



PLANNING & ZONING COMMISSION

Regular Meeting Agenda
CITY OF PARKVILLE, MISSOURI
Tuesday, October 14, 2025 5:30 PM
City Hall Board Room

1. **Call to Order**
2. **Roll Call**
3. **General Business**
 - A. Approval of the October 14, 2025, regular meeting agenda.
 - B. Approve the minutes for the September 9, 2025, regular meeting
 - C. Proclamation for National Community Planning Month
4. **Unfinished Business**
5. **Regular Business**
 - A. Application for Subdivision - Preliminary Plat for The Estates at Thousand Oaks 3rd-7th Plats. (Case No. PZ2025-21); *Forest Park Development, Applicant.*
 - B. Request for one-year extension of Final Development Plan approval for Village on the Green. (Case No. PZ2021-54); *Adam Tholen, Applicant.*
6. **Public Hearing**
 - A. Application for text amendment to Parkville Municipal Code, Title IV – Development Code, Section 404.040 Required Improvements and Engineering Specifications, to create requirements for the construction of perimeter streets as a part of public improvements for the subdivision process, and provide additional provisions for storm drainage requirements. (Case No. PZ2025-27); *City of Parkville, Applicant.*
7. **Other Business**
 - A. Upcoming meetings & dates of importance:
 - Board of Aldermen Meetings: Tuesday, October 21 and November 4 at 6:00 p.m.
 - Board of Zoning Adjustments Meeting: Awaiting Application
 - Planning & Zoning Commission Regular Meeting: **THURSDAY**, November 13 at 5:30 p.m.
8. **Adjournment**

**Minutes of the
Planning & Zoning Commission Regular Meeting
City of Parkville, Missouri**
Tuesday, September 9, 2025 5:30 PM
City Hall Board Room
City Hall Board Room

1. Call to Order

Chair Wright called the meeting to order at 05:32 PM.

2. Roll Call

Commissioners Present:

Michael Wright
Barbara Wassmer
R. Douglas Krtek
Walt Lane
Andrew Barchers
Gareld Butler

Absent:

Spencer Keesee
Timothy Cahill
Jackson Kutey

A quorum of the Commission was present.

Staff Present:

Stephen Lachky, Community Development Director
Brad Stanton, Planner
Dan Harper, Public Works Director
John Mautino, City Attorney

3. General Business

A. Approval of the September 9, 2025, regular meeting agenda.

ACTION: R. Douglas Krtek moved to approve, Gareld Butler seconded. Motion Passed: 6-0.

AYES: Michael Wright, Barbara Wassmer, R. Douglas Krtek, Walt Lane, Andrew Barchers, Gareld Butler

NOES: None

ABSTAIN: None

B. Approve the minutes for the August 12, 2025, regular meeting

ACTION: Andrew Barchers moved to approve, Gareld Butler seconded. Motion Passed: 6-0.

AYES: Michael Wright, Barbara Wassmer, R. Douglas Krtek, Walt Lane, Andrew Barchers, Gareld Butler

NOES: None

ABSTAIN: None

4. Unfinished Business

5. Public Hearing

- A. Application for Zoning Map Amendment for three (3) parcels between Thousand Oaks and NW River Rd from Platte County "AG" Agricultural District to Parkville City "R-3" Single-Family Residential. (Case No. PZ2025-22); *Forest Park Development, Applicant.*

DEVELOPER'S PRESENTATION

Dustin Burton, RIC, Engineer for the Applicant, stated that the rezoning is to clean up the zoning from the Agricultural District. He stated that there was a rethink to the layout of the 1st Plat.

QUESTIONS & CLARIFICATIONS

Commissioner Butler asked about the development in Thousand Oaks Phase 13B. David Barth, applicant, stated that he was trying to conserve green space. Commissioner Butler asked about the differentiation between Thousand Oaks and Estates at Thousand Oaks. Mr. Barth responded it would be the same HOA. Commissioner Butler asked about the change in lot size. Mr. Barth responded it was substantially larger.

PUBLIC HEARING

No public comment.

MOTION

ACTION: R. Douglas Krtek moved to approve, Walt Lane seconded. Motion Passed: 6-0.

AYES: Michael Wright, Barbara Wassmer, R. Douglas Krtek, Walt Lane, Andrew Barchers, Gareld Butler

NOES: None

ABSTAIN: None

6. Regular Business

- A. Application for Subdivision - Final Plat for The Estates at Thousand Oaks 1st Plat. (Case No. PZ2025-24); *Forest Park Development, Applicant.*

STAFF ANALYSIS & SUMMARY

Brad Stanton, Senior Planner, presented an overview of the project. He stated that the proposal, submitted by David Barth of Forest Park Development, is to final plat approximately 45.58 acres into 66 single-family residential lots and four tracts of private open space.

MOTION

ACTION: Andrew Barchers moved to approve, Barbara Wassmer seconded. Motion

Passed: 6-0.

AYES: Michael Wright, Barbara Wassmer, R. Douglas Krtek, Walt Lane, Andrew Barchers, Gareld Butler

NOES: None

ABSTAIN: None

- B. Application for Subdivision - Final Plat for The Estates at Thousand Oaks 2nd Plat. (Case No. PZ2025-25); *Forest Park Development, Applicant.*

STAFF ANALYSIS & SUMMARY

Brad Stanton, Senior Planner, presented an overview of the project. He stated that the proposal, submitted by David Barth of Forest Park Development, is to final plat approximately 80.27 acres into 44 single-family residential lots and five tracts of private open space.

MOTION

ACTION: Andrew Barchers moved to approve, Barbara Wassmer seconded. Motion Passed: 6-0.

AYES: Michael Wright, Barbara Wassmer, R. Douglas Krtek, Walt Lane, Andrew Barchers, Gareld Butler

NOES: None

ABSTAIN: None

- C. Application for Major Site Plan for Fresh Karma Dispensary, a marijuana dispensary generally located at the southeast corner of Highway 45 and Ensign Dr in Parkville, MO 64152. (Case No. PZ2025-20); *Daniel Vargas, The Plan Consultant, LLC, Applicant.*

STAFF ANALYSIS & SUMMARY

Brad Stanton, Senior Planner, provided an overview of the project. He stated that the application is for a major site plan for Fresh Karma dispensary, a proposed one-story, 4,500 sq. ft. marijuana dispensary with a drive-through, located at the southeast corner of Highway 45 and Ensign Drive. The site is zoned BP Business Park, which permits marijuana dispensaries by right. The plan deviates from the previous CODES dispensary approval by proposing a two-phased approach that includes a future restaurant on the western portion of the site. Staff notes two key issues: the plan exceeds the maximum allowed parking (79 spaces provided versus a 70 space maximum), which requires a waiver from the Planning Commission, and a request to relocate required street trees from the Highway 45 frontage to the Ensign Drive frontage due to a sanitary sewer easement.

DEVELOPER'S PRESENTATION

Daniel Vargas, The Plan Consultant, Applicant, stated that dispensaries have high number of staff members and dispensaries around the metro use additional parking. Chair Wright asked about having two entrances. Mr. Vargas responded it was for convenience and redundancy to reduce the bottleneck. Chair Wright asked about the phasing. Mr. Vargas responded that they would just connect the new building and drive to the edge of the pavement. The applicant stated that the glass will be tinted, not mirrored.

MOTION

ACTION: Andrew Barchers moved to approve, R. Douglas Krtek seconded. Motion Passed: 6-0.

AYES: Michael Wright, Barbara Wassmer, R. Douglas Krtek, Walt Lane, Andrew Barchers, Gareld Butler
NOES: None
ABSTAIN: None

7. Other Business

A. Upcoming meetings & dates of importance:

- Board of Aldermen Meetings: Tuesday, September 16 and October 7 at 6:00 p.m.
- Board of Zoning Adjustments Meeting: Awaiting Applications
- Planning & Zoning Commission Regular Meeting: Tuesday, October 14 at 5:30 p.m.

8. Adjournment

Chairman Wright called further discussion. Seeing none, he called for a motion to adjourn.

Submitted by:

Stephen Lachky, AICP
Community Development Director

Date

Brad Stanton
Planner

Date



Staff Analysis

Agenda Item: 5.A.

Proposal: Application for Subdivision – Preliminary Plat for The Estates at Thousand Oaks 3rd-7th Plats with 134 single-family residential lots on 113.7 acres, more or less, generally located between Thousand Oaks and NW River Rd.

Staff Recommendation: Approval

Case No: PZ25-21

Applicant & Owner: Forest Park Development Company of Kansas City, LLC

Location: Generally located between the existing Thousand Oaks subdivision and NW River Rd

Zoning: R-3 Single-Family Residential

Parcel #s: All of Platte County parcels #20-9.0-30-000-000-012.000, 20-9.0-31-000-000-001.001, 20-9.0-29-000-000-010.000, and 20-9.0-32-000-000-003.000

Exhibits:

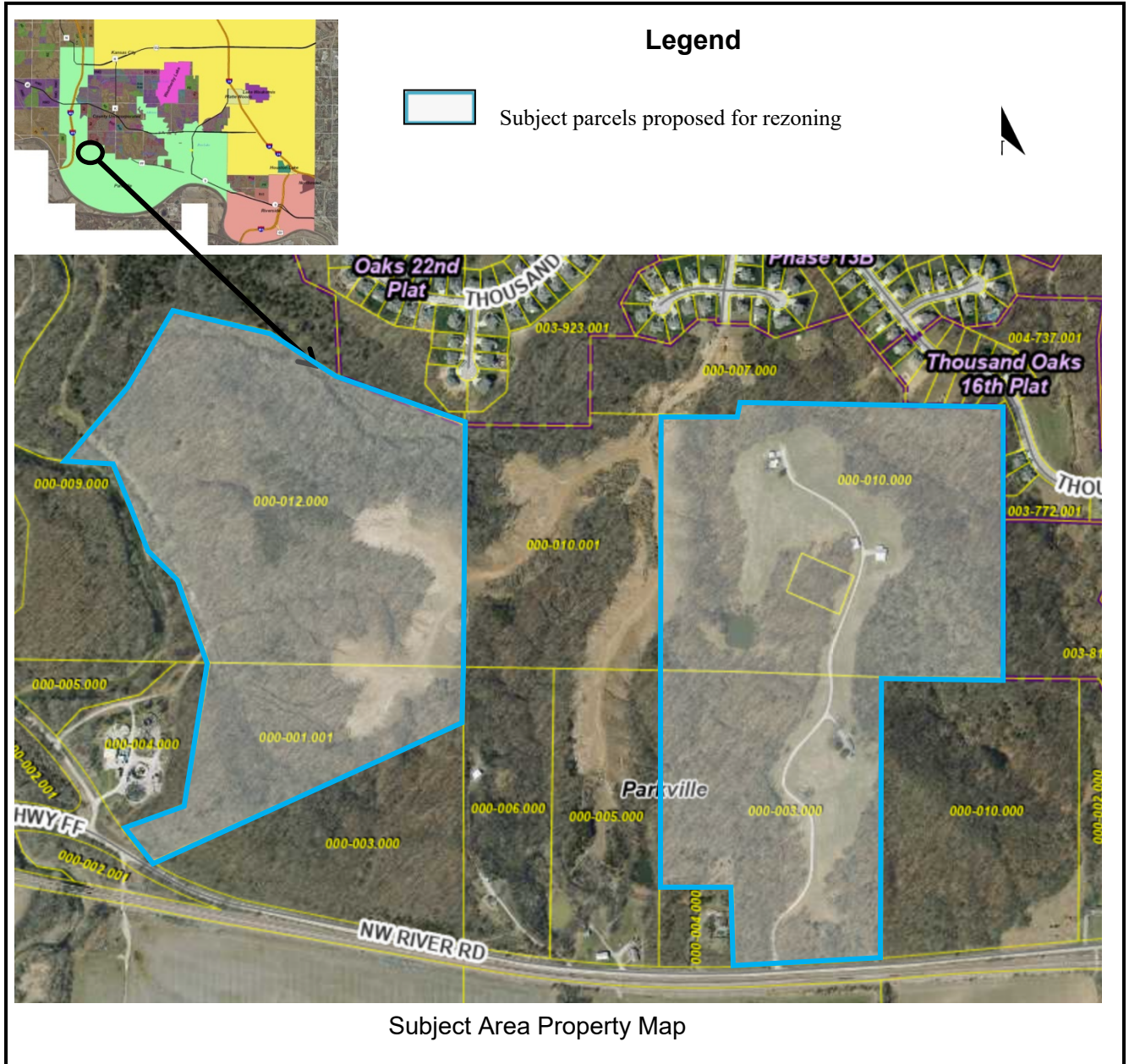
- A. This Staff Analysis
- B. Application for Subdivision – Preliminary Plat
- C. Subject Area Property Map
- D. Preliminary Plat, The Estates at Thousand Oaks 3rd – 7th Plat (prepared by Renaissance Infrastructure Consulting; dated July 25, 2025)
- E. Additional exhibits as may be presented during the regular meeting

By Reference:

- A. Parkville Municipal Code, Title IV – Development Code in its entirety (http://parkvillemo.gov/download/ZoningCodeUpdate_FinalDraft.pdf)
 - 1. Section 403.020, D. Preliminary Plat
 - 2. Chapter 404 Subdivision Regulations
 - 3. Section 405.010 Zoning Districts Established
 - 4. Section 405.020 Districts & Uses
 - 5. Section 405.030 Standards Applicable to All Districts
- B. Parkville Master Plan (<http://parkvillemo.gov/departments/community-development-department/master-plan/>)

Overview

The applicant proposes a preliminary plat for five (5) new phases of The Estates at Thousand Oaks, the 3rd – 7th plats. These plats would encompass 134 single-family residential lots on 113.7 acres, more or less, generally located south of the existing Thousand Oaks subdivisions and north of NW River Rd. Also included in the preliminary plat are new public streets and 6 tracts of private open space. Table 1 on the next page details the lots and tracts per proposed plat.



On April 18, 2023, the Board of Aldermen approved Ordinance No. 3183 to rezone property to “R-3” Single-Family Residential for this development. On September 2, 2025, the Board of Aldermen approved Ordinance No. 3273 to rezone property to “R-3” Single-Family Residential for this development. On October 7, 2025, the Board of Aldermen approved Ordinance No. 3276 to rezone property to “R-3” Single-Family Residential for this development.

Table 1. Lots and Tracts per Plat

Plat	Lots	Tracts
3 rd Plat	15	1 (H)
4 th Plat	34	1 (J)
5 th Plat	42	2 (K & L)
6 th Plat	29	1 (M)
7 th Plat	14	1 (N)
Total	134	6

Review and Analysis

Plat applications are required to establish or alter the legal boundaries of property, and to account for public facilities, infrastructure, development patterns, public realm design or other long-range growth and development considerations prior to potential fracturing of ownership. Preliminary plats are larger division of land that enable new ownership and development patterns; or which impact public facilities or land, and are proposed in a preliminary or conceptual format to prepare for detailed engineering and design facilities.

Preliminary Plat Application (PZ25-21)

Parkville Municipal Code, Section 403.020, Subsection D provides criteria for how the Planning and Zoning Commission shall determine if a preliminary plat is acceptable. The following are staff’s findings and conclusions for the preliminary plat application.

- 1. The application is in accordance with the Master Plan and in particular the physical patterns, arrangement of streets, blocks, lots and open spaces, and public realm investments that reflect the principles and concepts of the plan.**

This application reasonably reflects the principles and concepts of the Master Plan. The development pattern matches that of the surrounding Thousand Oaks and Estates at Thousand Oaks neighborhoods.

- 2. Compliance with the requirements of this Development Code, and in particular the blocks and lots proposed are capable of meeting all development and site design standards under the existing or proposed zoning.**

Staff has reviewed the submitted plat drawing against the requirements of the Code and found that it meets the requirements. The blocks and lots proposed are capable of meeting all development and site design standards under the R-3 zoning district.

- 3. Any phasing proposed in the application is clearly indicated and demonstrates a logical and coordinated approach to development, including coordination with existing and potential development on adjacent property.**

The proposed phasing plan is logical and allows for the appropriate development of public infrastructure.

- 4. Any impacts identified by specific studies or technical reports, including a preliminary review of stormwater, are mitigated with generally accepted and sound planning, engineering, and urban design solutions that reflect long-term solutions and sound fiscal investments.**

The applicant submitted a preliminary stormwater management plan. This study will be reviewed by Public Works and must be found to meet the requirements of the Municipal Code and include generally accepted and sound planning, engineering, and urban design solutions that reflect long-term solutions and sound fiscal investments. A final stormwater management plan will be required prior to construction document approval.

- 5. The application does not deter any existing or future development on adjacent property from meeting the goals and policies of the Master Plan.**

Staff does not find this application to deter any existing or future development on adjacent property from meeting the goals and policies of the Master Plan. Any impacts on adjacent property from this proposed subdivision are expected to be minimal. The proposed preliminary plats match and complement the existing development pattern of the Thousand Oaks and Estates at Thousand Oaks neighborhoods.

- 6. The design does not impede the construction of anticipated or planned future public infrastructure within the area.**

Staff does not find the design of the proposed plat to impede any construction of public infrastructure in the area.

- 7. The recommendations of professional staff, or any other public entity asked to officially review the plat.**

Staff recommends approval of the Application for Subdivision – Preliminary Plat for The Estates at Thousand Oaks 3rd-7th Plats.

Staff Conclusion and Recommendation

Staff recommends approval of the Application for Subdivision – Preliminary Plat for The Estates at Thousand Oaks 3rd-7th Plats based on the merits of the application and the findings and conclusions in the report. Staff recommends approval of the application, subject to the following conditions:

1. Approval is based on the representations of the drawings presented as part of this application and does not waive any requirement or development standard contained within the Municipal Code.
2. Prior to Construction Document approval, sanitary sewer plans must be approved by the Platte County Regional Sewer District (PCRSB).
3. Prior to Construction Document approval, the Public Works Department must review and approve the drainage study's methodology and stormwater best management practices (BMPs).
4. Any other conditions the Planning and Zoning Commission determines are necessary.

It should be noted that the recommendation contained in this report is made without knowledge of facts, comments or any additional information which may be presented during the meeting. For that reason, the conclusions herein are subject to change as a result of evaluating additional information; additionally, staff reserves the right to modify or confirm the conclusions and recommendations herein based on consideration of any additional information that may be presented.

Necessary Action

Following consideration of the Application for Subdivision – Preliminary Plat, supporting information, associated exhibits, factors discussed above and any testimony presented at the meeting, the Planning and Zoning Commission should vote for approval (with or without conditions), denial, or postpone the application for further consideration. If approved subject to conditions, the conditions should be noted for the record. The Planning & Zoning Commission’s action shall be the final action on this item.

End of Memorandum



Brad Stanton, AICP

10-10-2025

Date

The Estates At Thousand Oaks 3rd - 7th Plat

LEGAL DESCRIPTION

The Estates at Thousand Oaks East Boundary Description

A tract of land lying in part of the Southwest Quarter of Section 29, T51N, R34W and part of the Northwest Quarter of Section 32, T51N, R34W of the Fifth Principal Meridian, in the City of Parkville, Platte County, Missouri, described as follows:

Beginning at the Southeast corner of the Southwest Quarter of said Section 29, said corner also being the Northeast corner of the Northwest Quarter of said Section 32; thence North 89°29'12" West, along the South line of said Southwest Quarter and the North line of said Northwest Quarter, a distance of 586.96 feet; thence, departing said South line and said North line, South 00°10'20" West, a distance of 1,361.66 feet to the North right-of-way line of NW River Road, as now established; thence South 86°47'51" West, along said North right-of-way line, a distance of 559.04 feet; thence, Westerly along said North right-of-way line, on a non-tangent curve to the right having a radius of 5,617.02 feet, a chord bearing of South 87°26'20" West, a chord length of 169.30 feet, and an arc length of 169.30 feet; thence, departing said North right-of-way line, North 00°18'33" East, a distance of 366.81 feet; thence North 89°37'24" West, a distance of 354.04 feet; thence North 00°18'33" East, a distance of 603.49 feet; thence South 89°29'42" East, a distance of 279.58 feet; thence North 00°18'33" East, a distance of 437.45 feet to a point on the North line of said Northwest Quarter and the South line of said Southwest Quarter; thence continuing North 00°18'33" East, a distance of 1,250.16 feet; thence North 55°05'15" East, a distance of 163.83 feet; thence North 53°57'43" East, a distance of 62.94 feet; thence North 64°06'13" East, a distance of 160.00 feet; thence North 33°40'20" West, a distance of 131.24 feet; thence North 28°56'31" West, a distance of 66.06 feet; thence North 01°32'53" West, a distance of 46.84 feet to point on the Southwesterly line of Lot 656, THOUSAND OAKS - PHASE 13B, a subdivision of land in the City of Parkville, Platte County, Missouri; thence South 61°10'50" East, along the Southwesterly line of said Lot 656 and the Southwesterly line of Lot 655, THOUSAND OAKS - PHASE 13B, a distance of 57.84 feet to the South corner of said Lot 655; thence North 72°05'58" East, along the Southeasterly line of said Lot 655, the Southeasterly line of Lot 654 and Tract D, THOUSAND OAKS - PHASE 13B, a distance of 370.69 feet to the Southeast corner of said Tract D, said corner also being the Westerly corner of Lot 638, THOUSAND OAKS - PHASE 13B; thence South 38°30'03" East, along the Southwesterly line of said Lot 638, the Southwesterly line of Lots 637 and 636, THOUSAND OAKS - PHASE 13B and the Southwesterly line of Lots 784 and 783, THOUSAND OAKS SIXTEENTH PLAT, a subdivision of land in the City of Parkville, Platte County, Missouri, a distance of 447.79 feet to the Southerly corner of said Lot 783, said corner also being the Westerly corner of Lot 782, THOUSAND OAKS SIXTEENTH PLAT; thence South 00°31'27" West, along the West line of said Lot 782, a distance of 90.95 feet to the Southwest corner of said Lot 782, said corner also being on the North line of the South Half of the Southwest Quarter of said Section 29;

thence South 89°27'33" East, along the South line of said Lot 782, the North line of said South Half and the South line of Lots 781, 780, 779, 778 and Tract "A", THOUSAND OAKS SIXTEENTH PLAT, a distance of 477.40 feet to corner of said Tract "A", said corner also being the Northeast corner of said South Half; thence South 00°09'02" West, along the West line of said Tract "A", the East line of the Southwest Quarter of said Section 29, the West line of Lots 774 and 773, THOUSAND OAKS SIXTEENTH PLAT and the West line of Tract "A", THOUSAND OAKS - 19TH PLAT, a subdivision of land in the City of Parkville, Platte County, Missouri, a distance of 1,317.25 feet to the POINT OF BEGINNING, containing 3,289,666 square feet or 75.520 acres more or less.

FLOOD PLAIN NOTE

According to the Flood Insurance Rate Map of The Federal Emergency Management Agency, Panels Number 360 and 375 of 425, Community-Panel Numbers 29165C0360D and 29165C0378D, effective date: April 2, 2015, portions of the subject property lay within: OTHER AREAS, ZONE X, defined as areas determined to be outside the 0.2% annual chance floodplain.

UTILITY CONTACTS

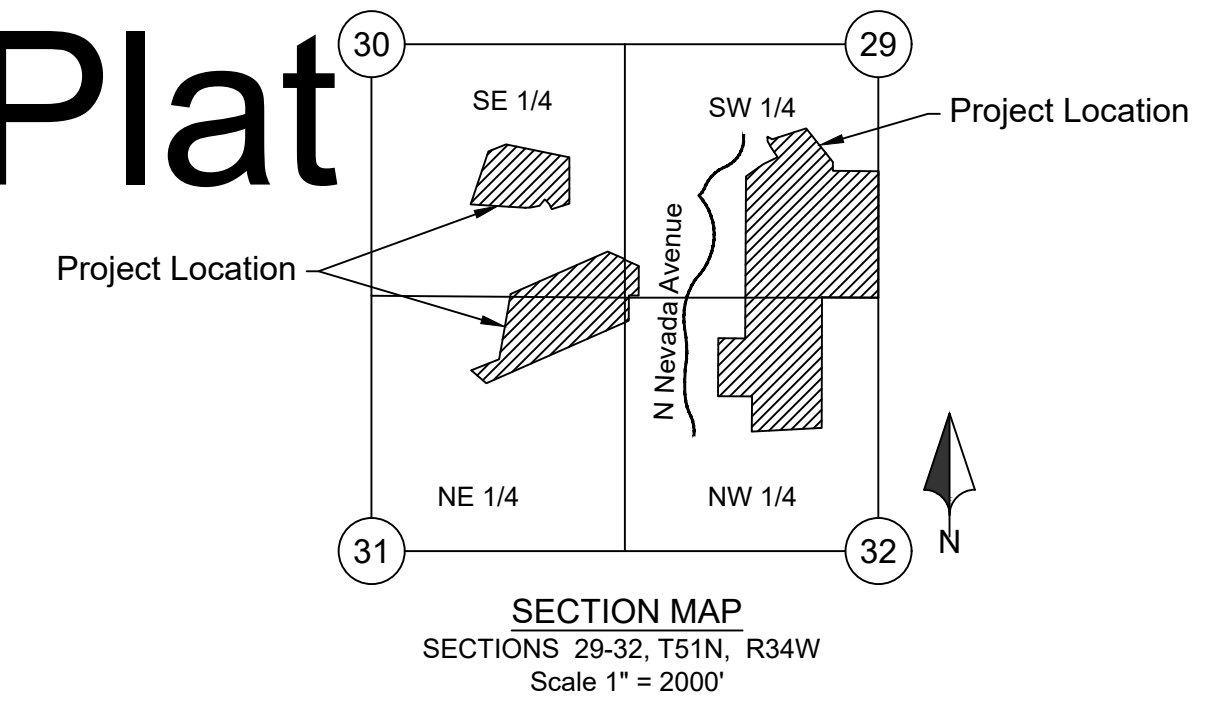
Parkville Special Road District	(816) 891-9044
CPWSD #6 of Platte County	(816) 741-7790
Platte County Regional Sewer District	(816) 858-2052
Spire	(816) 339-9401
Evergy	(816) 719-9725
Platte Clay Electric	(816) 807-7502
Century Link	(816) 243-5642
Unite Private Networks	(816) 903-9400
Spectrum	(816) 431-5818
Missouri One Call	(800) DIG-RITE
AT&T	(800) 464-7928
Comcast	(913) 891-3457

UTILITIES

The information concerning locations of underground utilities shown hereon which are not visible from the surface, has been taken from the records and field locations of the various utility companies and has not been field verified by this company. These locations are not to be construed as accurate or exact.

Parkville, Platte County, Missouri
Sections 29&30, Township 51N, Range 34W

Preliminary Plat



VICINITY MAP
Scale 1" = 2000'

Sheet Number	Sheet Title
C01	Title Sheet
C02	Existing Conditions
C03	General Layout
C04	Grading Plan
C05	Preliminary Plat West
C06	Preliminary Plat East

OWNER/DEVELOPER

Forest Park Development Company of Kansas City, LLC
David Barth
6014 N Hwy 9, Suite B
Parkville, MO 64152
816.591.2555

ENGINEER

Renaissance Infrastructure Consulting
400 E. 17th Street
Kansas City, Missouri 64108
816.800.0950
dburton@ric-consult.com

LEGEND

—	Existing Section Line	—	Proposed Right-of-Way
---	Existing Right-of-Way Line	---	Proposed Property Line
---	Existing Lot Line	---	Proposed Lot Line
---	Existing Easement Line	---	Proposed Easement
---	Existing Curb & Gutter	---	Proposed Curb & Gutter
---	Existing Sidewalk	---	Proposed Sidewalk
---	Existing Storm Sewer	---	Proposed Storm Sewer
□	Existing Storm Structure	□	Proposed Storm Structure
---	Existing Waterline	▲	Proposed Fire Hydrant
---	Existing Gas Main	---	Proposed Waterline
---	Existing Sanitary Sewer	---	Proposed Sanitary Sewer
●	Existing Sanitary Manhole	●	Proposed Sanitary Manhole
---	Existing Contour Major	---	Proposed Contour Major
---	Existing Contour Minor	---	Proposed Contour Minor
-----	Future Curb and Gutter		
U/E	Utility Easement	A/E	Access Easement
SS/E	Sanitary Sewer Easement	T/E	Temporary Easement
D/E	Drainage Easement		

SITE DATA TABLE

Existing / Proposed Zoning: AG & R-3 / R-3 Single-Family Residential
Total Area: 113.714 Acres
Open Area: 58.332 Acres
New RW: 8.354 Acres
Lots: 134 Residential Units
Density: 1.178 Units/Acre (Dwelling Units/Total Area)

Setbacks:

Front - 25ft
Rear - 25ft
Side - 6.5ft
Side (Corner) - 15ft

Tract Description:

Tracts H, J - N are reserved for common open space

Preliminary Plat

22-0138

The Estates At Thousand Oaks 3rd - 7th Plat
Parkville, Platte County, Missouri

Title Sheet

NO.	DATE	REVISION
1	07/25/25	1st Submittal

DRAWN BY	CHECKED BY
AOB	KLH

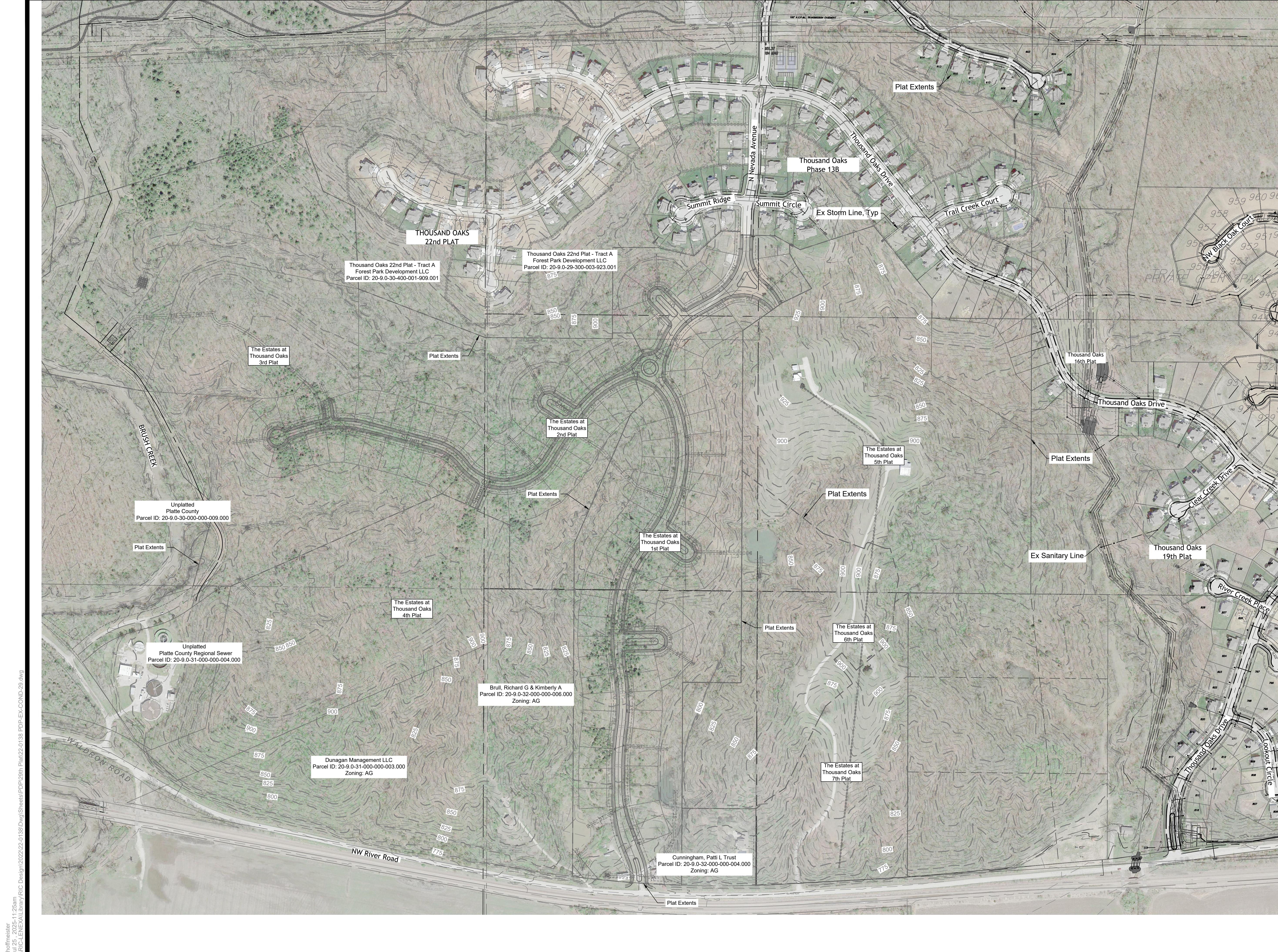
Renaissance Infrastructure Consulting
400 E 17th Street
Kansas City, Missouri 64108
816.800.0950
www.ric-consult.com
MO Certificate of Authority: E-20100303630

Sheet
C01

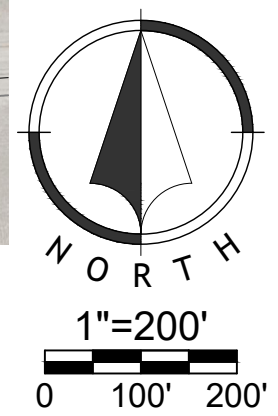
NOT FOR CONSTRUCTION
FOR CONSTRUCTION



Know what's below.
Call before you dig.



krcfmeister
 Jul 25, 2025-11:25am
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Preliminary Plat
 22-0138
 The Estates At Thousand Oaks 3rd - 7th Plat
 Parkville, Platte County, Missouri

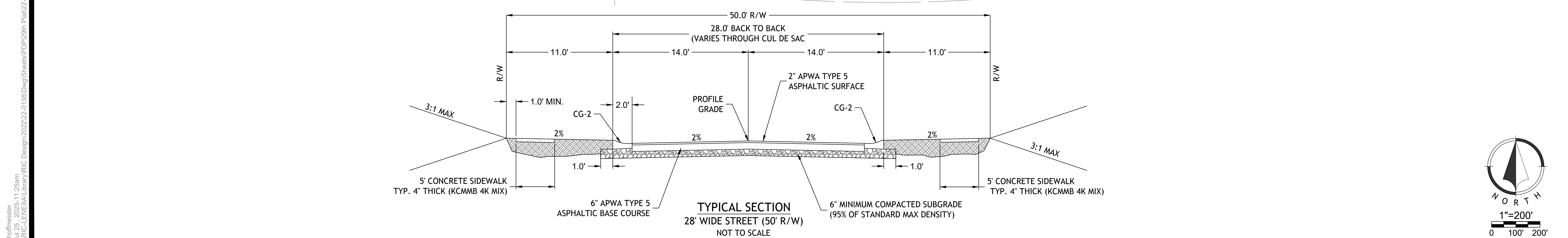
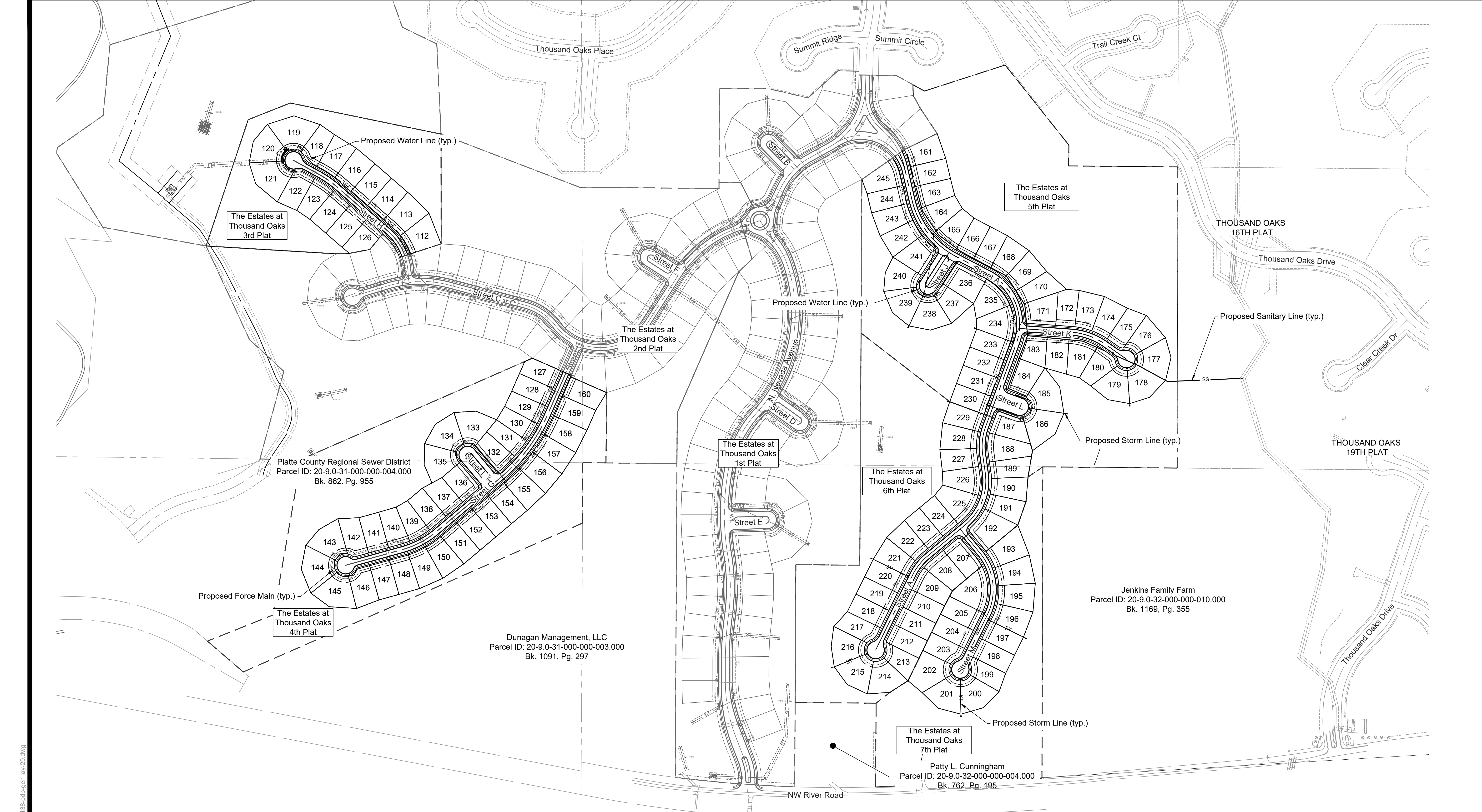
Existing Conditions

NO.	DATE	REVISION
1	07/25/25	1st Submittal

DRAWN BY: AOB
 CHECKED BY: KLH

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Sheet
 C02



Preliminary Plat

22-0138

The Estates at Thousand Oaks 3rd - 7th Plat
Parkville, Platte County, Missouri

General Layout

NO.	DATE	REVISION
1	07/25/25	1st Submittal

DRAWN BY	CHECKED BY
AOB	KLH

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Sheet
C03

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Contour Legend	
	Existing Major Contour
	Existing Minor Contour
	Proposed Major Contour
	Proposed Minor Contour



Preliminary Plat

22-0138

The Estates At Thousand Oaks 3rd - 7th Plat
Parkville, Platte County, Missouri

Grading Plan

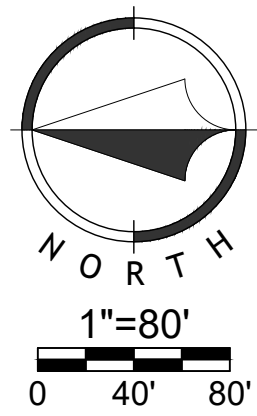
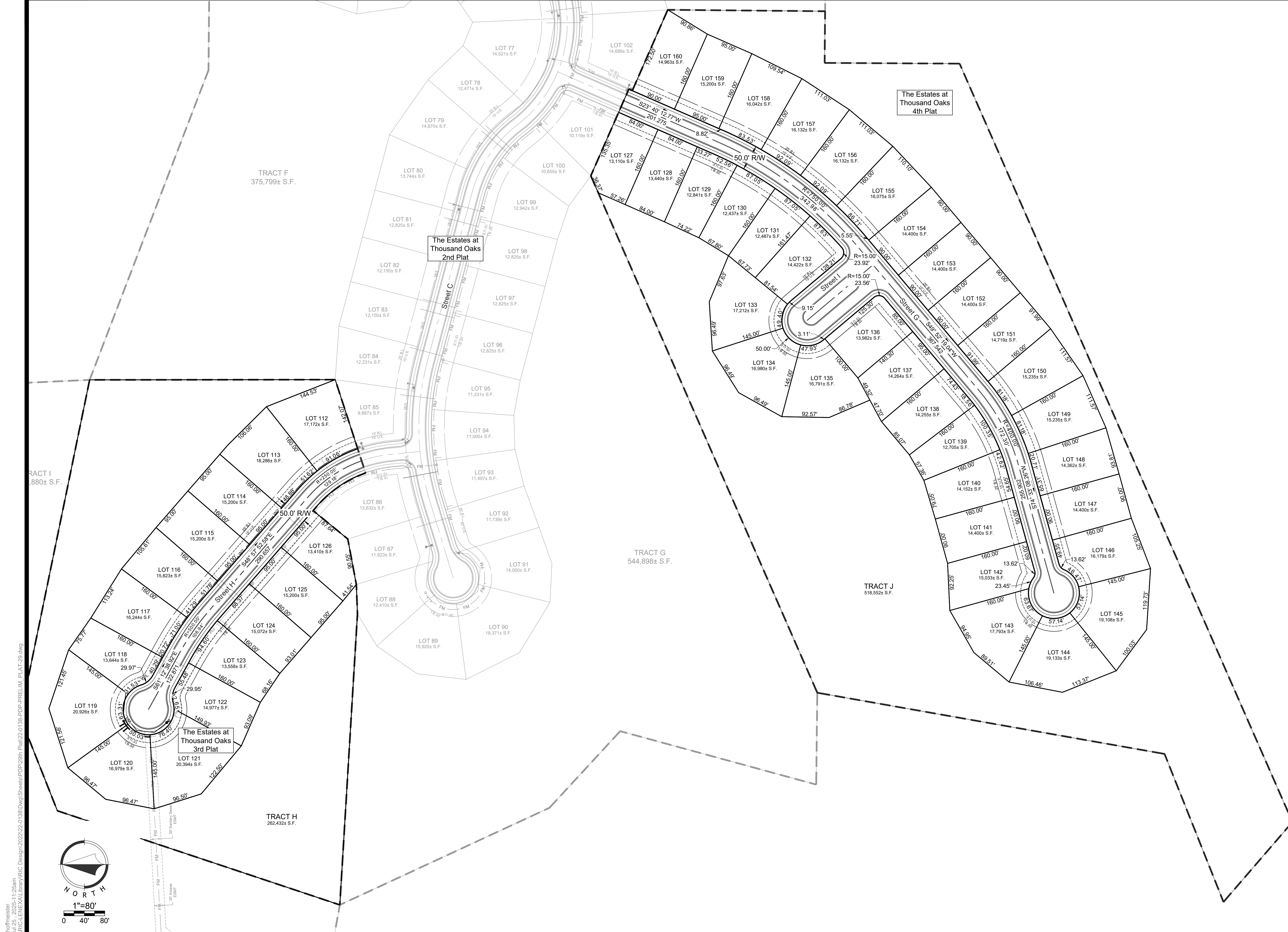
NO.	DATE	REVISION
1	07/25/25	1st Submittal

DRAWN BY: AOB CHECKED BY: KLH

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 MO Certificate of Authority: E-2010033630

Sheet
C04

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R:\Projects\2022\22-0138\Drawings\Sheet\22-0138-PDP-PRELIM-PLAT-29.dwg
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Preliminary Plat
 22-0138
 The Estates At Thousand Oaks 3rd - 7th Plat
 Parkville, Platte County, Missouri

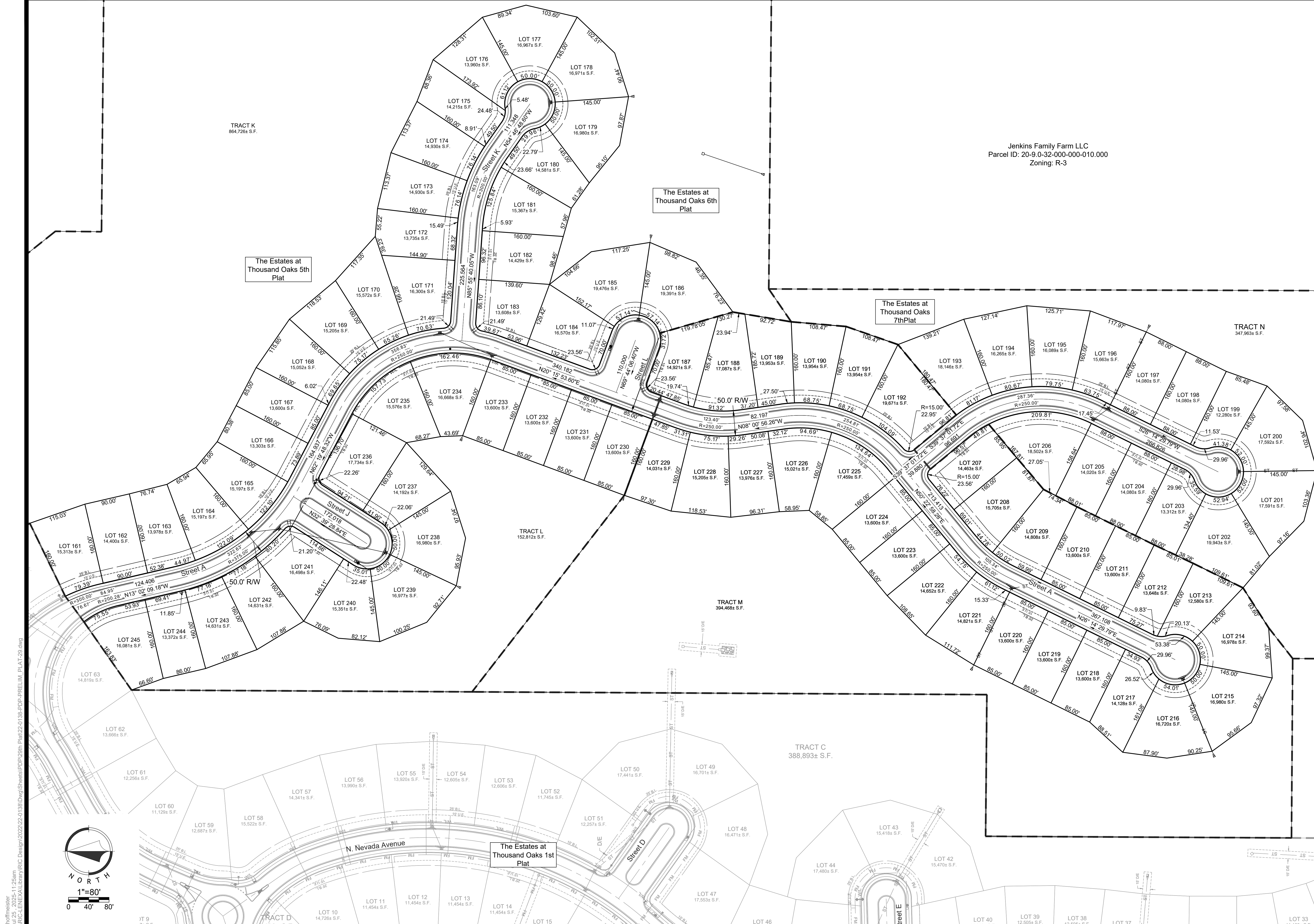
Preliminary Plat West

NO.	DATE	REVISION
072525		1st Submittal

DRAWN BY: AOB
 CHECKED BY: KLH

Renaissance Infrastructure Consulting
 400 E 17th Street
 Kansas City, Missouri 64108 www.riic-consult.com
 MO Certificate of Authority: E-2010033630

Sheet
 C05



TRACT K
864,726± S.F.

The Estates at
Thousand Oaks 5th
Plat

The Estates at
Thousand Oaks 6th
Plat

The Estates at
Thousand Oaks
7th Plat

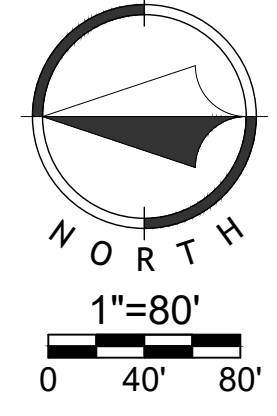
TRACT L
152,812± S.F.

TRACT M
394,488± S.F.

TRACT C
388,893± S.F.

Jenkins Family Farm LLC
Parcel ID: 20-9.0-32-000-000-010.000
Zoning: R-3

TRACT N
347,963± S.F.



Krcofmeister
 Jul 25, 2025-11:25am
 \R\C\LEX\Library\RIC Design\2022-0138-Dwg\Sheets\PP-28th Plat\22-0138-PP-PRELIM-PLAT-29.dwg

Preliminary Plat
22-0138
The Estates At Thousand Oaks 3rd - 7th Plat
Parkville, Platte County, Missouri

Preliminary Plat East

NO.	DATE	REVISION
07/25/25		1st Submittal

DRAWN BY: AOB
CHECKED BY: KJH

Renaissance Infrastructure Consulting
 400 E 17th Street
 Kansas City, Missouri 64108
 816.800.0950
 www.ri-c-consult.com
 MO Certificate of Authority: E-20100303630

Sheet
C06



Application #: _____
 Date Submitted: _____
 Public Hearing: _____
 Date Approved: _____

CITY OF PARKVILLE • 8880 Clark Avenue • Parkville, MO 64152 • (816) 741-7676 • FAX (816) 741-0013

Application for Subdivision – Preliminary Plat
 Pre-application meeting required per Parkville Municipal Code Title IV, Section 403.010, Subsection C

1. Applicant/Contact Information

Applicant(s)

Name: _____
 Address _____
 City, State _____
 Phone: _____ Fax: _____
 E-mail _____

Owner(s), if different from applicant(s)

Name: _____
 Address: _____
 City, State: _____
 Phone: _____ Fax: _____
 E-mail: _____

Engineer/Surveyor(s) preparing plat & legal description

Name: _____
 Address _____
 City, State _____
 Phone: _____ Fax: _____
 E-mail _____

Contact Person, if different from applicant(s)

Name: _____
 Address: _____
 City, State: _____
 Phone: _____ Fax: _____
 E-mail: _____

We, the undersigned, do hereby authorize the submittal of this application and associated documents and certify that all information contained therein is true and correct. We acknowledge that development in the City of Parkville is subject to the Municipal Code of the City of Parkville. We do hereby agree to abide by and comply with the above-mentioned codes, and further understand that any violations from the provisions of such or from the conditions as stated herein shall constitute cause for fines, punishments and revocation of approvals as applicable.

Applicant's Signature (Required) _____ Date: _____

Property Owner's Signature (Required) _____ Date: _____

2. Property Information

Proposed name of subdivision: _____

Current use(s) of the property: _____

Current zoning district: _____

Acreage open space: _____

Proposed zoning: _____

Density of development: _____

Minimum lot size: _____

3. Signatures of Acknowledgement

The following signatures by authorized representatives indicate the entity had notice of the intent to subdivide and, pending detailed plan review can provide their applicable service to the proposed development. A signed letter from the entity may be submitted in place of a signature.

Water District (PWSD #1 or Missouri American Water Co.)
816.891.9141 816.741.2992

South Platte Fire Protection District (SPFPD)
816.741.2900

Sanitary sewer/septic (PCRSD, Parkville Public Works or Platte County Health Department)
816.858-2052 816.741.7676 816.858.2412

Streets (Parkville Public Works)
816.741.7676

Missouri Department of Transportation (for access/adjacent to a state maintained roadway)
816.622-0414

Electricity (Evergy)
816.471.5275

Natural Gas (Spire Energy dba Missouri Gas Energy)
816.756.5252

School District (Park Hill or Platte County)
816.741.1521 816.858.2822

4. Public Improvements

- **All public improvements must be designed to city standards and require approval, guarantees and permits prior to installation.**

Length of proposed new roadways: _____

Proposed surface material: _____ Maximum grade: _____

General character of the neighborhood: _____

Are area streets and utilities sufficient to serve the property once subdivided? _____
(Note: a traffic study may be required in order to adequately address this question)

Explain:

Attach a stormwater management study showing facilities/improvements needed to handle stormwater adequately.

Attach a narrative addressing:

1. How the application is in accordance with the Master Plan and in particular the physical patterns, arrangement of streets, blocks, lots and open spaces, and public realm investments that reflect the principles and concepts of the plan.
2. Compliance with the requirements of the Development Code, and in particular the blocks and lots proposed is capable of meeting all development and site design standards under the existing or proposed zoning.
3. Any phasing proposed in the application is clearly indicated and demonstrates a logical and coordinated approach to development, including coordination with existing and potential development on adjacent property.
4. How any impacts identified by specific studies or technical reports, including a preliminary review of storm water, are mitigated with generally accepted and sound planning, engineering, and urban design solutions that reflect long-term solutions and sound fiscal investments.
5. How the application does not deter any existing or future development on adjacent property from meeting the goals and policies of the Master Plan.
6. How the design does not impede the construction of anticipated or planned future public infrastructure in the area.
7. Any other information relevant to the application.

5. Checklist of required submittals

- Completed application with authorization signatures of service providers.
- Application fee of \$300.00, plus \$5.00 per lot or tract. *This fee shall include the expense of initial engineering review, plus the expense of reviewing one re-submittal. All other expenses including, but not limited to, consulting fees, attorney fees, reproduction costs, mailing costs, and other expenses resulting from the necessary review, processing, filing, recording, and action on said applications or permits, shall be borne by the sub-divider based on actual costs.*
- Deed with owner's name and legal description of property to be platted.
- Five (5) copies 24" x 36" size, or larger sets, and one (1) electronic set (PDF format) of the preliminary plat containing the requirements outlined in Section 403.020 Subsection D. of the Development Code for initial staff and entity review. Additional large size copies may be requested following review by staff.
- Drainage plan containing the requirements outlined in Parkville Municipal Code Title IV, Section 404.030 Subsection C3.

For City Use Only

Application accepted as complete by: _____
Name/Title _____ Date _____

Application Fee (27.0000): \$ _____ By: Check # _____ MO# _____
 Credit Card _____ Cash _____
 Date Paid: _____ Received by: _____
 Payment by: _____

Final reimbursable costs paid (if applicable). Date of Action: _____

Planning Commission Action: Approved Approved with Conditions Denied Date of Action: _____

Conditions if any: _____

Board of Aldermen Action: Approved Approved with Conditions Denied Date of Action: _____

Conditions if any: _____

6. Subdivision – Preliminary Plat checklist for staff review**1. Basic Information**

- a. Name of the plat, phase and/or number if applicable
- b. Name, address, contact information of person / registered surveyor or firm that prepared the plat
- c. Date plat was prepared, including any revision dates

2. Plat Information

- a. Full property/legal description
- b. Total land area in square feet and acres of property
- c. Boundary survey notes
- d. Dedication language for property to be subdivided
- e. Easement language for easements to be granted to utility companies franchised to operate in Parkville, Mo.
- f. Open space dedication if applicable

3. Plat Drawing

- a. Graphic, engineering scale
- b. North arrow
- c. Monumentation/symbology legend
- d. Vicinity map identifying boundaries and location of property in relation to City
- e. Property lines and lot dimensions with total land area in square feet and acres
- f. Numbering of all lots (Lot 1, Lot 2, Lot 3, etc.)
- g. Lettering of all tracts (Tract A, Tract B, Tract C, etc.)
- h. Watermark designation with labeling of any previously platted lots or tracts
- i. Proposed rights-of-way, public and/or private streets with dimensions, centerlines and names
- j. Proposed easements for access or utilities
- k. Dimensions of all radii, acres, points of tangency, central angles and lengths of curves
- l. Indication of FEMA Special Flood Hazard Areas (SFHA) if applicable

4. Signature Information

- a. Signature line with date for property owner(s) and notary public
- b. Signature line with date for Mayor (with full name), City Clerk (with full name), and Community Development Director (with full name) of the City of Parkville
- c. Ordinance number with date that the ordinance was passed by the Board of Aldermen
- d. Signature line with date for surveyor's certification (to be signed & stamped on all plat copies to be recorded)

The Estates at Thousand Oaks 5th – 7th Plats Drainage Study

Sections 29 & 32, Township 51 North, Range 34 West
Parkville, Platte County, Missouri

1st Submittal: July 2025

Prepared For:

Forest Park Development Company of Kansas City, LLC
6014 N Highway 9, Suite B
Parkville, MO 64152
Contact: David Barth
816.591.2555

Prepared By:

Renaissance Infrastructure Consulting
400 E. 17th Street
Kansas City, MO 64108
Contact: Dusty Burton, PE
dburton@ric-consult.com
816.800.0950





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I. Project Information

A. Purpose

The purpose of this Drainage Study for The Estates at Thousand Oaks 5th – 7th Plats is to describe the onsite and offsite drainage patterns, existing and proposed storm infrastructure, and safe routing of developed stormwater to adequate outfalls. This report includes hydrologic and hydraulic calculations, tables, graphs, and appendices showing drainage basins, routing, and proposed storm improvements.

B. Location

1. *City, County and Local Streets within and Adjacent to the Site*
The Estates at Thousand Oaks 5th – 7th Plats is a proposed single-family residential development located in the City of Parkville, County of Platte, Missouri. It is bounded to the north, east and west by a single-family residential development and to the south by NW River Road. The proposed site is approximately 0.80 miles east of I-435 and just to the east of the recent 25th Plat of Thousand Oaks.
2. *Township, Range and Section*
The Estates at Thousand Oaks 5th – 7th Plats is within Sections 29 & 32, Township 51 North, Range 34 West.
3. *Site location map*
A location map is presented in Appendix A.

C. Description of Property

1. *Proposed Development*
The Estates at Thousand Oaks 5th – 7th Plats development is approximately 75.51 acres. The proposed development consists of 85 residential lots ranging from 12,580 - 19,943 square feet along with the associated residential local roadways and infrastructure.
2. *Existing topography, vegetation and drainage*
The site currently consists of undeveloped land. Native grasses and weeds currently cover the site. The site generally drains from north to south. On site elevations range from 938' – 764' with an average slope of 8 percent. There are no wetlands located on the site or significant geological features. Thousand Oaks 5th -7th Plats is tributary to the Rush Creek Watershed.
3. *Floodplain Information*
This majority of property is located within Zone X (area of minimal flood hazard). There is a small portion of the south part of the property that is within Zone X (areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile). None of the Property lies within Zone AE. A FEMA Firm Map is included in Appendix B.
4. *Soils*
The USDA Natural Resources Conservation Service Web Soil survey was consulted to approximate site soil conditions. Soil types found on site are shown in Table 1 below. See Appendix C for Soil Map.



Table 1: Site Soil Conditions		
Map Unit Symbol	Map Unit Name	HSG
10051	Knox silt loam, 20 to 35 percent slopes, eroded	C
10055	Knox silt loam, 5 to 9 percent slopes, eroded	B
10059	Knox silty clay loam, 14 to 20 percent slopes, severely eroded	B
10141	Snead-Rock outcrop complex, 14 to 30 percent slopes	D
13523	Haynie silt loam, clayey substratum, 0 to 2 percent slopes, occasionally flooded	B
13570	Parkville silty clay loam, 0 to 2 percent slopes, occasionally flooded	D

II. Drainage Design Criteria

A. Development Criteria Reference

This Final Drainage Report is based on the criteria set forth in the following reference manuals:

- Section 5600 – Storm Drainage Systems and Facilities (February 16, 2011) of the Kansas City Metropolitan Chapter of the American Public Works Association (APWA)
- Title 5, Chapter 507 – Stormwater Detention of the City of Parkville Code
- Manual of Best Management Practices for Stormwater Quality (October 2012) of the Kansas City Metropolitan Chapter of the APWA
- SCS (now NRCS) Technical Release No. 55 “Urban Hydrology for Small Watersheds” (2nd Edition, June 1986)

B. Hydrologic Criteria

1. Design Rainfall

Runoff calculations were performed using the Type II 24-hour storm distribution for 1% (100 year), 2% (50 year), 4% (25 year), 10% (10 year), 20% (5 year) and 50% (2 year) annual probability storm events. Rainfall values used in this study are included in Table 2 below.

Table 2: Rainfall Values		
Return Period (Year)	Design Storm (%)	Rainfall Depth (in)
2	50%	3.59
5	20%	4.54
10	10%	5.37
25	4%	6.58
50	2%	7.55
100	1%	8.57

2. Runoff Calculation Method

Pre and post development runoff was determined using the curve number method described in SCS (now NRCS) Technical Release No. 55 “Urban Hydrology for Small Watersheds” (2nd Edition, June



1986) as specified in APWA Section 5602.2B. Curve numbers (CN) used in the TR55 analysis were taken from Table 4.1 of the APWA MARC BMP Manual (October 2012).

3. *Detention Discharge and Storage Calculation Method*

Pond design was completed using Autodesk Storm and Sanitary Analysis (2022). In accordance with the City Code (Title 5, Chapter 507) release rates from the proposed detention facilities are limited to the rate of runoff from the proposed development in its undeveloped condition for the runoff resulting from the 2-, 5-, 10-, 25-, 50- and 100-year storm.

III. Existing Conditions Analysis

A. Runoff Analysis

The existing site is composed of three sub-basins: Existing_01, Existing_02 and Existing_03.

The Northern portion of Basin Existing_01 flows south and east through the existing drainage channel and crosses NW River Road through a system of triple box culverts. Runoff from the southern portion of Basin Existing_01 enters one of two 24" culverts to cross NW River Road and then flows east into the roadside ditch along NW River Road. All runoff from Basin Existing_01 combines and passes under the railroad tracks via the bridge at Outfall_01.

Basin Existing_02 flows west to the existing Thousand Oaks 25th Plat Northeast Pond which was designed to support runoff from these plats in the ultimate condition. Runoff is then discharged from the Northeast Pond into an existing drainage channel, ultimately flowing into the existing Thousand Oaks 1st Plat Southeast Pond.

Basin Existing_03 flows west to the existing Thousand Oaks 25th Plat Southeast Pond which was designed to support runoff from these plats in the ultimate condition. From there, the Southeast Pond will release runoff through an existing 108" culvert that crosses NW River Road, eventually draining into the existing floodplain.

The approved drainage reports for the surrounding properties referred to herein as Thousand Oaks 25th and 26th Plats have since been renamed to The Estates at Thousand Oaks 1st and 2nd Plats. For clarity and consistency with the approved reports the subdivisions will be referred to by their original names within this report.

A CN of 55, 70, and 77 was utilized for the undisturbed areas (HSG B, C, and D – Woods-grass, Good).

A map of the existing sub-basins is presented in Appendix E.

Time of concentration calculations were performed using figures 5602-2 and 5602-3 in the Storm Drainage Systems and Facilities (February 16, 2011) of the Kansas City Metropolitan Chapter of the American Public Works Association (APWA). Table 3 provides a summary of the results of the existing conditions analysis. The time of concentration results can be found in Appendix D.



Table 3: Existing Condition Analysis				
Sub-Basin	Area (ac)	CN	Time of Concentration (min)	Downstream Discharge Point
Existing_01	57.26	70	15.0	Outfall_01
Existing_02	13.64	56	11.6	NE 25 th Plat Pond
Existing_03	11.65	55	8.1	SE 25 th Plat Pond

Table 4 below summarizes the peak outflow from each design storm in the existing condition.

Table 4: Existing Peak Outflow						
Outfall Description	Q ₂ (cfs)	Q ₅ (cfs)	Q ₁₀ (cfs)	Q ₂₅ (cfs)	Q ₅₀ (cfs)	Q ₁₀₀ (cfs)
Outfall_01	60.93	107.20	151.15	219.13	275.45	336.13
Outfall_02	5.17	12.81	20.97	34.62	46.65	60.13
Outfall_03	4.59	11.33	18.46	30.44	41.27	53.53

Detailed results of this analysis can be found in Appendix F.

B. Culvert Analysis

Runoff from the northern portion of Basin Existing_01 flows south and east through the existing drainage channel and crosses NW River Road through a system of triple box culverts. Runoff from the southern portion of Existing_01 drains to the south to two existing 24" culverts that run under NW River Road. NW River Road is classified as a Collector, which means the storm event required to pass in the culvert is the 25-yr storm event (4%) as specified in APWA Table 5601-1. Table 5 below summarizes the existing culvert conditions.

Existing_02 and Existing_03 flow to an existing 108" culvert across NW River Road previously analyzed with Thousand Oaks 25th Plat Drainage Study which was designed to support runoff from these plats in the ultimate condition.

Table 5: Existing Culvert Analysis			
Existing Culvert	Diameter (in)	Existing 25-yr Runoff	Existing 100-yr Runoff
West Culvert	24" RCP	42.93	67.96
East Culvert	24" RCP	46.09	73.80
Triple Box Culvert	3 – 8'x5' RCB	219.13	336.13

IV. Proposed Conditions Analysis

A. Runoff Analysis

The site is divided into five sub-basins: Proposed_01A, Proposed_01B Proposed_01C, Proposed 02 and Proposed _03.

The Northern portion of Basin Proposed_01A flows south and east through the existing drainage channel and crosses NW River Road through a system of triple box culverts. Runoff from the southern portion of Basin Proposed_01A enters one of two 24" culverts to cross NW River Road and then flows east into the roadside ditch along NW River Road.



Basin Proposed_01B contains the proposed Northeast Pond, designed to control runoff from the proposed development. Runoff generated in this basin flows through the proposed Northeast detention pond and flows east through an existing channel and crosses NW River Road through a system of triple box culverts.

Basin Proposed_01C contains the proposed Southeast Pond, designed to control runoff from the proposed development. Runoff generated in this basin flows through the proposed Southeast detention pond and enters the West 24” Culvert that crosses NW River Road. These flows then flow east into the roadside ditch along NW River Road.

All runoff from Basins Proposed_01A, Proposed 01B and Proposed_01C combine and pass under the railroad tracks via the bridge at Outfall_01.

Basin Proposed_02 flows west to the existing Thousand Oaks 25th Plat Northeast Pond which was designed to support runoff from these plats in the ultimate condition. Runoff is then discharged from the Northeast Pond into an existing drainage channel, ultimately flowing into the existing Thousand Oaks 25th Plat Southeast Pond. In the 25th Plat Study 15.04 acres from the 5th – 7th Plats was estimated to be tributary to the Northeast Pond. The actual area tributary to this existing pond is 16.29 acres. The projected and actual curve number is 72. The existing pond is adequate to support the additional 1.25 acres without modification as additional freeboard was built into the initial design because of the uncertainty. Updated pond inflow, ponding elevation and depth, and pond outflow values are shown in Table 13 of this report.

Basin Proposed_03 flows west to the existing Thousand Oaks 25th Plat Southeast Pond which was designed to support runoff from these plats in the ultimate condition. From there, the Southeast Pond will release runoff through an existing 108” culvert that crosses NW River Road, eventually draining into the existing floodplain. In the 25th Plat Study 12.99 acres from the 5th – 7th Plats was estimated to be tributary to the Southeast Pond with a curve number of 69. The actual area tributary to this existing pond is 12.40 acres was a curve number is 68. Updated pond inflow, ponding elevation and depth, and pond outflow values are shown in Table 13 of this report.

A map of the proposed sub-basins is presented in Appendix G.

A CN of 55, 70, and 77 was utilized for the undisturbed areas (HSG B, C, and D – Woods-grass, Good). A curve number of 81 and 86 was utilized for the developed areas (HSG C and D – Residential, 1/3 acre lots). The post development curve number for disturbed land is assumed to be one HSG higher as specified in APWA Section 5602.3.

Time of concentration calculations were performed using figures 5602-2 and 5602-3 in the Storm Drainage Systems and Facilities (February 16, 2011) of the Kansas City Metropolitan Chapter of the American Public Works Association (APWA). Table 6 provides a summary of the results of the proposed conditions analysis. The time of concentration results can be found in Appendix D.

Table 6 provides a summary of the results of the proposed conditions analysis. Detailed results of this analysis can be found in Appendix H.

Table 6: Proposed Condition Analysis				
Sub-Basin	Area (ac)	CN	Time of Concentration (min)	Downstream Discharge Point
Proposed_01A	35.43	76	15.0	Outfall_01



Proposed_01B	6.22	77	6.4	Outfall_01
Proposed_01C	12.21	80	8.2	Outfall_01
Proposed_02	16.29	72	12.1	25 th Plat NE Pond
Proposed_03	12.40	68	6.7	25 th Plat SE Pond

Table 7 below summarizes the peak runoff generated in each basin prior to being detained.

Table 7: Proposed Peak Runoff						
Basin Description	Q ₂ (cfs)	Q ₅ (cfs)	Q ₁₀ (cfs)	Q ₂₅ (cfs)	Q ₅₀ (cfs)	Q ₁₀₀ (cfs)
Proposed_01A	61.12	93.72	123.68	168.74	205.68	244.93
Proposed_01B	14.23	21.45	28.04	37.91	45.94	54.40
Proposed_01C	29.41	43.28	55.81	74.47	89.56	105.48
Proposed_02	24.69	39.51	53.48	74.85	92.44	111.40
Proposed_03	16.40	28.14	39.48	57.17	71.98	88.10

Detailed results of this analysis can be found in Appendix H.

B. Proposed Culvert Analysis

Runoff from the northern portion of Basin Proposed_01A flows south and east through the existing drainage channel and crosses NW River Road through a system of triple box culverts. The southern portion of Proposed_01A and all runoff from Proposed_01C drains to the south to two existing 24" culverts that run under NW River Road. NW River Road is classified as a Collector, which means the storm event required to pass in the culvert is the 25-yr storm event (4%) as specified in APWA Table 5601-1. Table 5 below summarizes the existing culvert conditions.

Existing_02 and Existing_03 flow to an existing 108" culvert across NW River Road previously analyzed with Thousand Oaks 25th Plat Drainage Study which was designed to support runoff from these plats in the ultimate condition.

Table 8: Proposed Culvert Analysis			
Existing Culvert	Diameter (in)	Proposed 25-yr Runoff	Proposed 100-yr Runoff
West Culvert	24" RCP	18.75	27.84
East Culvert	24" RCP	32.74	51.05
Triple Box Culvert	3 – 8'x5' RCB	170.56	252.86

Runoff is reduced in the proposed condition, however, analysis will need to be conducted to confirm adequate sizing of each culvert with the respective plat micro-study.

V. Proposed Detention Facilities

A. Northeast Pond

The Northeast Pond will be used as onsite detention for sub-basin Proposed_01B. In accordance with the City Code (Title 5, Chapter 507) release rates from the proposed detention facility are limited to the rate of runoff from the proposed development in its undeveloped condition for the runoff resulting from the 2-, 5-, 10-, 25-, 50- and 100-year storm. Table 9 provides a summary of the proposed pond design.



Table 9: Northeast Pond Design	
Pond Attribute	Elevation (ft)
Pond Bottom	845
Top of Berm	852
Emergency Overflow Elevation	850
4'x4' Outlet Control Structure	
6" Circular Orifice	845
(H" x W") 6" X 12" Rectangular Orifice	846.5
(H" x W") 6" X 12" Rectangular Orifice	848.25
Discharge Pipe	
18" HDPE	844.75

An 18' emergency overflow weir has been provided on the south end of the pond. This has been designed to carry an additional 100-year flood with 1 foot of freeboard, assuming that the detention basin is already filled to the design storage capacity in accordance with City Code (Title 5, Chapter 507.05).

B. Southeast Pond

The Southeast Pond will be used as onsite detention for sub-basin Proposed_01C. In accordance with the City Code (Title 5, Chapter 507) release rates from the proposed detention facility are limited to the rate of runoff from the proposed development in its undeveloped condition for the runoff resulting from the 2-, 5-, 10-, 25-, 50- and 100-year storm. Table 10 provides a summary of the proposed pond design.

Table 10: Southeast Pond Design	
Pond Attribute	Elevation (ft)
Pond Bottom	786
Top of Berm	794
Emergency Overflow Elevation	792
4'x4' Outlet Control Structure	
(H" x W") 6" X 12" Rectangular Orifice	786
(H" x W") 6" X 18" Rectangular Orifice	787.5
(H" x W") 6" X 18" Rectangular Orifice	790.5
Discharge Pipe	
36" HDPE	785.75

A 35' emergency overflow weir has been provided on the south end of the pond. This has been designed to carry an additional 100-year flood with 1 foot of freeboard, assuming that the detention basin is already filled to the design storage capacity in accordance with City Code (Title 5, Chapter 507.05).



C. Pond Routing Summary

Table 12 provides a summary of the proposed pond routing. Detailed results of this analysis can be found in Appendix H.

Pond	Storm Event	Q _{in} (cfs)	Max Depth Attained (ft)	Ponding Elevation	Q _{out} (cfs)
Northeast Pond	1% Storm	53.17	4.49	849.49	8.64
	2% Storm	44.90	3.90	848.90	7.11
	4% Storm	36.82	3.32	848.32	4.92
	10% Storm	27.13	2.52	847.52	3.67
	20% Storm	20.57	2.00	847.00	2.53
	50% Storm	13.50	1.42	846.42	1.04
Southeast Pond	1% Storm	99.36	5.47	791.47	16.19
	2% Storm	84.67	4.80	790.80	12.80
	4% Storm	70.75	4.10	790.10	10.70
	10% Storm	53.52	3.16	789.16	8.75
	20% Storm	41.78	2.52	788.52	7.08
	50% Storm	28.74	1.80	787.80	4.00

Table 13 provides the pond routing values originally estimated with the Thousand Oaks 25th Plat study compared to the actual values from the design of the Estates at Thousand Oaks 5th – 7th Plats. The existing ponds are adequate to support the additional runoff without modification as additional freeboard was built into the initial design because of the uncertainty. It should be noted that the peak outflow from the Existing Southeast Basin includes runoff from the Northeast Basin, showing an overall reduction in runoff from the existing system.

Pond	Storm Event	Estimated Q _{in} (cfs)	Actual Q _{in} (cfs)	Estimated Max Depth Attained (ft)	Actual Max Depth Attained (ft)	Estimated Ponding Elevation	Actual Ponding Elevation	Estimated Q _{out} (cfs)	Actual Q _{out} (cfs)
Thousand Oaks 25 th Plat Northeast Pond	1% Storm	179.59	184.05	8.42	8.48	834.42	834.48	88.73	89.99
	2% Storm	149.75	152.92	7.62	7.66	833.62	833.66	72.54	73.49
	4% Storm	121.86	123.97	6.88	6.89	832.88	832.89	51.37	52.14
	10% Storm	87.98	88.87	5.93	5.93	831.93	831.93	17.89	17.75
	20% Storm	65.69	65.88	5.25	5.23	831.25	831.23	4.72	4.68
	50% Storm	41.86	41.34	4.26	4.25	830.26	830.25	1.58	1.52



Thousand Oaks 25 th Plat Southeast Pond	1% Storm	234.62	231.17	12.34	12.29	797.34	797.29	107.43	106.24
	2% Storm	188.24	184.24	11.51	11.47	796.51	796.47	84.72	83.11
	4% Storm	129.61	127.30	10.70	10.66	795.70	795.66	50.47	48.94
	10% Storm	77.41	74.87	9.10	8.99	794.10	793.99	18.81	18.54
	20% Storm	57.04	55.08	7.27	7.15	792.27	792.15	13.30	12.86
	50% Storm	35.16	33.85	5.89	5.81	790.89	790.81	5.76	5.26

VI. Site Outfall Summary

In accordance with the City Code (Title 5, Chapter 507) release rates from the proposed site is limited to the rate of runoff from the proposed development in its undeveloped condition for the runoff resulting from the 2-, 5-, 10-, 25-, 50- and 100-year storm. Table 14 provides a summary of the pre vs. post development release rates from the site at Outfall_01. Detailed results of this analysis can be found in Appendices F and H.

Outfall Description	Q ₂ (cfs)	Q ₅ (cfs)	Q ₁₀ (cfs)	Q ₂₅ (cfs)	Q ₅₀ (cfs)	Q ₁₀₀ (cfs)
Out_01 Existing	60.93	107.20	151.15	219.13	275.45	336.13
Out-01 Proposed	56.25	92.11	123.85	170.56	209.48	252.86
Out-01 Comparison	-4.68	-15.09	-27.30	-48.57	-65.97	-83.27
Out-01 % Change	-7.68%	-14.08%	-18.06%	-22.16%	-23.95%	-24.77%

Runoff from Basins Proposed_02 and Proposed_03 are directed to the existing Thousand Oaks 25th Plat Northeast and Southeast Pond, respectively, which were each designed to support runoff from these plats in the ultimate condition. Values vary slightly from the estimations and assumptions made in the previous study. Table 15 provides a summary comparing the projected runoff rates from the previous study to the actual runoff rates calculated with this study.

Outfall Description	Area (ac)	Q ₂ (cfs)	Q ₅ (cfs)	Q ₁₀ (cfs)	Q ₂₅ (cfs)	Q ₅₀ (cfs)	Q ₁₀₀ (cfs)
Out-02 Estimated	15.04	22.83	36.61	49.57	69.46	85.87	103.48
Out-02 Actual	16.29	23.88	38.83	52.83	74.30	91.96	110.93
Out-02 Comparison	1.25	1.05	2.22	3.26	4.84	6.09	7.45
Out-03 Estimated	12.99	18.96	31.72	43.92	62.81	78.66	95.59
Out-03 Actual	12.40	16.23	26.96	37.16	54.47	68.88	84.77
Out-03 Comparison	-0.59	-2.73	-4.76	-6.76	-8.34	-9.78	-10.82
Total Comparison	0.66	-1.68	-2.54	-3.50	-3.50	-3.69	-3.37



With these proposed conditions the overall flow from Proposed_02 that will be going to the existing pond is slightly higher than calculated in the 25th plat, however the higher flow will not adversely affect the design of the existing Northeast and pond. This is demonstrated in Table 13 in the previous section.

VII. Level of Service and Value Rating

Level of service calculations are provided for area within The Estates at Thousand Oaks 5th - 7th plats. The proposed site has a predevelopment curve number of 65. The post-development weighted curve number is 75, creating a delta of 10. According to the APWA BMP Manual Table 4.2, the required level of service is 6.4. The existing site has an abundance of well-established vegetation. Through preserving these natural areas and utilizing extended dry detention basins, the proposed development reaches a weighted value rating of 8.20. Detailed results of this analysis, including an exhibit showing the treatment areas, can be found in Appendix I.

VIII. Summary and Conclusions

The storm drainage design of the Estates at Thousand Oaks 5th – 7th Plats will mitigate damage from storm runoff by intercepting runoff from the proposed development and routing them through four extended detention basins. The combined runoff from these basins release below historic rates for the 2-, 5-, 10-, 25-, 50- and 100-year storm.

Native vegetation will be preserved wherever possible. This, along with the proposed extended detention basins help to meet the required level of service for the development.

No negative impacts on downstream properties, channel depths, velocities, and erosion rates, or regional detention facilities are expected due to flow being released below historic rates.

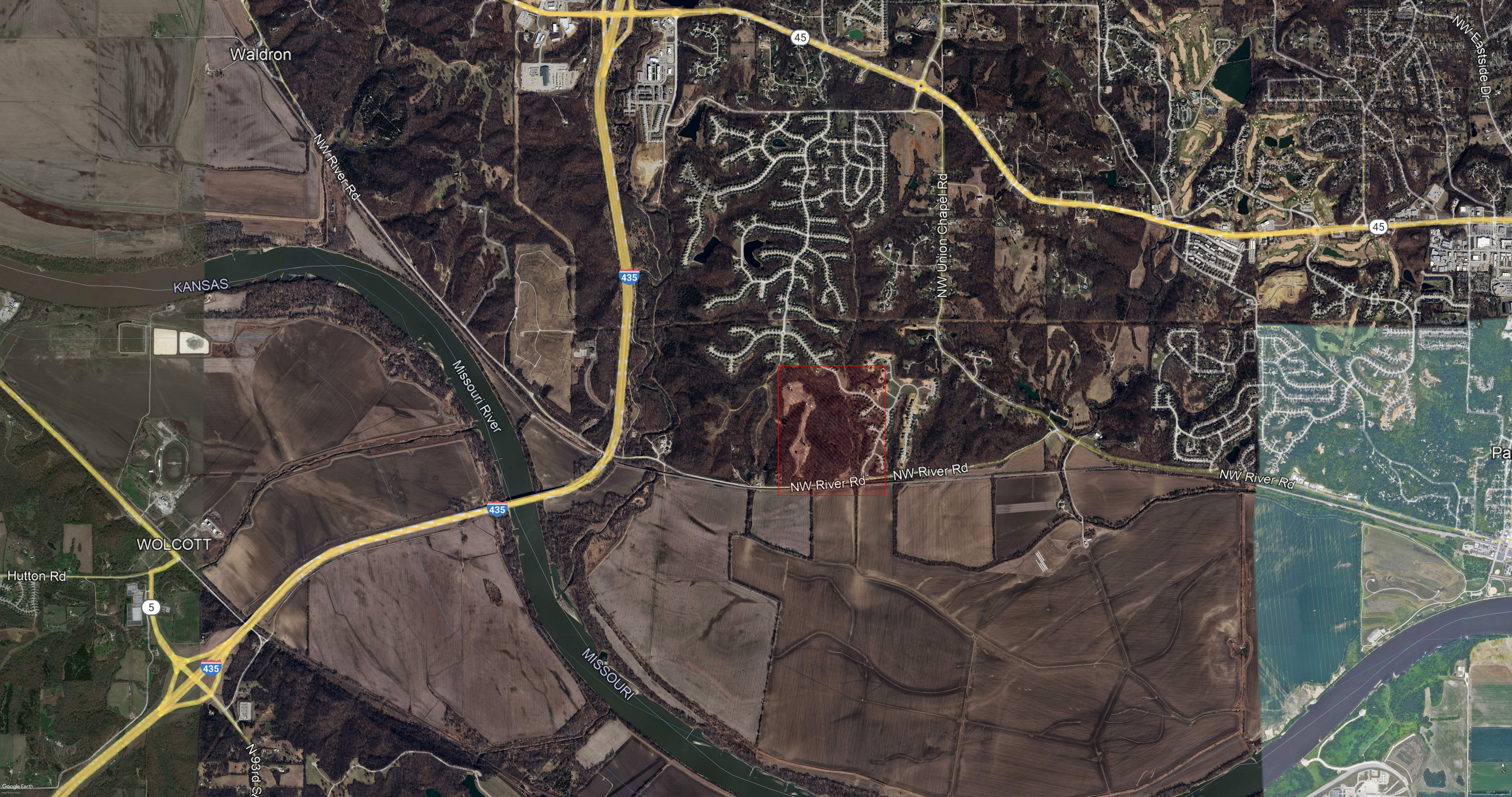


IX. Appendices

- A. Site Location Map
- B. FEMA Firm Map
- C. NRCS Web Soil Survey
- D. Time of Concentration
- E. Existing Drainage Map
- F. Existing Conditions Analysis
- G. Proposed Drainage Map
- H. Proposed Conditions Analysis
- I. BMP Analysis



Appendix A Site Location Map



Waldron

NW River Rd

45

435

NW Union Chapel Rd

45

NW Eastside Dr

KANSAS

Missouri River

NW River Rd

NW River Rd

NW River Rd

Pa

WOLCOTT

Hutton Rd

5

435

N 93rd St

MISSOURI



Missouri River

NW River Rd

435

435

NW River Rd

NW River Rd

NW Union Chapel Rd

NW Union Chapel Rd

NW River Rd

435

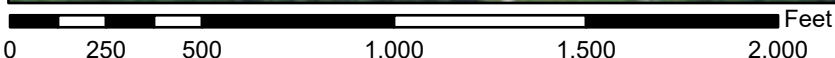
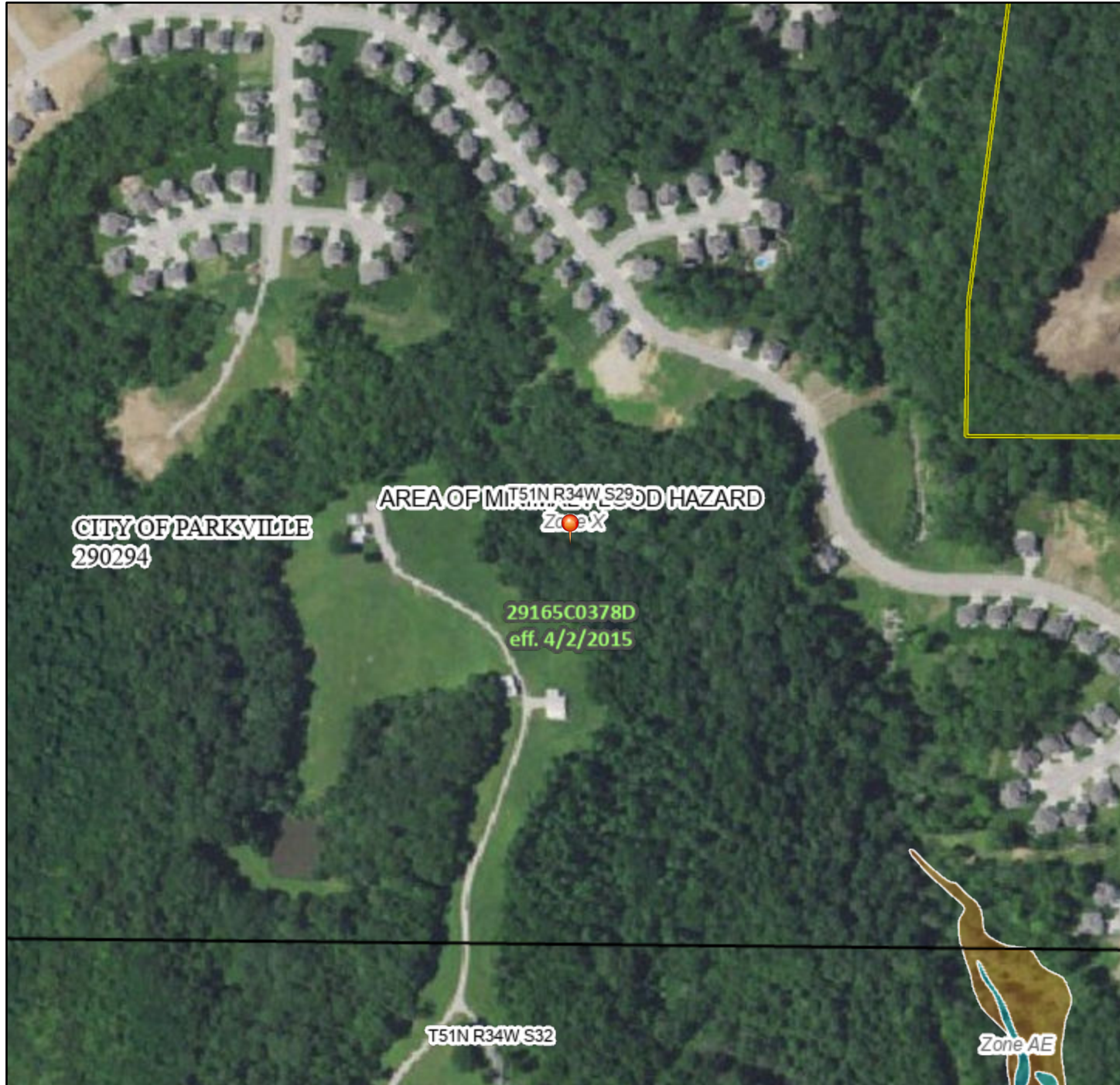


Appendix B FEMA Firm Map

National Flood Hazard Layer FIRMette



94°44'59"W 39°12'12"N



1:6,000

94°44'22"W 39°11'44"N

Basemap Imagery Source: USGS National Map 2023

Legend

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

SPECIAL FLOOD HAZARD AREAS		Without Base Flood Elevation (BFE) <i>Zone A, V, A99</i>
		With BFE or Depth <i>Zone AE, AO, AH, VE, AR</i>
		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 <i>Zone X</i>
		Future Conditions 1% Annual Chance Flood Hazard <i>Zone X</i>
		Area with Reduced Flood Risk due to Levee. See Notes. <i>Zone X</i>
		Area with Flood Risk due to Levee <i>Zone D</i>
OTHER AREAS		NO SCREEN Area of Minimal Flood Hazard <i>Zone X</i>
		Effective LOMRs
GENERAL STRUCTURES		Area of Undetermined Flood Hazard <i>Zone D</i>
		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
		Base Flood Elevation Line (BFE)
		Limit of Study
		Jurisdiction Boundary
MAP PANELS		Digital Data Available
		No Digital Data Available
		Unmapped
		The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.



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

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on **4/14/2025 at 8:43 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.

National Flood Hazard Layer FIRMMette



94°45'4"W 39°11'51"N



Legend

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

- | | | |
|------------------------------------|--|--|
| SPECIAL FLOOD HAZARD AREAS | | Without Base Flood Elevation (BFE)
<i>Zone A, V, A99</i> |
| | | With BFE or Depth <i>Zone AE, AO, AH, VE, AR</i> |
| | | 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 <i>Zone X</i> |
| | | Future Conditions 1% Annual Chance Flood Hazard <i>Zone X</i> |
| | | Area with Reduced Flood Risk due to Levee. See Notes. <i>Zone X</i> |
| | | Area with Flood Risk due to Levee <i>Zone D</i> |
| OTHER AREAS | | NO SCREEN Area of Minimal Flood Hazard <i>Zone X</i> |
| | | Effective LOMRs |
| | | Area of Undetermined Flood Hazard <i>Zone D</i> |
| 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 |
| | | 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 |
- 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 **4/14/2025 at 8:44 PM** and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

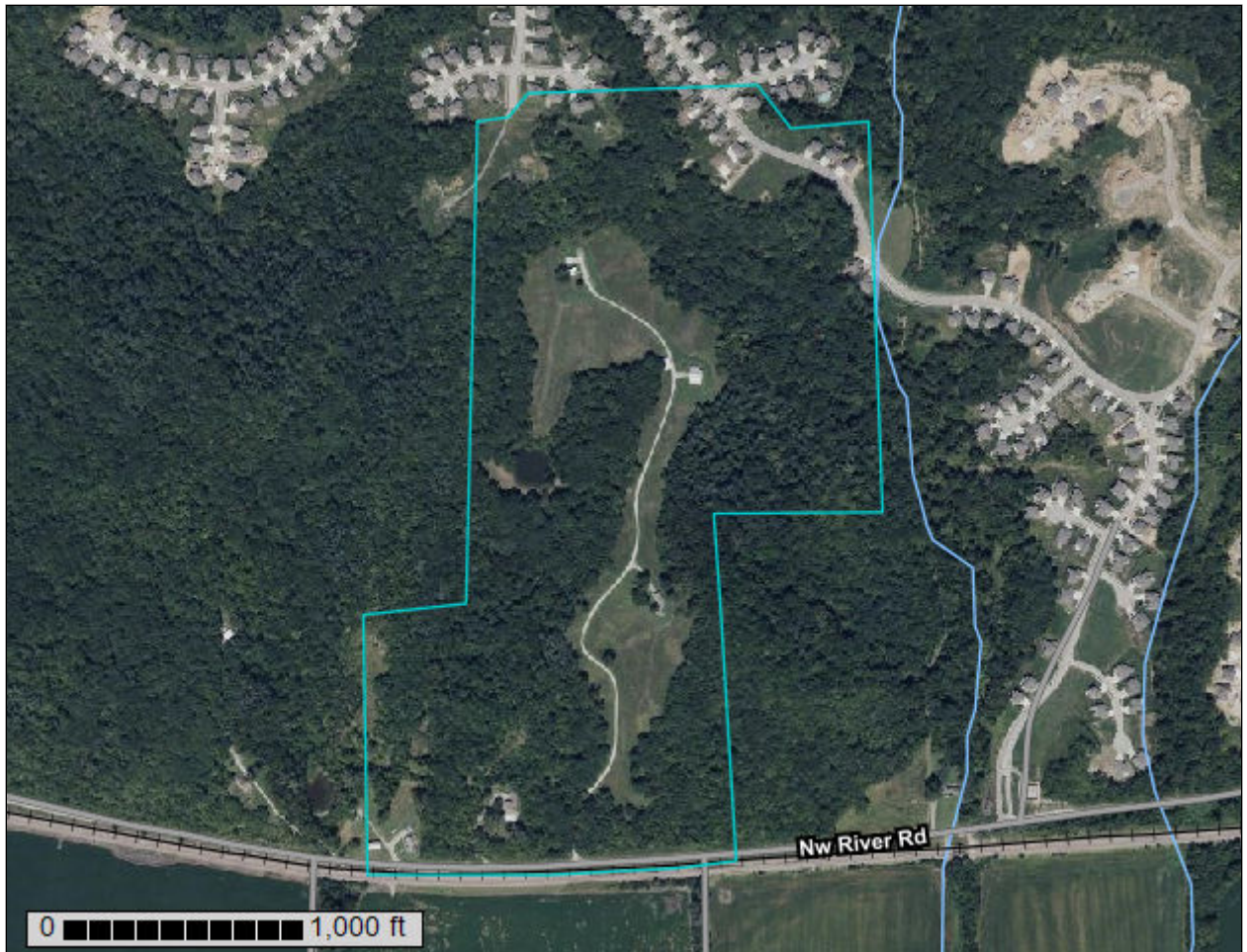
This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory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





Appendix C NRCS Web Soil Survey

Custom Soil Resource Report for Platte County, Missouri



Preface

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

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

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

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

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

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

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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

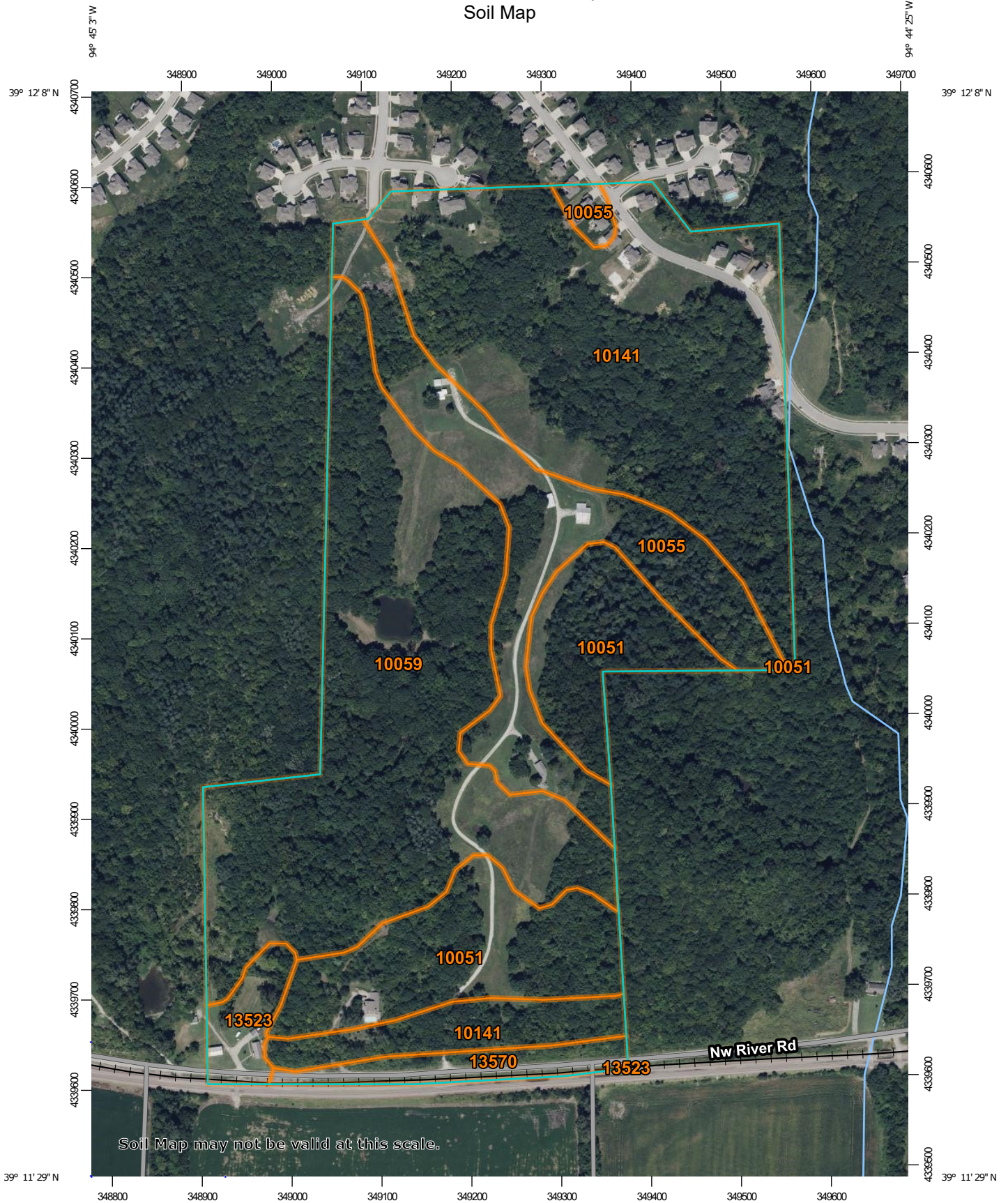
Custom Soil Resource Report

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: 1:5,860 if printed on A portrait (8.5" x 11") sheet.


0 50 100 200 300 Meters

0 250 500 1000 1500 Feet


Map projection: Web Mercator Corner coordinates: WGS84 Edge ticks: 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: Platte County, Missouri
 Survey Area Data: Version 25, Aug 20, 2024

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 16, 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
10051	Knox silt loam, 20 to 35 percent slopes, eroded	17.4	15.3%
10055	Knox silt loam, 5 to 9 percent slopes, eroded	16.9	14.9%
10059	Knox silty clay loam, 14 to 20 percent slopes, severely eroded	36.2	31.9%
10141	Snead-Rock outcrop complex, 14 to 30 percent slopes	37.9	33.3%
13523	Haynie silt loam, clayey substratum, 0 to 2 percent slopes, occasionally flooded	2.4	2.1%
13570	Parkville silty clay loam, 0 to 2 percent slopes, occasionally flooded	2.9	2.6%
Totals for Area of Interest		113.6	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

Custom Soil Resource Report

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.

Platte County, Missouri

10051—Knox silt loam, 20 to 35 percent slopes, eroded

Map Unit Setting

National map unit symbol: 2qkyk
Elevation: 700 to 1,000 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: Not prime farmland

Map Unit Composition

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

Description of Knox

Setting

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

Typical profile

A - 0 to 4 inches: silt loam
Bt - 4 to 22 inches: silty clay loam
C - 22 to 80 inches: silt loam

Properties and qualities

Slope: 20 to 35 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Very high (about 12.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: C
Ecological site: F107XB004MO - Deep Loess Protected Backslope Woodland,
R107XB003MO - Deep Loess Exposed Backslope Savanna
Hydric soil rating: No

Minor Components

Knox

Percent of map unit: 10 percent
Landform: Hillslopes
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Ecological site: F107XB004MO - Deep Loess Protected Backslope Woodland,
R107XB003MO - Deep Loess Exposed Backslope Savanna
Hydric soil rating: No

10055—Knox silt loam, 5 to 9 percent slopes, eroded

Map Unit Setting

National map unit symbol: 2qkym
Elevation: 700 to 1,000 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: Farmland of statewide importance

Map Unit Composition

Knox and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Knox

Setting

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

Typical profile

Ap - 0 to 6 inches: silt loam
Bt - 6 to 46 inches: silty clay loam
C - 46 to 60 inches: silt loam

Properties and qualities

Slope: 5 to 9 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high
(0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches

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Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: High (about 11.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: B
Ecological site: R107XB002MO - Deep Loess Upland Prairie
Hydric soil rating: No

10059—Knox silty clay loam, 14 to 20 percent slopes, severely eroded

Map Unit Setting

National map unit symbol: 2qkyq
Elevation: 700 to 1,000 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: Not prime farmland

Map Unit Composition

Knox and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Knox

Setting

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

Typical profile

Ap - 0 to 6 inches: silty clay loam
Bt - 6 to 32 inches: silty clay loam
C - 32 to 60 inches: silt loam

Properties and qualities

Slope: 14 to 20 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high
(0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: High (about 11.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: B
Ecological site: F107XB004MO - Deep Loess Protected Backslope Woodland,
R107XB003MO - Deep Loess Exposed Backslope Savanna
Hydric soil rating: No

10141—Snead-Rock outcrop complex, 14 to 30 percent slopes

Map Unit Setting

National map unit symbol: 2zccn
Elevation: 710 to 1,130 feet
Mean annual precipitation: 28 to 43 inches
Mean annual air temperature: 52 to 55 degrees F
Frost-free period: 175 to 220 days
Farmland classification: Not prime farmland

Map Unit Composition

Snead and similar soils: 65 percent
Rock outcrop: 20 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Snead

Setting

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

Typical profile

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

Properties and qualities

Slope: 14 to 30 percent
Depth to restrictive feature: 20 to 40 inches to paralithic bedrock
Drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 24 to 30 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 10 percent

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Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 4.5 inches)

Interpretive groups

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

Description of Rock Outcrop

Typical profile

R - 0 to 79 inches: bedrock

Properties and qualities

Slope: 14 to 30 percent
Depth to restrictive feature: 0 inches to lithic bedrock
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately high (0.00 to 0.20 in/hr)

Interpretive groups

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

Minor Components

Sampsel

Percent of map unit: 5 percent
Landform: Hillslopes
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Concave
Ecological site: R109XY010MO - Interbedded Sedimentary Upland Savanna
Hydric soil rating: Yes

Armster, eroded

Percent of map unit: 4 percent
Landform: Hillslopes
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Ecological site: R109XY046MO - Till Upland Savanna
Hydric soil rating: No

Chillicothe

Percent of map unit: 4 percent
Landform: Hillslopes
Landform position (two-dimensional): Shoulder, backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Ecological site: R109XY002MO - Loess Upland Prairie
Hydric soil rating: No

Kennebec, occasionally flooded

Percent of map unit: 2 percent
Landform: Drainageways
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Talf
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R109XY028MO - Loamy Upland Drainageway Savanna
Hydric soil rating: No

13523—Haynie silt loam, clayey substratum, 0 to 2 percent slopes, occasionally flooded

Map Unit Setting

National map unit symbol: ysn9
Elevation: 450 to 1,650 feet
Mean annual precipitation: 33 to 41 inches
Mean annual air temperature: 50 to 55 degrees F
Frost-free period: 177 to 220 days
Farmland classification: All areas are prime farmland

Map Unit Composition

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

Description of Haynie, Clayey Substratum

Setting

Landform: Flood-plain steps
Down-slope shape: Linear, convex
Across-slope shape: Linear, convex
Parent material: Calcareous loamy alluvium over calcareous clayey alluvium

Typical profile

Ap - 0 to 9 inches: silt loam
C - 9 to 54 inches: very fine sandy loam
Ab - 54 to 60 inches: silty clay

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Moderately well drained
Runoff class: Low
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 48 to 72 inches
Frequency of flooding: Occasional

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Frequency of ponding: None
Calcium carbonate, maximum content: 15 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: High (about 10.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2w
Hydrologic Soil Group: B
Ecological site: F107XB016MO - Loamy Floodplain Forest
Hydric soil rating: No

Minor Components

Haynie, frequently flooded

Percent of map unit: 5 percent
Landform: Flood plains
Down-slope shape: Convex
Across-slope shape: Linear
Ecological site: F107XB015MO - Sandy/Loamy Floodplain Forest
Hydric soil rating: Yes

Sarpy, frequently flooded

Percent of map unit: 5 percent
Landform: Flood plains
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: F107XB015MO - Sandy/Loamy Floodplain Forest
Hydric soil rating: Yes

13570—Parkville silty clay loam, 0 to 2 percent slopes, occasionally flooded

Map Unit Setting

National map unit symbol: 2qmv5
Elevation: 610 to 1,140 feet
Mean annual precipitation: 28 to 41 inches
Mean annual air temperature: 49 to 55 degrees F
Frost-free period: 145 to 220 days
Farmland classification: Not prime farmland

Map Unit Composition

Parkville and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Parkville

Setting

Landform: Flood-plain steps
Down-slope shape: Linear

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Across-slope shape: Linear
Parent material: Clayey alluvium over loamy alluvium

Typical profile

A1 - 0 to 10 inches: silty clay loam
A2 - 10 to 17 inches: silty clay
2C - 17 to 60 inches: stratified very fine sand to silt loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: About 12 to 24 inches
Frequency of flooding: Occasional
Frequency of ponding: None
Calcium carbonate, maximum content: 7 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Very low (about 2.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2w
Hydrologic Soil Group: D
Ecological site: F107XB017MO - Clayey Floodplain Forest
Hydric soil rating: No

Minor Components

Haynie, occasionally flooded

Percent of map unit: 5 percent
Landform: Flood plains
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Talf
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: F107XB016MO - Loamy Floodplain Forest
Hydric soil rating: No

Parkville, frequently flooded

Percent of map unit: 5 percent
Landform: Flood plains
Landform position (three-dimensional): Rise
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: F107XB017MO - Clayey Floodplain Forest
Hydric soil rating: Yes

Waldron, frequently flooded

Percent of map unit: 5 percent
Landform: Flood plains
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: F107XB017MO - Clayey Floodplain Forest
Hydric soil rating: Yes

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>

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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



Appendix D Time of Concentration

Initial Time of Concentration

- Ex_01: 6.0 min
- Ex_02: 8.1 min
- Ex_03: 6.7 min

$$T_I = \frac{1.8(1.1-C)D^{1/2}}{S^{1/3}}$$

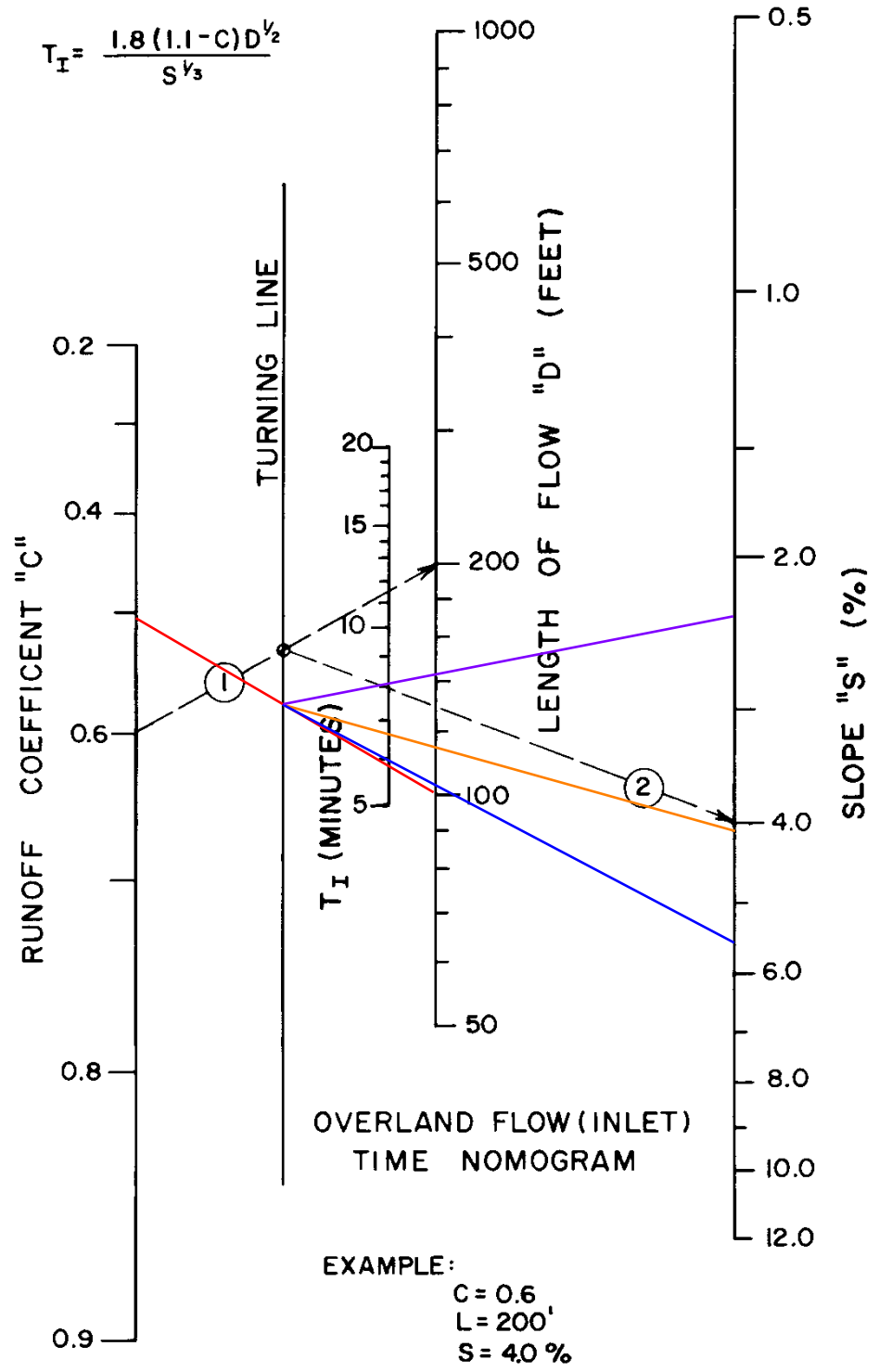


Figure 5602-2: Overland Flow (Inlet) Time Nomograph

Travel Time	
—	Ex_01: 6.8 min
—	Ex_02: 3.5 min
—	Ex_03: 1.4 min

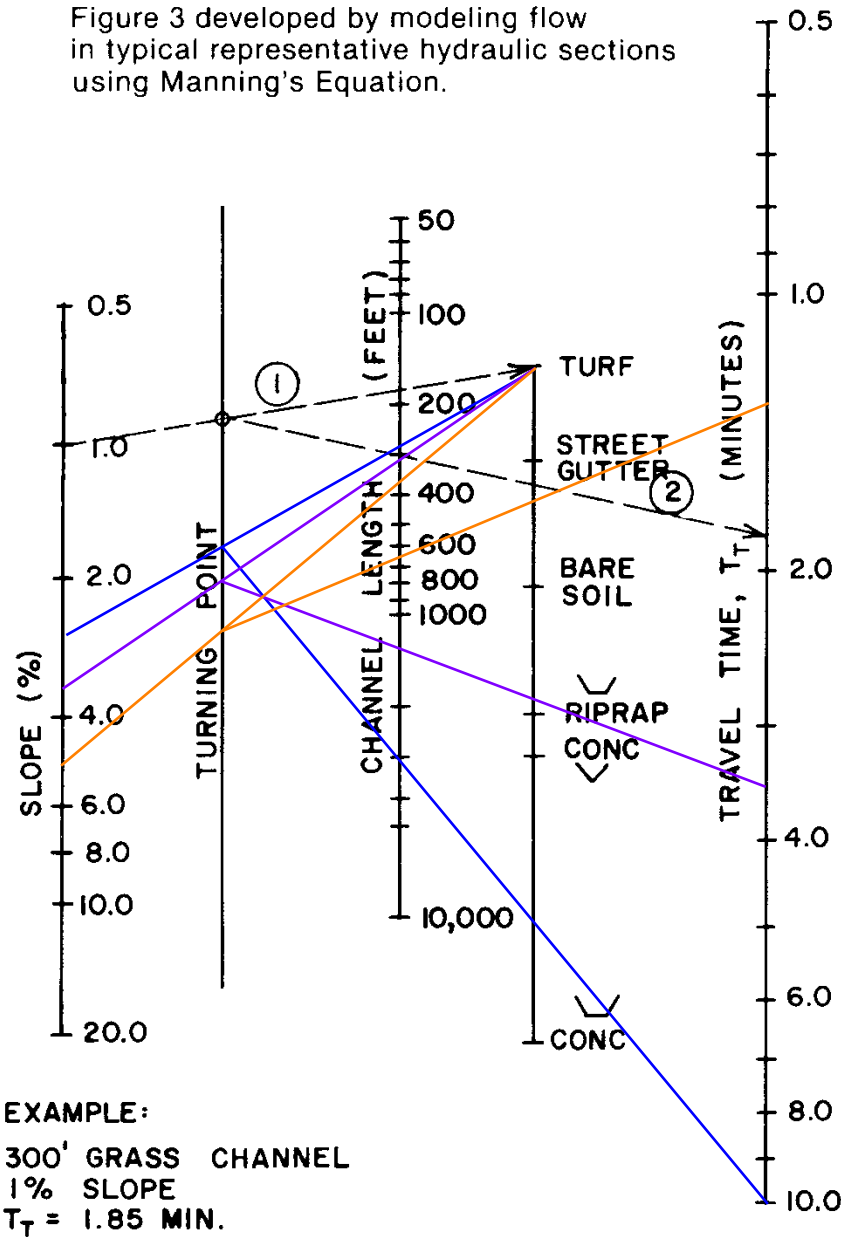
Per APWA 5602.7 $T_c = T_i + T_t$ (between 5 and 15 minutes)

Ex_01: $T_c = T_i + T_t = 6.0 + 10.0 = 16.0 \text{ min} = 15.0 \text{ min}$

Ex_02: $T_c = T_i + T_t = 8.1 + 3.5 = 11.6 \text{ min}$

Ex_03: $T_c = T_i + T_t = 6.7 + 1.4 = 8.1 \text{ min}$

Figure 3 developed by modeling flow in typical representative hydraulic sections using Manning's Equation.



- ① Connect Slope & Channel Condition to locate point on Turning Line
- ② Extend line from Turning Line through Channel Length, Read T_T

Figure 5602-3: Channel Flow Time Nomograph

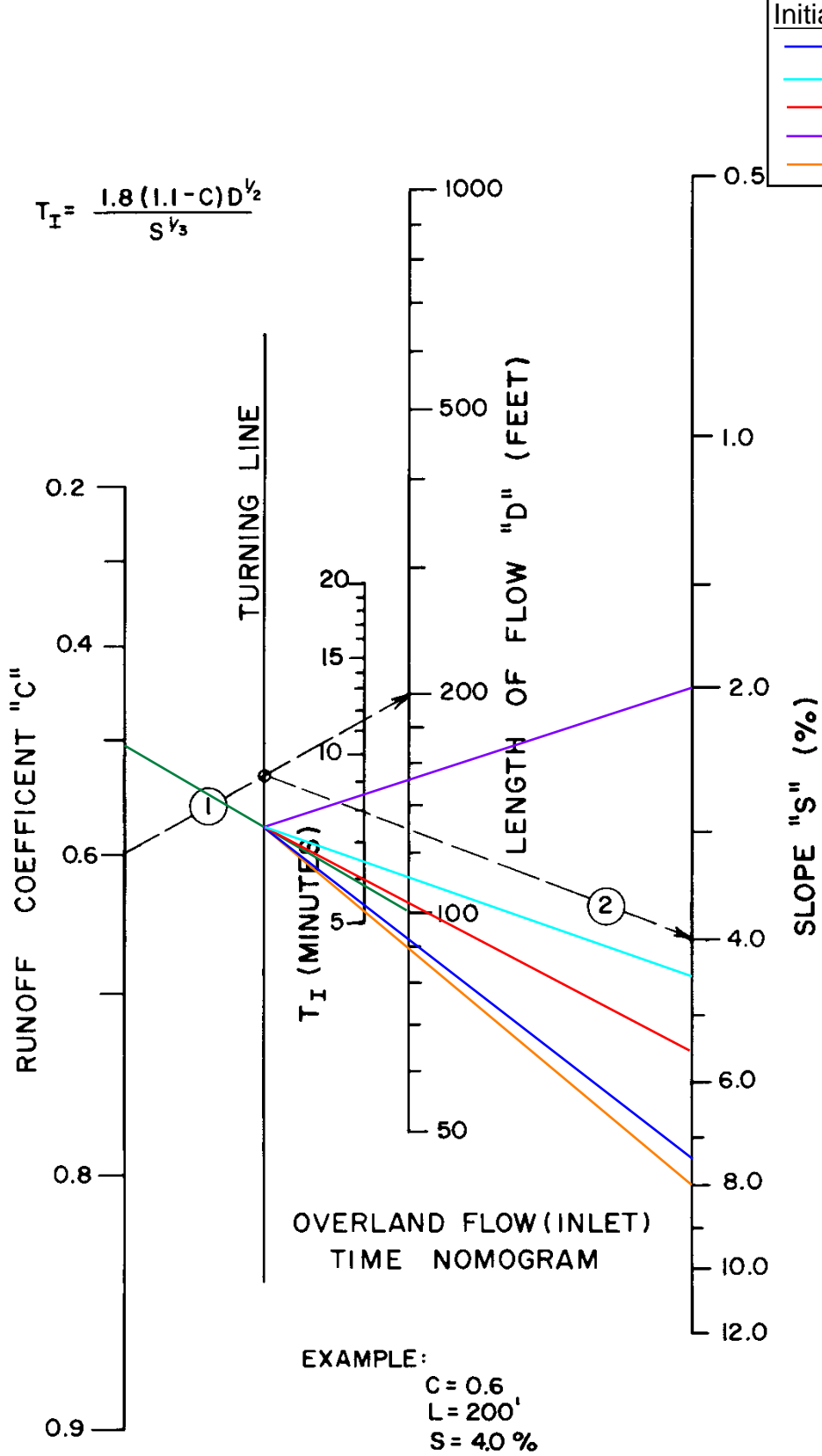


Figure 5602-2: Overland Flow (Inlet) Time Nomograph

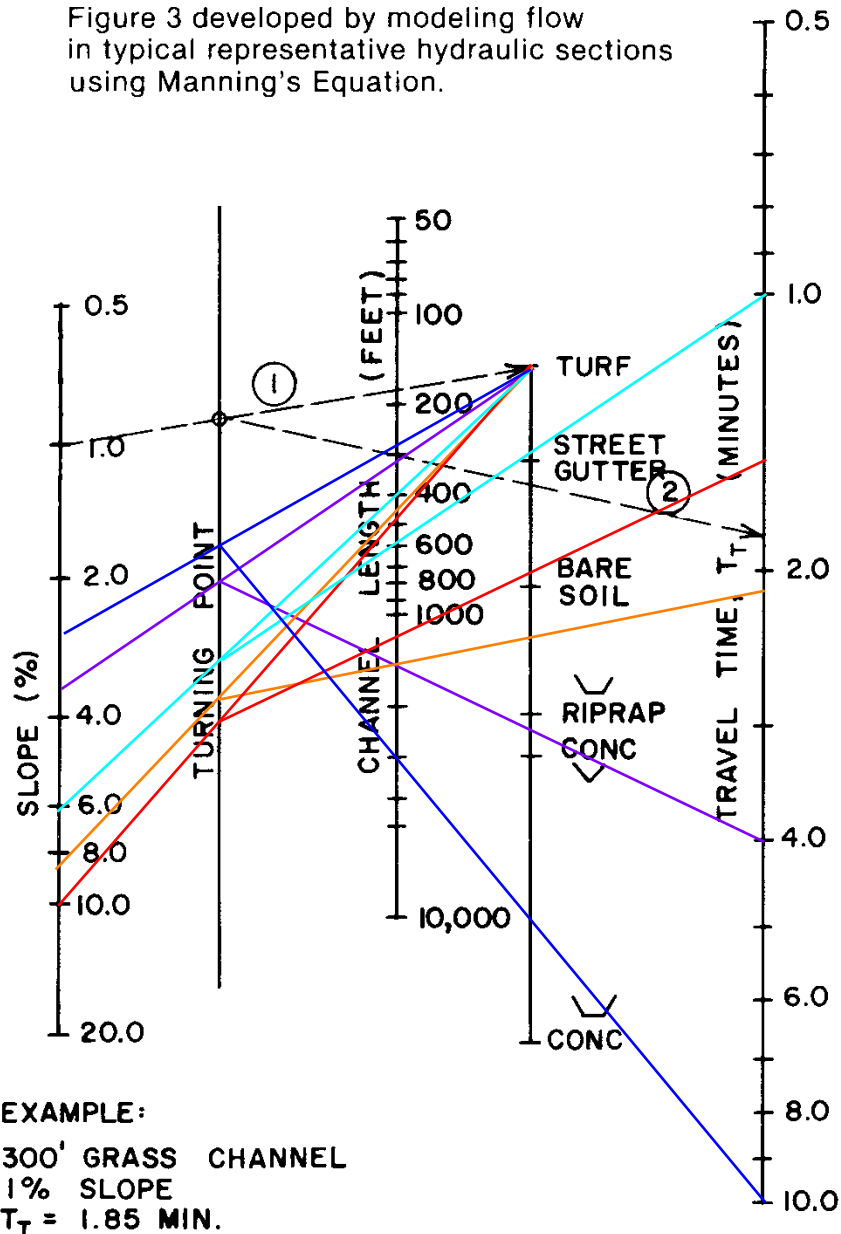
Travel Time

- Pr_01A: 10.0 min
- Pr_01B: 1.0 min
- Pr_01C: 2.1 min
- Pr_02: 3.5 min
- Pr_03: 1.4 min

Per APWA 5602.7 $T_c = T_i + T_t$ (between 5 and 15 minutes)

Pr_01A: $T_c = T_i + T_t = 6.0 + 10.0 = 16.0 \text{ min} = 15.0 \text{ min}$
 Pr_01B: $T_c = T_i + T_t = 5.4 + 1.0 = 6.4 \text{ min}$
 Pr_01C: $T_c = T_i + T_t = 6.1 + 2.1 = 8.2 \text{ min}$
 Pr_02: $T_c = T_i + T_t = 8.1 + 4.0 = 12.1 \text{ min}$
 Pr_03: $T_c = T_i + T_t = 5.3 + 1.4 = 6.7 \text{ min}$

Figure 3 developed by modeling flow in typical representative hydraulic sections using Manning's Equation.



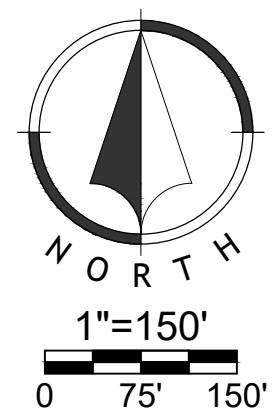
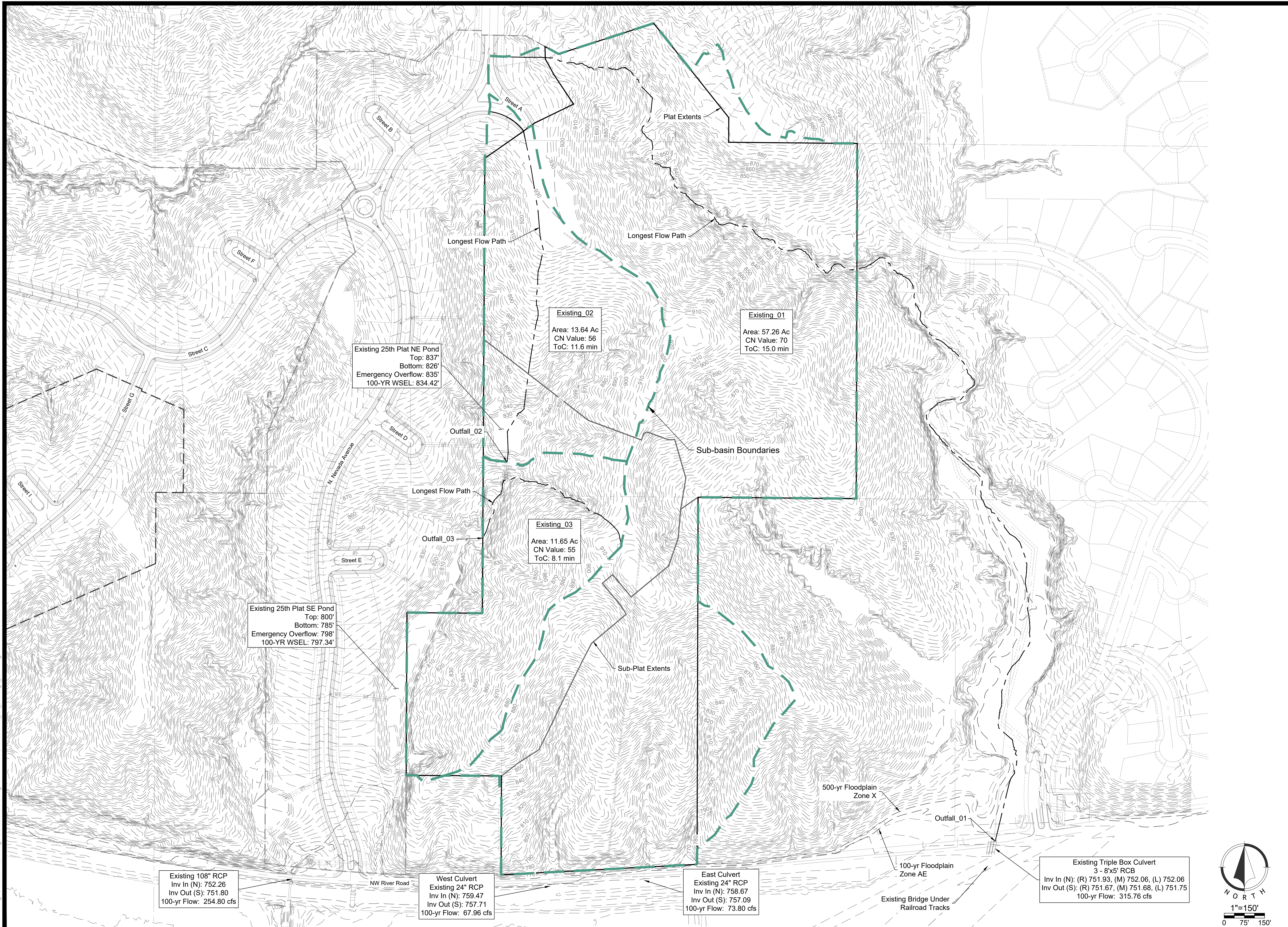
- ① Connect Slope & Channel Condition to locate point on Turning Line
- ② Extend line from Turning Line through Channel Length, Read T_T

Figure 5602-3: Channel Flow Time Nomograph



Appendix E Existing Drainage Map

jkullgren
 May 28, 2025-3:30pm
 Z:\R\C\Design\2022-0138\Design Data\Storm Drainage\East\Storm CAD\22-0138_EX_Drainage_Estat.dwg



NO.	DATE	REVISION

DRAWN BY: CHECKED BY:

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Appendix F Existing Conditions Analysis

Project Description

File Name 22-0138_Ex_Conditions_East.SPF

Project Options

Flow Units CFS
 Elevation Type Elevation
 Hydrology Method SCS TR-55
 Time of Concentration (TOC) Method SCS TR-55
 Link Routing Method Kinematic Wave
 Enable Overflow Ponding at Nodes YES
 Skip Steady State Analysis Time Periods ... YES

Analysis Options

Start Analysis On 00:00:00 0:00:00
 End Analysis On 00:00:00 0:00:00
 Start Reporting On 00:00:00 0:00:00
 Antecedent Dry Days 0 days
 Runoff (Dry Weather) Time Step 0 01:00:00 days hh:mm:ss
 Runoff (Wet Weather) Time Step 0 00:05:00 days hh:mm:ss
 Reporting Time Step 0 00:00:01 days hh:mm:ss
 Routing Time Step 1 seconds

Number of Elements

	Qty
Rain Gages	1
Subbasins.....	3
Nodes.....	4
<i>Junctions</i>	1
<i>Outfalls</i>	3
<i>Flow Diversions</i>	0
<i>Inlets</i>	0
<i>Storage Nodes</i>	0
Links.....	1
<i>Channels</i>	1
<i>Pipes</i>	0
<i>Pumps</i>	0
<i>Orifices</i>	0
<i>Weirs</i>	0
<i>Outlets</i>	0
Pollutants	0
Land Uses	0

Rainfall Details

SN	Rain Gage ID	Data Source	Data Source ID	Rainfall Type	Rain Units	State	County	Return Period (years)	Rainfall Depth (inches)	Rainfall Distribution
49		Time Series	2-yr	Cumulative	inches	Missouri	Platte	2.00	3.59	SCS Type II 24-hr

Subbasin Summary

SN Subbasin ID	Area (ac)	Peak Rate Factor	Weighted Curve Number	Total Rainfall (in)	Total Runoff (in)	Total Runoff Volume (ac-in)	Peak Runoff (cfs)	Time of Concentration (days hh:mm:ss)
1 Existing-01	57.26	484.00	69.72	3.59	1.05	60.01	70.68	0 00:15:00
2 Existing-02	13.64	484.00	56.16	3.59	0.42	5.70	5.17	0 00:11:36
3 Existing-03	11.65	484.00	55.39	3.59	0.39	4.54	4.59	0 00:08:06

Node Summary

SN	Element ID	Element Type	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Initial Water Elevation (ft)	Surcharge Elevation (ft)	Ponded Area (ft ²)	Peak Inflow (cfs)	Max HGL Elevation (ft)	Max Surcharge Depth (ft)	Min Freeboard (ft)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	1-Jun	Junction	830.00	845.00	830.00	0.00	0.00	70.68	830.82	0.00	14.18	0 00:00	0.00	0.00
2	Out-01	Outfall	0.00					60.93	765.75					
3	Out-02	Outfall	0.00					5.17	0.00					
4	Out-03	Outfall	0.00					4.59	0.00					

Link Summary

SN Element ID	Element Type	From (Inlet) Node	To (Outlet) Node	Length (ft)	Inlet Invert Elevation (ft)	Outlet Invert Elevation (ft)	Average Slope (%)	Diameter or Height (in)	Manning's Roughness	Peak Flow (cfs)	Design Flow Capacity (cfs)	Peak Flow/ Design Flow Ratio	Peak Flow Velocity (ft/sec)	Peak Flow Depth (ft)	Peak Flow Depth/ Total Depth Ratio	Total Time Reported Surcharged Condition (min)
1 Link-01	Channel	1-Jun	Out-01	3672.92	830.00	765.00	1.7700	120.000	0.0320	60.93	8923.48	0.01	5.39	0.73	0.07	0.00

Subbasin Hydrology

Subbasin : Existing-01

Input Data

Area (ac) 57.26
 Peak Rate Factor 484
 Weighted Curve Number 69.72
 Rain Gage ID Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
32			
Woods, Good	14.92	B	55
Woods, Good	15.34	C	70
Woods, Good	24.72	D	77
1/3 acre lots, 30% impervious	1.95	D	86
1/3 acre lots, 30% impervious	0.33	C	81
Composite Area & Weighted CN	57.26		69.72

Time of Concentration

TOC Method : SCS TR-55

Sheet Flow Equation :

$$T_c = (0.007 * ((n * L_f)^{0.8}) / ((P^{0.5}) * (S_f^{0.4}))$$

Where :

Tc = Time of Concentration (hr)
 n = Manning's roughness
 Lf = Flow Length (ft)
 P = 2 yr, 24 hr Rainfall (inches)
 Sf = Slope (ft/ft)

Shallow Concentrated Flow Equation :

V = 16.1345 * (Sf^{0.5}) (unpaved surface)
 V = 20.3282 * (Sf^{0.5}) (paved surface)
 V = 15.0 * (Sf^{0.5}) (grassed waterway surface)
 V = 10.0 * (Sf^{0.5}) (nearly bare & untilled surface)
 V = 9.0 * (Sf^{0.5}) (cultivated straight rows surface)
 V = 7.0 * (Sf^{0.5}) (short grass pasture surface)
 V = 5.0 * (Sf^{0.5}) (woodland surface)
 V = 2.5 * (Sf^{0.5}) (forest w/heavy litter surface)
 Tc = (Lf / V) / (3600 sec/hr)

Where:

Tc = Time of Concentration (hr)
 Lf = Flow Length (ft)
 V = Velocity (ft/sec)
 Sf = Slope (ft/ft)

Channel Flow Equation :

$$V = (1.49 * (R^{2/3}) * (S_f^{0.5})) / n$$

$$R = A_q / W_p$$

$$T_c = (L_f / V) / (3600 \text{ sec/hr})$$

Where :

Tc = Time of Concentration (hr)
 Lf = Flow Length (ft)
 R = Hydraulic Radius (ft)
 Aq = Flow Area (ft²)
 Wp = Wetted Perimeter (ft)
 V = Velocity (ft/sec)
 Sf = Slope (ft/ft)
 n = Manning's roughness

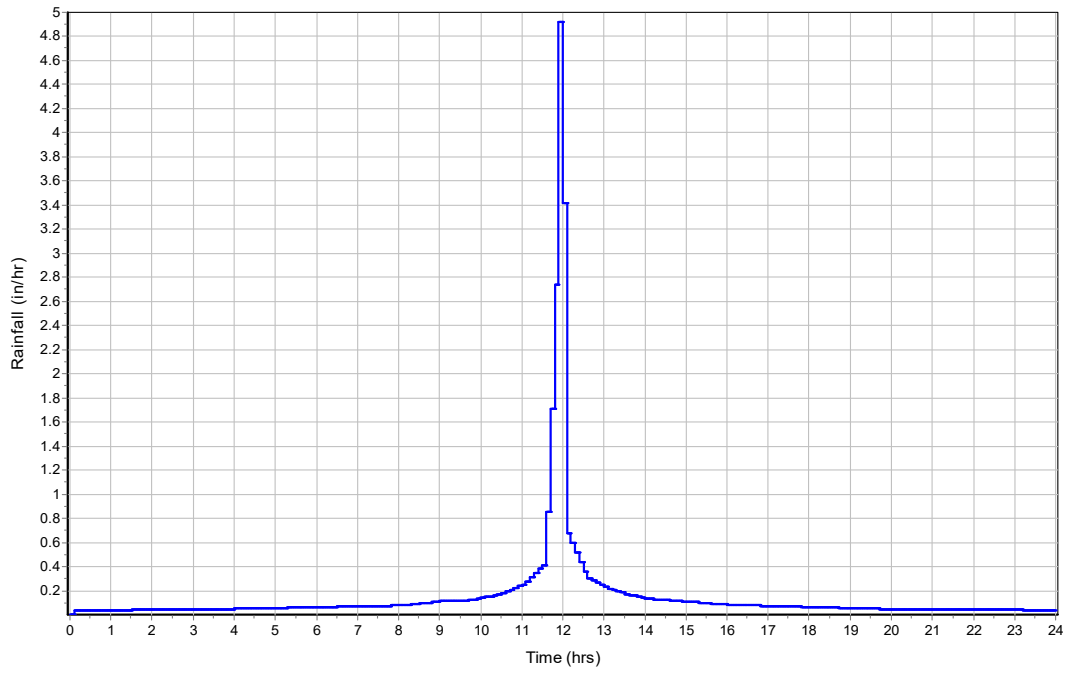
User-Defined TOC override (minutes): 15

Subbasin Runoff Results

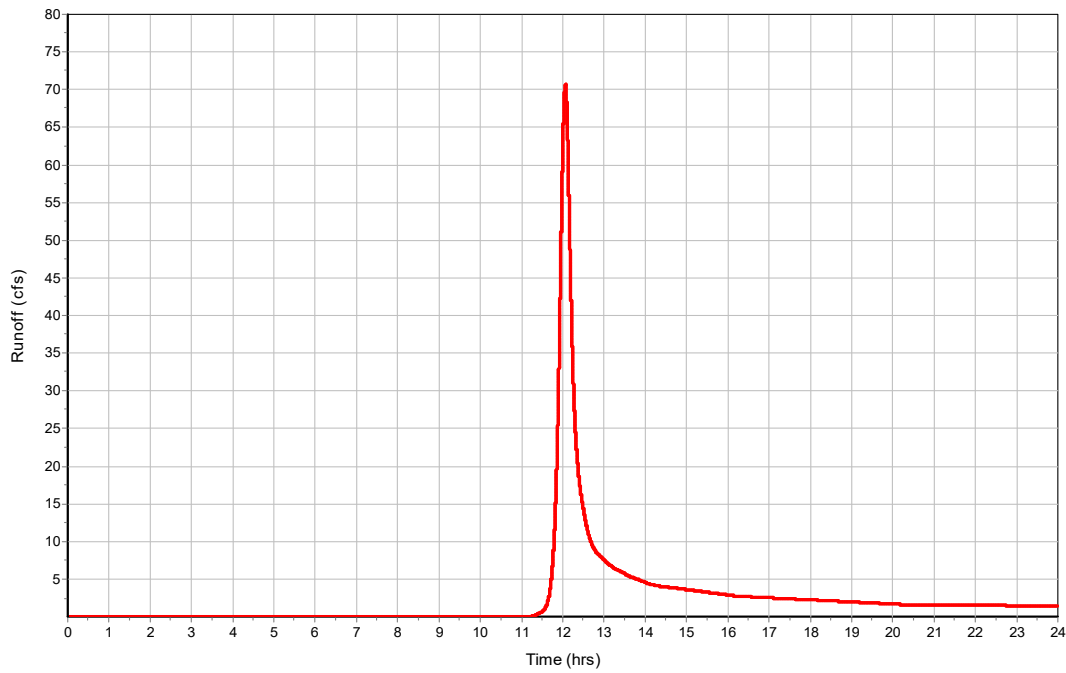
Total Rainfall (in)	3.59
Total Runoff (in)	1.05
Peak Runoff (cfs)	70.68
Weighted Curve Number	69.72
Time of Concentration (days hh:mm:ss)	0 00:15:00

Subbasin : Existing-01

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : Existing-02

Input Data

Area (ac) 13.64
 Peak Rate Factor 484
 Weighted Curve Number 56.16
 Rain Gage ID Rain Gage-01

Composite Curve Number

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
Woods, Good	13.01	B	55
Woods, Good	0.2	D	77
1/3 acre lots, 30% impervious	0.39	C	81
1/3 acre lots, 30% impervious	0.04	D	86
Composite Area & Weighted CN	13.64		56.16

Time of Concentration

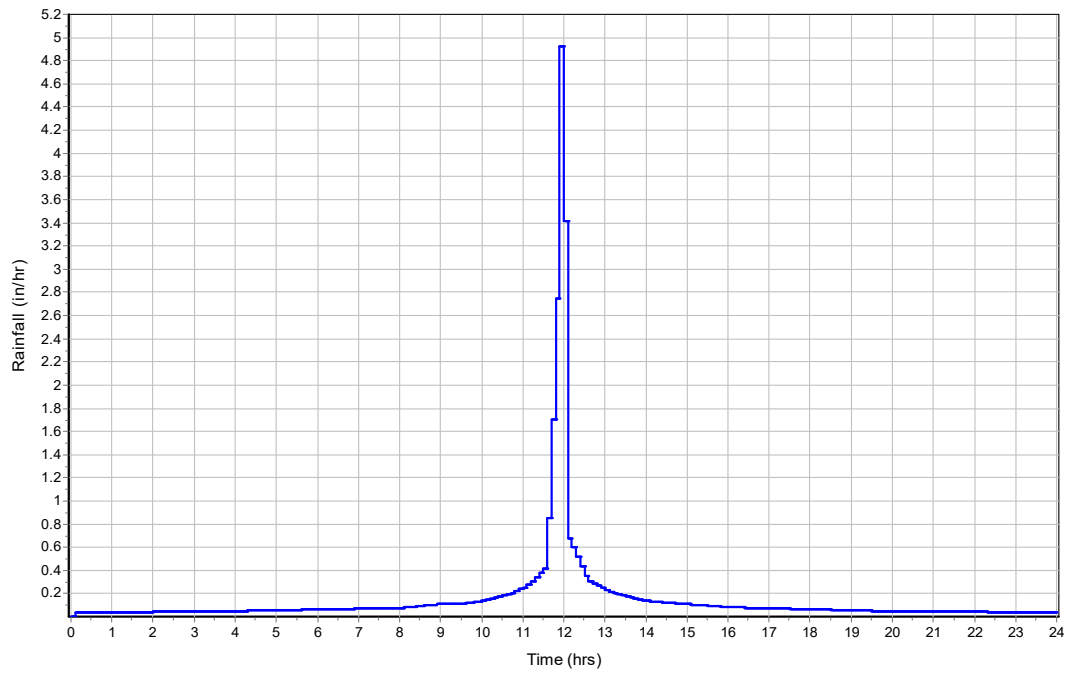
User-Defined TOC override (minutes): 11.6

Subbasin Runoff Results

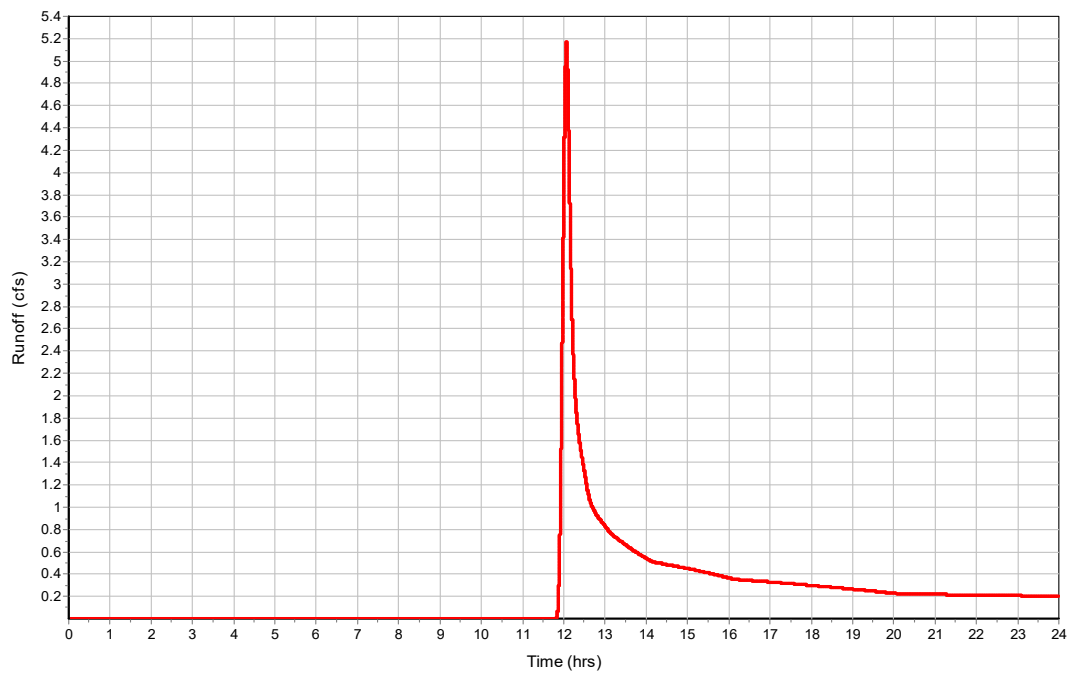
Total Rainfall (in) 3.59
 Total Runoff (in) 0.42
 Peak Runoff (cfs) 5.17
 Weighted Curve Number 56.16
 Time of Concentration (days hh:mm:ss) 0 00:11:36

Subbasin : Existing-02

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : Existing-03

Input Data

Area (ac) 11.65
 Peak Rate Factor 484
 Weighted Curve Number 55.39
 Rain Gage ID Rain Gage-01

Composite Curve Number

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
Woods, Good	11.35	B	55
Woods, Good	0.3	C	70
Composite Area & Weighted CN	11.65		55.39

Time of Concentration

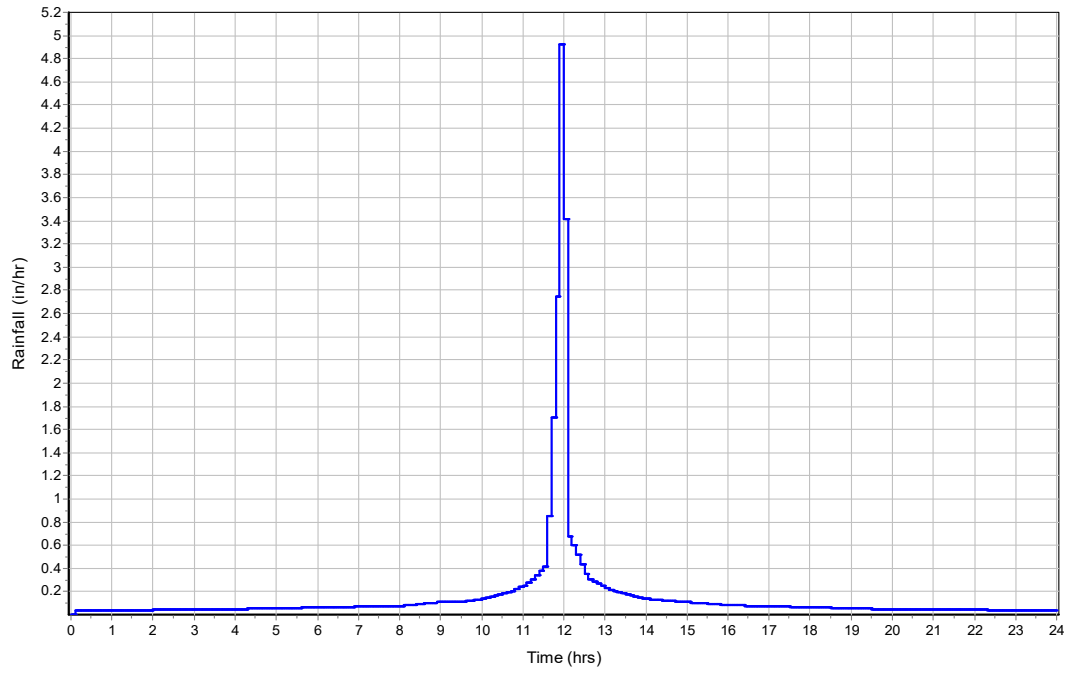
User-Defined TOC override (minutes): 8.1

Subbasin Runoff Results

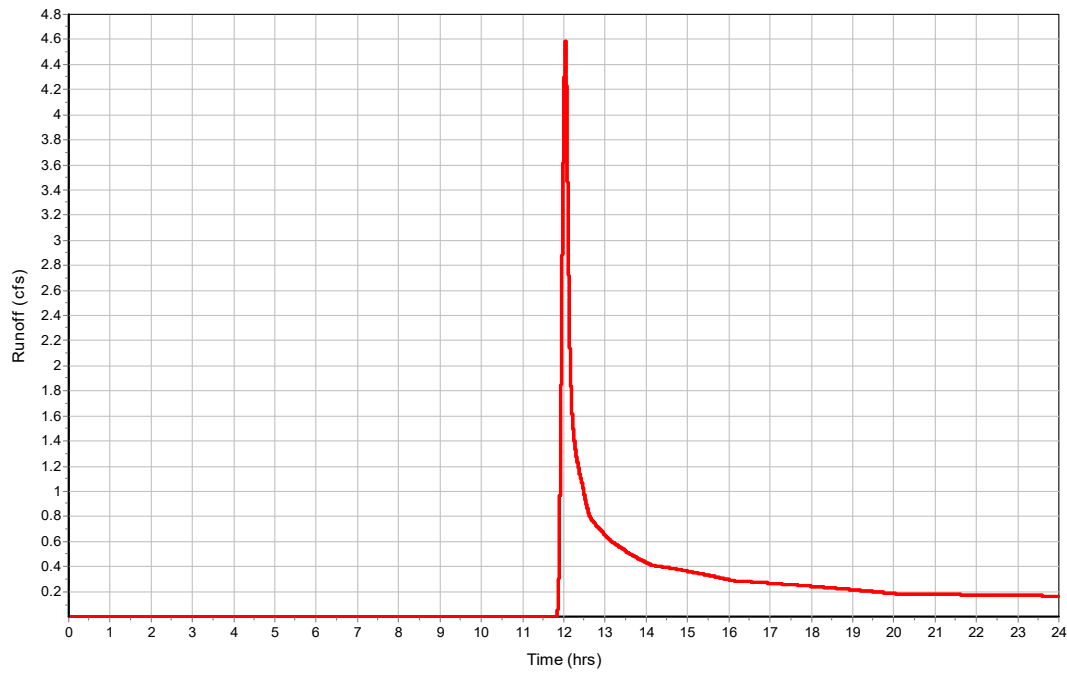
Total Rainfall (in) 3.59
 Total Runoff (in) 0.39
 Peak Runoff (cfs) 4.59
 Weighted Curve Number 55.39
 Time of Concentration (days hh:mm:ss) 0 00:08:06

Subbasin : Existing-03

Rainfall Intensity Graph



Runoff Hydrograph



Junction Input

SN Element ID	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Ground/Rim (Max) Offset (ft)	Initial Water Elevation (ft)	Initial Water Depth (ft)	Surcharge Elevation (ft)	Surcharge Depth (ft)	Ponded Area (ft ²)	Minimum Pipe Cover (in)
1 1-Jun	830.00	845.00	15.00	830.00	0.00	0.00	-845.00	0.00	0.00

Junction Results

SN Element ID	Peak Inflow	Peak Lateral Inflow	Max HGL Elevation	Max HGL Depth	Max Surcharge Depth	Min Freeboard	Average HGL Elevation	Average HGL Depth	Time of Max HGL Occurrence	Time of Peak Flooding Occurrence	Total Flooded Volume	Total Time Flooded
	(cfs)	(cfs)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(days hh:mm)	(days hh:mm)	(ac-in)	(min)
1 1-Jun	70.68	70.68	830.82	0.82	0.00	14.18	830.07	0.07	0 12:04	0 00:00	0.00	0.00

Channel Input

SN Element ID	Length (ft)	Inlet Invert (ft)	Inlet Invert Offset (ft)	Outlet Invert Elevation (ft)	Outlet Invert Offset (ft)	Total Drop (ft)	Average Slope (%)	Shape	Height (ft)	Width (ft)	Manning's Roughness	Entrance Losses	Exit/Bend Losses	Additional Losses	Initial Flow (cfs)	Flap Gate
1 Link-01	3672.92	830.00	0.00	765.00	765.00	65.00	1.7700	Trapezoidal	10.000	75.000	0.0320	0.5000	0.5000	0.0000	0.00	No

Channel Results

SN Element ID	Peak Flow	Time of Peak Flow Occurrence	Design Flow Capacity	Peak Flow/ Design Flow Ratio	Peak Flow Velocity	Travel Time	Peak Flow Depth	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged	Froude Number	Reported Condition
	(cfs)	(days hh:mm)	(cfs)		(ft/sec)	(min)	(ft)		(min)		
1 Link-01	60.93	0 12:11	8923.48	0.01	5.39	11.36	0.73	0.07	0.00		

Project Description

File Name 22-0138_Ex_Conditions_East.SPF

Project Options

Flow Units CFS
 Elevation Type Elevation
 Hydrology Method SCS TR-55
 Time of Concentration (TOC) Method SCS TR-55
 Link Routing Method Kinematic Wave
 Enable Overflow Ponding at Nodes YES
 Skip Steady State Analysis Time Periods ... YES

Analysis Options

Start Analysis On 00:00:00 0:00:00
 End Analysis On 00:00:00 0:00:00
 Start Reporting On 00:00:00 0:00:00
 Antecedent Dry Days 0 days
 Runoff (Dry Weather) Time Step 0 01:00:00 days hh:mm:ss
 Runoff (Wet Weather) Time Step 0 00:05:00 days hh:mm:ss
 Reporting Time Step 0 00:00:01 days hh:mm:ss
 Routing Time Step 1 seconds

Number of Elements

	Qty
Rain Gages	1
Subbasins.....	3
Nodes.....	4
<i>Junctions</i>	1
<i>Outfalls</i>	3
<i>Flow Diversions</i>	0
<i>Inlets</i>	0
<i>Storage Nodes</i>	0
Links.....	1
<i>Channels</i>	1
<i>Pipes</i>	0
<i>Pumps</i>	0
<i>Orifices</i>	0
<i>Weirs</i>	0
<i>Outlets</i>	0
Pollutants	0
Land Uses	0

Rainfall Details

SN	Rain Gage ID	Data Source	Data Source ID	Rainfall Type	Rain Units	State	County	Return Period (years)	Rainfall Depth (inches)	Rainfall Distribution
49		Time Series	5-yr	Cumulative	inches	Missouri	Platte	5.00	4.54	SCS Type II 24-hr

Subbasin Summary

SN Subbasin ID	Area (ac)	Peak Rate Factor	Weighted Curve Number	Total Rainfall (in)	Total Runoff (in)	Total Runoff Volume (ac-in)	Peak Runoff (cfs)	Time of Concentration (days hh:mm:ss)
1 Existing-01	57.26	484.00	69.72	4.54	1.68	96.31	117.56	0 00:15:00
2 Existing-02	13.64	484.00	56.16	4.54	0.82	11.23	12.81	0 00:11:36
3 Existing-03	11.65	484.00	55.39	4.54	0.78	9.10	11.33	0 00:08:06

Node Summary

SN	Element ID	Element Type	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Initial Water Elevation (ft)	Surcharge Elevation (ft)	Ponded Area (ft ²)	Peak Inflow (cfs)	Max HGL Elevation (ft)	Max Surcharge Depth (ft)	Min Freeboard (ft)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	1-Jun	Junction	830.00	845.00	830.00	0.00	0.00	117.56	831.10	0.00	13.90	0 00:00	0.00	0.00
2	Out-01	Outfall	0.00					107.20	766.04					
3	Out-02	Outfall	0.00					12.81	0.00					
4	Out-03	Outfall	0.00					11.33	0.00					

Link Summary

SN Element ID	Element Type	From (Inlet) Node	To (Outlet) Node	Length (ft)	Inlet Invert Elevation (ft)	Outlet Invert Elevation (ft)	Average Slope (%)	Diameter or Height (in)	Manning's Roughness	Peak Flow (cfs)	Design Flow Capacity (cfs)	Peak Flow/Design Flow Ratio	Peak Flow Velocity (ft/sec)	Peak Flow Depth (ft)	Peak Flow Depth/Total Depth Ratio	Total Time Reported Surcharged Condition (min)
1 Link-01	Channel	1-Jun	Out-01	3672.92	830.00	765.00	1.7700	120.000	0.0320	107.20	8923.48	0.01	6.46	1.02	0.10	0.00

Subbasin Hydrology

Subbasin : Existing-01

Input Data

Area (ac) 57.26
 Peak Rate Factor 484
 Weighted Curve Number 69.72
 Rain Gage ID Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
32			
Woods, Good	14.92	B	55
Woods, Good	15.34	C	70
Woods, Good	24.72	D	77
1/3 acre lots, 30% impervious	1.95	D	86
1/3 acre lots, 30% impervious	0.33	C	81
Composite Area & Weighted CN	57.26		69.72

Time of Concentration

TOC Method : SCS TR-55

Sheet Flow Equation :

$$T_c = (0.007 * ((n * L_f)^{0.8}) / ((P^{0.5}) * (S_f^{0.4})))$$

Where :

Tc = Time of Concentration (hr)
 n = Manning's roughness
 Lf = Flow Length (ft)
 P = 2 yr, 24 hr Rainfall (inches)
 Sf = Slope (ft/ft)

Shallow Concentrated Flow Equation :

V = 16.1345 * (Sf^{0.5}) (unpaved surface)
 V = 20.3282 * (Sf^{0.5}) (paved surface)
 V = 15.0 * (Sf^{0.5}) (grassed waterway surface)
 V = 10.0 * (Sf^{0.5}) (nearly bare & untilled surface)
 V = 9.0 * (Sf^{0.5}) (cultivated straight rows surface)
 V = 7.0 * (Sf^{0.5}) (short grass pasture surface)
 V = 5.0 * (Sf^{0.5}) (woodland surface)
 V = 2.5 * (Sf^{0.5}) (forest w/heavy litter surface)
 Tc = (Lf / V) / (3600 sec/hr)

Where:

Tc = Time of Concentration (hr)
 Lf = Flow Length (ft)
 V = Velocity (ft/sec)
 Sf = Slope (ft/ft)

Channel Flow Equation :

V = (1.49 * (R^{2/3}) * (Sf^{0.5})) / n
 R = Aq / Wp
 Tc = (Lf / V) / (3600 sec/hr)

Where :

Tc = Time of Concentration (hr)
 Lf = Flow Length (ft)
 R = Hydraulic Radius (ft)
 Aq = Flow Area (ft²)
 Wp = Wetted Perimeter (ft)
 V = Velocity (ft/sec)
 Sf = Slope (ft/ft)
 n = Manning's roughness

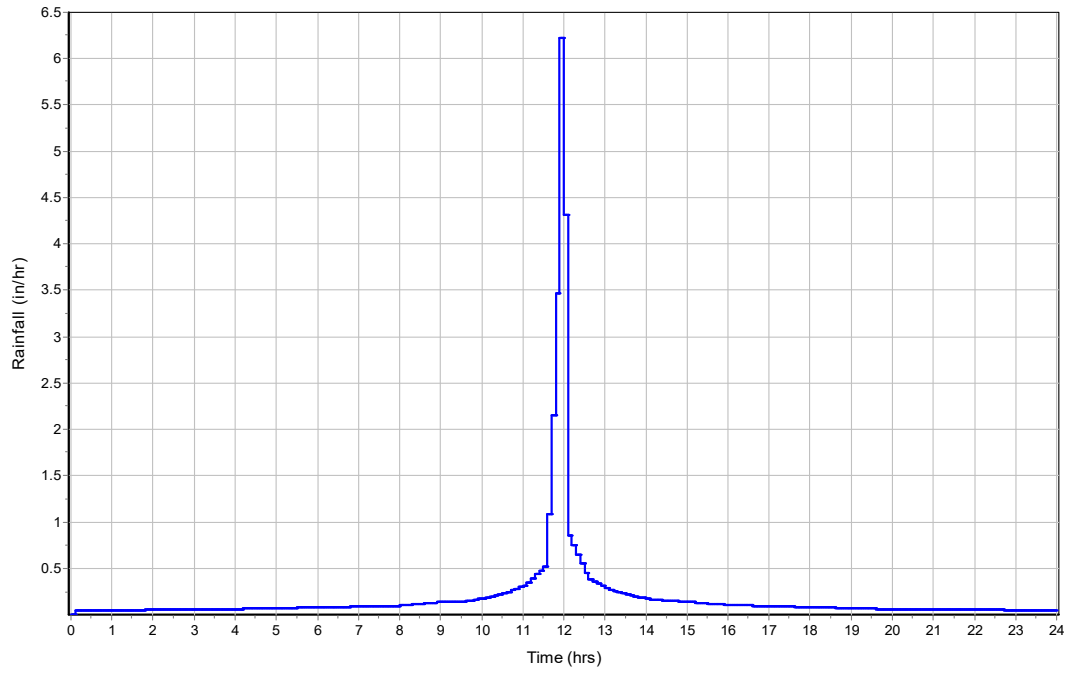
User-Defined TOC override (minutes): 15

Subbasin Runoff Results

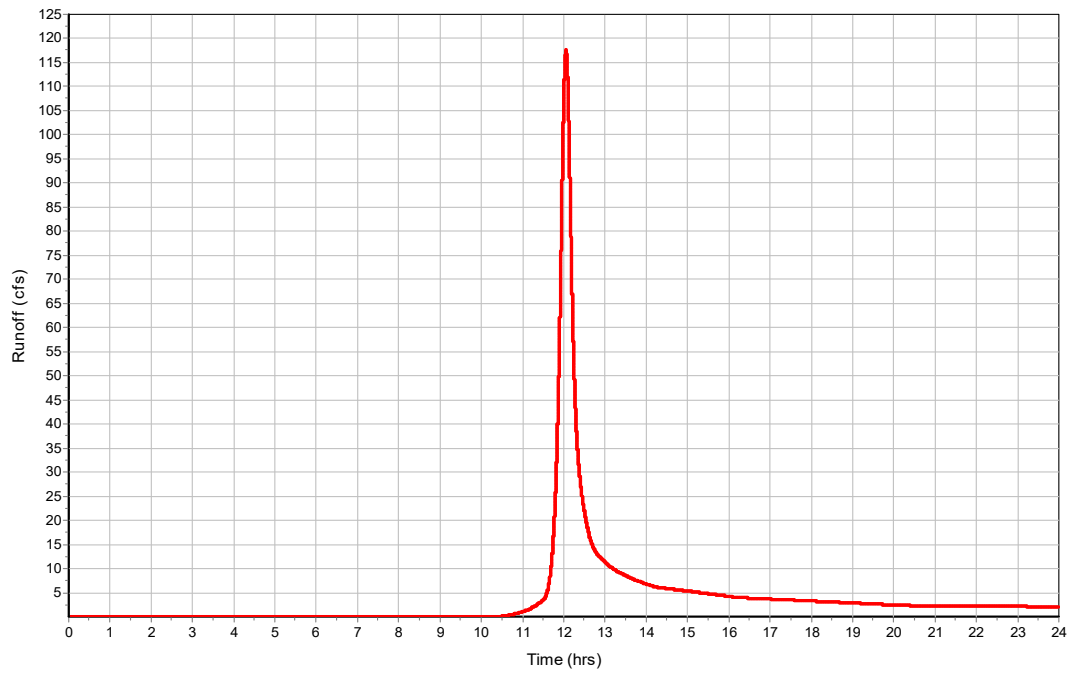
Total Rainfall (in)	4.54
Total Runoff (in)	1.68
Peak Runoff (cfs)	117.56
Weighted Curve Number	69.72
Time of Concentration (days hh:mm:ss)	0 00:15:00

Subbasin : Existing-01

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : Existing-02

Input Data

Area (ac) 13.64
 Peak Rate Factor 484
 Weighted Curve Number 56.16
 Rain Gage ID Rain Gage-01

Composite Curve Number

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
Woods, Good	13.01	B	55
Woods, Good	0.2	D	77
1/3 acre lots, 30% impervious	0.39	C	81
1/3 acre lots, 30% impervious	0.04	D	86
Composite Area & Weighted CN	13.64		56.16

Time of Concentration

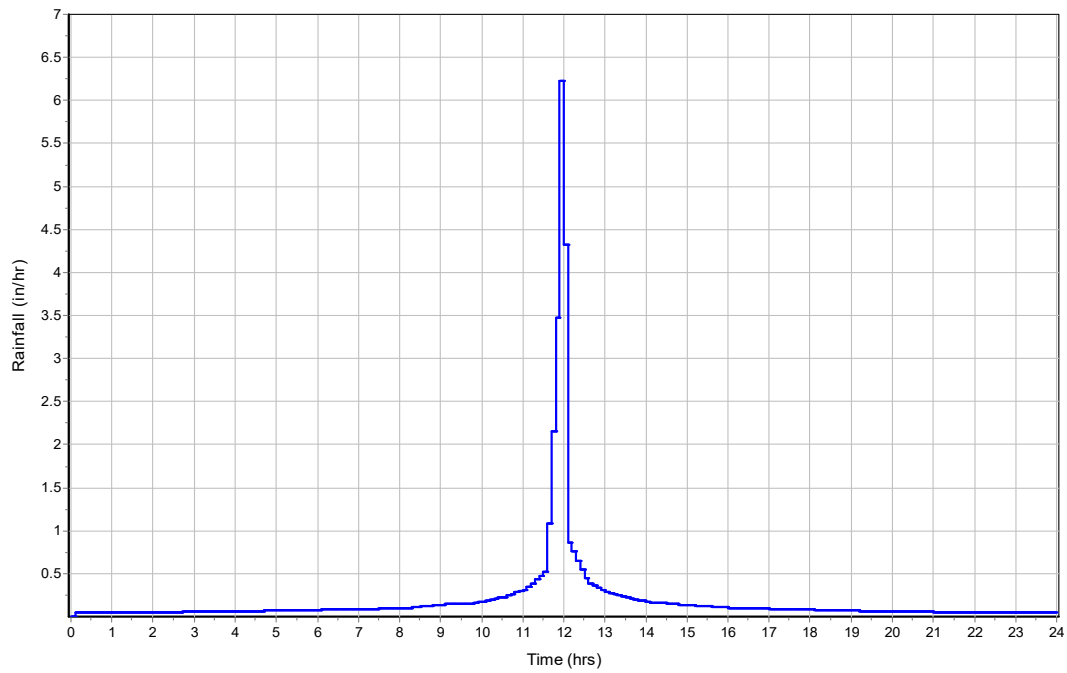
User-Defined TOC override (minutes): 11.6

Subbasin Runoff Results

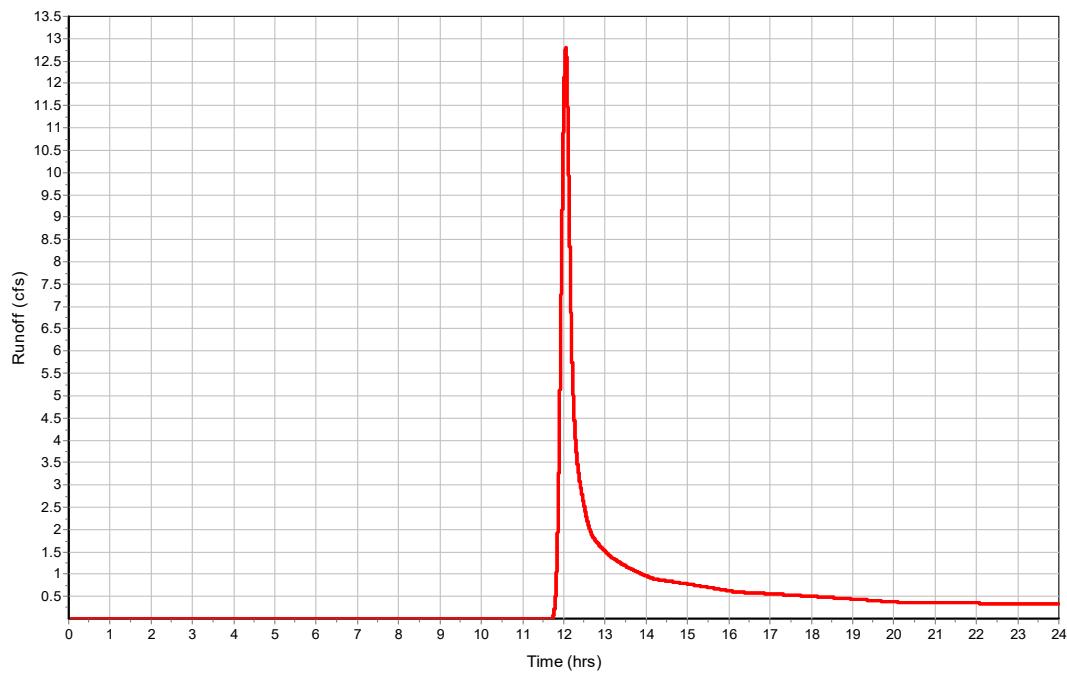
Total Rainfall (in) 4.54
 Total Runoff (in) 0.82
 Peak Runoff (cfs) 12.81
 Weighted Curve Number 56.16
 Time of Concentration (days hh:mm:ss) 0 00:11:36

Subbasin : Existing-02

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : Existing-03

Input Data

Area (ac) 11.65
 Peak Rate Factor 484
 Weighted Curve Number 55.39
 Rain Gage ID Rain Gage-01

Composite Curve Number

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
Woods, Good	11.35	B	55
Woods, Good	0.3	C	70
Composite Area & Weighted CN	11.65		55.39

Time of Concentration

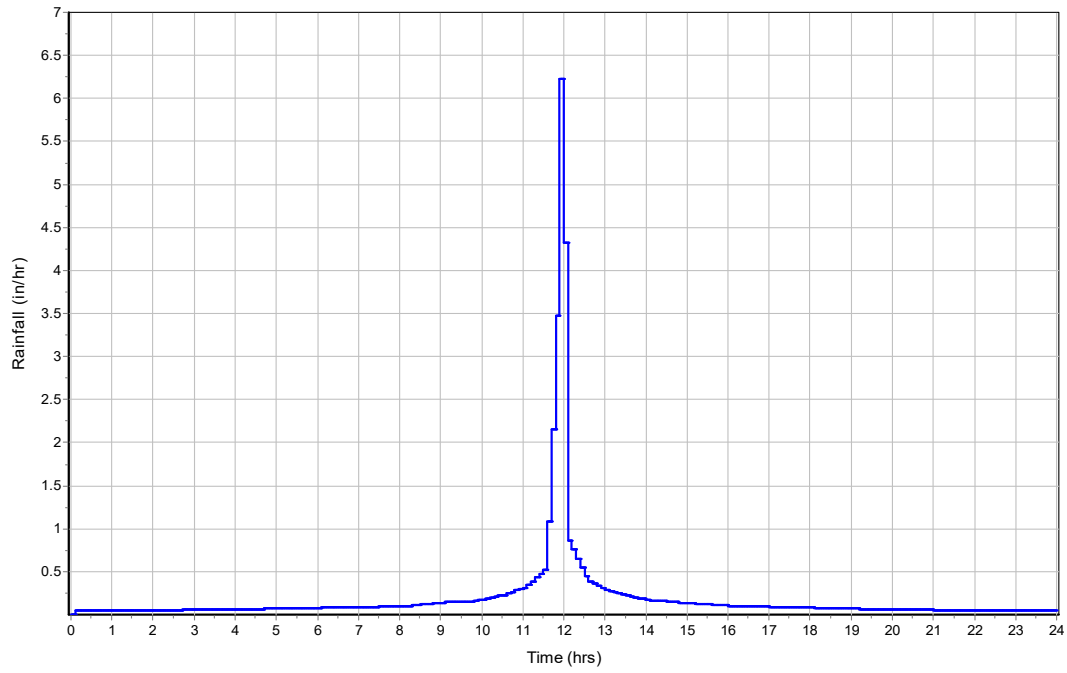
User-Defined TOC override (minutes): 8.1

Subbasin Runoff Results

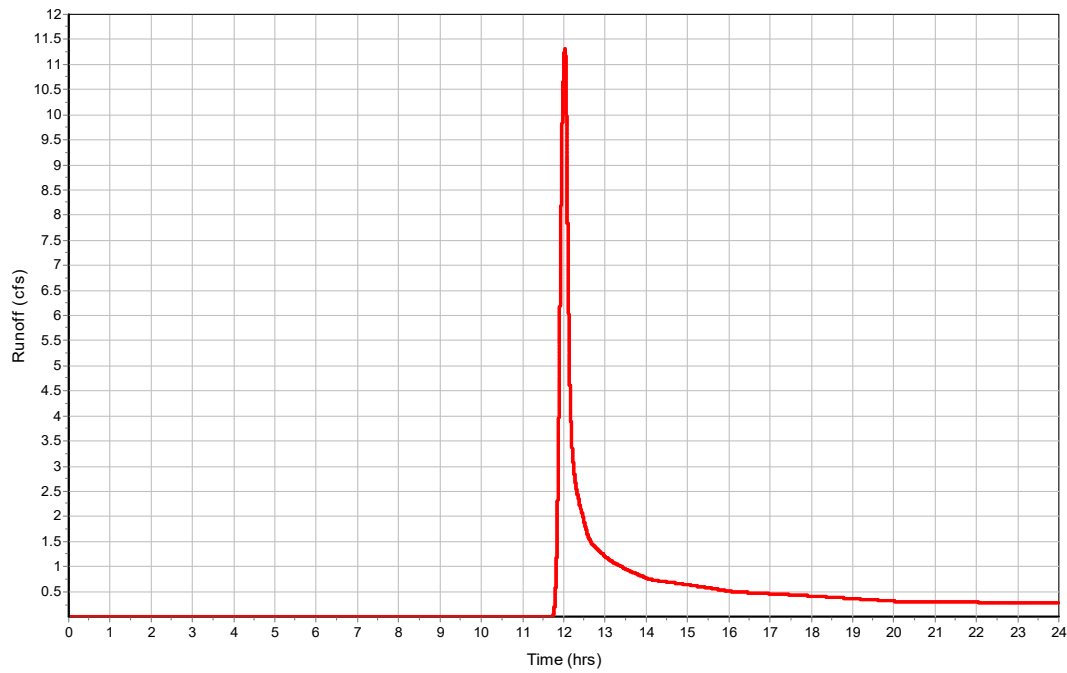
Total Rainfall (in) 4.54
 Total Runoff (in) 0.78
 Peak Runoff (cfs) 11.33
 Weighted Curve Number 55.39
 Time of Concentration (days hh:mm:ss) 0 00:08:06

Subbasin : Existing-03

Rainfall Intensity Graph



Runoff Hydrograph



Junction Input

SN Element ID	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Ground/Rim (Max) Offset (ft)	Initial Water Elevation (ft)	Initial Water Depth (ft)	Surcharge Elevation (ft)	Surcharge Depth (ft)	Ponded Area (ft ²)	Minimum Pipe Cover (in)
1 1-Jun	830.00	845.00	15.00	830.00	0.00	0.00	-845.00	0.00	0.00

Junction Results

SN Element ID	Peak Inflow	Peak Lateral Inflow	Max HGL Elevation	Max HGL Depth	Max Surcharge Depth	Min Freeboard Attained	Average HGL Elevation	Average HGL Depth	Time of Max HGL Occurrence	Time of Peak Flooding Occurrence	Total Flooded Volume	Total Time Flooded
	(cfs)	(cfs)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(days hh:mm)	(days hh:mm)	(ac-in)	(min)
1 1-Jun	117.56	117.56	831.10	1.10	0.00	13.90	830.10	0.10	0 12:03	0 00:00	0.00	0.00

Channel Input

SN Element ID	Length (ft)	Inlet Invert (ft)	Inlet Invert Offset (ft)	Outlet Invert Elevation (ft)	Outlet Invert Offset (ft)	Total Drop (ft)	Average Slope (%)	Shape	Height (ft)	Width (ft)	Manning's Roughness	Entrance Losses	Exit/Bend Losses	Additional Losses	Initial Flow (cfs)	Flap Gate
1 Link-01	3672.92	830.00	0.00	765.00	765.00	65.00	1.7700	Trapezoidal	10.000	75.000	0.0320	0.5000	0.5000	0.0000	0.00	No

Channel Results

SN Element ID	Peak Flow	Time of Peak Flow Occurrence	Design Flow Capacity	Peak Flow/ Design Flow Ratio	Peak Flow Velocity	Travel Time	Peak Flow Depth	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged	Froude Number	Reported Condition
	(cfs)	(days hh:mm)	(cfs)		(ft/sec)	(min)	(ft)		(min)		
1 Link-01	107.20	0 12:09	8923.48	0.01	6.46	9.48	1.02	0.10	0.00		

Project Description

File Name 22-0138_Ex_Conditions_East.SPF

Project Options

Flow Units CFS
 Elevation Type Elevation
 Hydrology Method SCS TR-55
 Time of Concentration (TOC) Method SCS TR-55
 Link Routing Method Kinematic Wave
 Enable Overflow Ponding at Nodes YES
 Skip Steady State Analysis Time Periods ... YES

Analysis Options

Start Analysis On 00:00:00 0:00:00
 End Analysis On 00:00:00 0:00:00
 Start Reporting On 00:00:00 0:00:00
 Antecedent Dry Days 0 days
 Runoff (Dry Weather) Time Step 0 01:00:00 days hh:mm:ss
 Runoff (Wet Weather) Time Step 0 00:05:00 days hh:mm:ss
 Reporting Time Step 0 00:00:01 days hh:mm:ss
 Routing Time Step 1 seconds

Number of Elements

	Qty
Rain Gages	1
Subbasins.....	3
Nodes.....	4
<i>Junctions</i>	1
<i>Outfalls</i>	3
<i>Flow Diversions</i>	0
<i>Inlets</i>	0
<i>Storage Nodes</i>	0
Links.....	1
<i>Channels</i>	1
<i>Pipes</i>	0
<i>Pumps</i>	0
<i>Orifices</i>	0
<i>Weirs</i>	0
<i>Outlets</i>	0
Pollutants	0
Land Uses	0

Rainfall Details

SN	Rain Gage ID	Data Source	Data Source ID	Rainfall Type	Rain Units	State	County	Return Period (years)	Rainfall Depth (inches)	Rainfall Distribution
49		Time Series	10-yr	Cumulative	inches	Missouri	Platte	10.00	5.37	SCS Type II 24-hr

Subbasin Summary

SN Subbasin ID	Area (ac)	Peak Rate Factor	Weighted Curve Number	Total Rainfall (in)	Total Runoff (in)	Total Runoff Volume (ac-in)	Peak Runoff (cfs)	Time of Concentration (days hh:mm:ss)
1 Existing-01	57.26	484.00	69.72	5.37	2.29	131.18	162.10	0 00:15:00
2 Existing-02	13.64	484.00	56.16	5.37	1.25	17.04	20.97	0 00:11:36
3 Existing-03	11.65	484.00	55.39	5.37	1.20	13.93	18.46	0 00:08:06

Node Summary

SN	Element ID	Element Type	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Initial Water Elevation (ft)	Surcharge Elevation (ft)	Ponded Area (ft ²)	Peak Inflow (cfs)	Max HGL Elevation (ft)	Max Surcharge Depth (ft)	Min Freeboard Attained (ft)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	1-Jun	Junction	830.00	845.00	830.00	0.00	0.00	162.09	831.32	0.00	13.68	0 00:00	0.00	0.00
2	Out-01	Outfall	0.00					151.15	766.27					
3	Out-02	Outfall	0.00					20.97	0.00					
4	Out-03	Outfall	0.00					18.46	0.00					

Link Summary

SN	Element ID	Element Type	From (Inlet) Node	To (Outlet) Node	Length (ft)	Inlet Invert Elevation (ft)	Outlet Invert Elevation (ft)	Average Slope (%)	Diameter or Height (in)	Manning's Roughness	Peak Flow (cfs)	Design Flow Capacity (cfs)	Peak Flow/Design Flow Ratio	Peak Flow Velocity (ft/sec)	Peak Flow Depth (ft)	Peak Flow Depth/Total Depth Ratio	Total Time Reported Surcharged Condition (min)
1	Link-01	Channel	1-Jun	Out-01	3672.92	830.00	765.00	1.7700	120.000	0.0320	151.15	8923.48	0.02	7.16	1.24	0.12	0.00

Subbasin Hydrology

Subbasin : Existing-01

Input Data

Area (ac) 57.26
 Peak Rate Factor 484
 Weighted Curve Number 69.72
 Rain Gage ID Rain Gage-01

Composite Curve Number

32 Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Woods, Good	14.92	B	55
Woods, Good	15.34	C	70
Woods, Good	24.72	D	77
1/3 acre lots, 30% impervious	1.95	D	86
1/3 acre lots, 30% impervious	0.33	C	81
Composite Area & Weighted CN	57.26		69.72

Time of Concentration

TOC Method : SCS TR-55

Sheet Flow Equation :

$$T_c = (0.007 * ((n * L_f)^{0.8}) / ((P^{0.5}) * (S_f^{0.4}))$$

Where :

Tc = Time of Concentration (hr)
 n = Manning's roughness
 Lf = Flow Length (ft)
 P = 2 yr, 24 hr Rainfall (inches)
 Sf = Slope (ft/ft)

Shallow Concentrated Flow Equation :

V = 16.1345 * (Sf^{0.5}) (unpaved surface)
 V = 20.3282 * (Sf^{0.5}) (paved surface)
 V = 15.0 * (Sf^{0.5}) (grassed waterway surface)
 V = 10.0 * (Sf^{0.5}) (nearly bare & untilled surface)
 V = 9.0 * (Sf^{0.5}) (cultivated straight rows surface)
 V = 7.0 * (Sf^{0.5}) (short grass pasture surface)
 V = 5.0 * (Sf^{0.5}) (woodland surface)
 V = 2.5 * (Sf^{0.5}) (forest w/heavy litter surface)
 Tc = (Lf / V) / (3600 sec/hr)

Where:

Tc = Time of Concentration (hr)
 Lf = Flow Length (ft)
 V = Velocity (ft/sec)
 Sf = Slope (ft/ft)

Channel Flow Equation :

V = (1.49 * (R^{2/3}) * (Sf^{0.5})) / n
 R = Aq / Wp
 Tc = (Lf / V) / (3600 sec/hr)

Where :

Tc = Time of Concentration (hr)
 Lf = Flow Length (ft)
 R = Hydraulic Radius (ft)
 Aq = Flow Area (ft²)
 Wp = Wetted Perimeter (ft)
 V = Velocity (ft/sec)
 Sf = Slope (ft/ft)
 n = Manning's roughness

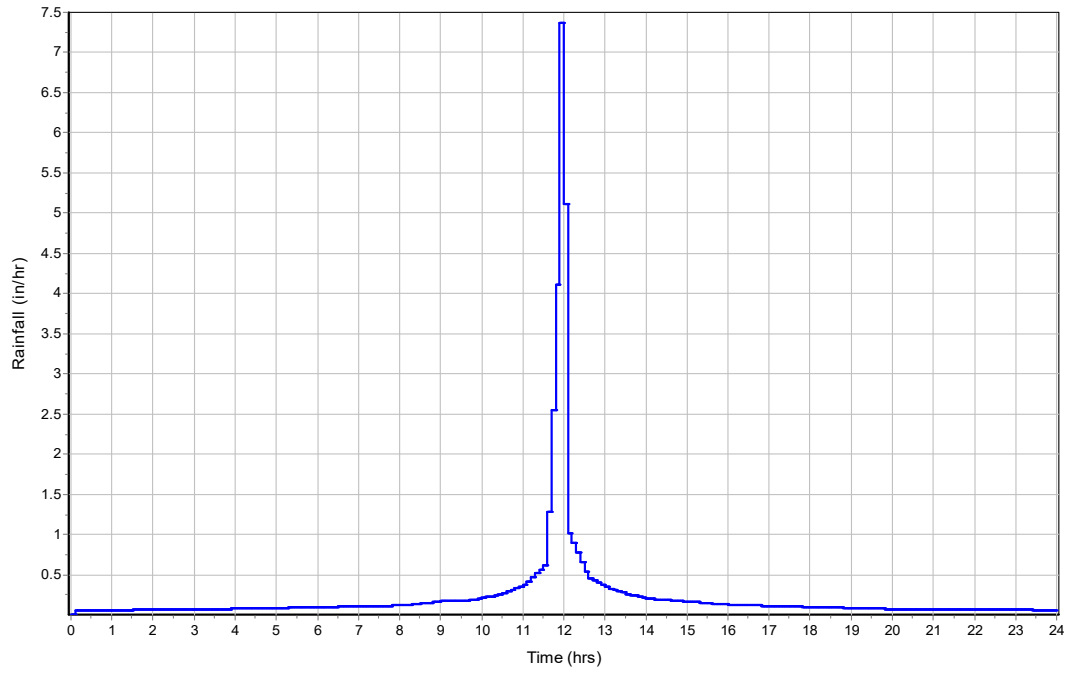
User-Defined TOC override (minutes): 15

Subbasin Runoff Results

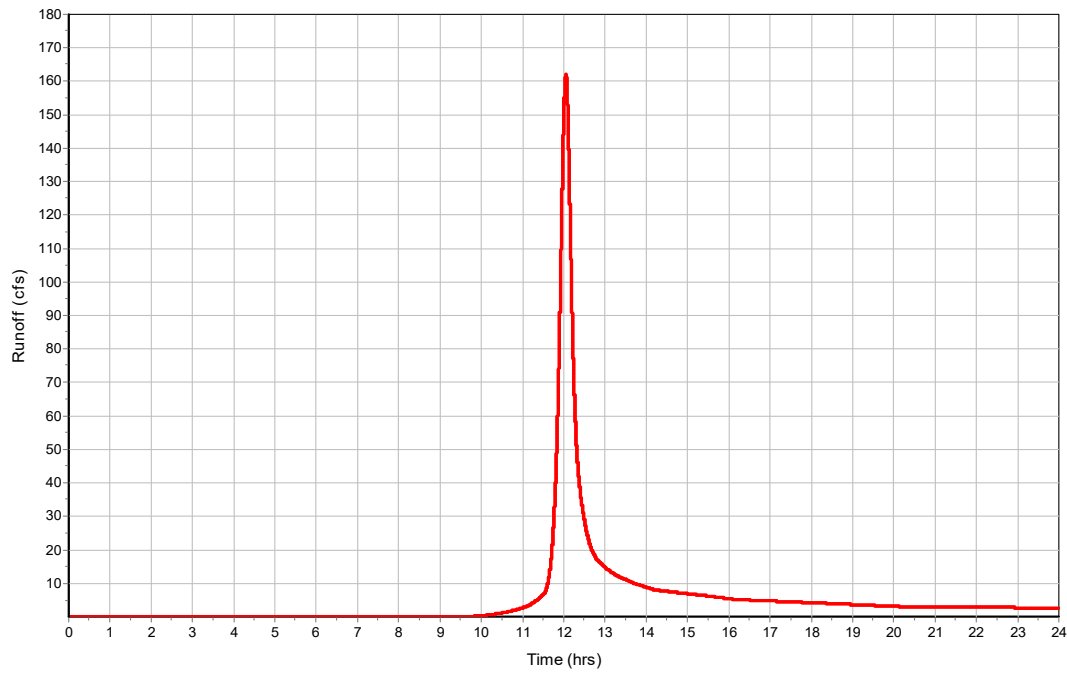
Total Rainfall (in)	5.37
Total Runoff (in)	2.29
Peak Runoff (cfs)	162.1
Weighted Curve Number	69.72
Time of Concentration (days hh:mm:ss)	0 00:15:00

Subbasin : Existing-01

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : Existing-02

Input Data

Area (ac) 13.64
 Peak Rate Factor 484
 Weighted Curve Number 56.16
 Rain Gage ID Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
32			
Woods, Good	13.01	B	55
Woods, Good	0.2	D	77
1/3 acre lots, 30% impervious	0.39	C	81
1/3 acre lots, 30% impervious	0.04	D	86
Composite Area & Weighted CN	13.64		56.16

Time of Concentration

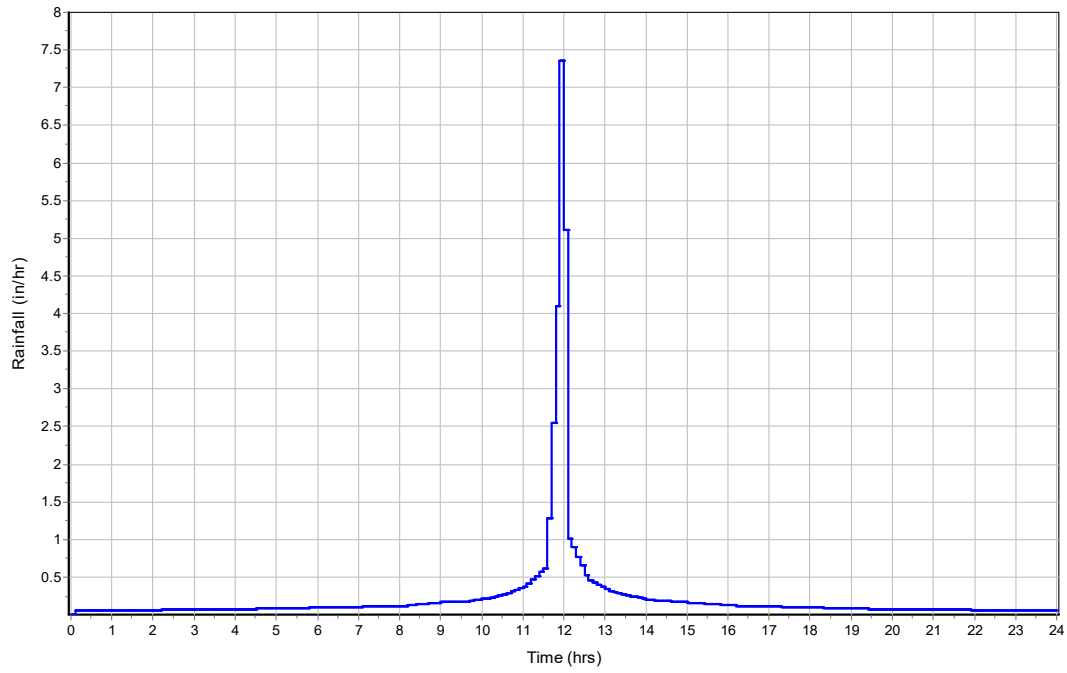
User-Defined TOC override (minutes): 11.6

Subbasin Runoff Results

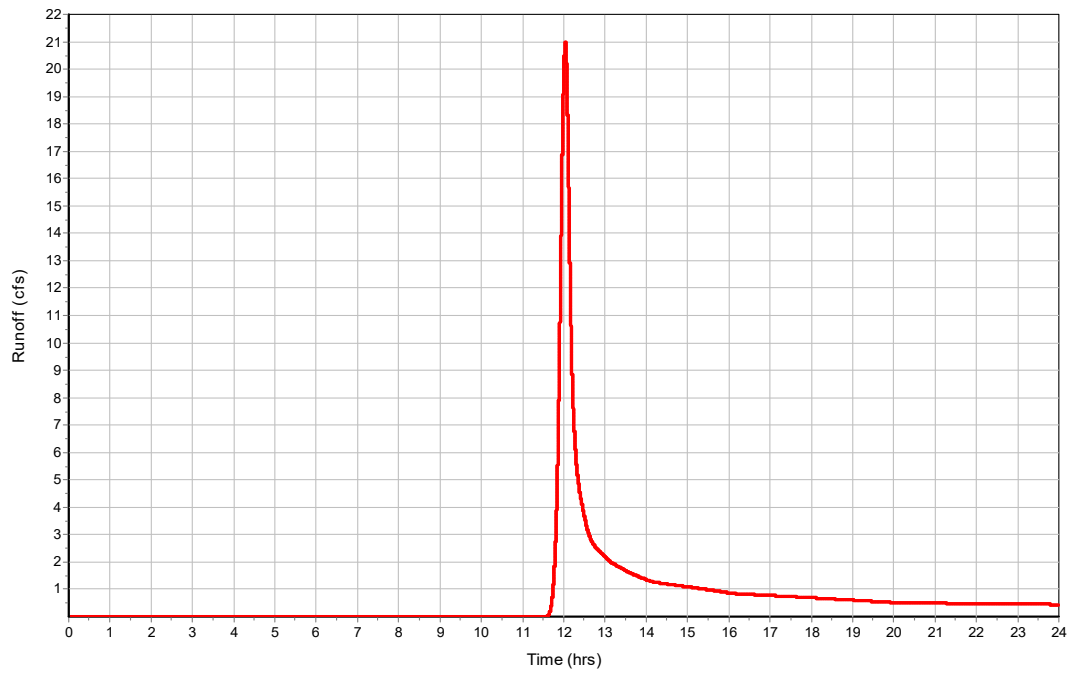
Total Rainfall (in) 5.37
 Total Runoff (in) 1.25
 Peak Runoff (cfs) 20.97
 Weighted Curve Number 56.16
 Time of Concentration (days hh:mm:ss) 0 00:11:36

Subbasin : Existing-02

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : Existing-03

Input Data

Area (ac) 11.65
 Peak Rate Factor 484
 Weighted Curve Number 55.39
 Rain Gage ID Rain Gage-01

Composite Curve Number

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
Woods, Good	11.35	B	55
Woods, Good	0.3	C	70
Composite Area & Weighted CN	11.65		55.39

Time of Concentration

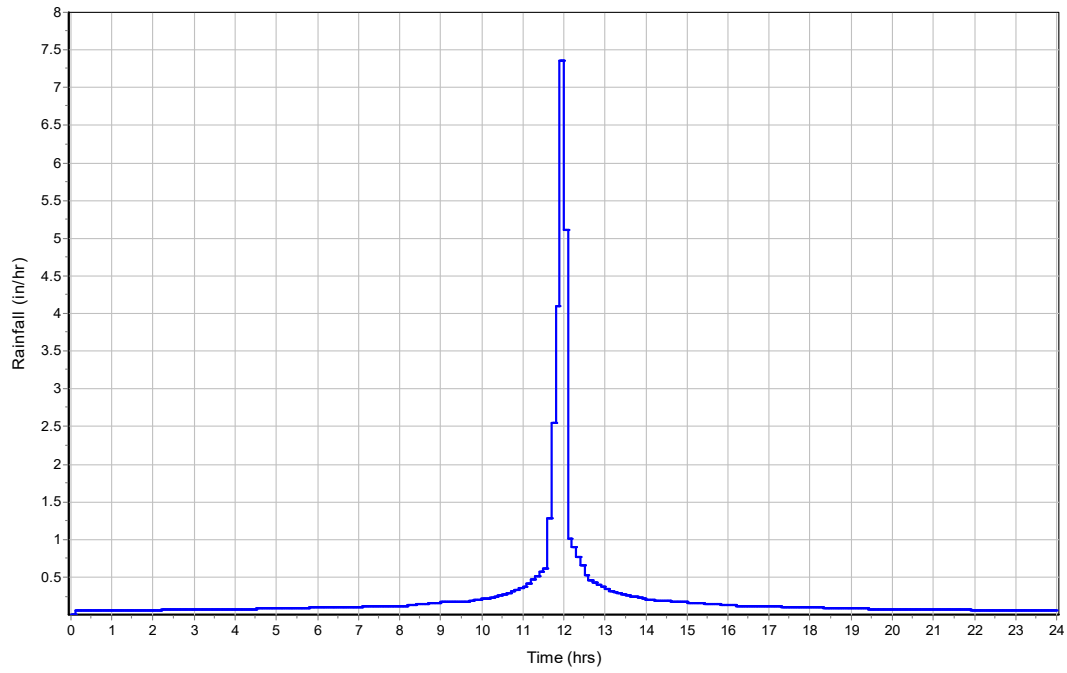
User-Defined TOC override (minutes): 8.1

Subbasin Runoff Results

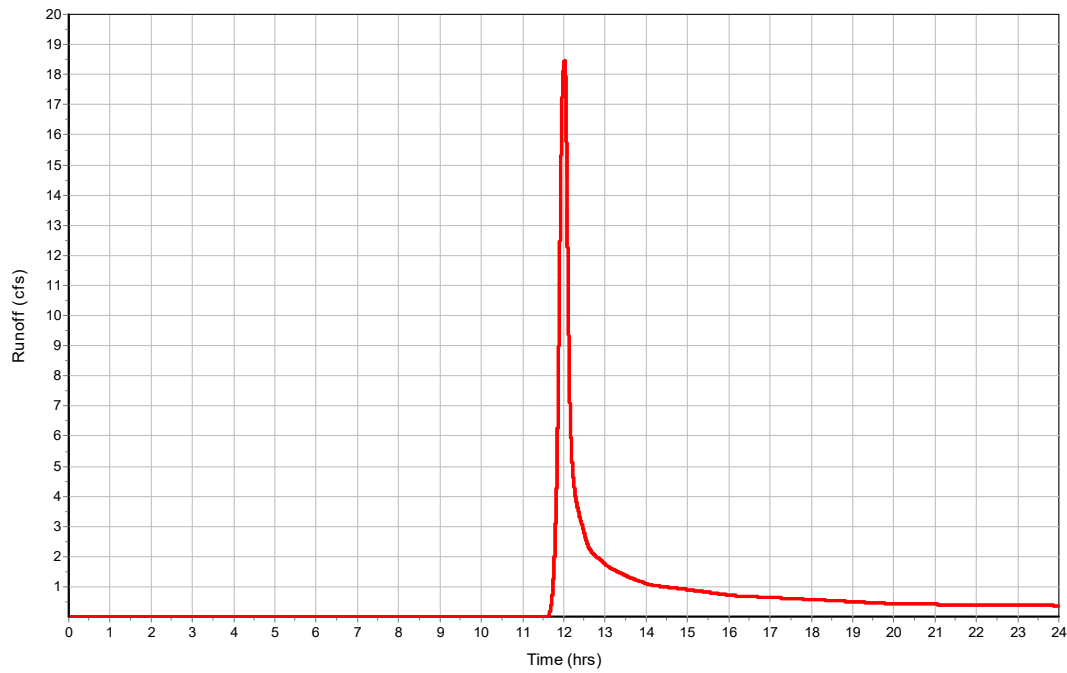
Total Rainfall (in) 5.37
 Total Runoff (in) 1.2
 Peak Runoff (cfs) 18.46
 Weighted Curve Number 55.39
 Time of Concentration (days hh:mm:ss) 0 00:08:06

Subbasin : Existing-03

Rainfall Intensity Graph



Runoff Hydrograph



Junction Input

SN Element ID	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Ground/Rim (Max) Offset (ft)	Initial Water Elevation (ft)	Initial Water Depth (ft)	Surcharge Elevation (ft)	Surcharge Depth (ft)	Ponded Area (ft ²)	Minimum Pipe Cover (in)
1 1-Jun	830.00	845.00	15.00	830.00	0.00	0.00	-845.00	0.00	0.00

Junction Results

SN Element ID	Peak Inflow	Peak Lateral Inflow	Max HGL Elevation Attained	Max HGL Depth Attained	Max Surcharge Depth Attained	Min Freeboard Attained	Average HGL Elevation Attained	Average HGL Depth Attained	Time of Max HGL Occurrence	Time of Peak Flooding Occurrence	Total Flooded Volume	Total Time Flooded
	(cfs)	(cfs)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(days hh:mm)	(days hh:mm)	(ac-in)	(min)
1 1-Jun	162.09	162.09	831.32	1.32	0.00	13.68	830.12	0.12	0 12:03	0 00:00	0.00	0.00

Channel Input

SN Element ID	Length (ft)	Inlet Invert (ft)	Inlet Invert Offset (ft)	Outlet Invert Elevation (ft)	Outlet Invert Offset (ft)	Total Drop (ft)	Average Slope (%)	Shape	Height (ft)	Width (ft)	Manning's Roughness	Entrance Losses	Exit/Bend Losses	Additional Losses	Initial Flow (cfs)	Flap Gate
1 Link-01	3672.92	830.00	0.00	765.00	765.00	65.00	1.7700	Trapezoidal	10.000	75.000	0.0320	0.5000	0.5000	0.0000	0.00	No

Channel Results

SN Element ID	Peak Flow	Time of Peak Flow Occurrence	Design Flow Capacity	Peak Flow/Design Flow Ratio	Peak Flow Velocity	Travel Time	Peak Flow Depth	Peak Flow Depth/Total Depth Ratio	Total Time Surcharged	Froude Number	Reported Condition
	(cfs)	(days hh:mm)	(cfs)		(ft/sec)	(min)	(ft)		(min)		
1 Link-01	151.15	0 12:08	8923.48	0.02	7.16	8.55	1.24	0.12	0.00		

Project Description

File Name 22-0138_Ex_Conditions_East.SPF

Project Options

Flow Units CFS
 Elevation Type Elevation
 Hydrology Method SCS TR-55
 Time of Concentration (TOC) Method SCS TR-55
 Link Routing Method Kinematic Wave
 Enable Overflow Ponding at Nodes YES
 Skip Steady State Analysis Time Periods ... YES

Analysis Options

Start Analysis On 00:00:00 0:00:00
 End Analysis On 00:00:00 0:00:00
 Start Reporting On 00:00:00 0:00:00
 Antecedent Dry Days 0 days
 Runoff (Dry Weather) Time Step 0 01:00:00 days hh:mm:ss
 Runoff (Wet Weather) Time Step 0 00:05:00 days hh:mm:ss
 Reporting Time Step 0 00:00:01 days hh:mm:ss
 Routing Time Step 1 seconds

Number of Elements

	Qty
Rain Gages	1
Subbasins.....	3
Nodes.....	4
<i>Junctions</i>	1
<i>Outfalls</i>	3
<i>Flow Diversions</i>	0
<i>Inlets</i>	0
<i>Storage Nodes</i>	0
Links.....	1
<i>Channels</i>	1
<i>Pipes</i>	0
<i>Pumps</i>	0
<i>Orifices</i>	0
<i>Weirs</i>	0
<i>Outlets</i>	0
Pollutants	0
Land Uses	0

Rainfall Details

SN	Rain Gage ID	Data Source	Data Source ID	Rainfall Type	Rain Units	State	County	Return Period (years)	Rainfall Depth (inches)	Rainfall Distribution
49		Time Series	25-yr	Cumulative	inches	Missouri	Platte	25.00	6.58	SCS Type II 24-hr

Subbasin Summary

SN Subbasin ID	Area (ac)	Peak Rate Factor	Weighted Curve Number	Total Rainfall (in)	Total Runoff (in)	Total Runoff Volume (ac-in)	Peak Runoff (cfs)	Time of Concentration (days hh:mm:ss)
1 Existing-01	57.26	484.00	69.72	6.58	3.24	185.75	230.72	0 00:15:00
2 Existing-02	13.64	484.00	56.16	6.58	1.96	26.79	34.62	0 00:11:36
3 Existing-03	11.65	484.00	55.39	6.58	1.90	22.09	30.44	0 00:08:06

Node Summary

SN	Element ID	Element Type	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Initial Water Elevation (ft)	Surcharge Elevation (ft)	Ponded Area (ft ²)	Peak Inflow (cfs)	Max HGL Elevation (ft)	Max Surcharge Depth (ft)	Min Freeboard (ft)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	1-Jun	Junction	830.00	845.00	830.00	0.00	0.00	230.71	831.61	0.00	13.39	0 00:00	0.00	0.00
2	Out-01	Outfall	0.00					219.13	766.56					
3	Out-02	Outfall	0.00					34.62	0.00					
4	Out-03	Outfall	0.00					30.44	0.00					

Link Summary

SN Element ID	Element Type	From (Inlet) Node	To (Outlet) Node	Length (ft)	Inlet Invert Elevation (ft)	Outlet Invert Elevation (ft)	Average Slope (%)	Diameter or Height (in)	Manning's Roughness	Peak Flow (cfs)	Design Flow Capacity (cfs)	Peak Flow/Design Flow Ratio	Peak Flow Velocity (ft/sec)	Peak Flow Depth (ft)	Peak Flow Depth/Total Depth Ratio	Total Time Reported Surcharged Condition (min)
1 Link-01	Channel	1-Jun	Out-01	3672.92	830.00	765.00	1.7700	120.000	0.0320	219.13	8923.48	0.02	7.99	1.53	0.15	0.00

Subbasin Hydrology

Subbasin : Existing-01

Input Data

Area (ac) 57.26
 Peak Rate Factor 484
 Weighted Curve Number 69.72
 Rain Gage ID Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
32			
Woods, Good	14.92	B	55
Woods, Good	15.34	C	70
Woods, Good	24.72	D	77
1/3 acre lots, 30% impervious	1.95	D	86
1/3 acre lots, 30% impervious	0.33	C	81
Composite Area & Weighted CN	57.26		69.72

Time of Concentration

TOC Method : SCS TR-55

Sheet Flow Equation :

$$T_c = (0.007 * ((n * L_f)^{0.8}) / ((P^{0.5}) * (S_f^{0.4})))$$

Where :

Tc = Time of Concentration (hr)
 n = Manning's roughness
 Lf = Flow Length (ft)
 P = 2 yr, 24 hr Rainfall (inches)
 Sf = Slope (ft/ft)

Shallow Concentrated Flow Equation :

V = 16.1345 * (Sf^{0.5}) (unpaved surface)
 V = 20.3282 * (Sf^{0.5}) (paved surface)
 V = 15.0 * (Sf^{0.5}) (grassed waterway surface)
 V = 10.0 * (Sf^{0.5}) (nearly bare & untilled surface)
 V = 9.0 * (Sf^{0.5}) (cultivated straight rows surface)
 V = 7.0 * (Sf^{0.5}) (short grass pasture surface)
 V = 5.0 * (Sf^{0.5}) (woodland surface)
 V = 2.5 * (Sf^{0.5}) (forest w/heavy litter surface)
 Tc = (Lf / V) / (3600 sec/hr)

Where:

Tc = Time of Concentration (hr)
 Lf = Flow Length (ft)
 V = Velocity (ft/sec)
 Sf = Slope (ft/ft)

Channel Flow Equation :

V = (1.49 * (R^{2/3}) * (Sf^{0.5})) / n
 R = Aq / Wp
 Tc = (Lf / V) / (3600 sec/hr)

Where :

Tc = Time of Concentration (hr)
 Lf = Flow Length (ft)
 R = Hydraulic Radius (ft)
 Aq = Flow Area (ft²)
 Wp = Wetted Perimeter (ft)
 V = Velocity (ft/sec)
 Sf = Slope (ft/ft)
 n = Manning's roughness

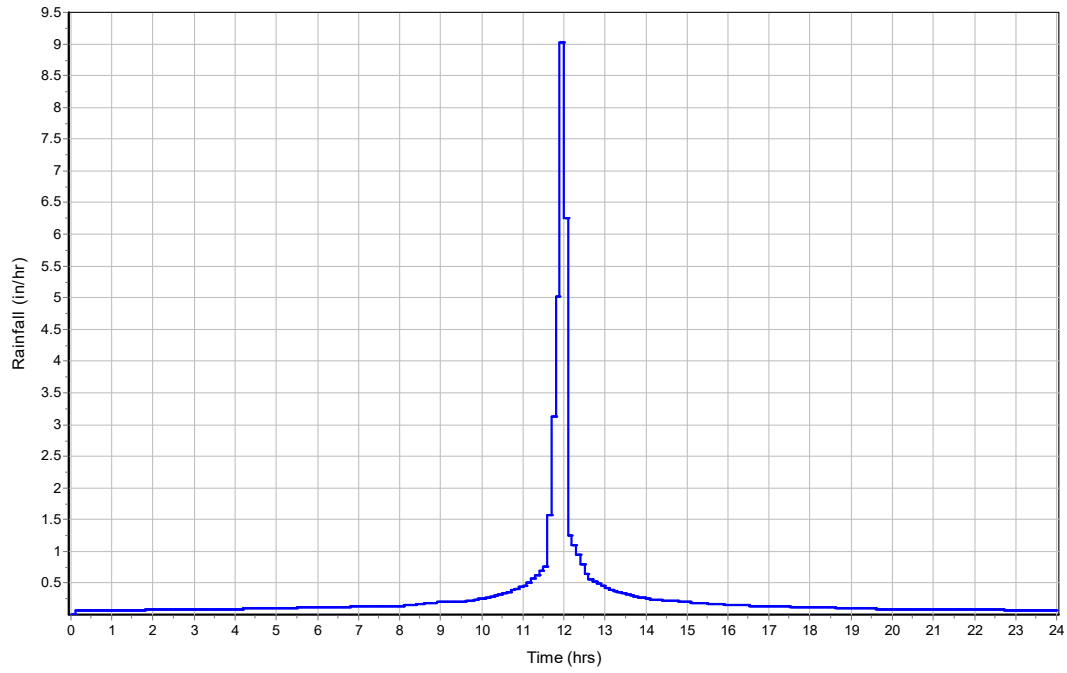
User-Defined TOC override (minutes): 15

Subbasin Runoff Results

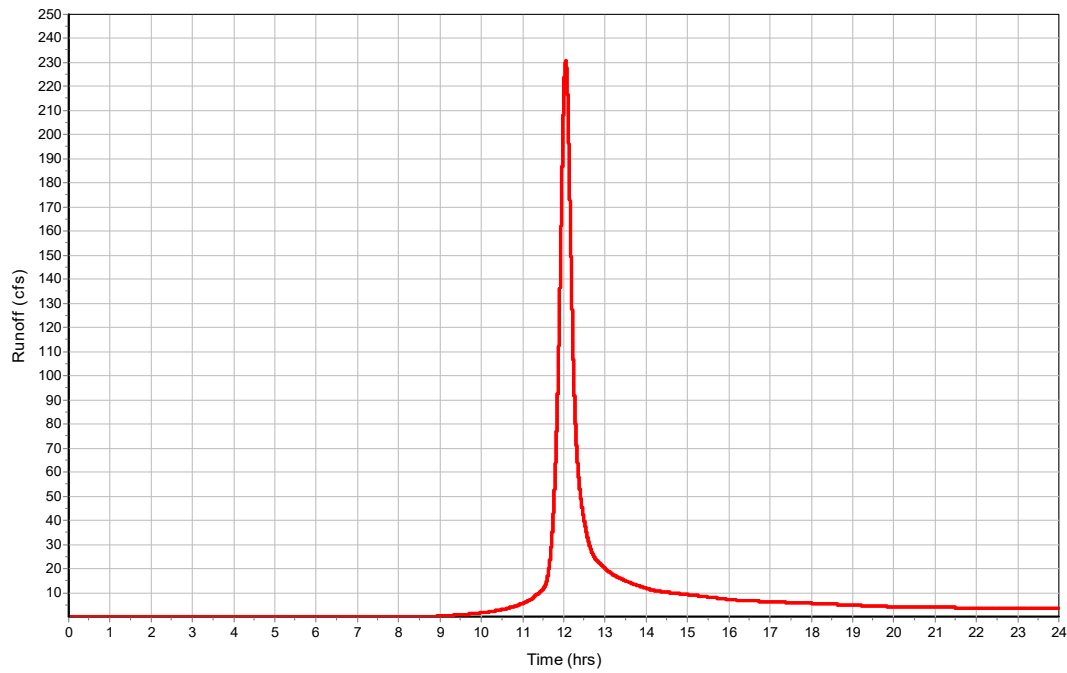
Total Rainfall (in)	6.58
Total Runoff (in)	3.24
Peak Runoff (cfs)	230.72
Weighted Curve Number	69.72
Time of Concentration (days hh:mm:ss)	0 00:15:00

Subbasin : Existing-01

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : Existing-02

Input Data

Area (ac) 13.64
 Peak Rate Factor 484
 Weighted Curve Number 56.16
 Rain Gage ID Rain Gage-01

Composite Curve Number

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
Woods, Good	13.01	B	55
Woods, Good	0.2	D	77
1/3 acre lots, 30% impervious	0.39	C	81
1/3 acre lots, 30% impervious	0.04	D	86
Composite Area & Weighted CN	13.64		56.16

Time of Concentration

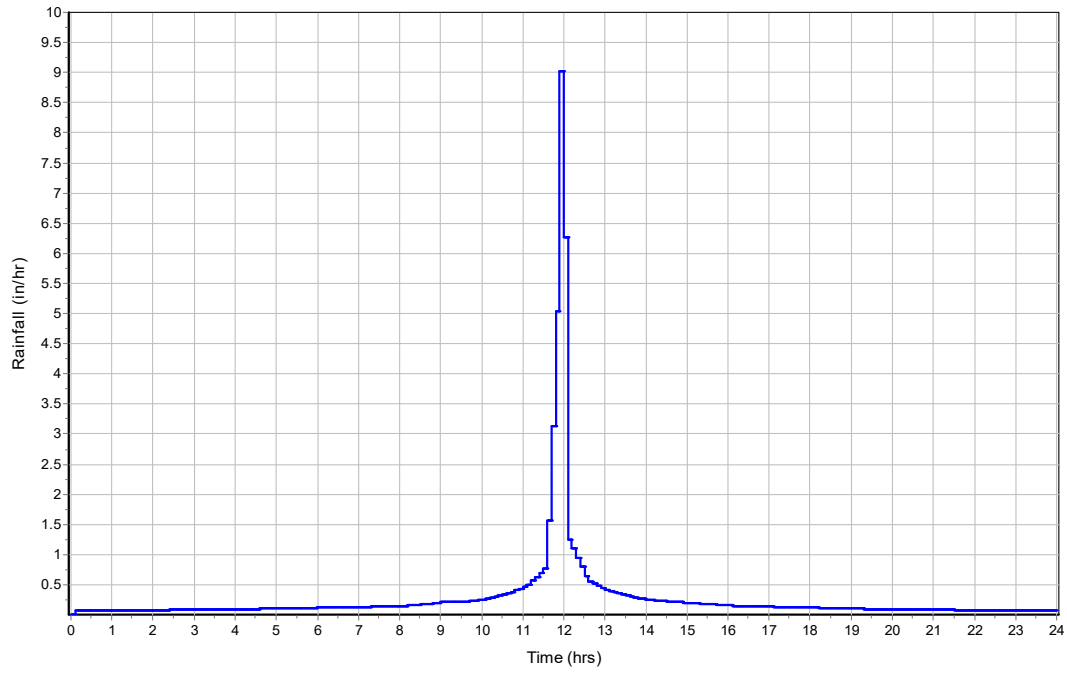
User-Defined TOC override (minutes): 11.6

Subbasin Runoff Results

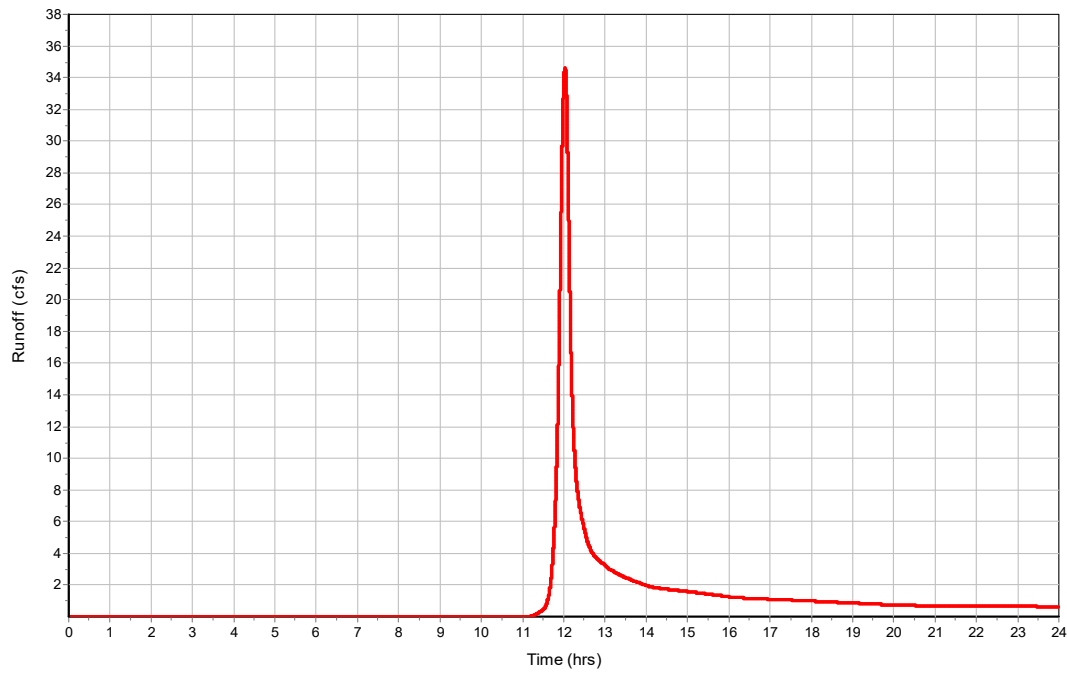
Total Rainfall (in) 6.58
 Total Runoff (in) 1.96
 Peak Runoff (cfs) 34.62
 Weighted Curve Number 56.16
 Time of Concentration (days hh:mm:ss) 0 00:11:36

Subbasin : Existing-02

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : Existing-03

Input Data

Area (ac) 11.65
 Peak Rate Factor 484
 Weighted Curve Number 55.39
 Rain Gage ID Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
32 Woods, Good	11.35	B	55
Woods, Good	0.3	C	70
Composite Area & Weighted CN	11.65		55.39

Time of Concentration

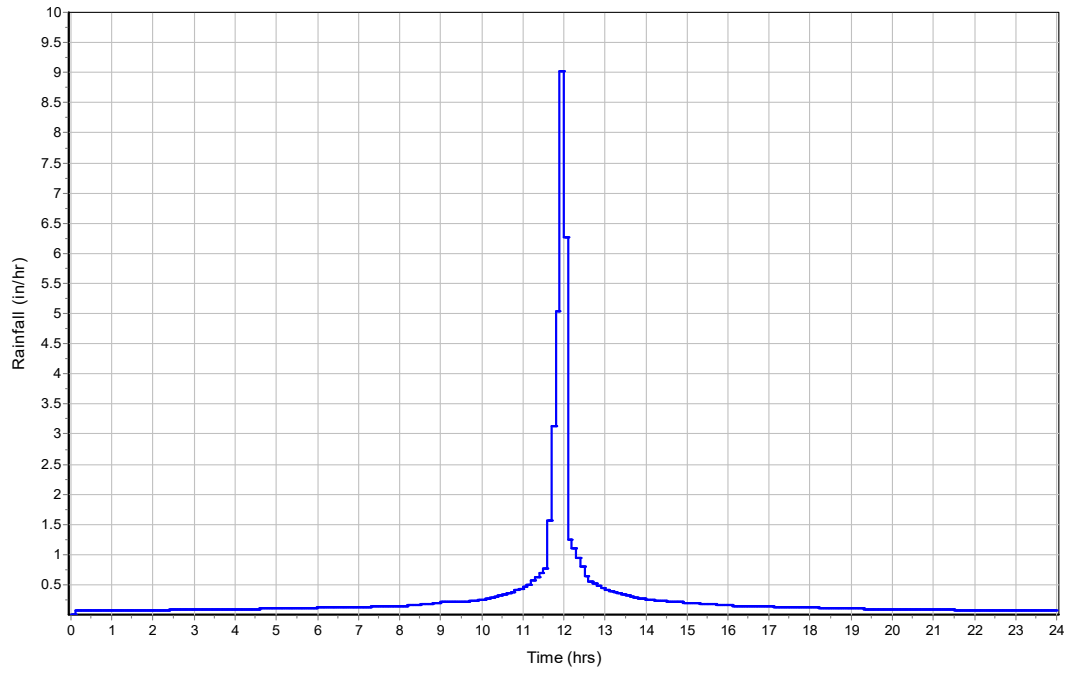
User-Defined TOC override (minutes): 8.1

Subbasin Runoff Results

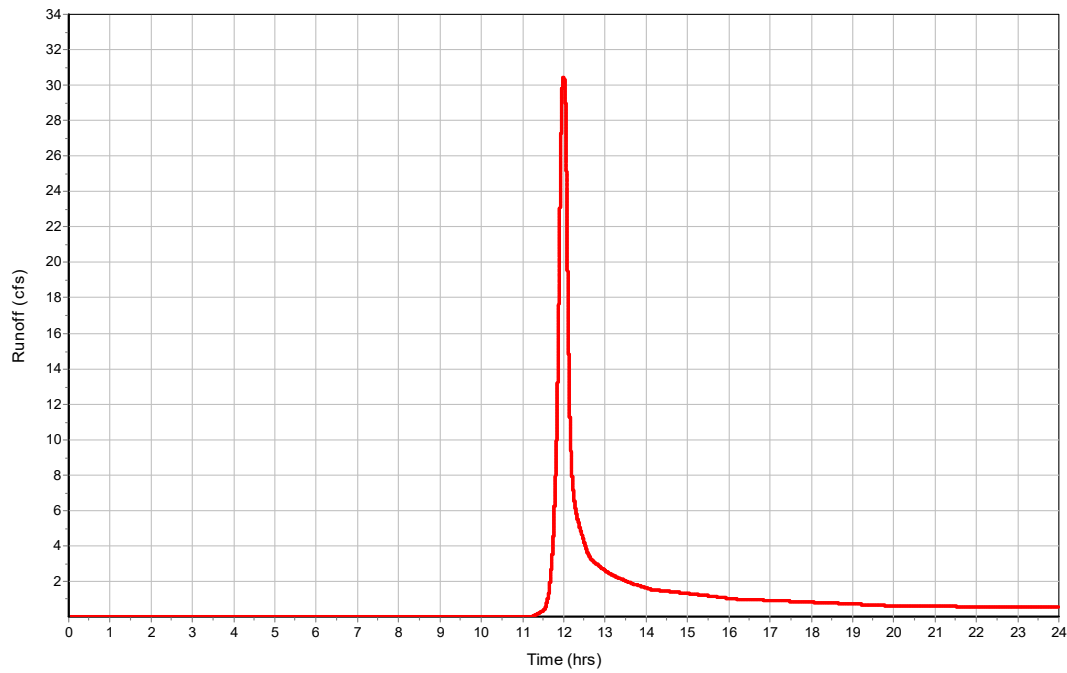
Total Rainfall (in) 6.58
 Total Runoff (in) 1.9
 Peak Runoff (cfs) 30.44
 Weighted Curve Number 55.39
 Time of Concentration (days hh:mm:ss) 0 00:08:06

Subbasin : Existing-03

Rainfall Intensity Graph



Runoff Hydrograph



Junction Input

SN Element ID	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Ground/Rim (Max) Offset (ft)	Initial Water Elevation (ft)	Initial Water Depth (ft)	Surcharge Elevation (ft)	Surcharge Depth (ft)	Ponded Area (ft ²)	Minimum Pipe Cover (in)
1 1-Jun	830.00	845.00	15.00	830.00	0.00	0.00	-845.00	0.00	0.00

Junction Results

SN Element ID	Peak Inflow	Peak Lateral Inflow	Max HGL Elevation	Max HGL Depth	Max Surcharge Depth	Min Freeboard Attained	Average HGL Elevation	Average HGL Depth	Time of Max HGL Occurrence	Time of Peak Flooding Occurrence	Total Flooded Volume	Total Time Flooded
	(cfs)	(cfs)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(days hh:mm)	(days hh:mm)	(ac-in)	(min)
1 1-Jun	230.71	230.71	831.61	1.61	0.00	13.39	830.15	0.15	0 12:02	0 00:00	0.00	0.00

Channel Input

SN Element ID	Length (ft)	Inlet Invert (ft)	Inlet Invert Offset (ft)	Outlet Invert Elevation (ft)	Outlet Invert Offset (ft)	Total Drop (ft)	Average Slope (%)	Shape	Height (ft)	Width (ft)	Manning's Roughness	Entrance Losses	Exit/Bend Losses	Additional Losses	Initial Flow (cfs)	Flap Gate
1 Link-01	3672.92	830.00	0.00	765.00	765.00	65.00	1.7700	Trapezoidal	10.000	75.000	0.0320	0.5000	0.5000	0.0000	0.00	No

Channel Results

SN Element ID	Peak Flow	Time of Peak Flow Occurrence	Design Flow Capacity	Peak Flow/Design Flow Ratio	Peak Flow Velocity	Travel Time	Peak Flow Depth	Peak Flow Depth/Total Depth Ratio	Total Time Surcharged	Froude Number	Reported Condition
	(cfs)	(days hh:mm)	(cfs)		(ft/sec)	(min)	(ft)		(min)		
1 Link-01	219.13	0 12:08	8923.48	0.02	7.99	7.66	1.53	0.15	0.00		

Project Description

File Name 22-0138_Ex_Conditions_East.SPF

Project Options

Flow Units CFS
 Elevation Type Elevation
 Hydrology Method SCS TR-55
 Time of Concentration (TOC) Method SCS TR-55
 Link Routing Method Kinematic Wave
 Enable Overflow Ponding at Nodes YES
 Skip Steady State Analysis Time Periods ... YES

Analysis Options

Start Analysis On 00:00:00 0:00:00
 End Analysis On 00:00:00 0:00:00
 Start Reporting On 00:00:00 0:00:00
 Antecedent Dry Days 0 days
 Runoff (Dry Weather) Time Step 0 01:00:00 days hh:mm:ss
 Runoff (Wet Weather) Time Step 0 00:05:00 days hh:mm:ss
 Reporting Time Step 0 00:00:01 days hh:mm:ss
 Routing Time Step 1 seconds

Number of Elements

	Qty
Rain Gages	1
Subbasins.....	3
Nodes.....	4
<i>Junctions</i>	1
<i>Outfalls</i>	3
<i>Flow Diversions</i>	0
<i>Inlets</i>	0
<i>Storage Nodes</i>	0
Links.....	1
<i>Channels</i>	1
<i>Pipes</i>	0
<i>Pumps</i>	0
<i>Orifices</i>	0
<i>Weirs</i>	0
<i>Outlets</i>	0
Pollutants	0
Land Uses	0

Rainfall Details

SN	Rain Gage ID	Data Source	Data Source ID	Rainfall Type	Rain Units	State	County	Return Period (years)	Rainfall Depth (inches)	Rainfall Distribution
49		Time Series	50-yr	Cumulative	inches	Missouri	Platte	50.00	7.55	SCS Type II 24-hr

Subbasin Summary

SN Subbasin ID	Area (ac)	Peak Rate Factor	Weighted Curve Number	Total Rainfall (in)	Total Runoff (in)	Total Runoff Volume (ac-in)	Peak Runoff (cfs)	Time of Concentration (days hh:mm:ss)
1 Existing-01	57.26	484.00	69.72	7.55	4.05	231.85	287.80	0 00:15:00
2 Existing-02	13.64	484.00	56.16	7.55	2.60	35.46	46.65	0 00:11:36
3 Existing-03	11.65	484.00	55.39	7.55	2.52	29.37	41.27	0 00:08:06

Node Summary

SN	Element ID	Element Type	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Initial Water Elevation (ft)	Surcharge Elevation (ft)	Ponded Area (ft ²)	Peak Inflow (cfs)	Max HGL Elevation (ft)	Max Surcharge Depth (ft)	Min Freeboard Attained (ft)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	1-Jun	Junction	830.00	845.00	830.00	0.00	0.00	287.80	831.82	0.00	13.18	0 00:00	0.00	0.00
2	Out-01	Outfall	0.00					275.45	766.77					
3	Out-02	Outfall	0.00					46.65	0.00					
4	Out-03	Outfall	0.00					41.27	0.00					

Link Summary

SN	Element ID	Element Type	From (Inlet) Node	To (Outlet) Node	Length (ft)	Inlet Invert Elevation (ft)	Outlet Invert Elevation (ft)	Average Slope (%)	Diameter or Height (in)	Manning's Roughness	Peak Flow (cfs)	Design Flow Capacity (cfs)	Peak Flow/Design Flow Ratio	Peak Flow Velocity (ft/sec)	Peak Flow Depth (ft)	Peak Flow Depth/Total Depth Ratio	Total Time Reported Surcharged Condition (min)
1	Link-01	Channel	1-Jun	Out-01	3672.92	830.00	765.00	1.7700	120.000	0.0320	275.45	8923.48	0.03	8.49	1.74	0.17	0.00

Subbasin Hydrology

Subbasin : Existing-01

Input Data

Area (ac) 57.26
 Peak Rate Factor 484
 Weighted Curve Number 69.72
 Rain Gage ID Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
32			
Woods, Good	14.92	B	55
Woods, Good	15.34	C	70
Woods, Good	24.72	D	77
1/3 acre lots, 30% impervious	1.95	D	86
1/3 acre lots, 30% impervious	0.33	C	81
Composite Area & Weighted CN	57.26		69.72

Time of Concentration

TOC Method : SCS TR-55

Sheet Flow Equation :

$$T_c = (0.007 * ((n * L_f)^{0.8}) / ((P^{0.5}) * (S_f^{0.4}))$$

Where :

Tc = Time of Concentration (hr)
 n = Manning's roughness
 Lf = Flow Length (ft)
 P = 2 yr, 24 hr Rainfall (inches)
 Sf = Slope (ft/ft)

Shallow Concentrated Flow Equation :

V = 16.1345 * (Sf^{0.5}) (unpaved surface)
 V = 20.3282 * (Sf^{0.5}) (paved surface)
 V = 15.0 * (Sf^{0.5}) (grassed waterway surface)
 V = 10.0 * (Sf^{0.5}) (nearly bare & untilled surface)
 V = 9.0 * (Sf^{0.5}) (cultivated straight rows surface)
 V = 7.0 * (Sf^{0.5}) (short grass pasture surface)
 V = 5.0 * (Sf^{0.5}) (woodland surface)
 V = 2.5 * (Sf^{0.5}) (forest w/heavy litter surface)
 Tc = (Lf / V) / (3600 sec/hr)

Where:

Tc = Time of Concentration (hr)
 Lf = Flow Length (ft)
 V = Velocity (ft/sec)
 Sf = Slope (ft/ft)

Channel Flow Equation :

V = (1.49 * (R^{2/3}) * (Sf^{0.5})) / n
 R = Aq / Wp
 Tc = (Lf / V) / (3600 sec/hr)

Where :

Tc = Time of Concentration (hr)
 Lf = Flow Length (ft)
 R = Hydraulic Radius (ft)
 Aq = Flow Area (ft²)
 Wp = Wetted Perimeter (ft)
 V = Velocity (ft/sec)
 Sf = Slope (ft/ft)
 n = Manning's roughness

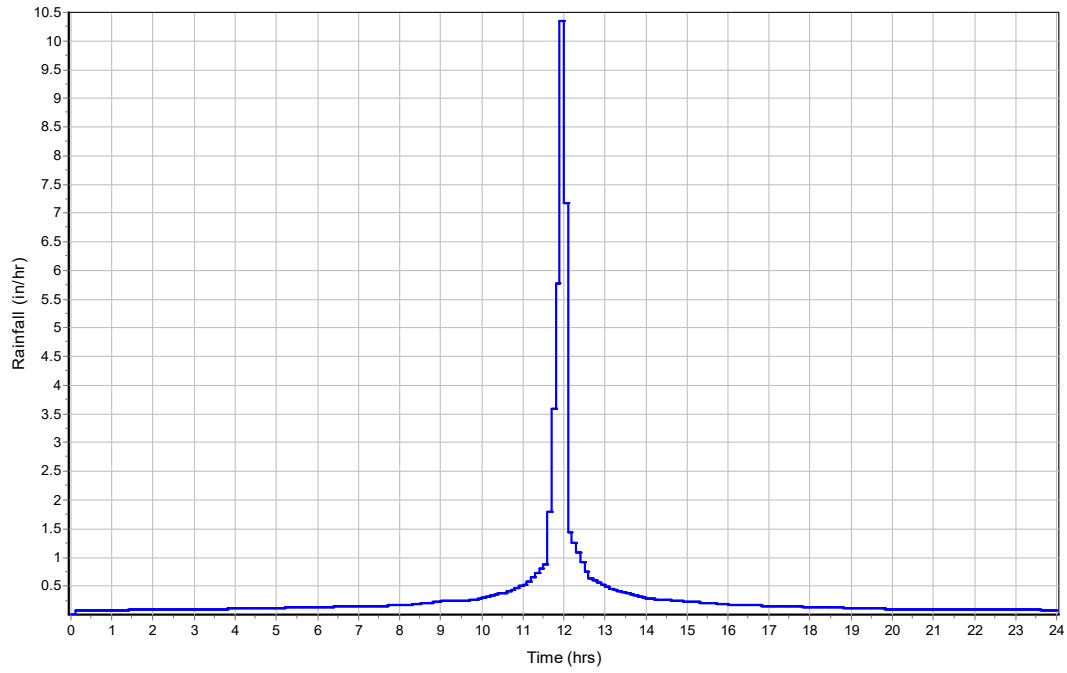
User-Defined TOC override (minutes): 15

Subbasin Runoff Results

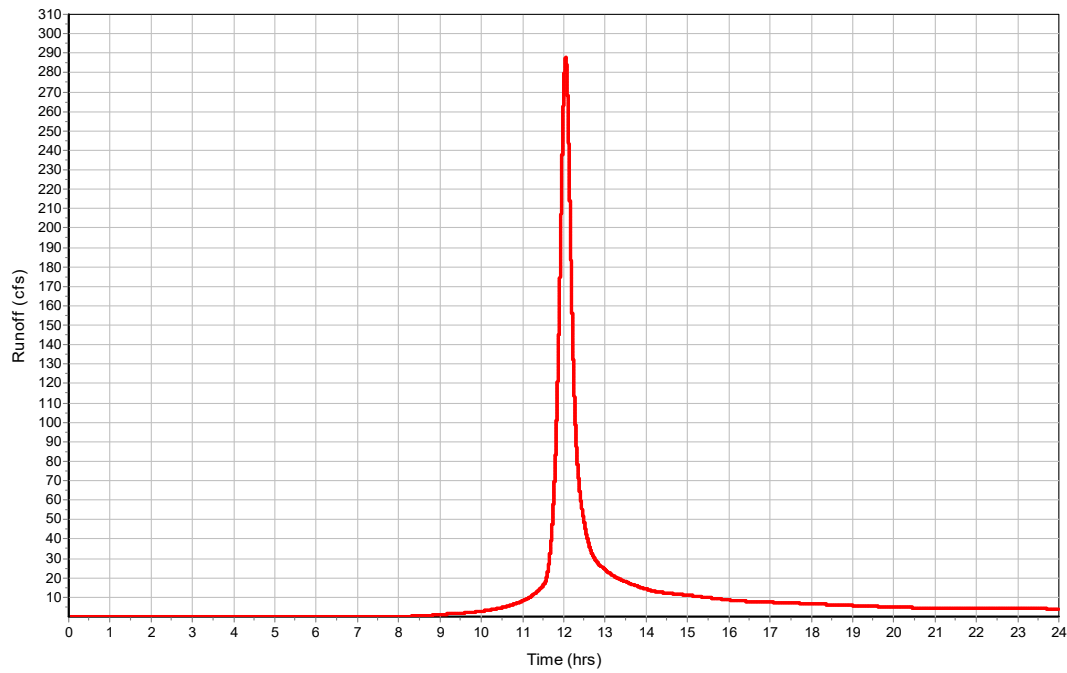
Total Rainfall (in)	7.55
Total Runoff (in)	4.05
Peak Runoff (cfs)	287.8
Weighted Curve Number	69.72
Time of Concentration (days hh:mm:ss)	0 00:15:00

Subbasin : Existing-01

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : Existing-02

Input Data

Area (ac) 13.64
 Peak Rate Factor 484
 Weighted Curve Number 56.16
 Rain Gage ID Rain Gage-01

Composite Curve Number

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
Woods, Good	13.01	B	55
Woods, Good	0.2	D	77
1/3 acre lots, 30% impervious	0.39	C	81
1/3 acre lots, 30% impervious	0.04	D	86
Composite Area & Weighted CN	13.64		56.16

Time of Concentration

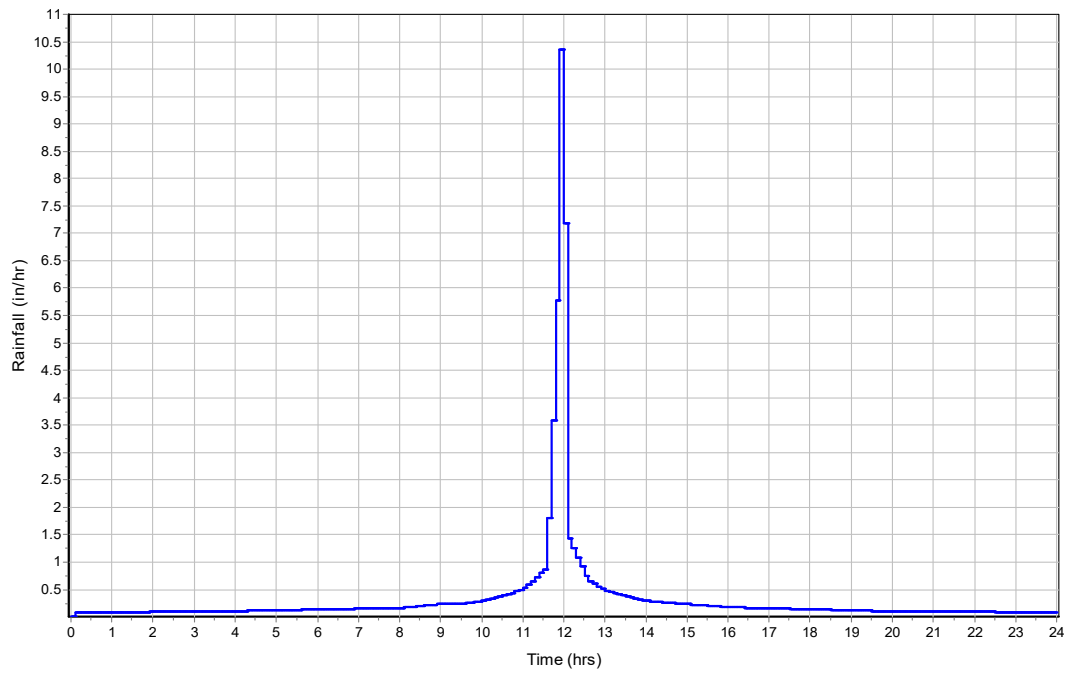
User-Defined TOC override (minutes): 11.6

Subbasin Runoff Results

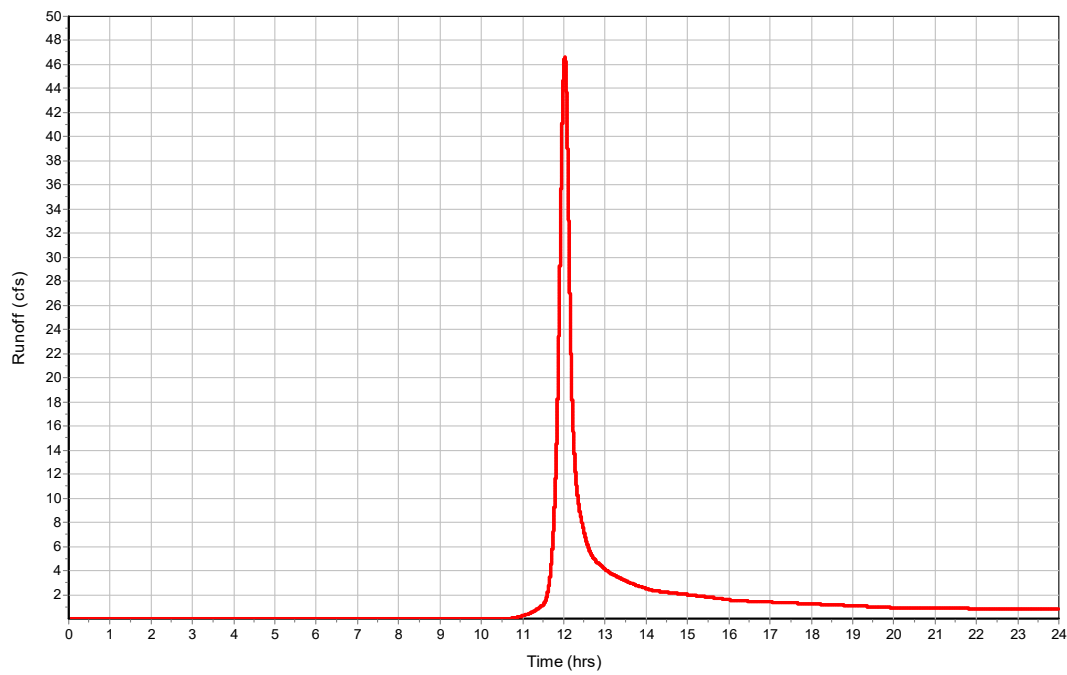
Total Rainfall (in) 7.55
 Total Runoff (in) 2.6
 Peak Runoff (cfs) 46.65
 Weighted Curve Number 56.16
 Time of Concentration (days hh:mm:ss) 0 00:11:36

Subbasin : Existing-02

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : Existing-03

Input Data

Area (ac) 11.65
 Peak Rate Factor 484
 Weighted Curve Number 55.39
 Rain Gage ID Rain Gage-01

Composite Curve Number

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
Woods, Good	11.35	B	55
Woods, Good	0.3	C	70
Composite Area & Weighted CN	11.65		55.39

Time of Concentration

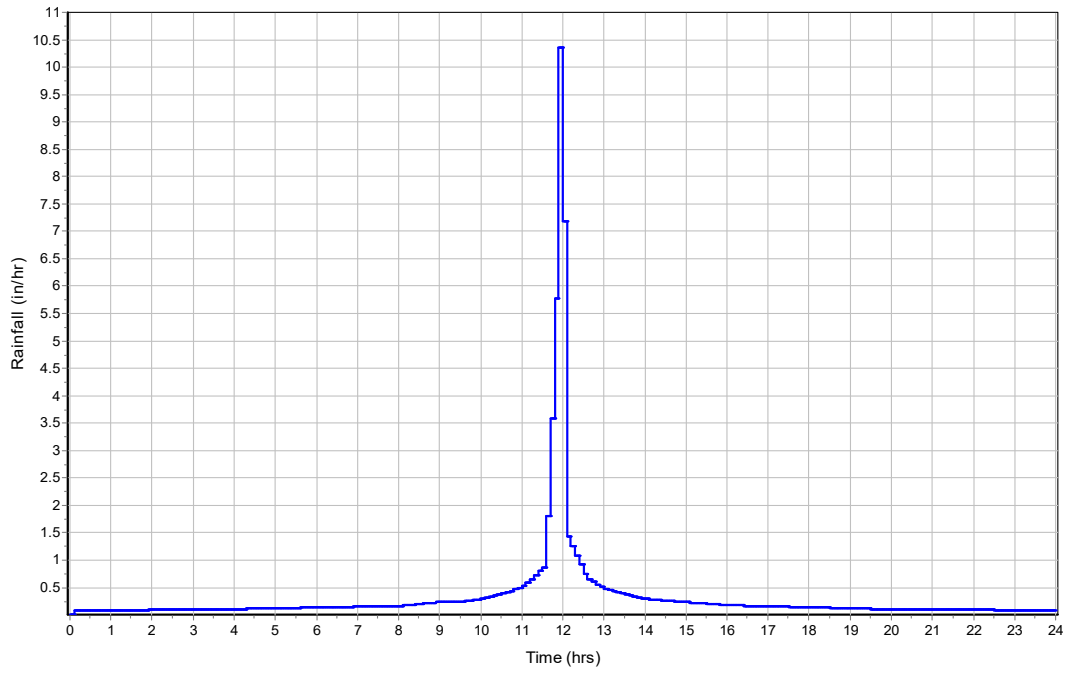
User-Defined TOC override (minutes): 8.1

Subbasin Runoff Results

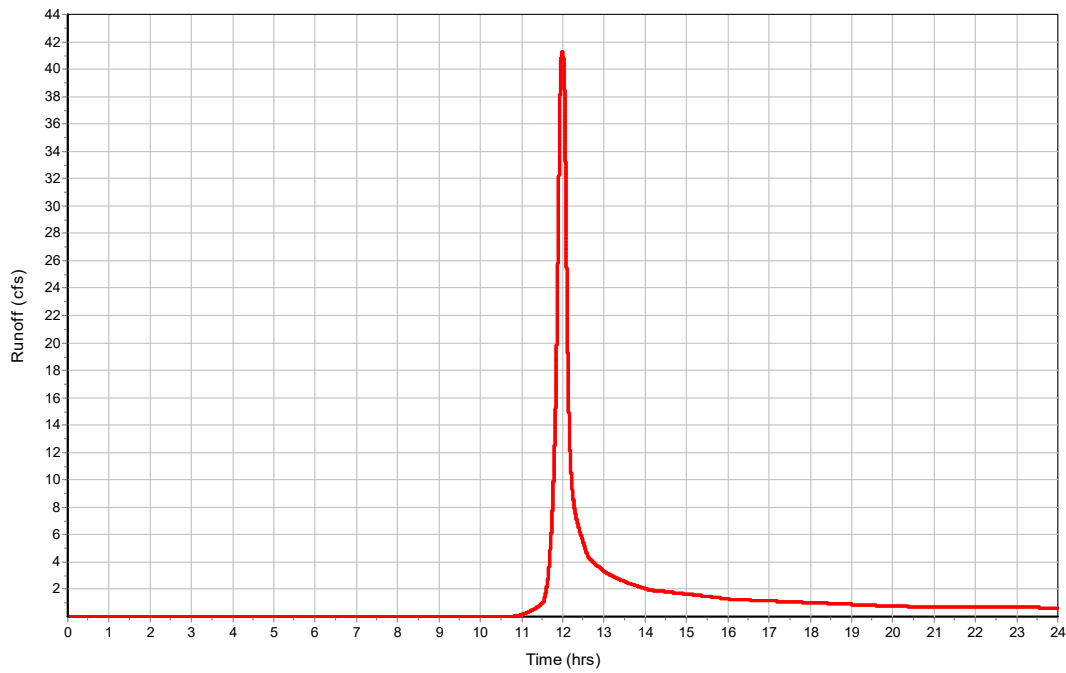
Total Rainfall (in) 7.55
 Total Runoff (in) 2.52
 Peak Runoff (cfs) 41.27
 Weighted Curve Number 55.39
 Time of Concentration (days hh:mm:ss) 0 00:08:06

Subbasin : Existing-03

Rainfall Intensity Graph



Runoff Hydrograph



Junction Input

SN Element ID	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Ground/Rim (Max) Offset (ft)	Initial Water Elevation (ft)	Initial Water Depth (ft)	Surcharge Elevation (ft)	Surcharge Depth (ft)	Ponded Area (ft ²)	Minimum Pipe Cover (in)
1 1-Jun	830.00	845.00	15.00	830.00	0.00	0.00	-845.00	0.00	0.00

Junction Results

SN Element ID	Peak Inflow	Peak Lateral Inflow	Max HGL Elevation Attained	Max HGL Depth Attained	Max Surcharge Depth Attained	Min Freeboard Attained	Average HGL Elevation Attained	Average HGL Depth Attained	Time of Max HGL Occurrence	Time of Peak Flooding Occurrence	Total Flooded Volume	Total Time Flooded
	(cfs)	(cfs)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(days hh:mm)	(days hh:mm)	(ac-in)	(min)
1 1-Jun	287.80	287.80	831.82	1.82	0.00	13.18	830.17	0.17	0 12:03	0 00:00	0.00	0.00

Channel Input

SN Element ID	Length (ft)	Inlet Invert (ft)	Inlet Invert Offset (ft)	Outlet Invert Elevation (ft)	Outlet Invert Offset (ft)	Total Drop (ft)	Average Slope (%)	Shape	Height (ft)	Width (ft)	Manning's Roughness	Entrance Losses	Exit/Bend Losses	Additional Losses	Initial Flow (cfs)	Flap Gate
1 Link-01	3672.92	830.00	0.00	765.00	765.00	65.00	1.7700	Trapezoidal	10.000	75.000	0.0320	0.5000	0.5000	0.0000	0.00	No

Channel Results

SN Element ID	Peak Flow	Time of Peak Flow Occurrence	Design Flow Capacity	Peak Flow/Design Flow Ratio	Peak Flow Velocity	Travel Time	Peak Flow Depth	Peak Flow Depth/Total Depth Ratio	Total Time Surcharged	Froude Number	Reported Condition
	(cfs)	(days hh:mm)	(cfs)		(ft/sec)	(min)	(ft)		(min)		
1 Link-01	275.45	0 12:07	8923.48	0.03	8.49	7.21	1.74	0.17	0.00		

Project Description

File Name 22-0138_Ex_Conditions_East.SPF

Project Options

Flow Units CFS
 Elevation Type Elevation
 Hydrology Method SCS TR-55
 Time of Concentration (TOC) Method SCS TR-55
 Link Routing Method Kinematic Wave
 Enable Overflow Ponding at Nodes YES
 Skip Steady State Analysis Time Periods ... YES

Analysis Options

Start Analysis On 00:00:00 0:00:00
 End Analysis On 00:00:00 0:00:00
 Start Reporting On 00:00:00 0:00:00
 Antecedent Dry Days 0 days
 Runoff (Dry Weather) Time Step 0 01:00:00 days hh:mm:ss
 Runoff (Wet Weather) Time Step 0 00:05:00 days hh:mm:ss
 Reporting Time Step 0 00:00:01 days hh:mm:ss
 Routing Time Step 1 seconds

Number of Elements

	Qty
Rain Gages	1
Subbasins.....	3
Nodes.....	4
<i>Junctions</i>	1
<i>Outfalls</i>	3
<i>Flow Diversions</i>	0
<i>Inlets</i>	0
<i>Storage Nodes</i>	0
Links.....	1
<i>Channels</i>	1
<i>Pipes</i>	0
<i>Pumps</i>	0
<i>Orifices</i>	0
<i>Weirs</i>	0
<i>Outlets</i>	0
Pollutants	0
Land Uses	0

Rainfall Details

SN	Rain Gage ID	Data Source	Data Source ID	Rainfall Type	Rain Units	State	County	Return Period (years)	Rainfall Depth (inches)	Rainfall Distribution
49		Time Series	100-yr	Cumulative	inches	Missouri	Platte	100.00	8.57	SCS Type II 24-hr

Subbasin Summary

SN Subbasin ID	Area (ac)	Peak Rate Factor	Weighted Curve Number	Total Rainfall (in)	Total Runoff (in)	Total Runoff Volume (ac-in)	Peak Runoff (cfs)	Time of Concentration (days hh:mm:ss)
1 Existing-01	57.26	484.00	69.72	8.57	4.92	281.95	349.70	0 00:15:00
2 Existing-02	13.64	484.00	56.16	8.57	3.32	45.23	60.13	0 00:11:36
3 Existing-03	11.65	484.00	55.39	8.57	3.23	37.58	53.53	0 00:08:06

Node Summary

SN	Element ID	Element Type	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Initial Water Elevation (ft)	Surcharge Elevation (ft)	Ponded Area (ft ²)	Peak Inflow (cfs)	Max HGL Elevation (ft)	Max Surcharge Depth (ft)	Min Freeboard (ft)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	1-Jun	Junction	830.00	845.00	830.00	0.00	0.00	349.70	832.02	0.00	12.98	0 00:00	0.00	0.00
2	Out-01	Outfall	0.00					336.13	766.98					
3	Out-02	Outfall	0.00					60.13	0.00					
4	Out-03	Outfall	0.00					53.53	0.00					

Link Summary

SN	Element ID	Element Type	From (Inlet) Node	To (Outlet) Node	Length (ft)	Inlet Invert Elevation (ft)	Outlet Invert Elevation (ft)	Average Slope (%)	Diameter or Height (in)	Manning's Roughness	Peak Flow (cfs)	Design Flow Capacity (cfs)	Peak Flow/Design Flow Ratio	Peak Flow Velocity (ft/sec)	Peak Flow Depth (ft)	Peak Flow Depth/Total Depth Ratio	Total Time Reported Surcharged Condition (min)
1	Link-01	Channel	1-Jun	Out-01	3672.92	830.00	765.00	1.7700	120.000	0.0320	336.13	8923.48	0.04	8.98	1.95	0.19	0.00

Subbasin Hydrology

Subbasin : Existing-01

Input Data

Area (ac) 57.26
 Peak Rate Factor 484
 Weighted Curve Number 69.72
 Rain Gage ID Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
32			
Woods, Good	14.92	B	55
Woods, Good	15.34	C	70
Woods, Good	24.72	D	77
1/3 acre lots, 30% impervious	1.95	D	86
1/3 acre lots, 30% impervious	0.33	C	81
Composite Area & Weighted CN	57.26		69.72

Time of Concentration

TOC Method : SCS TR-55

Sheet Flow Equation :

$$T_c = (0.007 * ((n * L_f)^{0.8}) / ((P^{0.5}) * (S_f^{0.4})))$$

Where :

Tc = Time of Concentration (hr)
 n = Manning's roughness
 Lf = Flow Length (ft)
 P = 2 yr, 24 hr Rainfall (inches)
 Sf = Slope (ft/ft)

Shallow Concentrated Flow Equation :

V = 16.1345 * (Sf^{0.5}) (unpaved surface)
 V = 20.3282 * (Sf^{0.5}) (paved surface)
 V = 15.0 * (Sf^{0.5}) (grassed waterway surface)
 V = 10.0 * (Sf^{0.5}) (nearly bare & untilled surface)
 V = 9.0 * (Sf^{0.5}) (cultivated straight rows surface)
 V = 7.0 * (Sf^{0.5}) (short grass pasture surface)
 V = 5.0 * (Sf^{0.5}) (woodland surface)
 V = 2.5 * (Sf^{0.5}) (forest w/heavy litter surface)
 Tc = (Lf / V) / (3600 sec/hr)

Where:

Tc = Time of Concentration (hr)
 Lf = Flow Length (ft)
 V = Velocity (ft/sec)
 Sf = Slope (ft/ft)

Channel Flow Equation :

V = (1.49 * (R^{2/3}) * (Sf^{0.5})) / n
 R = Aq / Wp
 Tc = (Lf / V) / (3600 sec/hr)

Where :

Tc = Time of Concentration (hr)
 Lf = Flow Length (ft)
 R = Hydraulic Radius (ft)
 Aq = Flow Area (ft²)
 Wp = Wetted Perimeter (ft)
 V = Velocity (ft/sec)
 Sf = Slope (ft/ft)
 n = Manning's roughness

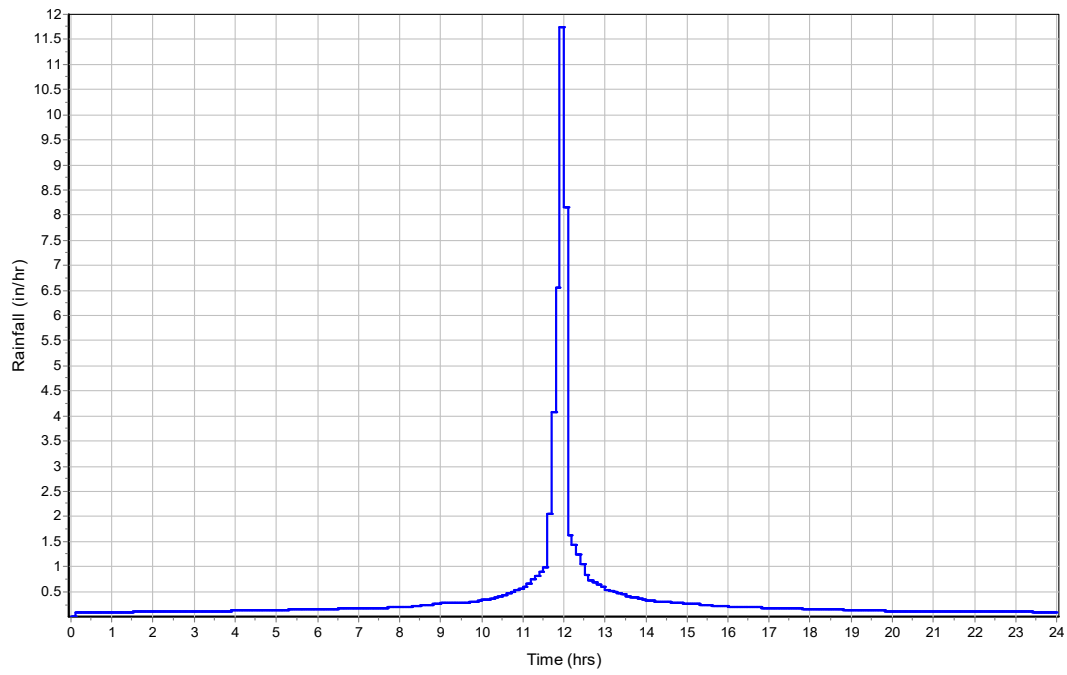
User-Defined TOC override (minutes): 15

Subbasin Runoff Results

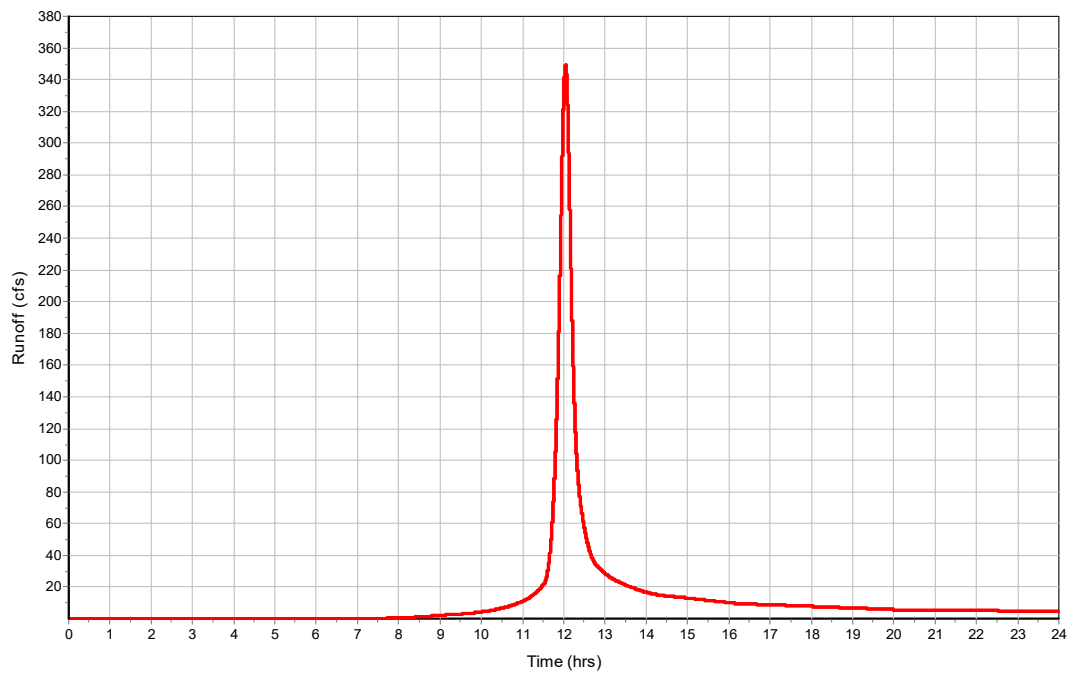
Total Rainfall (in)	8.57
Total Runoff (in)	4.92
Peak Runoff (cfs)	349.7
Weighted Curve Number	69.72
Time of Concentration (days hh:mm:ss)	0 00:15:00

Subbasin : Existing-01

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : Existing-02

Input Data

Area (ac) 13.64
 Peak Rate Factor 484
 Weighted Curve Number 56.16
 Rain Gage ID Rain Gage-01

Composite Curve Number

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
Woods, Good	13.01	B	55
Woods, Good	0.2	D	77
1/3 acre lots, 30% impervious	0.39	C	81
1/3 acre lots, 30% impervious	0.04	D	86
Composite Area & Weighted CN	13.64		56.16

Time of Concentration

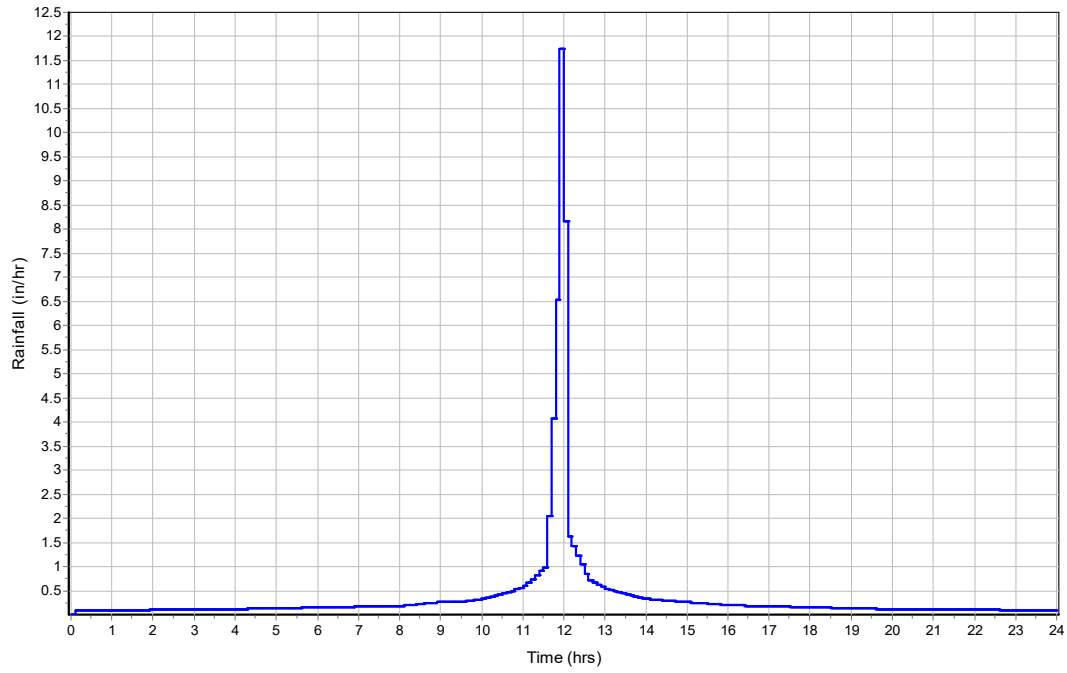
User-Defined TOC override (minutes): 11.6

Subbasin Runoff Results

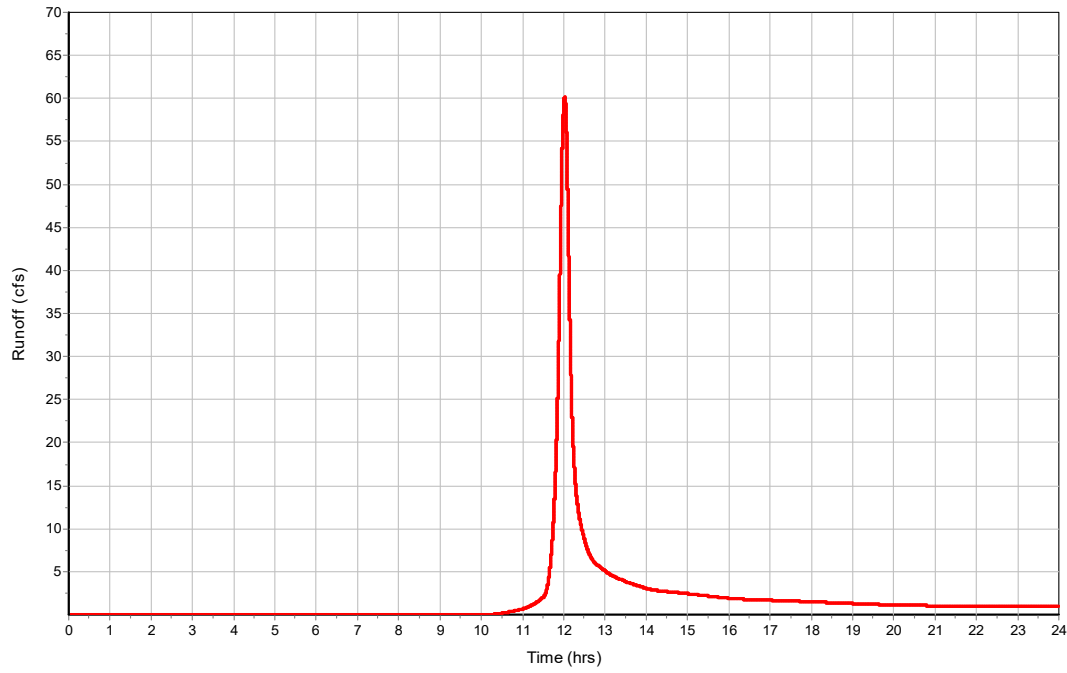
Total Rainfall (in) 8.57
 Total Runoff (in) 3.32
 Peak Runoff (cfs) 60.13
 Weighted Curve Number 56.16
 Time of Concentration (days hh:mm:ss) 0 00:11:36

Subbasin : Existing-02

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : Existing-03

Input Data

Area (ac) 11.65
 Peak Rate Factor 484
 Weighted Curve Number 55.39
 Rain Gage ID Rain Gage-01

Composite Curve Number

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
Woods, Good	11.35	B	55
Woods, Good	0.3	C	70
Composite Area & Weighted CN	11.65		55.39

Time of Concentration

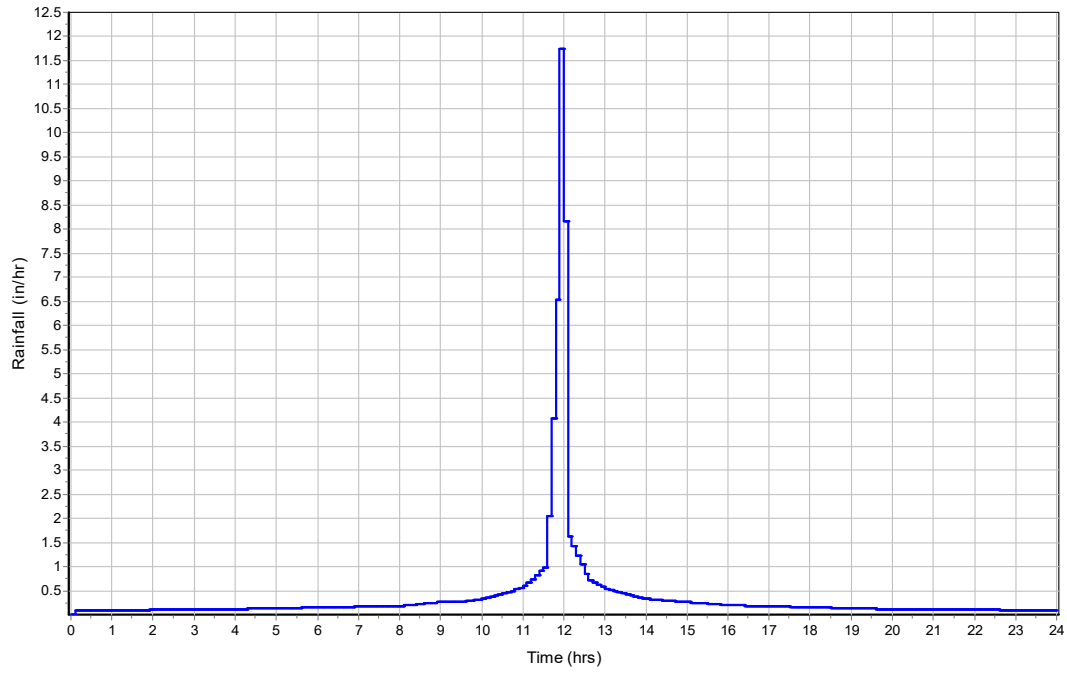
User-Defined TOC override (minutes): 8.1

Subbasin Runoff Results

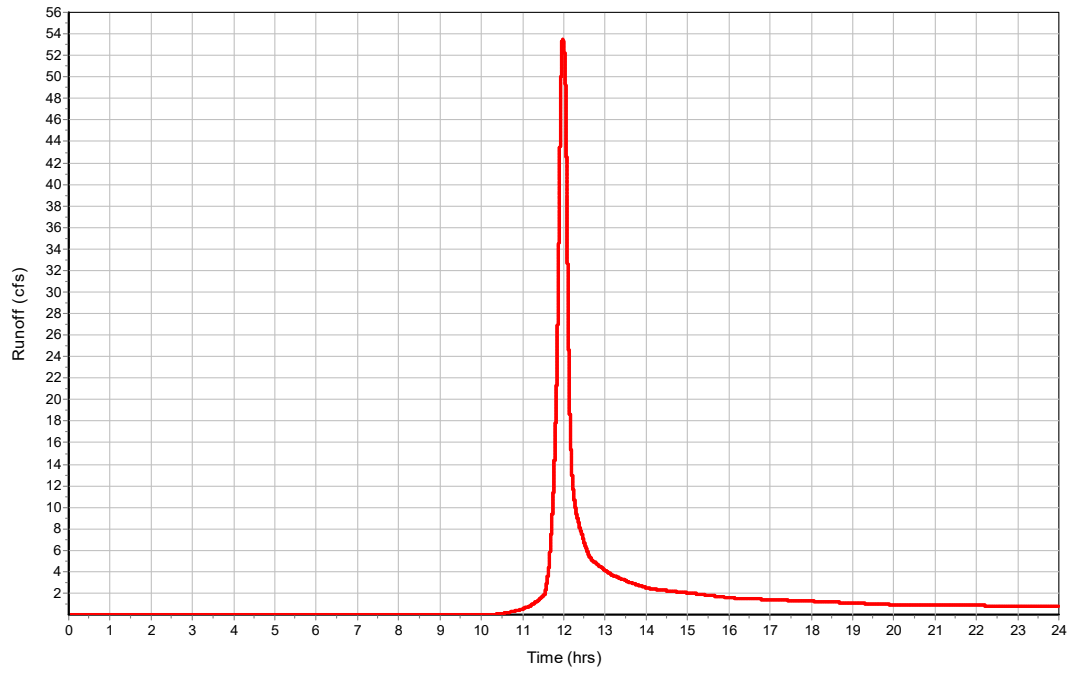
Total Rainfall (in) 8.57
 Total Runoff (in) 3.23
 Peak Runoff (cfs) 53.53
 Weighted Curve Number 55.39
 Time of Concentration (days hh:mm:ss) 0 00:08:06

Subbasin : Existing-03

Rainfall Intensity Graph



Runoff Hydrograph



Junction Input

SN Element ID	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Ground/Rim (Max) Offset (ft)	Initial Water Elevation (ft)	Initial Water Depth (ft)	Surcharge Elevation (ft)	Surcharge Depth (ft)	Ponded Area (ft ²)	Minimum Pipe Cover (in)
1 1-Jun	830.00	845.00	15.00	830.00	0.00	0.00	-845.00	0.00	0.00

Junction Results

SN Element ID	Peak Inflow	Peak Lateral Inflow	Max HGL Elevation	Max HGL Depth	Max Surcharge Depth	Min Freeboard Attained	Average HGL Elevation	Average HGL Depth	Time of Max HGL Occurrence	Time of Peak Flooding Occurrence	Total Flooded Volume	Total Time Flooded
	(cfs)	(cfs)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(days hh:mm)	(days hh:mm)	(ac-in)	(min)
1 1-Jun	349.70	349.70	832.02	2.02	0.00	12.98	830.19	0.19	0 12:02	0 00:00	0.00	0.00

Channel Input

SN Element ID	Length (ft)	Inlet Invert Elevation (ft)	Inlet Invert Offset (ft)	Outlet Invert Elevation (ft)	Outlet Invert Offset (ft)	Total Drop (ft)	Average Slope (%)	Shape	Height (ft)	Width (ft)	Manning's Roughness	Entrance Losses	Exit/Bend Losses	Additional Losses	Initial Flow (cfs)	Flap Gate
1 Link-01	3672.92	830.00	0.00	765.00	765.00	65.00	1.7700	Trapezoidal	10.000	75.000	0.0320	0.5000	0.5000	0.0000	0.00	No

Channel Results

SN Element ID	Peak Flow	Time of Peak Flow Occurrence	Design Flow Capacity	Peak Flow/Design Flow Ratio	Peak Flow Velocity	Travel Time	Peak Flow Depth	Peak Flow Depth/Total Depth Ratio	Total Time Surcharged	Froude Number	Reported Condition
	(cfs)	(days hh:mm)	(cfs)		(ft/sec)	(min)	(ft)		(min)		
1 Link-01	336.13	0 12:07	8923.48	0.04	8.98	6.82	1.95	0.19	0.00		



Appendix G Proposed Drainage Map



Appendix H Proposed Conditions Analysis

Project Description

File Name 22-0138_Prop_Conditions_East.SPF

Project Options

Flow Units CFS
 Elevation Type Elevation
 Hydrology Method SCS TR-55
 Time of Concentration (TOC) Method SCS TR-55
 Link Routing Method Kinematic Wave
 Enable Overflow Ponding at Nodes YES
 Skip Steady State Analysis Time Periods ... YES

Analysis Options

Start Analysis On 00:00:00 0:00:00
 End Analysis On 00:00:00 0:00:00
 Start Reporting On 00:00:00 0:00:00
 Antecedent Dry Days 0 days
 Runoff (Dry Weather) Time Step 0 01:00:00 days hh:mm:ss
 Runoff (Wet Weather) Time Step 0 00:05:00 days hh:mm:ss
 Reporting Time Step 0 00:05:00 days hh:mm:ss
 Routing Time Step 30 seconds

Number of Elements

	Qty
Rain Gages	1
Subbasins.....	5
Nodes.....	8
<i>Junctions</i>	3
<i>Outfalls</i>	3
<i>Flow Diversions</i>	0
<i>Inlets</i>	0
<i>Storage Nodes</i>	2
Links.....	11
<i>Channels</i>	1
<i>Pipes</i>	2
<i>Pumps</i>	0
<i>Orifices</i>	6
<i>Weirs</i>	2
<i>Outlets</i>	0
Pollutants	0
Land Uses	0

Rainfall Details

SN	Rain Gage ID	Data Source	Data Source ID	Rainfall Type	Rain Units	State	County	Return Period (years)	Rainfall Depth (inches)	Rainfall Distribution
49		Time Series	2-yr	Cumulative	inches	Missouri	Platte	2.00	3.59	SCS Type II 24-hr

Subbasin Summary

SN Subbasin ID	Area (ac)	Peak Rate Factor	Weighted Curve Number	Total Rainfall (in)	Total Runoff (in)	Total Runoff Volume (ac-in)	Peak Runoff (cfs)	Time of Concentration (days hh:mm:ss)
1 Proposed_01A	35.43	484.00	75.61	3.59	1.41	49.78	61.12	0 00:15:00
2 Proposed_01B	6.22	484.00	77.27	3.59	1.52	9.43	14.23	0 00:06:24
3 Proposed_01C	12.21	484.00	79.47	3.59	1.67	20.39	29.41	0 00:08:11
4 Proposed_02	16.29	484.00	71.87	3.59	1.17	19.09	24.69	0 00:12:06
5 Proposed_03	12.40	484.00	67.89	3.59	0.95	11.76	16.40	0 00:06:42

Node Summary

SN Element ID	Element Type	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Initial Water Elevation (ft)	Surcharge Elevation (ft)	Ponded Area (ft ²)	Peak Inflow (cfs)	Max HGL Elevation (ft)	Max Surcharge Depth (ft)	Min Freeboard (ft)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	1-Jun Junction	830.00	845.00	830.00	0.00	0.00	59.43	830.74	0.00	14.26	0 00:00	0.00	0.00
2	2-Jun Junction	844.75	849.25	844.75	0.00	0.00	1.04	844.91	0.00	4.34	0 00:00	0.00	0.00
3	4-Jun Junction	785.75	791.50	785.75	0.00	0.00	4.00	786.08	0.00	5.42	0 00:00	0.00	0.00
4	Out-01 Outfall	0.00					56.25	822.09					
5	Out-02 Outfall	0.00					23.88	0.00					
6	Out-03 Outfall	0.00					16.23	0.00					
7	NE-Pond Storage Node	845.00	852.00	845.00		0.00	13.50	846.42				0.00	0.00
8	SE-Pond Storage Node	786.00	794.00	786.00		0.00	28.74	787.80				0.00	0.00

Link Summary

SN	Element ID	Element Type	From (Inlet) Node	To (Outlet) Node	Length (ft)	Inlet Invert Elevation (ft)	Outlet Invert Elevation (ft)	Average Slope (%)	Diameter or Height (in)	Manning's Roughness	Peak Flow (cfs)	Design Flow Capacity (cfs)	Peak Flow/Design Flow Ratio	Peak Flow Velocity (ft/sec)	Peak Flow Depth (ft)	Peak Flow Depth/Total Depth Ratio	Total Time Reported (min)	Surcharged Condition
1	NE-Out	Pipe	2-Jun	Out-01	122.68	844.75	821.93	18.6000	18.000	0.0130	1.04	45.30	0.02	10.28	0.16	0.11	0.00	Calculated
2	SE-Out	Pipe	4-Jun	Out-01	95.88	785.75	772.89	13.4100	18.000	0.0130	4.00	38.47	0.10	14.08	0.33	0.22	0.00	Calculated
3	East_Channel	Channel	1-Jun	Out-01	3672.92	830.00	765.00	1.7700	120.000	0.0320	51.58	8923.48	0.01	5.19	0.65	0.07	0.00	
4	NE-Low	Orifice	NE-Pond	2-Jun		845.00	844.75		6.000		1.04							
5	NE-Middle	Orifice	NE-Pond	2-Jun		845.00	844.75		6.000		0.00							
6	NE-Top	Orifice	NE-Pond	2-Jun		845.00	844.75		6.000		0.00							
7	SE-Low	Orifice	SE-Pond	4-Jun		786.00	785.75		6.000		3.13							
8	SE-Middle	Orifice	SE-Pond	4-Jun		786.00	785.75		6.000		0.88							
9	SE-Top	Orifice	SE-Pond	4-Jun		786.00	785.75		6.000		0.00							
10	NE-High	Weir	NE-Pond	Out-01		845.00	0.00				0.00							
11	SE-Weir	Weir	SE-Pond	Out-01		786.00	0.00				0.00							

Subbasin Hydrology

Subbasin : Proposed_01A

Input Data

Area (ac) 35.43
 Peak Rate Factor 484
 Weighted Curve Number 75.61
 Rain Gage ID Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
32			
Woods, Good	3.71	B	55
Woods, Good	4.79	C	70
Woods, Good	19.01	D	77
1/3 acre lots, 30% impervious	1.06	C	81
1/3 acre lots, 30% impervious	6.86	D	86
Composite Area & Weighted CN	35.43		75.61

Time of Concentration

TOC Method : SCS TR-55

Sheet Flow Equation :

$$T_c = (0.007 * ((n * L_f)^{0.8}) / ((P^{0.5}) * (S_f^{0.4}))$$

Where :

Tc = Time of Concentration (hr)
 n = Manning's roughness
 Lf = Flow Length (ft)
 P = 2 yr, 24 hr Rainfall (inches)
 Sf = Slope (ft/ft)

Shallow Concentrated Flow Equation :

V = 16.1345 * (Sf^{0.5}) (unpaved surface)
 V = 20.3282 * (Sf^{0.5}) (paved surface)
 V = 15.0 * (Sf^{0.5}) (grassed waterway surface)
 V = 10.0 * (Sf^{0.5}) (nearly bare & untilled surface)
 V = 9.0 * (Sf^{0.5}) (cultivated straight rows surface)
 V = 7.0 * (Sf^{0.5}) (short grass pasture surface)
 V = 5.0 * (Sf^{0.5}) (woodland surface)
 V = 2.5 * (Sf^{0.5}) (forest w/heavy litter surface)
 Tc = (Lf / V) / (3600 sec/hr)

Where:

Tc = Time of Concentration (hr)
 Lf = Flow Length (ft)
 V = Velocity (ft/sec)
 Sf = Slope (ft/ft)

Channel Flow Equation :

V = (1.49 * (R^{2/3}) * (Sf^{0.5})) / n
 R = Aq / Wp
 Tc = (Lf / V) / (3600 sec/hr)

Where :

Tc = Time of Concentration (hr)
 Lf = Flow Length (ft)
 R = Hydraulic Radius (ft)
 Aq = Flow Area (ft²)
 Wp = Wetted Perimeter (ft)
 V = Velocity (ft/sec)
 Sf = Slope (ft/ft)
 n = Manning's roughness

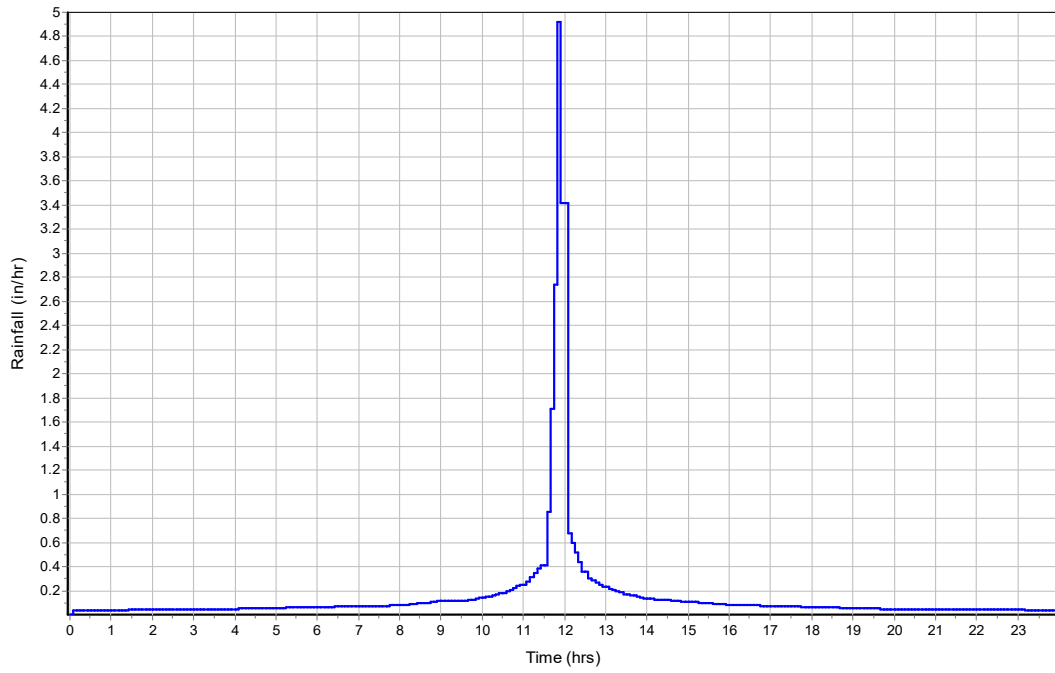
User-Defined TOC override (minutes): 15

Subbasin Runoff Results

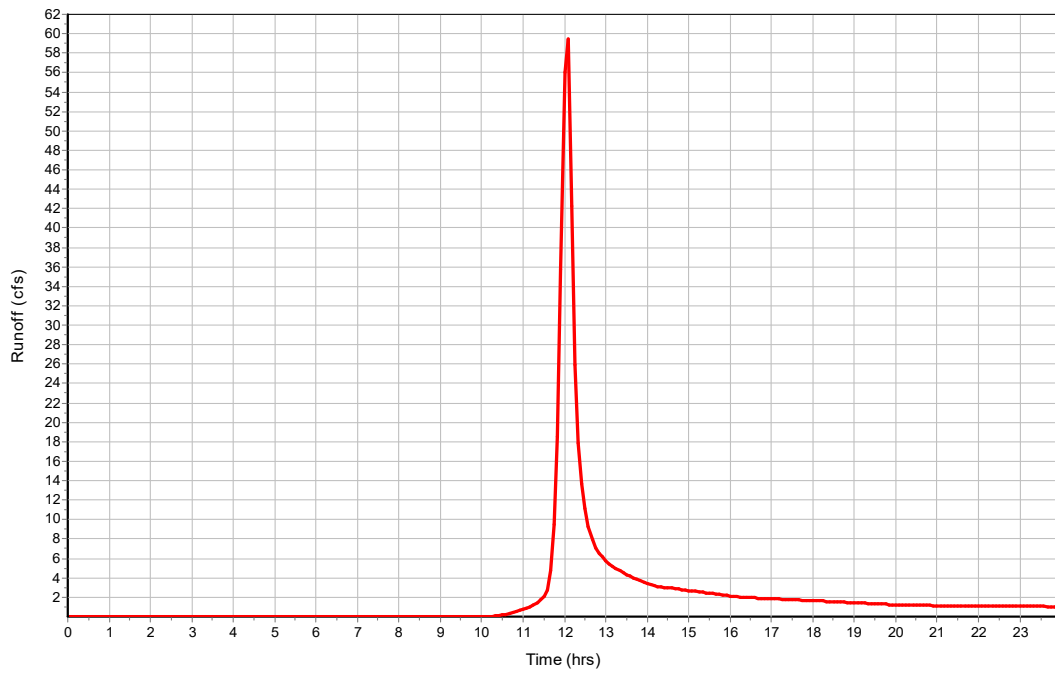
Total Rainfall (in)	3.59
Total Runoff (in)	1.41
Peak Runoff (cfs)	61.12
Weighted Curve Number	75.61
Time of Concentration (days hh:mm:ss)	0 00:15:00

Subbasin : Proposed_01A

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : Proposed_01B

Input Data

Area (ac) 6.22
 Peak Rate Factor 484
 Weighted Curve Number 77.27
 Rain Gage ID Rain Gage-01

Composite Curve Number

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
Woods, Good	0.55	B	55
Woods, Good	1.47	C	70
1/3 acre lots, 30% impervious	2.73	C	81
1/3 acre lots, 30% impervious	1.46	D	86
Composite Area & Weighted CN	6.21		77.27

Time of Concentration

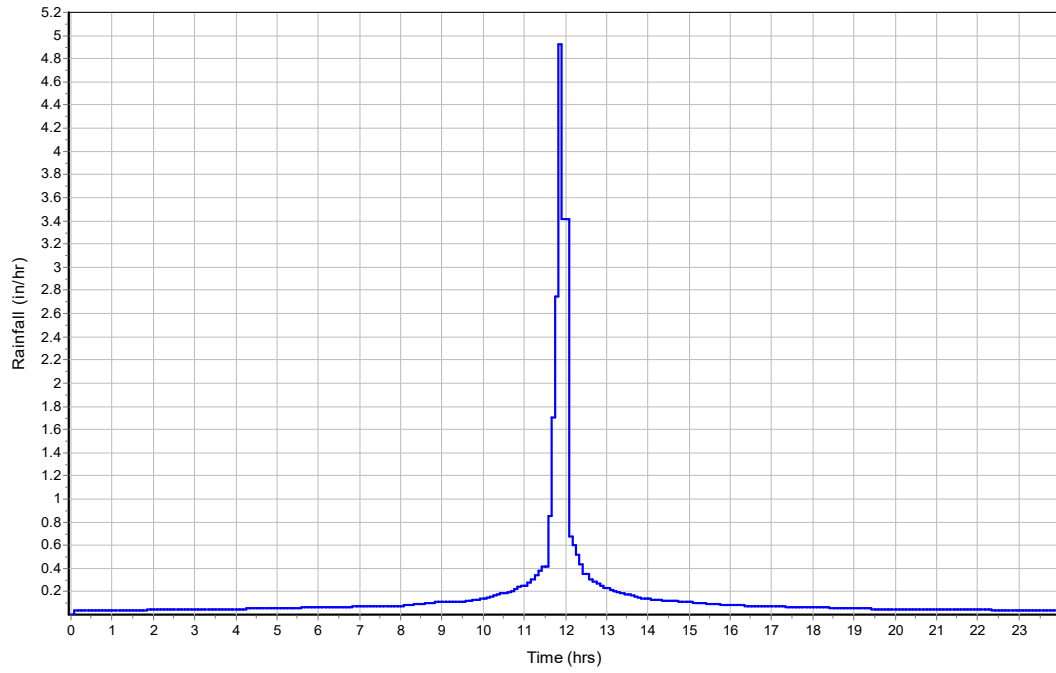
User-Defined TOC override (minutes): 6.4

Subbasin Runoff Results

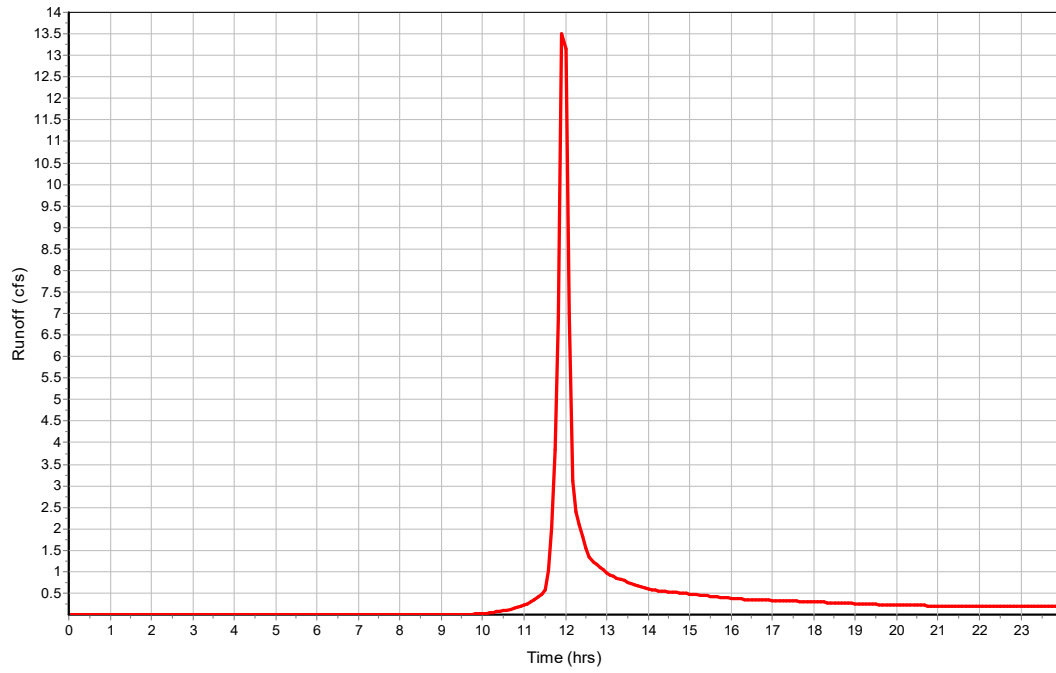
Total Rainfall (in) 3.59
 Total Runoff (in) 1.52
 Peak Runoff (cfs) 14.23
 Weighted Curve Number 77.27
 Time of Concentration (days hh:mm:ss) 0 00:06:24

Subbasin : Proposed_01B

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : Proposed_01C

Input Data

Area (ac) 12.21
 Peak Rate Factor 484
 Weighted Curve Number 79.47
 Rain Gage ID Rain Gage-01

Composite Curve Number

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
Woods, Good	0.12	B	55
Woods, Good	2.52	C	70
Woods, Good	1.24	D	77
1/3 acre lots, 30% impervious	4.9	C	81
1/3 acre lots, 30% impervious	3.43	D	86
Composite Area & Weighted CN	12.21		79.47

Time of Concentration

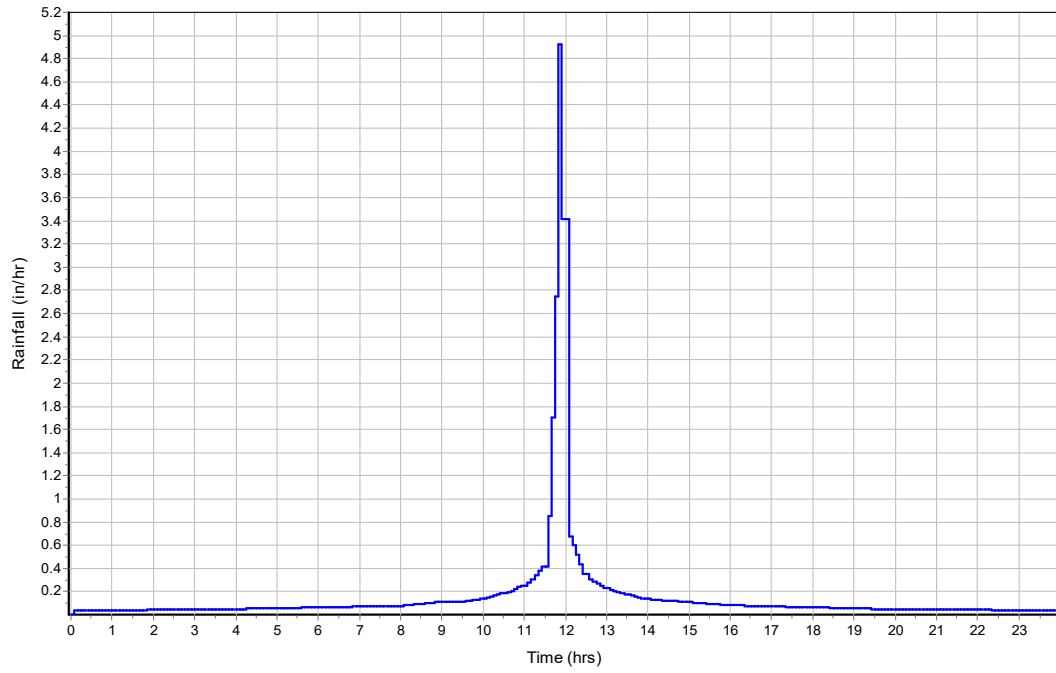
User-Defined TOC override (minutes): 8.2

Subbasin Runoff Results

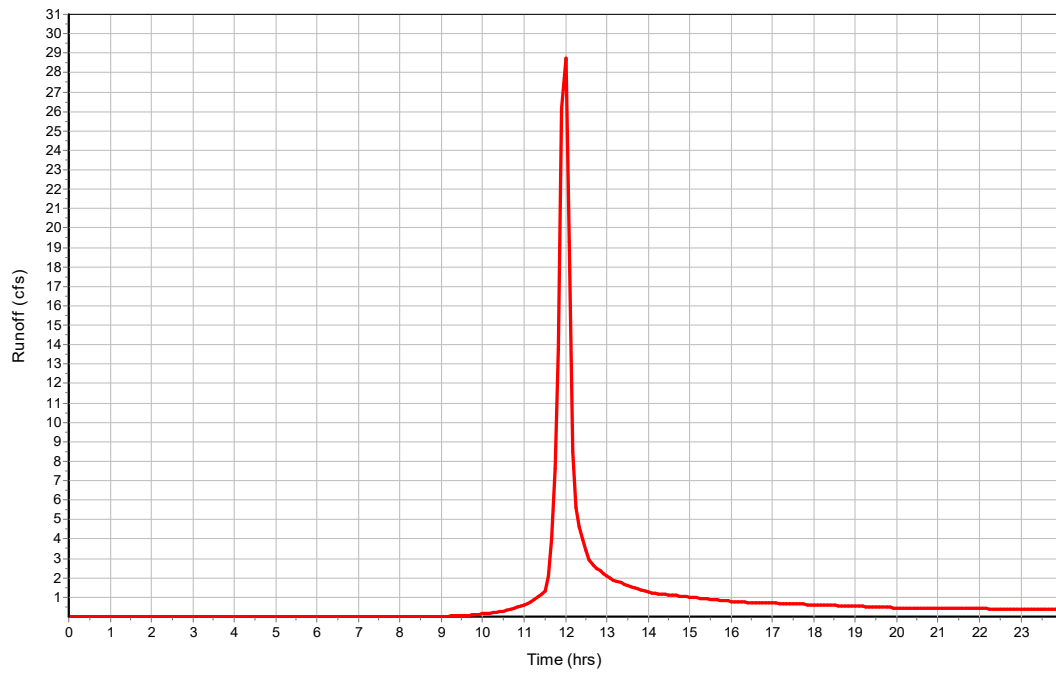
Total Rainfall (in) 3.59
 Total Runoff (in) 1.67
 Peak Runoff (cfs) 29.41
 Weighted Curve Number 79.47
 Time of Concentration (days hh:mm:ss) 0 00:08:12

Subbasin : Proposed_01C

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : Proposed_02

Input Data

Area (ac) 16.29
 Peak Rate Factor 484
 Weighted Curve Number 71.87
 Rain Gage ID Rain Gage-01

Composite Curve Number

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
Woods, Good	6	B	55
1/3 acre lots, 30% impervious	8.84	C	81
1/3 acre lots, 30% impervious	1.45	D	86
Composite Area & Weighted CN	16.29		71.87

Time of Concentration

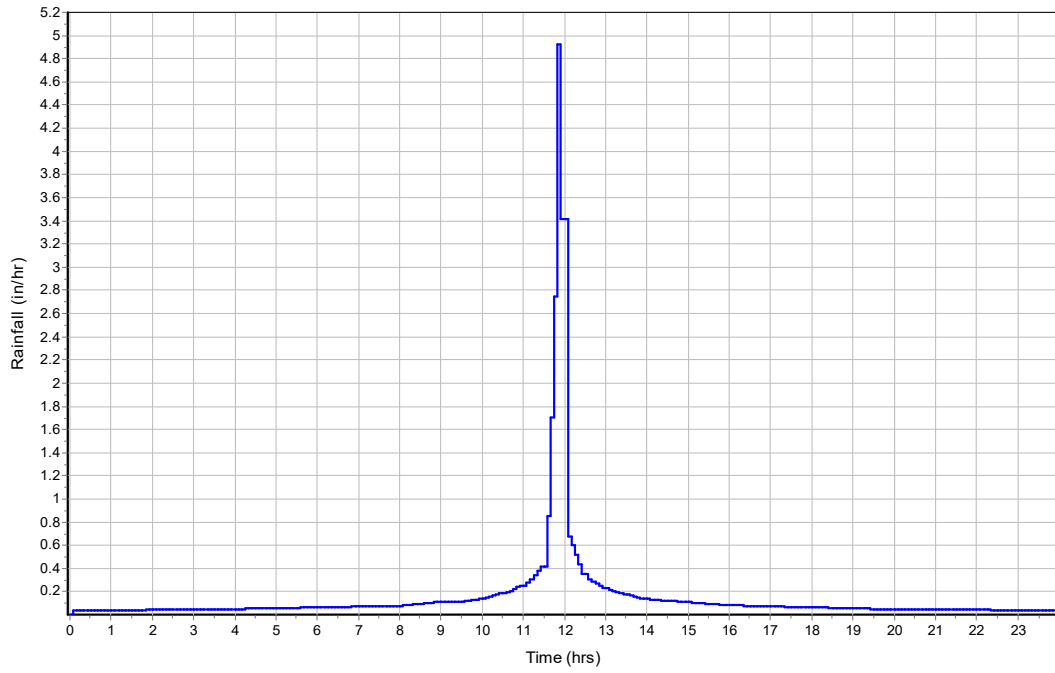
User-Defined TOC override (minutes): 12.1

Subbasin Runoff Results

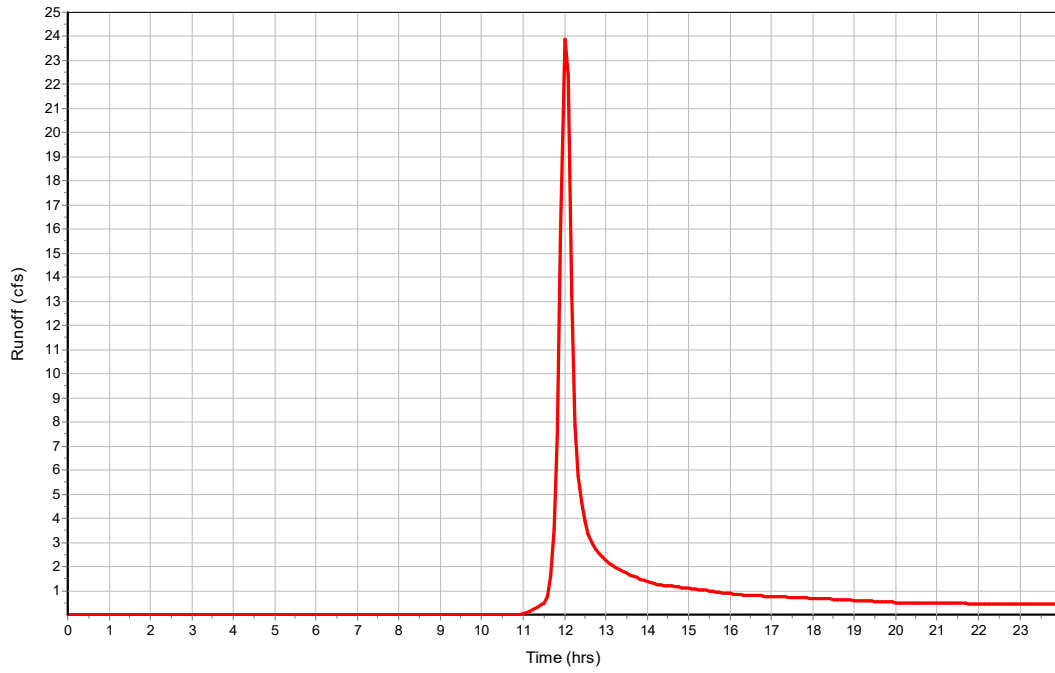
Total Rainfall (in) 3.59
 Total Runoff (in) 1.17
 Peak Runoff (cfs) 24.69
 Weighted Curve Number 71.87
 Time of Concentration (days hh:mm:ss) 0 00:12:06

Subbasin : Proposed_02

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : Proposed_03

Input Data

Area (ac) 12.4
 Peak Rate Factor 484
 Weighted Curve Number 67.89
 Rain Gage ID Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
32			
Woods, Good	6.17	B	55
Woods, Good	0.23	C	70
1/3 acre lots, 30% impervious	5.92	C	81
1/3 acre lots, 30% impervious	0.08	D	86
Composite Area & Weighted CN	12.4		67.89

Time of Concentration

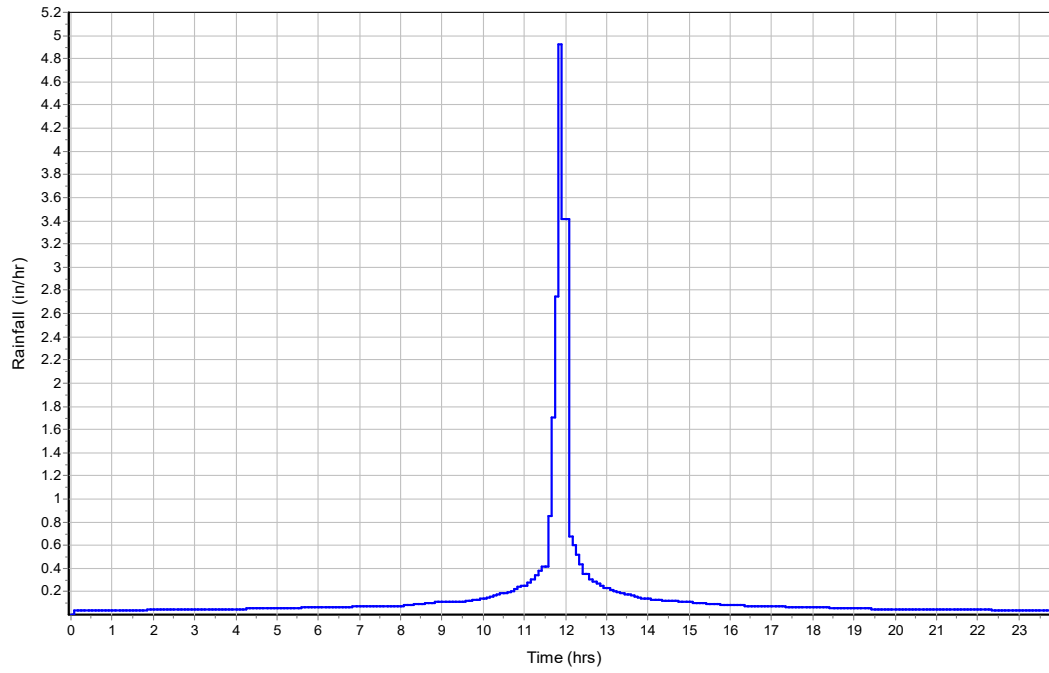
User-Defined TOC override (minutes): 6.7

Subbasin Runoff Results

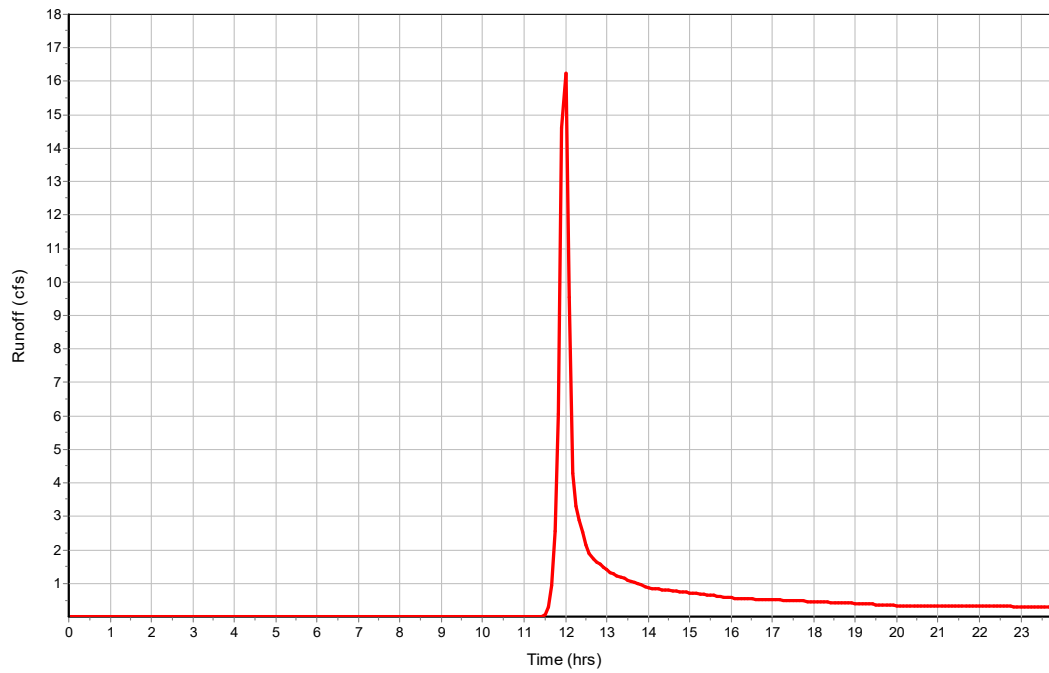
Total Rainfall (in) 3.59
 Total Runoff (in) 0.95
 Peak Runoff (cfs) 16.4
 Weighted Curve Number 67.89
 Time of Concentration (days hh:mm:ss) 0 00:06:42

Subbasin : Proposed_03

Rainfall Intensity Graph



Runoff Hydrograph



Junction Input

SN Element ID	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Ground/Rim (Max) Offset (ft)	Initial Water Elevation (ft)	Initial Water Depth (ft)	Surcharge Elevation (ft)	Surcharge Depth (ft)	Ponded Area (ft ²)	Minimum Pipe Cover (in)
1 1-Jun	830.00	845.00	15.00	830.00	0.00	0.00	-845.00	0.00	0.00
2 2-Jun	844.75	849.25	4.50	844.75	0.00	0.00	-849.25	0.00	0.00
3 4-Jun	785.75	791.50	5.75	785.75	0.00	0.00	-791.50	0.00	0.00

Junction Results

SN Element ID	Peak Inflow	Peak Lateral Inflow	Max HGL Elevation	Max HGL Depth	Max Surcharge Depth	Min Freeboard	Average HGL Elevation	Average HGL Depth	Time of Max HGL Occurrence	Time of Peak Flooding Occurrence	Total Flooded Volume	Total Time Flooded
	(cfs)	(cfs)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(days hh:mm)	(days hh:mm)	(ac-in)	(min)
1 1-Jun	59.43	59.43	830.74	0.74	0.00	14.26	830.07	0.07	0 12:10	0 00:00	0.00	0.00
2 2-Jun	1.04	0.00	844.91	0.16	0.00	4.34	844.82	0.07	0 13:00	0 00:00	0.00	0.00
3 4-Jun	4.00	0.00	786.08	0.33	0.00	5.42	785.85	0.10	0 12:30	0 00:00	0.00	0.00

Channel Input

SN Element ID	Length	Inlet Invert Elevation (ft)	Inlet Invert Offset (ft)	Outlet Invert Elevation (ft)	Outlet Invert Offset (ft)	Total Drop (ft)	Average Slope (%)	Shape	Height (ft)	Width (ft)	Manning's Roughness	Entrance Losses	Exit/Bend Losses	Additional Losses	Initial Flow (cfs)	Flap Gate
1 East_Channel	3672.92	830.00	0.00	765.00	765.00	65.00	1.7700	Trapezoidal	10.000	75.000	0.0320	0.5000	0.5000	0.0000	0.00	No

Channel Results

SN Element ID	Peak Flow	Time of Peak Flow Occurrence	Design Flow Capacity	Peak Flow/ Design Flow Ratio	Peak Flow Velocity	Travel Time	Peak Flow Depth	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged	Froude Number	Reported Condition
	(cfs)	(days hh:mm)	(cfs)		(ft/sec)	(min)	(ft)		(min)		
1 East_Channel	51.58	0 12:16	8923.48	0.01	5.19	11.79	0.65	0.07	0.00		

Pipe Input

SN Element ID	Length (ft)	Inlet Invert Elevation (ft)	Inlet Invert Offset (ft)	Outlet Invert Elevation (ft)	Outlet Invert Offset (ft)	Total Drop (ft)	Average Pipe Slope (%)	Pipe Shape	Pipe Diameter or Height (in)	Pipe Width (in)	Manning's Roughness	Entrance Losses	Exit/Bend Losses	Additional Losses	Initial Flow (cfs)	Flap Gate	No. of Barrels
1 NE-Out	122.68	844.75	0.00	821.93	821.93	22.82	18.6000	CIRCULAR	18.000	18.000	0.0130	0.5000	0.5000	0.0000	0.00	No	1
2 SE-Out	95.88	785.75	0.00	772.89	772.89	12.86	13.4100	CIRCULAR	18.000	18.000	0.0130	0.5000	0.5000	0.0000	0.00	No	1

Pipe Results

SN Element ID	Peak Flow	Time of Peak Flow Occurrence	Design Flow Capacity	Peak Flow/ Design Flow Ratio	Peak Flow Velocity	Travel Time	Peak Flow Depth	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged	Froude Number	Reported Condition
	(cfs)	(days hh:mm)	(cfs)		(ft/sec)	(min)	(ft)		(min)		
1 NE-Out	1.04	0 13:00	45.30	0.02	10.28	0.20	0.16	0.11	0.00		Calculated
2 SE-Out	4.00	0 12:30	38.47	0.10	14.08	0.11	0.33	0.22	0.00		Calculated

Storage Nodes

Storage Node : NE-Pond

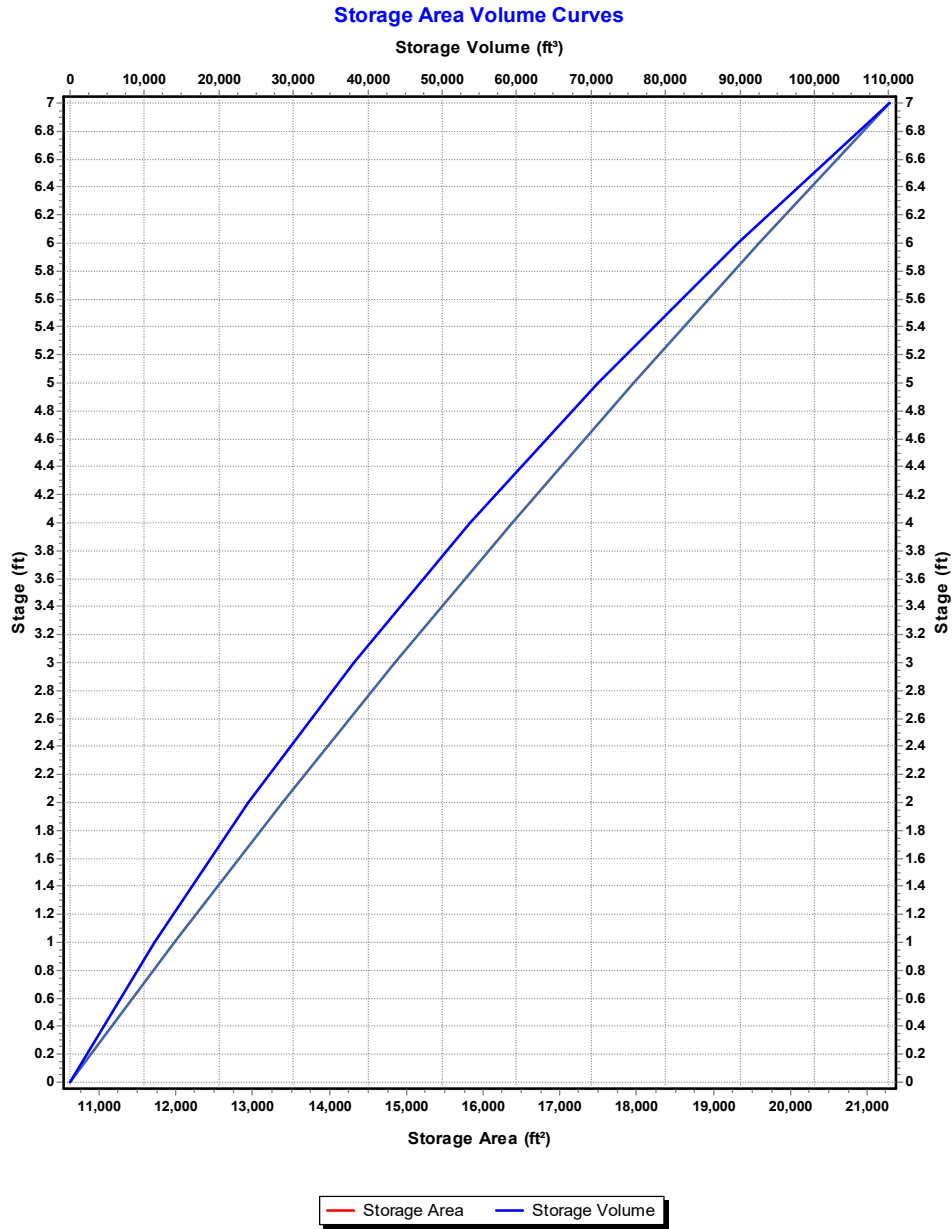
Input Data

Invert Elevation (ft)	845.00
Max (Rim) Elevation (ft)	852.00
Max (Rim) Offset (ft)	7.00
Initial Water Elevation (ft)	845.00
Initial Water Depth (ft)	0.00
Ponded Area (ft ²)	0.00
Evaporation Loss	0.00

Storage Area Volume Curves

Storage Curve : North East Pond

Stage	Storage Area	Storage Volume
(ft)	(ft ²)	(ft ³)
0	10623.06	0
1	11977.56	11300.31
2	13388.6	23983.39
3	14856.2	38105.79
4	16380.34	53724.06
5	17961.03	70894.75
6	19598.27	89674.4
7	21292.06	110119.57



Storage Node : NE-Pond (continued)

Outflow Weirs

SN Element ID	Weir Type	Flap Gate	Crest Elevation (ft)	Crest Offset (ft)	Length (ft)	Weir Total Height (ft)	Discharge Coefficient
1 NE-High	Trapezoidal	No	850.00	5.00	18.00	2.00	3.33

Outflow Orifices

SN Element ID	Orifice Type	Orifice Shape	Flap Gate	Circular Orifice Diameter (in)	Rectangular Orifice Height (in)	Rectangular Orifice Width (in)	Orifice Invert Elevation (ft)	Orifice Coefficient
1 NE-Low	Side	CIRCULAR	No	6.00			845.00	0.61
2 NE-Middle	Side	Rectangular	No		6.00	12.00	846.50	0.63
3 NE-Top	Side	Rectangular	No		6.00	12.00	848.25	0.63

Output Summary Results

Peak Inflow (cfs)	13.5
Peak Lateral Inflow (cfs)	13.5
Peak Outflow (cfs)	1.04
Peak Exfiltration Flow Rate (cfm)	0
Max HGL Elevation Attained (ft)	846.42
Max HGL Depth Attained (ft)	1.42
Average HGL Elevation Attained (ft)	845.43
Average HGL Depth Attained (ft)	0.43
Time of Max HGL Occurrence (days hh:mm)	0 13:00
Total Exfiltration Volume (1000-ft ³)	0
Total Flooded Volume (ac-in)	0
Total Time Flooded (min)	0
Total Retention Time (sec)	0

Storage Node : SE-Pond

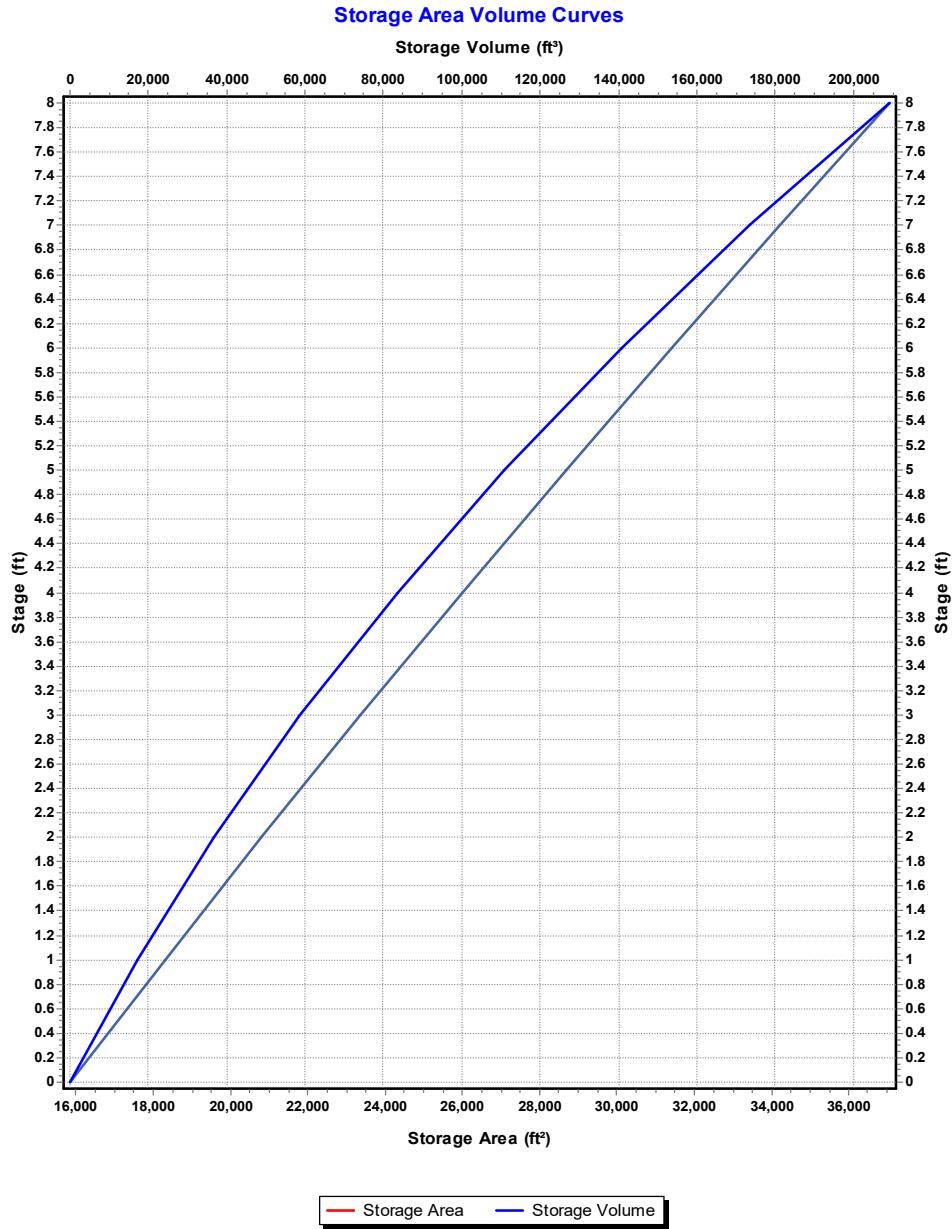
Input Data

Invert Elevation (ft)	786.00
Max (Rim) Elevation (ft)	794.00
Max (Rim) Offset (ft)	8.00
Initial Water Elevation (ft)	786.00
Initial Water Depth (ft)	0.00
Ponded Area (ft ²)	0.00
Evaporation Loss	0.00

Storage Area Volume Curves

Storage Curve : South East Pond

Stage (ft)	Storage Area (ft ²)	Storage Volume (ft ³)
0	15847.77	0
1	18300.77	17074.27
2	20810.31	36629.81
3	23376.41	58723.17
4	25999.05	83410.9
5	28678.24	110749.55
6	31413.98	140795.66
7	34206.27	173605.79
8	37055.1	209236.48



Storage Node : SE-Pond (continued)

Outflow Weirs

SN Element ID	Weir Type	Flap Gate	Crest Elevation (ft)	Crest Offset (ft)	Length (ft)	Weir Total Height (ft)	Discharge Coefficient
1 SE-Weir	Trapezoidal	No	792.00	6.00	35.00	1.50	3.33

Outflow Orifices

SN Element ID	Orifice Type	Orifice Shape	Flap Gate	Circular Orifice Diameter (in)	Rectangular Orifice Height (in)	Rectangular Orifice Width (in)	Orifice Invert Elevation (ft)	Orifice Coefficient
1 SE-Low	Side	Rectangular	No		6.00	12.00	786.00	0.63
2 SE-Middle	Side	Rectangular	No		6.00	18.00	787.50	0.63
3 SE-Top	Side	Rectangular	No		6.00	18.00	790.50	0.63

Output Summary Results

Peak Inflow (cfs)	28.74
Peak Lateral Inflow (cfs)	28.74
Peak Outflow (cfs)	4
Peak Exfiltration Flow Rate (cfm)	0
Max HGL Elevation Attained (ft)	787.8
Max HGL Depth Attained (ft)	1.8
Average HGL Elevation Attained (ft)	786.39
Average HGL Depth Attained (ft)	0.39
Time of Max HGL Occurrence (days hh:mm)	0 12:30
Total Exfiltration Volume (1000-ft ³)	0
Total Flooded Volume (ac-in)	0
Total Time Flooded (min)	0
Total Retention Time (sec)	0

Project Description

File Name 22-0138_Prop_Conditions_East.SPF

Project Options

Flow Units CFS
 Elevation Type Elevation
 Hydrology Method SCS TR-55
 Time of Concentration (TOC) Method SCS TR-55
 Link Routing Method Kinematic Wave
 Enable Overflow Ponding at Nodes YES
 Skip Steady State Analysis Time Periods ... YES

Analysis Options

Start Analysis On 00:00:00 0:00:00
 End Analysis On 00:00:00 0:00:00
 Start Reporting On 00:00:00 0:00:00
 Antecedent Dry Days 0 days
 Runoff (Dry Weather) Time Step 0 01:00:00 days hh:mm:ss
 Runoff (Wet Weather) Time Step 0 00:05:00 days hh:mm:ss
 Reporting Time Step 0 00:05:00 days hh:mm:ss
 Routing Time Step 30 seconds

Number of Elements

	Qty
Rain Gages	1
Subbasins.....	5
Nodes.....	8
<i>Junctions</i>	3
<i>Outfalls</i>	3
<i>Flow Diversions</i>	0
<i>Inlets</i>	0
<i>Storage Nodes</i>	2
Links.....	11
<i>Channels</i>	1
<i>Pipes</i>	2
<i>Pumps</i>	0
<i>Orifices</i>	6
<i>Weirs</i>	2
<i>Outlets</i>	0
Pollutants	0
Land Uses	0

Rainfall Details

SN	Rain Gage ID	Data Source	Data Source ID	Rainfall Type	Rain Units	State	County	Return Period (years)	Rainfall Depth (inches)	Rainfall Distribution
49		Time Series	5-yr	Cumulative	inches	Missouri	Platte	5.00	4.54	SCS Type II 24-hr

Subbasin Summary

SN Subbasin ID	Area (ac)	Peak Rate Factor	Weighted Curve Number	Total Rainfall (in)	Total Runoff (in)	Total Runoff Volume (ac-in)	Peak Runoff (cfs)	Time of Concentration (days hh:mm:ss)
1 Proposed_01A	35.43	484.00	75.61	4.54	2.13	75.47	93.72	0 00:15:00
2 Proposed_01B	6.22	484.00	77.27	4.54	2.27	14.09	21.45	0 00:06:24
3 Proposed_01C	12.21	484.00	79.47	4.54	2.45	29.91	43.28	0 00:08:11
4 Proposed_02	16.29	484.00	71.87	4.54	1.84	29.97	39.51	0 00:12:06
5 Proposed_03	12.40	484.00	67.89	4.54	1.55	19.24	28.14	0 00:06:42

Node Summary

SN	Element ID	Element Type	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Initial Water Elevation (ft)	Surcharge Elevation (ft)	Ponded Area (ft ²)	Peak Inflow (cfs)	Max HGL Elevation (ft)	Max Surcharge Depth (ft)	Min Freeboard (ft)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	1-Jun	Junction	830.00	845.00	830.00	0.00	0.00	90.32	830.95	0.00	14.05	0 00:00	0.00	0.00
2	2-Jun	Junction	844.75	849.25	844.75	0.00	0.00	2.53	844.99	0.00	4.26	0 00:00	0.00	0.00
3	4-Jun	Junction	785.75	791.50	785.75	0.00	0.00	7.08	786.19	0.00	5.31	0 00:00	0.00	0.00
4	Out-01	Outfall	0.00					92.11	822.17					
5	Out-02	Outfall	0.00					38.83	0.00					
6	Out-03	Outfall	0.00					26.96	0.00					
7	NE-Pond	Storage Node	845.00	852.00	845.00	0.00	20.57	847.00					0.00	0.00
8	SE-Pond	Storage Node	786.00	794.00	786.00	0.00	41.78	788.52					0.00	0.00

Link Summary

SN	Element ID	Element Type	From (Inlet) Node	To (Outlet) Node	Length (ft)	Inlet Invert Elevation (ft)	Outlet Invert Elevation (ft)	Average Slope (%)	Diameter or Height (in)	Manning's Roughness	Peak Flow (cfs)	Design Flow Capacity (cfs)	Peak Flow/Design Flow Ratio	Peak Flow Velocity (ft/sec)	Peak Flow Depth (ft)	Peak Flow Depth/Total Depth Ratio	Total Time Reported (min)	Surcharged Condition
1	NE-Out	Pipe	2-Jun	Out-01	122.68	844.75	821.93	18.6000	18.000	0.0130	2.53	45.30	0.06	13.82	0.24	0.16	0.00	Calculated
2	SE-Out	Pipe	4-Jun	Out-01	95.88	785.75	772.89	13.4100	18.000	0.0130	7.08	38.47	0.18	16.58	0.44	0.29	0.00	Calculated
3	East_Channel	Channel	1-Jun	Out-01	3672.92	830.00	765.00	1.7700	120.000	0.0320	82.91	8923.48	0.01	6.02	0.87	0.09	0.00	
4	NE-Low	Orifice	NE-Pond	2-Jun		845.00	844.75		6.000									
5	NE-Middle	Orifice	NE-Pond	2-Jun		845.00	844.75		6.000									
6	NE-Top	Orifice	NE-Pond	2-Jun		845.00	844.75		6.000									
7	SE-Low	Orifice	SE-Pond	4-Jun		786.00	785.75		6.000									
8	SE-Middle	Orifice	SE-Pond	4-Jun		786.00	785.75		6.000									
9	SE-Top	Orifice	SE-Pond	4-Jun		786.00	785.75		6.000									
10	NE-High	Weir	NE-Pond	Out-01		845.00	0.00											
11	SE-Weir	Weir	SE-Pond	Out-01		786.00	0.00											

Subbasin Hydrology

Subbasin : Proposed_01A

Input Data

Area (ac) 35.43
 Peak Rate Factor 484
 Weighted Curve Number 75.61
 Rain Gage ID Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
32			
Woods, Good	3.71	B	55
Woods, Good	4.79	C	70
Woods, Good	19.01	D	77
1/3 acre lots, 30% impervious	1.06	C	81
1/3 acre lots, 30% impervious	6.86	D	86
Composite Area & Weighted CN	35.43		75.61

Time of Concentration

TOC Method : SCS TR-55

Sheet Flow Equation :

$$T_c = (0.007 * ((n * L_f)^{0.8}) / ((P^{0.5}) * (S_f^{0.4}))$$

Where :

Tc = Time of Concentration (hr)
 n = Manning's roughness
 Lf = Flow Length (ft)
 P = 2 yr, 24 hr Rainfall (inches)
 Sf = Slope (ft/ft)

Shallow Concentrated Flow Equation :

V = 16.1345 * (Sf^{0.5}) (unpaved surface)
 V = 20.3282 * (Sf^{0.5}) (paved surface)
 V = 15.0 * (Sf^{0.5}) (grassed waterway surface)
 V = 10.0 * (Sf^{0.5}) (nearly bare & untilled surface)
 V = 9.0 * (Sf^{0.5}) (cultivated straight rows surface)
 V = 7.0 * (Sf^{0.5}) (short grass pasture surface)
 V = 5.0 * (Sf^{0.5}) (woodland surface)
 V = 2.5 * (Sf^{0.5}) (forest w/heavy litter surface)
 Tc = (Lf / V) / (3600 sec/hr)

Where:

Tc = Time of Concentration (hr)
 Lf = Flow Length (ft)
 V = Velocity (ft/sec)
 Sf = Slope (ft/ft)

Channel Flow Equation :

V = (1.49 * (R^{2/3}) * (Sf^{0.5})) / n
 R = Aq / Wp
 Tc = (Lf / V) / (3600 sec/hr)

Where :

Tc = Time of Concentration (hr)
 Lf = Flow Length (ft)
 R = Hydraulic Radius (ft)
 Aq = Flow Area (ft²)
 Wp = Wetted Perimeter (ft)
 V = Velocity (ft/sec)
 Sf = Slope (ft/ft)
 n = Manning's roughness

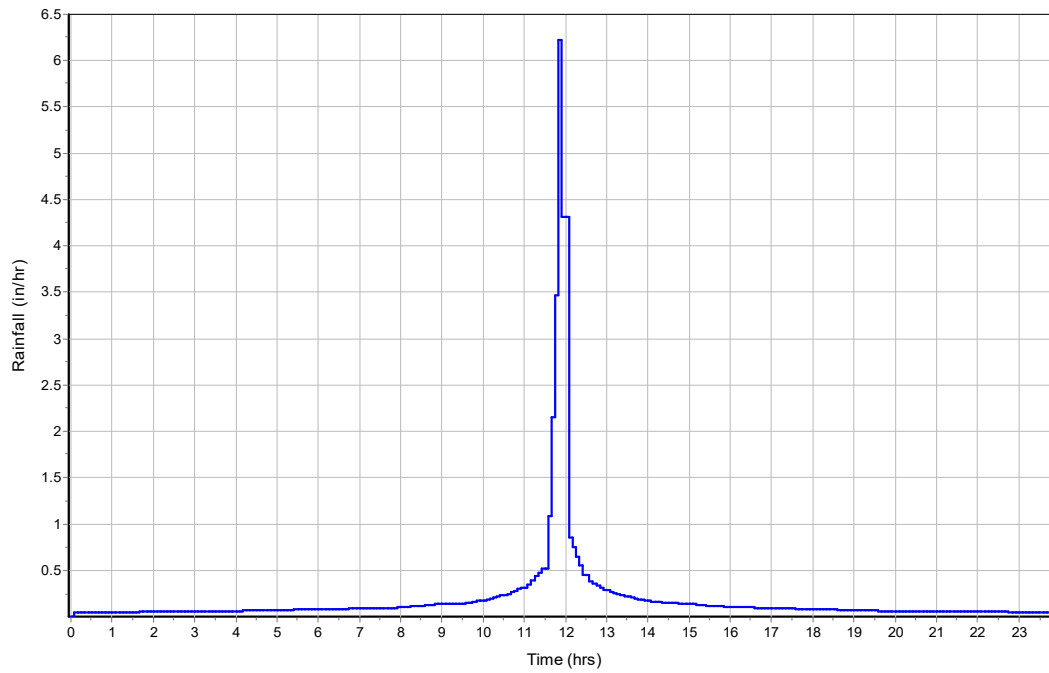
User-Defined TOC override (minutes): 15

Subbasin Runoff Results

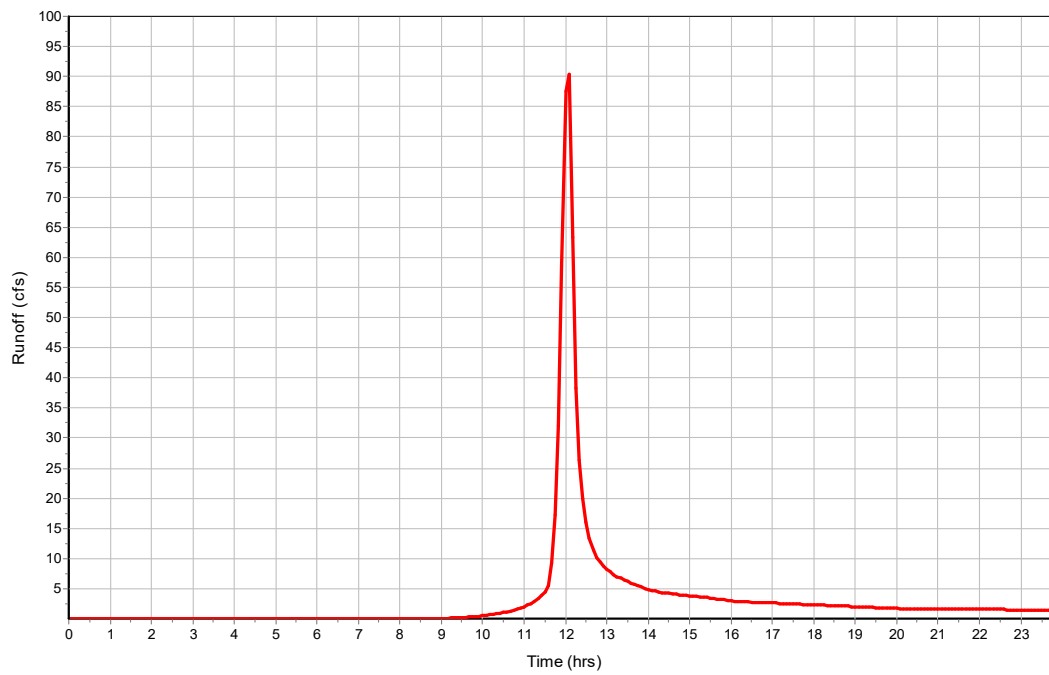
Total Rainfall (in)	4.54
Total Runoff (in)	2.13
Peak Runoff (cfs)	93.72
Weighted Curve Number	75.61
Time of Concentration (days hh:mm:ss)	0 00:15:00

Subbasin : Proposed_01A

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : Proposed_01B

Input Data

Area (ac) 6.22
 Peak Rate Factor 484
 Weighted Curve Number 77.27
 Rain Gage ID Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
32			
Woods, Good	0.55	B	55
Woods, Good	1.47	C	70
1/3 acre lots, 30% impervious	2.73	C	81
1/3 acre lots, 30% impervious	1.46	D	86
Composite Area & Weighted CN	6.21		77.27

Time of Concentration

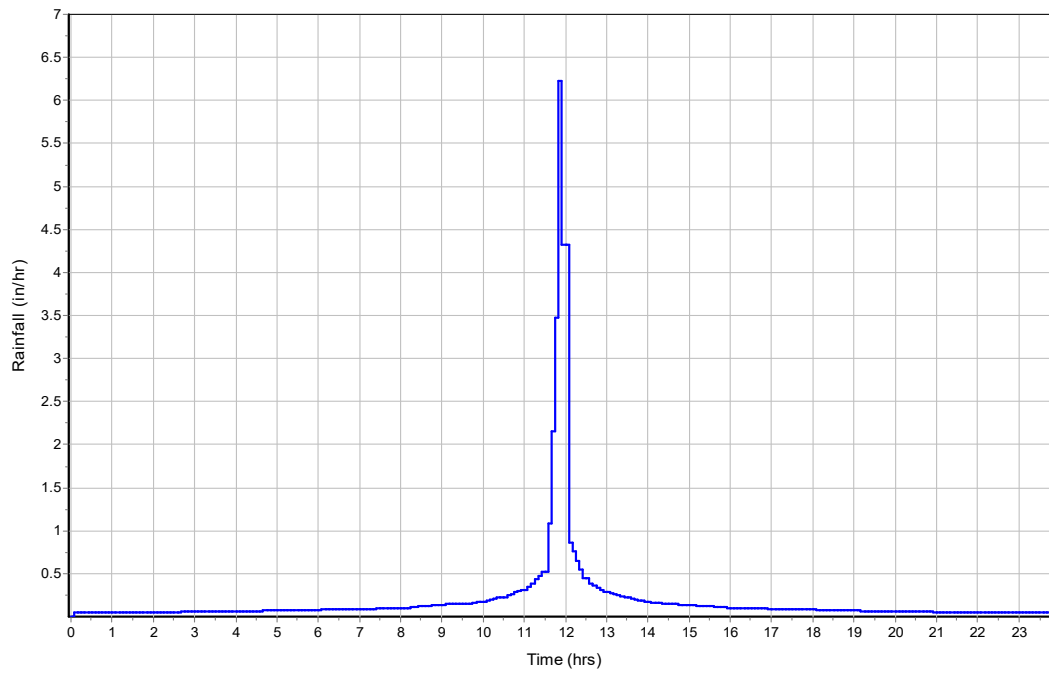
User-Defined TOC override (minutes): 6.4

Subbasin Runoff Results

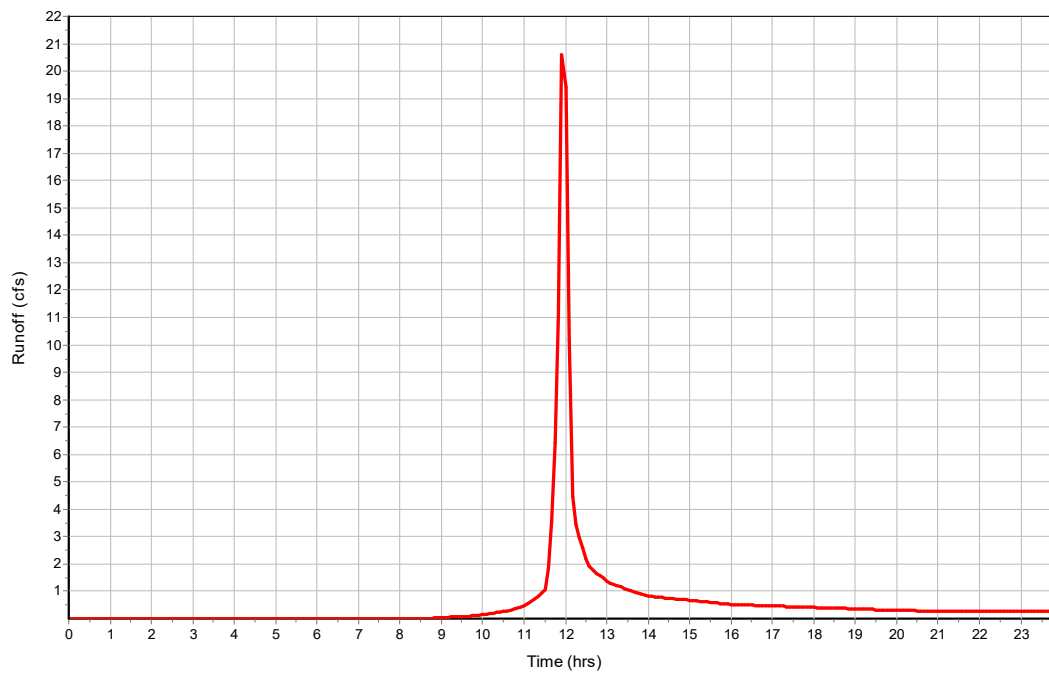
Total Rainfall (in) 4.54
 Total Runoff (in) 2.27
 Peak Runoff (cfs) 21.45
 Weighted Curve Number 77.27
 Time of Concentration (days hh:mm:ss) 0 00:06:24

Subbasin : Proposed_01B

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : Proposed_01C

Input Data

Area (ac) 12.21
 Peak Rate Factor 484
 Weighted Curve Number 79.47
 Rain Gage ID Rain Gage-01

Composite Curve Number

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
Woods, Good	0.12	B	55
Woods, Good	2.52	C	70
Woods, Good	1.24	D	77
1/3 acre lots, 30% impervious	4.9	C	81
1/3 acre lots, 30% impervious	3.43	D	86
Composite Area & Weighted CN	12.21		79.47

Time of Concentration

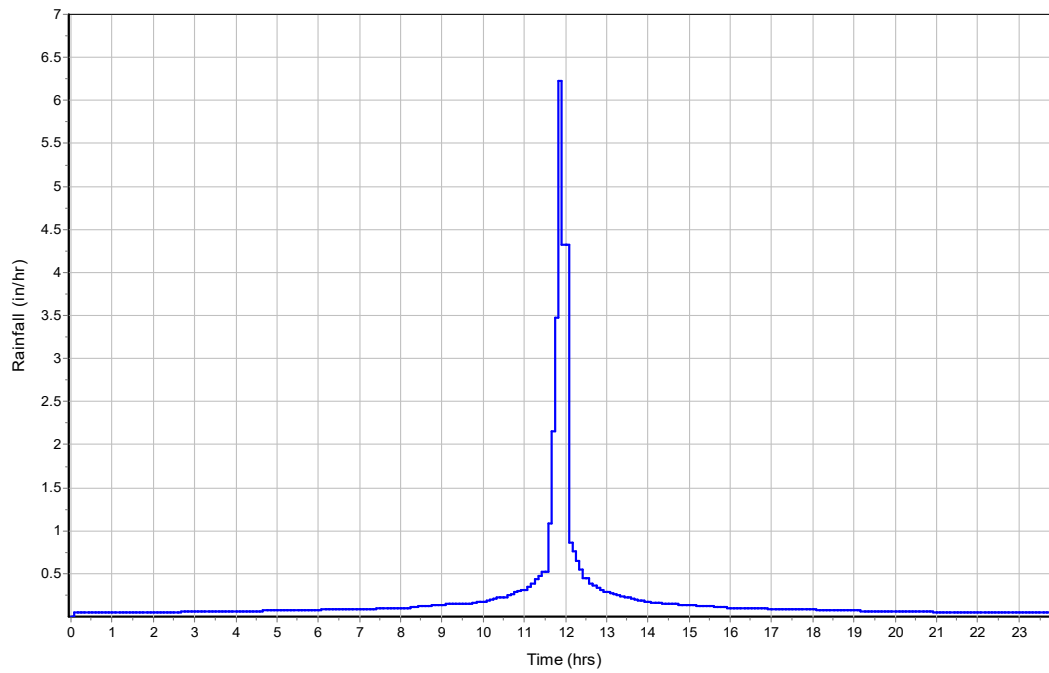
User-Defined TOC override (minutes): 8.2

Subbasin Runoff Results

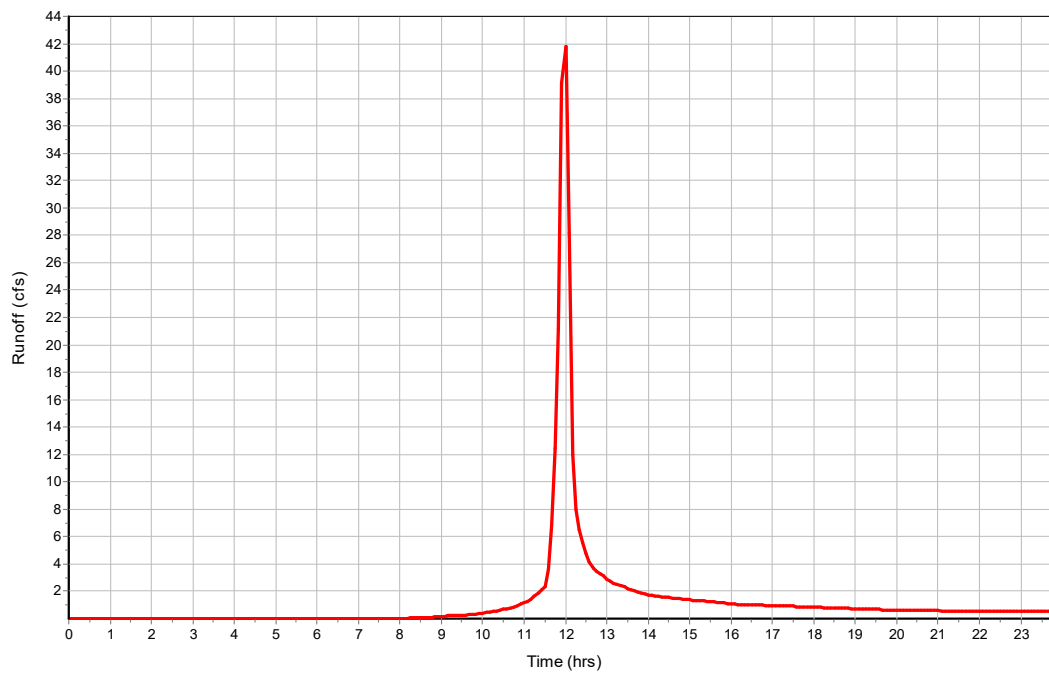
Total Rainfall (in) 4.54
 Total Runoff (in) 2.45
 Peak Runoff (cfs) 43.28
 Weighted Curve Number 79.47
 Time of Concentration (days hh:mm:ss) 0 00:08:12

Subbasin : Proposed_01C

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : Proposed_02

Input Data

Area (ac) 16.29
 Peak Rate Factor 484
 Weighted Curve Number 71.87
 Rain Gage ID Rain Gage-01

Composite Curve Number

32 Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Woods, Good	6	B	55
1/3 acre lots, 30% impervious	8.84	C	81
1/3 acre lots, 30% impervious	1.45	D	86
Composite Area & Weighted CN	16.29		71.87

Time of Concentration

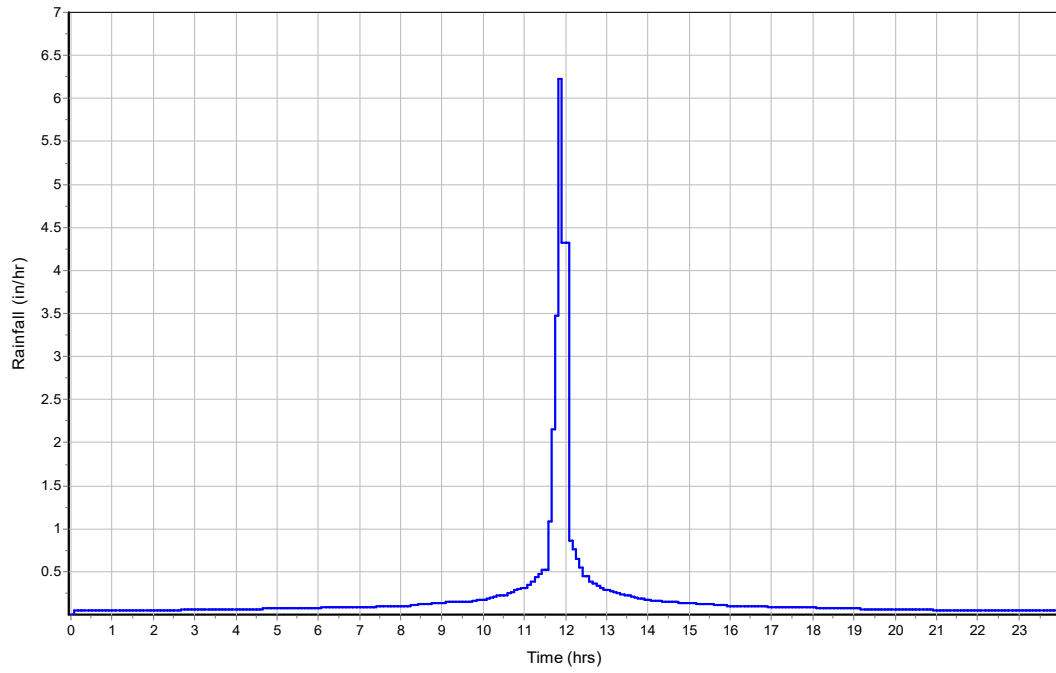
User-Defined TOC override (minutes): 12.1

Subbasin Runoff Results

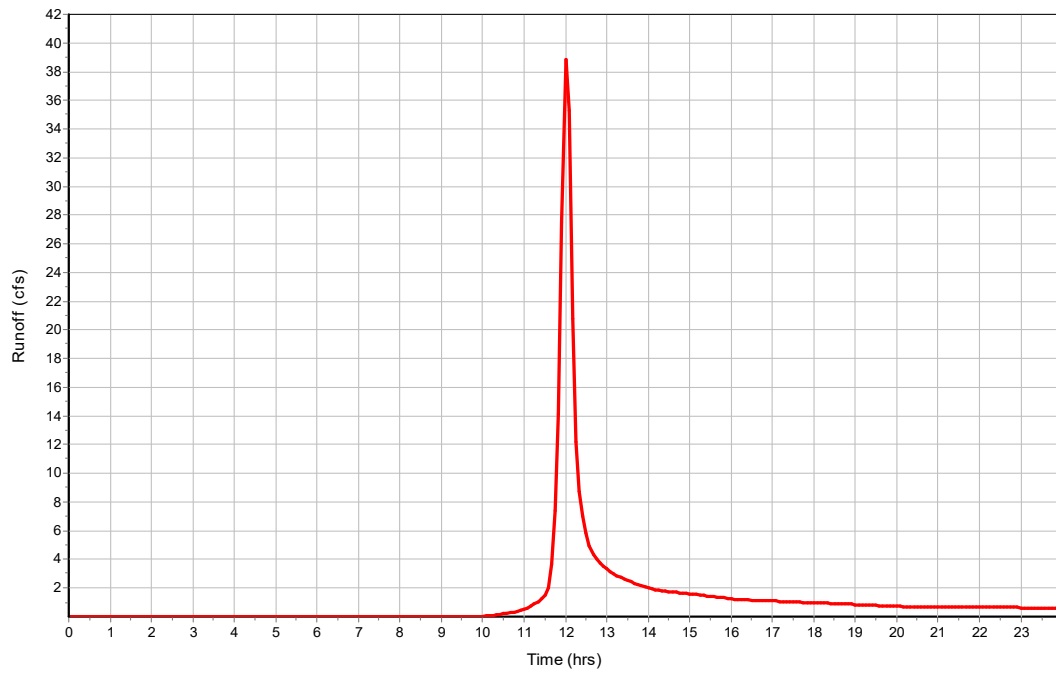
Total Rainfall (in) 4.54
 Total Runoff (in) 1.84
 Peak Runoff (cfs) 39.51
 Weighted Curve Number 71.87
 Time of Concentration (days hh:mm:ss) 0 00:12:06

Subbasin : Proposed_02

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : Proposed_03

Input Data

Area (ac) 12.4
 Peak Rate Factor 484
 Weighted Curve Number 67.89
 Rain Gage ID Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
32			
Woods, Good	6.17	B	55
Woods, Good	0.23	C	70
1/3 acre lots, 30% impervious	5.92	C	81
1/3 acre lots, 30% impervious	0.08	D	86
Composite Area & Weighted CN	12.4		67.89

Time of Concentration

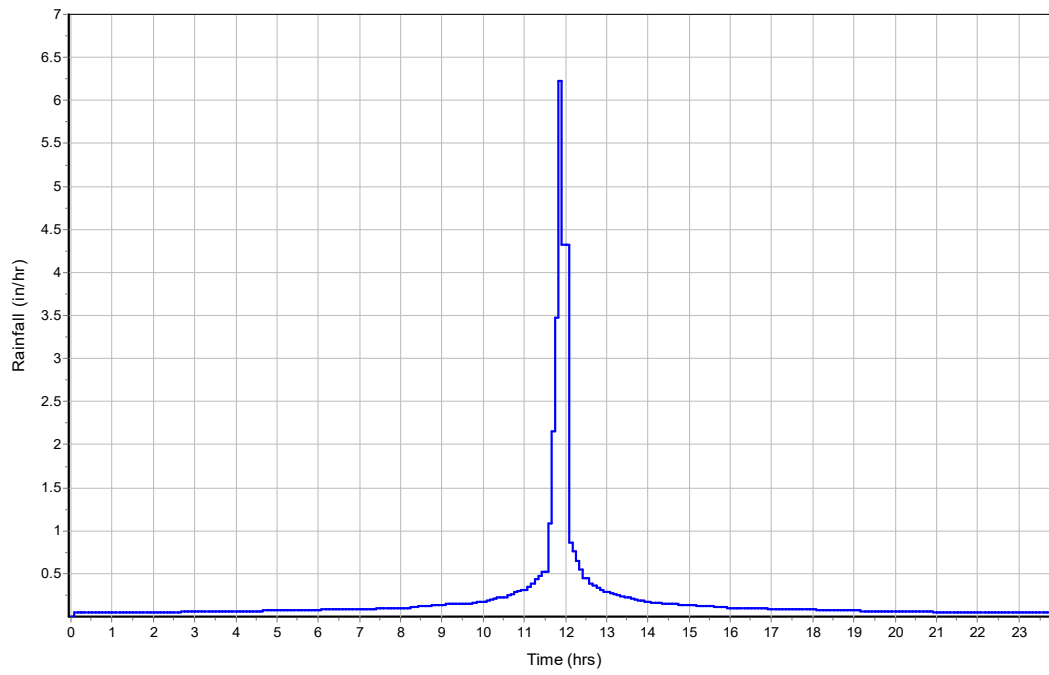
User-Defined TOC override (minutes): 6.7

Subbasin Runoff Results

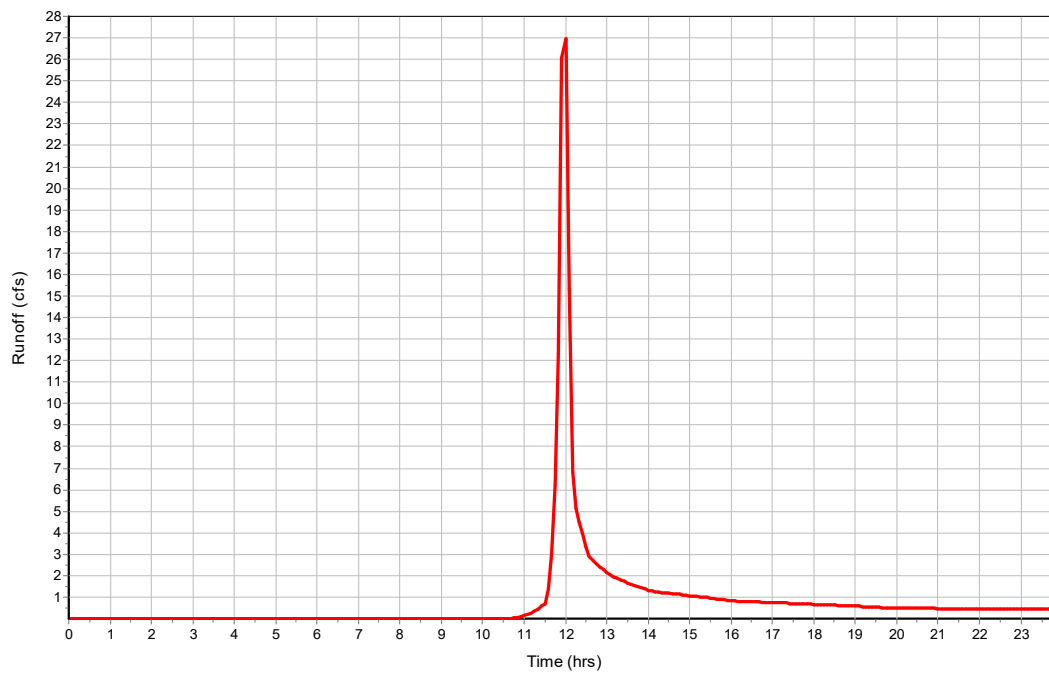
Total Rainfall (in) 4.54
 Total Runoff (in) 1.55
 Peak Runoff (cfs) 28.14
 Weighted Curve Number 67.89
 Time of Concentration (days hh:mm:ss) 0 00:06:42

Subbasin : Proposed_03

Rainfall Intensity Graph



Runoff Hydrograph



Junction Input

SN Element ID	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Ground/Rim (Max) Offset (ft)	Initial Water Elevation (ft)	Initial Water Depth (ft)	Surcharge Elevation (ft)	Surcharge Depth (ft)	Ponded Area (ft ²)	Minimum Pipe Cover (in)
1 1-Jun	830.00	845.00	15.00	830.00	0.00	0.00	-845.00	0.00	0.00
2 2-Jun	844.75	849.25	4.50	844.75	0.00	0.00	-849.25	0.00	0.00
3 4-Jun	785.75	791.50	5.75	785.75	0.00	0.00	-791.50	0.00	0.00

Junction Results

SN Element ID	Peak Inflow	Peak Lateral Inflow	Max HGL Elevation	Max HGL Depth	Max Surcharge Depth	Min Freeboard	Average HGL Elevation	Average HGL Depth	Time of Max HGL Occurrence	Time of Peak Flooding Occurrence	Total Flooded Volume	Total Time Flooded
	(cfs)	(cfs)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(days hh:mm)	(days hh:mm)	(ac-in)	(min)
1 1-Jun	90.32	90.32	830.95	0.95	0.00	14.05	830.09	0.09	0 12:10	0 00:00	0.00	0.00
2 2-Jun	2.53	0.00	844.99	0.24	0.00	4.26	844.83	0.08	0 12:31	0 00:00	0.00	0.00
3 4-Jun	7.08	0.00	786.19	0.44	0.00	5.31	785.88	0.13	0 12:23	0 00:00	0.00	0.00

Channel Input

SN Element ID	Length	Inlet Invert Elevation (ft)	Inlet Invert Offset (ft)	Outlet Invert Elevation (ft)	Outlet Invert Offset (ft)	Total Drop (ft)	Average Slope (%)	Shape	Height (ft)	Width (ft)	Manning's Roughness	Entrance Losses	Exit/Bend Losses	Additional Losses	Initial Flow (cfs)	Flap Gate
1 East_Channel	3672.92	830.00	0.00	765.00	765.00	65.00	1.7700	Trapezoidal	10.000	75.000	0.0320	0.5000	0.5000	0.0000	0.00	No

Channel Results

SN Element ID	Peak Flow	Time of Peak Flow Occurrence	Design Flow Capacity	Peak Flow/ Design Flow Ratio	Peak Flow Velocity	Travel Time	Peak Flow Depth	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged	Froude Number	Reported Condition
	(cfs)	(days hh:mm)	(cfs)		(ft/sec)	(min)	(ft)		(min)		
1 East_Channel	82.91	0 12:14	8923.48	0.01	6.02	10.17	0.87	0.09	0.00		

Pipe Input

SN Element ID	Length (ft)	Inlet Invert Elevation (ft)	Inlet Invert Offset (ft)	Outlet Invert Elevation (ft)	Outlet Invert Offset (ft)	Total Drop (ft)	Average Pipe Slope (%)	Pipe Shape	Pipe Diameter or Height (in)	Pipe Width (in)	Manning's Roughness	Entrance Losses	Exit/Bend Losses	Additional Losses	Initial Flow (cfs)	Flap Gate	No. of Barrels
1 NE-Out	122.68	844.75	0.00	821.93	821.93	22.82	18.6000	CIRCULAR	18.000	18.000	0.0130	0.5000	0.5000	0.0000	0.00	No	1
2 SE-Out	95.88	785.75	0.00	772.89	772.89	12.86	13.4100	CIRCULAR	18.000	18.000	0.0130	0.5000	0.5000	0.0000	0.00	No	1

Pipe Results

SN Element ID	Peak Flow	Time of Peak Flow Occurrence	Design Flow Capacity	Peak Flow/ Design Flow Ratio	Peak Flow Velocity	Travel Time	Peak Flow Depth	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged	Froude Number	Reported Condition
	(cfs)	(days hh:mm)	(cfs)		(ft/sec)	(min)	(ft)		(min)		
1 NE-Out	2.53	0 12:31	45.30	0.06	13.82	0.15	0.24	0.16	0.00		Calculated
2 SE-Out	7.08	0 12:23	38.47	0.18	16.58	0.10	0.44	0.29	0.00		Calculated

Storage Nodes

Storage Node : NE-Pond

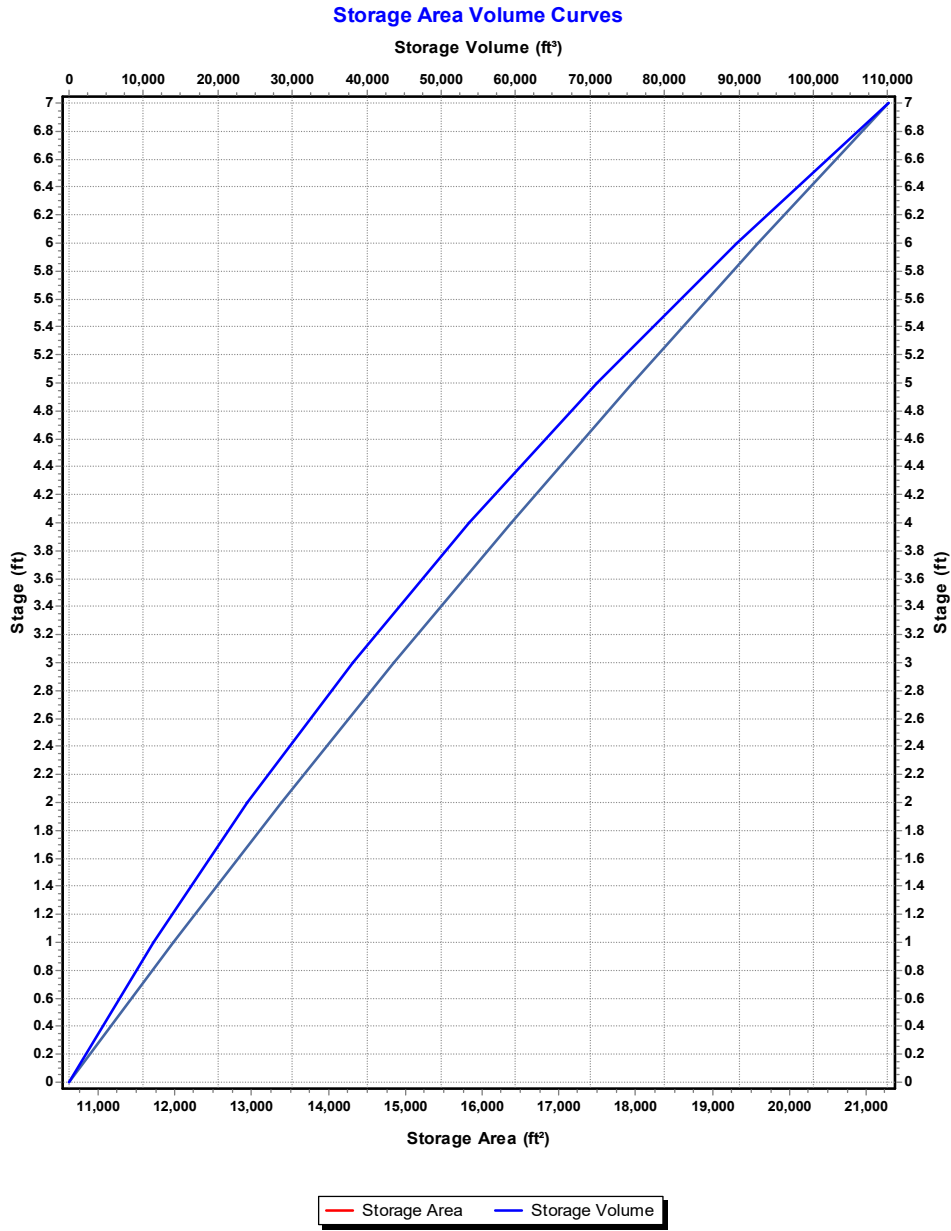
Input Data

Invert Elevation (ft)	845.00
Max (Rim) Elevation (ft)	852.00
Max (Rim) Offset (ft)	7.00
Initial Water Elevation (ft)	845.00
Initial Water Depth (ft)	0.00
Ponded Area (ft ²)	0.00
Evaporation Loss	0.00

Storage Area Volume Curves

Storage Curve : North East Pond

Stage	Storage Area	Storage Volume
(ft)	(ft ²)	(ft ³)
0	10623.06	0
1	11977.56	11300.31
2	13388.6	23983.39
3	14856.2	38105.79
4	16380.34	53724.06
5	17961.03	70894.75
6	19598.27	89674.4
7	21292.06	110119.57



Storage Node : NE-Pond (continued)

Outflow Weirs

SN Element ID	Weir Type	Flap Gate	Crest Elevation (ft)	Crest Offset (ft)	Length (ft)	Weir Total Height (ft)	Discharge Coefficient
1 NE-High	Trapezoidal	No	850.00	5.00	18.00	2.00	3.33

Outflow Orifices

SN Element ID	Orifice Type	Orifice Shape	Flap Gate	Circular Orifice Diameter (in)	Rectangular Orifice Height (in)	Rectangular Orifice Width (in)	Orifice Invert Elevation (ft)	Orifice Coefficient
1 NE-Low	Side	CIRCULAR	No	6.00			845.00	0.61
2 NE-Middle	Side	Rectangular	No		6.00	12.00	846.50	0.63
3 NE-Top	Side	Rectangular	No		6.00	12.00	848.25	0.63

Output Summary Results

Peak Inflow (cfs)	20.57
Peak Lateral Inflow (cfs)	20.57
Peak Outflow (cfs)	2.53
Peak Exfiltration Flow Rate (cfm)	0
Max HGL Elevation Attained (ft)	847
Max HGL Depth Attained (ft)	2
Average HGL Elevation Attained (ft)	845.59
Average HGL Depth Attained (ft)	0.59
Time of Max HGL Occurrence (days hh:mm)	0 12:31
Total Exfiltration Volume (1000-ft ³)	0
Total Flooded Volume (ac-in)	0
Total Time Flooded (min)	0
Total Retention Time (sec)	0

Storage Node : SE-Pond

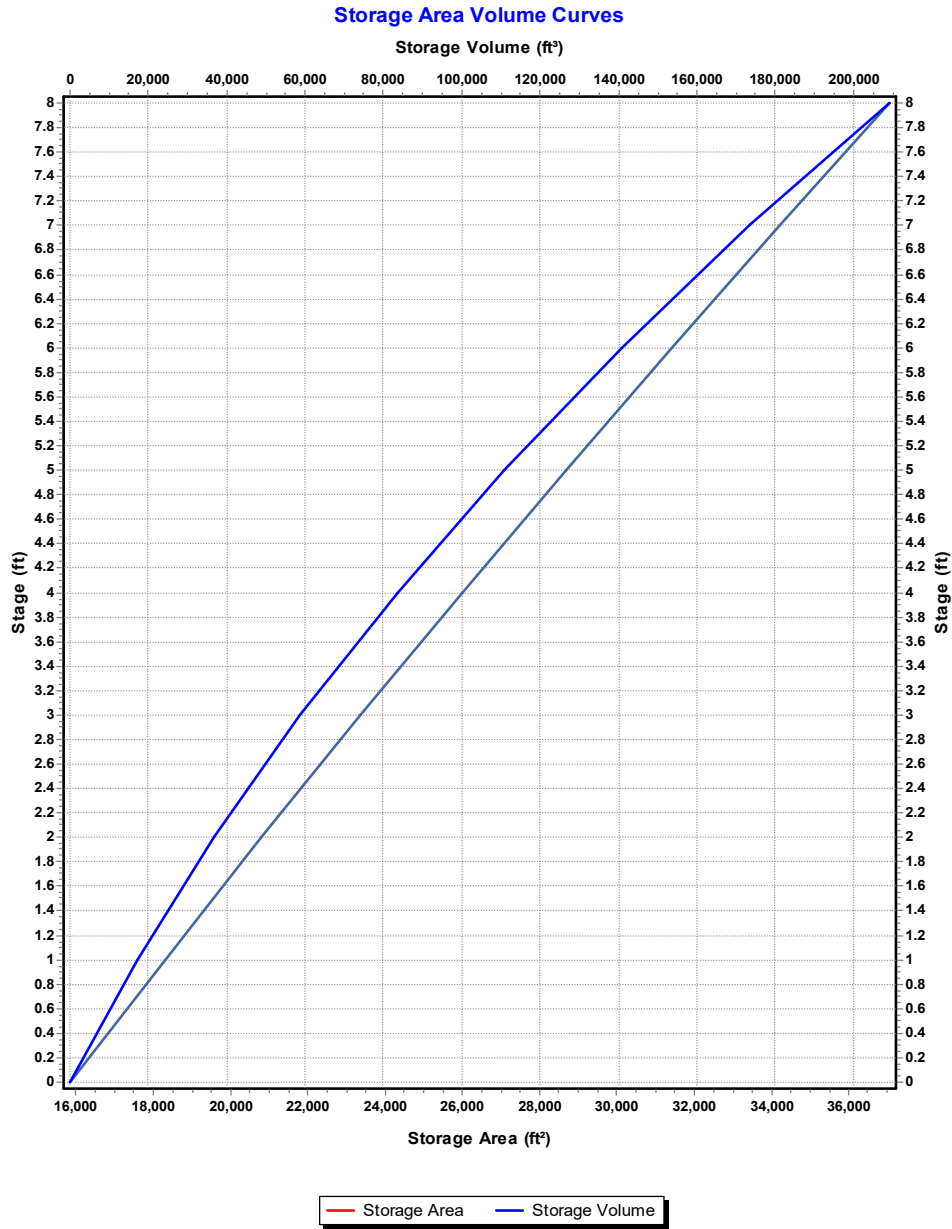
Input Data

Invert Elevation (ft)	786.00
Max (Rim) Elevation (ft)	794.00
Max (Rim) Offset (ft)	8.00
Initial Water Elevation (ft)	786.00
Initial Water Depth (ft)	0.00
Ponded Area (ft ²)	0.00
Evaporation Loss	0.00

Storage Area Volume Curves

Storage Curve : South East Pond

Stage (ft)	Storage Area (ft ²)	Storage Volume (ft ³)
0	15847.77	0
1	18300.77	17074.27
2	20810.31	36629.81
3	23376.41	58723.17
4	25999.05	83410.9
5	28678.24	110749.55
6	31413.98	140795.66
7	34206.27	173605.79
8	37055.1	209236.48



Storage Node : SE-Pond (continued)

Outflow Weirs

SN Element ID	Weir Type	Flap Gate	Crest Elevation (ft)	Crest Offset (ft)	Length (ft)	Weir Total Height (ft)	Discharge Coefficient
1 SE-Weir	Trapezoidal	No	792.00	6.00	35.00	1.50	3.33

Outflow Orifices

SN Element ID	Orifice Type	Orifice Shape	Flap Gate	Circular Orifice Diameter (in)	Rectangular Orifice Height (in)	Rectangular Orifice Width (in)	Orifice Invert Elevation (ft)	Orifice Coefficient
1 SE-Low	Side	Rectangular	No		6.00	12.00	786.00	0.63
2 SE-Middle	Side	Rectangular	No		6.00	18.00	787.50	0.63
3 SE-Top	Side	Rectangular	No		6.00	18.00	790.50	0.63

Output Summary Results

Peak Inflow (cfs)	41.78
Peak Lateral Inflow (cfs)	41.78
Peak Outflow (cfs)	7.08
Peak Exfiltration Flow Rate (cfm)	0
Max HGL Elevation Attained (ft)	788.52
Max HGL Depth Attained (ft)	2.52
Average HGL Elevation Attained (ft)	786.52
Average HGL Depth Attained (ft)	0.52
Time of Max HGL Occurrence (days hh:mm)	0 12:23
Total Exfiltration Volume (1000-ft ³)	0
Total Flooded Volume (ac-in)	0
Total Time Flooded (min)	0
Total Retention Time (sec)	0

Project Description

File Name 22-0138_Prop_Conditions_East.SPF

Project Options

Flow Units CFS
 Elevation Type Elevation
 Hydrology Method SCS TR-55
 Time of Concentration (TOC) Method SCS TR-55
 Link Routing Method Kinematic Wave
 Enable Overflow Ponding at Nodes YES
 Skip Steady State Analysis Time Periods ... YES

Analysis Options

Start Analysis On 00:00:00 0:00:00
 End Analysis On 00:00:00 0:00:00
 Start Reporting On 00:00:00 0:00:00
 Antecedent Dry Days 0 days
 Runoff (Dry Weather) Time Step 0 01:00:00 days hh:mm:ss
 Runoff (Wet Weather) Time Step 0 00:05:00 days hh:mm:ss
 Reporting Time Step 0 00:05:00 days hh:mm:ss
 Routing Time Step 30 seconds

Number of Elements

	Qty
Rain Gages	1
Subbasins.....	5
Nodes.....	8
<i>Junctions</i>	3
<i>Outfalls</i>	3
<i>Flow Diversions</i>	0
<i>Inlets</i>	0
<i>Storage Nodes</i>	2
Links.....	11
<i>Channels</i>	1
<i>Pipes</i>	2
<i>Pumps</i>	0
<i>Orifices</i>	6
<i>Weirs</i>	2
<i>Outlets</i>	0
Pollutants	0
Land Uses	0

Rainfall Details

SN	Rain Gage ID	Data Source	Data Source ID	Rainfall Type	Rain Units	State	County	Return Period (years)	Rainfall Depth (inches)	Rainfall Distribution
49		Time Series	10-yr	Cumulative	inches	Missouri	Platte	10.00	5.37	SCS Type II 24-hr

Subbasin Summary

SN	Subbasin ID	Area (ac)	Peak Rate Factor	Weighted Curve Number	Total Rainfall (in)	Total Runoff (in)	Total Runoff Volume (ac-in)	Peak Runoff (cfs)	Time of Concentration (days hh:mm:ss)
1	Proposed_01A	35.43	484.00	75.61	5.37	2.81	99.49	123.68	0 00:15:00
2	Proposed_01B	6.22	484.00	77.27	5.37	2.96	18.41	28.04	0 00:06:24
3	Proposed_01C	12.21	484.00	79.47	5.37	3.17	38.67	55.81	0 00:08:11
4	Proposed_02	16.29	484.00	71.87	5.37	2.48	40.32	53.48	0 00:12:06
5	Proposed_03	12.40	484.00	67.89	5.37	2.14	26.51	39.48	0 00:06:42

Node Summary

SN Element ID	Element Type	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Initial Water Elevation (ft)	Surcharge Elevation (ft)	Ponded Area (ft ²)	Peak Inflow (cfs)	Max HGL Elevation (ft)	Max Surcharge Depth (ft)	Min Freeboard (ft)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	1-Jun Junction	830.00	845.00	830.00	0.00	0.00	118.48	831.11	0.00	13.89	0 00:00	0.00	0.00
2	2-Jun Junction	844.75	849.25	844.75	0.00	0.00	3.67	845.04	0.00	4.21	0 00:00	0.00	0.00
3	4-Jun Junction	785.75	791.50	785.75	0.00	0.00	8.75	786.24	0.00	5.26	0 00:00	0.00	0.00
4	Out-01 Outfall	0.00					123.85	822.22					
5	Out-02 Outfall	0.00					52.83	0.00					
6	Out-03 Outfall	0.00					37.16	0.00					
7	NE-Pond Storage Node	845.00	852.00	845.00		0.00	27.13	847.52				0.00	0.00
8	SE-Pond Storage Node	786.00	794.00	786.00		0.00	53.52	789.16				0.00	0.00

Link Summary

SN	Element ID	Element Type	From (Inlet) Node	To (Outlet) Node	Length (ft)	Inlet Invert Elevation (ft)	Outlet Invert Elevation (ft)	Average Slope (%)	Diameter or Height (in)	Manning's Roughness	Peak Flow (cfs)	Design Flow Capacity (cfs)	Peak Flow/Design Flow Ratio	Peak Flow Velocity (ft/sec)	Peak Flow Depth (ft)	Peak Flow Depth/Total Depth Ratio	Total Time Surcharged (min)	Reported Condition
1	NE-Out	Pipe	2-Jun	Out-01	122.68	844.75	821.93	18.6000	18.000	0.0130	3.67	45.30	0.08	15.42	0.29	0.19	0.00	Calculated
2	SE-Out	Pipe	4-Jun	Out-01	95.88	785.75	772.89	13.4100	18.000	0.0130	8.75	38.47	0.23	17.62	0.49	0.32	0.00	Calculated
3	East_Channel	Channel	1-Jun	Out-01	3672.92	830.00	765.00	1.7700	120.000	0.0320	111.72	8923.48	0.01	6.56	1.04	0.10	0.00	
4	NE-Low	Orifice	NE-Pond	2-Jun		845.00	844.75		6.000									
5	NE-Middle	Orifice	NE-Pond	2-Jun		845.00	844.75		6.000									
6	NE-Top	Orifice	NE-Pond	2-Jun		845.00	844.75		6.000									
7	SE-Low	Orifice	SE-Pond	4-Jun		786.00	785.75		6.000									
8	SE-Middle	Orifice	SE-Pond	4-Jun		786.00	785.75		6.000									
9	SE-Top	Orifice	SE-Pond	4-Jun		786.00	785.75		6.000									
10	NE-High	Weir	NE-Pond	Out-01		845.00	0.00											
11	SE-Weir	Weir	SE-Pond	Out-01		786.00	0.00											

Subbasin Hydrology

Subbasin : Proposed_01A

Input Data

Area (ac) 35.43
 Peak Rate Factor 484
 Weighted Curve Number 75.61
 Rain Gage ID Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
32			
Woods, Good	3.71	B	55
Woods, Good	4.79	C	70
Woods, Good	19.01	D	77
1/3 acre lots, 30% impervious	1.06	C	81
1/3 acre lots, 30% impervious	6.86	D	86
Composite Area & Weighted CN	35.43		75.61

Time of Concentration

TOC Method : SCS TR-55

Sheet Flow Equation :

$$T_c = (0.007 * ((n * L_f)^{0.8}) / ((P^{0.5}) * (S_f^{0.4}))$$

Where :

Tc = Time of Concentration (hr)
 n = Manning's roughness
 Lf = Flow Length (ft)
 P = 2 yr, 24 hr Rainfall (inches)
 Sf = Slope (ft/ft)

Shallow Concentrated Flow Equation :

V = 16.1345 * (Sf^{0.5}) (unpaved surface)
 V = 20.3282 * (Sf^{0.5}) (paved surface)
 V = 15.0 * (Sf^{0.5}) (grassed waterway surface)
 V = 10.0 * (Sf^{0.5}) (nearly bare & untilled surface)
 V = 9.0 * (Sf^{0.5}) (cultivated straight rows surface)
 V = 7.0 * (Sf^{0.5}) (short grass pasture surface)
 V = 5.0 * (Sf^{0.5}) (woodland surface)
 V = 2.5 * (Sf^{0.5}) (forest w/heavy litter surface)
 Tc = (Lf / V) / (3600 sec/hr)

Where:

Tc = Time of Concentration (hr)
 Lf = Flow Length (ft)
 V = Velocity (ft/sec)
 Sf = Slope (ft/ft)

Channel Flow Equation :

V = (1.49 * (R^{2/3}) * (Sf^{0.5})) / n
 R = Aq / Wp
 Tc = (Lf / V) / (3600 sec/hr)

Where :

Tc = Time of Concentration (hr)
 Lf = Flow Length (ft)
 R = Hydraulic Radius (ft)
 Aq = Flow Area (ft²)
 Wp = Wetted Perimeter (ft)
 V = Velocity (ft/sec)
 Sf = Slope (ft/ft)
 n = Manning's roughness

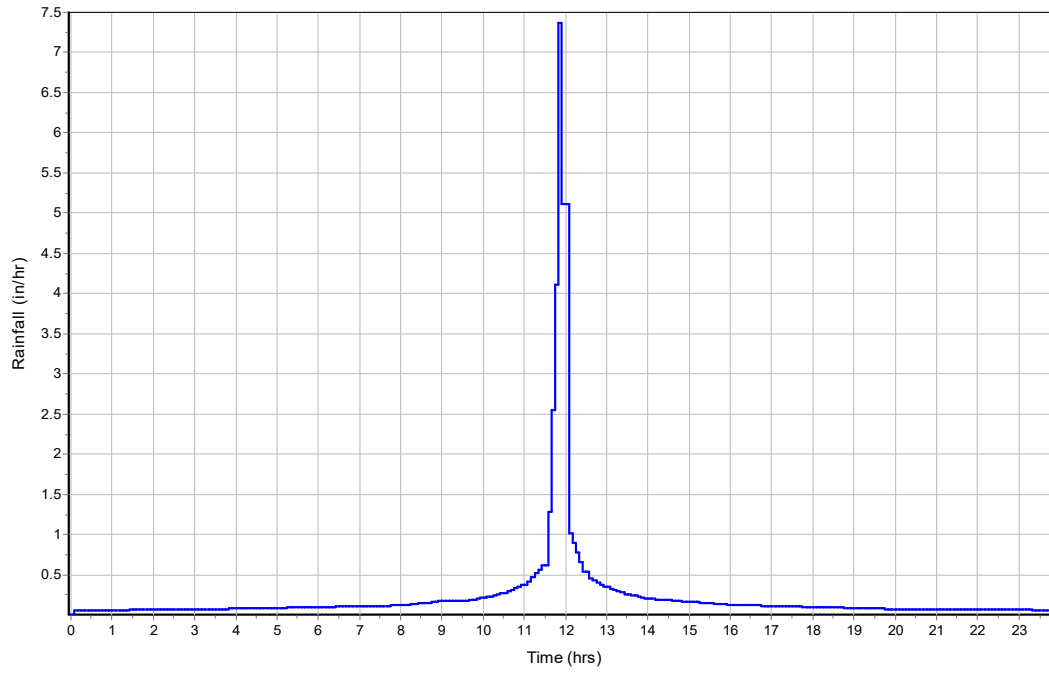
User-Defined TOC override (minutes): 15

Subbasin Runoff Results

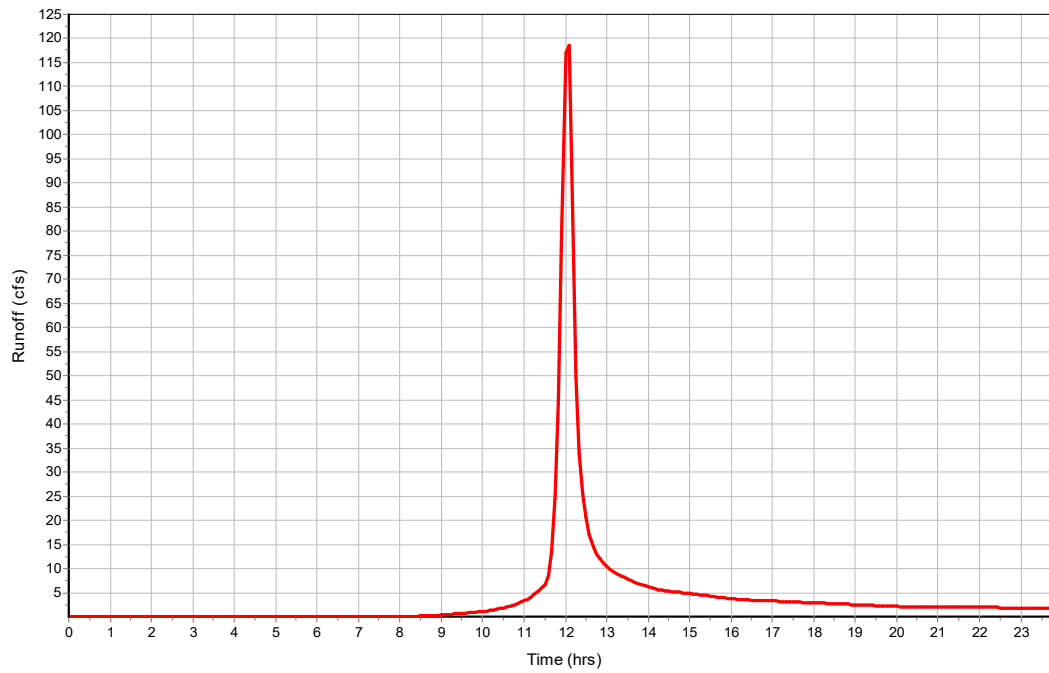
Total Rainfall (in)	5.37
Total Runoff (in)	2.81
Peak Runoff (cfs)	123.68
Weighted Curve Number	75.61
Time of Concentration (days hh:mm:ss)	0 00:15:00

Subbasin : Proposed_01A

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : Proposed_01B

Input Data

Area (ac) 6.22
 Peak Rate Factor 484
 Weighted Curve Number 77.27
 Rain Gage ID Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
32			
Woods, Good	0.55	B	55
Woods, Good	1.47	C	70
1/3 acre lots, 30% impervious	2.73	C	81
1/3 acre lots, 30% impervious	1.46	D	86
Composite Area & Weighted CN	6.21		77.27

Time of Concentration

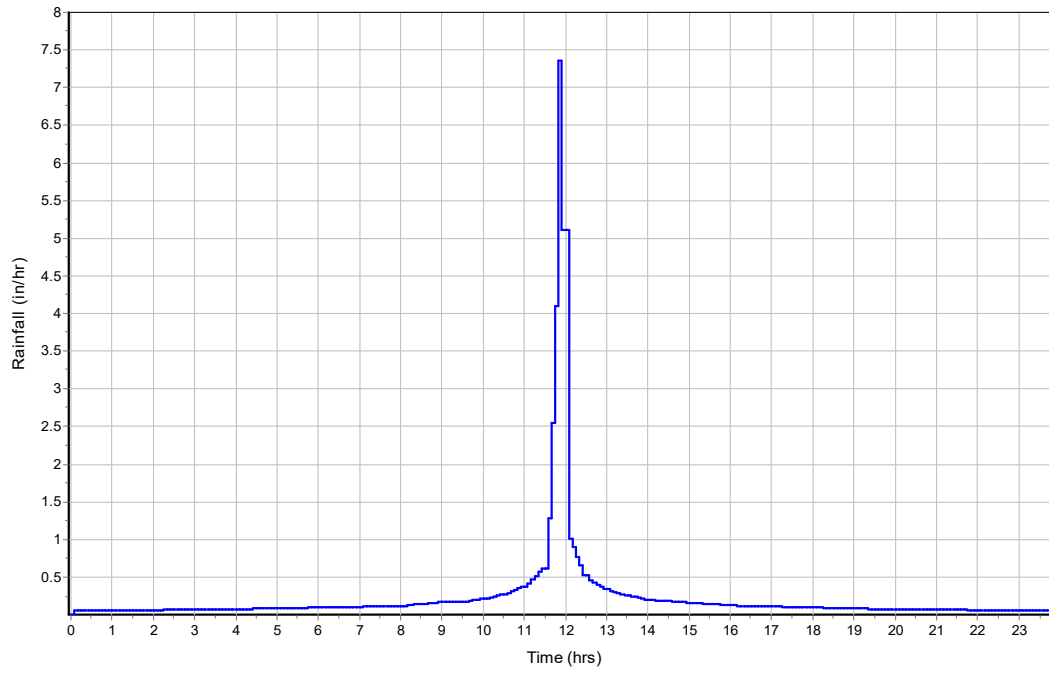
User-Defined TOC override (minutes): 6.4

Subbasin Runoff Results

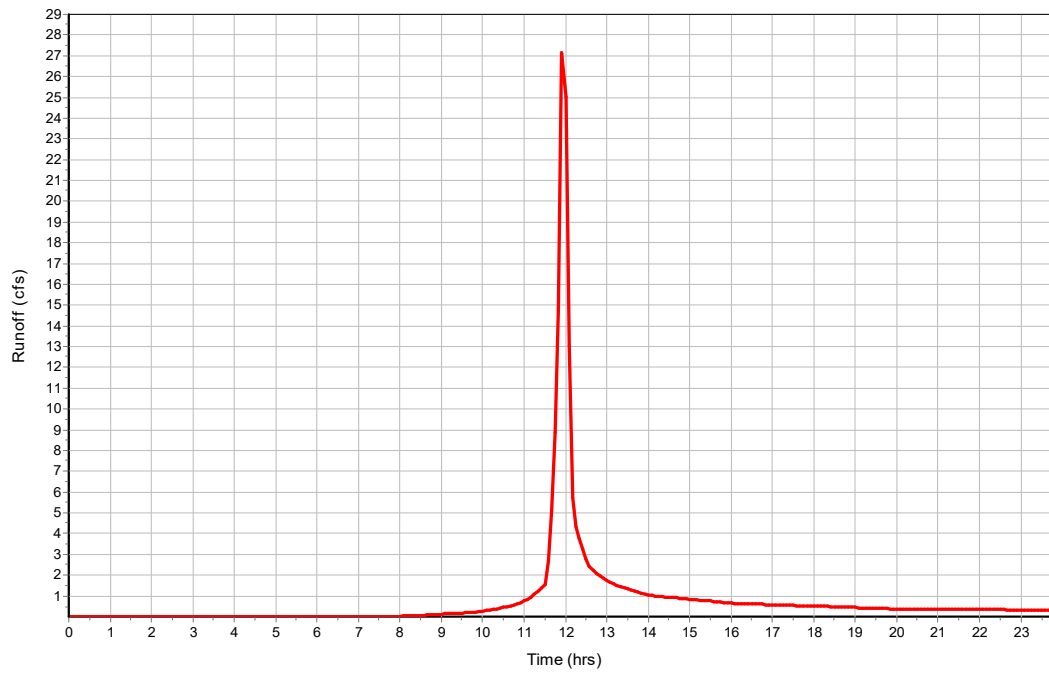
Total Rainfall (in) 5.37
 Total Runoff (in) 2.96
 Peak Runoff (cfs) 28.04
 Weighted Curve Number 77.27
 Time of Concentration (days hh:mm:ss) 0 00:06:24

Subbasin : Proposed_01B

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : Proposed_01C

Input Data

Area (ac) 12.21
 Peak Rate Factor 484
 Weighted Curve Number 79.47
 Rain Gage ID Rain Gage-01

Composite Curve Number

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
Woods, Good	0.12	B	55
Woods, Good	2.52	C	70
Woods, Good	1.24	D	77
1/3 acre lots, 30% impervious	4.9	C	81
1/3 acre lots, 30% impervious	3.43	D	86
Composite Area & Weighted CN	12.21		79.47

Time of Concentration

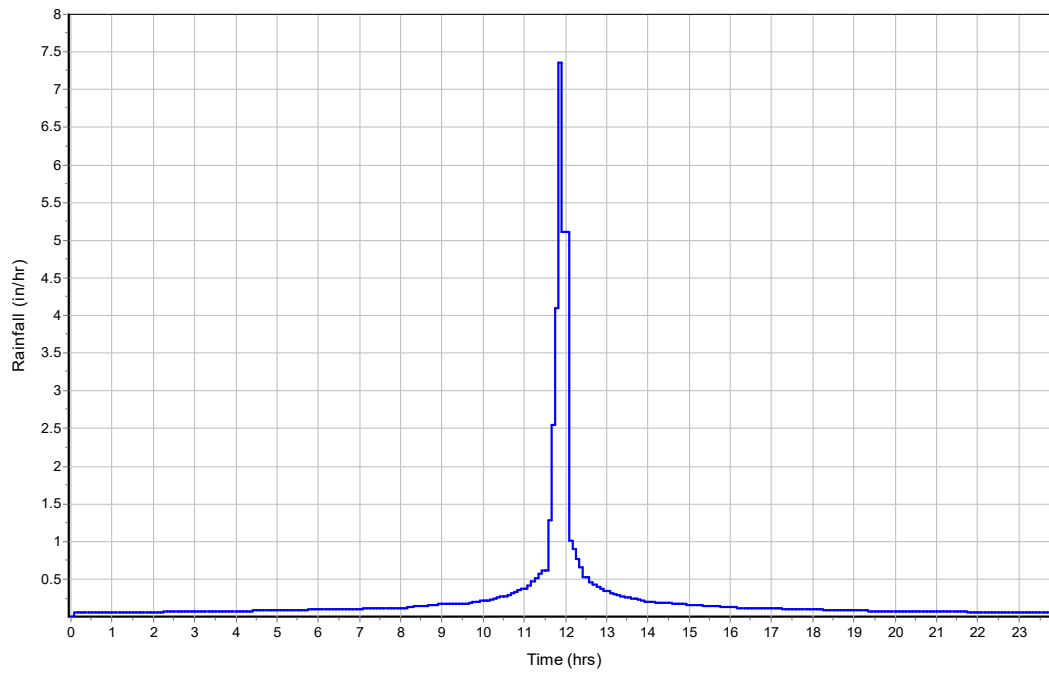
User-Defined TOC override (minutes): 8.2

Subbasin Runoff Results

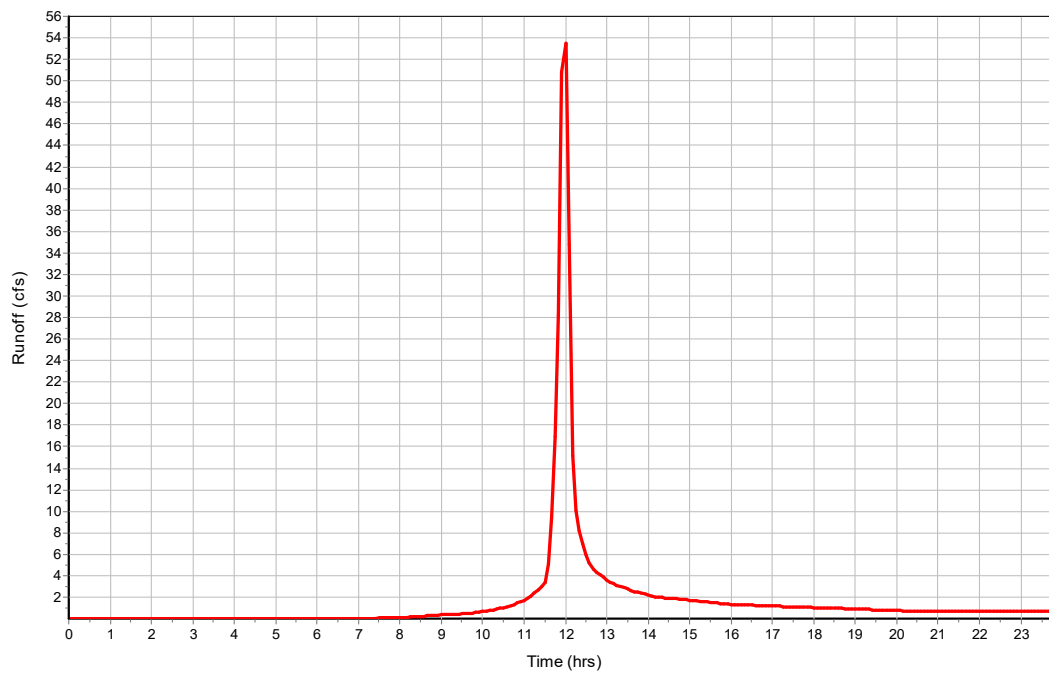
Total Rainfall (in) 5.37
 Total Runoff (in) 3.17
 Peak Runoff (cfs) 55.81
 Weighted Curve Number 79.47
 Time of Concentration (days hh:mm:ss) 0 00:08:12

Subbasin : Proposed_01C

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : Proposed_02

Input Data

Area (ac) 16.29
 Peak Rate Factor 484
 Weighted Curve Number 71.87
 Rain Gage ID Rain Gage-01

Composite Curve Number

32 Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Woods, Good	6	B	55
1/3 acre lots, 30% impervious	8.84	C	81
1/3 acre lots, 30% impervious	1.45	D	86
Composite Area & Weighted CN	16.29		71.87

Time of Concentration

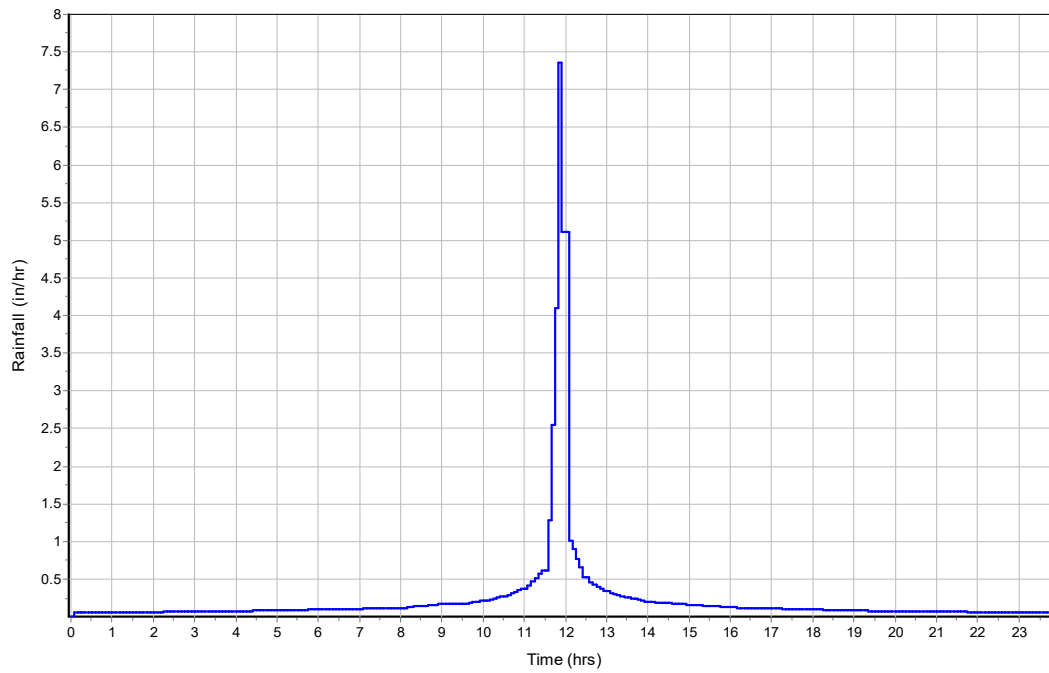
User-Defined TOC override (minutes): 12.1

Subbasin Runoff Results

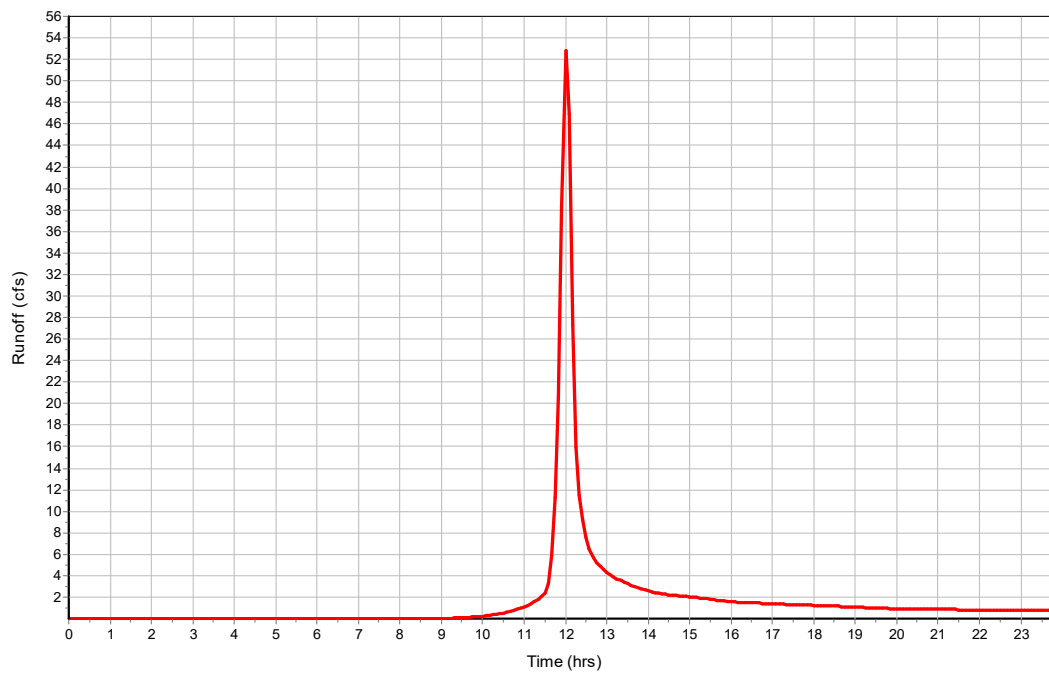
Total Rainfall (in) 5.37
 Total Runoff (in) 2.48
 Peak Runoff (cfs) 53.48
 Weighted Curve Number 71.87
 Time of Concentration (days hh:mm:ss) 0 00:12:06

Subbasin : Proposed_02

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : Proposed_03

Input Data

Area (ac) 12.4
 Peak Rate Factor 484
 Weighted Curve Number 67.89
 Rain Gage ID Rain Gage-01

Composite Curve Number

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
Woods, Good	6.17	B	55
Woods, Good	0.23	C	70
1/3 acre lots, 30% impervious	5.92	C	81
1/3 acre lots, 30% impervious	0.08	D	86
Composite Area & Weighted CN	12.4		67.89

Time of Concentration

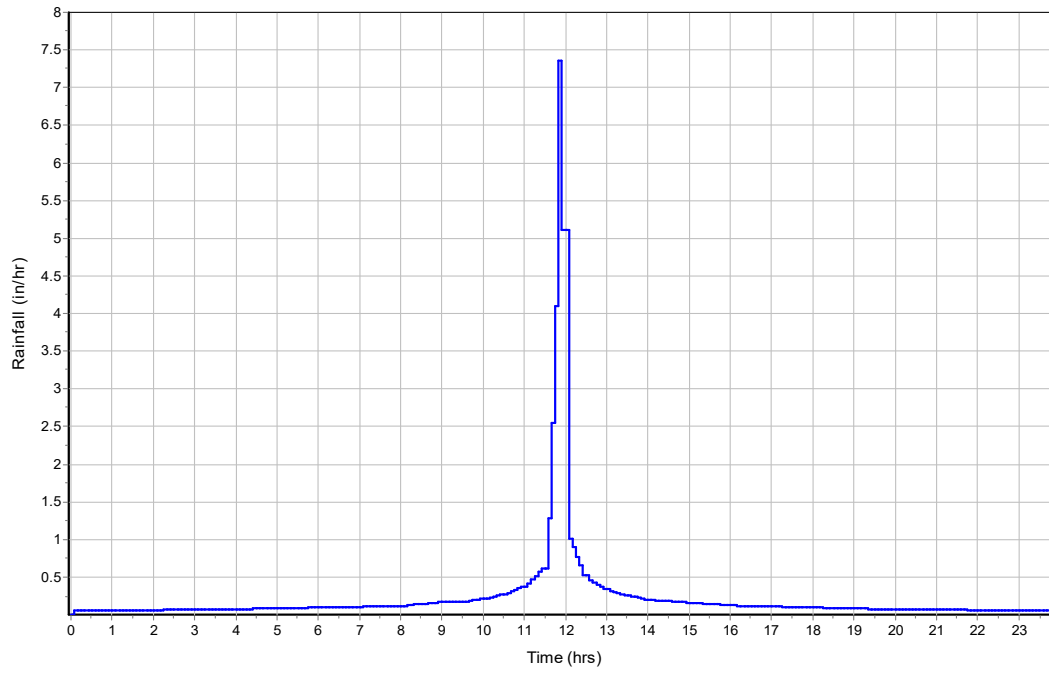
User-Defined TOC override (minutes): 6.7

Subbasin Runoff Results

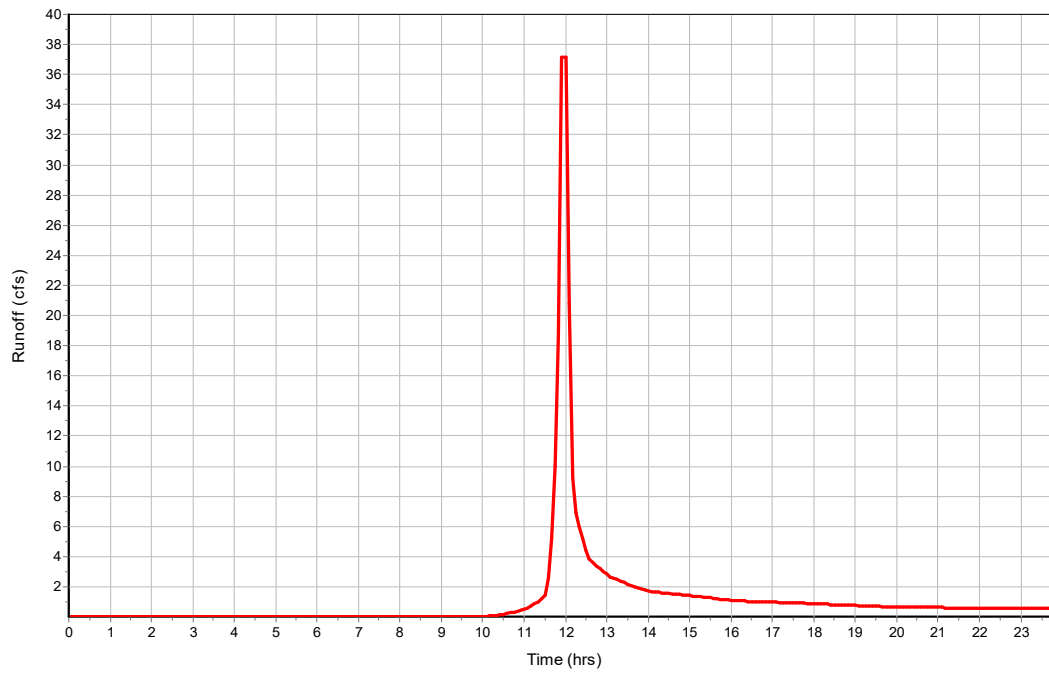
Total Rainfall (in) 5.37
 Total Runoff (in) 2.14
 Peak Runoff (cfs) 39.48
 Weighted Curve Number 67.89
 Time of Concentration (days hh:mm:ss) 0 00:06:42

Subbasin : Proposed_03

Rainfall Intensity Graph



Runoff Hydrograph



Junction Input

SN Element ID	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Ground/Rim (Max) Offset (ft)	Initial Water Elevation (ft)	Initial Water Depth (ft)	Surcharge Elevation (ft)	Surcharge Depth (ft)	Ponded Area (ft ²)	Minimum Pipe Cover (in)
1 1-Jun	830.00	845.00	15.00	830.00	0.00	0.00	-845.00	0.00	0.00
2 2-Jun	844.75	849.25	4.50	844.75	0.00	0.00	-849.25	0.00	0.00
3 4-Jun	785.75	791.50	5.75	785.75	0.00	0.00	-791.50	0.00	0.00

Junction Results

SN Element ID	Peak Inflow	Peak Lateral Inflow	Max HGL Elevation	Max HGL Depth	Max Surcharge Depth	Min Freeboard Attained	Average HGL Elevation	Average HGL Depth	Time of Max HGL Occurrence	Time of Peak Flooding Occurrence	Total Flooded Volume	Total Time Flooded
	(cfs)	(cfs)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(days hh:mm)	(days hh:mm)	(ac-in)	(min)
1 1-Jun	118.48	118.48	831.11	1.11	0.00	13.89	830.10	0.10	0 12:10	0 00:00	0.00	0.00
2 2-Jun	3.67	0.00	845.04	0.29	0.00	4.21	844.84	0.09	0 12:26	0 00:00	0.00	0.00
3 4-Jun	8.75	0.00	786.24	0.49	0.00	5.26	785.90	0.15	0 12:24	0 00:00	0.00	0.00

Channel Input

SN Element ID	Length	Inlet Invert Elevation (ft)	Inlet Invert Offset (ft)	Outlet Invert Elevation (ft)	Outlet Invert Offset (ft)	Total Drop (ft)	Average Slope (%)	Shape	Height (ft)	Width (ft)	Manning's Roughness	Entrance Losses	Exit/Bend Losses	Additional Losses	Initial Flow (cfs)	Flap Gate
1 East_Channel	3672.92	830.00	0.00	765.00	765.00	65.00	1.7700	Trapezoidal	10.000	75.000	0.0320	0.5000	0.5000	0.0000	0.00	No

Channel Results

SN Element ID	Peak Flow	Time of Peak Flow Occurrence	Design Flow Capacity	Peak Flow/Design Flow Ratio	Peak Flow Velocity	Travel Time	Peak Flow Depth	Peak Flow Depth/Total Depth Ratio	Total Time Surcharged	Froude Number	Reported Condition
	(cfs)	(days hh:mm)	(cfs)		(ft/sec)	(min)	(ft)		(min)		
1 East_Channel	111.72	0 12:14	8923.48	0.01	6.56	9.33	1.04	0.10	0.00		

Pipe Input

SN Element ID	Length (ft)	Inlet Invert Elevation (ft)	Inlet Invert Offset (ft)	Outlet Invert Elevation (ft)	Outlet Invert Offset (ft)	Total Drop (ft)	Average Pipe Slope (%)	Pipe Shape	Pipe Diameter or Height (in)	Pipe Width (in)	Manning's Roughness	Entrance Losses	Exit/Bend Losses	Additional Losses	Initial Flow (cfs)	Flap Gate	No. of Barrels
1 NE-Out	122.68	844.75	0.00	821.93	821.93	22.82	18.6000	CIRCULAR	18.000	18.000	0.0130	0.5000	0.5000	0.0000	0.00	No	1
2 SE-Out	95.88	785.75	0.00	772.89	772.89	12.86	13.4100	CIRCULAR	18.000	18.000	0.0130	0.5000	0.5000	0.0000	0.00	No	1

Pipe Results

SN Element ID	Peak Flow	Time of Peak Flow Occurrence	Design Flow Capacity	Peak Flow/ Design Flow Ratio	Peak Flow Velocity	Travel Time	Peak Flow Depth	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged	Froude Number	Reported Condition
	(cfs)	(days hh:mm)	(cfs)		(ft/sec)	(min)	(ft)		(min)		
1 NE-Out	3.67	0 12:26	45.30	0.08	15.42	0.13	0.29	0.19	0.00		Calculated
2 SE-Out	8.75	0 12:24	38.47	0.23	17.62	0.09	0.49	0.32	0.00		Calculated

Storage Nodes

Storage Node : NE-Pond

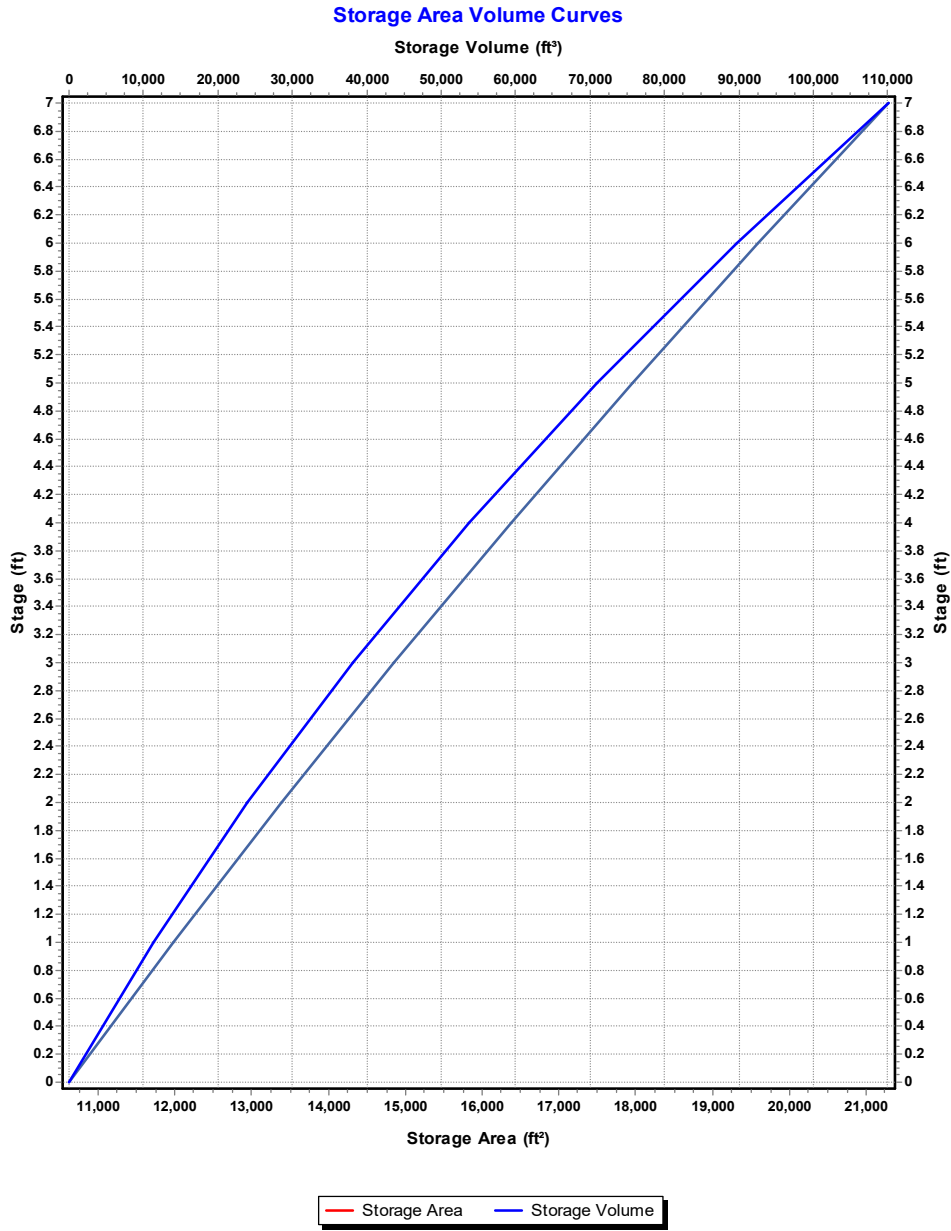
Input Data

Invert Elevation (ft)	845.00
Max (Rim) Elevation (ft)	852.00
Max (Rim) Offset (ft)	7.00
Initial Water Elevation (ft)	845.00
Initial Water Depth (ft)	0.00
Ponded Area (ft ²)	0.00
Evaporation Loss	0.00

Storage Area Volume Curves

Storage Curve : North East Pond

Stage	Storage Area	Storage Volume
(ft)	(ft ²)	(ft ³)
0	10623.06	0
1	11977.56	11300.31
2	13388.6	23983.39
3	14856.2	38105.79
4	16380.34	53724.06
5	17961.03	70894.75
6	19598.27	89674.4
7	21292.06	110119.57



Storage Node : NE-Pond (continued)

Outflow Weirs

SN Element ID	Weir Type	Flap Gate	Crest Elevation (ft)	Crest Offset (ft)	Length (ft)	Weir Total Height (ft)	Discharge Coefficient
1 NE-High	Trapezoidal	No	850.00	5.00	18.00	2.00	3.33

Outflow Orifices

SN Element ID	Orifice Type	Orifice Shape	Flap Gate	Circular Orifice Diameter (in)	Rectangular Orifice Height (in)	Rectangular Orifice Width (in)	Orifice Invert Elevation (ft)	Orifice Coefficient
1 NE-Low	Side	CIRCULAR	No	6.00			845.00	0.61
2 NE-Middle	Side	Rectangular	No		6.00	12.00	846.50	0.63
3 NE-Top	Side	Rectangular	No		6.00	12.00	848.25	0.63

Output Summary Results

Peak Inflow (cfs)	27.13
Peak Lateral Inflow (cfs)	27.13
Peak Outflow (cfs)	3.67
Peak Exfiltration Flow Rate (cfm)	0
Max HGL Elevation Attained (ft)	847.52
Max HGL Depth Attained (ft)	2.52
Average HGL Elevation Attained (ft)	845.7
Average HGL Depth Attained (ft)	0.7
Time of Max HGL Occurrence (days hh:mm)	0 12:26
Total Exfiltration Volume (1000-ft ³)	0
Total Flooded Volume (ac-in)	0
Total Time Flooded (min)	0
Total Retention Time (sec)	0

Storage Node : SE-Pond

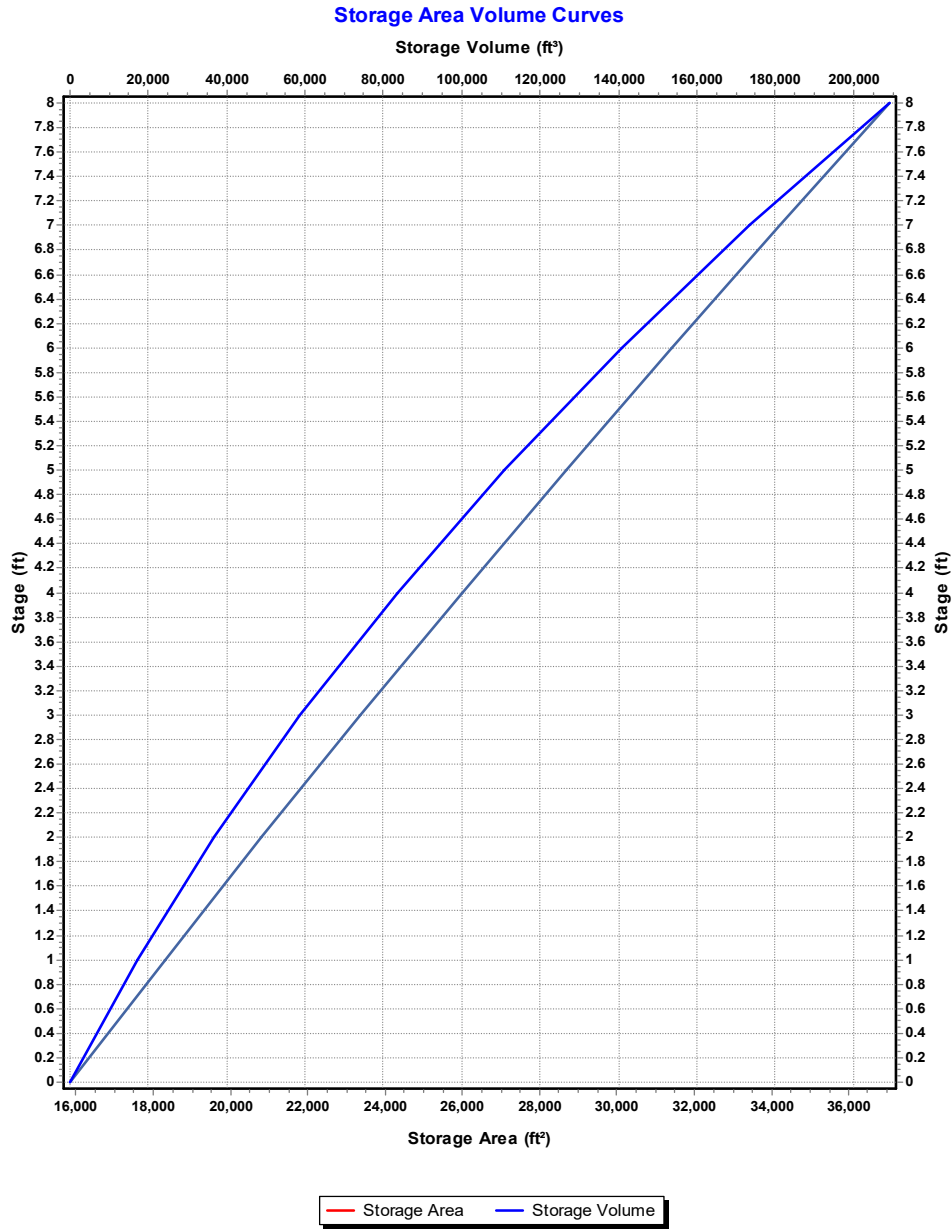
Input Data

Invert Elevation (ft)	786.00
Max (Rim) Elevation (ft)	794.00
Max (Rim) Offset (ft)	8.00
Initial Water Elevation (ft)	786.00
Initial Water Depth (ft)	0.00
Ponded Area (ft ²)	0.00
Evaporation Loss	0.00

Storage Area Volume Curves

Storage Curve : South East Pond

Stage (ft)	Storage Area (ft ²)	Storage Volume (ft ³)
0	15847.77	0
1	18300.77	17074.27
2	20810.31	36629.81
3	23376.41	58723.17
4	25999.05	83410.9
5	28678.24	110749.55
6	31413.98	140795.66
7	34206.27	173605.79
8	37055.1	209236.48



Storage Node : SE-Pond (continued)

Outflow Weirs

SN Element ID	Weir Type	Flap Gate	Crest Elevation (ft)	Crest Offset (ft)	Length (ft)	Weir Total Height (ft)	Discharge Coefficient
1 SE-Weir	Trapezoidal	No	792.00	6.00	35.00	1.50	3.33

Outflow Orifices

SN Element ID	Orifice Type	Orifice Shape	Flap Gate	Circular Orifice Diameter (in)	Rectangular Orifice Height (in)	Rectangular Orifice Width (in)	Orifice Invert Elevation (ft)	Orifice Coefficient
1 SE-Low	Side	Rectangular	No		6.00	12.00	786.00	0.63
2 SE-Middle	Side	Rectangular	No		6.00	18.00	787.50	0.63
3 SE-Top	Side	Rectangular	No		6.00	18.00	790.50	0.63

Output Summary Results

Peak Inflow (cfs)	53.52
Peak Lateral Inflow (cfs)	53.52
Peak Outflow (cfs)	8.75
Peak Exfiltration Flow Rate (cfm)	0
Max HGL Elevation Attained (ft)	789.16
Max HGL Depth Attained (ft)	3.16
Average HGL Elevation Attained (ft)	786.65
Average HGL Depth Attained (ft)	0.65
Time of Max HGL Occurrence (days hh:mm)	0 12:24
Total Exfiltration Volume (1000-ft ³)	0
Total Flooded Volume (ac-in)	0
Total Time Flooded (min)	0
Total Retention Time (sec)	0

Project Description

File Name 22-0138_Prop_Conditions_East.SPF

Project Options

Flow Units CFS
 Elevation Type Elevation
 Hydrology Method SCS TR-55
 Time of Concentration (TOC) Method SCS TR-55
 Link Routing Method Kinematic Wave
 Enable Overflow Ponding at Nodes YES
 Skip Steady State Analysis Time Periods ... YES

Analysis Options

Start Analysis On 00:00:00 0:00:00
 End Analysis On 00:00:00 0:00:00
 Start Reporting On 00:00:00 0:00:00
 Antecedent Dry Days 0 days
 Runoff (Dry Weather) Time Step 0 01:00:00 days hh:mm:ss
 Runoff (Wet Weather) Time Step 0 00:05:00 days hh:mm:ss
 Reporting Time Step 0 00:05:00 days hh:mm:ss
 Routing Time Step 30 seconds

Number of Elements

	Qty
Rain Gages	1
Subbasins.....	5
Nodes.....	8
<i>Junctions</i>	3
<i>Outfalls</i>	3
<i>Flow Diversions</i>	0
<i>Inlets</i>	0
<i>Storage Nodes</i>	2
Links.....	11
<i>Channels</i>	1
<i>Pipes</i>	2
<i>Pumps</i>	0
<i>Orifices</i>	6
<i>Weirs</i>	2
<i>Outlets</i>	0
Pollutants	0
Land Uses	0

Rainfall Details

SN	Rain Gage ID	Data Source	Data Source ID	Rainfall Type	Rain Units	State	County	Return Period (years)	Rainfall Depth (inches)	Rainfall Distribution
49		Time Series	25-yr	Cumulative	inches	Missouri	Platte	25.00	6.58	SCS Type II 24-hr

Subbasin Summary

SN	Subbasin ID	Area (ac)	Peak Rate Factor	Weighted Curve Number	Total Rainfall (in)	Total Runoff (in)	Total Runoff Volume (ac-in)	Peak Runoff (cfs)	Time of Concentration (days hh:mm:ss)
1	Proposed_01A	35.43	484.00	75.61	6.58	3.85	136.23	168.74	0 00:15:00
2	Proposed_01B	6.22	484.00	77.27	6.58	4.02	25.00	37.91	0 00:06:24
3	Proposed_01C	12.21	484.00	79.47	6.58	4.25	51.92	74.47	0 00:08:11
4	Proposed_02	16.29	484.00	71.87	6.58	3.46	56.38	74.85	0 00:12:06
5	Proposed_03	12.40	484.00	67.89	6.58	3.06	37.98	57.17	0 00:06:42

Node Summary

SN Element ID	Element Type	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Initial Water Elevation (ft)	Surcharge Elevation (ft)	Ponded Area (ft ²)	Peak Inflow (cfs)	Max HGL Elevation (ft)	Max Surcharge Depth (ft)	Min Freeboard (ft)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	1-Jun Junction	830.00	845.00	830.00	0.00	0.00	161.20	831.32	0.00	13.68	0 00:00	0.00	0.00
2	2-Jun Junction	844.75	849.25	844.75	0.00	0.00	4.92	845.08	0.00	4.17	0 00:00	0.00	0.00
3	4-Jun Junction	785.75	791.50	785.75	0.00	0.00	10.70	786.29	0.00	5.21	0 00:00	0.00	0.00
4	Out-01 Outfall	0.00					170.56	822.26					
5	Out-02 Outfall	0.00					74.30	0.00					
6	Out-03 Outfall	0.00					54.47	0.00					
7	NE-Pond Storage Node	845.00	852.00	845.00		0.00	36.82	848.32				0.00	0.00
8	SE-Pond Storage Node	786.00	794.00	786.00		0.00	70.75	790.10				0.00	0.00

Link Summary

SN	Element ID	Element Type	From (Inlet) Node	To (Outlet) Node	Length (ft)	Inlet Invert Elevation (ft)	Outlet Invert Elevation (ft)	Average Slope (%)	Diameter or Height (in)	Manning's Roughness	Peak Flow (cfs)	Design Flow Capacity (cfs)	Peak Flow/Design Flow Ratio	Peak Flow Velocity (ft/sec)	Peak Flow Depth (ft)	Peak Flow Depth/Total Depth Ratio	Total Time Surcharged (min)	Reported Condition
1	NE-Out	Pipe	2-Jun	Out-01	122.68	844.75	821.93	18.6000	18.000	0.0130	4.92	45.30	0.11	16.79	0.33	0.22	0.00	Calculated
2	SE-Out	Pipe	4-Jun	Out-01	95.88	785.75	772.89	13.4100	18.000	0.0130	10.70	38.47	0.28	18.64	0.54	0.36	0.00	Calculated
3	East_Channel	Channel	1-Jun	Out-01	3672.92	830.00	765.00	1.7700	120.000	0.0320	155.32	8923.48	0.02	7.17	1.26	0.13	0.00	
4	NE-Low	Orifice	NE-Pond	2-Jun		845.00	844.75		6.000		1.70							
5	NE-Middle	Orifice	NE-Pond	2-Jun		845.00	844.75		6.000		3.15							
6	NE-Top	Orifice	NE-Pond	2-Jun		845.00	844.75		6.000		0.07							
7	SE-Low	Orifice	SE-Pond	4-Jun		786.00	785.75		6.000		4.93							
8	SE-Middle	Orifice	SE-Pond	4-Jun		786.00	785.75		6.000		5.77							
9	SE-Top	Orifice	SE-Pond	4-Jun		786.00	785.75		6.000		0.00							
10	NE-High	Weir	NE-Pond	Out-01		845.00	0.00				0.00							
11	SE-Weir	Weir	SE-Pond	Out-01		786.00	0.00				0.00							

Subbasin Hydrology

Subbasin : Proposed_01A

Input Data

Area (ac) 35.43
 Peak Rate Factor 484
 Weighted Curve Number 75.61
 Rain Gage ID Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
32			
Woods, Good	3.71	B	55
Woods, Good	4.79	C	70
Woods, Good	19.01	D	77
1/3 acre lots, 30% impervious	1.06	C	81
1/3 acre lots, 30% impervious	6.86	D	86
Composite Area & Weighted CN	35.43		75.61

Time of Concentration

TOC Method : SCS TR-55

Sheet Flow Equation :

$$T_c = (0.007 * ((n * L_f)^{0.8}) / ((P^{0.5}) * (S_f^{0.4}))$$

Where :

Tc = Time of Concentration (hr)
 n = Manning's roughness
 Lf = Flow Length (ft)
 P = 2 yr, 24 hr Rainfall (inches)
 Sf = Slope (ft/ft)

Shallow Concentrated Flow Equation :

V = 16.1345 * (Sf^{0.5}) (unpaved surface)
 V = 20.3282 * (Sf^{0.5}) (paved surface)
 V = 15.0 * (Sf^{0.5}) (grassed waterway surface)
 V = 10.0 * (Sf^{0.5}) (nearly bare & untilled surface)
 V = 9.0 * (Sf^{0.5}) (cultivated straight rows surface)
 V = 7.0 * (Sf^{0.5}) (short grass pasture surface)
 V = 5.0 * (Sf^{0.5}) (woodland surface)
 V = 2.5 * (Sf^{0.5}) (forest w/heavy litter surface)
 Tc = (Lf / V) / (3600 sec/hr)

Where:

Tc = Time of Concentration (hr)
 Lf = Flow Length (ft)
 V = Velocity (ft/sec)
 Sf = Slope (ft/ft)

Channel Flow Equation :

V = (1.49 * (R^{2/3}) * (Sf^{0.5})) / n
 R = Aq / Wp
 Tc = (Lf / V) / (3600 sec/hr)

Where :

Tc = Time of Concentration (hr)
 Lf = Flow Length (ft)
 R = Hydraulic Radius (ft)
 Aq = Flow Area (ft²)
 Wp = Wetted Perimeter (ft)
 V = Velocity (ft/sec)
 Sf = Slope (ft/ft)
 n = Manning's roughness

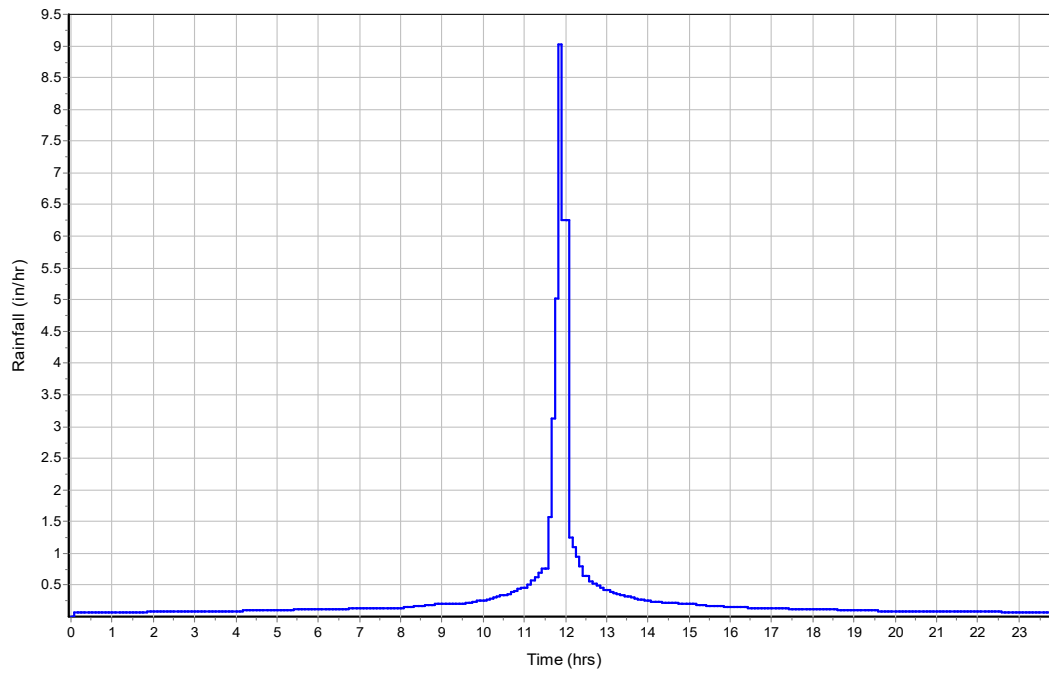
User-Defined TOC override (minutes): 15

Subbasin Runoff Results

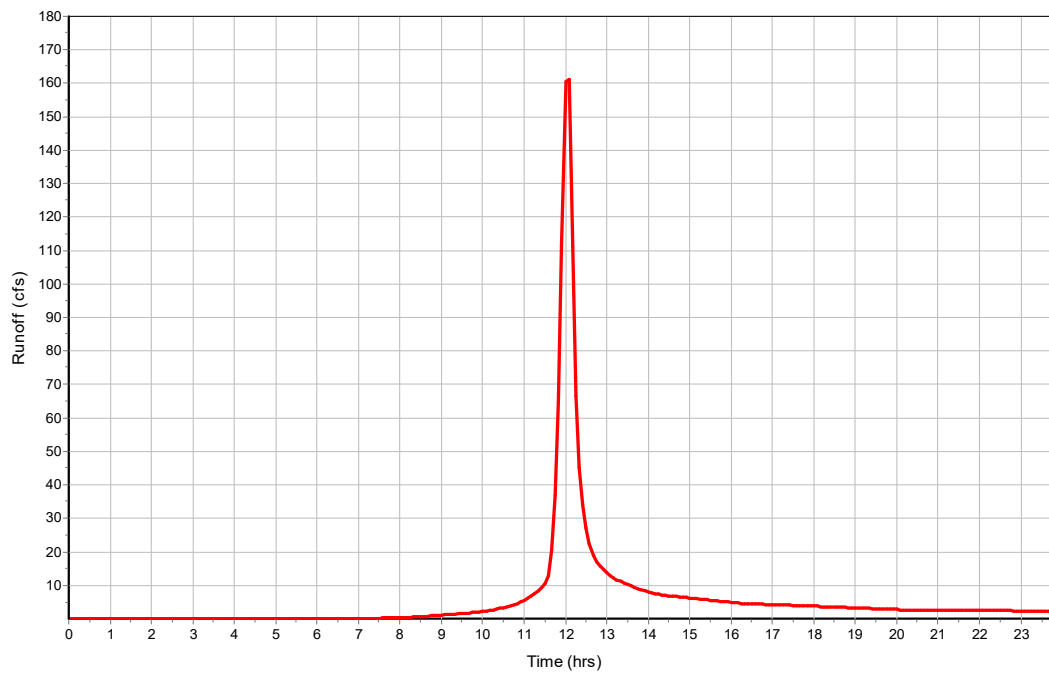
Total Rainfall (in)	6.58
Total Runoff (in)	3.85
Peak Runoff (cfs)	168.74
Weighted Curve Number	75.61
Time of Concentration (days hh:mm:ss)	0 00:15:00

Subbasin : Proposed_01A

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : Proposed_01B

Input Data

Area (ac) 6.22
 Peak Rate Factor 484
 Weighted Curve Number 77.27
 Rain Gage ID Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
32			
Woods, Good	0.55	B	55
Woods, Good	1.47	C	70
1/3 acre lots, 30% impervious	2.73	C	81
1/3 acre lots, 30% impervious	1.46	D	86
Composite Area & Weighted CN	6.21		77.27

Time of Concentration

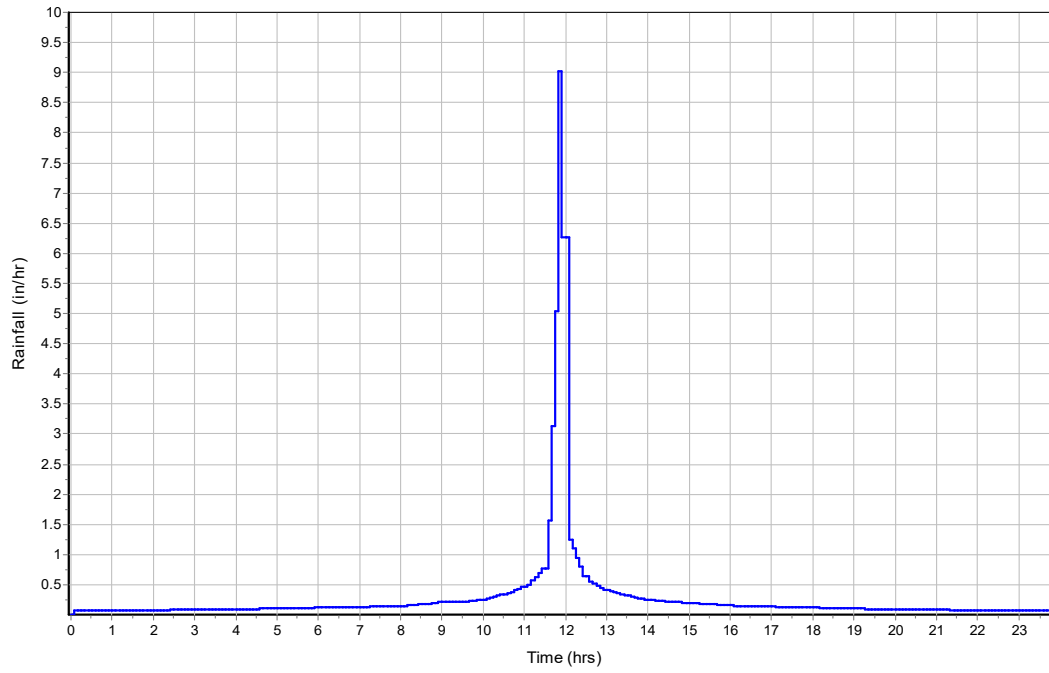
User-Defined TOC override (minutes): 6.4

Subbasin Runoff Results

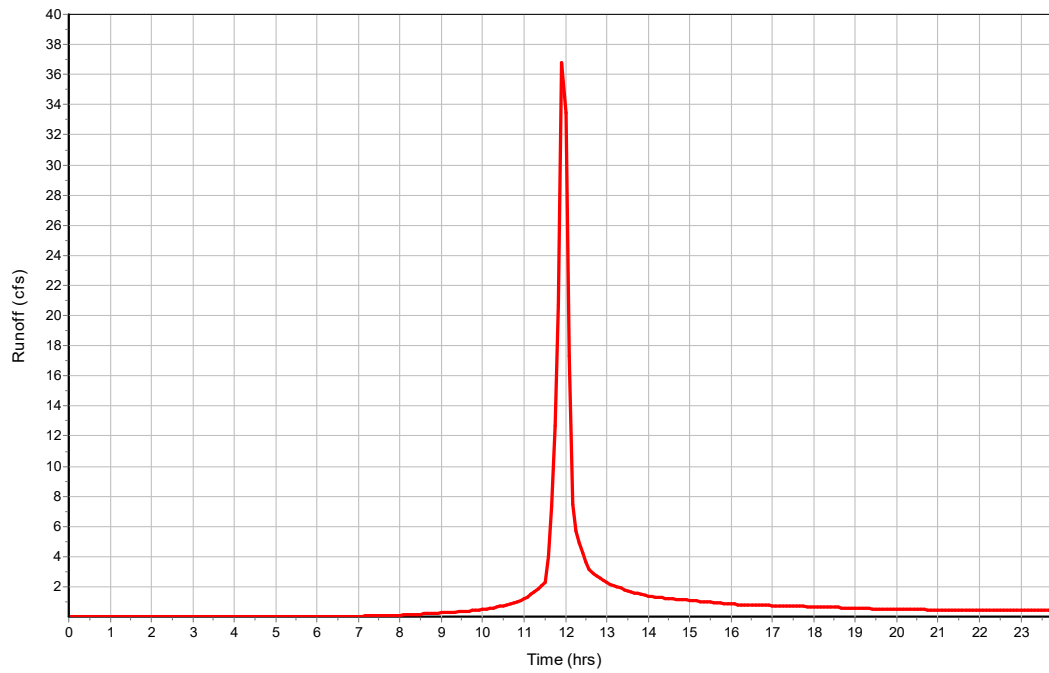
Total Rainfall (in) 6.58
 Total Runoff (in) 4.02
 Peak Runoff (cfs) 37.91
 Weighted Curve Number 77.27
 Time of Concentration (days hh:mm:ss) 0 00:06:24

Subbasin : Proposed_01B

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : Proposed_01C

Input Data

Area (ac) 12.21
 Peak Rate Factor 484
 Weighted Curve Number 79.47
 Rain Gage ID Rain Gage-01

Composite Curve Number

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
Woods, Good	0.12	B	55
Woods, Good	2.52	C	70
Woods, Good	1.24	D	77
1/3 acre lots, 30% impervious	4.9	C	81
1/3 acre lots, 30% impervious	3.43	D	86
Composite Area & Weighted CN	12.21		79.47

Time of Concentration

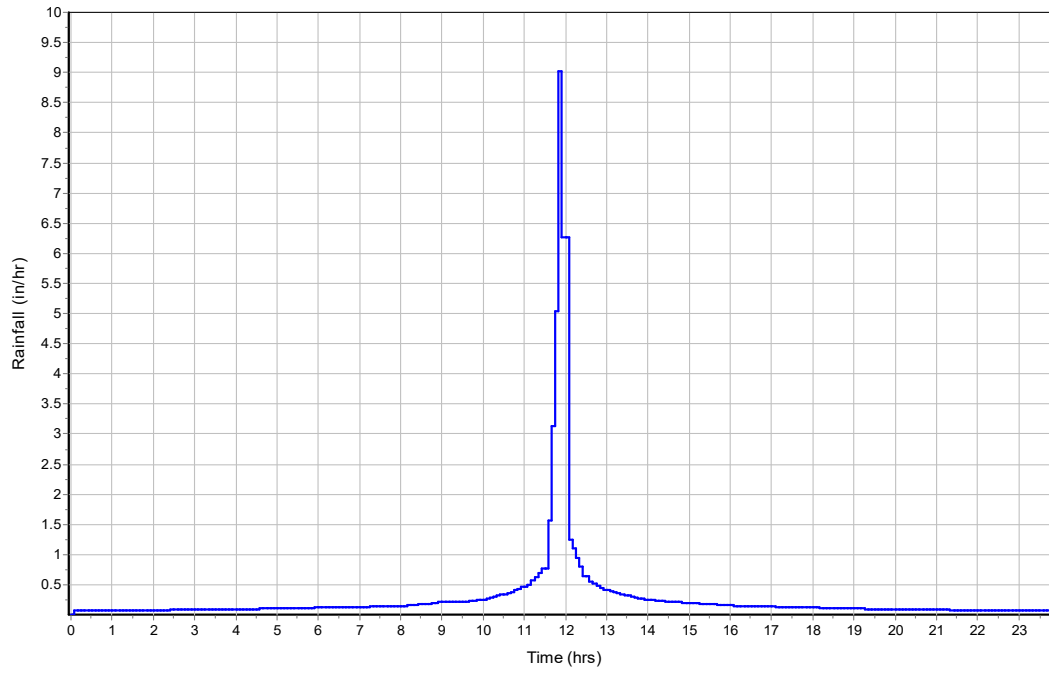
User-Defined TOC override (minutes): 8.2

Subbasin Runoff Results

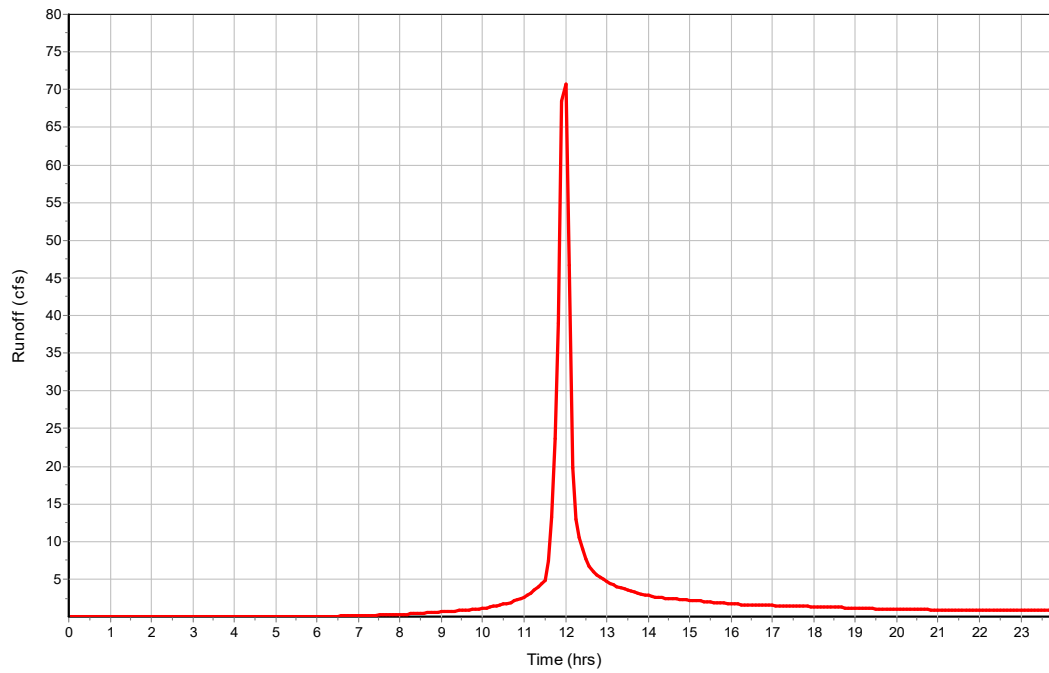
Total Rainfall (in) 6.58
 Total Runoff (in) 4.25
 Peak Runoff (cfs) 74.47
 Weighted Curve Number 79.47
 Time of Concentration (days hh:mm:ss) 0 00:08:12

Subbasin : Proposed_01C

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : Proposed_02

Input Data

Area (ac) 16.29
 Peak Rate Factor 484
 Weighted Curve Number 71.87
 Rain Gage ID Rain Gage-01

Composite Curve Number

32 Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Woods, Good	6	B	55
1/3 acre lots, 30% impervious	8.84	C	81
1/3 acre lots, 30% impervious	1.45	D	86
Composite Area & Weighted CN	16.29		71.87

Time of Concentration

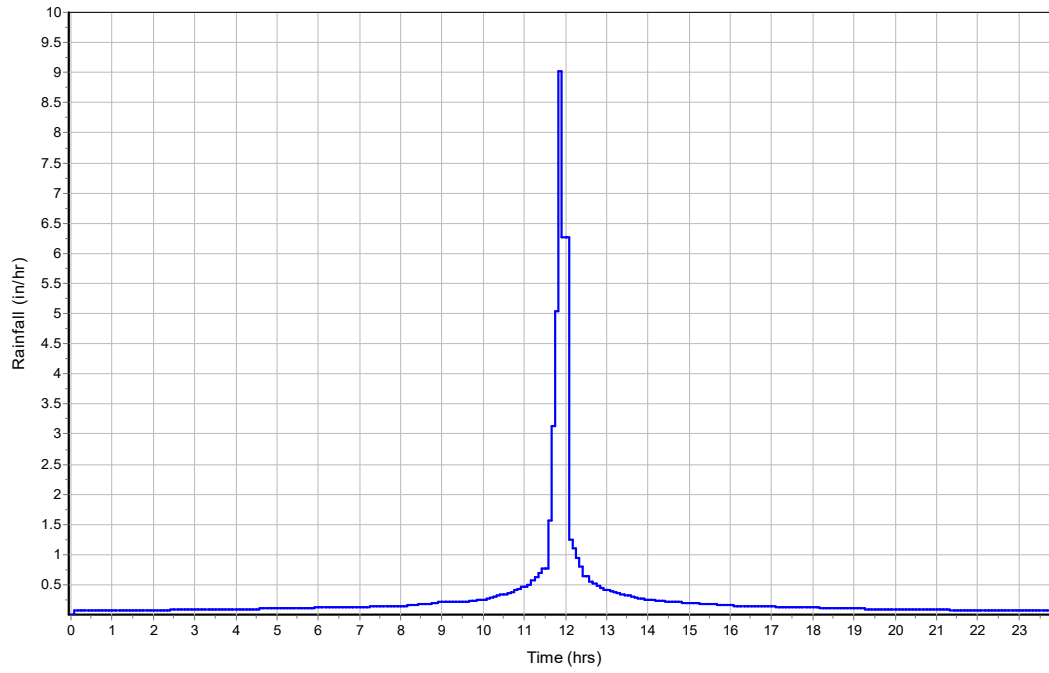
User-Defined TOC override (minutes): 12.1

Subbasin Runoff Results

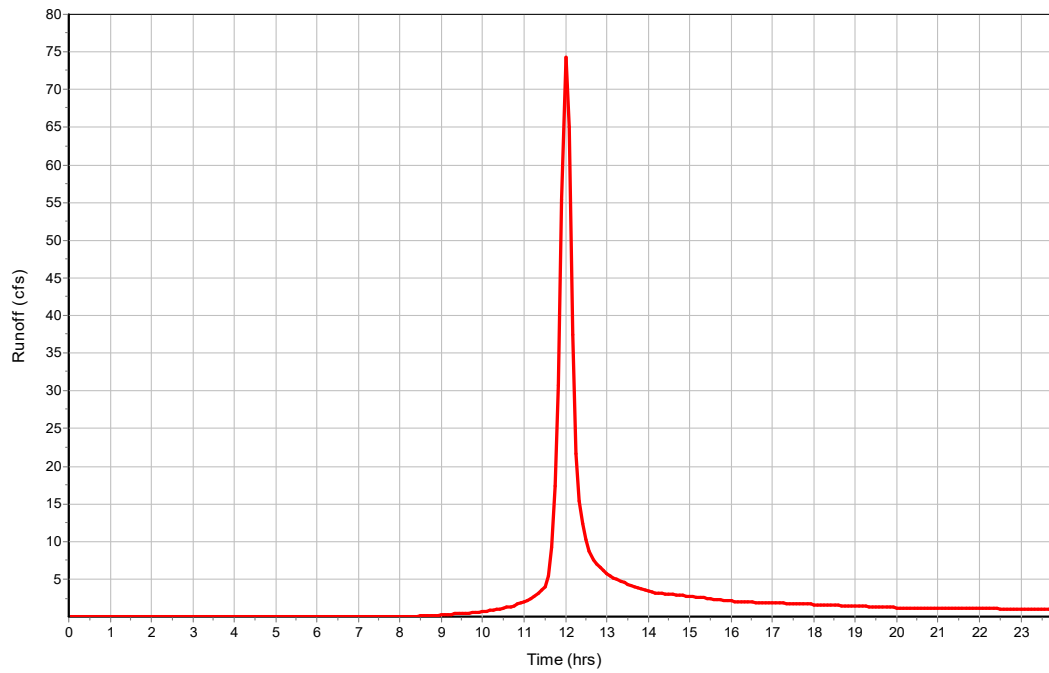
Total Rainfall (in) 6.58
 Total Runoff (in) 3.46
 Peak Runoff (cfs) 74.85
 Weighted Curve Number 71.87
 Time of Concentration (days hh:mm:ss) 0 00:12:06

Subbasin : Proposed_02

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : Proposed_03

Input Data

Area (ac) 12.4
 Peak Rate Factor 484
 Weighted Curve Number 67.89
 Rain Gage ID Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
32			
Woods, Good	6.17	B	55
Woods, Good	0.23	C	70
1/3 acre lots, 30% impervious	5.92	C	81
1/3 acre lots, 30% impervious	0.08	D	86
Composite Area & Weighted CN	12.4		67.89

Time of Concentration

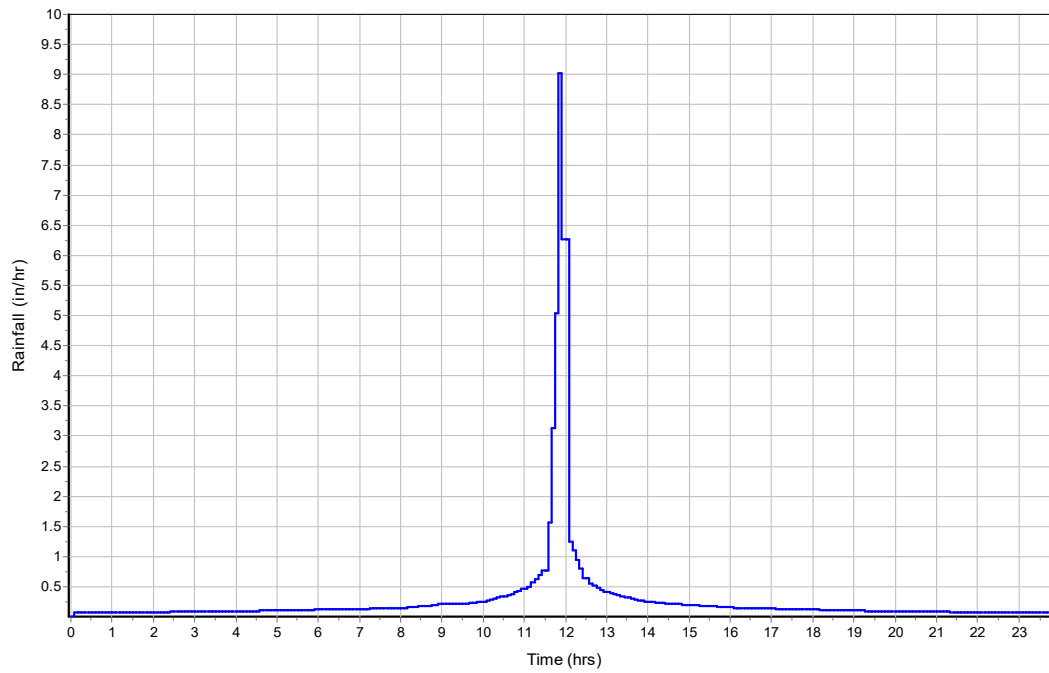
User-Defined TOC override (minutes): 6.7

Subbasin Runoff Results

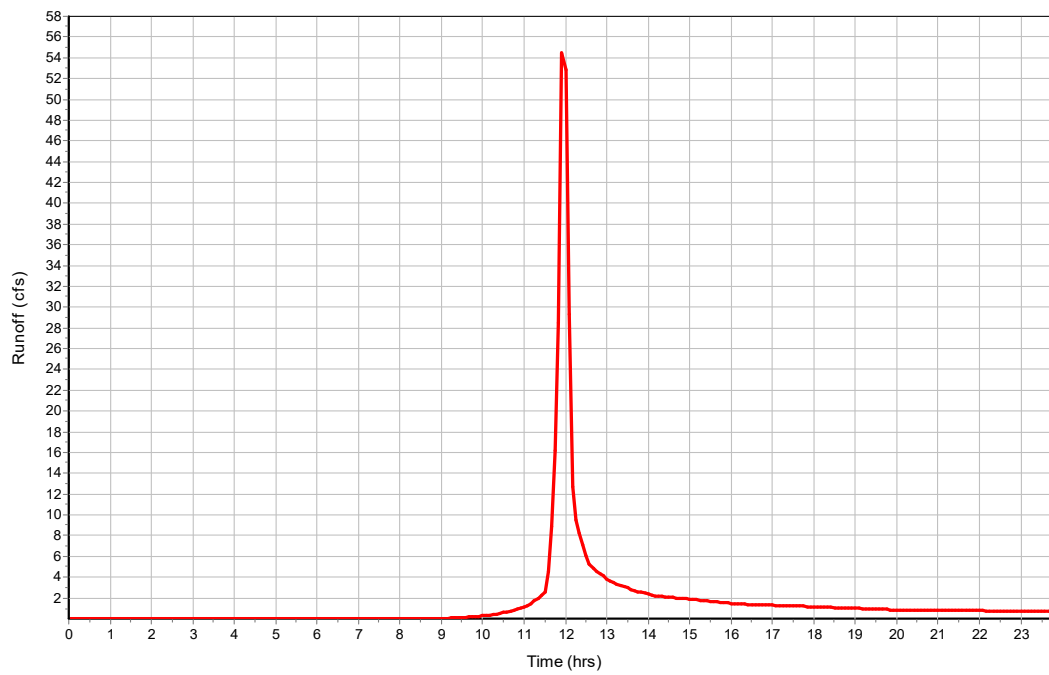
Total Rainfall (in) 6.58
 Total Runoff (in) 3.06
 Peak Runoff (cfs) 57.17
 Weighted Curve Number 67.89
 Time of Concentration (days hh:mm:ss) 0 00:06:42

Subbasin : Proposed_03

Rainfall Intensity Graph



Runoff Hydrograph



Junction Input

SN Element ID	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Ground/Rim (Max) Offset (ft)	Initial Water Elevation (ft)	Initial Water Depth (ft)	Surcharge Elevation (ft)	Surcharge Depth (ft)	Ponded Area (ft ²)	Minimum Pipe Cover (in)
1 1-Jun	830.00	845.00	15.00	830.00	0.00	0.00	-845.00	0.00	0.00
2 2-Jun	844.75	849.25	4.50	844.75	0.00	0.00	-849.25	0.00	0.00
3 4-Jun	785.75	791.50	5.75	785.75	0.00	0.00	-791.50	0.00	0.00

Junction Results

SN Element ID	Peak Inflow	Peak Lateral Inflow	Max HGL Elevation	Max HGL Depth	Max Surcharge Depth	Min Freeboard Attained	Average HGL Elevation	Average HGL Depth	Time of Max HGL Occurrence	Time of Peak Flooding Occurrence	Total Flooded Volume	Total Time Flooded
	(cfs)	(cfs)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(days hh:mm)	(days hh:mm)	(ac-in)	(min)
1 1-Jun	161.20	161.20	831.32	1.32	0.00	13.68	830.13	0.13	0 12:10	0 00:00	0.00	0.00
2 2-Jun	4.92	0.00	845.08	0.33	0.00	4.17	844.86	0.11	0 12:25	0 00:00	0.00	0.00
3 4-Jun	10.70	0.00	786.29	0.54	0.00	5.21	785.92	0.17	0 12:25	0 00:00	0.00	0.00

Channel Input

SN Element ID	Length	Inlet Invert Elevation (ft)	Inlet Invert Offset (ft)	Outlet Invert Elevation (ft)	Outlet Invert Offset (ft)	Total Drop (ft)	Average Slope (%)	Shape	Height (ft)	Width (ft)	Manning's Roughness	Entrance Losses	Exit/Bend Losses	Additional Losses	Initial Flow (cfs)	Flap Gate
1 East_Channel	3672.92	830.00	0.00	765.00	765.00	65.00	1.7700	Trapezoidal	10.000	75.000	0.0320	0.5000	0.5000	0.0000	0.00	No

Channel Results

SN Element ID	Peak Flow	Time of Peak Flow Occurrence	Design Flow Capacity	Peak Flow/Design Flow Ratio	Peak Flow Velocity	Travel Time	Peak Flow Depth	Peak Flow Depth/Total Depth Ratio	Total Time Surcharged	Froude Number	Reported Condition
	(cfs)	(days hh:mm)	(cfs)		(ft/sec)	(min)	(ft)		(min)		
1 East_Channel	155.32	0 12:13	8923.48	0.02	7.17	8.54	1.26	0.13	0.00		

Pipe Input

SN Element ID	Length (ft)	Inlet Invert Elevation (ft)	Inlet Invert Offset (ft)	Outlet Invert Elevation (ft)	Outlet Invert Offset (ft)	Total Drop (ft)	Average Pipe Slope (%)	Pipe Shape	Pipe Diameter or Height (in)	Pipe Width (in)	Manning's Roughness	Entrance Losses	Exit/Bend Losses	Additional Losses	Initial Flow (cfs)	Flap Gate	No. of Barrels
1 NE-Out	122.68	844.75	0.00	821.93	821.93	22.82	18.6000	CIRCULAR	18.000	18.000	0.0130	0.5000	0.5000	0.0000	0.00	No	1
2 SE-Out	95.88	785.75	0.00	772.89	772.89	12.86	13.4100	CIRCULAR	18.000	18.000	0.0130	0.5000	0.5000	0.0000	0.00	No	1

Pipe Results

SN Element ID	Peak Flow	Time of Peak Flow Occurrence	Design Flow Capacity	Peak Flow/Design Flow Ratio	Peak Flow Velocity	Travel Time	Peak Flow Depth	Peak Flow Depth/Total Depth Ratio	Total Time Surcharged	Froude Number	Reported Condition
	(cfs)	(days hh:mm)	(cfs)		(ft/sec)	(min)	(ft)		(min)		
1 NE-Out	4.92	0 12:25	45.30	0.11	16.79	0.12	0.33	0.22	0.00		Calculated
2 SE-Out	10.70	0 12:25	38.47	0.28	18.64	0.09	0.54	0.36	0.00		Calculated

Storage Nodes

Storage Node : NE-Pond

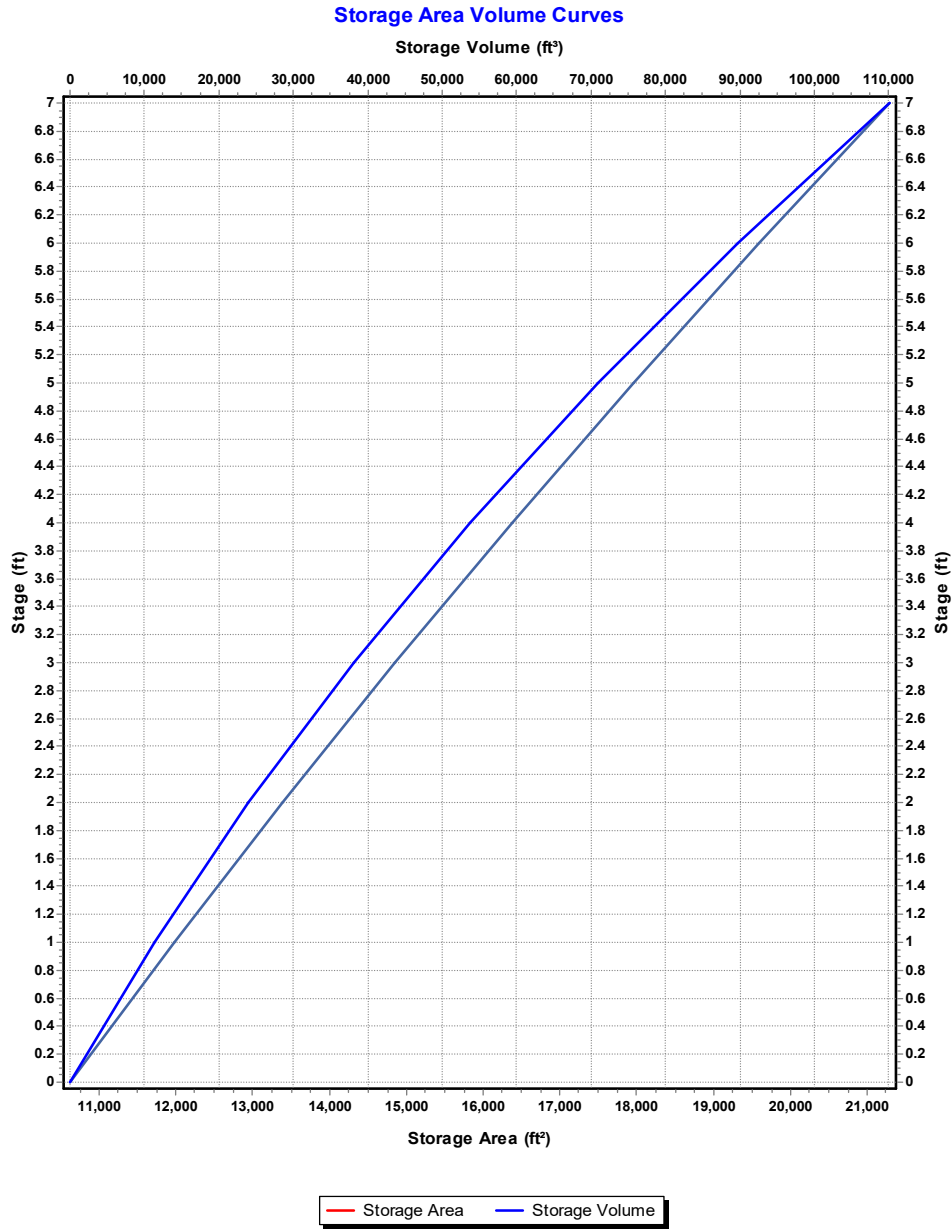
Input Data

Invert Elevation (ft)	845.00
Max (Rim) Elevation (ft)	852.00
Max (Rim) Offset (ft)	7.00
Initial Water Elevation (ft)	845.00
Initial Water Depth (ft)	0.00
Ponded Area (ft ²)	0.00
Evaporation Loss	0.00

Storage Area Volume Curves

Storage Curve : North East Pond

Stage	Storage Area	Storage Volume
(ft)	(ft ²)	(ft ³)
0	10623.06	0
1	11977.56	11300.31
2	13388.6	23983.39
3	14856.2	38105.79
4	16380.34	53724.06
5	17961.03	70894.75
6	19598.27	89674.4
7	21292.06	110119.57



Storage Node : NE-Pond (continued)

Outflow Weirs

SN Element ID	Weir Type	Flap Gate	Crest Elevation (ft)	Crest Offset (ft)	Length (ft)	Weir Total Height (ft)	Discharge Coefficient
1 NE-High	Trapezoidal	No	850.00	5.00	18.00	2.00	3.33

Outflow Orifices

SN Element ID	Orifice Type	Orifice Shape	Flap Gate	Circular Orifice Diameter (in)	Rectangular Orifice Height (in)	Rectangular Orifice Width (in)	Orifice Invert Elevation (ft)	Orifice Coefficient
1 NE-Low	Side	CIRCULAR	No	6.00			845.00	0.61
2 NE-Middle	Side	Rectangular	No		6.00	12.00	846.50	0.63
3 NE-Top	Side	Rectangular	No		6.00	12.00	848.25	0.63

Output Summary Results

Peak Inflow (cfs)	36.82
Peak Lateral Inflow (cfs)	36.82
Peak Outflow (cfs)	4.92
Peak Exfiltration Flow Rate (cfm)	0
Max HGL Elevation Attained (ft)	848.32
Max HGL Depth Attained (ft)	3.32
Average HGL Elevation Attained (ft)	845.88
Average HGL Depth Attained (ft)	0.88
Time of Max HGL Occurrence (days hh:mm)	0 12:25
Total Exfiltration Volume (1000-ft ³)	0
Total Flooded Volume (ac-in)	0
Total Time Flooded (min)	0
Total Retention Time (sec)	0

Storage Node : SE-Pond

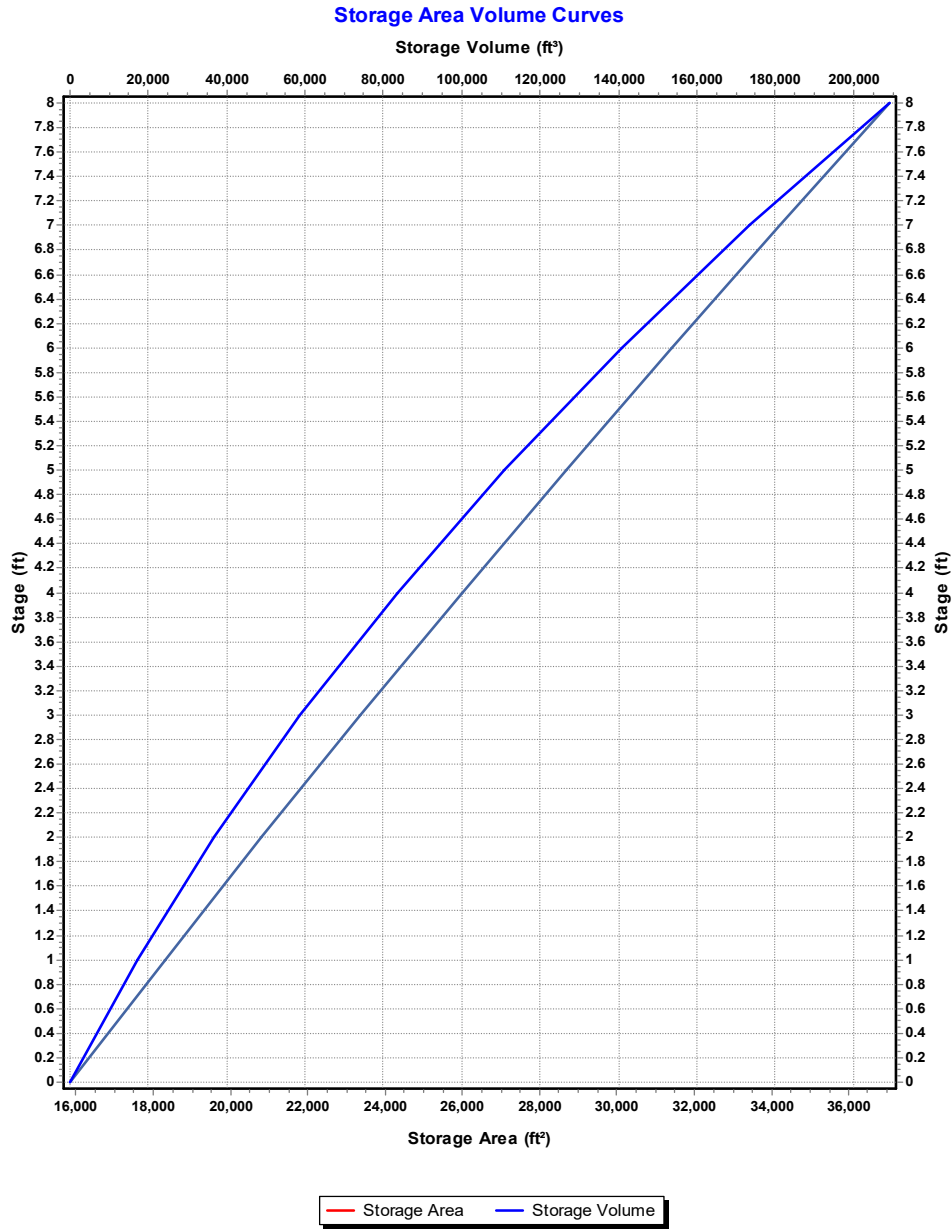
Input Data

Invert Elevation (ft)	786.00
Max (Rim) Elevation (ft)	794.00
Max (Rim) Offset (ft)	8.00
Initial Water Elevation (ft)	786.00
Initial Water Depth (ft)	0.00
Ponded Area (ft ²)	0.00
Evaporation Loss	0.00

Storage Area Volume Curves

Storage Curve : South East Pond

Stage	Storage Area	Storage Volume
(ft)	(ft ²)	(ft ³)
0	15847.77	0
1	18300.77	17074.27
2	20810.31	36629.81
3	23376.41	58723.17
4	25999.05	83410.9
5	28678.24	110749.55
6	31413.98	140795.66
7	34206.27	173605.79
8	37055.1	209236.48



Storage Node : SE-Pond (continued)

Outflow Weirs

SN Element ID	Weir Type	Flap Gate	Crest Elevation (ft)	Crest Offset (ft)	Length (ft)	Weir Total Height (ft)	Discharge Coefficient
1 SE-Weir	Trapezoidal	No	792.00	6.00	35.00	1.50	3.33

Outflow Orifices

SN Element ID	Orifice Type	Orifice Shape	Flap Gate	Circular Orifice Diameter (in)	Rectangular Orifice Height (in)	Rectangular Orifice Width (in)	Orifice Invert Elevation (ft)	Orifice Coefficient
1 SE-Low	Side	Rectangular	No		6.00	12.00	786.00	0.63
2 SE-Middle	Side	Rectangular	No		6.00	18.00	787.50	0.63
3 SE-Top	Side	Rectangular	No		6.00	18.00	790.50	0.63

Output Summary Results

Peak Inflow (cfs)	70.75
Peak Lateral Inflow (cfs)	70.75
Peak Outflow (cfs)	10.7
Peak Exfiltration Flow Rate (cfm)	0
Max HGL Elevation Attained (ft)	790.1
Max HGL Depth Attained (ft)	4.1
Average HGL Elevation Attained (ft)	786.86
Average HGL Depth Attained (ft)	0.86
Time of Max HGL Occurrence (days hh:mm)	0 12:25
Total Exfiltration Volume (1000-ft ³)	0
Total Flooded Volume (ac-in)	0
Total Time Flooded (min)	0
Total Retention Time (sec)	0

Project Description

File Name 22-0138_Prop_Conditions_East.SPF

Project Options

Flow Units CFS
 Elevation Type Elevation
 Hydrology Method SCS TR-55
 Time of Concentration (TOC) Method SCS TR-55
 Link Routing Method Kinematic Wave
 Enable Overflow Ponding at Nodes YES
 Skip Steady State Analysis Time Periods ... YES

Analysis Options

Start Analysis On 00:00:00 0:00:00
 End Analysis On 00:00:00 0:00:00
 Start Reporting On 00:00:00 0:00:00
 Antecedent Dry Days 0 days
 Runoff (Dry Weather) Time Step 0 01:00:00 days hh:mm:ss
 Runoff (Wet Weather) Time Step 0 00:05:00 days hh:mm:ss
 Reporting Time Step 0 00:05:00 days hh:mm:ss
 Routing Time Step 30 seconds

Number of Elements

	Qty
Rain Gages	1
Subbasins.....	5
Nodes.....	8
<i>Junctions</i>	3
<i>Outfalls</i>	3
<i>Flow Diversions</i>	0
<i>Inlets</i>	0
<i>Storage Nodes</i>	2
Links.....	11
<i>Channels</i>	1
<i>Pipes</i>	2
<i>Pumps</i>	0
<i>Orifices</i>	6
<i>Weirs</i>	2
<i>Outlets</i>	0
Pollutants	0
Land Uses	0

Rainfall Details

SN	Rain Gage ID	Data Source	Data Source ID	Rainfall Type	Rain Units	State	County	Return Period (years)	Rainfall Depth (inches)	Rainfall Distribution
49		Time Series	50-yr	Cumulative	inches	Missouri	Platte	50.00	7.55	SCS Type II 24-hr

Subbasin Summary

SN Subbasin ID	Area (ac)	Peak Rate Factor	Weighted Curve Number	Total Rainfall (in)	Total Runoff (in)	Total Runoff Volume (ac-in)	Peak Runoff (cfs)	Time of Concentration (days hh:mm:ss)
1 Proposed_01A	35.43	484.00	75.61	7.55	4.71	166.73	205.68	0 00:15:00
2 Proposed_01B	6.22	484.00	77.27	7.55	4.89	30.44	45.94	0 00:06:24
3 Proposed_01C	12.21	484.00	79.47	7.55	5.14	62.81	89.56	0 00:08:11
4 Proposed_02	16.29	484.00	71.87	7.55	4.29	69.84	92.44	0 00:12:06
5 Proposed_03	12.40	484.00	67.89	7.55	3.85	47.72	71.98	0 00:06:42

Node Summary

SN Element ID	Element Type	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Initial Water Elevation (ft)	Surcharge Elevation (ft)	Ponded Area (ft ²)	Peak Inflow (cfs)	Max HGL Elevation (ft)	Max Surcharge Depth (ft)	Min Freeboard (ft)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	1-Jun Junction	830.00	845.00	830.00	0.00	0.00	196.84	831.47	0.00	13.53	0 00:00	0.00	0.00
2	2-Jun Junction	844.75	849.25	844.75	0.00	0.00	7.11	845.15	0.00	4.10	0 00:00	0.00	0.00
3	4-Jun Junction	785.75	791.50	785.75	0.00	0.00	12.80	786.35	0.00	5.15	0 00:00	0.00	0.00
4	Out-01 Outfall	0.00					209.48	822.33					
5	Out-02 Outfall	0.00					91.96	0.00					
6	Out-03 Outfall	0.00					68.88	0.00					
7	NE-Pond Storage Node	845.00	852.00	845.00		0.00	44.90	848.90				0.00	0.00
8	SE-Pond Storage Node	786.00	794.00	786.00		0.00	84.67	790.80				0.00	0.00

Link Summary

SN	Element ID	Element Type	From (Inlet) Node	To (Outlet) Node	Length (ft)	Inlet Invert Elevation (ft)	Outlet Invert Elevation (ft)	Average Slope (%)	Diameter or Height (in)	Manning's Roughness	Peak Flow (cfs)	Design Flow Capacity (cfs)	Peak Flow/Design Flow Ratio	Peak Flow Velocity (ft/sec)	Peak Flow Depth (ft)	Peak Flow Depth/Total Depth Ratio	Total Time Surcharged (min)	Reported Condition
1	NE-Out	Pipe	2-Jun	Out-01	122.68	844.75	821.93	18.6000	18.000	0.0130	7.11	45.30	0.16	18.67	0.40	0.27	0.00	Calculated
2	SE-Out	Pipe	4-Jun	Out-01	95.88	785.75	772.89	13.4100	18.000	0.0130	12.80	38.47	0.33	19.56	0.60	0.40	0.00	Calculated
3	East_Channel	Channel	1-Jun	Out-01	3672.92	830.00	765.00	1.7700	120.000	0.0320	190.65	8923.48	0.02	7.58	1.42	0.14	0.00	
4	NE-Low	Orifice	NE-Pond	2-Jun		845.00	844.75		6.000									
5	NE-Middle	Orifice	NE-Pond	2-Jun		845.00	844.75		6.000									
6	NE-Top	Orifice	NE-Pond	2-Jun		845.00	844.75		6.000									
7	SE-Low	Orifice	SE-Pond	4-Jun		786.00	785.75		6.000									
8	SE-Middle	Orifice	SE-Pond	4-Jun		786.00	785.75		6.000									
9	SE-Top	Orifice	SE-Pond	4-Jun		786.00	785.75		6.000									
10	NE-High	Weir	NE-Pond	Out-01		845.00	0.00											
11	SE-Weir	Weir	SE-Pond	Out-01		786.00	0.00											

Subbasin Hydrology

Subbasin : Proposed_01A

Input Data

Area (ac) 35.43
 Peak Rate Factor 484
 Weighted Curve Number 75.61
 Rain Gage ID Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
32			
Woods, Good	3.71	B	55
Woods, Good	4.79	C	70
Woods, Good	19.01	D	77
1/3 acre lots, 30% impervious	1.06	C	81
1/3 acre lots, 30% impervious	6.86	D	86
Composite Area & Weighted CN	35.43		75.61

Time of Concentration

TOC Method : SCS TR-55

Sheet Flow Equation :

$$T_c = (0.007 * ((n * L_f)^{0.8}) / ((P^{0.5}) * (S_f^{0.4}))$$

Where :

Tc = Time of Concentration (hr)
 n = Manning's roughness
 Lf = Flow Length (ft)
 P = 2 yr, 24 hr Rainfall (inches)
 Sf = Slope (ft/ft)

Shallow Concentrated Flow Equation :

V = 16.1345 * (Sf^{0.5}) (unpaved surface)
 V = 20.3282 * (Sf^{0.5}) (paved surface)
 V = 15.0 * (Sf^{0.5}) (grassed waterway surface)
 V = 10.0 * (Sf^{0.5}) (nearly bare & untilled surface)
 V = 9.0 * (Sf^{0.5}) (cultivated straight rows surface)
 V = 7.0 * (Sf^{0.5}) (short grass pasture surface)
 V = 5.0 * (Sf^{0.5}) (woodland surface)
 V = 2.5 * (Sf^{0.5}) (forest w/heavy litter surface)
 Tc = (Lf / V) / (3600 sec/hr)

Where:

Tc = Time of Concentration (hr)
 Lf = Flow Length (ft)
 V = Velocity (ft/sec)
 Sf = Slope (ft/ft)

Channel Flow Equation :

V = (1.49 * (R^{2/3}) * (Sf^{0.5})) / n
 R = Aq / Wp
 Tc = (Lf / V) / (3600 sec/hr)

Where :

Tc = Time of Concentration (hr)
 Lf = Flow Length (ft)
 R = Hydraulic Radius (ft)
 Aq = Flow Area (ft²)
 Wp = Wetted Perimeter (ft)
 V = Velocity (ft/sec)
 Sf = Slope (ft/ft)
 n = Manning's roughness

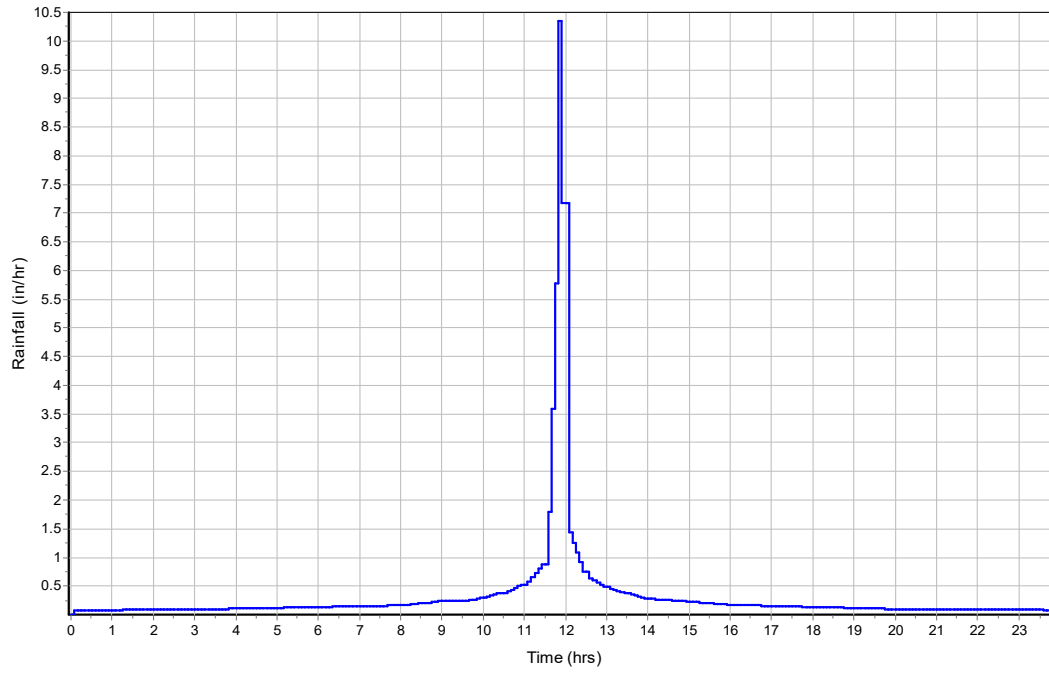
User-Defined TOC override (minutes): 15

Subbasin Runoff Results

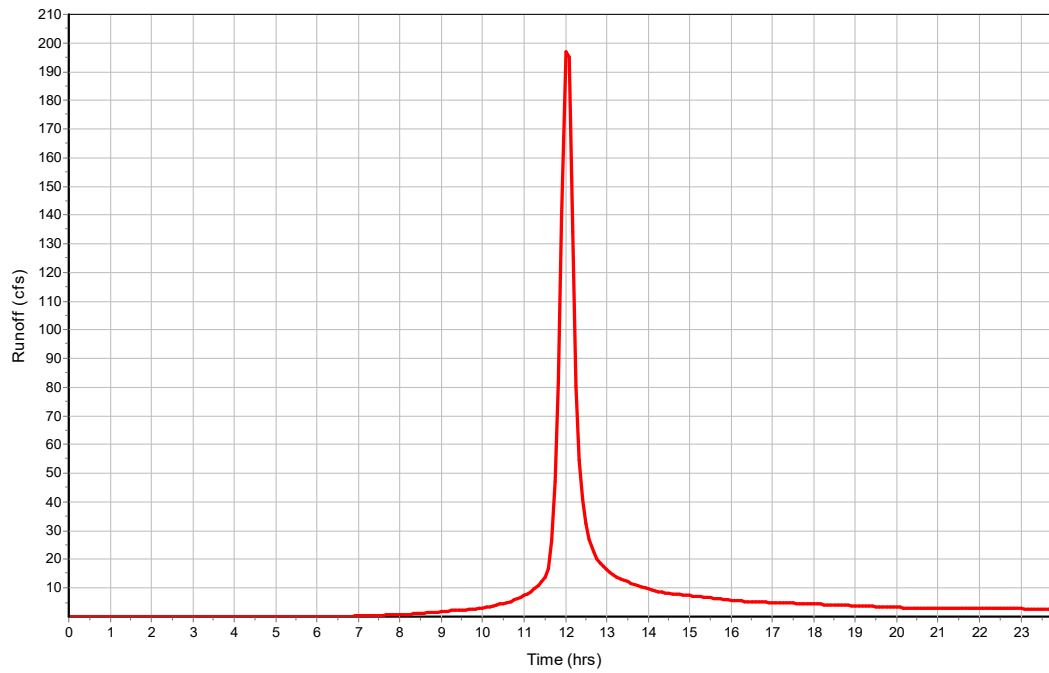
Total Rainfall (in)	7.55
Total Runoff (in)	4.71
Peak Runoff (cfs)	205.68
Weighted Curve Number	75.61
Time of Concentration (days hh:mm:ss)	0 00:15:00

Subbasin : Proposed_01A

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : Proposed_01B

Input Data

Area (ac) 6.22
 Peak Rate Factor 484
 Weighted Curve Number 77.27
 Rain Gage ID Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
32			
Woods, Good	0.55	B	55
Woods, Good	1.47	C	70
1/3 acre lots, 30% impervious	2.73	C	81
1/3 acre lots, 30% impervious	1.46	D	86
Composite Area & Weighted CN	6.21		77.27

Time of Concentration

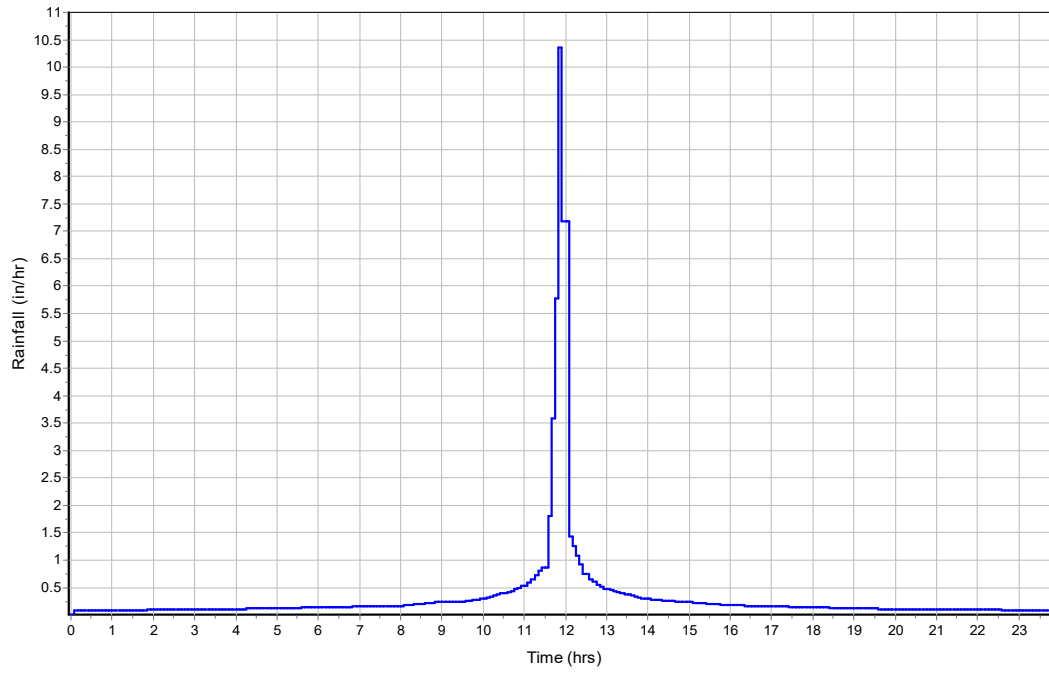
User-Defined TOC override (minutes): 6.4

Subbasin Runoff Results

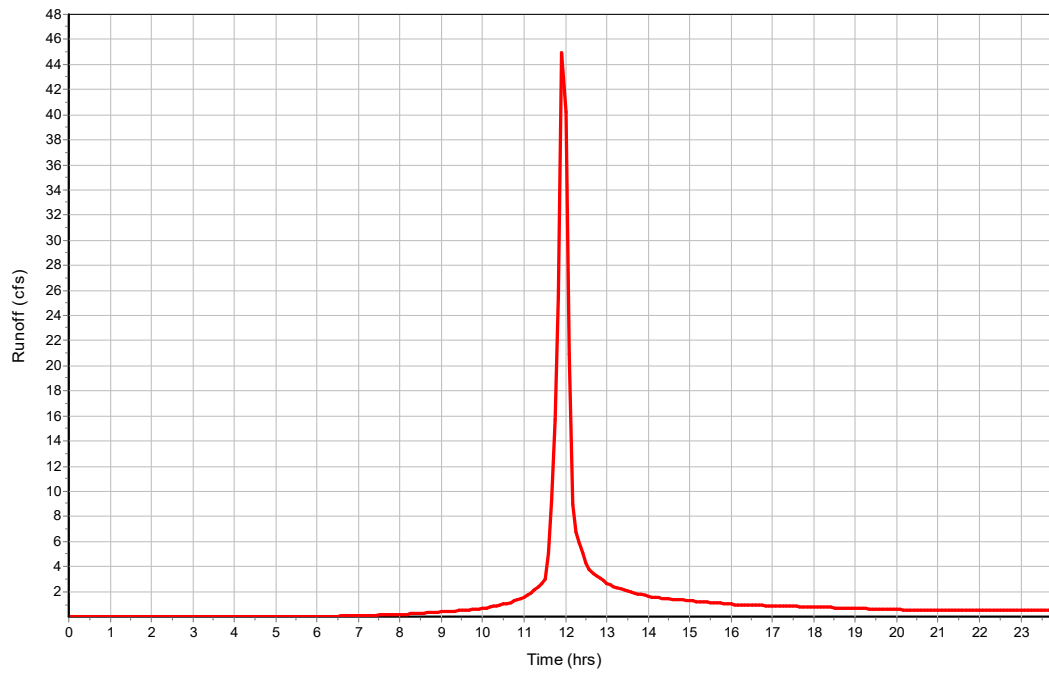
Total Rainfall (in) 7.55
 Total Runoff (in) 4.89
 Peak Runoff (cfs) 45.94
 Weighted Curve Number 77.27
 Time of Concentration (days hh:mm:ss) 0 00:06:24

Subbasin : Proposed_01B

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : Proposed_01C

Input Data

Area (ac) 12.21
 Peak Rate Factor 484
 Weighted Curve Number 79.47
 Rain Gage ID Rain Gage-01

Composite Curve Number

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
Woods, Good	0.12	B	55
Woods, Good	2.52	C	70
Woods, Good	1.24	D	77
1/3 acre lots, 30% impervious	4.9	C	81
1/3 acre lots, 30% impervious	3.43	D	86
Composite Area & Weighted CN	12.21		79.47

Time of Concentration

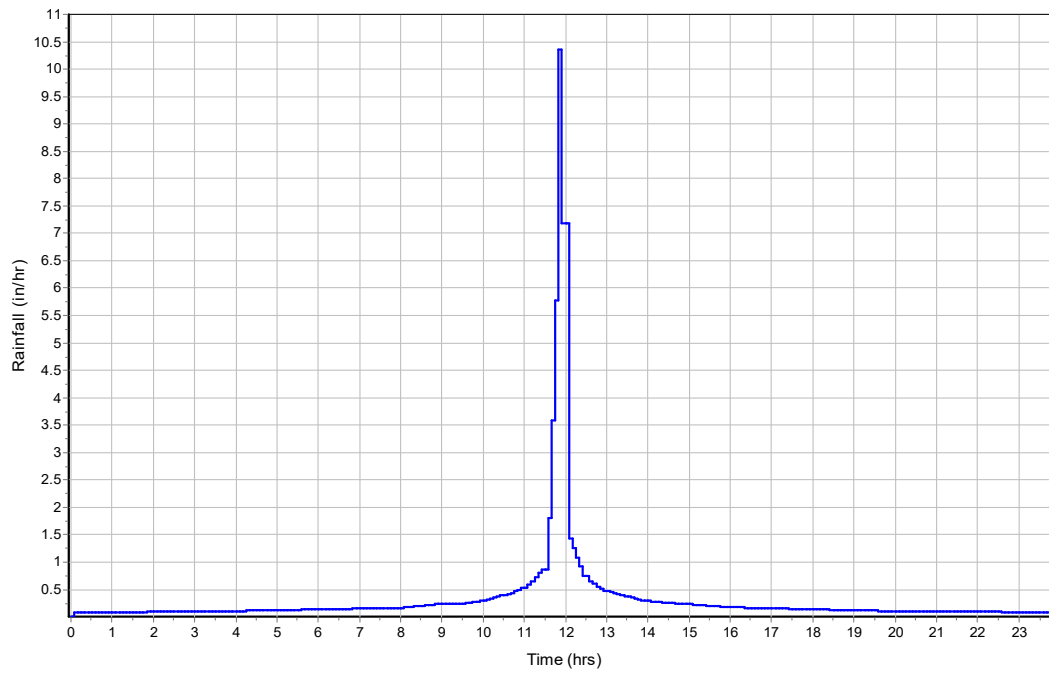
User-Defined TOC override (minutes): 8.2

Subbasin Runoff Results

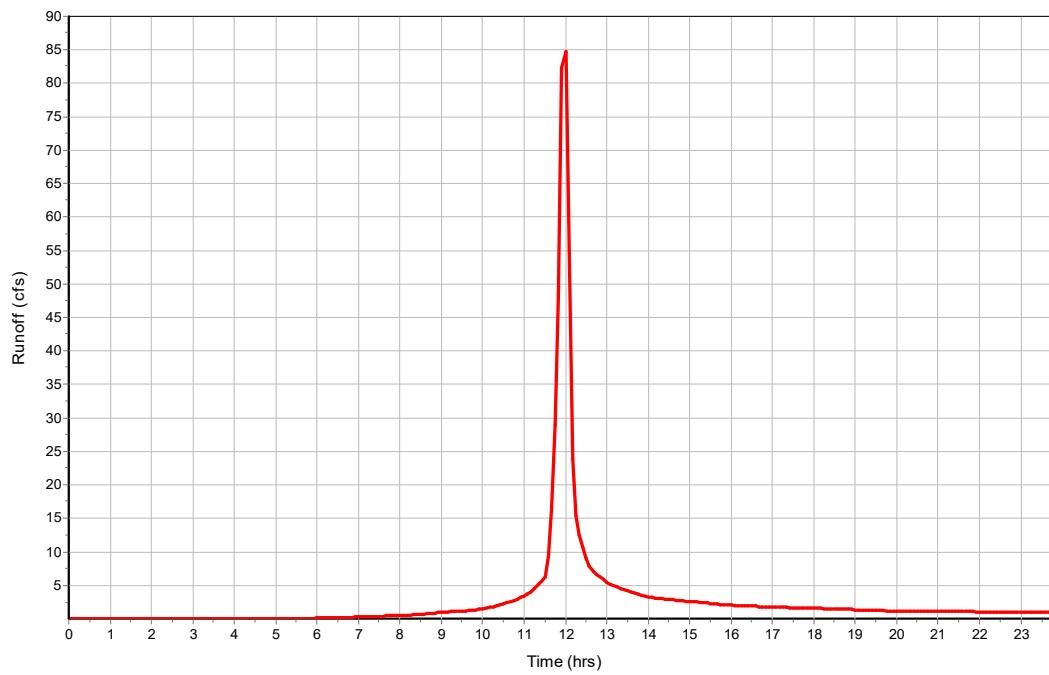
Total Rainfall (in) 7.55
 Total Runoff (in) 5.14
 Peak Runoff (cfs) 89.56
 Weighted Curve Number 79.47
 Time of Concentration (days hh:mm:ss) 0 00:08:12

Subbasin : Proposed_01C

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : Proposed_02

Input Data

Area (ac) 16.29
 Peak Rate Factor 484
 Weighted Curve Number 71.87
 Rain Gage ID Rain Gage-01

Composite Curve Number

32 Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Woods, Good	6	B	55
1/3 acre lots, 30% impervious	8.84	C	81
1/3 acre lots, 30% impervious	1.45	D	86
Composite Area & Weighted CN	16.29		71.87

Time of Concentration

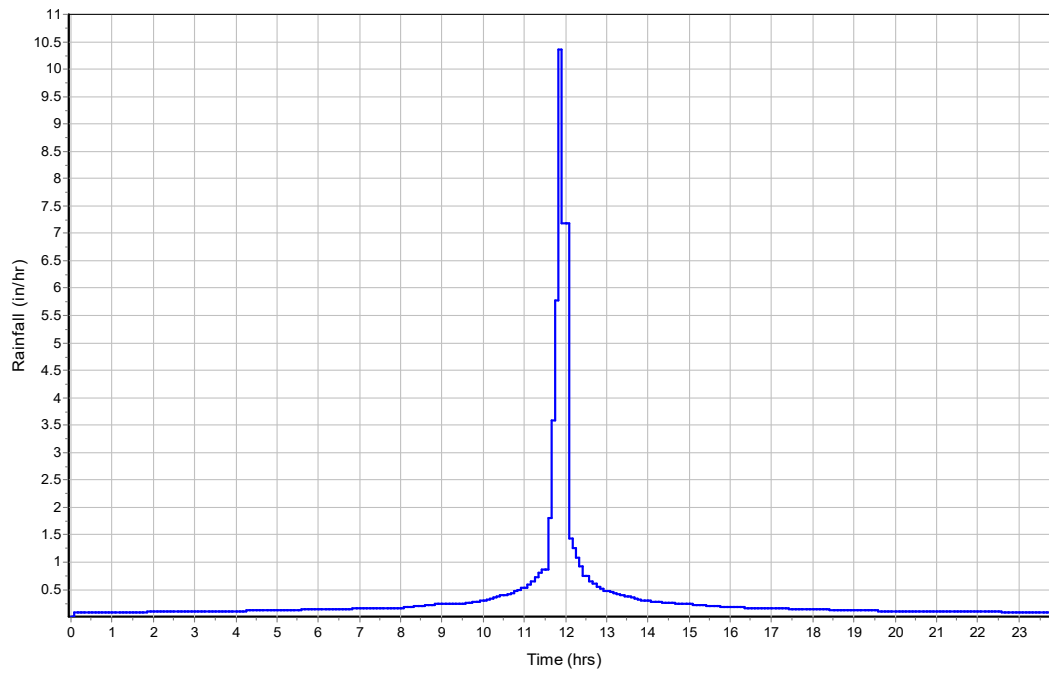
User-Defined TOC override (minutes): 12.1

Subbasin Runoff Results

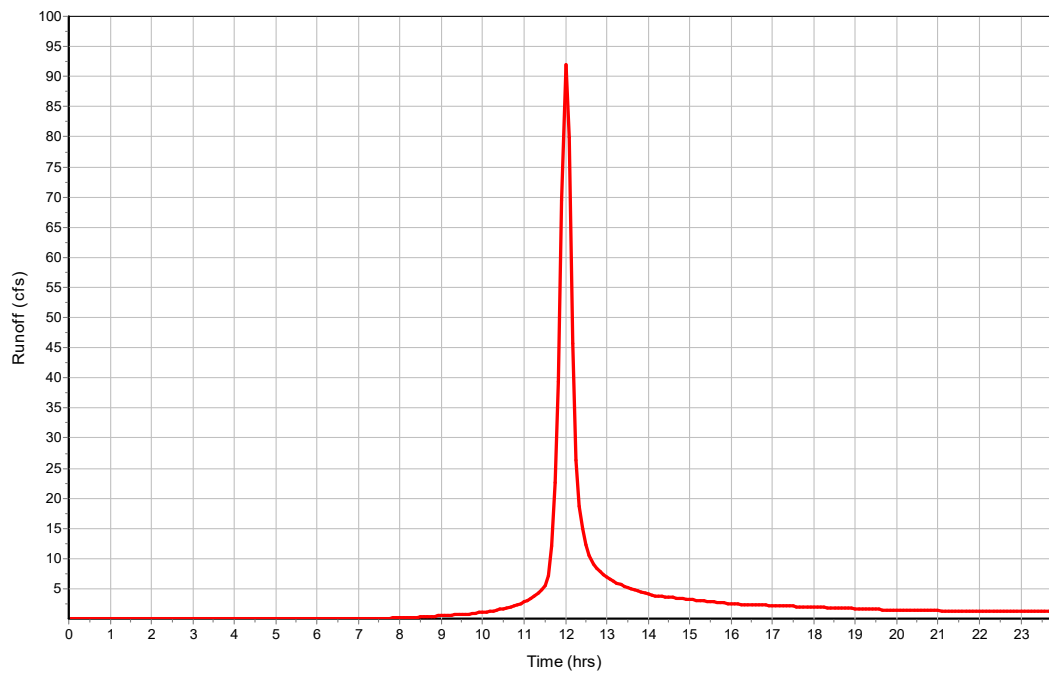
Total Rainfall (in) 7.55
 Total Runoff (in) 4.29
 Peak Runoff (cfs) 92.44
 Weighted Curve Number 71.87
 Time of Concentration (days hh:mm:ss) 0 00:12:06

Subbasin : Proposed_02

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : Proposed_03

Input Data

Area (ac) 12.4
 Peak Rate Factor 484
 Weighted Curve Number 67.89
 Rain Gage ID Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
32			
Woods, Good	6.17	B	55
Woods, Good	0.23	C	70
1/3 acre lots, 30% impervious	5.92	C	81
1/3 acre lots, 30% impervious	0.08	D	86
Composite Area & Weighted CN	12.4		67.89

Time of Concentration

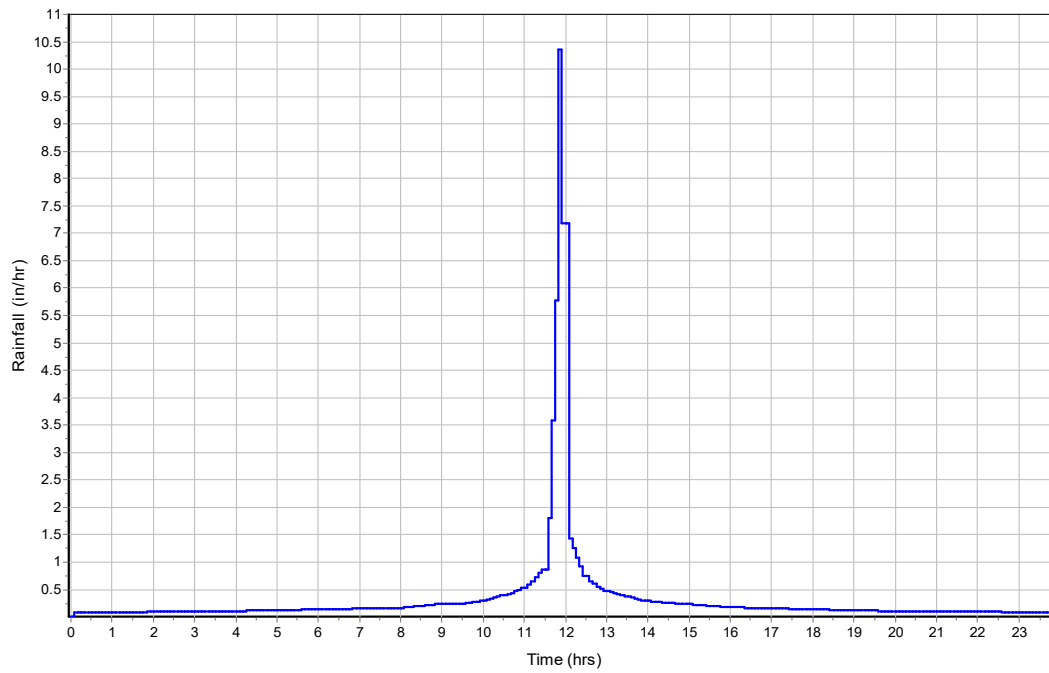
User-Defined TOC override (minutes): 6.7

Subbasin Runoff Results

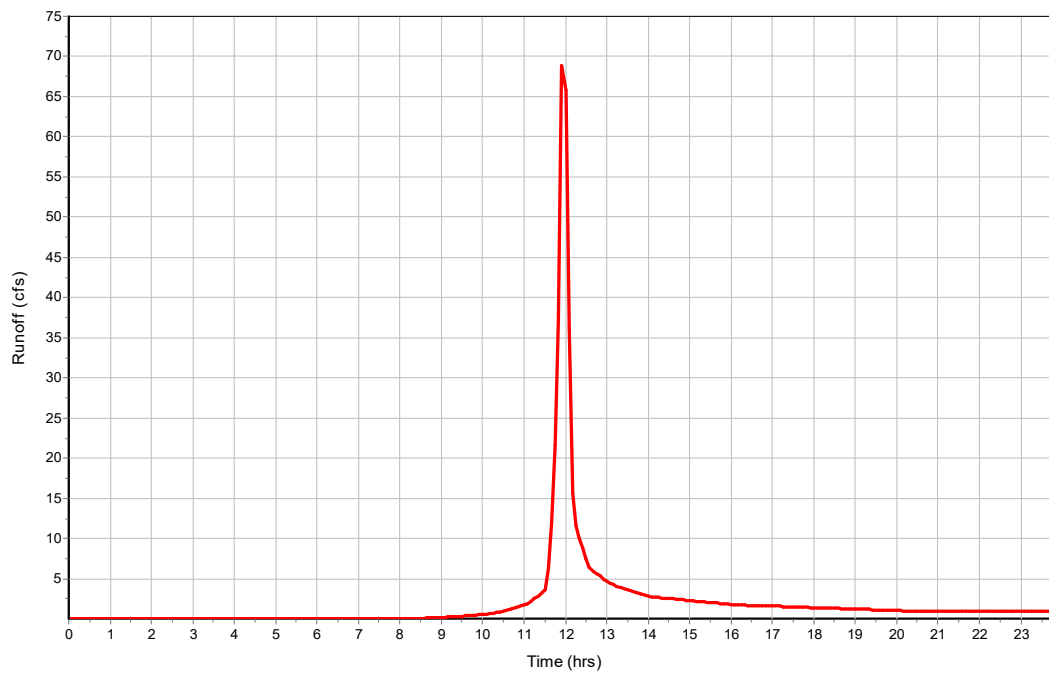
Total Rainfall (in) 7.55
 Total Runoff (in) 3.85
 Peak Runoff (cfs) 71.98
 Weighted Curve Number 67.89
 Time of Concentration (days hh:mm:ss) 0 00:06:42

Subbasin : Proposed_03

Rainfall Intensity Graph



Runoff Hydrograph



Junction Input

SN Element ID	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Ground/Rim (Max) Offset (ft)	Initial Water Elevation (ft)	Initial Water Depth (ft)	Surcharge Elevation (ft)	Surcharge Depth (ft)	Ponded Area (ft ²)	Minimum Pipe Cover (in)
1 1-Jun	830.00	845.00	15.00	830.00	0.00	0.00	-845.00	0.00	0.00
2 2-Jun	844.75	849.25	4.50	844.75	0.00	0.00	-849.25	0.00	0.00
3 4-Jun	785.75	791.50	5.75	785.75	0.00	0.00	-791.50	0.00	0.00

Junction Results

SN Element ID	Peak Inflow	Peak Lateral Inflow	Max HGL Elevation	Max HGL Depth	Max Surcharge Depth	Min Freeboard Attained	Average HGL Elevation	Average HGL Depth	Time of Max HGL Occurrence	Time of Peak Flooding Occurrence	Total Flooded Volume	Total Time Flooded
	(cfs)	(cfs)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(days hh:mm)	(days hh:mm)	(ac-in)	(min)
1 1-Jun	196.84	196.84	831.47	1.47	0.00	13.53	830.14	0.14	0 12:05	0 00:00	0.00	0.00
2 2-Jun	7.11	0.00	845.15	0.40	0.00	4.10	844.87	0.12	0 12:19	0 00:00	0.00	0.00
3 4-Jun	12.80	0.00	786.35	0.60	0.00	5.15	785.94	0.19	0 12:25	0 00:00	0.00	0.00

Channel Input

SN Element ID	Length	Inlet Invert Elevation (ft)	Inlet Invert Offset (ft)	Outlet Invert Elevation (ft)	Outlet Invert Offset (ft)	Total Drop (ft)	Average Slope (%)	Shape	Height (ft)	Width (ft)	Manning's Roughness	Entrance Losses	Exit/Bend Losses	Additional Losses	Initial Flow (cfs)	Flap Gate
1 East_Channel	3672.92	830.00	0.00	765.00	765.00	65.00	1.7700	Trapezoidal	10.000	75.000	0.0320	0.5000	0.5000	0.0000	0.00	No

Channel Results

SN Element ID	Peak Flow	Time of Peak Flow Occurrence	Design Flow Capacity	Peak Flow/Design Flow Ratio	Peak Flow Velocity	Travel Time	Peak Flow Depth	Peak Flow Depth/Total Depth Ratio	Total Time Surcharged	Froude Number	Reported Condition
	(cfs)	(days hh:mm)	(cfs)		(ft/sec)	(min)	(ft)		(min)		
1 East_Channel	190.65	0 12:13	8923.48	0.02	7.58	8.08	1.42	0.14	0.00		

Pipe Input

SN Element ID	Length (ft)	Inlet Invert Elevation (ft)	Inlet Invert Offset (ft)	Outlet Invert Elevation (ft)	Outlet Invert Offset (ft)	Total Drop (ft)	Average Pipe Slope (%)	Pipe Shape	Pipe Diameter or Height (in)	Pipe Width (in)	Manning's Roughness	Entrance Losses	Exit/Bend Losses	Additional Losses	Initial Flow (cfs)	Flap Gate	No. of Barrels
1 NE-Out	122.68	844.75	0.00	821.93	821.93	22.82	18.6000	CIRCULAR	18.000	18.000	0.0130	0.5000	0.5000	0.0000	0.00	No	1
2 SE-Out	95.88	785.75	0.00	772.89	772.89	12.86	13.4100	CIRCULAR	18.000	18.000	0.0130	0.5000	0.5000	0.0000	0.00	No	1

Pipe Results

SN Element ID	Peak Flow	Time of Peak Flow Occurrence	Design Flow Capacity	Peak Flow/Design Flow Ratio	Peak Flow Velocity	Travel Time	Peak Flow Depth	Peak Flow Depth/Total Depth Ratio	Total Time Surcharged	Froude Number	Reported Condition
	(cfs)	(days hh:mm)	(cfs)		(ft/sec)	(min)	(ft)		(min)		
1 NE-Out	7.11	0 12:19	45.30	0.16	18.67	0.11	0.40	0.27	0.00		Calculated
2 SE-Out	12.80	0 12:25	38.47	0.33	19.56	0.08	0.60	0.40	0.00		Calculated

Storage Nodes

Storage Node : NE-Pond

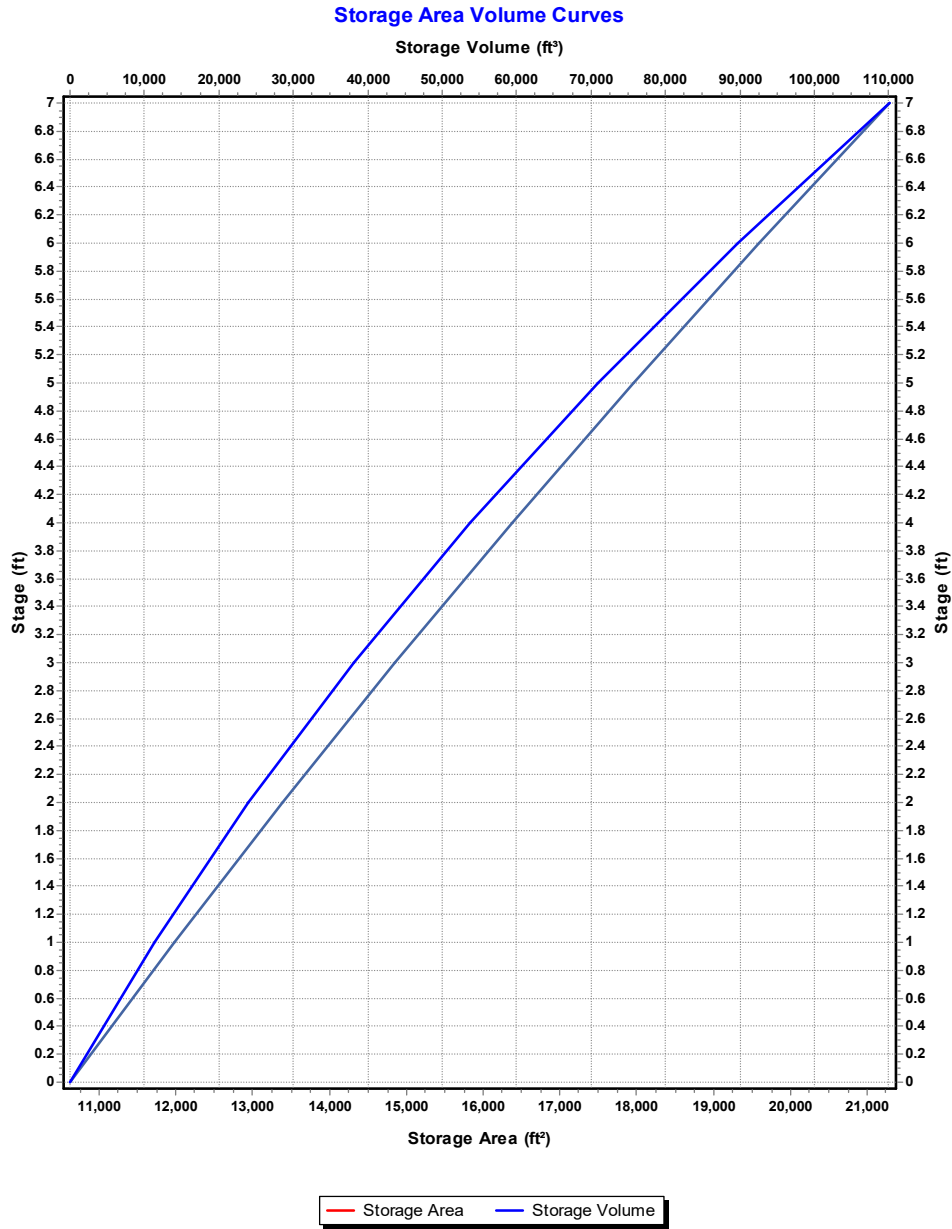
Input Data

Invert Elevation (ft)	845.00
Max (Rim) Elevation (ft)	852.00
Max (Rim) Offset (ft)	7.00
Initial Water Elevation (ft)	845.00
Initial Water Depth (ft)	0.00
Ponded Area (ft ²)	0.00
Evaporation Loss	0.00

Storage Area Volume Curves

Storage Curve : North East Pond

Stage	Storage Area	Storage Volume
(ft)	(ft ²)	(ft ³)
0	10623.06	0
1	11977.56	11300.31
2	13388.6	23983.39
3	14856.2	38105.79
4	16380.34	53724.06
5	17961.03	70894.75
6	19598.27	89674.4
7	21292.06	110119.57



Storage Node : NE-Pond (continued)

Outflow Weirs

SN Element ID	Weir Type	Flap Gate	Crest Elevation (ft)	Crest Offset (ft)	Length (ft)	Weir Total Height (ft)	Discharge Coefficient
1 NE-High	Trapezoidal	No	850.00	5.00	18.00	2.00	3.33

Outflow Orifices

SN Element ID	Orifice Type	Orifice Shape	Flap Gate	Circular Orifice Diameter (in)	Rectangular Orifice Height (in)	Rectangular Orifice Width (in)	Orifice Invert Elevation (ft)	Orifice Coefficient
1 NE-Low	Side	CIRCULAR	No	6.00			845.00	0.61
2 NE-Middle	Side	Rectangular	No		6.00	12.00	846.50	0.63
3 NE-Top	Side	Rectangular	No		6.00	12.00	848.25	0.63

Output Summary Results

Peak Inflow (cfs)	44.9
Peak Lateral Inflow (cfs)	44.9
Peak Outflow (cfs)	7.11
Peak Exfiltration Flow Rate (cfm)	0
Max HGL Elevation Attained (ft)	848.9
Max HGL Depth Attained (ft)	3.9
Average HGL Elevation Attained (ft)	845.99
Average HGL Depth Attained (ft)	0.99
Time of Max HGL Occurrence (days hh:mm)	0 12:19
Total Exfiltration Volume (1000-ft ³)	0
Total Flooded Volume (ac-in)	0
Total Time Flooded (min)	0
Total Retention Time (sec)	0

Storage Node : SE-Pond

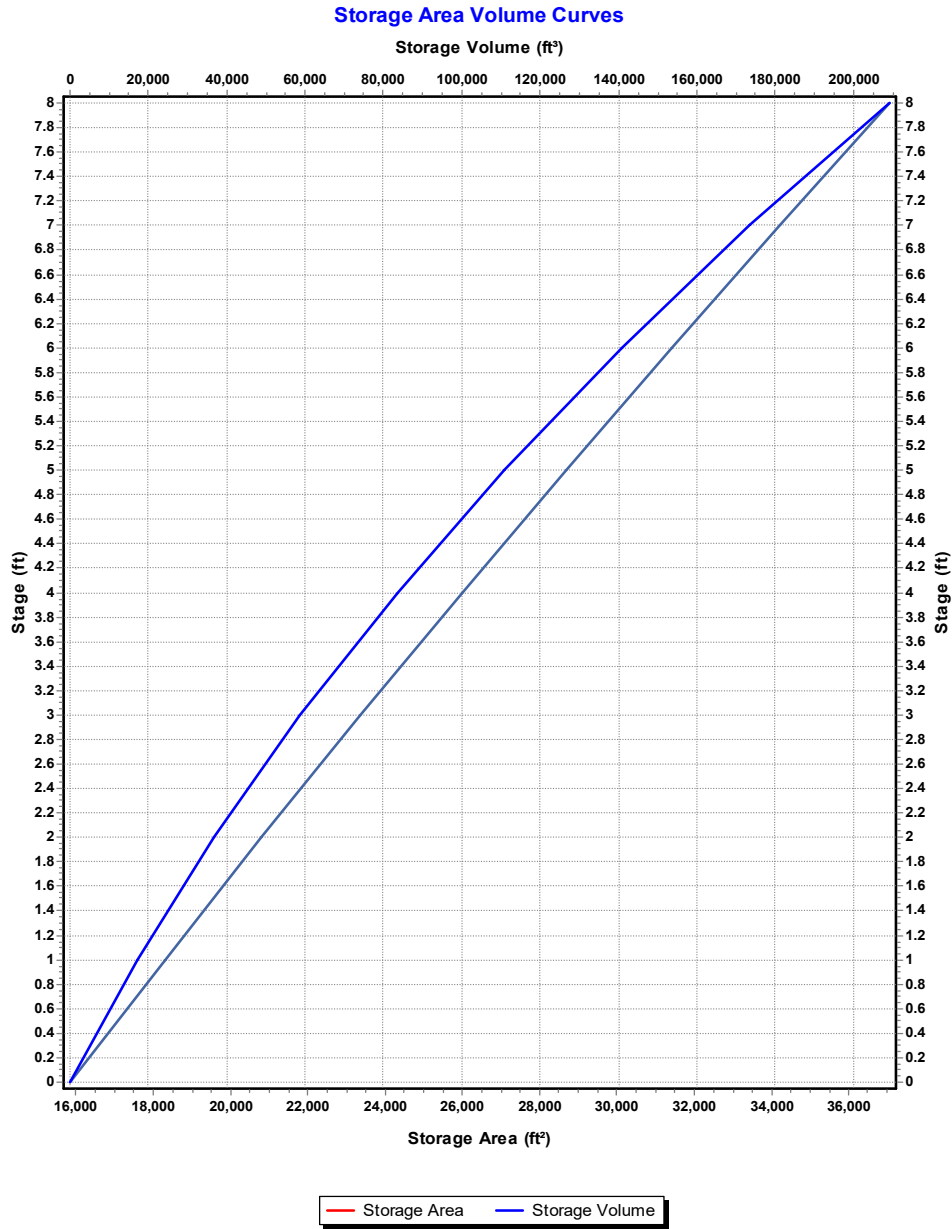
Input Data

Invert Elevation (ft)	786.00
Max (Rim) Elevation (ft)	794.00
Max (Rim) Offset (ft)	8.00
Initial Water Elevation (ft)	786.00
Initial Water Depth (ft)	0.00
Ponded Area (ft ²)	0.00
Evaporation Loss	0.00

Storage Area Volume Curves

Storage Curve : South East Pond

Stage (ft)	Storage Area (ft ²)	Storage Volume (ft ³)
0	15847.77	0
1	18300.77	17074.27
2	20810.31	36629.81
3	23376.41	58723.17
4	25999.05	83410.9
5	28678.24	110749.55
6	31413.98	140795.66
7	34206.27	173605.79
8	37055.1	209236.48



Storage Node : SE-Pond (continued)

Outflow Weirs

SN Element ID	Weir Type	Flap Gate	Crest Elevation (ft)	Crest Offset (ft)	Length (ft)	Weir Total Height (ft)	Discharge Coefficient
1 SE-Weir	Trapezoidal	No	792.00	6.00	35.00	1.50	3.33

Outflow Orifices

SN Element ID	Orifice Type	Orifice Shape	Flap Gate	Circular Orifice Diameter (in)	Rectangular Orifice Height (in)	Rectangular Orifice Width (in)	Orifice Invert Elevation (ft)	Orifice Coefficient
1 SE-Low	Side	Rectangular	No		6.00	12.00	786.00	0.63
2 SE-Middle	Side	Rectangular	No		6.00	18.00	787.50	0.63
3 SE-Top	Side	Rectangular	No		6.00	18.00	790.50	0.63

Output Summary Results

Peak Inflow (cfs)	84.67
Peak Lateral Inflow (cfs)	84.67
Peak Outflow (cfs)	12.8
Peak Exfiltration Flow Rate (cfm)	0
Max HGL Elevation Attained (ft)	790.8
Max HGL Depth Attained (ft)	4.8
Average HGL Elevation Attained (ft)	787.03
Average HGL Depth Attained (ft)	1.03
Time of Max HGL Occurrence (days hh:mm)	0 12:25
Total Exfiltration Volume (1000-ft ³)	0
Total Flooded Volume (ac-in)	0
Total Time Flooded (min)	0
Total Retention Time (sec)	0

Project Description

File Name 22-0138_Prop_Conditions_East.SPF

Project Options

Flow Units CFS
 Elevation Type Elevation
 Hydrology Method SCS TR-55
 Time of Concentration (TOC) Method SCS TR-55
 Link Routing Method Kinematic Wave
 Enable Overflow Ponding at Nodes YES
 Skip Steady State Analysis Time Periods ... YES

Analysis Options

Start Analysis On 00:00:00 0:00:00
 End Analysis On 00:00:00 0:00:00
 Start Reporting On 00:00:00 0:00:00
 Antecedent Dry Days 0 days
 Runoff (Dry Weather) Time Step 0 01:00:00 days hh:mm:ss
 Runoff (Wet Weather) Time Step 0 00:05:00 days hh:mm:ss
 Reporting Time Step 0 00:05:00 days hh:mm:ss
 Routing Time Step 30 seconds

Number of Elements

	Qty
Rain Gages	1
Subbasins.....	5
Nodes.....	8
<i>Junctions</i>	3
<i>Outfalls</i>	3
<i>Flow Diversions</i>	0
<i>Inlets</i>	0
<i>Storage Nodes</i>	2
Links.....	11
<i>Channels</i>	1
<i>Pipes</i>	2
<i>Pumps</i>	0
<i>Orifices</i>	6
<i>Weirs</i>	2
<i>Outlets</i>	0
Pollutants	0
Land Uses	0

Rainfall Details

SN	Rain Gage ID	Data Source	Data Source ID	Rainfall Type	Rain Units	State	County	Return Period (years)	Rainfall Depth (inches)	Rainfall Distribution
49		Time Series	100-yr	Cumulative	inches	Missouri	Platte	100.00	8.57	SCS Type II 24-hr

Subbasin Summary

SN	Subbasin ID	Area (ac)	Peak Rate Factor	Weighted Curve Number	Total Rainfall (in)	Total Runoff (in)	Total Runoff Volume (ac-in)	Peak Runoff (cfs)	Time of Concentration (days hh:mm:ss)
1	Proposed_01A	35.43	484.00	75.61	8.57	5.63	199.54	244.93	0 00:15:00
2	Proposed_01B	6.22	484.00	77.27	8.57	5.83	36.28	54.40	0 00:06:24
3	Proposed_01C	12.21	484.00	79.47	8.57	6.10	74.44	105.48	0 00:08:11
4	Proposed_02	16.29	484.00	71.87	8.57	5.18	84.41	111.40	0 00:12:06
5	Proposed_03	12.40	484.00	67.89	8.57	4.71	58.34	88.10	0 00:06:42

Node Summary

SN	Element ID	Element Type	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Initial Water Elevation (ft)	Surcharge Elevation (ft)	Ponded Area (ft ²)	Peak Inflow (cfs)	Max HGL Elevation (ft)	Max Surcharge Depth (ft)	Min Freeboard (ft)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	1-Jun	Junction	830.00	845.00	830.00	0.00	0.00	235.22	831.63	0.00	13.37	0 00:00	0.00	0.00
2	2-Jun	Junction	844.75	849.25	844.75	0.00	0.00	8.64	845.19	0.00	4.06	0 00:00	0.00	0.00
3	4-Jun	Junction	785.75	791.50	785.75	0.00	0.00	16.19	786.43	0.00	5.07	0 00:00	0.00	0.00
4	Out-01	Outfall	0.00					252.86	822.37					
5	Out-02	Outfall	0.00					110.93	0.00					
6	Out-03	Outfall	0.00					84.77	0.00					
7	NE-Pond	Storage Node	845.00	852.00	845.00		0.00	53.17	849.49				0.00	0.00
8	SE-Pond	Storage Node	786.00	794.00	786.00		0.00	99.36	791.47				0.00	0.00

Link Summary

SN	Element ID	Element Type	From (Inlet) Node	To (Outlet) Node	Length (ft)	Inlet Invert Elevation (ft)	Outlet Invert Elevation (ft)	Average Slope (%)	Diameter or Height (in)	Manning's Roughness	Peak Flow (cfs)	Design Flow Capacity (cfs)	Peak Flow/Design Flow Ratio	Peak Flow Velocity (ft/sec)	Peak Flow Depth (ft)	Peak Flow Depth/Total Depth Ratio	Total Time Surcharged (min)	Reported Condition
1	NE-Out	Pipe	2-Jun	Out-01	122.68	844.75	821.93	18.6000	18.000	0.0130	8.64	45.30	0.19	19.74	0.44	0.30	0.00	Calculated
2	SE-Out	Pipe	4-Jun	Out-01	95.88	785.75	772.89	13.4100	18.000	0.0130	16.19	38.47	0.42	20.83	0.68	0.45	0.00	Calculated
3	East_Channel	Channel	1-Jun	Out-01	3672.92	830.00	765.00	1.7700	120.000	0.0320	228.89	8923.48	0.03	7.95	1.57	0.16	0.00	
4	NE-Low	Orifice	NE-Pond	2-Jun		845.00	844.75		6.000									
5	NE-Middle	Orifice	NE-Pond	2-Jun		845.00	844.75		6.000									
6	NE-Top	Orifice	NE-Pond	2-Jun		845.00	844.75		6.000									
7	SE-Low	Orifice	SE-Pond	4-Jun		786.00	785.75		6.000									
8	SE-Middle	Orifice	SE-Pond	4-Jun		786.00	785.75		6.000									
9	SE-Top	Orifice	SE-Pond	4-Jun		786.00	785.75		6.000									
10	NE-High	Weir	NE-Pond	Out-01		845.00	0.00											
11	SE-Weir	Weir	SE-Pond	Out-01		786.00	0.00											

Subbasin Hydrology

Subbasin : Proposed_01A

Input Data

Area (ac) 35.43
 Peak Rate Factor 484
 Weighted Curve Number 75.61
 Rain Gage ID Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
32			
Woods, Good	3.71	B	55
Woods, Good	4.79	C	70
Woods, Good	19.01	D	77
1/3 acre lots, 30% impervious	1.06	C	81
1/3 acre lots, 30% impervious	6.86	D	86
Composite Area & Weighted CN	35.43		75.61

Time of Concentration

TOC Method : SCS TR-55

Sheet Flow Equation :

$$T_c = (0.007 * ((n * L_f)^{0.8}) / ((P^{0.5}) * (S_f^{0.4})))$$

Where :

Tc = Time of Concentration (hr)
 n = Manning's roughness
 Lf = Flow Length (ft)
 P = 2 yr, 24 hr Rainfall (inches)
 Sf = Slope (ft/ft)

Shallow Concentrated Flow Equation :

V = 16.1345 * (Sf^{0.5}) (unpaved surface)
 V = 20.3282 * (Sf^{0.5}) (paved surface)
 V = 15.0 * (Sf^{0.5}) (grassed waterway surface)
 V = 10.0 * (Sf^{0.5}) (nearly bare & untilled surface)
 V = 9.0 * (Sf^{0.5}) (cultivated straight rows surface)
 V = 7.0 * (Sf^{0.5}) (short grass pasture surface)
 V = 5.0 * (Sf^{0.5}) (woodland surface)
 V = 2.5 * (Sf^{0.5}) (forest w/heavy litter surface)
 Tc = (Lf / V) / (3600 sec/hr)

Where:

Tc = Time of Concentration (hr)
 Lf = Flow Length (ft)
 V = Velocity (ft/sec)
 Sf = Slope (ft/ft)

Channel Flow Equation :

V = (1.49 * (R^{2/3}) * (Sf^{0.5})) / n
 R = Aq / Wp
 Tc = (Lf / V) / (3600 sec/hr)

Where :

Tc = Time of Concentration (hr)
 Lf = Flow Length (ft)
 R = Hydraulic Radius (ft)
 Aq = Flow Area (ft²)
 Wp = Wetted Perimeter (ft)
 V = Velocity (ft/sec)
 Sf = Slope (ft/ft)
 n = Manning's roughness

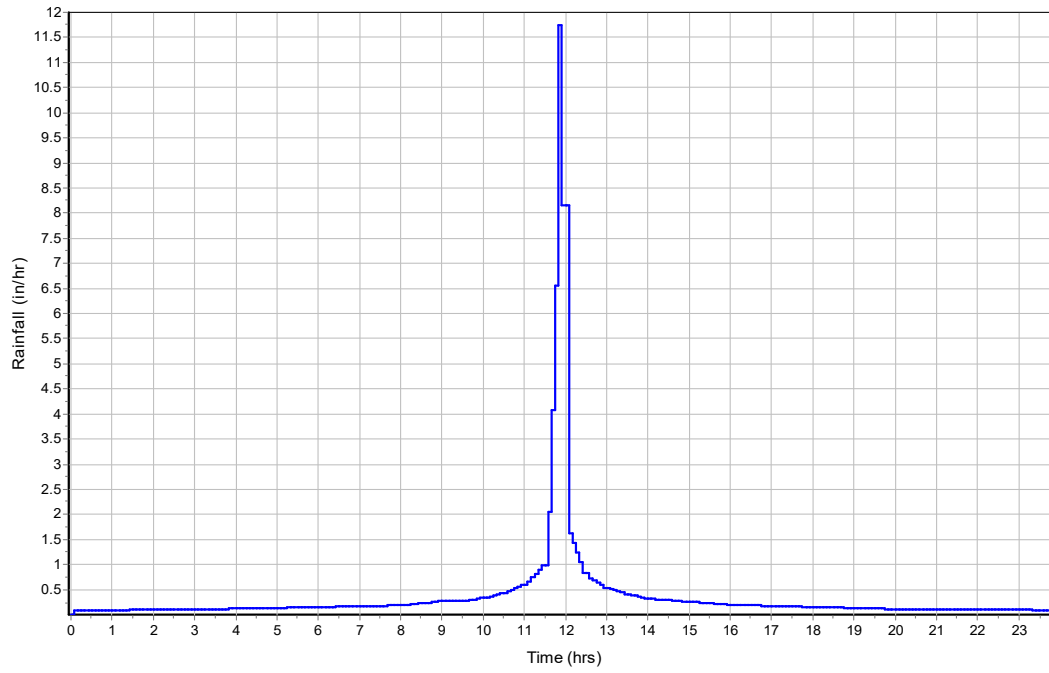
User-Defined TOC override (minutes): 15

Subbasin Runoff Results

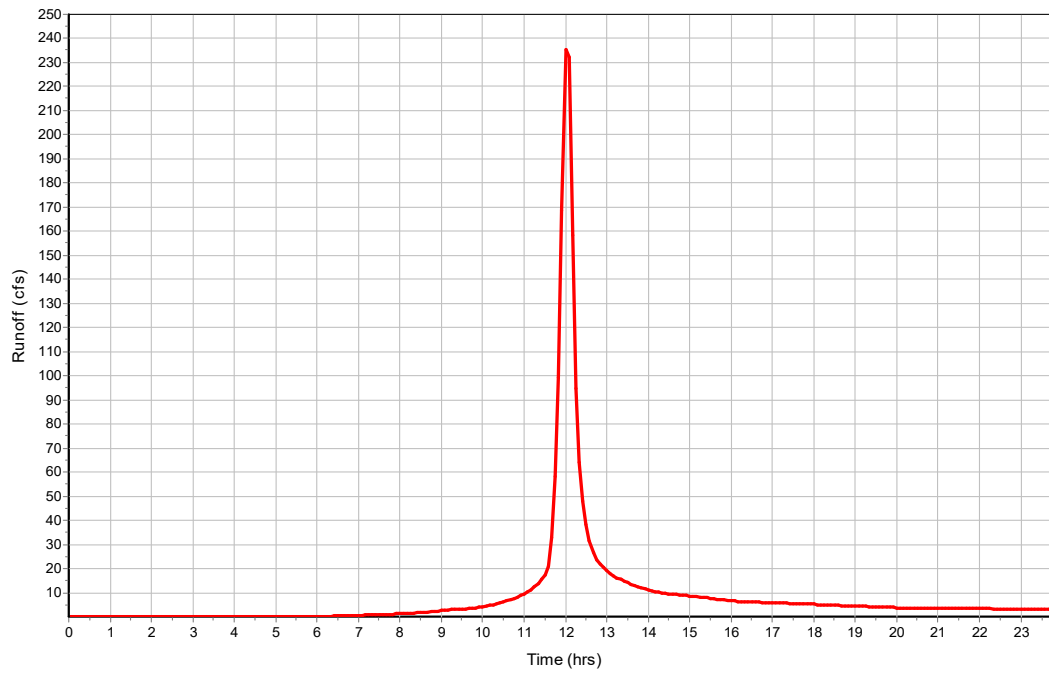
Total Rainfall (in)	8.57
Total Runoff (in)	5.63
Peak Runoff (cfs)	244.93
Weighted Curve Number	75.61
Time of Concentration (days hh:mm:ss)	0 00:15:00

Subbasin : Proposed_01A

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : Proposed_01B

Input Data

Area (ac) 6.22
 Peak Rate Factor 484
 Weighted Curve Number 77.27
 Rain Gage ID Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
32			
Woods, Good	0.55	B	55
Woods, Good	1.47	C	70
1/3 acre lots, 30% impervious	2.73	C	81
1/3 acre lots, 30% impervious	1.46	D	86
Composite Area & Weighted CN	6.21		77.27

Time of Concentration

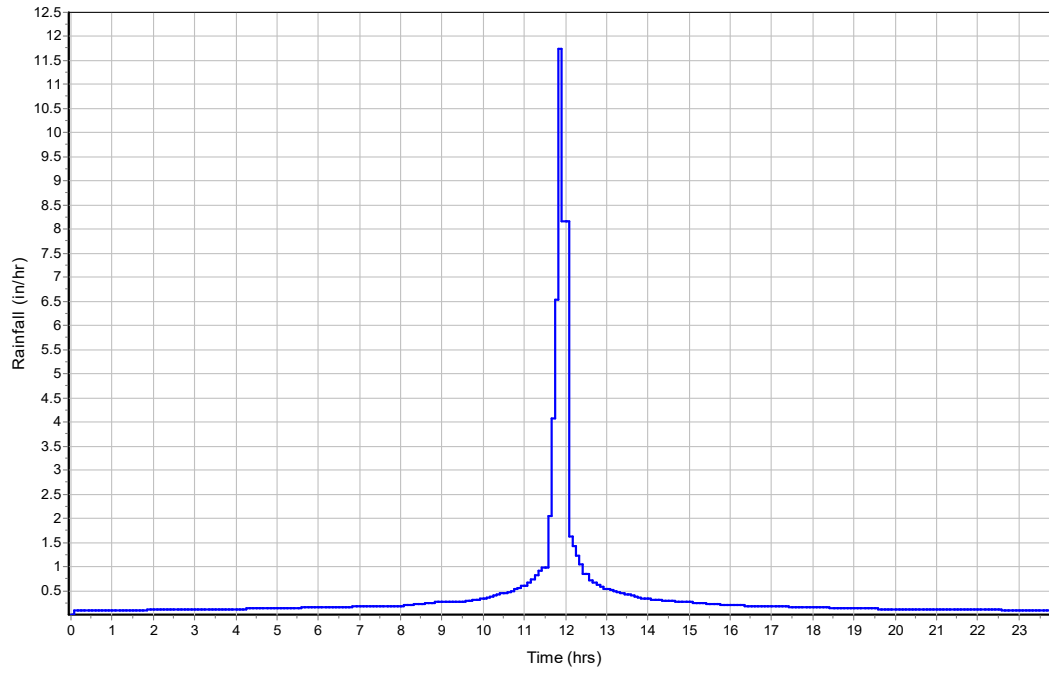
User-Defined TOC override (minutes): 6.4

Subbasin Runoff Results

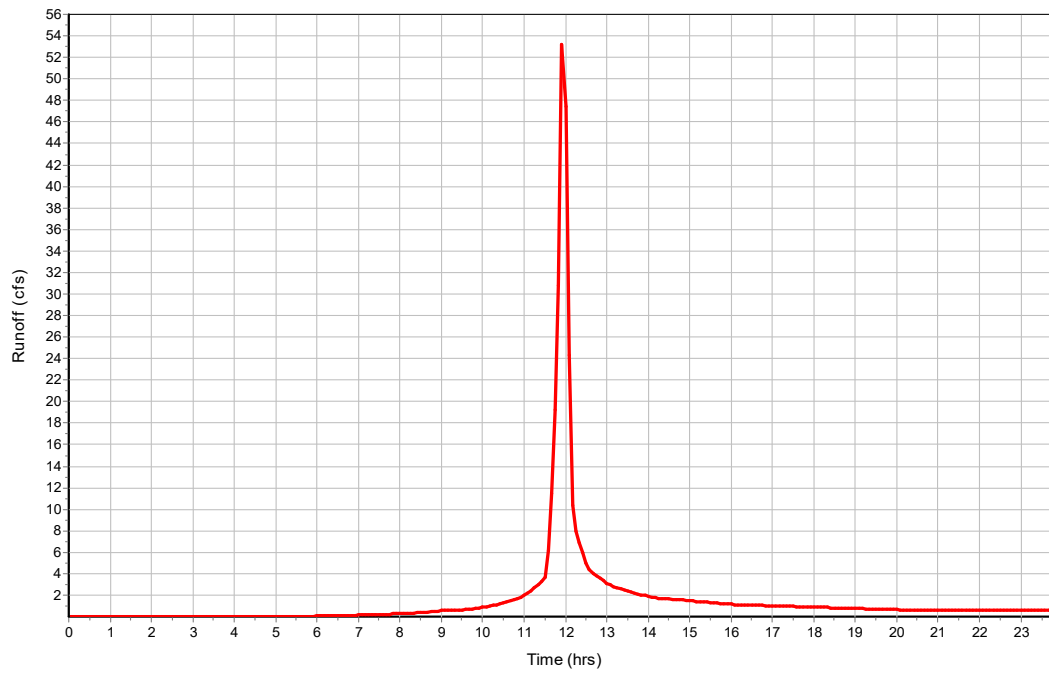
Total Rainfall (in) 8.57
 Total Runoff (in) 5.83
 Peak Runoff (cfs) 54.4
 Weighted Curve Number 77.27
 Time of Concentration (days hh:mm:ss) 0 00:06:24

Subbasin : Proposed_01B

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : Proposed_01C

Input Data

Area (ac) 12.21
 Peak Rate Factor 484
 Weighted Curve Number 79.47
 Rain Gage ID Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
32			
Woods, Good	0.12	B	55
Woods, Good	2.52	C	70
Woods, Good	1.24	D	77
1/3 acre lots, 30% impervious	4.9	C	81
1/3 acre lots, 30% impervious	3.43	D	86
Composite Area & Weighted CN	12.21		79.47

Time of Concentration

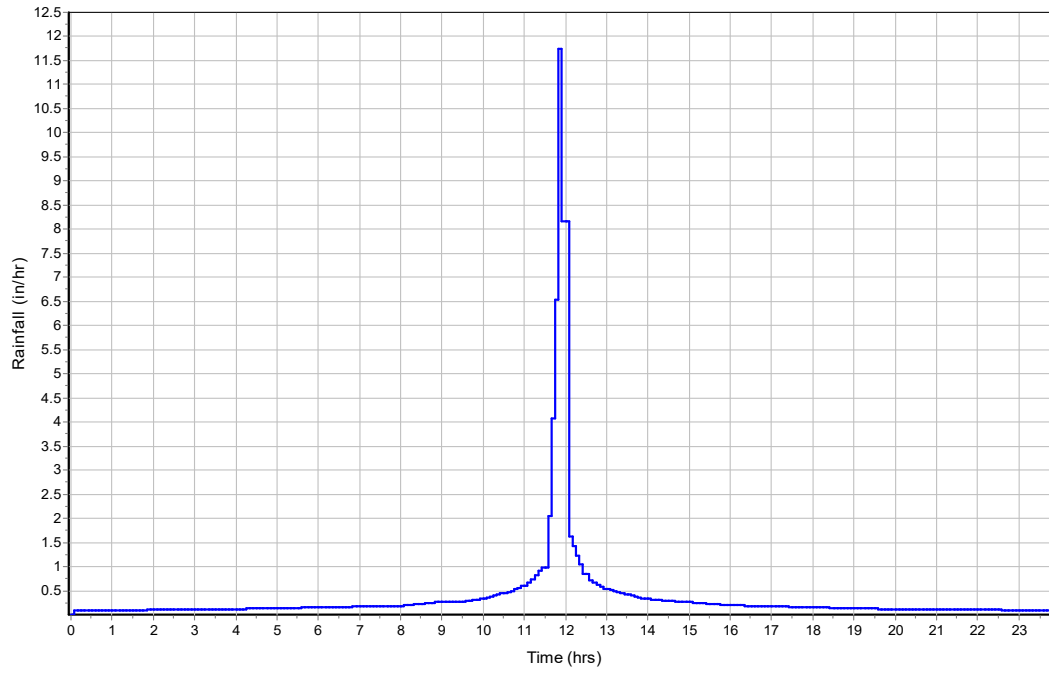
User-Defined TOC override (minutes): 8.2

Subbasin Runoff Results

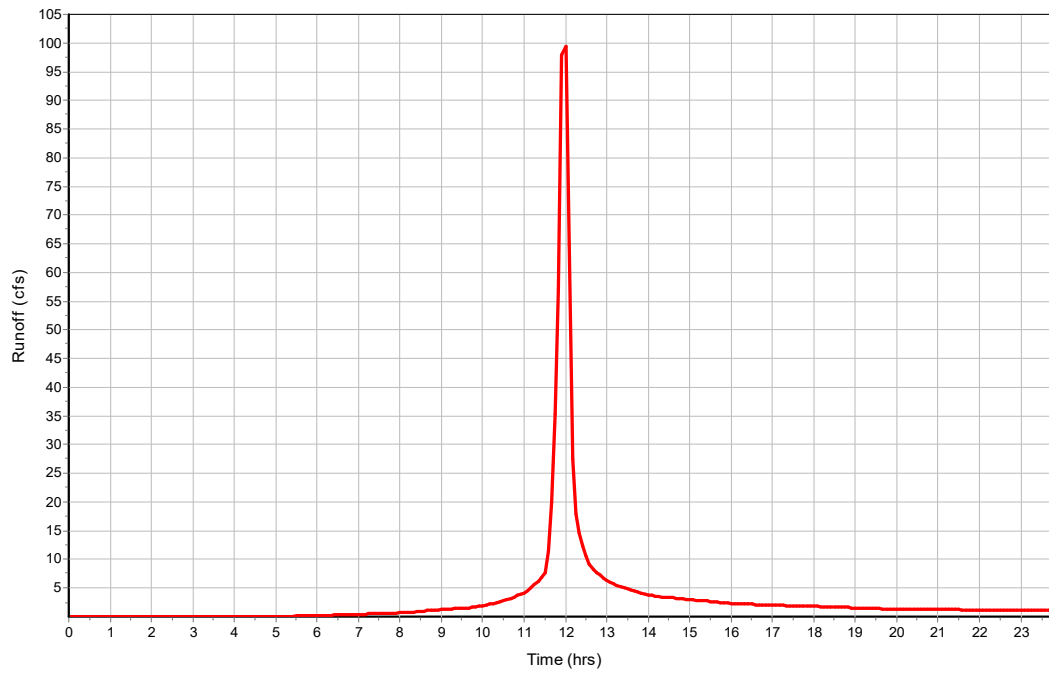
Total Rainfall (in) 8.57
 Total Runoff (in) 6.1
 Peak Runoff (cfs) 105.48
 Weighted Curve Number 79.47
 Time of Concentration (days hh:mm:ss) 0 00:08:12

Subbasin : Proposed_01C

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : Proposed_02

Input Data

Area (ac) 16.29
 Peak Rate Factor 484
 Weighted Curve Number 71.87
 Rain Gage ID Rain Gage-01

Composite Curve Number

32 Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Woods, Good	6	B	55
1/3 acre lots, 30% impervious	8.84	C	81
1/3 acre lots, 30% impervious	1.45	D	86
Composite Area & Weighted CN	16.29		71.87

Time of Concentration

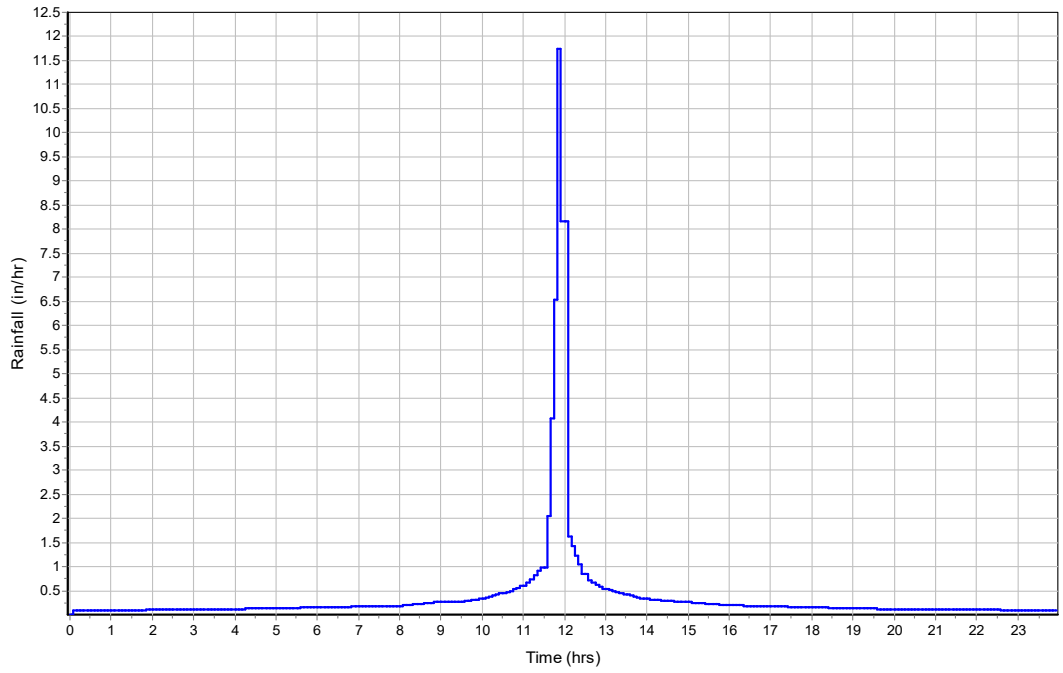
User-Defined TOC override (minutes): 12.1

Subbasin Runoff Results

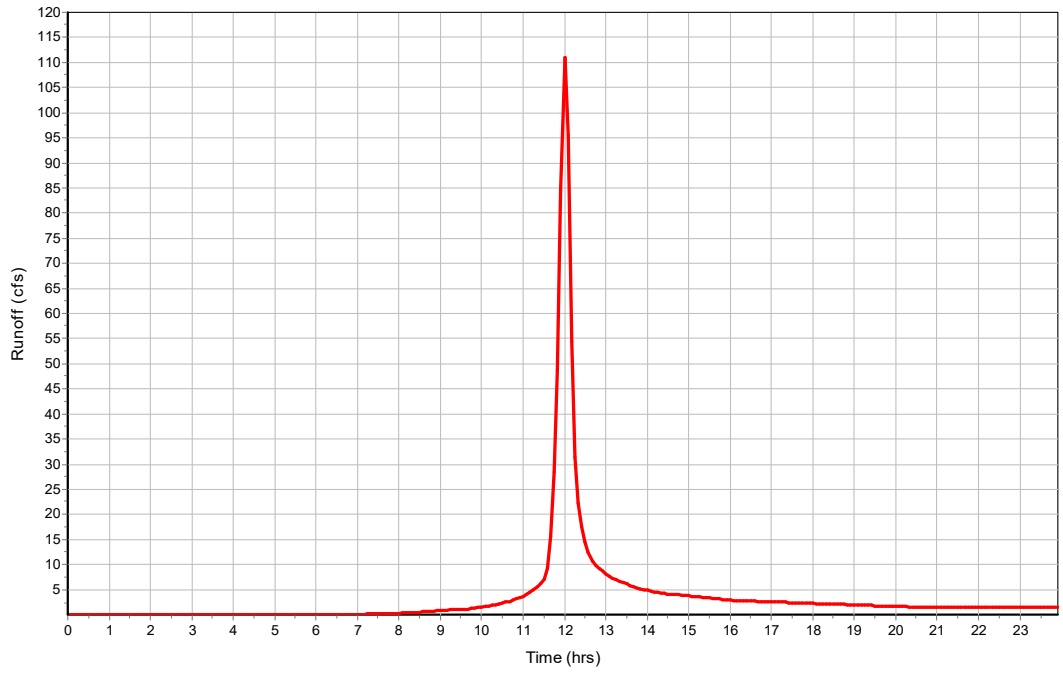
Total Rainfall (in) 8.57
 Total Runoff (in) 5.18
 Peak Runoff (cfs) 111.4
 Weighted Curve Number 71.87
 Time of Concentration (days hh:mm:ss) 0 00:12:06

Subbasin : Proposed_02

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : Proposed_03

Input Data

Area (ac) 12.4
 Peak Rate Factor 484
 Weighted Curve Number 67.89
 Rain Gage ID Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
32			
Woods, Good	6.17	B	55
Woods, Good	0.23	C	70
1/3 acre lots, 30% impervious	5.92	C	81
1/3 acre lots, 30% impervious	0.08	D	86
Composite Area & Weighted CN	12.4		67.89

Time of Concentration

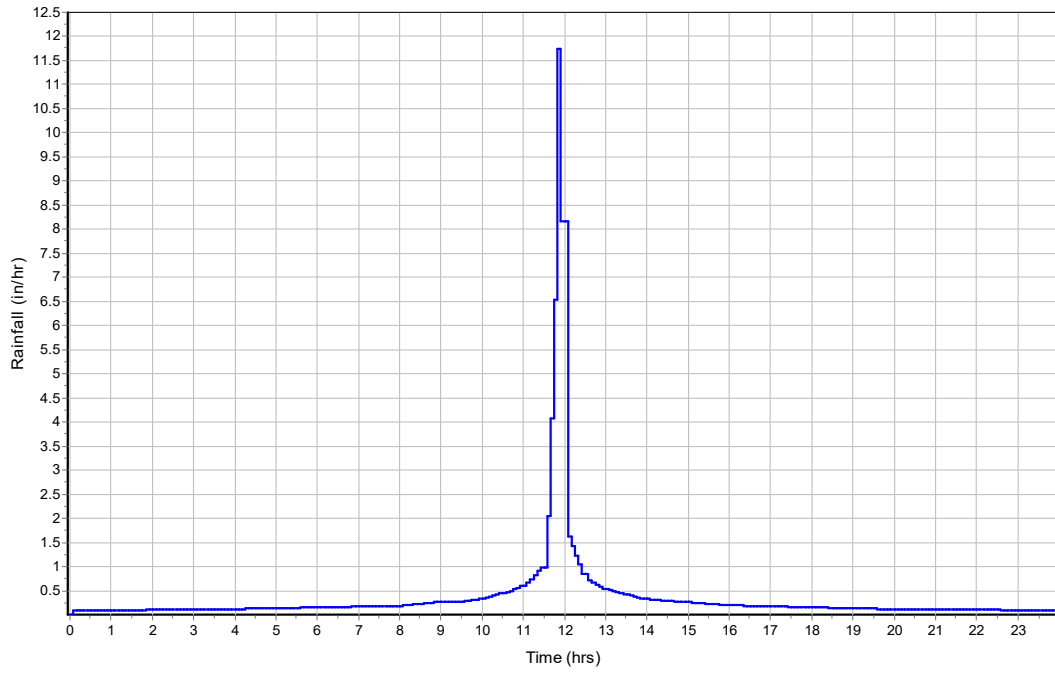
User-Defined TOC override (minutes): 6.7

Subbasin Runoff Results

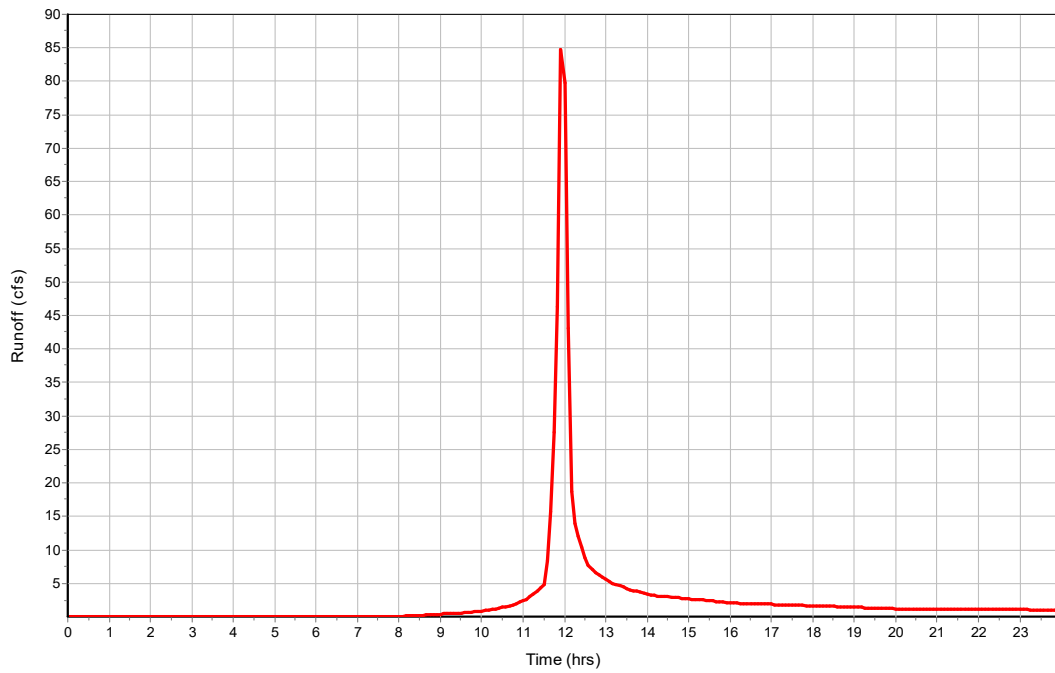
Total Rainfall (in) 8.57
 Total Runoff (in) 4.71
 Peak Runoff (cfs) 88.1
 Weighted Curve Number 67.89
 Time of Concentration (days hh:mm:ss) 0 00:06:42

Subbasin : Proposed_03

Rainfall Intensity Graph



Runoff Hydrograph



Junction Input

SN Element ID	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Ground/Rim (Max) Offset (ft)	Initial Water Elevation (ft)	Initial Water Depth (ft)	Surcharge Elevation (ft)	Surcharge Depth (ft)	Ponded Area (ft ²)	Minimum Pipe Cover (in)
1 1-Jun	830.00	845.00	15.00	830.00	0.00	0.00	-845.00	0.00	0.00
2 2-Jun	844.75	849.25	4.50	844.75	0.00	0.00	-849.25	0.00	0.00
3 4-Jun	785.75	791.50	5.75	785.75	0.00	0.00	-791.50	0.00	0.00

Junction Results

SN Element ID	Peak Inflow	Peak Lateral Inflow	Max HGL Elevation	Max HGL Depth	Max Surcharge Depth	Min Freeboard Attained	Average HGL Elevation	Average HGL Depth	Time of Max HGL Occurrence	Time of Peak Flooding Occurrence	Total Flooded Volume	Total Time Flooded
	(cfs)	(cfs)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(days hh:mm)	(days hh:mm)	(ac-in)	(min)
1 1-Jun	235.22	235.22	831.63	1.63	0.00	13.37	830.16	0.16	0 12:05	0 00:00	0.00	0.00
2 2-Jun	8.64	0.00	845.19	0.44	0.00	4.06	844.88	0.13	0 12:19	0 00:00	0.00	0.00
3 4-Jun	16.19	0.00	786.43	0.68	0.00	5.07	785.96	0.21	0 12:23	0 00:00	0.00	0.00

Channel Input

SN Element ID	Length	Inlet Invert Elevation (ft)	Inlet Invert Offset (ft)	Outlet Invert Elevation (ft)	Outlet Invert Offset (ft)	Total Drop (ft)	Average Slope (%)	Shape	Height (ft)	Width (ft)	Manning's Roughness	Entrance Losses	Exit/Bend Losses	Additional Losses	Initial Flow (cfs)	Flap Gate
1 East_Channel	3672.92	830.00	0.00	765.00	765.00	65.00	1.7700	Trapezoidal	10.000	75.000	0.0320	0.5000	0.5000	0.0000	0.00	No

Channel Results

SN Element ID	Peak Flow	Time of Peak Flow Occurrence	Design Flow Capacity	Peak Flow/Design Flow Ratio	Peak Flow Velocity	Travel Time	Peak Flow Depth	Peak Flow Depth/Total Depth Ratio	Total Time Surcharged	Froude Number	Reported Condition
	(cfs)	(days hh:mm)	(cfs)		(ft/sec)	(min)	(ft)		(min)		
1 East_Channel	228.89	0 12:12	8923.48	0.03	7.95	7.70	1.57	0.16	0.00		

Pipe Input

SN Element ID	Length (ft)	Inlet Invert Elevation (ft)	Inlet Invert Offset (ft)	Outlet Invert Elevation (ft)	Outlet Invert Offset (ft)	Total Drop (ft)	Average Pipe Slope (%)	Pipe Shape	Pipe Diameter or Height (in)	Pipe Width (in)	Manning's Roughness	Entrance Losses	Exit/Bend Losses	Additional Losses	Initial Flow (cfs)	Flap Gate	No. of Barrels
1 NE-Out	122.68	844.75	0.00	821.93	821.93	22.82	18.6000	CIRCULAR	18.000	18.000	0.0130	0.5000	0.5000	0.0000	0.00	No	1
2 SE-Out	95.88	785.75	0.00	772.89	772.89	12.86	13.4100	CIRCULAR	18.000	18.000	0.0130	0.5000	0.5000	0.0000	0.00	No	1

Pipe Results

SN Element ID	Peak Flow	Time of Peak Flow Occurrence	Design Flow Capacity	Peak Flow/Design Flow Ratio	Peak Flow Velocity	Travel Time	Peak Flow Depth	Peak Flow Depth/Total Depth Ratio	Total Time Surcharged	Froude Number	Reported Condition
	(cfs)	(days hh:mm)	(cfs)		(ft/sec)	(min)	(ft)		(min)		
1 NE-Out	8.64	0 12:19	45.30	0.19	19.74	0.10	0.44	0.30	0.00		Calculated
2 SE-Out	16.19	0 12:23	38.47	0.42	20.83	0.08	0.68	0.45	0.00		Calculated

Storage Nodes

Storage Node : NE-Pond

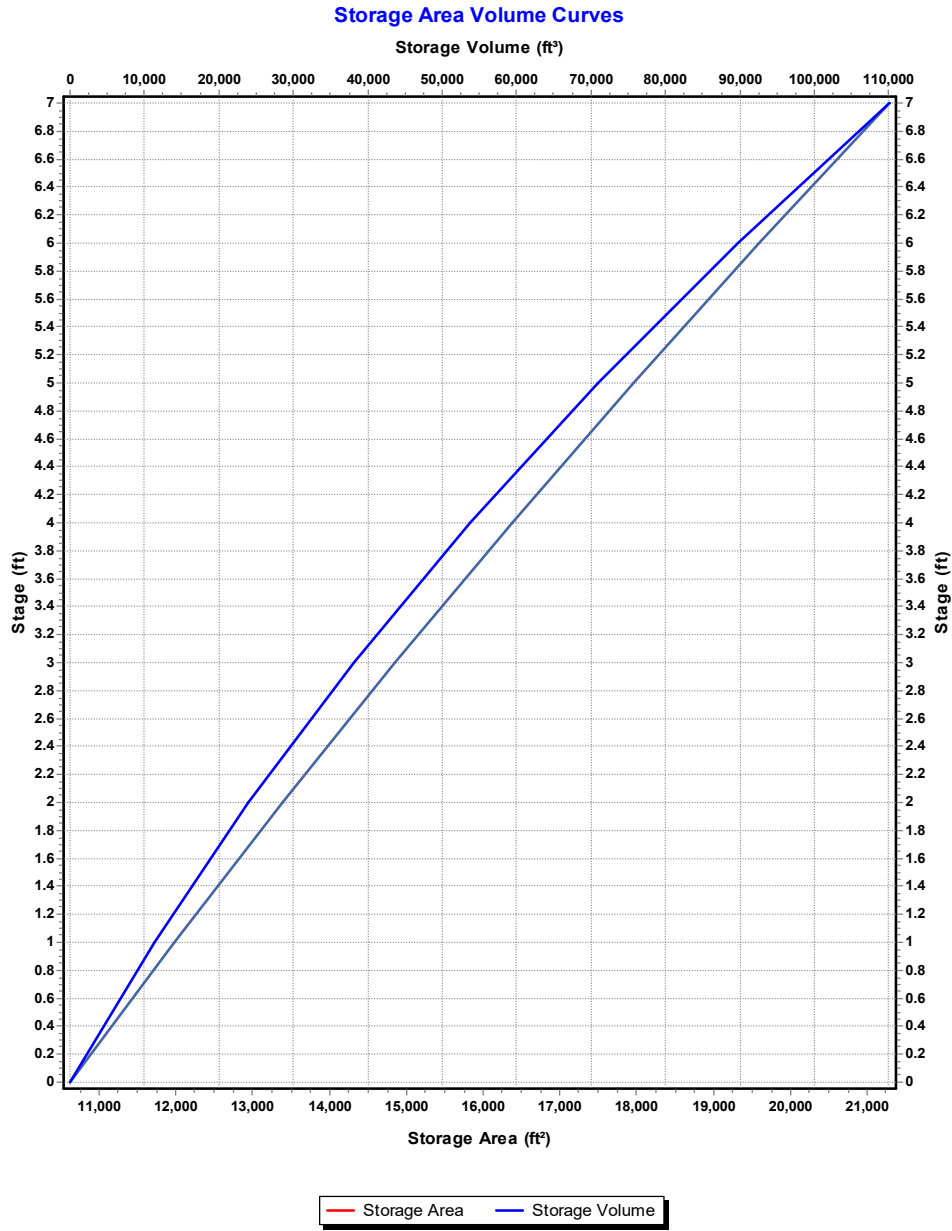
Input Data

Invert Elevation (ft)	845.00
Max (Rim) Elevation (ft)	852.00
Max (Rim) Offset (ft)	7.00
Initial Water Elevation (ft)	845.00
Initial Water Depth (ft)	0.00
Ponded Area (ft ²)	0.00
Evaporation Loss	0.00

Storage Area Volume Curves

Storage Curve : North East Pond

Stage	Storage Area	Storage Volume
(ft)	(ft ²)	(ft ³)
0	10623.06	0
1	11977.56	11300.31
2	13388.6	23983.39
3	14856.2	38105.79
4	16380.34	53724.06
5	17961.03	70894.75
6	19598.27	89674.4
7	21292.06	110119.57



Storage Node : NE-Pond (continued)

Outflow Weirs

SN Element ID	Weir Type	Flap Gate	Crest Elevation (ft)	Crest Offset (ft)	Length (ft)	Weir Total Height (ft)	Discharge Coefficient
1 NE-High	Trapezoidal	No	850.00	5.00	18.00	2.00	3.33

Outflow Orifices

SN Element ID	Orifice Type	Orifice Shape	Flap Gate	Circular Orifice Diameter (in)	Rectangular Orifice Height (in)	Rectangular Orifice Width (in)	Orifice Invert Elevation (ft)	Orifice Coefficient
1 NE-Low	Side	CIRCULAR	No	6.00			845.00	0.61
2 NE-Middle	Side	Rectangular	No		6.00	12.00	846.50	0.63
3 NE-Top	Side	Rectangular	No		6.00	12.00	848.25	0.63

Output Summary Results

Peak Inflow (cfs)	53.17
Peak Lateral Inflow (cfs)	53.17
Peak Outflow (cfs)	8.64
Peak Exfiltration Flow Rate (cfm)	0
Max HGL Elevation Attained (ft)	849.49
Max HGL Depth Attained (ft)	4.49
Average HGL Elevation Attained (ft)	846.11
Average HGL Depth Attained (ft)	1.11
Time of Max HGL Occurrence (days hh:mm)	0 12:19
Total Exfiltration Volume (1000-ft ³)	0
Total Flooded Volume (ac-in)	0
Total Time Flooded (min)	0
Total Retention Time (sec)	0

Storage Node : SE-Pond

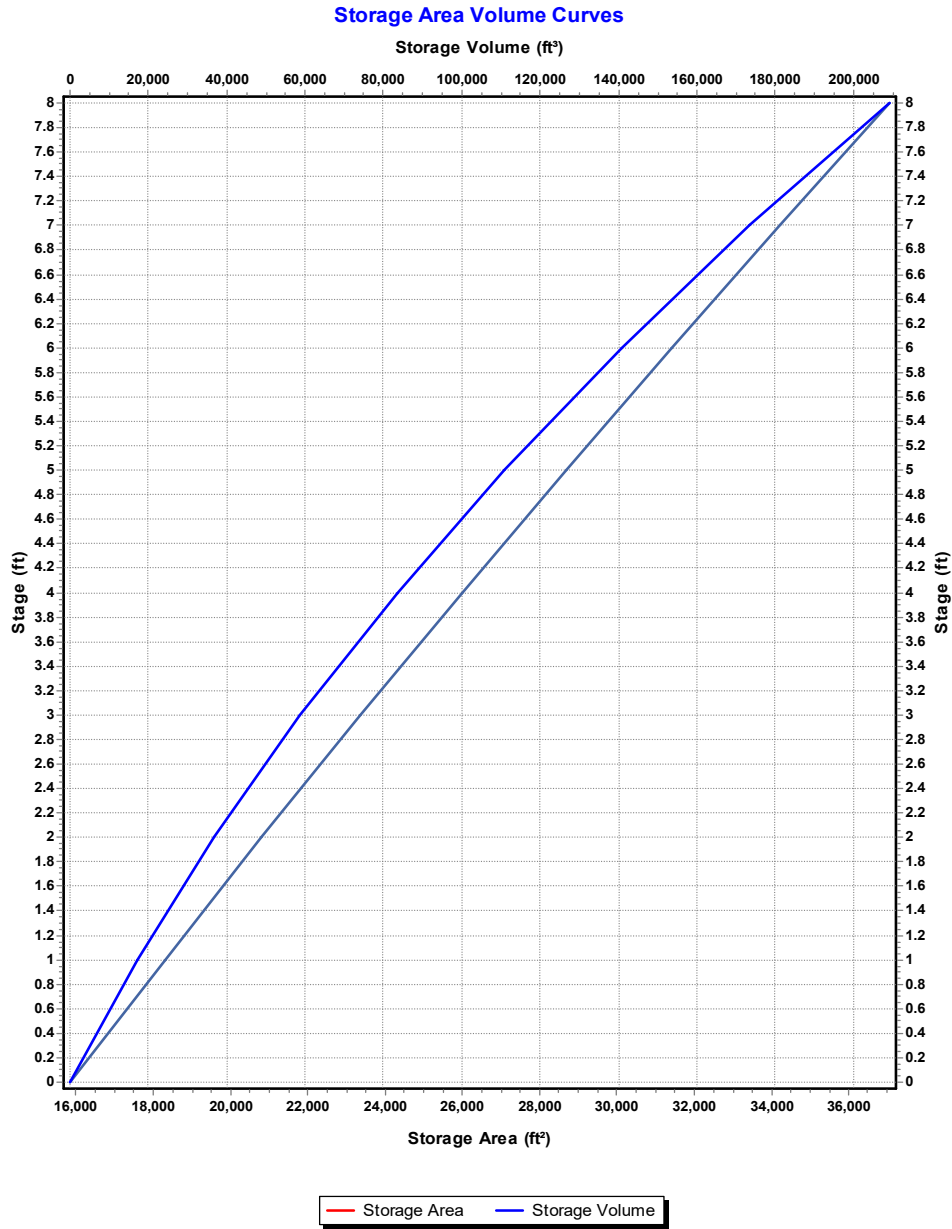
Input Data

Invert Elevation (ft)	786.00
Max (Rim) Elevation (ft)	794.00
Max (Rim) Offset (ft)	8.00
Initial Water Elevation (ft)	786.00
Initial Water Depth (ft)	0.00
Ponded Area (ft ²)	0.00
Evaporation Loss	0.00

Storage Area Volume Curves

Storage Curve : South East Pond

Stage (ft)	Storage Area (ft ²)	Storage Volume (ft ³)
0	15847.77	0
1	18300.77	17074.27
2	20810.31	36629.81
3	23376.41	58723.17
4	25999.05	83410.9
5	28678.24	110749.55
6	31413.98	140795.66
7	34206.27	173605.79
8	37055.1	209236.48



Storage Node : SE-Pond (continued)

Outflow Weirs

SN Element ID	Weir Type	Flap Gate	Crest Elevation (ft)	Crest Offset (ft)	Length (ft)	Weir Total Height (ft)	Discharge Coefficient
1 SE-Weir	Trapezoidal	No	792.00	6.00	35.00	1.50	3.33

Outflow Orifices

SN Element ID	Orifice Type	Orifice Shape	Flap Gate	Circular Orifice Diameter (in)	Rectangular Orifice Height (in)	Rectangular Orifice Width (in)	Orifice Invert Elevation (ft)	Orifice Coefficient
1 SE-Low	Side	Rectangular	No		6.00	12.00	786.00	0.63
2 SE-Middle	Side	Rectangular	No		6.00	18.00	787.50	0.63
3 SE-Top	Side	Rectangular	No		6.00	18.00	790.50	0.63

Output Summary Results

Peak Inflow (cfs)	99.36
Peak Lateral Inflow (cfs)	99.36
Peak Outflow (cfs)	16.19
Peak Exfiltration Flow Rate (cfm)	0
Max HGL Elevation Attained (ft)	791.47
Max HGL Depth Attained (ft)	5.47
Average HGL Elevation Attained (ft)	787.19
Average HGL Depth Attained (ft)	1.19
Time of Max HGL Occurrence (days hh:mm)	0 12:23
Total Exfiltration Volume (1000-ft ³)	0
Total Flooded Volume (ac-in)	0
Total Time Flooded (min)	0
Total Retention Time (sec)	0

Weir Report

North East Pond Emergency Outflow Weir

Trapezoidal Weir

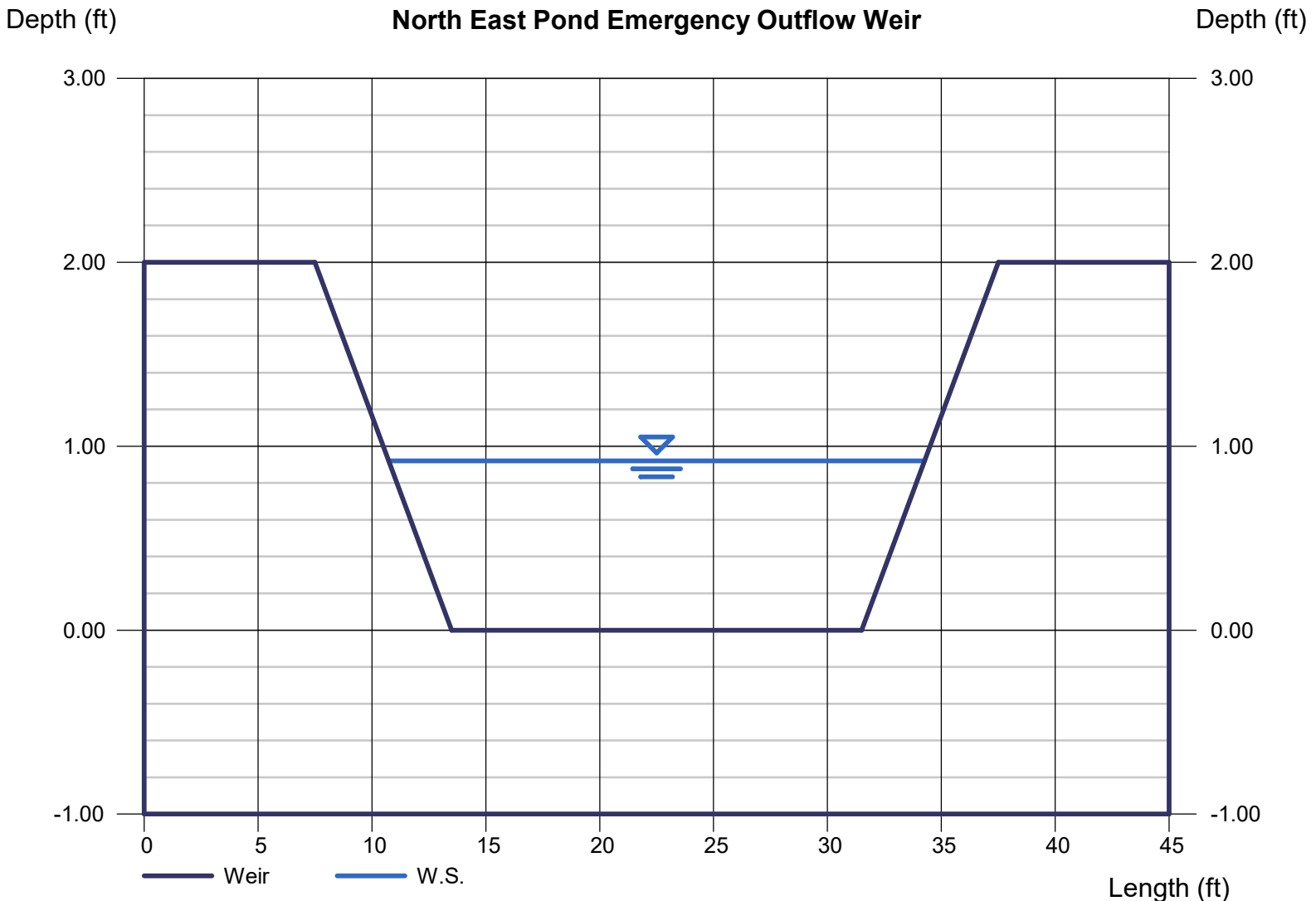
Crest = Sharp
Bottom Length (ft) = 18.00
Total Depth (ft) = 2.00
Side Slope (z:1) = 3.00

Highlighted

Depth (ft) = 0.92
Q (cfs) = 54.40
Area (sqft) = 19.10
Velocity (ft/s) = 2.85
Top Width (ft) = 23.52

Calculations

Weir Coeff. Cw = 3.10
Compute by: Known Q
Known Q (cfs) = 54.40



Weir Report

South East Pond Emergency Outflow Weir

Trapezoidal Weir

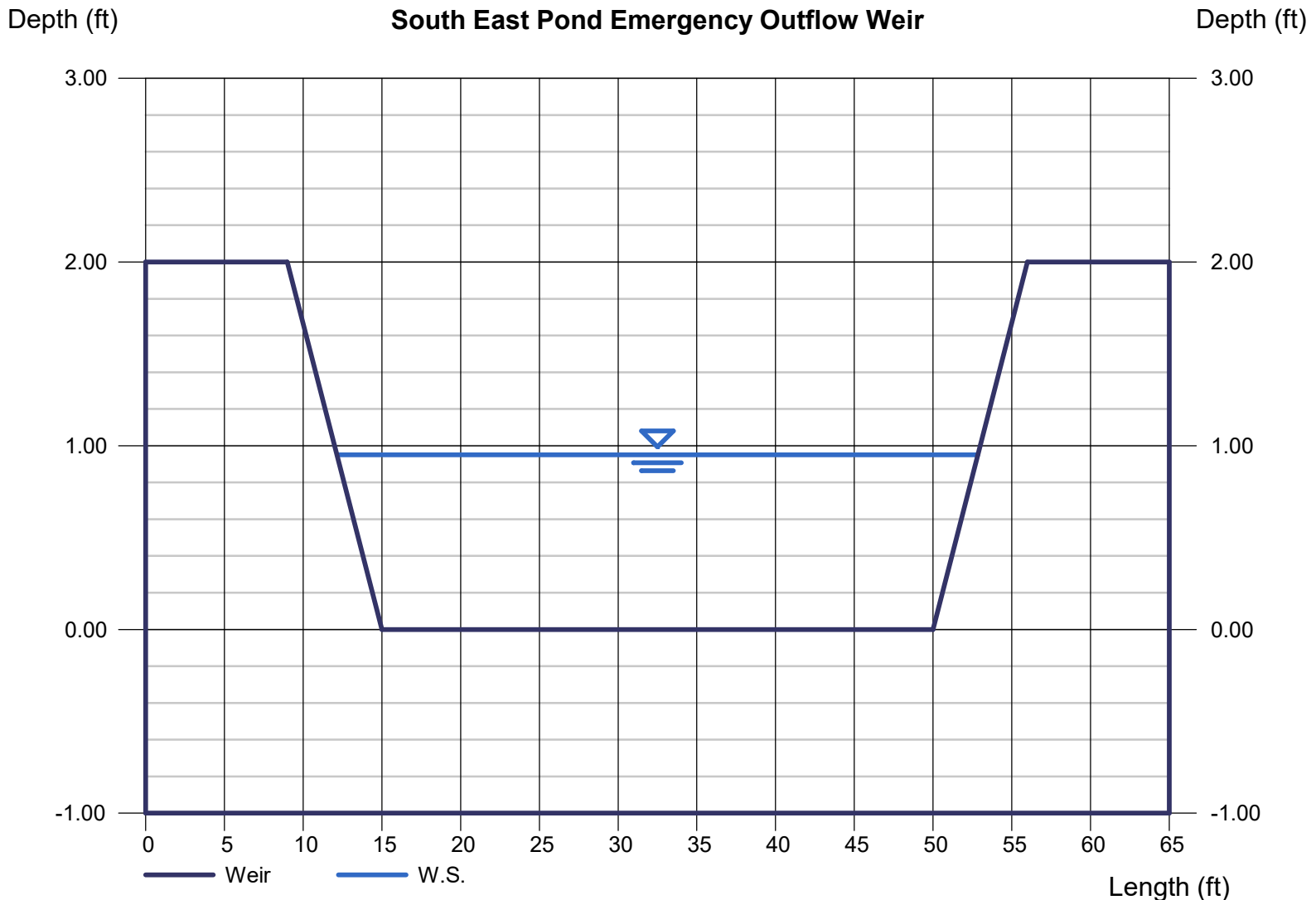
Crest = Sharp
Bottom Length (ft) = 35.00
Total Depth (ft) = 2.00
Side Slope (z:1) = 3.00

Highlighted

Depth (ft) = 0.95
Q (cfs) = 105.48
Area (sqft) = 35.96
Velocity (ft/s) = 2.93
Top Width (ft) = 40.70

Calculations

Weir Coeff. Cw = 3.10
Compute by: Known Q
Known Q (cfs) = 105.48





Appendix I BMP Analysis

BMP WORKSHEET 1: REQUIRED LEVEL OF SERVICE - UNDEVELOPED SITE

Project:	22-0138 The Estates at Thousand Oaks East
Location:	Parkville, MO
Option:	LS for Undeveloped Site
Date:	April 28, 2025
By:	JAK

I. Runoff Curve Number

A. Predevelopment CN

Cover Description	Soil HSG	CN from Table 1*	Area, acres	Product of CN x Area
Undeveloped - Woods & Grass, Good	B	55	36.84	2026.20
Undeveloped - Woods & Grass, Good	C	70	14.05	983.50
Undeveloped - Woods & Grass, Good	D	77	24.62	1895.74
Totals:			75.51	4905.44

Area-Weighted CN = total product/total area =	64.96
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* [Based on BMP Manual Table 4.1](#)

B. Post development CN

Cover Description	Soil HSG**	CN from Table 1*	Area, acres	Product of CN x Area
Undeveloped - Woods & Grass, Good	B	55	14.11	776.05
Undeveloped - Woods & Grass, Good	C	70	7.43	520.10
Undeveloped - Woods & Grass, Good	D	77	19.17	1476.09
Residential, 1/3-acre	C	81	22.73	1841.13
Residential, 1/3-acre	D	86	12.07	1038.02
Totals:			75.51	5651.39

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

Area-Weighted CN = total product/total area =	74.84
--	--------------

C. Level of Service (LS) Calculation

Predevelopment CN	65
Postdevelopment CN	75
Difference	10
LS Required (see scale at right):	6.4

**Table 4.2
LS for Previously Undeveloped Sites**

Change in CN	LS	Change in CN	LS
1	4.3	17	7.1
2	4.7	18	7.2
3	5	19	7.3
4	5.3	20	7.4
5	5.7	21	7.6
6	6	22	7.7
7	6.1	23	7.8
8	6.2	24	7.9
9	6.3	25	8
10	6.4	25+	8
11	6.5		
12	6.6		
13	6.7		
14	6.8		
15	6.9		
16	7		

BMP WORKSHEET: DEVELOP MITIGATION PACKAGE(S) THAT MEET THE REQUIRED LS OR VR

Project:	22-0138 The Estates at Thousand Oaks East
Location:	Parkville, MO
Option:	LS for Undeveloped Site
Date:	April 28, 2025
By:	JAK

I. Required LS OR VR 6.4

Note: Various BMP's May Alter CN of Proposed Development and LS; Recalculate Both if Applicable

II. Proposed BMP Option Package No. 1

Cover/BMP Description	Treatment Area	VR from Table 4.4 or Table 4.6*	Product of VR x Area
Native Vegetation	22.42	9.25	207.39
Native Vegetation to E.D.D. Treatment Train	43.30	9.25	400.53
Extended Dry Detention (EDD)	2.87	4.00	11.48
Untreated	6.92	0.00	0.00
Total	75.51	Total	619.39

Weighted VR:** 8.20 =Total Product/Total Area

* [Based on BMP Manual Tables 4.4 and 4.6](#)
 ** Blank in Redevelopment

1. Refer to Mitigation Instructions and Tables 2 and 4 as Appropriate When Determining VR.***
 2. Total Treatment Area Cannot Exceed 100 Percent of the Actual Site Area
 *** [Based on BMP Manual Section 4: BMP Selection Criteria \(Tables 4.2 and 4.4\)](#)

Meets Required Total LS or VR (Yes/No)? Yes

75.51 **Area of Site, acres**

Adam Tholen

7712 NW Scenic Drive
Weatherby Lake, MO 64152
adamtholen@icloud.com
816-985-0077

Planning and Zoning Commission

City of Parkville, Missouri
8880 Clark Avenue
Parkville, MO 64152

Subject: Request for Extension of Time to Submit Building and Applicable Permits

Dear Members of the Planning and Zoning Commission,

I hope this letter finds you well. I am writing to respectfully request an extension of time to submit the required building and/or applicable permits related to Village on the Green Development, located on 45 HWY.

Due to unexpected delays in working with the Platte County Land Trust to avoid easement encroachment, along with architectural plan approvals, and environmental site assessments, I am unable to meet the original deadline for submission. I am fully committed to complying with all applicable zoning and permitting requirements, and I am actively working to complete all necessary documentation and coordination.

Therefore, I kindly request that the Planning and Zoning Commission consider granting an extension of one year to allow sufficient time to finalize and submit all required materials.

I appreciate your time and consideration for this request. Please feel free to contact me at 816-985-0077 or adamtholen@icloud.com should you need any additional information.

Sincerely,

Adam Tholen



MEMORANDUM

To: Members of the Planning & Zoning Commission

From: Brad Stanton, AICP, Senior Planner

Date: October 10, 2025

Re: Request for one-year extension of Final Development Plan approval for Village on the Green

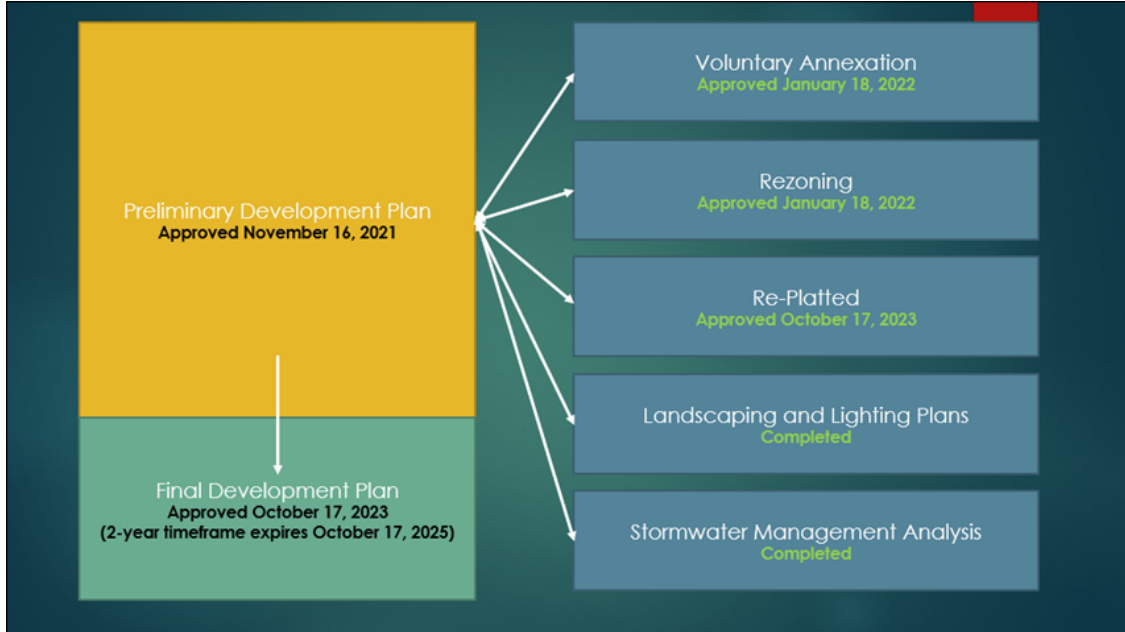
On September 10, 2025, the Community Development Department received a request for a one-year extension to the approval of the Final Development Plan for Village on the Green from Adam Tholen, developer on the project. Per §403.060(D) of the Parkville Municipal Code, an approved Final Development Plan shall expire if an application for building permit (or similar) is not filed within two (2) years of approval, however, the Planning & Zoning Commission may grant an extension to the approval for up to one (1) additional year.

On October 17, 2023, the Community Development Department approved the Final Development Plan for Village on the Green (Case No. PZ2021-54) starting the two (2) year clock for building permit to be submitted for one (1) or more buildings within the Plan. Mr. Tholen has submitted a request for a one (1) year extension of approval to October 17, 2026 prior to the Plan approval expiring on October 17, 2025.

Exhibit 1 on the next page details the development applications that have been approved to date for the Village on the Green project. At this time, the developer has all approvals necessary to apply for a Land Disturbance Permit (for grading), Construction Permit (for infrastructure installation), and Building Permit (for construction of buildings).

Community Development Department Staff have no concerns with the request for an extension. The property owner has had to coordinate an easement boundary dispute that has pushed back the start date of construction. Ultimately, the decision whether to grant an extension or not falls to the Planning & Zoning Commission.

Exhibit 1. Village on the Green Development Approvals



Respectfully submitted,

Brad Stanton, AICP

Senior Planner



Staff Analysis

- Agenda Item:** 5.A
- Proposal:** Request for text amendment to Parkville Municipal Code, Title IV – Development Code, Section 404.040 Required Improvements and Engineering Specifications, to create requirements for the construction of perimeter streets as a part of public improvements for the subdivision process, and provide additional provisions for storm drainage requirements.
- Staff Recommendation:** Approval
- Case No:** PZ 2025-27
- Applicant:** City of Parkville
- Pre-Application Conference Mtg:** N/A
- Exhibits:** A. This Staff Analysis
B. Application for Text Amendment
C. Proposed Text Amendment to Section 404.040 Required Improvements and Engineering Specifications
D. Additional exhibits as may be presented during the meeting
- By Reference:** A. Parkville Municipal Code, [Title IV- Development Code](#) in its entirety
1. Section 404.040 Required Improvements and Engineering Specifications
B. Notification of Public Hearing (published in The Platte County Citizen newspaper on September 17, 2025)
- Comments Received:** No written comments have been received by the Community Development Department as of the completion of this staff analysis on October 1, 2025.

Background

As residential and commercial growth occurs within the City of Parkville, new subdivisions generate motor vehicle trips, which place additional traffic and stress on the community's transportation network. When new [public] local roadways are constructed to provide access to the subdivision, they typically lead to perimeter streets, which are either classified as minor collector roadways (e.g., N Crooked Rd, NW Brink-Myer Rd), major collector roadways (e.g., NW Union Chapel Rd, NW River Rd), minor arterial roadways (e.g., N 9 Hwy), or principal arterial roadways (e.g., NW 45 Hwy). Most perimeter streets are existing roadways constructed prior to the new development; however, depending on their age, said roadways were generally designed & constructed years ago to support a lesser level of service than experience today. As a result, it's important for the City's transportation network to adequately support current and future motor vehicle trips from new subdivisions, as well as ensure public improvements are up to current City standards to protect the public health, safety, and welfare of the community.

As a result, many municipalities throughout the Kansas City region have provisions in their municipal codes requiring public improvements to perimeter streets when the development of subdivisions abuts said roadways:

Municipality	Municipal Code Section	Requirement
City of Belton, Mo.	Article V. – Public Improvements, Sec. 36-108. Required Improvements	All streets that directly serve the subdivision are to be paved, as well as improved.
City of Blue Springs, Mo.	Chapter 406. Subdivision and Design Improvements, Subsection D. Street Design, Subsection 3.b. Half-Street Improvements	Half-street improvements are required when a subdivision abuts an existing street.
City of Liberty, Mo.	Article VI. – Adequate Public Facilities, Sec. 30-35.2. Street capacity requirements; required improvements	The developer is required to improve all collector or arterial streets that abut the proposed development, along the entire limits of the development, to City standards.
City of Lee's Summit, Mo.	Division IV. – Minimum Public Improvements. Sec. 7.420. – Abutting streets	Abutting streets shall be improved in accordance to the City's <i>Thoroughfare Master Plan</i> (ex: street widening, street resurfacing or replacement, installation of curbs and gutters, sidewalks, and stormwater management facilities).
City of Smithville, Mo.	Title IV. – Land Use. Section 425.300 Required Improvements, A.1.	The developer shall install half-street improvements on all adjoining, existing streets to City standards (ex: pavement, curb and gutter).
Platte County, Mo.	Article IV, Subsection C.1.p.	Construction of perimeter streets adjacent to the

		<p>development shall be the responsibility of the developer (minimum 50% of the right-of-way and a minimum of 50% of the construction costs). Additional responsibilities may be imposed by the Planning Commission.</p>
--	--	--

As a result, it's in the City's interest to require the construction of perimeter streets and sidewalks as part of public improvements during the subdivision process too, to ensure that any proposed development abutting a planned or existing perimeter roadway doesn't negatively impact said perimeter street in terms of traffic generation/volume, traffic type, or create a safety hazard.

Proposed Text Amendment

The intent of Section 404.040 Required Improvements and Engineering Specifications is to ensure that all improvements necessary to serve lots within a subdivision are constructed, inspected, or otherwise assured of completion prior to the issuance of building permits; and the standards of Section 404.040 apply to any division of land or platting involving new blocks or lot, to the extent the division impacts and of the standards. In consultation with our Public Works Department and legal counsel, City staff have prepared a proposed text amendment to Section 404.040 to create requirements for the construction of perimeter streets as a part of public improvements for the subdivision process (see Exhibit C). Additionally, in review of Section 404.040, staff determined it to be of interest to also update provisions for our storm drainage requirements.

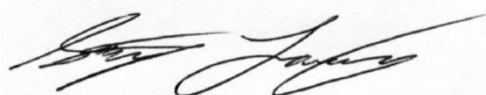
Staff Conclusion and Recommendation

Staff recommends approval of the proposed text amendment to Parkville Municipal Code, Title IV – Development Code, Section 404.040 Required Improvements and Engineering Specifications, to create requirements for the construction of perimeter streets as a part of public improvements for the subdivision process, and provide additional provisions for storm drainage requirements. Consideration of a text amendment requires a public hearing. Required public hearing notices were published and no comments have been received as of the date of this staff analysis report. It should be noted that the recommendation contained in this report is made without knowledge of any facts and testimony which may be presented during the public hearing, and that the conclusions herein are subject to change as a result of any additional information that may be presented.

Necessary Action

Following consideration of the Application for Text Amendment, supporting information, associated exhibits, factors discussed above and any testimony presented during the public hearing, the Planning and Zoning Commission should recommend approval (with or without conditions), denial, or postpone the application for further consideration. If approved subject to conditions, the conditions should be noted for the record. Unless postponed, the Planning and Zoning Commission's action will be forwarded to the Board of Aldermen on October 21, 2025, for final action.

End of Memorandum



10-01-2025

Stephen Lachky, AICP, CPM, CFM
Community Development Director

Date



Application #: PZ 2025-27
 Date Submitted: September 5, 2025
 Public Hearing: October 14, 2025
 Date Approved: _____

CITY OF PARKVILLE • 8880 Clark Avenue • Parkville, MO 64152 • (816) 741-7676 • FAX (816) 741-0013

Application for Text Amendment
 Applicable to Chapters, Sections and Subsections within Parkville Municipal Code Title IV Development Code

1. Applicant / Contact Information

Applicant(s)

Name: Alexa Barton
 Address: 8880 Clark Ave
 City, State: Parkville, MO
 Phone: (816) 741-7676 Fax: (816) 741-1300
 E-mail: abarton@parkvillemo.gov

Primary Contact(s), if different from applicant(s)

Name: Stephen Lachky
 Address: 8880 Clark Ave
 City, State: Parkville, MO
 Phone: (816) 741-7676 Fax: (816) 741-1300
 E-mail: slachky@parkvillemo.gov

We, the undersigned, do hereby authorize the submittal of this application and associated documents and certify that all information contained therein is true and correct. We acknowledge that all text amendments are subject to statutory requirements and the Municipal Code of the City of Parkville. We do hereby agree to abide by and comply with the above-mentioned codes, and further understand that any violations from the provisions of such shall constitute cause for fines, punishments and revocation of approvals as applicable.

Applicant's Signature (Required) Alexa Barton Date: 09/05/25

2. Proposed Text Amendment

The following information may be submitted on a separate sheet if necessary.

Amendment proposed to (Chapter, Section and Subsection number): Title IV: Development Code
 Section / Subsection Title: Section 404.040. Required Improvements and Engineering Specifications

Existing text:
 See attached

Proposed text:
 Perimeter Streets. Where a new public or private street is to be constructed as part of the subdivision, or a major subdivision is proposed, dedication and construction of perimeter streets shall also be the responsibility of the developer.
 a. If the street is adjacent to the development, the developer is responsible for a minimum of 50% of the right-of-way and a minimum of 50% of the construction costs. +

Reason for amendment:
 To ensure that any proposed development abutting a planned or existing perimeter roadway does not generate traffic volume/type or create a safety hazard on said perimeter roadway via exceeding its design capacity.

3. Potential benefits / effects

Generally, amendments are evaluated based on whether their benefit will likely outweigh any potential pitfalls, and their ability to implement community goals and objectives and improve the existing code. Describe below or on a separate sheet potential benefits and effects of the proposed amendment.

General benefits to property and residents in the City of Parkville (i.e., does the amendment make the code conform more closely with the City's Master Plan; improve public health, safety or general welfare; clarify or better implement the intent of the Code; or other):

The proposed text amendment ensures the City's transportation network is in a proper manner to support the public health, safety and welfare of the community.

General effects to property and residents in the City of Parkville:

Ensures the City's transportation network can adequately support design capacity, as well as safety and other public improvements necessary for the environmental health and safety of the community.

4. Checklist of required submittals

Completed application, including all required details and supporting data.

Nonrefundable application fee of \$300.00. Separately, the applicant will be billed to recover costs for required publication notice per Parkville Municipal Code Title IV, Section 403.010, Subsection E.

For City Use Only

Application accepted as complete by: Stephen Lachky, Community Development Director 09/08/2025
Name/Title Date

Application fee payment by Check # M.O. Cash

Accepted by: _____ Date _____
Name/Title Date

Hearing notice published in: The Platte County Citizen Date of publication: September 17, 2025

Final reimbursable costs paid (if applicable). Date of Action: _____

Planning Commission Action: Approved Approved with Conditions Denied Date of Action: _____
Conditions if any: _____

Board of Aldermen Action: Approved Approved with Conditions Denied Date of Action: _____
Conditions if any: _____

Chapter 404. Subdivision Regulations

Section 404.010 Street Networks and Design

Section 404.020 Civic and Open Space System

Section 404.030 Block and Lot Arrangement

Section 404.040 Required Improvements & Engineering Specifications

Section 404.040. Required Improvements and Engineering Specifications

- A. **Intent.** The intent of this Section is to insure that all improvements necessary to serve lots within a subdivision are constructed, inspected, or otherwise assured of completion prior to the issuance of building permits.
1. Coordinate the design and construction of infrastructure for lots and projects with surrounding systems.
 2. Promote specifications and installation of infrastructure that supports planning and urban design policies for the City and specific areas.
 3. Ensure that all lots are served with necessary improvements prior to or in association with the issuance of building permits.
 4. References in this Section to "a development" refers to developments requiring a major site plan.
 5. Requirements for off-site public improvements will be made prior to approval of the corresponding application.
- B. **Applicability.** The standards in this section apply to any division of land or platting involving new blocks or lot, to the extent the division impacts any of the standards.
- C. **Generally.** The 1997 or the latest consecutive edition of the American Public Works Association (APWA) Standard Specifications and Design Criteria shall be the governing specifications and design criteria for the City of Parkville, which may be supplemented by the Director of Public Works policy statements. However, where any of the planning and urban design standards in this Chapter require or recommend a different physical arrangement of spaces, the construction and the engineering specifications of the APWA manual shall be applied within the planning and urban design standards of this Chapter.
- D. **Streets and Sidewalks.** Except as altered for particular contexts by application of the street Design Types and Context Appropriate Street Design Standards in Section 404.010 and Appendix A, all streets and sidewalks shall be constructed to the following Standard Specifications and Design Criteria, APWA 1981:
1. *Arterials.* Standard Drawing ST-3
 2. *Collectors.* Standard Drawing ST-2
 3. *Local.* Standard Drawing ST-1.
 4. *Sidewalks.* SW-2. Sidewalks shall be constructed at the time of street construction along arterial and collector streets, but may be deferred until building permits are issued on local streets provided the developer enters into an agreement of with the City to construct all sidewalks within 3 years for the date of acceptance of the street, and record the agreement with the final plat. The agreement shall provide that upon notification by the City to the property owner that sidewalks shall be built within 60 days, weather permitting. Should sidewalks not be completed with that time period the City may proceed with sidewalk construction and by ordinance levy a special assessment against the property for the cost of construction. Sidewalks across private and commercial approaches will be

- the same thickness as the paved approach. All sidewalks shall be constructed to current Americans with Disabilities Act (ADA) standards.
5. **Street Lights.** Street lights shall be constructed as specified in the Standard Specifications and Design Criteria, APWA 1982.
 6. **Grades.** In general, streets shall be so arranged that grades shall not exceed 10 percent for major thoroughfares and 15 percent for minor streets. The City Planning Commission may permit variation from these grades where it deems modifications advisable to adjust to topographic situations.
 - a. Gutter grades on paved gutters shall not be less than one-half of one percent
 - b. All changes in street grades shall be connected by a vertical curve of reasonable length to assure adequate visibility.
 - c. In approaching intersections, there should be a suitable leveling of the street at a grade generally not exceeding five percent and for a distance of generally not less than 100 feet from the nearest line of the intersecting street. The grade within the intersection should be as level as possible, permitting proper drainage.
 7. **Street Names.** Street shall use the names of other existing and named streets in alignment. Names of new streets or streets not in alignment with others shall show the names on the final plat and shall not duplicate or sound similar to existing street names. The City shall determine the street names and lot numbers.
 8. Driveway approaches shall conform to the design specified in APWA 1997 Edition Standard Drawing D-1. Approaches must conform to one-quarter ($\frac{1}{4}$) inch to one-half ($\frac{1}{2}$) inch max slope within the right-of-way. The cross slopes of driveway approaches containing sidewalk must adhere to current ADA standards and match the width of the existing or planned sidewalk. Colored concrete or decorative driveway approaches may be installed to the curb with the following conditions:
 - a. Owner must pay for the special improvement and must be otherwise installed according to APWA standards.
 - b. Owner agrees to have continuing responsibility for contracting and installation of all such approaches requiring repairs due to utility, street or other such work; however, said utility, contractor or municipal contractor shall pay the amount of a standard APWA approach replacement to said owner; or if the owner does not want a decorative driveway any longer, a standard replacement approach will be installed in the affected drive by the said contractor.
- E. Off-Site Streets and Sidewalks.** In addition to providing a direct connection to a development or subdivision, the developer shall also be required to improve all perimeter streets and sidewalks that abut the development or subdivision, along their entire limits, to City standards. Perimeter streets and sidewalks are those existing streets and sidewalks to which the proposed subdivision or development abuts on only one side.
1. The Public Works Director may determine whether additional off-site street, sidewalk, or intersection improvements are necessary to support the proposed subdivision or development and mitigate its impact on surrounding public infrastructure, and to ensure the volume or type of traffic generated by the proposed subdivision or development will not create a safety hazard or cause any street or intersection to exceed its design capacity. The Public Works Director may require additional engineering studies from the developer to make these determinations.
 2. If the Public Works Director determines such off-site public improvements are necessary, the developer shall be required to complete such off-site public improvements concurrently with their development prior to the issuance of a certificate of occupancy and/or a certificate of substantial completion.
- F. Water and Sanitary Sewer.**
1. Where a public water main is reasonably accessible, connections between each lot and the water main shall be made in accordance with City standards.
 2. Where a public sanitary sewer is reasonably accessible, connections between each lot and the sanitary sewer shall be made, sewer systems within the subdivision to make

sanitary sewer accessible to each lot. Sewer systems shall be approved by the Board of Aldermen and the Missouri Department of Natural Resources.

3. Where sanitary sewers are not available, other facilities, as approved by the Board of Aldermen and the Platte County Health Department, must be provided for the adequate disposal of sanitary wastes.

G. Storm Drainage. Culverts, storm sewer inlets, rip-rap slopes, stabilized ditches and other improvements shall be installed to handle storm water adequately. Such improvements may be a part of a benefit district, may be installed by the applicant prior to building permit issuance on abutting land, or installation may be guaranteed by performance as may be negotiated with the Governing Body. All storm drainage facilities shall meet the specification and standards of the City, and be planned and designed according to the site design standards in Section 408.050.

1. The Public Works Director may determine whether off-site stormwater improvements (i.e., improvements outside the boundaries of the subdivision or development) are necessary to support the proposed subdivision or development and mitigate its impact on surrounding public infrastructure, and to ensure that the volume or type of stormwater generated by the proposed subdivision or development will not create a safety hazard or cause any existing stormwater facility to exceed its design capacity. The Public Works Director may require additional engineering studies from the developer to make these determinations.
2. If the Public Works Director determines such off-site public improvements are necessary, the developer shall be required to complete such off-site public improvements concurrently with their development prior to the issuance of a certificate of occupancy and/or a certificate of substantial completion.

H. Upsizing. Whenever any portions of the required public improvements are part of a planned future facility for the City, serving an area larger than the subdivision and its impact, the City and applicant will enter into an upsizing agreement. The City and the applicant shall negotiate the following aspects of the agreement prior to approval of the plat:

1. The applicant shall construct the facilities as planned by the City for future capacity as part of the subdivision and development process.
2. The applicant shall be responsible for the portion of the costs required to serve the proposed subdivision based on actual total cost to build the facilities absent any upsizing agreement.
3. The City shall be responsible for any incremental costs to expand the facility to the planned capacity, beyond the capacity to serve the subdivision. The City's participation may be based by the applicant bidding the project with bid alternates, one alternate to build the minimum required facility to serve the subdivision or development and the second bid alternate being for the upsized facility planned by the City.
4. The agreement shall be subject to approval by the City Attorney.

I. Permitting, Inspection and Acceptance. No work on required improvements shall be done unless the following regulations and provisions have first been complied with:

1. Plans and specifications for the private construction or repair of improvements, including but not limited shall be submitted to the Public Works Director for approval, along with the specified improvement permit fee.
2. A permit shall be obtained from the Public Works Director authorizing the construction according to plans and specifications submitted.
3. Following the issuance of the permit, construction shall not be started until the Public Works Director has been notified as to the time, location, and scope of the construction. All construction work may be stopped at any time by the Public Works Director, when in the opinion of the Public Works Director the workmanship, materials used, or procedures of work do not meet the requirements or comply with the City Code, ordinances, specifications and procedures for such work.
4. All permitted work shall be subject to final inspection for City maintenance by the Public Works Director who shall recommend action to the Mayor and Board of Aldermen. No

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- building permit shall be issued prior to the official acceptance of streets and sewers necessary to adequately serve such building.
5. Before acceptance by the City of streets or sewers, the owner shall post a maintenance bond, cash or irrevocable letter of credit satisfactory to the Board of Aldermen and in accordance with City policies and Public Works procedures, guaranteeing against defects in construction for a period of two years.
 6. Any private improvements such as landscape islands, benches, trash cans, landscaping or subdivision monuments approved within the right-of-way shall have a Right-of-Way Maintenance Agreement signed by the developer and assigning responsibility to an association of property owners or any specific lot or property owner.

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