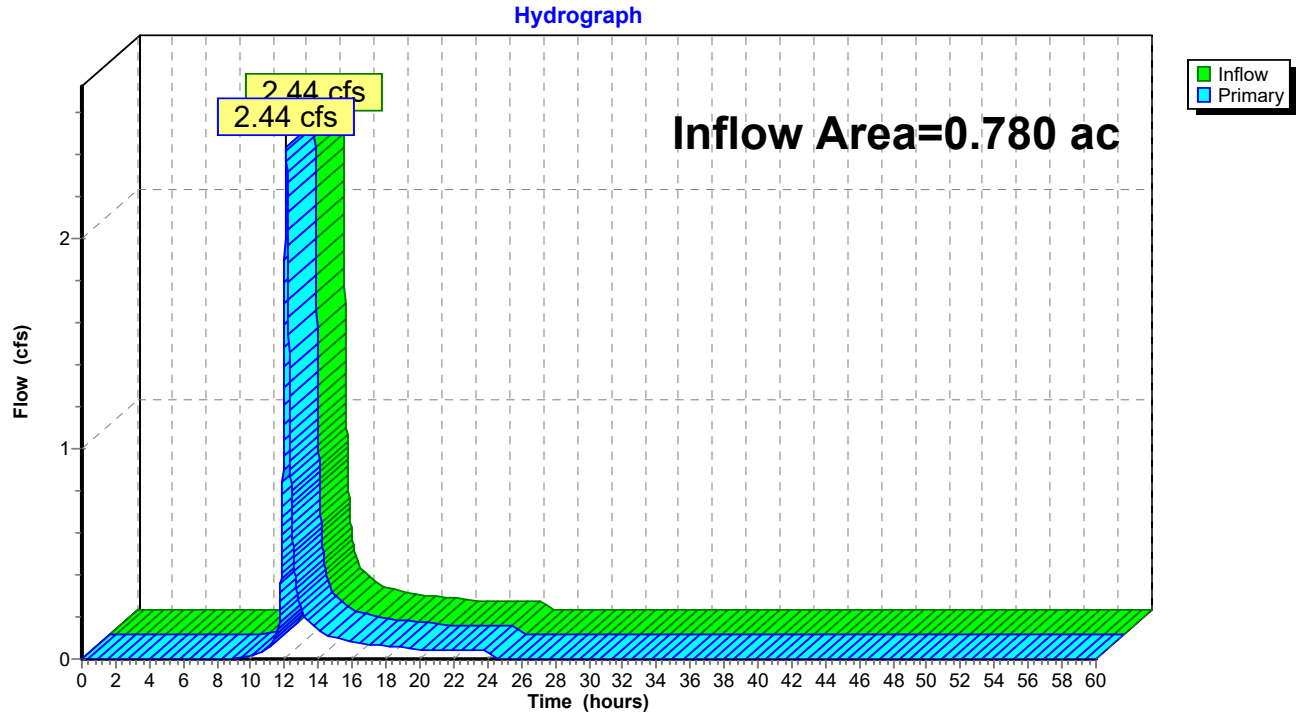


Summary for Link RP1: Release Point 1

Inflow Area = 0.780 ac, 0.00% Impervious, Inflow Depth = 2.61" for 10-Year event
Inflow = 2.44 cfs @ 12.10 hrs, Volume= 0.169 af
Primary = 2.44 cfs @ 12.10 hrs, Volume= 0.169 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-60.00 hrs, dt= 0.01 hrs

Link RP1: Release Point 1

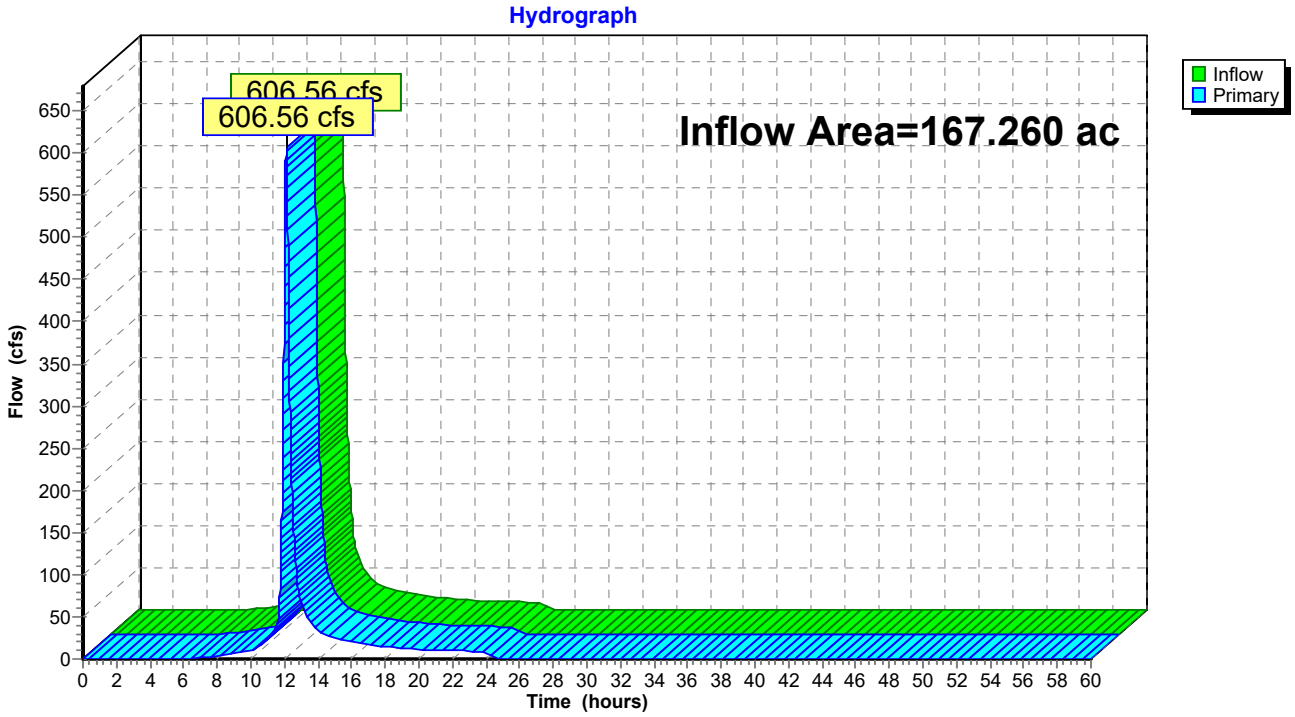


Summary for Link RP2: Release Point 2

Inflow Area = 167.260 ac, 11.77% Impervious, Inflow Depth = 3.35" for 10-Year event
Inflow = 606.56 cfs @ 12.11 hrs, Volume= 46.739 af
Primary = 606.56 cfs @ 12.11 hrs, Volume= 46.739 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-60.00 hrs, dt= 0.01 hrs

Link RP2: Release Point 2



Time span=0.00-60.00 hrs, dt=0.01 hrs, 6001 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 DA1: Drainage Runoff Area=0.780 ac 0.00% Impervious Runoff Depth=4.66"
Flow Length=244' Tc=17.4 min CN=74 Runoff=4.36 cfs 0.303 af

Subcatchment DA2: Runoff Area=18.590 ac 1.08% Impervious Runoff Depth=4.66"
Flow Length=1,285' Tc=41.2 min CN=74 Runoff=60.63 cfs 7.216 af

Subcatchment OFF2: Runoff Area=148.670 ac 13.10% Impervious Runoff Depth=5.69"
Flow Length=5,079' Tc=18.7 min CN=83 Runoff=955.78 cfs 70.512 af

Link RP1: Release Point 1 Inflow=4.36 cfs 0.303 af
Primary=4.36 cfs 0.303 af

Link RP2: Release Point 2 Inflow=989.18 cfs 77.728 af
Primary=989.18 cfs 77.728 af

Total Runoff Area = 168.040 ac Runoff Volume = 78.031 af Average Runoff Depth = 5.57"
88.29% Pervious = 148.357 ac 11.71% Impervious = 19.683 ac

Summary for Subcatchment DA1: Drainage Area 1

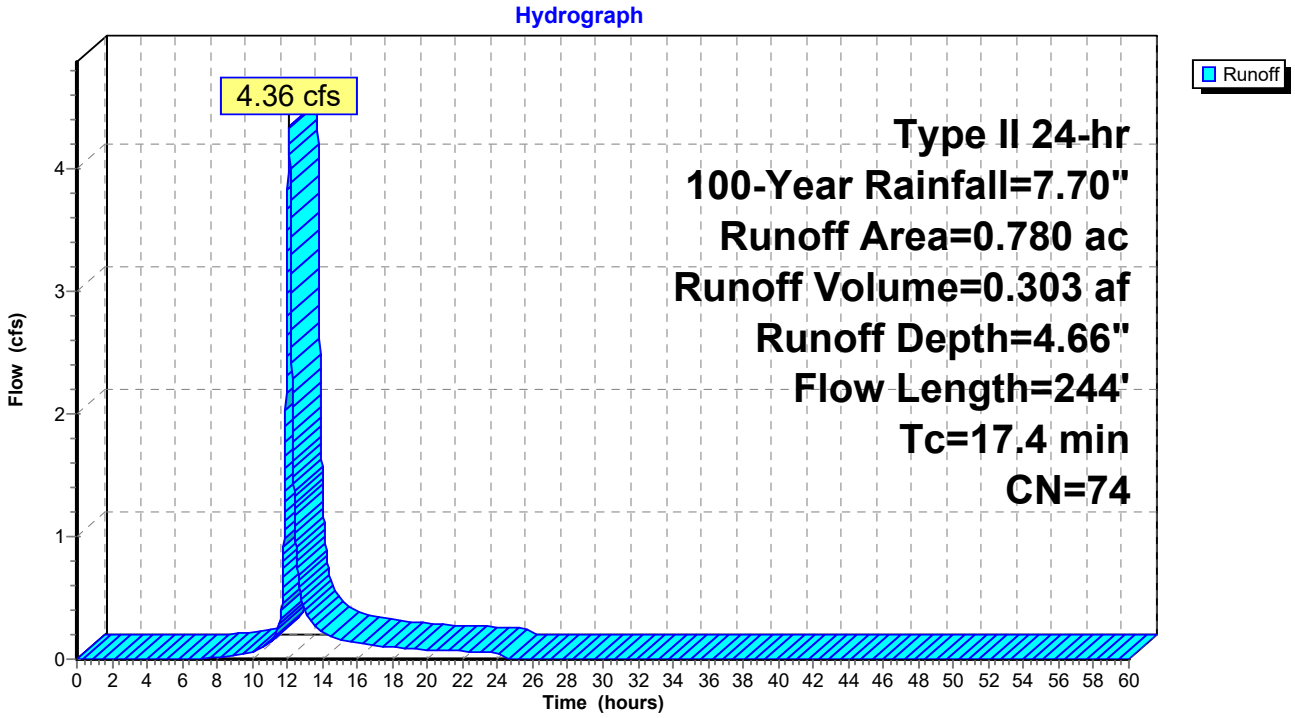
Runoff = 4.36 cfs @ 12.09 hrs, Volume= 0.303 af, Depth= 4.66"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-60.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-Year Rainfall=7.70"

	Area (ac)	CN	Description
*	0.250	74	Woods/grass comb., Fair, HSG C
*	0.050	74	Small grain, contoured, Poor, HSG C
*	0.480	74	50-75% Grass cover, Fair, HSG C
	0.780	74	Weighted Average
	0.780		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.7	100	0.0121	0.10		**Sheet Flow, SHEET** Grass: Dense n= 0.240 P2= 3.50"
0.7	144	0.0522	3.68		**Shallow Concentrated Flow, SHALLOW** Unpaved Kv= 16.1 fps
17.4	244	Total			

Subcatchment DA1: Drainage Area 1



Summary for Subcatchment DA2: Drainage Area 2

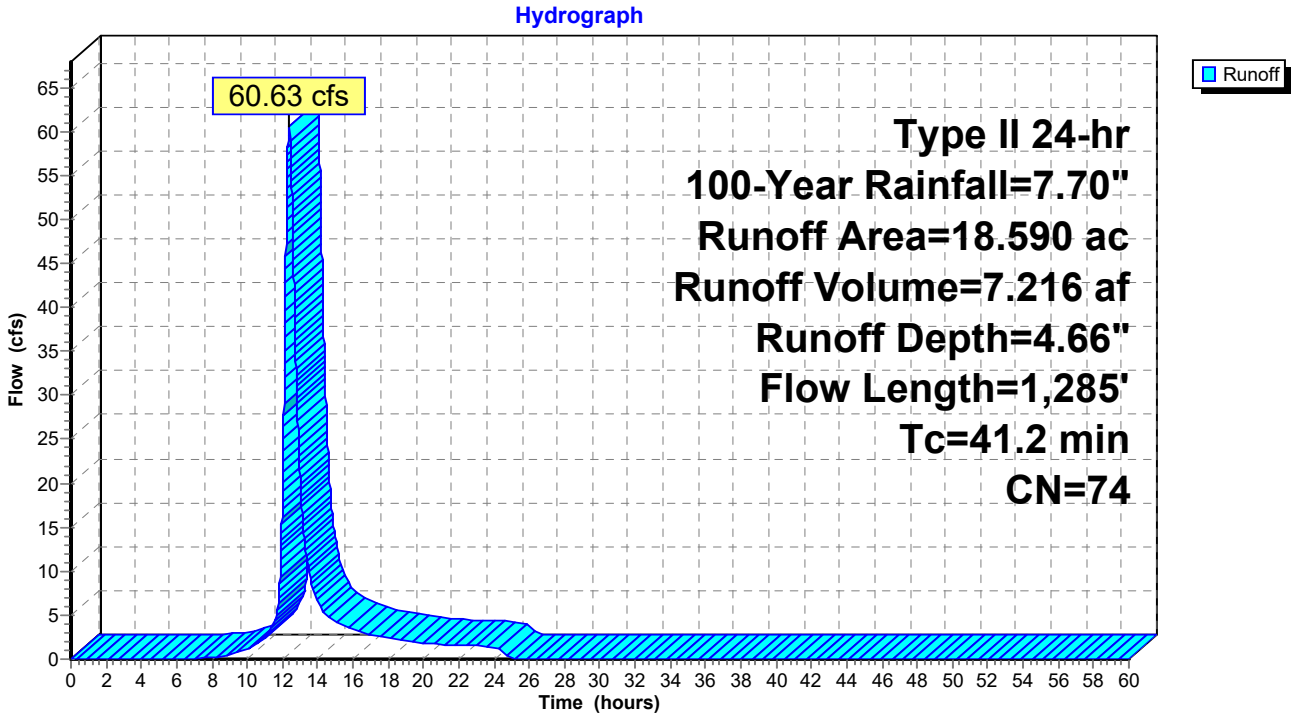
Runoff = 60.63 cfs @ 12.40 hrs, Volume= 7.216 af, Depth= 4.66"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-60.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-Year Rainfall=7.70"

	Area (ac)	CN	Description
*	1.950	74	Woods/grass comb., Fair, HSG C
*	1.000	74	Woods/grass comb., Fair, HSG C
*	3.850	74	Woods/grass comb., Fair, HSG C
	0.110	98	Water Surface, HSG D
	0.030	98	Water Surface, HSG D
	0.060	98	Water Surface, HSG D
*	11.290	74	Small grain, contoured, Poor, HSG C
*	0.300	74	50-75% Grass cover, Fair, HSG C
	18.590	74	Weighted Average
	18.390		98.92% Pervious Area
	0.200		1.08% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
29.1	100	0.0084	0.06		**Sheet Flow, SHEET** Woods: Light underbrush n= 0.400 P2= 3.50"
12.1	1,180	0.0327	1.63		**Shallow Concentrated Flow, SHALLOW** Cultivated Straight Rows Kv= 9.0 fps
0.0	5	0.0208	14.30	364.75	**Channel Flow, CHANNEL** Area= 25.5 sf Perim= 9.0' r= 2.83' n= 0.030 Earth, clean & winding
41.2	1,285	Total			

Subcatchment DA2: Drainage Area 2



Summary for Subcatchment OFF2: Offsite Area 2

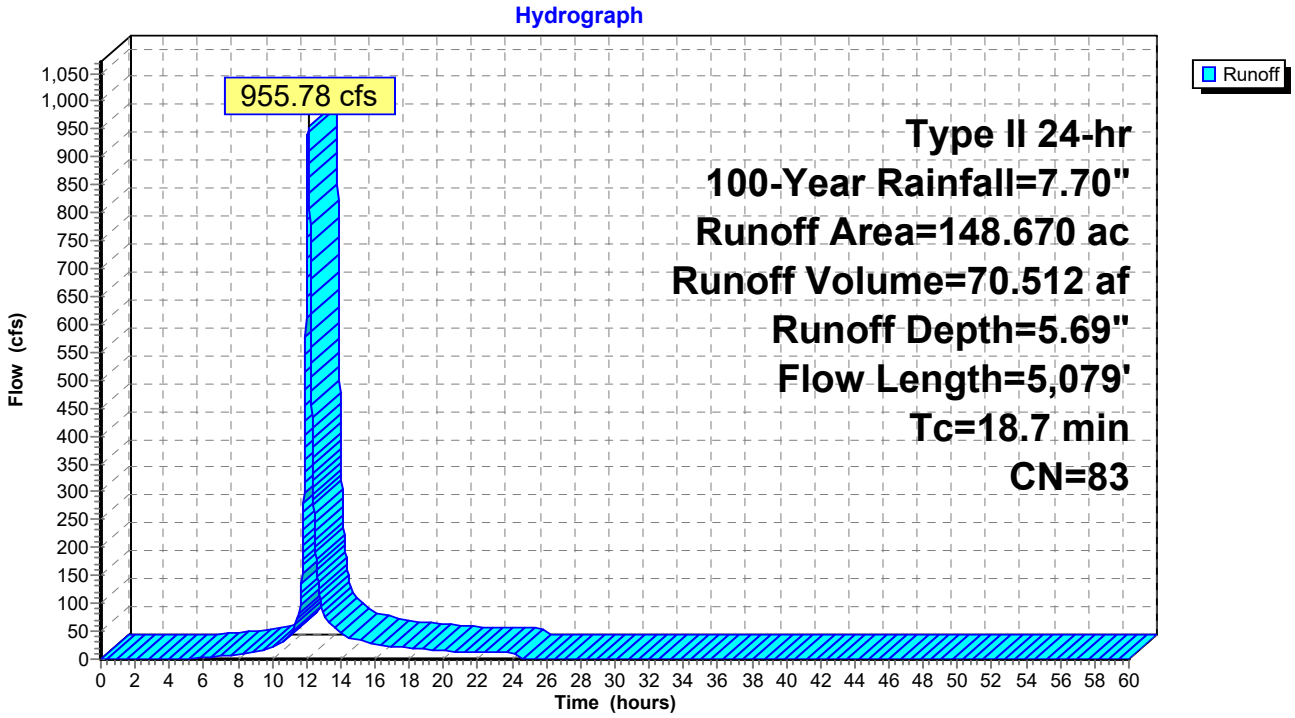
Runoff = 955.78 cfs @ 12.11 hrs, Volume= 70.512 af, Depth= 5.69"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-60.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-Year Rainfall=7.70"

Area (ac)	CN	Description
6.400	89	Row crops, straight row, Good, HSG D
3.520	77	Woods, Good, HSG D
49.030	80	>75% Grass cover, Good, HSG D
38.450	80	Pasture/grassland/range, Good, HSG D
20.210	87	1/4 acre lots, 38% imp, HSG D
31.060	87	1/4 acre lots, 38% imp, HSG D
148.670	83	Weighted Average
129.187		86.90% Pervious Area
19.483		13.10% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.6	100	0.0940	0.30		**Sheet Flow, SHEET** Cultivated: Residue>20% n= 0.170 P2= 3.50"
3.4	410	0.0506	2.02		**Shallow Concentrated Flow, SHALLOW** Cultivated Straight Rows Kv= 9.0 fps
3.6	216	0.0400	1.00		**Shallow Concentrated Flow, SHALLOW** Woodland Kv= 5.0 fps
2.4	1,261	0.0327	8.67	104.04	**Channel Flow, CHANNEL** Area= 12.0 sf Perim= 10.0' r= 1.20' n= 0.035 High grass
1.3	1,985	0.1450	26.29	670.29	**Channel Flow, CHANNEL** Area= 25.5 sf Perim= 15.5' r= 1.65' n= 0.030 Earth, clean & winding
2.2	980	0.0114	7.43	223.03	**Channel Flow, CHANNEL** Area= 30.0 sf Perim= 18.0' r= 1.67' n= 0.030
0.2	127	0.0265	11.24	286.55	**Channel Flow, CHANNEL** Area= 25.5 sf Perim= 15.5' r= 1.65' n= 0.030
18.7	5,079	Total			

Subcatchment OFF2: Offsite Area 2

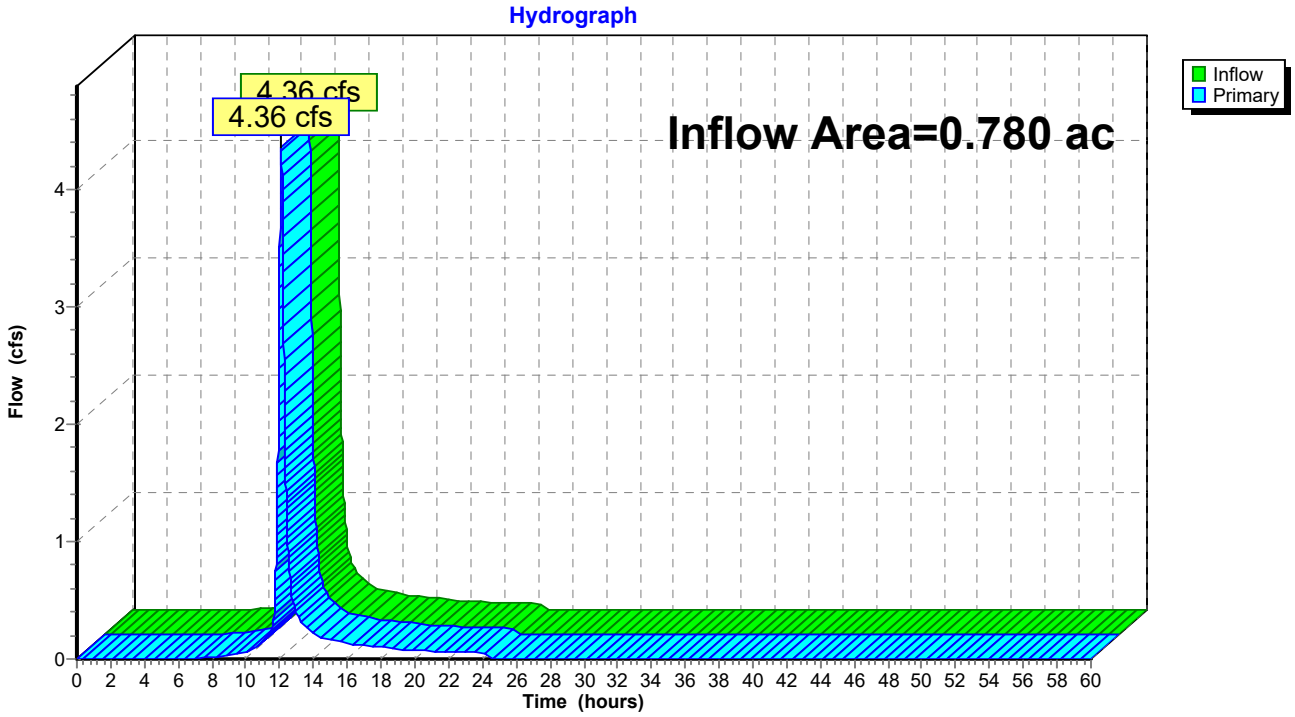


Summary for Link RP1: Release Point 1

Inflow Area = 0.780 ac, 0.00% Impervious, Inflow Depth = 4.66" for 100-Year event
Inflow = 4.36 cfs @ 12.09 hrs, Volume= 0.303 af
Primary = 4.36 cfs @ 12.09 hrs, Volume= 0.303 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-60.00 hrs, dt= 0.01 hrs

Link RP1: Release Point 1

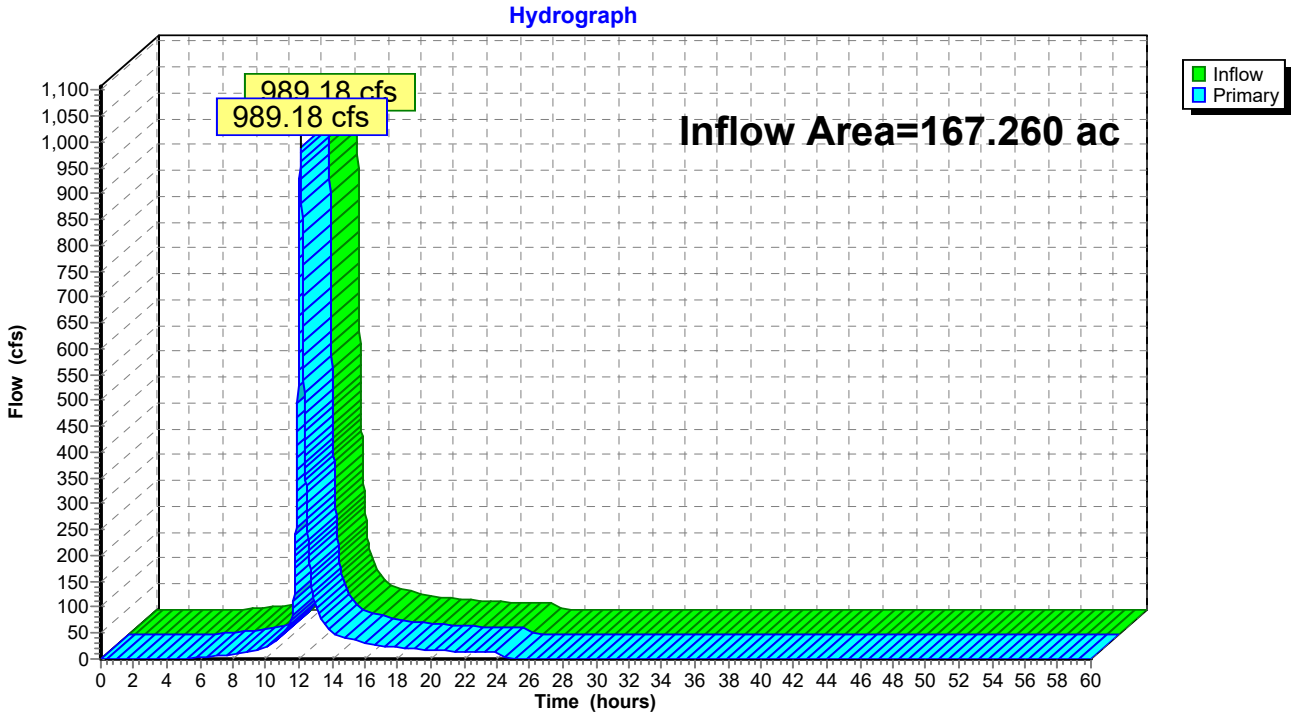


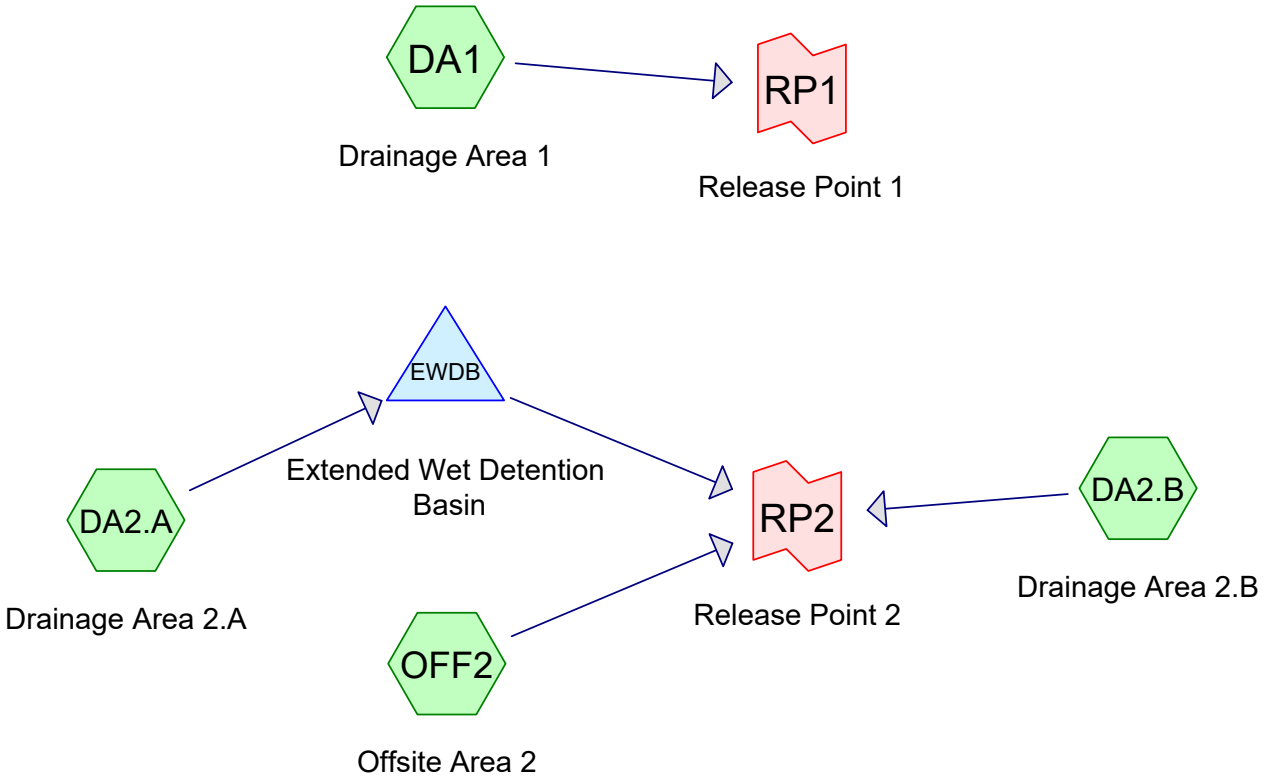
Summary for Link RP2: Release Point 2

Inflow Area = 167.260 ac, 11.77% Impervious, Inflow Depth = 5.58" for 100-Year event
Inflow = 989.18 cfs @ 12.11 hrs, Volume= 77.728 af
Primary = 989.18 cfs @ 12.11 hrs, Volume= 77.728 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-60.00 hrs, dt= 0.01 hrs

Link RP2: Release Point 2





Subcat Reach Pond Link

Routing Diagram for 23-013-HYDRO-PRO
Prepared by SCHLAGEL, Printed 6/9/2023

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
51.270	87	1/4 acre lots, 38% imp, HSG D (OFF2)
55.470	80	>75% Grass cover, Good, HSG D (DA1, DA2.A, DA2.B, OFF2)
38.450	80	Pasture/grassland/range, Good, HSG D (OFF2)
0.020	98	Paved parking, HSG D (DA1)
7.640	98	Paved roads w/curbs & sewers, HSG D (DA2.A)
6.400	89	Row crops, straight row, Good, HSG D (OFF2)
0.010	98	Unconnected pavement, HSG D (DA2.B)
2.920	98	Unconnected roofs, HSG D (DA2.A)
1.060	95	Urban commercial, 85% imp, HSG D (DA2.A)
0.500	98	Water Surface, HSG D (DA2.A)
3.520	77	Woods, Good, HSG D (OFF2)
0.780	82	Woods/grass comb., Fair, HSG D (DA2.B)
168.040	**84**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
0.000	HSG C	
168.040	HSG D	DA1, DA2.A, DA2.B, OFF2
0.000	Other	
168.040		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover
0.000	0.000	0.000	51.270	0.000	51.270	1/4 acre lots, 38% imp
0.000	0.000	0.000	55.470	0.000	55.470	>75% Grass cover, Good
0.000	0.000	0.000	38.450	0.000	38.450	Pasture/grassland/ range, Good
0.000	0.000	0.000	0.020	0.000	0.020	Paved parking
0.000	0.000	0.000	7.640	0.000	7.640	Paved roads w/curbs & sewers
0.000	0.000	0.000	6.400	0.000	6.400	Row crops, straight row, Good
0.000	0.000	0.000	0.010	0.000	0.010	Unconnected pavement
0.000	0.000	0.000	2.920	0.000	2.920	Unconnected roofs
0.000	0.000	0.000	1.060	0.000	1.060	Urban commercial, 85% imp
0.000	0.000	0.000	0.500	0.000	0.500	Water Surface
0.000	0.000	0.000	3.520	0.000	3.520	Woods, Good
0.000	0.000	0.000	0.780	0.000	0.780	Woods/grass comb., Fair
0.000	**0.000**	**0.000**	**168.040**	**0.000**	**168.040**	**TOTAL AREA**

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Diam/Width (inches)	Height (inches)	Insi (i
1	EWDB	999.50	998.80	63.3	0.0111	0.013	30.0	0.0	

Time span=0.00-60.00 hrs, dt=0.01 hrs, 6001 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 DA1: Drainage Runoff Area=0.250 ac 8.00% Impervious Runoff Depth=1.71"
Flow Length=190' Slope=0.0200 '/' Tc=5.0 min CN=81 Runoff=0.79 cfs 0.036 af

Subcatchment DA2.A: Runoff Area=17.450 ac 68.54% Impervious Runoff Depth=2.64"
Flow Length=1,357' Slope=0.0110 '/' Tc=5.0 min CN=92 Runoff=79.91 cfs 3.834 af

Subcatchment DA2.B: Runoff Area=1.670 ac 0.60% Impervious Runoff Depth=1.71"
Tc=5.0 min CN=81 Runoff=5.30 cfs 0.238 af

Subcatchment OFF2: Runoff Area=148.670 ac 13.10% Impervious Runoff Depth=1.86"
Flow Length=5,079' Tc=18.7 min CN=83 Runoff=319.70 cfs 23.026 af

Pond EWDB: Extended Peak Elev=1,003.64' Storage=102,635 cf Inflow=79.91 cfs 3.834 af
Outflow=3.44 cfs 3.625 af

Link RP1: Release Point 1 Inflow=0.79 cfs 0.036 af
Primary=0.79 cfs 0.036 af

Link RP2: Release Point 2 Inflow=324.04 cfs 26.889 af
Primary=324.04 cfs 26.889 af

Total Runoff Area = 168.040 ac Runoff Volume = 27.134 af Average Runoff Depth = 1.94"
81.27% Pervious = 136.566 ac 18.73% Impervious = 31.474 ac

Summary for Subcatchment DA1: Drainage Area 1

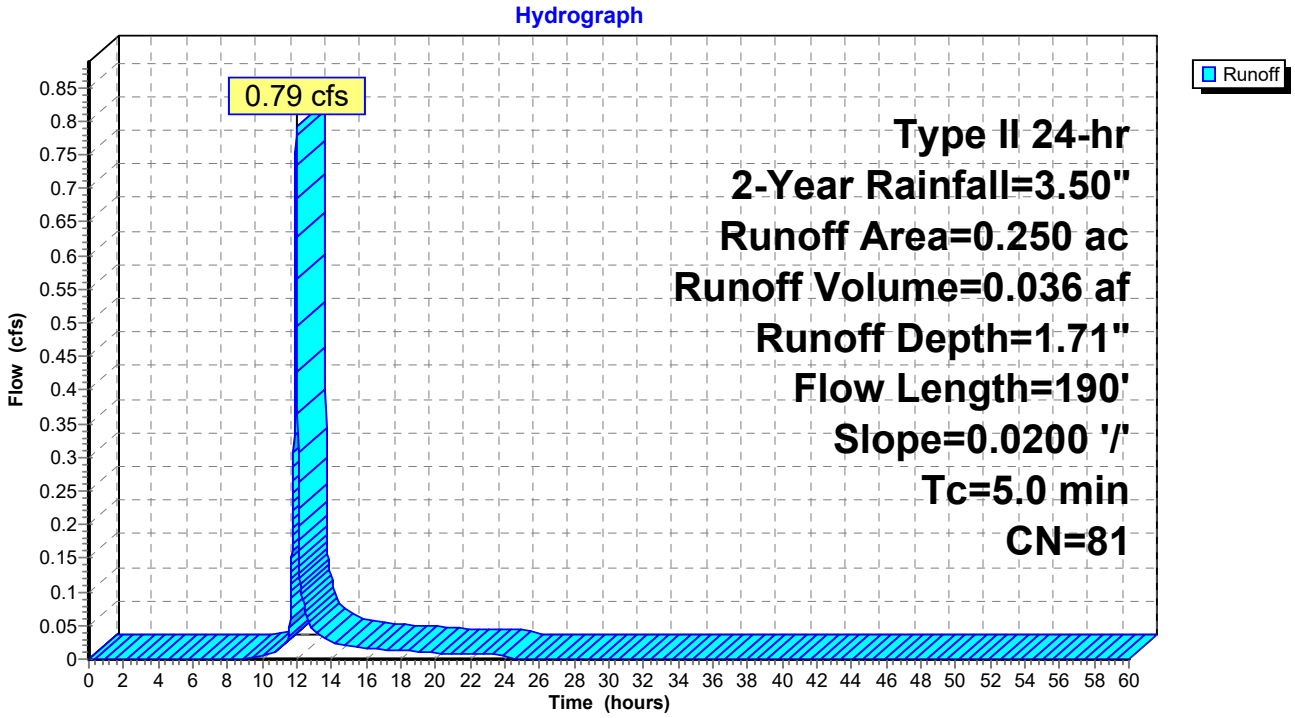
Runoff = 0.79 cfs @ 11.96 hrs, Volume= 0.036 af, Depth= 1.71"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-60.00 hrs, dt= 0.01 hrs
Type II 24-hr 2-Year Rainfall=3.50"

Area (ac)	CN	Description
0.020	98	Paved parking, HSG D
0.230	80	>75% Grass cover, Good, HSG D
0.250	81	Weighted Average
0.230		92.00% Pervious Area
0.020		8.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	100	0.0200	1.44		**Sheet Flow, SHEET** Smooth surfaces n= 0.011 P2= 3.50"
0.7	90	0.0200	2.28		**Shallow Concentrated Flow, SHALLOW** Unpaved Kv= 16.1 fps
3.1					**Direct Entry, 5 min.**
5.0	190	Total			

Subcatchment DA1: Drainage Area 1



Summary for Subcatchment DA2.A: Drainage Area 2.A

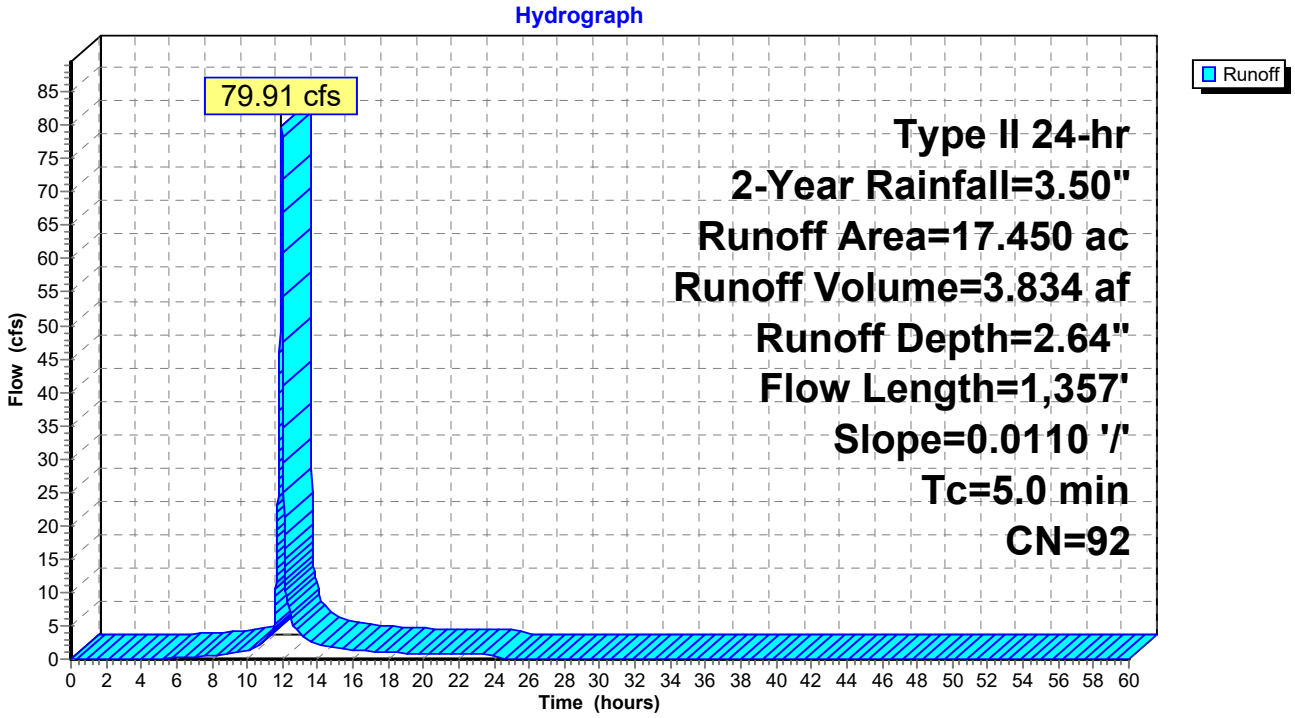
Runoff = 79.91 cfs @ 11.96 hrs, Volume= 3.834 af, Depth= 2.64"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-60.00 hrs, dt= 0.01 hrs
Type II 24-hr 2-Year Rainfall=3.50"

Area (ac)	CN	Description
2.920	98	Unconnected roofs, HSG D
0.370	95	Urban commercial, 85% imp, HSG D
0.690	95	Urban commercial, 85% imp, HSG D
5.330	80	>75% Grass cover, Good, HSG D
7.640	98	Paved roads w/curbs & sewers, HSG D
0.500	98	Water Surface, HSG D
17.450	92	Weighted Average
5.489		31.46% Pervious Area
11.961		68.54% Impervious Area
2.920		24.41% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.5	100	0.0110	1.13		**Sheet Flow, SHEET** Smooth surfaces n= 0.011 P2= 3.50"
0.6	81	0.0110	2.13		**Shallow Concentrated Flow, SHALLOW** Paved Kv= 20.3 fps
1.7	910		9.00		**Direct Entry, PIPE STORM**
0.1	100		11.35		**Lake or Reservoir, EWDB** Mean Depth= 4.00'
0.3	166		9.00		**Direct Entry, PIPE STORM**
0.8					**Direct Entry, 5 min.**
5.0	1,357	Total			

Subcatchment DA2.A: Drainage Area 2.A



Summary for Subcatchment DA2.B: Drainage Area 2.B

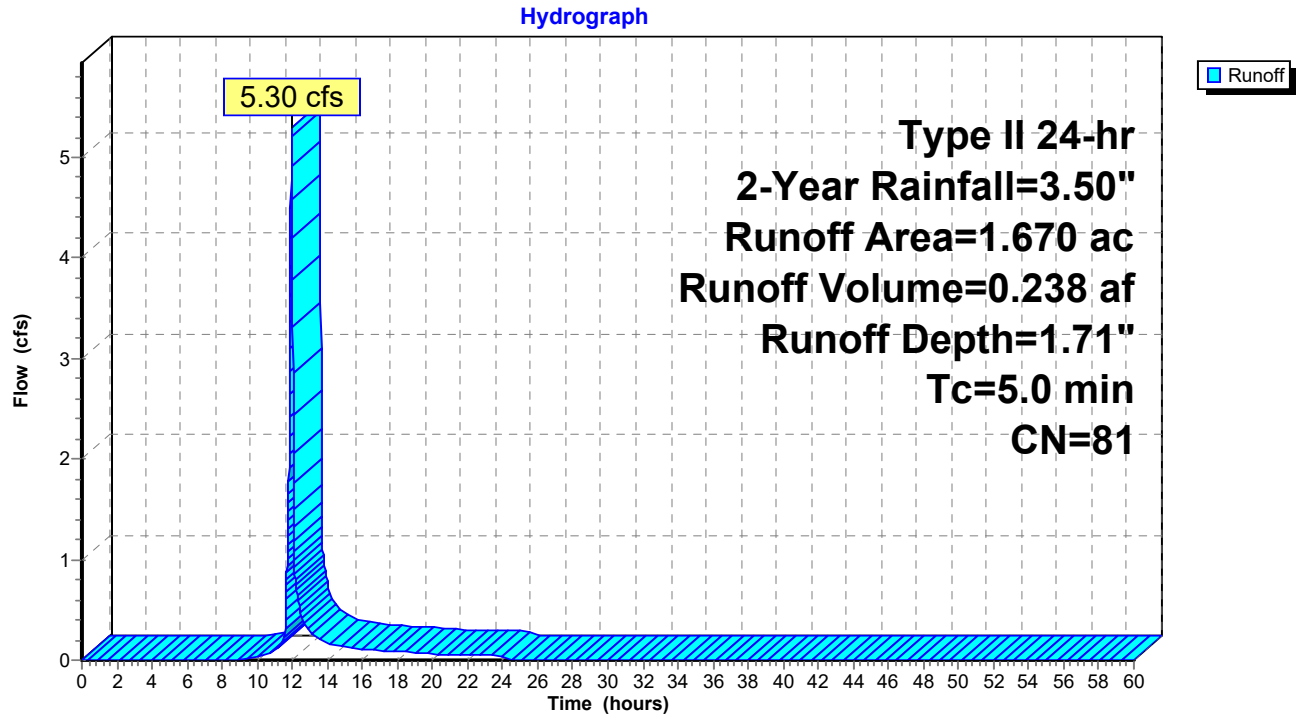
Runoff = 5.30 cfs @ 11.96 hrs, Volume= 0.238 af, Depth= 1.71"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-60.00 hrs, dt= 0.01 hrs
Type II 24-hr 2-Year Rainfall=3.50"

Area (ac)	CN	Description
0.880	80	>75% Grass cover, Good, HSG D
0.780	82	Woods/grass comb., Fair, HSG D
0.010	98	Unconnected pavement, HSG D
1.670	81	Weighted Average
1.660		99.40% Pervious Area
0.010		0.60% Impervious Area
0.010		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, 5 min.**

Subcatchment DA2.B: Drainage Area 2.B



Summary for Subcatchment OFF2: Offsite Area 2

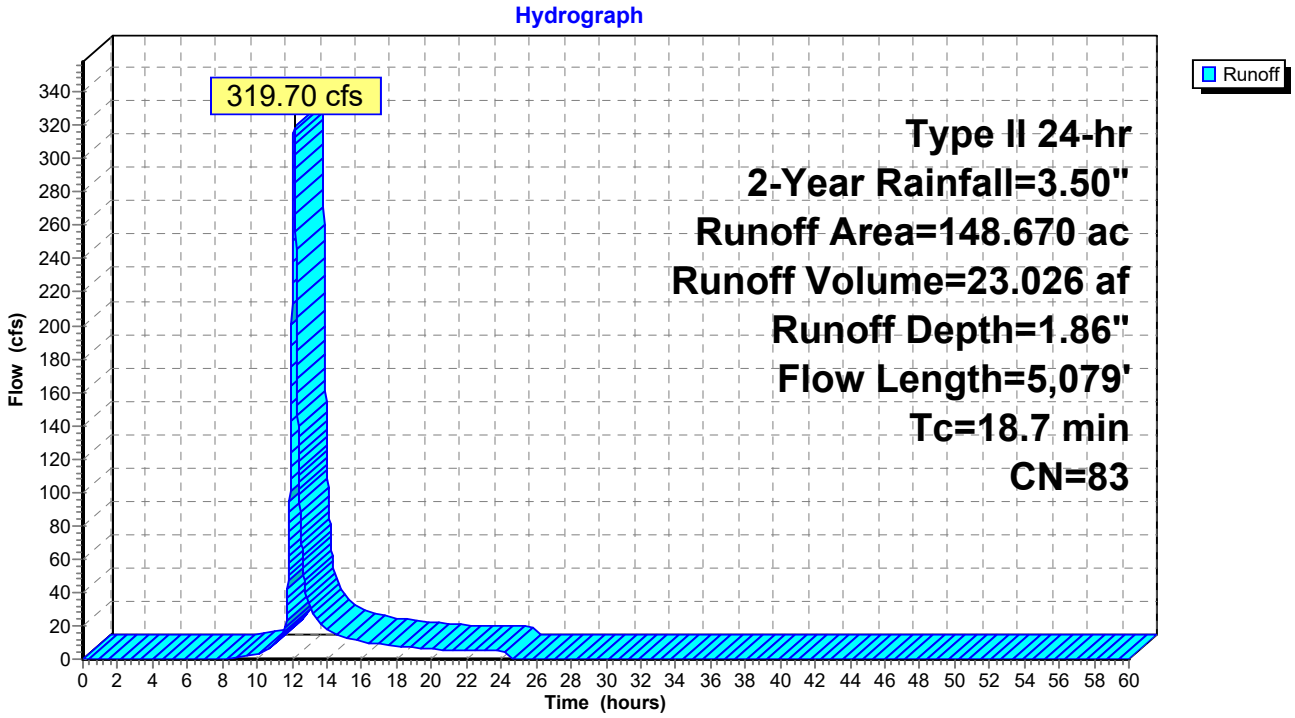
Runoff = 319.70 cfs @ 12.11 hrs, Volume= 23.026 af, Depth= 1.86"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-60.00 hrs, dt= 0.01 hrs
Type II 24-hr 2-Year Rainfall=3.50"

Area (ac)	CN	Description
6.400	89	Row crops, straight row, Good, HSG D
3.520	77	Woods, Good, HSG D
49.030	80	>75% Grass cover, Good, HSG D
38.450	80	Pasture/grassland/range, Good, HSG D
20.210	87	1/4 acre lots, 38% imp, HSG D
31.060	87	1/4 acre lots, 38% imp, HSG D
148.670	83	Weighted Average
129.187		86.90% Pervious Area
19.483		13.10% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.6	100	0.0940	0.30		**Sheet Flow, SHEET** Cultivated: Residue>20% n= 0.170 P2= 3.50"
3.4	410	0.0506	2.02		**Shallow Concentrated Flow, SHALLOW** Cultivated Straight Rows Kv= 9.0 fps
3.6	216	0.0400	1.00		**Shallow Concentrated Flow, SHALLOW** Woodland Kv= 5.0 fps
2.4	1,261	0.0327	8.67	104.04	**Channel Flow, CHANNEL** Area= 12.0 sf Perim= 10.0' r= 1.20' n= 0.035 High grass
1.3	1,985	0.1450	26.29	670.29	**Channel Flow, CHANNEL** Area= 25.5 sf Perim= 15.5' r= 1.65' n= 0.030 Earth, clean & winding
2.2	980	0.0114	7.43	223.03	**Channel Flow, CHANNEL** Area= 30.0 sf Perim= 18.0' r= 1.67' n= 0.030
0.2	127	0.0265	11.24	286.55	**Channel Flow, CHANNEL** Area= 25.5 sf Perim= 15.5' r= 1.65' n= 0.030
18.7	5,079	Total			

Subcatchment OFF2: Offsite Area 2



Summary for Pond EWDB: Extended Wet Detention Basin

Inflow Area = 17.450 ac, 68.54% Impervious, Inflow Depth = 2.64" for 2-Year event
Inflow = 79.91 cfs @ 11.96 hrs, Volume= 3.834 af
Outflow = 3.44 cfs @ 13.13 hrs, Volume= 3.625 af, Atten= 96%, Lag= 70.0 min
Primary = 3.44 cfs @ 13.13 hrs, Volume= 3.625 af

Routing by Stor-Ind method, Time Span= 0.00-60.00 hrs, dt= 0.01 hrs
Peak Elev= 1,003.64' @ 13.13 hrs Surf.Area= 33,430 sf Storage= 102,635 cf

Plug-Flow detention time= 455.4 min calculated for 3.625 af (95% of inflow)
Center-of-Mass det. time= 424.1 min (1,214.6 - 790.5)

Volume	Invert	Avail.Storage	Storage Description
#1	1,000.00'	278,254 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

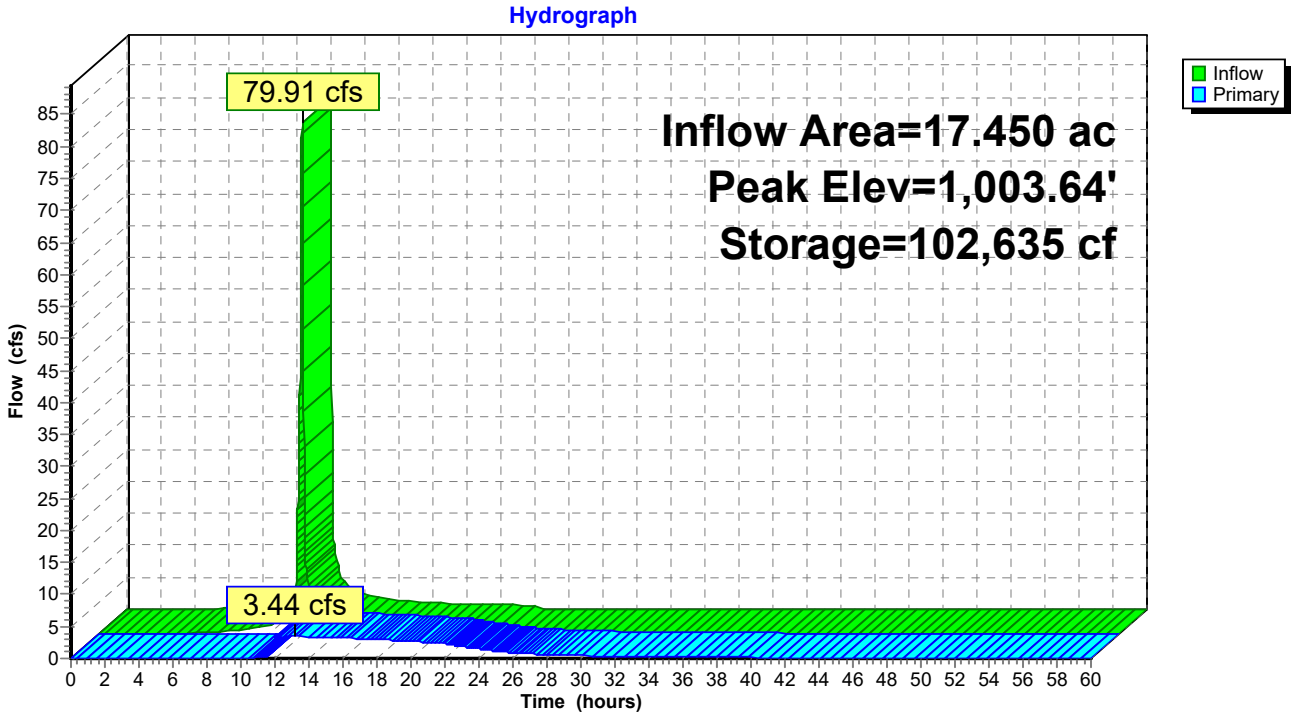
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,000.00	23,193	0	0
1,001.00	25,869	24,531	24,531
1,002.00	28,647	27,258	51,789
1,003.00	31,526	30,087	81,876
1,004.00	34,505	33,016	114,891
1,005.00	37,585	36,045	150,936
1,006.00	40,765	39,175	190,111
1,007.00	44,046	42,406	232,517
1,008.00	47,428	45,737	278,254

Device	Routing	Invert	Outlet Devices
#1	Primary	999.50'	**30.0" Round RCP_Round 30"** L= 63.3' RCP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 999.50' / 998.80' S= 0.0111 '/' Cc= 0.900 n= 0.013 Concrete pipe, straight & clean, Flow Area= 4.91 sf
#2	Device 1	1,000.00'	**20.0 deg x 6.75' rise Sharp-Crested Vee Weir** Cv= 2.69 (C= 3.36)
#3	Device 1	1,006.75'	**48.0" x 60.0" Horiz. Grate** C= 0.600 Limited to weir flow at low heads
#4	Device 2	1,000.00'	**8.5" Vert. Orifice** C= 0.600
#5	Device 2	1,004.75'	**3.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00

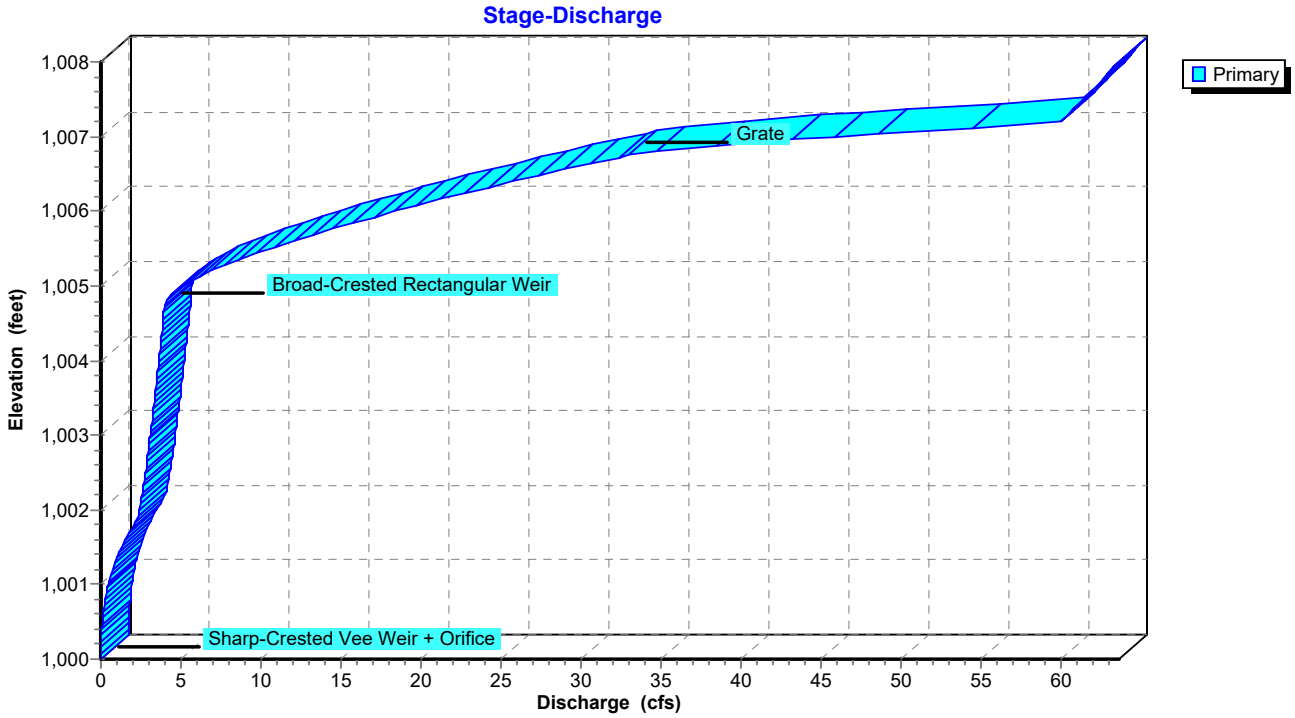
Coef. (English) 2.80 2.92 3.08 3.30 3.32

Primary OutFlow Max=3.44 cfs @ 13.13 hrs HW=1,003.64' (Free Discharge)
└─**1=RCP_Round 30"** (Passes 3.44 cfs of 40.17 cfs potential flow)
  └─**2=Sharp-Crested Vee Weir** (Passes 3.44 cfs of 11.98 cfs potential flow)
    └─**4=Orifice** (Orifice Controls 3.44 cfs @ 8.73 fps)
    └─**5=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)
  └─**3=Grate** (Controls 0.00 cfs)

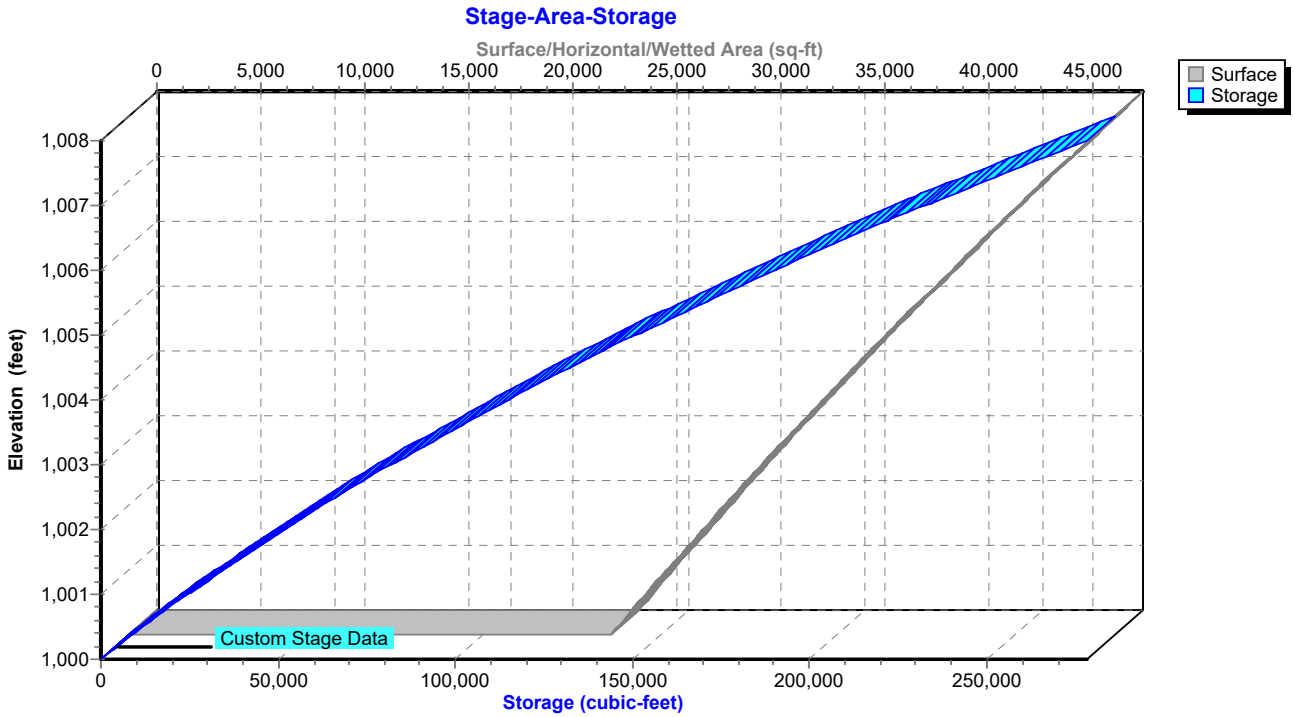
Pond EWDB: Extended Wet Detention Basin



Pond EWDB: Extended Wet Detention Basin



Pond EWDB: Extended Wet Detention Basin

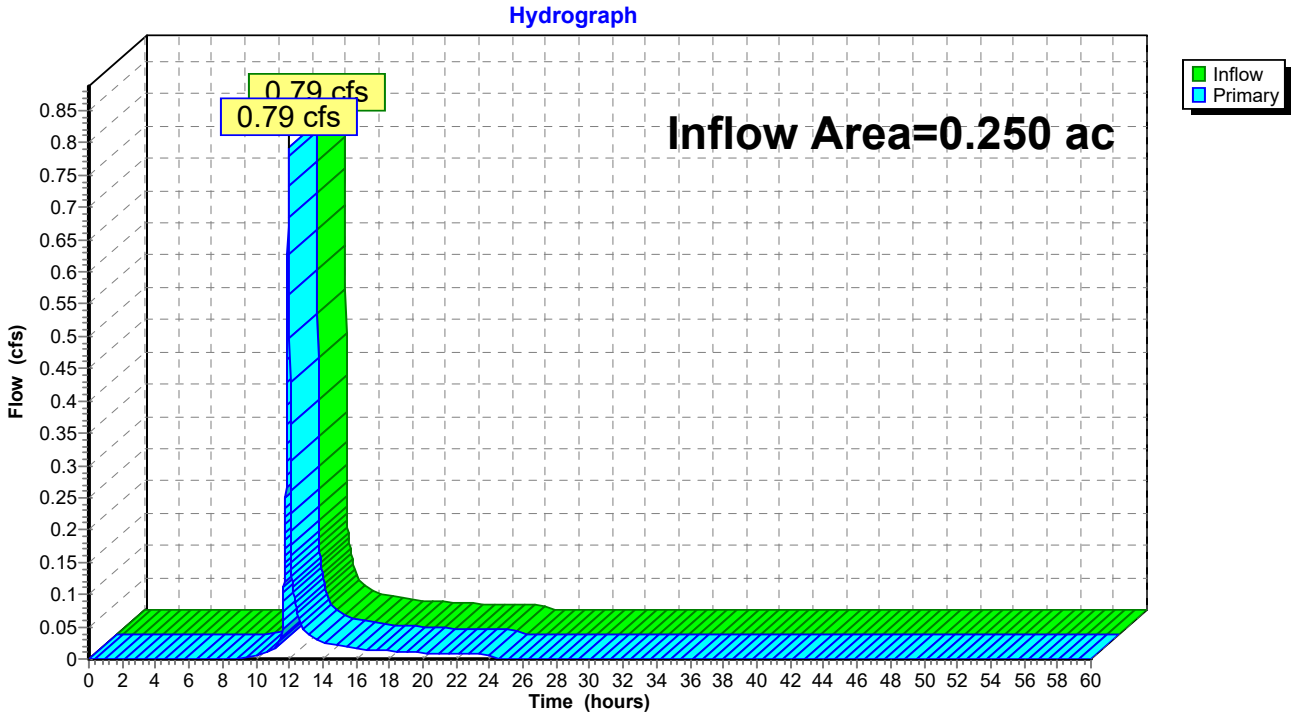


Summary for Link RP1: Release Point 1

Inflow Area = 0.250 ac, 8.00% Impervious, Inflow Depth = 1.71" for 2-Year event
Inflow = 0.79 cfs @ 11.96 hrs, Volume= 0.036 af
Primary = 0.79 cfs @ 11.96 hrs, Volume= 0.036 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-60.00 hrs, dt= 0.01 hrs

Link RP1: Release Point 1

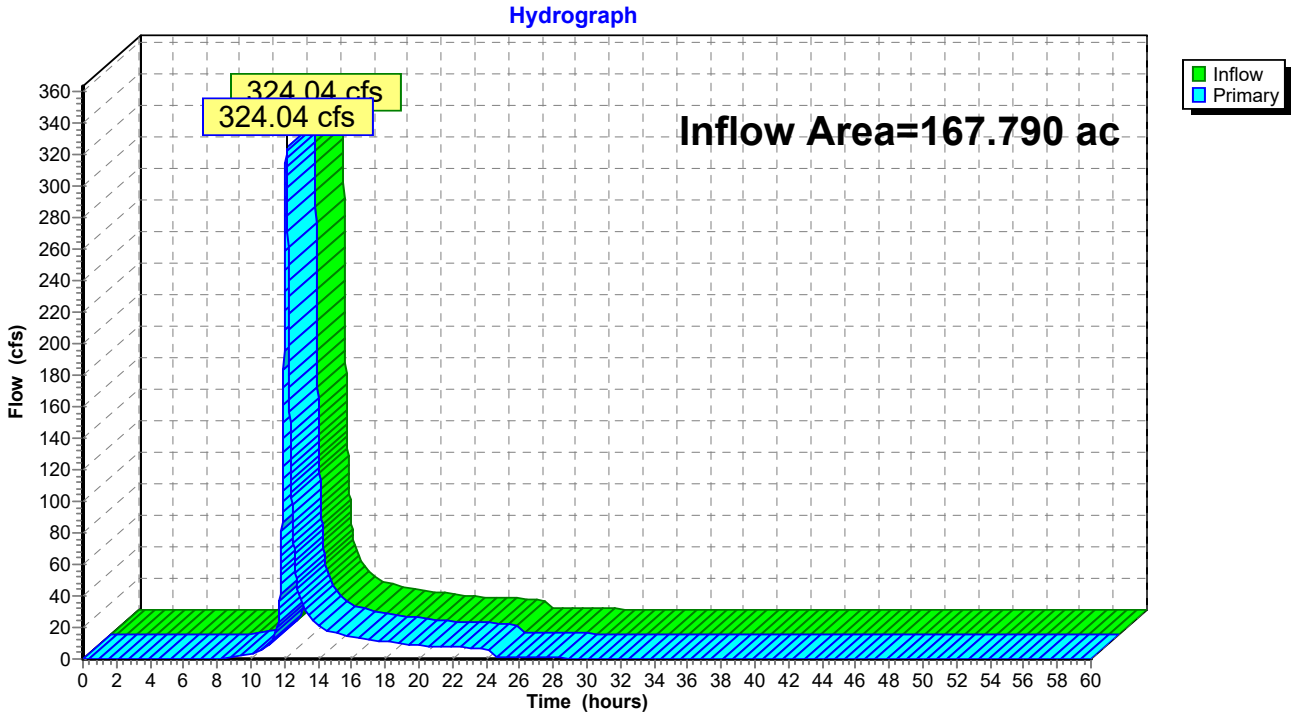


Summary for Link RP2: Release Point 2

Inflow Area = 167.790 ac, 18.75% Impervious, Inflow Depth > 1.92" for 2-Year event
Inflow = 324.04 cfs @ 12.11 hrs, Volume= 26.889 af
Primary = 324.04 cfs @ 12.11 hrs, Volume= 26.889 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-60.00 hrs, dt= 0.01 hrs

Link RP2: Release Point 2



Time span=0.00-60.00 hrs, dt=0.01 hrs, 6001 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 DA1: Drainage Runoff Area=0.250 ac 8.00% Impervious Runoff Depth=3.25"
Flow Length=190' Slope=0.0200 '/' Tc=5.0 min CN=81 Runoff=1.48 cfs 0.068 af

Subcatchment DA2.A: Runoff Area=17.450 ac 68.54% Impervious Runoff Depth=4.38"
Flow Length=1,357' Slope=0.0110 '/' Tc=5.0 min CN=92 Runoff=128.32 cfs 6.373 af

Subcatchment DA2.B: Runoff Area=1.670 ac 0.60% Impervious Runoff Depth=3.25"
Tc=5.0 min CN=81 Runoff=9.86 cfs 0.453 af

Subcatchment OFF2: Runoff Area=148.670 ac 13.10% Impervious Runoff Depth=3.45"
Flow Length=5,079' Tc=18.7 min CN=83 Runoff=589.07 cfs 42.703 af

Pond EWDB: Extended Peak Elev=1,005.37' Storage=164,974 cf Inflow=128.32 cfs 6.373 af
Outflow=8.77 cfs 6.147 af

Link RP1: Release Point 1 Inflow=1.48 cfs 0.068 af
Primary=1.48 cfs 0.068 af

Link RP2: Release Point 2 Inflow=597.37 cfs 49.302 af
Primary=597.37 cfs 49.302 af

Total Runoff Area = 168.040 ac Runoff Volume = 49.596 af Average Runoff Depth = 3.54"
81.27% Pervious = 136.566 ac 18.73% Impervious = 31.474 ac

Summary for Subcatchment DA1: Drainage Area 1

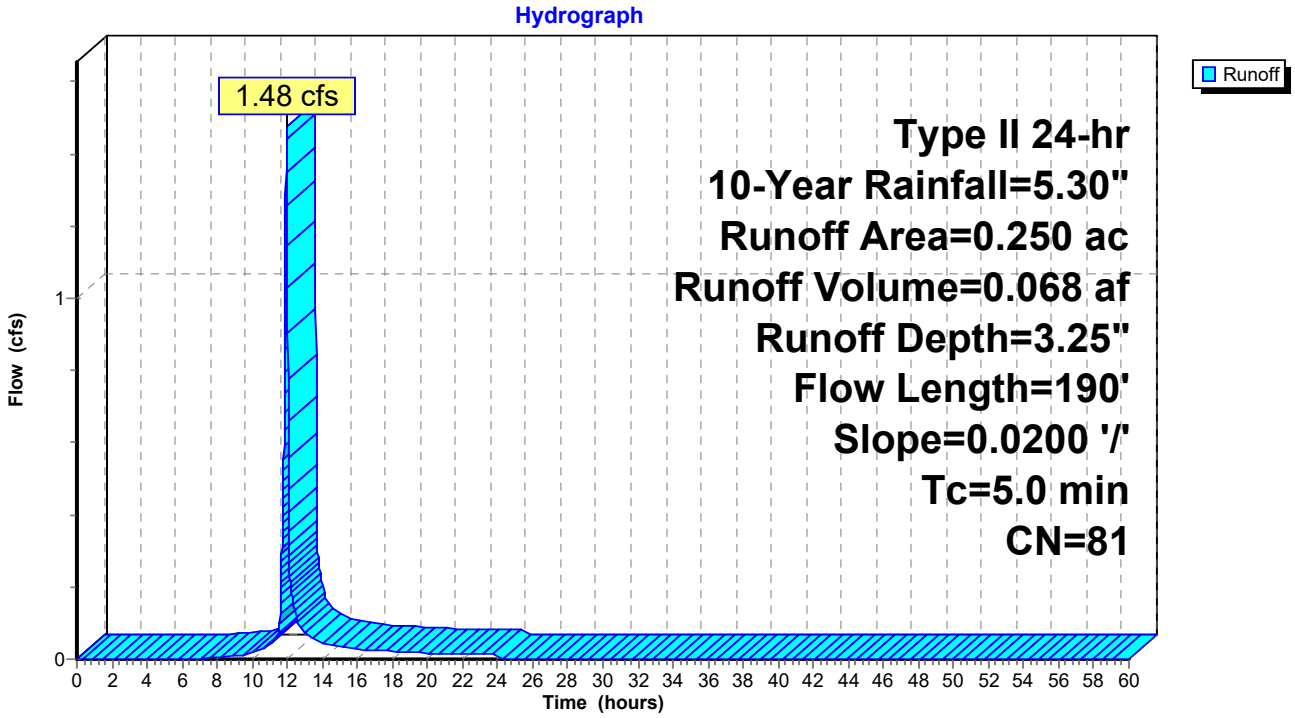
Runoff = 1.48 cfs @ 11.96 hrs, Volume= 0.068 af, Depth= 3.25"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-60.00 hrs, dt= 0.01 hrs
Type II 24-hr 10-Year Rainfall=5.30"

Area (ac)	CN	Description
0.020	98	Paved parking, HSG D
0.230	80	>75% Grass cover, Good, HSG D
0.250	81	Weighted Average
0.230		92.00% Pervious Area
0.020		8.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	100	0.0200	1.44		**Sheet Flow, SHEET** Smooth surfaces n= 0.011 P2= 3.50"
0.7	90	0.0200	2.28		**Shallow Concentrated Flow, SHALLOW** Unpaved Kv= 16.1 fps
3.1					**Direct Entry, 5 min.**
5.0	190	Total			

Subcatchment DA1: Drainage Area 1



Summary for Subcatchment DA2.A: Drainage Area 2.A

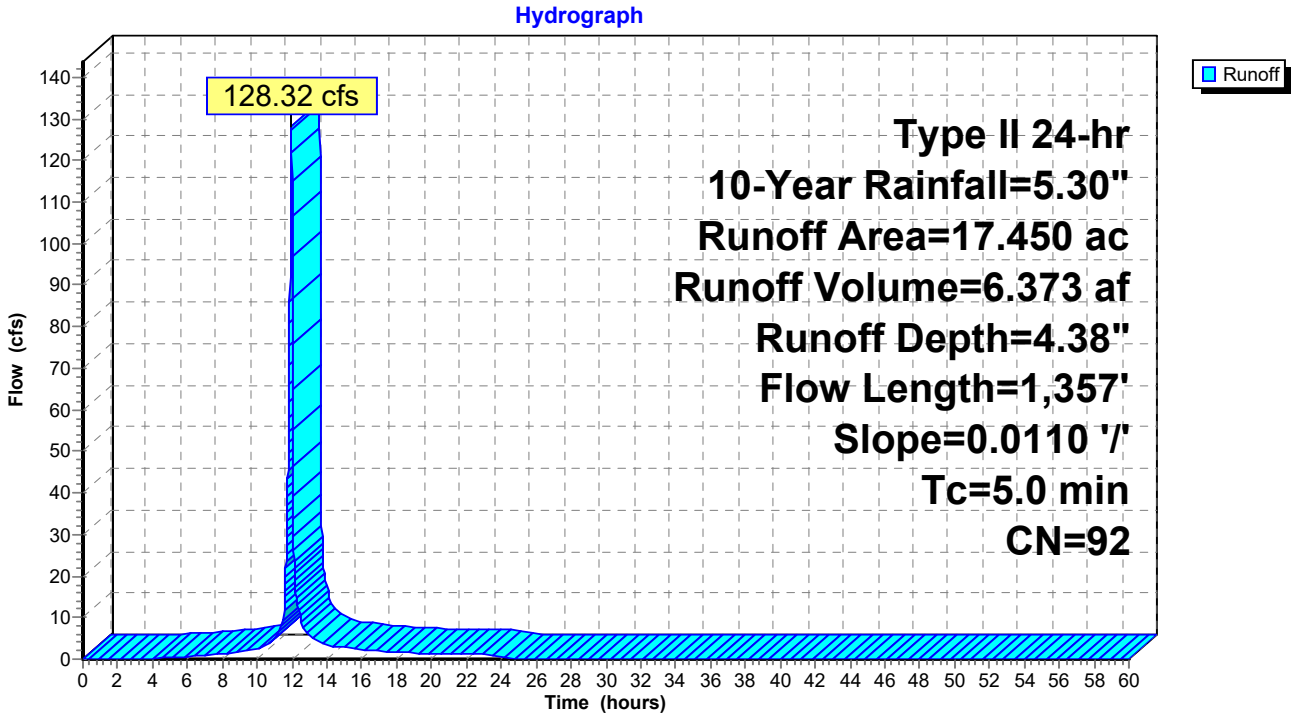
Runoff = 128.32 cfs @ 11.96 hrs, Volume= 6.373 af, Depth= 4.38"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-60.00 hrs, dt= 0.01 hrs
Type II 24-hr 10-Year Rainfall=5.30"

Area (ac)	CN	Description
2.920	98	Unconnected roofs, HSG D
0.370	95	Urban commercial, 85% imp, HSG D
0.690	95	Urban commercial, 85% imp, HSG D
5.330	80	>75% Grass cover, Good, HSG D
7.640	98	Paved roads w/curbs & sewers, HSG D
0.500	98	Water Surface, HSG D
17.450	92	Weighted Average
5.489		31.46% Pervious Area
11.961		68.54% Impervious Area
2.920		24.41% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.5	100	0.0110	1.13		**Sheet Flow, SHEET** Smooth surfaces n= 0.011 P2= 3.50"
0.6	81	0.0110	2.13		**Shallow Concentrated Flow, SHALLOW** Paved Kv= 20.3 fps
1.7	910		9.00		**Direct Entry, PIPE STORM**
0.1	100		11.35		**Lake or Reservoir, EWDB** Mean Depth= 4.00'
0.3	166		9.00		**Direct Entry, PIPE STORM**
0.8					**Direct Entry, 5 min.**
5.0	1,357	Total			

Subcatchment DA2.A: Drainage Area 2.A



Summary for Subcatchment DA2.B: Drainage Area 2.B

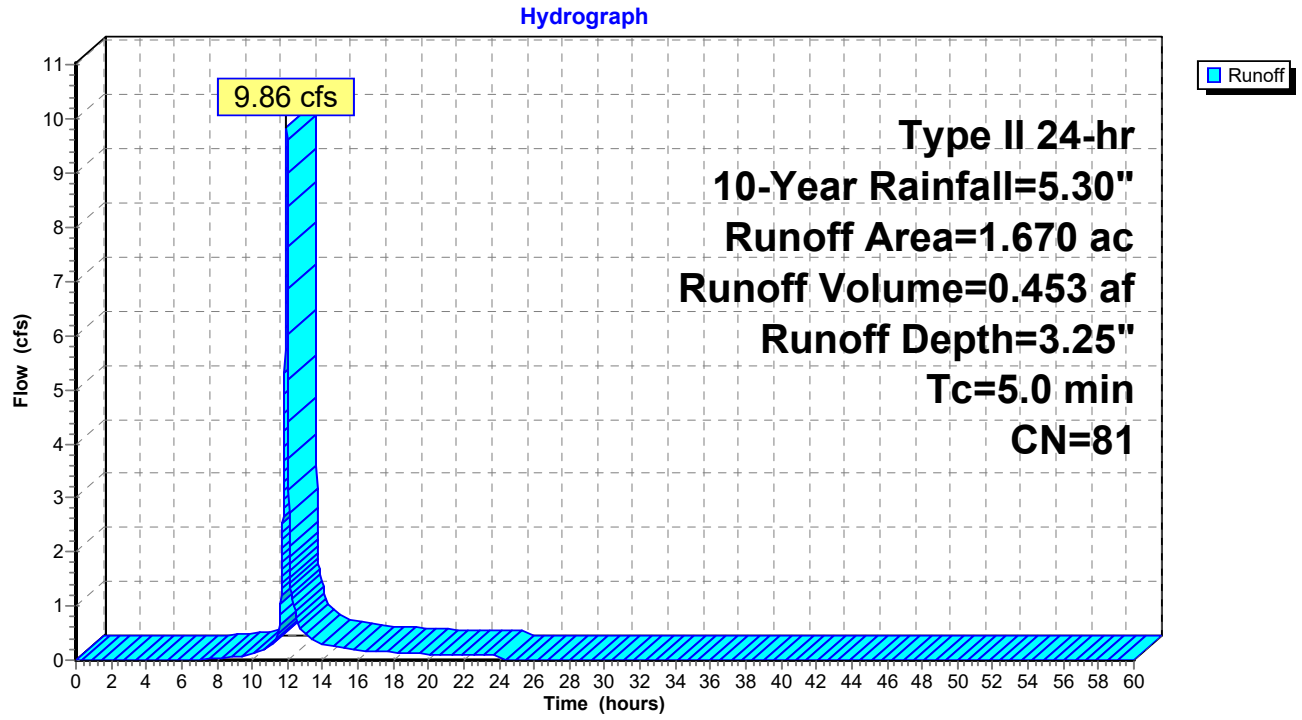
Runoff = 9.86 cfs @ 11.96 hrs, Volume= 0.453 af, Depth= 3.25"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-60.00 hrs, dt= 0.01 hrs
Type II 24-hr 10-Year Rainfall=5.30"

Area (ac)	CN	Description
0.880	80	>75% Grass cover, Good, HSG D
0.780	82	Woods/grass comb., Fair, HSG D
0.010	98	Unconnected pavement, HSG D
1.670	81	Weighted Average
1.660		99.40% Pervious Area
0.010		0.60% Impervious Area
0.010		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, 5 min.**

Subcatchment DA2.B: Drainage Area 2.B



Summary for Subcatchment OFF2: Offsite Area 2

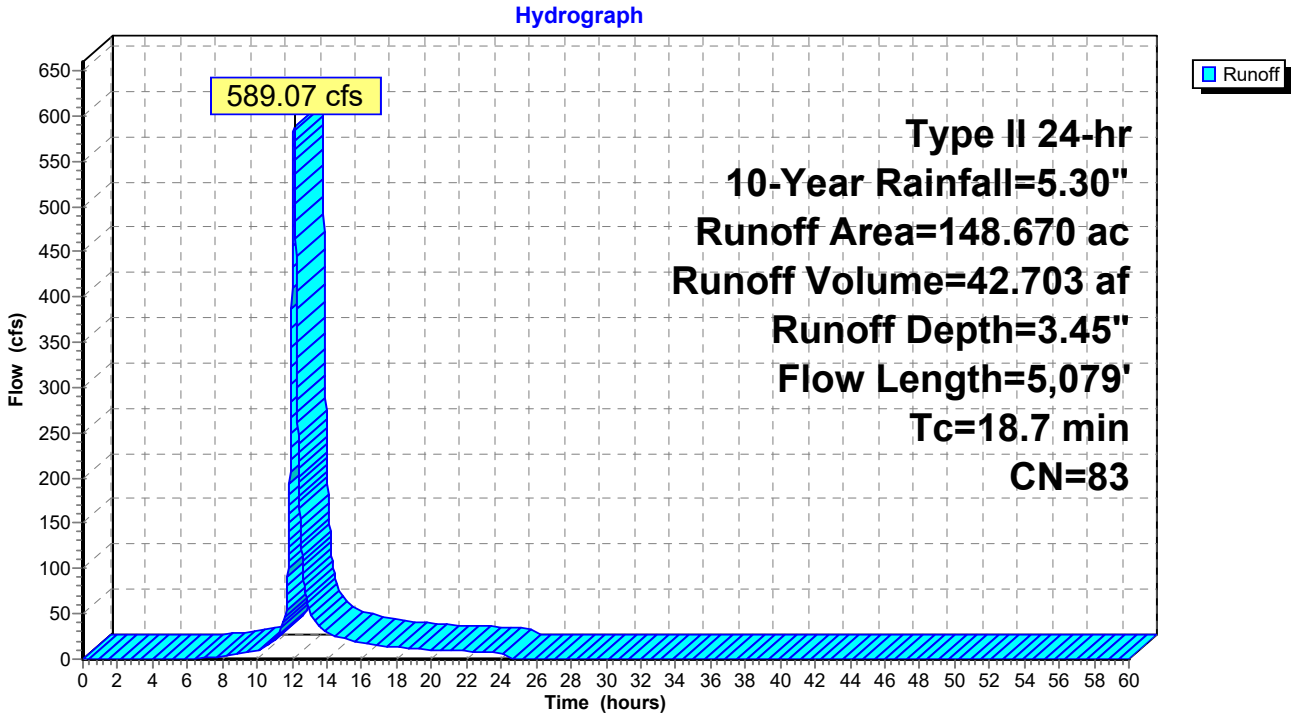
Runoff = 589.07 cfs @ 12.11 hrs, Volume= 42.703 af, Depth= 3.45"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-60.00 hrs, dt= 0.01 hrs
Type II 24-hr 10-Year Rainfall=5.30"

Area (ac)	CN	Description
6.400	89	Row crops, straight row, Good, HSG D
3.520	77	Woods, Good, HSG D
49.030	80	>75% Grass cover, Good, HSG D
38.450	80	Pasture/grassland/range, Good, HSG D
20.210	87	1/4 acre lots, 38% imp, HSG D
31.060	87	1/4 acre lots, 38% imp, HSG D
148.670	83	Weighted Average
129.187		86.90% Pervious Area
19.483		13.10% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.6	100	0.0940	0.30		**Sheet Flow, SHEET** Cultivated: Residue>20% n= 0.170 P2= 3.50"
3.4	410	0.0506	2.02		**Shallow Concentrated Flow, SHALLOW** Cultivated Straight Rows Kv= 9.0 fps
3.6	216	0.0400	1.00		**Shallow Concentrated Flow, SHALLOW** Woodland Kv= 5.0 fps
2.4	1,261	0.0327	8.67	104.04	**Channel Flow, CHANNEL** Area= 12.0 sf Perim= 10.0' r= 1.20' n= 0.035 High grass
1.3	1,985	0.1450	26.29	670.29	**Channel Flow, CHANNEL** Area= 25.5 sf Perim= 15.5' r= 1.65' n= 0.030 Earth, clean & winding
2.2	980	0.0114	7.43	223.03	**Channel Flow, CHANNEL** Area= 30.0 sf Perim= 18.0' r= 1.67' n= 0.030
0.2	127	0.0265	11.24	286.55	**Channel Flow, CHANNEL** Area= 25.5 sf Perim= 15.5' r= 1.65' n= 0.030
18.7	5,079	Total			

Subcatchment OFF2: Offsite Area 2



Summary for Pond EWDB: Extended Wet Detention Basin

Inflow Area = 17.450 ac, 68.54% Impervious, Inflow Depth = 4.38" for 10-Year event
Inflow = 128.32 cfs @ 11.96 hrs, Volume= 6.373 af
Outflow = 8.77 cfs @ 12.53 hrs, Volume= 6.147 af, Atten= 93%, Lag= 34.5 min
Primary = 8.77 cfs @ 12.53 hrs, Volume= 6.147 af

Routing by Stor-Ind method, Time Span= 0.00-60.00 hrs, dt= 0.01 hrs
Peak Elev= 1,005.37' @ 12.53 hrs Surf.Area= 38,755 sf Storage= 164,974 cf

Plug-Flow detention time= 459.6 min calculated for 6.146 af (96% of inflow)
Center-of-Mass det. time= 438.2 min (1,214.8 - 776.6)

Volume	Invert	Avail.Storage	Storage Description
#1	1,000.00'	278,254 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

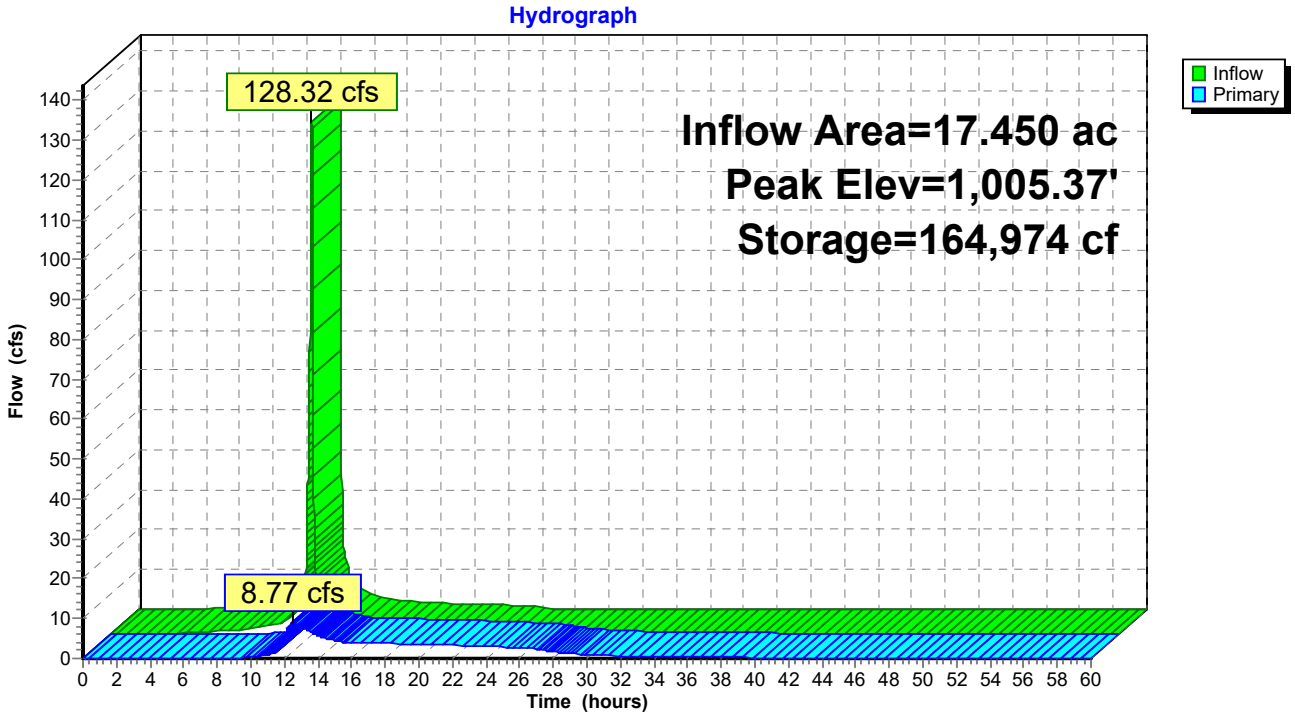
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,000.00	23,193	0	0
1,001.00	25,869	24,531	24,531
1,002.00	28,647	27,258	51,789
1,003.00	31,526	30,087	81,876
1,004.00	34,505	33,016	114,891
1,005.00	37,585	36,045	150,936
1,006.00	40,765	39,175	190,111
1,007.00	44,046	42,406	232,517
1,008.00	47,428	45,737	278,254

Device	Routing	Invert	Outlet Devices
#1	Primary	999.50'	**30.0" Round RCP_Round 30"** L= 63.3' RCP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 999.50' / 998.80' S= 0.0111 '/' Cc= 0.900 n= 0.013 Concrete pipe, straight & clean, Flow Area= 4.91 sf
#2	Device 1	1,000.00'	**20.0 deg x 6.75' rise Sharp-Crested Vee Weir** Cv= 2.69 (C= 3.36)
#3	Device 1	1,006.75'	**48.0" x 60.0" Horiz. Grate** C= 0.600 Limited to weir flow at low heads
#4	Device 2	1,000.00'	**8.5" Vert. Orifice** C= 0.600
#5	Device 2	1,004.75'	**3.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00

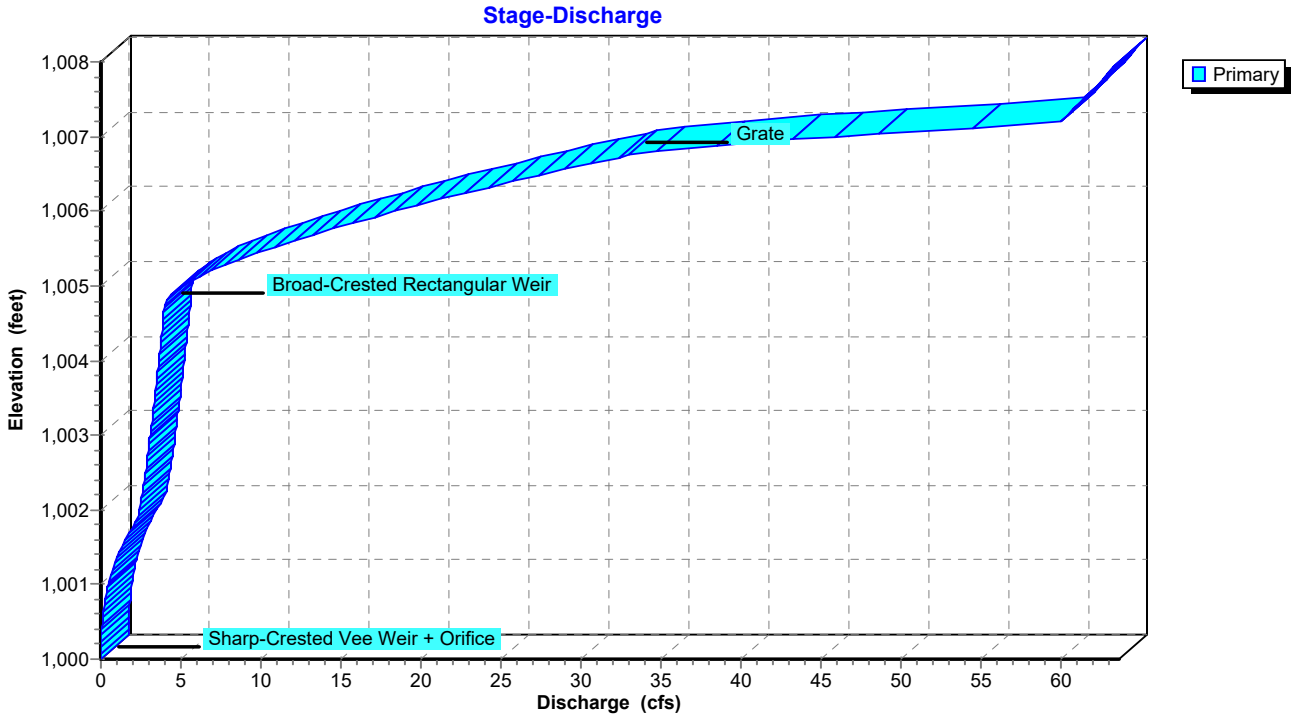
Coef. (English) 2.80 2.92 3.08 3.30 3.32

Primary OutFlow Max=8.76 cfs @ 12.53 hrs HW=1,005.37' (Free Discharge)
└─**1=RCP_Round 30"** (Passes 8.76 cfs of 50.79 cfs potential flow)
  └─**2=Sharp-Crested Vee Weir** (Passes 8.76 cfs of 31.66 cfs potential flow)
    └─**4=Orifice** (Orifice Controls 4.25 cfs @ 10.78 fps)
    └─**5=Broad-Crested Rectangular Weir** (Weir Controls 4.52 cfs @ 2.44 fps)
  └─**3=Grate** (Controls 0.00 cfs)

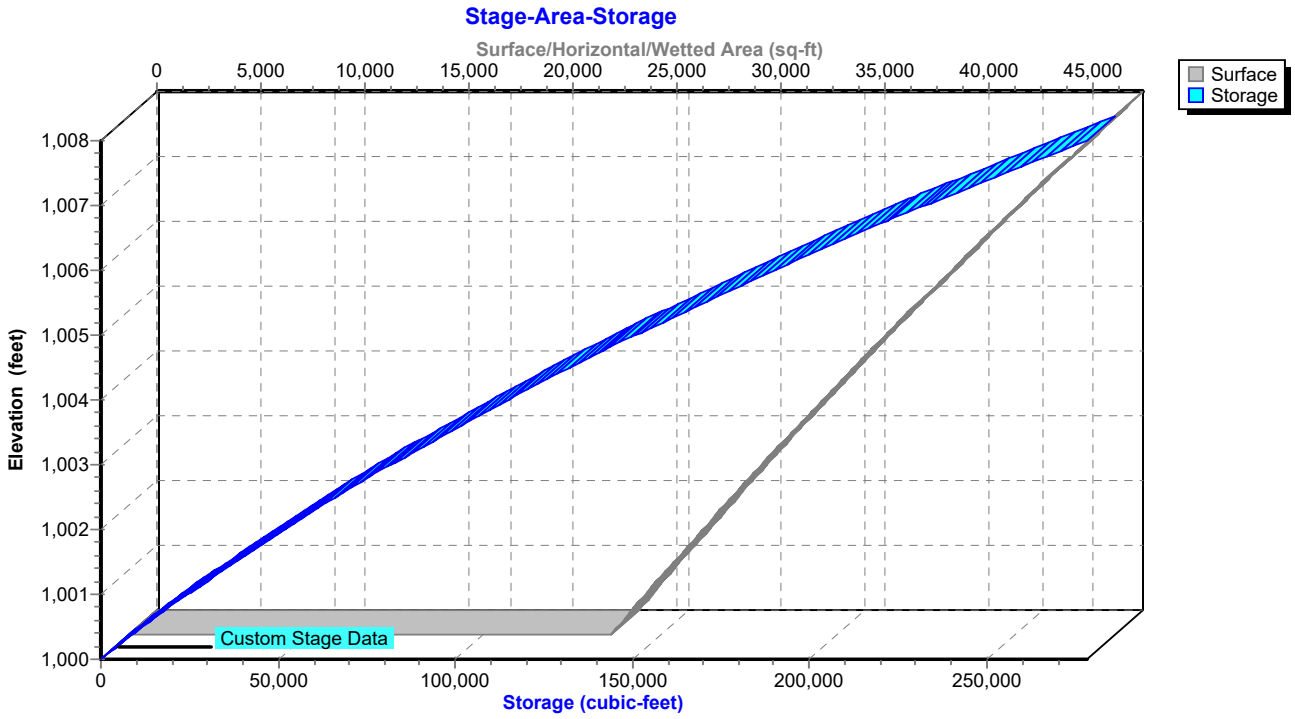
Pond EWDB: Extended Wet Detention Basin



Pond EWDB: Extended Wet Detention Basin



Pond EWDB: Extended Wet Detention Basin

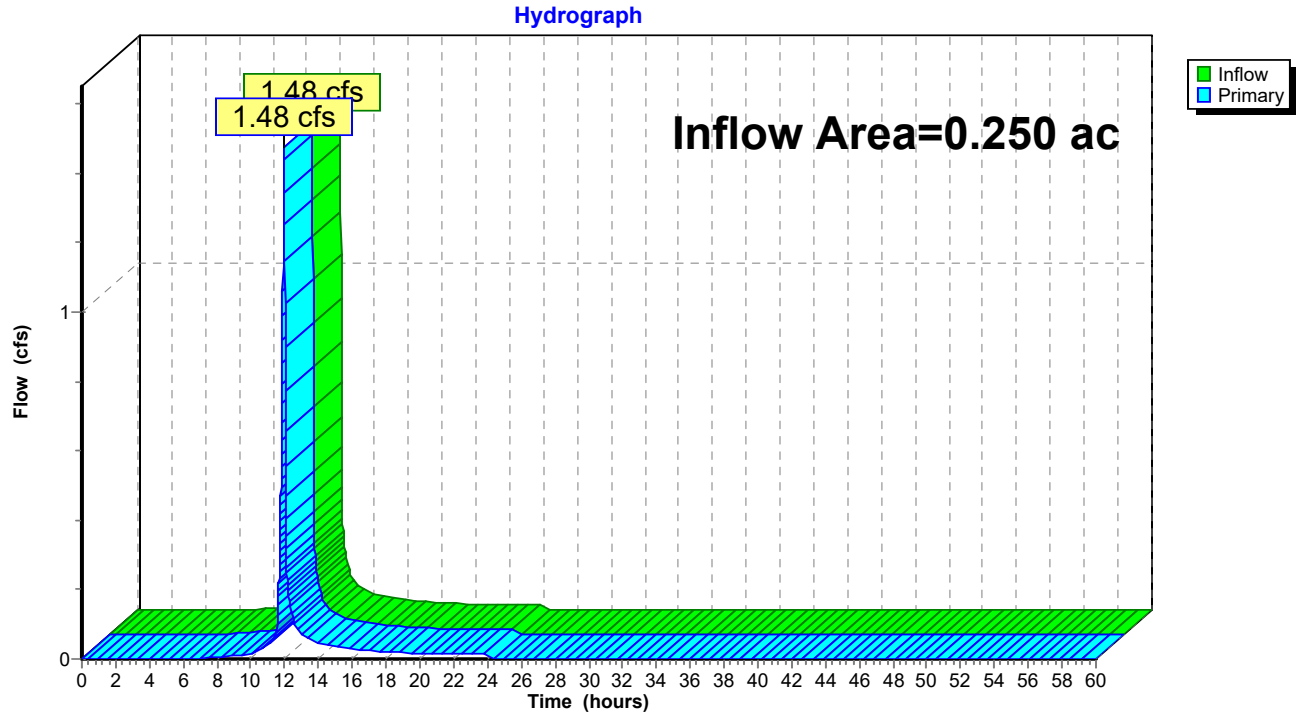


Summary for Link RP1: Release Point 1

Inflow Area = 0.250 ac, 8.00% Impervious, Inflow Depth = 3.25" for 10-Year event
Inflow = 1.48 cfs @ 11.96 hrs, Volume= 0.068 af
Primary = 1.48 cfs @ 11.96 hrs, Volume= 0.068 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-60.00 hrs, dt= 0.01 hrs

Link RP1: Release Point 1

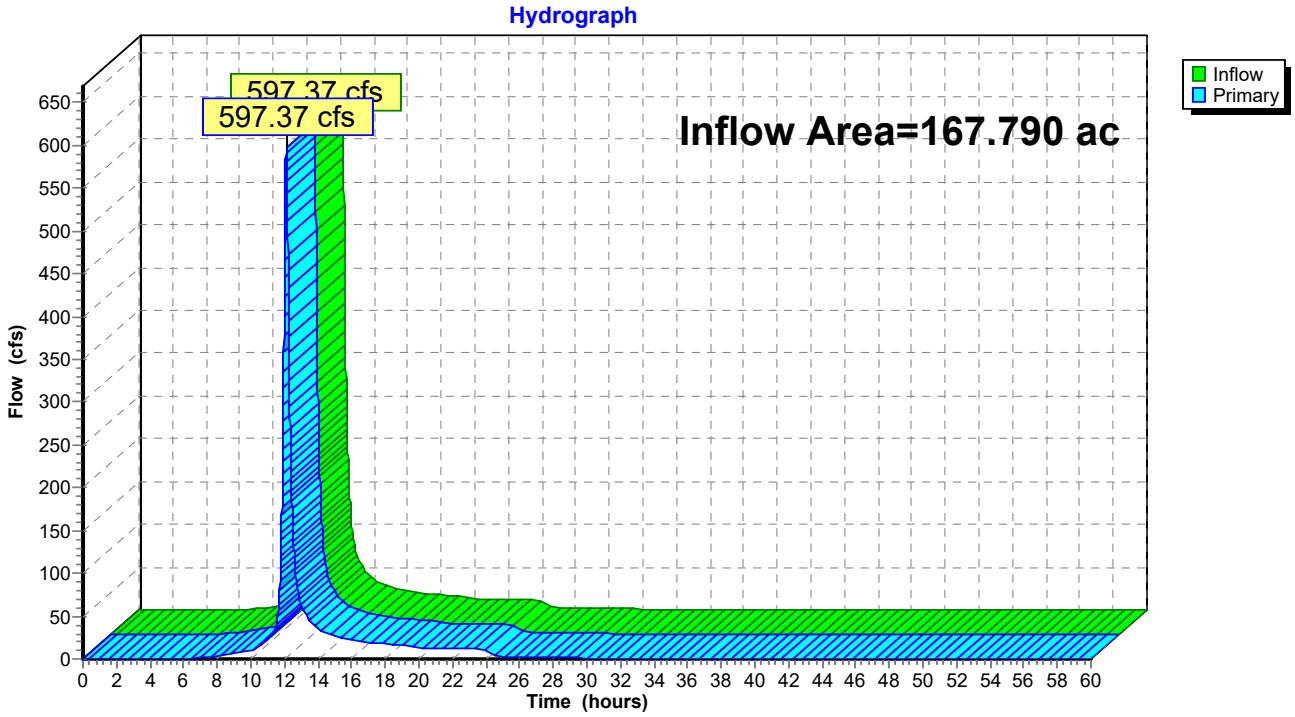


Summary for Link RP2: Release Point 2

Inflow Area = 167.790 ac, 18.75% Impervious, Inflow Depth = 3.53" for 10-Year event
Inflow = 597.37 cfs @ 12.11 hrs, Volume= 49.302 af
Primary = 597.37 cfs @ 12.11 hrs, Volume= 49.302 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-60.00 hrs, dt= 0.01 hrs

Link RP2: Release Point 2



Time span=0.00-60.00 hrs, dt=0.01 hrs, 6001 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 DA1: Drainage Runoff Area=0.250 ac 8.00% Impervious Runoff Depth=5.46"
Flow Length=190' Slope=0.0200 '/' Tc=5.0 min CN=81 Runoff=2.41 cfs 0.114 af

Subcatchment DA2.A: Runoff Area=17.450 ac 68.54% Impervious Runoff Depth=6.75"
Flow Length=1,357' Slope=0.0110 '/' Tc=5.0 min CN=92 Runoff=191.96 cfs 9.811 af

Subcatchment DA2.B: Runoff Area=1.670 ac 0.60% Impervious Runoff Depth=5.46"
Tc=5.0 min CN=81 Runoff=16.11 cfs 0.760 af

Subcatchment OFF2: Runoff Area=148.670 ac 13.10% Impervious Runoff Depth=5.69"
Flow Length=5,079' Tc=18.7 min CN=83 Runoff=955.78 cfs 70.512 af

Pond EWDB: Extended Peak Elev=1,006.87' Storage=226,679 cf Inflow=191.96 cfs 9.811 af
Outflow=37.93 cfs 9.577 af

Link RP1: Release Point 1 Inflow=2.41 cfs 0.114 af
Primary=2.41 cfs 0.114 af

Link RP2: Release Point 2 Inflow=996.83 cfs 80.849 af
Primary=996.83 cfs 80.849 af

Total Runoff Area = 168.040 ac Runoff Volume = 81.196 af Average Runoff Depth = 5.80"
81.27% Pervious = 136.566 ac 18.73% Impervious = 31.474 ac

Summary for Subcatchment DA1: Drainage Area 1

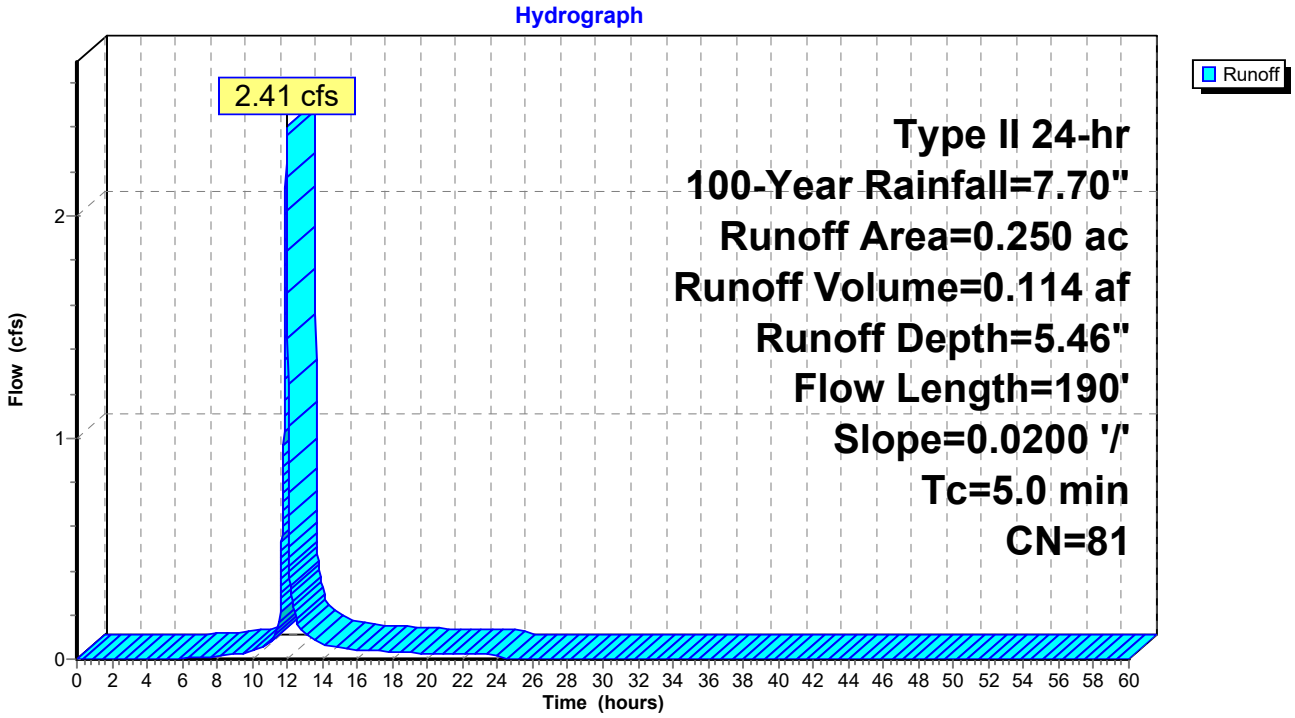
Runoff = 2.41 cfs @ 11.96 hrs, Volume= 0.114 af, Depth= 5.46"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-60.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-Year Rainfall=7.70"

Area (ac)	CN	Description
0.020	98	Paved parking, HSG D
0.230	80	>75% Grass cover, Good, HSG D
0.250	81	Weighted Average
0.230		92.00% Pervious Area
0.020		8.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	100	0.0200	1.44		**Sheet Flow, SHEET** Smooth surfaces n= 0.011 P2= 3.50"
0.7	90	0.0200	2.28		**Shallow Concentrated Flow, SHALLOW** Unpaved Kv= 16.1 fps
3.1					**Direct Entry, 5 min.**
5.0	190	Total			

Subcatchment DA1: Drainage Area 1



Summary for Subcatchment DA2.A: Drainage Area 2.A

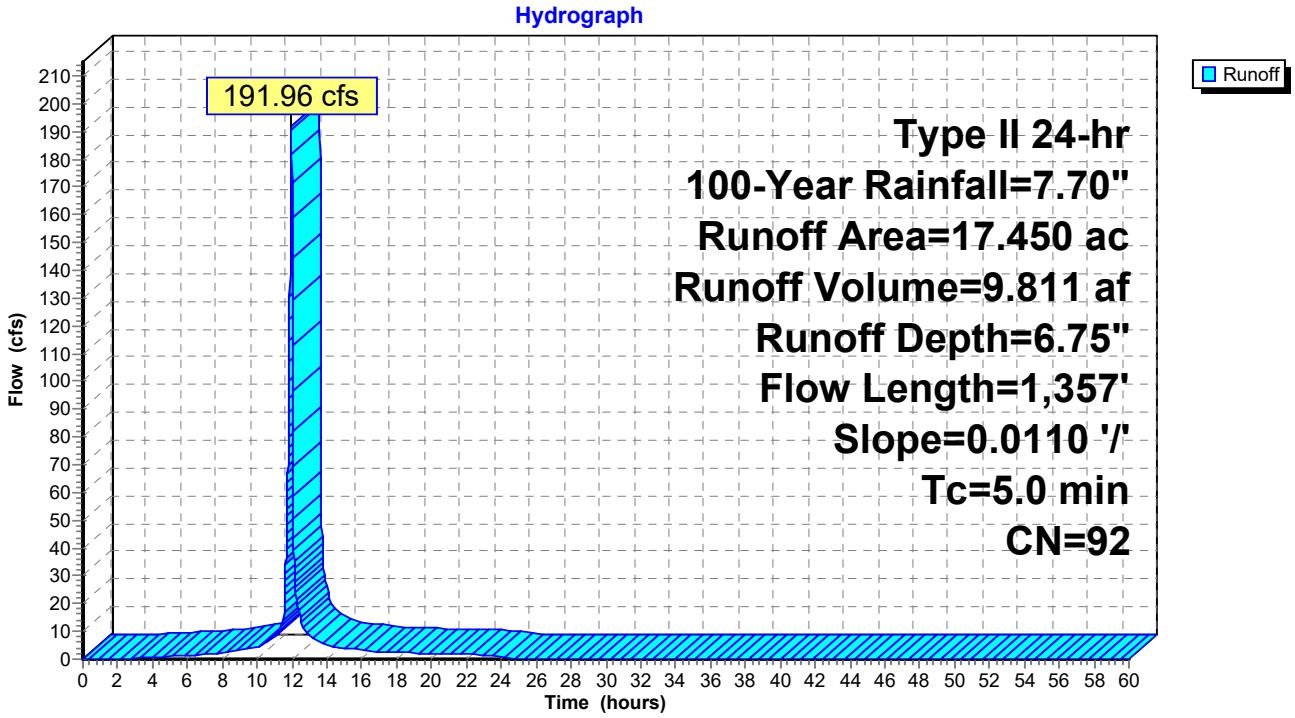
Runoff = 191.96 cfs @ 11.96 hrs, Volume= 9.811 af, Depth= 6.75"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-60.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-Year Rainfall=7.70"

Area (ac)	CN	Description
2.920	98	Unconnected roofs, HSG D
0.370	95	Urban commercial, 85% imp, HSG D
0.690	95	Urban commercial, 85% imp, HSG D
5.330	80	>75% Grass cover, Good, HSG D
7.640	98	Paved roads w/curbs & sewers, HSG D
0.500	98	Water Surface, HSG D
17.450	92	Weighted Average
5.489		31.46% Pervious Area
11.961		68.54% Impervious Area
2.920		24.41% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.5	100	0.0110	1.13		**Sheet Flow, SHEET** Smooth surfaces n= 0.011 P2= 3.50"
0.6	81	0.0110	2.13		**Shallow Concentrated Flow, SHALLOW** Paved Kv= 20.3 fps
1.7	910		9.00		**Direct Entry, PIPE STORM**
0.1	100		11.35		**Lake or Reservoir, EWDB** Mean Depth= 4.00'
0.3	166		9.00		**Direct Entry, PIPE STORM**
0.8					**Direct Entry, 5 min.**
5.0	1,357	Total			

Subcatchment DA2.A: Drainage Area 2.A



Summary for Subcatchment DA2.B: Drainage Area 2.B

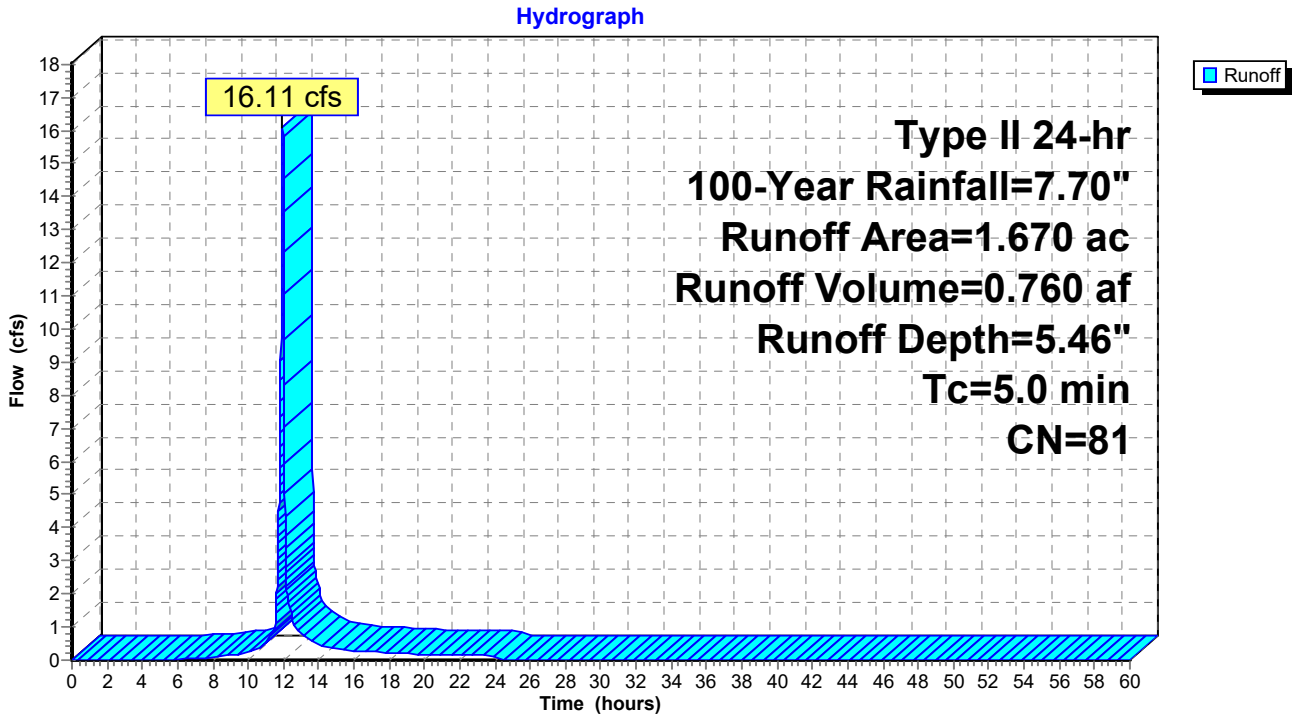
Runoff = 16.11 cfs @ 11.96 hrs, Volume= 0.760 af, Depth= 5.46"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-60.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-Year Rainfall=7.70"

Area (ac)	CN	Description
0.880	80	>75% Grass cover, Good, HSG D
0.780	82	Woods/grass comb., Fair, HSG D
0.010	98	Unconnected pavement, HSG D
1.670	81	Weighted Average
1.660		99.40% Pervious Area
0.010		0.60% Impervious Area
0.010		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, 5 min.**

Subcatchment DA2.B: Drainage Area 2.B



Summary for Subcatchment OFF2: Offsite Area 2

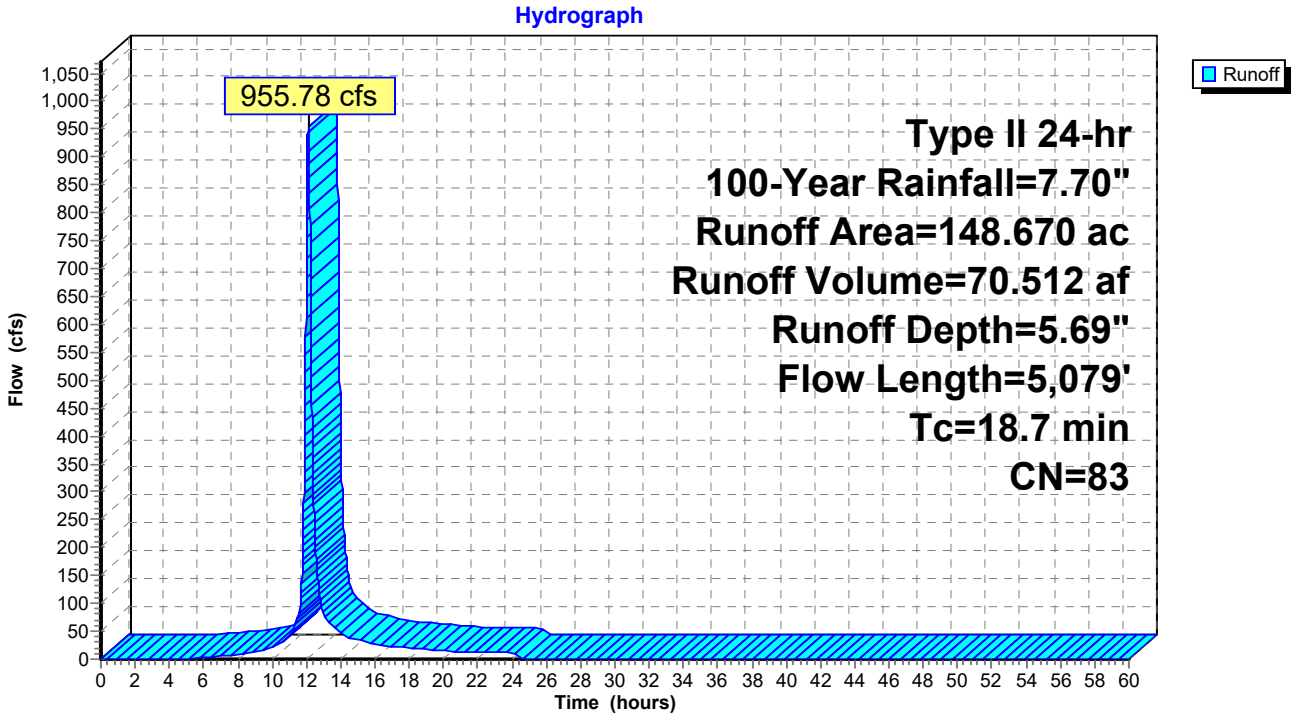
Runoff = 955.78 cfs @ 12.11 hrs, Volume= 70.512 af, Depth= 5.69"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-60.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-Year Rainfall=7.70"

Area (ac)	CN	Description
6.400	89	Row crops, straight row, Good, HSG D
3.520	77	Woods, Good, HSG D
49.030	80	>75% Grass cover, Good, HSG D
38.450	80	Pasture/grassland/range, Good, HSG D
20.210	87	1/4 acre lots, 38% imp, HSG D
31.060	87	1/4 acre lots, 38% imp, HSG D
148.670	83	Weighted Average
129.187		86.90% Pervious Area
19.483		13.10% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.6	100	0.0940	0.30		**Sheet Flow, SHEET** Cultivated: Residue>20% n= 0.170 P2= 3.50"
3.4	410	0.0506	2.02		**Shallow Concentrated Flow, SHALLOW** Cultivated Straight Rows Kv= 9.0 fps
3.6	216	0.0400	1.00		**Shallow Concentrated Flow, SHALLOW** Woodland Kv= 5.0 fps
2.4	1,261	0.0327	8.67	104.04	**Channel Flow, CHANNEL** Area= 12.0 sf Perim= 10.0' r= 1.20' n= 0.035 High grass
1.3	1,985	0.1450	26.29	670.29	**Channel Flow, CHANNEL** Area= 25.5 sf Perim= 15.5' r= 1.65' n= 0.030 Earth, clean & winding
2.2	980	0.0114	7.43	223.03	**Channel Flow, CHANNEL** Area= 30.0 sf Perim= 18.0' r= 1.67' n= 0.030
0.2	127	0.0265	11.24	286.55	**Channel Flow, CHANNEL** Area= 25.5 sf Perim= 15.5' r= 1.65' n= 0.030
18.7	5,079	Total			

Subcatchment OFF2: Offsite Area 2



Summary for Pond EWDB: Extended Wet Detention Basin

Inflow Area = 17.450 ac, 68.54% Impervious, Inflow Depth = 6.75" for 100-Year event
Inflow = 191.96 cfs @ 11.96 hrs, Volume= 9.811 af
Outflow = 37.93 cfs @ 12.10 hrs, Volume= 9.577 af, Atten= 80%, Lag= 8.8 min
Primary = 37.93 cfs @ 12.10 hrs, Volume= 9.577 af

Routing by Stor-Ind method, Time Span= 0.00-60.00 hrs, dt= 0.01 hrs
Peak Elev= 1,006.87' @ 12.10 hrs Surf.Area= 43,609 sf Storage= 226,679 cf

Plug-Flow detention time= 356.5 min calculated for 9.577 af (98% of inflow)
Center-of-Mass det. time= 341.3 min (1,106.9 - 765.6)

Volume	Invert	Avail.Storage	Storage Description
#1	1,000.00'	278,254 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

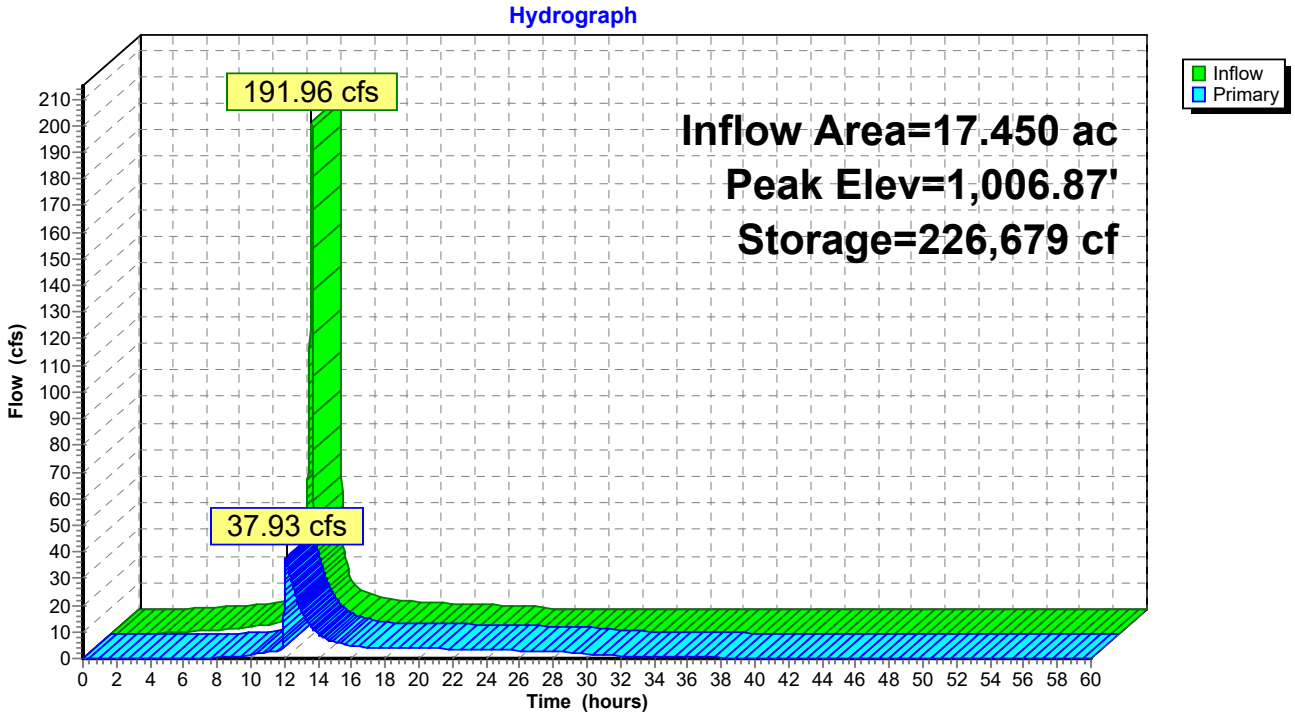
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,000.00	23,193	0	0
1,001.00	25,869	24,531	24,531
1,002.00	28,647	27,258	51,789
1,003.00	31,526	30,087	81,876
1,004.00	34,505	33,016	114,891
1,005.00	37,585	36,045	150,936
1,006.00	40,765	39,175	190,111
1,007.00	44,046	42,406	232,517
1,008.00	47,428	45,737	278,254

Device	Routing	Invert	Outlet Devices
#1	Primary	999.50'	**30.0" Round RCP_Round 30"** L= 63.3' RCP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 999.50' / 998.80' S= 0.0111 '/' Cc= 0.900 n= 0.013 Concrete pipe, straight & clean, Flow Area= 4.91 sf
#2	Device 1	1,000.00'	**20.0 deg x 6.75' rise Sharp-Crested Vee Weir** Cv= 2.69 (C= 3.36)
#3	Device 1	1,006.75'	**48.0" x 60.0" Horiz. Grate** C= 0.600 Limited to weir flow at low heads
#4	Device 2	1,000.00'	**8.5" Vert. Orifice** C= 0.600
#5	Device 2	1,004.75'	**3.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00

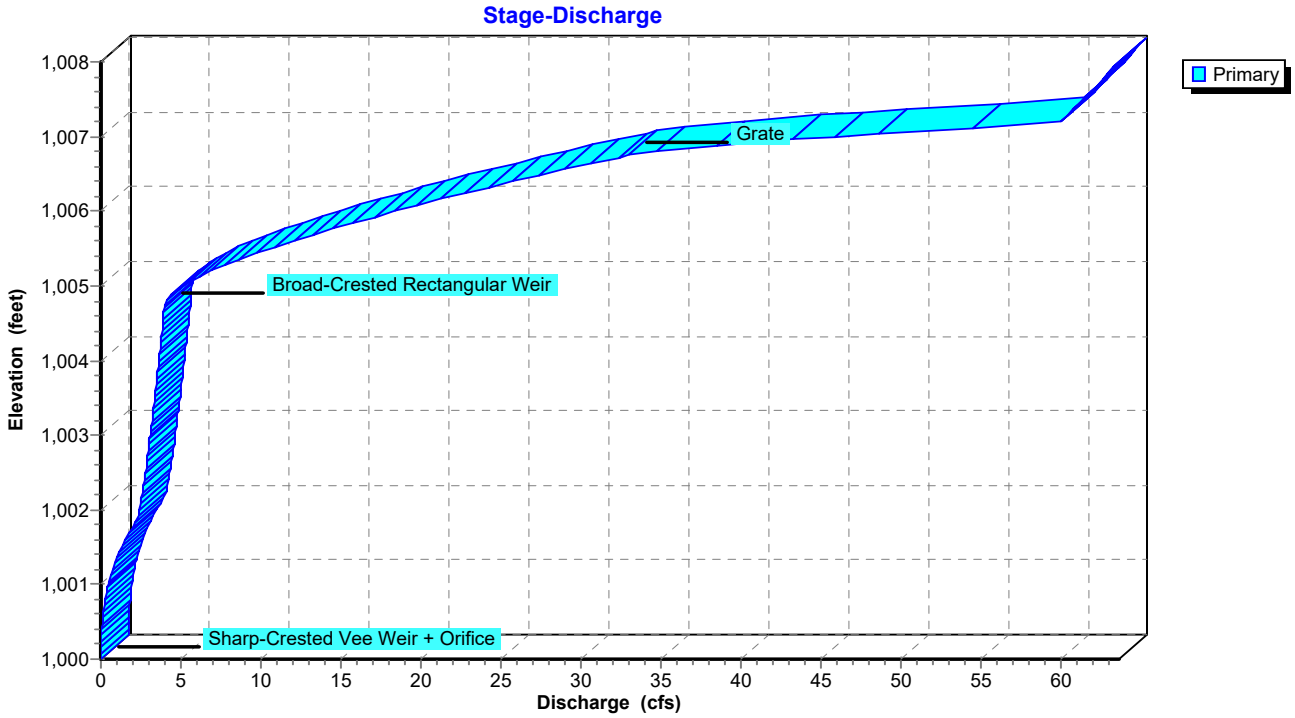
Coef. (English) 2.80 2.92 3.08 3.30 3.32

Primary OutFlow Max=37.85 cfs @ 12.10 hrs HW=1,006.87' (Free Discharge)
└─**1=RCP_Round 30"** (Passes 37.85 cfs of 58.45 cfs potential flow)
  ├─**2=Sharp-Crested Vee Weir** (Passes 35.51 cfs of 58.28 cfs potential flow)
  │ ├─**4=Orifice** (Orifice Controls 4.84 cfs @ 12.29 fps)
  │ └─**5=Broad-Crested Rectangular Weir** (Weir Controls 30.67 cfs @ 4.83 fps)
  └─**3=Grate** (Weir Controls 2.34 cfs @ 1.12 fps)

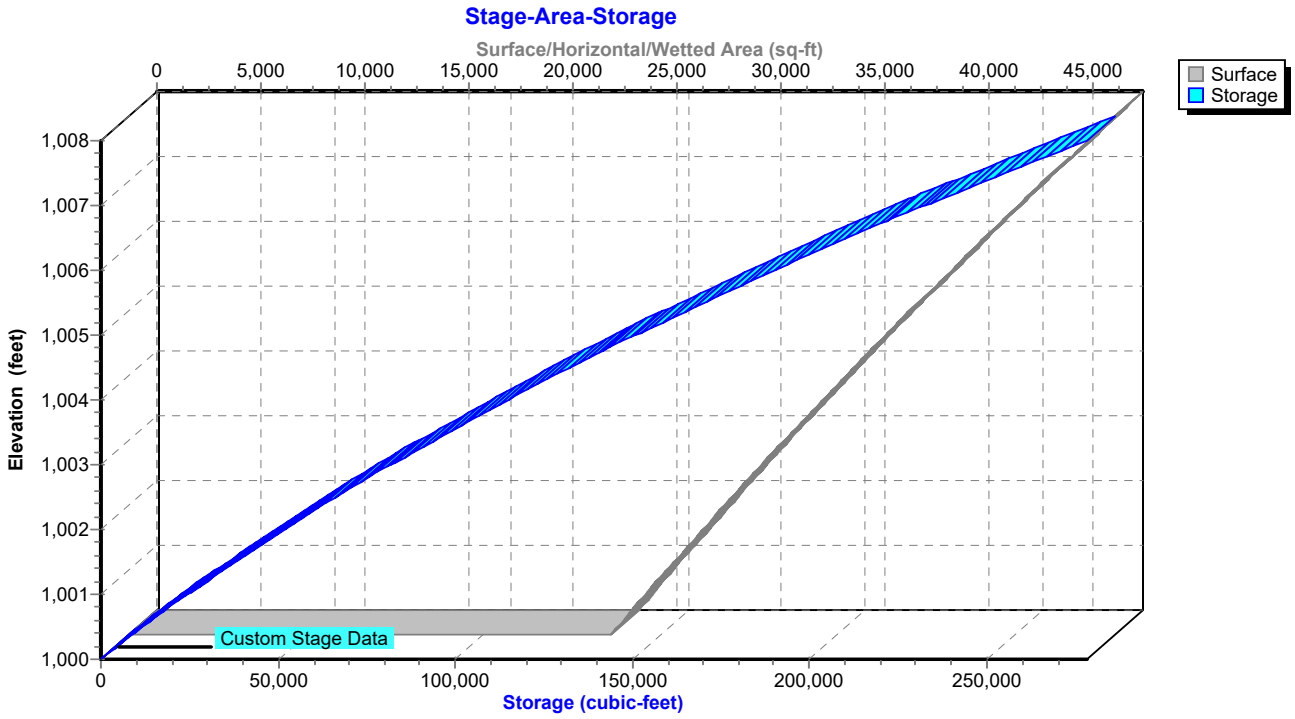
Pond EWDB: Extended Wet Detention Basin



Pond EWDB: Extended Wet Detention Basin



Pond EWDB: Extended Wet Detention Basin

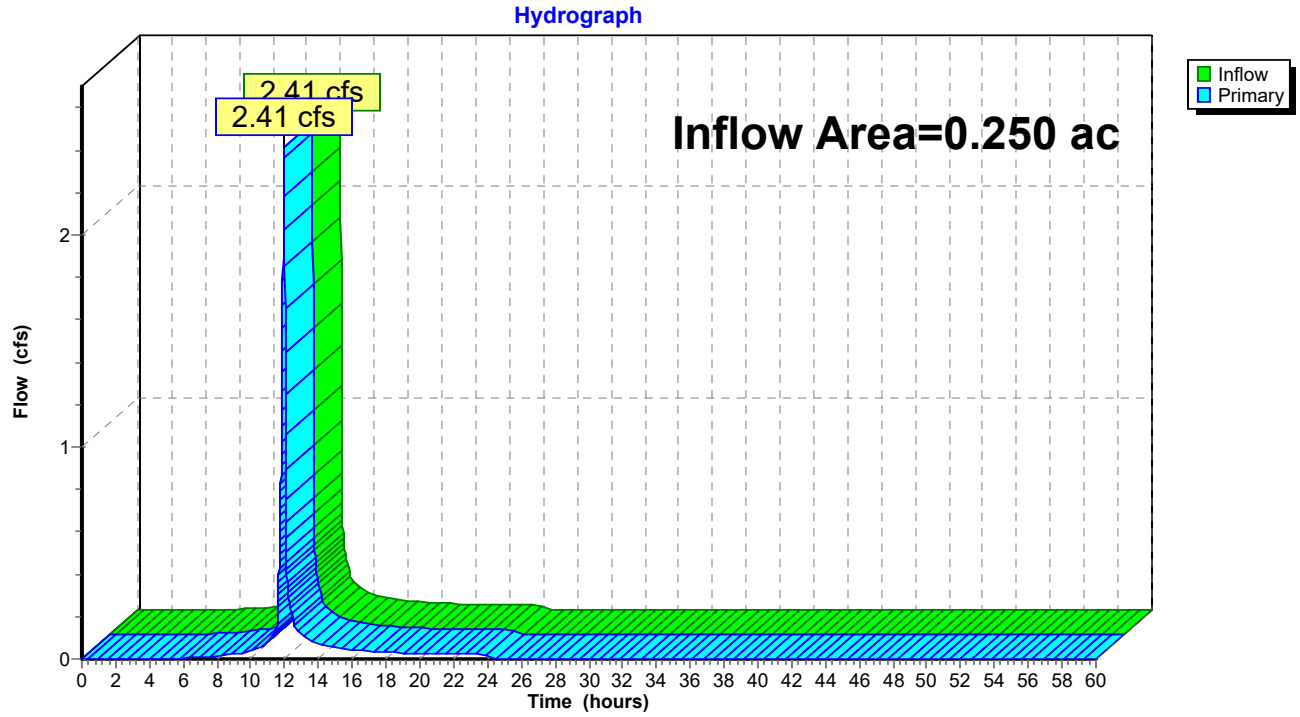


Summary for Link RP1: Release Point 1

Inflow Area = 0.250 ac, 8.00% Impervious, Inflow Depth = 5.46" for 100-Year event
Inflow = 2.41 cfs @ 11.96 hrs, Volume= 0.114 af
Primary = 2.41 cfs @ 11.96 hrs, Volume= 0.114 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-60.00 hrs, dt= 0.01 hrs

Link RP1: Release Point 1



Summary for Link RP2: Release Point 2

Inflow Area = 167.790 ac, 18.75% Impervious, Inflow Depth = 5.78" for 100-Year event
Inflow = 996.83 cfs @ 12.11 hrs, Volume= 80.849 af
Primary = 996.83 cfs @ 12.11 hrs, Volume= 80.849 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-60.00 hrs, dt= 0.01 hrs

Link RP2: Release Point 2