Attachment L

Preliminary Drainage and Stormwater Treatment Report by Stantec 2021-05-01

Preliminary Drainage & Stormwater Treatment Report

Camp Hess Kramer/Gindling Hilltop Camp

Woolsey Fire Rebuild

11495 & 11677 Pacific Coast Highway
Ventura County, CA

May 1, 2021

Prepared for:

Wilshire Boulevard Temple Camps
3663 Wilshire Boulevard
Los Angeles, CA 90010

Prepared by:

Stantec Consulting Services, Inc.
111 E Victoria Street
Santa Barbara, CA, 93101

This document entitled Preliminary Drainage & Stormwater Treatment Report was prepared by Stantec Consulting Services Inc. ("Stantec") for the account of Wilshire Boulevard Temple Camps (the "Client"). Any reliance on this document by any third party is strictly prohibited. The material in it reflects Stantec's professional judgment in light of the scope, schedule and other limitations stated in the document and in the contract between Stantec and the Client. The opinions in the document are based on conditions and information existing at the time the document was published and do not take into account any subsequent changes. In preparing the document, Stantec did not verify information supplied to it by others. Any use which a third party makes of this document is the responsibility of such third party. Such third party agrees that Stantec shall not be responsible for costs or damages of any kind, if any, suffered by it or any other third party as a result of decisions made or actions taken based on this document.

Prepared by _____
(signature)
Craig Steward, P.E., CFM

Reviewed by _____
(signature)
Pete Silvia, P.E.

Approved by _____
(signature)
Hady Izadpanah, P.E.

Table of Contents

1.0 INTRODUCTION 1

2.0 STORMWATER TREATMENT 3
2.1 METHODOLOGY 3
2.2 STORMWATER TREATMENT 3
2.3 STORMWATER TREATMENT DESIGN CONCEPTS 4

3.0 DRAINAGE ANALYSIS 4
3.1 METHODOLOGY 5
3.2 STORM DRAIN ANALYSIS 5
3.3 OVERLAND ESCAPE ASSESSMENT 5
3.4 DETENTION ASSESSMENT 6
3.5 100-YEAR FLOOD PLAIN ANALYSIS 8

4.0 CONCLUSION 10

LIST OF TABLES

Table 1 - Camp Hess Kramer Project Imperviousness 4
Table 2 - Increased Impervious Analysis 7
Table 3 - Pre-Project and Post-Project Peak Runoff Comparison in Little Sycamore Creek 8

LIST OF FIGURES

Figure A - Location Map 2
Figure B - Project Vicinity Map 3
Figure C - FIRMette of Lower Portion of Project 9

LIST OF APPENDICES

APPENDIX A – EXHIBITS AND PLANS

APPENDIX B – POST-CONSTRUCTION STORMWATER MANAGEMENT PLAN (PCSMP)

APPENDIX C – BMP SIZING WORKSHEETS

APPENDIX D – INFILTRATION TESTING REPORT

APPENDIX E – HYDRAULIC CALCULATIONS

APPENDIX F – DETENTION ASSESSMENT

1.0 INTRODUCTION

In 2018, the Woolsey Fire burned a large portion of Camp Hess Kramer. The fire was followed by a rain event on the burned watershed and a catastrophic slide on the camp property which devastated the camp facilities. This report works to support the preliminary design of stormwater treatment and drainage facility design within the project site designated areas. The project is identified as the Camp Hess Kramer/Gindling Hilltop Camp Rebuild Project. Camp Hess Kramer sits on approximately 187 acres within Little Sycamore Canyon in Malibu, northwesterly of the intersection of Pacific Coast Highway (PCH) and Yerba Buena Road, on the southerly boundary of Ventura County. See Figure A and Figure B.

The project description is as follows:

Wilshire Boulevard Temple Camp (WBT), a California not-for-profit corporation, is requesting a Major Mod to LU10-0069 to rebuild Camp Hess Kramer (Lower and Middle Camps) and Gindling Hilltop Camp (Upper Camp) which were near-completely destroyed by the Woolsey Fire and subsequent heavy rains between December 2018 and March 2019. Prior to the Fire, Camp had been operating on this site since 1952 and its pre-fire uses and structures are described in a Ventura County-approved CUP (County ref: LU10-0069). The proposed rebuilding effort includes restoration of damaged buildings and construction of new buildings to replace functions of destroyed structures, restoration of outdoor activity areas, landscaping, fuel modification, and restoration of the Little Sycamore Creek corridor. The project will also repair, replace, and or construct necessary infrastructure including access roads, parking, vehicle and pedestrian bridges and walkways, water and wastewater infrastructure, electrical and communication lines, stormwater and drainage facilities and lighting.

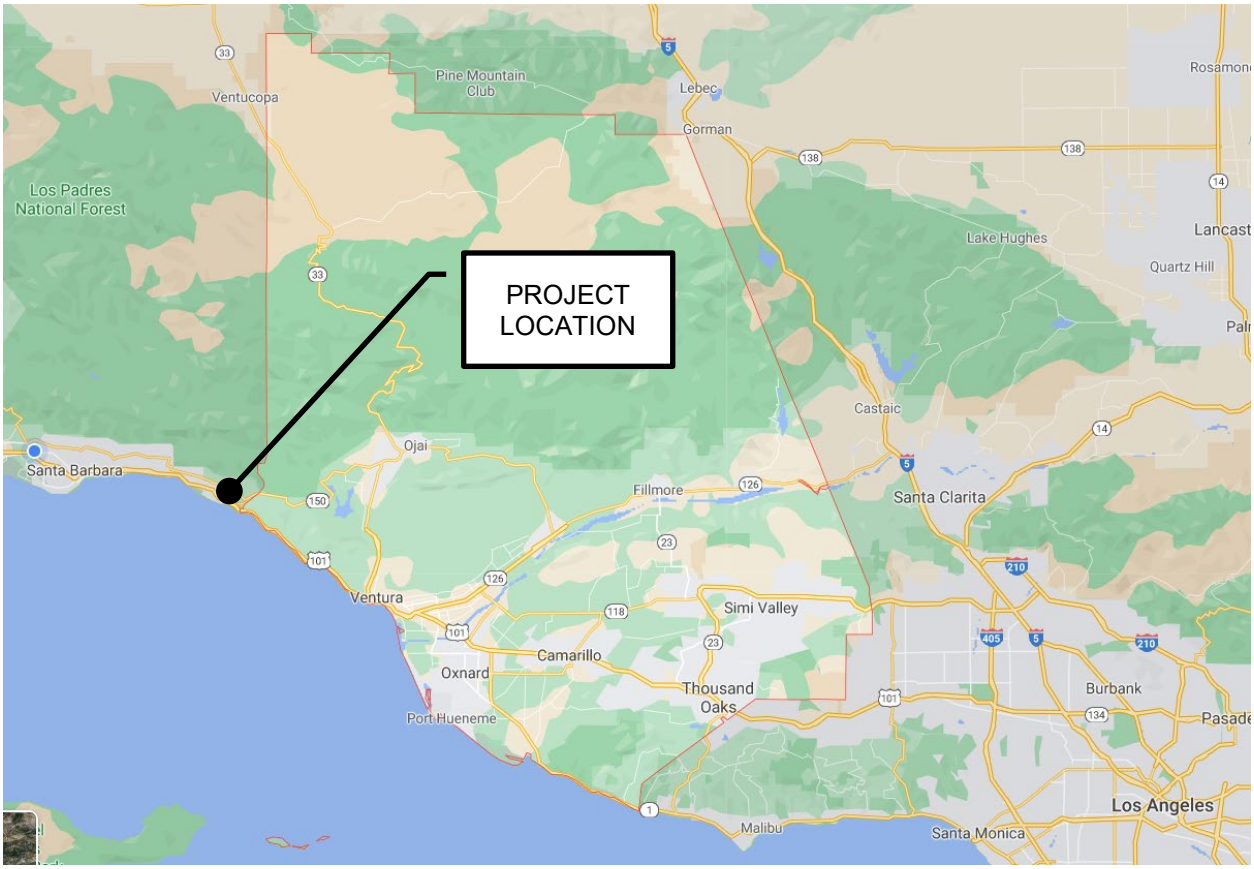


Figure A - Location Map

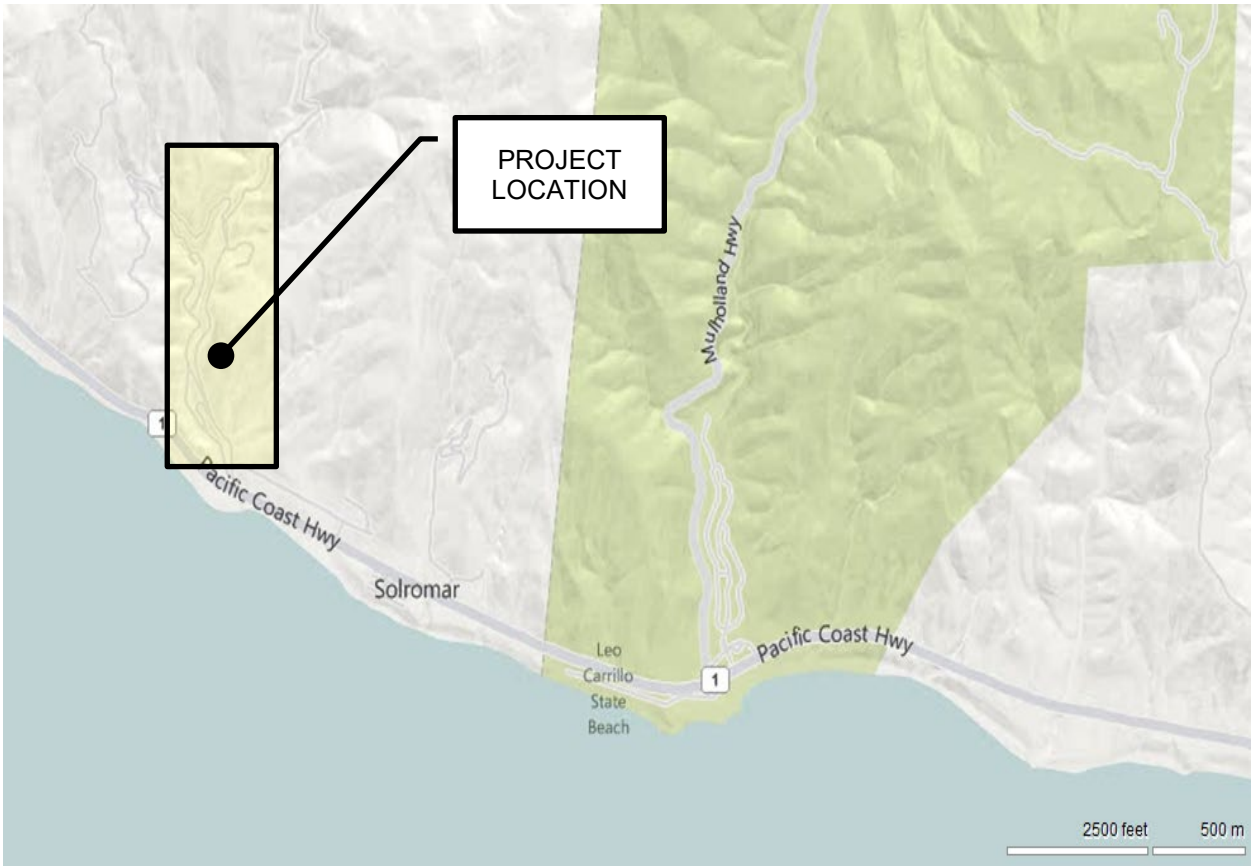


Figure B - Project Vicinity Map

2.0 STORMWATER TREATMENT

2.1 METHODOLOGY

The report identifies storm drain runoff impacts due to the proposed improvements. Methods of treating runoff are identified. Runoff calculations were performed using the Ventura County Technical Guidance Manual for Stormwater Quality Control Measures updated 2018.

2.2 STORMWATER TREATMENT

Based on the Ventura Countywide Stormwater Quality Program Post-Construction Stormwater Management Plan (PCSMP), this project is considered a redevelopment project where the redevelopment results in an alteration of less than fifty percent of impervious surfaces of a previously existing development (see Table 1.0). Projects like these shall mitigate only the altered portion of the redevelopment project area and not the entire project area. Therefore, Camp is not responsible for

treating any offsite drainage, or onsite drainage unrelated to the project area and can be bypassed and conveyed to Little Sycamore Creek.

Table 1 - Camp Hess Kramer Project Imperviousness

Total Project Area (ac)	Existing Impervious (ac)	New/Replaced Impervious (ac)	Total Impervious (ac)	Total Project Impervious
58.9	7.9	5.7	13.6	23%

Infiltration testing rates vary throughout the site, therefore various water treatment types are proposed: infiltration basins (INF-1), infiltration trenches (INF-2), bioretention (INF-3), permeable pavement (INF-5), bioretention with underdrain (BIO-1), planter boxes (BIO-2), vegetated swales (BIO-3), and vegetated filter strips (BIO-4). The Infiltration Testing Report by Earth Systems can be found in the Appendix D. Stormwater Treatment Sheets 1-10 for proposed locations and sizes of the stormwater treatment facilities, the bmp sizing worksheets and to sheet C58 for typical stormwater treatment details/sections proposed are found in Appendix C.

The infiltration BMPs are sized to treat the calculated stormwater Quality Design Volume (SQDV) per the Ventura County Technical Guidance Manual for Stormwater Quality Control Measures, updated 2011, Errata update 2018. Refer to the Appendix for the Post Construction Stormwater Management Plan (PCSMP).

2.3 STORMWATER TREATMENT DESIGN CONCEPTS

For Lower and Middle Camp areas, the stormwater treatment design concept varies based on infiltration rate results, existing topography, proposed design topography, and proposed surface materials. Various water treatment types are proposed: infiltration basins (INF-1), infiltration trenches (INF-2), bioretention (INF-3), permeable pavement (INF-5), bioretention with underdrain (BIO-1), planter boxes (BIO-2), vegetated swales (BIO-3), and vegetated filter strips (BIO-4).

For Gindling Hilltop Camp (Upper Camp), the stormwater treatment design concept for all the proposed structures is to incorporate raised planter boxes (BIO-2). Historic drainage patterns for Upper Camp will remain.

3.0 DRAINAGE ANALYSIS

The Rational Method as described in the Ventura County Watershed Protection District Design Hydrology Manual dated July 2017 was used to calculate the existing and on-site developed peak runoff amounts. Times of concentration were calculated for the existing and developed conditions by using the Ventura County Time of Concentration Calculator.

The following guidelines/assumptions were applied in use of the hydrology calculations:

The project area is located in Flood Zone 4 and in L Rainfall Intensity Zone which was obtained from the Design Hydrology Manual. The soil types for the site were determined to be soils type 1 and 4.

3.1 METHODOLOGY

A number of off-site flows are intercepted and conducted directly to outlet locations in Little Sycamore Creek, receiving only treated flows from on-site development. Since these watersheds are significantly larger than the on-site watersheds, peak flow rates for sizing these storm drain systems are based on the "Little Sycamore Creek Hydrology and Hydraulics Analysis, Camp Hess Kramer/Gindling Hilltop Camp, Woolsey Fire Rebuild, 11495 & 11677 Pacific Coast Highway, Ventura County", dated May 1, 2021 which was also used for detention analysis, overland escape evaluation, and floodplain analysis. Affected subbasin watershed peak flow rates are proportionally reduced by the actual area tributary to the storm drain. These peak flow rates are used for assessing overland escape in case of storm drain failure.

The hydrologic and hydraulic report is a separate document in this project submittal.

All proposed on-site storm drains will be sized for a minimum 25-year storm event. Proposed catch basins shall be sized for the 25-year storm event in flow by conditions, and the 100-year bulked storm event for areas impacted by potential overland escape in case of storm drain failure.

3.2 STORM DRAIN ANALYSIS

Off-site stormwater that enters the project area is intercepted by storm drain facilities and directed to Little Sycamore Creek. In some cases, such as stormwater flowing under Yerba Buena Road, stormwater is collected directly from public storm drain facilities into the proposed project storm drains. In other cases, typically on the westerly side of the project, stormwater is collected into a small basin with grates or trash racks to reduce entry of debris or rocks into the storm drain system. Stormwater from the storm drains is released into Little Sycamore Creek in such a way as to reduce erosive energy at the point of discharge.

It is the project intention to design storm drain facilities to accept and conduct at least a 25-year peak storm flow. Preliminary alignments and design analysis using WSPGW water surface profile design program have been completed and preliminary plan and profile designs are shown on the preliminary grading and drainage plans. Calculations for the preliminary storm drain design are attached as Appendix E.

3.3 OVERLAND ESCAPE ASSESSMENT

In the case that storm drain facilities fail or the runoff exceeds the 25-year event design capacity, overland escape facilities have been designed to convey surface flow safely to Little Sycamore Creek. Calculations and exhibits are attached as Appendix E.

3.4 DETENTION ASSESSMENT

The analysis of the increased imperviousness is summarized in Table 2. Table 3 illustrates the differences in the peak stormwater flow rate of Little Sycamore Creek between pre-project and post-project conditions. While some individual subwatersheds experience increased runoff due to the proposed development, it is not enough to affect the peak flow rate in Little Sycamore Creek. Other findings of the hydrologic analysis include that the increased development was not enough to increase the calculated volume of runoff in the creek or duration of flow.

Table 2 - Increased Impervious Analysis

Development Area 1	Total Site	Increased Imperviousness in Watersheds			
	sf	66B	67B	68B	Total
Pre-Project Impervious	396,500				
Post-Project Impervious	449,000	738	38,965	12,797	
Increased Impervious	52,500	738	38,965	12,797	52,500

Development Area 2	Total Site	Increased Imperviousness in Watersheds			
	sf	66B	67B	68B	Total
Pre-Project Impervious	255,800				
Post-Project Impervious	279,212		9,437		
Increased Impervious	23,412		9,437		9,437
Note: Not all of Development Area 2 drains to the Little Sycamore Creek watersheds.					

Development Area 3	Total Site	Increased Imperviousness in Watersheds			
	sf	66B	67B	68B	Total
Pre-Project Impervious	3,600		3,600		
Post-Project Impervious	3,600		3,600		
Increased Impervious	0		0		0

Development Area 4	Total Site	Increased Imperviousness in Watersheds			
	sf	66B	67B	68B	Total
Pre-Project Impervious	3,300		3,300		
Post-Project Impervious	3,300				
Increased Impervious	0		0		0

Project Total New Impervious by Watershed (sf)		738	48,402	12,797	61,937
Project Total New Impervious by Watershed (sm)		0.00003	0.00174	0.00046	0.00222
Watershed Area, sm		0.162	0.43	0.255	
Increased Percent Impervious		0.0%	0.4%	0.2%	

Note: 66B, 67B, and 68B refer to watersheds identified in the Hydrology and Hydraulics report what will be impacted by project development. Development Areas are identified in Appendix F.

Table 3 - Pre-Project and Post-Project Peak Runoff Comparison in Little Sycamore Creek

	2-yr			5-yr			10-yr		
CP	Pre-Dev	Post-Dev	ΔQ	Pre-Dev	Post-Dev	ΔQ	Pre-Dev	Post-Dev	ΔQ
	cfs	cfs	cfs	cfs	cfs	cfs	cfs	cfs	cfs
15C	520	520	0	898	898	0	1,275	1,275	0
14C	534	534	0	922	922	0	1,303	1,303	0
13C	595	595	0	1,045	1,045	0	1,446	1,446	0
12C	569	569	0	980	980	0	1,395	1,395	0

	25-yr			50-yr			100-yr		
CP	Pre-Dev	Post-Dev	ΔQ	Pre-Dev	Post-Dev	ΔQ	Pre-Dev	Post-Dev	ΔQ
	cfs	cfs	cfs	cfs	cfs	cfs	cfs	cfs	cfs
15C	1,848	1,848	0	2,344	2,344	0	2,859	2,859	0
14C	1,891	1,891	0	2,394	2,394	0	2,921	2,921	0
13C	2,104	2,104	0	2,655	2,655	0	3,248	3,248	0
12C	2,034	2,034	0	2,573	2,573	0	3,160	3,160	0

Note: CP refers to collection points which are identified in the Hydrology and Hydraulics report in Appendix xx.

3.5 100-YEAR FLOOD PLAIN ANALYSIS

A hydraulic analysis of the creek water surface elevations was prepared using United States Army Corps of Engineers hydraulic model HEC-RAS 5.0.7. Based on the preliminary grading and drainage plans, channel restoration concepts prepared by ESA, and hydraulic modeling, 100-year inundation limits 100-year water surface elevations were calculated. This information was (or will be) used in locating buildings, assessing finish floor elevations and analyzing forces for bridge design. A comparison of the pre-project 100-year water surface elevation to the post-project 100-year water surface elevation indicates that there will be no increase in the 100-year water surface elevation due to the proposed project either upstream or downstream of the project area.

Only a small portion of Little Sycamore Creek is shown as a special flood hazard area (Zone A) and which extends into the lower proposed project area. See Figure C. Therefore, a separate evaluation of the hydrology and hydraulics of Little Sycamore Creek has been prepared[1]. It is a separate submittal for this project. Resulting 100-year inundation limits and 100-year water surface elevations are shown on the

[1] Little Sycamore Creek Hydrology and Hydraulics Analysis, Camp Hess Kramer/Gindling Hilltop Camp, Woolsey Fire Rebuild, 11495 & 11677 Pacific Coast Highway, Ventura County, dated May 1, 2021

project grading and drainage plans and in the referenced report. The results of the analysis were used to safely position proposed buildings and to elevate them to the required 1 ft above the 100-year water surface elevation. In a few cases, some structures are existing and are not being substantially improved or do not qualify as an enclosed structure, allowing floodwater pressures to equilibrate. Some structures may require some floodproofing or special alterations to address utilities or basement elevations. The hydrology analysis includes a bulking factor of 1.25, based on similar coastal watersheds that have gaging data.

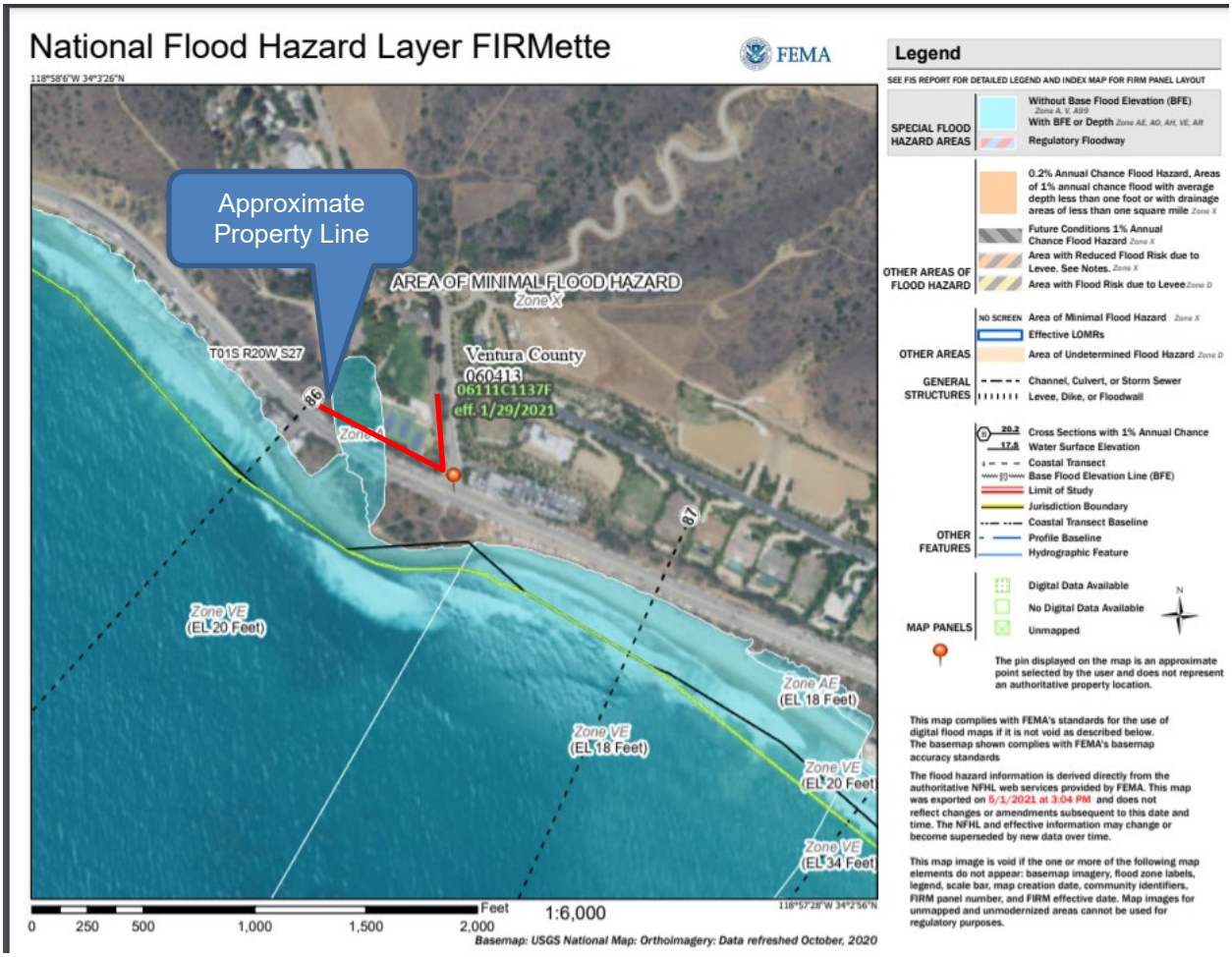
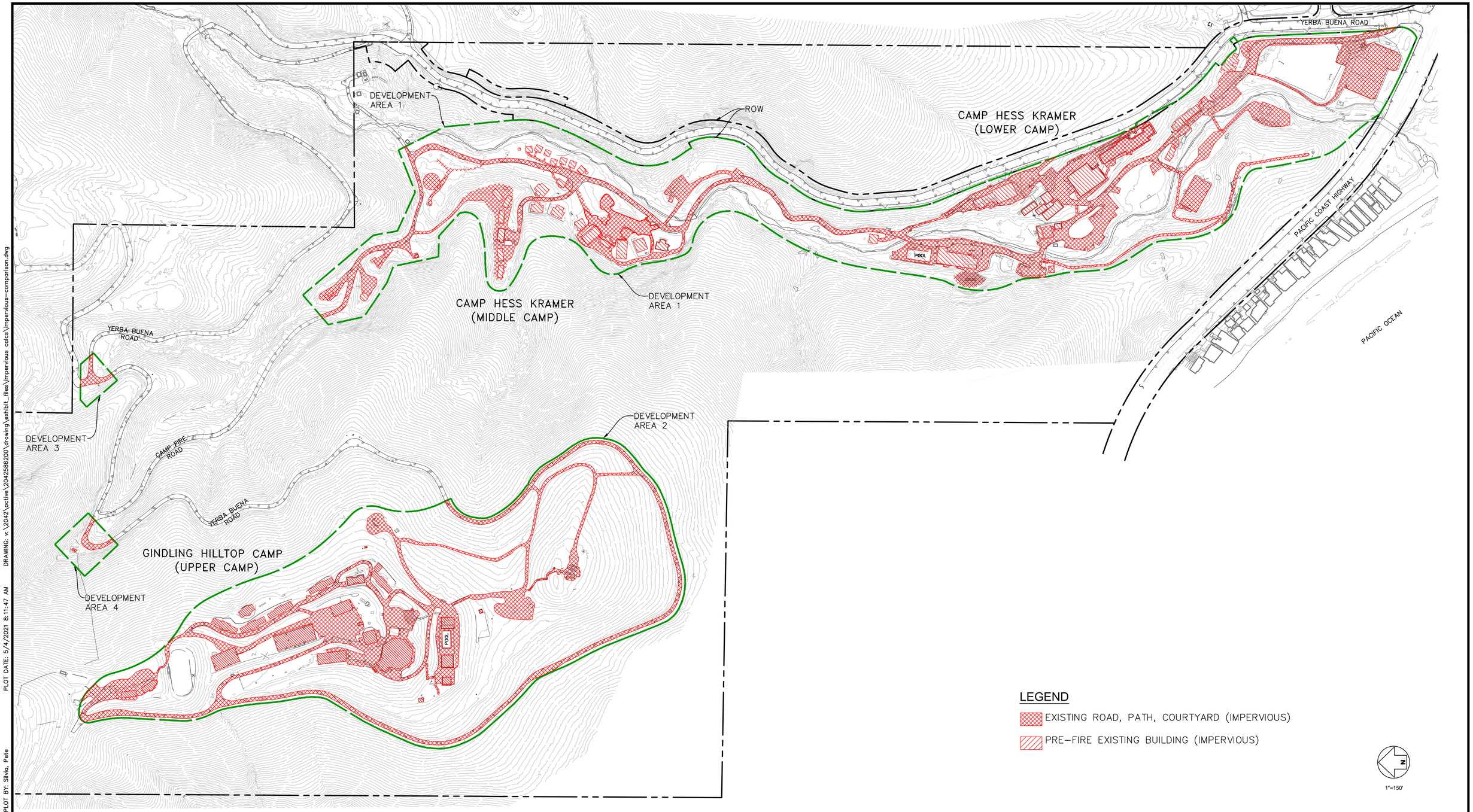


Figure C - FIRMette of Lower Portion of Project

4.0 CONCLUSION

The drainage and treatment systems for this project have been designed in accordance with the requirements of the County of Ventura, using the methods proscribed in the County of Ventura Hydrology and Technical Guidance Manuals.

Appendix A – EXHIBITS AND PLANS



DEVELOPMENT AREA 1 - 1,351,281 SF (31.0 ACRES)
IMPERVIOUS AREA- 398,500 SF (9.1 ACRES)

DEVELOPMENT AREA 2 - 1,173,726 SF (26.9 ACRES)
IMPERVIOUS AREA - 255,800 SF (5.9 ACRES)

DEVELOPMENT AREA 3 - 14,175 SF
IMPERVIOUS AREA - 3,600 SF (0.1 ACRES)

DEVELOPMENT AREA 4 - 24,485 SF
IMPERVIOUS AREA - 3,300 SF (0.1 ACRES)

ALL DEVELOPMENT AREAS - 2,564,000 SF (58.9 ACRES)
IMPERVIOUS AREA - 661,000 SF (15.2 ACRES)
EXISTING IMPERVIOUS AREA: 26%

LEGEND

EXISTING ROAD, PATH, COURTYARD (IMPERVIOUS)

PRE-FIRE EXISTING BUILDING (IMPERVIOUS)

N

1"=150'

IMPERVIOUS SURFACE EXHIBIT - PRE-FIRE PRE-DEVELOPMENT
CAMP HESS KRAMER / GINDLING HILLTOP CAMP
WOOLSEY FIRE REBUILD

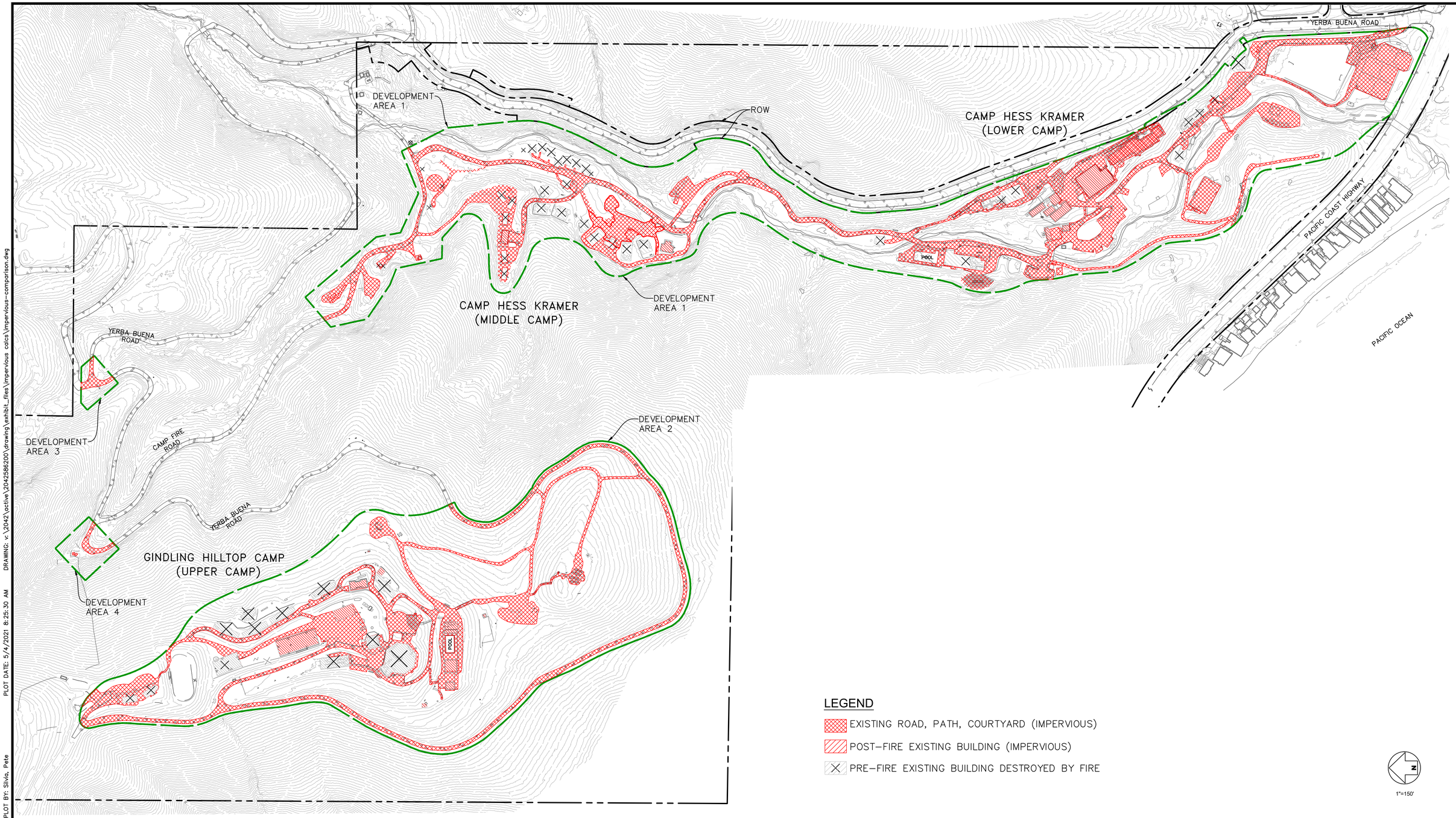
COUNTY OF VENTURA, CALIFORNIA
APRIL 1, 2021

Stantec
111 East Victoria Street, Santa Barbara, CA 93101
Phone: (805) 963-9532

ATTENTION: IF THIS DOCUMENT IS PROVIDED AS A COURTESY IN AN ELECTRONIC FORMAT, THE DELIVERY OF THE ELECTRONIC FILE DOES NOT CONSTITUTE THE DELIVERY OF THE PROFESSIONAL WORK PRODUCT. ONLY A HARD COPY DOCUMENT THAT IS SIGNED AND SEALED BY AN AUTHORIZED PROFESSIONAL EMPLOYEE OF STANTEC CONSTITUTES THE PROFESSIONAL WORK PRODUCT. IN THE EVENT THE ELECTRONIC FILE IS ALTERED, THE HARD COPY MUST BE REFERRED TO FOR THE ORIGINAL AND CORRECT INFORMATION. STANTEC SHALL NOT BE RESPONSIBLE FOR ANY MODIFICATIONS MADE TO THE ELECTRONIC FILE, OR ANY PRODUCTS DERIVED FROM THE ELECTRONIC FILE WHICH ARE NOT REVIEWED, SIGNED AND SEALED BY AN AUTHORIZED PROFESSIONAL EMPLOYEE OF STANTEC. COPYRIGHT 2016, STANTEC CONSULTING SERVICES INC

36-EXB SAVE DATE: 4/1/2021 10:15:58 AM PLOT BY: Silvia, Pete PLOT DATE: 5/4/2021 8:11:47 AM DRAWING: v:\2042\active\2042586200\drowing\exhibit_files\impervious calcs\impervious-comparison.dwg

SAVE DATE: 5/4/2021 8:16:25 AM PLOT BY: Silvia, Pete PLOT DATE: 5/4/2021 8:25:30 AM DRAWING: v:\2042\active\2042586200\drawing\exhibit_files\impervious calcs\impervious-comparison.dwg



DEVELOPMENT AREA 1 - 1,351,281 SF (31.0 ACRES)
IMPERVIOUS AREA- 347,500 SF (8.0 ACRES)

DEVELOPMENT AREA 2 - 1,173,726 SF (26.9 ACRES)
IMPERVIOUS AREA - 230,500 SF (5.3 ACRES)

DEVELOPMENT AREA 3 - 14,175 SF
IMPERVIOUS AREA - 3,600 SF (0.1 ACRES)

DEVELOPMENT AREA 4 - 24,485 SF
IMPERVIOUS AREA - 3,300 SF (0.1 ACRES)

ALL DEVELOPMENT AREAS - 2,564,000 SF (58.9 ACRES)
IMPERVIOUS AREA - 584,500 SF (13.4 ACRES)
EXISTING IMPERVIOUS AREA: 23%

LEGEND

- EXISTING ROAD, PATH, COURTYARD (IMPERVIOUS)
- POST-FIRE EXISTING BUILDING (IMPERVIOUS)
- PRE-FIRE EXISTING BUILDING DESTROYED BY FIRE

N

1"=150'

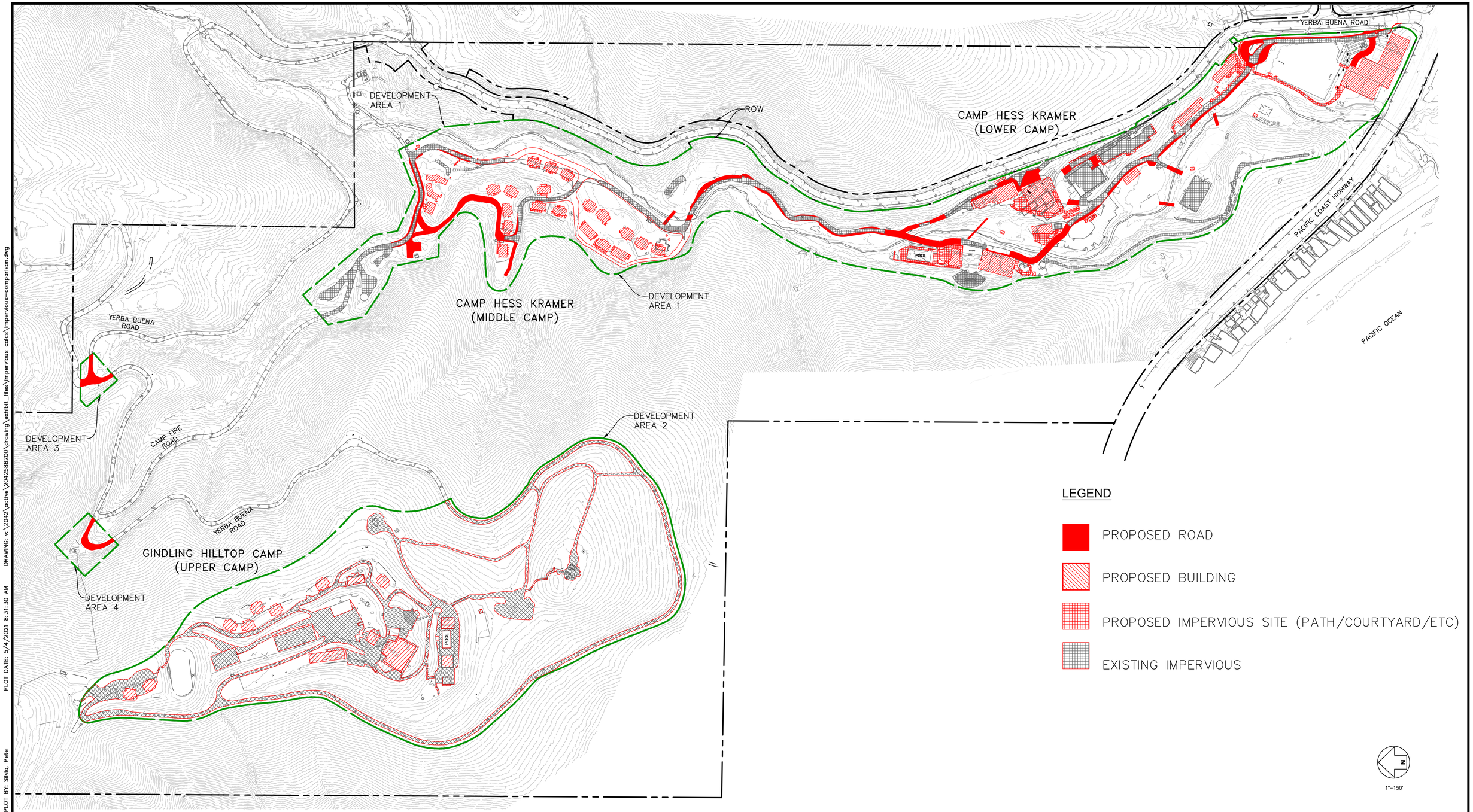
IMPERVIOUS SURFACE EXHIBIT
POST-FIRE PRE-DEVELOPMENT (TREATMENT ANALYSIS)
CAMP HESS KRAMER / GINDLING HILLTOP CAMP WOOLSEY FIRE REBUILD

COUNTY OF VENTURA, CALIFORNIA
APRIL 1, 2021

Stantec
111 East Victoria Street, Santa Barbara, CA 93101
Phone: (805) 963-9532

36-EXB

ATTENTION: IF THIS DOCUMENT IS PROVIDED AS A COURTESY IN AN ELECTRONIC FORMAT, THE DELIVERY OF THE ELECTRONIC FILE DOES NOT CONSTITUTE THE DELIVERY OF THE PROFESSIONAL WORK PRODUCT. ONLY A HARD COPY DOCUMENT THAT IS SIGNED AND SEALED BY AN AUTHORIZED PROFESSIONAL EMPLOYEE OF STANTEC CONSTITUTES THE PROFESSIONAL WORK PRODUCT. IN THE EVENT THE ELECTRONIC FILE IS ALTERED, THE HARD COPY MUST BE REFERRED TO FOR THE ORIGINAL AND CORRECT INFORMATION. STANTEC SHALL NOT BE RESPONSIBLE FOR ANY MODIFICATIONS MADE TO THE ELECTRONIC FILE, OR ANY PRODUCTS DERIVED FROM THE ELECTRONIC FILE WHICH ARE NOT REVIEWED, SIGNED AND SEALED BY AN AUTHORIZED PROFESSIONAL EMPLOYEE OF STANTEC. COPYRIGHT 2016, STANTEC CONSULTING SERVICES INC



LEGEND

- PROPOSED ROAD
- PROPOSED BUILDING
- PROPOSED IMPERVIOUS SITE (PATH/COURTYARD/ETC)
- EXISTING IMPERVIOUS

N

1"=150'

DEVELOPMENT AREA 1 - 1,351,281 SF (31.0 ACRES)
EXISTING IMPERVIOUS AREA - 124,000 SF (2.8 ACRES)
NEW/REPLACED IMPERVIOUS AREA - 212,500 SF (4.9 ACRES)
TOTAL IMPERVIOUS AREA - 336,000 SF (7.7 ACRES)

DEVELOPMENT AREA 2 - 1,173,726 SF (26.9 ACRES)
EXISTING IMPERVIOUS AREA - 220,500 SF (5.1 ACRES)
NEW/REPLACED IMPERVIOUS AREA - 31,500 SF (0.6 ACRES)
TOTAL IMPERVIOUS AREA - 252,000 SF (5.8 ACRES)

DEVELOPMENT AREA 3 - 14,175 SF (0.3 ACRES)
EXISTING IMPERVIOUS AREA -
NEW/REPLACED IMPERVIOUS AREA - 3,600 SF (0.1 ACRES)
TOTAL IMPERVIOUS AREA - 3,600 SF (0.1 ACRES)

DEVELOPMENT AREA 4 - 24,485 SF (0.6 ACRES)
EXISTING IMPERVIOUS AREA -
NEW/REPLACED IMPERVIOUS AREA - 3,300 SF (0.1 ACRES)
TOTAL IMPERVIOUS AREA - 3,300 SF (0.1 ACRES)

ALL DEVELOPMENT AREAS - 2,563,668 SF (58.9 ACRES)
EXISTING IMPERVIOUS AREA - 341,000 SF (7.8 ACRES)
NEW/REPLACED IMPERVIOUS AREA - 250,000 SF (5.7 ACRES)
TOTAL IMPERVIOUS AREA - 591,000 SF (13.6 ACRES)
TOTAL IMPERVIOUS AREA: 23%

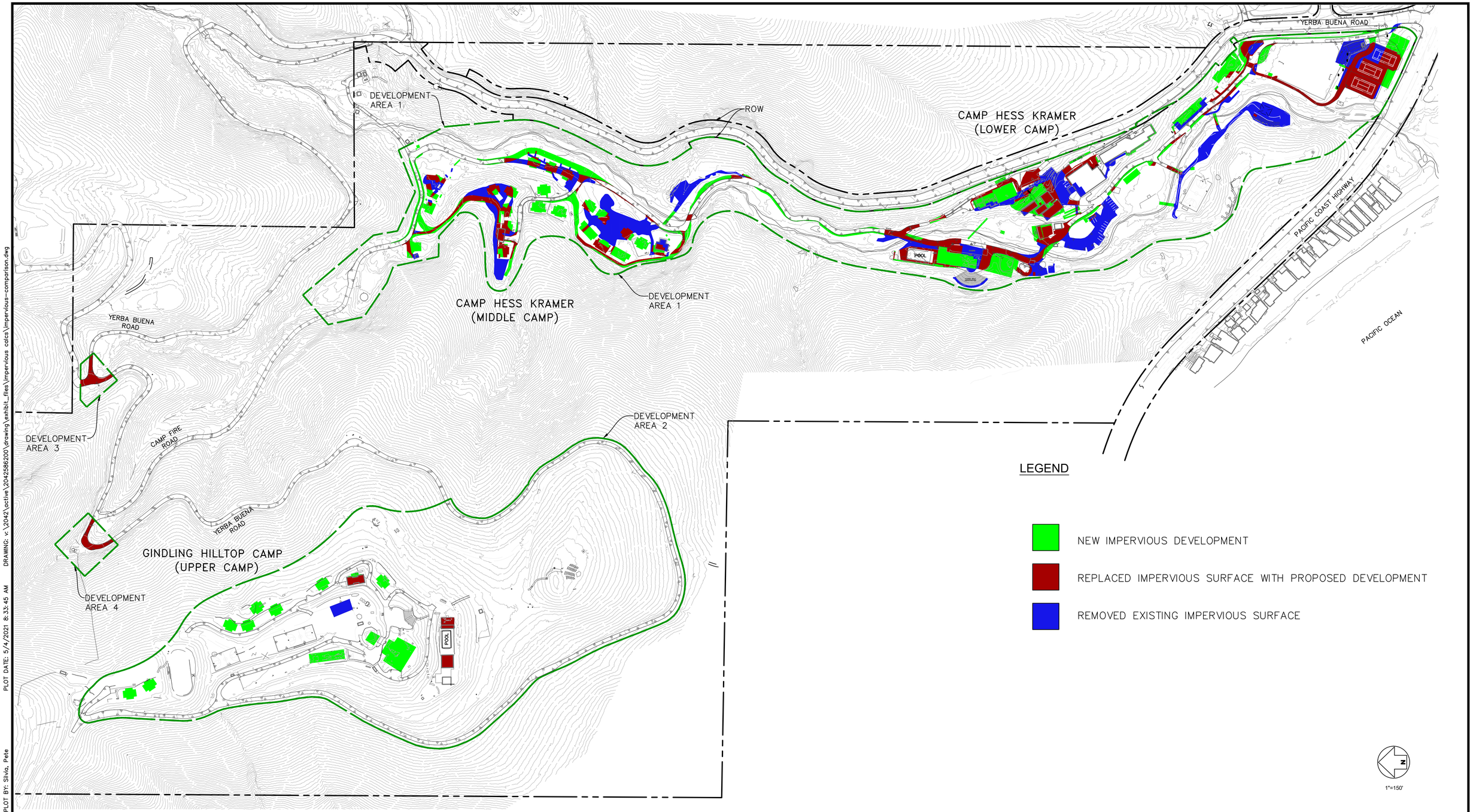
IMPERVIOUS SURFACE EXHIBIT
POST-FIRE POST-DEVELOPMENT (DETENTION ANALYSIS)
CAMP HESS KRAMER / GINDLING HILLTOP CAMP WOOLSEY FIRE REBUILD

COUNTY OF VENTURA, CALIFORNIA
APRIL 1, 2021

Stantec
111 East Victoria Street, Santa Barbara, CA 93101
Phone: (805) 963-9532

DRAWING: v:\2042\active\2042586200\drawing\exhibit_files\impervious calcs\impervious-comparison.dwg
PLOT DATE: 5/4/2021 8:31:30 AM
PLOT BY: Silvia, Pete
SAVE DATE: 5/4/2021 8:16:25 AM
36-EXB

ATTENTION: IF THIS DOCUMENT IS PROVIDED AS A COURTESY IN AN ELECTRONIC FORMAT, THE DELIVERY OF THE ELECTRONIC FILE DOES NOT CONSTITUTE THE DELIVERY OF THE PROFESSIONAL WORK PRODUCT. ONLY A HARD COPY DOCUMENT THAT IS SIGNED AND SEALED BY AN AUTHORIZED PROFESSIONAL EMPLOYEE OF STANTEC CONSTITUTES THE PROFESSIONAL WORK PRODUCT. IN THE EVENT THE ELECTRONIC FILE IS ALTERED, THE HARD COPY MUST BE REFERRED TO FOR THE ORIGINAL AND CORRECT INFORMATION. STANTEC SHALL NOT BE RESPONSIBLE FOR ANY MODIFICATIONS MADE TO THE ELECTRONIC FILE, OR ANY PRODUCTS DERIVED FROM THE ELECTRONIC FILE WHICH ARE NOT REVIEWED, SIGNED AND SEALED BY AN AUTHORIZED PROFESSIONAL EMPLOYEE OF STANTEC. COPYRIGHT 2016, STANTEC CONSULTING SERVICES INC



LEGEND

- NEW IMPERVIOUS DEVELOPMENT
- REPLACED IMPERVIOUS SURFACE WITH PROPOSED DEVELOPMENT
- REMOVED EXISTING IMPERVIOUS SURFACE

N

1"=150'

DEVELOPMENT AREA 1 - 1,351,281 SF
NEW 110,000 SF (2.5 ACRES)
REPLACED 111,500 SF (2.6 ACRES)
REMOVED 106,500 SF (2.4 ACRES)

DEVELOPMENT AREA 2 - 1,176,726 SF
NEW 26,500 SF (0.6 ACRES)
REPLACED 5,000 SF (0.1 ACRES)
REMOVED 2,700 SF (0.1 ACRES)

DEVELOPMENT AREA 3 - 14,175 SF
NEW -
REPLACED 3,600 SF (0.1 ACRES)
REMOVED -

DEVELOPMENT AREA 4 - 24,485 SF
NEW -
REPLACED 3,100 SF (0.1 ACRES)
REMOVED -

ALL DEVELOPMENT AREAS - 2,564,000 SF (58.9 ACRES)
NEW - 136,000 (3.1 ACRES)
REPLACED - 123,000 SF (2.8 ACRES)
REMOVED - 110,000 SF (2.5 ACRES)

IMPERVIOUS SURFACE EXHIBIT
POST-FIRE POST-DEVELOPMENT (TREATMENT ANALYSIS)
CAMP HESS KRAMER / GINDLING HILLTOP CAMP WOOLSEY FIRE REBUILD

COUNTY OF VENTURA, CALIFORNIA
APRIL 1, 2021

Stantec
111 East Victoria Street, Santa Barbara, CA 93101
Phone: (805) 963-9532

ATTENTION: IF THIS DOCUMENT IS PROVIDED AS A COURTESY IN AN ELECTRONIC FORMAT, THE DELIVERY OF THE ELECTRONIC FILE DOES NOT CONSTITUTE THE DELIVERY OF THE PROFESSIONAL WORK PRODUCT. ONLY A HARD COPY DOCUMENT THAT IS SIGNED AND SEALED BY AN AUTHORIZED PROFESSIONAL EMPLOYEE OF STANTEC CONSTITUTES THE PROFESSIONAL WORK PRODUCT. IN THE EVENT THE ELECTRONIC FILE IS ALTERED, THE HARD COPY MUST BE REFERRED TO FOR THE ORIGINAL AND CORRECT INFORMATION. STANTEC SHALL NOT BE RESPONSIBLE FOR ANY MODIFICATIONS MADE TO THE ELECTRONIC FILE, OR ANY PRODUCTS DERIVED FROM THE ELECTRONIC FILE WHICH ARE NOT REVIEWED, SIGNED AND SEALED BY AN AUTHORIZED PROFESSIONAL EMPLOYEE OF STANTEC. COPYRIGHT 2016, STANTEC CONSULTING SERVICES INC

DRAWING: v:\2042\active\2042586200\drawing\exhibit_files\impervious calcs\impervious-comparison.dwg
PLOT DATE: 5/4/2021 8:33:45 AM
PLOT BY: Silvia, Pete
SAVE DATE: 5/4/2021 8:16:25 AM
36-EXB

SEE SHEET 2 FOR CONTINUATION

BMP LEGEND

- INF-1 INFILTRATION BASIN
- INF-2 INFILTRATION TRENCH
- INF-3 BIORETENTION
- INF-5 PERMEABLE PAVEMENT
- BIO-1 BIORETENTION WITH UNDERDRAIN
- BIO-2 PLANTER BOX
- BIO-3 VEGETATED SWALE
- BIO-4 VEGETATED FILTER STRIP

YERBA BUENA ROAD

PACIFIC COAST HIGHWAY

LITTLE SYCAMORE CREEK

TREATMENT 2:
BIO-4 VEGETATED
FILTER STRIP
270' WIDE BY 22' LONG

TREATMENT 1: BIO-1
BIORETENTION WITH
UNDERDRAIN
AREA: 1,030 SF

SCO$_0$

INF-3

SCALE: 1"=20'
0 20 40 60

NO.	DATE	REVISION BLOCK	APPD.

PREPARED FOR:
CAMP HESS KRAMER & WILLIAM WILSHIRE BOULEVARD TEMPLE CAMPS

PREPARED BY:
Stantec
111 East Victoria Street, Santa Barbara, CA 93101
Phone: (805) 963-9532

PETE SILVA	70,435	9/30/2022
PROJECT ENGINEER	R.C.E.	DATE

REGISTERED PROFESSIONAL ENGINEER PETER A. SILVA NO 70435 CIVIL STATE OF CALIFORNIA

WATER QUALITY TREATMENT PLAN
CAMP HESS KRAMER/GINDLING HILLTOP CAMP WOOLSEY FIRE REBUILD
11495 & 11677 PACIFIC COAST HWY
VENTURA COUNTY, CA

PRELIMINARY

STANTEC PROJECT NO. 2042586200
SHEET 1 OF 10
PLAN DATE 5/01/2021

DESIGN PAS CHECKED HI
42-ENG SAVE DATE: 4/23/2021 8:22:55 AM PLOT BY: DuBoy, Kirby PLOT DATE: 4/26/2021 10:17:33 AM

DRAWING: c:\2042\active\2042586200\drawing\exhibit_files\2042586200_water_treatment_plan.dwg

COPYRIGHT RESERVED: THE CONTRACTOR SHALL VERIFY AND BE RESPONSIBLE FOR ALL DIMENSIONS. DO NOT SCALE THE DRAWING – ANY ERRORS OR OMISSIONS SHALL BE REPORTED TO STANTEC WITHOUT DELAY. THE COPYRIGHTS TO ALL DESIGNS AND DRAWINGS ARE THE PROPERTY OF STANTEC. REPRODUCTION OR USE FOR ANY PURPOSE OTHER THAN THAT AUTHORIZED BY STANTEC IS FORBIDDEN.

BMP LEGEND

- INF-1 INFILTRATION BASIN
- INF-2 INFILTRATION TRENCH
- INF-3 BIORETENTION
- INF-5 PERMEABLE PAVEMENT
- BIO-1 BIORETENTION WITH UNDERDRAIN
- BIO-2 PLANTER BOX
- BIO-3 VEGETATED SWALE
- BIO-4 VEGETATED FILTER STRIP

SEE SHEET 3 FOR CONTINUATION

SEE SHEET 1 FOR CONTINUATION

BUILDING

EXISTING BUILDING TO REMAIN. NO TREATMENT NEEDED.

FF=60.00

FF=50.20

FF=50.00

FF=53.00

TREATMENT 6: INF-3
BIORETENTION
AREA: 225 SF

TREATMENT 5: BIO-2
PLANTER BOX
AREA: 115 SF

TREATMENT 9: BIO-4
VEGETATED FILTER STRIP
AREA: 7,925 SF

TREATMENT 7: INF-1
INFILTRATION BASIN
AREA: 1010 SF

TREATMENT 8: INF-3
BIORETENTION
AREA: 173 SF

TREATMENT 4: INF-3
BIORETENTION
AREA: 277 SF

TREATMENT 3: INF-3
BIORETENTION
AREA: 697 SF

SCALE: 1"=20'
0 20 40 60

NO.	DATE	REVISION BLOCK	APPD.

PREPARED FOR:
CAMP HESS KRAMER GINDLING HILLTOP CAMP
WILSHIRE BOULEVARD
TEMPLE CAMPS

PREPARED BY:
Stantec
111 East Victoria Street, Santa Barbara, CA 93101
Phone: (805) 963-9532
PETE SILVA 70,435 9/30/2022
PROJECT ENGINEER R.C.E. DATE

REGISTERED PROFESSIONAL ENGINEER
PETER A. SILVA
NO 70435
CIVIL
STATE OF CALIFORNIA

WATER QUALITY TREATMENT PLAN
CAMP HESS KRAMER/GINDLING HILLTOP CAMP
WOOLSEY FIRE REBUILD
11495 & 11677 PACIFIC COAST HWY
VENTURA COUNTY, CA

PRELIMINARY

STANTEC PROJECT NO. 2042586200
SHEET 2 OF 10
PLAN DATE 5/01/2021

DESIGN PAS CHECKED HI
42-ENG SAVE DATE: 4/23/2021 8:22:55 AM PLOT BY: DuBoy, Kirby PLOT DATE: 4/26/2021 10:18:11 AM
DRAWING: c:\2042\active\2042586200\drawing\exhibit_files\2042586200_water_treatment_plan.dwg

COPYRIGHT RESERVED: THE CONTRACTOR SHALL VERIFY AND BE RESPONSIBLE FOR ALL DIMENSIONS. DO NOT SCALE THE DRAWING – ANY ERRORS OR OMISSIONS SHALL BE REPORTED TO STANTEC WITHOUT DELAY. THE COPYRIGHTS TO ALL DESIGNS AND DRAWINGS ARE THE PROPERTY OF STANTEC. REPRODUCTION OR USE FOR ANY PURPOSE OTHER THAN THAT AUTHORIZED BY STANTEC IS FORBIDDEN.

BMP LEGEND

- INF-1 INFILTRATION BASIN
- INF-2 INFILTRATION TRENCH
- INF-3 BIORETENTION
- INF-5 PERMEABLE PAVEMENT
- BIO-1 BIORETENTION WITH UNDERDRAIN
- BIO-2 PLANTER BOX
- BIO-3 VEGETATED SWALE
- BIO-4 VEGETATED FILTER STRIP

YERBA BUENA ROAD

60.00'

60.00'

EXISTING BUILDING TO REMAIN. NO TREATMENT NEEDED.

EXISTING BUILDING TO REMAIN. NO TREATMENT NEEDED.

FF=88.40

EXISTING BUILDING TO REMAIN. NO TREATMENT NEEDED

FF=74.00

FF=60.00

FF=109.60

FF=109.30

FF=109.20

FF=108.90

FF=95.80

UPPER FF = 108.00

UPPER FF=108.00
LOWER FF=89.60
BASEMENT FF=79.60

TREATMENT 9: BIO-4
VEGETATED FILTER STRIP
AREA: 7,925 SF

TREATMENT 10: BIO-1
BIORETENTION WITH
UNDERDRAIN
AREA: 848 SF

TREATMENT 11: BIO-4
VEGETATED FILTER
STRIP
AREA: 7,810 SF

TREATMENT 12:
BIO-1 BIORETENTION
WITH UNDERDRAIN
AREA: 1,032 SF

TREATMENT 13: INF-5
PERMEABLE PAVEMENT
AREA: 5,018 SF

TREATMENT 14: BIO-2
PLANTER BOX
AREA: 330 SF

TREATMENT 15: BIO-2
PLANTER BOX
AREA: 159 SF

TREATMENT 16: BIO-2
PLANTER BOX
AREA: 394 SF

TREATMENT 17:
INF-5 PERMEABLE
PAVEMENT
AREA: 391 SF

THIS HALF OF ROOF
WILL DRAIN TO THE
PERMEABLE PAVEMENT
AREA.

HALF ROOF TO
DRAIN TO INF-1
INFILTRATION
BASIN TO THE
SOUTH

TREATMENT 77: INF-1
INFILTRATION BASIN
AREA: 597 SF

LITTLE SYCAMORE CREEK

FRED WOLF
AMPHITHEATER

SEE SHEET 4 FOR CONTINUATION

SEE SHEET 2 FOR CONTINUATION

SCALE: 1"=20'
0 20 40 60

NO.	DATE	REVISION BLOCK	APPD.

PREPARED FOR:
CAMP HESS KRAMER GINDLING HILLTOP CAMP
WILSHIRE BOULEVARD
TEMPLE CAMPS

PREPARED BY:
Stantec
111 East Victoria Street, Santa Barbara, CA 93101
Phone: (805) 963-9532
PETE SILVA — PROJECT ENGINEER — 70,435 R.C.E. — 9/30/2022 DATE

REGISTERED PROFESSIONAL ENGINEER
PETER A. SILVA
NO 70435
CIVIL
STATE OF CALIFORNIA

WATER QUALITY TREATMENT PLAN
CAMP HESS KRAMER/GINDLING HILLTOP CAMP WOOLSEY FIRE REBUILD
11495 & 11677 PACIFIC COAST HWY
VENTURA COUNTY, CA

PRELIMINARY

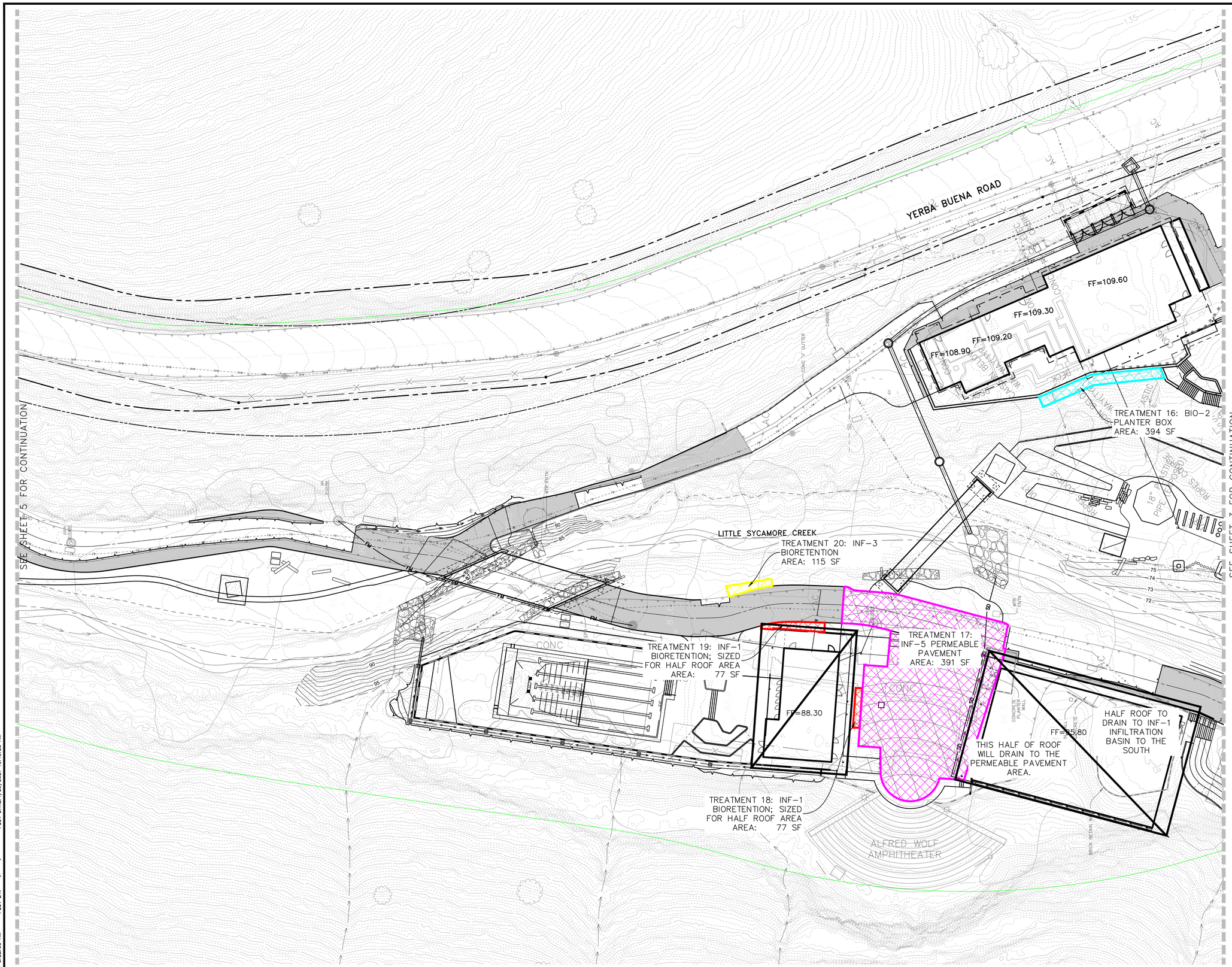
STANTEC PROJECT NO. 2042586200
SHEET 3 OF 10
PLAN DATE 5/01/2021

DESIGN PAS CHECKED HI
42-ENG SAVE DATE: 4/23/2021 8:22:55 AM
PLOT BY: DuBray, Kirby
PLOT DATE: 4/26/2021 10:18:47 AM
DRAWING: v:\2042\active\2042586200\drawing\exhibit_files\2042586200_water_treatment_plan.dwg

COPYRIGHT RESERVED: THE CONTRACTOR SHALL VERIFY AND BE RESPONSIBLE FOR ALL DIMENSIONS. DO NOT SCALE THE DRAWING – ANY ERRORS OR OMISSIONS SHALL BE REPORTED TO STANTEC WITHOUT DELAY. THE COPYRIGHTS TO ALL DESIGNS AND DRAWINGS ARE THE PROPERTY OF STANTEC. REPRODUCTION OR USE FOR ANY PURPOSE OTHER THAN THAT AUTHORIZED BY STANTEC IS FORBIDDEN.

BMP LEGEND

- INF-1 INFILTRATION BASIN
- INF-2 INFILTRATION TRENCH
- INF-3 BIORETENTION
- INF-5 PERMEABLE PAVEMENT
- BIO-1 BIORETENTION WITH UNDERDRAIN
- BIO-2 PLANTER BOX
- BIO-3 VEGETATED SWALE
- BIO-4 VEGETATED FILTER STRIP



SCALE: 1"=20'
0 20 40 60

NO.	DATE	REVISION BLOCK	APPD.

PREPARED FOR: CAMP HESS KRAMER GINDLING HILLTOP CAMP — WILSHIRE BOULEVARD TEMPLE CAMPS

PREPARED BY: Stantec
111 East Victoria Street, Santa Barbara, CA 93101
Phone: (805) 963-9532
PETE SILVA 70,435 9/30/2022
PROJECT ENGINEER R.C.E. DATE
REGISTERED PROFESSIONAL ENGINEER PETER A. SILVA NO 70435 CIVIL STATE OF CALIFORNIA

WATER QUALITY TREATMENT PLAN
CAMP HESS KRAMER/GINDLING HILLTOP CAMP WOOLSEY FIRE REBUILD
11495 & 11677 PACIFIC COAST HWY
VENTURA COUNTY, CA

PRELIMINARY

STANTEC PROJECT NO. 2042586200
SHEET 4 OF 10
PLAN DATE 5/01/2021

DESIGN PAS CHECKED HI
42-ENG SAVE DATE: 4/23/2021 8:22:55 AM PLOT BY: DuBay, Kirby PLOT DATE: 4/26/2021 10:19:25 AM

COPYRIGHT RESERVED: THE CONTRACTOR SHALL VERIFY AND BE RESPONSIBLE FOR ALL DIMENSIONS. DO NOT SCALE THE DRAWING — ANY ERRORS OR OMISSIONS SHALL BE REPORTED TO STANTEC WITHOUT DELAY. THE COPYRIGHTS TO ALL DESIGNS AND DRAWINGS ARE THE PROPERTY OF STANTEC. REPRODUCTION OR USE FOR ANY PURPOSE OTHER THAN THAT AUTHORIZED BY STANTEC IS FORBIDDEN.

DRAWING: v:\2042\active\2042586200\drawing\exhibit_files\2042586200_water_treatment_plan.dwg



BMP LEGEND

- INF-1 INFILTRATION BASIN
- INF-2 INFILTRATION TRENCH
- INF-3 BIORETENTION
- INF-5 PERMEABLE PAVEMENT
- BIO-1 BIORETENTION WITH UNDERDRAIN
- BIO-2 PLANTER BOX
- BIO-3 VEGETATED SWALE
- BIO-4 VEGETATED FILTER STRIP

SCALE: 1"=20'
0 20 40 60

NO.	DATE	REVISION BLOCK	APPD.

PREPARED FOR:
CAMP HESS KRAMER GINDLING HILLTOP CAMP
WILSHIRE BOULEVARD
TEMPLE CAMPS

PREPARED BY:
Stantec
111 East Victoria Street, Santa Barbara, CA 93101
Phone: (805) 963-9532

PETE SILVA	70,435	9/30/2022
PROJECT ENGINEER	R.C.E.	DATE

REGISTERED PROFESSIONAL ENGINEER
PETER A. SILVA
NO 70435
CIVIL
STATE OF CALIFORNIA

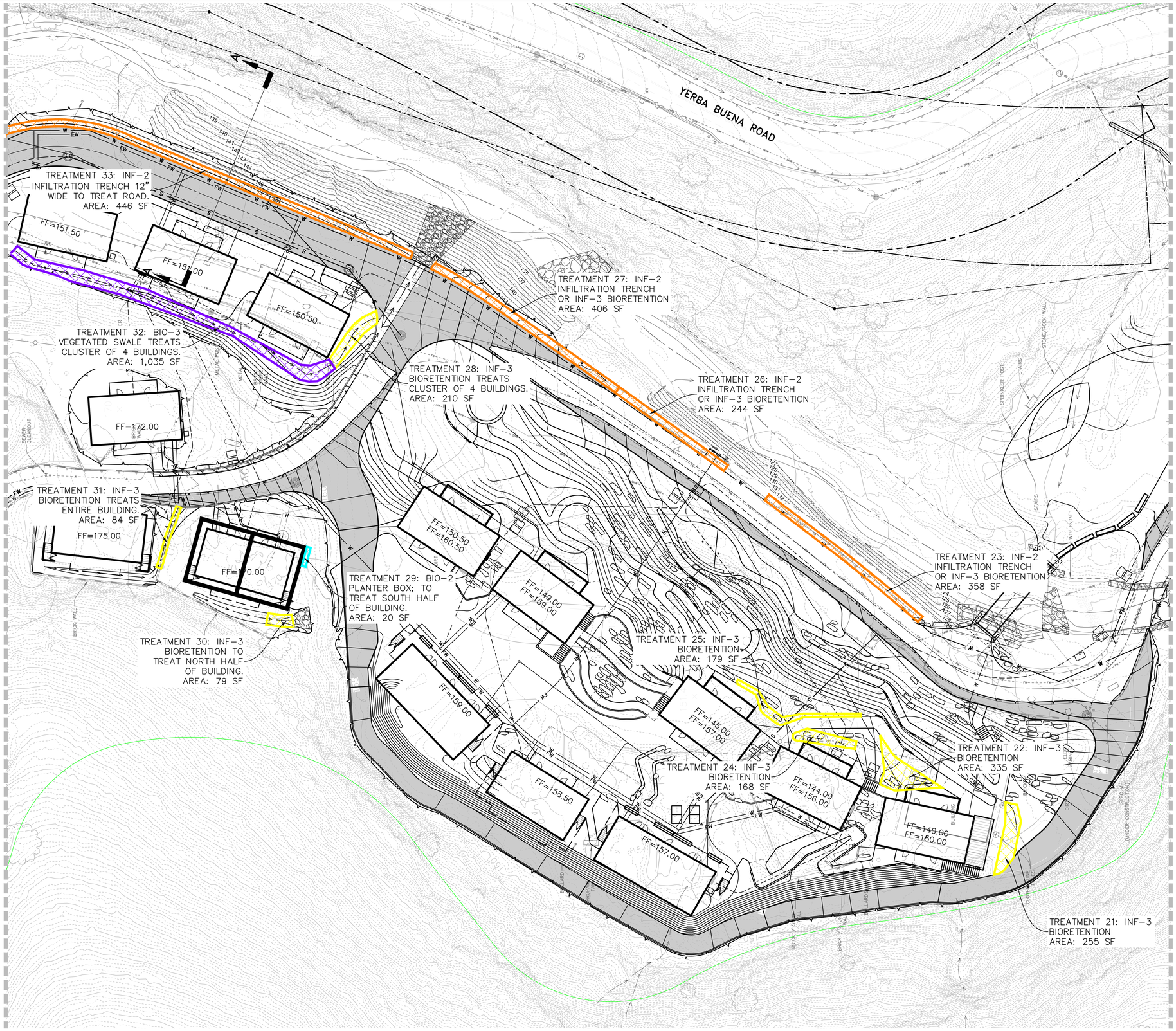
WATER QUALITY TREATMENT PLAN
CAMP HESS KRAMER/GINDLING HILLTOP CAMP WOOLSEY FIRE REBUILD
11495 & 11677 PACIFIC COAST HWY
VENTURA COUNTY, CA

PRELIMINARY

STANTEC PROJECT NO. 2042586200
SHEET 5 OF 10
PLAN DATE 5/01/2021

DESIGN PAS CHECKED HI
42-ENG SAVE DATE: 4/23/2021 8:22:55 AM PLOT BY: DuBoy, Kirby PLOT DATE: 4/26/2021 10:20:01 AM
DRAWING: v:\2042\active\2042586200\drawing\exhibit_files\2042586200_water_treatment_plan.dwg

COPYRIGHT RESERVED: THE CONTRACTOR SHALL VERIFY AND BE RESPONSIBLE FOR ALL DIMENSIONS. DO NOT SCALE THE DRAWING – ANY ERRORS OR OMISSIONS SHALL BE REPORTED TO STANTEC WITHOUT DELAY. THE COPYRIGHTS TO ALL DESIGNS AND DRAWINGS ARE THE PROPERTY OF STANTEC. REPRODUCTION OR USE FOR ANY PURPOSE OTHER THAN THAT AUTHORIZED BY STANTEC IS FORBIDDEN.



BMP LEGEND

- INF-1 INFILTRATION BASIN
- INF-2 INFILTRATION TRENCH
- INF-3 BIORETENTION
- INF-5 PERMEABLE PAVEMENT
- BIO-1 BIORETENTION WITH UNDERDRAIN
- BIO-2 PLANTER BOX
- BIO-3 VEGETATED SWALE
- BIO-4 VEGETATED FILTER STRIP

SCALE: 1"=20'
0 20 40 60

NO.	DATE	REVISION BLOCK	APPD.

PREPARED FOR: CAMP HESS KRAMER GINDLING HILLTOP CAMP — WILSHIRE BOULEVARD TEMPLE CAMPS

PREPARED BY: Stantec
111 East Victoria Street, Santa Barbara, CA 93101
Phone: (805) 963-9532

PETE SILVA	70,435	9/30/2022
PROJECT ENGINEER	R.C.E.	DATE

REGISTERED PROFESSIONAL ENGINEER — PETER A. SILVA — NO 70435 — CIVIL — STATE OF CALIFORNIA

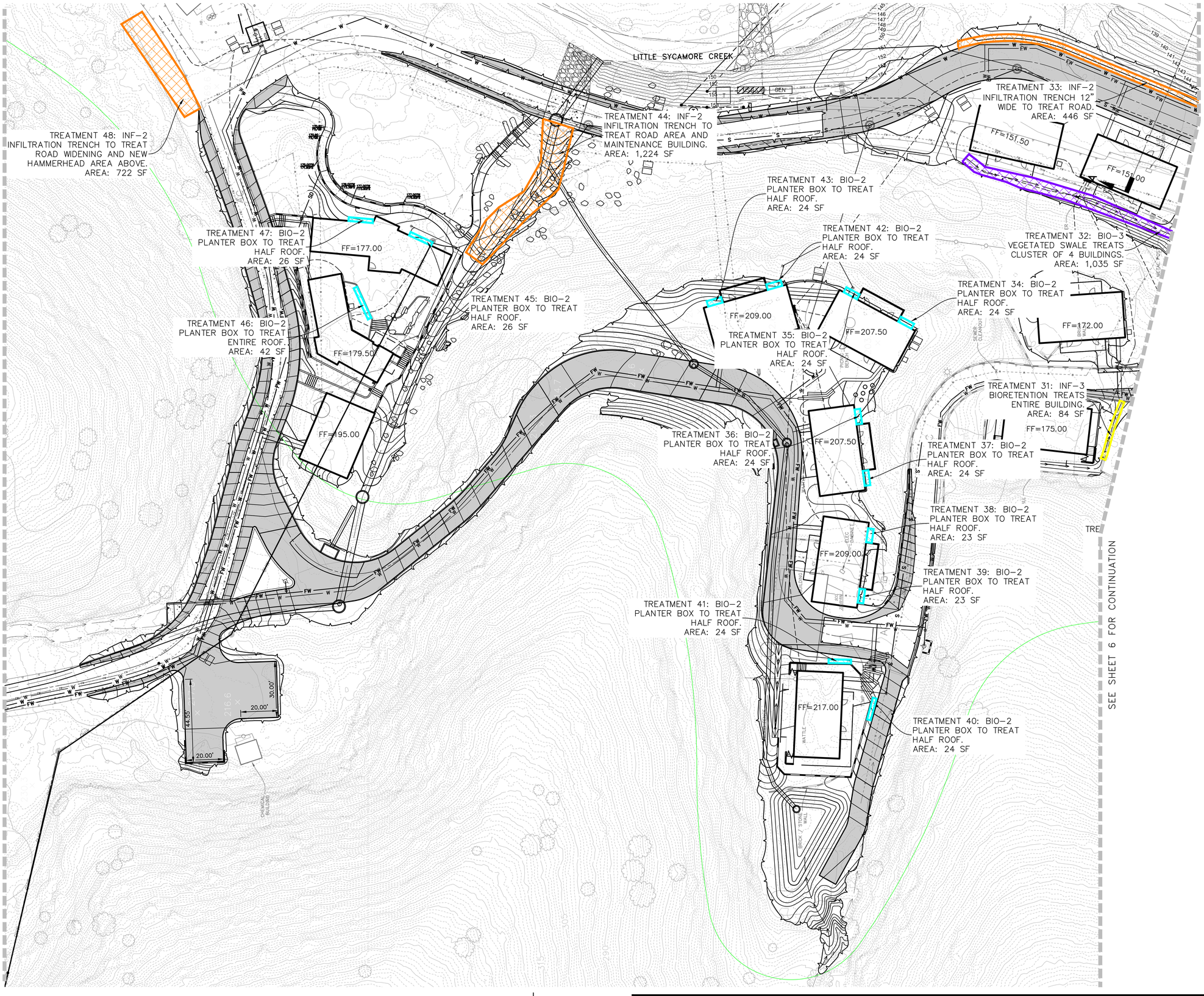
WATER QUALITY TREATMENT PLAN
CAMP HESS KRAMER/GINDLING HILLTOP CAMP WOOLSEY FIRE REBUILD
11495 & 11677 PACIFIC COAST HWY
VENTURA COUNTY, CA

PRELIMINARY

STANTEC PROJECT NO. 2042586200
SHEET 6 OF 10
PLAN DATE 5/01/2021

DESIGN PAS CHECKED HI
42-ENG SAVE DATE: 4/23/2021 8:22:55 AM PLOT BY: DuBoy, Kirby PLOT DATE: 4/26/2021 10:20:41 AM
DRAWING: x:\2042\active\2042586200\drawing\exhibit_files\2042586200_water_treatment_plan.dwg

COPYRIGHT RESERVED: THE CONTRACTOR SHALL VERIFY AND BE RESPONSIBLE FOR ALL DIMENSIONS. DO NOT SCALE THE DRAWING – ANY ERRORS OR OMISSIONS SHALL BE REPORTED TO STANTEC WITHOUT DELAY. THE COPYRIGHTS TO ALL DESIGNS AND DRAWINGS ARE THE PROPERTY OF STANTEC. REPRODUCTION OR USE FOR ANY PURPOSE OTHER THAN THAT AUTHORIZED BY STANTEC IS FORBIDDEN.



BMP LEGEND

- INF-1 INFILTRATION BASIN
- INF-2 INFILTRATION TRENCH
- INF-3 BIORETENTION
- INF-5 PERMEABLE PAVEMENT
- BIO-1 BIORETENTION WITH UNDERDRAIN
- BIO-2 PLANTER BOX
- BIO-3 VEGETATED SWALE
- BIO-4 VEGETATED FILTER STRIP

SCALE: 1"=20'
0 20 40 60

NO.	DATE	REVISION BLOCK	APPD.

PREPARED FOR:
CAMP HESS KRAMER GINDLING HILLTOP CAMP
WILSHIRE BOULEVARD
TEMPLE CAMPS

PREPARED BY:
Stantec
111 East Victoria Street, Santa Barbara, CA 93101
Phone: (805) 963-9532
PETE SILVA 70,435 9/30/2022
PROJECT ENGINEER R.C.E. DATE

REGISTERED PROFESSIONAL ENGINEER PETER A. SILVA NO 70435 CIVIL STATE OF CALIFORNIA

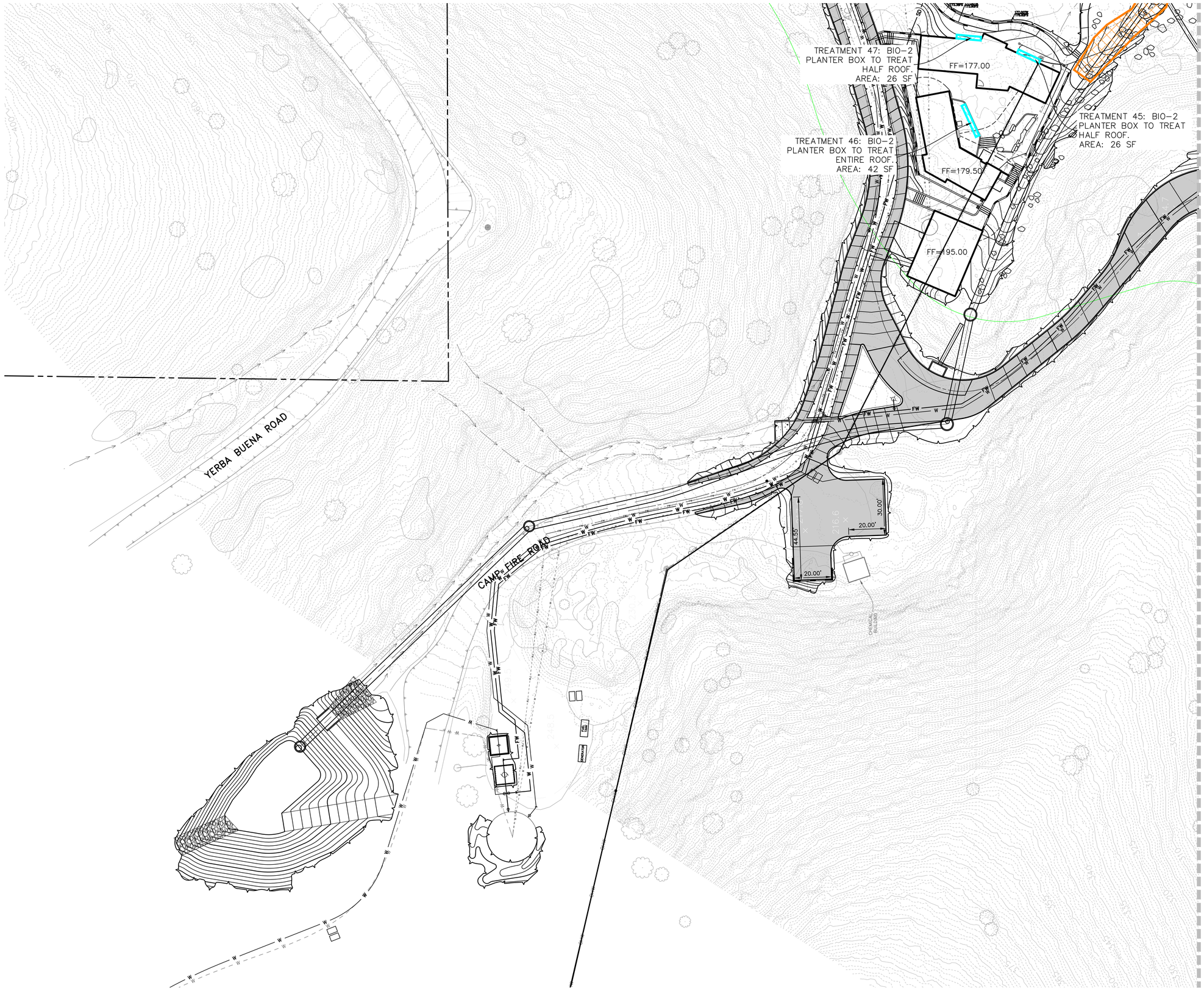
WATER QUALITY TREATMENT PLAN
CAMP HESS KRAMER/GINDLING HILLTOP CAMP
WOOLSEY FIRE REBUILD
11495 & 11677 PACIFIC COAST HWY
VENTURA COUNTY, CA

PRELIMINARY

STANTEC PROJECT NO. 2042586200
SHEET 7 OF 10
PLAN DATE 5/01/2021

DESIGN PAS CHECKED HI
42-ENG SAVE DATE: 4/23/2021 8:22:55 AM PLOT BY: DuBay, Kirby PLOT DATE: 4/26/2021 10:21:19 AM
DRAWING: v:\2042\active\2042586200\drawing\exhibit_files\2042586200_water_treatment_plan.dwg

COPYRIGHT RESERVED: THE CONTRACTOR SHALL VERIFY AND BE RESPONSIBLE FOR ALL DIMENSIONS. DO NOT SCALE THE DRAWING – ANY ERRORS OR OMISSIONS SHALL BE REPORTED TO STANTEC WITHOUT DELAY. THE COPYRIGHTS TO ALL DESIGNS AND DRAWINGS ARE THE PROPERTY OF STANTEC. REPRODUCTION OR USE FOR ANY PURPOSE OTHER THAN THAT AUTHORIZED BY STANTEC IS FORBIDDEN.



BMP LEGEND

- INF-1 INFILTRATION BASIN
- INF-2 INFILTRATION TRENCH
- INF-3 BIORETENTION
- INF-5 PERMEABLE PAVEMENT
- BIO-1 BIORETENTION WITH UNDERDRAIN
- BIO-2 PLANTER BOX
- BIO-3 VEGETATED SWALE
- BIO-4 VEGETATED FILTER STRIP

NO.	DATE	REVISION BLOCK	APPD.

PREPARED FOR:
CAMP HESS KRAMER · GINDLING HILLTOP CAMP
WILSHIRE BOULEVARD
TEMPLE CAMPS

PREPARED BY:
Stantec
111 East Victoria Street, Santa Barbara, CA 93101
Phone: (805) 963-9532
PETE SILVA 70,435 9/30/2022
PROJECT ENGINEER R.C.E. DATE

REGISTERED PROFESSIONAL ENGINEER · PETER A. SILVA · NO 70435 · CIVIL · STATE OF CALIFORNIA

WATER QUALITY TREATMENT PLAN
CAMP HESS KRAMER/GINDLING HILLTOP CAMP WOOLSEY FIRE REBUILD
11495 & 11677 PACIFIC COAST HWY
VENTURA COUNTY, CA

PRELIMINARY

STANTEC PROJECT NO. 2042586200
SHEET 8 OF 10
PLAN DATE 5/01/2021

COPYRIGHT RESERVED: THE CONTRACTOR SHALL VERIFY AND BE RESPONSIBLE FOR ALL DIMENSIONS. DO NOT SCALE THE DRAWING – ANY ERRORS OR OMISSIONS SHALL BE REPORTED TO STANTEC WITHOUT DELAY. THE COPYRIGHTS TO ALL DESIGNS AND DRAWINGS ARE THE PROPERTY OF STANTEC. REPRODUCTION OR USE FOR ANY PURPOSE OTHER THAN THAT AUTHORIZED BY STANTEC IS FORBIDDEN.

DESIGN PAS CHECKED HI
42-ENG SAVE DATE: 4/23/2021 8:22:55 AM PLOT BY: DuBay, Kirby PLOT DATE: 4/26/2021 10:22:01 AM
DRAWING: v:\2042\active\2042586200\drawing\exhibit_files\2042586200_water_treatment_plan.dwg

SEE SHEET 10 FOR CONTINUATION

BMP LEGEND

- INF-1 INFILTRATION BASIN
- INF-2 INFILTRATION TRENCH
- INF-3 BIORETENTION
- INF-5 PERMEABLE PAVEMENT
- BIO-1 BIORETENTION WITH UNDERDRAIN
- BIO-2 PLANTER BOX
- BIO-3 VEGETATED SWALE
- BIO-4 VEGETATED FILTER STRIP

TREATMENT 62: BIO-2 PLANTER BOX TO TREAT HALF OF BUILDING. AREA: 20 SF

TREATMENT 59: BIO-2 PLANTER BOX TO TREAT HALF OF BUILDING. AREA: 20 SF

TREATMENT 54: BIO-2 PLANTER BOX TO TREAT HALF OF BUILDING. AREA: 18 SF

TREATMENT 56: BIO-2 PLANTER BOX TO TREAT HALF OF BUILDING. AREA: 20 SF

TREATMENT 55: BIO-2 PLANTER BOX TO TREAT HALF OF BUILDING. AREA: 20 SF

TREATMENT 60: BIO-2 PLANTER BOX TO TREAT HALF OF BUILDING. AREA: 20 SF

TREATMENT 63: BIO-2 PLANTER BOX TO TREAT HALF OF BUILDING. AREA: 20 SF

TREATMENT 50: BIO-2 PLANTER BOX TO TREAT ENTIRE BUILDING. AREA: 20 SF

TREATMENT 51: BIO-2 PLANTER BOX TO TREAT ENTIRE BUILDING. AREA: 6 SF

TREATMENT 57: BIO-2 PLANTER BOX TO TREAT HALF OF BUILDING. AREA: 24 SF

TREATMENT 61: BIO-2 PLANTER BOX TO TREAT HALF OF BUILDING. AREA: 73 SF

TREATMENT 58: BIO-2 PLANTER BOX TO TREAT HALF OF BUILDING. AREA: 24 SF

TREATMENT 52: BIO-2 PLANTER BOX TO TREAT HALF OF BUILDING. AREA: 147 SF

TREATMENT 64: BIO-2 PLANTER BOX TO TREAT HALF OF BUILDING. AREA: 73 SF

TREATMENT 53: BIO-2 PLANTER BOX TO TREAT HALF OF BUILDING. AREA: 147 SF

TREATMENT 49: BIO-2 PLANTER BOX TO TREAT ENTIRE BUILDING. AREA: 51 SF

SHED C

SHED D

SHED E

SHED E1

SCALE: 1"=20'

0 20 40 60

NO.	DATE	REVISION BLOCK	APPD.

PREPARED FOR: CAMP HESS KRAMER GINDLING HILLTOP CAMP — WILSHIRE BOULEVARD TEMPLE CAMPS

PREPARED BY: Stantec
111 East Victoria Street, Santa Barbara, CA 93101
Phone: (805) 963-9532

PETE SILVA	70,435	9/30/2022
PROJECT ENGINEER	R.C.E.	DATE

REGISTERED PROFESSIONAL ENGINEER — PETER A. SILVA — NO 70435 — CIVIL — STATE OF CALIFORNIA

WATER QUALITY TREATMENT PLAN
CAMP HESS KRAMER/GINDLING HILLTOP CAMP
WOOLSEY FIRE REBUILD
11495 & 11677 PACIFIC COAST HWY
VENTURA COUNTY, CA

PRELIMINARY

STANTEC PROJECT NO. 2042586200
SHEET 9 OF 10
PLAN DATE 5/01/2021

DESIGN PAS CHECKED HI
42-ENG SAVE DATE: 4/23/2021 8:22:55 AM PLOT BY:DuBay, Kirby PLOT DATE:4/26/2021 10:22:36 AM

COPYRIGHT RESERVED: THE CONTRACTOR SHALL VERIFY AND BE RESPONSIBLE FOR ALL DIMENSIONS. DO NOT SCALE THE DRAWING – ANY ERRORS OR OMISSIONS SHALL BE REPORTED TO STANTEC WITHOUT DELAY. THE COPYRIGHTS TO ALL DESIGNS AND DRAWINGS ARE THE PROPERTY OF STANTEC. REPRODUCTION OR USE FOR ANY PURPOSE OTHER THAN THAT AUTHORIZED BY STANTEC IS FORBIDDEN.

DRAWING:v:\2042\active\2042586200\drawing\exhibit_files\2042586200_water_treatment_plan.dwg

BMP LEGEND

- INF-1 INFILTRATION BASIN
- INF-2 INFILTRATION TRENCH
- INF-3 BIORETENTION
- INF-5 PERMEABLE PAVEMENT
- BIO-1 BIORETENTION WITH UNDERDRAIN
- BIO-2 PLANTER BOX
- BIO-3 VEGETATED SWALE
- BIO-4 VEGETATED FILTER STRIP

TREATMENT 65: BIO-2 PLANTER BOX TO TREAT HALF ROOF FOR CLUSTER OF FOUR BUILDINGS. AREA: 20 SF

TREATMENT 67: BIO-2 PLANTER BOX TO TREAT HALF ROOF FOR CLUSTER OF FOUR BUILDINGS. AREA: 20 SF

TREATMENT 68: BIO-2 PLANTER BOX TO TREAT HALF ROOF FOR CLUSTER OF FOUR BUILDINGS. AREA: 20 SF

TREATMENT 70: BIO-2 PLANTER BOX TO TREAT HALF ROOF FOR CLUSTER OF FOUR BUILDINGS. AREA: 20 SF

TREATMENT 66: BIO-2 PLANTER BOX TO TREAT HALF ROOF FOR CLUSTER OF FOUR BUILDINGS. AREA: 20 SF

TREATMENT 72: BIO-2 PLANTER BOX TO TREAT HALF ROOF FOR CLUSTER OF FOUR BUILDINGS. AREA: 20 SF

TREATMENT 69: BIO-2 PLANTER BOX TO TREAT HALF ROOF FOR CLUSTER OF FOUR BUILDINGS. AREA: 20 SF

TREATMENT 71: BIO-2 PLANTER BOX TO TREAT HALF ROOF FOR CLUSTER OF FOUR BUILDINGS. AREA: 20 SF

SHED B

TREATMENT 73: BIO-2 PLANTER BOX TO TREAT HALF ROOF FOR CLUSTER OF TWO BUILDINGS. AREA: 55 SF

TREATMENT 75: BIO-2 PLANTER BOX TO TREAT HALF ROOF FOR CLUSTER OF TWO BUILDINGS. AREA: 55 SF

TREATMENT 74: BIO-2 PLANTER BOX TO TREAT HALF ROOF FOR CLUSTER OF TWO BUILDINGS. AREA: 55 SF

TREATMENT 76: BIO-2 PLANTER BOX TO TREAT HALF ROOF FOR CLUSTER OF TWO BUILDINGS. AREA: 55 SF

SEE SHEET 9 FOR CONTINUATION

SCALE: 1"=20'
0 20 40 60

NO.	DATE	REVISION BLOCK	APPD.

PREPARED FOR: CAMP HESS KRAMER & GINDLING HILLTOP CAMP — WILSHIRE BOULEVARD TEMPLE CAMPS

PREPARED BY: Stantec
111 East Victoria Street, Santa Barbara, CA 93101
Phone: (805) 963-9532
PETE SILVA — PROJECT ENGINEER — 70,435 R.C.E. — 9/30/2022 DATE

REGISTERED PROFESSIONAL ENGINEER — PETER A. SILVA — NO 70435 — CIVIL — STATE OF CALIFORNIA

WATER QUALITY TREATMENT PLAN
CAMP HESS KRAMER/GINDLING HILLTOP CAMP WOOLSEY FIRE REBUILD
11495 & 11677 PACIFIC COAST HWY
VENTURA COUNTY, CA

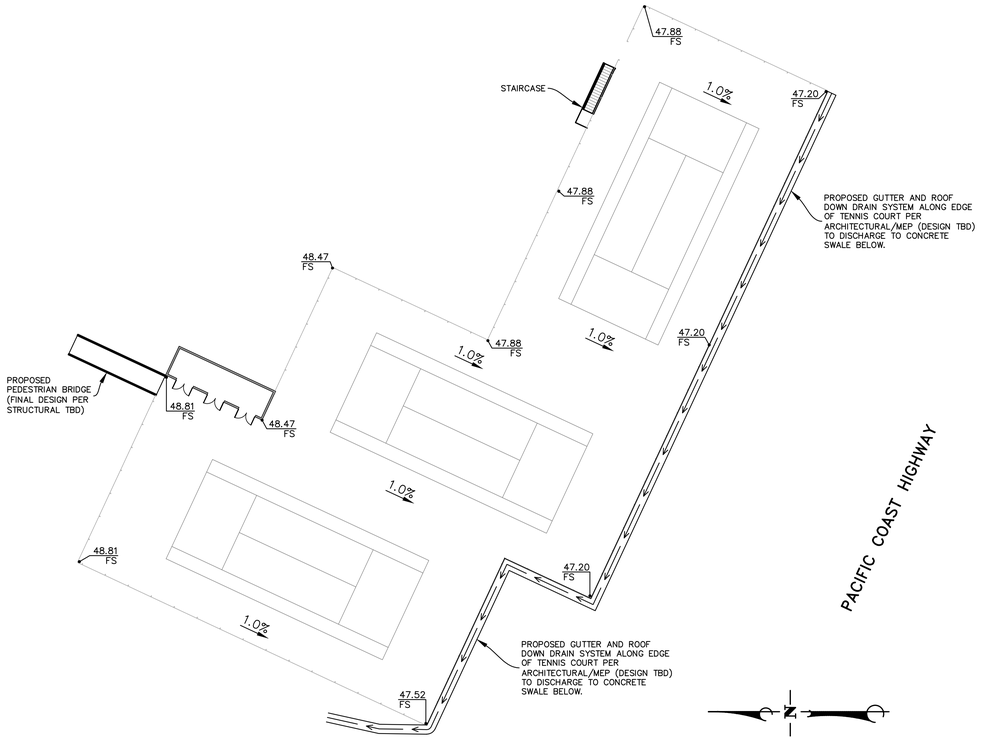
PRELIMINARY

STANTEC PROJECT NO. 2042586200
SHEET 10 OF 10
PLAN DATE 5/01/2021

DESIGN PAS CHECKED HI
42-ENG SAVE DATE: 4/23/2021 8:22:55 AM PLOT BY:DuBay, Kirby PLOT DATE:4/26/2021 10:23:09 AM

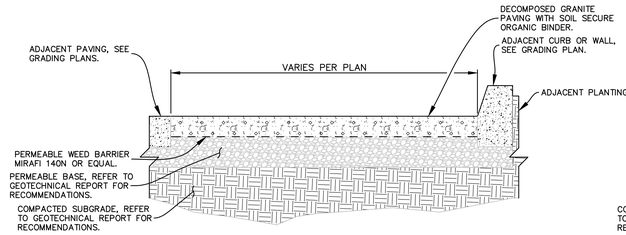
DRAWING:v:\2042\active\2042586200\drawing\exhibit_files\2042586200_water_treatment_plan.dwg

COPYRIGHT RESERVED: THE CONTRACTOR SHALL VERIFY AND BE RESPONSIBLE FOR ALL DIMENSIONS. DO NOT SCALE THE DRAWING – ANY ERRORS OR OMISSIONS SHALL BE REPORTED TO STANTEC WITHOUT DELAY. THE COPYRIGHTS TO ALL DESIGNS AND DRAWINGS ARE THE PROPERTY OF STANTEC. REPRODUCTION OR USE FOR ANY PURPOSE OTHER THAN THAT AUTHORIZED BY STANTEC IS FORBIDDEN.



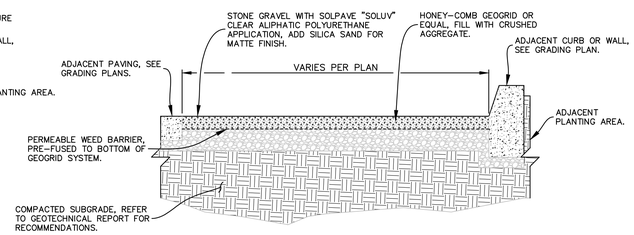
TENNIS COURTS DRAINAGE — A C58

SCALE: 1" = 20'



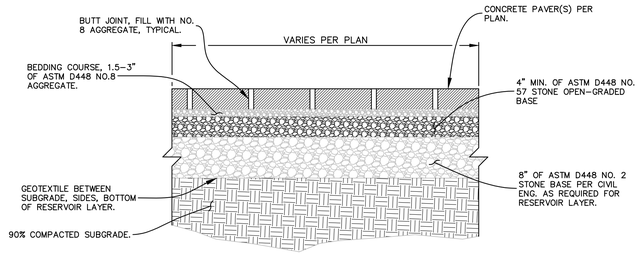
STABILIZED DECOMPOSED GRANITE PAVING — B C58

SCALE: 1" = 1'



STABILIZED STONE GRAVEL — C C58

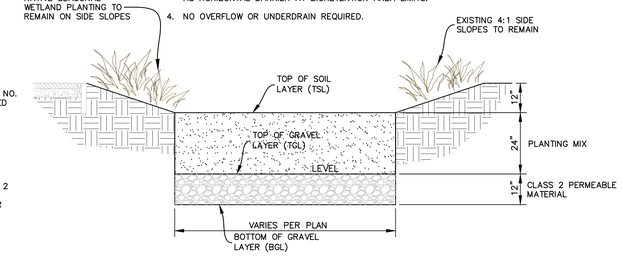
SCALE: 1" = 1'



PERMEABLE CONCRETE PAVER — D C58

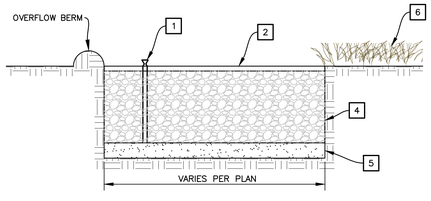
SCALE: 1" = 1'

1. NO LINER, FILTER FABRIC, OR LANDSCAPE CLOTH ARE TO BE USED IN THE BIORETENTION FACILITY.
2. PLANTING MIX CONSISTING OF 60 TO 70% FINE SAND PER ASTM C33 FINE AGGREGATE AND 30-40% COMPOST CERTIFIED THROUGH THE US COMPOSTING COUNCIL. PLANTING ON SURFACE PER LANDSCAPE ARCHITECT.
3. USE LANDSCAPE ARCHITECT APPROVED MATERIAL (PLYWOOD OR EQUAL) AS HORIZONTAL BARRIER AT BIORETENTION AREA LIMITS.
4. NO OVERFLOW OR UNDERDRAIN REQUIRED.



TYPICAL SECTION (INF-3: BIORETENTION) — E C58

NOT TO SCALE



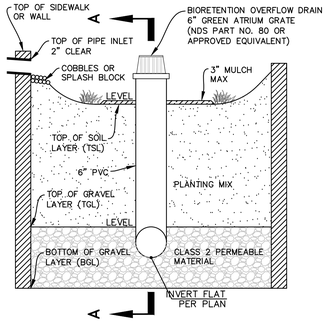
DETAIL NOTES

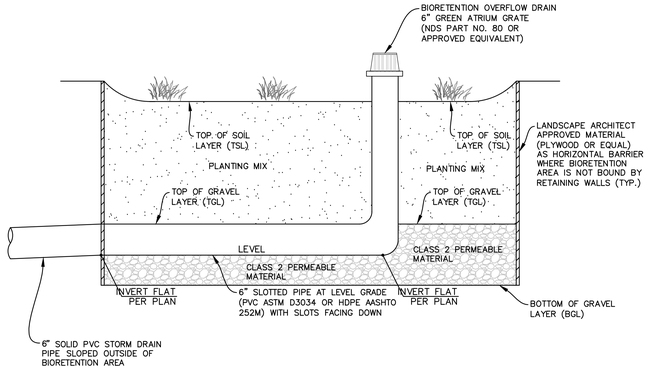
1. OBSERVATION WELL WITH LOCKABLE ABOVE-GROUND CAP.
2. 2" PEA GRAVEL FILTER LAYER.
3. MINIMUM 10' ABOVE SEASONAL HIGH GROUNDWATER TABLE AND 3' ABOVE BEDROCK.
4. 3' – 5' DEEP TRENCH FILLED WITH 2" – 6" DIAMETER CLEAN STONE WITH 30% – 40% VOIDS.
5. 6" DEEP SAND FILTER LAYER (OR FABRIC EQUIVALENT).
6. RUNOFF FILTERS THROUGH GRASS FILTER STRIP OR VEGETATED SWALE.
7. OPTIONAL FLOW CONTROL DEVICE FOR OFF-LINE CONFIGURATIONS.

TYPICAL SECTION (INF-2: INFILTRATION TRENCH) — F C58

NOT TO SCALE

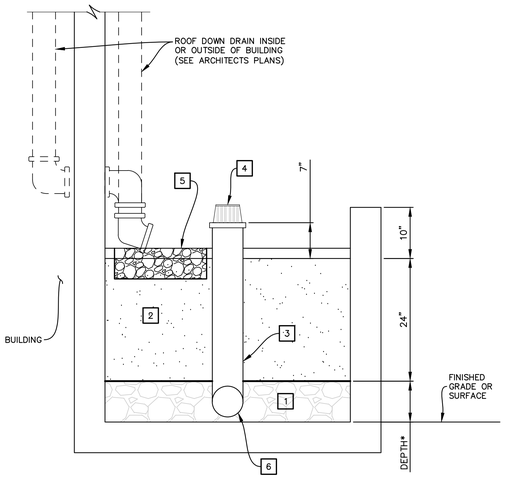
1. NO LINER, FILTER FABRIC, OR LANDSCAPE CLOTH ARE TO BE USED IN THE BIORETENTION FACILITY.
2. CLASS 2 PERMEABLE MATERIAL LAYER MAY EXTEND BELOW AND UNDERNEATH DROP INLET.
3. PLANTING MIX CONSISTING OF 60 TO 70% FINE SAND PER ASTM C33 FINE AGGREGATE AND 30-40% COMPOST CERTIFIED THROUGH THE US COMPOSTING COUNCIL. PLANTING ON SURFACE PER LANDSCAPE ARCHITECT.
4. USE LANDSCAPE ARCHITECT APPROVED MATERIAL (PLYWOOD OR EQUAL) AS HORIZONTAL BARRIER WHERE BIORETENTION AREA IS NOT BOUND BY RETAINING WALLS.
5. OK TO SLOPE SOIL MIX AGAINST CURB/EDGE OF WALKWAY TO REDUCE DROP-OFF. AND/OR USE PLANTINGS TO DISCOURAGE ENTRY.
6. PIPE INLET SIZE VARIES FROM ROOF DOWNDRAINS (ARCHITECT) AND TRENCH DRAIN PIPE (PLUMBING ENGINEER OR MEP).





TYPICAL SECTION (BIO-1: BIORETENTION W/ UNDERDRAIN) — G C58

SCALE: 1" = 1'



DETAIL NOTES

1. PLACE CLEANED, CRUSHED, ANGULAR, NO. 4 (AASHTO M43) STONE.
2. CONSTRUCT SOIL MIX CONSISTING OF 60 TO 70% FINE SAND PER ASTM C33 FINE AGGREGATE AND 30-40% COMPOST CERTIFIED THROUGH THE US COMPOSTING COUNCIL.
3. CONSTRUCT 6" SOLID PVC PIPE.
4. CONSTRUCT 6" GREEN ATRIUM GRATE (NDS PART NO. 80 OR APPROVED EQUIVALENT).
5. CONSTRUCT 18"x18" SPLASH BLOCK WITH 2" MINIMUM DIAMETER ROCK.
6. CONSTRUCT 6" DIAMETER PVC PERFORATED PIPE.

TYPICAL SECTION (BIO-2: PLANTER BOX) — H C58

SCALE: 1" = 1'

NO.	DATE	REVISION BLOCK	APPD.

PREPARED FOR: CAMP HESS KRAMER & GINDLING HILLTOP CAMP — WILSHIRE BOULEVARD TEMPLE CAMPS

PREPARED BY:
Stantec
111 East Victoria Street, Santa Barbara, CA 93101
Phone: (805) 963-9532
PETE SILVA 70,435 9/30/2022
PROJECT ENGINEER R.C.E. DATE

REGISTERED PROFESSIONAL ENGINEER — PETER A. SILVA — NO 70435 — CIVIL — STATE OF CALIFORNIA

DETAILS
CAMP HESS KRAMER/GINDLING HILLTOP CAMP
WOOLSEY FIRE REBUILD
11495 & 11677 PACIFIC COAST HWY
VENTURA COUNTY, CA

PREL[illegible]RY

STANTEC PROJECT NO. 2042586200
SHEET C58 OF C67
PLAN DATE 5/01/2021

DESIGN PAS CHECKED HI
42-ENG SAVE DATE: 4/23/2021 10:44:40 AM PLOT BY:Silva, Pete PLOT DATE:4/23/2021 10:57:50 AM
DRAWING:v:\2042\active\2042586200\drawing\exhibit_files\2042586200_details.dwg

COPYRIGHT RESERVED: THE CONTRACTOR SHALL VERIFY AND BE RESPONSIBLE FOR ALL DIMENSIONS. DO NOT SCALE THE DRAWING – ANY ERRORS OR OMISSIONS SHALL BE REPORTED TO STANTEC WITHOUT DELAY. THE COPYRIGHTS TO ALL DESIGNS AND DRAWINGS ARE THE PROPERTY OF STANTEC. REPRODUCTION OR USE FOR ANY PURPOSE OTHER THAN THAT AUTHORIZED BY STANTEC IS FORBIDDEN.

Tech Spec Guide

icpi
Interlocking Concrete Pavement Institute®

Your requested ICPI Tech Spec 18 follows this page.

Design and Installation Professionals frequently turn to interlocking concrete pavements and permeable interlocking concrete pavements because they offer lower initial and life cycle costs and provide environmentally sustainable solutions.

ICPI provides resources for ICP and PICP design, construction, and maintenance. These include: Tech Specs, Guide Specs, Detail Drawings, Construction Tolerance Guides, Fact Sheets, Design Manuals and design software. ICPI also offers several relevant continuing education courses at icpi.org and aecdaily.com

Find the right guide for your location.

Many ICPI members subscribe by state or province to this Tech Spec service to support the development and revision of these technical documents. The ICPI website Technical Center offers the opportunity to select Tech Specs by state or province.

This ICPI Tech Spec is provided courtesy of

Acker-Stone
800-258-2353 www.ackerstone.com

https://icpi.org/acker-stoneindustries

ICPI Tech Spec Library

- Tech Spec 1: Glossary of Terms for Segmental Concrete Pavement
- Tech Spec 2: Construction of Interlocking Concrete Pavements
- Tech Spec 3: Edge Restraints for Interlocking Concrete Pavements
- Tech Spec 4: Structural Design of Interlocking Concrete Pavement for Roads and Parking Lots
- Tech Spec 5: Cleaning, Sealing and Joint Sand Stabilization of Interlocking Concrete Pavement
- Tech Spec 6: Reinstatement of Interlocking Concrete Pavements
- Tech Spec 7: Repair of Utility Cuts Using Interlocking Concrete Pavements
- Tech Spec 8: Concrete Grid Pavements
- Tech Spec 9: Guide Specification for the Construction of Interlocking Concrete Pavement
- Tech Spec 10: Application Guide for Interlocking Concrete Pavements
- Tech Spec 11: Mechanical Installation of Interlocking Concrete Pavements
- Tech Spec 12: Snow Melting Systems for Interlocking Concrete Pavements
- Tech Spec 13: Slip and Skid Resistance of Interlocking Concrete Pavements
- Tech Spec 14: Concrete Paving Units
- Tech Spec 15: A Guide for the Construction of Mechanically Installed Interlocking Concrete Pavements
- Tech Spec 16: Achieving LEED Credits with Segmental Concrete Pavement
- Tech Spec 17: Bedding Sand Selection for Interlocking Concrete Pavements in Vehicular Applications
- Tech Spec 18: Construction of Permeable Interlocking Concrete Pavement Systems
- Tech Spec 19: Design, Construction and Maintenance of Interlocking Concrete Pavement Crosswalks
- Tech Spec 20: Construction of Bituminous- Sand Set Interlocking Concrete Pavement
- Tech Spec 21: Capping and Compression Strength Testing Procedures for Concrete Pavers
- Tech Spec 22: Geosynthetics for Segmental Concrete Pavements
- Tech Spec 23: Maintenance Guide for Permeable Interlocking Concrete Pavements
- Tech Spec 25: Construction Guidelines for Segmental Concrete Paving Slabs and Planks in Non-Vehicular Residential Applications

© 2020, Interlocking Concrete Pavement Institute

Tech Spec 18

icpi
Interlocking Concrete Pavement Institute®

Construction of Permeable Interlocking Concrete Pavement Systems

INTRODUCTION

Permeable interlocking concrete pavement (PICP) is recognized by federal and state stormwater and transportation agencies as a Best Management Practice (BMP) and Low Impact Development (LID) tool to reduce runoff and water pollution. In addition, PICP offers unique design opportunities for addressing combined sewer overflows with green alleys and streets, as well as use in parking lot and pedestrian surfaces. Traditional stormwater management solutions focus on collecting, concentrating and centralizing the disposal of stormwater. As a key BMP and LID tool, PICP helps disconnect, decentralize and more widely distribute runoff through infiltration, detention, filtering and treatment.

The Interlocking Concrete Pavement Institute (ICPI) provides a comprehensive, 92-page manual entitled *Permeable Interlocking Concrete Pavements,* which covers design, specifications, construction and maintenance. This manual is available on www.icpi.org and provides extensive information from academic research and practical field experience. This *Tech Spec* bulletin provides a summary of PICP construction techniques outlined in the manual, as well as further guidance on best construction practices. This bulletin is intended for contractors and for project inspectors.

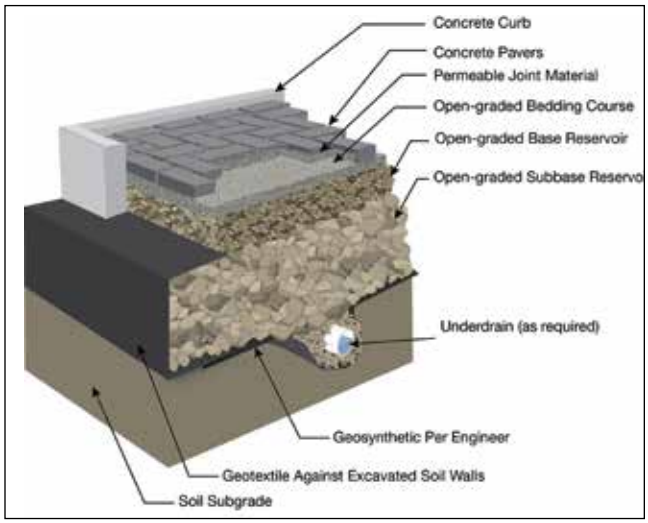


Figure 1. PICP typical cross section.

Figure 1 illustrates a typical PICP cross-section with the individual components defined below.

Concrete pavers—Solid concrete pavers with molded joints and/or openings that create an open area across the pavement surface. Concrete pavers should conform to ASTM C936 (ASTM 2012) in the U.S. or CSA A231.2 (CSA 2006) in Canada. Pavers are typically a minimum of 3 1/8 in. (80 mm) thick for vehicular areas and pedestrian areas may use 2 3/8 in. (60 mm) thick units. Pavers are manufactured in a range of shapes and colors. Filled with permeable joint material, the openings allow water from storm events to freely infiltrate through the pavement surface. Figure 2 shows several paver configurations.

Permeable Joint Material—The joint material typically consists of angular ASTM No. 8, 89 or 9 stone. The permeable joints allow stormwater to infiltrate through joints in the pavement surface.

Open-graded bedding course—This permeable layer is typically placed as a 2 in. (50 mm) thick lift and provides a setting bed for the pavers. It consists of small-sized, open-graded angular aggregate, typically ASTM No. 8 stone or similar sized material. After compaction this lift will consolidate slightly.

Open-graded base reservoir—This is an aggregate layer that is typically 4 in. (100 mm) thick (for vehicular applications see exception under sub-base definition). The base material is made of crushed stones primarily 1 in. down to 1/2 in. (25 mm down to 13 mm). For pedestrian application the base layer is a minimum of 6 in. (150 mm) and the subbase may be omitted. Besides providing water storage capacity in the spaces among the stones, this highly permeable material also serves as a choking layer between the bedding and subbase layers. The stone size is typically ASTM No. 57 or similar sized material.

© 2013 ICPI Tech Spec No. 18 • Interlocking Concrete Pavement Institute • All rights reserved. Revised March 2019



Figure 2. Various types of paving units used in PICP

Open-graded subbase reservoir—The stone sizes are larger than the base, primarily 3 in. down to 2 in. (75 mm down to 50 mm), typically ASTM No. 2, 3 or 4 stone. Like the base layer, water is stored in the spaces among the stones. The subbase layer thickness depends on water storage requirements and traffic loads. A subbase layer may not be required in pedestrian or residential driveway applications. In such instances, the base layer thickness is increased to provide water storage and support.

Underdrain (as required)—Where PICP is installed over low-infiltration soils, underdrains facilitate water removal from the base and subbase. The underdrains are perforated pipes that drain to a swale or stream, or connect to an outlet structure. Another option to which underdrains connect is plastic or concrete vaults or plastic crates. These can store significant amounts of runoff.

Geotextile (design option per engineer)—This functions primarily as a separation material between the subbase and subgrade by preventing the migration of soil into the aggregate subbase or base. Geotextiles are required along the sides of most PICP applications.

Subgrade Soil—This is the layer of soil immediately beneath the aggregate base or subbase. The infiltration rate of the saturated subgrade determines how much water can drain from the aggregate into the underlying soils. The subgrade soil is generally not compacted as this can substantially reduce soil infiltration. However, some poorly draining clay soils are often compacted to help ensure structural stability especially when saturated. Since compaction reduces infiltration, managing the excess water must be considered in the hydrologic design via the base/subbase thickness and use of perforated pipe underdrains.

BENEFITS

PICP offers a number of benefits compared to other common pavement systems.

Construction

- Immediately ready for traffic upon completion, no additional time needed for curing
- Can be installed in cold weather if subgrade and aggregates remain unfrozen
- Capable of wet weather (light rain) installation
- No time-sensitive materials that require site forming and management for curing
- Contractor training and credentials available through ICPI

Reduced Runoff

- Up to 100% surface runoff reduction (subject to design requirements)
- Up to 100% infiltration depending on the design and soil subgrade infiltration rate
- Capable of installation over or next to plastic underground storage vaults or crates
- Can be designed with water harvesting systems for site irrigation and gray water uses

Improved Water Quality

- Reduces nutrients, metals and oils
- By storing water below grade, runoff temperatures are not elevated which can damage aquatic life
- Can be used to achieve water quality capture volume
- Can be used to achieve total maximum daily load (TMDL) limits for a range of pollutants

Site Utilization

- Reduces or eliminates unsightly detention/retention ponds
- Increased site and building utilization
- Conservation of space on the site and reduction of impervious cover
- Preserves woods and open space that would have been destroyed for detention ponds
- Promotes tree survival by providing air and water to roots (roots do not heave pavement)

Drainage System

- Reduced downstream flows and stream bank erosion due to decreased peak flows and volumes
- Increased recharge of groundwater
- Decreases risk of salt water incursion and drinking water well pollution in coastal areas
- Reduced peak discharges and stress on storm sewers
- Reduces combined sanitary/storm sewer overflows

Reduced Operating Costs

- Can result in a reduction in overall project costs due to the reduction or elimination of storm sewers and drainage appurtenances
- Lower life-cycle costs than conventional pavements
- Capable of integration with horizontal ground source heat pumps to reduce building heating and cooling energy costs
- Enables landowner credits on stormwater utility fees
- Does not require sealing which lowers maintenance costs

Paver surface units

- 50-year design life based on proven field performance
- Most styles are ADA compliant
- Colored units can mark parking stalls and driving lanes; light colors can reduce night time lighting needs
- Eliminates puddles on parking lots, walkways, entrances, etc.
- Capable of plowing with municipal snow removal equipment
- Durable, high-strength, low-absorption concrete units resist freeze-thaw, heaving and degradation from deicing materials
- Reduced ice and deicing material use/costs due to rapid ice melt and surface infiltration
- Reduced liability from slipping on ice due to rapid ice melt and surface infiltration
- Provides traffic calming
- Paver surface can be coated with photocatalytic materials to reduce air pollution
- Units with high SRI surfaces help reduce micro-climatic temperatures and contributes to urban heat island reduction
- Units manufactured with recycled materials and cement substitutes reduce greenhouse gas emissions

Simpler Maintenance & Repairs

- Paving units and base materials can be removed and reinstated
- Utility cuts into the pavement do not cause damage to the surface that can in turn decrease pavement life
- Capable of winter repairs
- No unsightly patches from utility cuts
- Surface cleaning with standard vacuum equipment
- Clogged surfaces may be restored with vacuum equipment to reestablish high infiltration rates

SYSTEM BASICS

PICP is recommended in the following areas:

- Residential patios, walks and driveways.
- Walks, parking lots, main and service driveways around commercial, institutional, recreational and cultural buildings.
- Low speed (<40 mph or 65 kph) residential roads.
- Non-commercial boat landings and marinas.
- Industrial sites that do not receive hazardous materials, i.e., where there is no risk to groundwater or soils from spills.



Figure 3. A large PICP parking lot manages an overall site slope of 12% using terraced areas.

- Storage areas for shipping containers with non-hazardous contents.

When evaluating a site, the following characteristics should be considered:

- Runoff from contributing at-grade impervious areas does not exceed five times the area of the PICP receiving the runoff.
- The estimated depth from the bottom of the pavement base, for full or partial infiltration systems, to the seasonal high level of the water table is greater than 2 feet (0.6 m). Greater depths may be required to obtain additional filtering of pollutants through the soil.
- PICP is down slope from building foundations and the foundations have piped drainage at the footers. Waterproofing such as an impermeable liner is recommended on basement walls against PICP.
- The slope of the permeable pavement surface is at least 1% and no greater than 12%. Figure 3 illustrates a large unique PICP parking lot near Atlanta, Georgia with a slope of 12% across the site. PICP surface slopes are typically 5% or less. There should be a minimum 1% surface slope to enable removal of water in the extreme case of the entire system filling with water such that it emerges from the surface.
- Land surrounding and draining into the PICP does not exceed 20% slope.
- At least 100 ft (30 m) should be maintained between PICP and water supply wells. (Local jurisdictions may provide additional guidance or regulations.)
- Sites where the owner can meet maintenance requirements.
- Sites where runoff draining onto PICP surface is not from soil erosion, exposed topsoil or mulch.
- Sites where there will not be an increase in impervious cover draining into the PICP (unless the pavement is designed to infiltrate and store runoff from future increases in impervious cover due to future development).
- Sites where space constraints, high land prices, tree/green space conservation, land used by detention facilities, and/or runoff from additional development make PICP a cost-effective solution.
- Sites outside permafrost regions

SITES TO AVOID

PICP is not recommended on any site classified as a storm water hotspot, i.e., if there is any risk that storm water can infiltrate and contaminate groundwater. These land uses and activities may include the following:

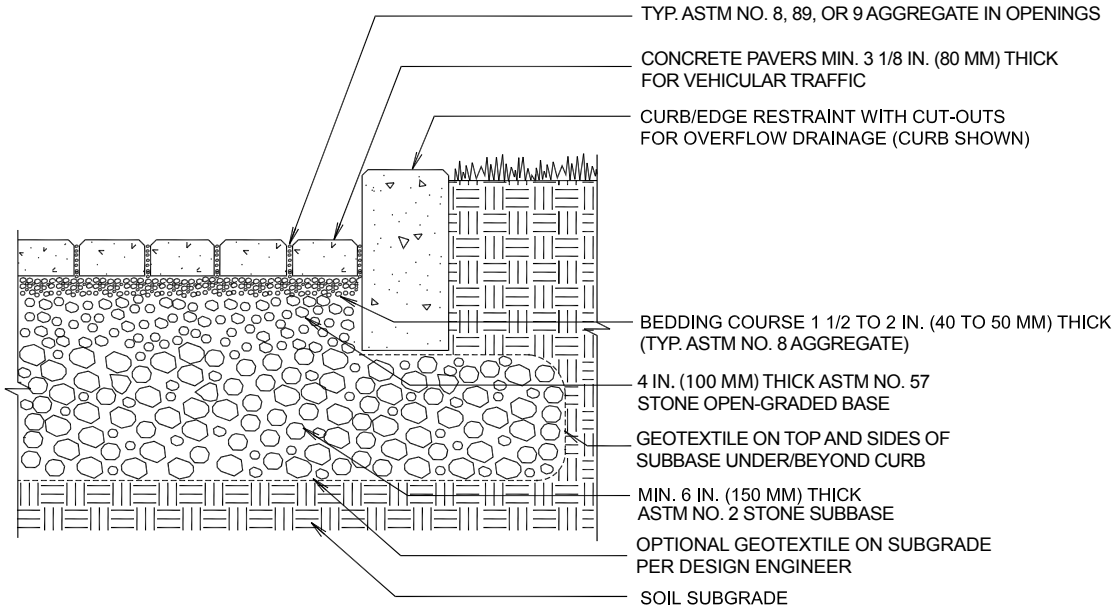


Figure 4. Full infiltration cross section allows storage and infiltration. Overflows are to swales, bioretention areas or storm sewer inlets.



Figure 5. Elmhurst College, Elmhurst, Illinois parking lots uses full infiltration through the soil subgrade with overflows directed through curb inlets into bioretention areas and overflow drains to manage extreme rain events.

- Vehicle salvage yards, recycling facilities, fueling stations, service and maintenance facilities, equipment and cleaning facilities
- Fleet storage areas (bus, truck, etc.)
- Commercial marina service and maintenance areas
- Outdoor liquid container storage areas
- Outdoor unloading facilities in industrial areas
- Public works materials/equipment storage areas
- Industrial facilities that generate or store hazardous materials
- Storage areas for commercial shipping containers with contents that could damage groundwater and soil
- Other land uses and activities not suitable for infiltration as designated by an appropriate review authority

BASIC PICP SYSTEMS

PICP can be built with full, partial or no infiltration of the open-graded stone base into the soil subgrade.

Full Infiltration—Full infiltration directs water through the base/subbase and infiltrates into the soil subgrade. This is the most common application over high infiltration soils such as gravels and sands. Overflows are managed via perimeter drains to swales, bioretention areas, or storm sewer inlets. Figure 4 illustrates schematic cross-section of a full infiltration PICP. Overflow drainage can exit from the surface but is better managed via large drainpipes from within the base. Figure 5 illustrates an example of handling PICP overflows via curb inlets to bioswales.

Partial Infiltration—Partial infiltration relies on drainage of the base/subbase into the subgrade soil and drainage pipes to direct excess water to a stormsewer, daylight or a stream. This controls the amount of time the subgrade is saturated. This design is common to lower infiltration rate soils such as silts and clays. Perforated drain pipes are typically placed in trenches in the subbase and covered with ASTM No. 57 stone to protect them while the ASTM No. 2 stone is compacted. Figure 6 illustrates a schematic cross-section of partial infiltration design. Figure 7 shows a full depth concrete grade beam being used to separate the open graded base from the adjacent pavement structure.

Outflow from the system is controlled by the outflow structure which retains a specific amount of water which is calculated to infiltrate into the subgrade in the specified amount of time. Water is typically detained for 24 to 48 hours. Soils with infiltration rates as low as 0.01 in./hr (7 x 10^{-6} cm/sec) can infiltrate about 0.5 in. (13 mm) over 48 hours. Stormwater in excess of the infiltration volume will flow over the weir and out of the system. The weir is designed to

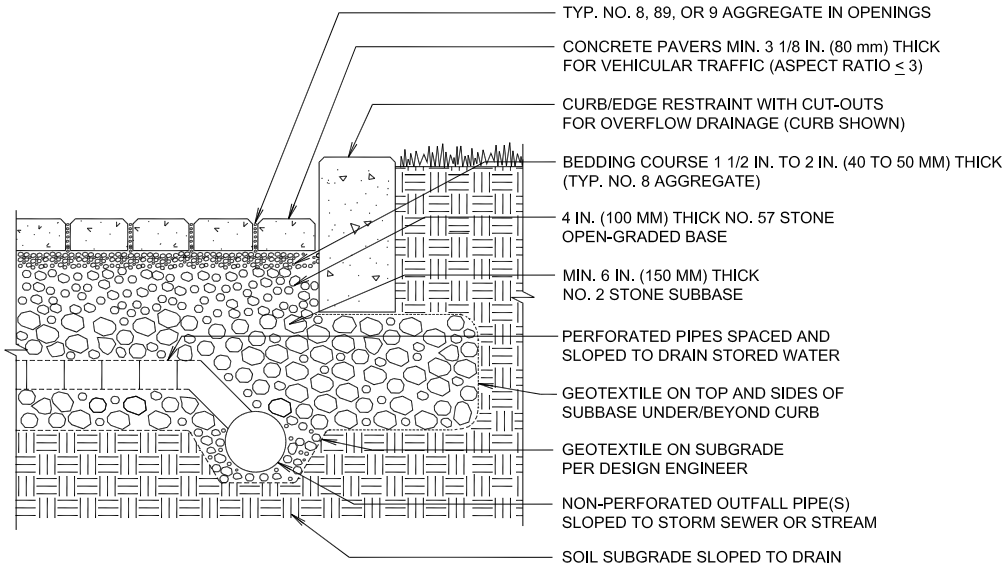


Figure 6. Partial infiltration through the soil subgrade. Perforated pipes can be raised above the soil subgrade to drain water from higher depth rainstorms. Smaller storms which often contain higher pollutant concentrations can be captured below the perforated pipes, stored and infiltrated.

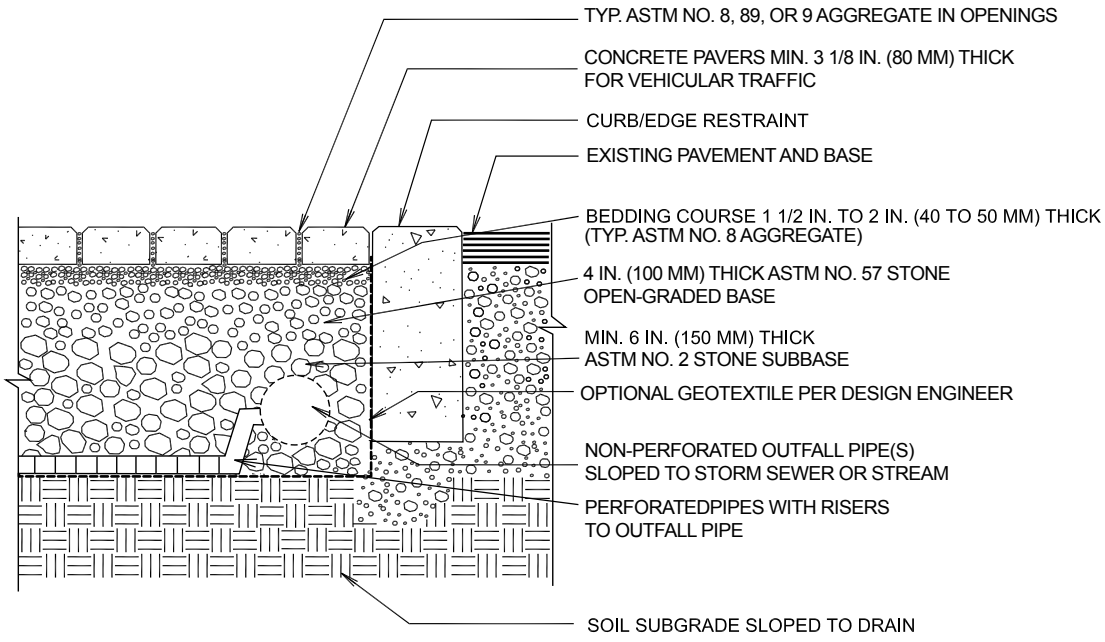


Figure 7. Typical cast-in-place concrete curb divides PICP from an adjacent impervious pavement.

control the discharge volume and rate. Figure 8 shows the outflow control structure.

No Infiltration—This is required when the soil has very low permeability or low strength, or there are other site limitations. The assembly is a detention pond with an outlet. An impermeable geomembrane may be used if the pollutant loads are expected to exceed the capacity of the base/subbase and soil subgrade to treat them. The geomembrane can be high density polyethylene (HDPE), ethylene propylene diene monomer (EPDM) or polyvinyl chloride (PVC) or other similar material. Geomembranes typically require a nonwoven geotextile for additional protection during aggregate filling and compaction. No infiltration is also used for creating a reservoir for water harvesting or horizontal ground source heat pumps that augment nearby building heating and cooling needs.

No infiltration designs with geomembranes are recommended in the following sites:

- Over aquifers with insufficient soil depth to filter the pollutants before entering the ground water. These can include karst, fissured or cleft aquifers.
- Over fill soils whose behavior when exposed to infiltrating water may cause unacceptable settling and movement. These might include expansive soils such as loess, poorly compacted soils, gypsiferous soils, etc.

DESIGN CONSIDERATIONS

A preliminary assessment is an essential prerequisite to detailed site, hydrological and structural design. This assessment includes a review of the following:

- Underlying geology and soils maps
- Identifying the NRCS hydrologic soil groups (A, B, C, D)
- Verifying history of fill soil, previous disturbances or compaction
- Review of topographical maps and identifying drainage patterns
- Identifying streams, wetlands, wells and structures
- Confirming absence of stormwater hotspots
- Identifying current and future land uses draining onto the site

PICP design involves structural and hydrological analyses. PICP design merges these two previously disconnected spheres of civil engineering and design. The base/subbase thickness is determined for hydrological and structural (vehicular traffic loading) needs, and the thicker section is selected for drawings, specifications and construction.

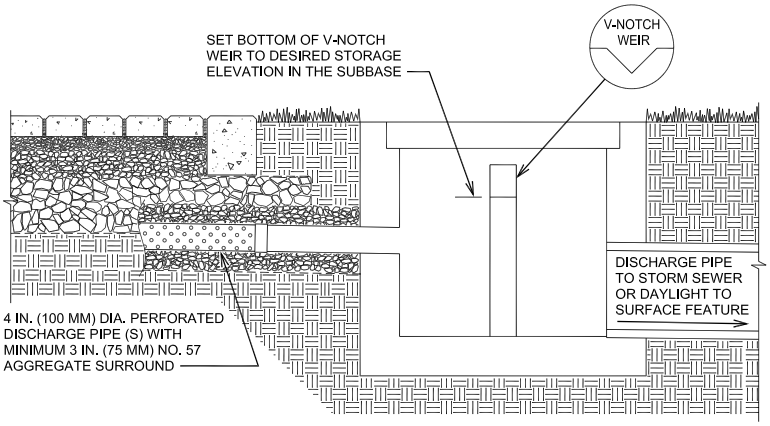


Figure 8. Outflow structure used to retain infiltration volume in subbase, while allowing excess water volume to be released.

In many cases, the hydrologic requirements will require a thicker base than that required for supporting traffic. The design process for PICP is outlined in the Figure 9 flow chart. Detailed design guidance is available in ICPI manual *Permeable Interlocking Concrete Pavement,* 5th Edition and the American Society of Civil Engineers *Permeable Interlocking Concrete Pavement Standard 68-18*.

Construction Overview

PICP construction for parking lots and roads involves the steps listed below and explains some variations depending on the application. In addition, a guide specification is available at www.icpi.org and can be downloaded and edited to project conditions.

Pre-construction meeting—For commercial and municipal projects, the specifications should include a pre-construction meeting. The pre-construction meeting is held to discuss methods of accomplishing all phases of the construction operation, contingency planning, and standards of workmanship. The general contractor typically provides the meeting facility, meeting date and time. Representatives from the following entities should be present;

1. "General" Contractor superintendent.
2. PICP subcontractor foreman.
3. Concrete paving unit manufacturer's representative.
4. Testing laboratory(ies) representative(s).
5. Engineer or owner's representative.
6. Other affected trades or representatives who will access PICP area.

The following items should be discussed and determined:

1. Test panel (mock-up) location and dimensions.
2. Methods for keeping all materials free from sediment during storage, placement, and on completed areas.
3. Methods for checking slopes, surface tolerances, and elevations.
4. Concrete paving unit delivery method(s), timing, storage location(s) on the site, staging, paving start point(s) and direction(s).
5. Anticipated daily paving production and actual record.
6. Diagrams of paving laying/layer pattern and joining layers as indicated on the drawings
7. Monitoring/verifying paver dimensional tolerances in the manufacturing facility and on-site if the concrete paving units are mechanically installed.
8. Testing intervals for sieve analyses of aggregates and for the concrete paving units.
9. Method(s) for tagging and numbering concrete unit paving packages delivered to the site.
10. Testing lab location, test methods, report delivery, contents and timing.
11. Engineer inspection intervals and procedures for correcting work that does not conform to the project specifications.
12. Procedure for testing and approval of subgrade, subbase and base.
13. Curb type and installation schedule.

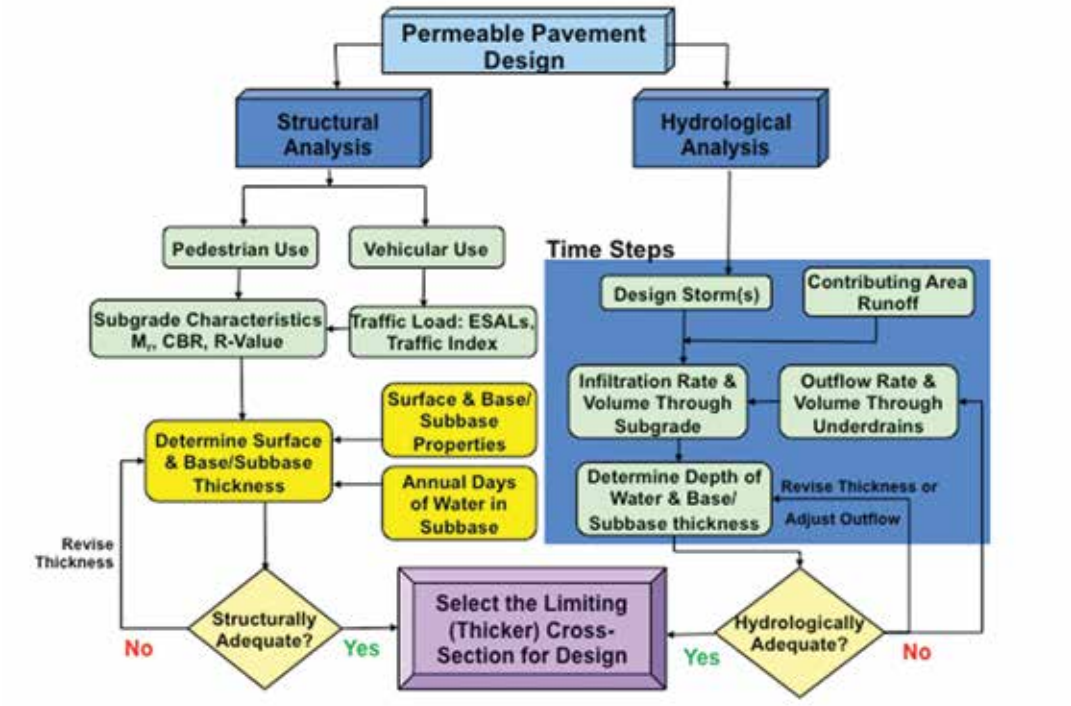


Figure 9. PICP design flow chart. See accompanying text that explains each step.



Figure 10. This temporary permeable edging around bare soil replaces silt fencing because it restrains sediment while allowing water to pass.



Figure 11. Larger PICP projects may require tire washing equipment for trucks to keep mud from contaminating PICP aggregates.

Plan site access and keeping PICP materials free from sediment—Preventing and diverting sediment from entering the aggregates and pavement surface during construction **must be the highest priority**. Extra care must be applied to keeping sediment completely away from aggregates stored on site as well as the PICP. In some cases, it may be necessary to construct PICP before other soil-disturbing construction is completed. The options below are for ensuring that the PICP does not become contaminated with sediment from construction vehicles. The options below are in ascending cost order. One or more of these options should be decided in the project planning stages and included in the specifications and drawings.

1. Install the PICP first and allow construction traffic to use the finished PICP surface. When construction traffic has ceased and adjacent soils are stabilized with vegetation or erosion control mats, clean the PICP surface and joints with a vacuum machine capable of removing an inch (25 mm) of the stone from the joints. Vacuum a test area and inspect the joints when stone is removed to be sure there are no visible traces of sediment on the stone remaining in the joints. If it is visible, then vacuum out jointing stones until no sediment is present. Fill the joints with clean stones and sweep the PICP surface clean.
2. Protect finished PICP system by covering the surface with a woven geotextile and a minimum 2 in. thick No. 8 open-graded aggregate layer. This aggregate layer and geotextile are removed upon project completion and when adjacent soils are stabilized with vegetation or erosion control mats. The PICP surface is swept clean.
3. Construct the aggregate subbase and base and protect the surface of the base aggregate with geotextile and an additional 2 in. (50 mm) thick layer of the same base aggregate over the geotextile. Thicken this layer at transitions to match elevations of adjacent pavement surfaces subject to vehicular traffic. A similar more costly approach can be taken using a temporary asphalt wearing course rather than the additional base aggregate and geotextile. When construction traffic has ceased and adjacent soils are vegetated or stabilized with erosion control mats, remove geotextile and soiled aggregate (or the asphalt) and install the remainder of the PICP system per the project specifications.
4. Establish temporary road or roads for site access that do not allow construction vehicle traffic to ride over and contaminate the PICP base materials and/or surface with mud and sediment. Other trades on the jobsite need to be informed on using temporary road(s) and staying off the PICP. The temporary road is removed upon completion of construction and opening of the PICP surface to traffic.

Other practices such as keeping muddy construction equipment away from the PICP, installing silt fences, staged excavation, and temporary drainage swales that divert runoff away from the area will make the difference between a pavement that infiltrates well or poorly. A simple technology that may be more effective than silt fences can help block sediment from eroding from bare soil. This consists of plastic temporary curbs with fabric in them to block the movement sediment from bare soil. Figure 10 illustrates this device.

Another more involved practice is a washing station for truck tires. Larger PICP projects may require this level of cleanliness as trucks enter a muddy PICP site. Figure 11 illustrates truck washing equipment which naturally requires disposal of dewatered sediment.

Excavate soil or an existing pavement—In some cases, the excavated area for base and PICP can be used as a sediment trap if there is time between the excavation and aggregate base installation. This is done by excavating within

6 in. (150 mm) of the final bottom elevation. This area can contain water during storms over the construction period and exit via temporary drain pipes. Heavy equipment should be kept from this area to prevent compaction. If equipment needs to traverse the bottom of the excavation, tracked vehicles can reduce the risk of soil compaction. As the project progresses, sediment and the remaining soil depth can be excavated to the final grade immediately before installing the aggregate subbase and base. Depending on the project design, this technique might eliminate the need for a separate sediment basin during construction.

Avoid soil compaction unless required in the plans and specifications—As discussed previously, soil compaction as part of the design is the engineer's decision and should be executed according to the project specifications. If compaction is not specified, the initial undisturbed soil infiltration should be carefully maintained during excavation and construction as this will enable the base to drain as designed. If the soil is inadvertently compacted by equipment during construction, there will be substantial loss of infiltration. A loss may be acceptable if the infiltration rate of the soil when compacted was initially considered during design and in drainage calculations.

Compacted soil can be remedied by scarifying to increase its infiltration. This is done by back-dragging loader bucket teeth across the soil prior to placing the aggregate subbase. This loose layer will receive subbase or base aggregate compacted into it to reduce the risk of surface settlement. If another contractor is responsible for the excavation, subgrade preparation and compaction, they should provide the paver contractor written assurance that the subgrade has been prepared to the specification.

Install geotextiles, impermeable liners and drain pipes if required in the plans and specifications—Geotextiles are used in some permeable pavement applications per the design engineer. If there are no concrete curbs and soil is restraining the sides of the base/subbase at its perimeter, then geotextile should be applied to prevent lateral migration of soil into the base/subbase aggregates. Geotextile is applied vertically against the soil with at least 1 ft (0.3 m) extending horizontally under the subbase and resting on the soil subgrade. A minimum 1 ft (0.3 m) overlap is recommended in stronger subgrade soils and 2 ft (0.6 m) overlap on poor-draining weaker soils (CBR<5%).

When specified, impermeable liners require assembly per the manufacturer's instructions at the shop or job site. Once assembled, they should be tested for leaks with special attention to seams and pipe penetrations.

Drain pipes are installed according to plans and specifications and should be rigid PVC. Designs should have curb cutouts or drain pipes from the PICP entering swales or storm sewer catch basins to handle overflow conditions. A minimum of 12 in. (300 mm) aggregate cover is recommended over drainpipes to protect them from damage during subbase or base compaction.

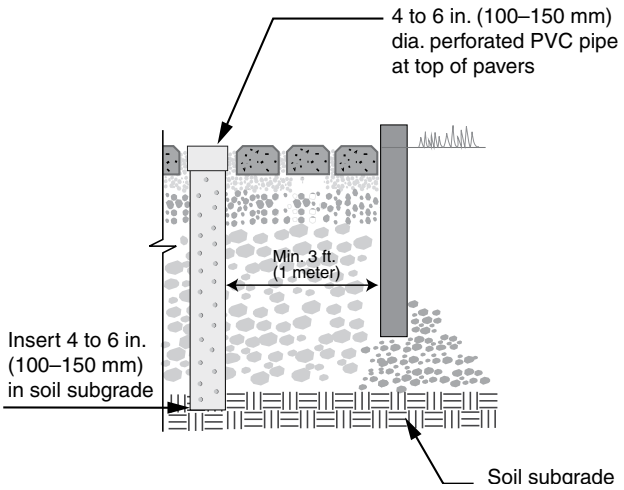


Figure 12. Observation well into PICP base and subbase with top accessible directly from the surface to observe drain down rate.

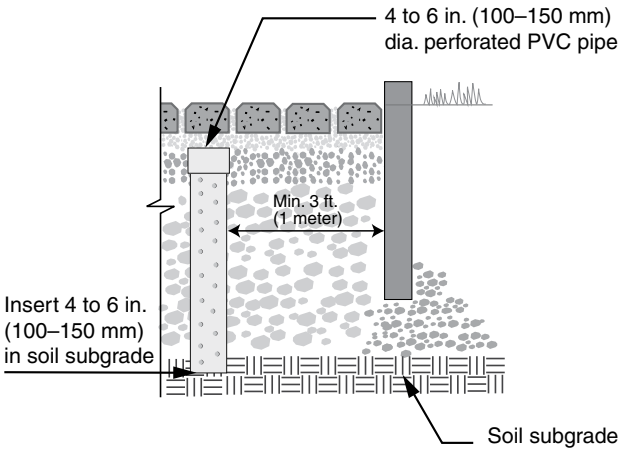


Figure 13. Observation well with top hidden under pavers and bedding to obscure from vandals.

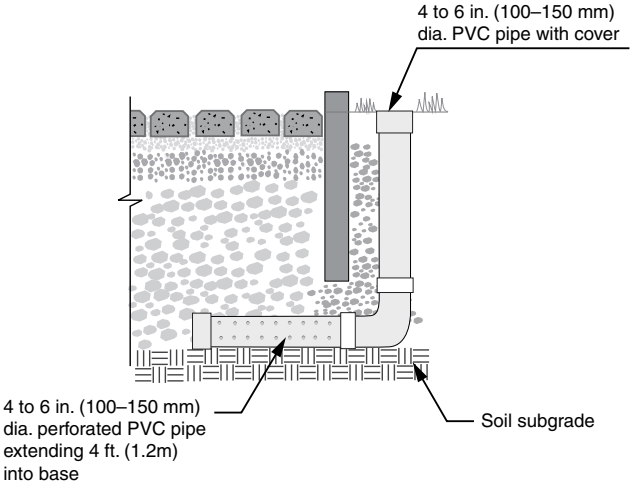


Figure 14. Observation well installed outside of pavement area.

Table 1. Recommended edge restraints for PICP

Edge Restraint Type	Pedestrian Only	Residential Driveway	Parking lot or street
Cast-in-place concrete curb	Yes	Yes	Yes
Precast concrete curb	Yes	Yes	Yes
Cut stone curb	Yes	Yes	Yes
Compacted, dense-graded berms around PICP base perimeter with spiked metal or plastic edging to restrain Pavers	Yes	Yes	No

If there is a risk of drain pipe damage, consider using a heavy gauge pipe or test the pipe and base in a trial area with compaction equipment prior to placing and compacting a large area. Perforations in pipes should terminate 1 ft (0.3 m) short of the sides of the opening for the base. When corrugated metal drain pipes are used, they should be aluminized, and aluminized pipe in contact with concrete should be coated to prevent corrosion. Perforated drain pipes should have caps fastened to the upslope ends. Daylighted drain pipes require wire mesh over the openings to keep out debris and animals.

Observation Wells—A 4 to 6 in. (100 to 150 mm) diameter vertical perforated pipe that serves as an observation well may be specified in PICP subject to vehicular traffic. The pipe should be kept vertical during filling of the excavated area with open-graded aggregate and during compaction. The bottom of the pipe can be forced into the soil subgrade and held in place during base/subbase filling and compaction. The pipe should be located in the lowest elevation and a minimum of 3 ft (1 m) from the PICP side. Figures 12, 13 and 14 illustrate a well accessible from the surface and another with the pipe under the pavers to prevent damage from vandals.

Place and compact the aggregate subbase—ASTM No. 2 subbase material should be spread in lifts up to 6 in. (150 mm). Compaction is typically done with a 10 ton (9 T) steel vibratory roller or a 13,500 lbf (60 kN) plate compactor.



Figure 15. A 10 ton (9 T) vibratory roller compactor settles ASTM No. 2 stone subbase for a large shopping center parking lot.

Greater lift thicknesses are normal (i.e., 12 in. or 0.3 m) when using either of these compactors. When using a roller, the first two passes are in vibratory mode and the last two are in static mode. Compaction is completed when no visible movement can be seen in the base when rolled by the compactor. Figure 15 illustrates a vibratory roller compacted No. 2 stone subbase.

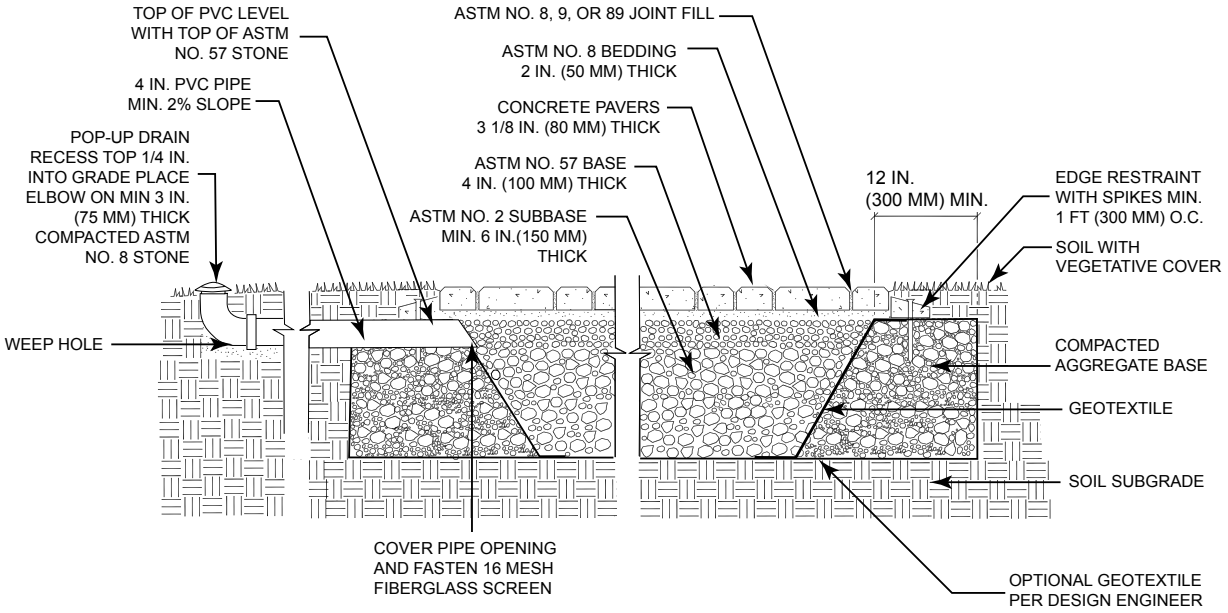
Plate compactors with a minimum compaction force of 13,500 lbf (60 kN) with compaction indicators should be used to determine when compaction is completed. Plate compactors are needed to compact in corners and edges where roller compactors are not effective. Aggregates should not be crushed by the compactor. Surface tolerance of the compacted ASTM #2 shall be +/- 2 1/2 in. (65 mm) over a 10 ft. (3 m) straightedge. If another contractor is responsible for the placement and compaction of the base/subbase, they should provide the paver contractor written assurance that the base/subbase has been prepared to the specification.

Install curbs or other edge restraints—The selection of edge restraints depends on whether the PICP is for pedestrian, residential driveway or vehicular use. Table 1 summarizes recommended by edge restraint type based on the application.

Cast-in-place concrete, precast concrete and cut stone curbs are typically a minimum of 9 in. (225 mm) high and rest on the compacted No. 2 stone subbase. Consideration should be given to installing a concrete haunch under precast concrete or stone curbs. Curbs may be higher than 9 in, (225 mm) if they hold back grass, a sidewalk, bioswale or other structure. Figure 6 illustrates typical curb cross-section.

If PICP is adjacent to existing impervious asphalt or concrete pavement, curbs level with the permeable and impervious surfaces are used. The curb should extend the full depth of the base under the impermeable pavement to protect its base from becoming weakened from excessive water. Another option is to separate the two bases with an impermeable liner. Figure 7 shows a concrete curb between impervious pavement and PICP base and subbase.

The risk of water weakening the base under the impervious pavement can be substantially decreased by sloping the soil subgrade under the PICP away from the impervious pavement base and by using perforated drain pipes to



NOTES:
1. DESIGN, MATERIAL AND CONSTRUCTION GUIDELINES TO FOLLOW ICPI GUIDE SPECIFICATIONS.
2. DAYLIGHT DRAIN PIPE TO DRAINAGE SWALE, USE POP-UP DRAIN IN YARD (AS SHOWN) OR CONNECT TO STORM SEWER.
3. APPLY WATERPROOF MEMBRANE VERTICALLY AGAINST HOUSE FOUNDATION PRIOR TO PLACING SUBBASE AND BASE.
4. ALL SOIL SUBGRADES SHALL SLOPE TOWARD STREET.
5. SUBGRADE SOIL MAXIMUM CROSS SLOPE IS 0.5%. MAXIMUM LONGITUDINAL SLOPE IS 2% TOWARD STREET.
6. USE SOIL BERMS FOR LONGITUDINAL SOIL SUBGRADE SLOPES EXCEEDING 2% TOWARD STREET.
7. 5% MAXIMUM SURFACE SLOPE.
8. THICKER SUBBASSE AND/OR ADDITIONAL DRAIN PIPES MAY BE REQUIRED IF DRIVEWAY RECEIVES RUNOFF FROM ADJACENT IMPERVIOUS SURFACES OR ROOFS.

Figure 16. Typical cross section detail using a dense-graded base berm as a foundation for anchoring metal or plastic edge restraints.



Figure 17. Perimeter berms made with dense-graded base are in place prior to placing open-graded aggregate in the driveway.



Figure 18. Compacting the berms along the perimeter and the PICP base

remove water before it can collect next to the base supporting the impervious pavement. Curbs installed against existing impervious pavement and base may cause erosion and weakening of the base from excavation due to installing the PICP. Eroded spaces can be filled with concrete to support the asphalt or concrete surface and base next to the curb.

For pedestrian areas and residential driveways, an edge restraint option is using compacted, dense graded berms around PICP base perimeter with plastic or metal edging fastened to their surface. The dense-graded base is a foundation for metal or plastic edging secured with steel spikes. These edge restraints are installed on the dense-graded berms in a manner identical to those on interlocking concrete pavement driveways. Figure 16 shows a typical cross-section of this construction and Figure 17 illustrates the berms in place prior to filling the driveway with open-graded aggregate. Figure 18 shows compaction of both types of bases. Figure 19 shows the pavers in place against a plastic edge



Figure 19. Edge restraint is spiked into the dense-graded base berms so it can hold the pavers in place during compaction and service.



Figure 20. A 10 ton (9 T) roller compacts the ASTM No. 57 base.



Figure 21. A 13,500 (60 kN) vibratory plate compactor is used on this ASTM No. 57 stone base.

restraint spiked or nailed into the dense-graded base. The edge restraint contains some of the bedding layer such that at least the bottom half of the pavers is also contained by the edging.

Place and compact the aggregate base—The ASTM No. 57 base layer is spread and compacted as one 4 in. (100 mm) lift. Like the subbase aggregate, the initial passes with the roller can be with vibration to consolidate the base material as shown in Figure 21. A 13,500 lbf (60 kN) plate compactor (Figure 22) also can be used to compact the No. 57 base layer. Surface tolerance of the compacted No. 57 stone shall be +/- $^{3}/_{4}$ in. (19 mm) over a 10 ft. (3 m) straightedge.

Equipment drivers should avoid rapid acceleration, hard braking, or sharp turning when driving on the compacted No. 2 subbase and on the No. 57 base. Tracked equipment is recommended. If the subbase or base surfaces are disturbed, they should be re-leveled and re-compacted.

A test section of the subbase and base should be constructed initially for compaction monitoring. The section will indicate settlement of the pavement section, and be used to monitor and prevent crushing of the aggregate. The area should be used to train inexperienced construction personnel on compaction techniques.

To confirm the compaction of an open graded aggregate ICPI recommends evaluating its stiffness using a lightweight deflectometer (LWD) and the test method described in ASTM E2835 Standard Test Method for Measuring Deflections using a Portable Impulse Plate Load Test Device. For a compacted open-graded base layer over a compacted subbase, the user tries to achieve a maximum average deflection not greater than 0.5 mm.

The test method requires three weight drops to seat the plate. Then the machine records the deflection from the next



Figure 22. Testing base stiffness using light-weight deflectometer.



Figure 23. Density testing with a nuclear gauge in backscatter mode can help assess consistent density of the ASTM No. 57 base layer.

three drops and calculates the average deflection. As the force is instantaneously applied, the plate presses into the soil or aggregate. The amount of plate movement or deflection is directly related to the stiffness of the compacted soils or base. This easy-to-use test method does not require soil testing in the lab nor operator certification. The machine also calculates a resilient modulus. Each test (all six drops) takes about 2 minutes, so a number of tests across a site can be conducted quickly.

LWD testing is a relatively new technology from Germany gaining broad acceptance by state and provincial DOTs for testing the stiffness of compacted soils, as well as dense-graded and open-graded aggregates.

If a light-weight deflectometer is not available, a nuclear density gauge running in backscatter mode can be used to test the density of the No. 57 base layer (Figure 24). The guide construction specification includes guidance on this test method. The purpose of this test method is to attain consistent density and is not as consistent as the LWD test method. Besides nuclear density gauges, (nonnuclear) stiffness gauges may also be used to assess compacted base density.

Place and screed the bedding layer—When subbase and base lifts are compacted the surface should then be topped with a 2 in. (50 mm) thick layer of No. 8 crushed stone bedding layer. This layer is screeded and leveled over the No. 57 base. Metal rails are placed on the compacted No. 57 layer and are used to guide screeding elevations. Various sizes of screeding equipment can be used ranging from hand tools, bucket screeds powered manually or by machine, or a modified asphalt spreader that uses a laser guidance system to maintain elevations. Figure 25 and 26 illustrate examples of screeding equipment. A moist bedding layer facilitates screeding.

The surface tolerance of the screeded No. 8 bedding material should be $\pm 3/8$ in. over 10 ft. ($\pm$ 10 mm over 3 m). The concrete pavers should be placed immediately after the No. 8 stone bedding is placed and screeded. Construction equipment and foot traffic should be kept off the screeded layer.

Install the pavers manually or with mechanical installation equipment—After screeding the bedding material, the pavers are placed on this layer. Paver installation can be by hand or with mechanical equipment. Spacing between units is $1/2$ in. (12 mm) or less in order to comply with ADA requirements. Mechanized installation may be a cost-efficient means to install the units and reduces installation time. Figure 27 and 28 shows mechanized equipment placing permeable paver layers manufactured for placement in their final laying pattern. Mechanical installation requires careful planning including selection available paver layer patterns from local manufacturers and well-orchestrated material flow logistics in order to gain efficiencies. For further information on mechanical installation, consult *ICPI Tech Spec 11—Mechanical Installation of Interlocking Concrete Pavements* and *ICPI Tech Spec 15—A Guide for the Construction of Mechanically Installed Interlocking Concrete Pavements*.



Figure 24. Manually screeding the No. 8 stone setting bed.



Figure 25. A screed beam pulled by equipment can be more efficient and productive.





Figure 26 and 27. Mechanical equipment accelerated installation of a parking lot in Illinois and a street in Oregon.







Figure 28. Various methods of filling and sweeping PICP joints.

An important consideration on large mechanical installation projects is monitoring paver production mold wear. *Tech Spec 15* covers managing dimensional growth of pavers and provides means for confirming dimensions of the pavers at the factory and on the job site. Managing paver dimensions should be decided between the paver manufacturer and paver installation contractor and confirmed at the preconstruction meeting.

Border courses consisting of mostly whole (uncut) pavers are typically used against curbs at PICP edges and at transitions to other pavement surfaces. Paving units abutting border courses should be cut to fill spaces prior to compaction. Cuts should provide gaps around the entire perimeter of the stone that are consistent with the typical joint size—this will allow for proper interlock between units and prevent direct paver on paver contact. Cut units should be no smaller than one-third of a whole unit if subject to vehicular traffic. All installed units should have joints filled and compacted within 6 ft (2 m) of the laying face at the end of each day.

Filling the paver joints and sweep the surface clean—The paver joints are filled with ASTM No. 8, 89 or 9 stone. Depending on the PICP area, spreading and sweeping can be done with shovels and brooms, or larger areas with machines and swept into the paver joints with powered brooms or sweepers. Once the joints are full (within $^{1}/_{4}$ in. or 6 mm of the paver surface), the surface must be swept clean prior to compaction as loose stones on the surface can mar the pavers when in contact with a plate compactor. Figure 29 illustrates various filling and sweeping methods.

Compact the pavers—After the PICP surface is swept clean, it is compacted with a plate compactor. A minimum of two passes should be made with the second pass in a perpendicular direction from the first pass. The path of the plate compactor should overlap several inches (cm). For paving units 3 $^{1}/_{8}$ to 4 in. (80 to 100 mm) thick, the plate compactor should exert a minimum 5,000 lbf (22 kN) at 75 to 90 Hz. Figure 30 shows permeable pavers being compacted for a street project using a large plate compactor.

Top up joints with joint filling stone as needed and sweep the surface clean—Compaction can cause some settlement of the aggregates inside the joints. If the aggregates are more than $^{1}/_{4}$ in. (6 mm) from the



Figure 29. PICP paver compaction shows that pavers need to be set about 3/4 in. (19 mm) above their final elevation before compaction and 3/8 in. (10mm) after compaction to account for downward movement.

paver surface, they should be topped up to this level with additional aggregates. The paver surface should be swept clean prior to opening the PICP to traffic.

Aggregates in the paver joints can settle in early in the life of the pavement. Some settlement can be reduced through consistent, thorough compaction of the base, pavers and bedding layers. However, it is advisable for the contractor to return to the site after six months, inspect the joints and top them up with aggregate if they have settled to more than 1/4 in. (6 mm) below the paver surface. This service should be included in the construction specifications.

Construction Checklist

The following provides a convenient checklist for contractors and project inspectors.

Pre-construction meeting

- ❑ Walk through site with builder/contractor/subcontractor to review erosion and sediment control plan/stormwater pollution prevention plan or SWPPP)
- ❑ Determine when PICP is built in project construction sequence; before or after building construction, and measures for PICP protection and surface cleaning
- ❑ Aggregate material locations identified (hard surface or on geotextile)
- ❑ Sediment management
  - ❑ Access routes for delivery and construction vehicles identified
  - ❑ Vehicle tire/track washing station (if specified in E&S plan/SWPPP) location / maintenance

Excavation

- ❑ Utilities located and marked by local service
- ❑ Excavated area marked with paint and/or stakes
- ❑ Excavation size and location conforms to plan
- ❑ Sediment management:
  - ❑ Excavation hole as sediment trap: cleaned immediately before subbase stone placement and runoff sources with sediment diverted away from the PICP, or
  - ❑ All runoff diverted away from excavated area.
  - ❑ Temporary soil stockpiles should be protected from run-on, run-off from adjacent areas and from erosion by wind.
  - ❑ Ensure linear sediment barriers (if used) are properly installed, free of accumulated litter, and built up sediment less than 1/3 the height of the barrier.
  - ❑ No runoff enters PICP until soils stabilized in area draining to PICP
- ❑ Foundation walls:
  - ❑ At least 10 ft (3 m) from foundation walls with no waterproofing or drainage
- ❑ At least 100 ft (30 m) from water supply wells
- ❑ Soil subgrade: rocks and roots removed, voids refilled with permeable soil
- ❑ Soil compacted to specifications (if required) and field tested with density measurements per specifications
- ❑ No groundwater seepage or standing water. If so dewatering or dewatering permit may be required.

Geotextile (if specified)

- ❑ Meets specifications
- ❑ Placement and down slope overlap (min. 2 ft or 0.6 m) conform to specifications and drawings
- ❑ Sides of excavation covered with geotextile prior to placing aggregate base/subbase
- ❑ No tears or holes
- ❑ No wrinkles, pulled taught and staked

Impermeable Liner (if specified)

- ❑ Meets specifications
- ❑ Placement, field welding, and seals at pipe penetrations done per specifications

Drain pipes/observations wells

- ❑ Size, perforations, locations, slope, and outfalls meet specifications and drawings
- ❑ Verify elevation of overflow pipes

Subbase, base, bedding and jointing aggregates

- ❑ Sieve analysis from quarry conforms to specifications
- ❑ Storage on hard surface or geotextile to keep sediment-free
- ❑ Thickness, placement, compaction and surface tolerances meet specifications and drawings

Edge restraints

- ❑ Elevation, placement, and materials meet specifications and drawings

Permeable interlocking concrete pavers

- ❑ Meet ASTM/CSA standards (as applicable) per manufacturer's test results
- ❑ Elevations, slope, laying pattern, joint widths, and placement/compaction meet drawings and specifications

- ❑ No cut paver subject to tire traffic is less than 1/3 of a whole paver
- ❑ All pavers within 6 ft (2 m) of the laying face fully compacted at the completion of each day
- ❑ Surface tolerance of compacted pavers deviate no more than ±3/8 (± 10 mm) under a 10 ft (3 m) long straightedge

Final inspection

- ❑ Surface swept clean
- ❑ Elevations and slope(s) conform to drawings
- ❑ Transitions to impervious paved areas separated with edge restraints
- ❑ Surface elevation of pavers 1/8 to 3/8 in. (3 to 10 mm) above adjacent drainage inlets, concrete collars or channels (for non-ADA accessible paths of travel); to 1/4 in. or 6 mm (for ADA accessible paths of travel)
- ❑ Lippage: no greater than 1/8 in. (3 mm) difference in height between adjacent pavers
- ❑ Bond lines for paver courses: ±1/2 in. (±15 mm) over a 50 ft (15 m) string line
- ❑ Stabilization of soil in area draining into permeable pavement (min. 20 ft (6 m) wide vegetative strips recommended)
- ❑ Drainage swales or storm sewer inlets for emergency overflow. If storm sewer inlets are used, confirm overflow drainage to them.
- ❑ Runoff from non-vegetated soil diverted from PICP surface
- ❑ Test surface for infiltration rate per specifications using ASTM C1701; minimum 100 in./hr (2500 mm/ hr) recommended

PICP Specialist Course

ICPI offers a one day PICP Specialist Course for training on PICP best construction practices. Installers who complete the course, pass the exam and meet the minimum experience requirements earn the PICP Specialist designation. This course is referenced as a requirement in an increasing number of commercial, municipal and state specifications. The classroom program is for contractors building residential and/or commercial interlocking concrete pavement installations, and who wish to move into the permeable pavement market. Participants should be experienced contractors, and participants should have completed the ICPI Concrete Paver Installer Course. The PICP Specialist Course is approved for ICPI installer continuing education.

The course cover PICP systems, job planning and documentation, job layout, flow and estimating quantities, soil and site characteristics, subbase and base materials, edge restraints, bedding and jointing materials, paver selection and installation, and maintenance. Participants who take the course receive a student manual and those that earn a passing grade on the exam receive a Record of Completion for the course. A Record of Completion does not expire, and will not require a renewal. Other Installer Development Courses include Concrete Paver Installer, Residential Paver Technician and Commercial Paver Technician courses. Most classes are sponsored by local ICPI manufacturing members. Visit www.icpi.org/picp-course for more information on dates and locations.

REFERENCES

*AASHTO 2010. "Geotextile Spe*cification for Highway Applications," AASHTO Designation M-288, in *Standard Specifications for Transportation Material and Methods of Sampling and Testing*, Part IB: Specifications, 31st Edition, American Association for State Highway and Transportation Officials, Washington, DC.

ASCE 2016. *Structural Design of Interlocking Concrete Pavement for Municipal Streets and Roadways*, ASCE/T&DI/ICPI Standard 58-16, American Society of Civil Engineers, Reston, Virginia.

ASCE 2018. *Permeable Interlocking Concrete Pavement*, ASCE/ T&DI/ ICPI Standard 68/18, American Society of Civil Engineers, Reston, Virginia.

ASTM 2009. ASTM C936, Standard Specification for Solid Concrete Interlocking Paving Units, *Annual Book of ASTM Standards*, Vol. 04.05, American Society for Testing and Materials International, Conshohocken, Pennsylvania.

ASTM 2009. ASTM C1701 *Standard Test Method for Infiltration Rate of In Place Pervious Concrete*, Annual Book of ASTM Standards, Vol. 04.02, American Society for Testing and Materials International, Conshohocken, Pennsylvania.

CSA 2006. A231.2-06, *Precast Concrete Pavers*, Canadian Standards Association, Rexdale, Ontario.

ICPI 2017, D. Smith, *Permeable Interlocking Concrete Pavements*, 5th Edition, Interlocking Concrete Pavement Institute, Herndon, Virginia

icpi
Interlocking Concrete Pavement Institute®

14801 Murdock Street
Suite 230
Chantilly, VA 20151

In Canada:
P.O. Box 1150
Uxbridge, ON L9P 1N4
Canada

Tel: 703.657.6900
Fax: 703.657.6901
E-mail: icpi@icpi.org
www.icpi.org

The content of ICPI Tech Spec technical bulletins is intended for use only as a guideline. It is not intended for use or reliance upon as an industry standard, certification or as a specification. ICPI makes no promises, representations or warranties of any kind, expressed or implied, as to the content of the Tech Spec Technical Bulletins and disclaims any liability for damages resulting from the use of Tech Spec Technical Bulletins. Professional assistance should be sought with respect to the design, specifications and construction of each project.

BOD Approved: March 2019

Pathway Materials



PRODUCERS OF ARCHITECTURAL
AND LANDSCAPE AGGREGATES

Kafka Granite

Kafka Granite Pathway Materials are used where a firm pathway is required for pedestrian or vehicular traffic, but a natural look, unlike hardscape surfaces, is preferred. We offer decomposed granite and crushed stone pathways in three variations: Standard Pathway Mix, Stabilized Pathway Mix, and Wax Polymer Pathway Mix. These products are an affordable and aesthetically pleasing alternative to concrete, asphalt, pavers and other hardscape surface materials.

STANDARD PATHWAY MIX

Beautiful Natural Pathways with Great Drainage

Kafka Granite's naturally occurring decomposed granite and crushed stone are screened to a 1/4" minus size, allowing for a firm surface that compacts well, while retaining permeability. Our 50+ colors of pathway materials make for beautiful and organic walkways, nature paths, bike trails, courtyards, patios, and more.



Platinum Granite Standard Pathway
Metropolitan Correctional Center | Chicago, IL

STABILIZED PATHWAY MIX

Durable Natural Surface for Higher Traffic Pathways

At Kafka Granite, we have the ability to pre-mix our Standard Pathway Mix with organic stabilizing binders to create an even more durable, yet natural, pathway. Compared to the traditional pathway mix, the stabilized mix better resists the erosive effects of weather and traffic, while retaining a natural look and feel.



Shamrock Green Granite Stabilized Pathway
Oakbrook Center | Oakbrook, IL

WAX POLYMER PATHWAY MIX

Waterless, Dustless Mix for Demanding Pathways

For an entirely waterless and dustless pathway solution, Kafka Granite combines their Standard Pathway Mix with an engineered wax polymer. For extremely high traffic areas or steep slopes, our Wax Polymer Pathway Mix trumps all other pathway solutions.



Beige Blend Marble Wax Polymer Pathway
Deer Grove Forest Preserve | Palatine, IL


American Heritage Granite


Antique Rose Marble


Autumn Blend Marble


Beige Blend Marble


Black Cherry Granite


Black Diamond Granite


Blue Mahogany Granite


Botticino Marble


Burnt Sienna Marble


Caramel Quartzite


Cherry Creek Granite


Chocolate Brown Granite


Desert Spar Gold Granite


Desert Spar Orange Granite


Desert Tan Marble


Dynamite Orange Granite


Evergreen Granite


Golden Cream Marble


Gun Metal Marble


Hazelnut Marble


Imperial Gray Granite


Linwood Granite


Mauve Granite

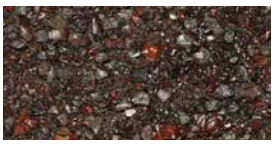

Midnight Blue Granite


Misty Gray Marble


Pewter Granite


Platinum Granite


Polar White Marble


Recycled Copper Slag


Recycled Fire Brick Blend


Recycled Kiln Slag


Recycled Porcelain


Red Cedar Granite


Rose Pink Quartz


Ruby Red Granite


Rustic Granite


Salt & Pepper Granite


Shamrock Green Granite


Sierra Black Granite


Snow White Granite


Starlight Black Granite


Sterling Quartz


Sugar & Spice Granite


Sunset Pink Granite


Turquoise Marble


Twilight Black Granite


Violetta Quartzite


White Quartz


Wineberry Granite


Wintergreen Granite



KAFKA GRANITE, LLC | is a family owned and operated company that was started in 1979 by Glenn Kafka. With over sixty colors of natural stone and recycled products, Kafka Granite has grown into one of the largest manufacturers and suppliers of specialty aggregates in the United States. Kafka Granite's architectural aggregates, manufactured sands, decomposed granite, and boulders are used for many applications including architectural precast concrete, terrazzo flooring, epoxy resin tile, epoxy overlays, pathway materials, ballyard materials, landscape stone, and more.

For more information on all of Kafka Granite's products, please visit kafkagranite.com.

Cover photo: Midnight Blue Granite Stabilized Pathway | Max McGraw Wildlife Foundation | Dundee, IL

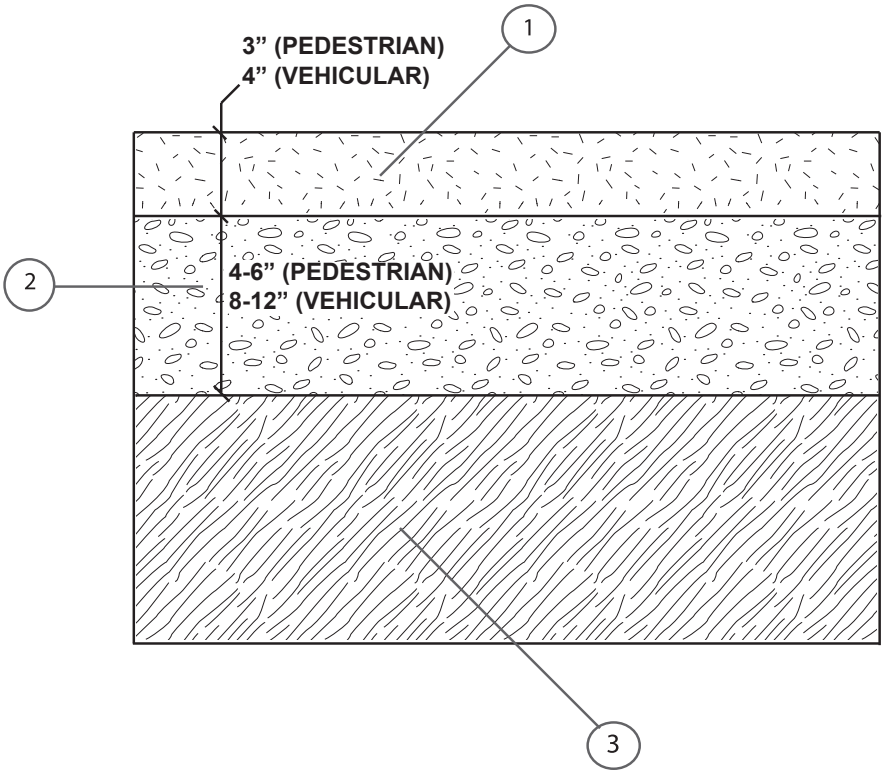
Kafka Granite, LLC
550 East Hwy 153
Mosinee, WI 54455

Ph. 800.852.7415
Fax. 715.687.2395
Email. kafka@kafkagranite.com
Web. kafkagranite.com

Kafka Granite

KAFKA PATHWAY MATERIALS

CRUSHED AGGREGATE CROSS-SECTION



1. 3 INCHES (PEDESTRIAN TRAFFIC) OR 4 INCHES (VEHICULAR TRAFFIC) OF COMPACTED KAFKA STANDARD OR STABILIZED PATHWAY MIX, AS SPECIFICED
2. 4 TO 6-INCHES (PEDESTRIAN TRAFFIC) OR 8 TO 12-INCHES (VEHICULAR TRAFFIC) OF YOUR STATE’S APPROVED DOT BASE COURSE, COMPACTED
3. COMPACTED SUBGRADE

KAFKA GRANITE, LLC
550 E HWY 153
MOSINEE, WI 54455

(800) 852-7415
KAFKAGRANITE.COM

SUMMER 2015

SECTION [32 15 40]

ORGANIC-LOCK FOR STABILIZED PATHWAY AGGREGATE: FOOT/BICYCLE TRAFFIC

PART 1: GENERAL

1.1 SUMMARY

A. This section includes materials and execution information for construction with aggregate with Organic-Lock binder for foot traffic applications

B. Related Sections:

Section [ ]
Section [ ]
Section [ ]

1.2 REFERENCES

A. ASTM C136 / C136M – 14, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates, ASTM International, West Conshohocken, PA, 2014, www.astm.org

B. ASTM D2419 – 14, Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregates, ASTM International, West Conshohocken, PA, 2014, www.astm.org

C. ASTM F1951 – 14, Standard Specification for Determination of Accessibility of Surface Systems Under and Around Playground Equipment, ASTM International, West Conshohocken, PA, 2014, www.astm.org

1.3 SUBMITTALS

A. Submit in accordance with Section 01 33 00 - Submittal Procedures:

1. Manufacturer's product data sheet.
2. [1 quart] [_____] sample of base course.

3. [1 quart] [_____] sample of stabilized crushed aggregate paving.
4. Stabilized crushed aggregate gradation indicating that the product meets specifications.
5. Manufacturer's Material Safety Data Sheet.

1.4 SITE CONDITIONS

A. Ensure that the subgrade and base are properly graded and compacted to required specifications.

B. Do not install the Organic-Lock pathway aggregate during rain. Rain within 3-5 days after installation will increase curing time.

C. Protect all nearby surfaces, plants, and structures from possible contamination from materials or damage by equipment.

D. It is not recommended to install when temperatures are below 40 degrees Fahrenheit (5 degrees Celsius).

1.5 TEST PLOT

A. Install [16] square feet minimum of stabilized crushed aggregate paving including base course, at location approved by [Architect] [Engineer].

B. Allow [Architect] [Engineer] to view test plot before proceeding with rest of stabilized crushed aggregate paving.

C. [Approved mock-up may remain as part of completed Work.] [Remove test plot after acceptance of work specified in this Section.]

1.6 DELIVERY, HANDLING, AND STORAGE

A. Delivery:

Delivery of Organic-Lock is available from the manufacturer or select Organic-Lock dealers. Please contact the manufacturer for more information.

Delivery of Organic-Lock pre-blended with aggregate is available from select dealers. Contact your closest dealer or the manufacturer for more information.

B. Handling:

When dealing with un-blended Organic-Lock, wear appropriate respirator when ventilation is inadequate. Avoid contact with skin and eyes.

C. Storage:

Protect stabilized crushed aggregate mix from contamination. Store undercover. If the blended aggregate is sitting for long periods of time and subject to rainfall, it needs to be turned with a skid steerer or loader to ensure consistent moisture content throughout prior to installation. Verify hydration level with snowball test before installation. For any questions regarding storage, contact the manufacturer or local dealer.

PART 2: PRODUCTS

2.1 MANUFACTURERS

A. Organic-Lock for Organic-Lock stabilized pathway aggregate provided by:

Kafka Granite, LLC
550 E HWY 153
Mosinee, WI 54455
800-852-7415
kafka@kafkagranite.com
www.kafkagranite.com

2.2 MATERIALS

A. Crushed Aggregate Materials:

1. Crushed Aggregate Material shall consist of sound, angular, durable particles.
2. Gradation, in accordance with ASTM C136:

Optimal Gradation		
Sieve	Sieve Size (mm)	Percent Passing
4	4.75	80% - 100%
8	2.36	65% - 90%
16	1.18	40% - 65%
30	0.6	25% - 55%
50	0.3	15% - 35%
100	0.15	10% - 20%
200	0.075	5% - 15%

B. Organic-Lock Binder

1. Patented powdered organic binder designed to be blended with crushed aggregate.

2. Made from 100% naturally occurring materials.

PART 3: EXECUTION

SPECIFIER NOTES:

Proper hydration of the Organic-Lock blended aggregate is crucial to the installation and longevity of the surface. The instructions below refer to Organic-Lock that has been pre-blended with aggregate and contains optimal moisture content. For more information on pre-wetting, and pre-blending Organic-Lock refer to our installation guideline video
https://www.kafkagranite.com/kafka-granite-organic-lock-stabilized-pathway-mix-installation

1. *Achieve best results installing Organic-Lock blended aggregate in dry conditions and temperatures above 40° Fahrenheit (5° Celsius). Both wet and cold conditions slow down the curing/drying process.*

3.1 PREPARATION

1. Prepare the Subgrade

   Excavate the area to the depth required so that finish grade can be established as noted on plans.

   A Foot-Traffic Pathway will require a full depth of 7-9 inches: 4-6 inches of compacted base depth together with 3 inches of compacted Organic-Lock Pathway Aggregate.

   Compact the subgrade to 95% Modified Proctor Density.

2. Prepare the Base

   Install the base material as per your region's approved DOT road base guidelines. Clear stone or ungraded base is NOT acceptable in this application. Compact the base to 95% modified proctor density.

   Foot-Traffic Pathway will require 4-6 inches of compacted base material.

   Depending upon the method of compaction the installation of base material may require separate lifts. 4 inches can be compacted in a single lift with a minimum 2-ton compaction roller.

   Compact the subgrade to 95% Modified Proctor Density using a single or double drum static roller or vibratory compactor.

3.2 WATERSHED MANAGEMENT

Crowns and/or cross-slopes must be incorporated into the compacted base material.

If the slope is 2% or lower, a crown should be incorporated into the pathway. If the slope is greater than 2%, incorporate a cross-slope.

Note: The addition of crowns and cross-slopes is heavily dependent upon surrounding watershed.

3.3 SPREADING

The use of a paving machine is recommended for large projects to evenly spread Organic-Lock Pathway Aggregate at the specified depth. It's recommended to screed the material to ensure the depth is consistent for smaller projects or projects with tight areas.

Spread the loose and uncompacted Organic-Lock Pathway Aggregate over the compacted base material.

Typically, a lift of 4 inches of loose, pre-wet Organic-Lock Pathway Aggregate will compact to the required 3-inch depth for Foot-Traffic Pathways.

3.4 COMPACTION

Make 4-6 passes using a 1-ton double or single static drum roller, or equivalent. A Foot-Traffic Pathway will typically require one lift, compacted to 3 inches.

Compaction will vary with different aggregates due to particle shape and size. It will compact 20-25%, less if using paving machinery. This level of compaction needs to be monitored as early as possible (starting during the test plot) to determine the actual degree of compaction. It is better to put down too much material and to remove it from the top than to put down too little and add a layer later.

Compact to 95% Modified Proctor Density.

Note: Vibratory compaction is acceptable for the base material but generally not suitable for Organic-Lock blended aggregate as it risks disassociating the bonds of the stabilized aggregate or allowing the fines and moisture to migrate to the surface, causing the surface to take on a smooth, concrete-like appearance. Organic-Lock Blended Aggregates should be compacted using a single or double drum static roller wherever possible. For tight spaces that are not accessible by drum rollers, a hand tamper is recommended. However, in certain circumstances, a vibratory or plate tamper can be used where the installer deems it to be more effective as hand-tamping over large spaces will create inconsistent results.

Provided the moisture content of the Organic-Lock blended aggregate is adequate, additional hydration should not be necessary. On dry, sunny days, however, the surface layer may start to dry out while installing, in which case, a light misting

would be appropriate to prevent surface cracks from appearing during compaction. Refer to our installation guideline video https://www.kafkagranite.com/kafka-granite-organic-lock-stabilized-pathway-mix-installation for more information.

3.5 COMPLETING INSTALLATION

Apply a light spray to the surface of the material to give a clean appearance. Apply water until the water begins to run-off.

Do not allow any traffic on the newly installed pathway until fully cured, a minimum of 24-72 hours.

3.7 3.6 REPAIRS AND PROTECTION

Excavate the damaged area and scarify exposed Organic-Lock Pathway Aggregate.

When possible, attic stock should be on hand for small repairs Water the material to achieve an 8-10% moisture content. Use the "snowball test" to determine moisture content - refer to https://www.kafkagranite.com/kafka-granite-organic-lock-stabilized-pathway-mix-installation for details. Apply the material to the excavated area and compact.

Allow the newly installed Organic-Lock Pathway Aggregate to cure.

When necessary, re-water and re-compact the material, ensuring that the final grade and crown are maintained.

3.7 MAINTENANCE

All outdoor products require a level of maintenance analysis. It is recommended to do a thorough analysis of your installed Organic-Lock blended aggregate 7 days after installation followed by monthly analysis to ensure no alterations are required.

Erosion Damage

The greatest element of concern is rainfall erosion. Often, this problem can be greatly reduced by adjusting the watershed areas surrounding the product itself. The best way to determine how the water is building up, is to examine your project area during a rainstorm. Learning where the water is coming from can lead to water diverting that dramatically reduces the stress on your surface.

Installing culverts, drains, cross slopes, crowns, or diverters can limit the majority of stress causing damage.

If you do experience erosion damage, first look at ways to get the water away or slow the water down, that's causing the damage...secondly, replace the lost material with new material following the guidelines below.

Excess Loose Material

Directly after the installation, the aggregate surface will be smooth because of the weight of the fresh compaction. As the surface weathers with traffic and time, the larger particles of the aggregate will loosen on the surface to create a natural look and feel which is often sought after. The loose aggregate particles on your surface should not exceed 1⁄4" in depth.

Sweeping off the excess particles can be accomplished in areas where excess 1⁄4" chip is not detrimental. These loose particles can also be shoveled and removed from site. The remaining surface will eventually chip loose again, so new material is recommended as a top up (see instructions below) after doing this more than once.

If material exceeds a 1⁄4", redistribute the particles over a greater surface, scarify the surface to a depth of 1" and water to a 1" depth and compact with a roller of no less than 1000-lbs. Keep traffic off for 24-72 hours.

Removing Debris

You can remove grass clippings, soil, debris or organic material by mechanically blowing or hand raking as needed.

Snow Plowing

When plowing snow, use a shoe lift or rubber baffle on the blade of the plow to lift the blade up 1/4" off the surface. Extra precautions should always be taken after the first snow and last snow of the season, as this is when the material is most prone (i.e. the ground is not frozen).

3.8 ADDING NEW BLENDED ORGANIC-LOCK BLENDED AGGREGATE MATERIAL TO DAMAGED AREAS

Below the loose surface particles, the firmed material should be stable to resist erosion and support the intended traffic.

If this lower level material incurs damage, we recommend the following:

Fixing Lightly Damaged Areas

Lightly damaged areas can be repaired by soaking, scarifying with a rake to 1-2 inches and compacting the scarified area using a roller or a hand tamper.

Adjusting Organic-Lock Blended Aggregate

The Organic-Lock gel activates each time it comes in contact with water, which allows for the blended aggregate to be physically broken up, re-worked and returned back to its initial state. This self-healing nature allows for a simplified maintenance procedure that leaves no sign of the maintenance itself.

For example:
If you have to run an irrigation line below your finished pathway, all you need to do is add water, dig the material up, put down your irrigation line, spread the material back in place, then water and compact it using a roller or a hand tamper back to new.

Fixing Larger or More Severely Damaged Areas

Excavate the damaged area to a depth of 2" to an approximate 50% increase in area (i.e. if your area is in a 4-foot radius circle, excavate a total of 6 feet in diameter.

Estimate amount of material lost or material needed to be topped up. Add this amount of preblended Organic-Lock aggregate in the area.

Blend this newly blended aggregate in by one of the following methods:

A. Rototill to a Depth of 2 Inches

   This needs to be done with multiple passes and should not exceed the depth of the Organic-Lock blended aggregate (i.e. avoid disrupting the base material). Spray the surface with a light spray and begin to till this material to achieve a homogeneous blend of the new and existing material. Add further water as you mix to achieve the optimal snowball (as seen in the snowball test).

B. Remove and Blend the Material Off Site

   Add the new Organic-Lock blended aggregate to the existing material on a clean pad. Using a front-end loader (or shovels for smaller projects) mechanically turn the material over until you achieve a homogeneous blend. Add water into this mixture until you achieve an optimal snowball (as seen in the snowball test).

Spread this newly blended material back into the area where the excavation was completed and compact using a roller or a hand tamper

Note: Maintenance or patching should not be compacted with a vibratory plate compactor because it will rattle and damage the surrounding cured area.

END OF SECTION



GREENDRIVEWAY

A GREEN ALTERNATIVE FOR PAVING & LANDSCAPING

Stabilized Gravel and Turf Surfaces

Green Landscaping Solutions for Residential and Commercial Applications.

GD Gravel™ | GD Geocell™

GD Grass™ | GD Solepave™





GD Gravel



GD Solepave



GD Grass



GD Geocell

What are core systems?

sustainable designs inspired by nature



Honeycombs

built by honeybees are unmatched in strength for their weight, a source of inspiration for Green Driveway.

porous paving... let the rain drain!

GD Gravel™
GD Solepave™ and GD Grass™
are popous across the ENTIRE surface,
offering better drainage than concrete,
asphalt and other permeable paving surfaces.
Accent your landscaping with GD Marker®.

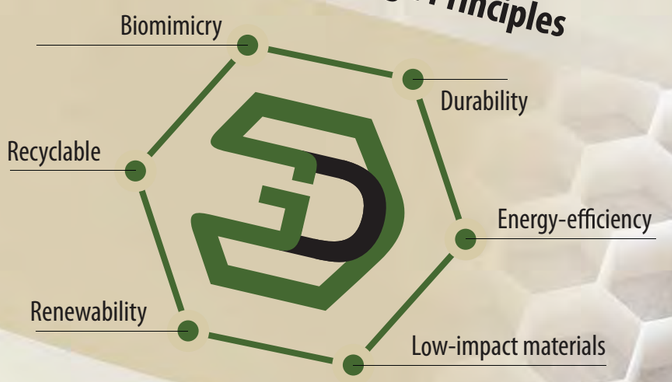
ABOUT GREEN DRIVEWAY DESIGNS

Engineering and design are keys to building a superior product. Our Green Driveway research and development department is constantly working to improve our already successful designs. In addition to creating new products, we often look to nature for inspiration, and we employ the use of the latest techniques and materials to bring the best products to market quickly. Our original designs have been recognized throughout the world as symbols of strength, quality and innovation.

Tracking market trends and spotting opportunities allow us to use our capabilities and expertise to improve the quality of people's lives in ways that are also commercially attractive for us and our customers. Also, by interacting with the extensive external know-how partners in universities and other industry research institutes, we are active at the forefront of today's most promising developments.

Environmentally-conscious design is integral to our vision to comply with the principles of economic, social, and ecological sustainability. Humbly acknowledging the need for responsible use of natural resources, it is important to us that Green Driveway products require a minimum of non-renewable resources, as well as impact the environment minimally. Manufacturing eco-friendly products that relate people with the natural environment is our passion.

Sustainable Design Principles





GREENDRIVEWAY is leading the way in sustainable landscaping solutions. ***Here's how...***

SUDS

"The aim of the SUDS approach is to mimic as closely as possible the natural drainage from a site before development and to treat runoff to remove pollutants. Adopting a holistic approach towards surface water drainage provides the benefits of combined water quality and quantity control, as well as increased amenity value. This is accomplished by managing the increased flows and pollution from surface water runoff that can arise from development, ideally utilizing a management train to achieve an equal balance of quantity, quality and amenity." –CIRIA

Our products are compatible with Sustainable (Urban) Drainage Solutions. GD™ Landscape Systems are porous surfaces. SUDS can be either porous or permeable. The important distinction and advantage between the two is: **Porous surfacing is a surface that infiltrates water across the entire surface.**

References:
– CIRIA (The Construction Industry Research And Information Association) ciria.org
– Brattebo, B. O., and D. B. Booth. 2003. "Long-Term Stormwater Quantity and Quality Performance of Permeable Pavement Systems."
– United States Environmental Protection Agency (EPA). Washington, D.C. "Field Evaluation of Permeable Pavements for Stormwater Management, Olympia, Washington."

Stormwater BMP
These completely porous surfaces allows the rain to drain through, therefore reducing the need for stormwater management infrastructure.

Valuable cooling effect
Reduce and mitigate urban heat island effects with these low-impact development practices allowing more vegetation and less concrete and asphalt.

Reduce risks of flooding
Flooding risks are reduced with every square foot of porous surfaces, since parking spaces account for over half of all non-porous development.

Improve quality of groundwater
Through bio-filtration these porous paving surfaces are more efficient at removing NPS pollutants and improving the quality of runoff while maintaining infiltration.

Recycled Plastic
Made of recycled polypropylene plastic for sustainability as well as lower costs, our products can also be repurposed and recycled at the end of their life-cycle.

Sustainable business
Helps businesses to "meet the needs of the present world without compromising the ability of the future generations to meet their own needs." – UN General Assembly (1987)

Sustainable homes
A key in reducing environmental impact with green building, by addressing efficient handling of water, as well as reducing pollution and environmental degradation.

Increase quantity of groundwater
The underlying stone reservoir temporarily stores surface runoff before infiltrating directly into the subsoil, reducing the exposure to the sun and heat, ensuring maximum infiltration.

LEED & SUDS compliant
Used in SUDS and LEED compliant porous paving BMPs for ideal draining and minimal environmental impact.

ADA compliant
Used in ADA disability compliant surfaces for pedestrians, bicycles, & wheelchair traffic.

Porous Paving:
a Stormwater BMP

Permeable surfaces have been demonstrated as effective in managing runoff from paved surfaces. Large volumes of urban runoff causes serious erosion and siltation in surface water bodies.

- Reduce stormwater runoff (to near 100%)
- Increase groundwater infiltration
- Reduce erosion problems caused by flooding
- Protect and recharge groundwater
- Reduce pollution and improve water quality through natural filtration
- Increase the quantity of quality water
- Preserve quality of local surface waterways
- Provide a valuable cooling effect

Permeable surfaces keep the pollutants in place in the soil or other material underlying the roadway, and allow water seepage to groundwater recharge while preventing the stream erosion problems. They capture the heavy metals that fall on them, preventing them from washing downstream and accumulating inadvertently in the environment. In the void spaces, naturally occurring micro-organisms digest car oils, leaving little but carbon dioxide and water; the oil ceases to exist as a pollutant. Rainwater infiltration its built-in stormwater management, is usually less than that of an impervious pavement with a separate stormwater management facility somewhere downstream.

Porous surfaces give urban trees the rooting space they need to grow to full size. A "structural-soil" pavement base combines structural aggregate with soil; a porous surface admits vital air and water to the rooting zone. This integrates healthy ecology and thriving cities, with the living tree canopy above, the city's traffic on the ground, and living tree roots below.

GD Gravel™ GD Grass™

True 100% Porous Surfaces

Water runs through the gravel or grass across the ENTIRE surface. This makes GD Gravel™ a true porous paving product that can be used in ADA-compliant surfaces for pedestrians, bicycles and wheelchair traffic. A Stormwater Best Management Practice (BMPs) designed to reduce stormwater volume, peak flows and/or non-point source pollution through evapotranspiration, infiltration and/or detention. Also, GD Gravel or GD Grass addresses a wide range of erosion control, eath retention, slope protection and stability issues.

GD Solepave™

Enhanced durability with SOLUV binder.

SOLEPAVE is a unique paving system designed with two key elements: GD Gravel grid and SOLUV binder. The combination of these two unique products creates a surface that is aesthetically pleasing, 100% porous, wheelchair accessible and allows for both flexibility in design as well as being suitable for vehicle use.

GD Geocell™

Stabilizing and protecting infill from erosion.

When filled with granular materials, GD Geocell creates a three dimensional erosion barrier and structural bridge that uniformly distributes weight-bearing loads. The cellular nature of GD Geocell enhances drainage and prevents build-up of hydrostatic pressure.

GD Geocell is ideal for Earth Retention, Slope Retention, Load Support & Water Channel Protection structures.

LEED

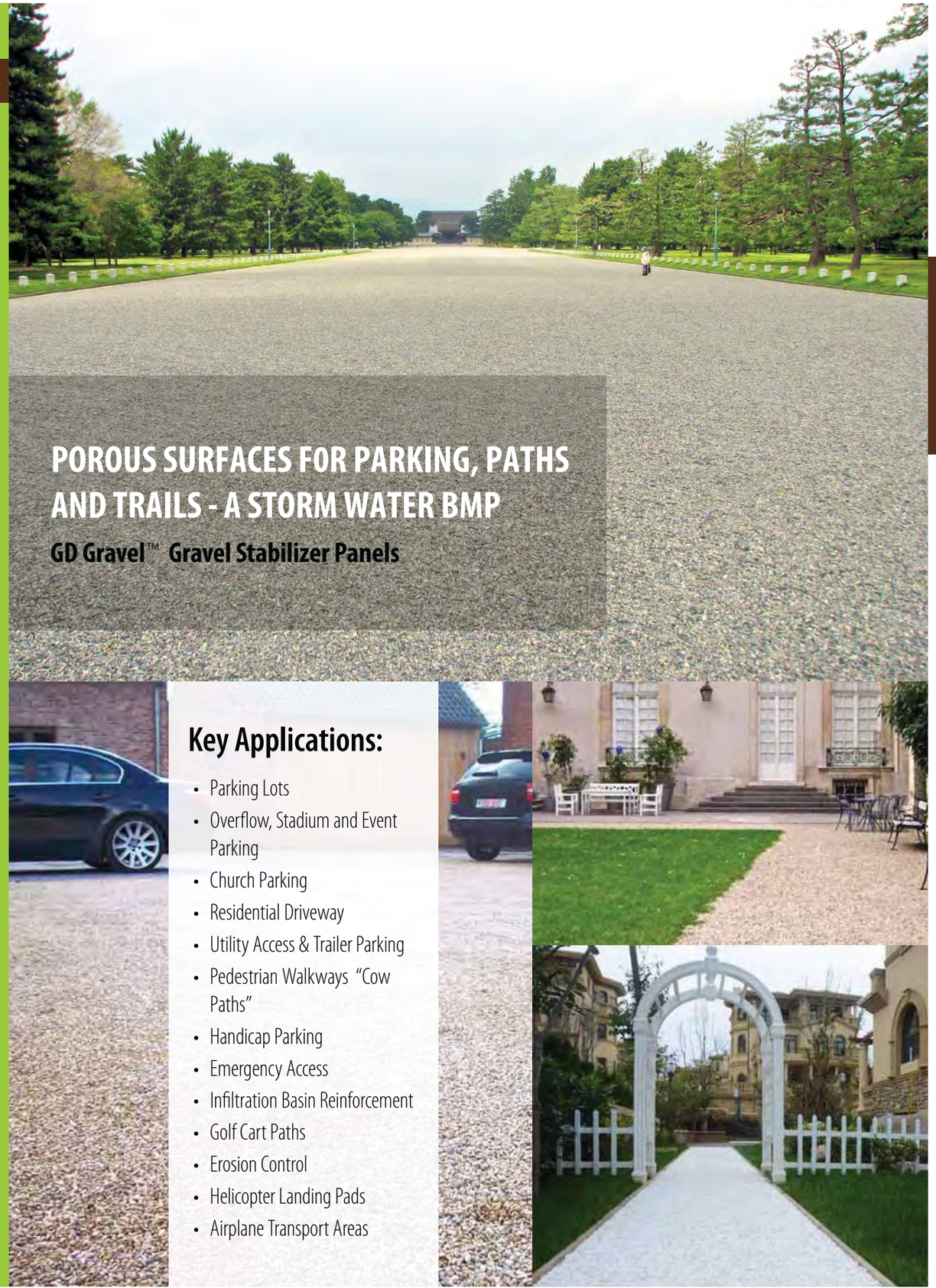
LEED® (Leadership in Energy and Environmental Design) is a national "Green" building assessment system developed by the United States Green Building Council (USGBC) to encourage and accelerate global adoption of sustainable green building and development practices. By defining green building through a common standard of measurement, LEED promotes integrated, whole-building design practices and helps raise awareness of green building benefits. LEED evaluates and rates the environmental performance of new and existing commercial, retail, institutional, educational and high-rise residential buildings over a project's life cycle. Developments incorporating LID practices, including permeable pavements, earn points toward this rating system and support the principles of a "Green Infrastructure" through the EPA. The higher the rating, the greater the impact on our ecology and future as whole.

PAVEMENT COMPARISON

GREENDRIVEWAY Environmentally Sustainable Benefits (LEED Credits*)	Concrete	Asphalt	Permeable Block Pavers	GD Gravel™	GD Grass™	GD Solepave™	GD Geocell™
Direct Stormwater Infiltration to reduce runoff quantity (SS 6.1)	None	None	Partial	✔	✔	✔	✔
Direct Stormwater Storage in Cross-section to reduce runoff quantity (SS 6.1)	None	None	Partial	✔	✔	✔	✔
Slow Stormwater Surface Flow Rate and Horizontal Migration (SS 6.1)	None	None	Partial	✔	✔	✔	✔
Improve Stormwater Quality & Treatment of NPS via natural filtration (SS 6.2)	None	None	Partial	✔	✔	✔	✔
Reduce Heat Island Effects with low SRI index on roof & non-roof areas (SS 7.1)	None	None	Partial	✔	✔	✔	✔
Water Efficient Landscaping (WE 1)	None	None	Partial	✔	✔	✔	✔
Innovative Wastewater Technology to reduce potable water demand and wastewater generation (WE 2)	None	None	Partial	✔	✔	✔	✔
Construction Activity Pollution and Erosion Prevention (SS Pre 1)	None	None	None	✔	✔	✔	✔
Materials Reuse to reduce demand for virgin materials and resources (MR 3)	None	None	None	✔	✔	✔	✔
Recycled Content (MR 4)	None	None	None	✔	✔	✔	✔
Protect or Restore Habitat for Site Development (SS 5.1)	None	None	Partial	✔	✔	✔	✔
Maximize Open Space for Site Development (SS 5.2)	None	None	Partial	✔	✔	✔	✔
Optimize Energy Performance in buildings via cool roofs and reduced solar reflection (EA 1)	None	None	Partial	✔	✔	✔	✔
ADA-compliant surface	✔	✔	✔	✔	✔	✔	✔

* Check with local organizations, and accredited professionals for exact details and accuracy, this is a general guide for most locations.
'LEED®' and related logo is a trademark owned by the U.S. Green Building Council®.





POROUS SURFACES FOR PARKING, PATHS AND TRAILS - A STORM WATER BMP

GD Gravel™ Gravel Stabilizer Panels

Key Applications:

- Parking Lots
- Overflow, Stadium and Event Parking
- Church Parking
- Residential Driveway
- Utility Access & Trailer Parking
- Pedestrian Walkways "Cow Paths"
- Handicap Parking
- Emergency Access
- Infiltration Basin Reinforcement
- Golf Cart Paths
- Erosion Control
- Helicopter Landing Pads
- Airplane Transport Areas

GREENDRIVEWAY leads the way in natural porous surfacing...

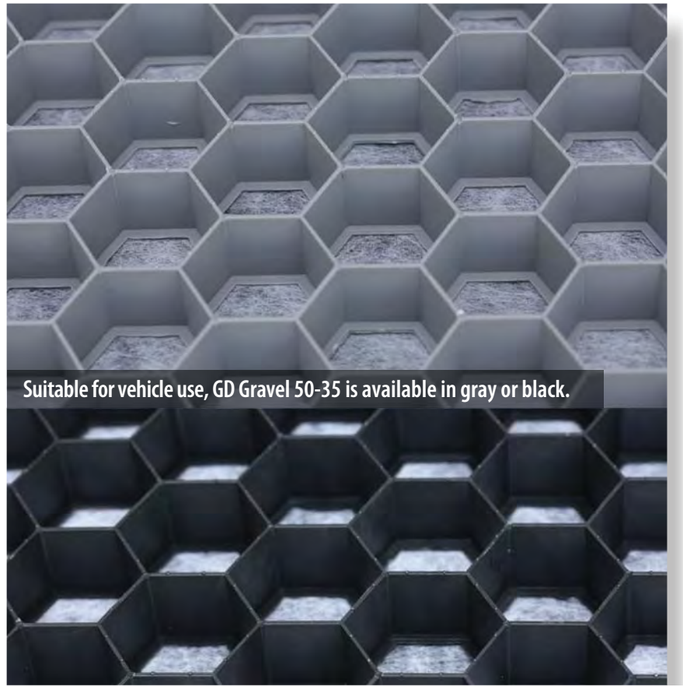
GRAVEL STABILIZER PANELS

Affordable, hassle-free gravel surfaces.

Part of a natural porous surface system, just add gravel to the interlocking panels of hexagon cells and you have an eco-friendly surface that costs less than asphalt, concrete, or block pavers. GD Gravel™ solves problems of aggregates sinking, migrating, and forming ruts without stabilization. GD Gravel™ Gravel Stabilizer offers hassle-free gravel paving for all types of vehicle or pedestrian traffic with no compromise in strength and durability.

The best choice for Low-impact Development.

GD Gravel™ gravel stabilizer panels are made from recycled or virgin PP (polypropylene) material, and the underside incorporates a durable geotextile that prevents weed growth without sacrificing drainage. Both LEED and SUDS compliant, this stormwater BMP reduces stormwater runoff significantly as well as mitigates urban heat-island effects. Able to address a wide range of erosion control, earth retention, slope protection, and stability issues, GD Gravel™ is also used in ADA disability compliant surfaces for pedestrians, bicycles, and wheelchair traffic. A 100% porous solution that is leading the way in sustainable and low-impact paving.



Suitable for vehicle use, GD Gravel 50-35 is available in gray or black.

Top 5 Benefits

- Gravel stays put, no ruts, no sinking, no problems.
- Environmentally Green porous paving surface.
- It's Beautiful with stunning curb appeal.
- Low Cost, less than asphalt, concrete, or pavers.
- Easy to install, in just four easy steps.



- **Material**: Recycled or Virgin PP
- **Colors**: White, Grey, Black, custom also available
- **UV & Chemical Resistant**
- **Membrane**: 50g/m Geotextile

GD Gravel panels lock together for added stability on slopes and grades.

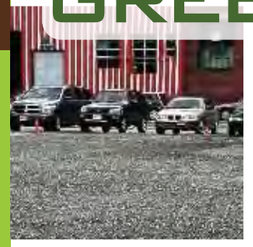


GD Gravel 60-40 features lateral drainage.



GREENDRIVEWAY

APPLICATIONS


Commercial Lots


Golf Courses


Playgrounds


Equestrian


Courtyards


Parks & Gardens


Parking Lots


Estate Walkways


Trailer and RV Parking


Patios

GD Gravel™



Solid Features

- Super strong, enhanced load bearing causes no ruts, separating or sliding with vehicle traffic.
- Address a wide range of erosion control, earth retention, slope protection, and stability issues.



- Keep maintenance costs low with easy upkeep and use less gravel, since the gravel won't wash away.
- Used in ADA-compliant surfaces for pedestrians, bicycles and wheelchair traffic.
- Geotextile backing underneath prevents weed growth and adds stability.
- When filled, the product is practically invisible.
- Easily add parking lines and edge indicators with GD Marker™ marking caps.
- Used in SUDS and LEED compliant paving installations.





Before & After

Residential parking areas always look neat and clean with GD Gravel™. Reduce the amount of gravel needed for a new installation by over half and, since no tire ruts form in the stabilized gravel, there is no need for constant leveling or adding further gravel. Additionally, the attached geotextile is a weed suppressor, so a win-win for a porous paving application.



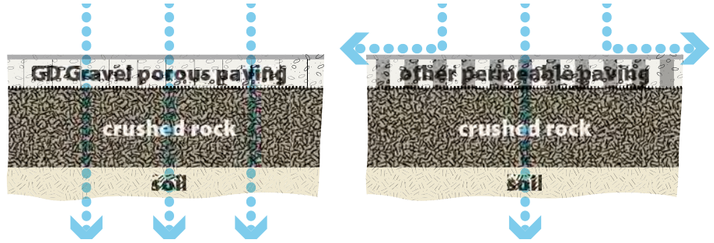




A Stormwater BMP

Porous paving systems reduce the need for traditional stormwater infrastructure, therefore reducing overall project costs associated with the installation and maintenance of typical stormwater drainage systems. This creates a surface that is superior to other types of pavement and has a lower life cycle cost.

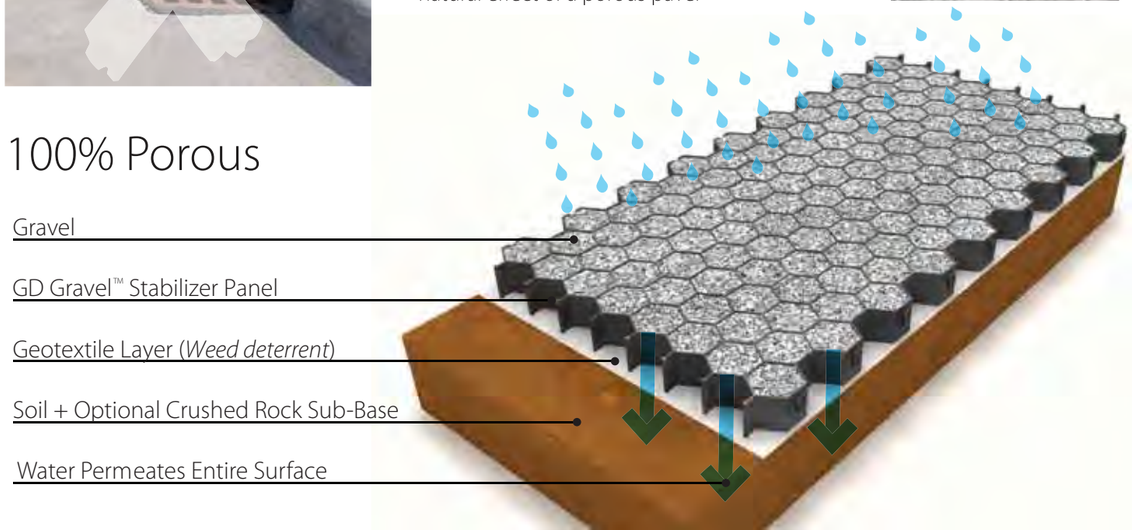




Environmentally friendly in design, function and material. Many plastic grass grids on the market lack the strength necessary to last and absorb high levels of traffic, not the case with our honeycomb design. You will find GD Gravel™ provides amazing stability, a sustainable drainage model as well as providing the desirable visual and natural effect of a porous paver



100% Porous



GD Gravel™

EASY INSTALLATION



1 BASE PREPARATION. For subgrade or base preparation, level and clear the area of large objects such as rocks, or pieces of wood. Excavate area allowing for unit thickness and top layer. Leave 50 mm (2.0 inches) for GD Gravel™ 50-30 and 50-35 and top layer to meet final grade. For GD Gravel™ 38-18 leave 30 mm (1.2 inches). For subgrade soil compaction a vibratory plate, compactor, or roller is recommended OR as per specifications provided by the Project Engineer or Landscape artchitect.

2 PLACE THE PANELS. Position the panels on the prepared subgrade with geotextile face down. Cut to shape with pruning shears or a utility knife. Use protective gloves to avoid abrasions. Top of hexagon cell panels should be 1 cm below adjacent hard surfaced pavements or final grade. Place first row of panels against a stationary edge if possible. Stagger panels in a bricklayer pattern. The panels have interlocking connectors, however most installations do not require them to be used. Only in areas with greater traffic or steeper grade are they used to lock one direction or both directions. No anchors are needed for gravel stabilizer panels since the geotextile backing prevents any push up.

3 FILL THE CELLS. Infill gravel or aggregate into the hexagon cells by hand, or by 'back dumping' directly from a truck. Trucks should be careful to avoid sharp turns on unfilled panels. Preferably the truck would dump gravel first on the edge of the installation area, then working inward, therefore only driving on filled cells. Gravel can be spread by hand with flat shovels, asphalt or tarmac rakes, blades, or stiff brooms. A power broom may spread the gravel faster.

4 SMOOTH SURFACE. Level gravel or aggregate to cover GD Gravel gravel stabilizer panels by 1 cm (0.4 inches) so the panels are just out of sight. This allows for aesthetics, stability and protection. Optionally, a vibratory plate, compactor, or roller can be used to set the gravel into the cells.



GD Gravel 38-18 retail packaging

APPLICATIONS GUIDE

** Also available in virgin plastic for even greater strength*

Specifications Model	Recommended Aggregate Size	Slopes / Grades greater than 30°	Strength/m² unfilled / filled	100% Recycled Plastic	Recommended Duty	Best Use Resid.	Best Use Comm.	Best Use HGV
GD Gravel 38-18R *	3-8 mm (Very Fine-Fine)	✔	40 Tons / +100 Tons	✔	Very Light	✔		
GD Gravel 50-35HDR *	5-15 mm (Fine-Medium)	✔	150 Tons / +250 Tons	✔	Medium-Heavy		✔	✔
GD Gravel 60-40HDR *	5-20 mm (Fine-Coarse)	✔	200 Tons / +300 Tons	✔	Medium-Heavy		✔	✔



GD Marker™

DELINEATION

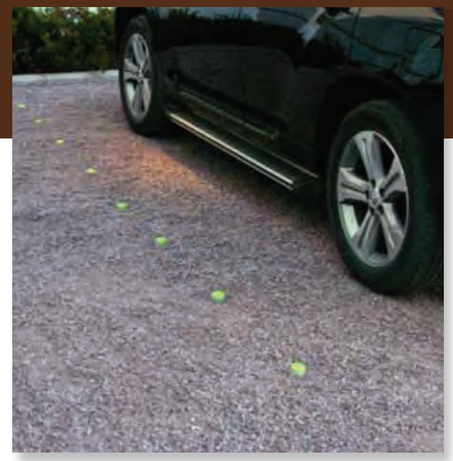
The ONLY real solution for marking gravel, with GD Marker™ defining parking space lines or pathway edges is simple and easy.

The easily visible, yet unobtrusive GD Marker™ fits snugly into the GD Gravel™ or GD Grass™ stabilizer panels.



GD Marker™ makes it easy to delineate parking space lines.

GD Marker™ is available in white, gray and green.



GREENDRIVEWAY

A GREEN ALTERNATIVE FOR PAVING & LANDSCAPING

Flexible sizes are available to fit every application. Custom sizes may also be available.

GD Gravel Specifications	Cell Diameter / Height / Wall	Weight per m²	Sheet Area MEDIUM / JUMBO	Sheets per Pallet* MEDIUM / JUMBO	40' HQ Container Quantity	Sheet Dimensions MEDIUM	JUMBO
GD Gravel 38-18R	38 mm / 18 mm / 1 mm (1.5 in / 0.7 in / 39 mil)	1.2 kg (2.64 lbs)	0.92 m² / 2.76 m² (9.9 ft² / 29.7 ft²)	133 / 133	3,532 m² (38,004 ft²)	1150 x 800 mm (45.3 x 31.5 in)	2300 x 1200 mm (90.6 x 47.2 in)
GD Gravel 50-30	50 mm / 30 mm / 1.3 mm (2.0 in / 1.2 in / 50.7 mil)	1.6 kg (3.5 lbs)	0.96 m² / 2.76 m² (10.3 ft² / 31 ft²)	78 / 78	2188 m² (23,543²)	1200 x 800 mm (47.2 x 31.5 in)	2300 x 1200 mm (90.5 x 47.2 in)
GD Gravel 50-35HD/R	50 mm / 35 mm / 2.3 mm (2.0 in / 1.4 in / 89.7 mil)	2.9 kg (6.4 lbs)	0.90m² / 1.67 m² (9.7 ft² / 18 ft²)	68 / 68	1,900 m² (20,444 ft²)	1150 x 780 mm (45.3 x 30.7 in)	2160 x 780 mm (85 x 30.7 in)
GD Gravel 60-40HDR	60 mm / 40 mm / 2.5 mm (2.4 in / 1.6 in / 98 mil)	3.5 kg (7.7 lbs)	1.15 m² / 2.3 m² (12.4 ft² / 24.8 ft²)	60 / 60	1,656 m² (17,825²)	1150 x 1000 mm (45.3 x 39.4 in)	2300 x 1000 mm (90.6 x 39.4 in)



AN ALL-INCLUSIVE SURFACE...
GD Gravel structural grid and resin-bound gravel.
A wheelchair accessible surface ideal for pedestrian and vehicular use.





Four Freedoms Park
New York City

RESIN SPECIFICATIONS

SOLUV	UV Resistant Resin	SOLAMB	Non-UV Resistant Resin
Material	Moisture cure, single component polyurethane binder, solvent-free	Material	Moisture cure, single component polyurethane binder
Colour	Clear	Colour	Amber
UV Resistance	Excellent	UV Resistance	No
Viscosity	500 – 2000 cps	Viscosity	500 – 2000 cps
Strength	High elongation, shock absorption	Strength	High elongation, shock absorption
Binder	Aliphatic Polyurethane	Binder	MDI Polyurethane
Flash Point	>93.3 °C (200 °F)	Flash Point	>93.3 °C (200 °F)
Packaging	5 gallon, drums, totes	Packaging	5 gallon, drums, totes
Ideal Storage Temperature	15-25 °C (60-80 °F)	Ideal Storage Temperature	15-25 °C (60-80 °F)

"The timeless beauty of natural stones."

SOLEPAVE™
STABILIZED PAVING SYSTEM



Take advantage of local surface material.

Solepave is a unique paving system composed of two key parts: GD Gravel grid and SOLUV binder. The combination of these 2 unique products creates a surface that is aesthetically pleasing, 100% porous, wheelchair accessible and allows for both flexibility in design as well as vehicular use.

Structurally sound and aesthetically pleasing.

Using local stone, glass or other products, you can create a surface that blends, conforms and integrates more cohesively into your landscape surface. Using the structurally stable honeycomb shaped grid (GD Gravel), filled with clean gravel and over-topped with resin-bound (SOLUV) gravel, glass or other, you have a surface that is A.D.A., S.U.D.S. and LEED compliant, 100% porous and aesthetically flexible.

SOLECOL's SOLUV binder is designed to bind the aggregate, glass or other product type together over the top of the plastic grid. This unique binder is UV resistant, solvent-free, clear and can handle extreme weather conditions. Also offered, SOLAMB, a non-UV resistant binder for applications where additional structural stability is required.



SOLEPAVE resin-bound pea gravel in GD Gravel honeycomb structural grid.



Ideal year round surface for pedestrian or vehicle use.



A variety of surface materials can be used with SOLEpave resin binder including gravel or glass.





MAX LOAD SUPPORT – FOR FIRE LANES & GREEN PARKING LOTS

GD Grass™ Turf Reinforcement Grids





GD Grass allows stormwater to permeate an entire ADA surface.

APPLICATIONS GUIDE

Specifications Model	Cell Diameter / Height / Wall	Weight per m^2	Sheet Area MEDIUM / JUMBO	Sheets per Pallet* MEDIUM / JUMBO	40'HQ Container Quantity	Sheet Dimensions MEDIUM	JUMBO
GD Grass 50-30	50 mm / 30 mm / 1.3 mm (2.0 in / 1.4 in / 79 mil)	2.9 kg (6.4 lbs)	0.96 m^2 / 2.88 m^2 (10.3 ft^2 / 31 ft^2)	66 / 33	1,900.8 m^2 (20,460 ft^2)	1200 x 720 mm (47.2 x 28.32 in)	2160 x 1200mm (85.0 x 47.2 in)
GD Grass 50-35	50 mm / 35 mm / 2 mm (2.0 in / 1.4 in / 79 mil)	2.9 kg (6.4 lbs)	0.90 m^2 / 1.67 m^2 (9.7 ft^2 / 18 ft^2)	66 / 33	1,900.8 m^2 (20,460 ft^2)	1150 x 780 mm (45.3 x 30.7 in)	2160 x 780 mm (85.0 x 40.7 in)
GD Grass 60-40	60 mm / 40 mm / 2.5 mm (2.4 in / 1.6 in / 98 mil)	3.5 kg (7.7 lbs)	1.15 m^2 / 2.3 m^2 (12.4 ft^2 / 24.8 ft^2)	120 / 60	1,656 m^2 (17,825 ft^2)	1150 x 1000 mm (45.3 x 39.4 in)	2300 x 1000 mm (90.6 x 39.4 in)

"Yes, you can park on my grass!"

GD Grass™

TURF REINFORCEMENT GRIDS

A 'green' choice for low-impact paving

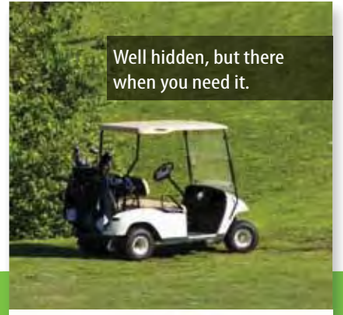
Beautiful, sustainable and economical solution to manage stormwater and reduce heat island effects in parking and traffic areas. Parking lots, access roads, and driveways with GD Grass™ porous paving are stabilized so turf can grow, with no ruts or sinking, with all the benefits of reducing stormwater runoff significantly and improving water quality with natural pollution filtration and treatment. In addition, GD Grass™ can reduce and mitigate urban heat island effects with this cool low-impact development practice used in SUDS and LEED compliant sites.

No unsightly infrastructure is seen, just green grass

GD Grass™ turf reinforcement grids are sheets of connected hexagon cells. Made from recycled or virgin PP (polypropylene) material, our proprietary manufacturing process provides a rigid honeycomb design that holds its uniform hexagon shape which provides maximum load bearing. With optional GD Marker™, easily add line delineation for parking spaces or edge indicators. You will find GD Grass™ provides amazing stability, grass protection, and a sustainable drainage model in a paver that is nearly invisible.



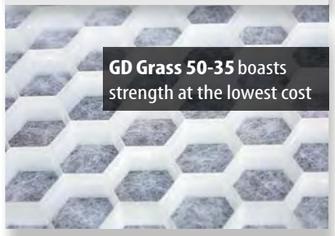
GD Grass 50-35



Well hidden, but there when you need it.



- **Material**: Recycled or Virgin PP
- **Colours**: Green, custom also available
- **UV & Chemical Resistant**
- **Membrane**: None, Optional
- **Interlocking Grid Connector**: Built-in



GD Grass 50-35 boasts strength at the lowest cost



GD Grass 60-40 features horizontal water movement

Key Applications:

- Emergency Access / Fire Lanes
- Overflow, Stadium and Event Parking Lots
- Church Parking
- Residential Driveway
- Utility Access & Trailer Parking
- Infiltration Basin Reinforcement
- Golf Cart Paths
- Erosion Control
- Helicopter Landing Pads
- Airplane Transport Areas

Benefits:

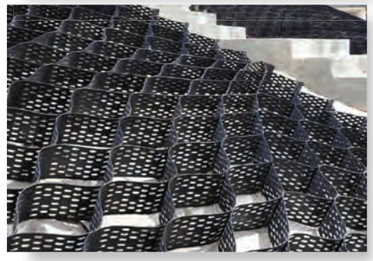
- Porous Load Bearing Surface
- Compressive Strength: +250 Tons/m2
- Stormwater BMP for Paving
- LEED & SUDS Credit

Stabilize and Protect Infill from Erosion

GD Geocell™

STABILIZATION SYSTEM





GD Geocell™ offers cost-effective, long term slope and channel proterction and stabilization.

Take advantage of a reusable stabilizing system.
The GD Geocell geosynthetic cellular confinement system is a matrix of lightweight, expandable and flexible thermoplastic strips that are ultrasonically bonded to form a strong, dimensionally stable and inert honeycomb structure.

When filled with granular materials, GD Geocell™ creates a three dimensional erosion barrier and structural bridge that uniformly distributes weight-bearing loads. The cellular nature of GD Geocell™ enhances drainage and prevents build-up of hydrostatic pressure.

Forms a Long Lasting Structural Barrier

GD Geocell is fabricated from a High Density Polyethylene (HDPE). The cell walls are perforated creating permeable walls to allow water to drain through the system.

GD Geocell™ is ideal for Earth Retention, Slope Retention, Load Support & Water Channel Protection structures.

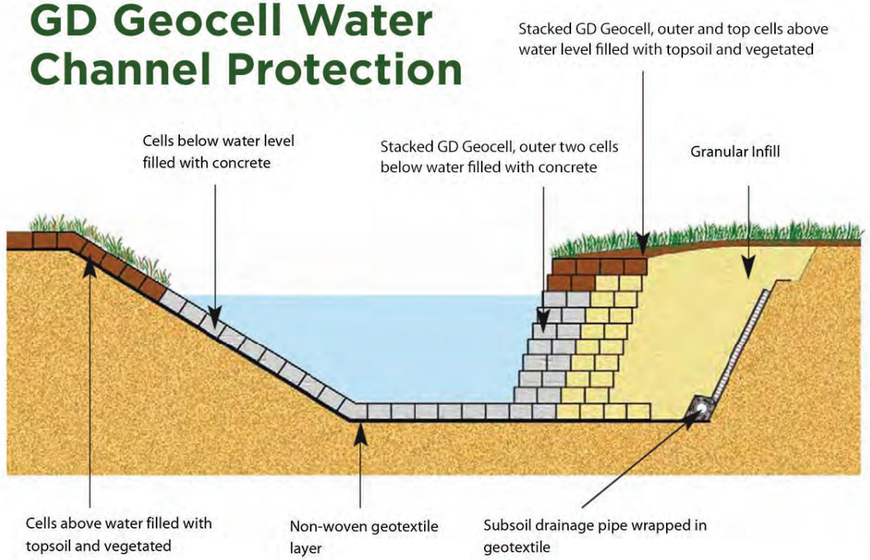
EARTH RETENTION
- Earth Walls

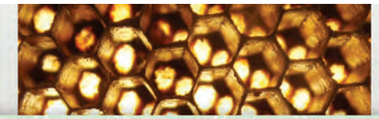
LOAD SUPPORT
- Roadways and Verges
- Pathways
- Railway Bases

SLOPE RETENTION
- Vegetative Slopes
- Road-sink Banks
- Embankments

CHANNEL PROTECTION
- Embankment Walls
- Waterway Channels

GD Geocell Water Channel Protection





GREENDRIVEWAY

A GREEN ALTERNATIVE FOR PAVING & LANDSCAPING

About Us

Green Driveway's products are manufactured in China and we are part of a team of sales representatives throughout Europe, Australia and North America. In addition to quality manufacturing, we bring real world experience and engineering experience to our North American and Mexican clientele. We provide timely delivery at surprisingly reasonable costs. Allow us to introduce to our line of world-class Green Driveway products and services.



Our Products

Excellence in polymer manufacturing is the cornerstone of our company. Priding ourselves on our engineering and craftsmanship in thermoplastic polymers, we employ precision equipment and experienced engineers to produce our designs in-house. Our techniques are specialized for Green Driveway permeable surfacing applications, using only superior injection type molding processes. We continually work hard to deliver value and green solutions utilizing our Green Driveway line of products.



Our Values

INNOVATION Forward thinking is a must for our engineers and designers, as well as all aspects of our business. Continuing to push for better original designs in order to create and maintain an advantage in the industry, we are always exploring new materials and processes to provide better quality, greater strength and lower cost.

STABILITY The honeycomb that honey bees build is unmatched in strength for its weight; the source of inspiration for GD Driveway. Firmly fixed on nature's design, we create products that are light weight and amazingly strong. We back this up with consistent, dependable service.

SUSTAINABILITY Master craftsmen in plastics, we have a passion for things that conserve, preserve and maintain. Our aim is to design Green Driveway products that impact the environment minimally, relate people with the natural environment, and require a minimum of non-renewable resources.



WWW.GREENDRIVEWAY.COM

GREENDRIVEWAY

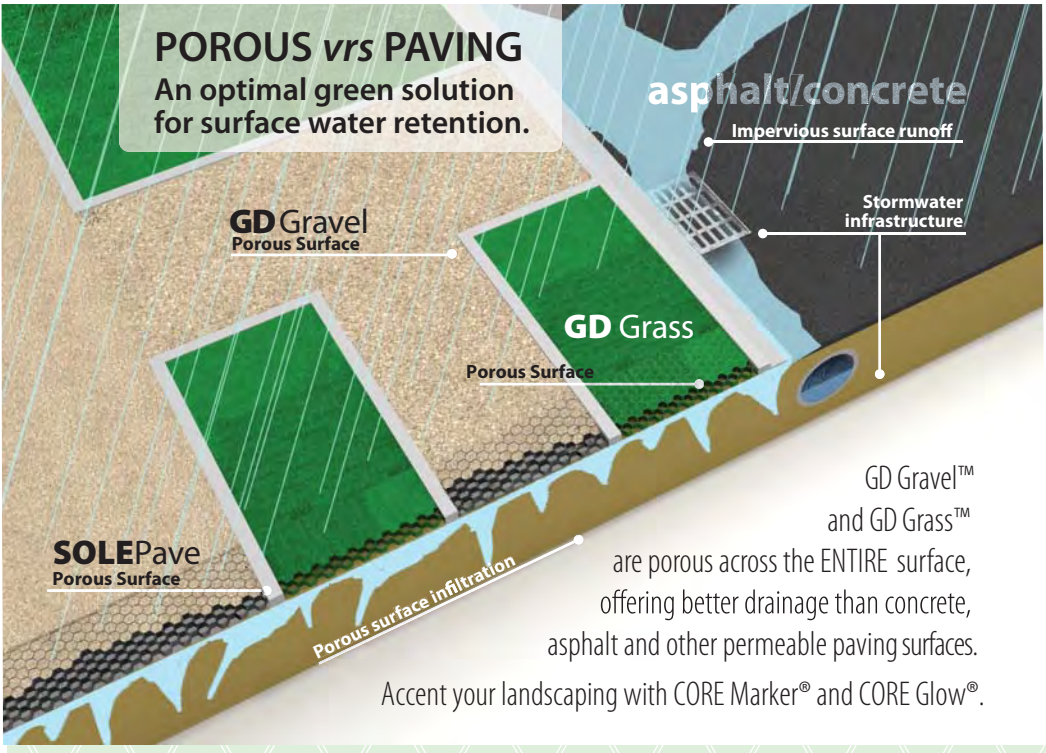
A GREEN ALTERNATIVE FOR PAVING & LANDSCAPING

Permeable Gravel or Grass Driveways

A proven green alternative to paving that prevents runoff and helps portect the environment.

Green Driveway offers green alternatives to paving, namely permeable stabilized gravel or grass surfaces ideal for driveways, parking areas, public walkways and pathways. The core of our product line is a proven system of honeycomb-celled polypropylene panels that interconnect as a stabilizing base for access roads, parking lots, pathways or landscaped parks and gardens. The underside incorporates a durable geo-textile which allows water to drain easily, dramatically suppressing weed growth.
Our line of Green Driveway products are high quality and eco-friendly, manufactured to last and require minimal maintenance. These driveway, roadway and landscaping products are manufactured in strict accordance with ISO 9001 and ISO 14001 standards. These standards are implemented from raw material acquisition to delivery of the finished article.
Each and every product is specifically designed to provide a long-term solution and minimize the impact of construction on the environment. Where possible, we source recycled materials to engineer our products, thus reducing our carbon footprint.

Toll Free: 1.855.384.7336 (38green)
info@greendriveway.com
www.greendriveway.com

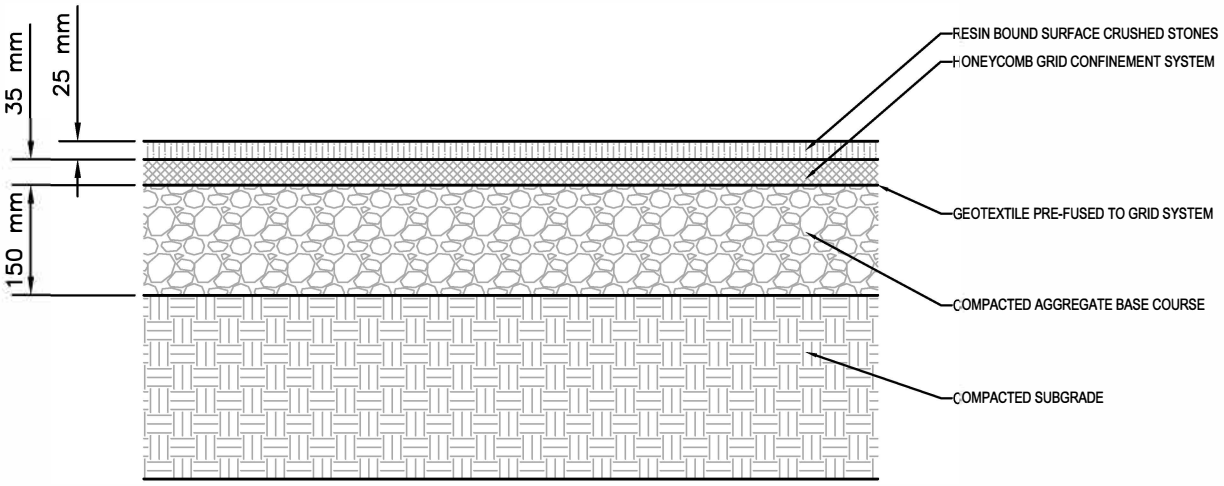


GD Gravel™ and GD Grass™ are porous across the ENTIRE surface, offering better drainage than concrete, asphalt and other permeable paving surfaces.

Accent your landscaping with CORE Marker® and CORE Glow®.

Green Driveway Distributor:

SOLEPAVE PAVING PUBLIC SPACES - PEDESTRIAN SURFACES



NOTE:

- RESIN BOUND STONES: 2 mm - 8 mm OR AS PER ARCHITECT SPECIFICATIONS.
- HONEYCOMB GRID SYSTEM: CORE GRAVEL 50-35 SYSTEM FILLED WITH 2 mm - 8 mm STONE, WASHED WITH NO FINES.
- GEOTEXTILE IS FUSED TO BOTTOM OF CORE GRAVEL, NOT INSTALLED SEPARATELY.
- COMPACTED AGGREGATE BASE COURSE IS 150mm (6") LAYER, COMPACTED LARGE, SINGLE SIZE STONES WHICH MEETS STATE DOT SPECIFICATIONS FOR POROUS APPLICATIONS.

Appendix B – POST-CONSTRUCTION STORMWATER MANAGEMENT PLAN (PCSMP)

VENTURA COUNTYWIDE STORMWATER QUALITY PROGRAM
POST-CONSTRUCTION STORMWATER MANAGEMENT PLAN (PCSMP)
FOR
Camp Hess Kramer
PARCEL #:

Project Name: Camp Hess Kramer

Preparation/Revision Date: **4/26/2021**

Prepared for:
Name of Owner/Developer:
Stress Address:
City, State, Zip Code:
Telephone:

Prepared by:
Name and Title of Preparer: Kirby DuBay, Engineer in Training
Company Name: Stantec Consulting Services, Inc.
Stress Address: 111 E Victoria Street
City, State, Zip Code: Santa Barbara, CA, 93101
Telephone: (805) 963-9532

I hereby certify that the information provided in this Application is correct.

Application Prepared by: Kirby DuBay, Stantec Consulting Services Inc.
Print Name and Firm

Signed
Signature of Project Engineer in the Firm Named Above

Title
Affix Professional registration stamp of the person named above with signature and expiration date

Project Name: Camp Hess Kramer

STEP 1: DETERMINE PROJECT APPLICABILITY

Instructions:
For new development projects, answer yes, no, or NA to questions (1) - (10) below.
For redevelopment projects, answer yes, no, or NA to questions (11) - (13) below.

NEW DEVELOPMENT PROJECTS	
Does the new development project fall within categories (1) - (10) below?	
Project Type and/or Characteristics	**Y/N/NA**
1) Development projects equal to 1 acre or greater of disturbed area that adds more than 10,000 square feet of impervious surface area **→go to Step 2**	
2) Industrial parks with 10,000 square feet or more of total altered surface area **→go to Step 2**	
3) Commercial strip malls with 10,000 square feet or more of impervious surface area **→go to Step 2**	
4) Retail gasoline outlets with 5,000 square feet or more of total altered surface area **→go to Step 2**	
5) Restaurants (Standard Industrial Classification (SIC) of 5812) with 5,000 square feet or more of total altered surface area **→go to Step 2**	
6) Parking lots with 5,000 square feet or more of impervious surface area, or with 25 or more parking spaces **→go to Step 2**	
7) Streets, roads, highways, and freeway construction of 10,000 square feet or more of impervious surface area **→ go to Roadway Projects**	
8) Automotive service facilities (Standard Industrial Classification (SIC) of 5013, 5014, 5511, 5541, 7532-7534 and 7536-7539) of 5,000 square feet or more of total altered surface area **→go to Step 2**	
9) Projects located in or directly adjacent to, or discharging directly to an Environmentally Sensitive Area (ESA), where the development will: a. Discharge stormwater runoff that is likely to impact a sensitive biological species or habitat; and b. Create 2,500 square feet or more of impervious surface area **→go to Step 2**	

10) Single-family hillside homes (see Section 2 of the TGM for specific requirements) **→go to SF Hillside**	

Project Name: Camp Hess Kramer

PROJECT APPLICABILITY, CONT.

REDEVELOPMENT PROJECTS	
For redevelopment projects that fall within categories (1) through (9) above, and that conduct land-disturbing activities that result in the creation, or addition, or replacement of 5,000 square feet or more of impervious surface area on an already developed site, answer questions 11-13 below.Existing single-family dwelling and accessory structures are exempt from redevelopment projects unless such projects create, add, or replace 10,000 square feet of impervious surface area.	
Project Type and/or Characteristics	**Y/N/NA**
11) Projects where redevelopment results in an alteration to more than fifty percent of impervious surfaces of a previously existing development, and the existing development was not subject to the post development stormwater quality control requirements of Board Order 00-108, these projects must mitigate the entire redevelopment project area **→go to Step 2**	N/A
12) Projects where redevelopment results in an alteration to more than fifty percent of impervious surfaces of a previously existing development, and the existing development was subject to the post development stormwater quality control requirements of Board Order 00-108, the project must mitigate only the altered portion of the redevelopment project area and not the entire project area **→go to Step 2**	N/A
13) Projects where redevelopment results in an alteration of less than fifty percent of impervious surfaces of a previously existing development these projects must mitigate only the altered portion of the redevelopment project area and not the entire project area **→go to Step 2**	Y

Project Name: Camp Hess Kramer

STEP 2: ASSESS SITE CONDITIONS

Provide an assessment of the project site using the following tables

New Development Project General Characteristics

General Project Characteristics	Area (acres)
Total Project Site Area	
Total Disturbed Area	
Total Existing (Pre-Project) Impervious Area	
Post-Project Impervious Area [1]	
Area of Green Roof (ET-1) [1]	
Area Draining to Hydrologic Source Controls (ET-2) [1]	
Revised Post-Project Impervious Area	0.00
Project Imperviousness (%)	

Redevelopment Project General Characteristics

General Project Characteristics	Area (acres)
Total Project Site Area	179.13
Total Altered Area [6]	58.90
Total Existing (Pre-Project) Impervious Area	7.90
Was existing (pre-project) impervious area subject to post-development stormwater quality control requirements? [2]	Y
Amount of Existing Impervious Area Altered [3]	0.10
Amount of Impervious Area Added	13.50
% Alteration of Existing Impervious Area [4]	N/A
Post-Project Impervious Area (Impervious Area to be Mitigated) [1], [4]	13.60
Area of Green Roof (ET-1) [1]	0.00
Area Draining to Hydrologic Source Controls (ET-2) [1]	0.00
Revised Post-Project Impervious Area	13.60
Project Imperviousness (%) [5]	23.09%

Project Name: Camp Hess Kramer

Project Description

Briefly describe project:
Camp Hess Kramer sits on approximately 192.2 acres within Little Sycamore Canyon in Malibu, northwesterly of the intersection of Pacific Coast Highway (PCH) and Yerba Buena Road, on the southerly boundary of Ventura County.
Describe current and proposed zoning and land use designation:
Describe topography of project area. Identify low and high points and the location of steep slopes (provide a range of grades):
Describe the site's soil types (A, B, C, D) and geological conditions:
Per the Ventura County Soils Map the project site is located in an area with Soil Numbes 1 and 4, per the Ventura County Technical Guidance manual (TGM). Onsite infiltration testing conducted adjacent to theinfiltration basin basin location resulted in varied measured infiltration rates. Refer to attachments for geotechnical report excerpts. *Attach soil type information*

Project Name: Camp Hess Kramer

Project Description, cont'd

Describe the site's groundwater conditions (e.g. depth to seasonal high groundwater):

Is there offsite drainage on the site? If so, identify the location(s) and source(s) of offsite drainage and the volume of water running onto the site:
Describe any existing utilities within the project area that would limit the possible locations of certain BMPs:
Describe any environmentally sensitive areas (e.g. riparian areas, wetlands) within the project area:

Geotechnical considerations:	
Does the site contain any of the following characteristics:	**Y/N/NA**
Collapsible Soil	
Expansion Soil	
Potential for seismically-inducted soil liquefaction	
Additional considerations:	
Attach relevant geotechnical information	

Project Name: Camp Hess Kramer

STEP 2: POLLUTANTS OF CONCERN

Pollutants of Concern (See Section 3.3 of TGM)

Activity / Potential Land Uses	Potential Pollutant*								
	Sediment	Nutrients	Metals	Pesticides	Oxygen Demanding Substances	Toxic Organics	Oil & Grease	Bacteria	Trash and Debris
Other [fill in if necessary]									
Other [fill in if necessary]									

*Denote potential pollutant with "x"

Receiving Waterbody Listings (see Section 3.3. of TGM)

Receiving Waterbody (watershed indicated in parentheses)	**Constituent Group [7]**	**Distance to Project (ft)**
Other [fill in if necessary]		

[1] Applicant should enter post-project impervious cover prior to accounting for green roof and hydrologic source control (HSC) credits. Volume reduction provided by green roofs and HSCs are accounted for implicitly in the sizing calcuations for BMPs by assuming the roof area covered by a green roof or the area draining to a HSC is pervious rather than impervious when caluclating the runoff coefficient for the site. Green roofs and HSCs are not required to be considered for all project locations and types. In order to obtain credit, Green Roofs and HSCs must be designed as specified in the TGM. Additional detail on Green Roofs (ET-1) and HSCs (ET-2) can be found in Section 6 of the TGM.

[2] Land-disturbing activity that results in the creation or addition or replacement of less than 5,000 square feet of impervious surface area on an already developed site, or that results in a decrease in impervious area which was subject to the post development stormwater quality control requirements of Board Order 00-108, is not subject to mitigation unless so directed by the local permitting agency

[3] Redevelopment does not include routine maintenance activities that are conducted to maintain the original line and grade, hydraulic capacity, or original purpose of the facility or emergency redevelopment activity required to protect public health and safety. Impervious surface replacement, such as the reconstruction of parking lots and roadways, that does not disturb additional area and maintains the original grade and alignment, is considered a routine maintenance activity. Agencies' flood control, drainage, and wet utilities projects that maintain original line and grade or hydraulic capacity are considered routine maintenance. Redevelopment also does not include the repaving of existing roads to maintain original line and grade.

[4] "% Alteration of Existing Impervious Area" determines the 50% threshold which is key in determining portion of site that must comply with post-construction requirements - see Step 1 redevelopment categories for more detail. The amount of "Post Project Impervious Area" that must adhere to post-construction requirements is dependant on 50% threshold

[5] "Project Imperviousness" is calculated using the "Total Project Area" except when redevelopment projects that must mitigate only the altered portion of the redevelopment project area. In this case, the "Total Disturbed Area" is used to calculate "Project Imperviousness"

[6] For the purposes of this calculation, Total Altered Area shall mean any area that is altered as a result of land disturbance, such as clearing, grading, grubbing, and excavation. This excludes areas used exclusively for temporary stockpiling.

[7] If a waterbody is listed for "toxicity" and the cause and/or contribution to toxicity is known, then the consituent group known to contribute to toxicity are listed here (in lieu of listing "toxicity")

Project Name: Camp Hess Kramer

STEP 3: APPLY SITE DESIGN PRINCIPLES AND TECHNIQUES

Provide a brief description of site design principles and techniques included within the proposed project site.

Site Design Measures [1]	Included? Y/N/NA	Brief Description of the Site Design Measure
Site Planning	Y	Site grading will direct stormwater runoff towards detention and infiltration basins prior to discharging offsite. Pre-treatment BMPs will be implimented.
Protect and Restore Natural Areas	Y	Natural areas will be protected and restored.
Minimize Land Disturbance	Y	The use of landscaped areas and the infiltration basin will help reduce the effective imperviousness of the site by treating and retainig onsite stormwater runoff.
Minimize Impervious Cover	Y	Landscaped areas, planter areas, and an infiltration basin are incoporated into the plan.
Apply LID at Various Scales	Y	The use of landscaped areas and the infiltration basins will help reduce the effective imperviousness of the site by treating and retainig onsite stormwater runoff.
Implement Integrated Water Resource Management Practices	Y	Infiltration of stormwater runoff and selction of drought-tolderant landscaping.

[1] Refer to Section 4.2 - 4.7 of the TGM for applicable Design Criteria.

Project Name: Camp Hess Kramer

STEP 4: APPLY SOURCE CONTROL MEASURES

Provide a brief description of the source control measures included in the proposed project site.

Site-Specific Source Control Measures[1]	Included? Y/N/NA	Brief Description of the Source Control Measure
S-1: Storm Drain Message and Signage	Y	Storm drain signage will be implemented.
S-2: Outdoor Material Storage Area Design		
S-3: Outdoor Trash Storage and Waste Handling Area Design	Y	An area(s) will be designated for trash storage and waste handling. Covered trash enclosures per City Specifications.
S-4: Outdoor Loading/Unloading Dock Area Design		
S-5: Outdoor Repair/Maintenance Bay Design		
S-6: Outdoor Vehicle /Equipment/ Accessory Washing Area Design		
S-7: Fueling Area Design		
S-8: Proof of Control Measure Maintenance	Y	A maintenance plan witll be provided.

[1] Refer to Fact Sheets in Section 5 of the TGM for detailed information and design criteria

Project Name: Camp Hess Kramer

STEP 5: APPLY BMPS TO REDUCE EIA TO <=5%

New development and redevelopment projects (Categories 1-6, 8, and 9) must reduce EIA to <=5%

Step 5a: Calculate Allowable EIA

EIA is defined as impervious area that is hydrologically connected via sheet flow over a hardened conveyance or impervious surface without any intervening medium to mitigate flow volume.

The allowable "EIA" for a project is calculated as:

$$EIA_{allowable} = (A_{project})*(\%_{allowable}) \quad \text{Equation 2-1}$$

Where:

$EIA_{allowable}$ = The maximum impervious area from which runoff can be treated and discharged offsite (and not retained onsite) [acres]

$A_{project}$ = The total project area [acres] [1]

$\%_{allowable}$ = 5 percent

Input:		**Units**
$A_{project}$ [1]	58.90	Acres
$\%_{allowable}$	5.00%	Percent
$EIA_{allowable}$	**2.95**	Acres

Step 5b: Calculate Impervious Area to be Retained

The impervious area from which runoff must be retained onsite is the total impervious area minus the EIA allowable, which should be calculated as follows:

$$A_{retain} = TIA - EIA_{allowable} = (IMP*A_{project}) - EIA_{allowable} \quad \text{Equation 2-2}$$

Where:

A_{retain} = the drainage area from which runoff must be retained [acres]

TIA = total impervious area [acres]

IMP = imperviousness of project area (%)

Input:		**Units**
Imperviousness	23.09%	
$A_{project}$ [1]	58.90	Acres
$EIA_{allowable}$	2.95	Acres
A_{retain}	**10.66**	Acres

Project Name: Camp Hess Kramer

BMPS TO REDUCE EIA TO <=5%, CONT.

Step 5c: Calculate the Volume to be Retained (SQDV)

The runoff volume that is to be retained onsite should be calculated using Equation 2-3 below:

$$V_{retain} = C*(0.75/12)*A_{retain}$$ Equation 2-3

Where:

V_{retain} = The stormwater quality design volume (SQDV) that must be retained onsite [ac-ft]

C = runoff coefficient (equals 0.95 for impervious surfaces)

Input:		Units
C	0.95	
A_{retain}	10.66	Acres
V_{retain}	0.633	ac-ft
	206,148.1	gallons
	27,557.8	cu.ft.

Continue to Step 5d

Project Name: Camp Hess Kramer

STEP 5d: SELECT RETENTION BMPs

Select and size Retention BMPs to meet the 5% EIA Requirement. Retention BMPs include INF1-6, RWH-1, and ET 1 and 2. See TGM, Section 6 for more information.

Retention BMPs	Included? Y/N	Drainage Area Retained (acres) [2]	Drainage Area Runoff Coefficient	Volume Retained (SQDV) (ac-ft) [1],[2]	If not applicable, state brief reason
Infiltration BMPs					
INF-1: Infiltration Basin	Y		0.95		
INF-2: Infiltration Trench			0.95		
INF-3: Bioretention			0.95		
INF-4: Drywell			0.95		
INF-5: Permeable Pavement			0.95		
INF-6: Proprietary Infiltration			0.95		
INF-7: Bioinfiltration			0.95		
Rainwater Harvesting BMPs					
RWH-1: Rainwater Harvesting			2		
			TOTAL Volume Retained	0.000	ac-ft
				0.0	gallons
				0.0	cu.ft.
			REMAINING Volume to meet 5% EIA requirement	0.6	ac-ft
				206,148	gallons
				27,558	cu.ft.

[1] SQDV Methodology #3 used here.

[2] If a Retention BMP is used more than once on a site (i.e., 2 Infiltration Trenches implemented on one site) then drainage area and volume retained shown here should be additive. A separate BMP sizing worksheet (see Appendix E of the TGM) should be submitted for each BMP.

ADDITIONAL INSTRUCTIONS: Retention BMPs must be used onsite to the maximum extent practicable. If the remaining volume to meet 5% EIA cannot be met, then project applicants must demonstrate technical infeasibilty. Consult Section 3.2 of the 2011 TGM for infeasability criteria. A technical infeasability site-specific analysis must be submitted. Projects that cannot prove technical infeasibility must reduce EIA to <=5% using Retention BMPs.

If onsite Retention BMPs cannot feasibly be used to meet the 5% EIA Requirement, move onto Step 5e; if 5%EIA Requirement is met go to Step 7

	Y/N/NA

A completed copy of the applicable "BMP Sizing Worksheet(s)" for the project's Retention BMPs from Appendix E of the TGM is included as an attachment. BMPs must be sized to meet the SQDV or SQDF (See Section 2 Step 7 of the TGM).	Y

Project Name: Camp Hess Kramer

STEP 5e: SELECT AND SIZE BIOFILTRATION BMPS TO REDUCE EIA TO <=5%

New development and redevelopment projects that demonstrate technical infeasibility (see Section 3.2 of TGM) for reducing EIA to <= 5% using Retention BMPs are eligible to use Biofiltration BMPs to achieve the 5% EIA Requirement.

	Y/N
Is it technically infeasible for Retention BMPs to meet the 5% EIA Requirement?	
If yes, volume-based biofiltration BMPs shall be sized to treat 1.5 times the volume not retained using Retention BMPs.	

The onsite biofiltered volume ($V_{biofilter}$), should be calculated as follows:

$$V_{biofilter} = (V_{retain} - V_{achieved}) * 1.5 \qquad \text{Equation 2-4}$$

Where:

$V_{biofilter}$ = the volume that must be captured and treated in a Biofiltration BMP [ac-ft]

V_{retain} = the stormwater quality design volume (SQDV) that must be retained [ac-ft]

$V_{achieved}$ = the volume retained onsite using Retention BMPs [ac-ft]

Input		Units
$V_{achieved}$	0.000	ac-ft
V_{retain}	0.633	ac-ft
$V_{biofilter}$	**0.95**	ac-ft
	309,222	gallons
	41,337	cu.ft.

BIOFILTRATION BMPs, CONT.

Biofiltration BMPs	Included? Y/N	Drainage Area Biofiltered (acres) [3]	Drainage Area Runoff Coefficient	Volume Biofiltered (1.5xSQDV) (ac-ft) [2],[3]	If not applicable, state brief reason
BIO-1: Bioretention with Underdrain			0.95		
BIO-2: Planter Box	Y	0.60	0.95	0.053	
BIO-3: Vegetated Swale [1]			0.95		
BIO-4: Vegetated Filter Strip [1]			0.95		
BIO-5: Proprietary Biotreatment [1]			0.95		
TOTAL Volume Biofiltered				0.05	ac-ft
				17,412.8	gallons
				2,327.7	cu.ft
REMAINING Volume to be addressed by Alternative Compliance				0.91	ac-ft
				297,613.6	gallons
				39,784.9	cu.ft

[1] BIO-3 and BIO-4 are flow-based and should be calculated using SQDF for sizing (see Table 2-1 of the TGM for the applicable design criteria for sizing). The SQDV is shown here for 5% EIA Requirement compliance purposes only.

[2] SQDV Methodology #3 used here.

[3] If a Biofiltration BMP is used more than once on a site (e.g., 2 Planter Boxes implemented on one site) then drainage area and volume biofiltered shown here be additive. A separate BMP sizing worksheet (see Appendix E of the TGM) should be submitted for each BMP.

ADDITIONAL INSTRUCTIONS: Certain new development and redevelopment project types are eligible for alternative compliance measures if onsite Retention and/or Biofiltration BMPs cannot feasibly be used to meet the 5% EIA requirement. Infeasibility is described in Section 3.2 of the TGM. A technical feasability site-specific analysis must be submitted. Projects that cannot prove infesibility must reduce EIA to <=5%.

If onsite Retention BMPs and/or Biofiltration BMPs cannot feasibly be used to meet the 5% EIA standard, move onto Step 6, otherwise, skip Step 6.

	Y/N/NA
A completed a copy of the applicable "BMP Sizing Worksheet(s)" for the project's Biofiltration BMPs from Appendix E of the TGM is included as an attachment.. BMPs must be sized to meet the 1.5 times SQDV or SQDF (see Section 2, Step 7 of the TGM) requirement. Guidance on flow based design for 150% sizing provided in Table 2-1 of the TGM.	

Project Name: Camp Hess Kramer

STEP 6: ALTERNATIVE COMPLIANCE [1], [2]
Mitigation Volume

► *Alternative compliance options will be based on the "mitigation volume." The mitigation volume is the difference between the volume of runoff associated with 5% EIA and the volume of runoff associated with the actual EIA achieved onsite less than or equal to 30% EIA.*
► *The offsite mitigation requirement for EIA is excess of 30% (>30%) is 1.5 times the amount of stormwater not managed onsite.*
► *Applicants must contact the local approval agency before proceeding with Alternative Compliance*

6a) Determine the volume of runoff that is retained and biofiltered onsite ($V_{ret/bio}$) using the equation below:

$$V_{ret/bio} = (V_{achieved} + (V_{biofiltered}/1.5)) \quad \text{Equation 2-5}$$

Where:

$V_{ret/bio}$ = the total volume of runoff retained and/or biofiltered onsite using Retention and Biofiltration BMPs [ac-ft]
$V_{achieved}$ = the runoff volume retained onsite [ac-ft]
$V_{biofiltered}$ = the runoff volume biofiltered onsite [ac-ft]

Eqn. 2-5		**Units**
$V_{achieved}$	0.000	ac-ft
$V_{biofiltered}$	0.053	ac-ft
$V_{ret/bio}$	**0.036**	ac-ft
	11,608.5	gallons
	1,551.8	cu.ft.

6b) Determine the Mitigation Volume ($V_{mitigation}$) @ 1:1 ratio, using the equation below:

$$V_{mitigation} = V_{retain} - V_{ret/bio} \quad \text{Equation 2-6}$$

Where:
$V_{mitigation}$ = the volume of runoff that must be mitigated offsite [ac-ft]
V_{retain}= the SQDV that must be retained onsite per the 5% EIA requirement calculated in Equation 2-3 [ac-ft]

$V_{ret/bio}$ = the total volume of runoff retained and/or biofiltered onsite using Retention and Biofiltration BMPs calculated in Equation 2-5 [ac-ft]

Eqn. 2-6		**Units**
V_{retain}	0.633	ac-ft
$V_{ret/bio}$	0.036	ac-ft
$V_{mitigation}$	**0.597**	ac-ft
	194,539.6	gallons
	26,006.0	cu.ft.

Project Name: Camp Hess Kramer

ALTERNATIVE COMPLIANCE, CONT.

6c) Determine whether EIA is reduced to <= 30% EIA

6c-1: Calculate area associated with 30% EIA ($A_{30\%eia}$)

$$A_{30\%eia} = (IMP*A_{project}) - (30\%*A_{project})$$ Equation 2-7

Where:

$A_{30\%eia}$ = the impervious portion of the drainage area retained or biofiltered at 30% EIA [acres]

IMP = total imperviousness of project area (%)

$A_{project}$ = the total project area [acres]

Eqn. 2-7		**Units**
IMP	23%	
$A_{project}$	58.90	acres
$A_{30\%eia}$	**-4.07**	acres

6c-2:Calculate volume retained or biofiltered onsite at 30% EIA ($V_{30\%eia}$):

$$V_{30\%eia} = C*(0.75/12)*A_{30\%eia}$$ Equation 2-8

Where:

$V_{30\%eia}$ = SQDV retained or biofiltered at 30% EIA [ac-ft]

(note: for the purposes of this calculation, the biofiltered volume does not include the 1.5 multiplier)

C = runoff coefficient (equals 0.95 for impervious surfaces)

$A_{30\%eia}$ = the impervious area from which runoff would have been retained or biofiltered at 30% EIA [acres]

Eqn. 2-8		**Units**
C	0.95	
$A_{30\%eia}$	-4.07	acres
$V_{30\%eia}$	**-0.242**	ac-ft
	-78,744.5	gallons
	-10,526.5	cu.ft.

Project Name: Camp Hess Kramer

ALTERNATIVE COMPLIANCE, CONT.

6d) Determine if the project's current EIA is greater than, equal to, or less than the volume at 30% EIA ($V_{30\%eia}$)

$V_{ret/bio}$ = the total volume of runoff retained and/or biofiltered onsite using Retention and Biofiltration BMPs [ac-ft]
$V_{30\%eia}$ = SQDV retained or biofiltered at 30% EIA [ac-ft]

$V_{30\%eia}$	-0.242	ac-ft
$V_{ret/bio}$	0.036	ac-ft
Your project's EIA is	**LESS THAN**	30%

Less than or equal to (<=) 30% EIA → go to Step 6e

Greater than (>) 30% EIA → go to Step 6f-g

[1] In order to simplify the use of the spreadsheet, these steps deviate from those presented in the 2011 TGM

[2] References to equations (e.g., Equation 2-5) refer to equations contained within the 2011 TGM

Projects w/ EIA<=30%

6e) Pursue Alternative Compliance for $V_{mitigation}$ at 1:1 Ratio

$V_{mitigation}$ = the volume of runoff that must be mitigated offsite [ac-ft] calculated in Equation 2-6

$V_{mitigation}$	**0.597**	ac-ft
	194,539.6	gallons
	26,006.0	cu.ft.

The site is required to mitigate the following volume:

0.597	ac-ft
194,539.6	gallons
26,006.0	cu.ft.

Continue to Step 7

Project Name: Camp Hess Kramer

ALTERNATIVE COMPLIANCE, CONT.

Projects with EIA > 30%

When the EIA of the project exceeds 30% due to infeasibility, the runoff volume associated with the EIA up to 30% must be mitigated offsite at a one-to-one ratio and the runoff volume associated with the EIA greater than 30% must be mitigated offsite at 1.5 times the volume.

6f) Determine the Mitigation Volume for 30% EIA ($V_{mitigation30\%}$), using the equation below:

$$V_{mitigation30\%} = V_{Retain} - V_{30\%EIA} \qquad \text{Equation 2-11}$$

Where:

$V_{mitigation30\%}$ = the mitigation volume for 30% EIA [ac-ft]

V_{retain} = the SQDV that must be retained onsite per the 5% EIA requirement calculated in Equation 2-3 [ac-ft]

$V_{30\%eia}$ = SQDV at 30% EIA [ac-ft]

		Units
V_{retain}	N/A	ac-ft
$V_{30\%eia}$	N/A	ac-ft
$V_{mitigation30\%}$	**N/A**	ac-ft
		gallons
		cu.ft.

6g) Determine the Mitigation Volume for >30% EIA ($V_{mitigation>30\%}$), using the equation below:

$$V_{mitigation>30\%} = (V_{30\%eia} - V_{ret/bio})*1.5$$

Where:

$V_{mitigation>30\%}$ = the mitigation volume for >30% EIA [ac-ft]

$V_{30\%eia}$ = SQDV at 30% EIA [ac-ft]

$V_{ret/bio}$ = the total volume of runoff retained and/or biofiltered onsite using Retention and Biofiltration BMPs calculated in

		Units
$V_{30\%eia}$	N/A	ac-ft
$V_{ret/bio}$	N/A	ac-ft
$V_{mitigation>30\%}$	**N/A**	ac-ft
		gallons
		cu.ft.

6h) Determine the Total Mitigation Volume ($V_{mitigationtotal}$), using the equation below:

$$V_{mitigationtotal} = V_{mitigation>30\%} + V_{mitigation30\%} \quad \text{Equation 2-13}$$

Where:

$V_{mitigationtotal}$ = the total mitigation volume for 30% EIA [ac-ft]

$V_{mitigation>30\%}$ = the mitigation volume for >30% EIA, calculated using Equation 2-11 [ac-ft]

$V_{mitigation30\%}$ = the mitigation volume for 30% EIA calculated using Equation 2-10 [ac-ft]

Eqn. 2-13		**Units**
$V_{mitigation30\%}$	N/A	ac-ft
$V_{mitigation>30\%}$	N/A	ac-ft
$V_{mitigationtotal}$	**N/A**	ac-ft
		gallons
		cu.ft.

The site is required to mitigate the following volume:

N/A	ac-ft
	gallons
	cu.ft.

Continue to Step 7

Project Name: Camp Hess Kramer

STEP 7: APPLY TREATMENT CONTRL MEASURES

► *Stormwater runoff from EIA and developed pervious surfaces must be mitigated using Retention BMPs, Biofiltration BMPs, or Treatment Control Measures (See Chapter 6 of TGM).*
► *Treatment Control Measures should be selected per the BMP selection process outlined in Section 3.3 of the TGM.*
► *BMPs must be sized to meet the SQDV or SQDF. See Section 2, Step 7 of the for guidance on calculating the SQDV and SQDF.*

	Y/N
Completed copy of the applicable "BMP Sizing Worksheet(s)" for the project's stormwater BMP(s) from Appendix E of the Technical Guidance Manual is included.	Y

Project Name: Camp Hess Kramer

ADDITIONAL REQUIRED SUBMITTALS

Yes	**Site map** that includes: o Property boundary o Major roadways or landmarks o Scale and north arrow o Drainage areas o Surrounding land uses o Presence of Environmentally Sensitive Areas o Open space preservation areas o Impervious areas o Natural hydrologic features o Location of discharge(s) o Existing and planned utilities o Topography (including steep slopes) o Key activities such as outdoor material storage, parking, food preparation, etc. o Potential pollutant areas (e.g., fueling island) o Location of nearby (within 2,000 ft of development project) bus or train station(s) o Location and type of source control measures o Location and type of stormwater BMPs
Yes	**BMP Sizing Worksheet(s) (see Appendix E of TGM); design specifiations and details must also be provided for Green Roofs and Hydrologic Source Controls (ET-1 & 2)**
Yes	Stormwater Treatment Device Access and Maintenance Agreement (see Appendix H of TGM for template)
Yes	Maintenance Plan (See Appendix I of TGM for guidance)
Yes	Technical Infeasibility Analysis – if Retention BMPs cannot be used, the applicant must submit a site-specific analysis showing technical infeasibility as described in Section 3.2 of the TGM. Technical infeasibility may include some (or all) of the components submitted with soil, groundwater and/or geotechnical reports. Technical infeasibility must also account for Rainwater Harvesting. Rainwater Harvesting is not required to be used if the available demands do not meet the volume required for 80% capture using a 72-hour drawndown time (See RWH-1 in Section 6 of the TGM for more detail).
Yes	**Soil Type Information** (may include site specific analyses, available geologic or geotechnical reports and/ or the Ventura Hydrology Manual Soil Map zoomed into site level)
	Groundwater Information (may include available groundwater data, site specific redoximorphic analytical/groundwater monitoring results, or known groundwater impacts such as contaminated sites registered with the State Water Board)
	Geotechnical Reports (may include site specific analyses with information on collapsible soils, expansive soil, liquefaction, or groundwater mounding analysis)

	Rainwater Harvesting - Include calculations and justification for rainwater harvesting demand. Section 3.2 for guidance of the TGM.

Appendix C – BMP SIZING WORKSHEETS

Sizing Worksheet

Designer: Kirby Dubay Project Proponent: Date: 4/16/2021 Project: Camp Hess Location: Ventura County	Treatment 1
Type of Vegetation:	
Outflow Collection:	
Step 1: Determine water quality design volume	
1-1. Enter Project area (acres), $A_{project}$	$A_{project}$ = 1.2 acres
1-2. Enter the maximum allowable percent of the Project area that may be effective impervious area (refer to permit), ranges from 5-30%, $\%_{allowable}$	$\%_{allowable}$ 5 %
1-3. Determine the maximum allowed effective impervious area (ac), $EIA_{allowable} = (A_{project})*(\%_{allowable})$	$EIA_{allowable}$= 0.06 acres
1-4. Enter Project impervious fraction, *Imp* (e.g. 60% = 0.60)	Imp= 0.6
1-5. Determine the Project Total Impervious area (acres), $TIA=A_{project}*Imp$	TIA= 0.8 acres
1-6. Determine the total area from which runoff must be retained (acres), $A_{retain}=TIA-EIA_{allowable}$	A_{retain} = 0.7 acres
1-7. Determine pervious runoff coefficient using Table E-1, C_p	C_p = 0.1
1-8. Calculate runoff coefficient, $C = 0.95*imp + C_p\ (1-imp)$	C = 0.63
1-9. Enter design rainfall depth of the storm (in), P_i	P_i = 0.75 in
1-10. Calculate rainfall depth (ft), $P = P_i/12$	P = 0.06 ft
1-11. Calculate water quality design volume (ft^3),	SQDV= 1150 ft^3

$SQDV=43560 \bullet C^{*}P^{*}A_{retain}$	

Step 2: Determine the design percolation rate			
2-1. Enter the design saturated hydraulic conductivity of the amended filter media (2.5 in/hr recommended rate), K_{design}	K_{design} =	2.5	in/hr
Step 3: Calculate Bioretention/Planter Box surface area			
3-1. Enter water quality design volume (ft^3), *SQDV*	SQDV =	1150	ft^3
3-2. Enter design saturated hydraulic conductivity (in/hr), K_{design}	K_{design} =	2.5	in/hr
3-3. Enter ponding depth (max 1.5 ft for Bioretention, 1 ft for Planter Box) above area, d_p	d_p =	1.5	ft
3-4. Calculate the drawdown time for the ponded water to filter through media (hours), $t_{ponding} = (d_p/K_{design}) \times 12$	$t_{ponding}$=	7.2	hrs
3-5. Enter the storm duration for routing calculations (use 3 hours unless there is rationale for an alternative), $T_{routing}$	$T_{routing}$ =	3	hrs
3-6. Calculate depth of water (ft) filtered by using the following two equations: $d_{filtered,1} = (K_{design} \times T_{routing})/12$ $d_{filteret,2} = d_p /2$	$d_{filtered,1}$ = $d_{filtered,2}$ =	0.63 0.75	ft ft
3.7 Enter the resultant depth (ft) (the lesser of the two calculated above), $d_{filtered}$	$d_{filtered}$ =	0.63	ft
3-8. Calculate the infiltrating surface area as follows (ft^2): $A_{req} = SQDV/(d_p + d_{filtered})$	A_{req} =	541	ft^2

Step 4: Calculate Bioretention Area Total Footprint	
4-1. Calculate total footprint required by including a buffer for side slopes and freeboard (ft^2) [A_{req} is measured at the as the filter bottom area (toe of side slopes)], A_{tot}	A_{tot} = 1333 ft^2
Step 5: Calculate Underdrain System Capacity	
To calculate the underdrain system capacity, continue through steps 5-1 to 5-7.	
Step 5: Calculate Underdrain System Capacity	
5-1. Calculated filtered flow rate to be conveyed by the longitudinal drain pipe, $Q_f = K_{design} A_{req}/43{,}200$	Q_f = cfs
5-2. Enter minimum slope for energy gradient, S_e	S_e =
5-3. Enter Hazen-Williams coefficient for plastic, C_{HW}	C_{HW} =
5-4. Enter pipe diameter (min 6 inches), D	D = in
5-5. Calculate pipe hydraulic radius (ft), $R_h = D/48$	R_h = ft
5-6. Calculate velocity at the outlet of the pipe (ft/s), $V_p = 1.318 C_{HW} R_h^{0.63} S_e^{0.54}$	V_p = ft/s
5-7. Calculate pipe capacity (cfs), $Q_{cap} = 0.25\pi (D/12)^2 V_p$	Q_{cap} = cfs

Sizing Worksheet

Designer: Kirby Dubay Project Proponent: Date: 4/16/2021 Project: Camp Hess Location: Ventura County	Treatment 2
Type of Vegetation: (describe)	_____ _____
Outflow Collection: (Check type used or describe "Other")	____ Grass Channel / Swale ____ Street Gutter ____ Storm Drain ____ Underdrain Used ____ Other _____ _____

Step 1: Calculate the design flow	
1-1. Enter Project area (acres), $A_{project}$	A_{design} = 1.4 acres
1-2. Enter impervious fraction, *Imp* (e.g. 60% = 0.60)	Imp = 0.2
1-3. Determine pervious runoff coefficient using Table E-1, C_p	C_p = 0.1
1-4. Calculate runoff coefficient, $C = 0.95*imp + C_p\ (1\text{-}imp)$	C = 0.25
1-5. Enter design rainfall intensity (in/hr), *i*	i = 0.2 in/hr

1-6. Calculate water quality design flow (cfs), *SQDF= CiA*	SQDF =	0.07	cfs
Step 2: Calculate the minimum width			
2-1. Enter the stormwater quality design flow (cfs), *SQDF*	SQDF =	0.07	cfs
2-2. Enter the minimum linear unit application rate (0.005 cfs/ft), $q_{a,min}$	$q_{a,min}$=	0.005	cfs/ft
2-3. Calculate the minimum width of filter strip (ft), W_{min}	W_{min}=	15	ft
Step 3: Calculate the design flow depth			
3-1. Enter filter strip longitudinal slope, *s* (ft/ft)	*s* =	0.03	ft/ft
3-2. Enter Manning roughness coefficient (0.25-0.30), n_{wq}	n_{wq} =	0.27	
3-3. Enter width of impervious surface contributing area (perpendicular to flow), *W* (ft)	W =	270	ft
Step 3: Calculate the design flow depth			
3-4. Calculate average depth of water using Manning equation (inches), $d_f = 12 * [SQDF * n_{wq} / 1.49 W_{trib} s^{0.5}]^{0.6}$	d_f =	0.09	inches
3-5. If d_f > 1" (0.083 ft), go back step 3-1 and decrease the slope			

3-6. If the slope cannot be changed due to construction constraints, go to step 3-3 and increase the width perpendicular to flow.			
Step 4: Calculate the design velocity			
4-1. Enter depth of water (ft), $d_{f,ft}$= d_f/12	d_f =	0.007	ft
4-2. Enter width of strip (ft), *W*	W =	270	ft
4-3. Calculate design flow velocity (ft/s), $V_{wq} = SQDF/(d_{f,ft}W)$	V_{wq}=	0.04	ft/s
4-4. If the V_{wq} >1 ft/s, go back to step 3-1 and decrease the slope.			
Step 5: Calculate the length of the filter strip			
5-1. Enter desired residence time (minimum 7 minutes), *t*	t =	10	min
5-2. Enter design flow velocity (ft/s), V_{wq}	V_{wq}=	0.04	ft/s
5-3. Calculate length of the filter strip (ft), $L = 60tV_{wq}$	L =	22	ft
5-4. If *L* < 4 ft, go to step 3-1 and increase the slope			

Sizing Worksheet

Designer: Kirby Dubay	Treatment 3
Project Proponent:	
Date: 4/16/2021	
Project: Camp Hess	
Location: Ventura County	
Type of Vegetation:	
Outflow Collection:	
Step 1: Determine water quality design volume	
1-1. Enter Project area (acres), $A_{project}$	$A_{project}$ = 3.9 acres
1-2. Enter the maximum allowable percent of the Project area that may be effective impervious area (%) (refer to permit), ranges from 5-30%, $\%_{allowable}$	$\%_{allowable}$ = 5 %
1-3. Determine the maximum allowable effective impervious area (acres), $EIA_{allowable} = (A_{project})*(\%_{allowable})$	$EIA_{allowable}$= 0.20 acres
1-4. Enter Project impervious fraction, *Imp* (e.g. 60% = 0.60)	Imp= 0.23
1-5. Determine the Project Total Impervious area (acres), $TIA=A_{project}*Imp$	TIA= 0.89 acres
1-6. Determine the total area from which runoff must be retained (acres), $A_{retain}=TIA-EIA_{allowable}$	A_{retain} = 0.70 acres
1-7. Determine pervious runoff coefficient using Table E-1, C_p	C_p = 0.05
1-8. Calculate runoff coefficient, $C = 0.95*imp + C_p\ (1-imp)$	C = 0.26
1-9. Enter design rainfall depth of the storm (in), P_i	P_i = 0.75 in
1-10. Calculate rainfall depth (ft), $P = P_i/12$	P = 0.06 ft

1-11. Calculate water quality design volume (ft^3), $SQDV=43560\times C^*P^*A_{retain}$	SQDV=472 ft^3

Step 2: Determine the design percolation rate	
2-1. Enter measured soil percolation rate (in/hr) (0.5 in/hr minimum), $P_{measured}$	$P_{measured}$ = 1.7 in/hr
2-2. Determine percolation rate correction factor, S_A based on suitability assessment (see Section 6 INF-3)	S_A = 3
2-3. Determine percolation rate correction factor, S_B based on design (see Section 6 INF-3)	S_B = 3
2-4. Calculate combined safety factor, $S = S_A \times S_b$	S = 9
2-5. Calculate the design percolation rate (in/hr), $P_{design} = P_{measured}/S$	P_{design} = 0.19 in/hr
Step 3: Calculate Bioretention Infiltrating surface area	
3-1. Enter water quality design volume (ft^3), *SQDV*	SQDV = 472 ft^3
3-2. Enter design percolation rate (in/hr), P_{design}	P_{design} = 0.19 in/hr
3.3 Enter the required drain time (48 hours), $t_{ponding}$	$t_{ponding}$ = 48 hours
3-3. Calculate the maximum depth of surface ponding that can be infiltrated within the required drain time (ft): $d_{max} = (P_{design} \times t_{ponding})/12$	d_{max} = 0.8 ft
3-4. Select surface ponding depth (ft), d_p, such that $d_p \leq d_{max}$	d_p = 0.5 ft
3-5. Select thickness of amended media (ft,2 feet minimum, 3 preferred), l_{media}	l_{media} = 3 ft

3-6. Enter porosity of amended media (roughly 25% or 0.25 ft/ft), n_{media}	n_{media} = 0.25 ft/ft
3-7. Select thickness of optional gravel layer (ft), l_{gravel}	l_{gravel} = 0 ft
3-8. Enter porosity of gravel (roughly 30% or 0.3 ft/ft), n_{gravel}	n_{gravel} = 0.3 ft/ft
3-9. Calculate the total effective storage depth of bioretention facility (ft): $d_{effective} \leq (d_p + n_{media}l_{media} + n_{gravel}l_{gravel})$	$d_{effective}$ = 1.3 ft
3-10. Check that the entire effective depth infiltrates in required drainage time, 96 hours: $t_{total} = (d_{effective}/P_{design}) \times 12$ If t_{total} > 96 hours, reduce surface ponding depth and/or amended media thickness and/or gravel thickness and return to 3-4. If $t_{total} \leq$ 96 hours, proceed to 3-11.	t_{total} = 79 hours
3-11. Calculate the required infiltrating surface area (ft²): $A_{req} = SQDV/d_{effective}$	A_{req} = 377 ft²
Step 4: Calculate Bioretention Area Total Footprint	
4-1. Calculate total footprint required by including a buffer for side slopes and freeboard (ft²) [A_{req} is measured at the as the filter bottom area (toe of side slopes)], A_{tot}	A_{tot} = 666 ft²

Sizing Worksheet

Designer: Kirby Dubay Project Proponent: Date: 4/16/2021 Project: Camp Hess Location: Ventura County	Treatment 4
Type of Vegetation:	
Outflow Collection:	
Step 1: Determine water quality design volume	
1-1. Enter Project area (acres), $A_{project}$	$A_{project}$ = 0.78 acres
1-2. Enter the maximum allowable percent of the Project area that may be effective impervious area (%) (refer to permit), ranges from 5-30%, $\%_{allowable}$	$\%_{allowable}$ = 5 %
1-3. Determine the maximum allowable effective impervious area (acres), $EIA_{allowable} = (A_{project})*(\%_{allowable})$	$EIA_{allowable}$= 0.04 acres
1-4. Enter Project impervious fraction, *Imp* (e.g. 60% = 0.60)	Imp= 0.23
1-5. Determine the Project Total Impervious area (acres), $TIA=A_{project}*Imp$	TIA= 0.22 acres
1-6. Determine the total area from which runoff must be retained (acres), $A_{retain}=TIA-EIA_{allowable}$	A_{retain} = 0.14 acres
1-7. Determine pervious runoff coefficient using Table E-1, C_p	C_p = 0.05
1-8. Calculate runoff coefficient, $C = 0.95*imp + C_p\ (1-imp)$	C = 0.26
1-9. Enter design rainfall depth of the storm (in), P_i	P_i = 0.75 in
1-10. Calculate rainfall depth (ft), $P = P_i/12$	P = 0.06 ft

2.0

1-11. Calculate water quality design volume (ft^3), $SQDV=43560\times C^*P^*A_{retain}$	SQDV= 94 ft^3

Step 2: Determine the design percolation rate	
2-1. Enter measured soil percolation rate (in/hr) (0.5 in/hr minimum), $P_{measured}$	$P_{measured}$ = 2.0 in/hr
2-2. Determine percolation rate correction factor, S_A based on suitability assessment (see Section 6 INF-3)	S_A = 3
2-3. Determine percolation rate correction factor, S_B based on design (see Section 6 INF-3)	S_B = 3
2-4. Calculate combined safety factor, S = S_A x S_b	S = 9
2-5. Calculate the design percolation rate (in/hr), $P_{design} = P_{measured}/S$	P_{design} = 0.22 in/hr

Step 3: Calculate Bioretention Infiltrating surface area	
3-1. Enter water quality design volume (ft^3), *SQDV*	SQDV = 94 ft^3
3-2. Enter design percolation rate (in/hr), P_{design}	P_{design} = 0.22 in/hr
3.3 Enter the required drain time (48 hours), $t_{ponding}$	$t_{ponding}$ = 48 hours
3-3. Calculate the maximum depth of surface ponding that can be infiltrated within the required drain time (ft): $d_{max} = (P_{design} \times t_{ponding})/12$	d_{max} = 0.9 ft
3-4. Select surface ponding depth (ft), d_p, such that $d_p \leq d_{max}$	d_p = 0.5 ft
3-5. Select thickness of amended media (ft,2 feet minimum, 3 preferred), l_{media}	l_{media} = 3 ft

3-6. Enter porosity of amended media (roughly 25% or 0.25 ft/ft), n_{media}	n_{media}= 0.25 ft/ft
3-7. Select thickness of optional gravel layer (ft), l_{gravel}	l_{gravel} = 0 ft
3-8. Enter porosity of gravel (roughly 30% or 0.3 ft/ft), n_{gravel}	n_{gravel}= 0.3 ft/ft
3-9. Calculate the total effective storage depth of bioretention facility (ft): $d_{effective} \leq (d_p + n_{media}l_{media} + n_{gravel}l_{gravel})$	$d_{effective}$= 1.3 ft
3-10. Check that the entire effective depth infiltrates in required drainage time, 96 hours: $t_{total} = (d_{effective}/P_{design}) \times 12$ If t_{total} > 96 hours, reduce surface ponding depth and/or amended media thickness and/or gravel thickness and return to 3-4. If $t_{total} \leq$ 96 hours, proceed to 3-11.	t_{total} = 68 hours
3-11. Calculate the required infiltrating surface area (ft²): $A_{req} = SQDV/d_{effective}$	A_{req} = 14 ft²
Step 4: Calculate Bioretention Area Total Footprint	
4-1. Calculate total footprint required by including a buffer for side slopes and freeboard (ft²) [A_{req} is measured at the as the filter bottom area (toe of side slopes)], A_{tot}	A_{tot} = 222 ft²

Sizing Worksheet

Designer: Kirby Dubay Project Proponent: Date: 4/16/2021 Project: Camp Hess Location: Ventura County	Treatment 5
Type of Vegetation:	
Outflow Collection:	
Step 1: Determine water quality design volume	
1-1. Enter Project area (acres), $A_{project}$	$A_{project}$ = 0.07 acres
1-2. Enter the maximum allowable percent of the Project area that may be effective impervious area (refer to permit), ranges from 5-30%, $\%_{allowable}$	$\%_{allowable}$ 5 %
1-3. Determine the maximum allowed effective impervious area (ac), $EIA_{allowable} = (A_{project})*(\%_{allowable})$	$EIA_{allowable}$= .004 acres
1-4. Enter Project impervious fraction, *Imp* (e.g. 60% = 0.60)	Imp= 1
1-5. Determine the Project Total Impervious area (acres), $TIA=A_{project}*Imp$	TIA= 0.07 acres
1-6. Determine the total area from which runoff must be retained (acres), $A_{retain}=TIA-EIA_{allowable}$	A_{retain} = 0.07 acres
1-7. Determine pervious runoff coefficient using Table E-1, C_p	C_p = 0.1
1-8. Calculate runoff coefficient, $C = 0.95*imp + C_p\ (1-imp)$	C = 0.95
1-9. Enter design rainfall depth of the storm (in), P_i	P_i = 0.75 in
1-10. Calculate rainfall depth (ft), $P = P_i/12$	P = 0.06 ft
1-11. Calculate water quality design volume (ft^3),	SQDV= 173 ft^3

$SQDV=43560 \bullet C^{*}P^{*}A_{retain}$	

Step 2: Determine the design percolation rate	
2-1. Enter the design saturated hydraulic conductivity of the amended filter media (2.5 in/hr recommended rate), K_{design}	K_{design} = 2.5 in/hr

Step 3: Calculate Bioretention/Planter Box surface area			
3-1. Enter water quality design volume (ft^3), *SQDV*	SQDV =	173	ft^3
3-2. Enter design saturated hydraulic conductivity (in/hr), K_{design}	K_{design} =	2.5	in/hr
3-3. Enter ponding depth (max 1.5 ft for Bioretention, 1 ft for Planter Box) above area, d_p	d_p =	1	ft
3-4. Calculate the drawdown time for the ponded water to filter through media (hours), $t_{ponding} = (d_p/K_{design}) \times 12$	$t_{ponding}$=	4.8	hrs
3-5. Enter the storm duration for routing calculations (use 3 hours unless there is rationale for an alternative), $T_{routing}$	$T_{routing}$ =	3	hrs
3-6. Calculate depth of water (ft) filtered by using the following two equations: $d_{filtered,1} = (K_{design} \times T_{routing})/12$ $d_{filteret,2} = d_p /2$	$d_{filtered,1}$ = $d_{filtered,2}$ =	0.63 0.5	ft ft
3.7 Enter the resultant depth (ft) (the lesser of the two calculated above), $d_{filtered}$	$d_{filtered}$ =	0.5	ft
3-8. Calculate the infiltrating surface area as follows (ft^2): $A_{req} = SQDV/(d_p + d_{filtered})$	A_{req} =	115	ft^2

Step 4: Calculate Bioretention Area Total Footprint	
4-1. Calculate total footprint required by including a buffer for side slopes and freeboard (ft^2) [A_{req} is measured at the as the filter bottom area (toe of side slopes)], A_{tot}	A_{tot} = ft²
Step 5: Calculate Underdrain System Capacity	
To calculate the underdrain system capacity, continue through steps 5-1 to 5-7.	
Step 5: Calculate Underdrain System Capacity	
5-1. Calculated filtered flow rate to be conveyed by the longitudinal drain pipe, $Q_f = K_{design} A_{req}/43{,}200$	Q_f = .007 cfs
5-2. Enter minimum slope for energy gradient, S_e	S_e = 0.005
5-3. Enter Hazen-Williams coefficient for plastic, C_{HW}	C_{HW} = 140
5-4. Enter pipe diameter (min 6 inches), D	D = 6 in
5-5. Calculate pipe hydraulic radius (ft), $R_h = D/48$	R_h = 0.13 ft
5-6. Calculate velocity at the outlet of the pipe (ft/s), $V_p = 1.318 C_{HW} R_h^{0.63} S_e^{0.54}$	V_p = 2.8 ft/s
5-7. Calculate pipe capacity (cfs), $Q_{cap} = 0.25\pi (D/12)^2 V_p$	Q_{cap} = 0.56 cfs

Sizing Worksheet

Designer: Kirby Dubay Project Proponent: Date: 4/16/2021 Project: Camp Hess Location: Ventura County	Treatment 6
Type of Vegetation:	
Outflow Collection:	
Step 1: Determine water quality design volume	
1-1. Enter Project area (acres), $A_{project}$	$A_{project}$ = 0.03 acres
1-2. Enter the maximum allowable percent of the Project area that may be effective impervious area (%) (refer to permit), ranges from 5-30%, $\%_{allowable}$	$\%_{allowable}$ = 5 %
1-3. Determine the maximum allowable effective impervious area (acres), $EIA_{allowable} = (A_{project})*(\%_{allowable})$	$EIA_{allowable}$ = 001 acres
1-4. Enter Project impervious fraction, *Imp* (e.g. 60% = 0.60)	Imp= 1
1-5. Determine the Project Total Impervious area (acres), $TIA=A_{project}*Imp$	TIA= 0.03 acres
1-6. Determine the total area from which runoff must be retained (acres), $A_{retain}=TIA-EIA_{allowable}$	A_{retain} = 0.02 acres
1-7. Determine pervious runoff coefficient using Table E-1, C_p	C_p = 0.05
1-8. Calculate runoff coefficient, $C = 0.95*imp + C_p\ (1-imp)$	C = 0.95
1-9. Enter design rainfall depth of the storm (in), P_i	P_i = 0.75 in
1-10. Calculate rainfall depth (ft), $P = P_i/12$	P = 0.06 ft

1-11. Calculate water quality design volume (ft^3), $SQDV=43560\times C^*P^*A_{retain}$	SQDV= 60 ft^3

Step 2: Determine the design percolation rate	
2-1. Enter measured soil percolation rate (in/hr) (0.5 in/hr minimum), $P_{measured}$	$P_{measured}$ = 2 in/hr
2-2. Determine percolation rate correction factor, S_A based on suitability assessment (see Section 6 INF-3)	S_A = 3
2-3. Determine percolation rate correction factor, S_B based on design (see Section 6 INF-3)	S_B = 3
2-4. Calculate combined safety factor, $S = S_A \times S_b$	S = 9
2-5. Calculate the design percolation rate (in/hr), $P_{design} = P_{measured}/S$	P_{design} = 0.22 in/hr
Step 3: Calculate Bioretention Infiltrating surface area	
3-1. Enter water quality design volume (ft^3), *SQDV*	SQDV = 60 ft^3
3-2. Enter design percolation rate (in/hr), P_{design}	P_{design} = 0.22 in/hr
3.3 Enter the required drain time (48 hours), $t_{ponding}$	$t_{ponding}$ = 48 hours
3-3. Calculate the maximum depth of surface ponding that can be infiltrated within the required drain time (ft): $d_{max} = (P_{design} \times t_{ponding})/12$	d_{max} = 0.9 ft
3-4. Select surface ponding depth (ft), d_p, such that $d_p \leq d_{max}$	d_p = 0.5 ft
3-5. Select thickness of amended media (ft,2 feet minimum, 3 preferred), l_{media}	l_{media} = 3 ft

3-6. Enter porosity of amended media (roughly 25% or 0.25 ft/ft), n_{media}	n_{media}= 0.25 ft/ft
3-7. Select thickness of optional gravel layer (ft), l_{gravel}	l_{gravel} = 0 ft
3-8. Enter porosity of gravel (roughly 30% or 0.3 ft/ft), n_{gravel}	n_{gravel}= 0.3 ft/ft
3-9. Calculate the total effective storage depth of bioretention facility (ft): $d_{effective} \leq (d_p + n_{media}l_{media} + n_{gravel}l_{gravel})$	$d_{effective}$= 1.3 ft
3-10. Check that the entire effective depth infiltrates in required drainage time, 96 hours: $t_{total} = (d_{effective}/P_{design}) \times 12$ If t_{total} > 96 hours, reduce surface ponding depth and/or amended media thickness and/or gravel thickness and return to 3-4. If $t_{total} \leq$ 96 hours, proceed to 3-11.	t_{total} = 68 hours
3-11. Calculate the required infiltrating surface area (ft²): $A_{req} = SQDV/d_{effective}$	A_{req} = 48 ft²
Step 4: Calculate Bioretention Area Total Footprint	
4-1. Calculate total footprint required by including a buffer for side slopes and freeboard (ft²) [A_{req} is measured at the as the filter bottom area (toe of side slopes)], A_{tot}	A_{tot} = 225 ft²

Sizing Worksheet

Designer: Kirby Dubay Project Proponent: Date: 4/16/2021 Project: Camp Hess Location: Ventura County	Treatment 7
Type of Vegetation: (Check type used or describe "Other")	____ Native Grasses ____ Irrigated Turf Grass ____ Other
Outflow Collection: ?	

Step 1: Determine water quality design volume	
1-1. Enter Project area (acres), $A_{project}$	$A_{project}$ = 8.7 acres
1-2. Enter the maximum allowable percent of the Project area that may be effective impervious area (%) (refer to permit), ranges from 5-30%, $\%_{allowable}$	$\%_{allowable}$ = 5 %
1-3. Determine the maximum allowable effective impervious area (acres), $EIA_{allowable} = (A_{project})*(\%_{allowable})$	$EIA_{allowable}$=0.44 acres
1-4. Enter Project impervious fraction, *Imp* (e.g. 60% = 0.60)	Imp= 0.23
1-5. Determine the Project Total Impervious area (acres), $TIA=A_{project}*Imp$	TIA= 2.0 acres
1-6. Determine the total area from which runoff must be retained (acres), $A_{retain}=TIA-EIA_{allowable}$	A_{retain} = 1.6 acres
1-7. Determine pervious runoff coefficient using Table E-1, C_p	C_p = 0.05
1-8. Calculate runoff coefficient, $C = 0.95*imp + C_p\ (1-imp)$	C = 0.26
1-9. Enter design rainfall depth of the storm (in), P_i	P_i = 0.75 in

1-10. Calculate rainfall depth (ft), $P = P_i/12$	P = 0.06 ft
1-11. Calculate water quality design volume (ft^3), $SQDV=43560\times C^*P^*A_{retain}$	SQDV= 1055 ft^3
Step 2: Determine the design percolation rate	
2-1. Enter measured soil percolation rate (in/hr, 0.5 in/hr min.), $P_{measured}$	$P_{measured}$ = 2.0 in/hr
2-2. Determine percolation rate correction factor, S_A based on suitability assessment (see Section 6 INF-1)	S_A = 3
2-3. Determine percolation rate correction factor, S_B based on design (see Section 6 INF-1)	S_b = 3
2-4. Calculate combined safety factor, $S = S_A \times S_b$	S = 9
2-5. Calculate the design percolation rate (in/hr), $P_{design} = P_{measured}/S$	P_{design} = 0.22 in/hr
Step 3: Calculate the surface area	
3-1. Enter required drain time(hours,72 hrs max.), t	t = 72 hrs
3-2. Calculate max. depth of runoff that can be infiltrated within the t (ft), $d_{max} = P_{design}\ t/12$	d_{max} = 1.3 ft
3-3. For basins, select ponding depth (ft), d_p, such that $d_p \le d_{max}$	d_p = 1.0 ft
3-4. For trenches, enter trench fill aggregate porosity, n_t	n_t =
3-5. For trenches, enter depth of trench fill (ft), d_t	d_t = ft
3-5. For trenches, select ponding depth d_p such that $d_p \le d_{max} - n_t d_t$	d_p= ft
3-6. Enter the time to fill infiltration basin or trench with water (Use 2 hours for most designs), T	T = 2 hrs

3-7. Calculate infiltrating surface area for infiltration basin (ft^2): $A_b = SQDV/((T\ P_{design}/12)+d_p)$ OR Calculate infiltrating surface area for infiltration trenches or aggregate- filled drywells (ft^2): $A_t = SQDV/((T\ P_{design}/12)+n_t d_t+dp)$	A_b = 1004 ft^2 A_t = ft^2
Step 4: Size the forebay (infiltration basins or trenches)	
If a separate pre-treatment unit is designed for the infiltration facility, skip to Step 5. If not, continue through 4-1 through 4-4.	
4-1. Calculate the volume of the forebay (ft^3), $V_{forebay}$=0.25*SQDV	$V_{forebay}$= 264 ft^3
4-2. Determine forebay depth (ft), $d_{forebay}$	$d_{forebay}$= 3 ft
4-3. Calculate forebay bottom surface area (ft^2), $A_{forebay}=V_{forebay}/d_{forebay}$	$A_{forebay}$= 88 ft^2
4-4. Provide outlet pipe such that the forebay drains to the infiltration facility within 10 minutes.	
Step 5: Provide conveyance capacity for filter clogging	
5-1.The infiltration facility should be placed off-line, but an emergency overflow must still be provided in the event the filter becomes clogged. Design emergency overflow in accordance with applicable standards of the Ventura County Flood Control District or local jurisdiction.	

Sizing Worksheet

Designer: Kirby Dubay Project Proponent: Date: 4/16/2021 Project: Camp Hess Location: Ventura County	Treatment 8
Type of Vegetation: ?	
Outflow Collection: ?	
Step 1: Determine water quality design volume	
1-1. Enter Project area (acres), $A_{project}$	$A_{project}$ = 0.48 acres
1-2. Enter the maximum allowable percent of the Project area that may be effective impervious area (%) (refer to permit), ranges from 5-30%, $\%_{allowable}$	$\%_{allowable}$ = 5 %
1-3. Determine the maximum allowable effective impervious area (acres), $EIA_{allowable} = (A_{project})*(\%_{allowable})$	$EIA_{allowable}$ = 0.024 acres
1-4. Enter Project impervious fraction, *Imp* (e.g. 60% = 0.60)	Imp= 0.23
1-5. Determine the Project Total Impervious area (acres), $TIA=A_{project}*Imp$	TIA= 0.11 acres
1-6. Determine the total area from which runoff must be retained (acres), $A_{retain}=TIA-EIA_{allowable}$	A_{retain} = 0.09 acres
1-7. Determine pervious runoff coefficient using Table E-1, C_p	C_p = 0.05
1-8. Calculate runoff coefficient, $C = 0.95*imp + C_p\ (1-imp)$	C = 0.26
1-9. Enter design rainfall depth of the storm (in), P_i	P_i = 0.75 in
1-10. Calculate rainfall depth (ft), $P = P_i/12$	P = 0.06 ft

1-11. Calculate water quality design volume (ft^3), $SQDV=43560\times C^*P^*A_{retain}$	SQDV= 58 ft^3

Step 2: Determine the design percolation rate	
2-1. Enter measured soil percolation rate (in/hr) (0.5 in/hr minimum), $P_{measured}$	$P_{measured}$ = 2.0 in/hr
2-2. Determine percolation rate correction factor, S_A based on suitability assessment (see Section 6 INF-3)	S_A = 3
2-3. Determine percolation rate correction factor, S_B based on design (see Section 6 INF-3)	S_B = 3
2-4. Calculate combined safety factor, S = S_A x S_b	S = 9
2-5. Calculate the design percolation rate (in/hr), $P_{design} = P_{measured}/S$	P_{design} = 0.22 in/hr
Step 3: Calculate Bioretention Infiltrating surface area	
3-1. Enter water quality design volume (ft^3), *SQDV*	SQDV = 58 ft^3
3-2. Enter design percolation rate (in/hr), P_{design}	P_{design} = 0.22 in/hr
3.3 Enter the required drain time (48 hours), $t_{ponding}$	$t_{ponding}$ = 48 hours
3-3. Calculate the maximum depth of surface ponding that can be infiltrated within the required drain time (ft): $d_{max} = (P_{design} \times t_{ponding})/12$	d_{max} = 0.9 ft
3-4. Select surface ponding depth (ft), d_p, such that $d_p \leq d_{max}$	d_p = 0.5 ft
3-5. Select thickness of amended media (ft,2 feet minimum, 3 preferred), l_{media}	l_{media} = 3 ft

3-6. Enter porosity of amended media (roughly 25% or 0.25 ft/ft), n_{media}	n_{media}= 0.25 ft/ft
3-7. Select thickness of optional gravel layer (ft), l_{gravel}	l_{gravel} = 1 ft
3-8. Enter porosity of gravel (roughly 30% or 0.3 ft/ft), n_{gravel}	n_{gravel}= 0.3 ft/ft
3-9. Calculate the total effective storage depth of bioretention facility (ft): $d_{effective} \leq (d_p + n_{media}l_{media} + n_{gravel}l_{gravel})$	$d_{effective}$= 1.3 ft
3-10. Check that the entire effective depth infiltrates in required drainage time, 96 hours: $t_{total} = (d_{effective}/P_{design}) \times 12$ If t_{total} > 96 hours, reduce surface ponding depth and/or amended media thickness and/or gravel thickness and return to 3-4. If $t_{total} \leq$ 96 hours, proceed to 3-11.	t_{total} = 68 hours
3-11. Calculate the required infiltrating surface area (ft²): $A_{req} = SQDV/d_{effective}$	A_{req} = 47 ft²
Step 4: Calculate Bioretention Area Total Footprint	
4-1. Calculate total footprint required by including a buffer for side slopes and freeboard (ft²) [A_{req} is measured at the as the filter bottom area (toe of side slopes)], A_{tot}	A_{tot} = 170 ft²

Sizing Worksheet

Designer: Kirby Dubay Project Proponent: Date: 4/16/2021 Project: Camp Hess Location: Ventura County	Treatment 9
Type of Vegetation: (describe)	_____ _____
Outflow Collection: (Check type used or describe "Other")	____ Grass Channel / Swale ____ Street Gutter ____ Storm Drain ____ Underdrain Used ____ Other _____ _____

Step 1: Calculate the design flow	
1-1. Enter Project area (acres), $A_{project}$	A_{design} = 3.9 acres
1-2. Enter impervious fraction, *Imp* (e.g. 60% = 0.60)	Imp = 0.2
1-3. Determine pervious runoff coefficient using Table E-1, C_p	C_p = 0.05
1-4. Calculate runoff coefficient, $C = 0.95*imp + C_p\ (1\text{-}imp)$	C = 0.26
1-5. Enter design rainfall intensity (in/hr), *i*	i = 0.2 in/hr

1-6. Calculate water quality design flow (cfs), *SQDF= CiA*	SQDF =	0.20	cfs
Step 2: Calculate the minimum width			
2-1. Enter the stormwater quality design flow (cfs), *SQDF*	SQDF =	0.20	cfs
2-2. Enter the minimum linear unit application rate (0.005 cfs/ft), $q_{a,min}$	$q_{a,min}$=	0.005	cfs/ft
2-3. Calculate the minimum width of filter strip (ft), W_{min}	W_{min}=	40	ft
Step 3: Calculate the design flow depth			
3-1. Enter filter strip longitudinal slope, *s* (ft/ft)	*s* =	0.03	ft/ft
3-2. Enter Manning roughness coefficient (0.25-0.30), n_{wq}	n_{wq} =	0.27	
3-3. Enter width of impervious surface contributing area (perpendicular to flow), *W* (ft)	W =	140	ft
Step 3: Calculate the design flow depth			
3-4. Calculate average depth of water using Manning equation (inches), $d_f = 12 * [SQDF * n_{wq} / 1.49 W_{trib} s^{0.5}]^{0.6}$	d_f =	0.24	inches
3-5. If d_f > 1" (0.083 ft), go back step 3-1 and decrease the slope			

3-6. If the slope cannot be changed due to construction constraints, go to step 3-3 and increase the width perpendicular to flow.			
Step 4: Calculate the design velocity			
4-1. Enter depth of water (ft), $d_{f,ft}$= d_f/12	d_f =	0.02	ft
4-2. Enter width of strip (ft), *W*	W =	140	ft
4-3. Calculate design flow velocity (ft/s), $V_{wq} = SQDF/(d_{f,ft}W)$	V_{wq}=	0.07	ft/s
4-4. If the V_{wq} >1 ft/s, go back to step 3-1 and decrease the slope.			
Step 5: Calculate the length of the filter strip			
5-1. Enter desired residence time (minimum 7 minutes), *t*	t =	10	min
5-2. Enter design flow velocity (ft/s), V_{wq}	V_{wq}=	0.05	ft/s
5-3. Calculate length of the filter strip (ft), $L = 60tV_{wq}$	L =	42	ft
5-4. If *L* < 4 ft, go to step 3-1 and increase the slope			

Sizing Worksheet

Designer: Kirby Dubay Project Proponent: Date: 4/16/2021 Project: Camp Hess Location: Ventura County	Treatment 10
Type of Vegetation:	
Outflow Collection:	
Step 1: Determine water quality design volume	
1-1. Enter Project area (acres), $A_{project}$	$A_{project}$ = 4.2 acres
1-2. Enter the maximum allowable percent of the Project area that may be effective impervious area (refer to permit), ranges from 5-30%, $\%_{allowable}$	$\%_{allowable}$ 5 %
1-3. Determine the maximum allowed effective impervious area (ac), $EIA_{allowable} = (A_{project})*(\%_{allowable})$	$EIA_{allowable}$= 0.21 acres
1-4. Enter Project impervious fraction, *Imp* (e.g. 60% = 0.60)	Imp= 0.23
1-5. Determine the Project Total Impervious area (acres), $TIA=A_{project}*Imp$	TIA= 0.98 acres
1-6. Determine the total area from which runoff must be retained (acres), $A_{retain}=TIA-EIA_{allowable}$	A_{retain} = 0.7 acres
1-7. Determine pervious runoff coefficient using Table E-1, C_p	C_p = 0.05
1-8. Calculate runoff coefficient, $C = 0.95*imp + C_p\ (1-imp)$	C = 0.26
1-9. Enter design rainfall depth of the storm (in), P_i	P_i = 0.75 in
1-10. Calculate rainfall depth (ft), $P = P_i/12$	P = 0.06 ft
1-11. Calculate water quality design volume (ft^3),	SQDV= 514 ft^3

$SQDV=43560 \bullet C^{*}P^{*}A_{retain}$	

Step 2: Determine the design percolation rate	
2-1. Enter the design saturated hydraulic conductivity of the amended filter media (2.5 in/hr recommended rate), K_{design}	K_{design} = 2.5 in/hr
Step 3: Calculate Bioretention/Planter Box surface area	
3-1. Enter water quality design volume (ft^3), *SQDV*	SQDV = 514 ft^3
3-2. Enter design saturated hydraulic conductivity (in/hr), K_{design}	K_{design} = 2.5 in/hr
3-3. Enter ponding depth (max 1.5 ft for Bioretention, 1 ft for Planter Box) above area, d_p	d_p = 1.5 ft
3-4. Calculate the drawdown time for the ponded water to filter through media (hours), $t_{ponding} = (d_p/K_{design}) \times 12$	$t_{ponding}$= 7.2 hrs
3-5. Enter the storm duration for routing calculations (use 3 hours unless there is rationale for an alternative), $T_{routing}$	$T_{routing}$ = 3 hrs
3-6. Calculate depth of water (ft) filtered by using the following two equations: $d_{filtered,1} = (K_{design} \times T_{routing})/12$ $d_{filteret,2} = d_p /2$	$d_{filtered,1}$ = 0.63 ft $d_{filtered,2}$ = 0.75 ft
3.7 Enter the resultant depth (ft) (the lesser of the two calculated above), $d_{filtered}$	$d_{filtered}$ = 0.63 ft
3-8. Calculate the infiltrating surface area as follows (ft^2): $A_{req} = SQDV/(d_p + d_{filtered})$	A_{req} = 242 ft^2

Step 4: Calculate Bioretention Area Total Footprint	
4-1. Calculate total footprint required by including a buffer for side slopes and freeboard (ft^2) [A_{req} is measured at the as the filter bottom area (toe of side slopes)], A_{tot}	A_{tot} = 836 ft^2
Step 5: Calculate Underdrain System Capacity	
To calculate the underdrain system capacity, continue through steps 5-1 to 5-7.	
Step 5: Calculate Underdrain System Capacity	
5-1. Calculated filtered flow rate to be conveyed by the longitudinal drain pipe, $Q_f = K_{design} A_{req}/43{,}200$	Q_f = cfs
5-2. Enter minimum slope for energy gradient, S_e	S_e =
5-3. Enter Hazen-Williams coefficient for plastic, C_{HW}	C_{HW} =
5-4. Enter pipe diameter (min 6 inches), D	D = in
5-5. Calculate pipe hydraulic radius (ft), $R_h = D/48$	R_h = ft
5-6. Calculate velocity at the outlet of the pipe (ft/s), $V_p = 1.318 C_{HW} R_h^{0.63} S_e^{0.54}$	V_p = ft/s
5-7. Calculate pipe capacity (cfs), $Q_{cap} = 0.25\pi (D/12)^2 V_p$	Q_{cap} = cfs

Sizing Worksheet

Designer: Kirby Dubay Project Proponent: Date: 4/16/2021 Project: Camp Hess Location: Ventura County	Treatment 11
Type of Vegetation: (describe)	_____ _____
Outflow Collection: (Check type used or describe "Other")	____ Grass Channel / Swale ____ Street Gutter ____ Storm Drain ____ Underdrain Used ____ Other _____ _____

Step 1: Calculate the design flow	
1-1. Enter Project area (acres), $A_{project}$	A_{design} = 3.7 acres
1-2. Enter impervious fraction, *Imp* (e.g. 60% = 0.60)	Imp = 0.2
1-3. Determine pervious runoff coefficient using Table E-1, C_p	C_p = 0.05
1-4. Calculate runoff coefficient, $C = 0.95*imp + C_p\ (1\text{-}imp)$	C = 0.26
1-5. Enter design rainfall intensity (in/hr), *i*	i = 0.2 in/hr

1-6. Calculate water quality design flow (cfs), *SQDF= CiA*	SQDF =	0.19	cfs
Step 2: Calculate the minimum width			
2-1. Enter the stormwater quality design flow (cfs), *SQDF*	SQDF =	0.19	cfs
2-2. Enter the minimum linear unit application rate (0.005 cfs/ft), $q_{a,min}$	$q_{a,min}$=	0.005	cfs/ft
2-3. Calculate the minimum width of filter strip (ft), W_{min}	W_{min}=	38	ft
Step 3: Calculate the design flow depth			
3-1. Enter filter strip longitudinal slope, *s* (ft/ft)	*s* =	0.03	ft/ft
3-2. Enter Manning roughness coefficient (0.25-0.30), n_{wq}	n_{wq} =	0.27	
3-3. Enter width of impervious surface contributing area (perpendicular to flow), *W* (ft)	W =	190	ft
Step 3: Calculate the design flow depth			
3-4. Calculate average depth of water using Manning equation (inches), $d_f = 12^* [SQDF^* n_{wq}/1.49 W_{trib} s^{0.5}]^{0.6}$	d_f =	0.20	inches
3-5. If d_f > 1" (0.083 ft), go back step 3-1 and decrease the slope			

3-6. If the slope cannot be changed due to construction constraints, go to step 3-3 and increase the width perpendicular to flow.			
Step 4: Calculate the design velocity			
4-1. Enter depth of water (ft), $d_{f,ft}$= d_f/12	d_f =	0.016	ft
4-2. Enter width of strip (ft), *W*	W =	190	ft
4-3. Calculate design flow velocity (ft/s), $V_{wq} = SQDF/(d_{f,ft}W)$	V_{wq}=	0.06	ft/s
4-4. If the V_{wq} >1 ft/s, go back to step 3-1 and decrease the slope.			
Step 5: Calculate the length of the filter strip			
5-1. Enter desired residence time (minimum 7 minutes), *t*	t =	10	min
5-2. Enter design flow velocity (ft/s), V_{wq}	V_{wq}=	0.06	ft/s
5-3. Calculate length of the filter strip (ft), $L = 60tV_{wq}$	L =	37	ft
5-4. If *L* < 4 ft, go to step 3-1 and increase the slope			

Sizing Worksheet

Designer: Kirby Dubay Project Proponent: Date: 4/16/2021 Project: Camp Hess Location: Ventura County	Treatment 12
Type of Vegetation:	
Outflow Collection:	
Step 1: Determine water quality design volume	
1-1. Enter Project area (acres), $A_{project}$	$A_{project}$ = 6.2 acres
1-2. Enter the maximum allowable percent of the Project area that may be effective impervious area (refer to permit), ranges from 5-30%, $\%_{allowable}$	$\%_{allowable}$ 5 %
1-3. Determine the maximum allowed effective impervious area (ac), $EIA_{allowable} = (A_{project})*(\%_{allowable})$	$EIA_{allowable}$=0.9 acres
1-4. Enter Project impervious fraction, *Imp* (e.g. 60% = 0.60)	Imp= 0.23
1-5. Determine the Project Total Impervious area (acres), $TIA=A_{project}*Imp$	TIA= 1.4 acres
1-6. Determine the total area from which runoff must be retained (acres), $A_{retain}=TIA-EIA_{allowable}$	A_{retain} = 1.1 acres
1-7. Determine pervious runoff coefficient using Table E-1, C_p	C_p = 0.05
1-8. Calculate runoff coefficient, $C = 0.95*imp + C_p\ (1-imp)$	C = 0.26
1-9. Enter design rainfall depth of the storm (in), P_i	P_i = 0.75 in
1-10. Calculate rainfall depth (ft), $P = P_i/12$	P = 0.06 ft
1-11. Calculate water quality design volume (ft^3),	SQDV= 750 ft^3

$SQDV=43560 \bullet C^{*}P^{*}A_{retain}$	

Step 2: Determine the design percolation rate	
2-1. Enter the design saturated hydraulic conductivity of the amended filter media (2.5 in/hr recommended rate), K_{design}	K_{design} = 2.5 in/hr
Step 3: Calculate Bioretention/Planter Box surface area	
3-1. Enter water quality design volume (ft^3), *SQDV*	SQDV = 750 ft^3
3-2. Enter design saturated hydraulic conductivity (in/hr), K_{design}	K_{design} = 2.5 in/hr
3-3. Enter ponding depth (max 1.5 ft for Bioretention, 1 ft for Planter Box) above area, d_p	d_p = 1.5 ft
3-4. Calculate the drawdown time for the ponded water to filter through media (hours), $t_{ponding} = (d_p/K_{design}) \times 12$	$t_{ponding}$= 7.2 hrs
3-5. Enter the storm duration for routing calculations (use 3 hours unless there is rationale for an alternative), $T_{routing}$	$T_{routing}$ = 3 hrs
3-6. Calculate depth of water (ft) filtered by using the following two equations: $d_{filtered,1} = (K_{design} \times T_{routing})/12$ $d_{filteret,2} = d_p /2$	$d_{filtered,1}$ = 0.63 ft $d_{filtered,2}$ = 0.75 ft
3.7 Enter the resultant depth (ft) (the lesser of the two calculated above), $d_{filtered}$	$d_{filtered}$ = 0.63 ft
3-8. Calculate the infiltrating surface area as follows (ft^2): $A_{req} = SQDV/(d_p + d_{filtered})$	A_{req} = 353 ft^2

Step 4: Calculate Bioretention Area Total Footprint	
4-1. Calculate total footprint required by including a buffer for side slopes and freeboard (ft^2) [A_{req} is measured at the as the filter bottom area (toe of side slopes)], A_{tot}	A_{tot} = 1032 ft^2
Step 5: Calculate Underdrain System Capacity	
To calculate the underdrain system capacity, continue through steps 5-1 to 5-7.	
Step 5: Calculate Underdrain System Capacity	
5-1. Calculated filtered flow rate to be conveyed by the longitudinal drain pipe, $Q_f = K_{design} A_{req}/43{,}200$	Q_f = cfs
5-2. Enter minimum slope for energy gradient, S_e	S_e =
5-3. Enter Hazen-Williams coefficient for plastic, C_{HW}	C_{HW} =
5-4. Enter pipe diameter (min 6 inches), D	D = in
5-5. Calculate pipe hydraulic radius (ft), $R_h = D/48$	R_h = ft
5-6. Calculate velocity at the outlet of the pipe (ft/s), $V_p = 1.318 C_{HW} R_h^{0.63} S_e^{0.54}$	V_p = ft/s
5-7. Calculate pipe capacity (cfs), $Q_{cap} = 0.25\pi (D/12)^2 V_p$	Q_{cap} = cfs

Sizing Worksheet

Designer: Kirby Dubay Project Proponent: Date: 4/16/2021 Project: Camp Hess Location: Ventura County	Treatment 13
Type of Vegetation:	
Outflow Collection:	
Step 1: Determine water quality design volume	
1-1. Enter Project area (acres), $A_{project}$	$A_{project}$ = 13.5 acres
1-2. Enter the maximum allowable percent of the Project area that may be effective impervious area (%) (refer to permit), ranges from 5-30%, $\%_{allowable}$	$\%_{allowable}$ 5 %
1-3. Determine the maximum allowable effective impervious area (acres), $EIA_{allowable} = (A_{project})*(\%_{allowable})$	$EIA_{allowable}$= 0.7 acres
1-4. Enter Project impervious fraction, *Imp* (e.g. 60% = 0.60)	Imp= 0.23
1-5. Determine the Project Total Impervious area (acres), $TIA=A_{project}*Imp$	TIA= 3.1 acres
1-6. Determine the total area from which runoff must be retained (acres), $A_{retain}=TIA-EIA_{allowable}$	A_{retain} = 2.4 acres
1-7. Determine pervious runoff coefficient using Table E-1, C_p	C_p = 0.05
1-8. Calculate runoff coefficient, $C = 0.95*imp + C_p\ (1-imp)$	C = 0.26
1-9. Enter design rainfall depth of the storm (in), P_i	P_i = 0.75 in
1-10. Calculate rainfall depth (ft), $P = P_i/12$	P = 0.06 ft
1-11. Calculate water quality design volume (ft^3),	SQDV= 1638 ft^3

$SQDV=43560\times C^{*}P^{*}A_{retain}$	
Step 2: Determine the design percolation rate	
2-1. Enter measured soil percolation rate (0.5 in/hr minimum), $P_{measured}$	$P_{measured}$ = 0.5 in/hr
2-2. Determine percolation rate correction factor, S_A based on suitability assessment (see Section 6 INF-5)	S_A = 3
Step 2: Determine the design percolation rate	
2-3. Determine percolation rate correction factor, S_B based on design (see Section 6 INF-5)	S_B = 3
2-4. Calculate combined safety factor, $S = S_A \times S_b$	S = 9
2-5. Calculate the design percolation rate (in/hr), $P_{design} = P_{measured}/S$	P_{design} = 0.06 in/hr
Step 3: Determine the Gravel Drainage Layer Depth	
3-1. Enter drawdown time (hours, 72 hrs max.), t	t = 72 hours
3-2. Calculate max. depth of runoff (ft) that can be infiltrated within the t, $d_{max}=P_{design}t/12$	d_{max} = 0.33 ft
3-3. Enter the gravel drainage layer porosity, n (typically 32% or 0.32 for gravel)	n = 0.32
3-4. Select the gravel drainage layer depth (ft) such that $d_{max} \geq n\times l$	l = 1 ft
Step 4: Determine infiltrating surface area	
4-1. Enter gravel drainage layer porosity, n	n = 0.32
4-2. Enter depth of gravel drainage layer (ft), l	l = 1 ft
4-3. Enter the time to fill the gravel drainage layer with water (Use 2 hours for most designs), T	T = 2 hrs

4-4. Calculate infiltrating surface area (ft^3): $A=SQDV/((TP_{design}/12)+nl)$	A = 4974 ft^2
Step 5: Provide conveyance capacity for clogging	
5-1. The permeable pavement must have an emergency overflow for storm events greater than the design and in the event the permeable pavement becomes clogged.	

Sizing Worksheet

Designer: Kirby Dubay Project Proponent: Date: 4/16/2021 Project: Camp Hess Location: Ventura County	Treatments 14, 15 & 16
Type of Vegetation:	
Outflow Collection:	
Step 1: Determine water quality design volume	
1-1. Enter Project area (acres), $A_{project}$	$A_{project}$ = 10.9 acres
1-2. Enter the maximum allowable percent of the Project area that may be effective impervious area (refer to permit), ranges from 5-30%, $\%_{allowable}$	$\%_{allowable}$ 5 %
1-3. Determine the maximum allowed effective impervious area (ac), $EIA_{allowable} = (A_{project})*(\%_{allowable})$	$EIA_{allowable}$= 0.5 acres
1-4. Enter Project impervious fraction, *Imp* (e.g. 60% = 0.60)	Imp= 0.23
1-5. Determine the Project Total Impervious area (acres), $TIA=A_{project}*Imp$	TIA= 2.5 acres
1-6. Determine the total area from which runoff must be retained (acres), $A_{retain}=TIA-EIA_{allowable}$	A_{retain} = 2.0 acres
1-7. Determine pervious runoff coefficient using Table E-1, C_p	C_p = 0.05
1-8. Calculate runoff coefficient, $C = 0.95*imp + C_p\ (1-imp)$	C = 0.26
1-9. Enter design rainfall depth of the storm (in), P_i	P_i = 0.75 in
1-10. Calculate rainfall depth (ft), $P = P_i/12$	P = 0.06 ft
1-11. Calculate water quality design volume (ft^3),	SQDV= 1324 ft^3

$SQDV=43560 \bullet C^{*}P^{*}A_{retain}$	

Step 2: Determine the design percolation rate			
2-1. Enter the design saturated hydraulic conductivity of the amended filter media (2.5 in/hr recommended rate), K_{design}	K_{design} =	2.5	in/hr
Step 3: Calculate Bioretention/Planter Box surface area			
3-1. Enter water quality design volume (ft^3), *SQDV*	SQDV =	1324	ft^3
3-2. Enter design saturated hydraulic conductivity (in/hr), K_{design}	K_{design} =	2.5	in/hr
3-3. Enter ponding depth (max 1.5 ft for Bioretention, 1 ft for Planter Box) above area, d_p	d_p =	1	ft
3-4. Calculate the drawdown time for the ponded water to filter through media (hours), $t_{ponding} = (d_p/K_{design}) \times 12$	$t_{ponding}$=	4.8	hrs
3-5. Enter the storm duration for routing calculations (use 3 hours unless there is rationale for an alternative), $T_{routing}$	$T_{routing}$ =	3	hrs
3-6. Calculate depth of water (ft) filtered by using the following two equations: $d_{filtered,1} = (K_{design} \times T_{routing})/12$ $d_{filteret,2} = d_p /2$	$d_{filtered,1}$ = $d_{filtered,2}$ =	0.63 0.5	ft ft
3.7 Enter the resultant depth (ft) (the lesser of the two calculated above), $d_{filtered}$	$d_{filtered}$ =	0.5	ft
3-8. Calculate the infiltrating surface area as follows (ft^2): $A_{req} = SQDV/(d_p + d_{filtered})$	A_{req} =	883	ft^2

Step 4: Calculate Bioretention Area Total Footprint	
4-1. Calculate total footprint required by including a buffer for side slopes and freeboard (ft^2) [A_{req} is measured at the as the filter bottom area (toe of side slopes)], A_{tot}	A_{tot} = ? ft^2
Step 5: Calculate Underdrain System Capacity	
To calculate the underdrain system capacity, continue through steps 5-1 to 5-7.	
Step 5: Calculate Underdrain System Capacity	
5-1. Calculated filtered flow rate to be conveyed by the longitudinal drain pipe, $Q_f = K_{design} A_{req}/43{,}200$	Q_f =0.051cfs
5-2. Enter minimum slope for energy gradient, S_e	S_e = 0.005
5-3. Enter Hazen-Williams coefficient for plastic, C_{HW}	C_{HW} = 140
5-4. Enter pipe diameter (min 6 inches), D	D = 6 in
5-5. Calculate pipe hydraulic radius (ft), $R_h = D/48$	R_h = 0.13 ft
5-6. Calculate velocity at the outlet of the pipe (ft/s), $V_p = 1.318 C_{HW} R_h^{0.63} S_e^{0.54}$	V_p = 2.8 ft/s
5-7. Calculate pipe capacity (cfs), $Q_{cap} = 0.25\pi (D/12)^2 V_p$	Q_{cap} = 0.56 cfs

Sizing Worksheet

Designer: Kirby Dubay Project Proponent: Date: 4/16/2021 Project: Camp Hess Location: Ventura County	Treatment 17
Type of Vegetation:	
Outflow Collection:	
Step 1: Determine water quality design volume	
1-1. Enter Project area (acres), $A_{project}$	$A_{project}$ = 0.10 acres
1-2. Enter the maximum allowable percent of the Project area that may be effective impervious area (%) (refer to permit), ranges from 5-30%, $\%_{allowable}$	$\%_{allowable}$ 5 %
1-3. Determine the maximum allowable effective impervious area (acres), $EIA_{allowable} = (A_{project})*(\%_{allowable})$	$EIA_{allowable}$= .005 acres
1-4. Enter Project impervious fraction, *Imp* (e.g. 60% = 0.60)	Imp= 1
1-5. Determine the Project Total Impervious area (acres), $TIA=A_{project}*Imp$	TIA= 0.10 acres
1-6. Determine the total area from which runoff must be retained (acres), $A_{retain}=TIA-EIA_{allowable}$	A_{retain} = 0.09 acres
1-7. Determine pervious runoff coefficient using Table E-1, C_p	C_p = 0.05
1-8. Calculate runoff coefficient, $C = 0.95*imp + C_p\ (1-imp)$	C = 0.95
1-9. Enter design rainfall depth of the storm (in), P_i	P_i = 0.75 in
1-10. Calculate rainfall depth (ft), $P = P_i/12$	P = 0.06 ft
1-11. Calculate water quality design volume (ft^3),	SQDV= 234 ft^3

$SQDV=43560\times C^{*}P^{*}A_{retain}$	
Step 2: Determine the design percolation rate	
2-1. Enter measured soil percolation rate (0.5 in/hr minimum), $P_{measured}$	$P_{measured}$ = 1.5 in/hr
2-2. Determine percolation rate correction factor, S_A based on suitability assessment (see Section 6 INF-5)	S_A = 3
Step 2: Determine the design percolation rate	
2-3. Determine percolation rate correction factor, S_B based on design (see Section 6 INF-5)	S_B = 3
2-4. Calculate combined safety factor, $S = S_A \times S_b$	S = 9
2-5. Calculate the design percolation rate (in/hr), $P_{design} = P_{measured}/S$	P_{design} = 0.17 in/hr
Step 3: Determine the Gravel Drainage Layer Depth	
3-1. Enter drawdown time (hours, 72 hrs max.), t	t = 72 hours
3-2. Calculate max. depth of runoff (ft) that can be infiltrated within the t, $d_{max}=P_{design}t/12$	d_{max} = 1.0 ft
3-3. Enter the gravel drainage layer porosity, n (typically 32% or 0.32 for gravel)	n = 0.32
3-4. Select the gravel drainage layer depth (ft) such that $d_{max} \geq n\times l$	l = 3 ft
Step 4: Determine infiltrating surface area	
4-1. Enter gravel drainage layer porosity, n	n = 0.32
4-2. Enter depth of gravel drainage layer (ft), l	l = 3 ft
4-3. Enter the time to fill the gravel drainage layer with water (Use 2 hours for most designs), T	T = 2 hrs

4-4. Calculate infiltrating surface area (ft^3): $A=SQDV/((TP_{design}/12)+nl)$	A = 237 ft^2
Step 5: Provide conveyance capacity for clogging	
5-1. The permeable pavement must have an emergency overflow for storm events greater than the design and in the event the permeable pavement becomes clogged.	

Sizing Worksheet

Designer: Kirby Dubay Project Proponent: Date: 4/16/2021 Project: Camp Hess Location: Ventura County	Treatments 18 & 19
Type of Vegetation: (Check type used or describe "Other")	____ Native Grasses ____ Irrigated Turf Grass ____ Other
Outflow Collection:	
Step 1: Determine water quality design volume	
1-1. Enter Project area (acres), $A_{project}$	$A_{project}$ = 0.05 acres
1-2. Enter the maximum allowable percent of the Project area that may be effective impervious area (%) (refer to permit), ranges from 5-30%, $\%_{allowable}$	$\%_{allowable}$ = 5 %
1-3. Determine the maximum allowable effective impervious area (acres), $EIA_{allowable} = (A_{project})*(\%_{allowable})$	$EIA_{allowable}$= .002 acres
1-4. Enter Project impervious fraction, *Imp* (e.g. 60% = 0.60)	Imp= 1
1-5. Determine the Project Total Impervious area (acres), $TIA=A_{project}*Imp$	TIA= 0.05 acres
1-6. Determine the total area from which runoff must be retained (acres), $A_{retain}=TIA-EIA_{allowable}$	A_{retain} = 0.04 acres
1-7. Determine pervious runoff coefficient using Table E-1, C_p	C_p = 0.05
1-8. Calculate runoff coefficient, $C = 0.95*imp + C_p\ (1-imp)$	C = 0.95
1-9. Enter design rainfall depth of the storm (in), P_i	P_i = 0.75 in

1-10. Calculate rainfall depth (ft), $P = P_i/12$	P = 0.06 ft
1-11. Calculate water quality design volume (ft^3), $SQDV=43560\times C^*P^*A_{retain}$	SQDV= 111 ft^3
Step 2: Determine the design percolation rate	
2-1. Enter measured soil percolation rate (in/hr, 0.5 in/hr min.), $P_{measured}$	$P_{measured}$ = 2.0 in/hr
2-2. Determine percolation rate correction factor, S_A based on suitability assessment (see Section 6 INF-1)	S_A = 3
2-3. Determine percolation rate correction factor, S_B based on design (see Section 6 INF-1)	S_b = 3
2-4. Calculate combined safety factor, $S = S_A \times S_b$	S = 9
2-5. Calculate the design percolation rate (in/hr), $P_{design} = P_{measured}/S$	P_{design} = 0.50 in/hr
Step 3: Calculate the surface area	
3-1. Enter required drain time(hours,72 hrs max.), t	t = 72 hrs
3-2. Calculate max. depth of runoff that can be infiltrated within the t (ft), $d_{max} = P_{design}\ t/12$	d_{max} = 3 ft
3-3. For basins, select ponding depth (ft), d_p, such that $d_p \le d_{max}$	d_p = 1.35 ft
3-4. For trenches, enter trench fill aggregate porosity, n_t	n_t =
3-5. For trenches, enter depth of trench fill (ft), d_t	d_t = ft
3-5. For trenches, select ponding depth d_p such that $d_p \le d_{max} - n_t d_t$	d_p= ft
3-6. Enter the time to fill infiltration basin or trench with water (Use 2 hours for most designs), T	T = 2 hrs

3-7. Calculate infiltrating surface area for infiltration basin (ft^2): $A_b = SQDV/((T\ P_{design}/12)+d_p)$ OR Calculate infiltrating surface area for infiltration trenches or aggregate- filled drywells (ft^2): $A_t = SQDV/((T\ P_{design}/12)+n_t d_t+dp)$	$A_b =$ 77 ft^2 $A_t =$ ft^2
Step 4: Size the forebay (infiltration basins or trenches)	
If a separate pre-treatment unit is designed for the infiltration facility, skip to Step 5. If not, continue through 4-1 through 4-4.	
4-1. Calculate the volume of the forebay (ft^3), $V_{forebay}$=0.25*SQDV	$V_{forebay}=$ 28 ft^3
4-2. Determine forebay depth (ft), $d_{forebay}$	$d_{forebay}=$ 3 ft
4-3. Calculate forebay bottom surface area (ft^2), $A_{forebay}=V_{forebay}/d_{forebay}$	$A_{forebay}=$ 9 ft^2
4-4. Provide outlet pipe such that the forebay drains to the infiltration facility within 10 minutes.	
Step 5: Provide conveyance capacity for filter clogging	
5-1.The infiltration facility should be placed off-line, but an emergency overflow must still be provided in the event the filter becomes clogged. Design emergency overflow in accordance with applicable standards of the Ventura County Flood Control District or local jurisdiction.	

Sizing Worksheet

Designer: Kirby Dubay Project Proponent: Date: 4/16/2021 Project: Camp Hess Location: Ventura County	Treatment 20
Type of Vegetation:	
Outflow Collection:	
Step 1: Determine water quality design volume	
1-1. Enter Project area (acres), $A_{project}$	$A_{project}$ = 0.07 acres
1-2. Enter the maximum allowable percent of the Project area that may be effective impervious area (%) (refer to permit), ranges from 5-30%, $\%_{allowable}$	$\%_{allowable}$ = 5 %
1-3. Determine the maximum allowable effective impervious area (acres), $EIA_{allowable} = (A_{project})*(\%_{allowable})$	$EIA_{allowable}$=0.003 acres
1-4. Enter Project impervious fraction, *Imp* (e.g. 60% = 0.60)	Imp= 0.23
1-5. Determine the Project Total Impervious area (acres), $TIA=A_{project}*Imp$	TIA=0.02 acres
1-6. Determine the total area from which runoff must be retained (acres), $A_{retain}=TIA-EIA_{allowable}$	A_{retain} = 0.02 acres
1-7. Determine pervious runoff coefficient using Table E-1, C_p	C_p = 0.05
1-8. Calculate runoff coefficient, $C = 0.95*imp + C_p\ (1-imp)$	C = 0.26
1-9. Enter design rainfall depth of the storm (in), P_i	P_i = 0.75 in
1-10. Calculate rainfall depth (ft), $P = P_i/12$	P = 0.06 ft

1-11. Calculate water quality design volume (ft^3), $SQDV=43560\times C^*P^*A_{retain}$	SQDV= 8 ft^3

Step 2: Determine the design percolation rate	
2-1. Enter measured soil percolation rate (in/hr) (0.5 in/hr minimum), $P_{measured}$	$P_{measured}$ = 1.5 in/hr
2-2. Determine percolation rate correction factor, S_A based on suitability assessment (see Section 6 INF-3)	S_A = 2
2-3. Determine percolation rate correction factor, S_B based on design (see Section 6 INF-3)	S_B = 2
2-4. Calculate combined safety factor, $S = S_A \times S_b$	S = 4
2-5. Calculate the design percolation rate (in/hr), $P_{design} = P_{measured}/S$	P_{design} = 0.38 in/hr

Step 3: Calculate Bioretention Infiltrating surface area	
3-1. Enter water quality design volume (ft^3), *SQDV*	SQDV = 8 ft^3
3-2. Enter design percolation rate (in/hr), P_{design}	P_{design} = 0.38 in/hr
3.3 Enter the required drain time (48 hours), $t_{ponding}$	$t_{ponding}$ = 48 hours
3-3. Calculate the maximum depth of surface ponding that can be infiltrated within the required drain time (ft): $d_{max} = (P_{design} \times t_{ponding})/12$	d_{max} = 1.5 ft
3-4. Select surface ponding depth (ft), d_p, such that $d_p \leq d_{max}$	d_p = 0.5 ft
3-5. Select thickness of amended media (ft,2 feet minimum, 3 preferred), l_{media}	l_{media} = 3 ft

3-6. Enter porosity of amended media (roughly 25% or 0.25 ft/ft), n_{media}	n_{media} = 0.25 ft/ft
3-7. Select thickness of optional gravel layer (ft), l_{gravel}	l_{gravel} = 0 ft
3-8. Enter porosity of gravel (roughly 30% or 0.3 ft/ft), n_{gravel}	n_{gravel} = 0.3 ft/ft
3-9. Calculate the total effective storage depth of bioretention facility (ft): $d_{effective} \leq (d_p + n_{media}l_{media} + n_{gravel}l_{gravel})$	$d_{effective}$ = 1.3 ft
3-10. Check that the entire effective depth infiltrates in required drainage time, 96 hours: $t_{total} = (d_{effective}/P_{design}) \times 12$ If t_{total} > 96 hours, reduce surface ponding depth and/or amended media thickness and/or gravel thickness and return to 3-4. If $t_{total} \leq$ 96 hours, proceed to 3-11.	t_{total} = 40 hours
3-11. Calculate the required infiltrating surface area (ft²): $A_{req} = SQDV/d_{effective}$	A_{req} = 7 ft²
Step 4: Calculate Bioretention Area Total Footprint	
4-1. Calculate total footprint required by including a buffer for side slopes and freeboard (ft²) [A_{req} is measured at the as the filter bottom area (toe of side slopes)], A_{tot}	A_{tot} = 113 ft²

Sizing Worksheet

Designer: Kirby Dubay Project Proponent: Date: 4/16/2021 Project: Camp Hess Location: Ventura County	Treatments 21, 22, 24 & 25
Type of Vegetation:	
Outflow Collection:	
Step 1: Determine water quality design volume	
1-1. Enter Project area (acres), $A_{project}$	$A_{project}$ = 4.5 acres
1-2. Enter the maximum allowable percent of the Project area that may be effective impervious area (%) (refer to permit), ranges from 5-30%, $\%_{allowable}$	$\%_{allowable}$ = 5 %
1-3. Determine the maximum allowable effective impervious area (acres), $EIA_{allowable} = (A_{project})*(\%_{allowable})$	$EIA_{allowable}$=0.22 acres
1-4. Enter Project impervious fraction, *Imp* (e.g. 60% = 0.60)	Imp= 0.23
1-5. Determine the Project Total Impervious area (acres), $TIA=A_{project}*Imp$	TIA=1.0 acres
1-6. Determine the total area from which runoff must be retained (acres), $A_{retain}=TIA-EIA_{allowable}$	A_{retain} =0.8 acres
1-7. Determine pervious runoff coefficient using Table E-1, C_p	C_p = 0.05
1-8. Calculate runoff coefficient, $C = 0.95*imp + C_p\ (1-imp)$	C = 0.26
1-9. Enter design rainfall depth of the storm (in), P_i	P_i = 0.75 in
1-10. Calculate rainfall depth (ft), $P = P_i/12$	P = 0.06 ft

1-11. Calculate water quality design volume (ft^3), $SQDV=43560\times C^*P^*A_{retain}$	SQDV= 542 ft^3

Step 2: Determine the design percolation rate	
2-1. Enter measured soil percolation rate (in/hr) (0.5 in/hr minimum), $P_{measured}$	$P_{measured}$ = 0.76in/hr
2-2. Determine percolation rate correction factor, S_A based on suitability assessment (see Section 6 INF-3)	S_A = 2
2-3. Determine percolation rate correction factor, S_B based on design (see Section 6 INF-3)	S_B = 2
2-4. Calculate combined safety factor, $S = S_A \times S_b$	S = 4
2-5. Calculate the design percolation rate (in/hr), $P_{design} = P_{measured}/S$	P_{design} = 0.19 in/hr

Step 3: Calculate Bioretention Infiltrating surface area	
3-1. Enter water quality design volume (ft^3), *SQDV*	SQDV = 542 ft^3
3-2. Enter design percolation rate (in/hr), P_{design}	P_{design} = 0.19 in/hr
3.3 Enter the required drain time (48 hours), $t_{ponding}$	$t_{ponding}$ = 48 hours
3-3. Calculate the maximum depth of surface ponding that can be infiltrated within the required drain time (ft): $d_{max} = (P_{design} \times t_{ponding})/12$	d_{max} = 0.8 ft
3-4. Select surface ponding depth (ft), d_p, such that $d_p \leq d_{max}$	d_p = 0.3 ft
3-5. Select thickness of amended media (ft,2 feet minimum, 3 preferred), l_{media}	l_{media} = 3 ft

3-6. Enter porosity of amended media (roughly 25% or 0.25 ft/ft), n_{media}	n_{media}= 0.25 ft/ft
3-7. Select thickness of optional gravel layer (ft), l_{gravel}	l_{gravel} = 0 ft
3-8. Enter porosity of gravel (roughly 30% or 0.3 ft/ft), n_{gravel}	n_{gravel}= 0.3 ft/ft
3-9. Calculate the total effective storage depth of bioretention facility (ft): $d_{effective} \leq (d_p + n_{media}l_{media} + n_{gravel}l_{gravel})$	$d_{effective}$= 1.1 ft
3-10. Check that the entire effective depth infiltrates in required drainage time, 96 hours: $t_{total} = (d_{effective}/P_{design}) \times 12$ If t_{total} > 96 hours, reduce surface ponding depth and/or amended media thickness and/or gravel thickness and return to 3-4. If $t_{total} \leq$ 96 hours, proceed to 3-11.	t_{total} = 66 hours
3-11. Calculate the required infiltrating surface area (ft²): $A_{req} = SQDV/d_{effective}$	A_{req} = 515 ft²
Step 4: Calculate Bioretention Area Total Footprint	
4-1. Calculate total footprint required by including a buffer for side slopes and freeboard (ft²) [A_{req} is measured at the as the filter bottom area (toe of side slopes)], A_{tot}	A_{tot} =937 ft²

Sizing Worksheet

Designer: Kirby Dubay Project Proponent: Date: 4/16/2021 Project: Camp Hess Location: Ventura County	Treatment 28
Type of Vegetation:	
Outflow Collection:	
Step 1: Determine water quality design volume	
1-1. Enter Project area (acres), $A_{project}$	$A_{project}$ = 0.02 acres
1-2. Enter the maximum allowable percent of the Project area that may be effective impervious area (%) (refer to permit), ranges from 5-30%, $\%_{allowable}$	$\%_{allowable}$ = 5 %
1-3. Determine the maximum allowable effective impervious area (acres), $EIA_{allowable} = (A_{project})*(\%_{allowable})$	$EIA_{allowable}$=.001 acres
1-4. Enter Project impervious fraction, *Imp* (e.g. 60% = 0.60)	Imp= 1
1-5. Determine the Project Total Impervious area (acres), $TIA=A_{project}*Imp$	TIA=0.02 acres
1-6. Determine the total area from which runoff must be retained (acres), $A_{retain}=TIA-EIA_{allowable}$	A_{retain} = 0.02 acres
1-7. Determine pervious runoff coefficient using Table E-1, C_p	C_p = 0.05
1-8. Calculate runoff coefficient, $C = 0.95*imp + C_p\ (1-imp)$	C = 0.95
1-9. Enter design rainfall depth of the storm (in), P_i	P_i = 0.75 in
1-10. Calculate rainfall depth (ft), $P = P_i/12$	P = 0.06 ft

1-11. Calculate water quality design volume (ft^3), $SQDV=43560\times C^*P^*A_{retain}$	SQDV= 43 ft^3

Step 2: Determine the design percolation rate	
2-1. Enter measured soil percolation rate (in/hr) (0.5 in/hr minimum), $P_{measured}$	$P_{measured}$ = 0.8 in/hr
2-2. Determine percolation rate correction factor, S_A based on suitability assessment (see Section 6 INF-3)	S_A = 2
2-3. Determine percolation rate correction factor, S_B based on design (see Section 6 INF-3)	S_B = 2
2-4. Calculate combined safety factor, $S = S_A \times S_b$	S = 4
2-5. Calculate the design percolation rate (in/hr), $P_{design} = P_{measured}/S$	P_{design} = 0.20 in/hr
Step 3: Calculate Bioretention Infiltrating surface area	
3-1. Enter water quality design volume (ft^3), *SQDV*	SQDV = 54 ft^3
3-2. Enter design percolation rate (in/hr), P_{design}	P_{design} = 0.20 in/hr
3.3 Enter the required drain time (48 hours), $t_{ponding}$	$t_{ponding}$ = 48 hours
3-3. Calculate the maximum depth of surface ponding that can be infiltrated within the required drain time (ft): $d_{max} = (P_{design} \times t_{ponding})/12$	d_{max} = 0.8 ft
3-4. Select surface ponding depth (ft), d_p, such that $d_p \leq d_{max}$	d_p = 0.5 ft
3-5. Select thickness of amended media (ft,2 feet minimum, 3 preferred), l_{media}	l_{media} = 3 ft

3-6. Enter porosity of amended media (roughly 25% or 0.25 ft/ft), n_{media}	n_{media} = 0.25 ft/ft
3-7. Select thickness of optional gravel layer (ft), l_{gravel}	l_{gravel} = 0 ft
3-8. Enter porosity of gravel (roughly 30% or 0.3 ft/ft), n_{gravel}	n_{gravel} = 0.3 ft/ft
3-9. Calculate the total effective storage depth of bioretention facility (ft): $d_{effective} \leq (d_p + n_{media}l_{media} + n_{gravel}l_{gravel})$	$d_{effective}$ = 1.3 ft
3-10. Check that the entire effective depth infiltrates in required drainage time, 96 hours: $t_{total} = (d_{effective}/P_{design}) \times 12$ If t_{total} > 96 hours, reduce surface ponding depth and/or amended media thickness and/or gravel thickness and return to 3-4. If $t_{total} \leq$ 96 hours, proceed to 3-11.	t_{total} = 75 hours
3-11. Calculate the required infiltrating surface area (ft²): $A_{req} = SQDV/d_{effective}$	A_{req} = 35 ft²
Step 4: Calculate Bioretention Area Total Footprint	
4-1. Calculate total footprint required by including a buffer for side slopes and freeboard (ft²) [A_{req} is measured at the as the filter bottom area (toe of side slopes)], A_{tot}	A_{tot} = 210 ft²

Sizing Worksheet

Designer: Kirby Dubay Project Proponent: Date: 4/16/2021 Project: Camp Hess Location: Ventura County	Treatment 29
Type of Vegetation:	
Outflow Collection:	
Step 1: Determine water quality design volume	
1-1. Enter Project area (acres), $A_{project}$	$A_{project}$ = 0.01 acres
1-2. Enter the maximum allowable percent of the Project area that may be effective impervious area (refer to permit), ranges from 5-30%, $\%_{allowable}$	$\%_{allowable}$ 5 %
1-3. Determine the maximum allowed effective impervious area (ac), $EIA_{allowable} = (A_{project})*(\%_{allowable})$	$EIA_{allowable}$=.0006 acres
1-4. Enter Project impervious fraction, *Imp* (e.g. 60% = 0.60)	Imp= 1
1-5. Determine the Project Total Impervious area (acres), $TIA=A_{project}*Imp$	TIA= 0.01 acres
1-6. Determine the total area from which runoff must be retained (acres), $A_{retain}=TIA-EIA_{allowable}$	A_{retain} = 0.01 acres
1-7. Determine pervious runoff coefficient using Table E-1, C_p	C_p = 0.05
1-8. Calculate runoff coefficient, $C = 0.95*imp + C_p\ (1-imp)$	C = 0.95
1-9. Enter design rainfall depth of the storm (in), P_i	P_i = 0.75 in
1-10. Calculate rainfall depth (ft), $P = P_i/12$	P = 0.06 ft
1-11. Calculate water quality design volume (ft^3),	SQDV= 30 ft^3

$SQDV=43560 \bullet C^{*}P^{*}A_{retain}$	

Step 2: Determine the design percolation rate	
2-1. Enter the design saturated hydraulic conductivity of the amended filter media (2.5 in/hr recommended rate), K_{design}	K_{design} = 2.5 in/hr

Step 3: Calculate Bioretention/Planter Box surface area			
3-1. Enter water quality design volume (ft^3), *SQDV*	SQDV =	30	ft^3
3-2. Enter design saturated hydraulic conductivity (in/hr), K_{design}	K_{design} =	2.5	in/hr
3-3. Enter ponding depth (max 1.5 ft for Bioretention, 1 ft for Planter Box) above area, d_p	d_p =	1	ft
3-4. Calculate the drawdown time for the ponded water to filter through media (hours), $t_{ponding} = (d_p/K_{design}) \times 12$	$t_{ponding}$=	4.8	hrs
3-5. Enter the storm duration for routing calculations (use 3 hours unless there is rationale for an alternative), $T_{routing}$	$T_{routing}$ =	3	hrs
3-6. Calculate depth of water (ft) filtered by using the following two equations: $d_{filtered,1} = (K_{design} \times T_{routing})/12$ $d_{filteret,2} = d_p /2$	$d_{filtered,1}$ = $d_{filtered,2}$ =	0.63 0.5	ft ft
3.7 Enter the resultant depth (ft) (the lesser of the two calculated above), $d_{filtered}$	$d_{filtered}$ =	0.5	ft
3-8. Calculate the infiltrating surface area as follows (ft^2): $A_{req} = SQDV/(d_p + d_{filtered})$	A_{req} =	20	ft^2

Step 4: Calculate Bioretention Area Total Footprint	
4-1. Calculate total footprint required by including a buffer for side slopes and freeboard (ft^2) [A_{req} is measured at the as the filter bottom area (toe of side slopes)], A_{tot}	A_{tot} = ft²
Step 5: Calculate Underdrain System Capacity	
To calculate the underdrain system capacity, continue through steps 5-1 to 5-7.	
Step 5: Calculate Underdrain System Capacity	
5-1. Calculated filtered flow rate to be conveyed by the longitudinal drain pipe, $Q_f = K_{design} A_{req}/43{,}200$	Q_f =.001 cfs
5-2. Enter minimum slope for energy gradient, S_e	S_e = 0.005
5-3. Enter Hazen-Williams coefficient for plastic, C_{HW}	C_{HW} = 140
5-4. Enter pipe diameter (min 6 inches), D	D = 6 in
5-5. Calculate pipe hydraulic radius (ft), $R_h = D/48$	R_h = 0.13 ft
5-6. Calculate velocity at the outlet of the pipe (ft/s), $V_p = 1.318 C_{HW} R_h^{0.63} S_e^{0.54}$	V_p = 2.8 ft/s
5-7. Calculate pipe capacity (cfs), $Q_{cap} = 0.25\pi (D/12)^2 V_p$	Q_{cap} = 0.56 cfs

Sizing Worksheet

Designer: Kirby Dubay Project Proponent: Date: 4/16/2021 Project: Camp Hess Location: Ventura County	Treatment 30
Type of Vegetation:	
Outflow Collection:	
Step 1: Determine water quality design volume	
1-1. Enter Project area (acres), $A_{project}$	$A_{project}$ = 0.02 acres
1-2. Enter the maximum allowable percent of the Project area that may be effective impervious area (%) (refer to permit), ranges from 5-30%, $\%_{allowable}$	$\%_{allowable}$ = 5 %
1-3. Determine the maximum allowable effective impervious area (acres), $EIA_{allowable} = (A_{project})*(\%_{allowable})$	$EIA_{allowable}$=.0009acres
1-4. Enter Project impervious fraction, *Imp* (e.g. 60% = 0.60)	Imp= 1
1-5. Determine the Project Total Impervious area (acres), $TIA=A_{project}*Imp$	TIA= 0.02 acres
1-6. Determine the total area from which runoff must be retained (acres), $A_{retain}=TIA-EIA_{allowable}$	A_{retain} = 0.02 acres
1-7. Determine pervious runoff coefficient using Table E-1, C_p	C_p = 0.15
1-8. Calculate runoff coefficient, $C = 0.95*imp + C_p\ (1-imp)$	C = 0.95
1-9. Enter design rainfall depth of the storm (in), P_i	P_i = 0.75 in
1-10. Calculate rainfall depth (ft), $P = P_i/12$	P = 0.06 ft

1-11. Calculate water quality design volume (ft^3), $SQDV=43560\times C^*P^*A_{retain}$	SQDV= 44 ft^3

Step 2: Determine the design percolation rate	
2-1. Enter measured soil percolation rate (in/hr) (0.5 in/hr minimum), $P_{measured}$	$P_{measured}$ = 0.8 in/hr
2-2. Determine percolation rate correction factor, S_A based on suitability assessment (see Section 6 INF-3)	S_A = 2
2-3. Determine percolation rate correction factor, S_B based on design (see Section 6 INF-3)	S_B = 2
2-4. Calculate combined safety factor, $S = S_A \times S_b$	S = 4
2-5. Calculate the design percolation rate (in/hr), $P_{design} = P_{measured}/S$	P_{design} = 0.20 in/hr
Step 3: Calculate Bioretention Infiltrating surface area	
3-1. Enter water quality design volume (ft^3), *SQDV*	SQDV = 44 ft^3
3-2. Enter design percolation rate (in/hr), P_{design}	P_{design} = 0.20 in/hr
3.3 Enter the required drain time (48 hours), $t_{ponding}$	$t_{ponding}$ = 48 hours
3-3. Calculate the maximum depth of surface ponding that can be infiltrated within the required drain time (ft): $d_{max} = (P_{design} \times t_{ponding})/12$	d_{max} = 0.8 ft
3-4. Select surface ponding depth (ft), d_p, such that $d_p \leq d_{max}$	d_p = 0.8 ft
3-5. Select thickness of amended media (ft,2 feet minimum, 3 preferred), l_{media}	l_{media} = 3 ft

3-6. Enter porosity of amended media (roughly 25% or 0.25 ft/ft), n_{media}	n_{media} = 0.25 ft/ft
3-7. Select thickness of optional gravel layer (ft), l_{gravel}	l_{gravel} = 0 ft
3-8. Enter porosity of gravel (roughly 30% or 0.3 ft/ft), n_{gravel}	n_{gravel} = 0.3 ft/ft
3-9. Calculate the total effective storage depth of bioretention facility (ft): $d_{effective} \leq (d_p + n_{media}l_{media} + n_{gravel}l_{gravel})$	$d_{effective}$ = 1.6 ft
3-10. Check that the entire effective depth infiltrates in required drainage time, 96 hours: $t_{total} = (d_{effective}/P_{design}) \times 12$ If t_{total} > 96 hours, reduce surface ponding depth and/or amended media thickness and/or gravel thickness and return to 3-4. If $t_{total} \leq$ 96 hours, proceed to 3-11.	t_{total} = 93 hours
3-11. Calculate the required infiltrating surface area (ft²): $A_{req} = SQDV/d_{effective}$	A_{req} = 29 ft²
Step 4: Calculate Bioretention Area Total Footprint	
4-1. Calculate total footprint required by including a buffer for side slopes and freeboard (ft²) [A_{req} is measured at the as the filter bottom area (toe of side slopes)], A_{tot}	A_{tot} = 222 ft²

Sizing Worksheet

Designer: Kirby Dubay Project Proponent: Date: 4/16/2021 Project: Camp Hess Location: Ventura County	T reatment 31
Type of Vegetation:	
Outflow Collection:	
Step 1: Determine water quality design volume	
1-1. Enter Project area (acres), $A_{project}$	$A_{project}$ = 0.04 acres
1-2. Enter the maximum allowable percent of the Project area that may be effective impervious area (%) (refer to permit), ranges from 5-30%, $\%_{allowable}$	$\%_{allowable}$ = 5 %
1-3. Determine the maximum allowable effective impervious area (acres), $EIA_{allowable} = (A_{project})*(\%_{allowable})$	$EIA_{allowable}$= .002 acres
1-4. Enter Project impervious fraction, *Imp* (e.g. 60% = 0.60)	Imp= 1
1-5. Determine the Project Total Impervious area (acres), $TIA=A_{project}*Imp$	TIA= 0.04 acres
1-6. Determine the total area from which runoff must be retained (acres), $A_{retain}=TIA-EIA_{allowable}$	A_{retain} = 0.04 acres
1-7. Determine pervious runoff coefficient using Table E-1, C_p	C_p = 0.05
1-8. Calculate runoff coefficient, $C = 0.95*imp + C_p\ (1-imp)$	C = 0.95
1-9. Enter design rainfall depth of the storm (in), P_i	P_i = 0.75 in
1-10. Calculate rainfall depth (ft), $P = P_i/12$	P = 0.06 ft

1-11. Calculate water quality design volume (ft^3), $SQDV=43560\times C^*P^*A_{retain}$	SQDV= 89 ft^3

Step 2: Determine the design percolation rate	
2-1. Enter measured soil percolation rate (in/hr) (0.5 in/hr minimum), $P_{measured}$	$P_{measured}$ = 0.8 in/hr
2-2. Determine percolation rate correction factor, S_A based on suitability assessment (see Section 6 INF-3)	S_A = 2
2-3. Determine percolation rate correction factor, S_B based on design (see Section 6 INF-3)	S_B = 2
2-4. Calculate combined safety factor, $S = S_A \times S_b$	S = 4
2-5. Calculate the design percolation rate (in/hr), $P_{design} = P_{measured}/S$	P_{design} = 0.20 in/hr
Step 3: Calculate Bioretention Infiltrating surface area	
3-1. Enter water quality design volume (ft^3), *SQDV*	SQDV = 89 ft^3
3-2. Enter design percolation rate (in/hr), P_{design}	P_{design} = 0.20 in/hr
3.3 Enter the required drain time (48 hours), $t_{ponding}$	$t_{ponding}$ = 48 hours
3-3. Calculate the maximum depth of surface ponding that can be infiltrated within the required drain time (ft): $d_{max} = (P_{design} \times t_{ponding})/12$	d_{max} = 0.8 ft
3-4. Select surface ponding depth (ft), d_p, such that $d_p \leq d_{max}$	d_p = 0.8 ft
3-5. Select thickness of amended media (ft,2 feet minimum, 3 preferred), l_{media}	l_{media} = 3 ft

3-6. Enter porosity of amended media (roughly 25% or 0.25 ft/ft), n_{media}	n_{media} = 0.25 ft/ft
3-7. Select thickness of optional gravel layer (ft), l_{gravel}	l_{gravel} = 0 ft
3-8. Enter porosity of gravel (roughly 30% or 0.3 ft/ft), n_{gravel}	n_{gravel} = 0.3 ft/ft
3-9. Calculate the total effective storage depth of bioretention facility (ft): $d_{effective} \leq (d_p + n_{media}l_{media} + n_{gravel}l_{gravel})$	$d_{effective}$ = 1.6 ft
3-10. Check that the entire effective depth infiltrates in required drainage time, 96 hours: $t_{total} = (d_{effective}/P_{design}) \times 12$ If t_{total} > 96 hours, reduce surface ponding depth and/or amended media thickness and/or gravel thickness and return to 3-4. If $t_{total} \leq$ 96 hours, proceed to 3-11.	t_{total} = 93 hours
3-11. Calculate the required infiltrating surface area (ft²): $A_{req} = SQDV/d_{effective}$	A_{req} = 57 ft²
Step 4: Calculate Bioretention Area Total Footprint	
4-1. Calculate total footprint required by including a buffer for side slopes and freeboard (ft²) [A_{req} is measured at the as the filter bottom area (toe of side slopes)], A_{tot}	A_{tot} = 243 ft²

Sizing Worksheet

Designer: Kirby Dubay Project Proponent: Date: 4/16/2021 Project: Camp Hess Location: Ventura County	Treatment 32
Type of Vegetation: (describe)	_____ _____ _
Outflow Collection: (Check type used or describe "Other")	____ Grated Inlet ____ Infiltration Trench ____ Underdrain Used ____ Other _____ _____ _

Step 1: Determine water quality design flow		
1-1. Enter Project area (acres), $A_{project}$	A_{design} = 0.14	acres
1-2. Enter impervious fraction, *Imp* (e.g. 60% = 0.60)	Imp = 1	
1-3. Determine pervious runoff coefficient using Table E-1, C_p	C_p 0.05	
1-4. Calculate runoff coefficient, $C = 0.95*imp + C_p\ (1-imp)$	C = 0.95	
1-5. Enter design rainfall intensity (in/hr), *i*	i = 0.2	in/hr
1-6. Calculate water quality design flow (cfs), *SQDF= CiA*	SQDF = 0.03	cfs

Step 2: Calculate swale bottom width	
2-1. Enter water quality design flow (cfs), *SQDF*	SQDF = 0.03 cfs
2-2. Enter Manning's roughness coefficient for shallow flow conditions, $n_{wq} = 0.2$	n_{wq} = 0.2
2-3. Calculate design flow depth (ft), *y*	y = 0.33 ft
2-4. Enter longitudinal slope (ft/ft) (along direction of flow), *s*	s = 0.04 ft/ft
2-5. Calculate bottom width of swale (ft), $b = (SQDF*n_{wq})/(1.49y^{1.67}s^{0.5})$	b = 0.11 ft
2-6. If *b* is between 2 and 10 feet, go to Step 3	
2-7. If b is less than 2 ft, assume b = 2 ft and recalculate flow depth, $y = ((SQDF*n_{wq})/(2.98\ s^{0.5}))^{0.6}$	y = 0.008 ft
2-8. If b is greater than 10 ft, one of the following design adjustments must be made (recalculate variables as necessary): • Increase the longitudinal slope to a maximum of 0.06 ft/ft. • Increase the design flow depth to a maximum of 4 in (0.33 ft). • Place a divider lengthwise along the swale bottom (Figure 3-1) at least three-quarters of the swale length (beginning at the inlet). Swale width can be increased to an absolute maximum of 16 feet if a divider is provided.	
Step 3: Determine design flow velocity	
3-1. Enter side slope length per unit height (H:V) (e.g. 3 if side slopes are 3H :1V), *Z*	Z = 3
3-2. Enter bottom width of swale (ft), *b*	b = 0.11 ft
3-3. Enter design flow depth (ft), *y*	y = 0.33 ft

3-4. Calculate the cross-sectional area of flow at design depth (ft^2), $A_{wq} = by + Zy^2$	A_{wq} =	0.36	ft^2
3-5. Calculate design flow velocity (ft/s), $V_{wq} = SQDF/ A_{wq}$	V_{wq} =	0.07	ft/s
3-6. If the design flow velocity exceeds 1 ft/s, go back to Step 2 and change one or more of the design parameters to reduce the design flow velocity. If design flow velocity is less than 1 ft/s, proceed to Step 4.			
Step 4: Calculate swale length			
4-1. Enter hydraulic residence time (minutes, minimum 7 min), t_{hr}	t_{hr} =	41	min
4-2. Calculate swale length (ft), $L = 60 t_{hr} V_{wq}$	L =	175	ft
Step 4: Calculate swale length			
4-3. If L is too long for the site, proceed to Step 5 to adjust the swale layout If L is greater than 100 ft and will fit within the constraints of the site, skip to Step 6 If L is less than 100 ft, increase the length to a minimum of 100 ft, leaving the bottom width unchanged, and skip to Step 6			
Step 5: Adjust swale layout to fit within site constraints			
5-1. Enter the bottom width calculated in Step 2 (ft), $b_i = b$	b_i =		ft
5-2. Enter design flow depth (ft), y	y=		ft
5-3. Enter the swale side slope ratio (H:V), Z	Z =		ft:ft
5-4. Enter the additional top width above the side slope for the design water depth (ft), $b_{slope} = 2Zy$	b_{slope} =		ft
5-5. Enter the initial length calculated in Step 4 (ft), $Li = L$	L_i =		ft

5-6. Calculate the top area at the design treatment depth (ft^2), $A_{top} = (b_i + b_{slope}) \times L_i$	A_{top} =	ft^2
5-7. Choose a reduced swale length based on site constraints (ft), L_f	L_f =	ft
5-8. Calculate the increased bottom width (ft), $b_f = (A_{top}/L_f) - b_{slope}$	b_f =	ft
5-9. Recalculate the cross-sectional area of flow at design depth (ft2), $A_{wq,f} = b_f y + Zy^2$	$A_{wq,f}$ =	ft^2
5-10. Recalculate design flow velocity (ft/s), $V_{wq} = SQDF / A_{wq}$ Revise design as necessary if design flow velocity exceeds 1 ft/s.	V_{wq} =	ft/s
5-11. Recalculate the hydraulic residence time (min), $t_{hr} = L_f/(60V_{wq})$ Ensure that t_{hr} is greater or equal to 10 minutes.	t_{hr} =	min
5-12. When V_{wq} and t_{hr} are recalculated to meet requirements, proceed to Step 6.		
Step 6: Provide conveyance capacity for flows higher than SQDF (if swale is on-line)		
6-1. If the swale already includes a high-flow bypass to convey flows higher than the water quality design flow rate, skip this step and verify that all parameters meet design requirements to complete sizing		
6-2. If swale does not include a high-flow bypass, determine that the swale can convey flood control design storm peak flows. Calculate the capital peak flow velocity per Ventura County requirements (ft/s), V_p	V_p =	ft/s

6-3. If V_p > 3.0 feet per second, return to Step 2 and increase the bottom width or flatten the longitudinal slope as necessary to reduce the flood control design storm peak flow velocity to 3.0 feet per second or less. If the longitudinal slope is flattened, the swale bottom width must be recalculated (Step 2) and must meet all design criteria.	

Sizing Worksheet

Designer: Kirby Dubay Project Proponent: Date: 4/16/2021 Project: Camp Hess Location: Ventura County	Treatments 23, 26, 27 & 33
Type of Vegetation: (Check type used or describe "Other")	____ Native Grasses ____ Irrigated Turf Grass ____ Other
Outflow Collection: ?	

Step 1: Determine water quality design volume	
1-1. Enter Project area (acres), $A_{project}$	$A_{project}$ = 14 acres
1-2. Enter the maximum allowable percent of the Project area that may be effective impervious area (%) (refer to permit), ranges from 5-30%, $\%_{allowable}$	$\%_{allowable}$ = 5 %
1-3. Determine the maximum allowable effective impervious area (acres), $EIA_{allowable} = (A_{project})*(\%_{allowable})$	$EIA_{allowable}$= 0.7 acres
1-4. Enter Project impervious fraction, *Imp* (e.g. 60% = 0.60)	Imp= 0.23
1-5. Determine the Project Total Impervious area (acres), $TIA=A_{project}*Imp$	TIA= 3.2 acres
1-6. Determine the total area from which runoff must be retained (acres), $A_{retain}=TIA-EIA_{allowable}$	A_{retain} = 2.5 acres
1-7. Determine pervious runoff coefficient using Table E-1, C_p	C_p = 0.05
1-8. Calculate runoff coefficient, $C = 0.95*imp + C_p\ (1-imp)$	C = 0.26
1-9. Enter design rainfall depth of the storm (in), P_i	P_i = 0.75 in

1-10. Calculate rainfall depth (ft), $P = P_i/12$	P = 0.06 ft
1-11. Calculate water quality design volume (ft^3), $SQDV=43560\times C^*P^*A_{retain}$	SQDV= 1676 ft^3
Step 2: Determine the design percolation rate	
2-1. Enter measured soil percolation rate (in/hr, 0.5 in/hr min.), $P_{measured}$	$P_{measured}$ = 0.8 in/hr
2-2. Determine percolation rate correction factor, S_A based on suitability assessment (see Section 6 INF-1)	S_A = 2
2-3. Determine percolation rate correction factor, S_B based on design (see Section 6 INF-1)	S_b = 2
2-4. Calculate combined safety factor, $S = S_A$ x S_b	S = 4
2-5. Calculate the design percolation rate (in/hr), $P_{design} = P_{measured}/S$	P_{design} = 0.20 in/hr
Step 3: Calculate the surface area	
3-1. Enter required drain time(hours,72 hrs max.), t	t = 72 hrs
3-2. Calculate max. depth of runoff that can be infiltrated within the t (ft), $d_{max} = P_{design}\ t/12$	d_{max} = 2.4 ft
3-3. For basins, select ponding depth (ft), d_p, such that $d_p \le d_{max}$	d_p = ft
3-4. For trenches, enter trench fill aggregate porosity, n_t	n_t = 0.32
3-5. For trenches, enter depth of trench fill (ft), d_t	d_t = 4 ft
3-5. For trenches, select ponding depth d_p such that $d_p \le d_{max} - n_t d_t$	d_p= 1.1 ft
3-6. Enter the time to fill infiltration basin or trench with water (Use 2 hours for most designs), T	T = 2 hrs

3-7. Calculate infiltrating surface area for infiltration basin (ft^2): $A_b = SQDV/((T\ P_{design}/12)+d_p)$ OR Calculate infiltrating surface area for infiltration trenches or aggregate- filled drywells (ft^2): $A_t = SQDV/((T\ P_{design}/12)+n_t d_t+dp)$	A_b = 1,454 ft^2 A_t = ft^2
Step 4: Size the forebay (infiltration basins or trenches)	
If a separate pre-treatment unit is designed for the infiltration facility, skip to Step 5. If not, continue through 4-1 through 4-4.	
4-1. Calculate the volume of the forebay (ft^3), $V_{forebay}$=0.25*SQDV	$V_{forebay}$= 419 ft^3
4-2. Determine forebay depth (ft), $d_{forebay}$	$d_{forebay}$= 3 ft
4-3. Calculate forebay bottom surface area (ft^2), $A_{forebay}=V_{forebay}/d_{forebay}$	$A_{forebay}$= 140 ft^2
4-4. Provide outlet pipe such that the forebay drains to the infiltration facility within 10 minutes.	
Step 5: Provide conveyance capacity for filter clogging	
5-1.The infiltration facility should be placed off-line, but an emergency overflow must still be provided in the event the filter becomes clogged. Design emergency overflow in accordance with applicable standards of the Ventura County Flood Control District or local jurisdiction.	

Sizing Worksheet

Designer: Kirby Dubay Project Proponent: Date: 4/16/2021 Project: Camp Hess Location: Ventura County	Treatments 34, 35, 42 & 43
Type of Vegetation:	
Outflow Collection:	
Step 1: Determine water quality design volume	
1-1. Enter Project area (acres), $A_{project}$	$A_{project}$ = 0.02acres
1-2. Enter the maximum allowable percent of the Project area that may be effective impervious area (refer to permit), ranges from 5-30%, $\%_{allowable}$	$\%_{allowable}$ 5 %
1-3. Determine the maximum allowed effective impervious area (ac), $EIA_{allowable} = (A_{project})*(\%_{allowable})$	$EIA_{allowable}$=.0008acres
1-4. Enter Project impervious fraction, *Imp* (e.g. 60% = 0.60)	Imp= 1
1-5. Determine the Project Total Impervious area (acres), $TIA=A_{project}*Imp$	TIA= 0.02 acres
1-6. Determine the total area from which runoff must be retained (acres), $A_{retain}=TIA-EIA_{allowable}$	A_{retain} = 0.01 acres
1-7. Determine pervious runoff coefficient using Table E-1, C_p	C_p = 0.15
1-8. Calculate runoff coefficient, $C = 0.95*imp + C_p\ (1-imp)$	C = 0.95
1-9. Enter design rainfall depth of the storm (in), P_i	P_i = 0.75 in
1-10. Calculate rainfall depth (ft), $P = P_i/12$	P = 0.06 ft
1-11. Calculate water quality design volume (ft^3),	SQDV= 35 ft^3

$SQDV=43560 \bullet C^{*}P^{*}A_{retain}$	

Step 2: Determine the design percolation rate	
2-1. Enter the design saturated hydraulic conductivity of the amended filter media (2.5 in/hr recommended rate), K_{design}	K_{design} = 2.5 in/hr

Step 3: Calculate Bioretention/Planter Box surface area			
3-1. Enter water quality design volume (ft^3), *SQDV*	SQDV =	35	ft^3
3-2. Enter design saturated hydraulic conductivity (in/hr), K_{design}	K_{design} =	2.5	in/hr
3-3. Enter ponding depth (max 1.5 ft for Bioretention, 1 ft for Planter Box) above area, d_p	d_p =	1	ft
3-4. Calculate the drawdown time for the ponded water to filter through media (hours), $t_{ponding} = (d_p/K_{design}) \times 12$	$t_{ponding}$=	4.8	hrs
3-5. Enter the storm duration for routing calculations (use 3 hours unless there is rationale for an alternative), $T_{routing}$	$T_{routing}$ =	3	hrs
3-6. Calculate depth of water (ft) filtered by using the following two equations: $d_{filtered,1} = (K_{design} \times T_{routing})/12$ $d_{filteret,2} = d_p /2$	$d_{filtered,1}$ = $d_{filtered,2}$ =	0.63 0.5	ft ft
3.7 Enter the resultant depth (ft) (the lesser of the two calculated above), $d_{filtered}$	$d_{filtered}$ =	0.5	ft
3-8. Calculate the infiltrating surface area as follows (ft^2): $A_{req} = SQDV/(d_p + d_{filtered})$	A_{req} =	24	ft^2

Step 4: Calculate Bioretention Area Total Footprint	
4-1. Calculate total footprint required by including a buffer for side slopes and freeboard (ft^2) [A_{req} is measured at the as the filter bottom area (toe of side slopes)], A_{tot}	A_{tot} = ft²
Step 5: Calculate Underdrain System Capacity	
To calculate the underdrain system capacity, continue through steps 5-1 to 5-7.	
Step 5: Calculate Underdrain System Capacity	
5-1. Calculated filtered flow rate to be conveyed by the longitudinal drain pipe, $Q_f = K_{design} A_{req}/43{,}200$	Q_f =.001 cfs
5-2. Enter minimum slope for energy gradient, S_e	S_e = 0.005
5-3. Enter Hazen-Williams coefficient for plastic, C_{HW}	C_{HW} = 140
5-4. Enter pipe diameter (min 6 inches), D	D = 6 in
5-5. Calculate pipe hydraulic radius (ft), $R_h = D/48$	R_h = 0.13 ft
5-6. Calculate velocity at the outlet of the pipe (ft/s), $V_p = 1.318 C_{HW} R_h^{0.63} S_e^{0.54}$	V_p = 2.8 ft/s
5-7. Calculate pipe capacity (cfs), $Q_{cap} = 0.25\pi (D/12)^2 V_p$	Q_{cap} = 0.56 cfs

Sizing Worksheet

Designer: Kirby Dubay Project Proponent: Date: 4/16/2021 Project: Camp Hess Location: Ventura County	Treatments 36 & 37
Type of Vegetation:	
Outflow Collection:	
Step 1: Determine water quality design volume	
1-1. Enter Project area (acres), $A_{project}$	$A_{project}$ = 0.02acres
1-2. Enter the maximum allowable percent of the Project area that may be effective impervious area (refer to permit), ranges from 5-30%, $\%_{allowable}$	$\%_{allowable}$ 5 %
1-3. Determine the maximum allowed effective impervious area (ac), $EIA_{allowable} = (A_{project})*(\%_{allowable})$	$EIA_{allowable}$=.0008acres
1-4. Enter Project impervious fraction, *Imp* (e.g. 60% = 0.60)	Imp= 1
1-5. Determine the Project Total Impervious area (acres), $TIA=A_{project}*Imp$	TIA= 0.02 acres
1-6. Determine the total area from which runoff must be retained (acres), $A_{retain}=TIA-EIA_{allowable}$	A_{retain} = 0.01 acres
1-7. Determine pervious runoff coefficient using Table E-1, C_p	C_p = 0.15
1-8. Calculate runoff coefficient, $C = 0.95*imp + C_p\ (1-imp)$	C = 0.95
1-9. Enter design rainfall depth of the storm (in), P_i	P_i = 0.75 in
1-10. Calculate rainfall depth (ft), $P = P_i/12$	P = 0.06 ft
1-11. Calculate water quality design volume (ft^3),	SQDV= 35 ft^3

$SQDV=43560 \bullet C^{*}P^{*}A_{retain}$	

Step 2: Determine the design percolation rate	
2-1. Enter the design saturated hydraulic conductivity of the amended filter media (2.5 in/hr recommended rate), K_{design}	K_{design} = 2.5 in/hr

Step 3: Calculate Bioretention/Planter Box surface area			
3-1. Enter water quality design volume (ft^3), *SQDV*	SQDV =	35	ft^3
3-2. Enter design saturated hydraulic conductivity (in/hr), K_{design}	K_{design} =	2.5	in/hr
3-3. Enter ponding depth (max 1.5 ft for Bioretention, 1 ft for Planter Box) above area, d_p	d_p =	1	ft
3-4. Calculate the drawdown time for the ponded water to filter through media (hours), $t_{ponding} = (d_p/K_{design}) \times 12$	$t_{ponding}$=	4.8	hrs
3-5. Enter the storm duration for routing calculations (use 3 hours unless there is rationale for an alternative), $T_{routing}$	$T_{routing}$ =	3	hrs
3-6. Calculate depth of water (ft) filtered by using the following two equations: $d_{filtered,1} = (K_{design} \times T_{routing})/12$ $d_{filteret,2} = d_p /2$	$d_{filtered,1}$ = $d_{filtered,2}$ =	0.63 0.5	ft ft
3.7 Enter the resultant depth (ft) (the lesser of the two calculated above), $d_{filtered}$	$d_{filtered}$ =	0.5	ft
3-8. Calculate the infiltrating surface area as follows (ft^2): $A_{req} = SQDV/(d_p + d_{filtered})$	A_{req} =	24	ft^2

Step 4: Calculate Bioretention Area Total Footprint	
4-1. Calculate total footprint required by including a buffer for side slopes and freeboard (ft^2) [A_{req} is measured at the as the filter bottom area (toe of side slopes)], A_{tot}	A_{tot} = ft²
Step 5: Calculate Underdrain System Capacity	
To calculate the underdrain system capacity, continue through steps 5-1 to 5-7.	
Step 5: Calculate Underdrain System Capacity	
5-1. Calculated filtered flow rate to be conveyed by the longitudinal drain pipe, $Q_f = K_{design} A_{req}/43{,}200$	Q_f =.001 cfs
5-2. Enter minimum slope for energy gradient, S_e	S_e = 0.005
5-3. Enter Hazen-Williams coefficient for plastic, C_{HW}	C_{HW} = 140
5-4. Enter pipe diameter (min 6 inches), D	D = 6 in
5-5. Calculate pipe hydraulic radius (ft), $R_h = D/48$	R_h = 0.13 ft
5-6. Calculate velocity at the outlet of the pipe (ft/s), $V_p = 1.318 C_{HW} R_h^{0.63} S_e^{0.54}$	V_p = 2.8 ft/s
5-7. Calculate pipe capacity (cfs), $Q_{cap} = 0.25\pi (D/12)^2 V_p$	Q_{cap} = 0.56 cfs

Sizing Worksheet

Designer: Kirby Dubay Project Proponent: Date: 4/16/2021 Project: Camp Hess Location: Ventura County	Treatments 38 & 39
Type of Vegetation:	
Outflow Collection:	
Step 1: Determine water quality design volume	
1-1. Enter Project area (acres), $A_{project}$	$A_{project}$ = 0.01 acres
1-2. Enter the maximum allowable percent of the Project area that may be effective impervious area (refer to permit), ranges from 5-30%, $\%_{allowable}$	$\%_{allowable}$ 5 %
1-3. Determine the maximum allowed effective impervious area (ac), $EIA_{allowable} = (A_{project})*(\%_{allowable})$	$EIA_{allowable}$=.0007 acres
1-4. Enter Project impervious fraction, *Imp* (e.g. 60% = 0.60)	Imp= 1
1-5. Determine the Project Total Impervious area (acres), $TIA=A_{project}*Imp$	TIA= 0.01 acres
1-6. Determine the total area from which runoff must be retained (acres), $A_{retain}=TIA-EIA_{allowable}$	A_{retain} = 0.01 acres
1-7. Determine pervious runoff coefficient using Table E-1, C_p	C_p = 0.15
1-8. Calculate runoff coefficient, $C = 0.95*imp + C_p\ (1-imp)$	C = 0.95
1-9. Enter design rainfall depth of the storm (in), P_i	P_i = 0.75 in
1-10. Calculate rainfall depth (ft), $P = P_i/12$	P = 0.06 ft
1-11. Calculate water quality design volume (ft^3),	SQDV= 35 ft^3

$SQDV=43560 \bullet C^{*}P^{*}A_{retain}$	

Step 2: Determine the design percolation rate	
2-1. Enter the design saturated hydraulic conductivity of the amended filter media (2.5 in/hr recommended rate), K_{design}	K_{design} = 2.5 in/hr

Step 3: Calculate Bioretention/Planter Box surface area			
3-1. Enter water quality design volume (ft^3), *SQDV*	SQDV =	35	ft^3
3-2. Enter design saturated hydraulic conductivity (in/hr), K_{design}	K_{design} =	2.5	in/hr
3-3. Enter ponding depth (max 1.5 ft for Bioretention, 1 ft for Planter Box) above area, d_p	d_p =	1	ft
3-4. Calculate the drawdown time for the ponded water to filter through media (hours), $t_{ponding} = (d_p/K_{design}) \times 12$	$t_{ponding}$=	4.8	hrs
3-5. Enter the storm duration for routing calculations (use 3 hours unless there is rationale for an alternative), $T_{routing}$	$T_{routing}$ =	3	hrs
3-6. Calculate depth of water (ft) filtered by using the following two equations: $d_{filtered,1} = (K_{design} \times T_{routing})/12$ $d_{filteret,2} = d_p /2$	$d_{filtered,1}$ = $d_{filtered,2}$ =	0.63 0.5	ft ft
3.7 Enter the resultant depth (ft) (the lesser of the two calculated above), $d_{filtered}$	$d_{filtered}$ =	0.5	ft
3-8. Calculate the infiltrating surface area as follows (ft^2): $A_{req} = SQDV/(d_p + d_{filtered})$	A_{req} =	23	ft^2

Step 4: Calculate Bioretention Area Total Footprint	
4-1. Calculate total footprint required by including a buffer for side slopes and freeboard (ft^2) [A_{req} is measured at the as the filter bottom area (toe of side slopes)], A_{tot}	A_{tot} = ft²
Step 5: Calculate Underdrain System Capacity	
To calculate the underdrain system capacity, continue through steps 5-1 to 5-7.	
Step 5: Calculate Underdrain System Capacity	
5-1. Calculated filtered flow rate to be conveyed by the longitudinal drain pipe, $Q_f = K_{design} A_{req}/43{,}200$	Q_f =.001 cfs
5-2. Enter minimum slope for energy gradient, S_e	S_e = 0.005
5-3. Enter Hazen-Williams coefficient for plastic, C_{HW}	C_{HW} = 140
5-4. Enter pipe diameter (min 6 inches), D	D = 6 in
5-5. Calculate pipe hydraulic radius (ft), $R_h = D/48$	R_h = 0.13 ft
5-6. Calculate velocity at the outlet of the pipe (ft/s), $V_p = 1.318 C_{HW} R_h^{0.63} S_e^{0.54}$	V_p = 2.8 ft/s
5-7. Calculate pipe capacity (cfs), $Q_{cap} = 0.25\pi (D/12)^2 V_p$	Q_{cap} = 0.56 cfs

Sizing Worksheet

Designer: Kirby Dubay Project Proponent: Date: 4/16/2021 Project: Camp Hess Location: Ventura County	Treatments 40 & 41
Type of Vegetation:	
Outflow Collection:	
Step 1: Determine water quality design volume	
1-1. Enter Project area (acres), $A_{project}$	$A_{project}$ = 0.02acres
1-2. Enter the maximum allowable percent of the Project area that may be effective impervious area (refer to permit), ranges from 5-30%, $\%_{allowable}$	$\%_{allowable}$ 5 %
1-3. Determine the maximum allowed effective impervious area (ac), $EIA_{allowable} = (A_{project})*(\%_{allowable})$	$EIA_{allowable}$=.0008acres
1-4. Enter Project impervious fraction, *Imp* (e.g. 60% = 0.60)	Imp= 1
1-5. Determine the Project Total Impervious area (acres), $TIA=A_{project}*Imp$	TIA= 0.02 acres
1-6. Determine the total area from which runoff must be retained (acres), $A_{retain}=TIA-EIA_{allowable}$	A_{retain} = 0.01 acres
1-7. Determine pervious runoff coefficient using Table E-1, C_p	C_p = 0.15
1-8. Calculate runoff coefficient, $C = 0.95*imp + C_p\ (1-imp)$	C = 0.95
1-9. Enter design rainfall depth of the storm (in), P_i	P_i = 0.75 in
1-10. Calculate rainfall depth (ft), $P = P_i/12$	P = 0.06 ft
1-11. Calculate water quality design volume (ft^3),	SQDV= 36 ft^3

$SQDV=43560 \bullet C^{*}P^{*}A_{retain}$	

Step 2: Determine the design percolation rate	
2-1. Enter the design saturated hydraulic conductivity of the amended filter media (2.5 in/hr recommended rate), K_{design}	K_{design} = 2.5 in/hr

Step 3: Calculate Bioretention/Planter Box surface area			
3-1. Enter water quality design volume (ft^3), *SQDV*	SQDV =	36	ft^3
3-2. Enter design saturated hydraulic conductivity (in/hr), K_{design}	K_{design} =	2.5	in/hr
3-3. Enter ponding depth (max 1.5 ft for Bioretention, 1 ft for Planter Box) above area, d_p	d_p =	1	ft
3-4. Calculate the drawdown time for the ponded water to filter through media (hours), $t_{ponding} = (d_p/K_{design}) \times 12$	$t_{ponding}$=	4.8	hrs
3-5. Enter the storm duration for routing calculations (use 3 hours unless there is rationale for an alternative), $T_{routing}$	$T_{routing}$ =	3	hrs
3-6. Calculate depth of water (ft) filtered by using the following two equations: $d_{filtered,1} = (K_{design} \times T_{routing})/12$ $d_{filteret,2} = d_p /2$	$d_{filtered,1}$ = $d_{filtered,2}$ =	0.63 0.5	ft ft
3.7 Enter the resultant depth (ft) (the lesser of the two calculated above), $d_{filtered}$	$d_{filtered}$ =	0.5	ft
3-8. Calculate the infiltrating surface area as follows (ft^2): $A_{req} = SQDV/(d_p + d_{filtered})$	A_{req} =	24	ft^2

Step 4: Calculate Bioretention Area Total Footprint	
4-1. Calculate total footprint required by including a buffer for side slopes and freeboard (ft^2) [A_{req} is measured at the as the filter bottom area (toe of side slopes)], A_{tot}	A_{tot} = ft²
Step 5: Calculate Underdrain System Capacity	
To calculate the underdrain system capacity, continue through steps 5-1 to 5-7.	
Step 5: Calculate Underdrain System Capacity	
5-1. Calculated filtered flow rate to be conveyed by the longitudinal drain pipe, $Q_f = K_{design} A_{req}/43{,}200$	Q_f =.001 cfs
5-2. Enter minimum slope for energy gradient, S_e	S_e = 0.005
5-3. Enter Hazen-Williams coefficient for plastic, C_{HW}	C_{HW} = 140
5-4. Enter pipe diameter (min 6 inches), D	D = 6 in
5-5. Calculate pipe hydraulic radius (ft), $R_h = D/48$	R_h = 0.13 ft
5-6. Calculate velocity at the outlet of the pipe (ft/s), $V_p = 1.318 C_{HW} R_h^{0.63} S_e^{0.54}$	V_p = 2.8 ft/s
5-7. Calculate pipe capacity (cfs), $Q_{cap} = 0.25\pi (D/12)^2 V_p$	Q_{cap} = 0.56 cfs

Sizing Worksheet

Designer: Kirby Dubay Project Proponent: Date: 4/16/2021 Project: Camp Hess Location: Ventura County	Treatment 44
Type of Vegetation: (Check type used or describe "Other")	____ Native Grasses ____ Irrigated Turf Grass ____ Other
Outflow Collection:	

Step 1: Determine water quality design volume	
1-1. Enter Project area (acres), $A_{project}$	$A_{project}$ = 12.3 acres
1-2. Enter the maximum allowable percent of the Project area that may be effective impervious area (%) (refer to permit), ranges from 5-30%, $\%_{allowable}$	$\%_{allowable}$ = 5 %
1-3. Determine the maximum allowable effective impervious area (acres), $EIA_{allowable} = (A_{project})*(\%_{allowable})$	$EIA_{allowable}$ = 0.62 acres
1-4. Enter Project impervious fraction, *Imp* (e.g. 60% = 0.60)	Imp= 0.23
1-5. Determine the Project Total Impervious area (acres), $TIA=A_{project}*Imp$	TIA= 2.8 acres
1-6. Determine the total area from which runoff must be retained (acres), $A_{retain}=TIA-EIA_{allowable}$	A_{retain} = 2.2 acres
1-7. Determine pervious runoff coefficient using Table E-1, C_p	C_p = 0.05
1-8. Calculate runoff coefficient, $C = 0.95*imp + C_p\ (1-imp)$	C = 0.95
1-9. Enter design rainfall depth of the storm (in), P_i	P_i = 0.75 in

1-10. Calculate rainfall depth (ft), $P = P_i/12$	P = 0.06 ft
1-11. Calculate water quality design volume (ft^3), $SQDV=43560\times C^*P^*A_{retain}$	SQDV= 1482 ft^3
Step 2: Determine the design percolation rate	
2-1. Enter measured soil percolation rate (in/hr, 0.5 in/hr min.), $P_{measured}$	$P_{measured}$ = 2.2 in/hr
2-2. Determine percolation rate correction factor, S_A based on suitability assessment (see Section 6 INF-1)	S_A = 2
2-3. Determine percolation rate correction factor, S_B based on design (see Section 6 INF-1)	S_b = 2
2-4. Calculate combined safety factor, $S = S_A \times S_b$	S = 4
2-5. Calculate the design percolation rate (in/hr), $P_{design} = P_{measured}/S$	P_{design} = 0.55 in/hr
Step 3: Calculate the surface area	
3-1. Enter required drain time(hours,72 hrs max.), t	t = 72 hrs
3-2. Calculate max. depth of runoff that can be infiltrated within the t (ft), $d_{max} = P_{design}\ t/12$	d_{max} = 2.4 ft
3-3. For basins, select ponding depth (ft), d_p, such that $d_p \le d_{max}$	d_p = ft
3-4. For trenches, enter trench fill aggregate porosity, n_t	n_t = 0.32
3-5. For trenches, enter depth of trench fill (ft), d_t	d_t = 4 ft
3-5. For trenches, select ponding depth d_p such that $d_p \le d_{max} - n_t d_t$	d_p= 1.1 ft
3-6. Enter the time to fill infiltration basin or trench with water (Use 2 hours for most designs), T	T = 2 hrs

3-7. Calculate infiltrating surface area for infiltration basin (ft^2): $A_b = SQDV/((T\ P_{design}/12)+d_p)$ OR Calculate infiltrating surface area for infiltration trenches or aggregate- filled drywells (ft^2): $A_t = SQDV/((T\ P_{design}/12)+n_t d_t+dp)$	A_b = ft² A_t = 1,224 ft²
Step 4: Size the forebay (infiltration basins or trenches)	
If a separate pre-treatment unit is designed for the infiltration facility, skip to Step 5. If not, continue through 4-1 through 4-4.	
4-1. Calculate the volume of the forebay (ft^3), $V_{forebay}$=0.25*SQDV	$V_{forebay}$= 370 ft^3
4-2. Determine forebay depth (ft), $d_{forebay}$	$d_{forebay}$= 3 ft
4-3. Calculate forebay bottom surface area (ft^2), $A_{forebay}=V_{forebay}/d_{forebay}$	$A_{forebay}$= 124 ft^2
4-4. Provide outlet pipe such that the forebay drains to the infiltration facility within 10 minutes.	
Step 5: Provide conveyance capacity for filter clogging	
5-1.The infiltration facility should be placed off-line, but an emergency overflow must still be provided in the event the filter becomes clogged. Design emergency overflow in accordance with applicable standards of the Ventura County Flood Control District or local jurisdiction.	

Sizing Worksheet

Designer: Kirby Dubay Project Proponent: Date: 4/16/2021 Project: Camp Hess Location: Ventura County	Treatments 45 & 47
Type of Vegetation:	
Outflow Collection:	
Step 1: Determine water quality design volume	
1-1. Enter Project area (acres), $A_{project}$	$A_{project}$ = 0.02acres
1-2. Enter the maximum allowable percent of the Project area that may be effective impervious area (refer to permit), ranges from 5-30%, $\%_{allowable}$	$\%_{allowable}$ 5 %
1-3. Determine the maximum allowed effective impervious area (ac), $EIA_{allowable} = (A_{project})*(\%_{allowable})$	$EIA_{allowable}$=.0008acres
1-4. Enter Project impervious fraction, *Imp* (e.g. 60% = 0.60)	Imp= 1
1-5. Determine the Project Total Impervious area (acres), $TIA=A_{project}*Imp$	TIA= 0.02 acres
1-6. Determine the total area from which runoff must be retained (acres), $A_{retain}=TIA-EIA_{allowable}$	A_{retain} = 0.02 acres
1-7. Determine pervious runoff coefficient using Table E-1, C_p	C_p = 0.05
1-8. Calculate runoff coefficient, $C = 0.95*imp + C_p\ (1-imp)$	C = 0.95
1-9. Enter design rainfall depth of the storm (in), P_i	P_i = 0.75 in
1-10. Calculate rainfall depth (ft), $P = P_i/12$	P = 0.06 ft
1-11. Calculate water quality design volume (ft^3),	SQDV= 39 ft^3

$SQDV=43560 \bullet C^{*}P^{*}A_{retain}$	

Step 2: Determine the design percolation rate	
2-1. Enter the design saturated hydraulic conductivity of the amended filter media (2.5 in/hr recommended rate), K_{design}	K_{design} = 2.5 in/hr

Step 3: Calculate Bioretention/Planter Box surface area			
3-1. Enter water quality design volume (ft^3), *SQDV*	SQDV =	39	ft^3
3-2. Enter design saturated hydraulic conductivity (in/hr), K_{design}	K_{design} =	2.5	in/hr
3-3. Enter ponding depth (max 1.5 ft for Bioretention, 1 ft for Planter Box) above area, d_p	d_p =	1	ft
3-4. Calculate the drawdown time for the ponded water to filter through media (hours), $t_{ponding} = (d_p/K_{design}) \times 12$	$t_{ponding}$=	4.8	hrs
3-5. Enter the storm duration for routing calculations (use 3 hours unless there is rationale for an alternative), $T_{routing}$	$T_{routing}$ =	3	hrs
3-6. Calculate depth of water (ft) filtered by using the following two equations: $d_{filtered,1} = (K_{design} \times T_{routing})/12$ $d_{filteret,2} = d_p /2$	$d_{filtered,1}$ = $d_{filtered,2}$ =	0.63 0.5	ft ft
3.7 Enter the resultant depth (ft) (the lesser of the two calculated above), $d_{filtered}$	$d_{filtered}$ =	0.5	ft
3-8. Calculate the infiltrating surface area as follows (ft^2): $A_{req} = SQDV/(d_p + d_{filtered})$	A_{req} =	26	ft^2

Step 4: Calculate Bioretention Area Total Footprint	
4-1. Calculate total footprint required by including a buffer for side slopes and freeboard (ft^2) [A_{req} is measured at the as the filter bottom area (toe of side slopes)], A_{tot}	A_{tot} = ft²
Step 5: Calculate Underdrain System Capacity	
To calculate the underdrain system capacity, continue through steps 5-1 to 5-7.	
Step 5: Calculate Underdrain System Capacity	
5-1. Calculated filtered flow rate to be conveyed by the longitudinal drain pipe, $Q_f = K_{design} A_{req}/43{,}200$	Q_f =.001 cfs
5-2. Enter minimum slope for energy gradient, S_e	S_e = 0.005
5-3. Enter Hazen-Williams coefficient for plastic, C_{HW}	C_{HW} = 140
5-4. Enter pipe diameter (min 6 inches), D	D = 6 in
5-5. Calculate pipe hydraulic radius (ft), $R_h = D/48$	R_h = 0.13 ft
5-6. Calculate velocity at the outlet of the pipe (ft/s), $V_p = 1.318 C_{HW} R_h^{0.63} S_e^{0.54}$	V_p = 2.8 ft/s
5-7. Calculate pipe capacity (cfs), $Q_{cap} = 0.25\pi (D/12)^2 V_p$	Q_{cap} = 0.56 cfs

Sizing Worksheet

Designer: Kirby Dubay Project Proponent: Date: 4/16/2021 Project: Camp Hess Location: Ventura County	Treatment 46
Type of Vegetation:	
Outflow Collection:	
Step 1: Determine water quality design volume	
1-1. Enter Project area (acres), $A_{project}$	$A_{project}$ = 0.03acres
1-2. Enter the maximum allowable percent of the Project area that may be effective impervious area (refer to permit), ranges from 5-30%, $\%_{allowable}$	$\%_{allowable}$ 5 %
1-3. Determine the maximum allowed effective impervious area (ac), $EIA_{allowable} = (A_{project})*(\%_{allowable})$	$EIA_{allowable}$=.001 acres
1-4. Enter Project impervious fraction, *Imp* (e.g. 60% = 0.60)	Imp= 1
1-5. Determine the Project Total Impervious area (acres), $TIA=A_{project}*Imp$	TIA= 0.03 acres
1-6. Determine the total area from which runoff must be retained (acres), $A_{retain}=TIA-EIA_{allowable}$	A_{retain} = 0.03 acres
1-7. Determine pervious runoff coefficient using Table E-1, C_p	C_p = 0.05
1-8. Calculate runoff coefficient, $C = 0.95*imp + C_p\ (1-imp)$	C = 0.95
1-9. Enter design rainfall depth of the storm (in), P_i	P_i = 0.75 in
1-10. Calculate rainfall depth (ft), $P = P_i/12$	P = 0.06 ft
1-11. Calculate water quality design volume (ft^3),	SQDV= 63 ft^3

$SQDV=43560 \bullet C^{*}P^{*}A_{retain}$	

Step 2: Determine the design percolation rate	
2-1. Enter the design saturated hydraulic conductivity of the amended filter media (2.5 in/hr recommended rate), K_{design}	K_{design} = 2.5 in/hr

Step 3: Calculate Bioretention/Planter Box surface area			
3-1. Enter water quality design volume (ft^3), *SQDV*	SQDV =	63	ft^3
3-2. Enter design saturated hydraulic conductivity (in/hr), K_{design}	K_{design} =	2.5	in/hr
3-3. Enter ponding depth (max 1.5 ft for Bioretention, 1 ft for Planter Box) above area, d_p	d_p =	1	ft
3-4. Calculate the drawdown time for the ponded water to filter through media (hours), $t_{ponding} = (d_p/K_{design}) \times 12$	$t_{ponding}$=	4.8	hrs
3-5. Enter the storm duration for routing calculations (use 3 hours unless there is rationale for an alternative), $T_{routing}$	$T_{routing}$ =	3	hrs
3-6. Calculate depth of water (ft) filtered by using the following two equations: $d_{filtered,1} = (K_{design} \times T_{routing})/12$ $d_{filteret,2} = d_p /2$	$d_{filtered,1}$ = $d_{filtered,2}$ =	0.63 0.5	ft ft
3.7 Enter the resultant depth (ft) (the lesser of the two calculated above), $d_{filtered}$	$d_{filtered}$ =	0.5	ft
3-8. Calculate the infiltrating surface area as follows (ft^2): $A_{req} = SQDV/(d_p + d_{filtered})$	A_{req} =	42	ft^2

Step 4: Calculate Bioretention Area Total Footprint	
4-1. Calculate total footprint required by including a buffer for side slopes and freeboard (ft^2) [A_{req} is measured at the as the filter bottom area (toe of side slopes)], A_{tot}	A_{tot} = ft²
Step 5: Calculate Underdrain System Capacity	
To calculate the underdrain system capacity, continue through steps 5-1 to 5-7.	
Step 5: Calculate Underdrain System Capacity	
5-1. Calculated filtered flow rate to be conveyed by the longitudinal drain pipe, $Q_f = K_{design} A_{req}/43{,}200$	Q_f =.001 cfs
5-2. Enter minimum slope for energy gradient, S_e	S_e = 0.005
5-3. Enter Hazen-Williams coefficient for plastic, C_{HW}	C_{HW} = 140
5-4. Enter pipe diameter (min 6 inches), D	D = 6 in
5-5. Calculate pipe hydraulic radius (ft), $R_h = D/48$	R_h = 0.13 ft
5-6. Calculate velocity at the outlet of the pipe (ft/s), $V_p = 1.318 C_{HW} R_h^{0.63} S_e^{0.54}$	V_p = 2.8 ft/s
5-7. Calculate pipe capacity (cfs), $Q_{cap} = 0.25\pi (D/12)^2 V_p$	Q_{cap} = 0.56 cfs

Sizing Worksheet

Designer: Kirby Dubay Project Proponent: Date: 4/16/2021 Project: Camp Hess Location: Ventura County	Treatment 48
Type of Vegetation: (Check type used or describe "Other")	____ Native Grasses ____ Irrigated Turf Grass ____ Other
Outflow Collection:	

Step 1: Determine water quality design volume	
1-1. Enter Project area (acres), $A_{project}$	$A_{project}$ = 7.2 acres
1-2. Enter the maximum allowable percent of the Project area that may be effective impervious area (%) (refer to permit), ranges from 5-30%, $\%_{allowable}$	$\%_{allowable}$ = 5 %
1-3. Determine the maximum allowable effective impervious area (acres), $EIA_{allowable} = (A_{project})*(\%_{allowable})$	$EIA_{allowable}$= 0.4 acres
1-4. Enter Project impervious fraction, *Imp* (e.g. 60% = 0.60)	Imp= 0.23
1-5. Determine the Project Total Impervious area (acres), $TIA=A_{project}*Imp$	TIA=1.7 acres
1-6. Determine the total area from which runoff must be retained (acres), $A_{retain}=TIA-EIA_{allowable}$	A_{retain} =1.3 acres
1-7. Determine pervious runoff coefficient using Table E-1, C_p	C_p = 0.05
1-8. Calculate runoff coefficient, $C = 0.95*imp + C_p\ (1-imp)$	C = 0.95
1-9. Enter design rainfall depth of the storm (in), P_i	P_i = 0.75 in

1-10. Calculate rainfall depth (ft), $P = P_i/12$	P = 0.06 ft
1-11. Calculate water quality design volume (ft^3), $SQDV=43560\times C^*P^*A_{retain}$	SQDV= 874 ft^3
Step 2: Determine the design percolation rate	
2-1. Enter measured soil percolation rate (in/hr, 0.5 in/hr min.), $P_{measured}$	$P_{measured}$ = 2.2 in/hr
2-2. Determine percolation rate correction factor, S_A based on suitability assessment (see Section 6 INF-1)	S_A = 2
2-3. Determine percolation rate correction factor, S_B based on design (see Section 6 INF-1)	S_b = 2
2-4. Calculate combined safety factor, $S = S_A \times S_b$	S = 4
2-5. Calculate the design percolation rate (in/hr), $P_{design} = P_{measured}/S$	P_{design} = 0.55 in/hr
Step 3: Calculate the surface area	
3-1. Enter required drain time(hours,72 hrs max.), t	t = 72 hrs
3-2. Calculate max. depth of runoff that can be infiltrated within the t (ft), $d_{max} = P_{design}\ t/12$	d_{max} = 2.4 ft
3-3. For basins, select ponding depth (ft), d_p, such that $d_p \le d_{max}$	d_p = ft
3-4. For trenches, enter trench fill aggregate porosity, n_t	n_t = 0.32
3-5. For trenches, enter depth of trench fill (ft), d_t	d_t = 4 ft
3-5. For trenches, select ponding depth d_p such that $d_p \le d_{max} - n_t d_t$	d_p= 1.1 ft
3-6. Enter the time to fill infiltration basin or trench with water (Use 2 hours for most designs), T	T = 2 hrs

3-7. Calculate infiltrating surface area for infiltration basin (ft^2): $A_b = SQDV/((T\ P_{design}/12)+d_p)$ OR Calculate infiltrating surface area for infiltration trenches or aggregate- filled drywells (ft^2): $A_t = SQDV/((T\ P_{design}/12)+n_t d_t+dp)$	A_b = ft² A_t = 722 ft²
Step 4: Size the forebay (infiltration basins or trenches)	
If a separate pre-treatment unit is designed for the infiltration facility, skip to Step 5. If not, continue through 4-1 through 4-4.	
4-1. Calculate the volume of the forebay (ft^3), $V_{forebay}$=0.25*SQDV	$V_{forebay}$= 217 ft³
4-2. Determine forebay depth (ft), $d_{forebay}$	$d_{forebay}$= 3 ft
4-3. Calculate forebay bottom surface area (ft^2), $A_{forebay}=V_{forebay}/d_{forebay}$	$A_{forebay}$= 72 ft²
4-4. Provide outlet pipe such that the forebay drains to the infiltration facility within 10 minutes.	
Step 5: Provide conveyance capacity for filter clogging	
5-1.The infiltration facility should be placed off-line, but an emergency overflow must still be provided in the event the filter becomes clogged. Design emergency overflow in accordance with applicable standards of the Ventura County Flood Control District or local jurisdiction.	

Sizing Worksheet

Designer: Kirby Dubay Project Proponent: Date: 4/16/2021 Project: Camp Hess Location: Ventura County	Treatment 49
Type of Vegetation:	
Outflow Collection:	
Step 1: Determine water quality design volume	
1-1. Enter Project area (acres), $A_{project}$	$A_{project}$ = 0.03acres
1-2. Enter the maximum allowable percent of the Project area that may be effective impervious area (refer to permit), ranges from 5-30%, $\%_{allowable}$	$\%_{allowable}$ 5 %
1-3. Determine the maximum allowed effective impervious area (ac), $EIA_{allowable} = (A_{project})*(\%_{allowable})$	$EIA_{allowable}$=.002 acres
1-4. Enter Project impervious fraction, *Imp* (e.g. 60% = 0.60)	Imp= 1
1-5. Determine the Project Total Impervious area (acres), $TIA=A_{project}*Imp$	TIA= 0.03 acres
1-6. Determine the total area from which runoff must be retained (acres), $A_{retain}=TIA-EIA_{allowable}$	A_{retain} = 0.03 acres
1-7. Determine pervious runoff coefficient using Table E-1, C_p	C_p = 0.15
1-8. Calculate runoff coefficient, $C = 0.95*imp + C_p\ (1-imp)$	C = 0.95
1-9. Enter design rainfall depth of the storm (in), P_i	P_i = 0.75 in
1-10. Calculate rainfall depth (ft), $P = P_i/12$	P = 0.06 ft
1-11. Calculate water quality design volume (ft^3),	SQDV= 76 ft^3

$SQDV=43560 \bullet C^{*}P^{*}A_{retain}$	

Step 2: Determine the design percolation rate	
2-1. Enter the design saturated hydraulic conductivity of the amended filter media (2.5 in/hr recommended rate), K_{design}	K_{design} = 2.5 in/hr

Step 3: Calculate Bioretention/Planter Box surface area			
3-1. Enter water quality design volume (ft^3), *SQDV*	SQDV =	76	ft^3
3-2. Enter design saturated hydraulic conductivity (in/hr), K_{design}	K_{design} =	2.5	in/hr
3-3. Enter ponding depth (max 1.5 ft for Bioretention, 1 ft for Planter Box) above area, d_p	d_p =	1	ft
3-4. Calculate the drawdown time for the ponded water to filter through media (hours), $t_{ponding} = (d_p/K_{design}) \times 12$	$t_{ponding}$=	4.8	hrs
3-5. Enter the storm duration for routing calculations (use 3 hours unless there is rationale for an alternative), $T_{routing}$	$T_{routing}$ =	3	hrs
3-6. Calculate depth of water (ft) filtered by using the following two equations: $d_{filtered,1} = (K_{design} \times T_{routing})/12$ $d_{filteret,2} = d_p /2$	$d_{filtered,1}$ = $d_{filtered,2}$ =	0.63 0.5	ft ft
3.7 Enter the resultant depth (ft) (the lesser of the two calculated above), $d_{filtered}$	$d_{filtered}$ =	0.5	ft
3-8. Calculate the infiltrating surface area as follows (ft^2): $A_{req} = SQDV/(d_p + d_{filtered})$	A_{req} =	51	ft^2

Step 4: Calculate Bioretention Area Total Footprint	
4-1. Calculate total footprint required by including a buffer for side slopes and freeboard (ft^2) [A_{req} is measured at the as the filter bottom area (toe of side slopes)], A_{tot}	A_{tot} = ft²
Step 5: Calculate Underdrain System Capacity	
To calculate the underdrain system capacity, continue through steps 5-1 to 5-7.	
Step 5: Calculate Underdrain System Capacity	
5-1. Calculated filtered flow rate to be conveyed by the longitudinal drain pipe, $Q_f = K_{design} A_{req}/43{,}200$	Q_f =.001 cfs
5-2. Enter minimum slope for energy gradient, S_e	S_e = 0.005
5-3. Enter Hazen-Williams coefficient for plastic, C_{HW}	C_{HW} = 140
5-4. Enter pipe diameter (min 6 inches), D	D = 6 in
5-5. Calculate pipe hydraulic radius (ft), $R_h = D/48$	R_h = 0.13 ft
5-6. Calculate velocity at the outlet of the pipe (ft/s), $V_p = 1.318 C_{HW} R_h^{0.63} S_e^{0.54}$	V_p = 2.8 ft/s
5-7. Calculate pipe capacity (cfs), $Q_{cap} = 0.25\pi (D/12)^2 V_p$	Q_{cap} = 0.56 cfs

Sizing Worksheet

Designer: Kirby Dubay Project Proponent: Date: 4/16/2021 Project: Camp Hess Location: Ventura County	Treatment 50
Type of Vegetation:	
Outflow Collection:	
Step 1: Determine water quality design volume	
1-1. Enter Project area (acres), $A_{project}$	$A_{project}$ = 0.01 acres
1-2. Enter the maximum allowable percent of the Project area that may be effective impervious area (refer to permit), ranges from 5-30%, $\%_{allowable}$	$\%_{allowable}$ 5 %
1-3. Determine the maximum allowed effective impervious area (ac), $EIA_{allowable} = (A_{project})*(\%_{allowable})$	$EIA_{allowable}$=.0006 acres
1-4. Enter Project impervious fraction, *Imp* (e.g. 60% = 0.60)	Imp= 1
1-5. Determine the Project Total Impervious area (acres), $TIA=A_{project}*Imp$	TIA= 0.01 acres
1-6. Determine the total area from which runoff must be retained (acres), $A_{retain}=TIA-EIA_{allowable}$	A_{retain} = 0.01 acres
1-7. Determine pervious runoff coefficient using Table E-1, C_p	C_p = 0.15
1-8. Calculate runoff coefficient, $C = 0.95*imp + C_p\ (1-imp)$	C = 0.95
1-9. Enter design rainfall depth of the storm (in), P_i	P_i = 0.75 in
1-10. Calculate rainfall depth (ft), $P = P_i/12$	P = 0.06 ft
1-11. Calculate water quality design volume (ft^3),	SQDV= 30 ft^3

$SQDV=43560 \bullet C^{*}P^{*}A_{retain}$	

Step 2: Determine the design percolation rate	
2-1. Enter the design saturated hydraulic conductivity of the amended filter media (2.5 in/hr recommended rate), K_{design}	K_{design} = 2.5 in/hr

Step 3: Calculate Bioretention/Planter Box surface area			
3-1. Enter water quality design volume (ft^3), *SQDV*	SQDV =	30	ft^3
3-2. Enter design saturated hydraulic conductivity (in/hr), K_{design}	K_{design} =	2.5	in/hr
3-3. Enter ponding depth (max 1.5 ft for Bioretention, 1 ft for Planter Box) above area, d_p	d_p =	1	ft
3-4. Calculate the drawdown time for the ponded water to filter through media (hours), $t_{ponding} = (d_p/K_{design}) \times 12$	$t_{ponding}$=	4.8	hrs
3-5. Enter the storm duration for routing calculations (use 3 hours unless there is rationale for an alternative), $T_{routing}$	$T_{routing}$ =	3	hrs
3-6. Calculate depth of water (ft) filtered by using the following two equations: $d_{filtered,1} = (K_{design} \times T_{routing})/12$ $d_{filteret,2} = d_p /2$	$d_{filtered,1}$ = $d_{filtered,2}$ =	0.63 0.5	ft ft
3.7 Enter the resultant depth (ft) (the lesser of the two calculated above), $d_{filtered}$	$d_{filtered}$ =	0.5	ft
3-8. Calculate the infiltrating surface area as follows (ft^2): $A_{req} = SQDV/(d_p + d_{filtered})$	A_{req} =	20	ft^2

Step 4: Calculate Bioretention Area Total Footprint	
4-1. Calculate total footprint required by including a buffer for side slopes and freeboard (ft^2) [A_{req} is measured at the as the filter bottom area (toe of side slopes)], A_{tot}	A_{tot} = ft²
Step 5: Calculate Underdrain System Capacity	
To calculate the underdrain system capacity, continue through steps 5-1 to 5-7.	
Step 5: Calculate Underdrain System Capacity	
5-1. Calculated filtered flow rate to be conveyed by the longitudinal drain pipe, $Q_f = K_{design} A_{req}/43{,}200$	Q_f =.001 cfs
5-2. Enter minimum slope for energy gradient, S_e	S_e = 0.005
5-3. Enter Hazen-Williams coefficient for plastic, C_{HW}	C_{HW} = 140
5-4. Enter pipe diameter (min 6 inches), D	D = 6 in
5-5. Calculate pipe hydraulic radius (ft), $R_h = D/48$	R_h = 0.13 ft
5-6. Calculate velocity at the outlet of the pipe (ft/s), $V_p = 1.318 C_{HW} R_h^{0.63} S_e^{0.54}$	V_p = 2.8 ft/s
5-7. Calculate pipe capacity (cfs), $Q_{cap} = 0.25\pi (D/12)^2 V_p$	Q_{cap} = 0.56 cfs

Sizing Worksheet

Designer: Kirby Dubay Project Proponent: Date: 4/16/2021 Project: Camp Hess Location: Ventura County	Treatment 51
Type of Vegetation:	
Outflow Collection:	
Step 1: Determine water quality design volume	
1-1. Enter Project area (acres), $A_{project}$	$A_{project}$ =0.004acres
1-2. Enter the maximum allowable percent of the Project area that may be effective impervious area (refer to permit), ranges from 5-30%, $\%_{allowable}$	$\%_{allowable}$ 5 %
1-3. Determine the maximum allowed effective impervious area (ac), $EIA_{allowable} = (A_{project})*(\%_{allowable})$	$EIA_{allowable}$=.0002acres
1-4. Enter Project impervious fraction, *Imp* (e.g. 60% = 0.60)	Imp= 1
1-5. Determine the Project Total Impervious area (acres), $TIA=A_{project}*Imp$	TIA=0.004acres
1-6. Determine the total area from which runoff must be retained (acres), $A_{retain}=TIA-EIA_{allowable}$	A_{retain} =0.004acres
1-7. Determine pervious runoff coefficient using Table E-1, C_p	C_p = 0.15
1-8. Calculate runoff coefficient, $C = 0.95*imp + C_p\ (1-imp)$	C = 0.95
1-9. Enter design rainfall depth of the storm (in), P_i	P_i = 0.75 in
1-10. Calculate rainfall depth (ft), $P = P_i/12$	P = 0.06 ft
1-11. Calculate water quality design volume (ft^3),	SQDV= 9 ft^3

$SQDV=43560 \bullet C^{*}P^{*}A_{retain}$	

Step 2: Determine the design percolation rate	
2-1. Enter the design saturated hydraulic conductivity of the amended filter media (2.5 in/hr recommended rate), K_{design}	K_{design} = 2.5 in/hr

Step 3: Calculate Bioretention/Planter Box surface area			
3-1. Enter water quality design volume (ft^3), *SQDV*	SQDV =	9	ft^3
3-2. Enter design saturated hydraulic conductivity (in/hr), K_{design}	K_{design} =	2.5	in/hr
3-3. Enter ponding depth (max 1.5 ft for Bioretention, 1 ft for Planter Box) above area, d_p	d_p =	1	ft
3-4. Calculate the drawdown time for the ponded water to filter through media (hours), $t_{ponding} = (d_p/K_{design}) \times 12$	$t_{ponding}$=	4.8	hrs
3-5. Enter the storm duration for routing calculations (use 3 hours unless there is rationale for an alternative), $T_{routing}$	$T_{routing}$ =	3	hrs
3-6. Calculate depth of water (ft) filtered by using the following two equations: $d_{filtered,1} = (K_{design} \times T_{routing})/12$ $d_{filteret,2} = d_p /2$	$d_{filtered,1}$ = $d_{filtered,2}$ =	0.63 0.5	ft ft
3.7 Enter the resultant depth (ft) (the lesser of the two calculated above), $d_{filtered}$	$d_{filtered}$ =	0.5	ft
3-8. Calculate the infiltrating surface area as follows (ft^2): $A_{req} = SQDV/(d_p + d_{filtered})$	A_{req} =	6	ft^2

Step 4: Calculate Bioretention Area Total Footprint	
4-1. Calculate total footprint required by including a buffer for side slopes and freeboard (ft^2) [A_{req} is measured at the as the filter bottom area (toe of side slopes)], A_{tot}	A_{tot} = ft²
Step 5: Calculate Underdrain System Capacity	
To calculate the underdrain system capacity, continue through steps 5-1 to 5-7.	
Step 5: Calculate Underdrain System Capacity	
5-1. Calculated filtered flow rate to be conveyed by the longitudinal drain pipe, $Q_f = K_{design} A_{req}/43{,}200$	Q_f =.001 cfs
5-2. Enter minimum slope for energy gradient, S_e	S_e = 0.005
5-3. Enter Hazen-Williams coefficient for plastic, C_{HW}	C_{HW} = 140
5-4. Enter pipe diameter (min 6 inches), D	D = 6 in
5-5. Calculate pipe hydraulic radius (ft), $R_h = D/48$	R_h = 0.13 ft
5-6. Calculate velocity at the outlet of the pipe (ft/s), $V_p = 1.318 C_{HW} R_h^{0.63} S_e^{0.54}$	V_p = 2.8 ft/s
5-7. Calculate pipe capacity (cfs), $Q_{cap} = 0.25\pi (D/12)^2 V_p$	Q_{cap} = 0.56 cfs

Sizing Worksheet

Designer: Kirby Dubay Project Proponent: Date: 4/16/2021 Project: Camp Hess Location: Ventura County	Treatments 52 & 53
Type of Vegetation:	
Outflow Collection:	
Step 1: Determine water quality design volume	
1-1. Enter Project area (acres), $A_{project}$	$A_{project}$ =0.09 acres
1-2. Enter the maximum allowable percent of the Project area that may be effective impervious area (refer to permit), ranges from 5-30%, $\%_{allowable}$	$\%_{allowable}$ 5 %
1-3. Determine the maximum allowed effective impervious area (ac), $EIA_{allowable} = (A_{project})*(\%_{allowable})$	$EIA_{allowable}$=.005 acres
1-4. Enter Project impervious fraction, *Imp* (e.g. 60% = 0.60)	Imp= 1
1-5. Determine the Project Total Impervious area (acres), $TIA=A_{project}*Imp$	TIA=0.09 acres
1-6. Determine the total area from which runoff must be retained (acres), $A_{retain}=TIA-EIA_{allowable}$	A_{retain} =0.09 acres
1-7. Determine pervious runoff coefficient using Table E-1, C_p	C_p = 0.15
1-8. Calculate runoff coefficient, $C = 0.95*imp + C_p\ (1-imp)$	C = 0.95
1-9. Enter design rainfall depth of the storm (in), P_i	P_i = 0.75 in
1-10. Calculate rainfall depth (ft), $P = P_i/12$	P = 0.06 ft
1-11. Calculate water quality design volume (ft^3),	SQDV= 221 ft^3

$SQDV=43560 \bullet C^{*}P^{*}A_{retain}$	

Step 2: Determine the design percolation rate	
2-1. Enter the design saturated hydraulic conductivity of the amended filter media (2.5 in/hr recommended rate), K_{design}	K_{design} = 2.5 in/hr
Step 3: Calculate Bioretention/Planter Box surface area	
3-1. Enter water quality design volume (ft^3), *SQDV*	SQDV = 221 ft^3
3-2. Enter design saturated hydraulic conductivity (in/hr), K_{design}	K_{design} = 2.5 in/hr
3-3. Enter ponding depth (max 1.5 ft for Bioretention, 1 ft for Planter Box) above area, d_p	d_p = 1 ft
3-4. Calculate the drawdown time for the ponded water to filter through media (hours), $t_{ponding} = (d_p/K_{design}) \times 12$	$t_{ponding}$= 4.8 hrs
3-5. Enter the storm duration for routing calculations (use 3 hours unless there is rationale for an alternative), $T_{routing}$	$T_{routing}$ = 3 hrs
3-6. Calculate depth of water (ft) filtered by using the following two equations: $d_{filtered,1} = (K_{design} \times T_{routing})/12$ $d_{filteret,2} = d_p /2$	$d_{filtered,1}$ = 0.63 ft $d_{filtered,2}$ = 0.5 ft
3.7 Enter the resultant depth (ft) (the lesser of the two calculated above), $d_{filtered}$	$d_{filtered}$ = 0.5 ft
3-8. Calculate the infiltrating surface area as follows (ft^2): $A_{req} = SQDV/(d_p + d_{filtered})$	A_{req} = 147 ft^2

Step 4: Calculate Bioretention Area Total Footprint	
4-1. Calculate total footprint required by including a buffer for side slopes and freeboard (ft^2) [A_{req} is measured at the as the filter bottom area (toe of side slopes)], A_{tot}	A_{tot} = ft²
Step 5: Calculate Underdrain System Capacity	
To calculate the underdrain system capacity, continue through steps 5-1 to 5-7.	
Step 5: Calculate Underdrain System Capacity	
5-1. Calculated filtered flow rate to be conveyed by the longitudinal drain pipe, $Q_f = K_{design} A_{req}/43{,}200$	Q_f =.001 cfs
5-2. Enter minimum slope for energy gradient, S_e	S_e = 0.005
5-3. Enter Hazen-Williams coefficient for plastic, C_{HW}	C_{HW} = 140
5-4. Enter pipe diameter (min 6 inches), D	D = 6 in
5-5. Calculate pipe hydraulic radius (ft), $R_h = D/48$	R_h = 0.13 ft
5-6. Calculate velocity at the outlet of the pipe (ft/s), $V_p = 1.318 C_{HW} R_h^{0.63} S_e^{0.54}$	V_p = 2.8 ft/s
5-7. Calculate pipe capacity (cfs), $Q_{cap} = 0.25\pi (D/12)^2 V_p$	Q_{cap} = 0.56 cfs

Sizing Worksheet

Designer: Kirby Dubay Project Proponent: Date: 4/16/2021 Project: Camp Hess Location: Ventura County	Treatment 54
Type of Vegetation:	
Outflow Collection:	
Step 1: Determine water quality design volume	
1-1. Enter Project area (acres), $A_{project}$	$A_{project}$ =0.01 acres
1-2. Enter the maximum allowable percent of the Project area that may be effective impervious area (refer to permit), ranges from 5-30%, $\%_{allowable}$	$\%_{allowable}$ 5 %
1-3. Determine the maximum allowed effective impervious area (ac), $EIA_{allowable} = (A_{project})*(\%_{allowable})$	$EIA_{allowable}$=.0006 acres
1-4. Enter Project impervious fraction, *Imp* (e.g. 60% = 0.60)	Imp= 1
1-5. Determine the Project Total Impervious area (acres), $TIA=A_{project}*Imp$	TIA=0.01 acres
1-6. Determine the total area from which runoff must be retained (acres), $A_{retain}=TIA-EIA_{allowable}$	A_{retain} =0.01 acres
1-7. Determine pervious runoff coefficient using Table E-1, C_p	C_p = 0.15
1-8. Calculate runoff coefficient, $C = 0.95*imp + C_p\ (1-imp)$	C = 0.95
1-9. Enter design rainfall depth of the storm (in), P_i	P_i = 0.75 in
1-10. Calculate rainfall depth (ft), $P = P_i/12$	P = 0.06 ft
1-11. Calculate water quality design volume (ft^3),	SQDV= 27 ft^3

$SQDV=43560 \bullet C^{*}P^{*}A_{retain}$	

Step 2: Determine the design percolation rate	
2-1. Enter the design saturated hydraulic conductivity of the amended filter media (2.5 in/hr recommended rate), K_{design}	K_{design} = 2.5 in/hr

Step 3: Calculate Bioretention/Planter Box surface area			
3-1. Enter water quality design volume (ft^3), *SQDV*	SQDV =	27	ft^3
3-2. Enter design saturated hydraulic conductivity (in/hr), K_{design}	K_{design} =	2.5	in/hr
3-3. Enter ponding depth (max 1.5 ft for Bioretention, 1 ft for Planter Box) above area, d_p	d_p =	1	ft
3-4. Calculate the drawdown time for the ponded water to filter through media (hours), $t_{ponding} = (d_p/K_{design}) \times 12$	$t_{ponding}$=	4.8	hrs
3-5. Enter the storm duration for routing calculations (use 3 hours unless there is rationale for an alternative), $T_{routing}$	$T_{routing}$ =	3	hrs
3-6. Calculate depth of water (ft) filtered by using the following two equations: $d_{filtered,1} = (K_{design} \times T_{routing})/12$ $d_{filteret,2} = d_p /2$	$d_{filtered,1}$ = $d_{filtered,2}$ =	0.63 0.5	ft ft
3.7 Enter the resultant depth (ft) (the lesser of the two calculated above), $d_{filtered}$	$d_{filtered}$ =	0.5	ft
3-8. Calculate the infiltrating surface area as follows (ft^2): $A_{req} = SQDV/(d_p + d_{filtered})$	A_{req} =	18	ft^2

Step 4: Calculate Bioretention Area Total Footprint	
4-1. Calculate total footprint required by including a buffer for side slopes and freeboard (ft^2) [A_{req} is measured at the as the filter bottom area (toe of side slopes)], A_{tot}	A_{tot} = ft²
Step 5: Calculate Underdrain System Capacity	
To calculate the underdrain system capacity, continue through steps 5-1 to 5-7.	
Step 5: Calculate Underdrain System Capacity	
5-1. Calculated filtered flow rate to be conveyed by the longitudinal drain pipe, $Q_f = K_{design} A_{req}/43{,}200$	Q_f =.001 cfs
5-2. Enter minimum slope for energy gradient, S_e	S_e = 0.005
5-3. Enter Hazen-Williams coefficient for plastic, C_{HW}	C_{HW} = 140
5-4. Enter pipe diameter (min 6 inches), D	D = 6 in
5-5. Calculate pipe hydraulic radius (ft), $R_h = D/48$	R_h = 0.13 ft
5-6. Calculate velocity at the outlet of the pipe (ft/s), $V_p = 1.318 C_{HW} R_h^{0.63} S_e^{0.54}$	V_p = 2.8 ft/s
5-7. Calculate pipe capacity (cfs), $Q_{cap} = 0.25\pi (D/12)^2 V_p$	Q_{cap} = 0.56 cfs

Sizing Worksheet

Designer: Kirby Dubay Project Proponent: Date: 4/16/2021 Project: Camp Hess Location: Ventura County	Treatments 55, 56, 59, 60, 62, 63, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75 & 76
Type of Vegetation:	
Outflow Collection:	
Step 1: Determine water quality design volume	
1-1. Enter Project area (acres), $A_{project}$	$A_{project}$ =0.01 acres
1-2. Enter the maximum allowable percent of the Project area that may be effective impervious area (refer to permit), ranges from 5-30%, $\%_{allowable}$	$\%_{allowable}$ 5 %
1-3. Determine the maximum allowed effective impervious area (ac), $EIA_{allowable} = (A_{project})*(\%_{allowable})$	$EIA_{allowable}$=.0006 acres
1-4. Enter Project impervious fraction, *Imp* (e.g. 60% = 0.60)	Imp= 1
1-5. Determine the Project Total Impervious area (acres), $TIA=A_{project}*Imp$	TIA=0.01 acres
1-6. Determine the total area from which runoff must be retained (acres), $A_{retain}=TIA-EIA_{allowable}$	A_{retain} =0.01 acres
1-7. Determine pervious runoff coefficient using Table E-1, C_p	C_p = 0.15
1-8. Calculate runoff coefficient, $C = 0.95*imp + C_p\ (1-imp)$	C = 0.95
1-9. Enter design rainfall depth of the storm (in), P_i	P_i = 0.75 in
1-10. Calculate rainfall depth (ft), $P = P_i/12$	P = 0.06 ft
1-11. Calculate water quality design volume (ft^3),	SQDV= 31 ft^3

$SQDV=43560 \bullet C^{*}P^{*}A_{retain}$	

Step 2: Determine the design percolation rate	
2-1. Enter the design saturated hydraulic conductivity of the amended filter media (2.5 in/hr recommended rate), K_{design}	K_{design} = 2.5 in/hr

Step 3: Calculate Bioretention/Planter Box surface area			
3-1. Enter water quality design volume (ft^3), *SQDV*	SQDV =	31	ft^3
3-2. Enter design saturated hydraulic conductivity (in/hr), K_{design}	K_{design} =	2.5	in/hr
3-3. Enter ponding depth (max 1.5 ft for Bioretention, 1 ft for Planter Box) above area, d_p	d_p =	1	ft
3-4. Calculate the drawdown time for the ponded water to filter through media (hours), $t_{ponding} = (d_p/K_{design}) \times 12$	$t_{ponding}$=	4.8	hrs
3-5. Enter the storm duration for routing calculations (use 3 hours unless there is rationale for an alternative), $T_{routing}$	$T_{routing}$ =	3	hrs
3-6. Calculate depth of water (ft) filtered by using the following two equations: $d_{filtered,1} = (K_{design} \times T_{routing})/12$ $d_{filteret,2} = d_p /2$	$d_{filtered,1}$ = $d_{filtered,2}$ =	0.63 0.5	ft ft
3.7 Enter the resultant depth (ft) (the lesser of the two calculated above), $d_{filtered}$	$d_{filtered}$ =	0.5	ft
3-8. Calculate the infiltrating surface area as follows (ft^2): $A_{req} = SQDV/(d_p + d_{filtered})$	A_{req} =	20	ft^2

Step 4: Calculate Bioretention Area Total Footprint	
4-1. Calculate total footprint required by including a buffer for side slopes and freeboard (ft^2) [A_{req} is measured at the as the filter bottom area (toe of side slopes)], A_{tot}	A_{tot} = ft²
Step 5: Calculate Underdrain System Capacity	
To calculate the underdrain system capacity, continue through steps 5-1 to 5-7.	
Step 5: Calculate Underdrain System Capacity	
5-1. Calculated filtered flow rate to be conveyed by the longitudinal drain pipe, $Q_f = K_{design} A_{req}/43{,}200$	Q_f =.001 cfs
5-2. Enter minimum slope for energy gradient, S_e	S_e = 0.005
5-3. Enter Hazen-Williams coefficient for plastic, C_{HW}	C_{HW} = 140
5-4. Enter pipe diameter (min 6 inches), D	D = 6 in
5-5. Calculate pipe hydraulic radius (ft), $R_h = D/48$	R_h = 0.13 ft
5-6. Calculate velocity at the outlet of the pipe (ft/s), $V_p = 1.318 C_{HW} R_h^{0.63} S_e^{0.54}$	V_p = 2.8 ft/s
5-7. Calculate pipe capacity (cfs), $Q_{cap} = 0.25\pi (D/12)^2 V_p$	Q_{cap} = 0.56 cfs

Sizing Worksheet

Designer: Kirby Dubay Project Proponent: Date: 4/16/2021 Project: Camp Hess Location: Ventura County	Treatments 57 & 58
Type of Vegetation:	
Outflow Collection:	
Step 1: Determine water quality design volume	
1-1. Enter Project area (acres), $A_{project}$	$A_{project}$ =0.01 acres
1-2. Enter the maximum allowable percent of the Project area that may be effective impervious area (refer to permit), ranges from 5-30%, $\%_{allowable}$	$\%_{allowable}$ 5 %
1-3. Determine the maximum allowed effective impervious area (ac), $EIA_{allowable} = (A_{project})*(\%_{allowable})$	$EIA_{allowable}$=.0007 acres
1-4. Enter Project impervious fraction, *Imp* (e.g. 60% = 0.60)	Imp= 1
1-5. Determine the Project Total Impervious area (acres), $TIA=A_{project}*Imp$	TIA=0.02 acres
1-6. Determine the total area from which runoff must be retained (acres), $A_{retain}=TIA-EIA_{allowable}$	A_{retain} =0.01 acres
1-7. Determine pervious runoff coefficient using Table E-1, C_p	C_p = 0.15
1-8. Calculate runoff coefficient, $C = 0.95*imp + C_p\ (1-imp)$	C = 0.95
1-9. Enter design rainfall depth of the storm (in), P_i	P_i = 0.75 in
1-10. Calculate rainfall depth (ft), $P = P_i/12$	P = 0.06 ft
1-11. Calculate water quality design volume (ft^3),	SQDV= 36 ft^3

$SQDV=43560 \bullet C^{*}P^{*}A_{retain}$	

Step 2: Determine the design percolation rate	
2-1. Enter the design saturated hydraulic conductivity of the amended filter media (2.5 in/hr recommended rate), K_{design}	K_{design} = 2.5 in/hr

Step 3: Calculate Bioretention/Planter Box surface area			
3-1. Enter water quality design volume (ft^3), *SQDV*	SQDV =	36	ft^3
3-2. Enter design saturated hydraulic conductivity (in/hr), K_{design}	K_{design} =	2.5	in/hr
3-3. Enter ponding depth (max 1.5 ft for Bioretention, 1 ft for Planter Box) above area, d_p	d_p =	1	ft
3-4. Calculate the drawdown time for the ponded water to filter through media (hours), $t_{ponding} = (d_p/K_{design}) \times 12$	$t_{ponding}$=	4.8	hrs
3-5. Enter the storm duration for routing calculations (use 3 hours unless there is rationale for an alternative), $T_{routing}$	$T_{routing}$ =	3	hrs
3-6. Calculate depth of water (ft) filtered by using the following two equations: $d_{filtered,1} = (K_{design} \times T_{routing})/12$ $d_{filteret,2} = d_p /2$	$d_{filtered,1}$ = $d_{filtered,2}$ =	0.63 0.5	ft ft
3.7 Enter the resultant depth (ft) (the lesser of the two calculated above), $d_{filtered}$	$d_{filtered}$ =	0.5	ft
3-8. Calculate the infiltrating surface area as follows (ft^2): $A_{req} = SQDV/(d_p + d_{filtered})$	A_{req} =	24	ft^2

Step 4: Calculate Bioretention Area Total Footprint	
4-1. Calculate total footprint required by including a buffer for side slopes and freeboard (ft^2) [A_{req} is measured at the as the filter bottom area (toe of side slopes)], A_{tot}	A_{tot} = ft²
Step 5: Calculate Underdrain System Capacity	
To calculate the underdrain system capacity, continue through steps 5-1 to 5-7.	
Step 5: Calculate Underdrain System Capacity	
5-1. Calculated filtered flow rate to be conveyed by the longitudinal drain pipe, $Q_f = K_{design} A_{req}/43{,}200$	Q_f =.001 cfs
5-2. Enter minimum slope for energy gradient, S_e	S_e = 0.005
5-3. Enter Hazen-Williams coefficient for plastic, C_{HW}	C_{HW} = 140
5-4. Enter pipe diameter (min 6 inches), D	D = 6 in
5-5. Calculate pipe hydraulic radius (ft), $R_h = D/48$	R_h = 0.13 ft
5-6. Calculate velocity at the outlet of the pipe (ft/s), $V_p = 1.318 C_{HW} R_h^{0.63} S_e^{0.54}$	V_p = 2.8 ft/s
5-7. Calculate pipe capacity (cfs), $Q_{cap} = 0.25\pi (D/12)^2 V_p$	Q_{cap} = 0.56 cfs

Sizing Worksheet

Designer: Kirby Dubay Project Proponent: Date: 4/16/2021 Project: Camp Hess Location: Ventura County	Treatments 61 & 64
Type of Vegetation:	
Outflow Collection:	
Step 1: Determine water quality design volume	
1-1. Enter Project area (acres), $A_{project}$	$A_{project}$ =0.05 acres
1-2. Enter the maximum allowable percent of the Project area that may be effective impervious area (refer to permit), ranges from 5-30%, $\%_{allowable}$	$\%_{allowable}$ 5 %
1-3. Determine the maximum allowed effective impervious area (ac), $EIA_{allowable} = (A_{project})*(\%_{allowable})$	$EIA_{allowable}$=.002 acres
1-4. Enter Project impervious fraction, *Imp* (e.g. 60% = 0.60)	Imp= 1
1-5. Determine the Project Total Impervious area (acres), $TIA=A_{project}*Imp$	TIA=0.05 acres
1-6. Determine the total area from which runoff must be retained (acres), $A_{retain}=TIA-EIA_{allowable}$	A_{retain} =0.04 acres
1-7. Determine pervious runoff coefficient using Table E-1, C_p	C_p = 0.15
1-8. Calculate runoff coefficient, $C = 0.95*imp + C_p\ (1-imp)$	C = 0.95
1-9. Enter design rainfall depth of the storm (in), P_i	P_i = 0.75 in
1-10. Calculate rainfall depth (ft), $P = P_i/12$	P = 0.06 ft
1-11. Calculate water quality design volume (ft^3),	SQDV= 110 ft^3

$SQDV=43560 \bullet C^{*}P^{*}A_{retain}$	

Step 2: Determine the design percolation rate	
2-1. Enter the design saturated hydraulic conductivity of the amended filter media (2.5 in/hr recommended rate), K_{design}	K_{design} = 2.5 in/hr

Step 3: Calculate Bioretention/Planter Box surface area			
3-1. Enter water quality design volume (ft^3), *SQDV*	SQDV =	110	ft^3
3-2. Enter design saturated hydraulic conductivity (in/hr), K_{design}	K_{design} =	2.5	in/hr
3-3. Enter ponding depth (max 1.5 ft for Bioretention, 1 ft for Planter Box) above area, d_p	d_p =	1	ft
3-4. Calculate the drawdown time for the ponded water to filter through media (hours), $t_{ponding} = (d_p/K_{design}) \times 12$	$t_{ponding}$=	4.8	hrs
3-5. Enter the storm duration for routing calculations (use 3 hours unless there is rationale for an alternative), $T_{routing}$	$T_{routing}$ =	3	hrs
3-6. Calculate depth of water (ft) filtered by using the following two equations: $d_{filtered,1} = (K_{design} \times T_{routing})/12$ $d_{filteret,2} = d_p /2$	$d_{filtered,1}$ = $d_{filtered,2}$ =	0.63 0.5	ft ft
3.7 Enter the resultant depth (ft) (the lesser of the two calculated above), $d_{filtered}$	$d_{filtered}$ =	0.5	ft
3-8. Calculate the infiltrating surface area as follows (ft^2): $A_{req} = SQDV/(d_p + d_{filtered})$	A_{req} =	73	ft^2

Step 4: Calculate Bioretention Area Total Footprint	
4-1. Calculate total footprint required by including a buffer for side slopes and freeboard (ft^2) [A_{req} is measured at the as the filter bottom area (toe of side slopes)], A_{tot}	A_{tot} = ft²
Step 5: Calculate Underdrain System Capacity	
To calculate the underdrain system capacity, continue through steps 5-1 to 5-7.	
Step 5: Calculate Underdrain System Capacity	
5-1. Calculated filtered flow rate to be conveyed by the longitudinal drain pipe, $Q_f = K_{design} A_{req}/43{,}200$	Q_f =.001 cfs
5-2. Enter minimum slope for energy gradient, S_e	S_e = 0.005
5-3. Enter Hazen-Williams coefficient for plastic, C_{HW}	C_{HW} = 140
5-4. Enter pipe diameter (min 6 inches), D	D = 6 in
5-5. Calculate pipe hydraulic radius (ft), $R_h = D/48$	R_h = 0.13 ft
5-6. Calculate velocity at the outlet of the pipe (ft/s), $V_p = 1.318 C_{HW} R_h^{0.63} S_e^{0.54}$	V_p = 2.8 ft/s
5-7. Calculate pipe capacity (cfs), $Q_{cap} = 0.25\pi (D/12)^2 V_p$	Q_{cap} = 0.56 cfs

Sizing Worksheet

Designer: Kirby Dubay Project Proponent: Date: 4/16/2021 Project: Camp Hess Location: Ventura County	Treatment 77
Type of Vegetation: (Check type used or describe "Other")	____ Native Grasses ____ Irrigated Turf Grass ____ Other
Outflow Collection: ?	
Step 1: Determine water quality design volume	
1-1. Enter Project area (acres), $A_{project}$	$A_{project}$ = 0.1 acres
1-2. Enter the maximum allowable percent of the Project area that may be effective impervious area (%) (refer to permit), ranges from 5-30%, $\%_{allowable}$	$\%_{allowable}$ = 5 %
1-3. Determine the maximum allowable effective impervious area (acres), $EIA_{allowable} = (A_{project})*(\%_{allowable})$	$EIA_{allowable}$=0.44 acres
1-4. Enter Project impervious fraction, *Imp* (e.g. 60% = 0.60)	Imp= 1
1-5. Determine the Project Total Impervious area (acres), $TIA=A_{project}*Imp$	TIA= 0.1 acres
1-6. Determine the total area from which runoff must be retained (acres), $A_{retain}=TIA-EIA_{allowable}$	A_{retain} = 0.1 acres
1-7. Determine pervious runoff coefficient using Table E-1, C_p	C_p = 0.05
1-8. Calculate runoff coefficient, $C = 0.95*imp + C_p\ (1-imp)$	C =0.95
1-9. Enter design rainfall depth of the storm (in), P_i	P_i = 0.75 in

1-10. Calculate rainfall depth (ft), $P = P_i/12$	P = 0.06 ft
1-11. Calculate water quality design volume (ft^3), $SQDV=43560\times C^*P^*A_{retain}$	SQDV= 234 ft^3
Step 2: Determine the design percolation rate	
2-1. Enter measured soil percolation rate (in/hr, 0.5 in/hr min.), $P_{measured}$	$P_{measured}$ = 2.0 in/hr
2-2. Determine percolation rate correction factor, S_A based on suitability assessment (see Section 6 INF-1)	S_A = 3
2-3. Determine percolation rate correction factor, S_B based on design (see Section 6 INF-1)	S_b = 3
2-4. Calculate combined safety factor, $S = S_A \times S_b$	S = 9
2-5. Calculate the design percolation rate (in/hr), $P_{design} = P_{measured}/S$	P_{design} = 0.22 in/hr
Step 3: Calculate the surface area	
3-1. Enter required drain time(hours,72 hrs max.), t	t = 72 hrs
3-2. Calculate max. depth of runoff that can be infiltrated within the t (ft), $d_{max} = P_{design}\ t/12$	d_{max} = 0.7 ft
3-3. For basins, select ponding depth (ft), d_p, such that $d_p \le d_{max}$	d_p = 0.4 ft
3-4. For trenches, enter trench fill aggregate porosity, n_t	n_t =
3-5. For trenches, enter depth of trench fill (ft), d_t	d_t = ft
3-5. For trenches, select ponding depth d_p such that $d_p \le d_{max} - n_t d_t$	d_p= ft
3-6. Enter the time to fill infiltration basin or trench with water (Use 2 hours for most designs), T	T = 2 hrs

3-7. Calculate infiltrating surface area for infiltration basin (ft^2): $A_b = SQDV/((T\ P_{design}/12)+d_p)$ OR Calculate infiltrating surface area for infiltration trenches or aggregate- filled drywells (ft^2): $A_t = SQDV/((T\ P_{design}/12)+n_t d_t+dp)$	A_b = 592 ft^2 A_t = ft^2
Step 4: Size the forebay (infiltration basins or trenches)	
If a separate pre-treatment unit is designed for the infiltration facility, skip to Step 5. If not, continue through 4-1 through 4-4.	
4-1. Calculate the volume of the forebay (ft^3), $V_{forebay}$=0.25*SQDV	$V_{forebay}$= 58 ft^3
4-2. Determine forebay depth (ft), $d_{forebay}$	$d_{forebay}$= 3 ft
4-3. Calculate forebay bottom surface area (ft^2), $A_{forebay}=V_{forebay}/d_{forebay}$	$A_{forebay}$= 19 ft^2
4-4. Provide outlet pipe such that the forebay drains to the infiltration facility within 10 minutes.	
Step 5: Provide conveyance capacity for filter clogging	
5-1.The infiltration facility should be placed off-line, but an emergency overflow must still be provided in the event the filter becomes clogged. Design emergency overflow in accordance with applicable standards of the Ventura County Flood Control District or local jurisdiction.	

Appendix D – INFILTRATION TESTING REPORT

INFILTRATION TESTING REPORT
FOR PROPOSED REBUILDING OF
LOWER AND MIDDLE CAMPS AT
CAMP HESS KRAMER,
11495 PACIFIC COAST HIGHWAY,
MALIBU AREA,
VENTURA COUNTY, CALIFORNIA

PROJECT NO.: 301529-003
MARCH 5, 2021

PREPARED FOR
STANTEC

BY
EARTH SYSTEMS PACIFIC
1731-A WALTER STREET
VENTURA, CALIFORNIA 93003

Earth Systems
1731 Walter Street, Suite A | Ventura, CA 93003 | Ph: 805.642.6727 | www.earthsystems.com

March 5, 2021

Project No.: 301529-003
Report No.: 21-03-12

Attention: Hady Izadpanah
Stantec
111 E. Victoria Street
Santa Barbara, CA 93101-2018
hady.izadpanah@stantec.com

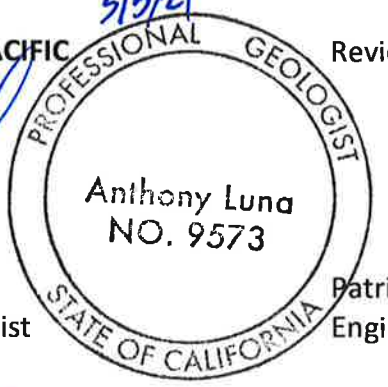
Project: Camp Hess Kramer Lower and Middle Camp Rebuilds
11495 Pacific Coast Highway
Malibu Area
Ventura County, California

As authorized, Earth Systems Pacific (Earth Systems) has prepared this Infiltration Testing Report that summarizes our evaluation of the feasibility for stormwater infiltration at Camp Hess Kramer located at 11495 Pacific Coast Highway in the Malibu area of Ventura County, California. The accompanying Infiltration Testing Report presents the results of our subsurface exploration and infiltration testing. This report completes the scope of services described within our Proposal No. VEN-20-12-008 dated December 10, 2020 and authorized by you on February 8, 2021. We have appreciated the opportunity to be of service to you on this project. Please call if you have any questions, or if we can be of further service.

Respectfully submitted,

EARTH SYSTEMS PACIFIC

3/5/21



Reviewed and Approved

Anthony Luna
Professional Geologist

Patrick V. Boales
Engineering Geologist

3-5-21

Anthony P. Mazzei
Geotechnical Engineer



3/5/21

Copies: 1 - Client (email)
1 - Project File

INTRODUCTION

Project Description

This report presents results of infiltration testing performed for proposed stormwater infiltration feasibility evaluation at Camp Hess Kramer at 11495 Pacific Coast Highway in the Malibu area of Ventura County, California. (see Vicinity Map in Appendix A).

Purpose and Scope of Work

The purpose of the geotechnical study was to analyze the soil conditions at the project site and to provide tested infiltration rates. The soil conditions include surface and subsurface soil types and the presence or absence of subsurface water. The scope of work included:

- Drilling and logging 14 borings to study soil and groundwater conditions.
- Performing infiltration testing in all of the boring locations.
- Analyzing the infiltration data obtained.
- Preparing this report.

Site Setting

Camp Hess Kramer occupies approximately 55.9 acres bounded by Pacific Coast Highway on the south, Yerba Buena Road on the east, Gindling Hilltop Camp to the north, and open space to the west. The Assessor Parcel Number of the property is 700-0-070-450. The lower camp and much of the middle camp are located in low lying areas within approximately 100 feet of Little Sycamore Creek and 15 feet above the tops of the creek banks. Exceptions in the lower camp include the existing administration building and the camp staff housing building, which are both further from the creek and at higher relative elevations. Exceptions in the middle camp are generally within the northern half, and are further from the creek than 100 feet and at relative elevations greater than 15 feet above the tops of the creek banks.

Most of the areas within the camp that supported structures were located near the toes of relatively steep ascending natural slopes. Slope heights are generally greater than 100 feet above the lower camp area and greater than 200 feet above the middle camp area. Gradients generally range above both camps from about 1:1 (horizontal to vertical) to 2.5:1.

Evaluation of the subsurface indicates that the project site is underlain mostly by native alluvial soils that generally consist of silty and gravelly sands. Artificial fill soils were also encountered at infiltration test locations IT-1, IT-2, and IT-5 through IT-8. These fill soils consist of clayey, silty, and gravelly sands. Groundwater was not encountered in any of our on-site borings to a maximum depth of about 14 feet below the existing ground surface. It should be noted that fluctuations in groundwater levels may occur because of variations in rainfall, regional climate, and other factors.

INFILTRATION TESTING

On February 22, 2021 twelve (IT-3 through IT-14) approximately 8-inch diameter infiltration borings and two 4 inch diameter hand auger borings (IT-1 and IT-2) were excavated to depths of about 3 and fourteen feet below the existing site grades to determine the soil profile and allow installation of plastic casing for infiltration testing (see Site Plan in Appendix A for infiltration boring locations).

After drilling was completed, 3-inch diameter slotted PVC casings were lowered into the boreholes. The annuli between the casings and boring walls were then filled with pea gravel. The falling-head borehole infiltration test procedure was used for infiltration testing. About 24 inches of water was added to the bottom of the holes to start the tests, and the drop in the water surface monitored by taking periodic measurements. Readings were taken at reasonable time intervals based on the infiltrating rate, and after each of these intervals, water was added to return the water level to its approximate original depth above the hole bottom. The tests were run until the infiltration rates were reasonably stable.

It should be noted that the rate the water surface drops in a borehole is a percolation rate, which is related to, but is not an infiltration rate. Percolation rate ignores the wetted soil surface area into which the water is infiltrating and does not account for the volume of water infiltrated. An infiltration rate considers both factors. Hence, percolation rates (in unit length per unit time) are an overestimation of infiltration rates (also in unit length per unit time). Earth Systems uses the Porchet equation to account for the wetted surface area and volume of water infiltrated to estimate an infiltration rate. Forms of the equation can be found in the Riverside County - Low Impact Development BMP Design Handbook (2001), the South Orange County Version, Technical Guidance Documents Appendices (2017), or in a paper by J.W. Van Hoorn, “Determining Hydraulic Conductivity with the Inversed Auger Hole and Infiltrometer Methods.” The Porchet equation in its most simple form is the volume of water infiltrated

divided by the product of the change in time and the wetted surface area. By substitution, the equation can be shown to be equal to:

$$\text{Infiltration Rate (inches /hr.)} = \frac{\Delta H * r * 60}{\Delta t * (r + 2H_{avg})}$$

where: ΔH = Change in water level (inches)
Δt = Change in time (minutes)
r = Radius of test hole (inches)
H_{avg} = Average height of water in test hole (inches)

The above equation does not account for the gravel pack in the annulus between the borehole wall and the slotted pipe fitted in the test hole. Ignoring the gravel pack inflates the amount of water infiltrated and, hence, yields an unconservative infiltration rate. A method to account for the volume occupied by the gravel (and the slotted pipe) and adjust the infiltration rate accordingly is presented in Caltrans Test 750. Earth Systems makes this additional adjustment to our test data. The equation is:

$$\text{Correction Factor} = n * [1 - (O/D)^2] + (I/D)^2$$

Where: n = Pea gravel porosity
O = Outside diameter of slotted pipe (inches)
D = Test hole diameter (inches)
I = Inside diameter of slotted pipe (inches)

Earth Systems has determined an average porosity for the pea gravel used in our testing. The other values are simple measurements.

Based on the infiltration testing results in Appendix B, the slowest measured test infiltration rates for the depths tested and boring locations are summarized in the following table:

Boring	Boring Depth (feet)	Infiltration Rate (inch/hour)
IT-1	2.9	0.21

IT-2	5.1	0.27
IT-3	3.0	1.67
IT-4	13.9	1.94
IT-5	3.0	0.05
IT-6	13.8	0.23
IT-7	3.0	1.13
IT-8	13.6	1.55
IT-9	3.1	0.31
IT-10	13.9	0.76
IT-11	3.1	18.09
IT-12	14.1	0.36
IT-13	3.2	1.13
IT-14	14.2	2.17

There are many factors that influence the infiltration rate. Clear water was used in our tests, whereas deleterious material will likely be contained in the storm water. Variations in soil conditions within the limits of the proposed infiltration system will likely affect infiltration characteristics. The designer who utilizes the infiltration results should consider these factors, as well as apply a factor-of-safety to the infiltration rate to account for future disposal bed siltation.

APPENDIX A

Vicinity Map
Regional Geologic Map
Historical High Groundwater Map
Field Study
Site Plan
Boring Logs
Boring Log Symbols
Unified Soil Classification System



*Taken from USGS Topo Map, Triunfo Pass Quadrangle, California, 2018.

Approximate Scale: 1" = 2,000'

0 2,000' 4,000'

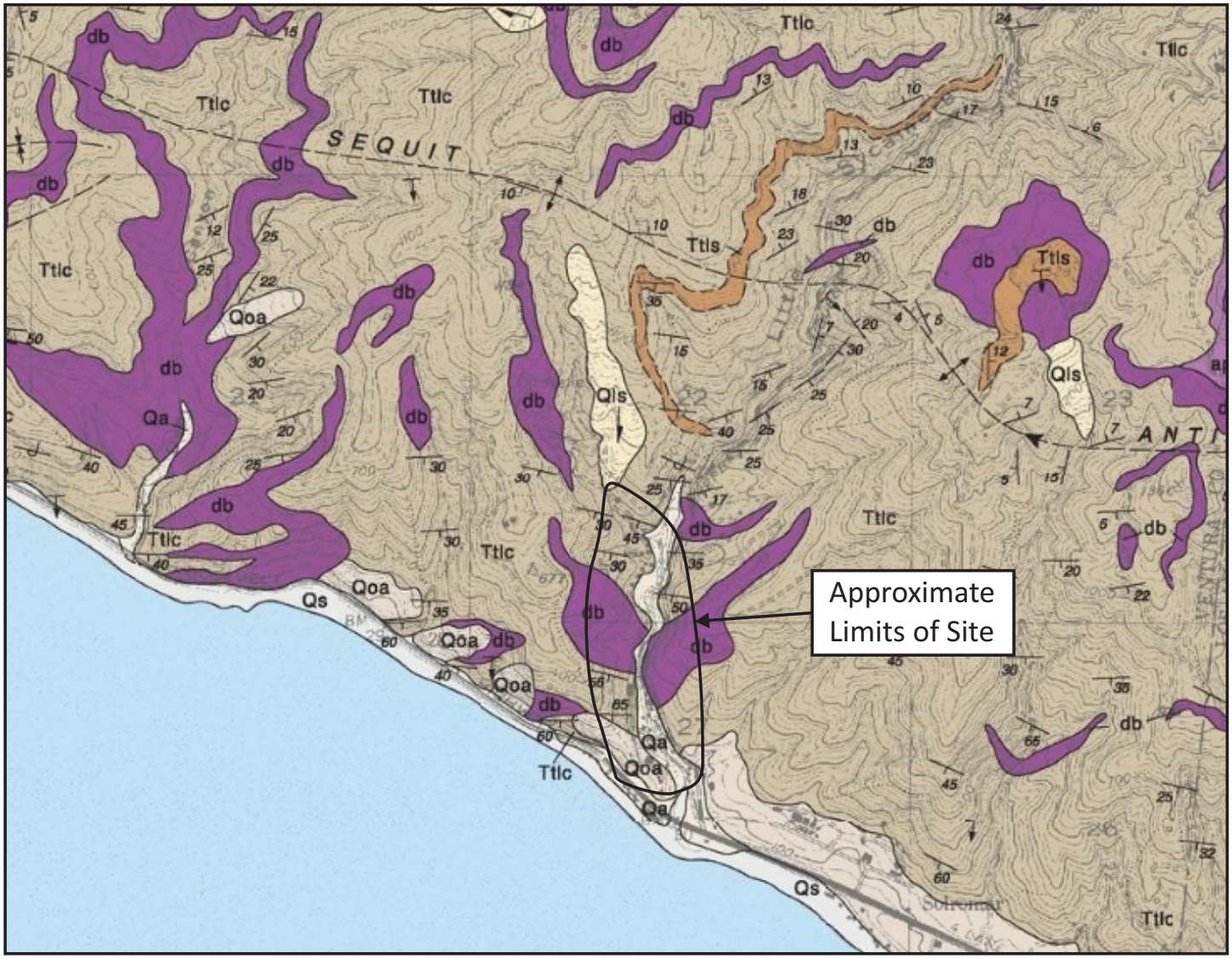
N

VICINITY MAP

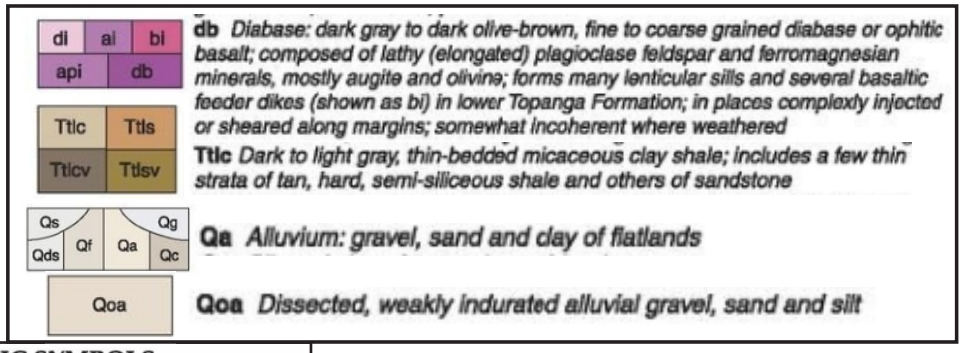
Camp Hess Kramer
Ventura County, CA

Earth Systems

March 2021	301529-003



*Taken from Dibblee, Jr., Geologic Map of The Triunfo Pass Quadrangle, Ventura County, California, 1990, DF-29.



db *Diabase: dark gray to dark olive-brown, fine to coarse grained diabase or ophitic basalt; composed of lathy (elongated) plagioclase feldspar and ferromagnesian minerals, mostly augite and olivine; forms many lenticular sills and several basaltic feeder dikes (shown as bi) in lower Topanga Formation; in places complexly injected or sheared along margins; somewhat incoherent where weathered*

Ttlc *Dark to light gray, thin-bedded micaceous clay shale; includes a few thin strata of tan, hard, semi-siliceous shale and others of sandstone*

Qa *Alluvium: gravel, sand and clay of flatlands*

Qoa *Dissected, weakly indurated alluvial gravel, sand and silt*

GEOLOGIC SYMBOLS

not all symbols shown on each map

FORMATION CONTACT — *dashed where inferred or indefinite, dotted where concealed*

MEMBER CONTACT — *between units of a formation* ····· Prominent bed

CONTACT BETWEEN SURFICIAL SEDIMENTS — *located only approximately in places*

FAULT: *Dashed where indefinite or inferred, dotted where concealed, queried where existence is doubtful. Parallel arrows indicate inferred relative lateral movement. Relative vertical movement is shown by U/D (U=upthrown side, D=downthrown side). Short arrow indicates dip of fault plane. Sawteeth are on upper plate of low angle thrust fault.*

FOLDS: overturned — ANTICLINE — SYNCLINE

arrow on axial trace of fold indicates direction of plunge; dotted where concealed by surficial sediments

Strike and dip of sedimentary rocks: inclined; inclined (approximate); overturned; horizontal; vertical

Strike and dip of metamorphic or igneous rock foliation or flow banding or compositional layers: inclined; inclined (approximate); vertical; overturned

OTHER SYMBOLS: *Direction of landslide movement; outline of water bodies shown on map; water well; oil well; springs*

Approximate Scale: 1" = 2,000'

0 2,000' 4,000'

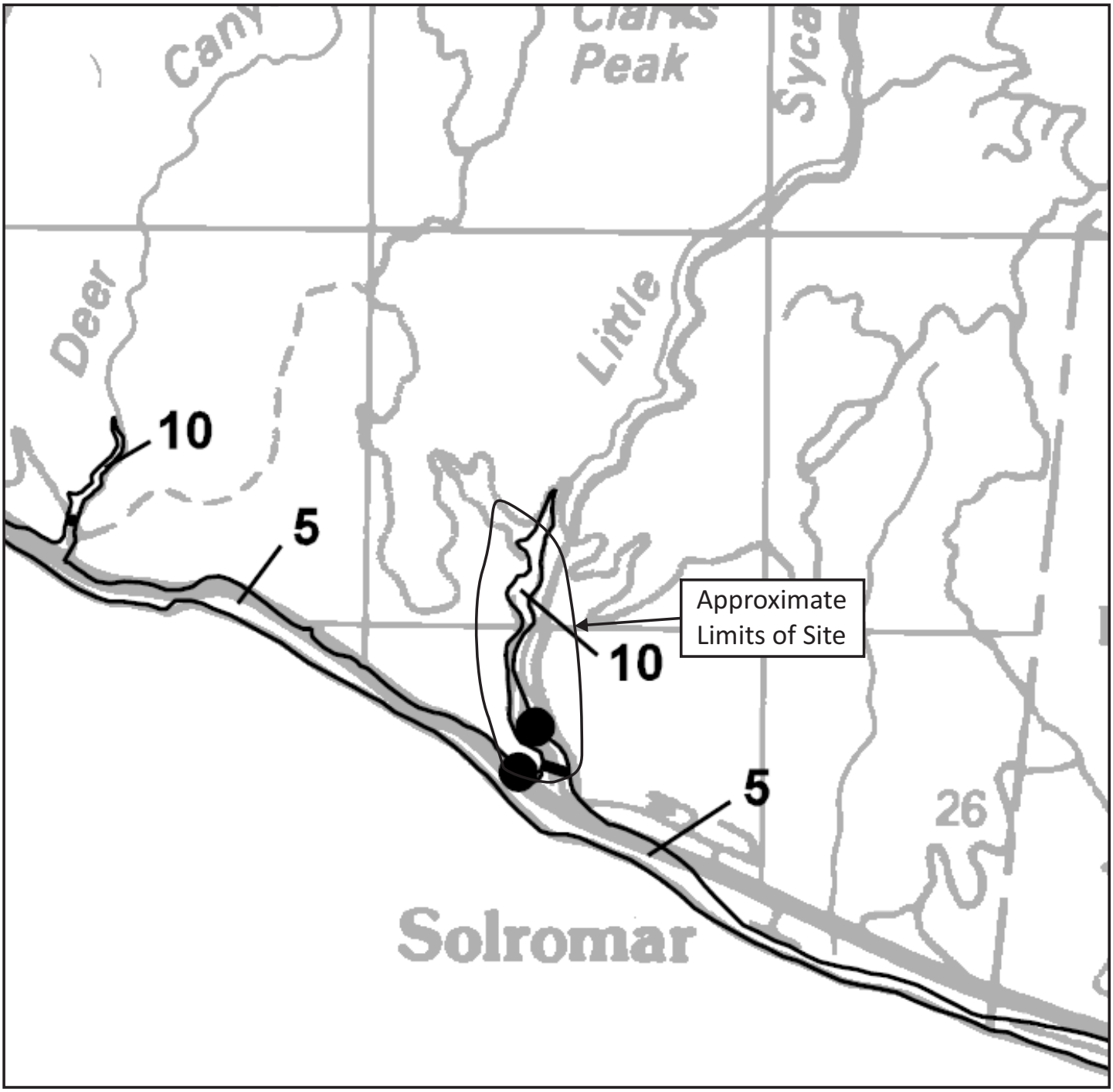
N

REGIONAL GEOLOGIC MAP

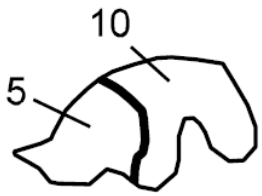
Camp Hess Kramer
Ventura County, California

Earth Systems

March 2021	301529-003



*Taken from CGS, Seismic Hazard Zone Report For The Triunfo Pass 7.5-Minute Quadrangle, Los Angeles & Ventura Counties, California, 2002.



Alluviated valley and zones of estimated historically highest ground-water depth (in feet)
B = Pre-Quaternary bedrock

● Borehole Site

Approximate Scale: 1" = 2,000'

0 2,000' 4,000'

N

HISTORICAL HIGH GROUNDWATER MAP

Camp Hess Kramer
Ventura County, CA

Earth Systems

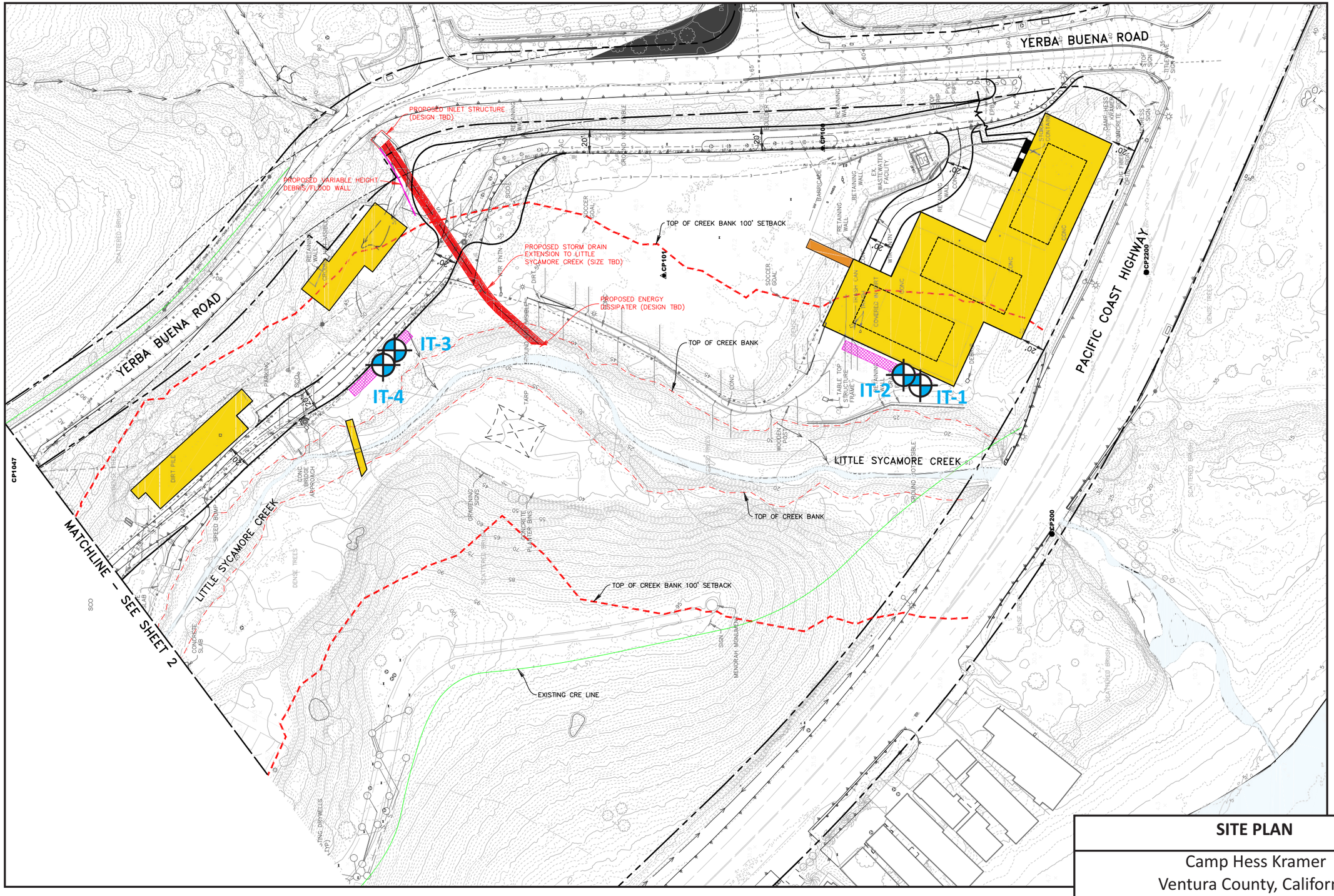
March 2021	301529-003

FIELD STUDY

A. Fourteen borings (IT-1 through IT-14) were drilled to depths of 3 and 14 feet below the existing ground surface to observe the soil profile and to perform infiltration testing. The borings were excavated on February 22, 2021, using hand tools and a CME-75 truck mounted drill rig. The approximate boring locations were determined in the field by pacing and sighting and are shown on the Site Plan in this Appendix.

B. On February 23 through February 25, 2021 infiltration testing was performed at each boring location.

C. The final boring logs represent interpretations of the field logs during the subsurface study. The final logs are included in this Appendix.



Approximate Scale: 1" = 80'

0 80' 160'

IT-1 : Infiltration tests locations

N

SITE PLAN

Camp Hess Kramer
Ventura County, California

Earth Systems

March 2021	301529-003

MATCHLINE – SEE SHEET 3

YERBA BUENA ROAD

TOP OF CREEK BANK 100' SETBACK

TOP OF CREEK BANK

LITTLE SYCAMORE CREEK

PROPOSED ENERGY DISSIPATER (DESIGN TBD)

PROPOSED STORM DRAIN PIPE TO LITTLE SYCAMORE CREEK

PROPOSED CONCRETE V-DITCH

PROPOSED 30"± HIGH SLOUGH WALL AND CONCRETE V-DITCH

IT-1 IT-2 IT-3 IT-4 IT-5 IT-6 IT-7 IT-8

EXISTING CRE LINE

Approximate Scale: 1" = 80'

0 80' 160'

IT-5 : Infiltration test locations

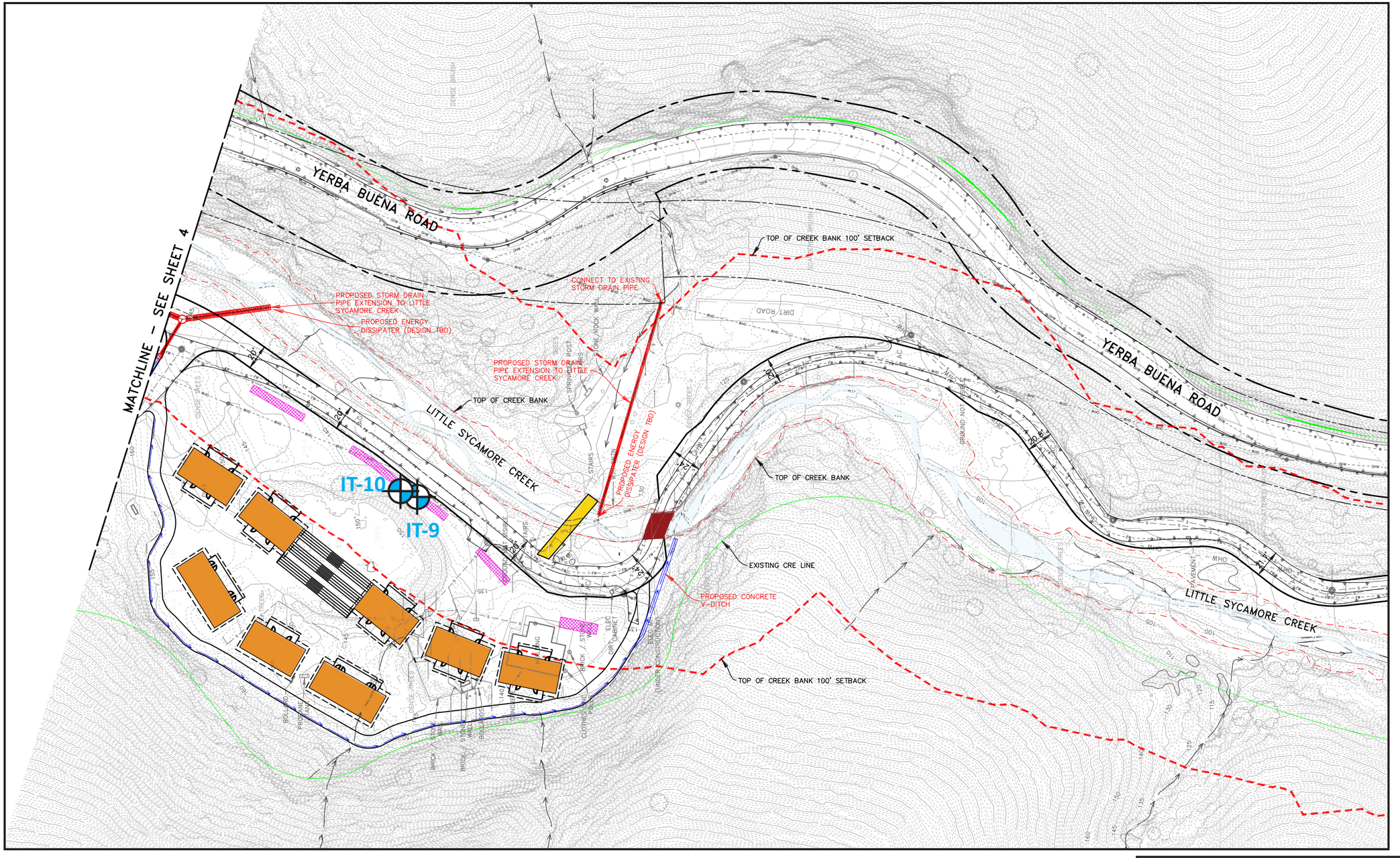
N

SITE PLAN

Camp Hess Kramer
Ventura County, California

Earth Systems

March 2021	301529-003



Approximate Scale: 1" = 80'

0 80' 160'

IT-9 : Infiltration test locations

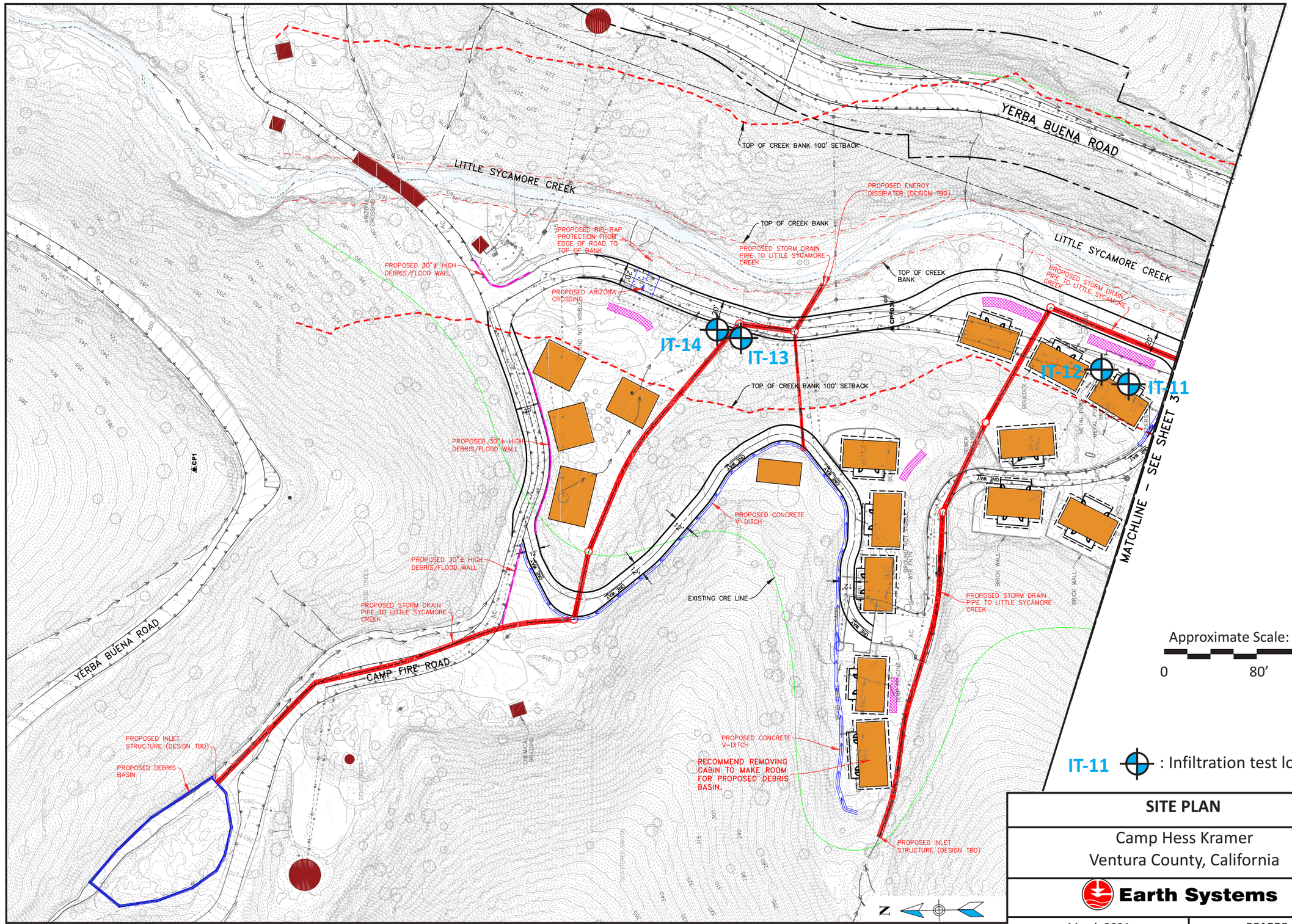
N

SITE PLAN

Camp Hess Kramer
Ventura County, California

Earth Systems

March 2021	301529-003



SITE PLAN

Camp Hess Kramer
Ventura County, California

Earth Systems

March 2021	301529-003

Earth Systems
1731-A Walter Street, Ventura, California 93003
PHONE: (805) 642-6727 FAX: (805) 642-1325

BORING NO: IT-1
PROJECT NAME: Camp Hess Kramer Rebuild
PROJECT NUMBER: 301529-003
BORING LOCATION: Per Plan

DRILLING DATE: February 22, 2021
DRILL RIG: CME-75
DRILLING METHOD: Hollow-Stem Auger
LOGGED BY: AL

Vertical Depth	Sample Type: Bulk	Sample Type: SPT	Sample Type: Mod. Calif.	PENETRATION RESISTANCE (BLOWS/6")	SYMBOL	USCS CLASS	UNIT DRY WT. (pcf)	MOISTURE CONTENT (%)	DESCRIPTION OF UNITS
0						SC			**ALLUVIUM:** Dark Gray Brown Clayey fine to coarse Sand, little fine to coarse Gravel, medium dense, damp
						SM			**ALLUVIUM:** Brown Silty fine to coarse Sand, little Clay, trace fine to coarse Gravel, medium dense to dense, damp
5									**Total Depth: 3.0 feet** **No Groundwater Encountered**
10									
15									
20									
25									
30									
35									

Note: The stratification lines shown represent the approximate boundaries between soil and/or rock types and the transitions may be gradual.

Earth Systems
1731-A Walter Street, Ventura, California 93003
PHONE: (805) 642-6727 FAX: (805) 642-1325

BORING NO: IT-2
PROJECT NAME: Camp Hess Kramer Rebuild
PROJECT NUMBER: 301529-003
BORING LOCATION: Per Plan

DRILLING DATE: February 22, 2021
DRILL RIG: CME-75
DRILLING METHOD: Hollow-Stem Auger
LOGGED BY: AL

Vertical Depth	Sample Type: Bulk	Sample Type: SPT	Sample Type: Mod. Calif.	PENETRATION RESISTANCE (BLOWS/6")	SYMBOL	USCS CLASS	UNIT DRY WT. (pcf)	MOISTURE CONTENT (%)	DESCRIPTION OF UNITS
0						SC			**ARTIFICIAL FILL:** Dark Gray Brown Clayey fine to coarse Sand, little fine to coarse Gravel, glass fragments, medium dense, damp
						SM			**ALLUVIUM:** Brown Silty fine to coarse Sand, trace fine to coarse Gravel, medium dense to dense, damp
5									**Total Depth: 5.5 feet** **No Groundwater Encountered**
10									
15									
20									
25									
30									
35									

Note: The stratification lines shown represent the approximate boundaries between soil and/or rock types and the transitions may be gradual.

Earth Systems
1731-A Walter Street, Ventura, California 93003
PHONE: (805) 642-6727 FAX: (805) 642-1325

BORING NO: IT-3
PROJECT NAME: Camp Hess Kramer Rebuild
PROJECT NUMBER: 301529-003
BORING LOCATION: Per Plan

DRILLING DATE: February 22, 2021
DRILL RIG: CME-75
DRILLING METHOD: Hollow-Stem Auger
LOGGED BY: AL

Vertical Depth	Sample Type: Bulk	Sample Type: SPT	Sample Type: Mod. Calif.	PENETRATION RESISTANCE (BLOWS/6")	SYMBOL	USCS CLASS	UNIT DRY WT. (pcf)	MOISTURE CONTENT (%)	DESCRIPTION OF UNITS
0						SM			**ALLUVIUM:** Brown Silty fine to coarse Sand, some fine to coarse Gravel, loose to medium dense, damp
5									**Total Depth: 3.0 feet** **No Groundwater Encountered**
10									
15									
20									
25									
30									
35									

Note: The stratification lines shown represent the approximate boundaries between soil and/or rock types and the transitions may be gradual.

Earth Systems
1731-A Walter Street, Ventura, California 93003
PHONE: (805) 642-6727 FAX: (805) 642-1325

BORING NO: IT-4
PROJECT NAME: Camp Hess Kramer Rebuild
PROJECT NUMBER: 301529-003
BORING LOCATION: Per Plan

DRILLING DATE: February 22, 2021
DRILL RIG: CME-75
DRILLING METHOD: Hollow-Stem Auger
LOGGED BY: AL

Vertical Depth	Sample Type: Bulk	Sample Type: SPT	Sample Type: Mod. Calif.	PENETRATION RESISTANCE (BLOWS/6"	SYMBOL	USCS CLASS	UNIT DRY WT. (pcf)	MOISTURE CONTENT (%)	DESCRIPTION OF UNITS
0						SM			**ALLUVIUM:** Brown Silty fine to coarse Sand, some fine to coarse Gravel, loose to medium dense, damp
5						SW			**ALLUVIUM:** Brown to Gray Brown Gravelly fine to coarse Sand, some Silt, occasional Cobbles, medium dense to dense, dry to damp
10						SM			**ALLUVIUM:** Brown Silty fine to coarse Sand, some fine to coarse Gravel, little Clay, dense, damp
15									**Total Depth: 14.0 feet** **No Groundwater Encountered**
20									
25									
30									
35									

Note: The stratification lines shown represent the approximate boundaries between soil and/or rock types and the transitions may be gradual.

Earth Systems
1731-A Walter Street, Ventura, California 93003
PHONE: (805) 642-6727 FAX: (805) 642-1325

BORING NO: IT-5
PROJECT NAME: Camp Hess Kramer Rebuild
PROJECT NUMBER: 301529-003
BORING LOCATION: Per Plan

DRILLING DATE: February 22, 2021
DRILL RIG: CME-75
DRILLING METHOD: Hollow-Stem Auger
LOGGED BY: AL

Vertical Depth	Sample Type: Bulk	Sample Type: SPT	Sample Type: Mod. Calif.	PENETRATION RESISTANCE (BLOWS/6")	SYMBOL	USCS CLASS	UNIT DRY WT. (pcf)	MOISTURE CONTENT (%)	DESCRIPTION OF UNITS
0						GW			**ALLUVIUM:** Dark Brown fine to coarse Sandy Gravel, little to some Silt, medium dense to dense, damp
						SM			**ALLUVIUM:** Light Brown Silty fine to coarse Sand, some fine to coarse Gravel, little Clay, medium dense, dry to damp
5									**Total Depth: 3.0 feet** **No Groundwater Encountered**
10									
15									
20									
25									
30									
35									

Note: The stratification lines shown represent the approximate boundaries between soil and/or rock types and the transitions may be gradual.

Earth Systems
1731-A Walter Street, Ventura, California 93003
PHONE: (805) 642-6727 FAX: (805) 642-1325

BORING NO: IT-6
PROJECT NAME: Camp Hess Kramer Rebuild
PROJECT NUMBER: 301529-003
BORING LOCATION: Per Plan

DRILLING DATE: February 22, 2021
DRILL RIG: CME-75
DRILLING METHOD: Hollow-Stem Auger
LOGGED BY: AL

Vertical Depth	Sample Type: Bulk	Sample Type: SPT	Sample Type: Mod. Calif.	PENETRATION RESISTANCE (BLOWS/6")	SYMBOL	USCS CLASS	UNIT DRY WT. (pcf)	MOISTURE CONTENT (%)	DESCRIPTION OF UNITS
0						GW			**ARTIFICIAL FILL:** Dark Brown to Gray Brown fine to coarse Sandy Gravel, some Silt, little Clay, dense, dry to damp
5						SW			**ALLUVIUM:** Brown Gravelly fine to coarse Sand, some Silt, dense, dry to damp
10									
						SM			**ALLUVIUM:** Dark Brown Silty fine to coarse Sand, some fine Gravel, little Clay, medium dense, damp
15									**Total Depth: 14.0 feet** **No Groundwater Encountered**
20									
25									
30									
35									

Note: The stratification lines shown represent the approximate boundaries between soil and/or rock types and the transitions may be gradual.

Earth Systems
1731-A Walter Street, Ventura, California 93003
PHONE: (805) 642-6727 FAX: (805) 642-1325

BORING NO: IT-7
PROJECT NAME: Camp Hess Kramer Rebuild
PROJECT NUMBER: 301529-003
BORING LOCATION: Per Plan

DRILLING DATE: February 22, 2021
DRILL RIG: CME-75
DRILLING METHOD: Hollow-Stem Auger
LOGGED BY: AL

Vertical Depth	Sample Type: Bulk	Sample Type: SPT	Sample Type: Mod. Calif.	PENETRATION RESISTANCE (BLOWS/6")	SYMBOL	USCS CLASS	UNIT DRY WT. (pcf)	MOISTURE CONTENT (%)	DESCRIPTION OF UNITS
0						SM			**ARTIFICIAL FILL:** Brown Silty fine to coarse Sand, little fine to coarse Gravel, medium dense, damp
						SM			**ALLUVIUM:** Brown to Light Brown Silty fine to coarse Sand, little fine to coarse Gravel, medium dense to dense, dry to damp
5									**Total Depth: 3.0 feet** **No Groundwater Encountered**
10									
15									
20									
25									
30									
35									

Note: The stratification lines shown represent the approximate boundaries between soil and/or rock types and the transitions may be gradual.

Earth Systems
1731-A Walter Street, Ventura, California 93003
PHONE: (805) 642-6727 FAX: (805) 642-1325

BORING NO: IT-8
PROJECT NAME: Camp Hess Kramer Rebuild
PROJECT NUMBER: 301529-003
BORING LOCATION: Per Plan

DRILLING DATE: February 22, 2021
DRILL RIG: CME-75
DRILLING METHOD: Hollow-Stem Auger
LOGGED BY: AL

Vertical Depth	Sample Type: Bulk	Sample Type: SPT	Sample Type: Mod. Calif.	PENETRATION RESISTANCE (BLOWS/6")	SYMBOL	USCS CLASS	UNIT DRY WT. (pcf)	MOISTURE CONTENT (%)	DESCRIPTION OF UNITS
0						SW			**ARTIFICIAL FILL:** Dark Brown Gravelly fine to coarse Sand, loose to medium dense, damp
5						GW			**ALLUVIUM:** Brown to Light Brown fine to coarse Gravel, dense, dry to damp
10									
15									**Total Depth: 14.0 feet** **No Groundwater Encountered**
20									
25									
30									
35									

Note: The stratification lines shown represent the approximate boundaries between soil and/or rock types and the transitions may be gradual.

Earth Systems
1731-A Walter Street, Ventura, California 93003
PHONE: (805) 642-6727 FAX: (805) 642-1325

BORING NO: IT-9
PROJECT NAME: Camp Hess Kramer Rebuild
PROJECT NUMBER: 301529-003
BORING LOCATION: Per Plan

DRILLING DATE: February 22, 2021
DRILL RIG: CME-75
DRILLING METHOD: Hollow-Stem Auger
LOGGED BY: AL

Vertical Depth	Sample Type: Bulk	Sample Type: SPT	Sample Type: Mod. Calif.	PENETRATION RESISTANCE (BLOWS/6"	SYMBOL	USCS CLASS	UNIT DRY WT. (pcf)	MOISTURE CONTENT (%)	DESCRIPTION OF UNITS
0						SM			**ALLUVIUM:** Brown Silty fine to coarse Sand, some fine to coarse Gravel, medium dense, dry to damp
5									**Total Depth: 3.0 feet** **No Groundwater Encountered**
10									
15									
20									
25									
30									
35									

Note: The stratification lines shown represent the approximate boundaries between soil and/or rock types and the transitions may be gradual.

Earth Systems
1731-A Walter Street, Ventura, California 93003
PHONE: (805) 642-6727 FAX: (805) 642-1325

BORING NO: IT-10
PROJECT NAME: Camp Hess Kramer Rebuild
PROJECT NUMBER: 301529-003
BORING LOCATION: Per Plan

DRILLING DATE: February 22, 2021
DRILL RIG: CME-75
DRILLING METHOD: Hollow-Stem Auger
LOGGED BY: AL

Vertical Depth	Sample Type: Bulk	Sample Type: SPT	Sample Type: Mod. Calif.	PENETRATION RESISTANCE (BLOWS/6")	SYMBOL	USCS CLASS	UNIT DRY WT. (pcf)	MOISTURE CONTENT (%)	DESCRIPTION OF UNITS
0						SM			**ALLUVIUM:** Brown Silty fine to coarse Sand, some fine to coarse Gravel, dense, dry to damp
10						SM			**ALLUVIUM:** Dark Brown Silty fine Sand, some medium to coarse Sand, trace fine Gravel, medium dense, damp
						SM			**ALLUVIUM:** Brown Silty fine to coarse Sand, some fine to coarse Gravel, very dense, damp
15									**Total Depth: 14.0 feet** **No Groundwater Encountered**
20									
25									
30									
35									

Note: The stratification lines shown represent the approximate boundaries between soil and/or rock types and the transitions may be gradual.

Earth Systems
1731-A Walter Street, Ventura, California 93003
PHONE: (805) 642-6727 FAX: (805) 642-1325

BORING NO: IT-11
PROJECT NAME: Camp Hess Kramer Rebuild
PROJECT NUMBER: 301529-003
BORING LOCATION: Per Plan

DRILLING DATE: February 22, 2021
DRILL RIG: CME-75
DRILLING METHOD: Hollow-Stem Auger
LOGGED BY: AL

Vertical Depth	Sample Type: Bulk	Sample Type: SPT	Sample Type: Mod. Calif.	PENETRATION RESISTANCE (BLOWS/6"	SYMBOL	USCS CLASS	UNIT DRY WT. (pcf)	MOISTURE CONTENT (%)	DESCRIPTION OF UNITS
0						GW			**ALLUVIUM:** Brown fine to coarse Sandy Gravel, some Silt, dense, dry to damp
5									**Total Depth: 3.0 feet** **No Groundwater Encountered**
10									
15									
20									
25									
30									
35									

Note: The stratification lines shown represent the approximate boundaries between soil and/or rock types and the transitions may be gradual.

Earth Systems
1731-A Walter Street, Ventura, California 93003
PHONE: (805) 642-6727 FAX: (805) 642-1325

BORING NO: IT-12
PROJECT NAME: Camp Hess Kramer Rebuild
PROJECT NUMBER: 301529-003
BORING LOCATION: Per Plan

DRILLING DATE: February 22, 2021
DRILL RIG: CME-75
DRILLING METHOD: Hollow-Stem Auger
LOGGED BY: AL

Vertical Depth	Sample Type: Bulk	Sample Type: SPT	Sample Type: Mod. Calif.	PENETRATION RESISTANCE (BLOWS/6")	SYMBOL	USCS CLASS	UNIT DRY WT. (pcf)	MOISTURE CONTENT (%)	DESCRIPTION OF UNITS
0						SM			**ALLUVIUM:** Dark Brown Silty fine to coarse Sand, some fine to coarse Gravel, loose to medium dense, damp
5						GW			**ALLUVIUM:** Brown fine to coarse Sandy Gravel, some Silt, dense, dry to damp
10						SM			**ALLUVIUM:** Dark Brown Silty fine to medium Sand, some coarse Sand, trace to little Clay, little fine to coarse Gravel, medium dense, dry to damp
15									**Total Depth: 14.0 feet** **No Groundwater Encountered**
20									
25									
30									
35									

Note: The stratification lines shown represent the approximate boundaries between soil and/or rock types and the transitions may be gradual.

Earth Systems
1731-A Walter Street, Ventura, California 93003
PHONE: (805) 642-6727 FAX: (805) 642-1325

BORING NO: IT-13
PROJECT NAME: Camp Hess Kramer Rebuild
PROJECT NUMBER: 301529-003
BORING LOCATION: Per Plan

DRILLING DATE: February 22, 2021
DRILL RIG: CME-75
DRILLING METHOD: Hollow-Stem Auger
LOGGED BY: AL

Vertical Depth	Sample Type: Bulk	Sample Type: SPT	Sample Type: Mod. Calif.	PENETRATION RESISTANCE (BLOWS/6")	SYMBOL	USCS CLASS	UNIT DRY WT. (pcf)	MOISTURE CONTENT (%)	DESCRIPTION OF UNITS
0						SW			**ALLUVIUM:** Brown to Dark Brown Gravelly fine to coarse Sand, some Silt, dense, dry to damp
5									**Total Depth: 3.0 feet** **No Groundwater Encountered**
10									
15									
20									
25									
30									
35									

Note: The stratification lines shown represent the approximate boundaries between soil and/or rock types and the transitions may be gradual.

Earth Systems
1731-A Walter Street, Ventura, California 93003
PHONE: (805) 642-6727 FAX: (805) 642-1325

BORING NO: IT-14
PROJECT NAME: Camp Hess Kramer Rebuild
PROJECT NUMBER: 301529-003
BORING LOCATION: Per Plan

DRILLING DATE: February 22, 2021
DRILL RIG: CME-75
DRILLING METHOD: Hollow-Stem Auger
LOGGED BY: AL

Vertical Depth	Sample Type: Bulk	Sample Type: SPT	Sample Type: Mod. Calif.	PENETRATION RESISTANCE (BLOWS/6")	SYMBOL	USCS CLASS	UNIT DRY WT. (pcf)	MOISTURE CONTENT (%)	DESCRIPTION OF UNITS
0						GW			**ALLUVIUM:** Brown fine to coarse Gravel, some Silt, dense, dry to damp
5									
10						SM			**ALLUVIUM:** Light Brown Silty fine to coarse Sand, some fine to coarse Gravel, medium dense to dense, dry to damp
15									**Total Depth: 14.0 feet** **No Groundwater Encountered**
20									
25									
30									
35									

Note: The stratification lines shown represent the approximate boundaries between soil and/or rock types and the transitions may be gradual.

BORING LOG SYMBOLS


Modified California Split Barrel Sampler


Modified California Split Barrel Sampler - No Recovery


Standard Penetration Test (SPT) Sampler


Standard Penetration Test (SPT) Sampler - No Recovery


Perched Water Level


Water Level First Encountered


Water Level After Drilling


Pocket Penetrometer (tsf)


Vane Shear (ksf)

1. The location of borings were approximately determined by pacing and/or siting from visible features. Elevations of borings are approximately determined by interpolating between plan contours. The location and elevation of the borings should be considered.

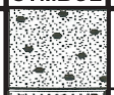
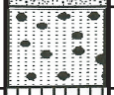
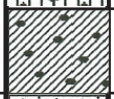
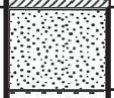
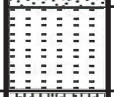
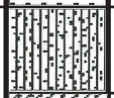
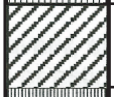
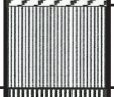
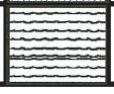
2. The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

3. Water level readings have been made in the drill holes at times and under conditions stated on the boring logs. This data has been reviewed and interpretations made in the text of this report. However, it must be noted that fluctuations in the level of the groundwater may occur due to variations in rainfall, tides, temperature, and other factors at the time measurements were made.

BORING LOG SYMBOLS

Earth Systems

UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS			GRAPH SYMBOL	LETTER SYMBOL	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	GRAVEL AND GRAVELLY SOILS MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
				GP	POORLY-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES
	SAND AND SANDY SOILS MORE THAN 50% OF COARSE FRACTION PASSING NO. 4 SIEVE	CLEAN SAND (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
				SP	POORLY-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
		SANDS WITH FINES (APPRECIABLE AMOUNTOF FINES)		SM	SILTY SANDS, SAND-SILT MIXTURES
				SC	CLAYEY SANDS, SAND-CLAY MIXTURES
FINE GRAINED SOILS MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENT

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

UNIFIED SOIL CLASSIFICATION SYSTEM

Earth Systems

APPENDIX B

Infiltration Test Results

INFILTRATION RATE BY THE BOREHOLE PERCOLATION TEST METHOD

This workbook calculates an adjusted infiltration rate from a borehole percolation test. The percolation rate is adjusted for sidewall area according to the Porchet method, and then re-adjusted for the effect of the gravel placed in annulus between the borehole wall and a pipe placed in the borehole by a method presented in Caltrans Test 750.

Project Name	Camp Hess Kramer Camp Rebuilds
Project Number	301529-003
Test Hole No.	IT-1
Tester	A. Luna
Pre-Soak Date	February 23, 2021
Test Date	February 24, 2021

Test Hole Radius, r (inches)	2
Total Depth of Test Hole, D_T (feet)	3.3
Inside Diameter of Pipe, I (inches)	3.00
Outside Diameter of Pipe, O (inches)	3.38
Pipe Stick-Up (feet)	0.4
Porosity of Gravel, n	0.41
Porosity Correction Factor, C	0.68
Factor of Safety (FOS), F	N/A

Interval No.	Delta Time, Δt (min.)	Initial Depth to Water from TOP, D_o (ft.)	Final Depth to Water from TOP, D_f (ft.)	Initial Water Height, H_o (in.)	Final Water Height, H_f (in.)	Change in Water Height, ΔH (in.)	Perc Rate, (in/hr)	Infiltration Rate (in./hr.)	Corrected Infiltration Rate (in/hr)
1	30.00	1.30	1.69	28.80	24.12	4.68	9.36	0.34	0.23
2	30.00	1.30	1.68	28.80	24.24	4.56	9.12	0.33	0.23
3	30.00	1.30	1.66	28.80	24.48	4.32	8.64	0.31	0.21
4	30.00	1.30	1.66	28.80	24.48	4.32	8.64	0.31	0.21
5	30.00	1.30	1.66	28.80	24.48	4.32	8.64	0.31	0.21
6	30.00	1.30	1.65	28.80	24.60	4.20	8.40	0.30	0.21
7	30.00	1.30	1.65	28.80	24.60	4.20	8.40	0.30	0.21
8	30.00	1.30	1.65	28.80	24.60	4.20	8.40	0.30	0.21
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									
21									
22									
23									
24									
25									

INFILTRATION RATE BY THE BOREHOLE PERCOLATION TEST METHOD

This workbook calculates an adjusted infiltration rate from a borehole percolation test. The percolation rate is adjusted for sidewall area according to the Porchet method, and then re-adjusted for the effect of the gravel placed in annulus between the borehole wall and a pipe placed in the borehole by a method presented in Caltrans Test 750.

Project Name	Camp Hess Kramer Camp Rebuilds
Project Number	301529-003
Test Hole No.	IT-2
Tester	A. Luna
Pre-Soak Date	February 23, 2021
Test Date	February 24, 2021

Test Hole Radius, r (inches)	2
Total Depth of Test Hole, D_T (feet)	5.2
Inside Diameter of Pipe, I (inches)	3.00
Outside Diameter of Pipe, O (inches)	3.38
Pipe Stick-Up (feet)	0.1
Porosity of Gravel, n	0.41
Porosity Correction Factor, C	0.68
Factor of Safety (FOS), F	N/A

Interval No.	Delta Time, Δt (min.)	Initial Depth to Water from TOP, D_o (ft.)	Final Depth to Water from TOP, D_f (ft.)	Initial Water Height, H_o (in.)	Final Water Height, H_f (in.)	Change in Water Height, ΔH (in.)	Perc Rate, (in/hr)	Infiltration Rate (in./hr.)	Corrected Infiltration Rate (in/hr)
1	30.00	3.20	3.67	25.20	19.56	5.64	11.28	0.48	0.33
2	30.00	3.20	3.62	25.20	20.16	5.04	10.08	0.43	0.29
3	30.00	3.20	3.61	25.20	20.28	4.92	9.84	0.41	0.28
4	30.00	3.20	3.62	25.20	20.16	5.04	10.08	0.43	0.29
5	30.00	3.20	3.60	25.20	20.40	4.80	9.60	0.40	0.27
6	30.00	3.20	3.59	25.20	20.52	4.68	9.36	0.39	0.27
7	30.00	3.20	3.59	25.20	20.52	4.68	9.36	0.39	0.27
8	30.00	3.20	3.58	25.20	20.64	4.56	9.12	0.38	0.26
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									
21									
22									
23									
24									
25									

INFILTRATION RATE BY THE BOREHOLE PERCOLATION TEST METHOD

This workbook calculates an adjusted infiltration rate from a borehole percolation test. The percolation rate is adjusted for sidewall area according to the Porchet method, and then re-adjusted for the effect of the gravel placed in annulus between the borehole wall and a pipe placed in the borehole by a method presented in Caltrans Test 750.

Project Name	Camp Hess Kramer Camp Rebuilds
Project Number	301529-003
Test Hole No.	IT-3
Tester	A. Luna
Pre-Soak Date	February 22, 2021
Test Date	February 23, 2021

Test Hole Radius, r (inches)	4
Total Depth of Test Hole, D_T (feet)	3.0
Inside Diameter of Pipe, I (inches)	3.00
Outside Diameter of Pipe, O (inches)	3.38
Pipe Stick-Up (feet)	0.0
Porosity of Gravel, n	0.41
Porosity Correction Factor, C	0.48
Factor of Safety (FOS), F	N/A

Interval No.	Delta Time, Δt (min.)	Initial Depth to Water from TOP, D_o (ft.)	Final Depth to Water from TOP, D_f (ft.)	Initial Water Height, H_o (in.)	Final Water Height, H_f (in.)	Change in Water Height, ΔH (in.)	Perc Rate, (in/hr)	Infiltration Rate (in./hr.)	Corrected Infiltration Rate (in/hr)
1	10.00	1.00	1.65	24.00	16.20	7.80	46.80	4.24	2.02
2	10.00	1.00	1.65	24.00	16.20	7.80	46.80	4.24	2.02
3	10.00	1.00	1.60	24.00	16.80	7.20	43.20	3.86	1.84
4	10.00	1.00	1.55	24.00	17.40	6.60	39.60	3.49	1.67
5	10.00	1.00	1.55	24.00	17.40	6.60	39.60	3.49	1.67
6	10.00	1.00	1.55	24.00	17.40	6.60	39.60	3.49	1.67
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									
21									
22									
23									
24									
25									

INFILTRATION RATE BY THE BOREHOLE PERCOLATION TEST METHOD

This workbook calculates an adjusted infiltration rate from a borehole percolation test. The percolation rate is adjusted for sidewall area according to the Porchet method, and then re-adjusted for the effect of the gravel placed in annulus between the borehole wall and a pipe placed in the borehole by a method presented in Caltrans Test 750.

Project Name	Camp Hess Kramer Camp Rebuilds
Project Number	301529-003
Test Hole No.	IT-4
Tester	A. Luna
Pre-Soak Date	February 22, 2021
Test Date	February 23, 2021

Test Hole Radius, r (inches)	4
Total Depth of Test Hole, D_T (feet)	13.9
Inside Diameter of Pipe, I (inches)	3.00
Outside Diameter of Pipe, O (inches)	3.38
Pipe Stick-Up (feet)	0.0
Porosity of Gravel, n	0.41
Porosity Correction Factor, C	0.48
Factor of Safety (FOS), F	N/A

Interval No.	Delta Time, Δt (min.)	Initial Depth to Water from TOP, D_o (ft.)	Final Depth to Water from TOP, D_f (ft.)	Initial Water Height, H_o (in.)	Final Water Height, H_f (in.)	Change in Water Height, ΔH (in.)	Perc Rate, (in/hr)	Infiltration Rate (in./hr.)	Corrected Infiltration Rate (in/hr)
1	10.00	11.90	12.61	24.00	15.48	8.52	51.12	4.70	2.25
2	10.00	11.90	12.57	24.00	15.96	8.04	48.24	4.39	2.10
3	10.00	11.90	12.54	24.00	16.32	7.68	46.08	4.16	1.99
4	10.00	11.90	12.53	24.00	16.44	7.56	45.36	4.08	1.95
5	10.00	11.90	12.52	24.00	16.56	7.44	44.64	4.01	1.91
6	10.00	11.90	12.53	24.00	16.44	7.56	45.36	4.08	1.95
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									
21									
22									
23									
24									
25									

INFILTRATION RATE BY THE BOREHOLE PERCOLATION TEST METHOD

This workbook calculates an adjusted infiltration rate from a borehole percolation test. The percolation rate is adjusted for sidewall area according to the Porchet method, and then re-adjusted for the effect of the gravel placed in annulus between the borehole wall and a pipe placed in the borehole by a method presented in Caltrans Test 750.

Project Name	Camp Hess Kramer Camp Rebuilds
Project Number	301529-003
Test Hole No.	IT-5
Tester	A. Luna
Pre-Soak Date	February 22, 2021
Test Date	February 23, 2021

Test Hole Radius, r (inches)	4
Total Depth of Test Hole, D_T (feet)	3.0
Inside Diameter of Pipe, I (inches)	3.00
Outside Diameter of Pipe, O (inches)	3.38
Pipe Stick-Up (feet)	0.0
Porosity of Gravel, n	0.41
Porosity Correction Factor, C	0.48
Factor of Safety (FOS), F	N/A

Interval No.	Delta Time, Δt (min.)	Initial Depth to Water from TOP, D_o (ft.)	Final Depth to Water from TOP, D_f (ft.)	Initial Water Height, H_o (in.)	Final Water Height, H_f (in.)	Change in Water Height, ΔH (in.)	Perc Rate, (in/hr)	Infiltration Rate (in./hr.)	Corrected Infiltration Rate (in/hr)
1	30.00	1.00	1.12	24.00	22.56	1.44	2.88	0.23	0.11
2	30.00	1.00	1.08	24.00	23.04	0.96	1.92	0.15	0.07
3	30.00	1.00	1.06	24.00	23.28	0.72	1.44	0.11	0.05
4	30.00	1.00	1.07	24.00	23.16	0.84	1.68	0.13	0.06
5	30.00	1.00	1.06	24.00	23.28	0.72	1.44	0.11	0.05
6	30.00	1.00	1.06	24.00	23.28	0.72	1.44	0.11	0.05
7	30.00	1.00	1.06	24.00	23.28	0.72	1.44	0.11	0.05
8									
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									
21									
22									
23									
24									
25									

INFILTRATION RATE BY THE BOREHOLE PERCOLATION TEST METHOD

This workbook calculates an adjusted infiltration rate from a borehole percolation test. The percolation rate is adjusted for sidewall area according to the Porchet method, and then re-adjusted for the effect of the gravel placed in annulus between the borehole wall and a pipe placed in the borehole by a method presented in Caltrans Test 750.

Project Name	Camp Hess Kramer Camp Rebuilds
Project Number	301529-003
Test Hole No.	IT-6
Tester	A. Luna
Pre-Soak Date	February 22, 2021
Test Date	February 23, 2021

Test Hole Radius, r (inches)	4
Total Depth of Test Hole, D_T (feet)	13.8
Inside Diameter of Pipe, I (inches)	3.00
Outside Diameter of Pipe, O (inches)	3.38
Pipe Stick-Up (feet)	0.0
Porosity of Gravel, n	0.41
Porosity Correction Factor, C	0.48
Factor of Safety (FOS), F	N/A

Interval No.	Delta Time, Δt (min.)	Initial Depth to Water from TOP, D_o (ft.)	Final Depth to Water from TOP, D_f (ft.)	Initial Water Height, H_o (in.)	Final Water Height, H_f (in.)	Change in Water Height, ΔH (in.)	Perc Rate, (in/hr)	Infiltration Rate (in./hr.)	Corrected Infiltration Rate (in/hr)
1	30.00	11.80	12.08	24.00	20.64	3.36	6.72	0.55	0.26
2	30.00	11.80	12.06	24.00	20.88	3.12	6.24	0.51	0.24
3	30.00	11.80	12.05	24.00	21.00	3.00	6.00	0.49	0.23
4	30.00	11.80	12.05	24.00	21.00	3.00	6.00	0.49	0.23
5	30.00	11.80	12.05	24.00	21.00	3.00	6.00	0.49	0.23
6	30.00	11.80	12.05	24.00	21.00	3.00	6.00	0.49	0.23
7	30.00	11.80	12.04	24.00	21.12	2.88	5.76	0.47	0.22
8									
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									
21									
22									
23									
24									
25									

INFILTRATION RATE BY THE BOREHOLE PERCOLATION TEST METHOD

This workbook calculates an adjusted infiltration rate from a borehole percolation test. The percolation rate is adjusted for sidewall area according to the Porchet method, and then re-adjusted for the effect of the gravel placed in annulus between the borehole wall and a pipe placed in the borehole by a method presented in Caltrans Test 750.

Project Name	Camp Hess Kramer Camp Rebuilds
Project Number	301529-003
Test Hole No.	IT-7
Tester	A. Luna
Pre-Soak Date	February 24, 2021
Test Date	February 25, 2021

Test Hole Radius, r (inches)	4
Total Depth of Test Hole, D_T (feet)	3.0
Inside Diameter of Pipe, I (inches)	3.00
Outside Diameter of Pipe, O (inches)	3.38
Pipe Stick-Up (feet)	0.0
Porosity of Gravel, n	0.41
Porosity Correction Factor, C	0.48
Factor of Safety (FOS), F	N/A

Interval No.	Delta Time, Δt (min.)	Initial Depth to Water from TOP, D_o (ft.)	Final Depth to Water from TOP, D_f (ft.)	Initial Water Height, H_o (in.)	Final Water Height, H_f (in.)	Change in Water Height, ΔH (in.)	Perc Rate, (in/hr)	Infiltration Rate (in./hr.)	Corrected Infiltration Rate (in/hr)
1	10.00	1.00	1.45	24.00	18.60	5.40	32.40	2.78	1.33
2	10.00	1.00	1.42	24.00	18.96	5.04	30.24	2.58	1.23
3	10.00	1.00	1.39	24.00	19.32	4.68	28.08	2.37	1.13
4	10.00	1.00	1.40	24.00	19.20	4.80	28.80	2.44	1.17
5	10.00	1.00	1.39	24.00	19.32	4.68	28.08	2.37	1.13
6	10.00	1.00	1.39	24.00	19.32	4.68	28.08	2.37	1.13
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									
21									
22									
23									
24									
25									

INFILTRATION RATE BY THE BOREHOLE PERCOLATION TEST METHOD

This workbook calculates an adjusted infiltration rate from a borehole percolation test. The percolation rate is adjusted for sidewall area according to the Porchet method, and then re-adjusted for the effect of the gravel placed in annulus between the borehole wall and a pipe placed in the borehole by a method presented in Caltrans Test 750.

Project Name	Camp Hess Kramer Camp Rebuilds
Project Number	301529-003
Test Hole No.	IT-8
Tester	A. Luna
Pre-Soak Date	February 24, 2021
Test Date	February 25, 2021

Test Hole Radius, r (inches)	4
Total Depth of Test Hole, D_T (feet)	13.9
Inside Diameter of Pipe, I (inches)	3.00
Outside Diameter of Pipe, O (inches)	3.38
Pipe Stick-Up (feet)	0.3
Porosity of Gravel, n	0.41
Porosity Correction Factor, C	0.48
Factor of Safety (FOS), F	N/A

Interval No.	Delta Time, Δt (min.)	Initial Depth to Water from TOP, D_o (ft.)	Final Depth to Water from TOP, D_f (ft.)	Initial Water Height, H_o (in.)	Final Water Height, H_f (in.)	Change in Water Height, ΔH (in.)	Perc Rate, (in/hr)	Infiltration Rate (in./hr.)	Corrected Infiltration Rate (in/hr)
1	10.00	11.90	12.59	27.60	19.32	8.28	49.68	3.90	1.86
2	10.00	11.90	12.48	27.60	20.64	6.96	41.76	3.20	1.53
3	10.00	11.90	12.49	27.60	20.52	7.08	42.48	3.26	1.56
4	10.00	11.90	12.49	27.60	20.52	7.08	42.48	3.26	1.56
5	10.00	11.90	12.49	27.60	20.52	7.08	42.48	3.26	1.56
6	10.00	11.90	12.48	27.60	20.64	6.96	41.76	3.20	1.53
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									
21									
22									
23									
24									
25									

INFILTRATION RATE BY THE BOREHOLE PERCOLATION TEST METHOD

This workbook calculates an adjusted infiltration rate from a borehole percolation test. The percolation rate is adjusted for sidewall area according to the Porchet method, and then re-adjusted for the effect of the gravel placed in annulus between the borehole wall and a pipe placed in the borehole by a method presented in Caltrans Test 750.

Project Name	Camp Hess Kramer Camp Rebuilds
Project Number	301529-003
Test Hole No.	IT-9
Tester	A. Luna
Pre-Soak Date	February 24, 2021
Test Date	February 25, 2021

Test Hole Radius, r (inches)	4
Total Depth of Test Hole, D_T (feet)	3.1
Inside Diameter of Pipe, I (inches)	3.00
Outside Diameter of Pipe, O (inches)	3.38
Pipe Stick-Up (feet)	0.0
Porosity of Gravel, n	0.41
Porosity Correction Factor, C	0.48
Factor of Safety (FOS), F	N/A

Interval No.	Delta Time, Δt (min.)	Initial Depth to Water from TOP, D_o (ft.)	Final Depth to Water from TOP, D_f (ft.)	Initial Water Height, H_o (in.)	Final Water Height, H_f (in.)	Change in Water Height, ΔH (in.)	Perc Rate, (in/hr)	Infiltration Rate (in./hr.)	Corrected Infiltration Rate (in/hr)
1	30.00	1.10	1.45	24.00	19.80	4.20	8.40	0.70	0.34
2	30.00	1.10	1.45	24.00	19.80	4.20	8.40	0.70	0.34
3	30.00	1.10	1.44	24.00	19.92	4.08	8.16	0.68	0.33
4	30.00	1.10	1.43	24.00	20.04	3.96	7.92	0.66	0.31
5	30.00	1.10	1.42	24.00	20.16	3.84	7.68	0.64	0.30
6	30.00	1.10	1.43	24.00	20.04	3.96	7.92	0.66	0.31
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									
21									
22									
23									
24									
25									

INFILTRATION RATE BY THE BOREHOLE PERCOLATION TEST METHOD

This workbook calculates an adjusted infiltration rate from a borehole percolation test. The percolation rate is adjusted for sidewall area according to the Porchet method, and then re-adjusted for the effect of the gravel placed in annulus between the borehole wall and a pipe placed in the borehole by a method presented in Caltrans Test 750.

Project Name	Camp Hess Kramer Camp Rebuilds
Project Number	301529-003
Test Hole No.	IT-10
Tester	A. Luna
Pre-Soak Date	February 24, 2021
Test Date	February 25, 2021

Test Hole Radius, r (inches)	4
Total Depth of Test Hole, D_T (feet)	13.9
Inside Diameter of Pipe, I (inches)	3.00
Outside Diameter of Pipe, O (inches)	3.38
Pipe Stick-Up (feet)	0.0
Porosity of Gravel, n	0.41
Porosity Correction Factor, C	0.48
Factor of Safety (FOS), F	N/A

Interval No.	Delta Time, Δt (min.)	Initial Depth to Water from TOP, D_o (ft.)	Final Depth to Water from TOP, D_f (ft.)	Initial Water Height, H_o (in.)	Final Water Height, H_f (in.)	Change in Water Height, ΔH (in.)	Perc Rate, (in/hr)	Infiltration Rate (in./hr.)	Corrected Infiltration Rate (in/hr)
1	30.00	11.90	12.78	24.00	13.44	10.56	21.12	2.04	0.97
2	30.00	11.90	12.68	24.00	14.64	9.36	18.72	1.76	0.84
3	30.00	11.90	12.66	24.00	14.88	9.12	18.24	1.70	0.81
4	30.00	11.90	12.63	24.00	15.24	8.76	17.52	1.62	0.77
5	30.00	11.90	12.62	24.00	15.36	8.64	17.28	1.59	0.76
6	30.00	11.90	12.62	24.00	15.36	8.64	17.28	1.59	0.76
7	30.00	11.90	12.61	24.00	15.48	8.52	17.04	1.57	0.75
8									
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									
21									
22									
23									
24									
25									

INFILTRATION RATE BY THE BOREHOLE PERCOLATION TEST METHOD

This workbook calculates an adjusted infiltration rate from a borehole percolation test. The percolation rate is adjusted for sidewall area according to the Porchet method, and then re-adjusted for the effect of the gravel placed in annulus between the borehole wall and a pipe placed in the borehole by a method presented in Caltrans Test 750.

Project Name	Camp Hess Kramer Camp Rebuilds
Project Number	301529-003
Test Hole No.	IT-11
Tester	A. Luna
Pre-Soak Date	February 23, 2021
Test Date	February 24, 2021

Test Hole Radius, r (inches)	4
Total Depth of Test Hole, D_T (feet)	3.2
Inside Diameter of Pipe, I (inches)	3.00
Outside Diameter of Pipe, O (inches)	3.38
Pipe Stick-Up (feet)	0.1
Porosity of Gravel, n	0.41
Porosity Correction Factor, C	0.48
Factor of Safety (FOS), F	N/A

Interval No.	Delta Time, Δt (min.)	Initial Depth to Water from TOP, D_o (ft.)	Final Depth to Water from TOP, D_f (ft.)	Initial Water Height, H_o (in.)	Final Water Height, H_f (in.)	Change in Water Height, ΔH (in.)	Perc Rate, (in/hr)	Infiltration Rate (in./hr.)	Corrected Infiltration Rate (in/hr)
1	5.00	1.20	3.20	25.20	1.20	24.00	288.00	37.89	18.09
2	5.00	1.20	3.20	25.20	1.20	24.00	288.00	37.89	18.09
3	5.00	1.20	3.20	25.20	1.20	24.00	288.00	37.89	18.09
4	5.00	1.20	3.20	25.20	1.20	24.00	288.00	37.89	18.09
5	5.00	1.20	3.20	25.20	1.20	24.00	288.00	37.89	18.09
6	5.00	1.20	3.20	25.20	1.20	24.00	288.00	37.89	18.09
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									
21									
22									
23									
24									
25									

INFILTRATION RATE BY THE BOREHOLE PERCOLATION TEST METHOD

This workbook calculates an adjusted infiltration rate from a borehole percolation test. The percolation rate is adjusted for sidewall area according to the Porchet method, and then re-adjusted for the effect of the gravel placed in annulus between the borehole wall and a pipe placed in the borehole by a method presented in Caltrans Test 750.

Project Name	Camp Hess Kramer Camp Rebuilds
Project Number	301529-003
Test Hole No.	IT-12
Tester	A. Luna
Pre-Soak Date	February 23, 2021
Test Date	February 24, 2021

Test Hole Radius, r (inches)	4
Total Depth of Test Hole, D_T (feet)	14.1
Inside Diameter of Pipe, I (inches)	3.00
Outside Diameter of Pipe, O (inches)	3.38
Pipe Stick-Up (feet)	0.0
Porosity of Gravel, n	0.41
Porosity Correction Factor, C	0.48
Factor of Safety (FOS), F	N/A

Interval No.	Delta Time, Δt (min.)	Initial Depth to Water from TOP, D_o (ft.)	Final Depth to Water from TOP, D_f (ft.)	Initial Water Height, H_o (in.)	Final Water Height, H_f (in.)	Change in Water Height, ΔH (in.)	Perc Rate, (in/hr)	Infiltration Rate (in./hr.)	Corrected Infiltration Rate (in/hr)
1	30.00	12.10	12.50	24.00	19.20	4.80	9.60	0.81	0.39
2	30.00	12.07	12.46	24.36	19.68	4.68	9.36	0.78	0.37
3	30.00	12.10	12.49	24.00	19.32	4.68	9.36	0.79	0.38
4	30.00	12.10	12.49	24.00	19.32	4.68	9.36	0.79	0.38
5	30.00	12.10	12.47	24.00	19.56	4.44	8.88	0.75	0.36
6	30.00	12.10	12.48	24.00	19.44	4.56	9.12	0.77	0.37
7	30.00	12.10	12.47	24.00	19.56	4.44	8.88	0.75	0.36
8	30.00	12.10	12.47	24.00	19.56	4.44	8.88	0.75	0.36
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									
21									
22									
23									
24									
25									

INFILTRATION RATE BY THE BOREHOLE PERCOLATION TEST METHOD

This workbook calculates an adjusted infiltration rate from a borehole percolation test. The percolation rate is adjusted for sidewall area according to the Porchet method, and then re-adjusted for the effect of the gravel placed in annulus between the borehole wall and a pipe placed in the borehole by a method presented in Caltrans Test 750.

Project Name	Camp Hess Kramer Camp Rebuilds
Project Number	301529-003
Test Hole No.	IT-13
Tester	A. Luna
Pre-Soak Date	February 23, 2021
Test Date	February 24, 2021

Test Hole Radius, r (inches)	4
Total Depth of Test Hole, D_T (feet)	3.4
Inside Diameter of Pipe, I (inches)	3.00
Outside Diameter of Pipe, O (inches)	3.38
Pipe Stick-Up (feet)	0.2
Porosity of Gravel, n	0.41
Porosity Correction Factor, C	0.48
Factor of Safety (FOS), F	N/A

Interval No.	Delta Time, Δt (min.)	Initial Depth to Water from TOP, D_o (ft.)	Final Depth to Water from TOP, D_f (ft.)	Initial Water Height, H_o (in.)	Final Water Height, H_f (in.)	Change in Water Height, ΔH (in.)	Perc Rate, (in/hr)	Infiltration Rate (in./hr.)	Corrected Infiltration Rate (in/hr)
1	10.00	1.40	1.86	26.40	20.88	5.52	33.12	2.58	1.23
2	10.00	1.40	1.85	26.40	21.00	5.40	32.40	2.52	1.20
3	10.00	1.40	1.84	26.40	21.12	5.28	31.68	2.46	1.17
4	10.00	1.40	1.83	26.40	21.24	5.16	30.96	2.40	1.14
5	10.00	1.40	1.82	26.40	21.36	5.04	30.24	2.34	1.12
6	10.00	1.40	1.83	26.40	21.24	5.16	30.96	2.40	1.14
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									
21									
22									
23									
24									
25									

INFILTRATION RATE BY THE BOREHOLE PERCOLATION TEST METHOD

This workbook calculates an adjusted infiltration rate from a borehole percolation test. The percolation rate is adjusted for sidewall area according to the Porchet method, and then re-adjusted for the effect of the gravel placed in annulus between the borehole wall and a pipe placed in the borehole by a method presented in Caltrans Test 750.

Project Name	Camp Hess Kramer Camp Rebuilds
Project Number	301529-003
Test Hole No.	IT-14
Tester	A. Luna
Pre-Soak Date	February 23, 2021
Test Date	February 24, 2021

Test Hole Radius, r (inches)	4
Total Depth of Test Hole, D_T (feet)	14.6
Inside Diameter of Pipe, I (inches)	3.00
Outside Diameter of Pipe, O (inches)	3.38
Pipe Stick-Up (feet)	0.4
Porosity of Gravel, n	0.41
Porosity Correction Factor, C	0.48
Factor of Safety (FOS), F	N/A

Interval No.	Delta Time, Δt (min.)	Initial Depth to Water from TOP, D_o (ft.)	Final Depth to Water from TOP, D_f (ft.)	Initial Water Height, H_o (in.)	Final Water Height, H_f (in.)	Change in Water Height, ΔH (in.)	Perc Rate, (in/hr)	Infiltration Rate (in./hr.)	Corrected Infiltration Rate (in/hr)
1	10.00	12.60	13.56	28.80	17.28	11.52	69.12	5.52	2.64
2	10.00	12.60	13.49	28.80	18.12	10.68	64.08	5.03	2.40
3	10.00	12.60	13.46	28.80	18.48	10.32	61.92	4.83	2.31
4	10.00	12.60	13.43	28.80	18.84	9.96	59.76	4.63	2.21
5	10.00	12.60	13.41	28.80	19.08	9.72	58.32	4.50	2.15
6	10.00	12.60	13.41	28.80	19.08	9.72	58.32	4.50	2.15
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									
21									
22									
23									
24									
25									

Appendix E – HYDRAULIC CALCULATIONS

64B

65B

66B

67B

68B

	Tributary Area		Hydrology Designation	Q_{100}	$Q_{100\ Bulked}$	Hydrology Area	Q/ac	Q_{design}
Area Name	Square Feet	Acres		cfs	cfs	ac	cfs/ac	cfs
A1	6,045,651	138.8	68B	435	543.8	163.2	3.33	462.4
A2	297,431	6.8	68B	435	543.8	163.2	3.33	22.7
B1	583,551	13.4	67B	565	706.3	275.2	2.57	34.4
C1	142,367	3.3	67B	565	706.3	275.2	2.57	8.4
D1	277,158	6.4	67B	565	706.3	275.2	2.57	16.3
E1	1,633,447	37.5	66B	390	487.5	103.7	4.70	136.3
			67B	565	706.3	275.2	2.57	
F1	28,732	0.7	67B	565	706.3	275.2	2.57	1.7
F2	54,527	1.3	67B	565	706.3	275.2	2.57	3.2
F3	277,158	6.4	67B	565	706.3	275.2	2.57	16.3
G1	5,630	0.1	67B	565	706.3	275.2	2.57	0.3
G2	25,444	0.6	67B	565	706.3	275.2	2.57	1.5
G3	3,441,401	79.0	67B	565	706.3	275.2	2.57	202.7
G3-A				565	706.3	71.5	2.57	183.5
G4	1,715,431	39.4	67B	565	706.3	275.2	2.57	101.1
G4-A				565	706.3	22.6	2.57	58.0
G5	1,096,812	25.2	67B	565	706.3	275.2	2.57	64.6
H1	1,039,410	23.9	67B	565	706.3	275.2	2.57	86.7
			66B	390	487.5	103.7	4.70	

CULVERT G4-A

CULVERT G3-A

G5

H1

G4

G3

G2

G1

F3

F2

F1

E1

C1

B1

A1

A2

OUTLET H

OUTLET G

OUTLET F

OUTLET D

OUTLET E

OUTLET C

OUTLET B

OUTLET A

WMS Subwatershed Boundaries

Storm Drain Subwatershed Boundaries

WMS Subwatershed Designation

BMP LEGEND

- INF-1 INFILTRATION BASIN
- INF-2 INFILTRATION TRENCH
- INF-3 BIORETENTION
- INF-5 PERMEABLE PAVEMENT
- BIO-1 BIORETENTION WITH UNDERDRAIN
- BIO-2 PLANTER BOX
- BIO-3 VEGETATED SWALE
- BIO-4 VEGETATED FILTER STRIP

STORM DRAIN A

EXISTING BUILDING TO REMAIN. NO TREATMENT NEEDED.

TREATMENT 9: BIO-4
VEGETATED FILTER STRIP
AREA: 7,925 SF

TREATMENT 8: INF-3
BIORETENTION
AREA: 173 SF

TREATMENT 7: INF-1
INFILTRATION BASIN
AREA: 1010 SF

TREATMENT 6: INF-3
BIORETENTION
AREA: 225 SF

TREATMENT 5: BIO-2
PLANTER BOX
AREA: 115 SF

TREATMENT 4: INF-3
BIORETENTION
AREA: 277 SF

TREATMENT 3: INF-3
BIORETENTION
AREA: 697 SF

DISCHARGE TO CREEK

FF=60.00 FF=50.20 FF=50.00 FF=53.00

SEE SHEET 3 FOR CONTINUATION

SEE SHEET 1 FOR CONTINUATION

SCALE: 1"=20'
0 20 40 60

NO.	DATE	REVISION BLOCK	APPD.

PREPARED FOR: CAMP HESS KRAMER & GINDLING HILLTOP CAMP — WILSHIRE BOULEVARD TEMPLE CAMPS

PREPARED BY: Stantec
111 East Victoria Street, Santa Barbara, CA 93101
Phone: (805) 963-9532
PETE SILVA 70,435 9/30/2022
PROJECT ENGINEER R.C.E. DATE

REGISTERED PROFESSIONAL ENGINEER PETER A. SILVA NO 70435 CIVIL STATE OF CALIFORNIA

WATER QUALITY TREATMENT PLAN
CAMP HESS KRAMER/GINDLING HILLTOP CAMP
WOOLSEY FIRE REBUILD
11495 & 11677 PACIFIC COAST HWY
VENTURA COUNTY, CA

PRELIMINARY

STANTEC PROJECT NO. 2042586200
SHEET 2 OF 10
PLAN DATE 5/01/2021

COPYRIGHT RESERVED: THE CONTRACTOR SHALL VERIFY AND BE RESPONSIBLE FOR ALL DIMENSIONS. DO NOT SCALE THE DRAWING — ANY ERRORS OR OMISSIONS SHALL BE REPORTED TO STANTEC WITHOUT DELAY. THE COPYRIGHTS TO ALL DESIGNS AND DRAWINGS ARE THE PROPERTY OF STANTEC. REPRODUCTION OR USE FOR ANY PURPOSE OTHER THAN THAT AUTHORIZED BY STANTEC IS FORBIDDEN.

DESIGN PAS CHECKED HI
42-ENG SAVE DATE: 4/23/2021 8:22:55 AM PLOT BY:DuBoy, Kirby PLOT DATE:4/26/2021 10:18:11 AM

DRAWING:V:\2042\active\2042586200\drawing\exhibit_files\2042586200_water_treatment_plan.dwg

BMP LEGEND

- INF-1 INFILTRATION BASIN
- INF-2 INFILTRATION TRENCH
- INF-3 BIORETENTION
- INF-5 PERMEABLE PAVEMENT
- BIO-1 BIORETENTION WITH UNDERDRAIN
- BIO-2 PLANTER BOX
- BIO-3 VEGETATED SWALE
- BIO-4 VEGETATED FILTER STRIP

SEE SHEET 5 FOR CONTINUATION

SEE SHEET 3 FOR CONTINUATION

STORM DRAIN B

DISCHARGE TO CREEK

YERBA BUENA ROAD

LITTLE SYCAMORE CREEK

TREATMENT 20: INF-3 BIORETENTION AREA: 115 SF

TREATMENT 16: BIO-2 PLANTER BOX AREA: 394 SF

TREATMENT 19: INF-1 BIORETENTION; SIZED FOR HALF ROOF AREA AREA: 77 SF

TREATMENT 17: INF-5 PERMEABLE PAVEMENT AREA: 391 SF

TREATMENT 18: INF-1 BIORETENTION; SIZED FOR HALF ROOF AREA AREA: 77 SF

THIS HALF OF ROOF WILL DRAIN TO THE PERMEABLE PAVEMENT AREA.

HALF ROOF TO DRAIN TO INF-1 INFILTRATION BASIN TO THE SOUTH

FF=109.60

FF=109.30

FF=109.20

FF=108.90

FF=88.30

FF=95.80

ALFRED WOLF AMPHITHEATER

SCALE: 1"=20'

0 20 40 60

NO.	DATE	REVISION BLOCK	APPD.

PREPARED FOR: WILSHIRE BOULEVARD TEMPLE CAMPS

PREPARED BY:
Stantec
111 East Victoria Street, Santa Barbara, CA 93101
Phone: (805) 963-9532
PETE SILVA 70,435 9/30/2022
PROJECT ENGINEER R.C.E. DATE

REGISTERED PROFESSIONAL ENGINEER PETER A. SILVA NO 70435 CIVIL STATE OF CALIFORNIA

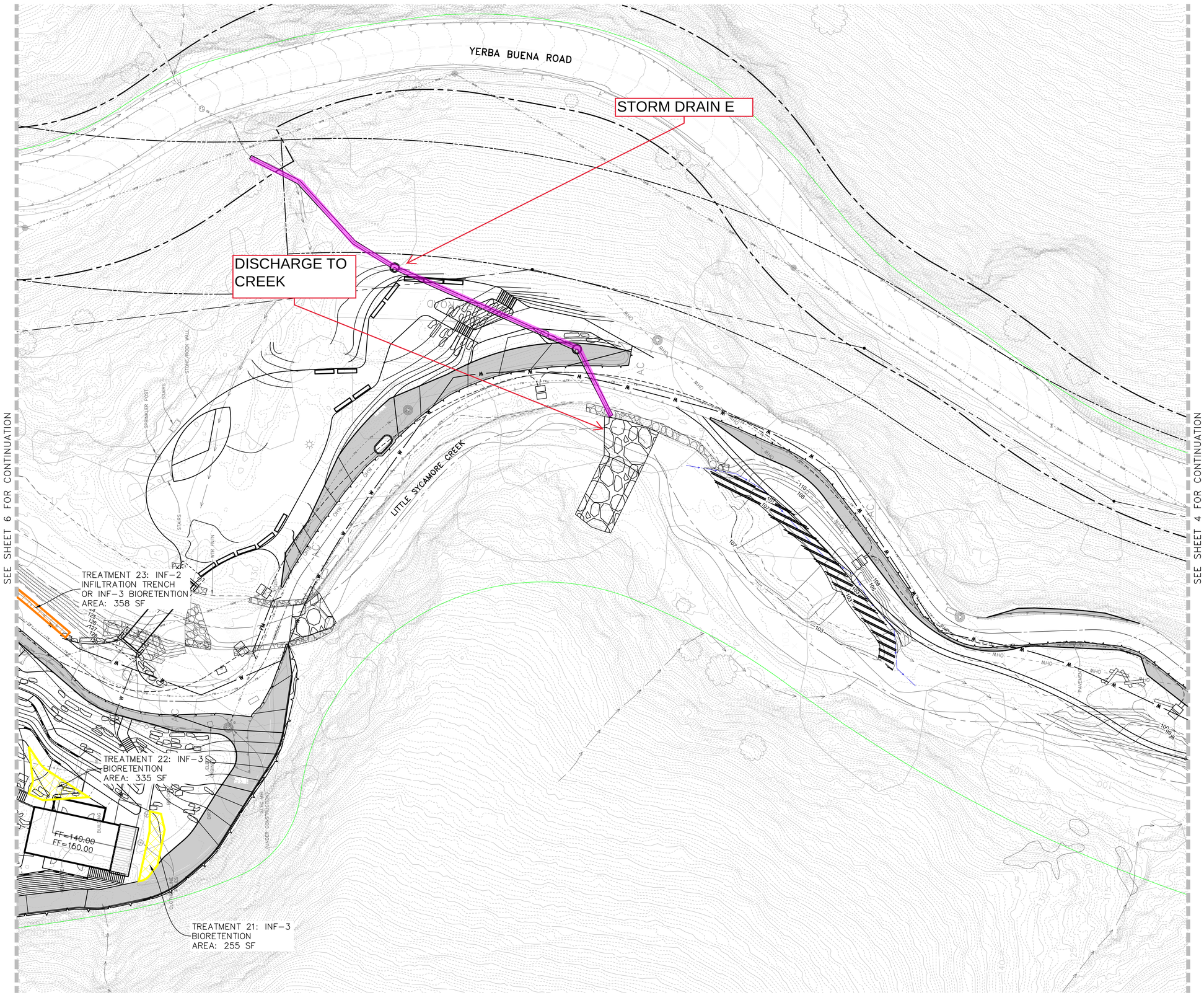
WATER QUALITY TREATMENT PLAN
CAMP HESS KRAMER/GINDLING HILLTOP CAMP WOOLSEY FIRE REBUILD
11495 & 11677 PACIFIC COAST HWY
VENTURA COUNTY, CA

PRELIMINARY

STANTEC PROJECT NO. 2042586200
SHEET 4 OF 10
PLAN DATE 5/01/2021

DESIGN PAS CHECKED HI
42-ENG SAVE DATE: 4/23/2021 8:22:55 AM PLOT BY: DuBay, Kirby PLOT DATE: 4/26/2021 10:19:25 AM
DRAWING: v:\2042\active\2042586200\drawing\exhibit_files\2042586200_water_treatment_plan.dwg

COPYRIGHT RESERVED: THE CONTRACTOR SHALL VERIFY AND BE RESPONSIBLE FOR ALL DIMENSIONS. DO NOT SCALE THE DRAWING – ANY ERRORS OR OMISSIONS SHALL BE REPORTED TO STANTEC WITHOUT DELAY. THE COPYRIGHTS TO ALL DESIGNS AND DRAWINGS ARE THE PROPERTY OF STANTEC. REPRODUCTION OR USE FOR ANY PURPOSE OTHER THAN THAT AUTHORIZED BY STANTEC IS FORBIDDEN.



BMP LEGEND

- INF-1 INFILTRATION BASIN
- INF-2 INFILTRATION TRENCH
- INF-3 BIORETENTION
- INF-5 PERMEABLE PAVEMENT
- BIO-1 BIORETENTION WITH UNDERDRAIN
- BIO-2 PLANTER BOX
- BIO-3 VEGETATED SWALE
- BIO-4 VEGETATED FILTER STRIP

SCALE: 1"=20'
0 20 40 60

NO.	DATE	REVISION BLOCK	APPD.

PREPARED FOR:
CAMP HESS KRAMER GINDLING HILLTOP CAMP
WILSHIRE BOULEVARD
TEMPLE CAMPS

PREPARED BY:
Stantec
111 East Victoria Street, Santa Barbara, CA 93101
Phone: (805) 963-9532

PETE SILVA — 70,435 — 9/30/2022
PROJECT ENGINEER — R.C.E. — DATE

REGISTERED PROFESSIONAL ENGINEER
PETER A. SILVA
NO 70435
CIVIL
STATE OF CALIFORNIA

WATER QUALITY TREATMENT PLAN
CAMP HESS KRAMER/GINDLING HILLTOP CAMP WOOLSEY FIRE REBUILD
11495 & 11677 PACIFIC COAST HWY
VENTURA COUNTY, CA

PRELIMINARY

STANTEC PROJECT NO. 2042586200
SHEET 5 OF 10
PLAN DATE 5/01/2021

DESIGN PAS CHECKED HI
42-ENG SAVE DATE: 4/23/2021 8:22:55 AM PLOT BY: DuBoy, Kirby PLOT DATE: 4/26/2021 10:20:01 AM
DRAWING: v:\2042\active\2042586200\drawing\exhibit_files\2042586200_water_treatment_plan.dwg

COPYRIGHT RESERVED: THE CONTRACTOR SHALL VERIFY AND BE RESPONSIBLE FOR ALL DIMENSIONS. DO NOT SCALE THE DRAWING – ANY ERRORS OR OMISSIONS SHALL BE REPORTED TO STANTEC WITHOUT DELAY. THE COPYRIGHTS TO ALL DESIGNS AND DRAWINGS ARE THE PROPERTY OF STANTEC. REPRODUCTION OR USE FOR ANY PURPOSE OTHER THAN THAT AUTHORIZED BY STANTEC IS FORBIDDEN.

DISCHARGE TO CREEK

YERBA BUENA ROAD

TREATMENT 33: INF-2 INFILTRATION TRENCH 12" WIDE TO TREAT ROAD. AREA: 446 SF

TREATMENT 32: BIO-3 VEGETATED SWALE TREATS CLUSTER OF 4 BUILDINGS. AREA: 1,035 SF

TREATMENT 31: INF-3 BIORETENTION TREATS ENTIRE BUILDING. AREA: 84 SF

TREATMENT 30: INF-3 BIORETENTION TO TREAT NORTH HALF OF BUILDING. AREA: 79 SF

TREATMENT 29: BIO-2 PLANTER BOX; TO TREAT SOUTH HALF OF BUILDING. AREA: 20 SF

TREATMENT 28: INF-3 BIORETENTION TREATS CLUSTER OF 4 BUILDINGS. AREA: 210 SF

TREATMENT 27: INF-2 INFILTRATION TRENCH OR INF-3 BIORETENTION AREA: 406 SF

TREATMENT 26: INF-2 INFILTRATION TRENCH OR INF-3 BIORETENTION AREA: 244 SF

TREATMENT 25: INF-3 BIORETENTION AREA: 179 SF

TREATMENT 24: INF-3 BIORETENTION AREA: 168 SF

TREATMENT 23: INF-2 INFILTRATION TRENCH OR INF-3 BIORETENTION AREA: 358 SF

TREATMENT 22: INF-3 BIORETENTION AREA: 335 SF

TREATMENT 21: INF-3 BIORETENTION AREA: 255 SF

OVERLAND ESCAPE TO CREEK

FF=151.50 FF=154.00 FF=150.50 FF=172.00 FF=175.00 FF=170.00 FF=150.50 FF=160.50 FF=149.00 FF=159.00 FF=159.00 FF=158.50 FF=157.00 FF=145.00 FF=157.00 FF=144.00 FF=156.00 FF=140.00 FF=160.00

SEE SHEET 7 FOR CONTINUATION

SEE SHEET 5 FOR CONTINUATION

BMP LEGEND

- INF-1 INFILTRATION BASIN
- INF-2 INFILTRATION TRENCH
- INF-3 BIORETENTION
- INF-5 PERMEABLE PAVEMENT
- BIO-1 BIORETENTION WITH UNDERDRAIN
- BIO-2 PLANTER BOX
- BIO-3 VEGETATED SWALE
- BIO-4 VEGETATED FILTER STRIP

SCALE: 1"=20'
0 20 40 60

NO.	DATE	REVISION BLOCK	APPD.

PREPARED FOR: CAMP HESS KRAMER & GINDLING HILLTOP CAMP — WILSHIRE BOULEVARD TEMPLE CAMPS

PREPARED BY: Stantec
111 East Victoria Street, Santa Barbara, CA 93101
Phone: (805) 963-9532
PETE SILVA — PROJECT ENGINEER — 70,435 R.C.E. — 9/30/2022 DATE
REGISTERED PROFESSIONAL ENGINEER — PETER A. SILVA — NO 70435 — CIVIL — STATE OF CALIFORNIA

WATER QUALITY TREATMENT PLAN
CAMP HESS KRAMER/GINDLING HILLTOP CAMP WOOLSEY FIRE REBUILD
11495 & 11677 PACIFIC COAST HWY
VENTURA COUNTY, CA

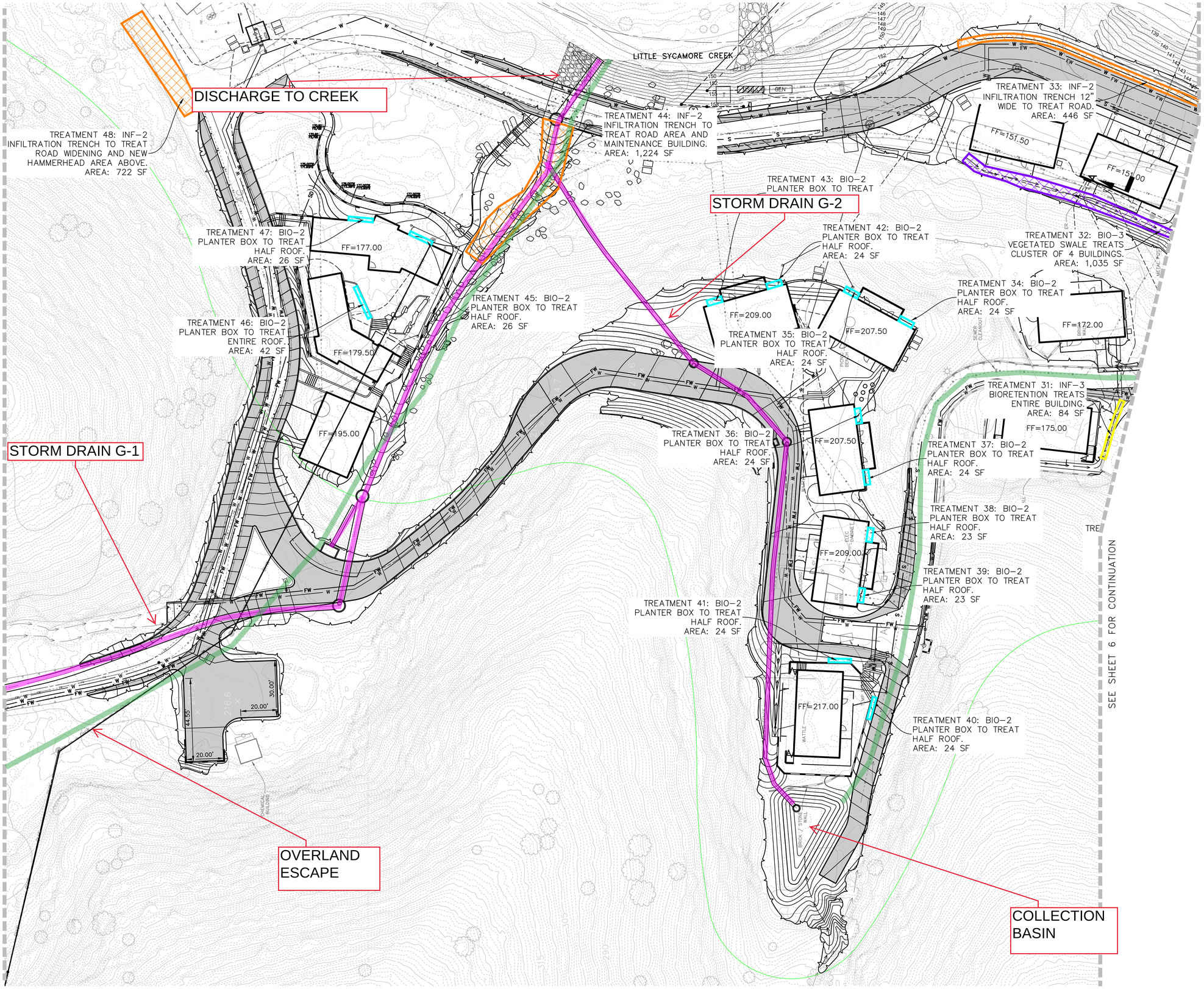
PRELIMINARY

STANTEC PROJECT NO. 2042586200
SHEET 6 OF 10
PLAN DATE 5/01/2021

DESIGN PAS CHECKED HI
42-ENG SAVE DATE: 4/23/2021 8:22:55 AM PLOT BY: DuBray, Kirby PLOT DATE: 4/26/2021 10:20:41 AM

DRAWING: v:\2042\active\2042586200\drawing\exhibit_files\2042586200_water_treatment_plan.dwg

COPYRIGHT RESERVED: THE CONTRACTOR SHALL VERIFY AND BE RESPONSIBLE FOR ALL DIMENSIONS. DO NOT SCALE THE DRAWING – ANY ERRORS OR OMISSIONS SHALL BE REPORTED TO STANTEC WITHOUT DELAY. THE COPYRIGHTS TO ALL DESIGNS AND DRAWINGS ARE THE PROPERTY OF STANTEC. REPRODUCTION OR USE FOR ANY PURPOSE OTHER THAN THAT AUTHORIZED BY STANTEC IS FORBIDDEN.



BMP LEGEND

- INF-1 INFILTRATION BASIN
- INF-2 INFILTRATION TRENCH
- INF-3 BIORETENTION
- INF-5 PERMEABLE PAVEMENT
- BIO-1 BIORETENTION WITH UNDERDRAIN
- BIO-2 PLANTER BOX
- BIO-3 VEGETATED SWALE
- BIO-4 VEGETATED FILTER STRIP

SCALE: 1"=20'
0 20 40 60

NO.	DATE	REVISION BLOCK	APPD.

PREPARED FOR:
CAMP HESS KRAMER GINDLING HILLTOP CAMP
WILSHIRE BOULEVARD
TEMPLE CAMPS

PREPARED BY:
Stantec
111 East Victoria Street, Santa Barbara, CA 93101
Phone: (805) 963-9532
PETE SILVA 70,435 9/30/2022
PROJECT ENGINEER R.C.E. DATE

REGISTERED PROFESSIONAL ENGINEER
PETER A. SILVA
NO 70435
CIVIL
STATE OF CALIFORNIA

WATER QUALITY TREATMENT PLAN
CAMP HESS KRAMER/GINDLING HILLTOP CAMP WOOLSEY FIRE REBUILD
11495 & 11677 PACIFIC COAST HWY
VENTURA COUNTY, CA

PRELIMINARY

STANTEC PROJECT NO. 2042586200
SHEET 7 OF 10
PLAN DATE 5/01/2021

DESIGN PAS CHECKED HI
42-ENG SAVE DATE: 4/23/2021 8:22:55 AM PLOT BY: DuBoy, Kirby PLOT DATE: 4/26/2021 10:21:19 AM

COPYRIGHT RESERVED: THE CONTRACTOR SHALL VERIFY AND BE RESPONSIBLE FOR ALL DIMENSIONS. DO NOT SCALE THE DRAWING – ANY ERRORS OR OMISSIONS SHALL BE REPORTED TO STANTEC WITHOUT DELAY. THE COPYRIGHTS TO ALL DESIGNS AND DRAWINGS ARE THE PROPERTY OF STANTEC. REPRODUCTION OR USE FOR ANY PURPOSE OTHER THAN THAT AUTHORIZED BY STANTEC IS FORBIDDEN.

DRAWING: v:\2042\active\2042586200\drawing\exhibit_files\2042586200_water_treatment_plan.dwg

STORM DRAIN G-1

COLLECTION BASIN

OVERLAND SCAPE

YERBA BUENA ROAD

CAMP 4 FIRE ROAD

TREATMENT 47: BIO-2 PLANTER BOX TO TREAT HALF ROOF. AREA: 26 SF

TREATMENT 46: BIO-2 PLANTER BOX TO TREAT ENTIRE ROOF. AREA: 42 SF

TREATMENT 45: BIO-2 PLANTER BOX TO TREAT HALF ROOF. AREA: 26 SF

FF=177.00

FF=179.50

FF=195.00

20.00'

30.00'

44.55'

CHEMICAL BUILDING

HAZ MAT

ROOFING

SCALE: 1"=20'

0 20 40 60

SEE SHEET 7 FOR CONTINUATION

BMP LEGEND

- INF-1 INFILTRATION BASIN
- INF-2 INFILTRATION TRENCH
- INF-3 BIORETENTION
- INF-5 PERMEABLE PAVEMENT
- BIO-1 BIORETENTION WITH UNDERDRAIN
- BIO-2 PLANTER BOX
- BIO-3 VEGETATED SWALE
- BIO-4 VEGETATED FILTER STRIP

NO.	DATE	REVISION BLOCK	APPD.

PREPARED FOR: CAMP HESS KRAMER GINDLING HILLTOP CAMP — WILSHIRE BOULEVARD TEMPLE CAMPS

PREPARED BY: Stantec
111 East Victoria Street, Santa Barbara, CA 93101
Phone: (805) 963-9532
PETE SILVA 70,435 9/30/2022
PROJECT ENGINEER R.C.E. DATE

REGISTERED PROFESSIONAL ENGINEER PETER A. SILVA NO 70435 CIVIL STATE OF CALIFORNIA

WATER QUALITY TREATMENT PLAN
CAMP HESS KRAMER/GINDLING HILLTOP CAMP WOOLSEY FIRE REBUILD
11495 & 11677 PACIFIC COAST HWY
VENTURA COUNTY, CA

PRELIMINARY

STANTEC PROJECT NO. 2042586200
SHEET 8 OF 10
PLAN DATE 5/01/2021

COPYRIGHT RESERVED: THE CONTRACTOR SHALL VERIFY AND BE RESPONSIBLE FOR ALL DIMENSIONS. DO NOT SCALE THE DRAWING – ANY ERRORS OR OMISSIONS SHALL BE REPORTED TO STANTEC WITHOUT DELAY. THE COPYRIGHTS TO ALL DESIGNS AND DRAWINGS ARE THE PROPERTY OF STANTEC. REPRODUCTION OR USE FOR ANY PURPOSE OTHER THAN THAT AUTHORIZED BY STANTEC IS FORBIDDEN.

DESIGN PAS CHECKED HI
42-ENG SAVE DATE: 4/23/2021 8:22:55 AM PLOT BY: DuBay, Kirby PLOT DATE: 4/26/2021 10:22:01 AM
DRAWING: v:\2042\active\2042586200\drawing\exhibit_files\2042586200_water_treatment_plan.dwg

HYDROLOGY SUMMARY

Last Update: 4/28/2021

For overland escape

	Tributary Area		Hydrology Designation	Q_{100}	$Q_{100\ Bulked}$	Hydrology Area	Q/ac	Q_{design}
Area Name	**Square Feet**	**Acres**		**cfs**	**cfs**	**ac**	**cfs/ac**	**cfs**
A1	6,045,651	138.8	68B	435	543.8	163.2	3.33	462.4
A2	297,431	6.8	68B	435	543.8	163.2	3.33	22.7
B1	583,551	13.4	67B	565	706.3	275.2	2.57	34.4
C1	142,367	3.3	67B	565	706.3	275.2	2.57	8.4
D1	277,158	6.4	67B	565	706.3	275.2	2.57	16.3
E1	1,633,447	37.5	66B	390	487.5	103.7	4.70	136.3
			67B	565	706.3	275.2	2.57	
F1	28,732	0.7	67B	565	706.3	275.2	2.57	1.7
F2	54,527	1.3	67B	565	706.3	275.2	2.57	3.2
F3	277,158	6.4	67B	565	706.3	275.2	2.57	16.3
G1	5,630	0.1	67B	565	706.3	275.2	2.57	0.3
G2	25,444	0.6	67B	565	706.3	275.2	2.57	1.5
G3	3,441,401	79.0	67B	565	706.3	275.2	2.57	202.7
G3-A				565	706.3	71.5	2.57	183.5
G4	1,715,431	39.4	67B	565	706.3	275.2	2.57	101.1
G4-A				565	706.3	22.6	2.57	58.0
G5	1,096,812	25.2	67B	565	706.3	275.2	2.57	64.6
H1	1,039,410	23.9	67B	565	706.3	275.2	2.57	86.7
			66B	390	487.5	103.7	4.70	

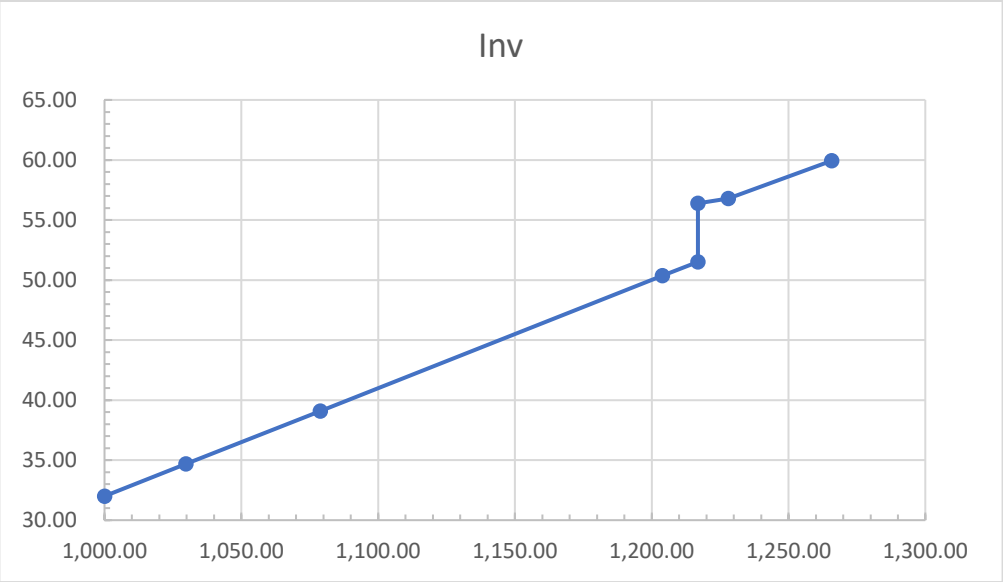
For Storm Drain Design

	Tributary Area		Hydrology Designation	Q_{50}	$Q_{50\ Bulked}$	Hydrology Area	Q/ac	Q_{design}
Area Name	**Square Feet**	**Acres**		**cfs**	**cfs**	**ac**	**cfs/ac**	**cfs**
A1	6,045,651	138.8	68B	370	370.0	163.2	2.27	314.7
A2	297,431	6.8	68B	370	370.0	163.2	2.27	15.5
B1	583,551	13.4	67B	565	475.0	275.2	1.73	23.1
C1	142,367	3.3	67B	565	475.0	275.2	1.73	5.6
D1	277,158	6.4	67B	565	475.0	275.2	1.73	11.0
E1	1,633,447	37.5	66B	390	330.0	103.7	3.18	92.0
			67B	565	475.0	275.2	1.73	
F1	28,732	0.7	67B	565	475.0	275.2	1.73	1.1
F2	54,527	1.3	67B	565	475.0	275.2	1.73	2.2
F3	277,158	6.4	67B	565	475.0	275.2	1.73	11.0
G1	5,630	0.1	67B	565	475.0	275.2	1.73	0.2
G2	25,444	0.6	67B	565	475.0	275.2	1.73	1.0
G3	3,441,401	79.0	67B	565	475.0	275.2	1.73	136.4
G3-A				565	475.0	71.5	1.73	123.4
G4	1,715,431	39.4	67B	565	475.0	275.2	1.73	68.0
G4-A				565	475.0	22.6	1.73	39.0
G5	1,096,812	25.2	67B	565	475.0	275.2	1.73	43.5
H1	1,039,410	23.9	67B	565	475.0	275.2	1.73	58.6
			66B	390	330.0	103.7	3.18	

STORM DRAIN A

Q_{design} = 330 cfs Drainage areas A1 + A2

Station	Distance	Inv			Slope
1,000.00		32.00			
1,029.73	29.73	34.68	SD		0.09
1,078.83	49.10	39.09	curve		0.09
1,203.90	125.07	50.35	SD		0.09
1,216.90	13.00	51.52	drop structure		0.09
1,216.90	-	56.40	open		#DIV/0!
1,228.06	11.16	56.80	open		0.035842
1,265.83	37.77	59.94	5'w x 7.5'h RCB		0.083135

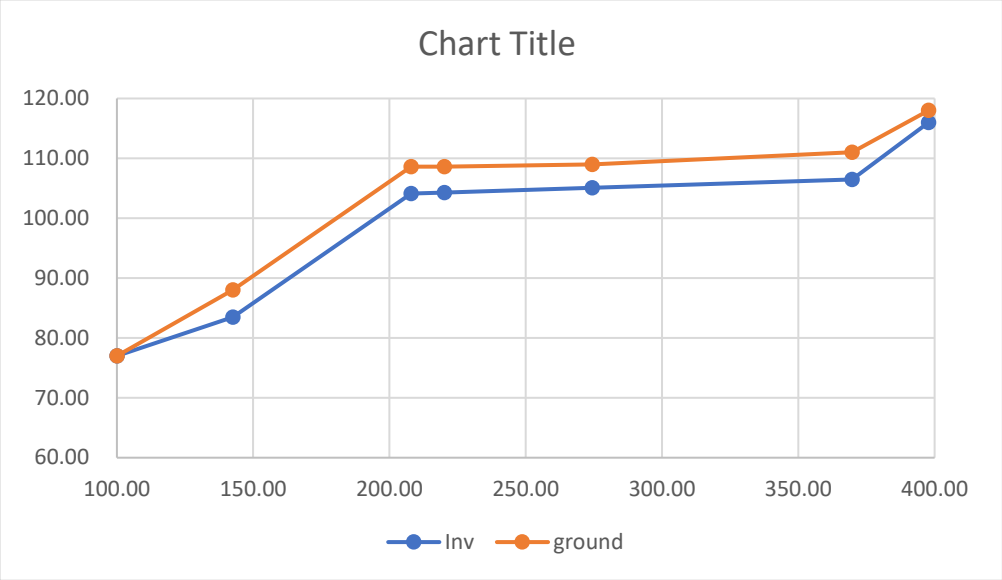


STORM DRAIN B

Q_{design} = 23 cfs Drainage area B1

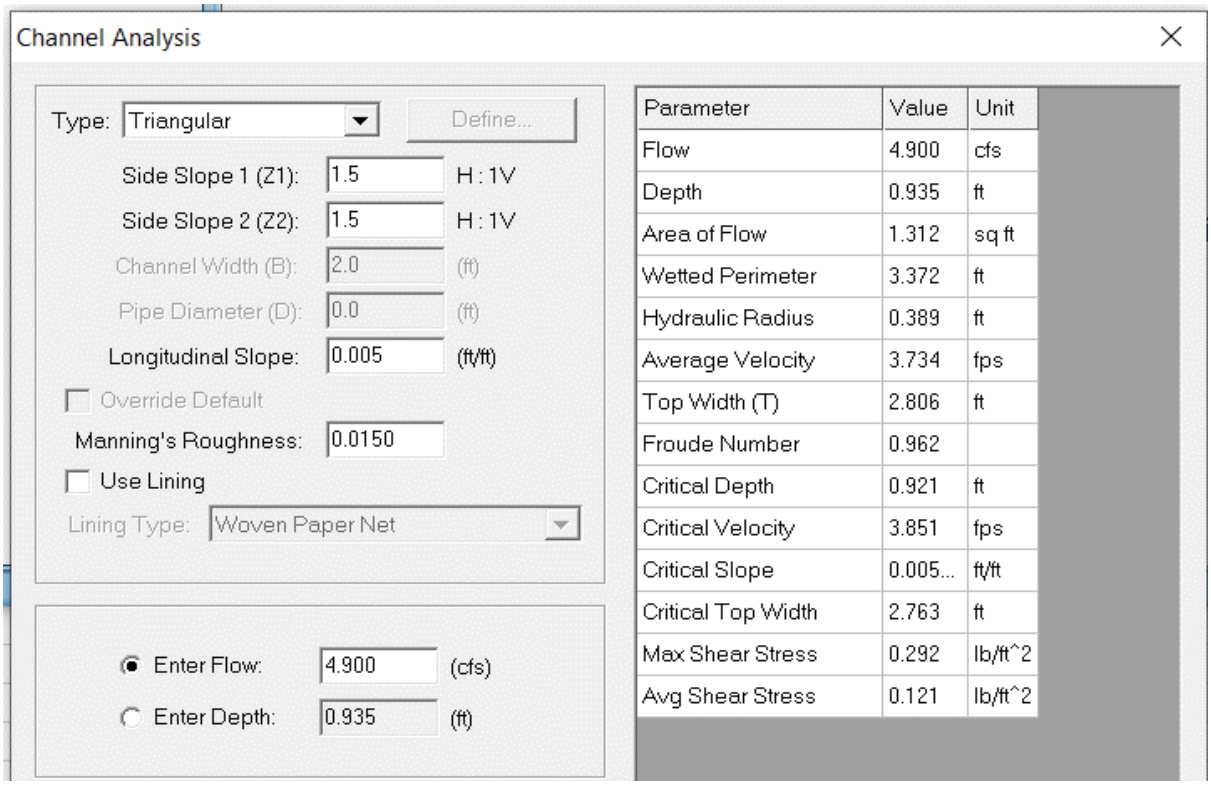
Station	Distance	Inv	ground			Slope
100.00		77.00	77.00			
142.60	42.60	83.50	88.00	mh		0.1526
208.00	65.40	104.10	108.60	angle	74.5+	0.3150
220.18	12.18	104.28	108.60	BC+		0.0148
274.43	54.25	105.09	109.00	EC		0.0148
369.73	95.30	106.50	111.00	angle	90-	0.0148
397.80	28.07	116.00	118.00	connect to 18" CMP		0.3384

24" pipe
Dc = 1.613
117.61



Drainage Facilities for Area C

Qdesign = 5.6 cfs For Drainge Area C1 + on-site



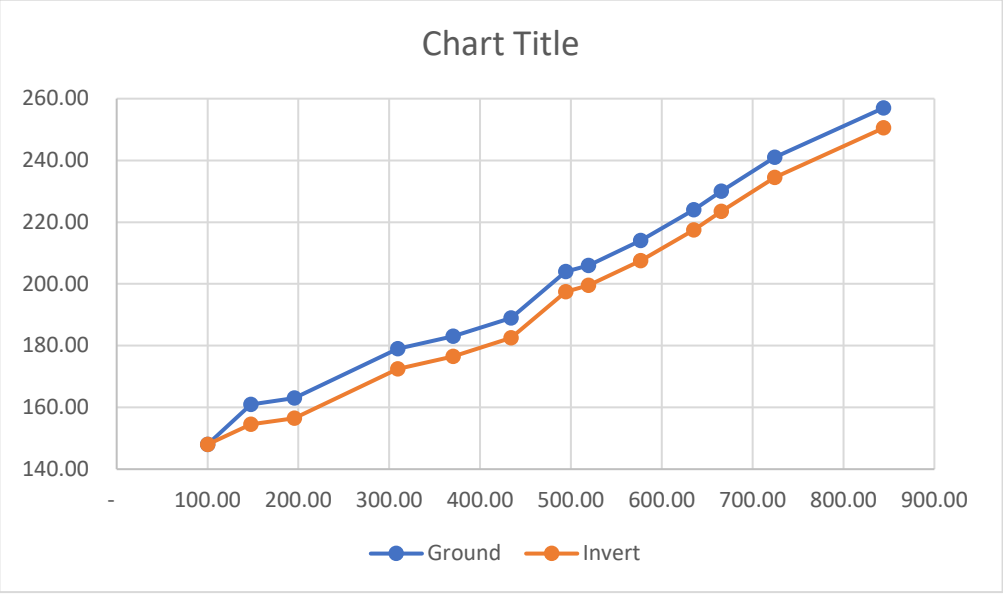
Use: Concrete V-Ditch, 1.5:1 slopes, 1.5 feet deep, Wtop = 4.5 ft

STORM DRAIN G

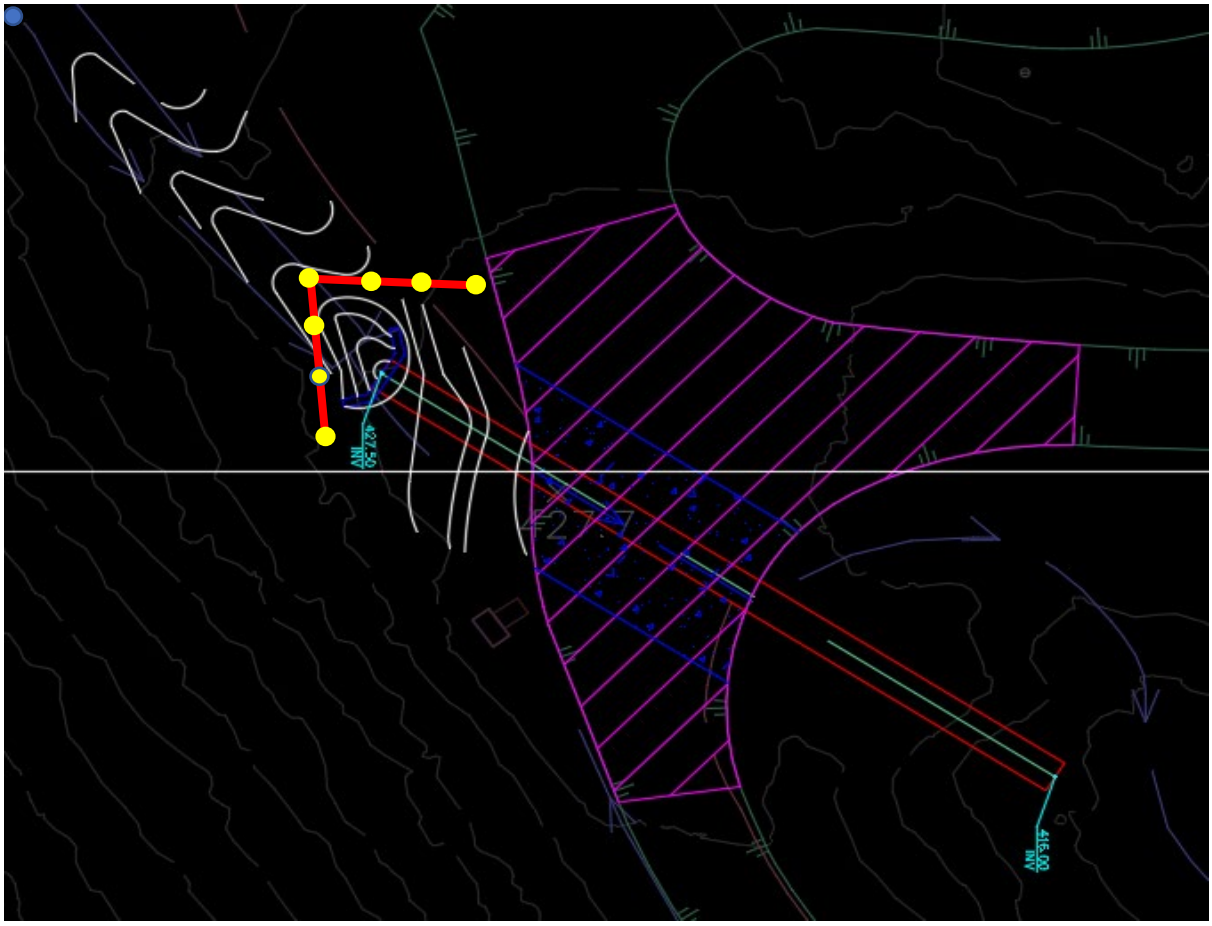
Q_{design} = 325 cfs total Covering areas G1, G2, G3, G4 and F2 + F3

Station	Distance	Ground	Invert			Slope
100.00		148.00	148.00			
147.72	47.72	161.00	154.50	Angle	66.5+	0.14
195.72	48.00	163.00	156.50	Angle	57.5-	0.04
309.33	113.61	179.00	172.50	BC-		0.14
370.48	61.15	183.00	176.50	EC		0.07
434.10	63.62	189.00	182.50	angle	9.8-	0.09
494.30	60.20	204.00	197.50	angle		0.25
519.23	24.93	206.00	199.50	BC-	74.4+	0.08
576.73	57.50	214.00	207.50	EC		0.14
635.02	58.29	224.00	217.50	BC+		0.17
665.56	30.54	230.00	223.50	EC		0.20
724.29	58.73	241.00	234.50	angle	33-	0.19
844.18	119.89	257.00	250.50	End		0.13
850.00			250.5	Basin/15'		

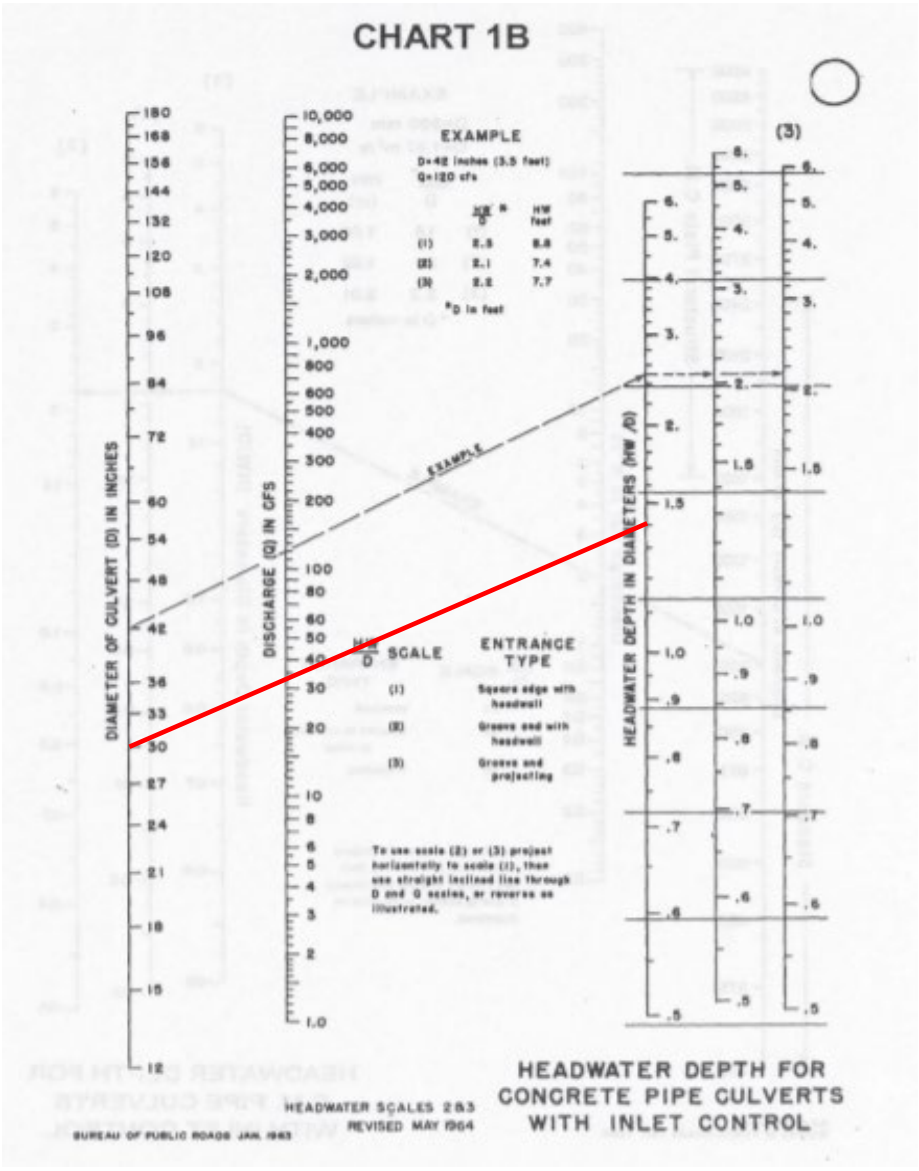
WSE = 254.393



CULVERTS G3-A



$Q_{50\ bulked}$ = 123 cfs
HW = 3.5 ft
D = 30 in
Entrance T 1
HW/D = 1.4



$Q_{capacity}$ = 33 cfs = 27% of total
$Q_{over\ road}$ = 90 cfs

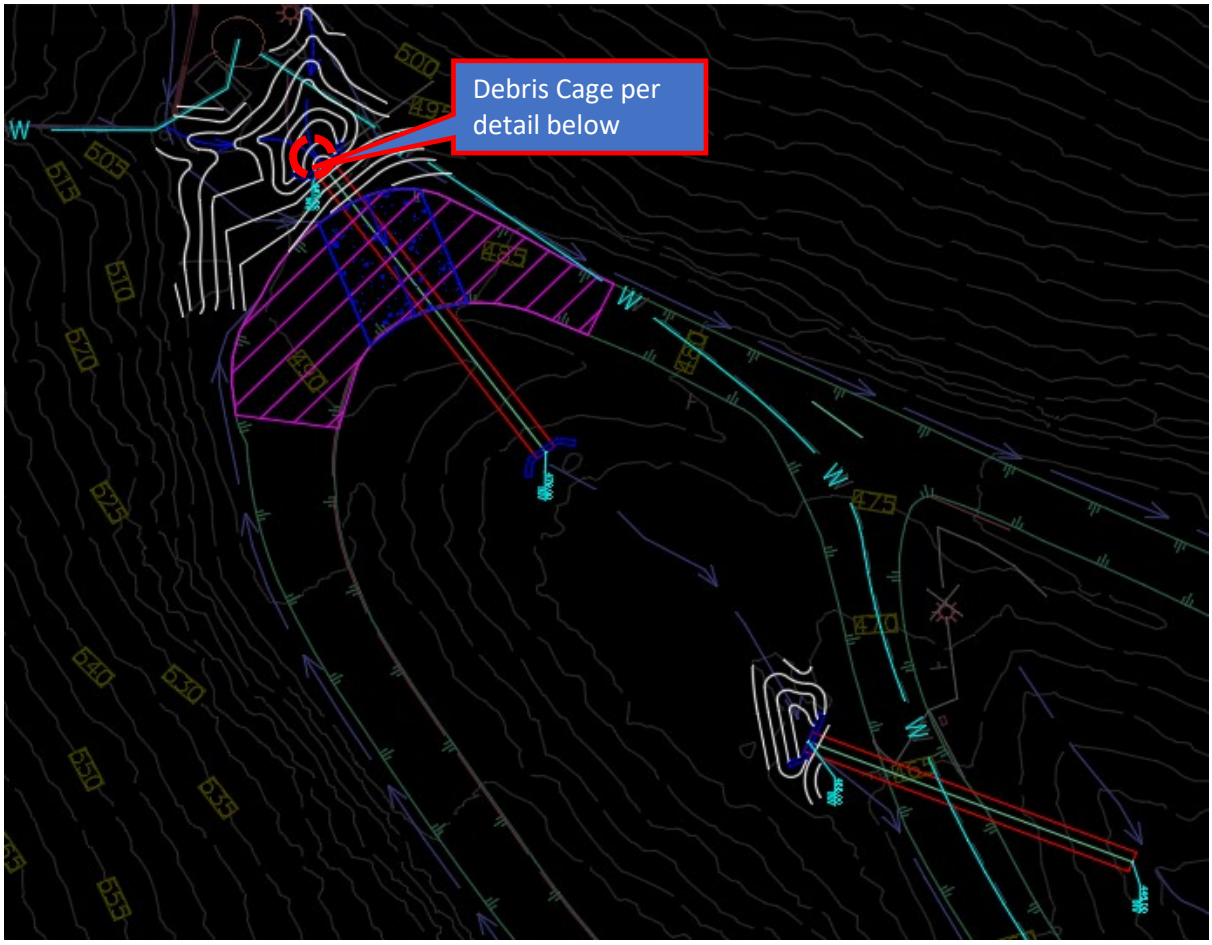
Recommended Debris Treatment for Culvert G4-A

(with a debris rack across the inlet opening)

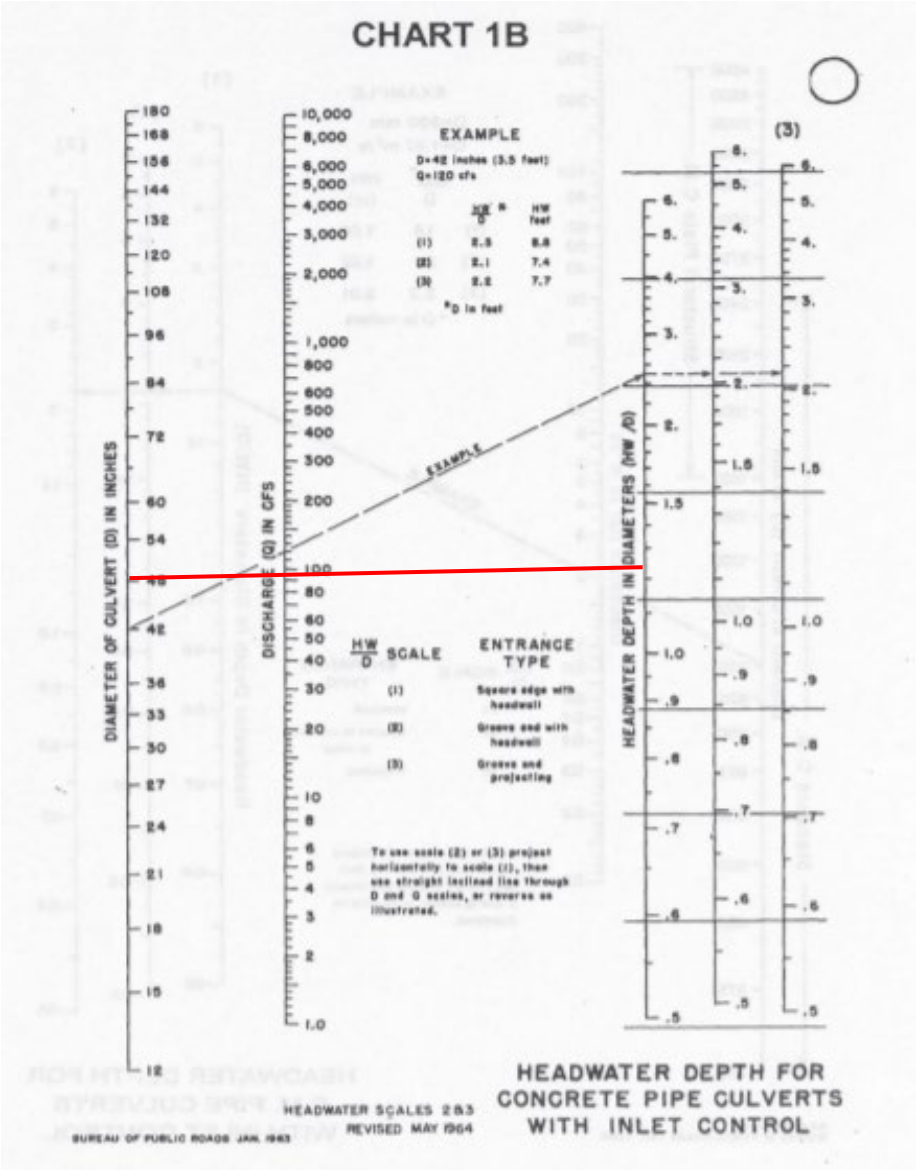


Santa Barbara County crews installed debris racks on San Antonio Creek at Tuckers Grove County Park, seen here, and one of the Maria Ygnacio Creek debris basins to catch woody debris and boulders. (Giana Magnoli / Noozhawk photo)

CULVERTS G4-A

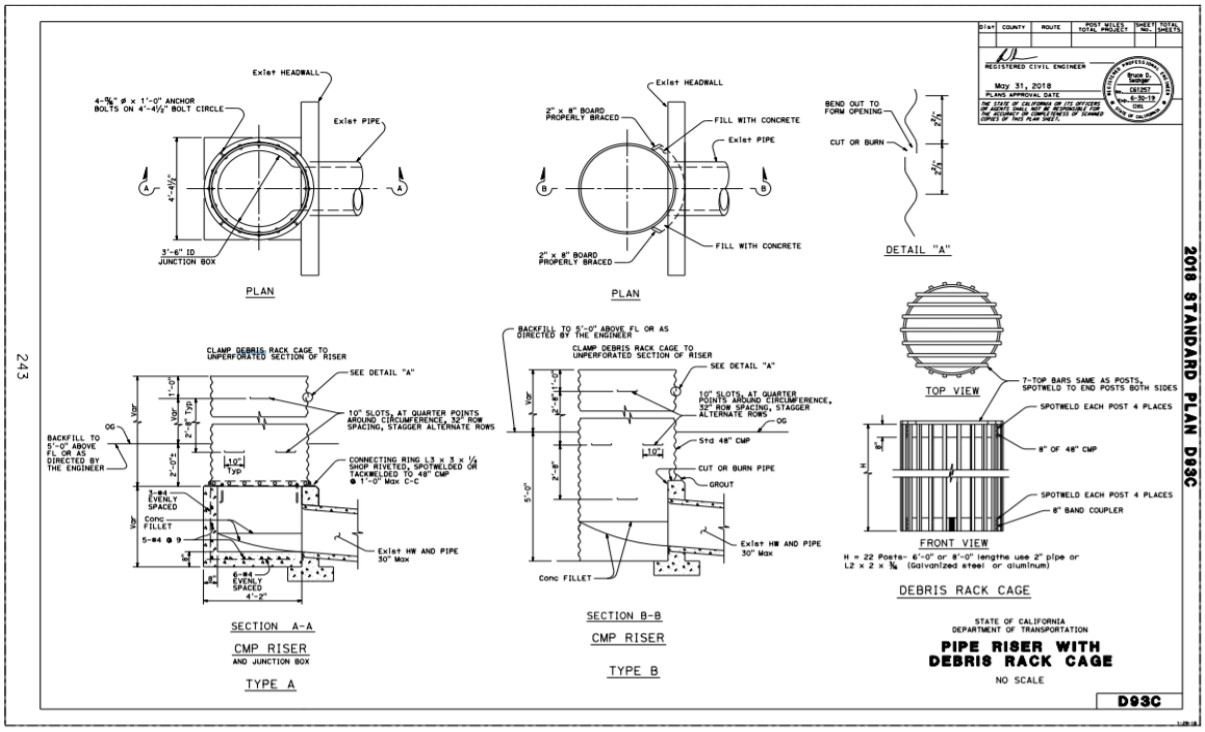


$Q_{50\ bulked}$ =	39	cfs
HW =	5	ft
D =	48	in
Entrance Type =	1	
HW/D =	1.25	



$Q_{capacity}$ =	94	cfs =	241% of total
$Q_{over\ road}$ =	-55	cfs	

Recommended Debris Treatment for Culvert G4-A



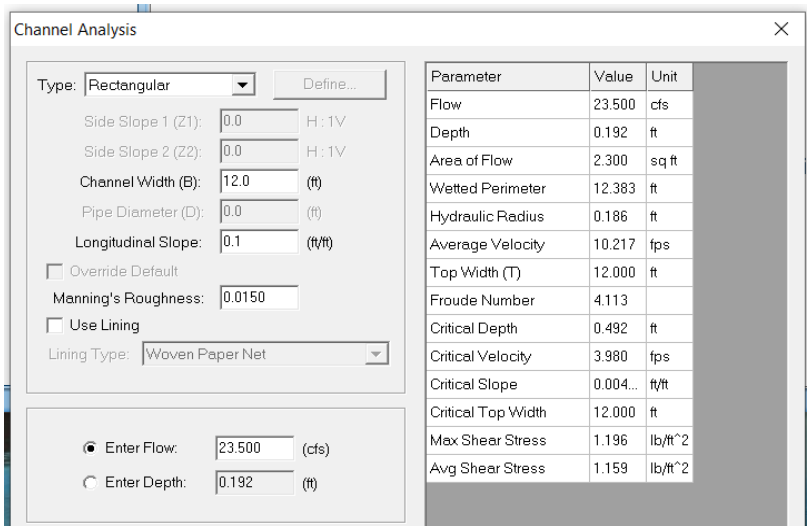
OVERLAND ESCAPE FOR SD F

Q_{100} = 20 cfs For Drainage areas F2 + F3

So = 0.10 ft/ft

W = 12 ft

Street Section: Rectangular



Note velocity and flow regime.

$V_{critical}$ = 4.00 fps

$D_{critical}$ = 0.49 ft

V_{normal} = 10.20 fps

D_{normal} = 0.20 ft

Because the overflow will likely be carrying significant debris, it should be assumed to be flowing at critical depth.

Use 8" curbs on straight sections and 12" curbs on curves.

Program Package Serial Number: 7193

WATER SURFACE PROFILE LISTING Date: 2-19-2021 Time: 2: 6:45

Line A Storm Drain - Yerba Buena

Preliminary Design for Q25 Bulked Peak Flow

Camp Hess Kramer

Station / L/Elem	Invert Elev / Ch Slope	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS) / SF Ave	Vel Head / HF	Energy Grd.El. / SE Dpth	Super Elev / Froude N	Critical Depth / Norm Dp	Flow Top Width / "N"	Height/Dia.-FT / X-Fall	Base Wt or I.D. / ZR	ZL	No Wth Prs/Pip / Type Ch
100.000	34.000	2.937	36.937	270.00	22.51	7.87	44.81	.00	4.54	4.92	5.000	.000	.00	1 .0
9.000	.0078					.0258	.23	2.94	2.54	5.00	.013	.00	.00	PIPE
109.000	34.070	2.908	36.978	270.00	22.79	8.06	45.04	.00	4.54	4.93	5.000	.000	.00	1 .0
27.420	.0079					.0276	.76	2.91	2.59	5.00	.013	.00	.00	PIPE
136.420	34.287	2.820	37.107	270.00	23.66	8.69	45.80	.00	4.54	4.96	5.000	.000	.00	1 .0
33.272	.0079					.0308	1.03	2.82	2.75	5.00	.013	.00	.00	PIPE
169.692	34.550	2.713	37.263	270.00	24.81	9.56	46.82	.00	4.54	4.98	5.000	.000	.00	1 .0
31.628	.0079					.0349	1.10	2.71	2.96	5.00	.013	.00	.00	PIPE
201.320	34.800	2.612	37.412	270.00	26.02	10.52	47.93	.00	4.54	5.00	5.000	.000	.00	1 .0
5.706	.0960					.0362	.21	2.61	3.18	1.99	.013	.00	.00	PIPE
207.026	35.348	2.650	37.998	270.00	25.55	10.14	48.14	.00	4.54	4.99	5.000	.000	.00	1 .0
13.048	.0960					.0333	.43	2.65	3.09	1.99	.013	.00	.00	PIPE
220.074	36.600	2.753	39.354	270.00	24.36	9.22	48.57	.00	4.54	4.97	5.000	.000	.00	1 .0
10.943	.0960					.0294	.32	2.75	2.88	1.99	.013	.00	.00	PIPE
231.017	37.651	2.862	40.513	270.00	23.23	8.38	48.89	.00	4.54	4.95	5.000	.000	.00	1 .0
9.234	.0960					.0260	.24	2.86	2.67	1.99	.013	.00	.00	PIPE
240.251	38.537	2.977	41.515	270.00	22.15	7.62	49.13	.00	4.54	4.91	5.000	.000	.00	1 .0
7.815	.0960					.0230	.18	2.98	2.48	1.99	.013	.00	.00	PIPE

Program Package Serial Number: 7193

WATER SURFACE PROFILE LISTING Date: 2-19-2021 Time: 2: 6:45

Line A Storm Drain - Yerba Buena

Preliminary Design for Q25 Bulked Peak Flow

Camp Hess Kramer

Station	Invert Elev	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head	Energy Grd.El.	Super Elev	Critical Depth	Flow Top Width	Height/ Dia.-FT	Base Wt or I.D.	ZL	No Wth Prs/Pip
L/Elem	Ch Slope					SF Ave	HF	SE Dpth	Froude N	Norm Dp	"N"	X-Fall	ZR	Type Ch
248.066	39.288	3.099	42.387	270.00	21.12	6.93	49.31	.00	4.54	4.85	5.000	.000	.00	1 .0
6.611	.0960					.0204	.13	3.10	2.29	1.99	.013	.00	.00	PIPE
254.677	39.922	3.229	43.151	270.00	20.14	6.30	49.45	.00	4.54	4.78	5.000	.000	.00	1 .0
5.571	.0960					.0181	.10	3.23	2.12	1.99	.013	.00	.00	PIPE
260.249	40.457	3.367	43.824	270.00	19.20	5.72	49.55	.00	4.54	4.69	5.000	.000	.00	1 .0
4.656	.0960					.0161	.07	3.37	1.95	1.99	.013	.00	.00	PIPE
264.905	40.904	3.515	44.419	270.00	18.31	5.20	49.62	.00	4.54	4.57	5.000	.000	.00	1 .0
3.832	.0960					.0144	.06	3.52	1.80	1.99	.013	.00	.00	PIPE
268.737	41.272	3.675	44.947	270.00	17.45	4.73	49.68	.00	4.54	4.41	5.000	.000	.00	1 .0
3.067	.0960					.0129	.04	3.68	1.64	1.99	.013	.00	.00	PIPE
271.804	41.566	3.850	45.417	270.00	16.64	4.30	49.72	.00	4.54	4.21	5.000	.000	.00	1 .0
2.328	.0960					.0116	.03	3.85	1.49	1.99	.013	.00	.00	PIPE
274.133	41.790	4.045	45.835	270.00	15.87	3.91	49.74	.00	4.54	3.93	5.000	.000	.00	1 .0
1.562	.0960					.0105	.02	4.04	1.34	1.99	.013	.00	.00	PIPE
275.694	41.940	4.267	46.207	270.00	15.13	3.55	49.76	.00	4.54	3.54	5.000	.000	.00	1 .0
.626	.0960					.0097	.01	4.27	1.19	1.99	.013	.00	.00	PIPE
276.320	42.000	4.537	46.537	270.00	14.42	3.23	49.77	.00	4.54	2.90	5.000	.000	.00	1 .0
WALL	ENTRANCE													

Program Package Serial Number: 7193

WATER SURFACE PROFILE LISTING Date: 2-19-2021 Time: 2: 6:45

Line A Storm Drain - Yerba Buena

Preliminary Design for Q25 Bulked Peak Flow

Camp Hess Kramer

Station	Invert Elev	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head	Energy Grd.El.	Super Elev	Critical Depth	Flow Top Width	Height/ Dia.-FT	Base Wt or I.D.	ZL	No Wth Prs/Pip
L/Elem	Ch Slope					SF Ave	HF	SE Dpth	Froude N	Norm Dp	"N"	X-Fall	ZR	Type Ch
276.320	42.000	10.449	52.449	270.00	2.87	.13	52.58	.00	3.04	9.00	10.900	9.000	.00	0 .0
5.000	.0100					.0002	.00	10.45	.16	2.19	.014	.00	.00	RECTANG
281.320	42.050	10.398	52.448	270.00	2.89	.13	52.58	.00	3.04	9.00	10.900	9.000	.00	0 .0
.002	*******					.0002	.00	10.40	.16	.09	.014	.00	.00	RECTANG
281.322	42.521	9.914	52.435	270.00	3.03	.14	52.58	.00	3.04	9.00	10.900	9.000	.00	0 .0
.002	*******					.0002	.00	9.91	.17	.09	.014	.00	.00	RECTANG
281.324	42.968	9.453	52.421	270.00	3.17	.16	52.58	.00	3.04	9.00	10.900	9.000	.00	0 .0
.002	*******					.0002	.00	9.45	.18	.09	.014	.00	.00	RECTANG
281.325	43.392	9.013	52.406	270.00	3.33	.17	52.58	.00	3.04	9.00	10.900	9.000	.00	0 .0
.002	*******					.0002	.00	9.01	.20	.09	.014	.00	.00	RECTANG
281.327	43.795	8.594	52.388	270.00	3.49	.19	52.58	.00	3.04	9.00	10.900	9.000	.00	0 .0
.001	*******					.0003	.00	8.59	.21	.09	.014	.00	.00	RECTANG
281.328	44.176	8.194	52.369	270.00	3.66	.21	52.58	.00	3.04	9.00	10.900	9.000	.00	0 .0
.001	*******					.0003	.00	8.19	.23	.09	.014	.00	.00	RECTANG
281.330	44.536	7.812	52.349	270.00	3.84	.23	52.58	.00	3.04	9.00	10.900	9.000	.00	0 .0
281.331	44.762	7.573	52.335	270.00	3.96	.24	52.58	.00	3.04	9.00	10.900	9.000	.00	0 .0
HYDRAULIC JUMP														
281.331	44.762	.871	45.633	270.00	34.44	18.42	64.06	.00	3.04	9.00	10.900	9.000	.00	0 .0
.003	*******					.1536	.00	.87	6.50	.09	.014	.00	.00	RECTANG

Program Package Serial Number: 7193

WATER SURFACE PROFILE LISTING Date: 2-19-2021 Time: 2: 6:45

Line A Storm Drain - Yerba Buena

Preliminary Design for Q25 Bulked Peak Flow

Camp Hess Kramer

Station	Invert Elev	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head	Energy Grd.El.	Super Elev	Critical Depth	Flow Top Width	Height/ Dia.-FT	Base Wt or I.D.	ZL	No Wth Prs/Pip
L/Elem	Ch Slope					SF Ave	HF	SE Dpth	Froude N	Norm Dp	"N"	X-Fall	ZR	Type Ch
281.334	45.609	.896	46.504	270.00	33.50	17.43	63.93	.00	3.04	9.00	10.900	9.000	.00	0 .0
.006	*******					.1369	.00	.90	6.24	.09	.014	.00	.00	RECTANG
281.340	47.150	.939	48.089	270.00	31.94	15.84	63.93	.00	3.04	9.00	10.900	9.000	.00	0 .0
1.973	.5005					.1221	.24	.94	5.81	.61	.014	.00	.00	RECTANG
283.313	48.137	.963	49.100	270.00	31.16	15.08	64.18	.00	3.04	9.00	10.900	9.000	.00	0 .0
3.384	.5005					.1093	.37	.96	5.60	.61	.014	.00	.00	RECTANG
286.696	49.831	1.010	50.841	270.00	29.71	13.71	64.55	.00	3.04	9.00	10.900	9.000	.00	0 .0
2.946	.5005					.0944	.28	1.01	5.21	.61	.014	.00	.00	RECTANG
289.643	51.306	1.059	52.365	270.00	28.33	12.46	64.82	.00	3.04	9.00	10.900	9.000	.00	0 .0
2.580	.5005					.0815	.21	1.06	4.85	.61	.014	.00	.00	RECTANG
292.222	52.597	1.111	53.708	270.00	27.01	11.33	65.04	.00	3.04	9.00	10.900	9.000	.00	0 .0
2.268	.5005					.0704	.16	1.11	4.52	.61	.014	.00	.00	RECTANG
294.490	53.732	1.165	54.897	270.00	25.75	10.30	65.19	.00	3.04	9.00	10.900	9.000	.00	0 .0
2.000	.5005					.0609	.12	1.16	4.20	.61	.014	.00	.00	RECTANG
296.490	54.733	1.222	55.955	270.00	24.55	9.36	65.32	.00	3.04	9.00	10.900	9.000	.00	0 .0
1.767	.5005					.0526	.09	1.22	3.91	.61	.014	.00	.00	RECTANG
298.257	55.618	1.281	56.899	270.00	23.41	8.51	65.41	.00	3.04	9.00	10.900	9.000	.00	0 .0
1.563	.5005					.0455	.07	1.28	3.64	.61	.014	.00	.00	RECTANG

Program Package Serial Number: 7193

WATER SURFACE PROFILE LISTING Date: 2-19-2021 Time: 2: 6:45

Line A Storm Drain - Yerba Buena

Preliminary Design for Q25 Bulked Peak Flow

Camp Hess Kramer

Station	Invert Elev	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head	Energy Grd.El.	Super Elev	Critical Depth	Flow Top Width	Height/ Dia.-FT	Base Wt or I.D.	ZL	No Wth Prs/Pip
L/Elem	Ch Slope					SF Ave	HF	SE Dpth	Froude N	Norm Dp	"N"	X-Fall	ZR	Type Ch
299.820	56.400	1.344	57.744	270.00	22.32	7.74	65.48	.00	3.04	9.00	10.900	9.000	.00	0 .0
TRANS STR	.0358					.0300	.34	1.34	3.39		.013	.00	.00	RECTANG
310.980	56.800	2.609	59.409	270.00	20.70	6.65	66.06	.00	4.49	5.00	7.500	5.000	.00	0 .0
3.243	.0831					.0231	.07	2.61	2.26	1.65	.013	.00	.00	BOX
314.223	57.070	2.658	59.728	270.00	20.31	6.41	66.14	.00	4.49	5.00	7.500	5.000	.00	0 .0
7.311	.0831					.0212	.15	2.66	2.20	1.65	.013	.00	.00	BOX
321.534	57.677	2.788	60.465	270.00	19.37	5.83	66.29	.00	4.49	5.00	7.500	5.000	.00	0 .0
6.107	.0831					.0187	.11	2.79	2.04	1.65	.013	.00	.00	BOX
327.641	58.185	2.924	61.109	270.00	18.47	5.30	66.41	.00	4.49	5.00	7.500	5.000	.00	0 .0
5.084	.0831					.0165	.08	2.92	1.90	1.65	.013	.00	.00	BOX
332.725	58.608	3.067	61.675	270.00	17.61	4.81	66.49	.00	4.49	5.00	7.500	5.000	.00	0 .0
4.201	.0831					.0146	.06	3.07	1.77	1.65	.013	.00	.00	BOX
336.926	58.957	3.216	62.173	270.00	16.79	4.38	66.55	.00	4.49	5.00	7.500	5.000	.00	0 .0
3.430	.0831					.0129	.04	3.22	1.65	1.65	.013	.00	.00	BOX
340.356	59.242	3.373	62.616	270.00	16.01	3.98	66.59	.00	4.49	5.00	7.500	5.000	.00	0 .0
2.748	.0831					.0114	.03	3.37	1.54	1.65	.013	.00	.00	BOX
343.104	59.471	3.538	63.009	270.00	15.26	3.62	66.63	.00	4.49	5.00	7.500	5.000	.00	0 .0
2.138	.0831					.0101	.02	3.54	1.43	1.65	.013	.00	.00	BOX

Program Package Serial Number: 7193

WATER SURFACE PROFILE LISTING Date: 2-19-2021 Time: 2: 6:45

Line A Storm Drain - Yerba Buena
Preliminary Design for Q25 Bulked Peak Flow
Camp Hess Kramer

Station	Invert Elev	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head	Energy Grd.El.	Super Elev	Critical Depth	Flow Top Width	Height/ Dia.-FT	Base Wt or I.D.	ZL	No Wth Prs/Pip
L/Elem	Ch Slope					SF Ave	HF	SE Dpth	Froude N	Norm Dp	"N"	X-Fall	ZR	Type Ch
345.242	59.648	3.711	63.359	270.00	14.55	3.29	66.65	.00	4.49	5.00	7.500	5.000	.00	0 .0
1.588	.0831					.0090	.01	3.71	1.33	1.65	.013	.00	.00	BOX
346.830	59.780	3.892	63.672	270.00	13.88	2.99	66.66	.00	4.49	5.00	7.500	5.000	.00	0 .0
1.088	.0831					.0079	.01	3.89	1.24	1.65	.013	.00	.00	BOX
347.918	59.871	4.082	63.953	270.00	13.23	2.72	66.67	.00	4.49	5.00	7.500	5.000	.00	0 .0
.629	.0831					.0070	.00	4.08	1.15	1.65	.013	.00	.00	BOX
348.547	59.923	4.281	64.204	270.00	12.61	2.47	66.67	.00	4.49	5.00	7.500	5.000	.00	0 .0
.203	.0831					.0063	.00	4.28	1.07	1.65	.013	.00	.00	BOX
348.750	59.940	4.491	64.431	270.00	12.02	2.24	66.68	.00	4.49	5.00	7.500	5.000	.00	0 .0
WALL	ENTRANCE													
348.750	59.940	7.110	67.050	270.00	4.75	.35	67.40	.00	3.28	8.00	6.600	8.000	.00	0 .0

Program Package Serial Number: 7193

WATER SURFACE PROFILE LISTING Date: 2-19-2021 Time: 2:44:41

Camp Hess Kramer
Preliminary Hydraulic Study
Storm Drain B Q25 Bulked

Station / L/Elem	Invert Elev / Ch Slope	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS) / SF Ave	Vel Head / HF	Energy Grd.El. / SE Dpth	Super Elev / Froude N	Critical Depth / Norm Dp	Flow Top Width / "N"	Height/Dia.-FT / X-Fall	Base Wt or I.D. / ZR	ZL	No Wth Prs/Pip / Type Ch
100.000	77.000	4.500	81.500	19.00	6.05	.57	82.07	.00	1.57	.00	2.000	.000	.00	1 .0
.523	.1526					.0071	.00	4.50	.00	.63	.013	.00	.00	PIPE
100.523	77.080	4.423	81.503	19.00	6.05	.57	82.07	.00	1.57	.00	2.000	.000	.00	1 .0
HYDRAULIC JUMP														
100.523	77.080	.601	77.681	19.00	23.91	8.88	86.56	.00	1.57	1.83	2.000	.000	.00	1 .0
17.708	.1526					.1945	3.44	.60	6.40	.63	.013	.00	.00	PIPE
118.231	79.782	.583	80.364	19.00	24.97	9.68	90.05	.00	1.57	1.82	2.000	.000	.00	1 .0
13.889	.1526					.2209	3.07	.58	6.80	.63	.013	.00	.00	PIPE
132.119	81.901	.563	82.464	19.00	26.19	10.65	93.11	.00	1.57	1.80	2.000	.000	.00	1 .0
10.481	.1526					.2524	2.65	.56	7.27	.63	.013	.00	.00	PIPE
142.600	83.500	.544	84.044	19.00	27.47	11.71	95.76	.00	1.57	1.78	2.000	.000	.00	1 .0
4.858	.3150					.2654	1.29	.54	7.76	.52	.013	.00	.00	PIPE
147.458	85.030	.548	85.578	19.00	27.18	11.47	97.05	.00	1.57	1.78	2.000	.000	.00	1 .0
14.667	.3150					.2452	3.60	.55	7.65	.52	.013	.00	.00	PIPE
162.125	89.650	.567	90.217	19.00	25.92	10.43	100.65	.00	1.57	1.80	2.000	.000	.00	1 .0
9.245	.3150					.2145	1.98	.57	7.16	.52	.013	.00	.00	PIPE
171.370	92.562	.587	93.149	19.00	24.71	9.48	102.63	.00	1.57	1.82	2.000	.000	.00	1 .0
6.617	.3150					.1878	1.24	.59	6.70	.52	.013	.00	.00	PIPE

Camp Hess Kramer
Preliminary Hydraulic Study
Storm Drain B Q25 Bulked

Station	Invert Elev	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head	Energy Grd.El.	Super Elev	Critical Depth	Flow Top Width	Height/ Dia.-FT	Base Wt or I.D.	ZL	No Wth Prs/Pip
L/Elem	Ch Slope				SF Ave	HF	SE Dpth	Froude N	Norm Dp	"N"	X-Fall	ZR	Type Ch	
177.987	94.646	.607	95.254	19.00	23.56	8.62	103.87	.00	1.57	1.84	2.000	.000	.00	1 .0
5.064	.3150				.1644	.83	.61	6.27	.52	.013	.00	.00	PIPE	
183.050	96.241	.629	96.870	19.00	22.47	7.84	104.71	.00	1.57	1.86	2.000	.000	.00	1 .0
4.037	.3150				.1440	.58	.63	5.87	.52	.013	.00	.00	PIPE	
187.088	97.513	.651	98.164	19.00	21.42	7.12	105.29	.00	1.57	1.87	2.000	.000	.00	1 .0
3.308	.3150				.1261	.42	.65	5.49	.52	.013	.00	.00	PIPE	
190.395	98.555	.674	99.229	19.00	20.42	6.48	105.71	.00	1.57	1.89	2.000	.000	.00	1 .0
2.762	.3150				.1105	.31	.67	5.13	.52	.013	.00	.00	PIPE	
193.158	99.425	.698	100.123	19.00	19.47	5.89	106.01	.00	1.57	1.91	2.000	.000	.00	1 .0
2.340	.3150				.0969	.23	.70	4.80	.52	.013	.00	.00	PIPE	
195.498	100.162	.723	100.885	19.00	18.57	5.35	106.24	.00	1.57	1.92	2.000	.000	.00	1 .0
2.003	.3150				.0849	.17	.72	4.48	.52	.013	.00	.00	PIPE	
197.501	100.793	.749	101.541	19.00	17.70	4.87	106.41	.00	1.57	1.94	2.000	.000	.00	1 .0
1.727	.3150				.0745	.13	.75	4.19	.52	.013	.00	.00	PIPE	
199.228	101.337	.776	102.112	19.00	16.88	4.42	106.54	.00	1.57	1.95	2.000	.000	.00	1 .0
1.498	.3150				.0654	.10	.78	3.91	.52	.013	.00	.00	PIPE	
200.726	101.809	.804	102.612	19.00	16.09	4.02	106.63	.00	1.57	1.96	2.000	.000	.00	1 .0
1.305	.3150				.0574	.07	.80	3.66	.52	.013	.00	.00	PIPE	

Camp Hess Kramer
Preliminary Hydraulic Study
Storm Drain B Q25 Bulked

Station / L/Elem	Invert Elev / Ch Slope	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS) / SF Ave	Vel Head / HF	Energy Grd.El. / SE Dpth	Super Elev / Froude N	Critical Depth / Norm Dp	Flow Top Width / "N"	Height/Dia.-FT / X-Fall	Base Wt or I.D. / ZR	ZL	No Wth Prs/Pip / Type Ch
202.031	102.220	.833	103.053	19.00	15.34	3.66	106.71	.00	1.57	1.97	2.000	.000	.00	1 .0
1.140	.3150				.0504	.06	.83	3.41	.52	.013		.00	.00	PIPE
203.172	102.579	.864	103.443	19.00	14.63	3.32	106.77	.00	1.57	1.98	2.000	.000	.00	1 .0
.998	.3150				.0442	.04	.86	3.18	.52	.013		.00	.00	PIPE
204.170	102.894	.895	103.789	19.00	13.95	3.02	106.81	.00	1.57	1.99	2.000	.000	.00	1 .0
.874	.3150				.0389	.03	.90	2.97	.52	.013		.00	.00	PIPE
205.044	103.169	.929	104.098	19.00	13.30	2.75	106.84	.00	1.57	1.99	2.000	.000	.00	1 .0
.765	.3150				.0342	.03	.93	2.77	.52	.013		.00	.00	PIPE
205.809	103.410	.964	104.373	19.00	12.68	2.50	106.87	.00	1.57	2.00	2.000	.000	.00	1 .0
.668	.3150				.0301	.02	.96	2.58	.52	.013		.00	.00	PIPE
206.477	103.620	1.000	104.621	19.00	12.09	2.27	106.89	.00	1.57	2.00	2.000	.000	.00	1 .0
.583	.3150				.0265	.02	1.00	2.40	.52	.013		.00	.00	PIPE
207.060	103.804	1.039	104.842	19.00	11.53	2.06	106.91	.00	1.57	2.00	2.000	.000	.00	1 .0
.505	.3150				.0234	.01	1.04	2.24	.52	.013		.00	.00	PIPE
207.565	103.963	1.079	105.042	19.00	10.99	1.88	106.92	.00	1.57	1.99	2.000	.000	.00	1 .0
.435	.3150				.0206	.01	1.08	2.08	.52	.013		.00	.00	PIPE
208.000	104.100	1.121	105.221	19.00	10.48	1.71	106.93	.03	1.57	1.99	2.000	.000	.00	1 .0
12.180	.0148				.0200	.24	1.16	1.93	1.22	.013		.00	.00	PIPE

Camp Hess Kramer
Preliminary Hydraulic Study
Storm Drain B Q25 Bulked

Station / L/Elem	Invert Elev / Ch Slope	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS) / SF Ave	Vel Head / HF	Energy Grd.El. / SE Dpth	Super Elev / Froude N	Critical Depth / Norm Dp	Flow Top Width / "N"	Height/ Dia.-FT / X-Fall	Base Wt or I.D. / ZR	ZL	No Wth Prs/Pip / Type Ch
220.180	104.280	1.099	105.379	19.00	10.74	1.79	107.17	.00	1.57	1.99	2.000	.000	.00	1 .0
10.537	.0148					.0213	.22	1.10	2.01	1.22	.013	.00	.00	PIPE
230.717	104.436	1.078	105.513	19.00	11.01	1.88	107.39	.00	1.57	1.99	2.000	.000	.00	1 .0
17.067	.0148					.0235	.40	1.08	2.08	1.22	.013	.00	.00	PIPE
247.784	104.688	1.038	105.726	19.00	11.54	2.07	107.80	.00	1.57	2.00	2.000	.000	.00	1 .0
14.262	.0148					.0266	.38	1.04	2.24	1.22	.013	.00	.00	PIPE
262.046	104.899	.999	105.898	19.00	12.11	2.28	108.17	.00	1.57	2.00	2.000	.000	.00	1 .0
12.384	.0148					.0302	.37	1.00	2.41	1.22	.013	.00	.00	PIPE
274.430	105.082	.963	106.045	19.00	12.70	2.50	108.55	.00	1.57	2.00	2.000	.000	.00	1 .0
10.192	.0149					.0341	.35	.96	2.59	1.22	.013	.00	.00	PIPE
284.622	105.234	.931	106.164	19.00	13.27	2.73	108.90	.00	1.57	2.00	2.000	.000	.00	1 .0
10.097	.0149					.0386	.39	.93	2.76	1.22	.013	.00	.00	PIPE
294.719	105.384	.897	106.281	19.00	13.91	3.01	109.29	.00	1.57	1.99	2.000	.000	.00	1 .0
9.242	.0149					.0439	.41	.90	2.96	1.22	.013	.00	.00	PIPE
303.960	105.521	.865	106.386	19.00	14.59	3.31	109.69	.00	1.57	1.98	2.000	.000	.00	1 .0
8.539	.0149					.0500	.43	.87	3.17	1.22	.013	.00	.00	PIPE
312.499	105.648	.835	106.483	19.00	15.31	3.64	110.12	.00	1.57	1.97	2.000	.000	.00	1 .0
7.944	.0149					.0570	.45	.83	3.40	1.22	.013	.00	.00	PIPE

Camp Hess Kramer
Preliminary Hydraulic Study
Storm Drain B Q25 Bulked

Station	Invert Elev	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head	Energy Grd.El.	Super Elev	Critical Depth	Flow Top Width	Height/ Dia.-FT	Base Wt or I.D.	ZL	No Wth Prs/Pip
L/Elem	Ch Slope					SF Ave	HF	SE Dpth	Froude N	Norm Dp	"N"	X-Fall	ZR	Type Ch
320.443	105.767	.805	106.572	19.00	16.05	4.00	110.57	.00	1.57	1.96	2.000	.000	.00	1 .0
7.435	.0149					.0649	.48	.81	3.64	1.22	.013	.00	.00	PIPE
327.878	105.877	.777	106.654	19.00	16.84	4.40	111.06	.00	1.57	1.95	2.000	.000	.00	1 .0
6.991	.0149					.0740	.52	.78	3.90	1.22	.013	.00	.00	PIPE
334.870	105.981	.750	106.731	19.00	17.66	4.84	111.57	.00	1.57	1.94	2.000	.000	.00	1 .0
6.597	.0149					.0844	.56	.75	4.17	1.22	.013	.00	.00	PIPE
341.467	106.079	.724	106.803	19.00	18.52	5.33	112.13	.00	1.57	1.92	2.000	.000	.00	1 .0
6.242	.0149					.0962	.60	.72	4.47	1.22	.013	.00	.00	PIPE
347.708	106.172	.699	106.871	19.00	19.42	5.86	112.73	.00	1.57	1.91	2.000	.000	.00	1 .0
5.923	.0149					.1098	.65	.70	4.78	1.22	.013	.00	.00	PIPE
353.631	106.260	.675	106.936	19.00	20.37	6.44	113.38	.00	1.57	1.89	2.000	.000	.00	1 .0
5.629	.0149					.1253	.71	.68	5.11	1.22	.013	.00	.00	PIPE
359.259	106.344	.652	106.996	19.00	21.37	7.09	114.09	.00	1.57	1.87	2.000	.000	.00	1 .0
5.360	.0149					.1430	.77	.65	5.47	1.22	.013	.00	.00	PIPE
364.619	106.424	.630	107.054	19.00	22.41	7.80	114.85	.00	1.57	1.86	2.000	.000	.00	1 .0
5.111	.0149					.1633	.83	.63	5.85	1.22	.013	.00	.00	PIPE
369.730	106.500	.609	107.109	19.00	23.50	8.58	115.69	.00	1.57	1.84	2.000	.000	.00	1 .0
3.703	.3384					.1649	.61	.61	6.25	.51	.013	.00	.00	PIPE

Camp Hess Kramer
Preliminary Hydraulic Study
Storm Drain B Q25 Bulked

Station / L/Elem	Invert Elev / Ch Slope	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS) / SF Ave	Vel Head / HF	Energy Grd.El. / SE Dpth	Super Elev / Froude N	Critical Depth / Norm Dp	Flow Top Width / "N"	Height/Dia.-FT / X-Fall	Base Wt or I.D. / ZR	ZL	No Wth Prs/Pip / Type Ch
373.433	107.753	.626	108.380	19.00	22.58	7.92	116.29	.00	1.57	1.86	2.000	.000	.00	1 .0
3.625	.3384					.1460	.53	.63	5.91	.51	.013	.00	.00	PIPE
377.057	108.980	.649	109.628	19.00	21.53	7.20	116.82	.00	1.57	1.87	2.000	.000	.00	1 .0
2.998	.3384					.1279	.38	.65	5.53	.51	.013	.00	.00	PIPE
380.056	109.995	.671	110.666	19.00	20.53	6.54	117.21	.00	1.57	1.89	2.000	.000	.00	1 .0
2.522	.3384					.1121	.28	.67	5.17	.51	.013	.00	.00	PIPE
382.577	110.848	.695	111.543	19.00	19.57	5.95	117.49	.00	1.57	1.90	2.000	.000	.00	1 .0
2.147	.3384					.0982	.21	.70	4.83	.51	.013	.00	.00	PIPE
384.725	111.575	.720	112.295	19.00	18.66	5.41	117.70	.00	1.57	1.92	2.000	.000	.00	1 .0
1.845	.3384					.0861	.16	.72	4.52	.51	.013	.00	.00	PIPE
386.570	112.199	.746	112.945	19.00	17.79	4.91	117.86	.00	1.57	1.93	2.000	.000	.00	1 .0
1.597	.3384					.0755	.12	.75	4.22	.51	.013	.00	.00	PIPE
388.168	112.740	.773	113.513	19.00	16.96	4.47	117.98	.00	1.57	1.95	2.000	.000	.00	1 .0
1.389	.3384					.0662	.09	.77	3.94	.51	.013	.00	.00	PIPE
389.557	113.210	.801	114.011	19.00	16.17	4.06	118.07	.00	1.57	1.96	2.000	.000	.00	1 .0
1.213	.3384					.0581	.07	.80	3.68	.51	.013	.00	.00	PIPE
390.770	113.621	.830	114.451	19.00	15.42	3.69	118.14	.00	1.57	1.97	2.000	.000	.00	1 .0
1.062	.3384					.0511	.05	.83	3.44	.51	.013	.00	.00	PIPE

Camp Hess Kramer
Preliminary Hydraulic Study
Storm Drain B Q25 Bulked

Station / L/Elem	Invert Elev / Ch Slope	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head / SF Ave	Energy Grd.El. / HF	Super Elev / SE Dpth	Critical Depth / Froude N	Flow Top Width / Norm Dp	Height/Dia.-FT / "N"	Base Wt or I.D. / X-Fall	ZL / ZR	No Wth Prs/Pip / Type Ch
391.833	113.980	.860	114.841	19.00	14.70	3.36	118.20	.00	1.57	1.98	2.000	.000	.00	1 .0
.931	.3384					.0448	.04	.86	3.21	.51	.013	.00	.00	PIPE
392.764	114.296	.892	115.188	19.00	14.02	3.05	118.24	.00	1.57	1.99	2.000	.000	.00	1 .0
.817	.3384					.0394	.03	.89	2.99	.51	.013	.00	.00	PIPE
393.580	114.572	.925	115.497	19.00	13.37	2.77	118.27	.00	1.57	1.99	2.000	.000	.00	1 .0
.716	.3384					.0347	.02	.93	2.79	.51	.013	.00	.00	PIPE
394.296	114.814	.960	115.774	19.00	12.74	2.52	118.30	.00	1.57	2.00	2.000	.000	.00	1 .0
.626	.3384					.0305	.02	.96	2.60	.51	.013	.00	.00	PIPE
394.922	115.026	.996	116.023	19.00	12.15	2.29	118.32	.00	1.57	2.00	2.000	.000	.00	1 .0
.547	.3384					.0269	.01	1.00	2.42	.51	.013	.00	.00	PIPE
395.469	115.211	1.035	116.246	19.00	11.59	2.08	118.33	.00	1.57	2.00	2.000	.000	.00	1 .0
.475	.3384					.0237	.01	1.03	2.25	.51	.013	.00	.00	PIPE
395.944	115.372	1.075	116.446	19.00	11.05	1.89	118.34	.00	1.57	1.99	2.000	.000	.00	1 .0
.410	.3384					.0209	.01	1.07	2.10	.51	.013	.00	.00	PIPE
396.353	115.510	1.117	116.627	19.00	10.53	1.72	118.35	.00	1.57	1.99	2.000	.000	.00	1 .0
.351	.3384					.0184	.01	1.12	1.95	.51	.013	.00	.00	PIPE
396.704	115.629	1.161	116.790	19.00	10.04	1.57	118.36	.00	1.57	1.97	2.000	.000	.00	1 .0
.296	.3384					.0163	.00	1.16	1.81	.51	.013	.00	.00	PIPE

Program Package Serial Number: 7193

WATER SURFACE PROFILE LISTING Date: 2-19-2021 Time: 2:44:41

Camp Hess Kramer
Preliminary Hydraulic Study
Storm Drain B Q25 Bulked

Station	Invert Elev	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head	Energy Grd.El.	Super Elev	Critical Depth	Flow Top Width	Height/ Dia.-FT	Base Wt or I.D.	ZL	No Wth Prs/Pip
L/Elem	Ch Slope				SF Ave	HF	SE Dpth	Froude N	Norm Dp	"N"	X-Fall	ZR	Type Ch	
397.000	115.729	1.208	116.937	19.00	9.58	1.42	118.36	.00	1.57	1.96	2.000	.000	.00	1 .0
.246	.3384				.0144	.00	1.21	1.68	.51	.013	.00	.00	PIPE	
397.246	115.812	1.258	117.070	19.00	9.13	1.29	118.36	.00	1.57	1.93	2.000	.000	.00	1 .0
.199	.3384				.0128	.00	1.26	1.55	.51	.013	.00	.00	PIPE	
397.444	115.880	1.311	117.191	19.00	8.70	1.18	118.37	.00	1.57	1.90	2.000	.000	.00	1 .0
.154	.3384				.0114	.00	1.31	1.43	.51	.013	.00	.00	PIPE	
397.598	115.932	1.368	117.299	19.00	8.30	1.07	118.37	.00	1.57	1.86	2.000	.000	.00	1 .0
.111	.3384				.0101	.00	1.37	1.32	.51	.013	.00	.00	PIPE	
397.709	115.969	1.429	117.398	19.00	7.91	.97	118.37	.00	1.57	1.81	2.000	.000	.00	1 .0
.068	.3384				.0091	.00	1.43	1.21	.51	.013	.00	.00	PIPE	
397.777	115.992	1.495	117.487	19.00	7.55	.88	118.37	.00	1.57	1.74	2.000	.000	.00	1 .0
.023	.3384				.0081	.00	1.49	1.10	.51	.013	.00	.00	PIPE	
397.800	116.000	1.568	117.568	19.00	7.19	.80	118.37	.00	1.57	1.65	2.000	.000	.00	1 .0

Program Package Serial Number: 7193

WATER SURFACE PROFILE LISTING Date: 2-24-2021 Time:12: 5: 5

Camp Hess Kramer
Storm Drain G-1
Q25 Bulked Starting WSEL = Q100 Bulked

Station / L/Elem	Invert Elev / Ch Slope	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS) / SF Ave	Vel Head / HF	Energy Grd.El. / SE Dpth	Super Elev / Froude N	Critical Depth / Norm Dp	Flow Top Width / "N"	Height/Dia.-FT / X-Fall	Base Wt or I.D. / ZR	ZL	No Wth Prs/Pip / Type Ch
1000.000	152.000	1.683	153.683	180.00	35.86	19.97	173.65	.00	3.77	3.95	4.000	.000	.00	1 .0
37.000	.0811					.1212	4.49	1.68	5.61	1.86	.013	.00	.00	PIPE
1037.000	155.000	1.636	156.636	180.00	37.21	21.50	178.14	4.00	3.77	3.93	4.000	.000	.00	1 .0
JUNCT STR	.2500					.1291	.52	4.00	5.91		.013	.00	.00	PIPE
1041.000	156.000	1.564	157.564	168.00	36.88	21.12	178.69	.00	3.72	3.90	4.000	.000	.00	1 .0
123.920	.1291					.1328	16.46	1.56	6.02	1.57	.013	.00	.00	PIPE
1164.920	172.000	1.552	173.552	168.00	37.29	21.60	195.15	.83	3.72	3.90	4.000	.000	.00	1 .0
3.909	.0873					.1357	.53	2.38	6.11	1.75	.013	.00	.00	PIPE
1168.829	172.341	1.546	173.888	168.00	37.46	21.80	195.68	.84	3.72	3.90	4.000	.000	.00	1 .0
36.171	.0873					.1461	5.28	2.38	6.15	1.75	.013	.00	.00	PIPE
1205.000	175.500	1.493	176.993	168.00	39.29	23.97	200.97	.00	3.72	3.87	4.000	.000	.00	1 .0
33.686	.1022					.1656	5.58	1.49	6.59	1.67	.013	.00	.00	PIPE
1238.686	178.942	1.445	180.387	168.00	41.05	26.16	206.55	.00	3.72	3.84	4.000	.000	.00	1 .0
29.934	.1022					.1879	5.62	1.45	7.01	1.67	.013	.00	.00	PIPE
1268.620	182.000	1.396	183.396	168.00	43.05	28.78	212.17	.00	3.72	3.81	4.000	.000	.00	1 .0
34.753	.2589					.1885	6.55	1.40	7.50	1.30	.013	.00	.00	PIPE
1303.373	190.996	1.443	192.439	168.00	41.14	26.28	218.72	.00	3.72	3.84	4.000	.000	.00	1 .0
25.127	.2589					.1658	4.17	1.44	7.03	1.30	.013	.00	.00	PIPE

Camp Hess Kramer
Storm Drain G-1
Q25 Bulked Starting WSEL = Q100 Bulked

Station	Invert Elev	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head	Energy Grd.El.	Super Elev	Critical Depth	Flow Top Width	Height/ Dia.-FT	Base Wt or I.D.	ZL	No Wth Prs/Pip
L/Elem	Ch Slope					SF Ave	HF	SE Dpth	Froude N	Norm Dp	"N"	X-Fall	ZR	Type Ch
1328.500	197.500	1.494	198.994	168.00	39.23	23.89	222.89	.00	3.72	3.87	4.000	.000	.00	1 .0
9.462	.3454					.1465	1.39	1.49	6.57	1.21	.013	.00	.00	PIPE
1337.962	200.768	1.542	202.309	168.00	37.62	21.98	224.29	.00	3.72	3.89	4.000	.000	.00	1 .0
9.005	.3454					.1297	1.17	1.54	6.19	1.21	.013	.00	.00	PIPE
1346.967	203.878	1.597	205.475	168.00	35.87	19.98	225.46	.00	3.72	3.92	4.000	.000	.00	1 .0
7.593	.3454					.1138	.86	1.60	5.78	1.21	.013	.00	.00	PIPE
1354.560	206.500	1.655	208.155	168.00	34.20	18.16	226.32	.36	3.72	3.94	4.000	.000	.00	1 .0
10.492	.0087					.1109	1.16	2.01	5.40	4.00	.013	.00	.00	PIPE
1365.052	206.591	1.619	208.210	168.00	35.23	19.27	227.48	.38	3.72	3.93	4.000	.000	.00	1 .0
16.309	.0087					.1234	2.01	2.00	5.63	4.00	.013	.00	.00	PIPE
1381.361	206.733	1.562	208.296	168.00	36.95	21.20	229.49	.41	3.72	3.90	4.000	.000	.00	1 .0
15.656	.0087					.1406	2.20	1.98	6.03	4.00	.013	.00	.00	PIPE
1397.017	206.869	1.508	208.377	168.00	38.75	23.32	231.70	.45	3.72	3.88	4.000	.000	.00	1 .0
15.033	.0087					.1603	2.41	1.96	6.46	4.00	.013	.00	.00	PIPE
1412.050	207.000	1.456	208.456	168.00	40.64	25.65	234.11	.00	3.72	3.85	4.000	.000	.00	1 .0
58.300	.1715					.1706	9.95	1.46	6.91	1.45	.013	.00	.00	PIPE
1470.350	217.000	1.457	218.457	168.00	40.60	25.60	244.06	.99	3.72	3.85	4.000	.000	.00	1 .0
24.850	.2012					.1664	4.14	2.44	6.90	1.39	.013	.00	.00	PIPE

Program Package Serial Number: 7193

WATER SURFACE PROFILE LISTING Date: 2-24-2021 Time:12: 5: 5

Camp Hess Kramer
Storm Drain G-1
Q25 Bulked Starting WSEL = Q100 Bulked

Station / L/Elem	Invert Elev / Ch Slope	Depth (FT) /	Water Elev /	Q (CFS) /	Vel (FPS) / SF Ave	Vel Head / HF	Energy Grd.El. / SE Dpth	Super Elev / Froude N	Critical Depth / Norm Dp	Flow Top Width / "N"	Height/Dia.-FT / X-Fall	Base Wt or I.D. / ZR	ZL /	No Wth Prs/Pip / Type Ch
1495.200	222.000	1.476	223.476	168.00	39.90	24.73	248.20	.00	3.72	3.86	4.000	.000	.00	1 .0
19.315	.1941					.1594	3.08	1.48	6.73	1.41	.013	.00	.00	PIPE
1514.515	225.749	1.491	227.240	168.00	39.36	24.06	251.30	.00	3.72	3.87	4.000	.000	.00	1 .0
45.085	.1941					.1468	6.62	1.49	6.60	1.41	.013	.00	.00	PIPE
1559.600	234.500	1.544	236.044	168.00	37.53	21.87	257.91	.00	3.72	3.89	4.000	.000	.00	1 .0
21.261	.2184					.1289	2.74	1.54	6.17	1.36	.013	.00	.00	PIPE
1580.861	239.143	1.599	240.743	168.00	35.81	19.92	260.66	.00	3.72	3.92	4.000	.000	.00	1 .0
16.670	.2184					.1133	1.89	1.60	5.77	1.36	.013	.00	.00	PIPE
1597.531	242.784	1.658	244.441	168.00	34.15	18.11	262.55	.00	3.72	3.94	4.000	.000	.00	1 .0
13.328	.2184					.0995	1.33	1.66	5.39	1.36	.013	.00	.00	PIPE
1610.860	245.695	1.718	247.413	168.00	32.56	16.46	263.87	.00	3.72	3.96	4.000	.000	.00	1 .0
10.937	.2184					.0874	.96	1.72	5.03	1.36	.013	.00	.00	PIPE
1621.796	248.083	1.782	249.865	168.00	31.04	14.96	264.83	.00	3.72	3.98	4.000	.000	.00	1 .0
9.137	.2184					.0768	.70	1.78	4.69	1.36	.013	.00	.00	PIPE
1630.934	250.079	1.848	251.927	168.00	29.60	13.60	265.53	.00	3.72	3.99	4.000	.000	.00	1 .0
7.737	.2184					.0675	.52	1.85	4.37	1.36	.013	.00	.00	PIPE
1638.671	251.769	1.917	253.686	168.00	28.22	12.37	266.05	.00	3.72	4.00	4.000	.000	.00	1 .0
6.614	.2184					.0594	.39	1.92	4.07	1.36	.013	.00	.00	PIPE

Camp Hess Kramer
Storm Drain G-1
Q25 Bulked Starting WSEL = Q100 Bulked

Station	Invert Elev	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head	Energy Grd.El.	Super Elev	Critical Depth	Flow Top Width	Height/ Dia.-FT	Base Wt or I.D.	ZL	No Wth Prs/Pip
L/Elem	Ch Slope					SF Ave	HF	SE Dpth	Froude N	Norm Dp	"N"	X-Fall	ZR	Type Ch
1645.285	253.213	1.990	255.203	168.00	26.91	11.24	266.45	.00	3.72	4.00	4.000	.000	.00	1 .0
5.695	.2184					.0523	.30	1.99	3.80	1.36	.013	.00	.00	PIPE
1650.981	254.457	2.066	256.523	168.00	25.65	10.22	266.74	.00	3.72	4.00	4.000	.000	.00	1 .0
4.928	.2184					.0461	.23	2.07	3.53	1.36	.013	.00	.00	PIPE
1655.909	255.533	2.146	257.680	168.00	24.46	9.29	266.97	.00	3.72	3.99	4.000	.000	.00	1 .0
4.279	.2184					.0407	.17	2.15	3.29	1.36	.013	.00	.00	PIPE
1660.188	256.468	2.231	258.698	168.00	23.32	8.45	267.14	.00	3.72	3.97	4.000	.000	.00	1 .0
3.721	.2184					.0359	.13	2.23	3.05	1.36	.013	.00	.00	PIPE
1663.909	257.280	2.319	259.600	168.00	22.24	7.68	267.28	.00	3.72	3.95	4.000	.000	.00	1 .0
3.238	.2184					.0317	.10	2.32	2.83	1.36	.013	.00	.00	PIPE
1667.147	257.988	2.413	260.401	168.00	21.20	6.98	267.38	.00	3.72	3.91	4.000	.000	.00	1 .0
2.812	.2184					.0281	.08	2.41	2.63	1.36	.013	.00	.00	PIPE
1669.959	258.602	2.512	261.114	168.00	20.22	6.35	267.46	.00	3.72	3.87	4.000	.000	.00	1 .0
2.435	.2184					.0249	.06	2.51	2.43	1.36	.013	.00	.00	PIPE
1672.394	259.134	2.618	261.752	168.00	19.27	5.77	267.52	.00	3.72	3.80	4.000	.000	.00	1 .0
2.096	.2184					.0221	.05	2.62	2.24	1.36	.013	.00	.00	PIPE
1674.490	259.591	2.731	262.323	168.00	18.38	5.24	267.57	.00	3.72	3.72	4.000	.000	.00	1 .0
1.788	.2184					.0197	.04	2.73	2.07	1.36	.013	.00	.00	PIPE

Program Package Serial Number: 7193

WATER SURFACE PROFILE LISTING Date: 2-24-2021 Time:12: 5: 5

Camp Hess Kramer
Storm Drain G-1
Q25 Bulked Starting WSEL = Q100 Bulked

Station	Invert Elev	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head	Energy Grd.El.	Super Elev	Critical Depth	Flow Top Width	Height/ Dia.-FT	Base Wt or I.D.	ZL	No Wth Prs/Pip
L/Elem	Ch Slope					SF Ave	HF	SE Dpth	Froude N	Norm Dp	"N"	X-Fall	ZR	Type Ch
1676.278	259.982	2.853	262.835	168.00	17.52	4.77	267.60	.00	3.72	3.62	4.000	.000	.00	1 .0
1.503	.2184					.0176	.03	2.85	1.90	1.36	.013	.00	.00	PIPE
1677.781	260.310	2.984	263.295	168.00	16.71	4.33	267.63	.00	3.72	3.48	4.000	.000	.00	1 .0
1.231	.2184					.0158	.02	2.98	1.73	1.36	.013	.00	.00	PIPE
1679.012	260.579	3.129	263.708	168.00	15.93	3.94	267.65	.00	3.72	3.30	4.000	.000	.00	1 .0
.963	.2184					.0143	.01	3.13	1.57	1.36	.013	.00	.00	PIPE
1679.975	260.789	3.291	264.080	168.00	15.19	3.58	267.66	.00	3.72	3.06	4.000	.000	.00	1 .0
.674	.2184					.0130	.01	3.29	1.41	1.36	.013	.00	.00	PIPE
1680.649	260.936	3.478	264.414	168.00	14.48	3.26	267.67	.00	3.72	2.69	4.000	.000	.00	1 .0
.291	.2184					.0122	.00	3.48	1.23	1.36	.013	.00	.00	PIPE
1680.940	261.000	3.715	264.715	168.00	13.81	2.96	267.67	.00	3.72	2.06	4.000	.000	.00	1 .0

Program Package Serial Number: 7193

WATER SURFACE PROFILE LISTING Date: 2-24-2021 Time: 3:35:25

Camp Hess Kramer
Storm Drain G-2
Q25 Bulked

Station / L/Elem	Invert Elev / Ch Slope	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS) / SF Ave	Vel Head / HF	Energy Grd.El. / SE Dpth	Super Elev / Froude N	Critical Depth / Norm Dp	Flow Top Width / "N"	Height/Dia.-FT / X-Fall	Base Wt or I.D. / ZR	ZL	No Wth Prs/Pip / Type Ch
2000.000	158.000	.468	158.468	12.00	21.48	7.16	165.63	.00	1.24	1.69	2.000	.000	.00	1 .0
90.896	.1958				.1958	17.80	.47	6.59	.47	.013	.00	.00	PIPE	
2090.896	175.795	.468	176.263	12.00	21.48	7.16	183.43	.00	1.24	1.69	2.000	.000	.00	1 .0
51.104	.1958				.1924	9.83	.47	6.59	.47	.013	.00	.00	PIPE	
2142.000	185.800	.472	186.272	12.00	21.21	6.99	193.26	.00	1.24	1.70	2.000	.000	.00	1 .0
24.980	.1962				.1826	4.56	.47	6.48	.47	.013	.00	.00	PIPE	
2166.980	190.700	.480	191.180	12.00	20.69	6.65	197.83	.45	1.24	1.71	2.000	.000	.00	1 .0
5.404	.1955				.1741	.94	.93	6.26	.47	.013	.00	.00	PIPE	
2172.384	191.756	.483	192.239	12.00	20.51	6.53	198.77	.45	1.24	1.71	2.000	.000	.00	1 .0
16.809	.1955				.1611	2.71	.93	6.18	.47	.013	.00	.00	PIPE	
2189.192	195.042	.500	195.542	12.00	19.56	5.94	201.48	.41	1.24	1.73	2.000	.000	.00	1 .0
9.582	.1955				.1409	1.35	.91	5.79	.47	.013	.00	.00	PIPE	
2198.774	196.915	.517	197.432	12.00	18.65	5.40	202.83	.38	1.24	1.75	2.000	.000	.00	1 .0
6.551	.1955				.1233	.81	.89	5.42	.47	.013	.00	.00	PIPE	
2205.324	198.196	.535	198.730	12.00	17.78	4.91	203.64	.35	1.24	1.77	2.000	.000	.00	1 .0
4.880	.1955				.1079	.53	.88	5.07	.47	.013	.00	.00	PIPE	
2210.204	199.150	.553	199.703	12.00	16.95	4.46	204.16	.32	1.24	1.79	2.000	.000	.00	1 .0
3.822	.1955				.0944	.36	.87	4.75	.47	.013	.00	.00	PIPE	

Camp Hess Kramer
Storm Drain G-2
Q25 Bulked

Station / L/Elem	Invert Elev / Ch Slope	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS) / SF Ave	Vel Head / HF	Energy Grd.El. / SE Dpth	Super Elev / Froude N	Critical Depth / Norm Dp	Flow Top Width / "N"	Height/Dia.-FT / X-Fall	Base Wt or I.D. / ZR	ZL	No Wth Prs/Pip / Type Ch
2214.026	199.897	.572	200.469	12.00	16.16	4.06	204.53	.29	1.24	1.81	2.000	.000	.00	1 .0
3.091	.1955				.0826	.26	.87	4.44	.47	.013	.00	.00		PIPE
2217.117	200.501	.592	201.093	12.00	15.41	3.69	204.78	.27	1.24	1.83	2.000	.000	.00	1 .0
2.553	.1955				.0723	.18	.86	4.16	.47	.013	.00	.00		PIPE
2219.670	201.000	.613	201.613	12.00	14.69	3.35	204.97	.00	1.24	1.84	2.000	.000	.00	1 .0
31.419	.0675				.0675	2.12	.61	3.89	.61	.013	.00	.00		PIPE
2251.089	203.121	.613	203.734	12.00	14.69	3.35	207.09	.00	1.24	1.84	2.000	.000	.00	1 .0
67.042	.0675				.0656	4.40	.61	3.89	.61	.013	.00	.00		PIPE
2318.131	207.647	.622	208.269	12.00	14.39	3.22	211.48	.00	1.24	1.85	2.000	.000	.00	1 .0
34.859	.0675				.0597	2.08	.62	3.78	.61	.013	.00	.00		PIPE
2352.990	210.000	.644	210.644	12.00	13.72	2.92	213.57	.22	1.24	1.87	2.000	.000	.00	1 .0
15.654	.0676				.0525	.82	.86	3.54	.61	.013	.00	.00		PIPE
2368.644	211.058	.666	211.724	12.00	13.11	2.67	214.39	.20	1.24	1.89	2.000	.000	.00	1 .0
10.181	.0676				.0461	.47	.87	3.31	.61	.013	.00	.00		PIPE
2378.825	211.746	.690	212.436	12.00	12.50	2.42	214.86	.18	1.24	1.90	2.000	.000	.00	1 .0
7.201	.0676				.0404	.29	.87	3.10	.61	.013	.00	.00		PIPE
2386.026	212.233	.714	212.947	12.00	11.92	2.20	215.15	.17	1.24	1.92	2.000	.000	.00	1 .0
5.434	.0676				.0354	.19	.88	2.90	.61	.013	.00	.00		PIPE

Camp Hess Kramer
Storm Drain G-2
Q25 Bulked

Station	Invert Elev	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head	Energy Grd.El.	Super Elev	Critical Depth	Flow Top Width	Height/ Dia.-FT	Base Wt or I.D.	ZL	No Wth Prs/Pip
L/Elem	Ch Slope					SF Ave	HF	SE Dpth	Froude N	Norm Dp	"N"	X-Fall	ZR	Type Ch
2391.460	212.600	.740	213.340	12.00	11.36	2.00	215.34	.00	1.24	1.93	2.000	.000	.00	1 .0
3.775	.0702					.0312	.12	.74	2.71	.61	.013	.00	.00	PIPE
2395.236	212.865	.765	213.630	12.00	10.86	1.83	215.46	.00	1.24	1.94	2.000	.000	.00	1 .0
3.250	.0702					.0275	.09	.76	2.54	.61	.013	.00	.00	PIPE
2398.486	213.093	.792	213.886	12.00	10.36	1.67	215.55	.00	1.24	1.96	2.000	.000	.00	1 .0
2.657	.0702					.0241	.06	.79	2.37	.61	.013	.00	.00	PIPE
2401.143	213.280	.821	214.101	12.00	9.88	1.51	215.62	.00	1.24	1.97	2.000	.000	.00	1 .0
2.195	.0702					.0212	.05	.82	2.21	.61	.013	.00	.00	PIPE
2403.337	213.434	.851	214.285	12.00	9.42	1.38	215.66	.00	1.24	1.98	2.000	.000	.00	1 .0
1.816	.0702					.0186	.03	.85	2.07	.61	.013	.00	.00	PIPE
2405.153	213.561	.883	214.444	12.00	8.98	1.25	215.70	.00	1.24	1.99	2.000	.000	.00	1 .0
1.503	.0702					.0163	.02	.88	1.93	.61	.013	.00	.00	PIPE
2406.656	213.667	.915	214.582	12.00	8.56	1.14	215.72	.00	1.24	1.99	2.000	.000	.00	1 .0
1.238	.0702					.0144	.02	.92	1.80	.61	.013	.00	.00	PIPE
2407.894	213.754	.950	214.704	12.00	8.16	1.03	215.74	.00	1.24	2.00	2.000	.000	.00	1 .0
1.010	.0702					.0126	.01	.95	1.68	.61	.013	.00	.00	PIPE
2408.903	213.825	.986	214.810	12.00	7.78	.94	215.75	.00	1.24	2.00	2.000	.000	.00	1 .0
.810	.0702					.0111	.01	.99	1.56	.61	.013	.00	.00	PIPE

Camp Hess Kramer
Storm Drain G-2
Q25 Bulked

Station	Invert Elev	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head	Energy Grd.El.	Super Elev	Critical Depth	Flow Top Width	Height/ Dia.-FT	Base Wt or I.D.	ZL	No Wth Prs/Pip
L/Elem	Ch Slope					SF Ave	HF	SE Dpth	Froude N	Norm Dp	"N"	X-Fall	ZR	Type Ch
2409.713	213.882	1.023	214.905	12.00	7.42	.85	215.76	.00	1.24	2.00	2.000	.000	.00	1 .0
.633	.0702					.0098	.01	1.02	1.45	.61	.013	.00	.00	PIPE
2410.346	213.926	1.063	214.989	12.00	7.07	.78	215.77	.00	1.24	2.00	2.000	.000	.00	1 .0
.472	.0702					.0086	.00	1.06	1.35	.61	.013	.00	.00	PIPE
2410.818	213.959	1.104	215.063	12.00	6.75	.71	215.77	.00	1.24	1.99	2.000	.000	.00	1 .0
.328	.0702					.0076	.00	1.10	1.26	.61	.013	.00	.00	PIPE
2411.146	213.982	1.148	215.130	12.00	6.43	.64	215.77	.00	1.24	1.98	2.000	.000	.00	1 .0
.190	.0702					.0067	.00	1.15	1.17	.61	.013	.00	.00	PIPE
2411.336	213.995	1.194	215.190	12.00	6.13	.58	215.77	.00	1.24	1.96	2.000	.000	.00	1 .0
.064	.0702					.0060	.00	1.19	1.08	.61	.013	.00	.00	PIPE
2411.400	214.000	1.244	215.244	12.00	5.84	.53	215.77	.00	1.24	1.94	2.000	.000	.00	1 .0

Appendix F – DETENTION ASSESSMENT

64B

65B

66B

67B

68B

	Tributary Area		Hydrology Designation	Q_{100}	$Q_{100\ Bulked}$	Hydrology Area	Q/ac	Q_{design}
Area Name	Square Feet	Acres		cfs	cfs	ac	cfs/ac	cfs
A1	6,045,651	138.8	68B	435	543.8	163.2	3.33	462.4
A2	297,431	6.8	68B	435	543.8	163.2	3.33	22.7
B1	583,551	13.4	67B	565	706.3	275.2	2.57	34.4
C1	142,367	3.3	67B	565	706.3	275.2	2.57	8.4
D1	277,158	6.4	67B	565	706.3	275.2	2.57	16.3
E1	1,633,447	37.5	66B	390	487.5	103.7	4.70	136.3
			67B	565	706.3	275.2	2.57	
F1	28,732	0.7	67B	565	706.3	275.2	2.57	1.7
F2	54,527	1.3	67B	565	706.3	275.2	2.57	3.2
F3	277,158	6.4	67B	565	706.3	275.2	2.57	16.3
G1	5,630	0.1	67B	565	706.3	275.2	2.57	0.3
G2	25,444	0.6	67B	565	706.3	275.2	2.57	1.5
G3	3,441,401	79.0	67B	565	706.3	275.2	2.57	202.7
G3-A				565	706.3	71.5	2.57	183.5
G4	1,715,431	39.4	67B	565	706.3	275.2	2.57	101.1
G4-A				565	706.3	22.6	2.57	58.0
G5	1,096,812	25.2	67B	565	706.3	275.2	2.57	64.6
H1	1,039,410	23.9	67B	565	706.3	275.2	2.57	86.7
			66B	390	487.5	103.7	4.70	

CULVERT G4-A

CULVERT G3-A

G5

H1

G4

G3

G2

G1

F3

F2

F1

E1

C1

B1

A1

A2

OUTLET H

OUTLET G

OUTLET F

OUTLET D

OUTLET E

OUTLET C

OUTLET B

OUTLET A

WMS Subwatershed Boundaries

Storm Drain Subwatershed Boundaries

WMS Subwatershed Designation

Project: Little_Sycamore_May2021
Simulation Run: 002-mp-Post-Fire
Simulation Start: 21 September 2020, 14:00
Simulation End: 22 September 2020, 14:00

HMS Version: 4.6.1
Executed: 29 April 2021, 23:20

Global Parameter Summary - Subbasin

Area

Element Name	Area
60b	0.65
61b	0.61
62b	0.53
63b	0.6
64b	1.09
65b	0.53
66b	0.16
67b	0.43
68b	0.26

Downstream

Element Name	Downstream
60b	J 60b 61b
61b	J 60b 61b
62b	17c
63b	16c
64b	20c
65b	15c
66b	14c
67b	13c
68b	12c

Loss Rate: Scs

Element Name	Percent Impervious Area	Curve Number	Initial Abstraction
60b	0	75	0.2
61b	0	75	0.2
62b	0	73.9	0.2
63b	0	74.6	0.2
64b	0	74.8	0.2
65b	0	74.4	0.2
66b	0	73.9	0.2
67b	0	73.7	0.2
68b	0	73.9	0.2

Transform: User - Specified S - Graph

Element Name	S - graph	Lag Method	Lag
60b	Ellsworth S - Graph	Specified	0.52
61b	Ellsworth S - Graph	Specified	0.37
62b	Ellsworth S - Graph	Specified	0.25
63b	Ellsworth S - Graph	Specified	0.41
64b	Ellsworth S - Graph	Specified	0.42
65b	Ellsworth S - Graph	Specified	0.24
66b	Ellsworth S - Graph	Specified	0.14
67b	Ellsworth S - Graph	Specified	0.44
68b	Ellsworth S - Graph	Specified	0.28

Global Parameter Summary - Reach

Downstream

Element Name	Downstream
18r	17c
17r	16c
16r	20c
20r	15c
15r	14c
14r	13c
13r	12c

Route: Modified Puls

Element Name	Method	Initial Variable	Number of Reaches	Storage Outflow Table Name
18r	Modified Puls	Combined Inflow	8	18r
17r	Modified Puls	Combined Inflow	4	17r
16r	Modified Puls	Combined Inflow	6	16r
20r	Modified Puls	Combined Inflow	6	20r
15r	Modified Puls	Combined Inflow	5	15r
14r	Modified Puls	Combined Inflow	5	14r
13r	Modified Puls	Combined Inflow	2	13r

Global Results Summary

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
60b	0.65	188.07	22Sep2020, 00:25	1.68
61b	0.61	216.56	22Sep2020, 00:15	1.69
J 60b 61b	1.25	393.35	22Sep2020, 00:19	1.69
18r	1.25	314.24	22Sep2020, 01:20	1.62
62b	0.53	227.32	22Sep2020, 00:08	1.65
17c	1.78	373.3	22Sep2020, 01:17	1.63
17r	1.78	333.71	22Sep2020, 02:01	1.56
63b	0.6	199.83	22Sep2020, 00:18	1.67
16c	2.38	395.47	22Sep2020, 01:58	1.59
16r	2.38	386.19	22Sep2020, 02:30	1.54
64b	1.09	358.99	22Sep2020, 00:18	1.68
20c	3.47	483.09	22Sep2020, 02:25	1.58
20r	3.47	479.54	22Sep2020, 02:46	1.55
65b	0.53	239.37	22Sep2020, 00:07	1.68
15c	4	519.57	22Sep2020, 01:08	1.57
15r	4	518.2	22Sep2020, 01:19	1.55
66b	0.16	93.22	22Sep2020, 00:02	1.66
14c	4.16	533.79	22Sep2020, 01:19	1.55
14r	4.16	533.43	22Sep2020, 01:25	1.54
67b	0.43	132.97	22Sep2020, 00:20	1.63
13c	4.59	595.2	22Sep2020, 01:16	1.55
13r	4.59	552.12	22Sep2020, 03:24	1.47
68b	0.26	103.44	22Sep2020, 00:10	1.65

12c	4.85	568.97	22Sep2020, 03:22	1.48
Pacific Ocean	4.85	568.97	22Sep2020, 03:22	1.48

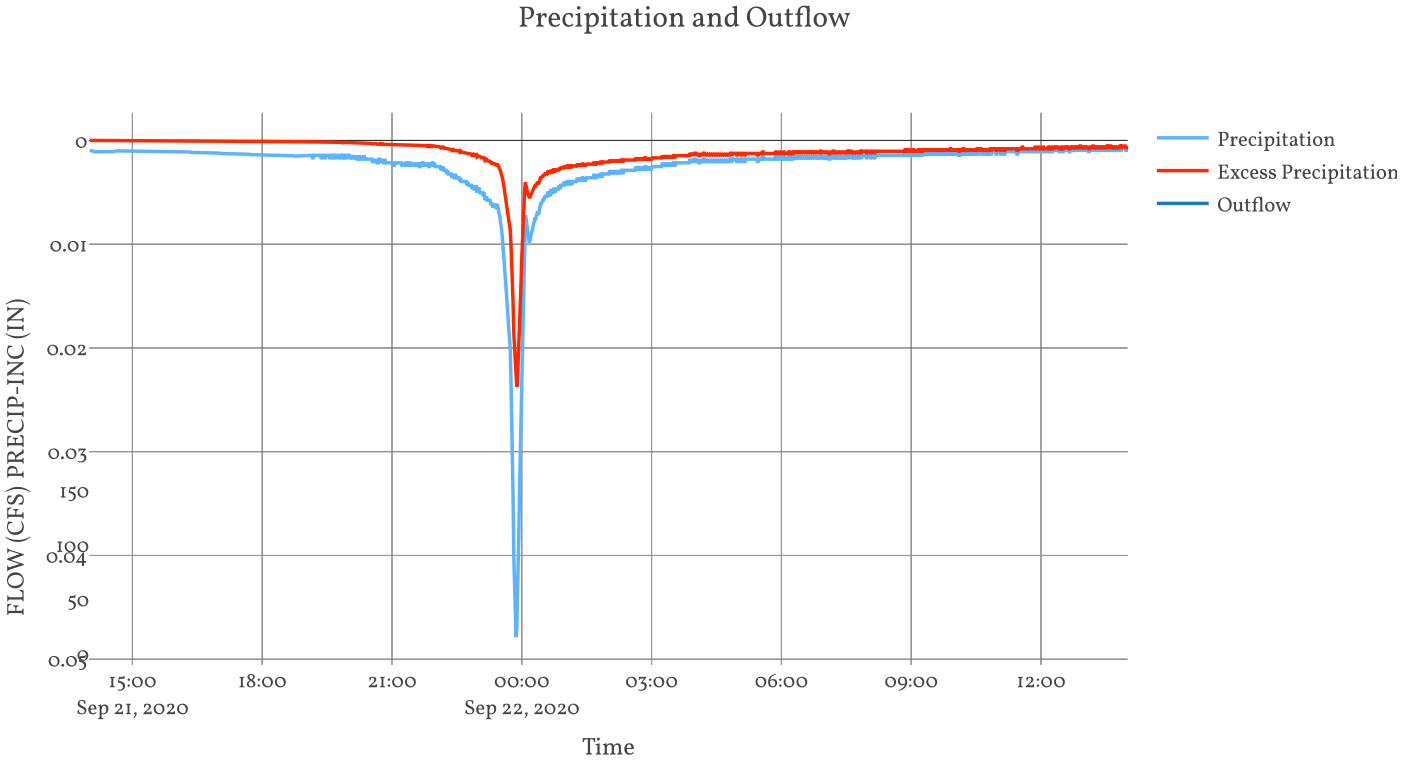
Subbasin: 60B

Area : 0.65
Downstream : J 60b 61b

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	75
Initial Abstraction	0.2

Transform: User - Specified S - Graph	
S - graph	Ellsworth S - Graph
Lag Method	Specified
Lag	0.52

Results: 60B	
Peak Discharge (CFS)	188.07
Time of Peak Discharge	22Sep2020, 00:25
Volume (IN)	1.68
Precipitation Volume (AC - FT)	123.84
Loss Volume (AC - FT)	64.78
Excess Volume (AC - FT)	59.06
Direct Runoff Volume (AC - FT)	57.9
Baseflow Volume (AC - FT)	0


Precipitation and Outflow
FLOW (CFS) PRECIP-INC (IN)
0
0.01
0.02
0.03
150
100
0.04
50
0.05
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
Sep 21, 2020
Sep 22, 2020
Time
Precipitation
Excess Precipitation
Outflow

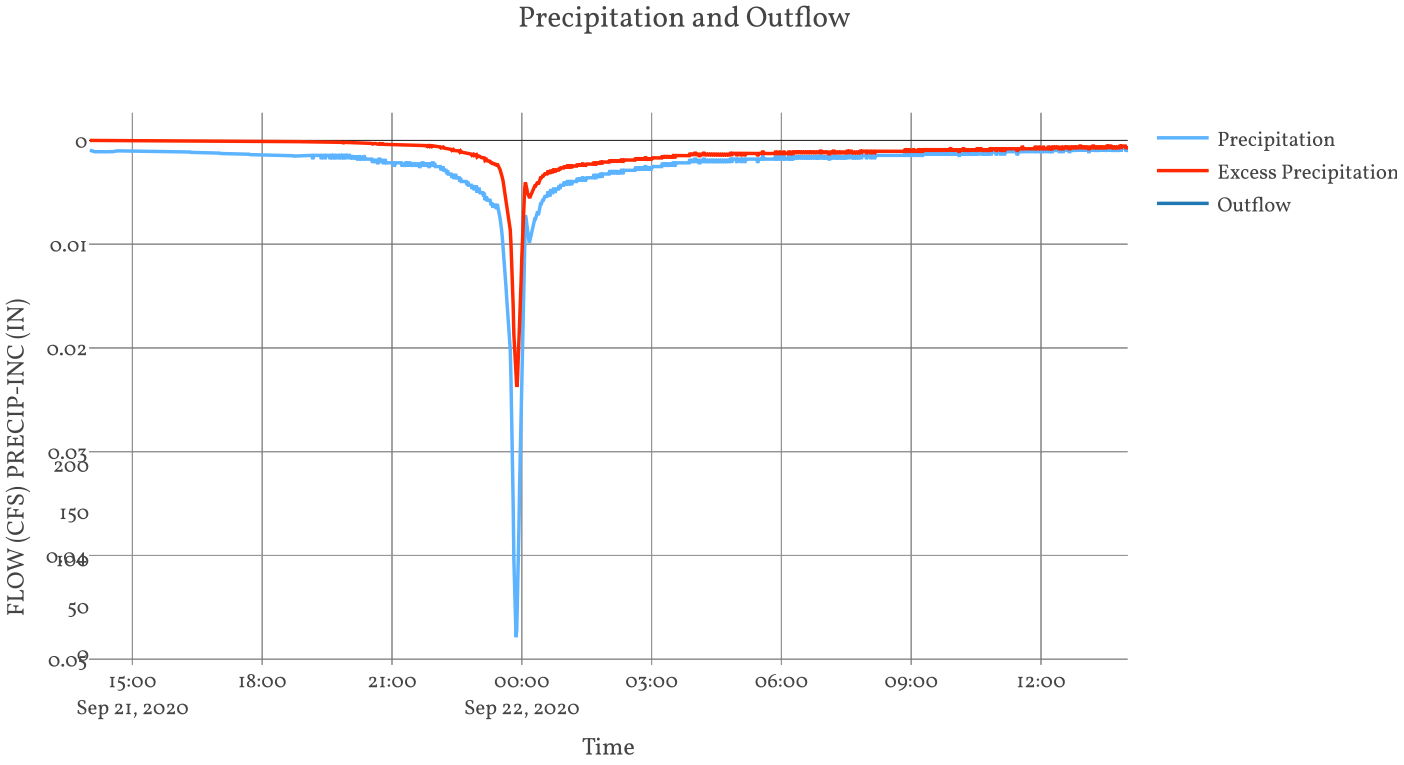
Subbasin: 61B

Area : 0.61
Downstream : J 60b 61b

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	75
Initial Abstraction	0.2

Transform: User - Specified S - Graph	
S - graph	Ellsworth S - Graph
Lag Method	Specified
Lag	0.37

Results: 61B	
Peak Discharge (CFS)	216.56
Time of Peak Discharge	22Sep2020, 00:15
Volume (IN)	1.69
Precipitation Volume (AC - FT)	116.35
Loss Volume (AC - FT)	60.86
Excess Volume (AC - FT)	55.49
Direct Runoff Volume (AC - FT)	54.73
Baseflow Volume (AC - FT)	0

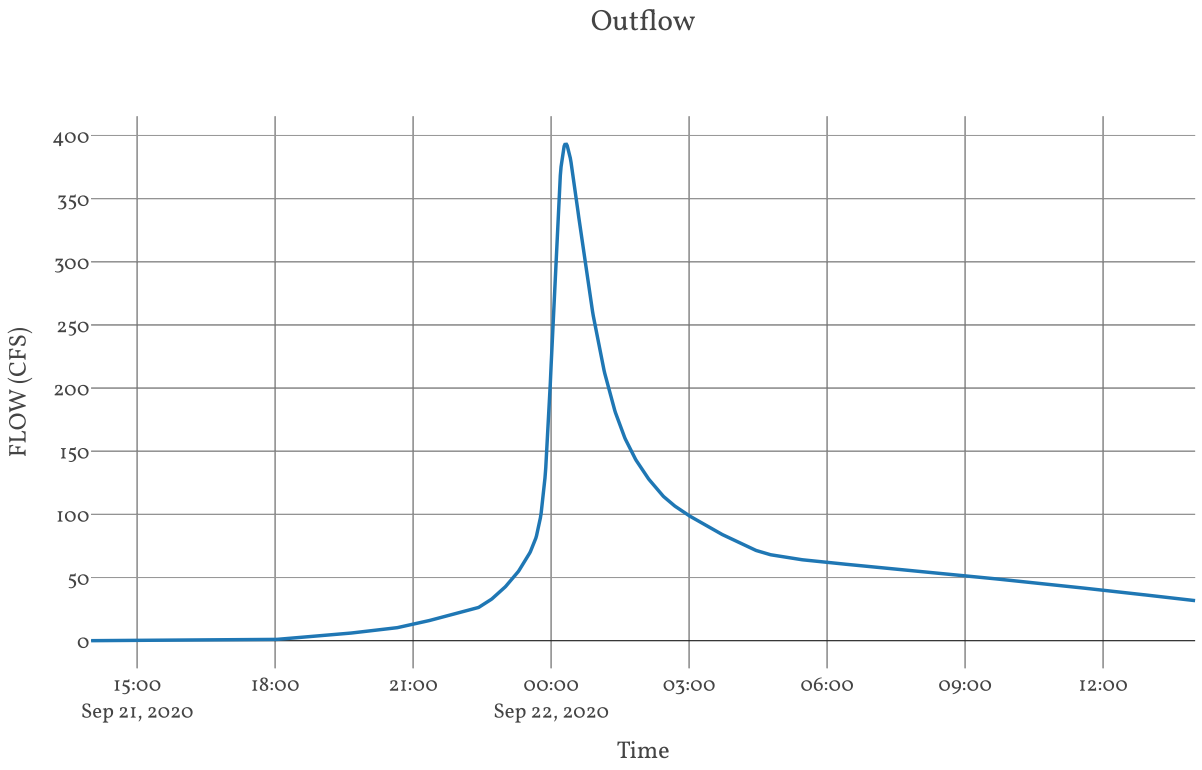

Precipitation and Outflow
FLOW (CFS) PRECIP-INC (IN)
0
0.01
0.02
0.03
200
150
100
50
0
0.09
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
Sep 21, 2020
Sep 22, 2020
Time
Precipitation
Excess Precipitation
Outflow

Junction: J 60B 61B

Downstream : 18r

Results: J 60B 61B

Peak Discharge (CFS)	393.35
Time of Peak Discharge	22Sep2020, 00:19
Volume (IN)	1.69



Reach: 18R

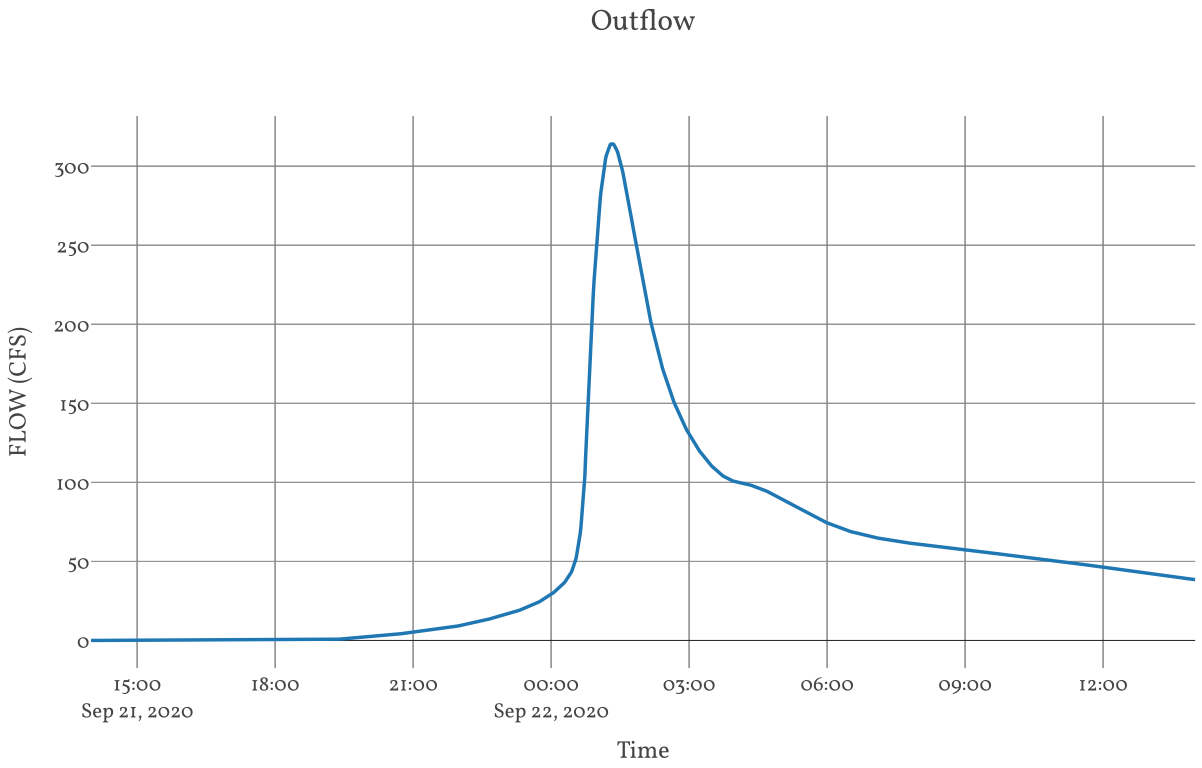
Downstream : 17c

Route: Modified Puls

Method	Modified Puls
Initial Variable	Combined Inflow
Number of Reaches	8
Storage Outflow Table Name	18r

Results: 18R

Peak Discharge (CFS)	314.24
Time of Peak Discharge	22Sep2020, 01:20
Volume (IN)	1.62
Peak Inflow (CFS)	393.35
Inflow Volume (AC - FT)	112.63



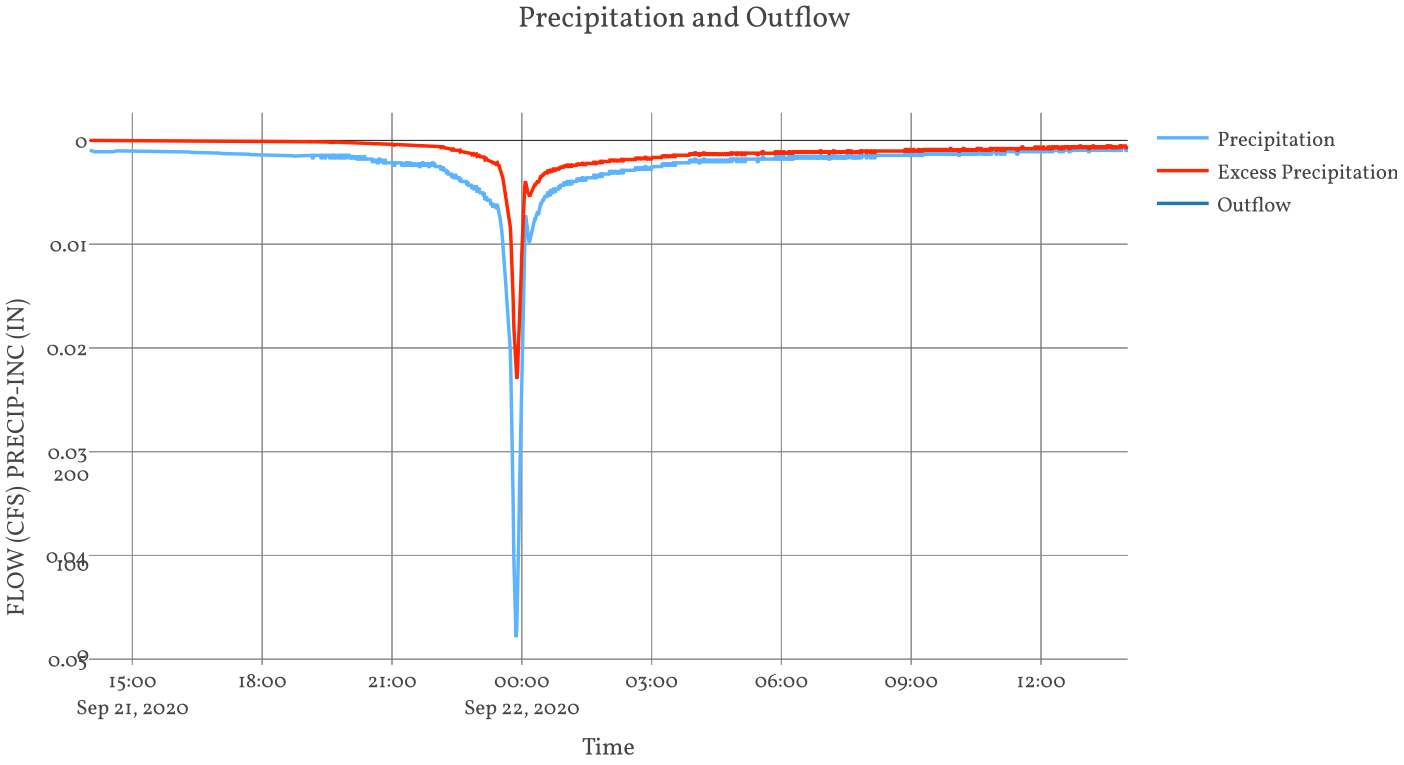
Subbasin: 62B

Area : 0.53
Downstream : 17c

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	73.9
Initial Abstraction	0.2

Transform: User - Specified S - Graph	
S - graph	Ellsworth S - Graph
Lag Method	Specified
Lag	0.25

Results: 62B	
Peak Discharge (CFS)	227.32
Time of Peak Discharge	22Sep2020, 00:08
Volume (IN)	1.65
Precipitation Volume (AC - FT)	100.92
Loss Volume (AC - FT)	54.17
Excess Volume (AC - FT)	46.75
Direct Runoff Volume (AC - FT)	46.32
Baseflow Volume (AC - FT)	0

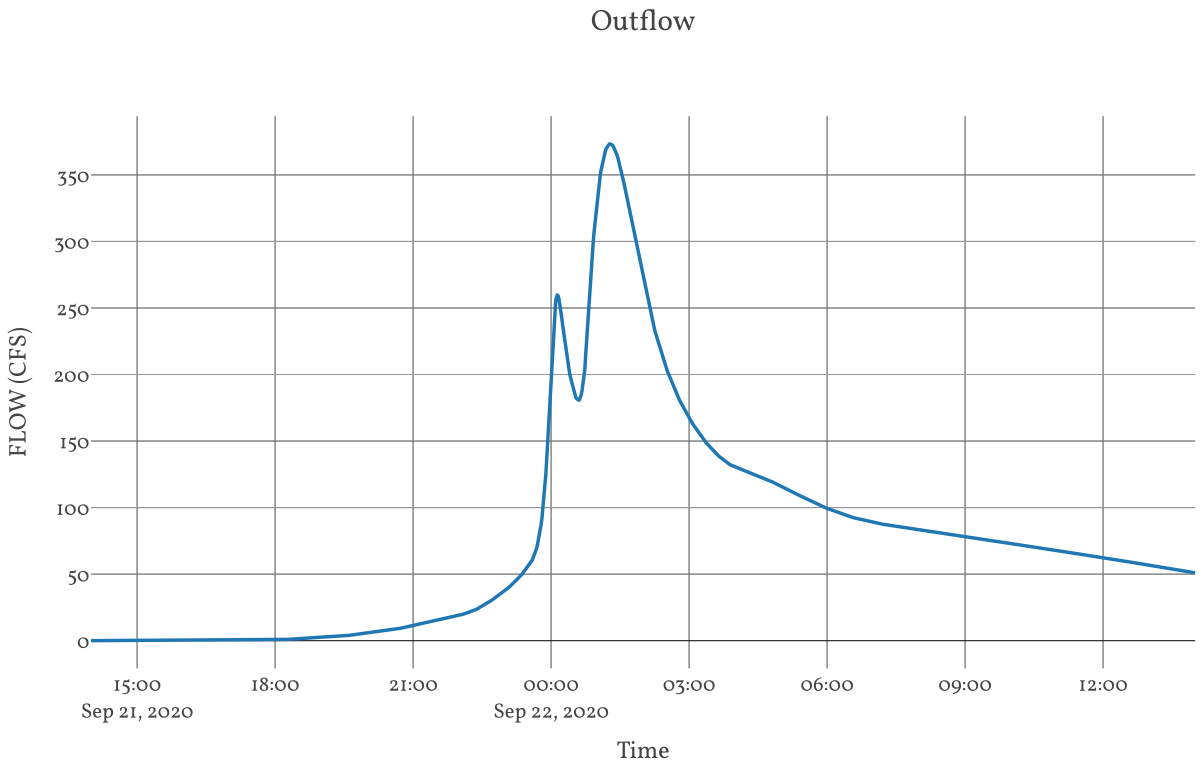

Precipitation and Outflow
FLOW (CFS) PRECIP-INC (IN)
0
0.01
0.02
0.03
0.04
0.05
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
Sep 21, 2020
Sep 22, 2020
Time
Precipitation
Excess Precipitation
Outflow

Junction: 17C

Downstream : 17r

Results: 17C

Peak Discharge (CFS)	373.3
Time of Peak Discharge	22Sep2020, 01:17
Volume (IN)	1.63



Reach: 17R

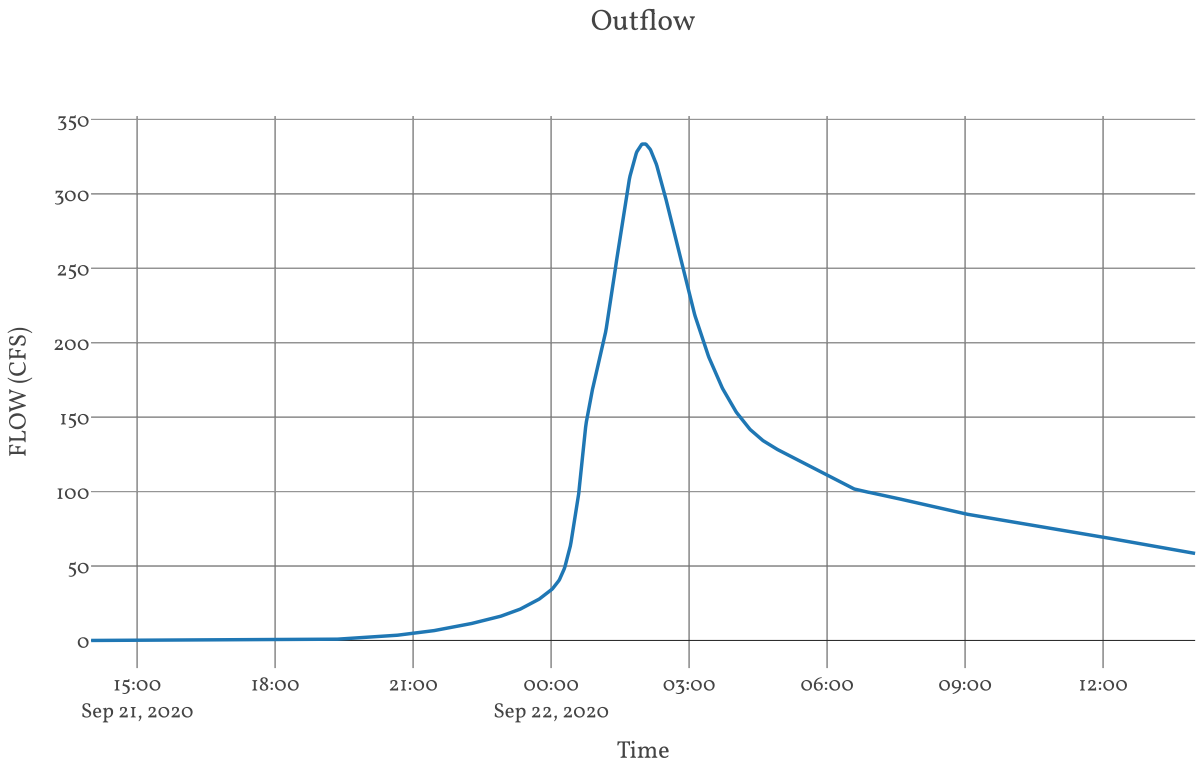
Downstream : 16c

Route: Modified Puls

Method	Modified Puls
Initial Variable	Combined Inflow
Number of Reaches	4
Storage Outflow Table Name	17r

Results: 17R

Peak Discharge (CFS)	333.71
Time of Peak Discharge	22Sep2020, 02:01
Volume (IN)	1.56
Peak Inflow (CFS)	373.3
Inflow Volume (AC - FT)	154.15



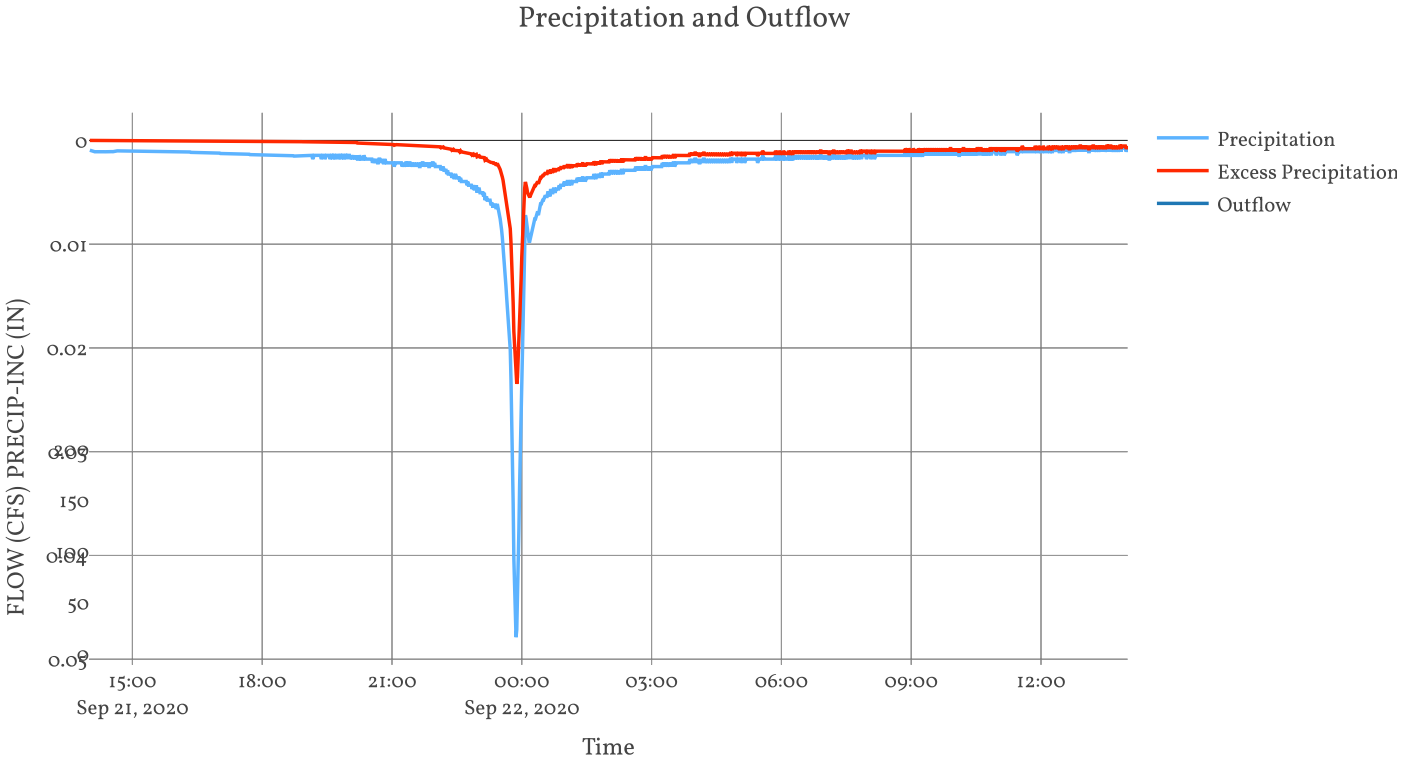
Subbasin: 63B

Area : 0.6
Downstream : 16c

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	74.6
Initial Abstraction	0.2

Transform: User - Specified S - Graph	
S - graph	Ellsworth S - Graph
Lag Method	Specified
Lag	0.41

Results: 63B	
Peak Discharge (CFS)	199.83
Time of Peak Discharge	22Sep2020, 00:18
Volume (IN)	1.67
Precipitation Volume (AC - FT)	115.58
Loss Volume (AC - FT)	61.04
Excess Volume (AC - FT)	54.54
Direct Runoff Volume (AC - FT)	53.71
Baseflow Volume (AC - FT)	0

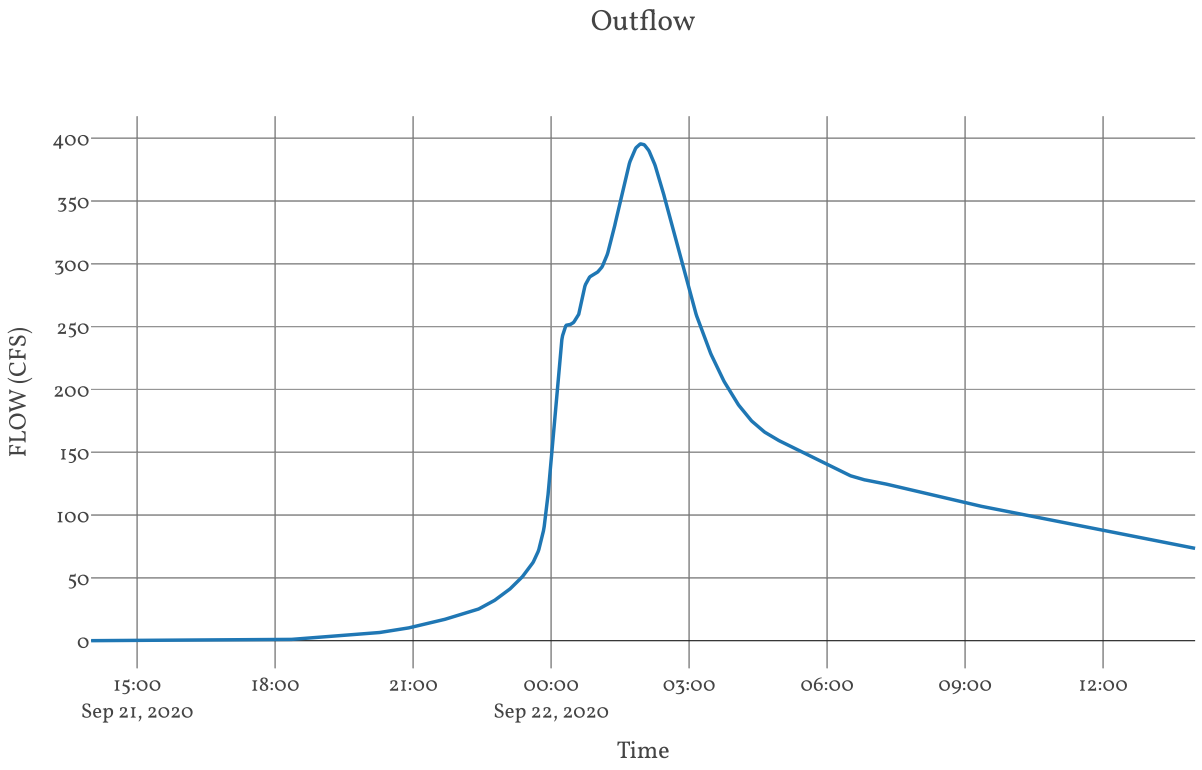

Precipitation and Outflow
FLOW (CFS) PRECIP-INC (IN)
0
0.01
0.02
0.03
0.04
0.05
150
100
50
0
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
Sep 21, 2020
Sep 22, 2020
Time
Precipitation
Excess Precipitation
Outflow

Junction: 16C

Downstream : 16r

Results: 16C

Peak Discharge (CFS)	395.47
Time of Peak Discharge	22Sep2020, 01:58
Volume (IN)	1.59



Reach: 16R

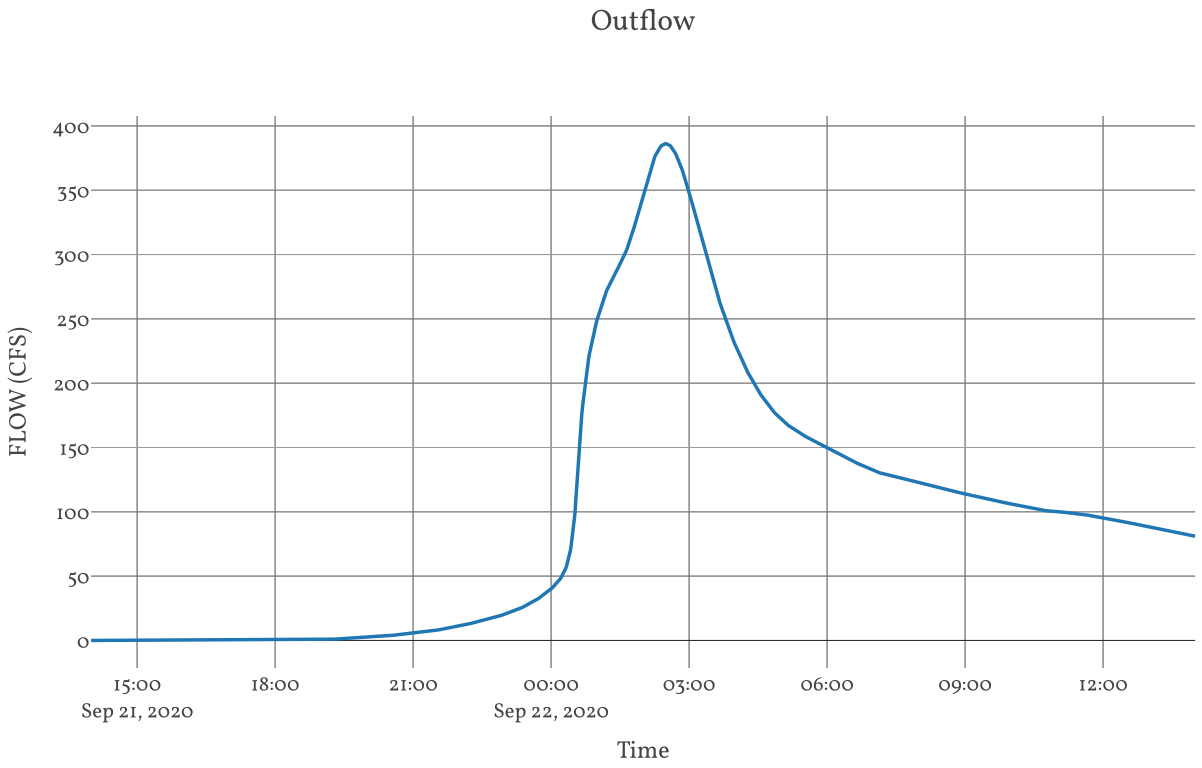
Downstream : 20C

Route: Modified Puls

Method	Modified Puls
Initial Variable	Combined Inflow
Number of Reaches	6
Storage Outflow Table Name	16r

Results: 16R

Peak Discharge (CFS)	386.19
Time of Peak Discharge	22Sep2020, 02:30
Volume (IN)	1.54
Peak Inflow (CFS)	395.47
Inflow Volume (AC - FT)	201.8



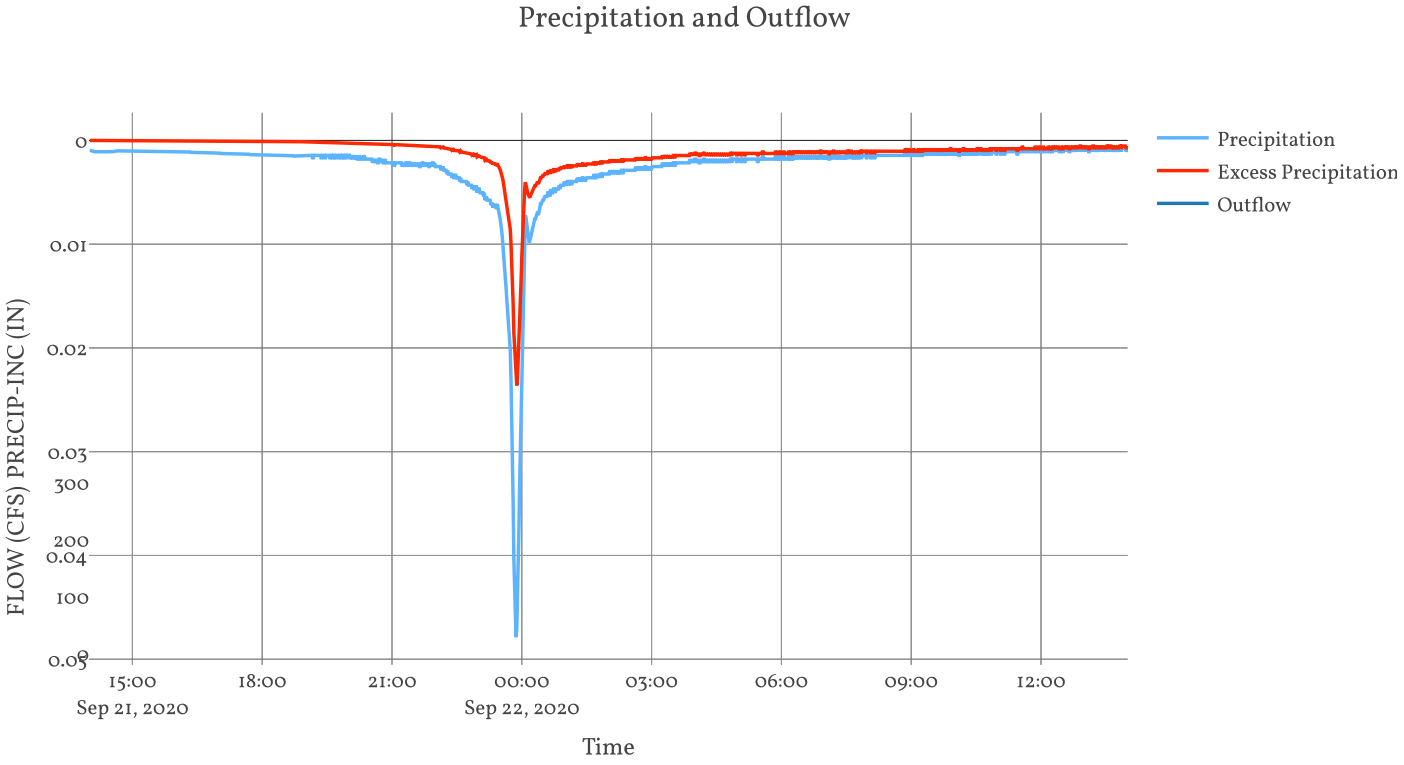
Subbasin: 64B

Area : 1.09
Downstream : 20c

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	74.8
Initial Abstraction	0.2

Transform: User - Specified S - Graph	
S - graph	Ellsworth S - Graph
Lag Method	Specified
Lag	0.42

Results: 64B	
Peak Discharge (CFS)	358.99
Time of Peak Discharge	22Sep2020, 00:18
Volume (IN)	1.68
Precipitation Volume (AC - FT)	209.28
Loss Volume (AC - FT)	110
Excess Volume (AC - FT)	99.28
Direct Runoff Volume (AC - FT)	97.73
Baseflow Volume (AC - FT)	0

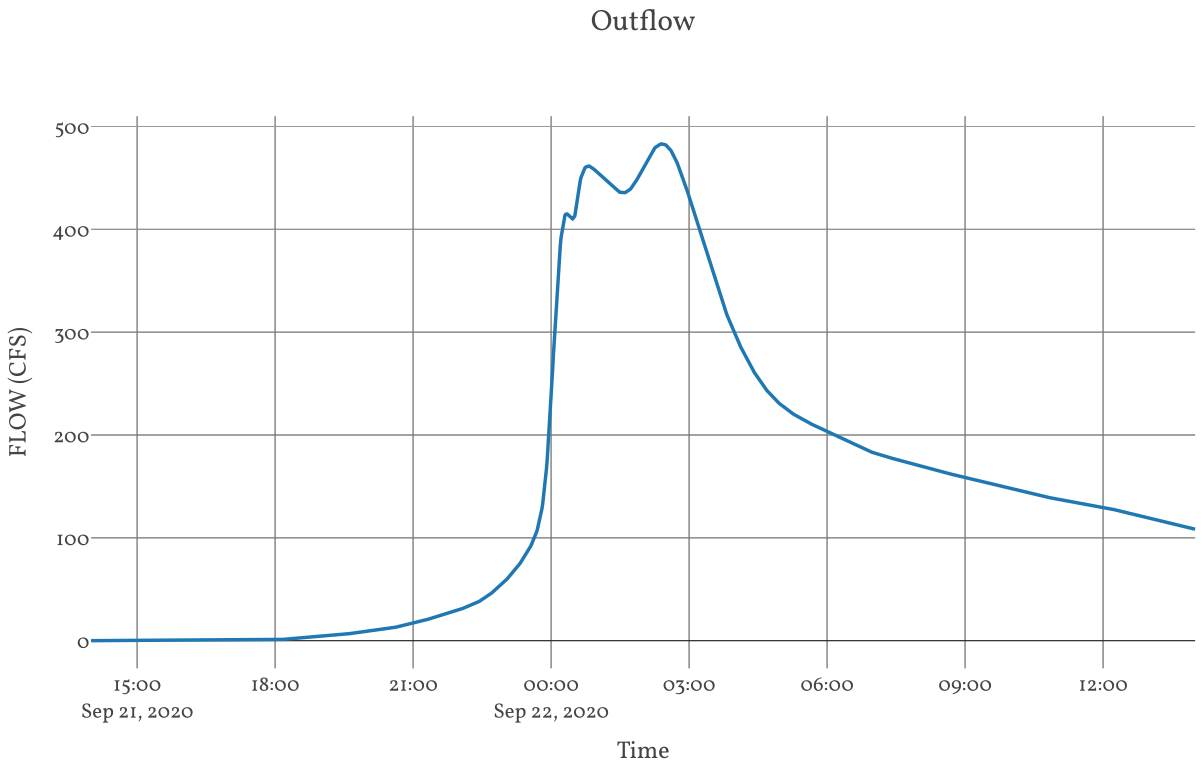

Precipitation and Outflow
FLOW (CFS) PRECIP-INC (IN)
0
0.01
0.02
0.03
300
200
0.04
100
0.05
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
Sep 21, 2020
Sep 22, 2020
Time
Precipitation
Excess Precipitation
Outflow

Junction: 20C

Downstream : 20r

Results: 20C

Peak Discharge (CFS)	483.09
Time of Peak Discharge	22Sep2020, 02:25
Volume (IN)	1.58



Reach: 20R

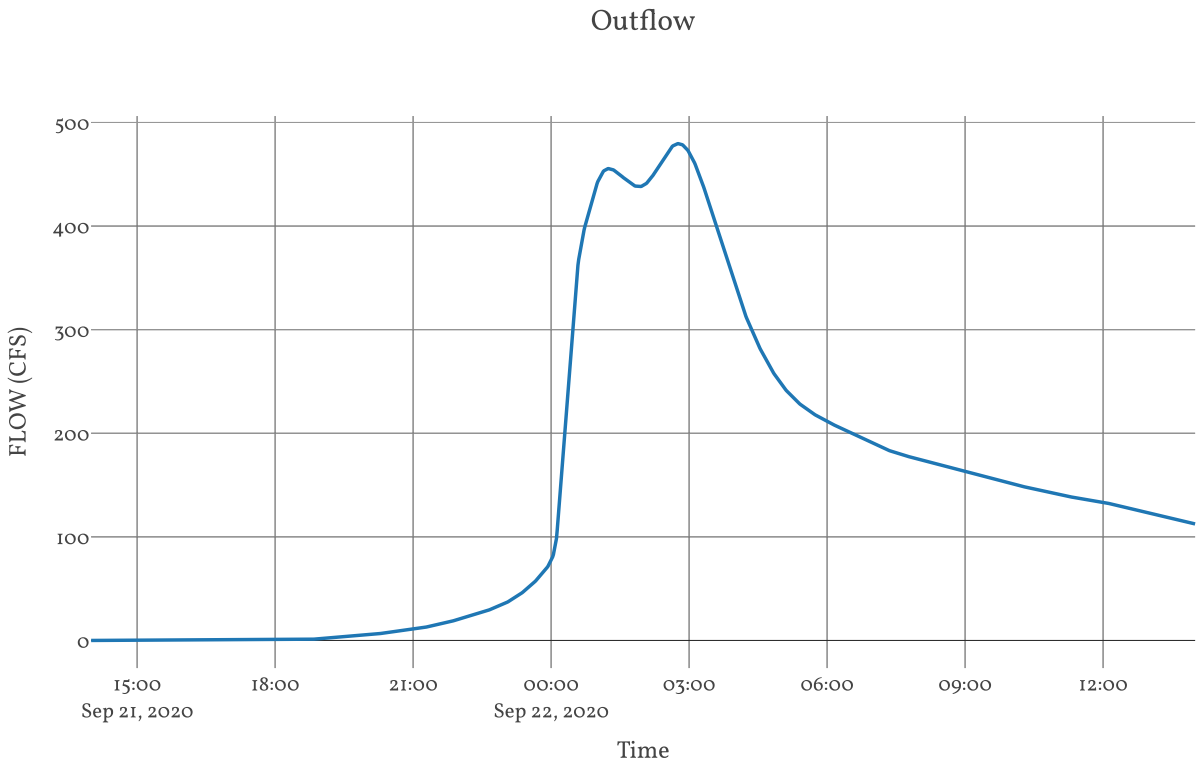
Downstream : 15c

Route: Modified Puls

Method	Modified Puls
Initial Variable	Combined Inflow
Number of Reaches	6
Storage Outflow Table Name	20r

Results: 20R

Peak Discharge (CFS)	479.54
Time of Peak Discharge	22Sep2020, 02:46
Volume (IN)	1.55
Peak Inflow (CFS)	483.09
Inflow Volume (AC - FT)	293.05



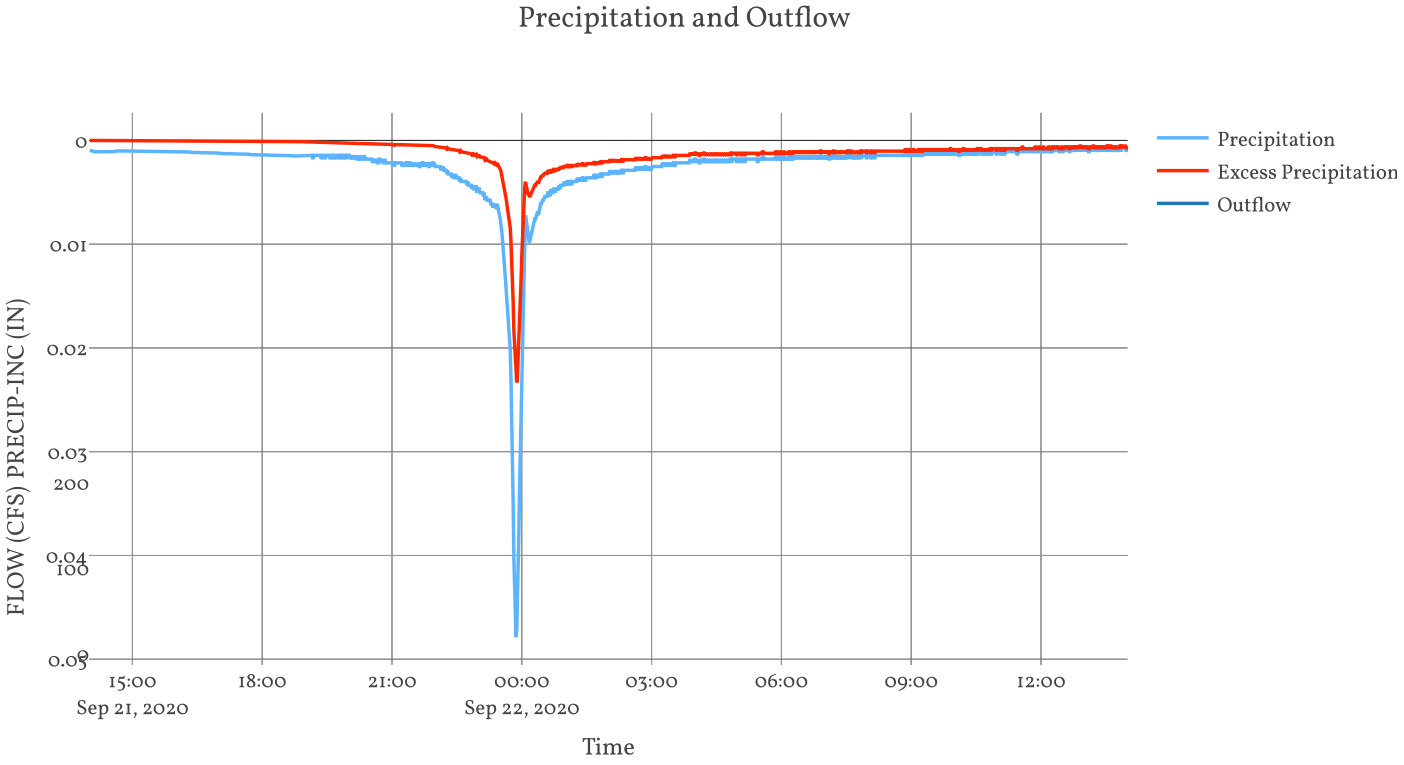
Subbasin: 65B

Area : 0.53
Downstream : 15c

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	74.4
Initial Abstraction	0.2

Transform: User - Specified S - Graph	
S - graph	Ellsworth S - Graph
Lag Method	Specified
Lag	0.24

Results: 65B	
Peak Discharge (CFS)	239.37
Time of Peak Discharge	22Sep2020, 00:07
Volume (IN)	1.68
Precipitation Volume (AC - FT)	102.34
Loss Volume (AC - FT)	54.3
Excess Volume (AC - FT)	48.04
Direct Runoff Volume (AC - FT)	47.62
Baseflow Volume (AC - FT)	0

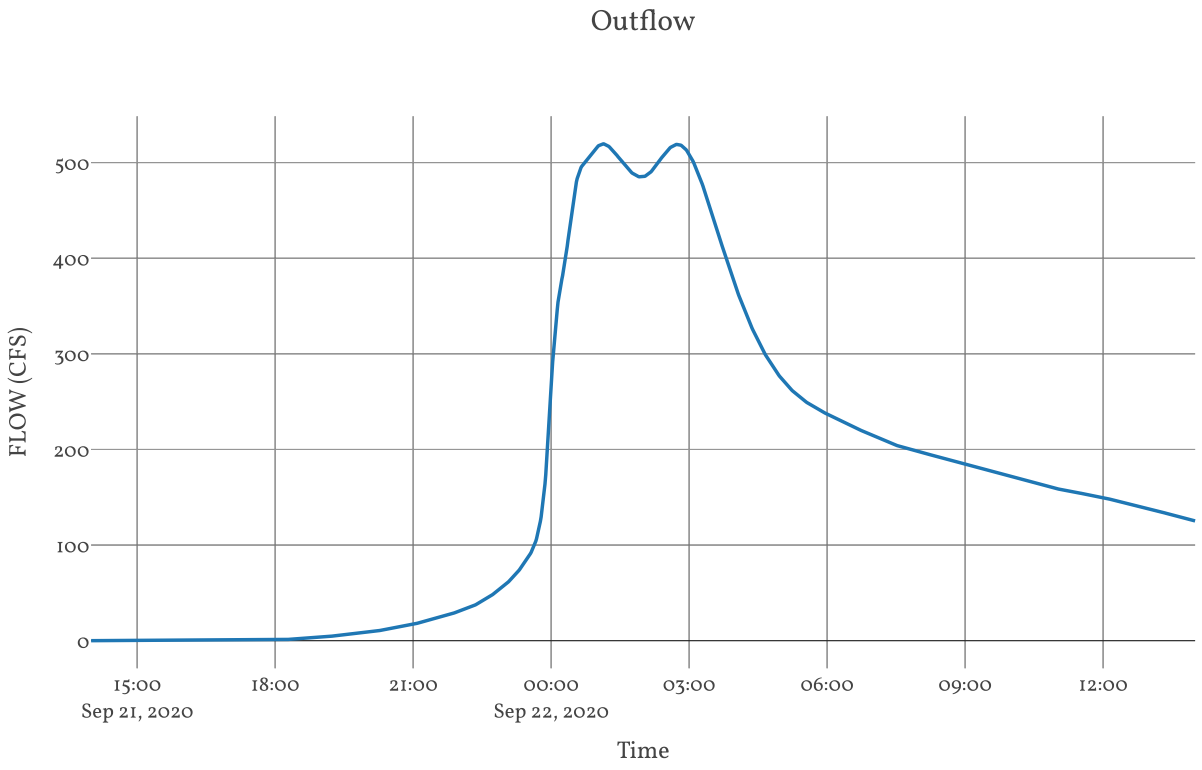

Precipitation and Outflow
FLOW (CFS) PRECIP-INC (IN)
0
0.01
0.02
0.03
200
0.04
100
0.05
0
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
Sep 21, 2020
Sep 22, 2020
Time
Precipitation
Excess Precipitation
Outflow

Junction: 15C

Downstream : 15r

Results: 15C

Peak Discharge (CFS)	519.57
Time of Peak Discharge	22Sep2020, 01:08
Volume (IN)	1.57



Reach: 15R

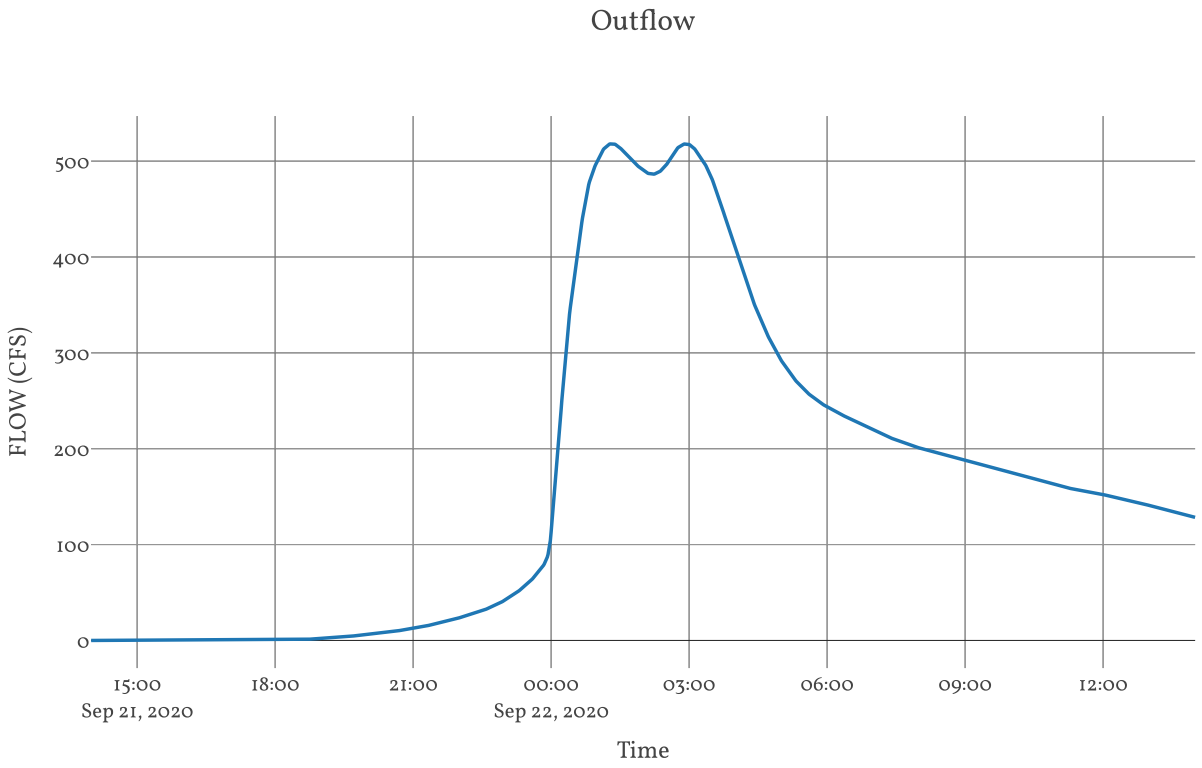
Downstream : 14c

Route: Modified Puls

Method	Modified Puls
Initial Variable	Combined Inflow
Number of Reaches	5
Storage Outflow Table Name	15r

Results: 15R

Peak Discharge (CFS)	518.2
Time of Peak Discharge	22Sep2020, 01:19
Volume (IN)	1.55
Peak Inflow (CFS)	519.57
Inflow Volume (AC - FT)	334.44



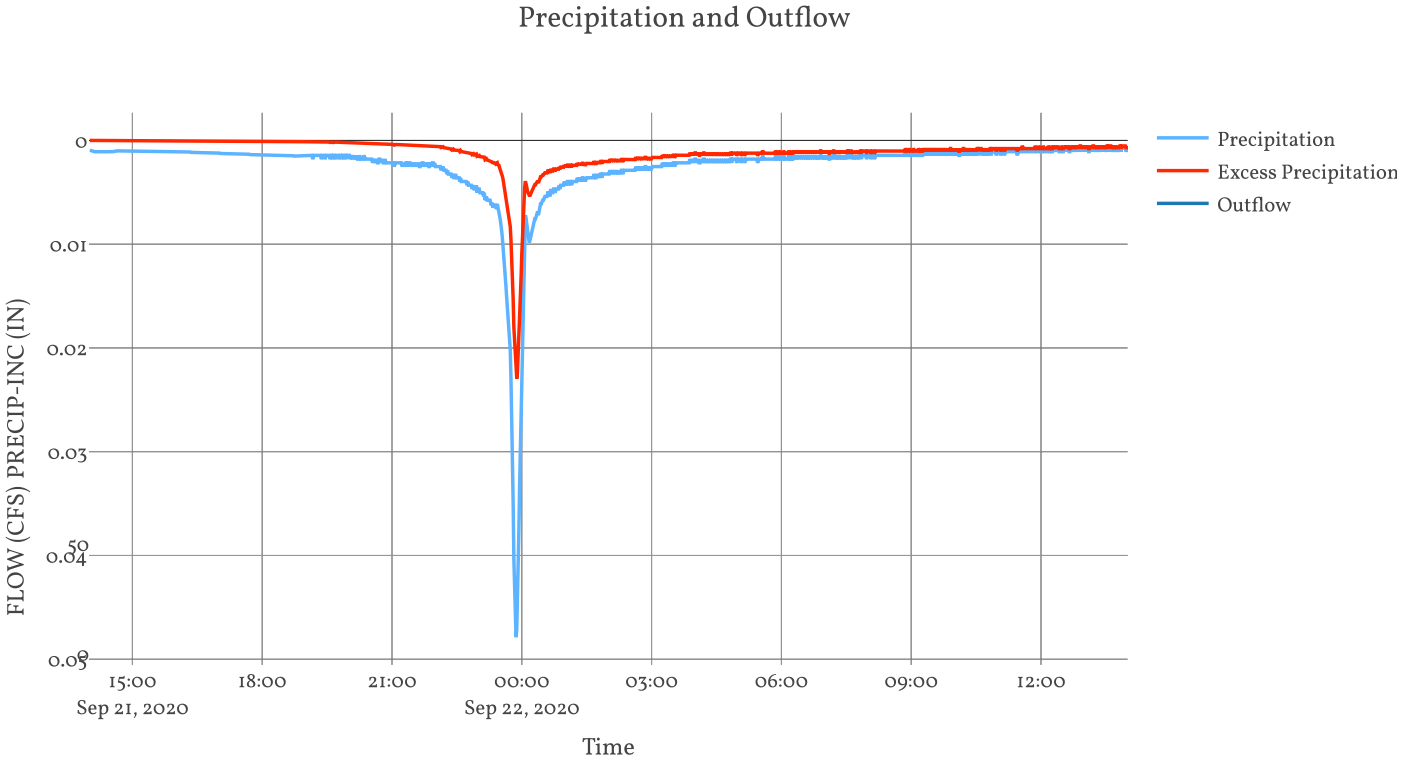
Subbasin: 66B

Area : 0.16
Downstream : 14c

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	73.9
Initial Abstraction	0.2

Transform: User - Specified S - Graph	
S - graph	Ellsworth S - Graph
Lag Method	Specified
Lag	0.14

Results: 66B	
Peak Discharge (CFS)	93.22
Time of Peak Discharge	22Sep2020, 00:02
Volume (IN)	1.66
Precipitation Volume (AC - FT)	31.1
Loss Volume (AC - FT)	16.7
Excess Volume (AC - FT)	14.41
Direct Runoff Volume (AC - FT)	14.34
Baseflow Volume (AC - FT)	0

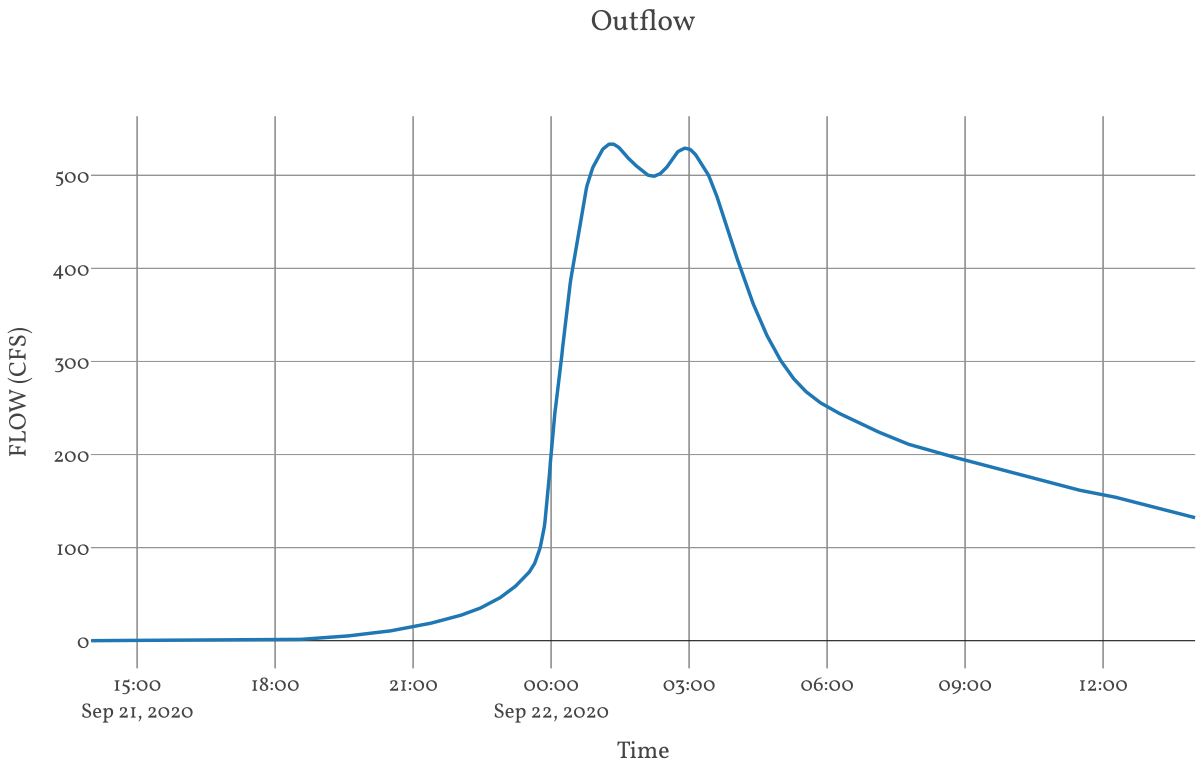

Precipitation and Outflow
FLOW (CFS) PRECIP-INC (IN)
0
0.01
0.02
0.03
0.04
0.05
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
Sep 21, 2020
Sep 22, 2020
Time
Precipitation
Excess Precipitation
Outflow

Junction: 14C

Downstream : 14r

Results: 14C

Peak Discharge (CFS)	533.79
Time of Peak Discharge	22Sep2020, 01:19
Volume (IN)	1.55



Reach: 14R

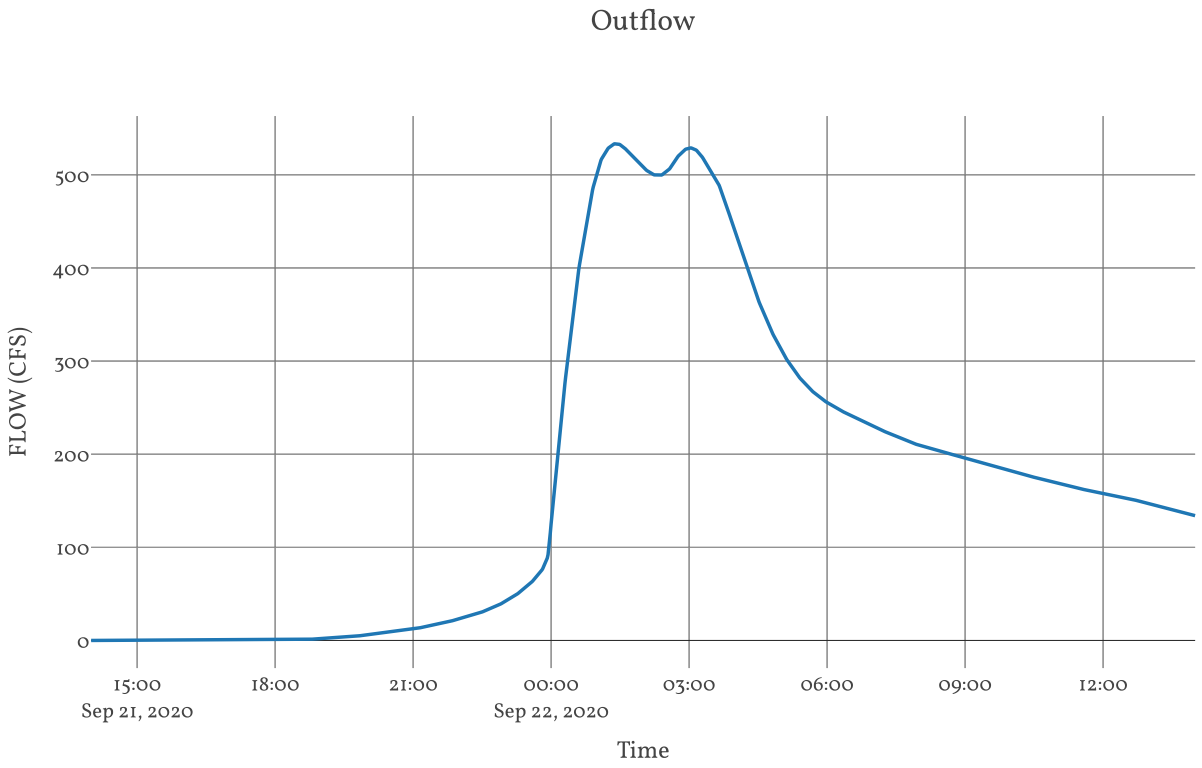
Downstream : 13c

Route: Modified Puls

Method	Modified Puls
Initial Variable	Combined Inflow
Number of Reaches	5
Storage Outflow Table Name	14r

Results: 14R

Peak Discharge (CFS)	533.43
Time of Peak Discharge	22Sep2020, 01:25
Volume (IN)	1.54
Peak Inflow (CFS)	533.79
Inflow Volume (AC - FT)	344.17



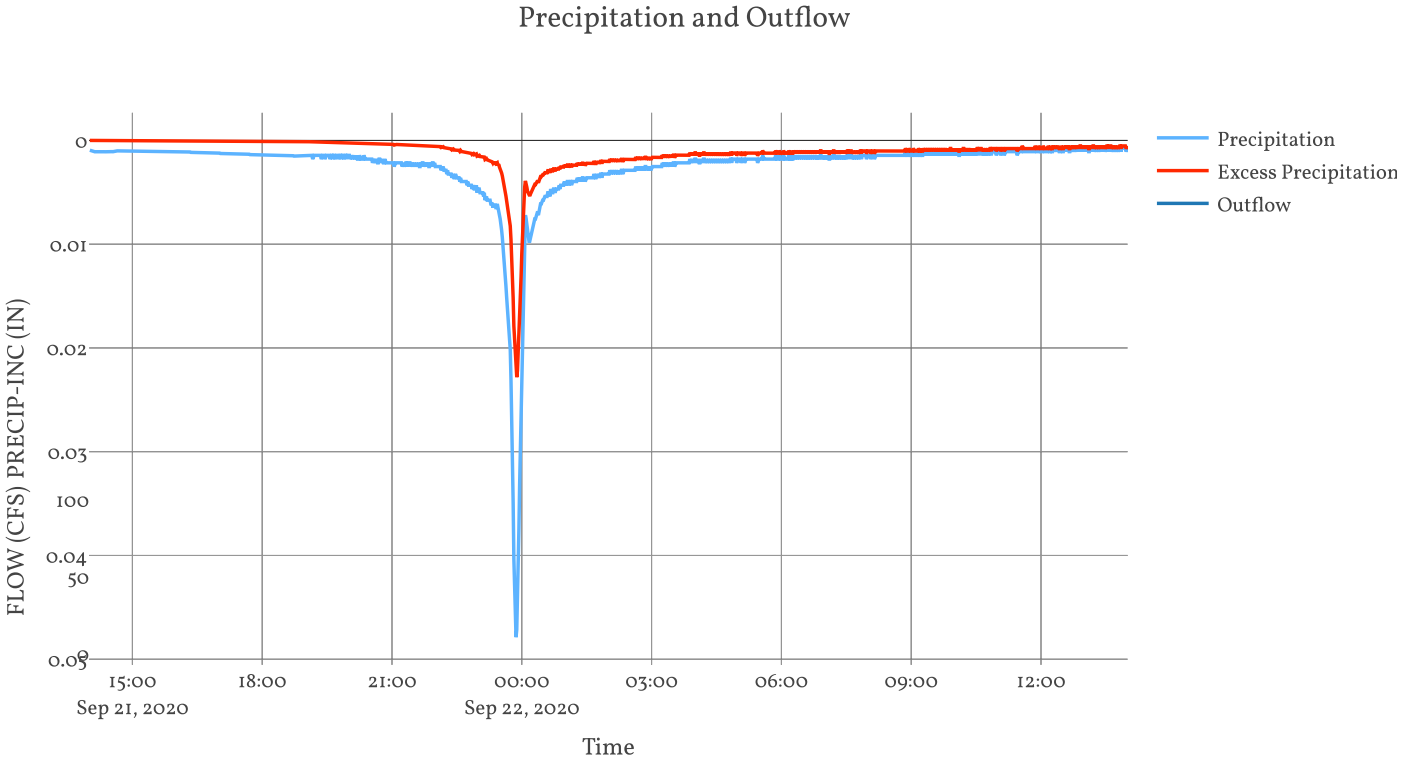
Subbasin: 67B

Area : 0.43
Downstream : 13c

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	73.7
Initial Abstraction	0.2

Transform: User - Specified S - Graph	
S - graph	Ellsworth S - Graph
Lag Method	Specified
Lag	0.44

Results: 67B	
Peak Discharge (CFS)	132.97
Time of Peak Discharge	22Sep2020, 00:20
Volume (IN)	1.63
Precipitation Volume (AC - FT)	82.56
Loss Volume (AC - FT)	44.52
Excess Volume (AC - FT)	38.04
Direct Runoff Volume (AC - FT)	37.41
Baseflow Volume (AC - FT)	0

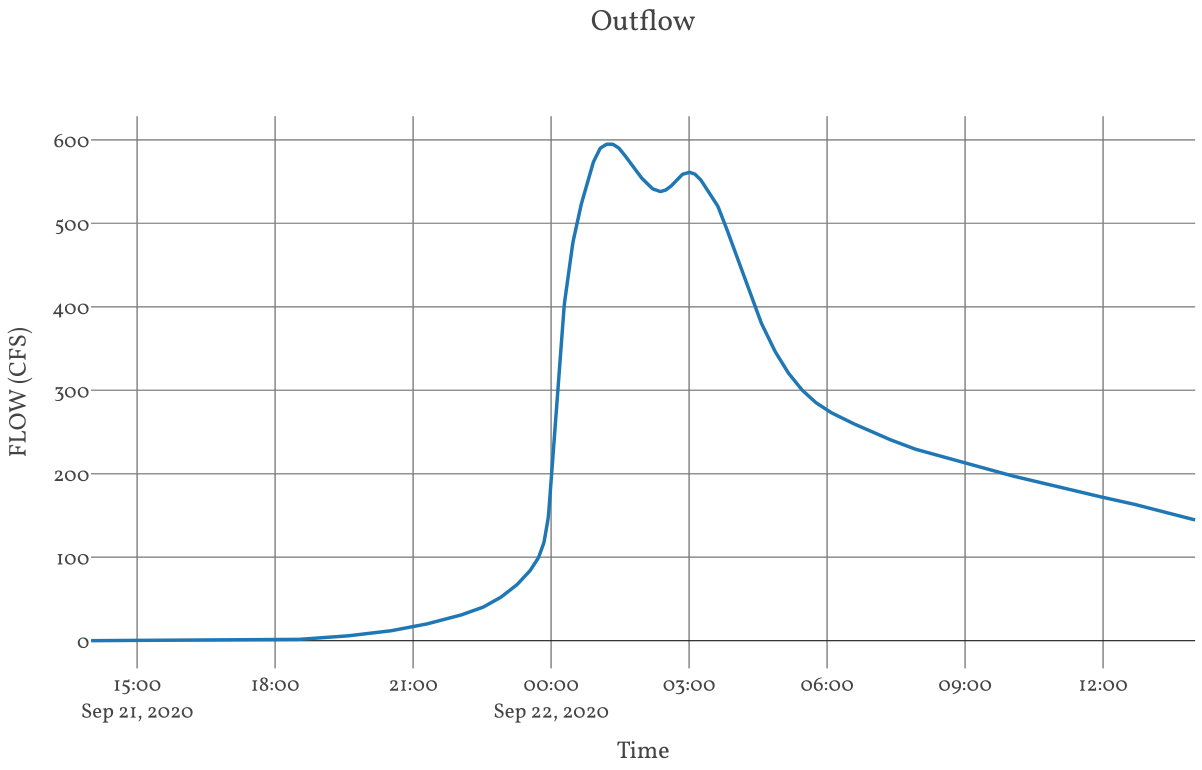

Precipitation and Outflow
FLOW (CFS) PRECIP-INC (IN)
0
0.01
0.02
0.03
100
0.04
50
0.05
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
Sep 21, 2020
Sep 22, 2020
Time
Precipitation
Excess Precipitation
Outflow

Junction: 13C

Downstream : 13r

Results: 13C

Peak Discharge (CFS)	595.2
Time of Peak Discharge	22Sep2020, 01:16
Volume (IN)	1.55



Reach: 13R

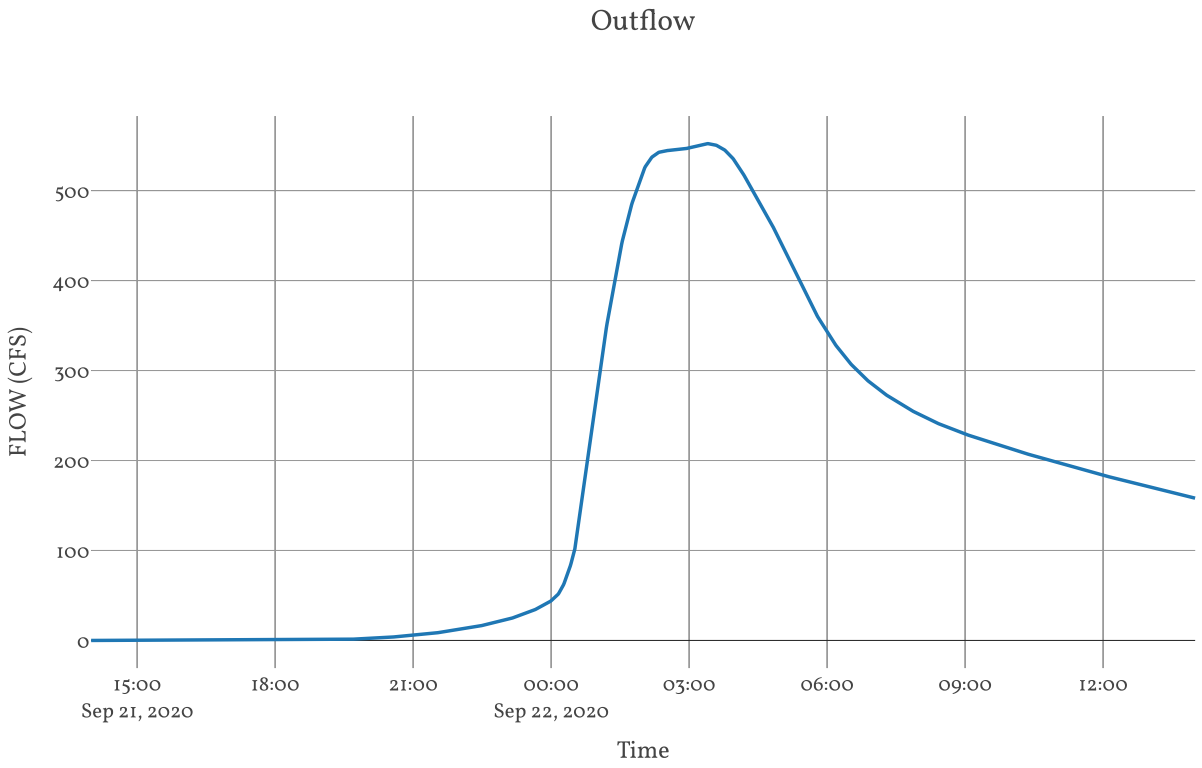
Downstream : 12C

Route: Modified Puls

Method	Modified Puls
Initial Variable	Combined Inflow
Number of Reaches	2
Storage Outflow Table Name	13r

Results: 13R

Peak Discharge (CFS)	552.12
Time of Peak Discharge	22Sep2020, 03:24
Volume (IN)	1.47
Peak Inflow (CFS)	595.2
Inflow Volume (AC - FT)	378.99



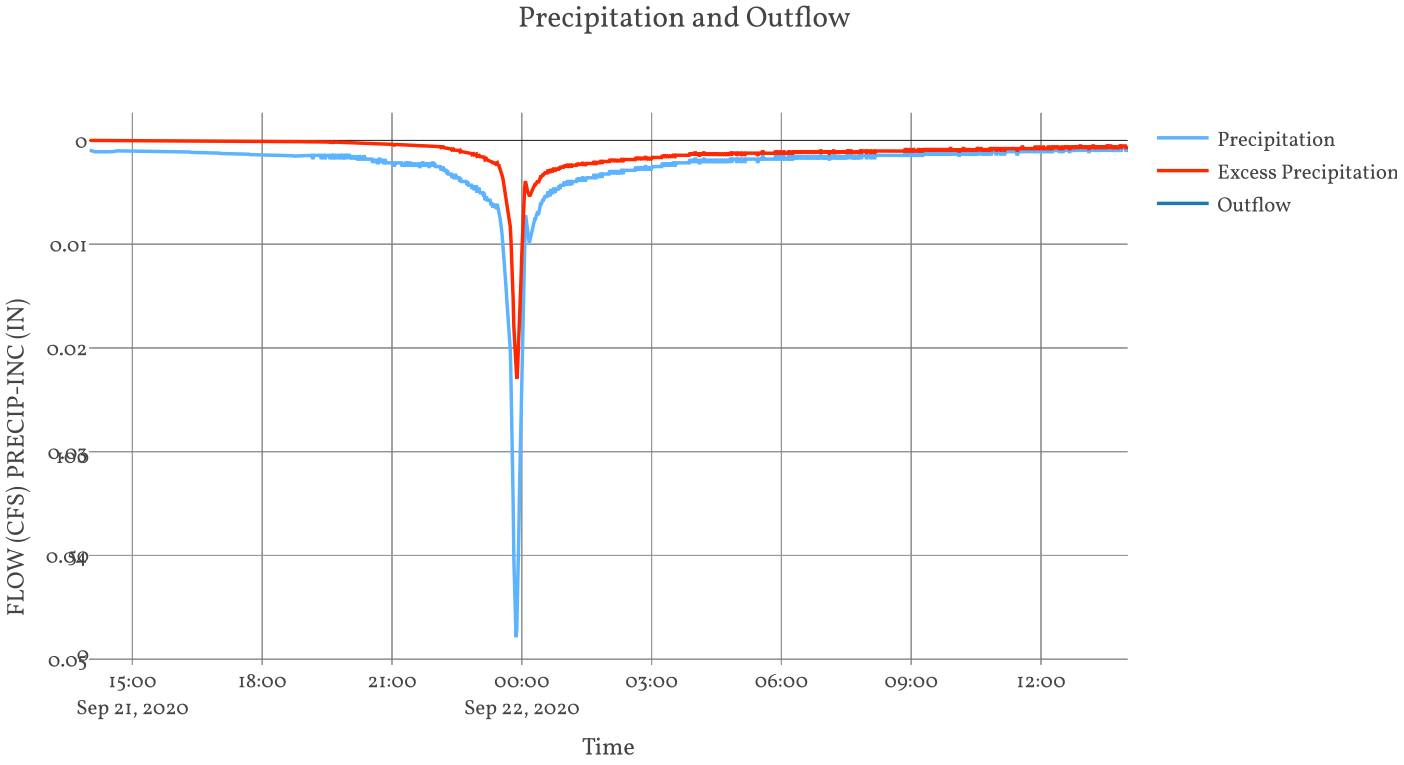
Subbasin: 68B

Area : 0.26
Downstream : 12c

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	73.9
Initial Abstraction	0.2

Transform: User - Specified S - Graph	
S - graph	Ellsworth S - Graph
Lag Method	Specified
Lag	0.28

Results: 68B	
Peak Discharge (CFS)	103.44
Time of Peak Discharge	22Sep2020, 00:10
Volume (IN)	1.65
Precipitation Volume (AC - FT)	48.96
Loss Volume (AC - FT)	26.28
Excess Volume (AC - FT)	22.68
Direct Runoff Volume (AC - FT)	22.45
Baseflow Volume (AC - FT)	0

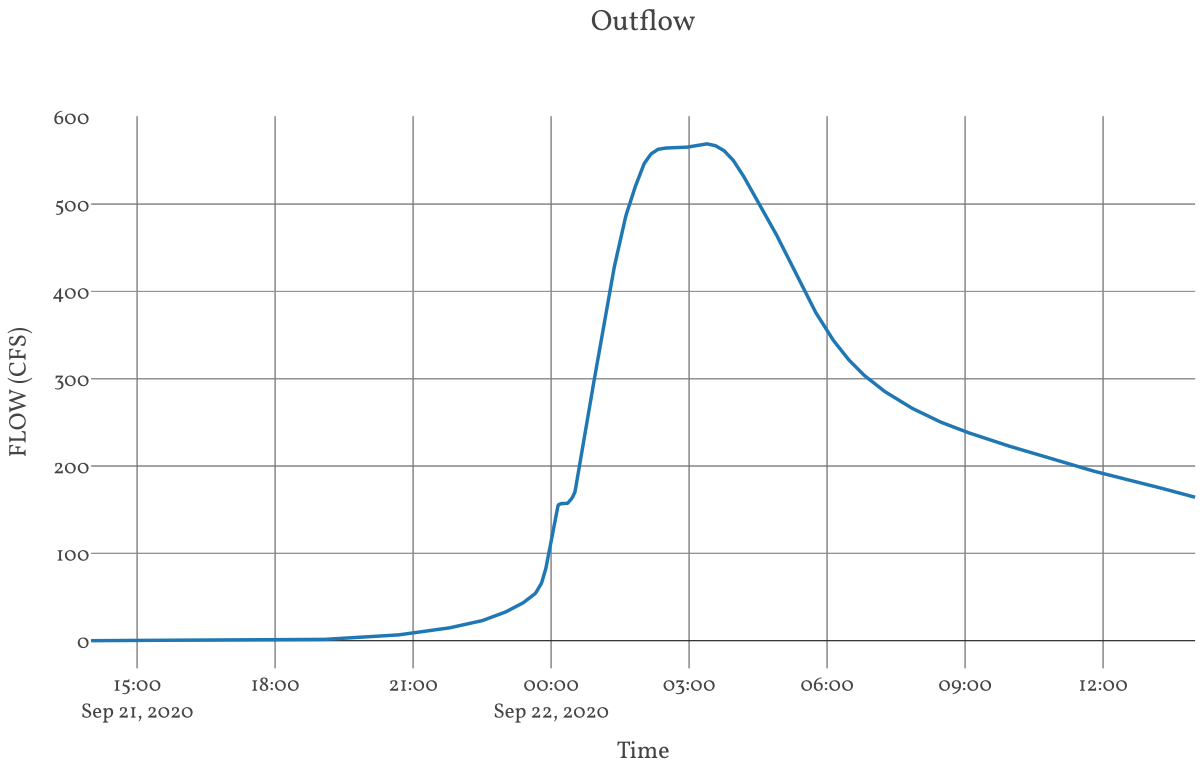

Precipitation and Outflow
FLOW (CFS) PRECIP-INC (IN)
0
0.01
0.02
0.03
0.04
0.05
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
Sep 21, 2020
Sep 22, 2020
Time
Precipitation
Excess Precipitation
Outflow

Junction: 12C

Downstream : Pacific Ocean

Results: 12C

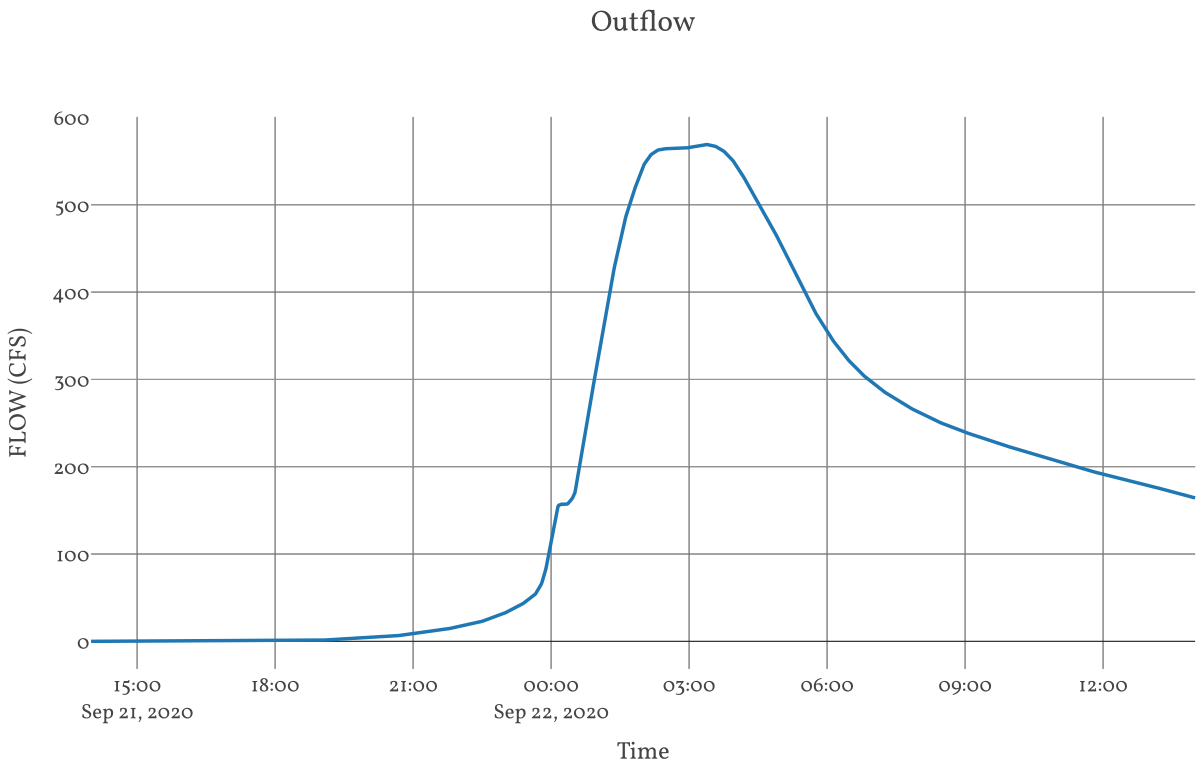
Peak Discharge (CFS)	568.97
Time of Peak Discharge	22Sep2020, 03:22
Volume (IN)	1.48



Sink: Pacific Ocean

Results: Pacific Ocean

Peak Discharge (CFS)	568.97
Time of Peak Discharge	22Sep2020, 03:22
Volume (IN)	1.48
Observed Flow Gage	Not specified
Observed Flow Volume (AC - FT)	Not specified
Observed Flow's RMSE Stdev	Not specified
Observed Flow's Percent Bias	Not specified
Observed Flow's Nash Sutcliffe	Not specified



Project: Little_Sycamore_May2021
Simulation Run: 005-mp-Post-Fire
Simulation Start: 21 September 2020, 14:00
Simulation End: 22 September 2020, 14:00

HMS Version: 4.6.1
Executed: 29 April 2021, 23:26

Global Parameter Summary - Subbasin

Area

Element Name	Area
60b	0.65
61b	0.61
62b	0.53
63b	0.6
64b	1.09
65b	0.53
66b	0.16
67b	0.43
68b	0.26

Downstream

Element Name	Downstream
60b	J 60b 61b
61b	J 60b 61b
62b	17c
63b	16c
64b	20c
65b	15c
66b	14c
67b	13c
68b	12c

Loss Rate: Scs

Element Name	Percent Impervious Area	Curve Number	Initial Abstraction
60b	0	75	0.2
61b	0	75	0.2
62b	0	73.9	0.2
63b	0	74.6	0.2
64b	0	74.8	0.2
65b	0	74.4	0.2
66b	0	73.9	0.2
67b	0	73.7	0.2
68b	0	73.9	0.2

Transform: User - Specified S - Graph

Element Name	S - graph	Lag Method	Lag
60b	Ellsworth S - Graph	Specified	0.52
61b	Ellsworth S - Graph	Specified	0.37
62b	Ellsworth S - Graph	Specified	0.25
63b	Ellsworth S - Graph	Specified	0.41
64b	Ellsworth S - Graph	Specified	0.42
65b	Ellsworth S - Graph	Specified	0.24
66b	Ellsworth S - Graph	Specified	0.14
67b	Ellsworth S - Graph	Specified	0.44
68b	Ellsworth S - Graph	Specified	0.28

Global Parameter Summary - Reach

Downstream

Element Name	Downstream
18r	17c
17r	16c
16r	20c
20r	15c
15r	14c
14r	13c
13r	12c

Route: Modified Puls

Element Name	Method	Initial Variable	Number of Reaches	Storage Outflow Table Name
18r	Modified Puls	Combined Inflow	8	18r
17r	Modified Puls	Combined Inflow	4	17r
16r	Modified Puls	Combined Inflow	6	16r
20r	Modified Puls	Combined Inflow	6	20r
15r	Modified Puls	Combined Inflow	5	15r
14r	Modified Puls	Combined Inflow	5	14r
13r	Modified Puls	Combined Inflow	2	13r

Global Results Summary

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
60b	0.65	299.05	22Sep2020, 00:24	2.6
61b	0.61	344.07	22Sep2020, 00:15	2.62
J 60b 61b	1.25	625.34	22Sep2020, 00:19	2.61
18r	1.25	502.51	22Sep2020, 01:13	2.5
62b	0.53	362.49	22Sep2020, 00:08	2.56
17c	1.78	599.85	22Sep2020, 01:11	2.52
17r	1.78	552.97	22Sep2020, 01:47	2.43
63b	0.6	318.15	22Sep2020, 00:17	2.59
16c	2.38	656.9	22Sep2020, 01:44	2.47
16r	2.38	644.4	22Sep2020, 02:08	2.4
64b	1.09	571.11	22Sep2020, 00:18	2.6
20c	3.47	809.6	22Sep2020, 02:04	2.46
20r	3.47	805.05	22Sep2020, 02:20	2.42
65b	0.53	380.96	22Sep2020, 00:07	2.59
15c	4	897.56	22Sep2020, 00:44	2.45
15r	4	894.79	22Sep2020, 01:00	2.42
66b	0.16	148.29	22Sep2020, 00:02	2.57
14c	4.16	922.42	22Sep2020, 00:58	2.42
14r	4.16	921.68	22Sep2020, 01:05	2.41
67b	0.43	212.62	22Sep2020, 00:19	2.53
13c	4.59	1044.93	22Sep2020, 00:59	2.42
13r	4.59	947.29	22Sep2020, 02:07	2.32
68b	0.26	164.98	22Sep2020, 00:10	2.56

12c	4.85	980.2	22Sep2020, 02:04	2.33
Pacific Ocean	4.85	980.2	22Sep2020, 02:04	2.33

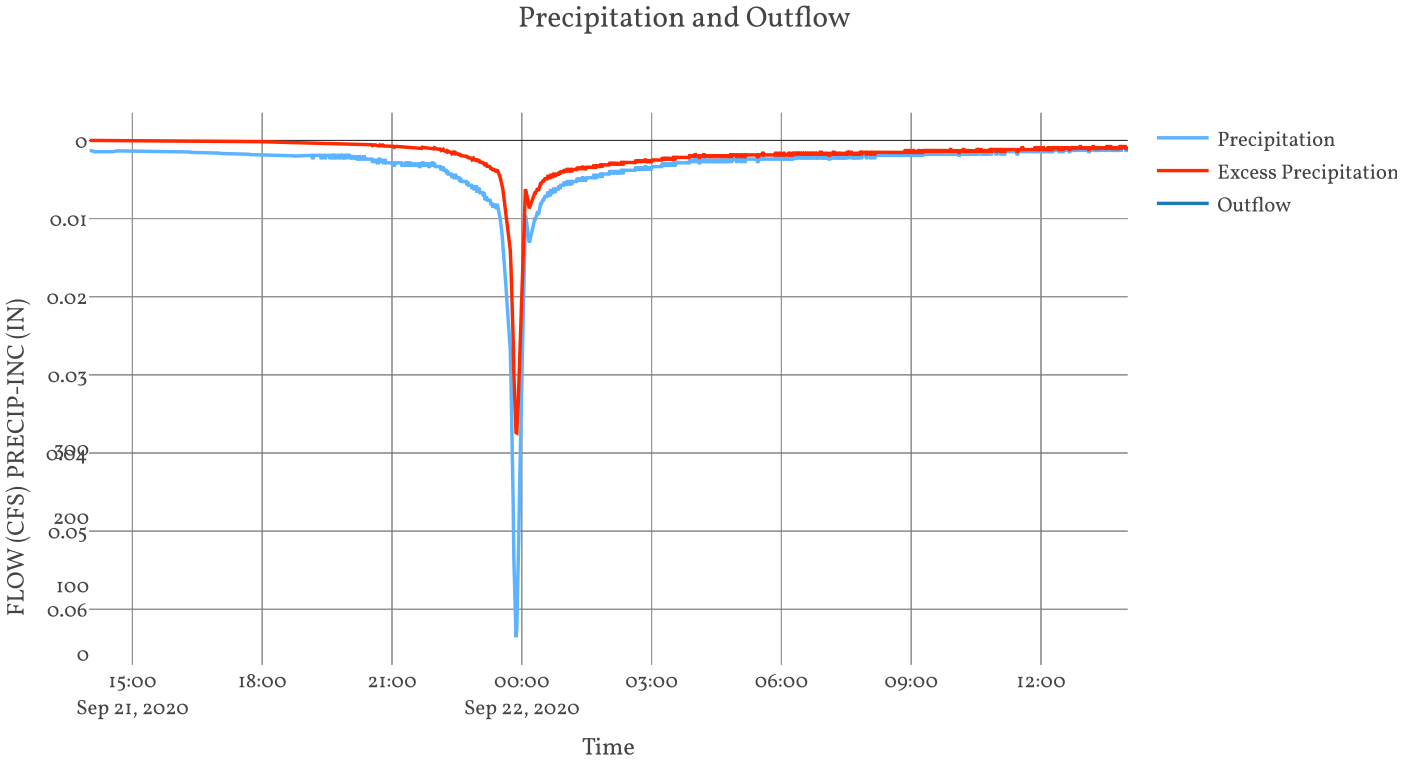
Subbasin: 60B

Area : 0.65
Downstream : J 60b 61b

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	75
Initial Abstraction	0.2

Transform: User - Specified S - Graph	
S - graph	Ellsworth S - Graph
Lag Method	Specified
Lag	0.52

Results: 60B	
Peak Discharge (CFS)	299.05
Time of Peak Discharge	22Sep2020, 00:24
Volume (IN)	2.6
Precipitation Volume (AC - FT)	164.43
Loss Volume (AC - FT)	73.25
Excess Volume (AC - FT)	91.19
Direct Runoff Volume (AC - FT)	89.51
Baseflow Volume (AC - FT)	0


Precipitation and Outflow
FLOW (CFS) PRECIP-INC (IN)
0
0.01
0.02
0.03
0.04
0.05
0.06
300
200
100
0
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
Sep 21, 2020
Sep 22, 2020
Time
Precipitation
Excess Precipitation
Outflow

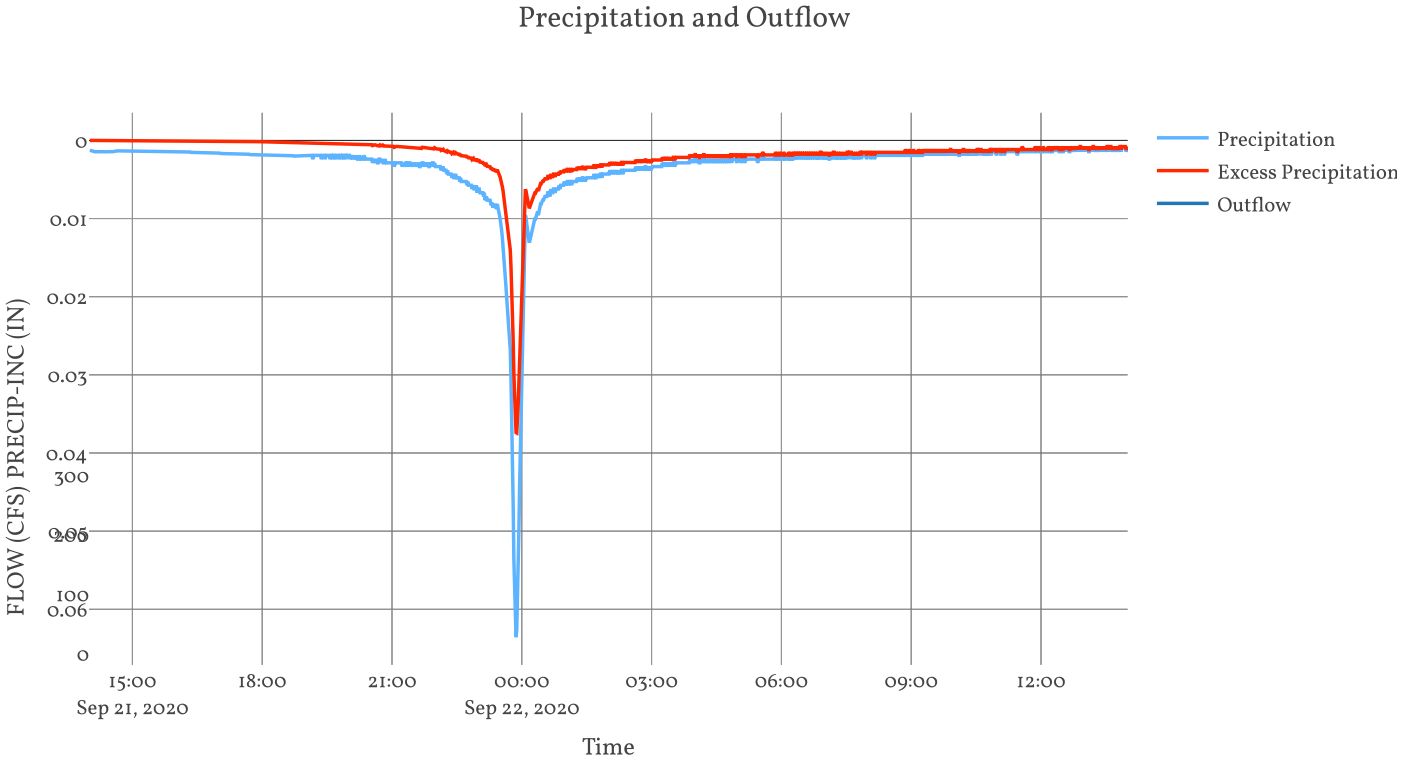
Subbasin: 61B

Area : 0.61
Downstream : J 60b 61b

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	75
Initial Abstraction	0.2

Transform: User - Specified S - Graph	
S - graph	Ellsworth S - Graph
Lag Method	Specified
Lag	0.37

Results: 61B	
Peak Discharge (CFS)	344.07
Time of Peak Discharge	22Sep2020, 00:15
Volume (IN)	2.62
Precipitation Volume (AC - FT)	154.49
Loss Volume (AC - FT)	68.82
Excess Volume (AC - FT)	85.67
Direct Runoff Volume (AC - FT)	84.58
Baseflow Volume (AC - FT)	0

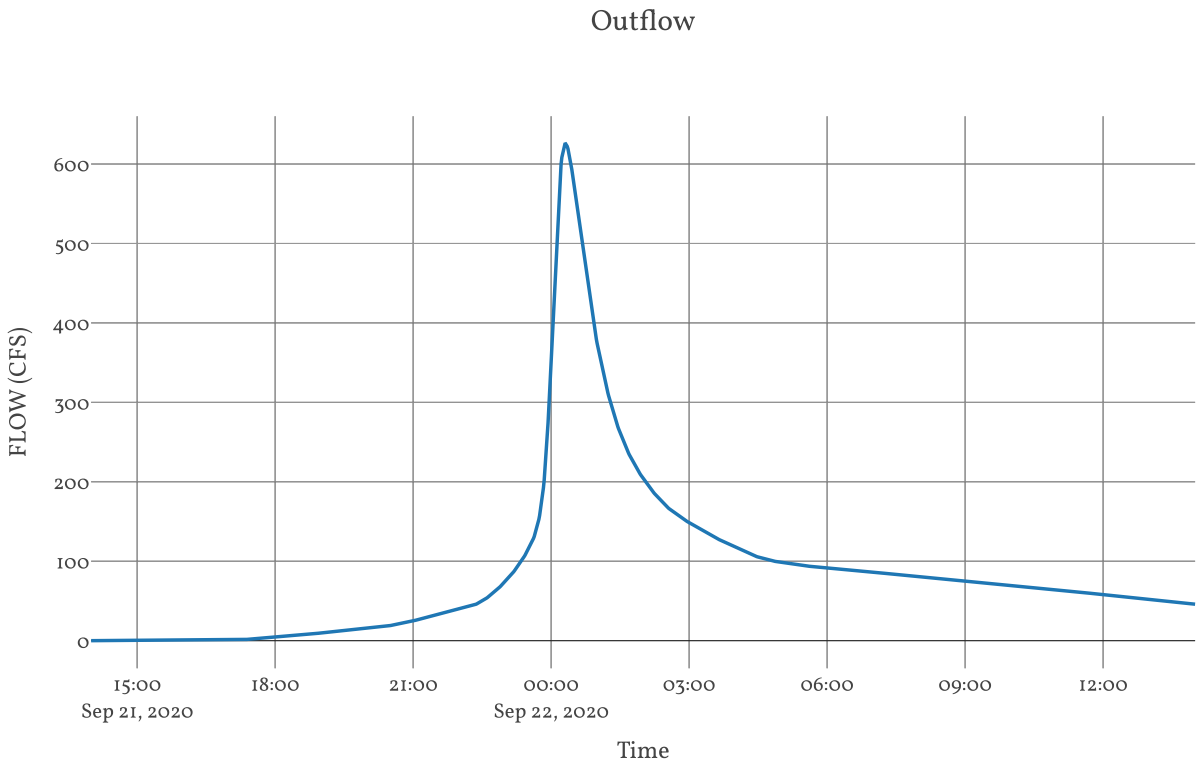

Precipitation and Outflow
FLOW (CFS) PRECIP-INC (IN)
0
0.01
0.02
0.03
0.04
300
200
100
0.06
0
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
Sep 21, 2020
Sep 22, 2020
Time
Precipitation
Excess Precipitation
Outflow

Junction: J 60B 61B

Downstream : 18r

Results: J 60B 61B

Peak Discharge (CFS)	625.34
Time of Peak Discharge	22Sep2020, 00:19
Volume (IN)	2.61



Reach: 18R

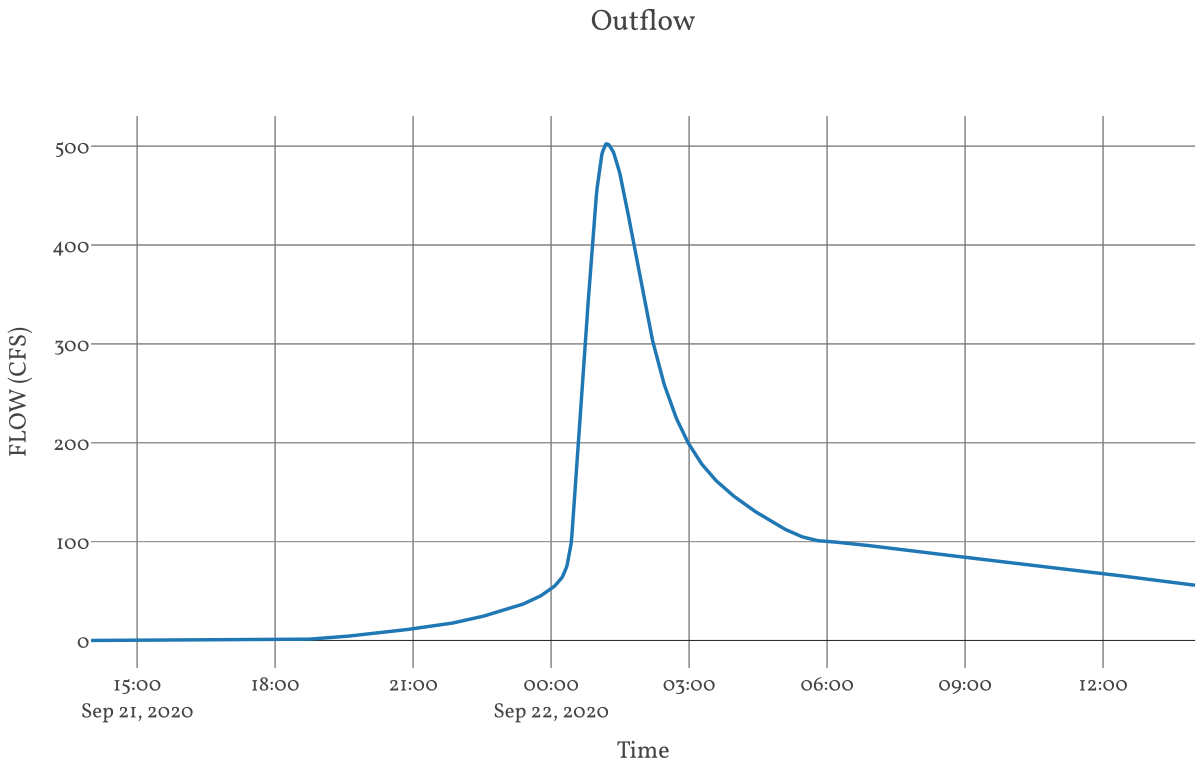
Downstream : 17c

Route: Modified Puls

Method	Modified Puls
Initial Variable	Combined Inflow
Number of Reaches	8
Storage Outflow Table Name	18r

Results: 18R

Peak Discharge (CFS)	502.51
Time of Peak Discharge	22Sep2020, 01:13
Volume (IN)	2.5
Peak Inflow (CFS)	625.34
Inflow Volume (AC - FT)	174.09



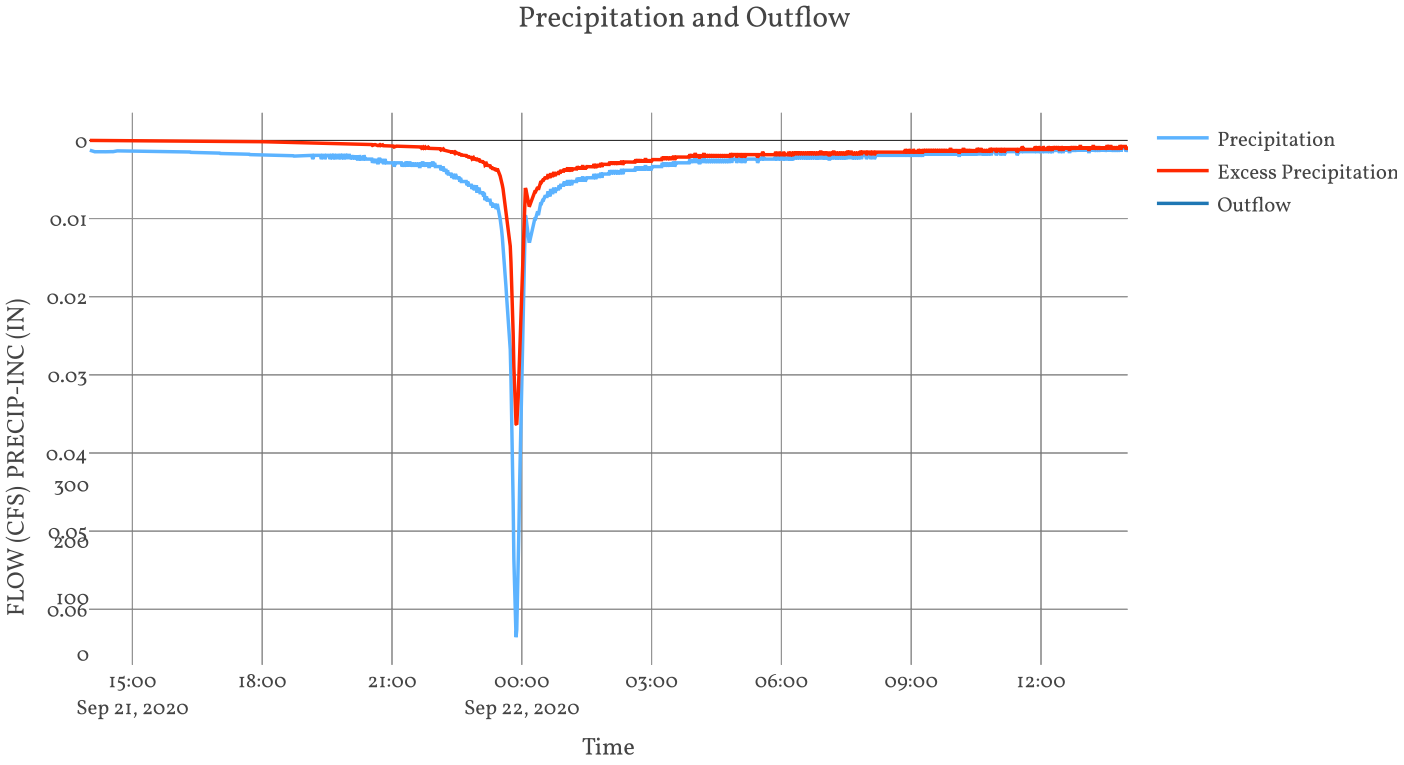
Subbasin: 62B

Area : 0.53
Downstream : 17c

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	73.9
Initial Abstraction	0.2

Transform: User - Specified S - Graph	
S - graph	Ellsworth S - Graph
Lag Method	Specified
Lag	0.25

Results: 62B	
Peak Discharge (CFS)	362.49
Time of Peak Discharge	22Sep2020, 00:08
Volume (IN)	2.56
Precipitation Volume (AC - FT)	133.99
Loss Volume (AC - FT)	61.5
Excess Volume (AC - FT)	72.49
Direct Runoff Volume (AC - FT)	71.87
Baseflow Volume (AC - FT)	0

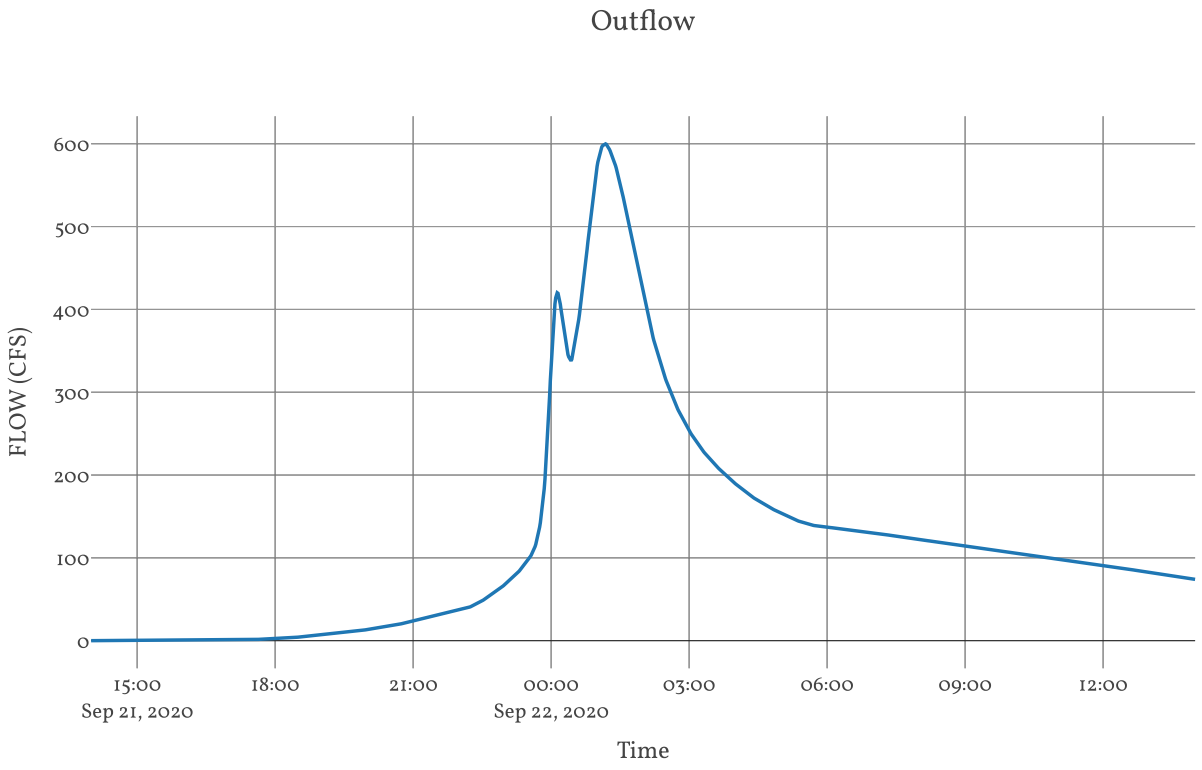

Precipitation and Outflow
FLOW (CFS) PRECIP-INC (IN)
0
0.01
0.02
0.03
0.04
300
0.05
200
100
0.06
0
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
Sep 21, 2020
Sep 22, 2020
Time
Precipitation
Excess Precipitation
Outflow

Junction: 17C

Downstream : 17r

Results: 17C

Peak Discharge (CFS)	599.85
Time of Peak Discharge	22Sep2020, 01:11
Volume (IN)	2.52



Reach: 17R

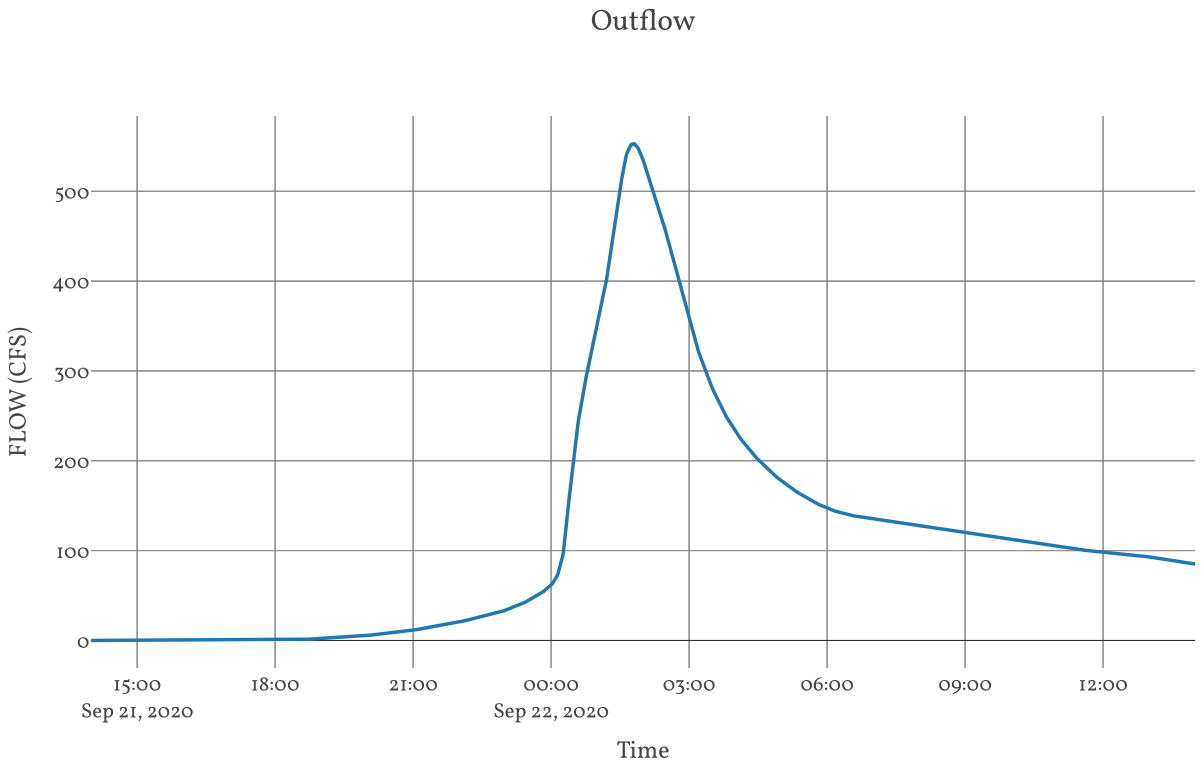
Downstream : 16c

Route: Modified Puls

Method	Modified Puls
Initial Variable	Combined Inflow
Number of Reaches	4
Storage Outflow Table Name	17r

Results: 17R

Peak Discharge (CFS)	552.97
Time of Peak Discharge	22Sep2020, 01:47
Volume (IN)	2.43
Peak Inflow (CFS)	599.85
Inflow Volume (AC - FT)	238.98



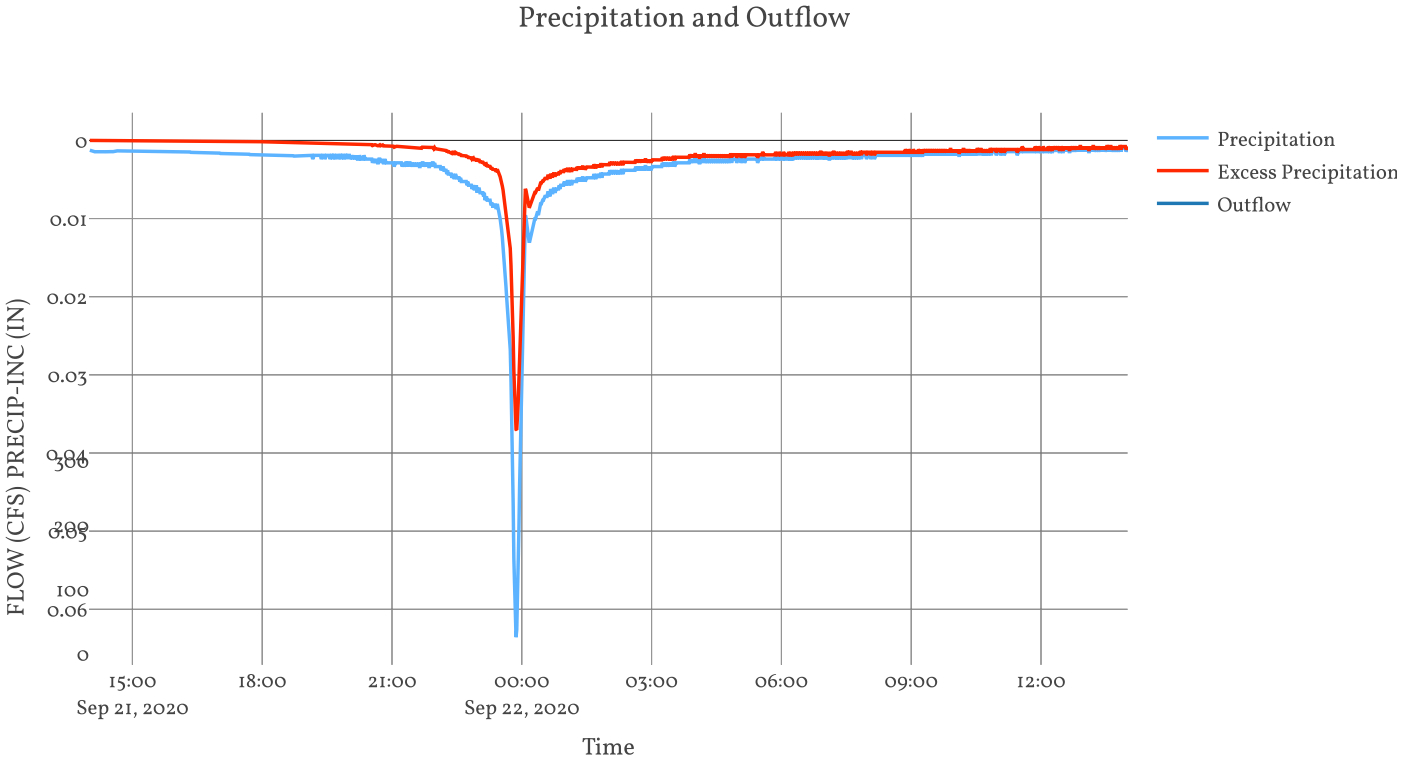
Subbasin: 63B

Area : 0.6
Downstream : 16c

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	74.6
Initial Abstraction	0.2

Transform: User - Specified S - Graph	
S - graph	Ellsworth S - Graph
Lag Method	Specified
Lag	0.41

Results: 63B	
Peak Discharge (CFS)	318.15
Time of Peak Discharge	22Sep2020, 00:17
Volume (IN)	2.59
Precipitation Volume (AC - FT)	153.47
Loss Volume (AC - FT)	69.12
Excess Volume (AC - FT)	84.35
Direct Runoff Volume (AC - FT)	83.14
Baseflow Volume (AC - FT)	0

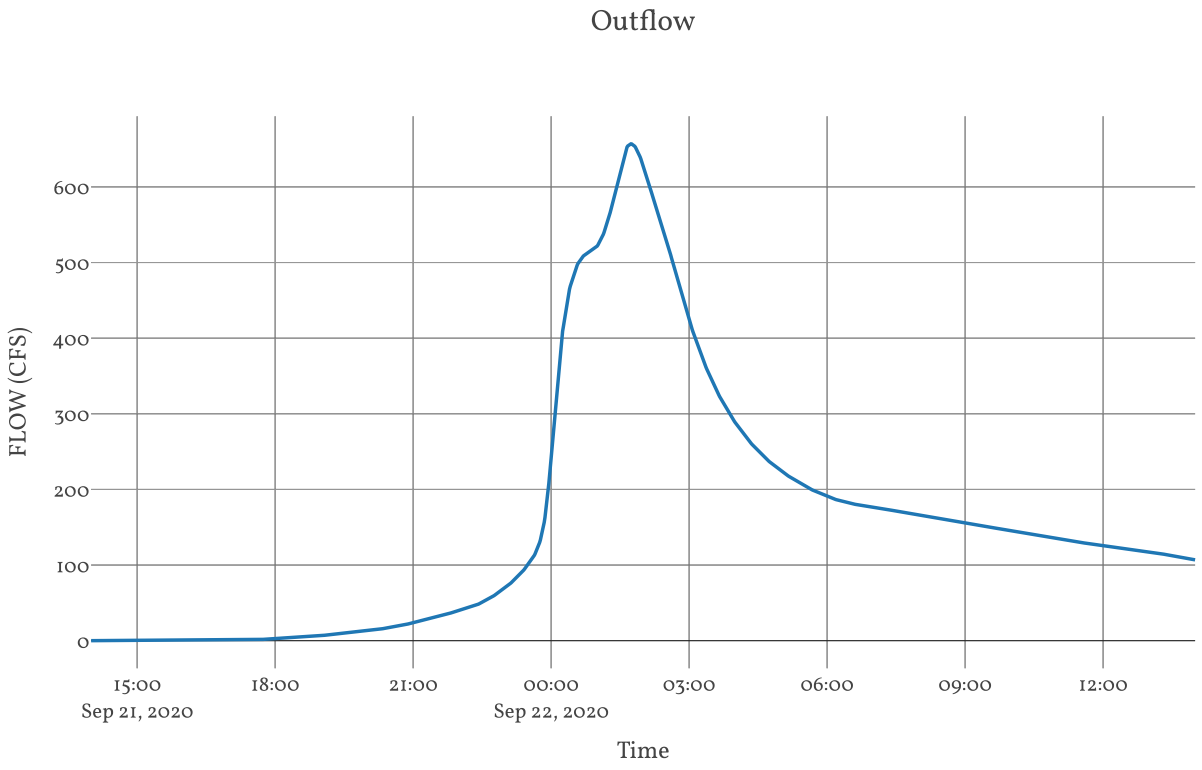

Precipitation and Outflow
FLOW (CFS) PRECIP-INC (IN)
0
0.01
0.02
0.03
0.04
0.05
0.06
300
200
100
0
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
Sep 21, 2020
Sep 22, 2020
Time
Precipitation
Excess Precipitation
Outflow

Junction: 16C

Downstream : 16r

Results: 16C

Peak Discharge (CFS)	656.9
Time of Peak Discharge	22Sep2020, 01:44
Volume (IN)	2.47



Reach: 16R

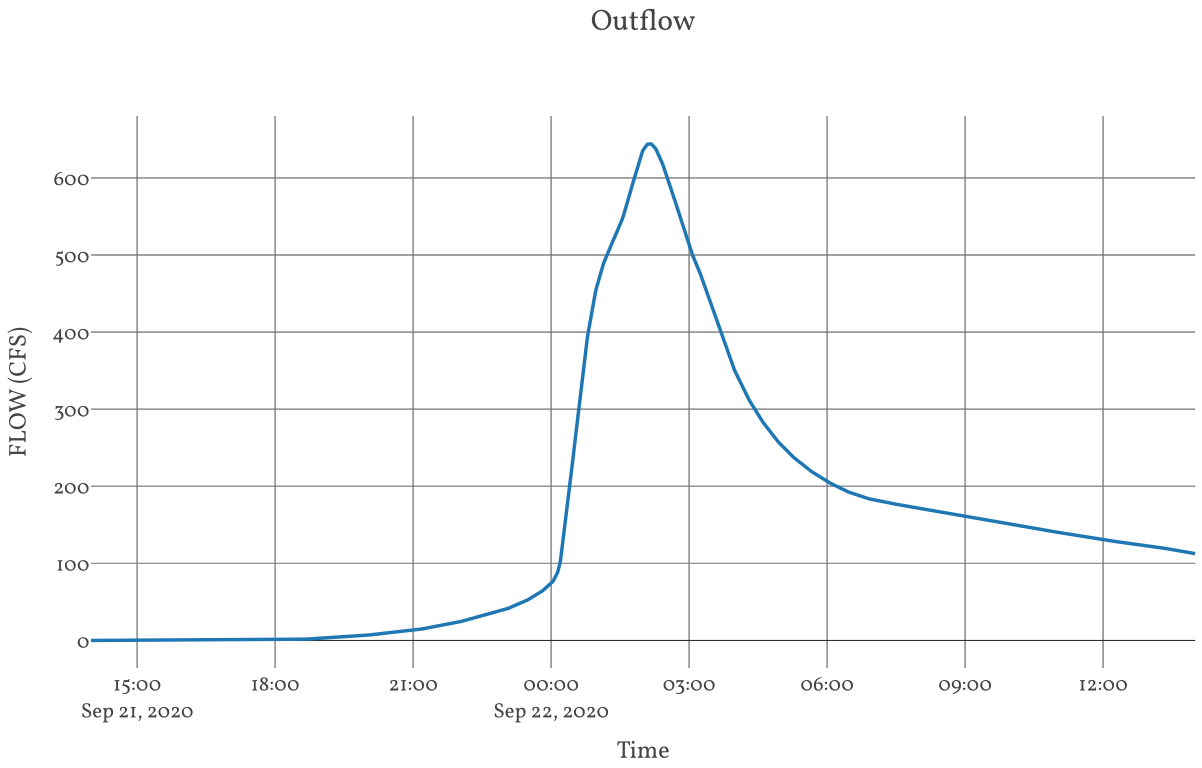
Downstream : 20C

Route: Modified Puls

Method	Modified Puls
Initial Variable	Combined Inflow
Number of Reaches	6
Storage Outflow Table Name	16r

Results: 16R

Peak Discharge (CFS)	644.4
Time of Peak Discharge	22Sep2020, 02:08
Volume (IN)	2.4
Peak Inflow (CFS)	656.9
Inflow Volume (AC - FT)	313.31



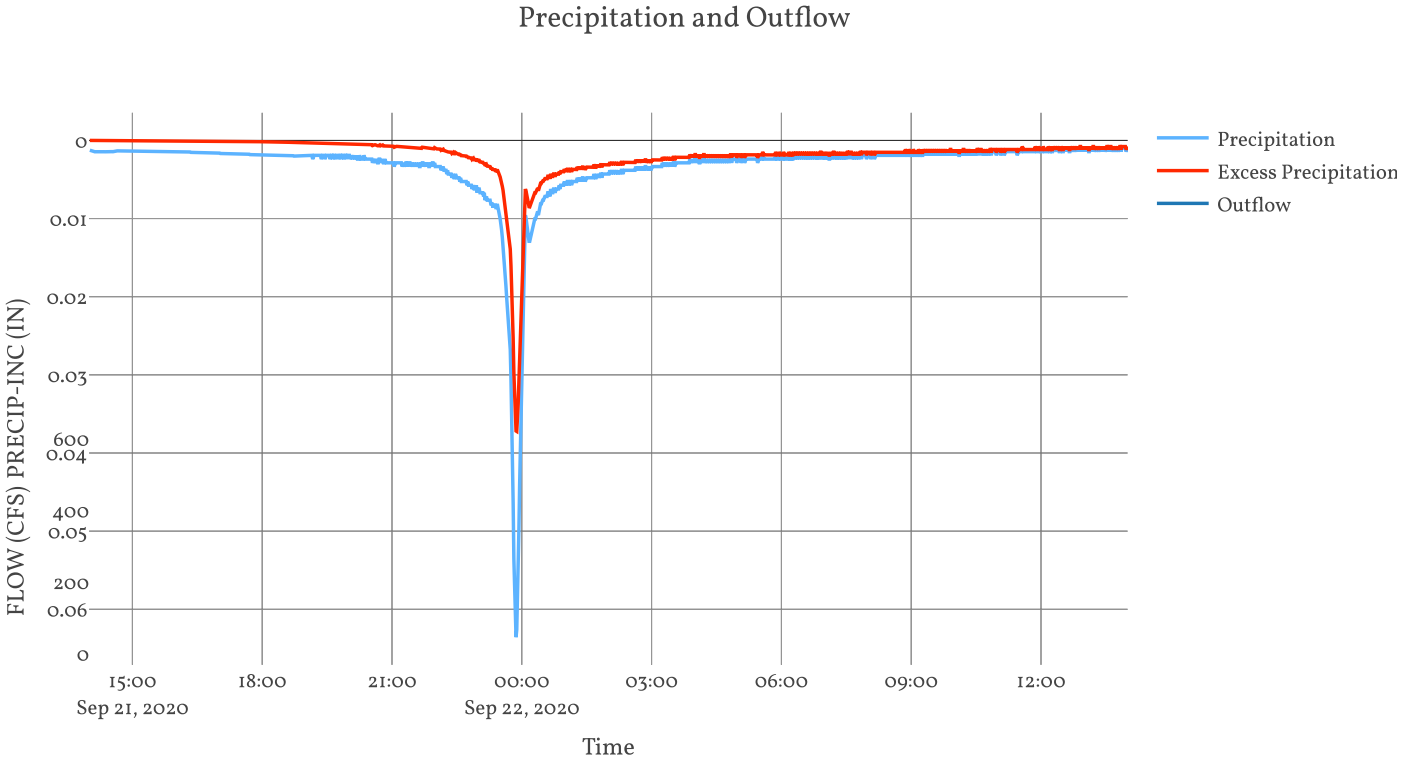
Subbasin: 64B

Area : 1.09
Downstream : 20c

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	74.8
Initial Abstraction	0.2

Transform: User - Specified S - Graph	
S - graph	Ellsworth S - Graph
Lag Method	Specified
Lag	0.42

Results: 64B	
Peak Discharge (CFS)	571.11
Time of Peak Discharge	22Sep2020, 00:18
Volume (IN)	2.6
Precipitation Volume (AC - FT)	277.88
Loss Volume (AC - FT)	124.47
Excess Volume (AC - FT)	153.41
Direct Runoff Volume (AC - FT)	151.16
Baseflow Volume (AC - FT)	0

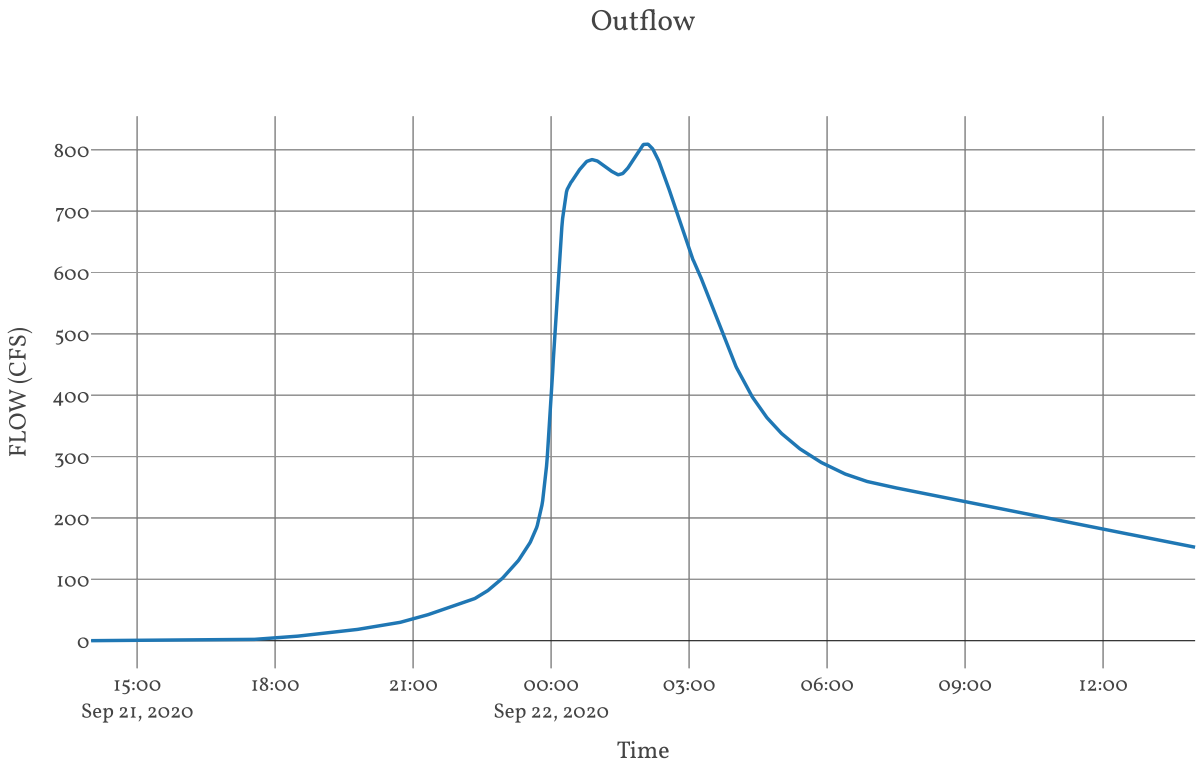

Precipitation and Outflow
FLOW (CFS) PRECIP-INC (IN)
0
0.01
0.02
0.03
600
0.04
400
0.05
200
0.06
0
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
Sep 21, 2020
Sep 22, 2020
Time
Precipitation
Excess Precipitation
Outflow

Junction: 20C

Downstream : 20r

Results: 20C

Peak Discharge (CFS)	809.6
Time of Peak Discharge	22Sep2020, 02:04
Volume (IN)	2.46



Reach: 20R

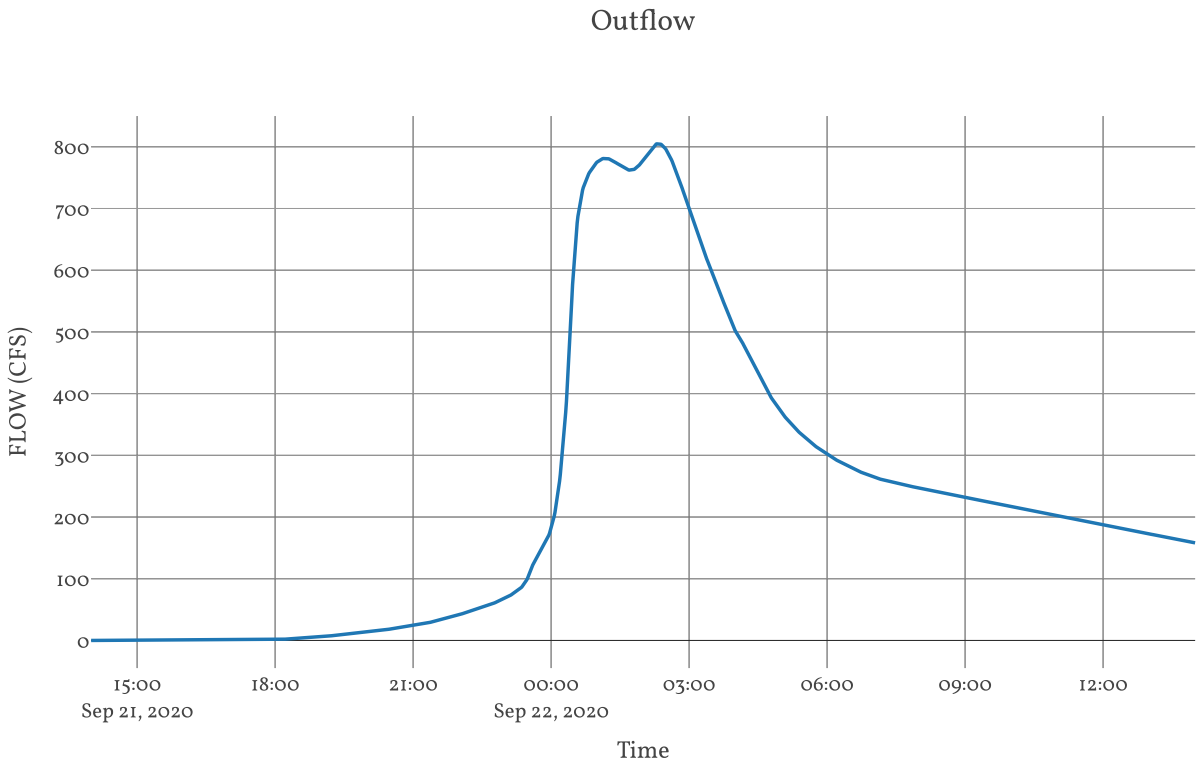
Downstream : 15C

Route: Modified Puls

Method	Modified Puls
Initial Variable	Combined Inflow
Number of Reaches	6
Storage Outflow Table Name	20r

Results: 20R

Peak Discharge (CFS)	805.05
Time of Peak Discharge	22Sep2020, 02:20
Volume (IN)	2.42
Peak Inflow (CFS)	809.6
Inflow Volume (AC - FT)	455.71



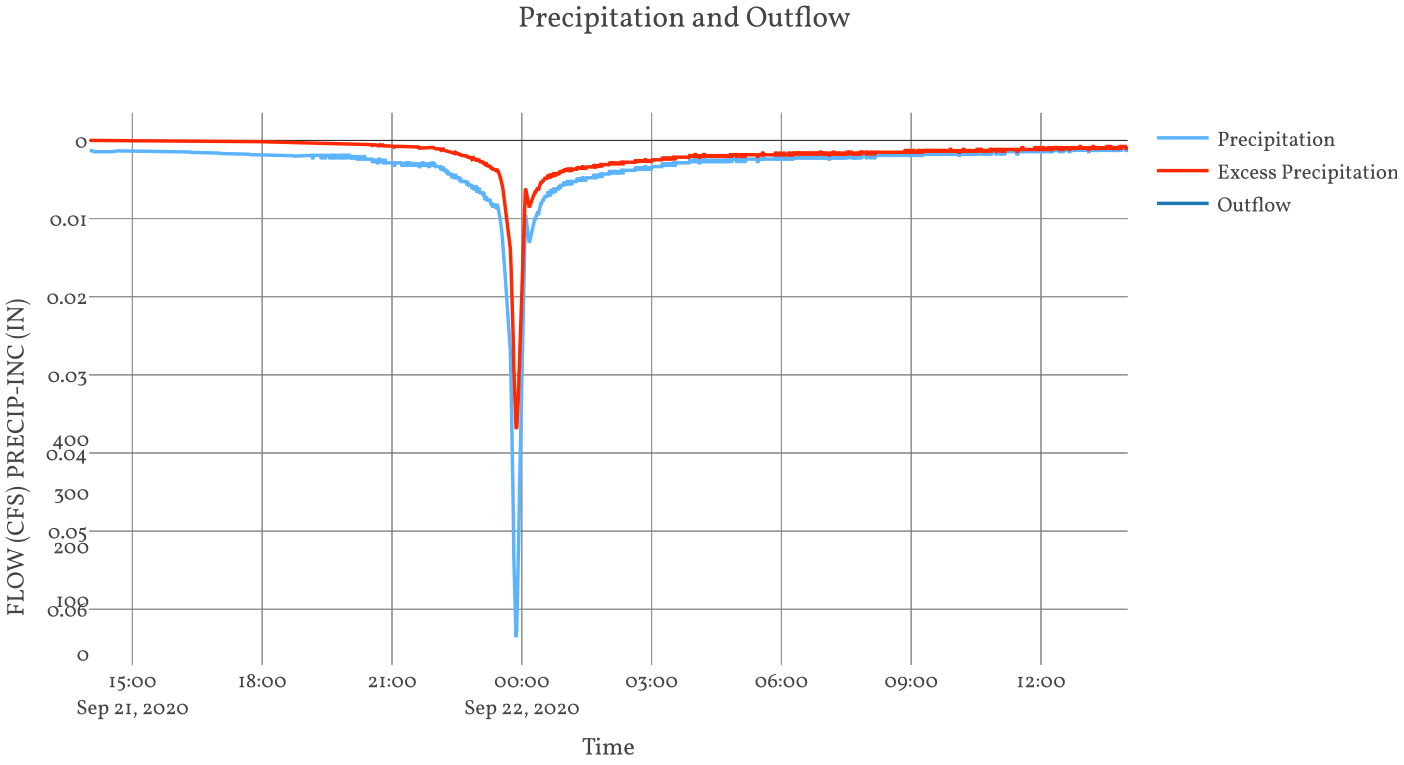
Subbasin: 65B

Area : 0.53
Downstream : 15c

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	74.4
Initial Abstraction	0.2

Transform: User - Specified S - Graph	
S - graph	Ellsworth S - Graph
Lag Method	Specified
Lag	0.24

Results: 65B	
Peak Discharge (CFS)	380.96
Time of Peak Discharge	22Sep2020, 00:07
Volume (IN)	2.59
Precipitation Volume (AC - FT)	135.88
Loss Volume (AC - FT)	61.54
Excess Volume (AC - FT)	74.34
Direct Runoff Volume (AC - FT)	73.74
Baseflow Volume (AC - FT)	0

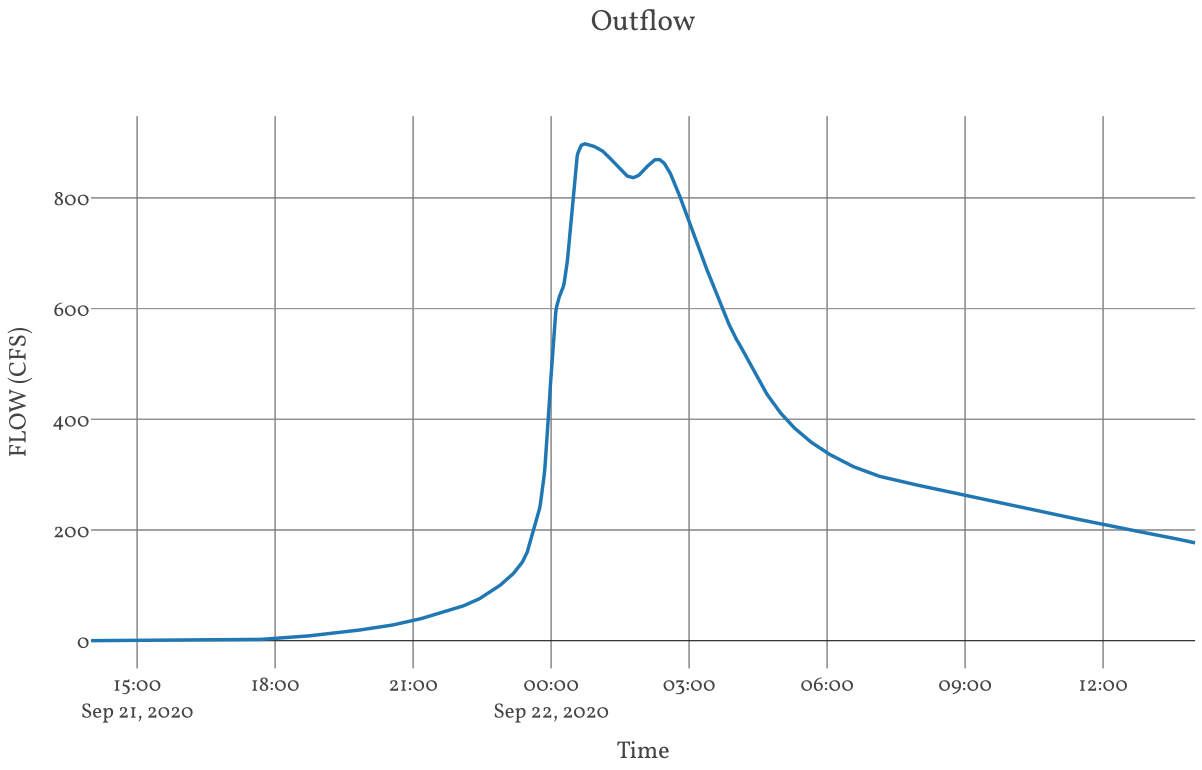

Precipitation and Outflow
FLOW (CFS) PRECIP-INC (IN)
0
0.01
0.02
0.03
400
0.04
300
0.05
200
100
0.06
0
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
Sep 21, 2020
Sep 22, 2020
Time
Precipitation
Excess Precipitation
Outflow

Junction: 15C

Downstream : 15r

Results: 15C

Peak Discharge (CFS)	897.56
Time of Peak Discharge	22Sep2020, 00:44
Volume (IN)	2.45



Reach: 15R

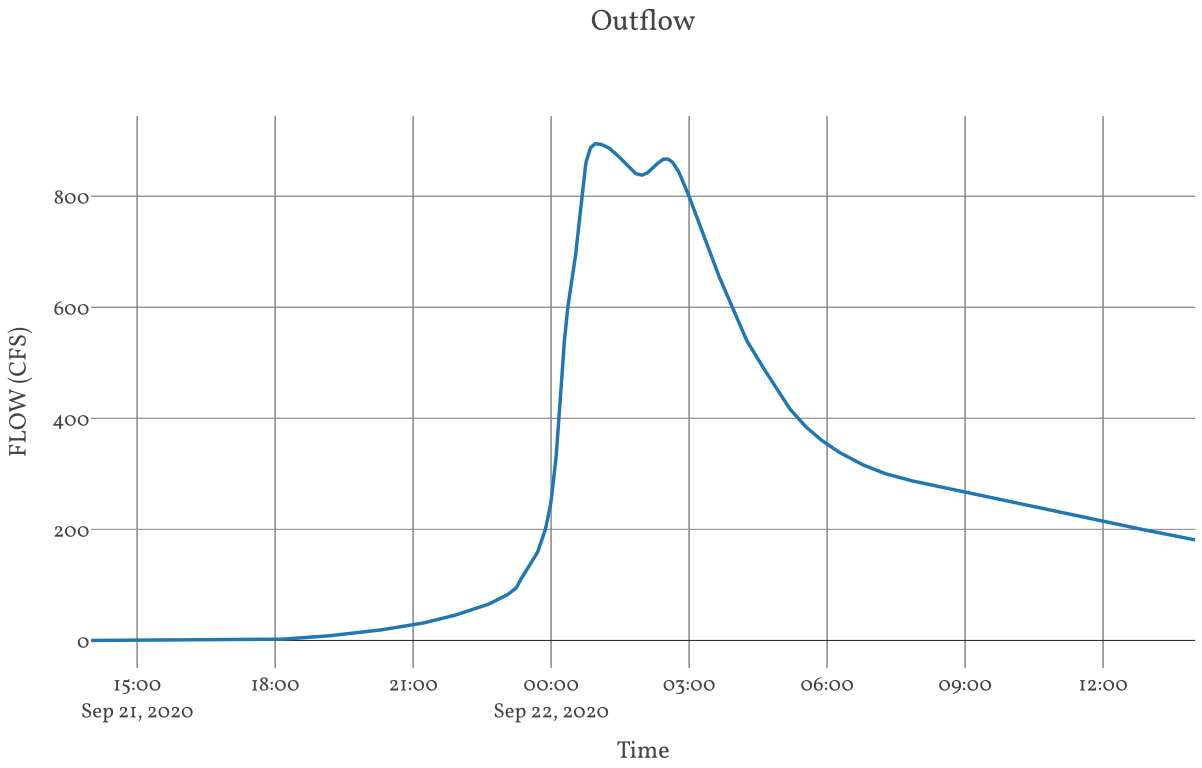
Downstream : 14c

Route: Modified Puls

Method	Modified Puls
Initial Variable	Combined Inflow
Number of Reaches	5
Storage Outflow Table Name	15r

Results: 15R

Peak Discharge (CFS)	894.79
Time of Peak Discharge	22Sep2020, 01:00
Volume (IN)	2.42
Peak Inflow (CFS)	897.56
Inflow Volume (AC - FT)	521.85



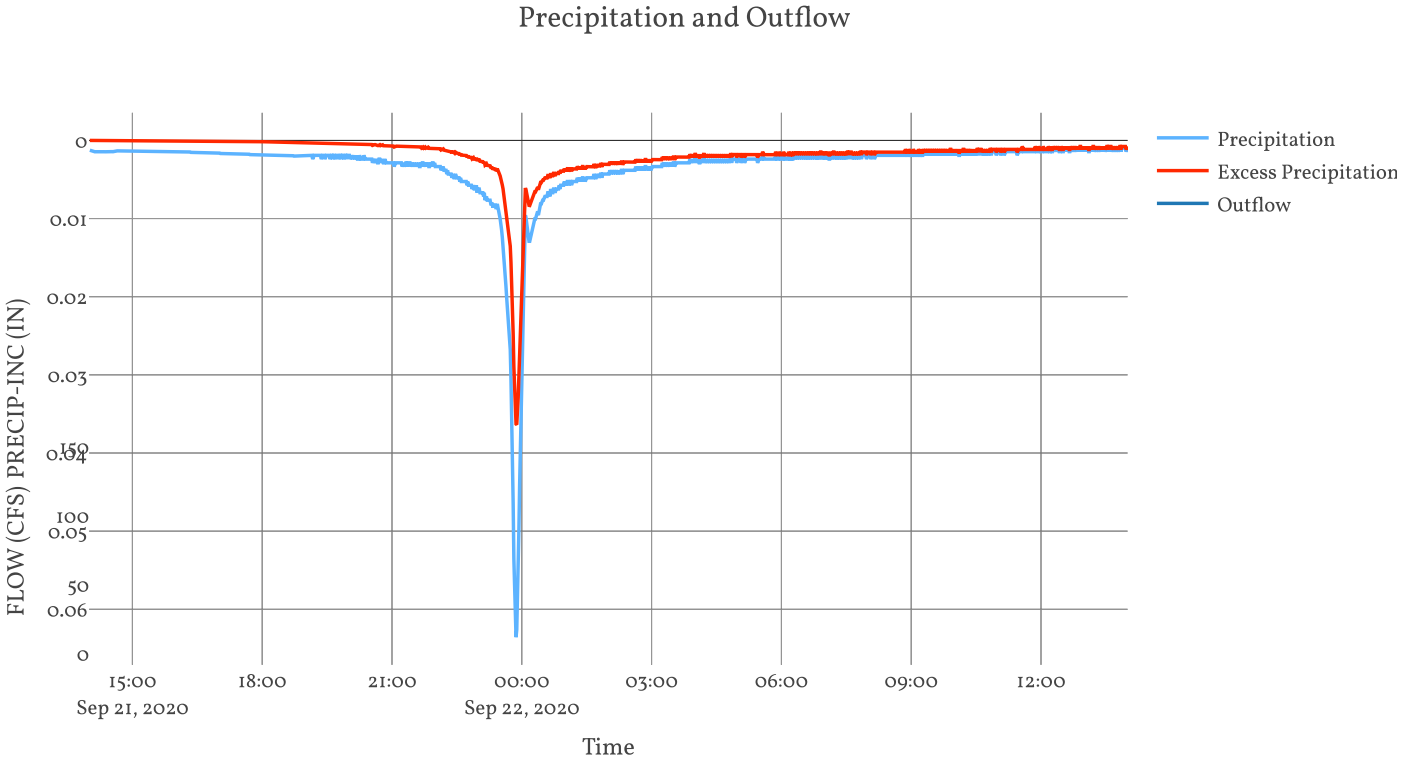
Subbasin: 66B

Area : 0.16
Downstream : 14c

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	73.9
Initial Abstraction	0.2

Transform: User - Specified S - Graph	
S - graph	Ellsworth S - Graph
Lag Method	Specified
Lag	0.14

Results: 66B	
Peak Discharge (CFS)	148.29
Time of Peak Discharge	22Sep2020, 00:02
Volume (IN)	2.57
Precipitation Volume (AC - FT)	41.3
Loss Volume (AC - FT)	18.96
Excess Volume (AC - FT)	22.34
Direct Runoff Volume (AC - FT)	22.24
Baseflow Volume (AC - FT)	0

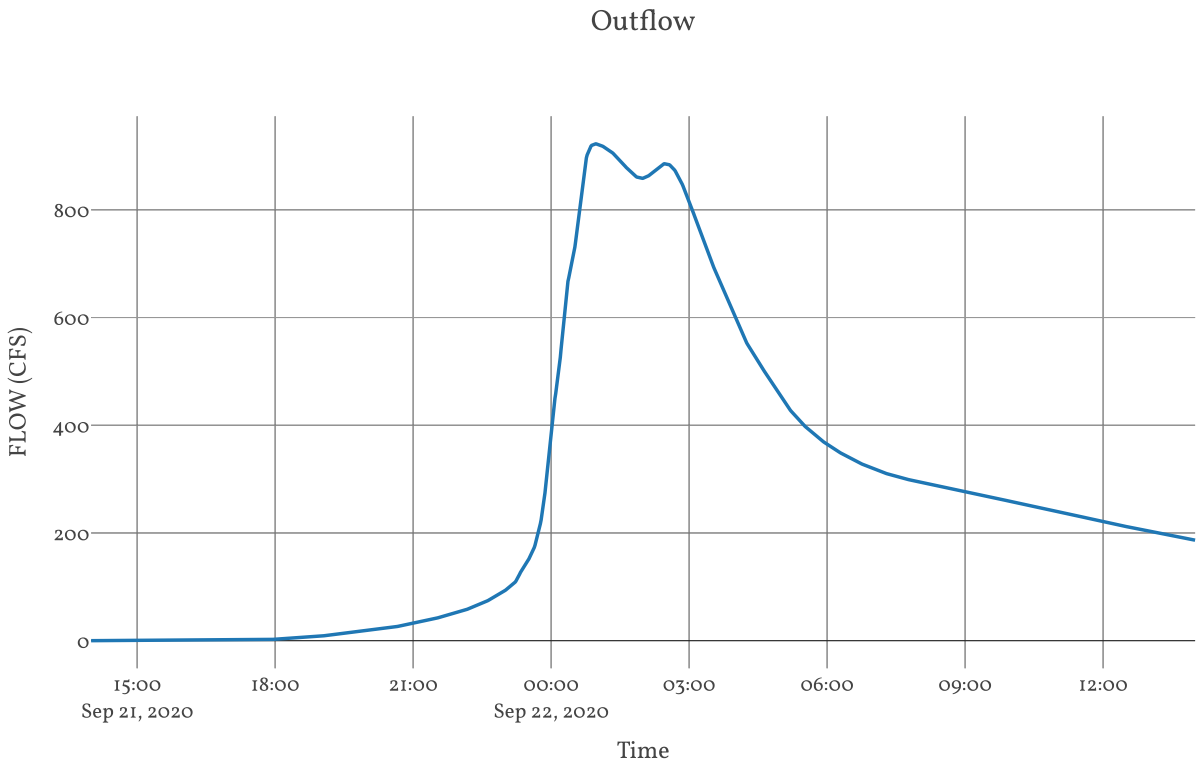

Precipitation and Outflow
FLOW (CFS) PRECIP-INC (IN)
0
0.01
0.02
0.03
0.04
0.05
0.06
0
150
100
50
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
Sep 21, 2020
Sep 22, 2020
Time
Precipitation
Excess Precipitation
Outflow

Junction: 14C

Downstream : 14r

Results: 14C

Peak Discharge (CFS)	922.42
Time of Peak Discharge	22Sep2020, 00:58
Volume (IN)	2.42



Reach: 14R

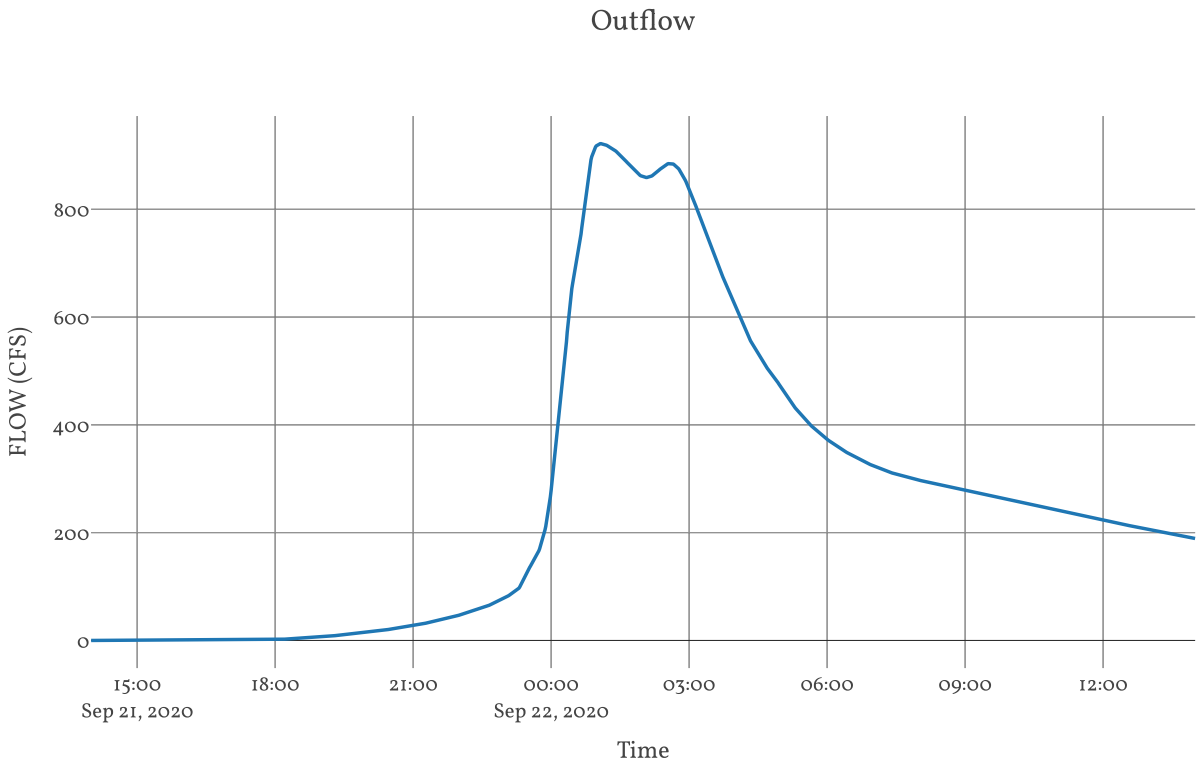
Downstream : 13c

Route: Modified Puls

Method	Modified Puls
Initial Variable	Combined Inflow
Number of Reaches	5
Storage Outflow Table Name	14r

Results: 14R

Peak Discharge (CFS)	921.68
Time of Peak Discharge	22Sep2020, 01:05
Volume (IN)	2.41
Peak Inflow (CFS)	922.42
Inflow Volume (AC - FT)	538.39



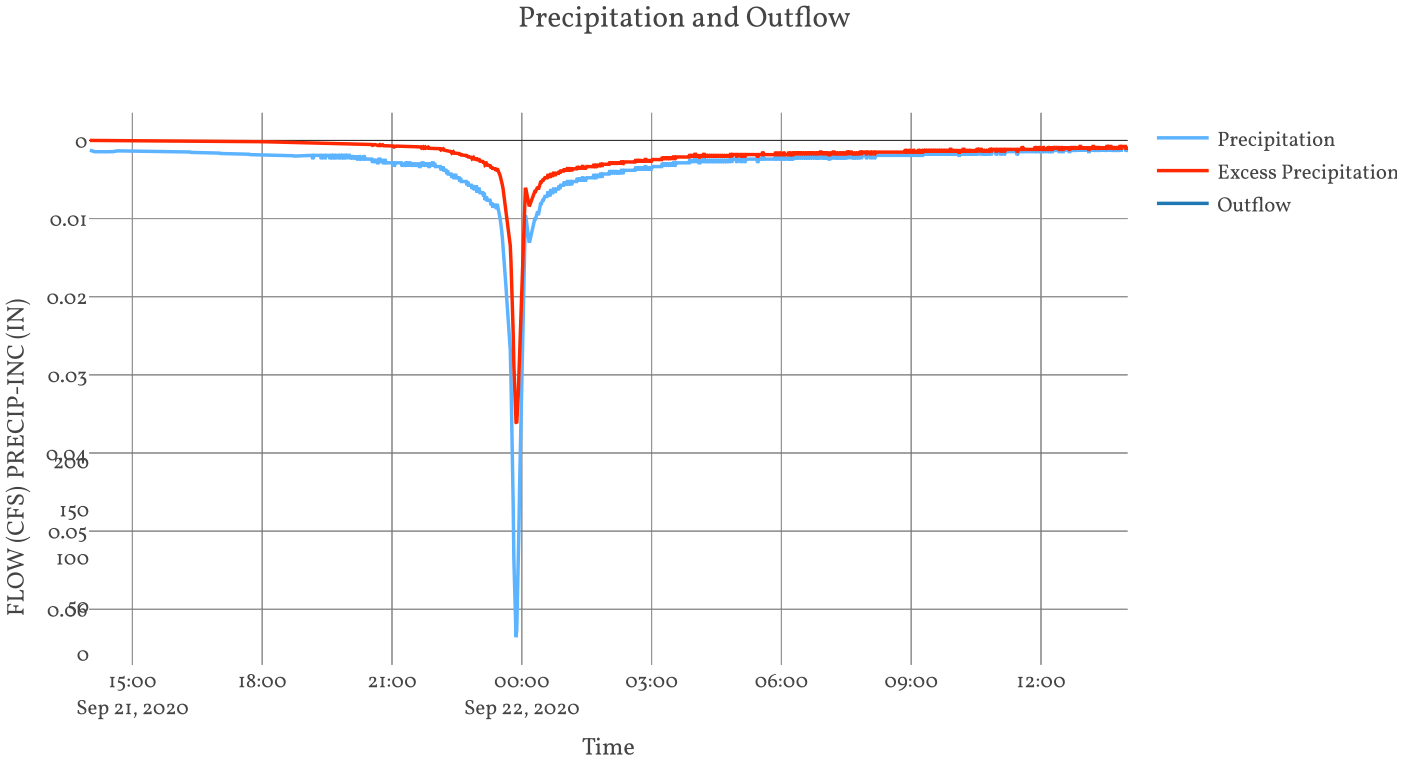
Subbasin: 67B

Area : 0.43
Downstream : 13c

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	73.7
Initial Abstraction	0.2

Transform: User - Specified S - Graph	
S - graph	Ellsworth S - Graph
Lag Method	Specified
Lag	0.44

Results: 67B	
Peak Discharge (CFS)	212.62
Time of Peak Discharge	22Sep2020, 00:19
Volume (IN)	2.53
Precipitation Volume (AC - FT)	109.62
Loss Volume (AC - FT)	50.59
Excess Volume (AC - FT)	59.04
Direct Runoff Volume (AC - FT)	58.12
Baseflow Volume (AC - FT)	0

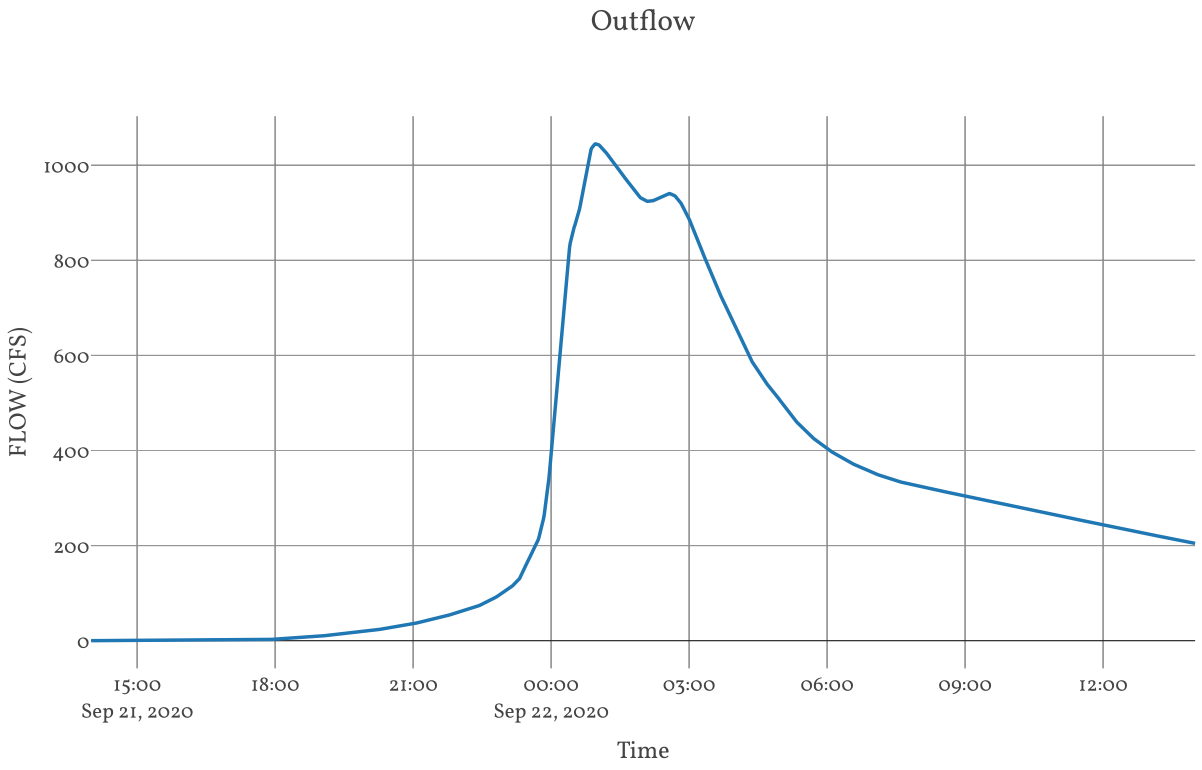

Precipitation and Outflow
FLOW (CFS) PRECIP-INC (IN)
0
0.01
0.02
0.03
0.04
0.05
0.06
200
150
100
50
0
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
Sep 21, 2020
Sep 22, 2020
Time
Precipitation
Excess Precipitation
Outflow

Junction: 13C

Downstream : 13r

Results: 13C

Peak Discharge (CFS)	1044.93
Time of Peak Discharge	22Sep2020, 00:59
Volume (IN)	2.42



Reach: 13R

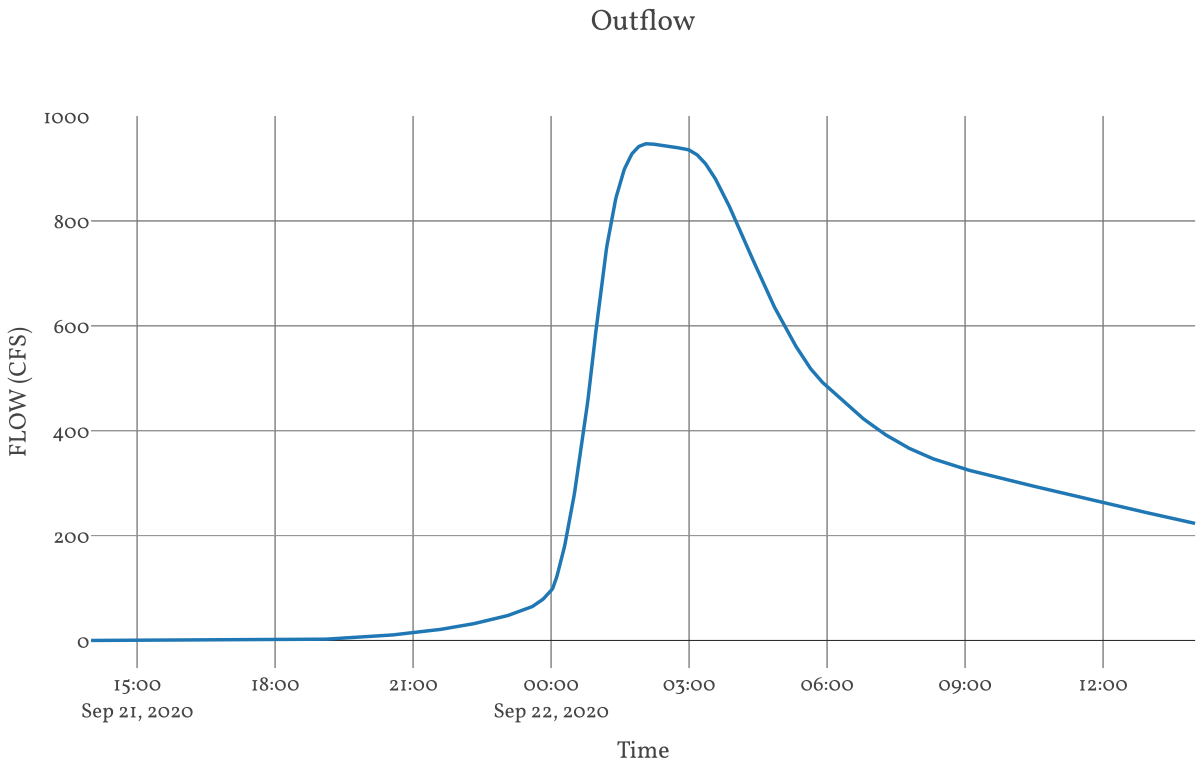
Downstream : 12C

Route: Modified Puls

Method	Modified Puls
Initial Variable	Combined Inflow
Number of Reaches	2
Storage Outflow Table Name	13r

Results: 13R

Peak Discharge (CFS)	947.29
Time of Peak Discharge	22Sep2020, 02:07
Volume (IN)	2.32
Peak Inflow (CFS)	1044.93
Inflow Volume (AC - FT)	593.29



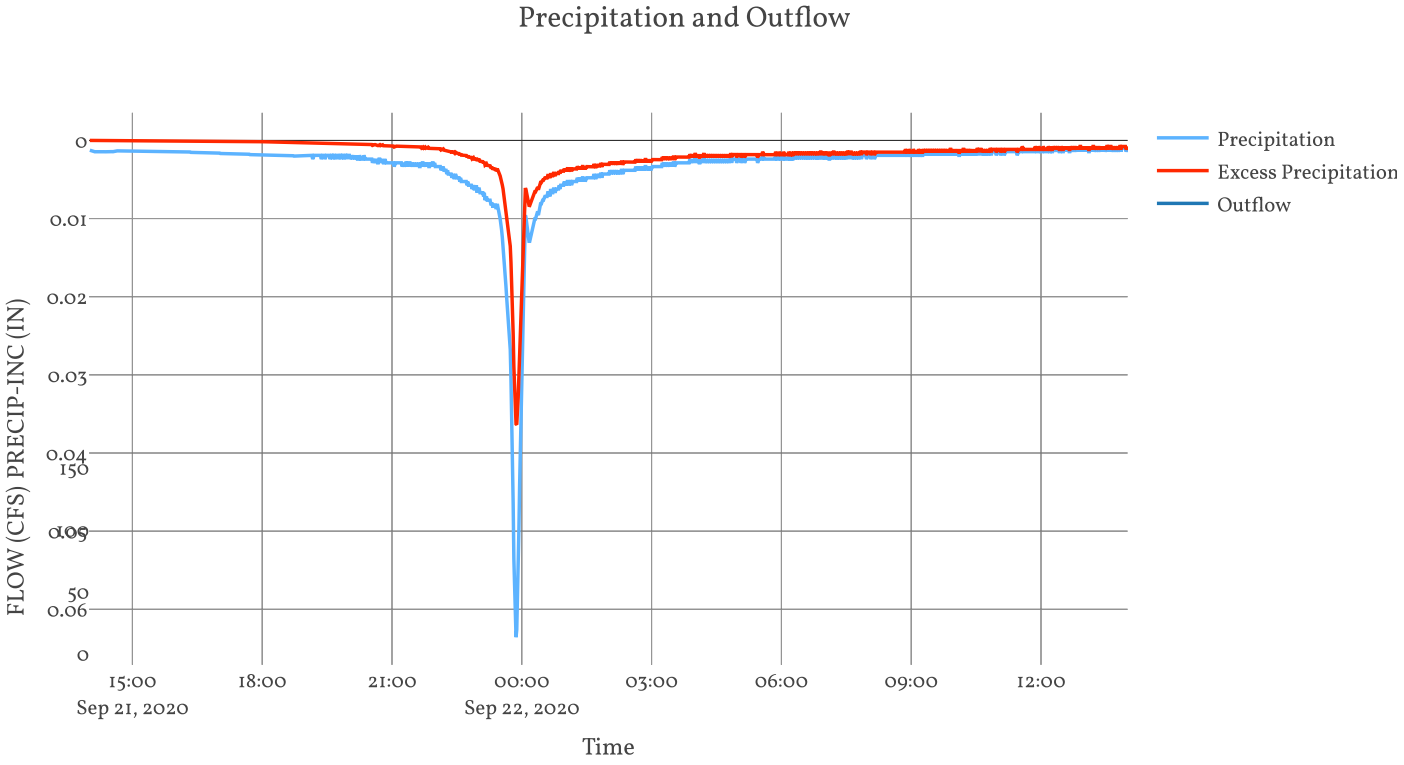
Subbasin: 68B

Area : 0.26
Downstream : 12c

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	73.9
Initial Abstraction	0.2

Transform: User - Specified S - Graph	
S - graph	Ellsworth S - Graph
Lag Method	Specified
Lag	0.28

Results: 68B	
Peak Discharge (CFS)	164.98
Time of Peak Discharge	22Sep2020, 00:10
Volume (IN)	2.56
Precipitation Volume (AC - FT)	65.01
Loss Volume (AC - FT)	29.84
Excess Volume (AC - FT)	35.17
Direct Runoff Volume (AC - FT)	34.83
Baseflow Volume (AC - FT)	0

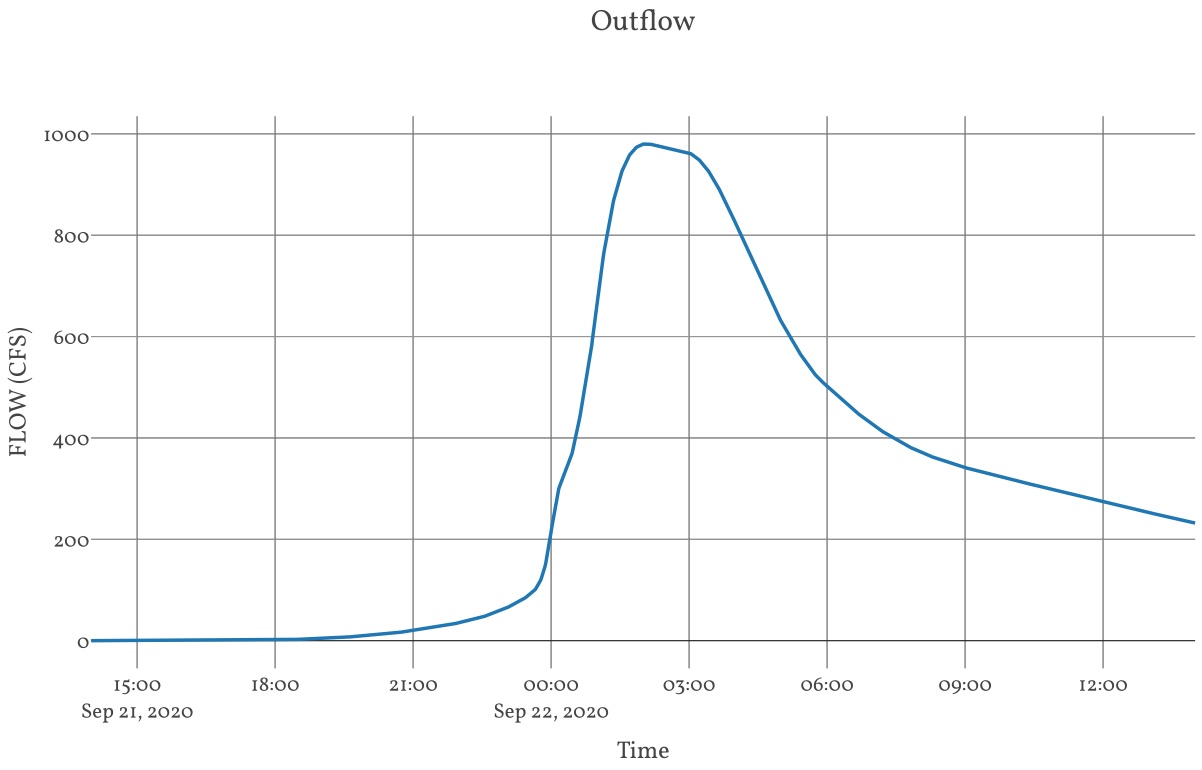

Precipitation and Outflow
FLOW (CFS) PRECIP-INC (IN)
0
0.01
0.02
0.03
0.04
150
100
50
0.06
0
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
Sep 21, 2020
Sep 22, 2020
Time
Precipitation
Excess Precipitation
Outflow

Junction: 12C

Downstream : Pacific Ocean

Results: 12C

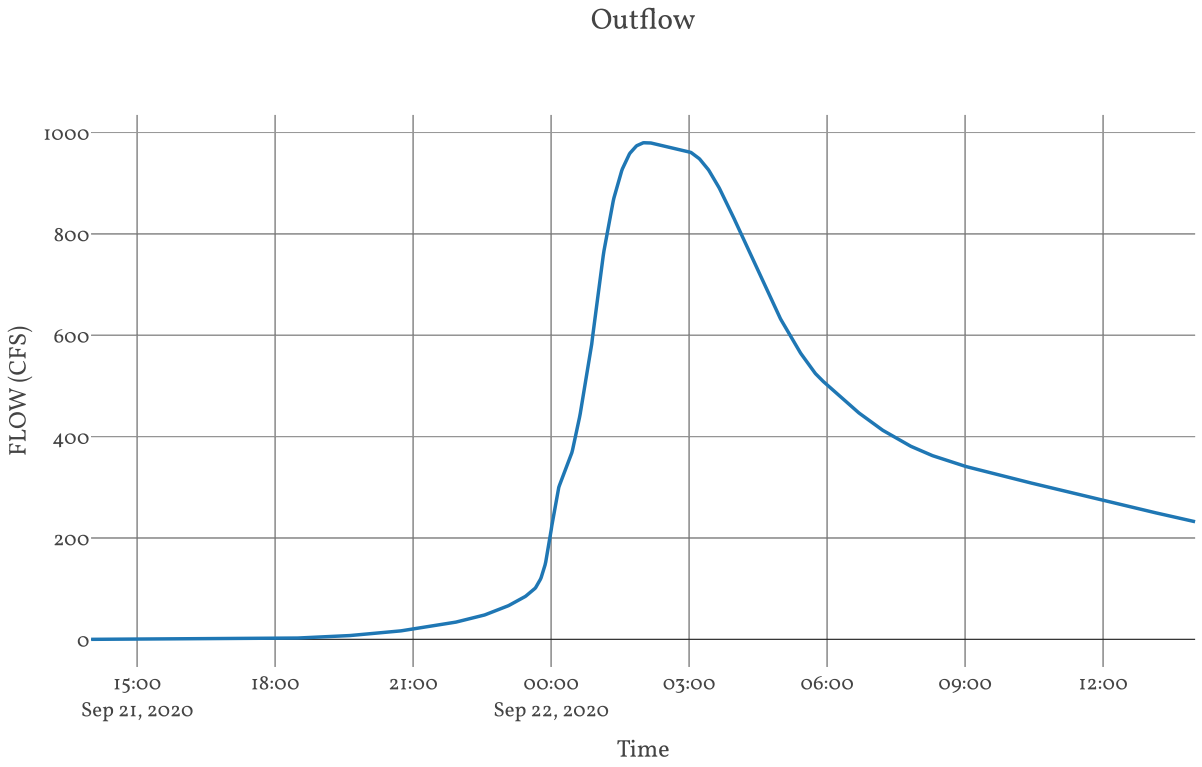
Peak Discharge (CFS)	980.2
Time of Peak Discharge	22Sep2020, 02:04
Volume (IN)	2.33



Sink: Pacific Ocean

Results: Pacific Ocean

Peak Discharge (CFS)	980.2
Time of Peak Discharge	22Sep2020, 02:04
Volume (IN)	2.33
Observed Flow Gage	Not specified
Observed Flow Volume (AC - FT)	Not specified
Observed Flow's RMSE Stdev	Not specified
Observed Flow's Percent Bias	Not specified
Observed Flow's Nash Sutcliffe	Not specified



Project: Little_Sycamore_May2021
Simulation Run: 010-mp-Post-Fire
Simulation Start: 21 September 2020, 14:00
Simulation End: 22 September 2020, 14:00

HMS Version: 4.6.1
Executed: 29 April 2021, 23:32

Global Parameter Summary - Subbasin

Area

Element Name	Area
60b	0.65
61b	0.61
62b	0.53
63b	0.6
64b	1.09
65b	0.53
66b	0.16
67b	0.43
68b	0.26

Downstream

Element Name	Downstream
60b	J 60b 61b
61b	J 60b 61b
62b	17c
63b	16c
64b	20c
65b	15c
66b	14c
67b	13c
68b	12c

Loss Rate: Scs

Element Name	Percent Impervious Area	Curve Number	Initial Abstraction
60b	0	75	0.2
61b	0	75	0.2
62b	0	73.9	0.2
63b	0	74.6	0.2
64b	0	74.8	0.2
65b	0	74.4	0.2
66b	0	73.9	0.2
67b	0	73.7	0.2
68b	0	73.9	0.2

Transform: User - Specified S - Graph

Element Name	S - graph	Lag Method	Lag
60b	Ellsworth S - Graph	Specified	0.52
61b	Ellsworth S - Graph	Specified	0.37
62b	Ellsworth S - Graph	Specified	0.25
63b	Ellsworth S - Graph	Specified	0.41
64b	Ellsworth S - Graph	Specified	0.42
65b	Ellsworth S - Graph	Specified	0.24
66b	Ellsworth S - Graph	Specified	0.14
67b	Ellsworth S - Graph	Specified	0.44
68b	Ellsworth S - Graph	Specified	0.28

Global Parameter Summary - Reach

Downstream

Element Name	Downstream
18r	17c
17r	16c
16r	20c
20r	15c
15r	14c
14r	13c
13r	12c

Route: Modified Puls

Element Name	Method	Initial Variable	Number of Reaches	Storage Outflow Table Name
18r	Modified Puls	Combined Inflow	8	18r
17r	Modified Puls	Combined Inflow	4	17r
16r	Modified Puls	Combined Inflow	6	16r
20r	Modified Puls	Combined Inflow	6	20r
15r	Modified Puls	Combined Inflow	5	15r
14r	Modified Puls	Combined Inflow	5	14r
13r	Modified Puls	Combined Inflow	2	13r

Global Results Summary

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
60b	0.65	398.39	22Sep2020, 00:24	3.41
61b	0.61	458.08	22Sep2020, 00:15	3.43
J 60b 61b	1.25	832.88	22Sep2020, 00:19	3.42
18r	1.25	702.52	22Sep2020, 01:04	3.29
62b	0.53	483.79	22Sep2020, 00:08	3.37
17c	1.78	845.88	22Sep2020, 01:02	3.32
17r	1.78	769.61	22Sep2020, 01:34	3.2
63b	0.6	424.27	22Sep2020, 00:17	3.4
16c	2.38	922.1	22Sep2020, 01:31	3.25
16r	2.38	904.53	22Sep2020, 01:54	3.18
64b	1.09	761.01	22Sep2020, 00:18	3.41
20c	3.47	1142.12	22Sep2020, 01:48	3.25
20r	3.47	1137.47	22Sep2020, 02:02	3.2
65b	0.53	507.77	22Sep2020, 00:07	3.41
15c	4	1274.95	22Sep2020, 01:00	3.23
15r	4	1270.86	22Sep2020, 01:10	3.2
66b	0.16	197.61	22Sep2020, 00:02	3.38
14c	4.16	1303.35	22Sep2020, 01:09	3.21
14r	4.16	1302.34	22Sep2020, 01:14	3.19
67b	0.43	284.32	22Sep2020, 00:19	3.34
13c	4.59	1446.43	22Sep2020, 00:55	3.2
13r	4.59	1349.74	22Sep2020, 01:54	3.09
68b	0.26	220.26	22Sep2020, 00:09	3.37

12c	4.85	1395.18	22Sep2020, 01:51	3.1
Pacific Ocean	4.85	1395.18	22Sep2020, 01:51	3.1

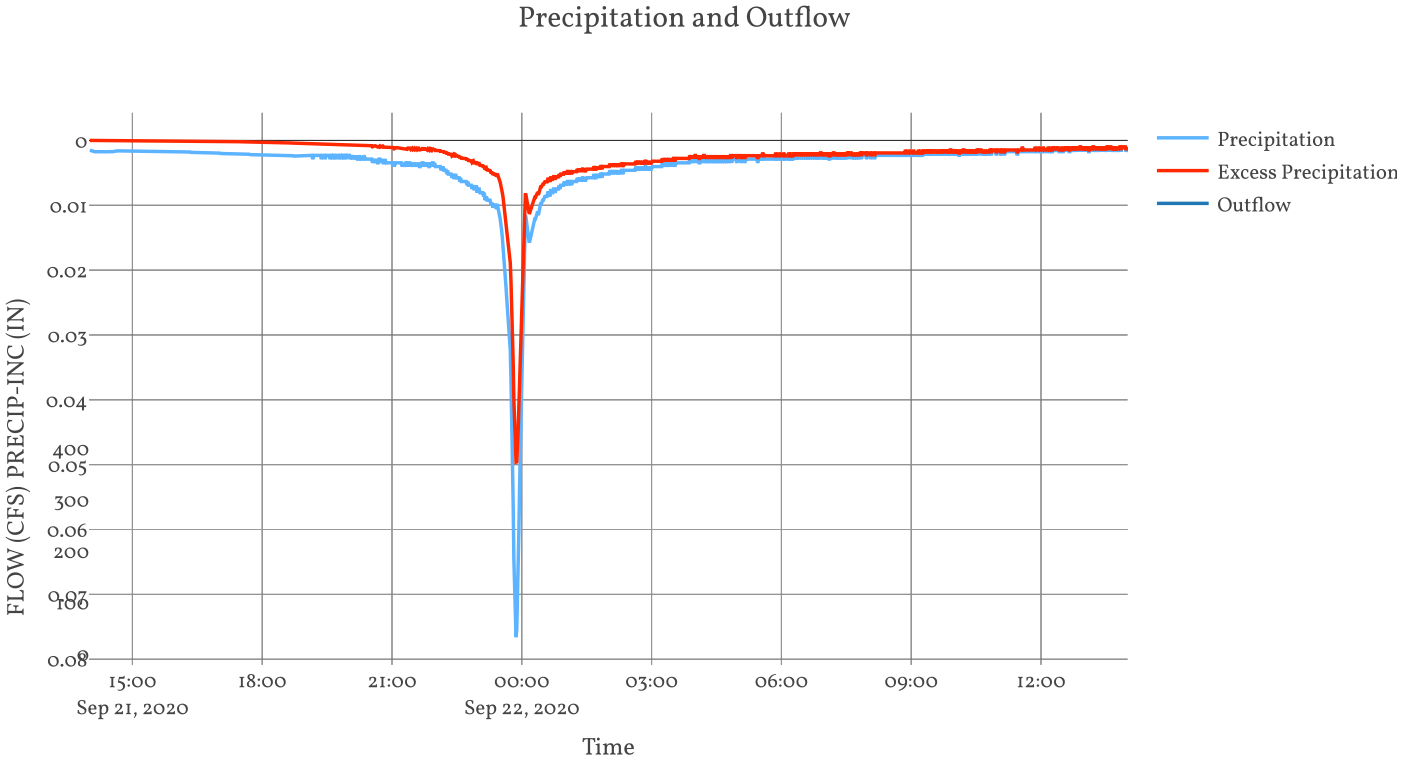
Subbasin: 60B

Area : 0.65
Downstream : J 60b 61b

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	75
Initial Abstraction	0.2

Transform: User - Specified S - Graph	
S - graph	Ellsworth S - Graph
Lag Method	Specified
Lag	0.52

Results: 60B	
Peak Discharge (CFS)	398.39
Time of Peak Discharge	22Sep2020, 00:24
Volume (IN)	3.41
Precipitation Volume (AC - FT)	198.14
Loss Volume (AC - FT)	78.57
Excess Volume (AC - FT)	119.58
Direct Runoff Volume (AC - FT)	117.46
Baseflow Volume (AC - FT)	0


Precipitation and Outflow
FLOW (CFS) PRECIP-INC (IN)
0
0.01
0.02
0.03
0.04
0.05
0.06
0.07
0.08
400
300
200
100
0
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
Sep 21, 2020
Sep 22, 2020
Time
Precipitation
Excess Precipitation
Outflow

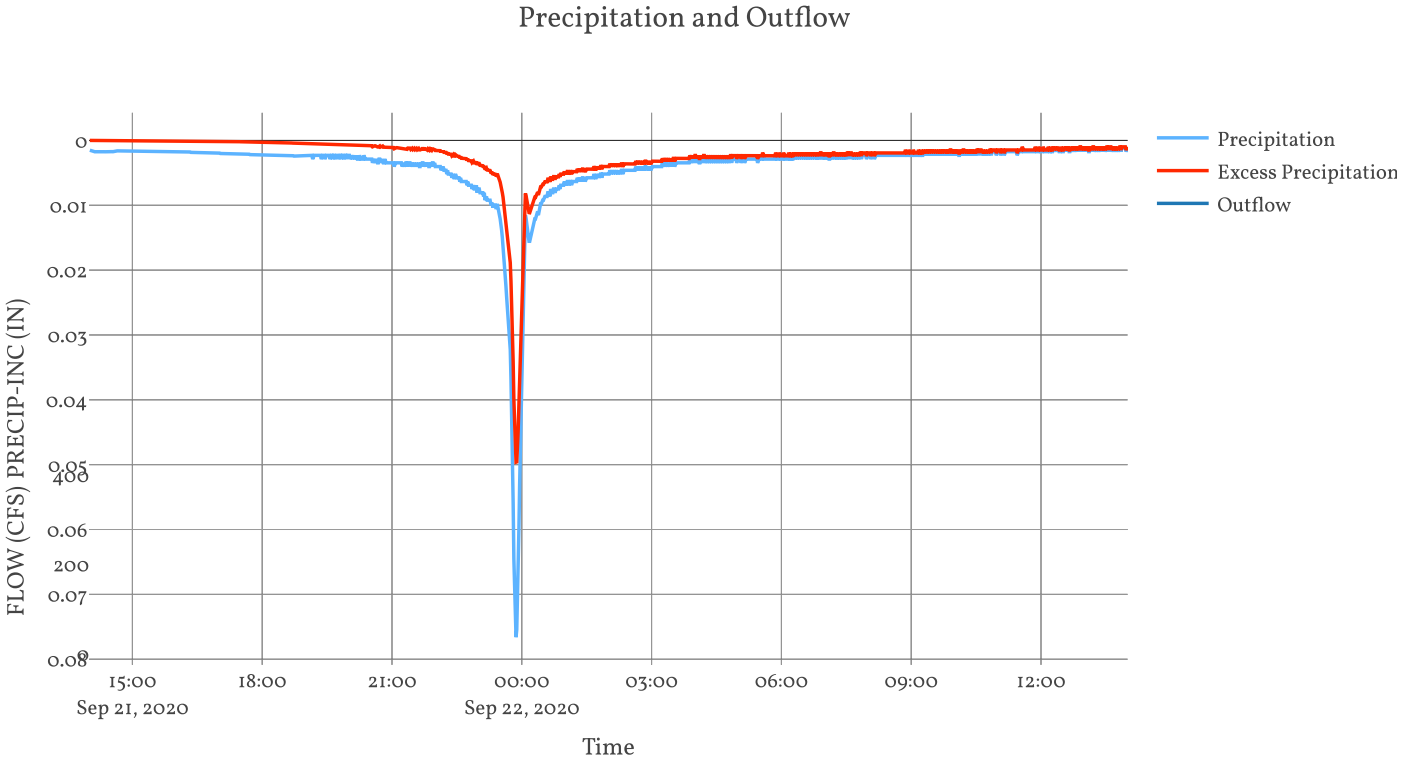
Subbasin: 61B

Area : 0.61
Downstream : J 60b 61b

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	75
Initial Abstraction	0.2

Transform: User - Specified S - Graph	
S - graph	Ellsworth S - Graph
Lag Method	Specified
Lag	0.37

Results: 61B	
Peak Discharge (CFS)	458.08
Time of Peak Discharge	22Sep2020, 00:15
Volume (IN)	3.43
Precipitation Volume (AC - FT)	186.16
Loss Volume (AC - FT)	73.82
Excess Volume (AC - FT)	112.35
Direct Runoff Volume (AC - FT)	110.97
Baseflow Volume (AC - FT)	0

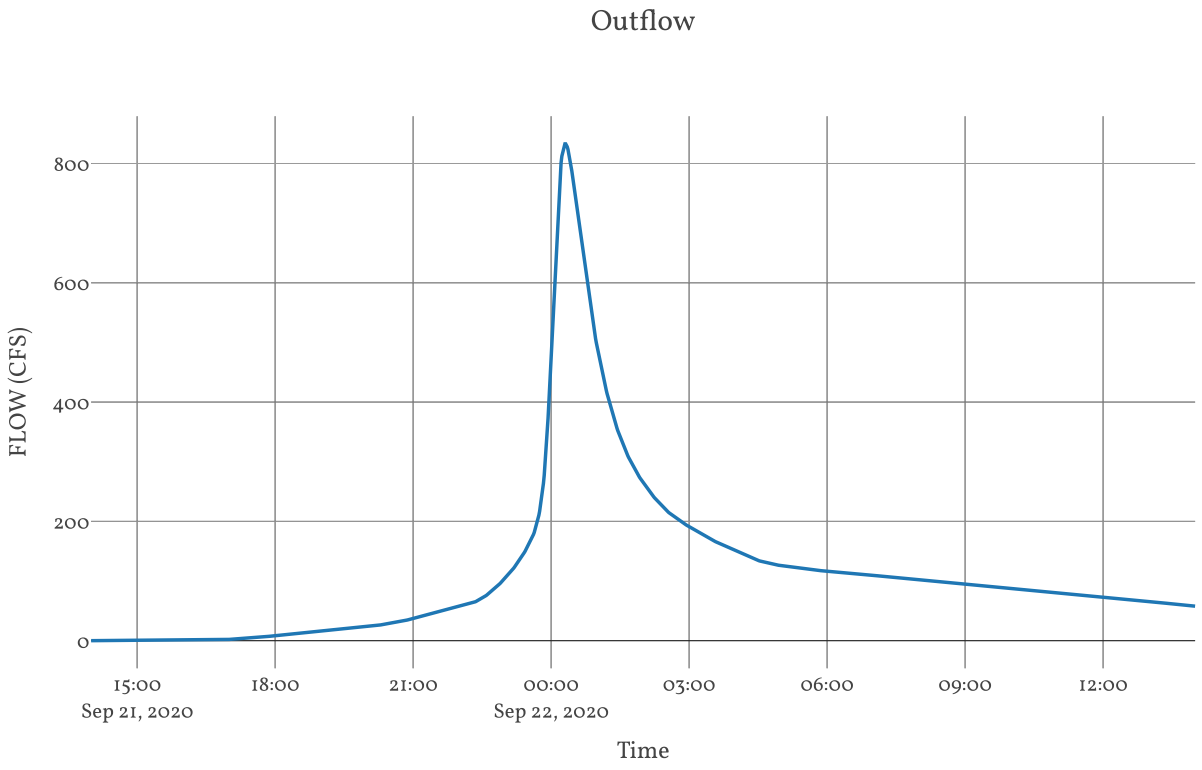

Precipitation and Outflow
FLOW (CFS) PRECIP-INC (IN)
0
0.01
0.02
0.03
0.04
0.05
0.06
0.07
0.08
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
Sep 21, 2020
Sep 22, 2020
Time
Precipitation
Excess Precipitation
Outflow

Junction: J 60B 61B

Downstream : 18r

Results: J 60B 61B

Peak Discharge (CFS)	832.88
Time of Peak Discharge	22Sep2020, 00:19
Volume (IN)	3.42



Reach: 18R

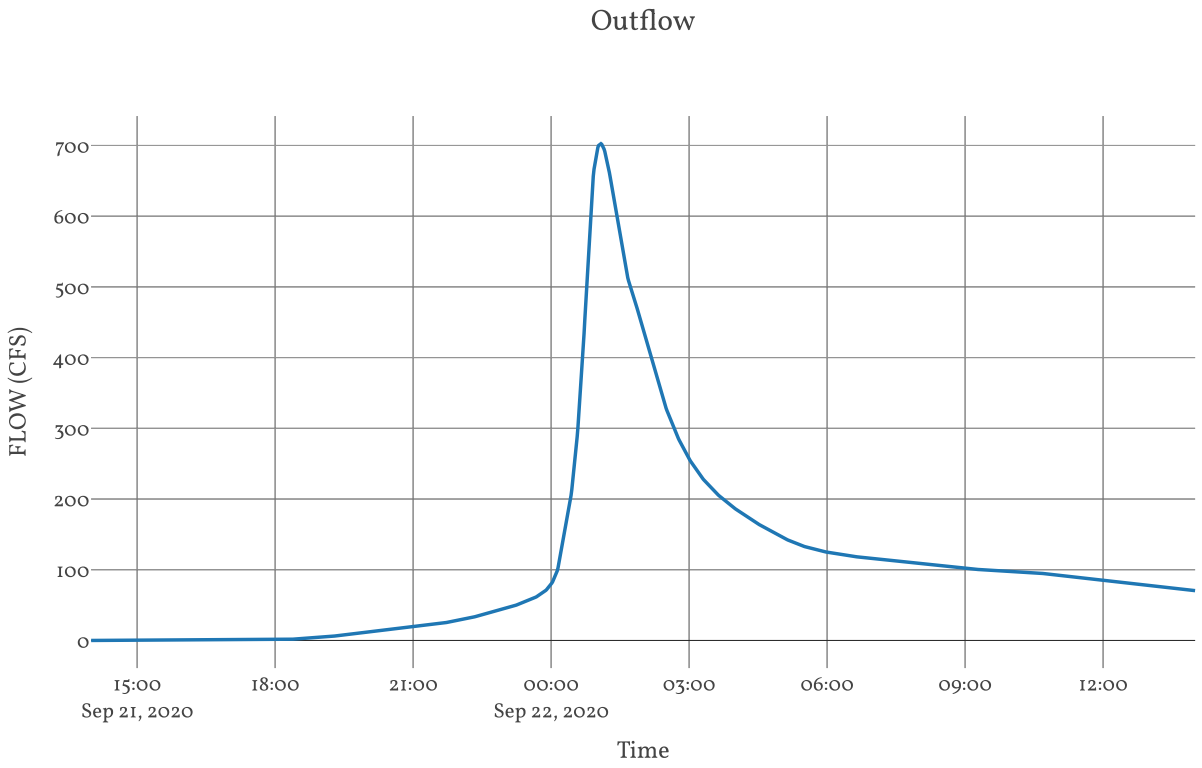
Downstream : 17c

Route: Modified Puls

Method	Modified Puls
Initial Variable	Combined Inflow
Number of Reaches	8
Storage Outflow Table Name	18r

Results: 18R

Peak Discharge (CFS)	702.52
Time of Peak Discharge	22Sep2020, 01:04
Volume (IN)	3.29
Peak Inflow (CFS)	832.88
Inflow Volume (AC - FT)	228.43



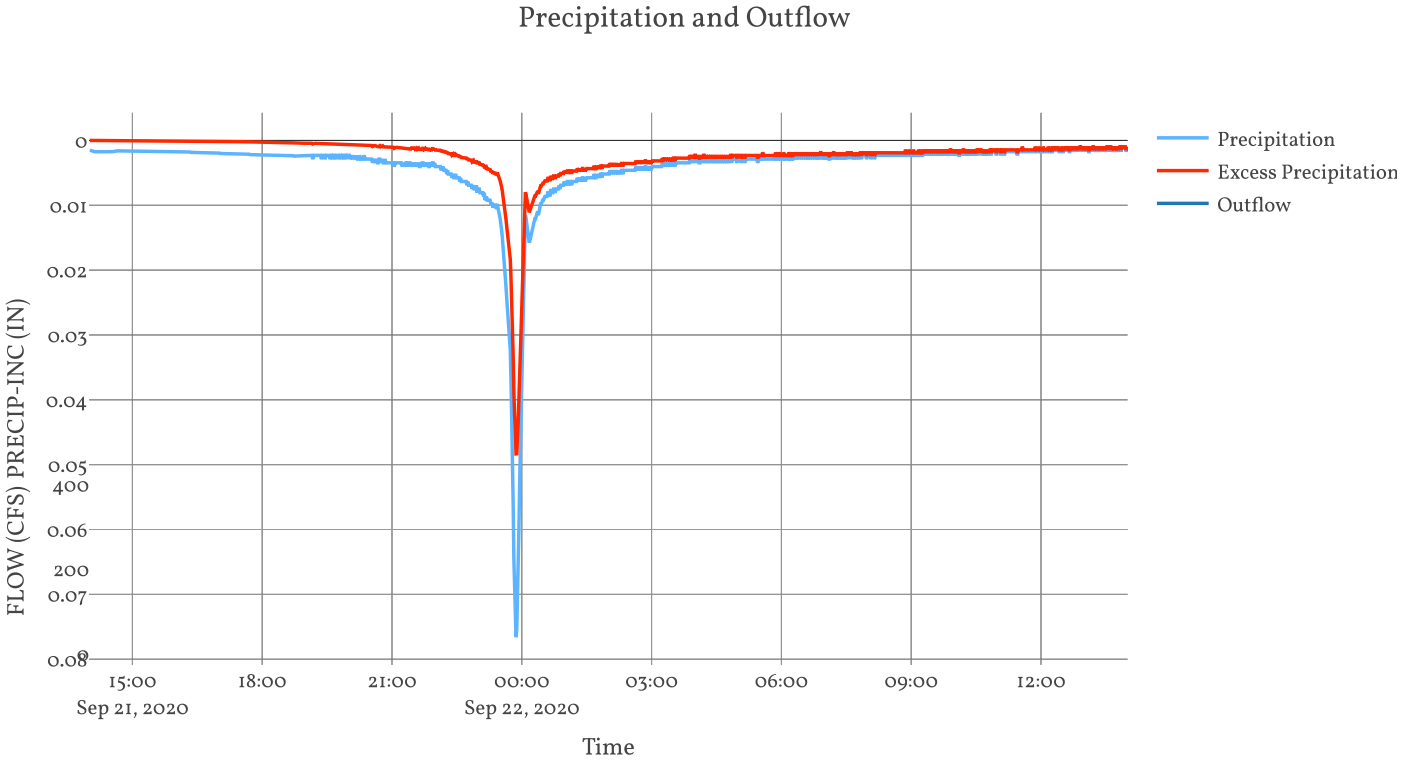
Subbasin: 62B

Area : 0.53
Downstream : 17c

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	73.9
Initial Abstraction	0.2

Transform: User - Specified S - Graph	
S - graph	Ellsworth S - Graph
Lag Method	Specified
Lag	0.25

Results: 62B	
Peak Discharge (CFS)	483.79
Time of Peak Discharge	22Sep2020, 00:08
Volume (IN)	3.37
Precipitation Volume (AC - FT)	161.46
Loss Volume (AC - FT)	66.15
Excess Volume (AC - FT)	95.31
Direct Runoff Volume (AC - FT)	94.53
Baseflow Volume (AC - FT)	0

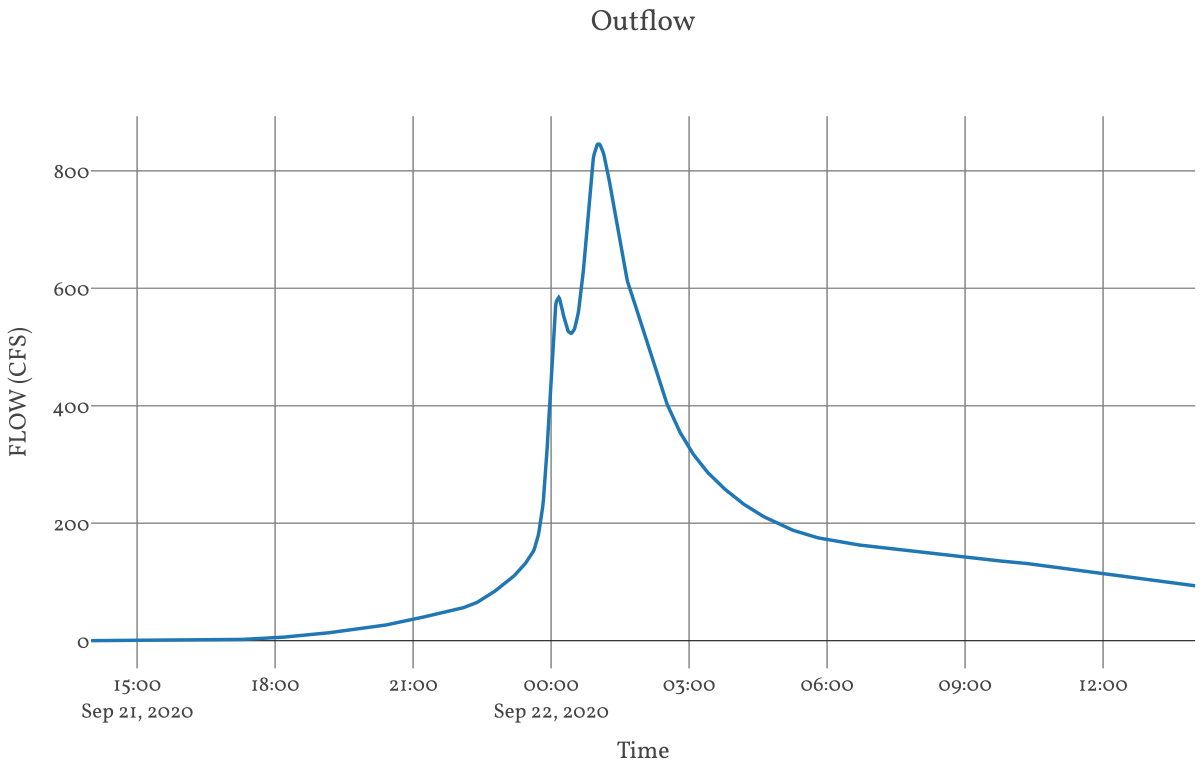

Precipitation and Outflow
FLOW (CFS) PRECIP-INC (IN)
0
0.01
0.02
0.03
0.04
0.05
400
0.06
200
0.07
0.08
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
Sep 21, 2020
Sep 22, 2020
Time
Precipitation
Excess Precipitation
Outflow

Junction: 17C

Downstream : 17r

Results: 17C

Peak Discharge (CFS)	845.88
Time of Peak Discharge	22Sep2020, 01:02
Volume (IN)	3.32



Reach: 17R

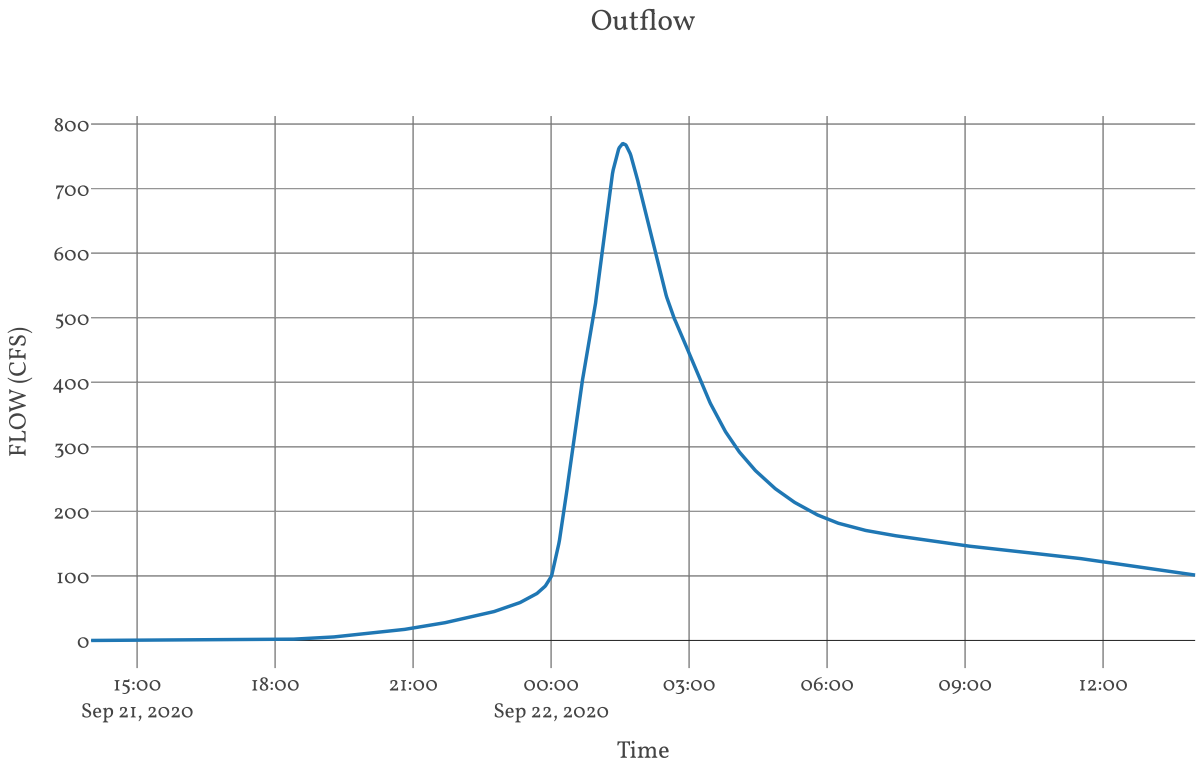
Downstream : 16c

Route: Modified Puls

Method	Modified Puls
Initial Variable	Combined Inflow
Number of Reaches	4
Storage Outflow Table Name	17r

Results: 17R

Peak Discharge (CFS)	769.61
Time of Peak Discharge	22Sep2020, 01:34
Volume (IN)	3.2
Peak Inflow (CFS)	845.88
Inflow Volume (AC - FT)	314.17



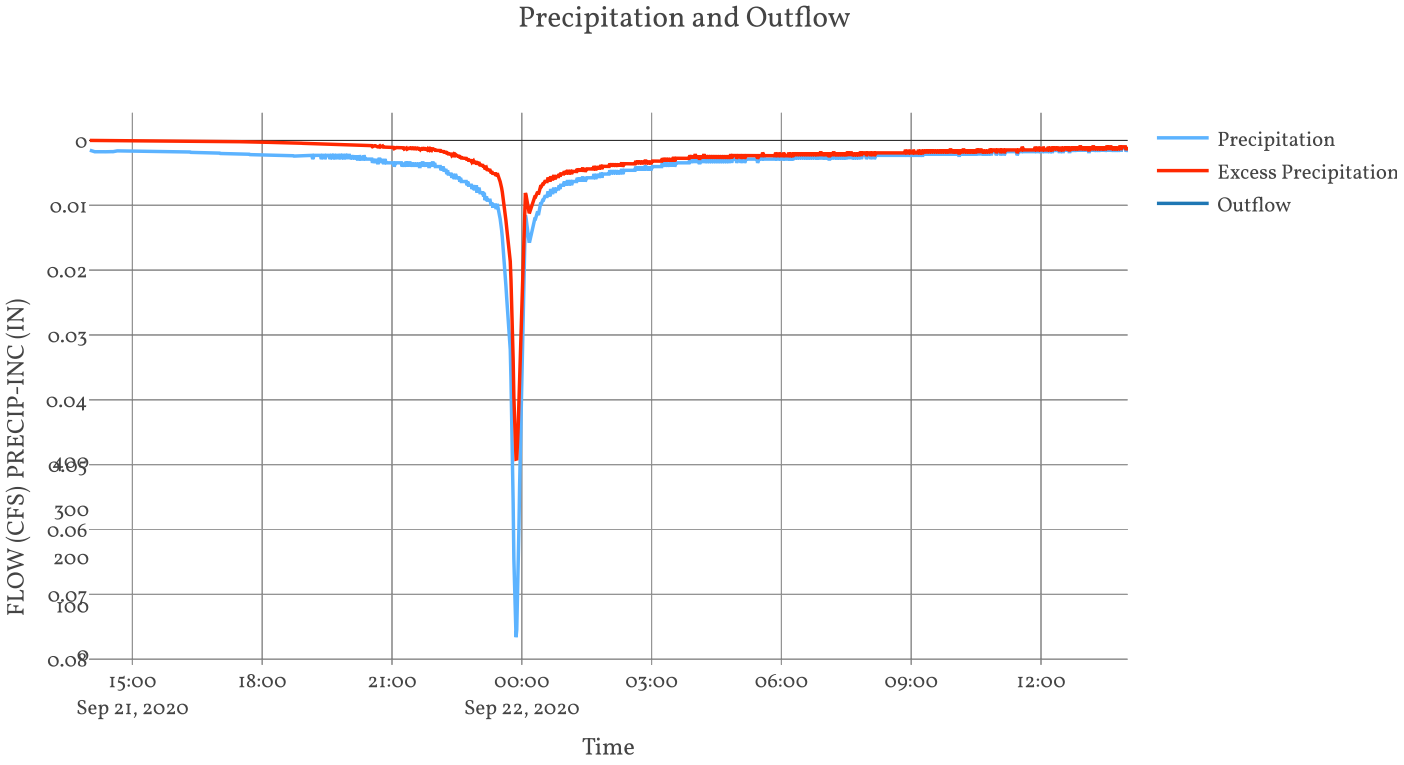
Subbasin: 63B

Area : 0.6
Downstream : 16c

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	74.6
Initial Abstraction	0.2

Transform: User - Specified S - Graph	
S - graph	Ellsworth S - Graph
Lag Method	Specified
Lag	0.41

Results: 63B	
Peak Discharge (CFS)	424.27
Time of Peak Discharge	22Sep2020, 00:17
Volume (IN)	3.4
Precipitation Volume (AC - FT)	184.93
Loss Volume (AC - FT)	74.22
Excess Volume (AC - FT)	110.71
Direct Runoff Volume (AC - FT)	109.19
Baseflow Volume (AC - FT)	0

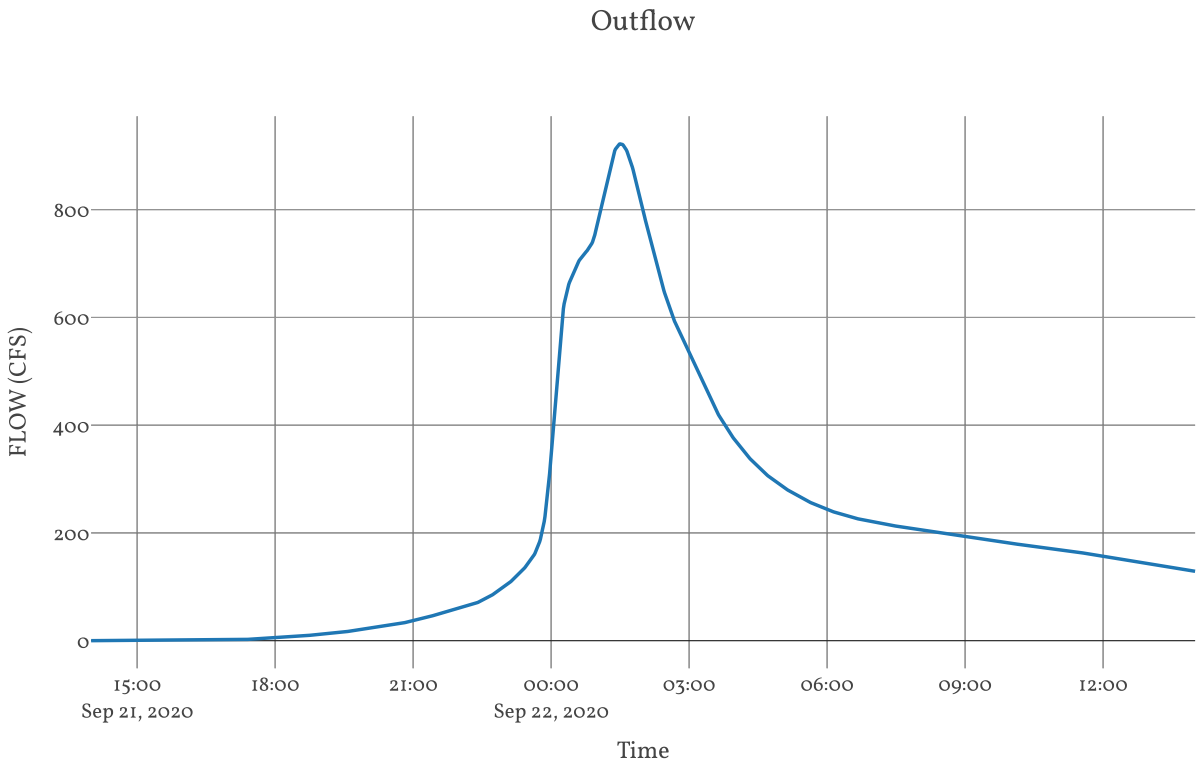

Precipitation and Outflow
FLOW (CFS) PRECIP-INC (IN)
0
0.01
0.02
0.03
0.04
0.05
0.06
0.07
0.08
400
300
200
100
0
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
Sep 21, 2020
Sep 22, 2020
Time
Precipitation
Excess Precipitation
Outflow

Junction: 16C

Downstream : 16r

Results: 16C

Peak Discharge (CFS)	922.1
Time of Peak Discharge	22Sep2020, 01:31
Volume (IN)	3.25



Reach: 16R

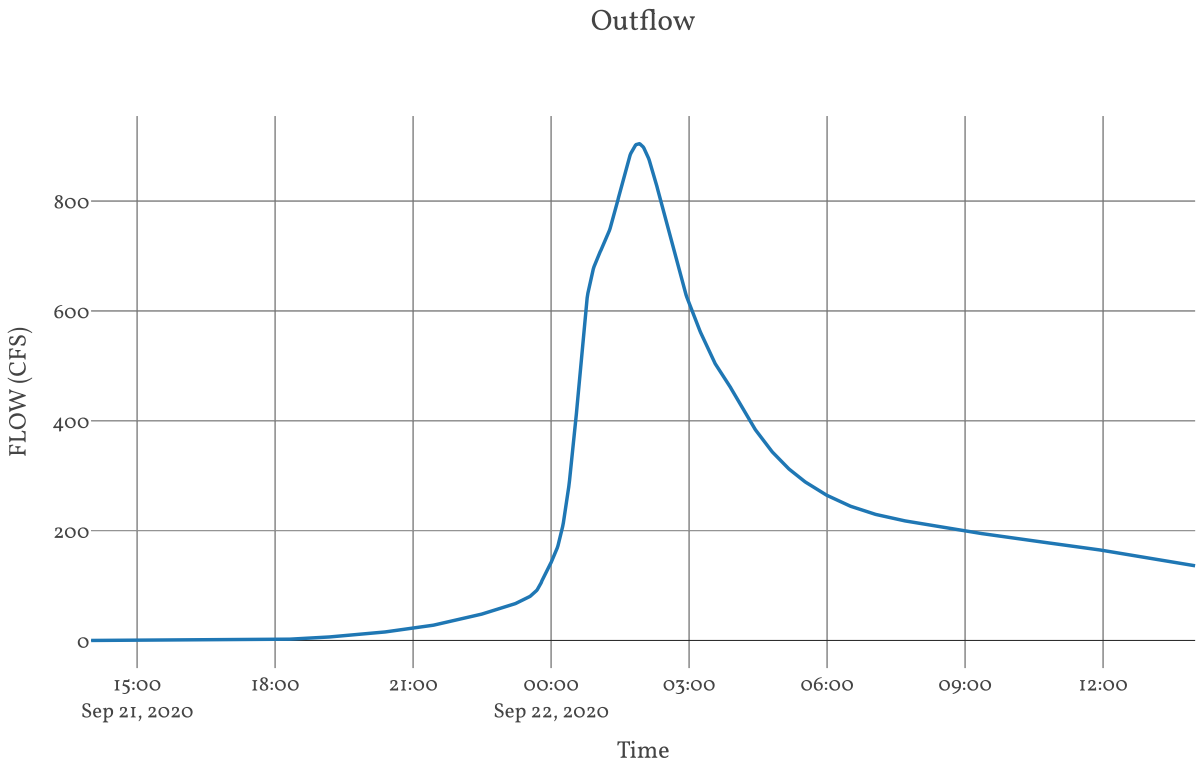
Downstream : 20C

Route: Modified Puls

Method	Modified Puls
Initial Variable	Combined Inflow
Number of Reaches	6
Storage Outflow Table Name	16r

Results: 16R

Peak Discharge (CFS)	904.53
Time of Peak Discharge	22Sep2020, 01:54
Volume (IN)	3.18
Peak Inflow (CFS)	922.1
Inflow Volume (AC - FT)	412.59



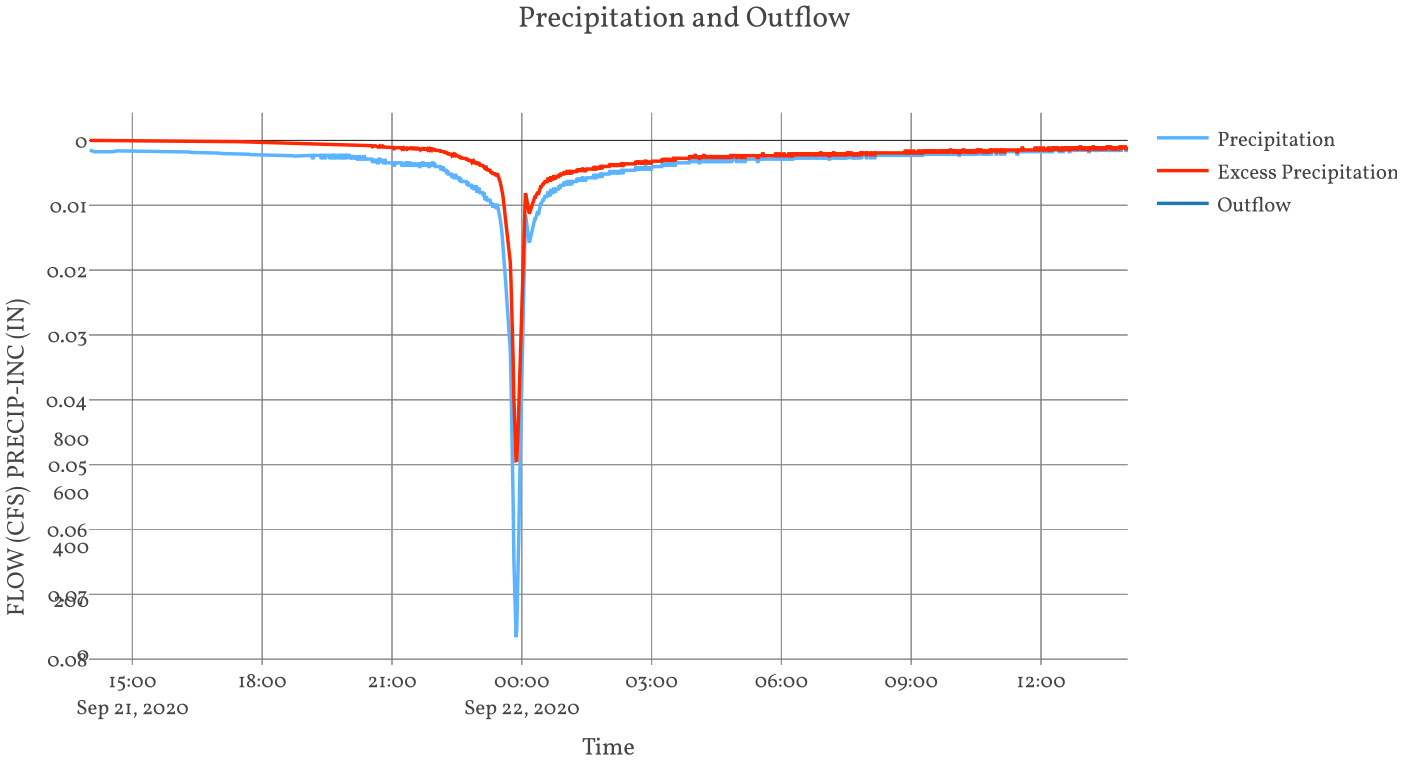
Subbasin: 64B

Area : 1.09
Downstream : 20c

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	74.8
Initial Abstraction	0.2

Transform: User - Specified S - Graph	
S - graph	Ellsworth S - Graph
Lag Method	Specified
Lag	0.42

Results: 64B	
Peak Discharge (CFS)	761.01
Time of Peak Discharge	22Sep2020, 00:18
Volume (IN)	3.41
Precipitation Volume (AC - FT)	334.85
Loss Volume (AC - FT)	133.58
Excess Volume (AC - FT)	201.27
Direct Runoff Volume (AC - FT)	198.44
Baseflow Volume (AC - FT)	0

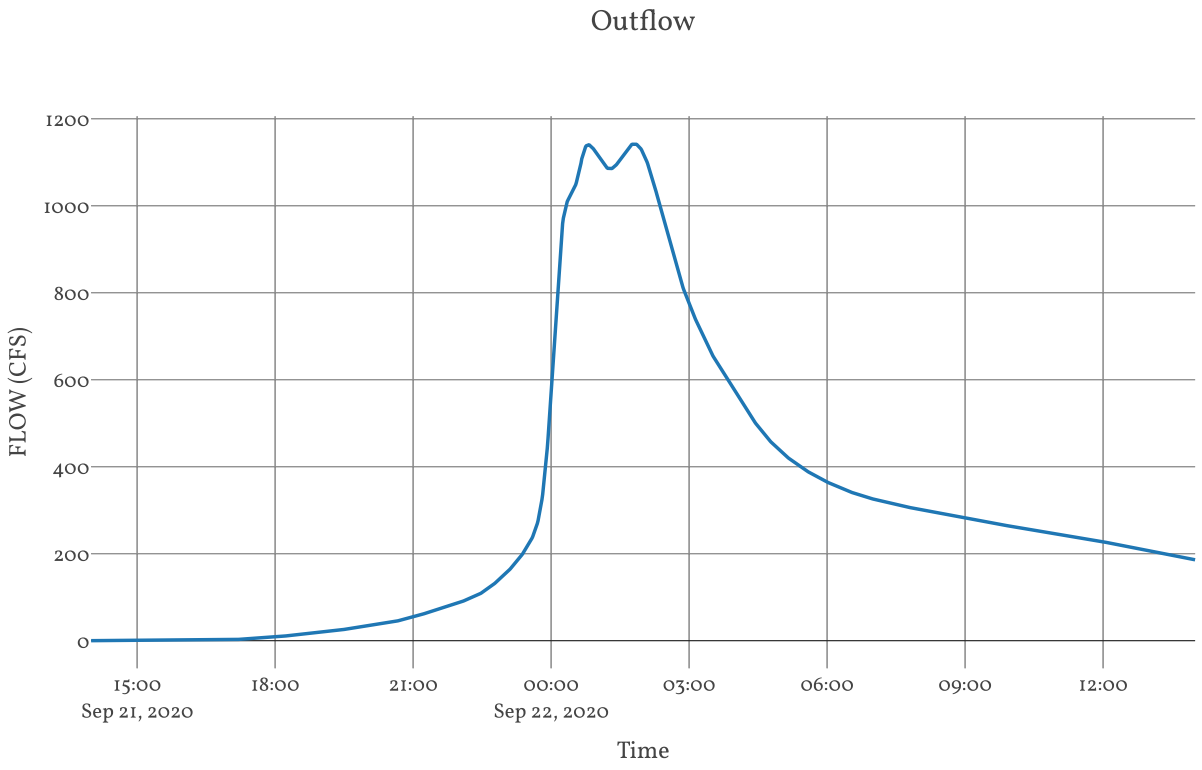

Precipitation and Outflow
FLOW (CFS) PRECIP-INC (IN)
0
0.01
0.02
0.03
0.04
800
0.05
600
0.06
400
0.07
200
0.08
0
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
Sep 21, 2020
Sep 22, 2020
Time
Precipitation
Excess Precipitation
Outflow

Junction: 20C

Downstream : 20r

Results: 20C

Peak Discharge (CFS)	1142.12
Time of Peak Discharge	22Sep2020, 01:48
Volume (IN)	3.25

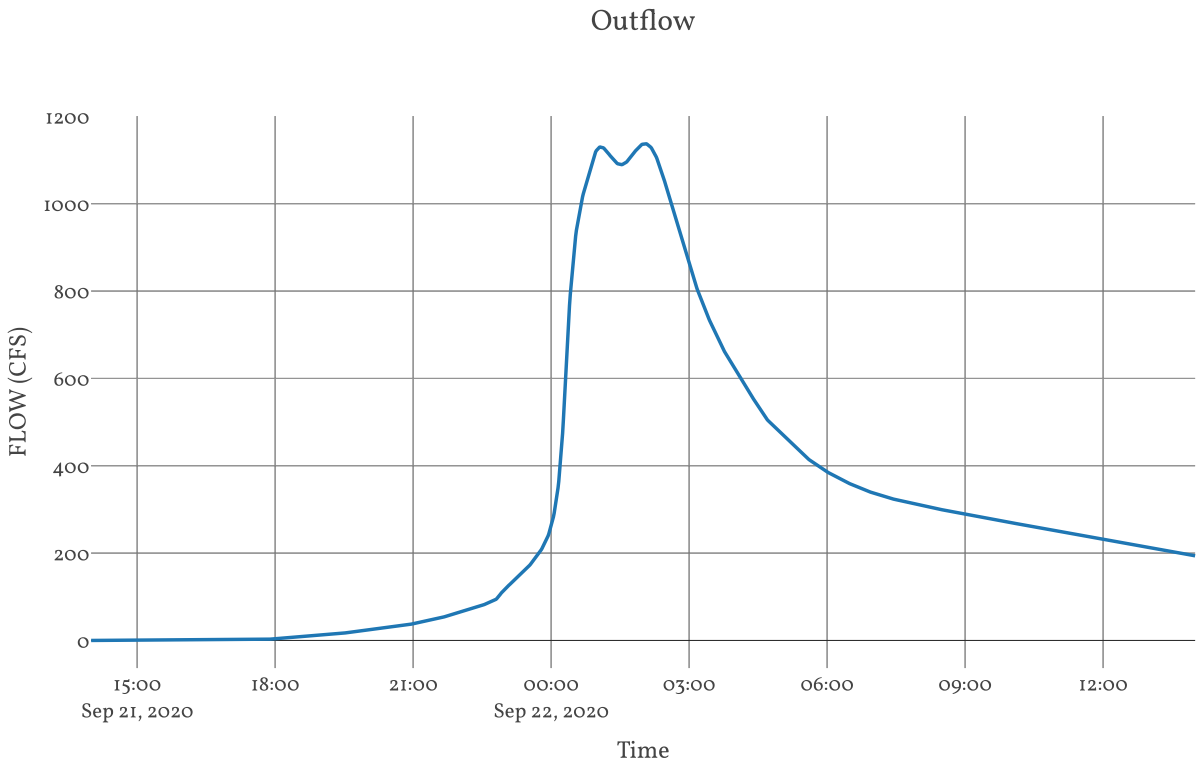


Reach: 20R

Downstream : 15C

Route: Modified Puls	
Method	Modified Puls
Initial Variable	Combined Inflow
Number of Reaches	6
Storage Outflow Table Name	20r

Results: 20R	
Peak Discharge (CFS)	1137.47
Time of Peak Discharge	22Sep2020, 02:02
Volume (IN)	3.2
Peak Inflow (CFS)	1142.12
Inflow Volume (AC - FT)	601.28



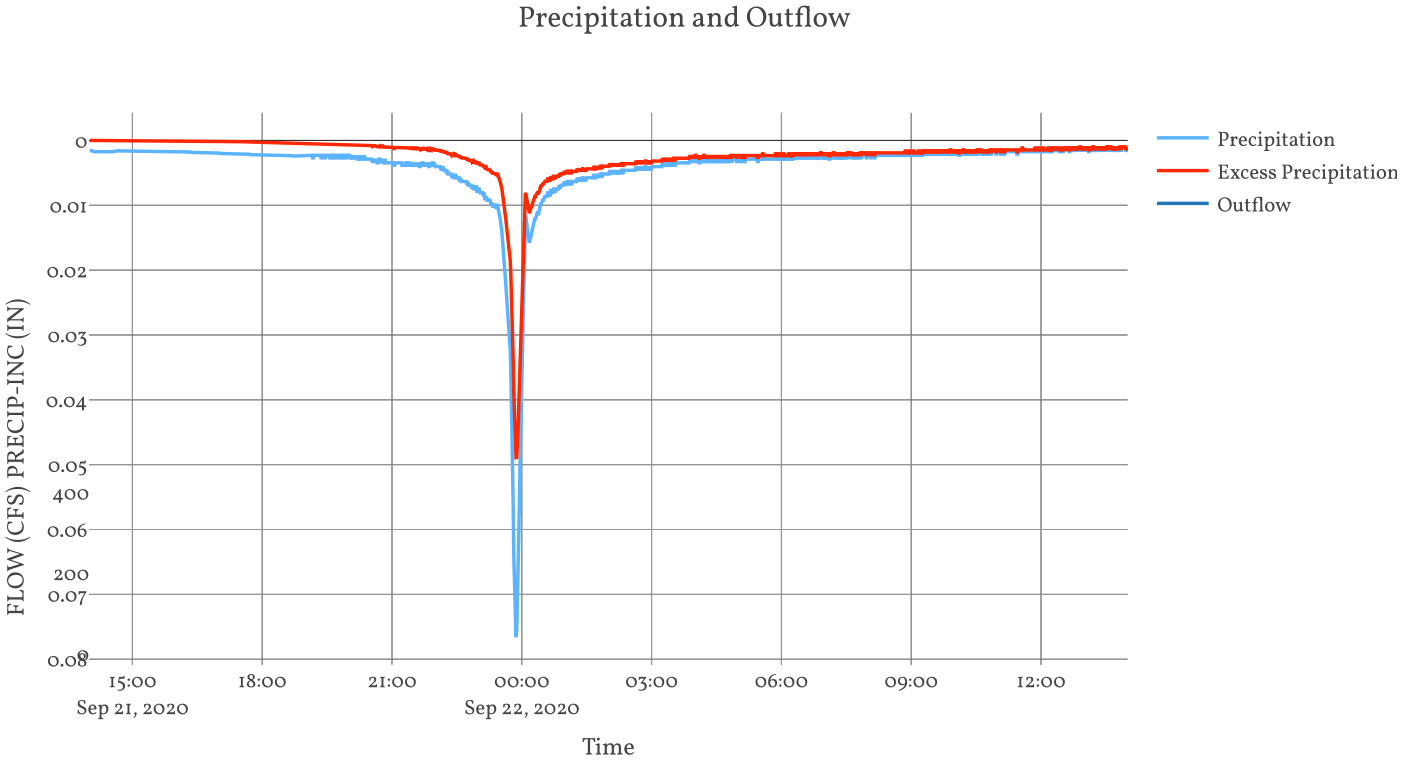
Subbasin: 65B

Area : 0.53
Downstream : 15c

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	74.4
Initial Abstraction	0.2

Transform: User - Specified S - Graph	
S - graph	Ellsworth S - Graph
Lag Method	Specified
Lag	0.24

Results: 65B	
Peak Discharge (CFS)	507.77
Time of Peak Discharge	22Sep2020, 00:07
Volume (IN)	3.41
Precipitation Volume (AC - FT)	163.74
Loss Volume (AC - FT)	66.11
Excess Volume (AC - FT)	97.63
Direct Runoff Volume (AC - FT)	96.87
Baseflow Volume (AC - FT)	0

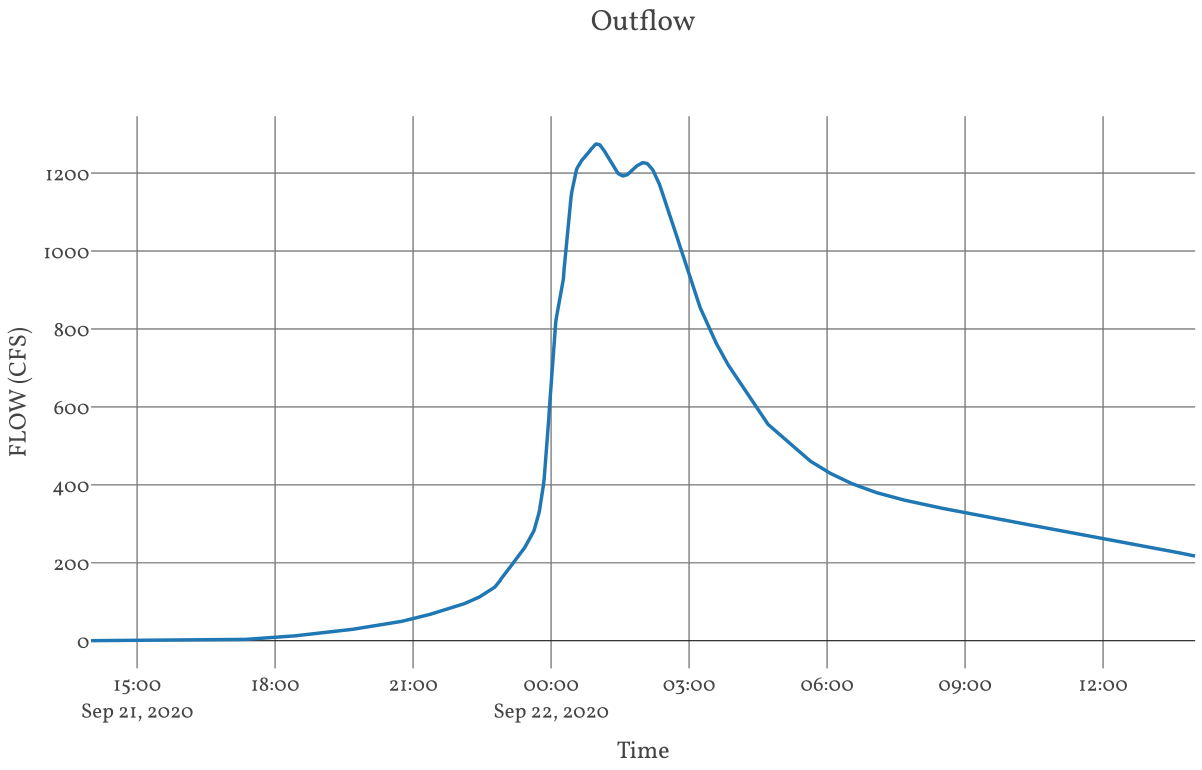

Precipitation and Outflow
FLOW (CFS) PRECIP-INC (IN)
0
0.01
0.02
0.03
0.04
0.05
400
0.06
200
0.07
0.08
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
Sep 21, 2020
Sep 22, 2020
Time
Precipitation
Excess Precipitation
Outflow

Junction: 15C

Downstream : 15r

Results: 15C

Peak Discharge (CFS)	1274.95
Time of Peak Discharge	22Sep2020, 01:00
Volume (IN)	3.23

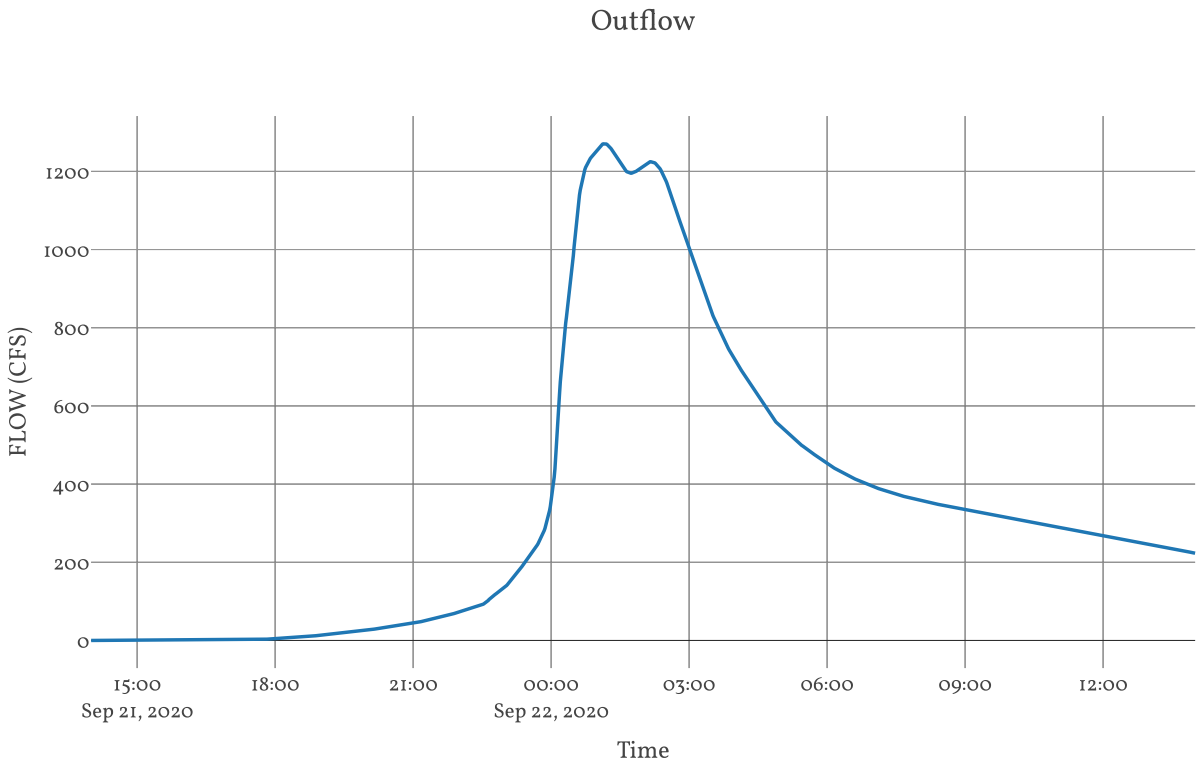


Reach: 15R

Downstream : 14c

Route: Modified Puls	
Method	Modified Puls
Initial Variable	Combined Inflow
Number of Reaches	5
Storage Outflow Table Name	15r

Results: 15R	
Peak Discharge (CFS)	1270.86
Time of Peak Discharge	22Sep2020, 01:10
Volume (IN)	3.2
Peak Inflow (CFS)	1274.95
Inflow Volume (AC - FT)	689.49



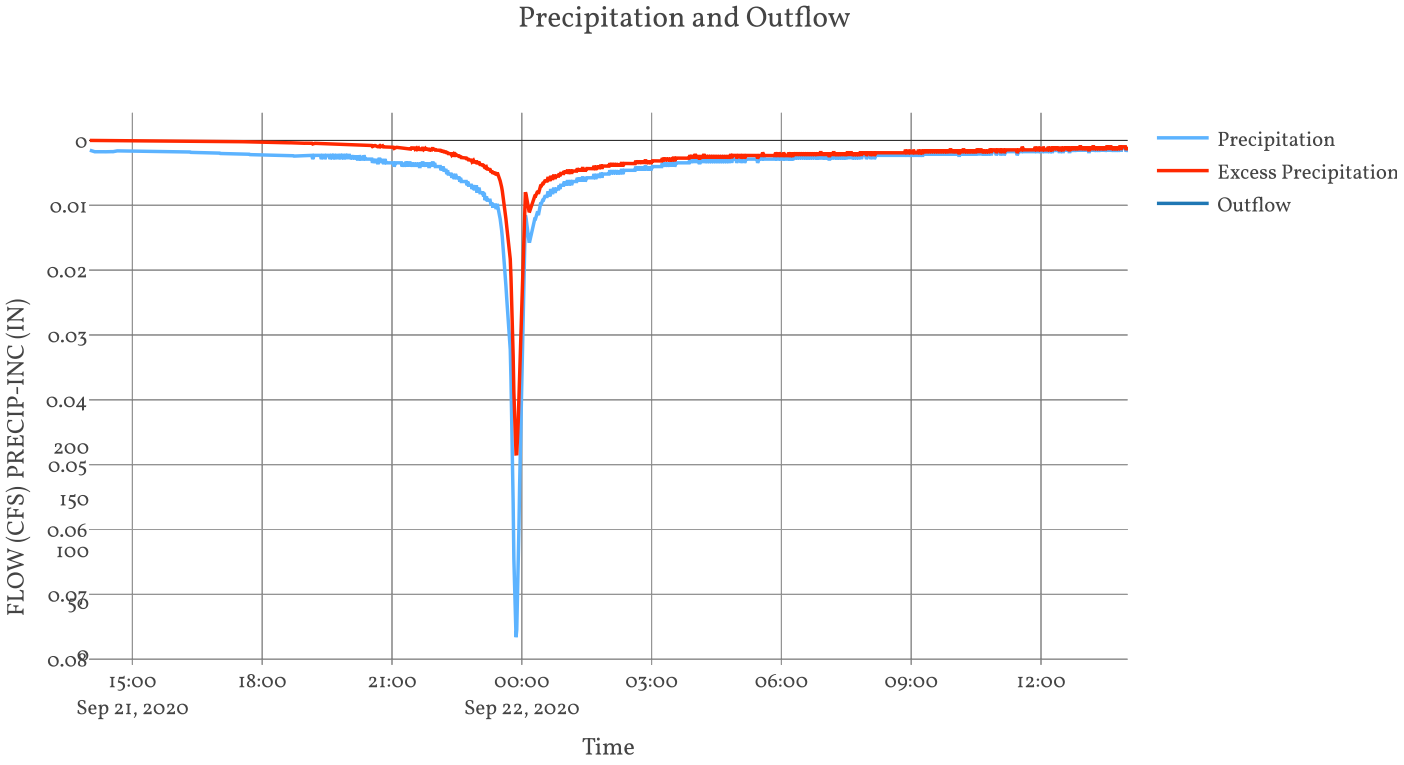
Subbasin: 66B

Area : 0.16
Downstream : 14c

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	73.9
Initial Abstraction	0.2

Transform: User - Specified S - Graph	
S - graph	Ellsworth S - Graph
Lag Method	Specified
Lag	0.14

Results: 66B	
Peak Discharge (CFS)	197.61
Time of Peak Discharge	22Sep2020, 00:02
Volume (IN)	3.38
Precipitation Volume (AC - FT)	49.77
Loss Volume (AC - FT)	20.39
Excess Volume (AC - FT)	29.38
Direct Runoff Volume (AC - FT)	29.25
Baseflow Volume (AC - FT)	0

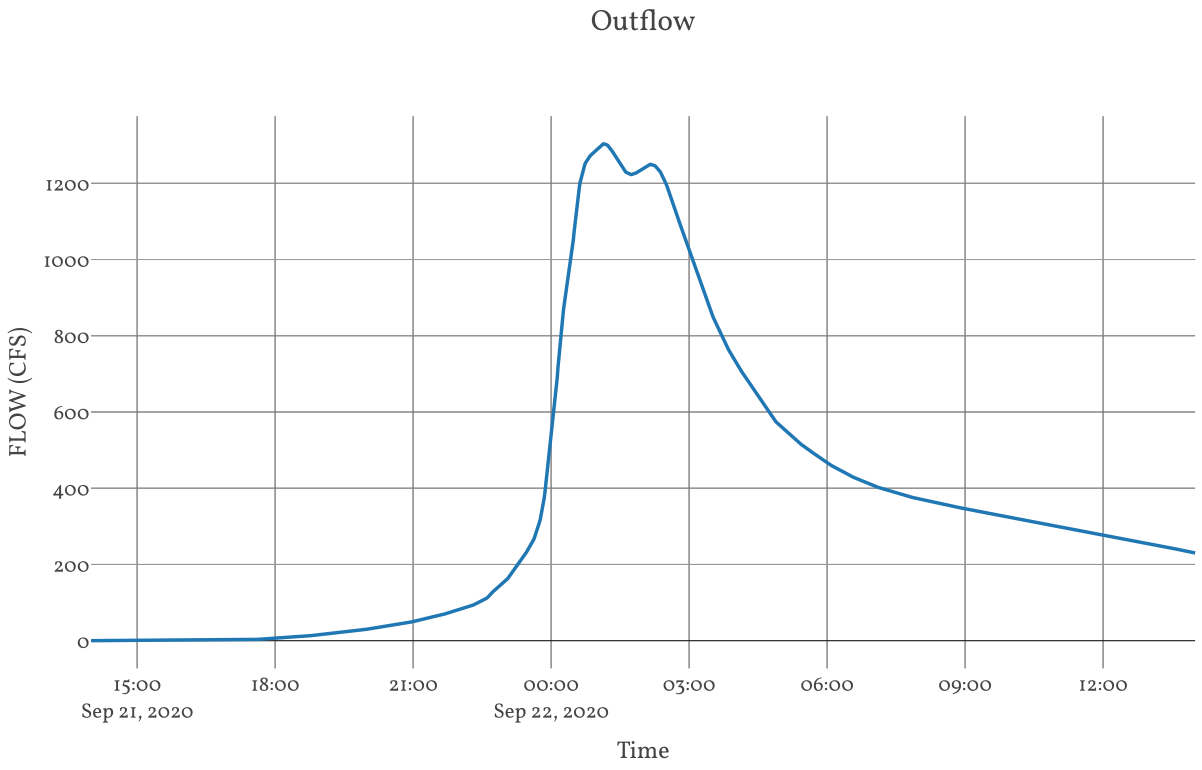

Precipitation and Outflow
FLOW (CFS) PRECIP-INC (IN)
0
0.01
0.02
0.03
0.04
200
0.05
150
0.06
100
0.07
50
0.08
0
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
Sep 21, 2020
Sep 22, 2020
Time
Precipitation
Excess Precipitation
Outflow

Junction: 14C

Downstream : 14r

Results: 14C

Peak Discharge (CFS)	1303.35
Time of Peak Discharge	22Sep2020, 01:09
Volume (IN)	3.21

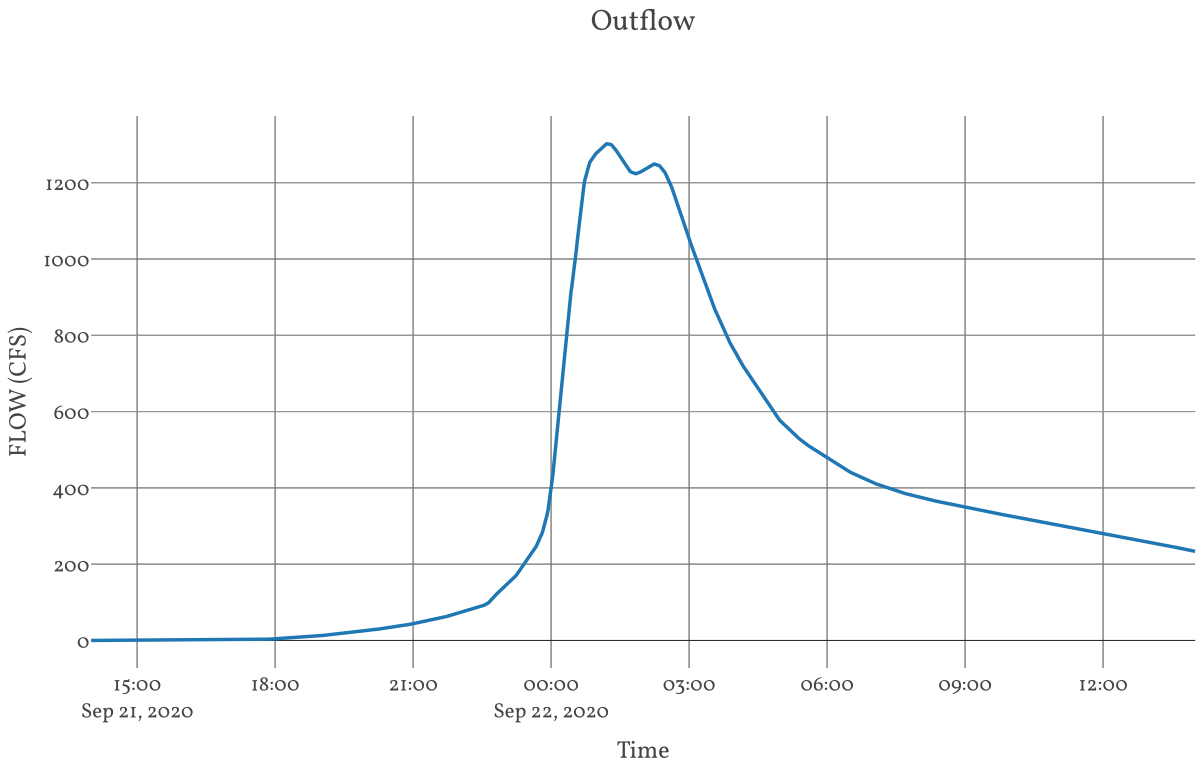


Reach: 14R

Downstream : 13c

Route: Modified Puls	
Method	Modified Puls
Initial Variable	Combined Inflow
Number of Reaches	5
Storage Outflow Table Name	14r

Results: 14R	
Peak Discharge (CFS)	1302.34
Time of Peak Discharge	22Sep2020, 01:14
Volume (IN)	3.19
Peak Inflow (CFS)	1303.35
Inflow Volume (AC - FT)	712.17



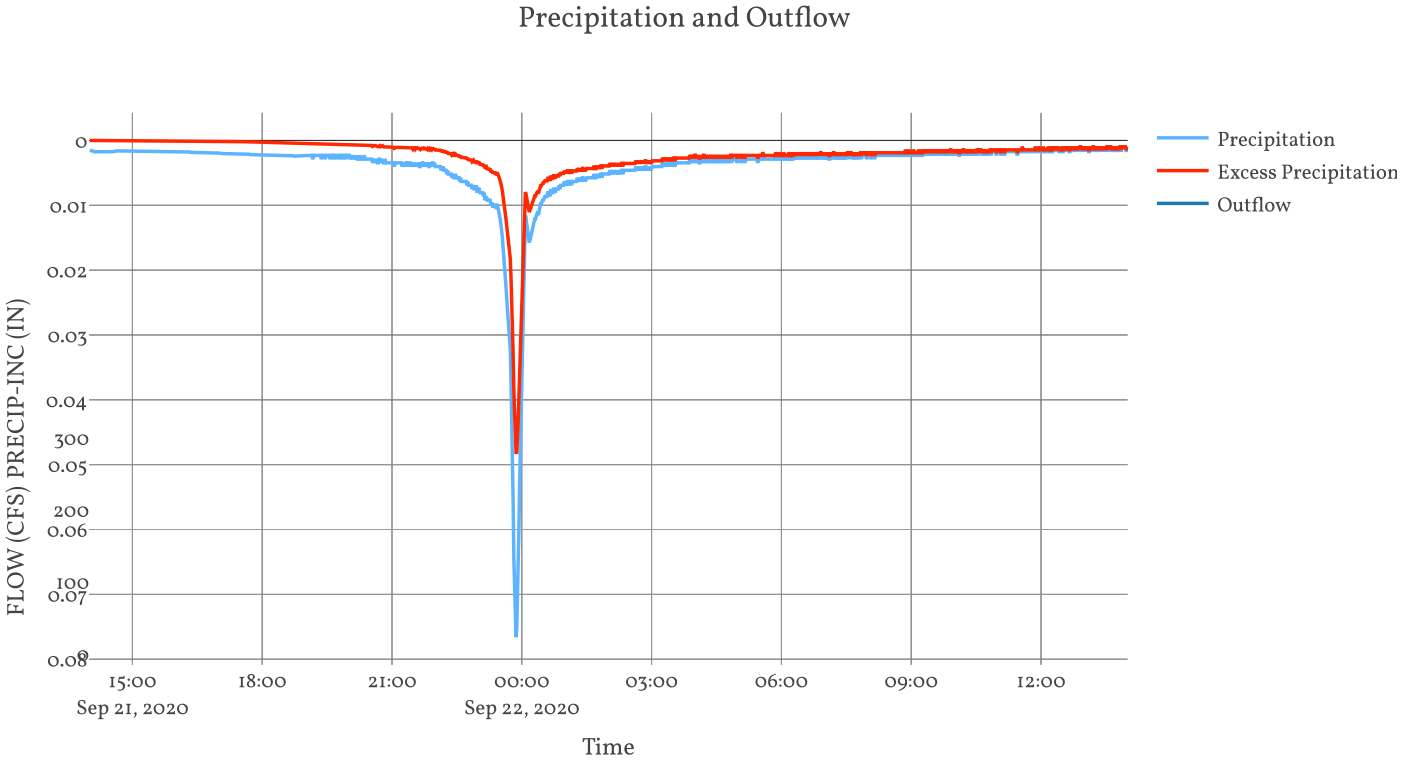
Subbasin: 67B

Area : 0.43
Downstream : 13c

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	73.7
Initial Abstraction	0.2

Transform: User - Specified S - Graph	
S - graph	Ellsworth S - Graph
Lag Method	Specified
Lag	0.44

Results: 67B	
Peak Discharge (CFS)	284.32
Time of Peak Discharge	22Sep2020, 00:19
Volume (IN)	3.34
Precipitation Volume (AC - FT)	132.1
Loss Volume (AC - FT)	54.43
Excess Volume (AC - FT)	77.66
Direct Runoff Volume (AC - FT)	76.5
Baseflow Volume (AC - FT)	0

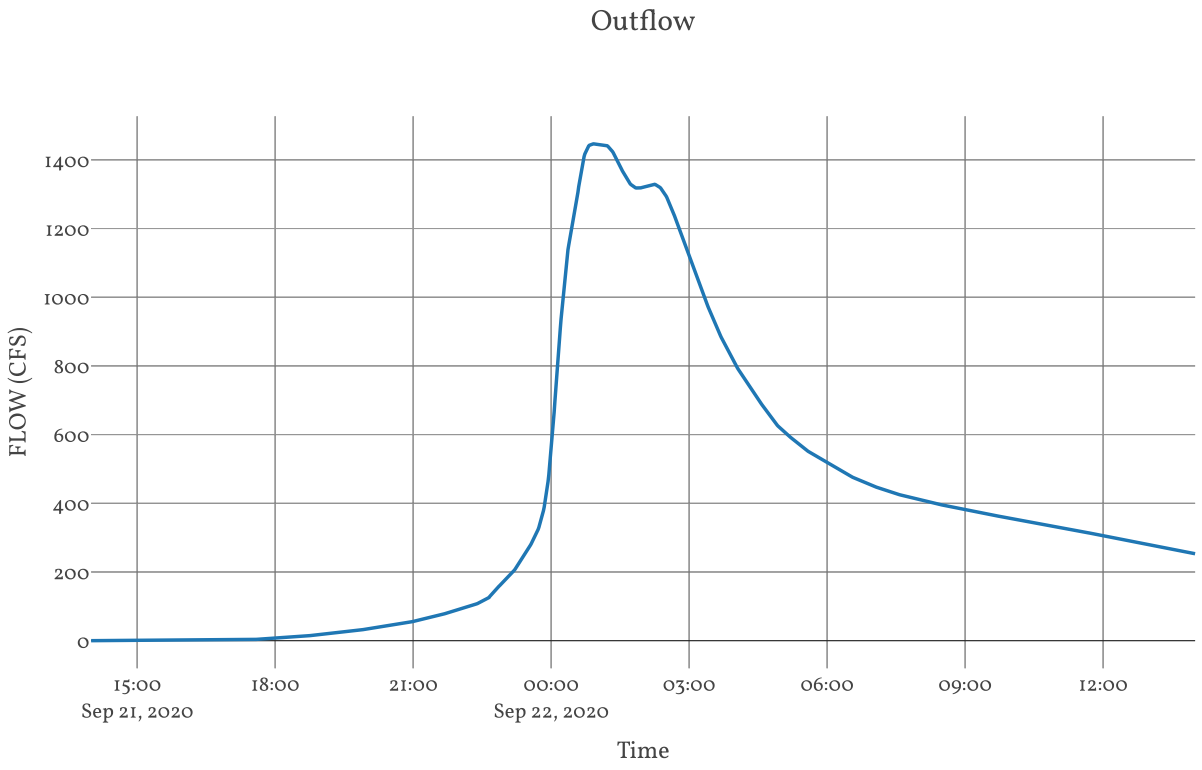

Precipitation and Outflow
FLOW (CFS) PRECIP-INC (IN)
0
0.01
0.02
0.03
0.04
300
0.05
200
0.06
100
0.07
0.08
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
Sep 21, 2020
Sep 22, 2020
Time
Precipitation
Excess Precipitation
Outflow

Junction: 13C

Downstream : 13r

Results: 13C

Peak Discharge (CFS)	1446.43
Time of Peak Discharge	22Sep2020, 00:55
Volume (IN)	3.2



Reach: 13R

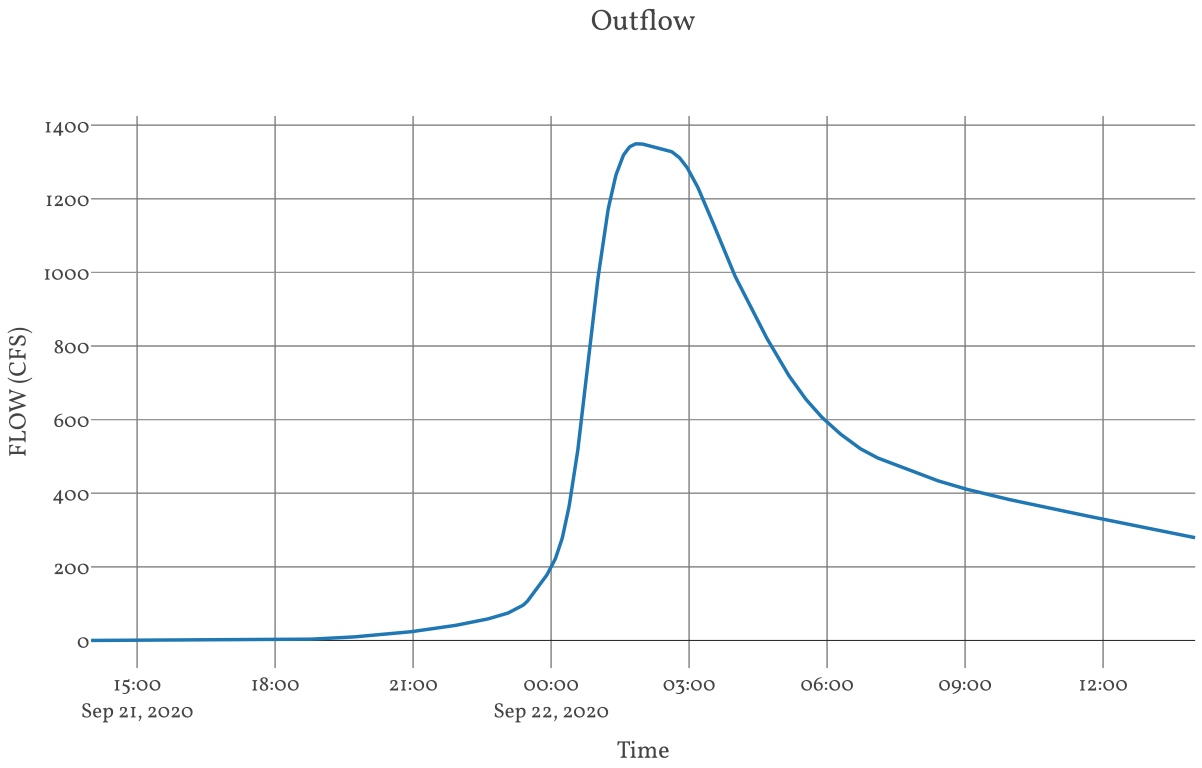
Downstream : 12C

Route: Modified Puls

Method	Modified Puls
Initial Variable	Combined Inflow
Number of Reaches	2
Storage Outflow Table Name	13r

Results: 13R

Peak Discharge (CFS)	1349.74
Time of Peak Discharge	22Sep2020, 01:54
Volume (IN)	3.09
Peak Inflow (CFS)	1446.43
Inflow Volume (AC - FT)	784.95



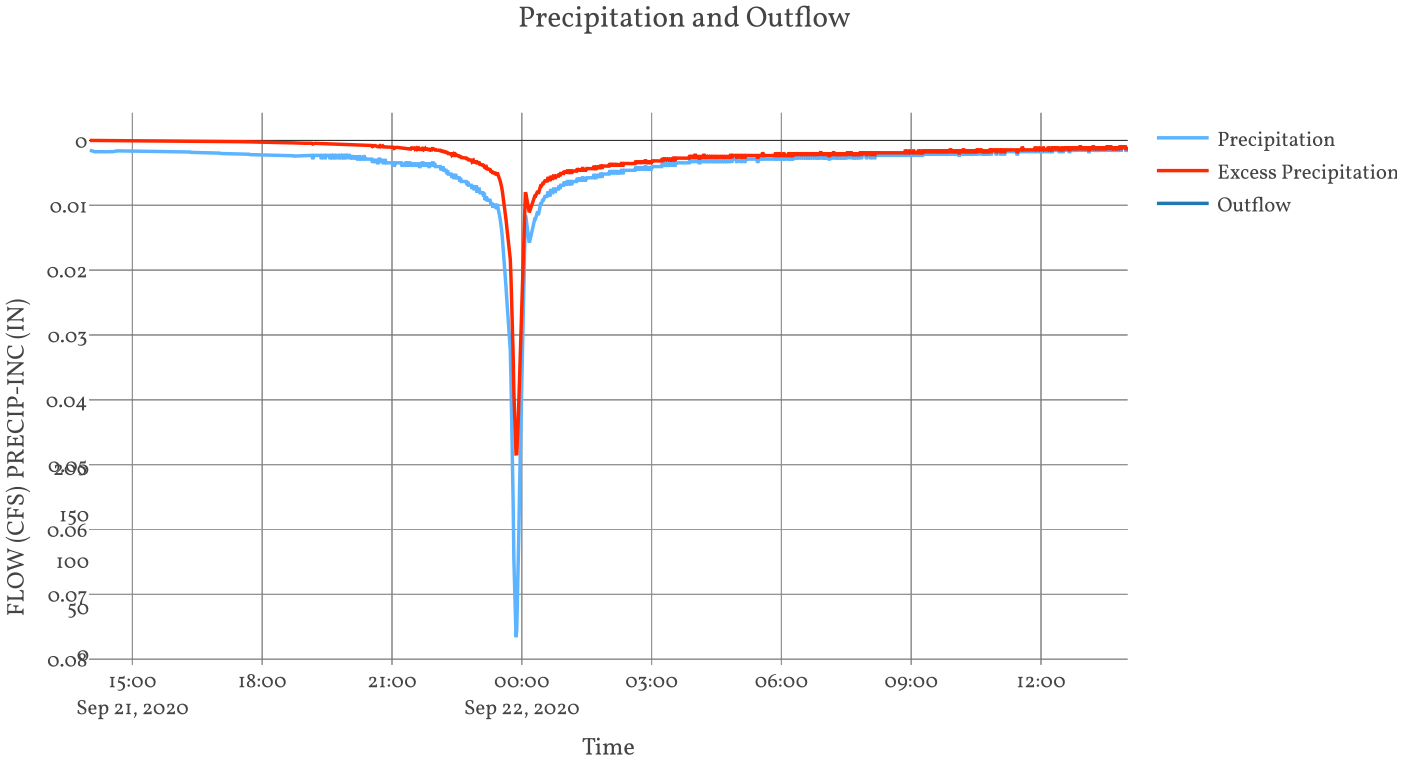
Subbasin: 68B

Area : 0.26
Downstream : I2C

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	73.9
Initial Abstraction	0.2

Transform: User - Specified S - Graph	
S - graph	Ellsworth S - Graph
Lag Method	Specified
Lag	0.28

Results: 68B	
Peak Discharge (CFS)	220.26
Time of Peak Discharge	22Sep2020, 00:09
Volume (IN)	3.37
Precipitation Volume (AC - FT)	78.34
Loss Volume (AC - FT)	32.09
Excess Volume (AC - FT)	46.24
Direct Runoff Volume (AC - FT)	45.82
Baseflow Volume (AC - FT)	0

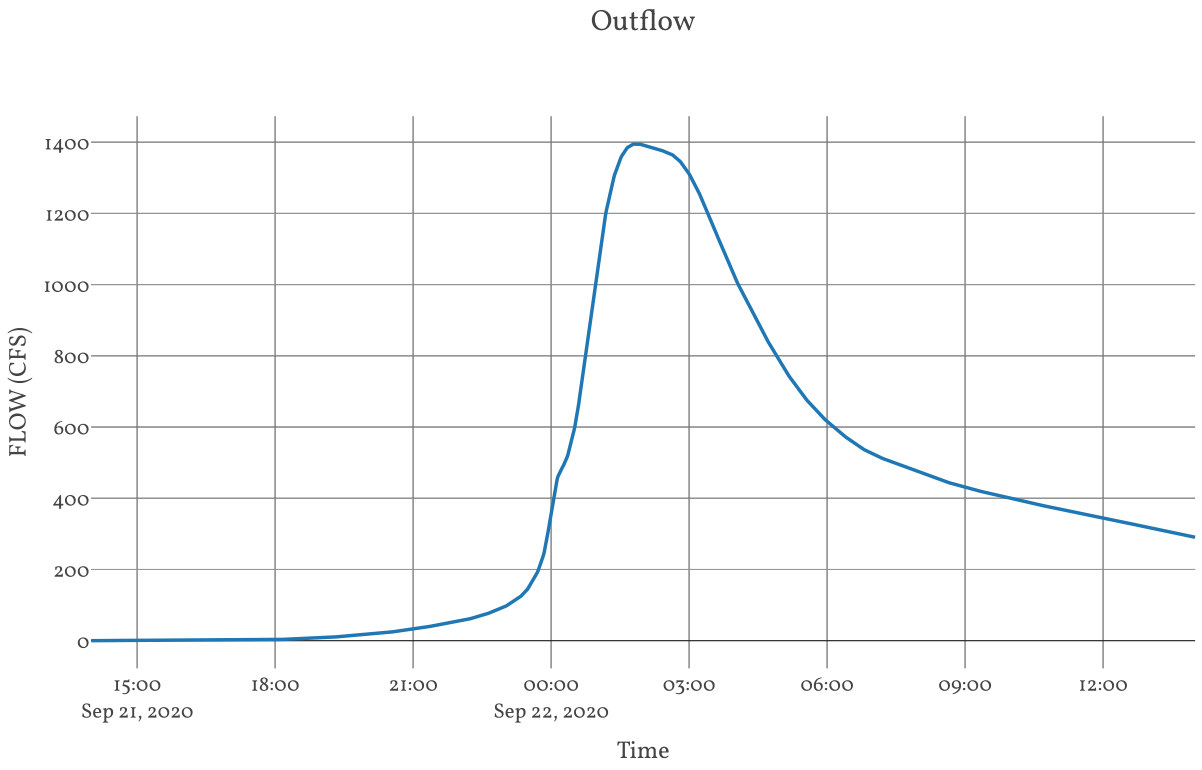

Precipitation and Outflow
FLOW (CFS) PRECIP-INC (IN)
0
0.01
0.02
0.03
0.04
0.05
0.06
0.07
0.08
200
150
100
50
0
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
Sep 21, 2020
Sep 22, 2020
Time
Precipitation
Excess Precipitation
Outflow

Junction: 12C

Downstream : Pacific Ocean

Results: 12C

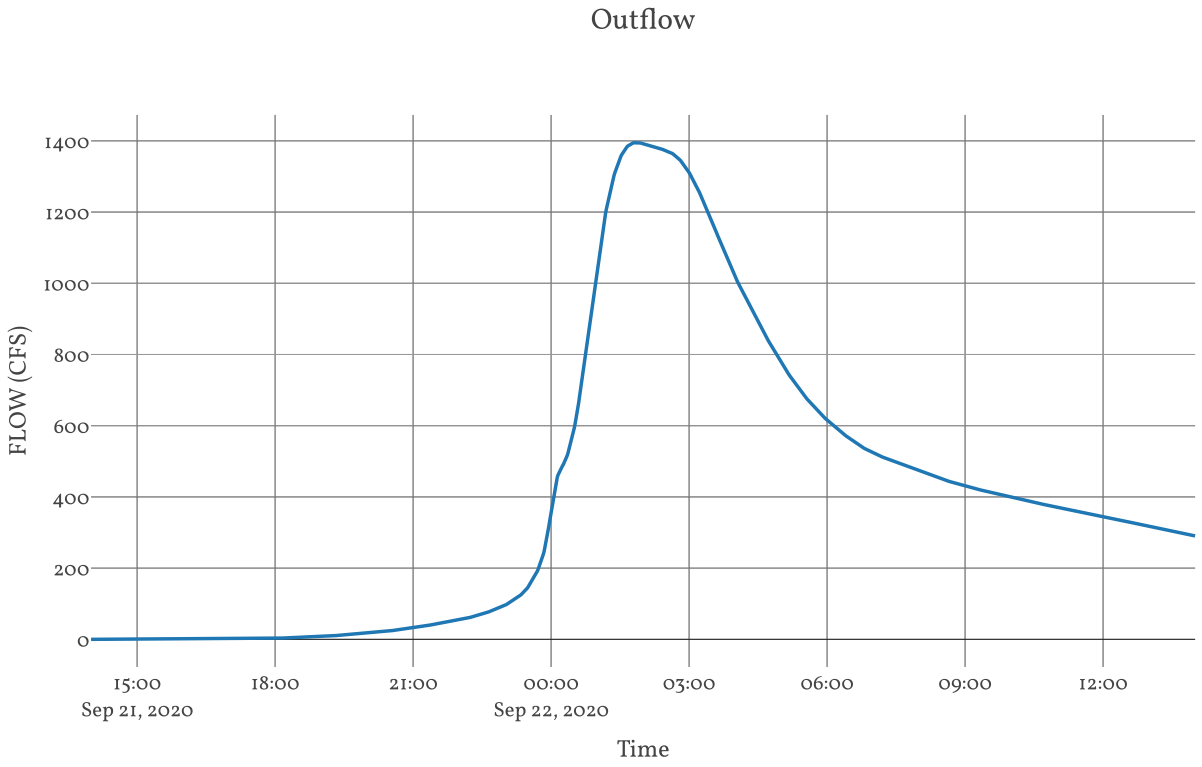
Peak Discharge (CFS)	1395.18
Time of Peak Discharge	22Sep2020, 01:51
Volume (IN)	3.1



Sink: Pacific Ocean

Results: Pacific Ocean

Peak Discharge (CFS)	1395.18
Time of Peak Discharge	22Sep2020, 01:51
Volume (IN)	3.1
Observed Flow Gage	Not specified
Observed Flow Volume (AC - FT)	Not specified
Observed Flow's RMSE Stdev	Not specified
Observed Flow's Percent Bias	Not specified
Observed Flow's Nash Sutcliffe	Not specified



Project: Little_Sycamore_May2021
Simulation Run: 025-mp-Post-Fire
Simulation Start: 21 September 2020, 14:00
Simulation End: 22 September 2020, 14:00

HMS Version: 4.6.1
Executed: 29 April 2021, 23:34

Global Parameter Summary - Subbasin

Area

Element Name	Area
60b	0.65
61b	0.61
62b	0.53
63b	0.6
64b	1.09
65b	0.53
66b	0.16
67b	0.43
68b	0.26

Downstream

Element Name	Downstream
60b	J 60b 61b
61b	J 60b 61b
62b	17c
63b	16c
64b	20c
65b	15c
66b	14c
67b	13c
68b	12c

Loss Rate: Scs

Element Name	Percent Impervious Area	Curve Number	Initial Abstraction
60b	0	75	0.2
61b	0	75	0.2
62b	0	73.9	0.2
63b	0	74.6	0.2
64b	0	74.8	0.2
65b	0	74.4	0.2
66b	0	73.9	0.2
67b	0	73.7	0.2
68b	0	73.9	0.2

Transform: User - Specified S - Graph

Element Name	S - graph	Lag Method	Lag
60b	Ellsworth S - Graph	Specified	0.52
61b	Ellsworth S - Graph	Specified	0.37
62b	Ellsworth S - Graph	Specified	0.25
63b	Ellsworth S - Graph	Specified	0.41
64b	Ellsworth S - Graph	Specified	0.42
65b	Ellsworth S - Graph	Specified	0.24
66b	Ellsworth S - Graph	Specified	0.14
67b	Ellsworth S - Graph	Specified	0.44
68b	Ellsworth S - Graph	Specified	0.28

Global Parameter Summary - Reach

Downstream

Element Name	Downstream
18r	17c
17r	16c
16r	20c
20r	15c
15r	14c
14r	13c
13r	12c

Route: Modified Puls

Element Name	Method	Initial Variable	Number of Reaches	Storage Outflow Table Name
18r	Modified Puls	Combined Inflow	8	18r
17r	Modified Puls	Combined Inflow	4	17r
16r	Modified Puls	Combined Inflow	6	16r
20r	Modified Puls	Combined Inflow	6	20r
15r	Modified Puls	Combined Inflow	5	15r
14r	Modified Puls	Combined Inflow	5	14r
13r	Modified Puls	Combined Inflow	2	13r

Global Results Summary

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
60b	0.65	541.94	22Sep2020, 00:24	4.58
61b	0.61	622.67	22Sep2020, 00:15	4.61
J 60b 61b	1.25	1133.19	22Sep2020, 00:18	4.59
18r	1.25	970.44	22Sep2020, 01:02	4.42
62b	0.53	659.42	22Sep2020, 00:08	4.54
17c	1.78	1171.23	22Sep2020, 00:58	4.46
17r	1.78	1084.81	22Sep2020, 01:28	4.33
63b	0.6	577.75	22Sep2020, 00:17	4.57
16c	2.38	1302.64	22Sep2020, 01:24	4.39
16r	2.38	1280.27	22Sep2020, 01:45	4.3
64b	1.09	1035.45	22Sep2020, 00:18	4.58
20c	3.47	1645.35	22Sep2020, 00:53	4.39
20r	3.47	1641.33	22Sep2020, 01:04	4.33
65b	0.53	691.07	22Sep2020, 00:07	4.58
15c	4	1848.15	22Sep2020, 00:53	4.37
15r	4	1844.61	22Sep2020, 01:03	4.33
66b	0.16	268.89	22Sep2020, 00:02	4.55
14c	4.16	1890.72	22Sep2020, 01:01	4.34
14r	4.16	1889.72	22Sep2020, 01:06	4.32
67b	0.43	388.37	22Sep2020, 00:19	4.49
13c	4.59	2103.7	22Sep2020, 01:00	4.33
13r	4.59	1968.98	22Sep2020, 01:43	4.19
68b	0.26	300.46	22Sep2020, 00:09	4.53

12c	4.85	2033.78	22Sep2020, 01:41	4.21
Pacific Ocean	4.85	2033.78	22Sep2020, 01:41	4.21

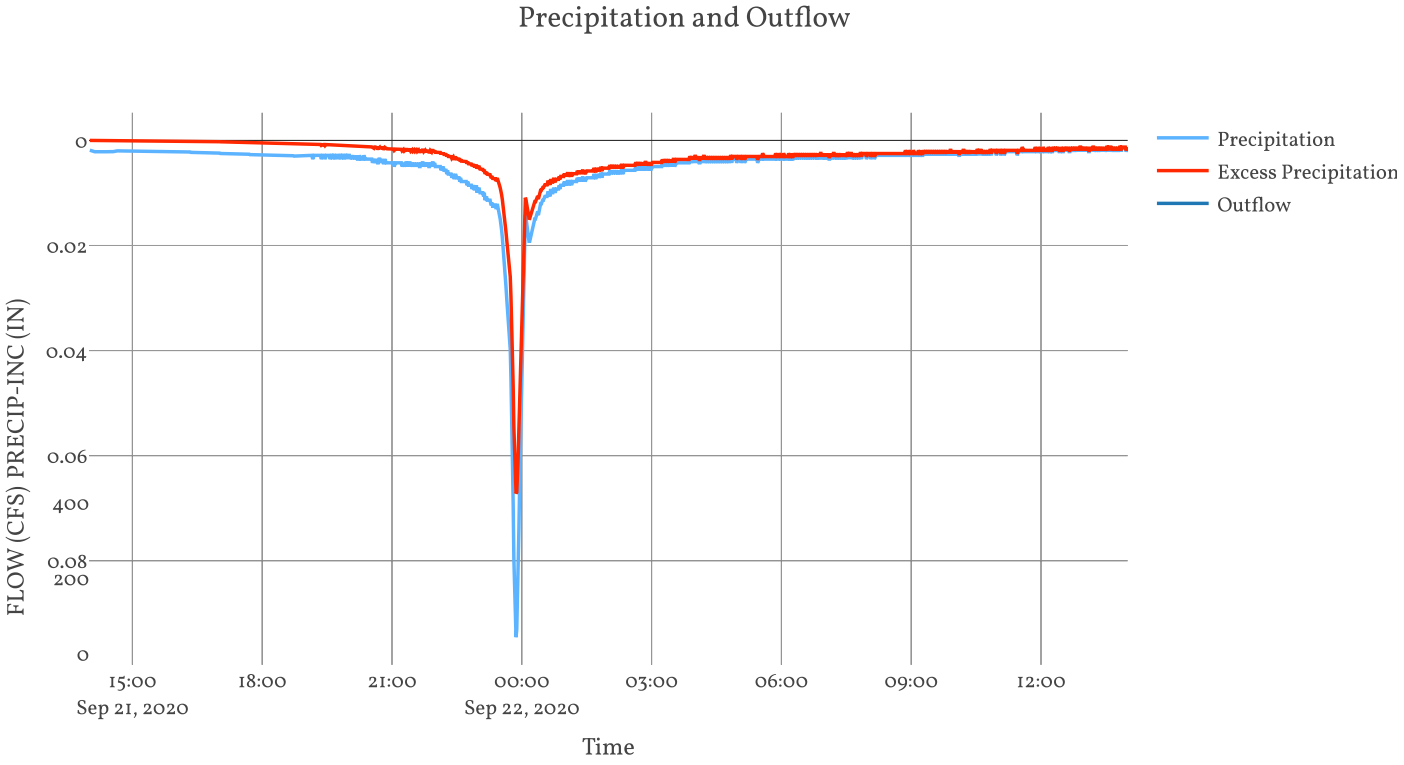
Subbasin: 60B

Area : 0.65
Downstream : J 60b 61b

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	75
Initial Abstraction	0.2

Transform: User - Specified S - Graph	
S - graph	Ellsworth S - Graph
Lag Method	Specified
Lag	0.52

Results: 60B	
Peak Discharge (CFS)	541.94
Time of Peak Discharge	22Sep2020, 00:24
Volume (IN)	4.58
Precipitation Volume (AC - FT)	244.58
Loss Volume (AC - FT)	84.23
Excess Volume (AC - FT)	160.35
Direct Runoff Volume (AC - FT)	157.64
Baseflow Volume (AC - FT)	0


Precipitation and Outflow
FLOW (CFS) PRECIP-INC (IN)
0
0.02
0.04
0.06
400
0.08
200
0
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
Sep 21, 2020
Sep 22, 2020
Time
Precipitation
Excess Precipitation
Outflow

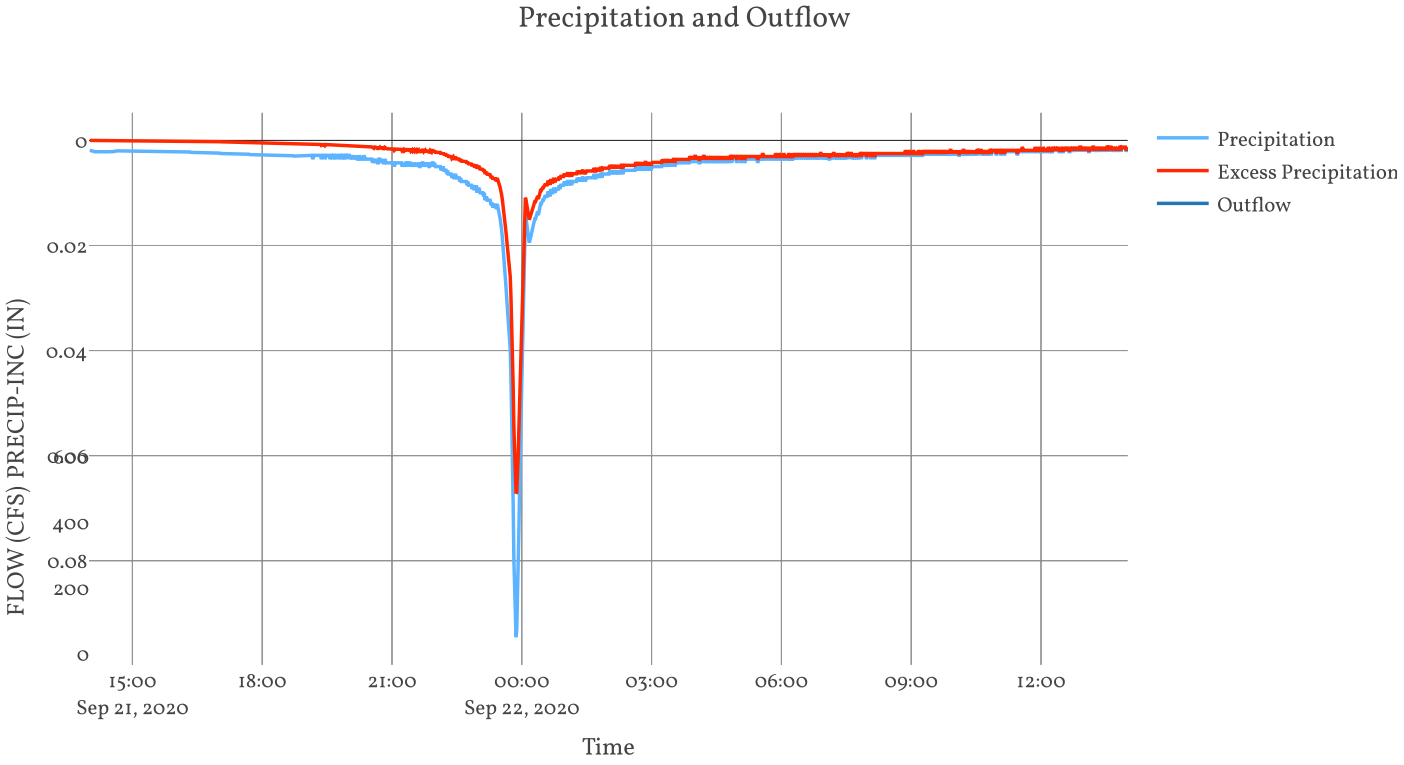
Subbasin: 61B

Area : 0.61
Downstream : J 60b 61b

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	75
Initial Abstraction	0.2

Transform: User - Specified S - Graph	
S - graph	Ellsworth S - Graph
Lag Method	Specified
Lag	0.37

Results: 61B	
Peak Discharge (CFS)	622.67
Time of Peak Discharge	22Sep2020, 00:15
Volume (IN)	4.61
Precipitation Volume (AC - FT)	229.8
Loss Volume (AC - FT)	79.14
Excess Volume (AC - FT)	150.66
Direct Runoff Volume (AC - FT)	148.89
Baseflow Volume (AC - FT)	0

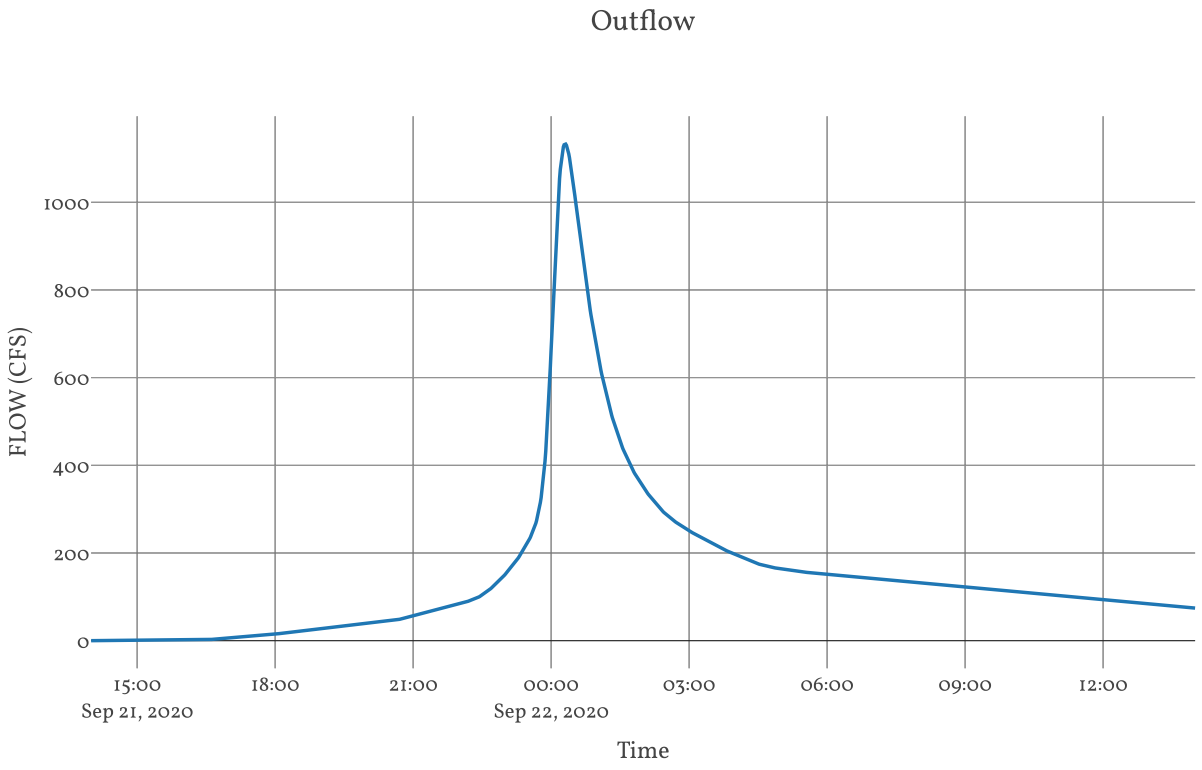

Precipitation and Outflow
FLOW (CFS) PRECIP-INC (IN)
0
0.02
0.04
0.06
0.08
0
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
Sep 21, 2020
Sep 22, 2020
Time
Precipitation
Excess Precipitation
Outflow

Junction: J 60B 61B

Downstream : 18r

Results: J 60B 61B

Peak Discharge (CFS)	1133.19
Time of Peak Discharge	22Sep2020, 00:18
Volume (IN)	4.59



Reach: 18R

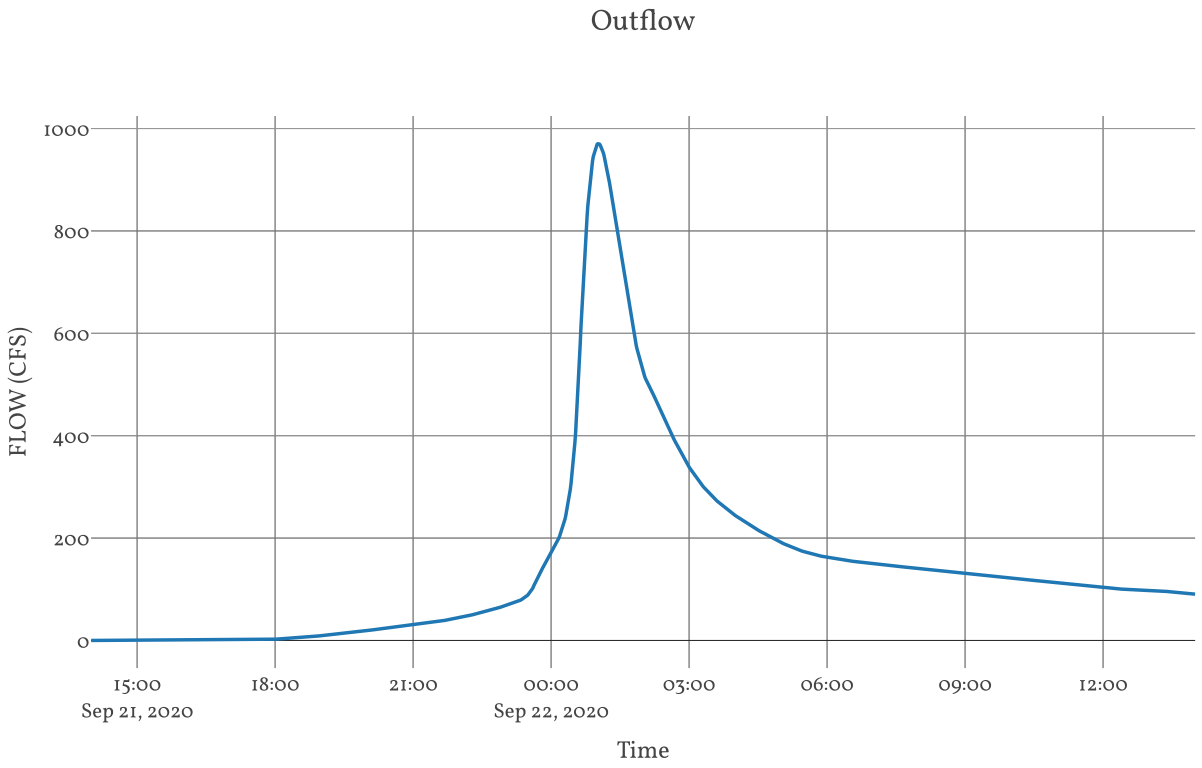
Downstream : 17c

Route: Modified Puls

Method	Modified Puls
Initial Variable	Combined Inflow
Number of Reaches	8
Storage Outflow Table Name	18r

Results: 18R

Peak Discharge (CFS)	970.44
Time of Peak Discharge	22Sep2020, 01:02
Volume (IN)	4.42
Peak Inflow (CFS)	1133.19
Inflow Volume (AC - FT)	306.52



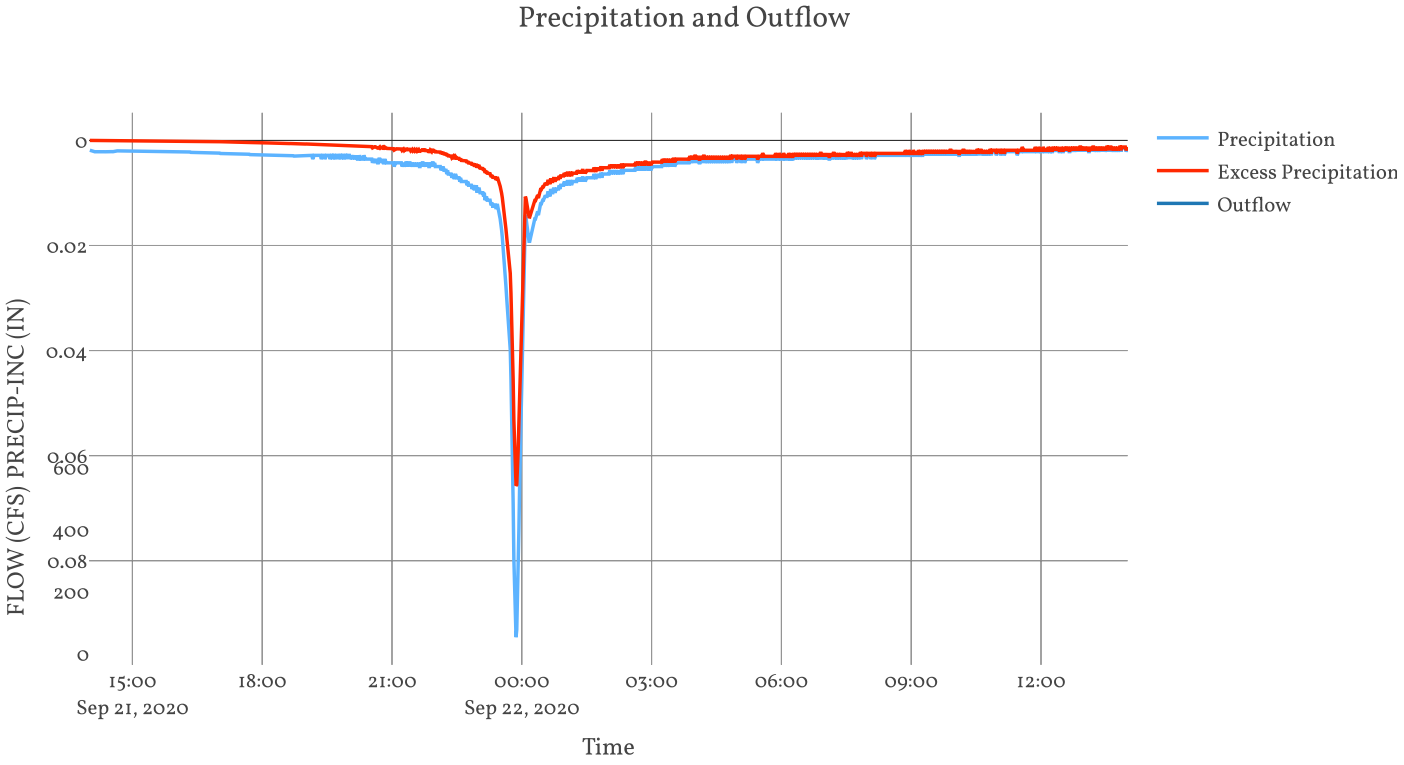
Subbasin: 62B

Area : 0.53
Downstream : 17c

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	73.9
Initial Abstraction	0.2

Transform: User - Specified S - Graph	
S - graph	Ellsworth S - Graph
Lag Method	Specified
Lag	0.25

Results: 62B	
Peak Discharge (CFS)	659.42
Time of Peak Discharge	22Sep2020, 00:08
Volume (IN)	4.54
Precipitation Volume (AC - FT)	199.31
Loss Volume (AC - FT)	71.12
Excess Volume (AC - FT)	128.18
Direct Runoff Volume (AC - FT)	127.18
Baseflow Volume (AC - FT)	0

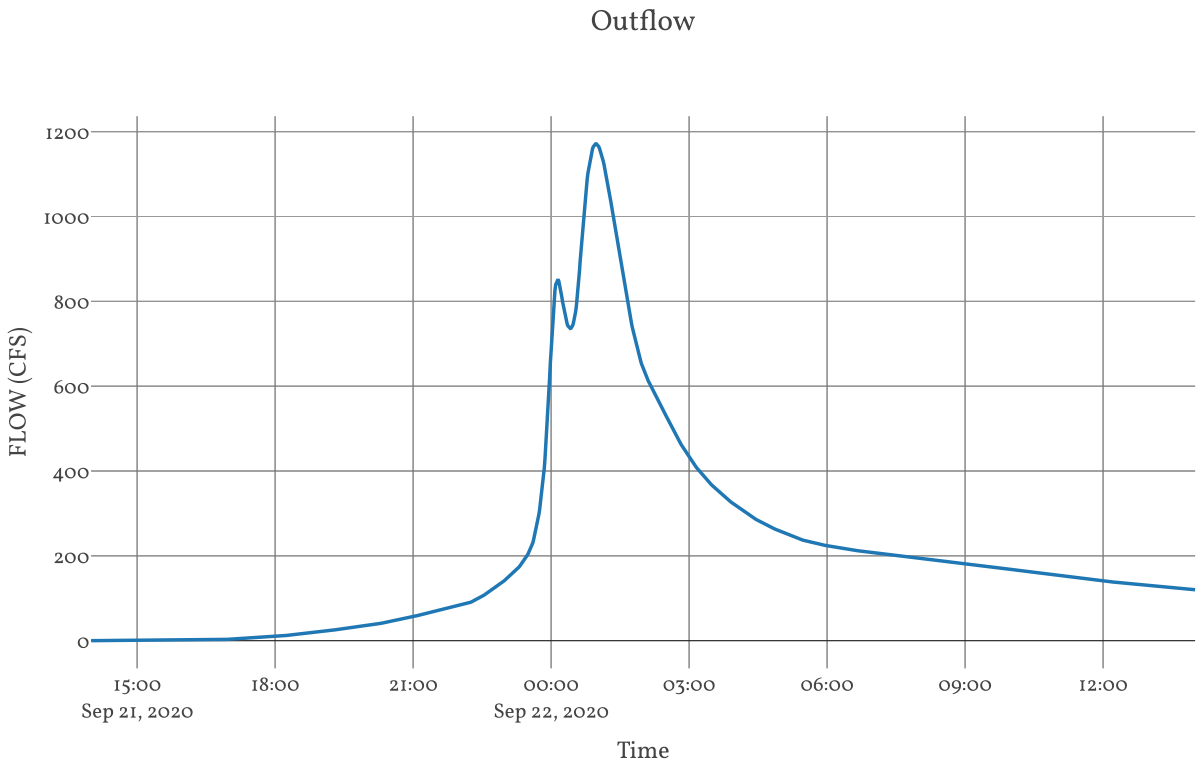

Precipitation and Outflow
FLOW (CFS) PRECIP-INC (IN)
0
0.02
0.04
0.06
600
400
0.08
200
0
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
Sep 21, 2020
Sep 22, 2020
Time
Precipitation
Excess Precipitation
Outflow

Junction: 17C

Downstream : 17r

Results: 17C

Peak Discharge (CFS)	1171.23
Time of Peak Discharge	22Sep2020, 00:58
Volume (IN)	4.46



Reach: 17R

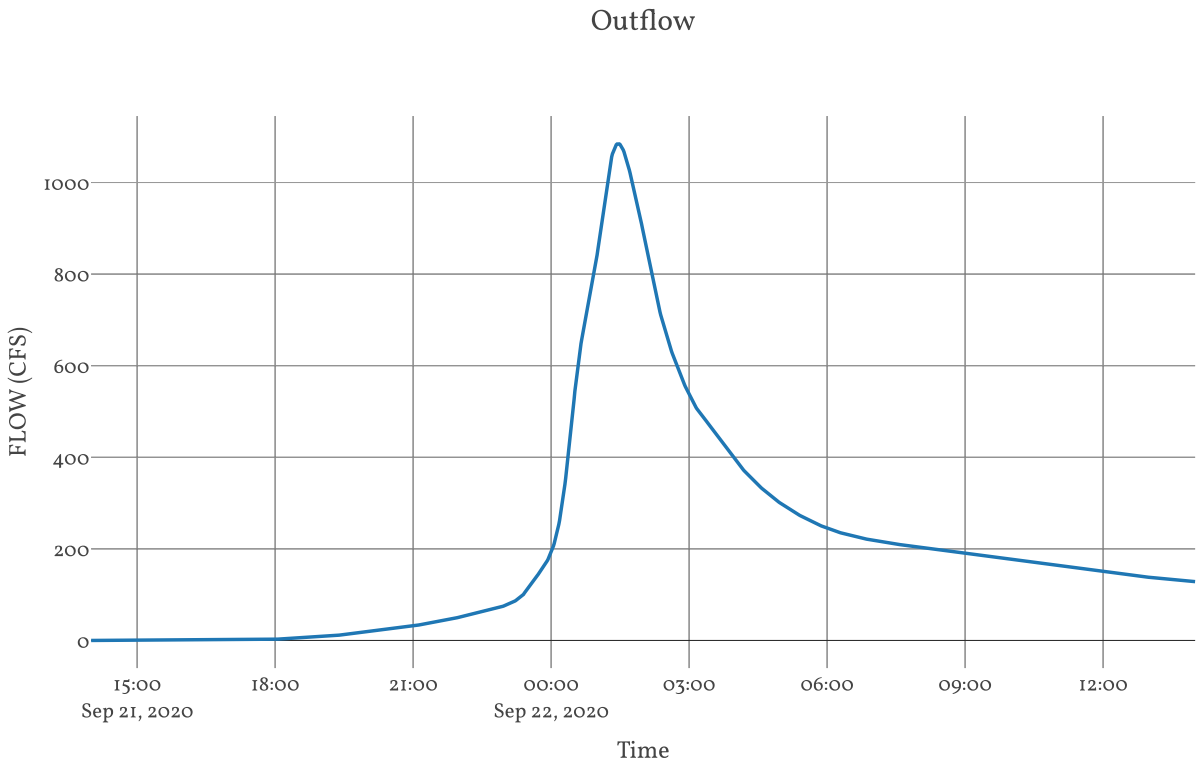
Downstream : 16c

Route: Modified Puls

Method	Modified Puls
Initial Variable	Combined Inflow
Number of Reaches	4
Storage Outflow Table Name	17r

Results: 17R

Peak Discharge (CFS)	1084.81
Time of Peak Discharge	22Sep2020, 01:28
Volume (IN)	4.33
Peak Inflow (CFS)	1171.23
Inflow Volume (AC - FT)	422.4



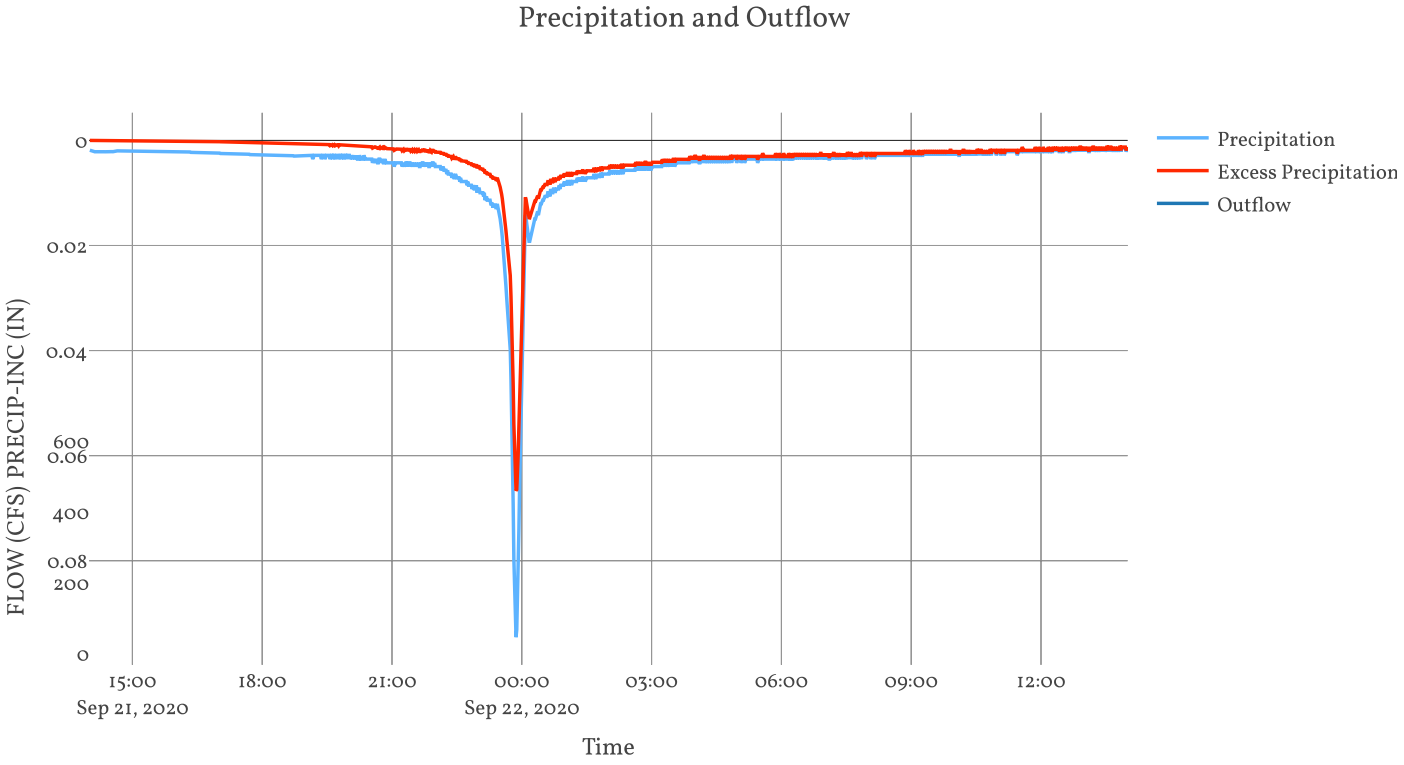
Subbasin: 63B

Area : 0.6
Downstream : 16c

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	74.6
Initial Abstraction	0.2

Transform: User - Specified S - Graph	
S - graph	Ellsworth S - Graph
Lag Method	Specified
Lag	0.41

Results: 63B	
Peak Discharge (CFS)	577.75
Time of Peak Discharge	22Sep2020, 00:17
Volume (IN)	4.57
Precipitation Volume (AC - FT)	228.28
Loss Volume (AC - FT)	79.65
Excess Volume (AC - FT)	148.62
Direct Runoff Volume (AC - FT)	146.67
Baseflow Volume (AC - FT)	0

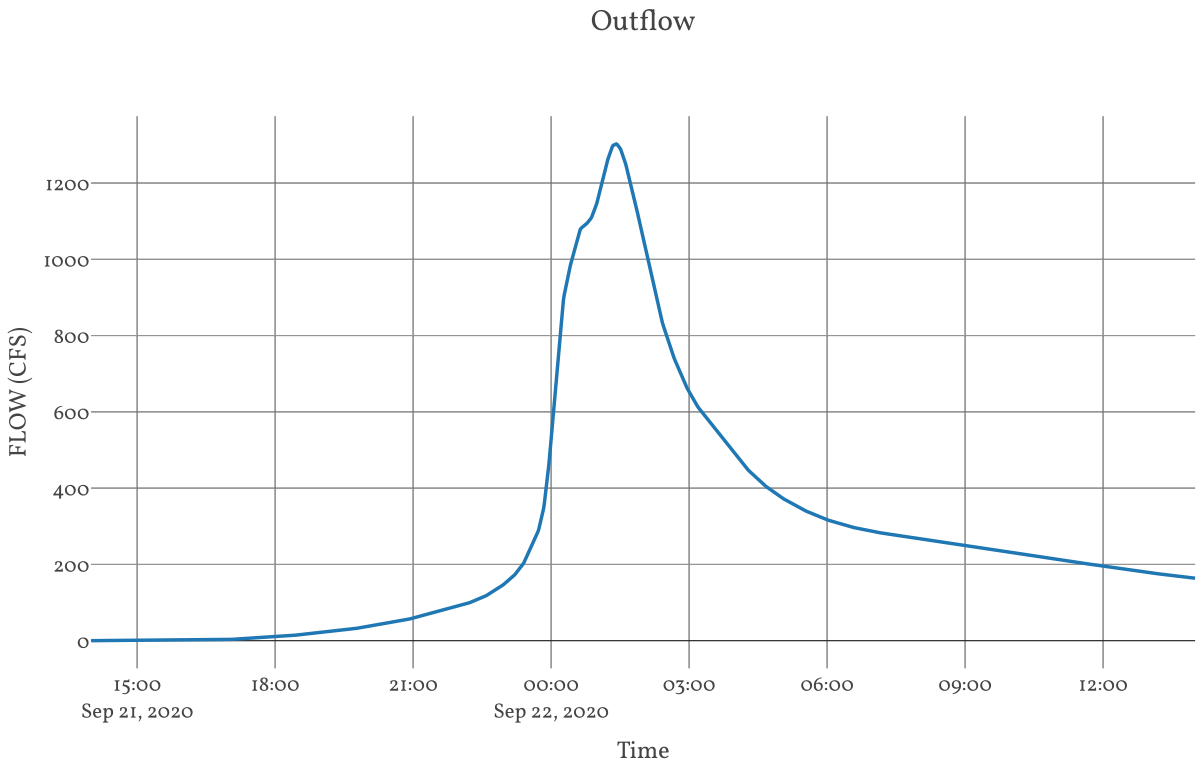

Precipitation and Outflow
FLOW (CFS) PRECIP-INC (IN)
0
0.02
0.04
600
0.06
400
0.08
200
0
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
Sep 21, 2020
Sep 22, 2020
Time
Precipitation
Excess Precipitation
Outflow

Junction: 16C

Downstream : 16r

Results: 16C

Peak Discharge (CFS)	1302.64
Time of Peak Discharge	22Sep2020, 01:24
Volume (IN)	4.39



Reach: 16R

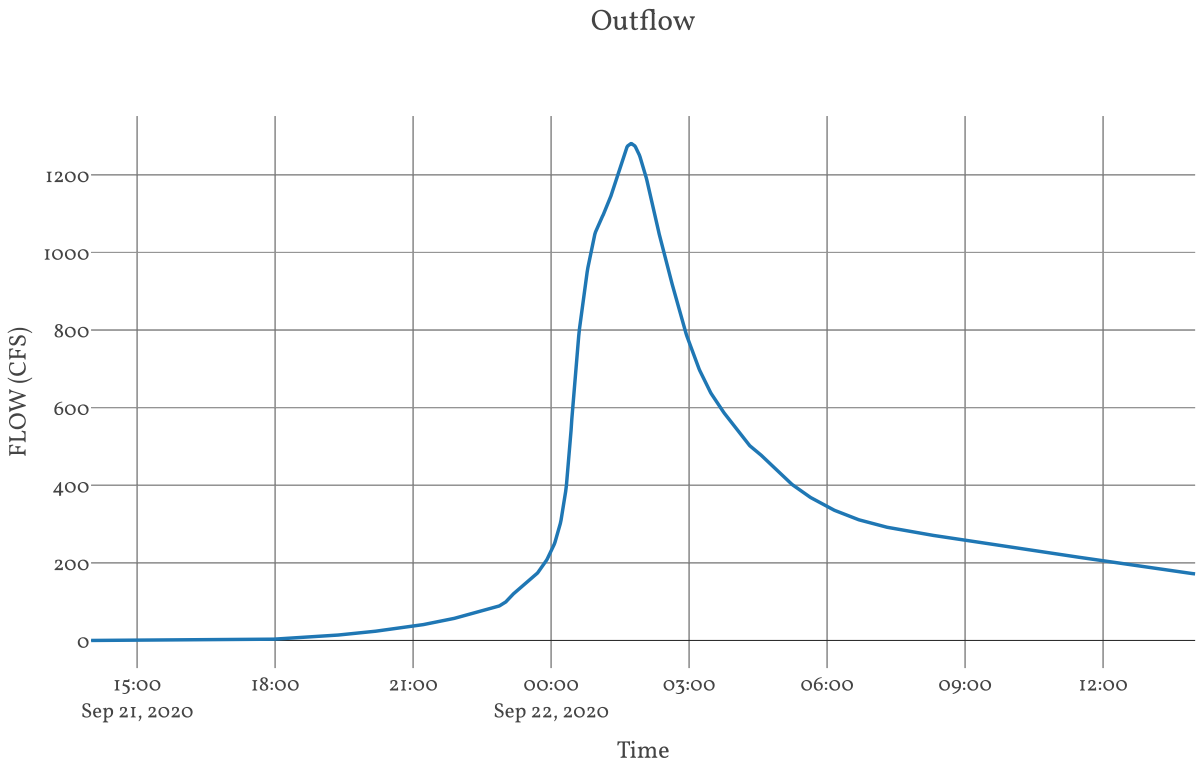
Downstream : 20C

Route: Modified Puls

Method	Modified Puls
Initial Variable	Combined Inflow
Number of Reaches	6
Storage Outflow Table Name	16r

Results: 16R

Peak Discharge (CFS)	1280.27
Time of Peak Discharge	22Sep2020, 01:45
Volume (IN)	4.3
Peak Inflow (CFS)	1302.64
Inflow Volume (AC - FT)	556.73



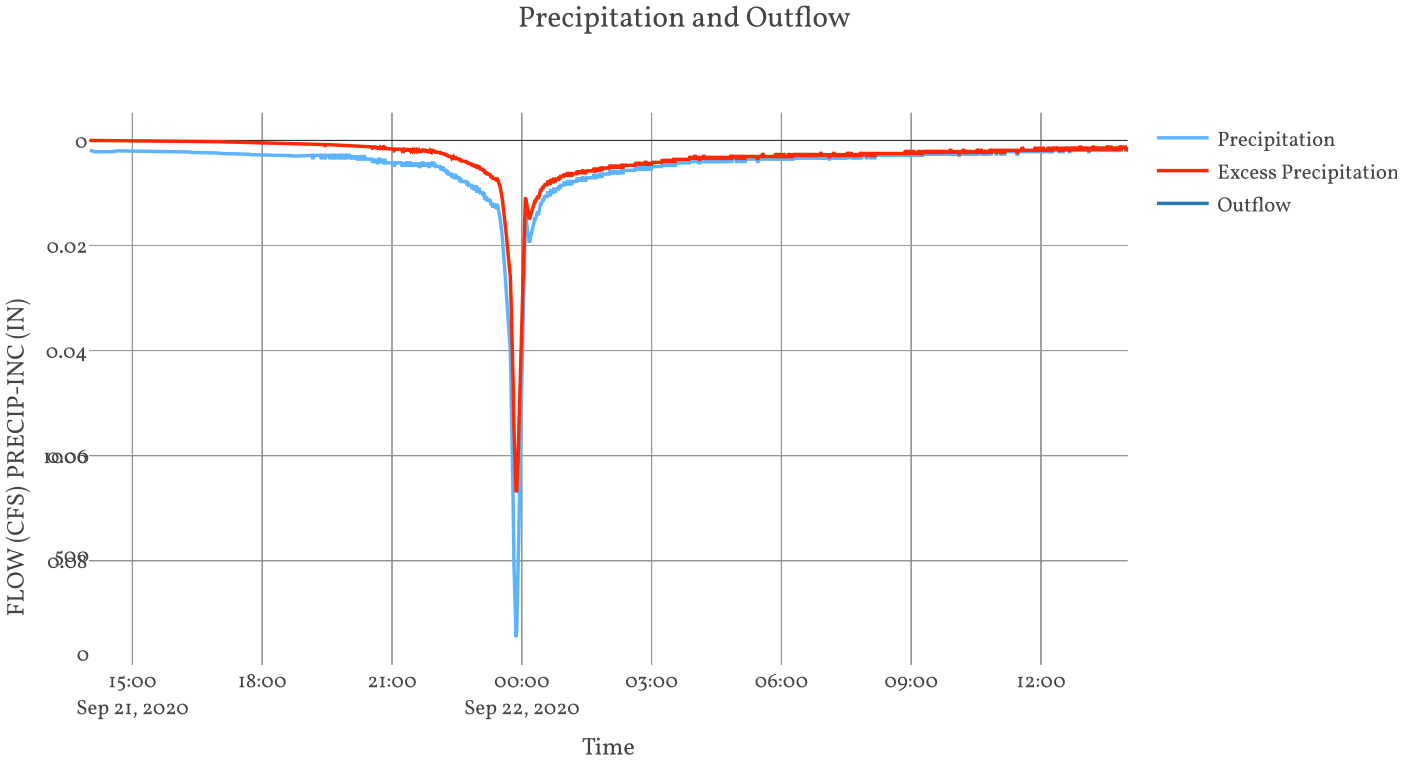
Subbasin: 64B

Area : 1.09
Downstream : 20c

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	74.8
Initial Abstraction	0.2

Transform: User - Specified S - Graph	
S - graph	Ellsworth S - Graph
Lag Method	Specified
Lag	0.42

Results: 64B	
Peak Discharge (CFS)	1035.45
Time of Peak Discharge	22Sep2020, 00:18
Volume (IN)	4.58
Precipitation Volume (AC - FT)	413.33
Loss Volume (AC - FT)	143.29
Excess Volume (AC - FT)	270.04
Direct Runoff Volume (AC - FT)	266.4
Baseflow Volume (AC - FT)	0

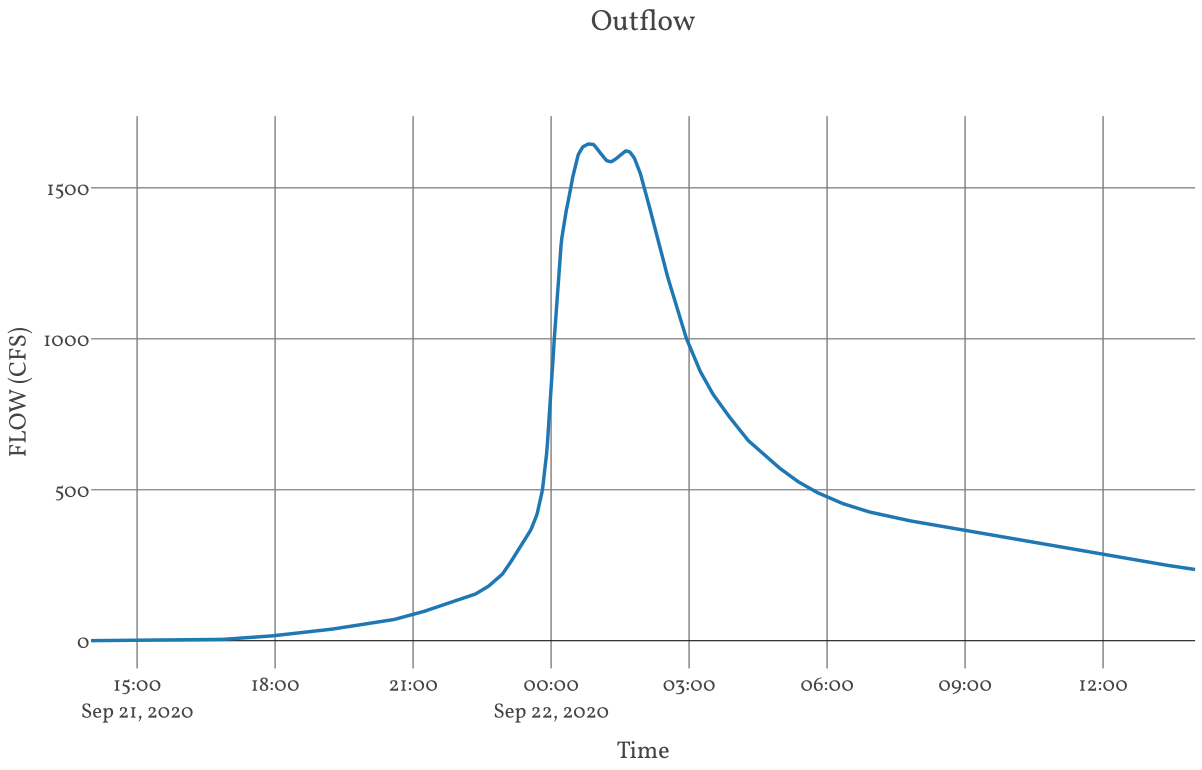

Precipitation and Outflow
FLOW (CFS) PRECIP-INC (IN)
0
0.02
0.04
0.06
0.08
0
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
Sep 21, 2020
Sep 22, 2020
Time
Precipitation
Excess Precipitation
Outflow

Junction: 20C

Downstream : 20r

Results: 20C

Peak Discharge (CFS)	1645.35
Time of Peak Discharge	22Sep2020, 00:53
Volume (IN)	4.39

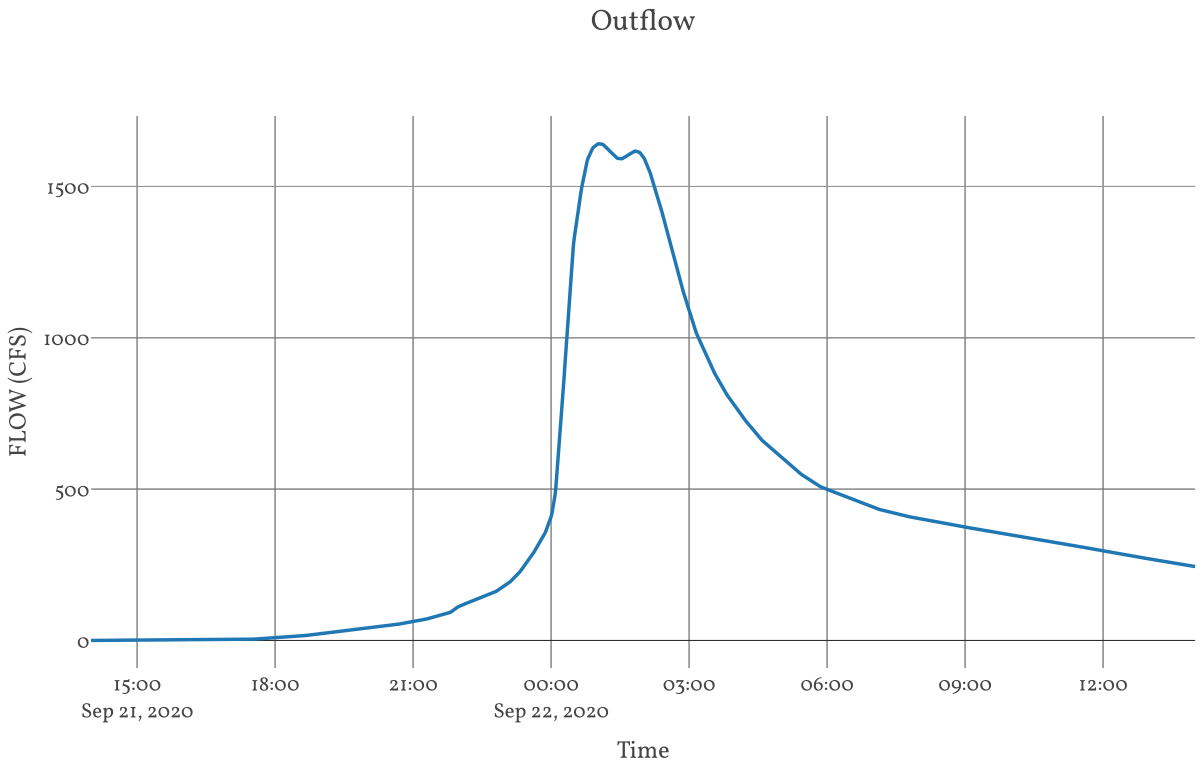


Reach: 20R

Downstream : 15c

Route: Modified Puls	
Method	Modified Puls
Initial Variable	Combined Inflow
Number of Reaches	6
Storage Outflow Table Name	20r

Results: 20R	
Peak Discharge (CFS)	1641.33
Time of Peak Discharge	22Sep2020, 01:04
Volume (IN)	4.33
Peak Inflow (CFS)	1645.35
Inflow Volume (AC - FT)	811.84



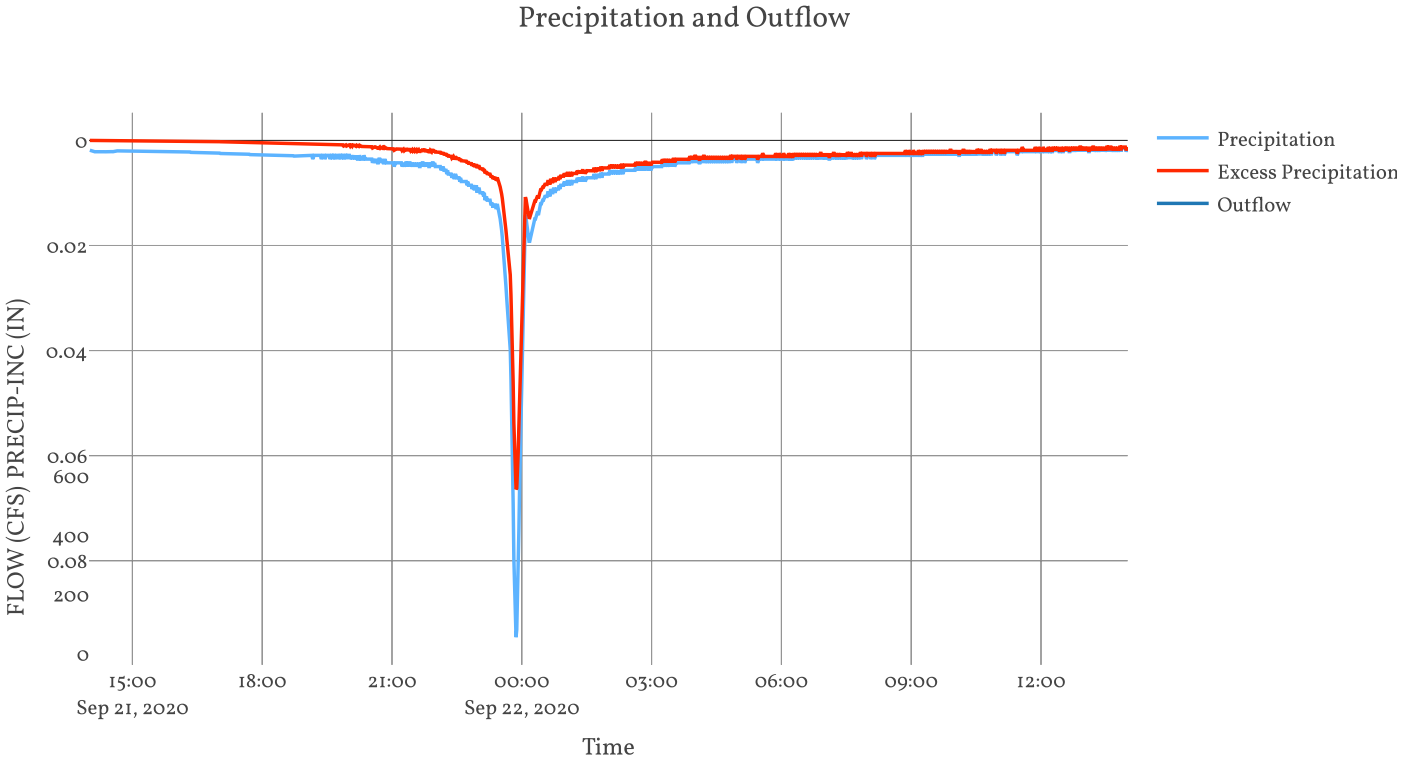
Subbasin: 65B

Area : 0.53
Downstream : 15c

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	74.4
Initial Abstraction	0.2

Transform: User - Specified S - Graph	
S - graph	Ellsworth S - Graph
Lag Method	Specified
Lag	0.24

Results: 65B	
Peak Discharge (CFS)	691.07
Time of Peak Discharge	22Sep2020, 00:07
Volume (IN)	4.58
Precipitation Volume (AC - FT)	202.11
Loss Volume (AC - FT)	70.98
Excess Volume (AC - FT)	131.13
Direct Runoff Volume (AC - FT)	130.15
Baseflow Volume (AC - FT)	0

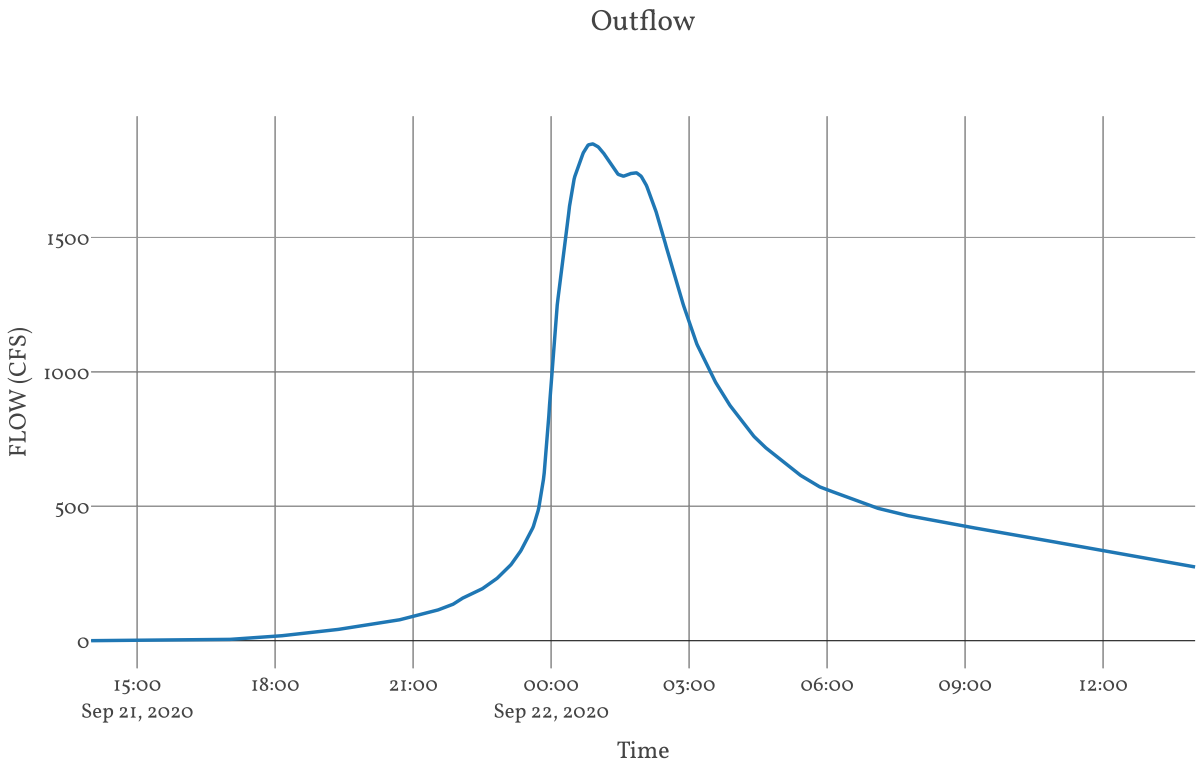

Precipitation and Outflow
FLOW (CFS) PRECIP-INC (IN)
0
0.02
0.04
0.06
600
400
0.08
200
0
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
Sep 21, 2020
Sep 22, 2020
Time
Precipitation
Excess Precipitation
Outflow

Junction: 15C

Downstream : 15r

Results: 15C

Peak Discharge (CFS)	1848.15
Time of Peak Discharge	22Sep2020, 00:53
Volume (IN)	4.37



Reach: 15R

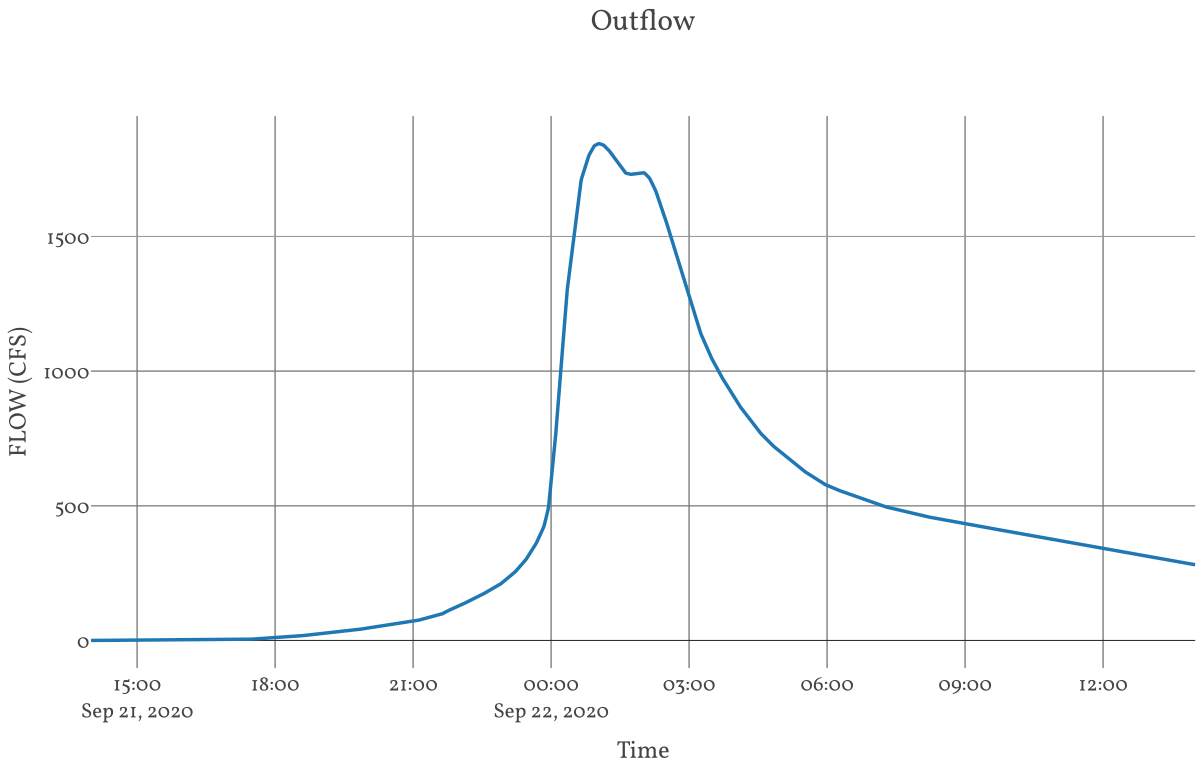
Downstream : 14c

Route: Modified Puls

Method	Modified Puls
Initial Variable	Combined Inflow
Number of Reaches	5
Storage Outflow Table Name	15r

Results: 15R

Peak Discharge (CFS)	1844.61
Time of Peak Discharge	22Sep2020, 01:03
Volume (IN)	4.33
Peak Inflow (CFS)	1848.15
Inflow Volume (AC - FT)	931.8



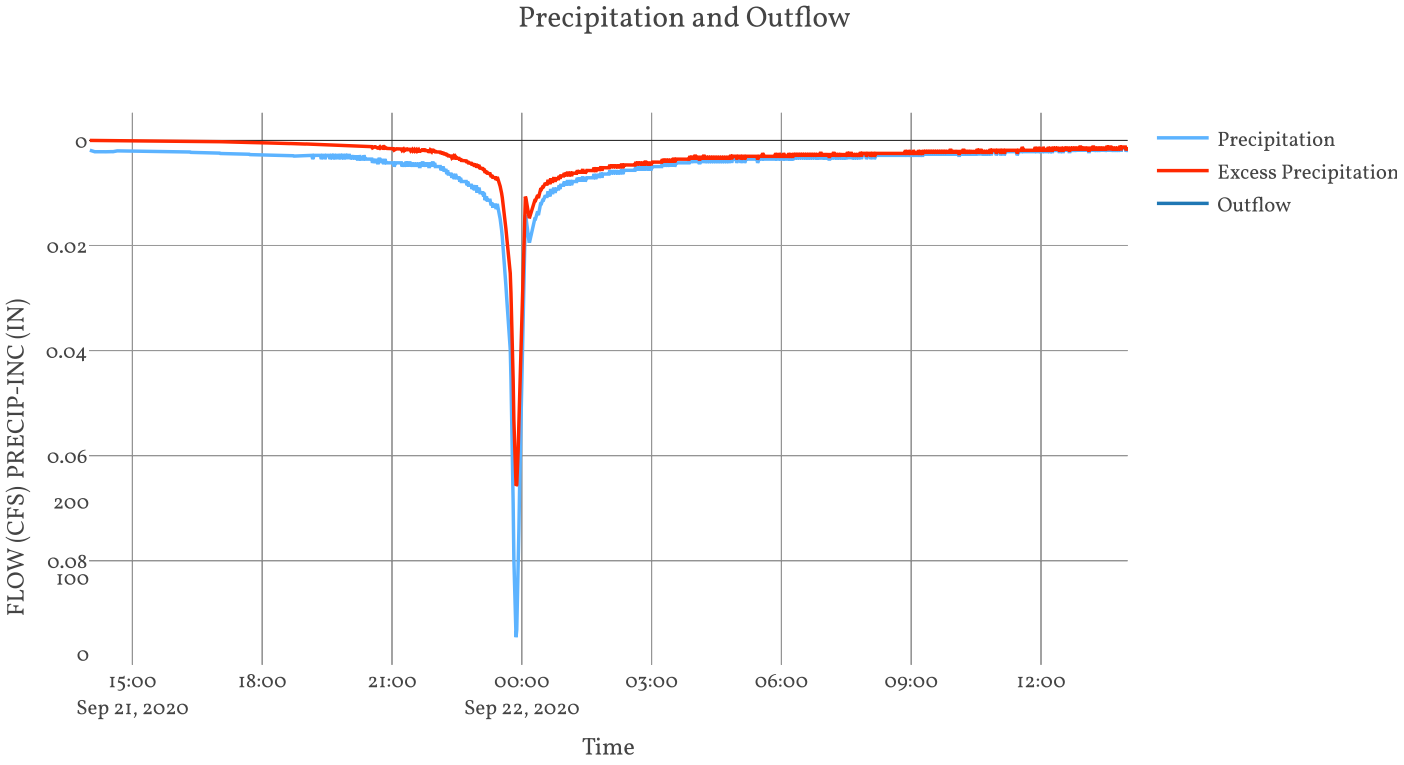
Subbasin: 66B

Area : 0.16
Downstream : 14c

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	73.9
Initial Abstraction	0.2

Transform: User - Specified S - Graph	
S - graph	Ellsworth S - Graph
Lag Method	Specified
Lag	0.14

Results: 66B	
Peak Discharge (CFS)	268.89
Time of Peak Discharge	22Sep2020, 00:02
Volume (IN)	4.55
Precipitation Volume (AC - FT)	61.43
Loss Volume (AC - FT)	21.92
Excess Volume (AC - FT)	39.51
Direct Runoff Volume (AC - FT)	39.34
Baseflow Volume (AC - FT)	0

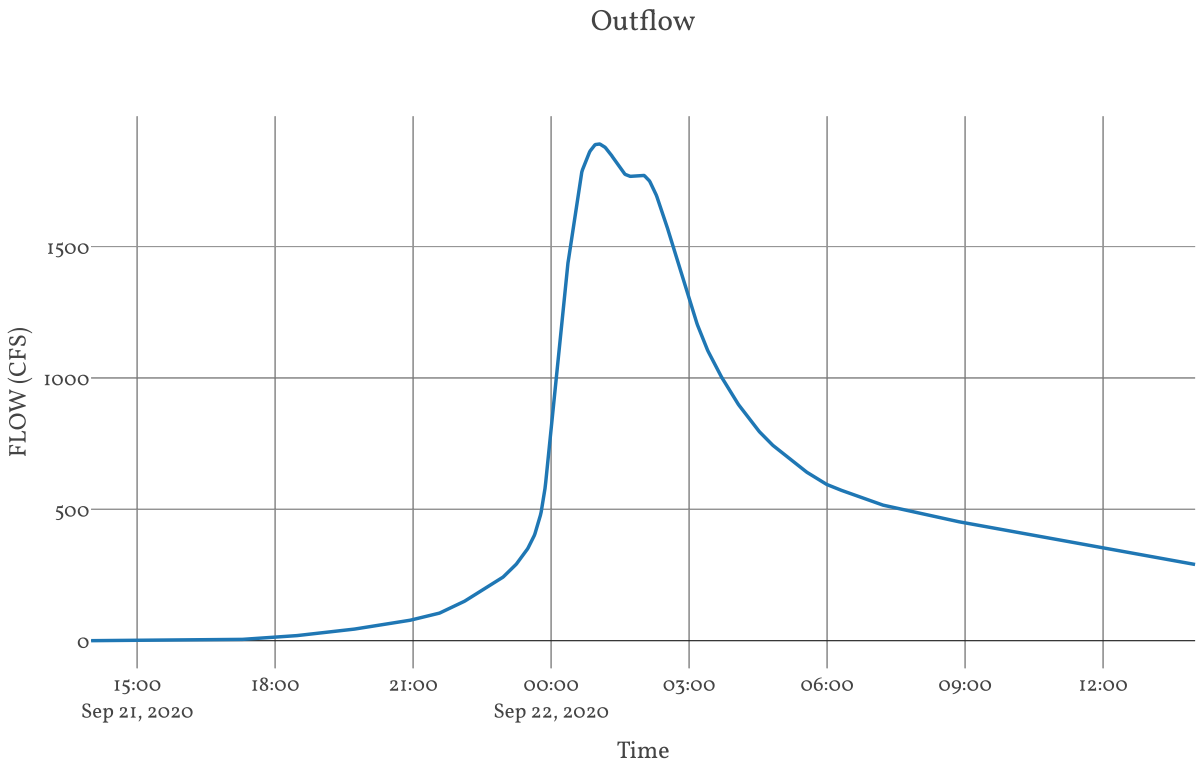

Precipitation and Outflow
FLOW (CFS) PRECIP-INC (IN)
0
0.02
0.04
0.06
200
0.08
100
0
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
Sep 21, 2020
Sep 22, 2020
Time
Precipitation
Excess Precipitation
Outflow

Junction: 14C

Downstream : 14r

Results: 14C

Peak Discharge (CFS)	1890.72
Time of Peak Discharge	22Sep2020, 01:01
Volume (IN)	4.34



Reach: 14R

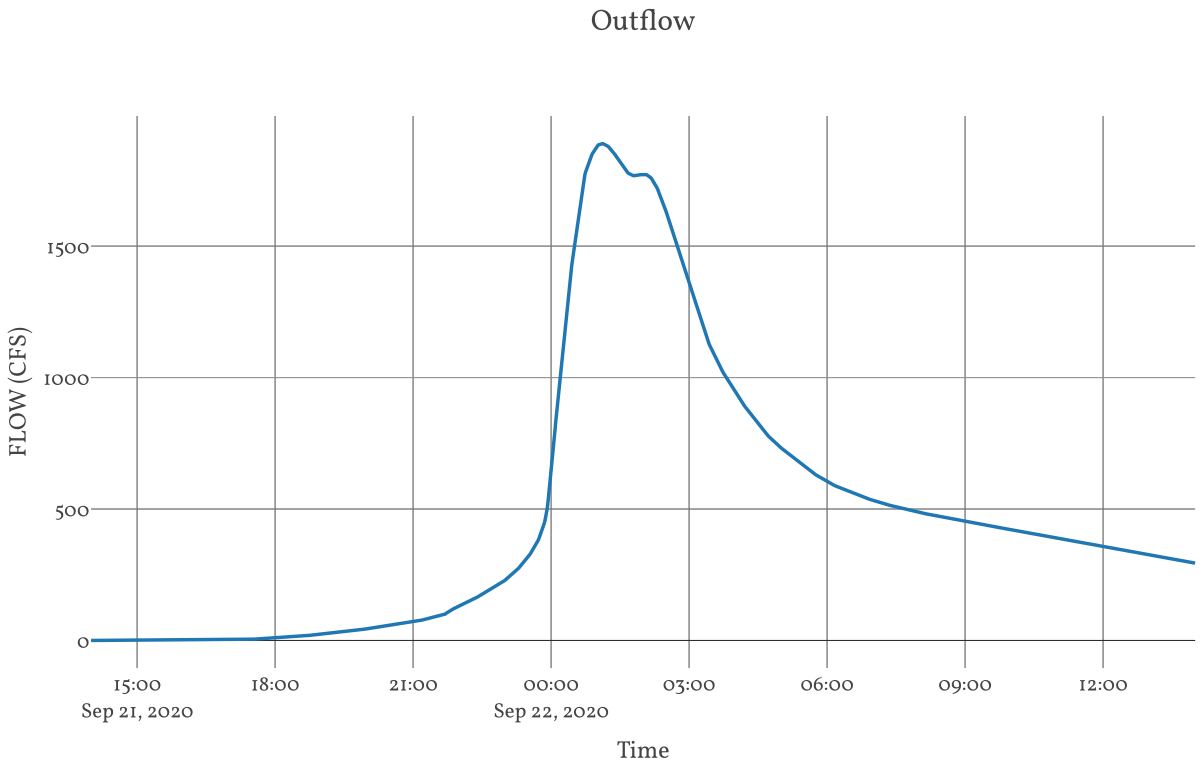
Downstream : 13c

Route: Modified Puls

Method	Modified Puls
Initial Variable	Combined Inflow
Number of Reaches	5
Storage Outflow Table Name	14r

Results: 14R

Peak Discharge (CFS)	1889.72
Time of Peak Discharge	22Sep2020, 01:06
Volume (IN)	4.32
Peak Inflow (CFS)	1890.72
Inflow Volume (AC - FT)	963.37



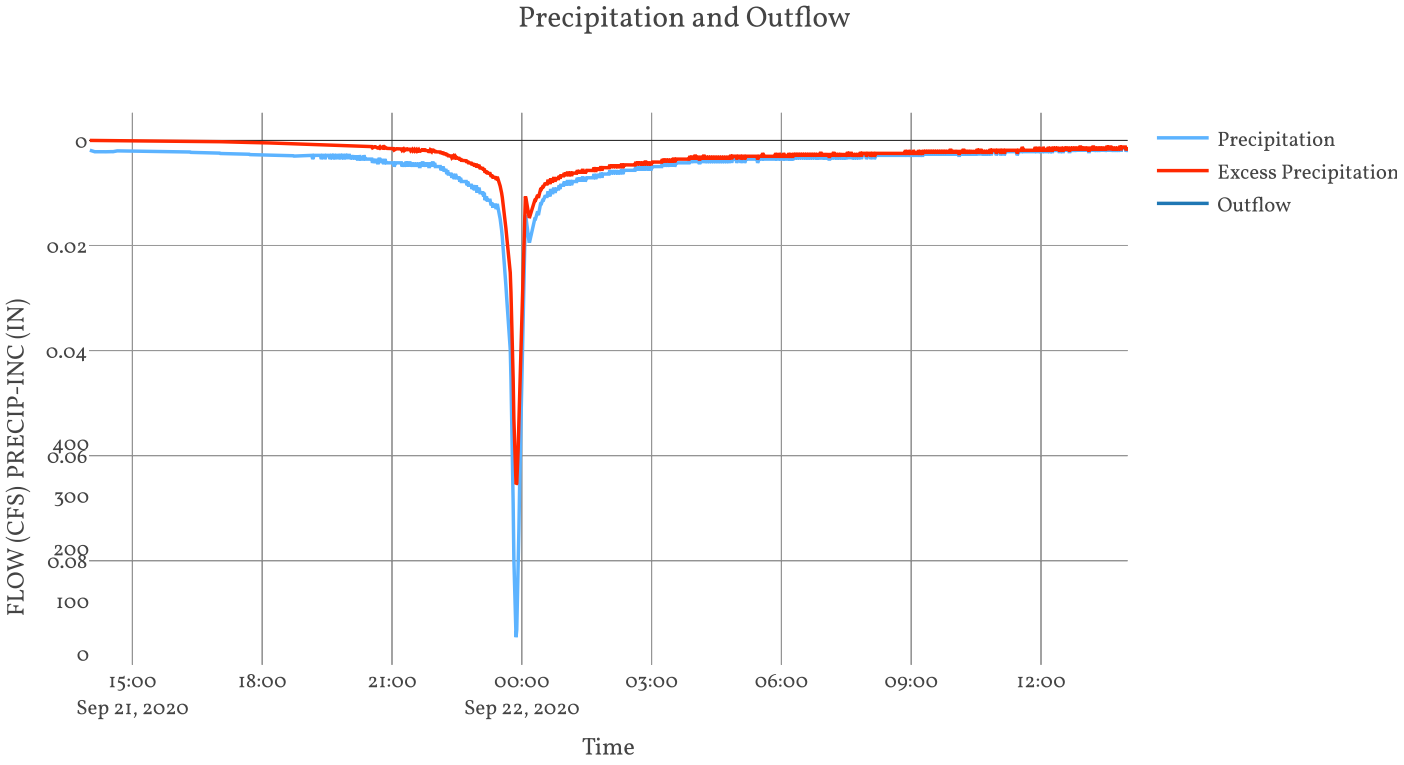
Subbasin: 67B

Area : 0.43
Downstream : 13c

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	73.7
Initial Abstraction	0.2

Transform: User - Specified S - Graph	
S - graph	Ellsworth S - Graph
Lag Method	Specified
Lag	0.44

Results: 67B	
Peak Discharge (CFS)	388.37
Time of Peak Discharge	22Sep2020, 00:19
Volume (IN)	4.49
Precipitation Volume (AC - FT)	163.06
Loss Volume (AC - FT)	58.55
Excess Volume (AC - FT)	104.5
Direct Runoff Volume (AC - FT)	103.01
Baseflow Volume (AC - FT)	0

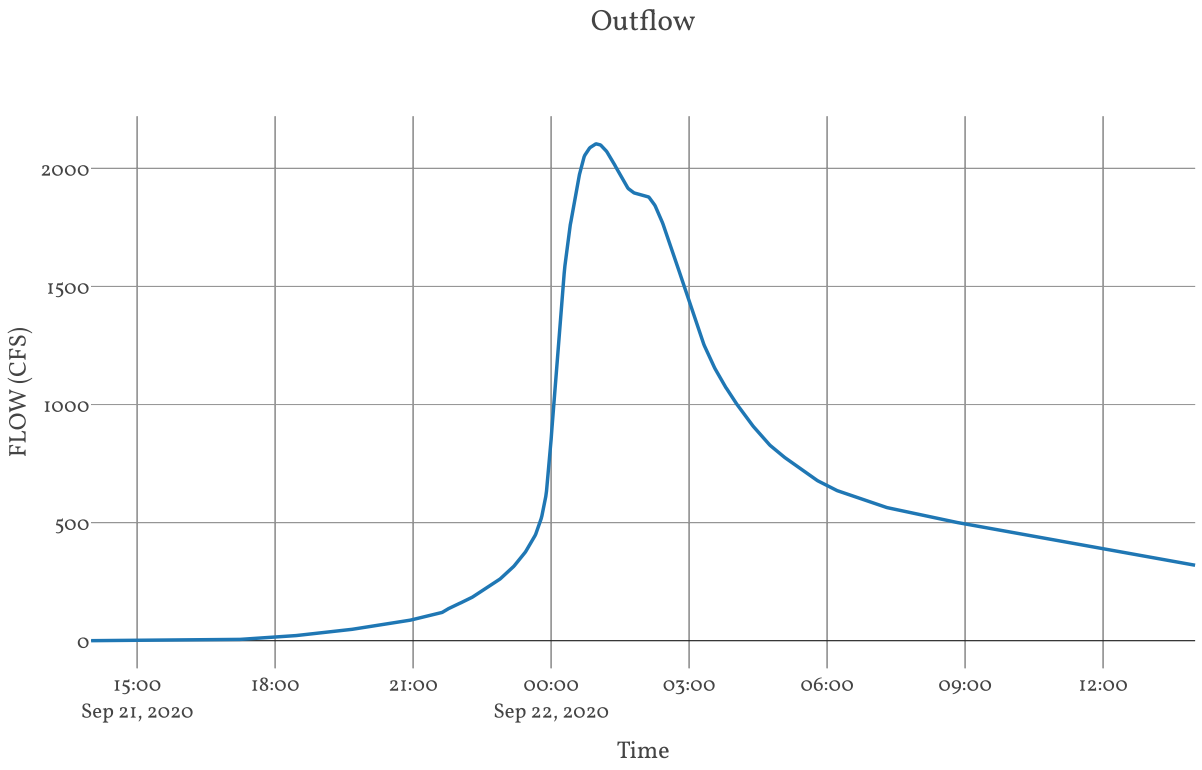

Precipitation and Outflow
FLOW (CFS) PRECIP-INC (IN)
0
0.02
0.04
400
0.06
300
200
0.08
100
0
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
Sep 21, 2020
Sep 22, 2020
Time
Precipitation
Excess Precipitation
Outflow

Junction: 13C

Downstream : 13r

Results: 13C

Peak Discharge (CFS)	2103.7
Time of Peak Discharge	22Sep2020, 01:00
Volume (IN)	4.33



Reach: 13R

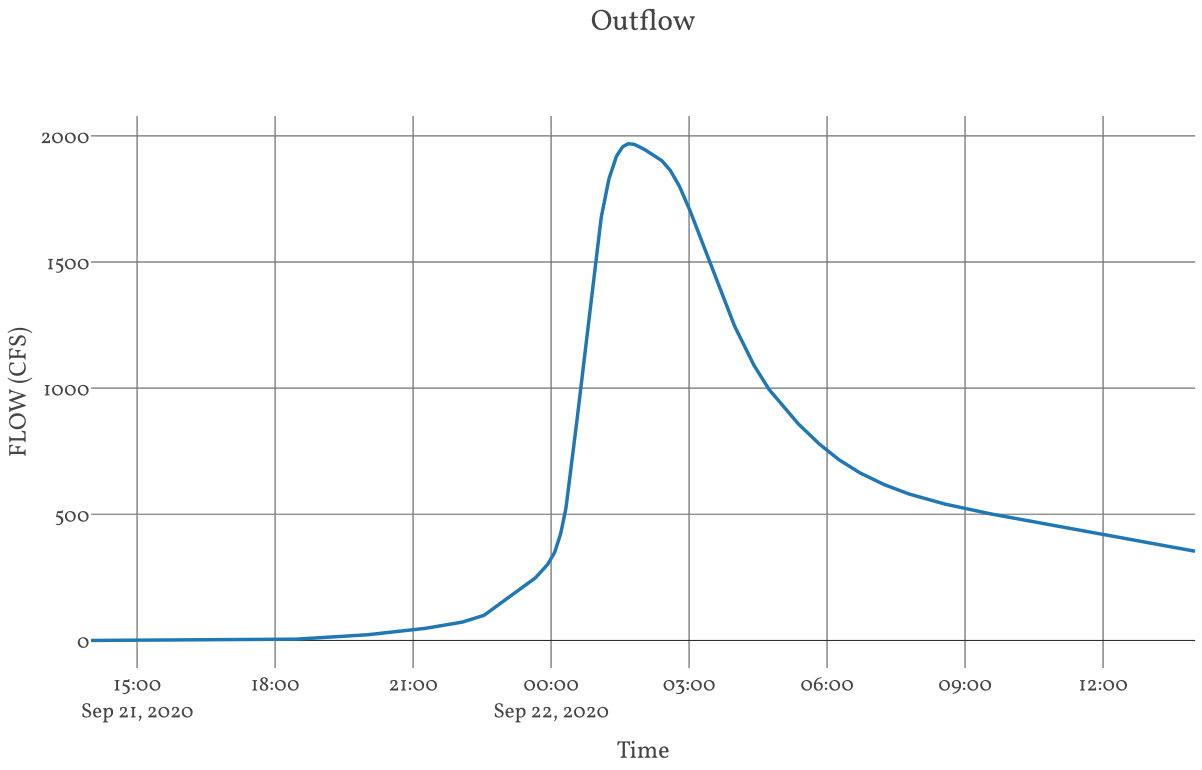
Downstream : 12C

Route: Modified Puls

Method	Modified Puls
Initial Variable	Combined Inflow
Number of Reaches	2
Storage Outflow Table Name	13r

Results: 13R

Peak Discharge (CFS)	1968.98
Time of Peak Discharge	22Sep2020, 01:43
Volume (IN)	4.19
Peak Inflow (CFS)	2103.7
Inflow Volume (AC - FT)	1061.97



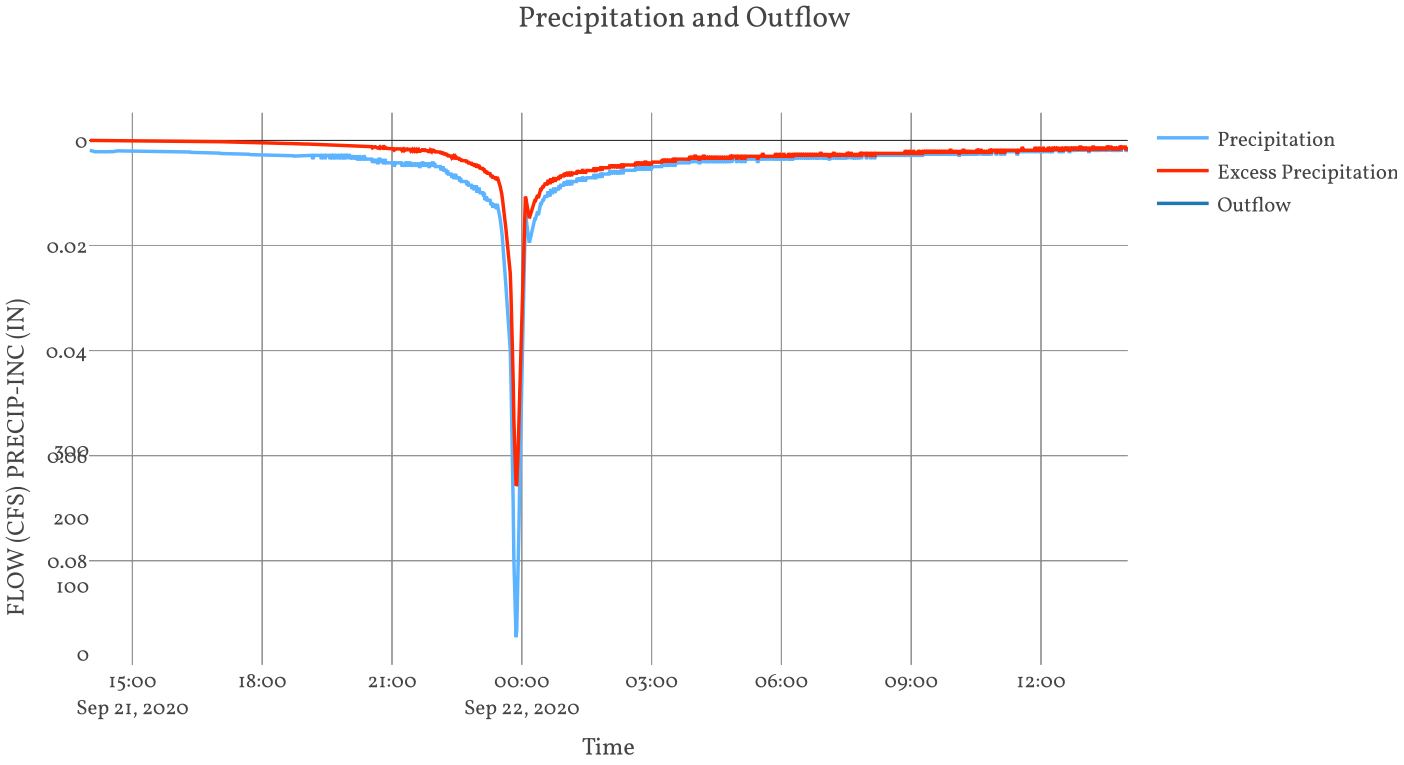
Subbasin: 68B

Area : 0.26
Downstream : 12c

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	73.9
Initial Abstraction	0.2

Transform: User - Specified S - Graph	
S - graph	Ellsworth S - Graph
Lag Method	Specified
Lag	0.28

Results: 68B	
Peak Discharge (CFS)	300.46
Time of Peak Discharge	22Sep2020, 00:09
Volume (IN)	4.53
Precipitation Volume (AC - FT)	96.7
Loss Volume (AC - FT)	34.51
Excess Volume (AC - FT)	62.19
Direct Runoff Volume (AC - FT)	61.64
Baseflow Volume (AC - FT)	0

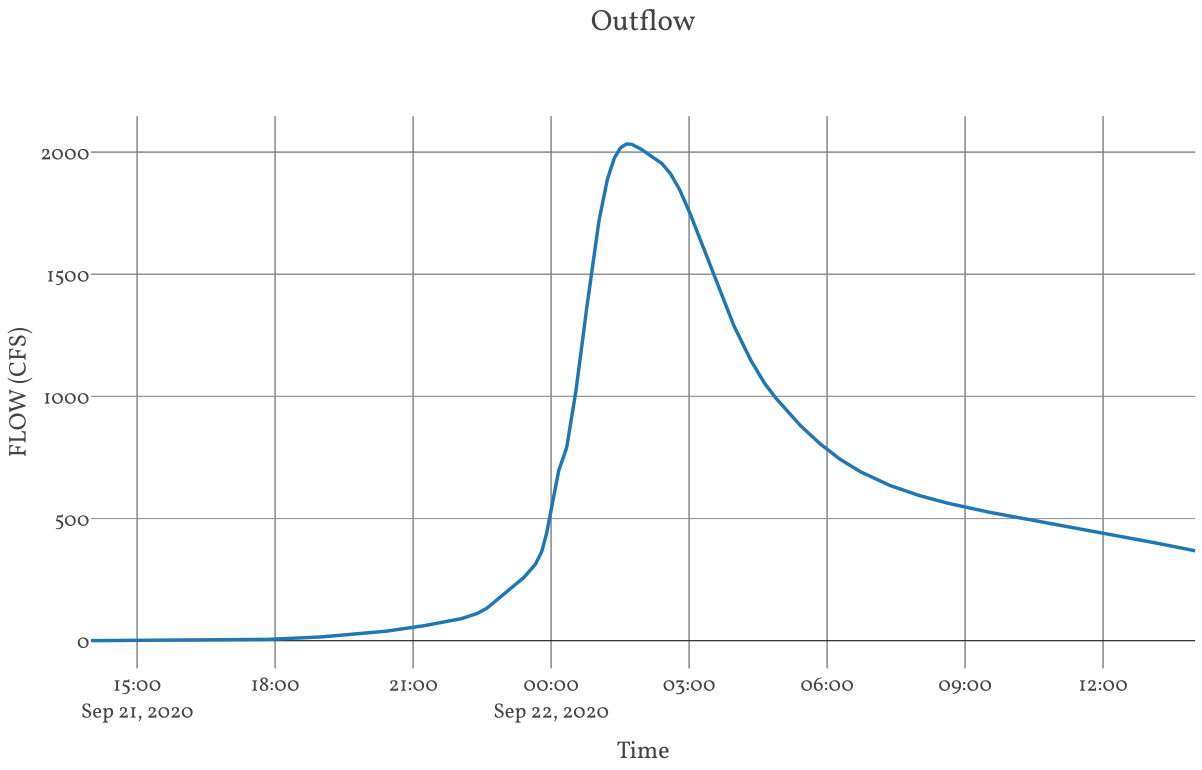

Precipitation and Outflow
FLOW (CFS) PRECIP-INC (IN)
0
0.02
0.04
0.06
0.08
0
100
200
300
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
Sep 21, 2020
Sep 22, 2020
Time
Precipitation
Excess Precipitation
Outflow

Junction: 12C

Downstream : Pacific Ocean

Results: 12C

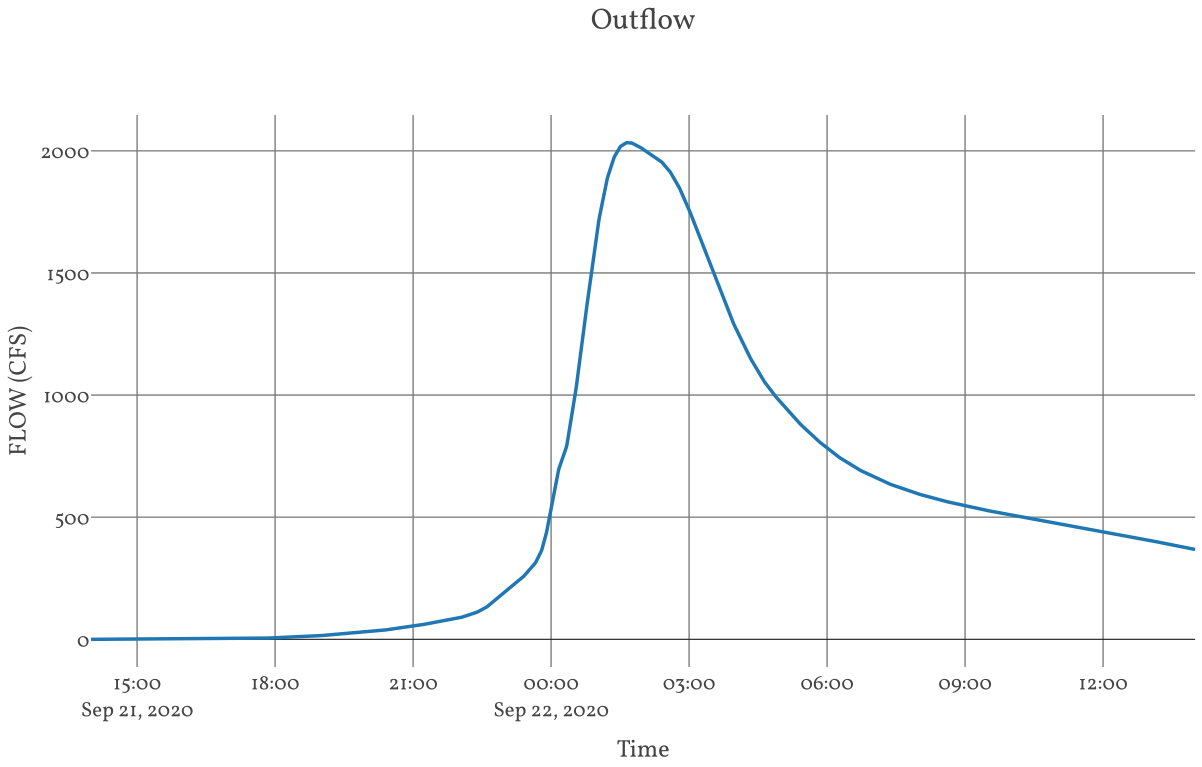
Peak Discharge (CFS)	2033.78
Time of Peak Discharge	22Sep2020, 01:41
Volume (IN)	4.21



Sink: Pacific Ocean

Results: Pacific Ocean

Peak Discharge (CFS)	2033.78
Time of Peak Discharge	22Sep2020, 01:41
Volume (IN)	4.21
Observed Flow Gage	Not specified
Observed Flow Volume (AC - FT)	Not specified
Observed Flow's RMSE Stdev	Not specified
Observed Flow's Percent Bias	Not specified
Observed Flow's Nash Sutcliffe	Not specified



Project: Little_Sycamore_May2021
Simulation Run: 050-mp-Post-Fire
Simulation Start: 21 September 2020, 14:00
Simulation End: 22 September 2020, 14:00

HMS Version: 4.6.1
Executed: 29 April 2021, 21:33

Global Parameter Summary - Subbasin

Area

Element Name	Area
60b	0.65
61b	0.61
62b	0.53
63b	0.6
64b	1.09
65b	0.53
66b	0.16
67b	0.43
68b	0.26

Downstream

Element Name	Downstream
60b	J 60b 61b
61b	J 60b 61b
62b	17c
63b	16c
64b	20c
65b	15c
66b	14c
67b	13c
68b	12c

Loss Rate: Scs

Element Name	Percent Impervious Area	Curve Number	Initial Abstraction
60b	0	75	0.2
61b	0	75	0.2
62b	0	73.9	0.2
63b	0	74.6	0.2
64b	0	74.8	0.2
65b	0	74.4	0.2
66b	0	73.9	0.2
67b	0	73.7	0.2
68b	0	73.9	0.2

Transform: User - Specified S - Graph

Element Name	S - graph	Lag Method	Lag
60b	Ellsworth S - Graph	Specified	0.52
61b	Ellsworth S - Graph	Specified	0.37
62b	Ellsworth S - Graph	Specified	0.25
63b	Ellsworth S - Graph	Specified	0.41
64b	Ellsworth S - Graph	Specified	0.42
65b	Ellsworth S - Graph	Specified	0.24
66b	Ellsworth S - Graph	Specified	0.14
67b	Ellsworth S - Graph	Specified	0.44
68b	Ellsworth S - Graph	Specified	0.28

Global Parameter Summary - Reach

Downstream

Element Name	Downstream
18r	17c
17r	16c
16r	20c
20r	15c
15r	14c
14r	13c
13r	12c

Route: Modified Puls

Element Name	Method	Initial Variable	Number of Reaches	Storage Outflow Table Name
18r	Modified Puls	Combined Inflow	8	18r
17r	Modified Puls	Combined Inflow	4	17r
16r	Modified Puls	Combined Inflow	6	16r
20r	Modified Puls	Combined Inflow	6	20r
15r	Modified Puls	Combined Inflow	5	15r
14r	Modified Puls	Combined Inflow	5	14r
13r	Modified Puls	Combined Inflow	2	13r

Global Results Summary

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
60b	0.65	658.2	22Sep2020, 00:24	5.53
61b	0.61	755.86	22Sep2020, 00:15	5.56
J 60b 61b	1.25	1376.41	22Sep2020, 00:18	5.54
18r	1.25	1201.59	22Sep2020, 00:57	5.35
62b	0.53	801.86	22Sep2020, 00:08	5.48
17c	1.78	1461.83	22Sep2020, 00:54	5.39
17r	1.78	1346.99	22Sep2020, 01:22	5.25
63b	0.6	702.15	22Sep2020, 00:17	5.51
16c	2.38	1626.68	22Sep2020, 01:18	5.31
16r	2.38	1603.52	22Sep2020, 01:37	5.22
64b	1.09	1257.72	22Sep2020, 00:18	5.53
20c	3.47	2095.06	22Sep2020, 00:45	5.31
20r	3.47	2083.23	22Sep2020, 00:58	5.25
65b	0.53	839.53	22Sep2020, 00:07	5.53
15c	4	2343.64	22Sep2020, 00:53	5.29
15r	4	2337.96	22Sep2020, 01:01	5.25
66b	0.16	326.61	22Sep2020, 00:02	5.5
14c	4.16	2393.85	22Sep2020, 01:00	5.26
14r	4.16	2392.33	22Sep2020, 01:05	5.24
67b	0.43	472.93	22Sep2020, 00:19	5.43
13c	4.59	2655.4	22Sep2020, 00:58	5.25
13r	4.59	2490.9	22Sep2020, 01:35	5.09
68b	0.26	365.55	22Sep2020, 00:09	5.48

12c	4.85	2573.16	22Sep2020, 01:33	5.11
Pacific Ocean	4.85	2573.16	22Sep2020, 01:33	5.11

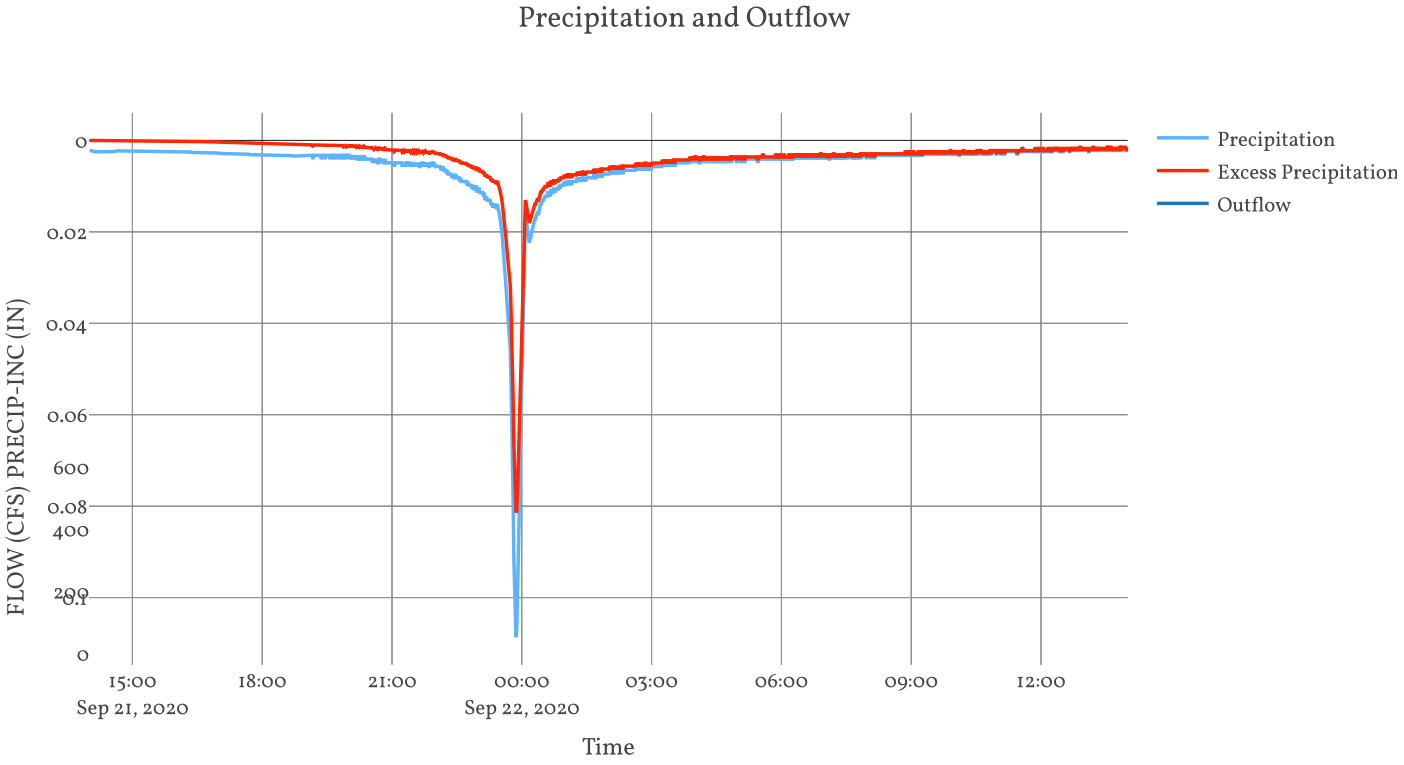
Subbasin: 60B

Area : 0.65
Downstream : J 60b 61b

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	75
Initial Abstraction	0.2

Transform: User - Specified S - Graph	
S - graph	Ellsworth S - Graph
Lag Method	Specified
Lag	0.52

Results: 60B	
Peak Discharge (CFS)	658.2
Time of Peak Discharge	22Sep2020, 00:24
Volume (IN)	5.53
Precipitation Volume (AC - FT)	281.05
Loss Volume (AC - FT)	87.73
Excess Volume (AC - FT)	193.32
Direct Runoff Volume (AC - FT)	190.13
Baseflow Volume (AC - FT)	0


Precipitation and Outflow
FLOW (CFS) PRECIP-INC (IN)
0
0.02
0.04
0.06
600
0.08
400
200
0.1
0
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
Sep 21, 2020
Sep 22, 2020
Time
Precipitation
Excess Precipitation
Outflow

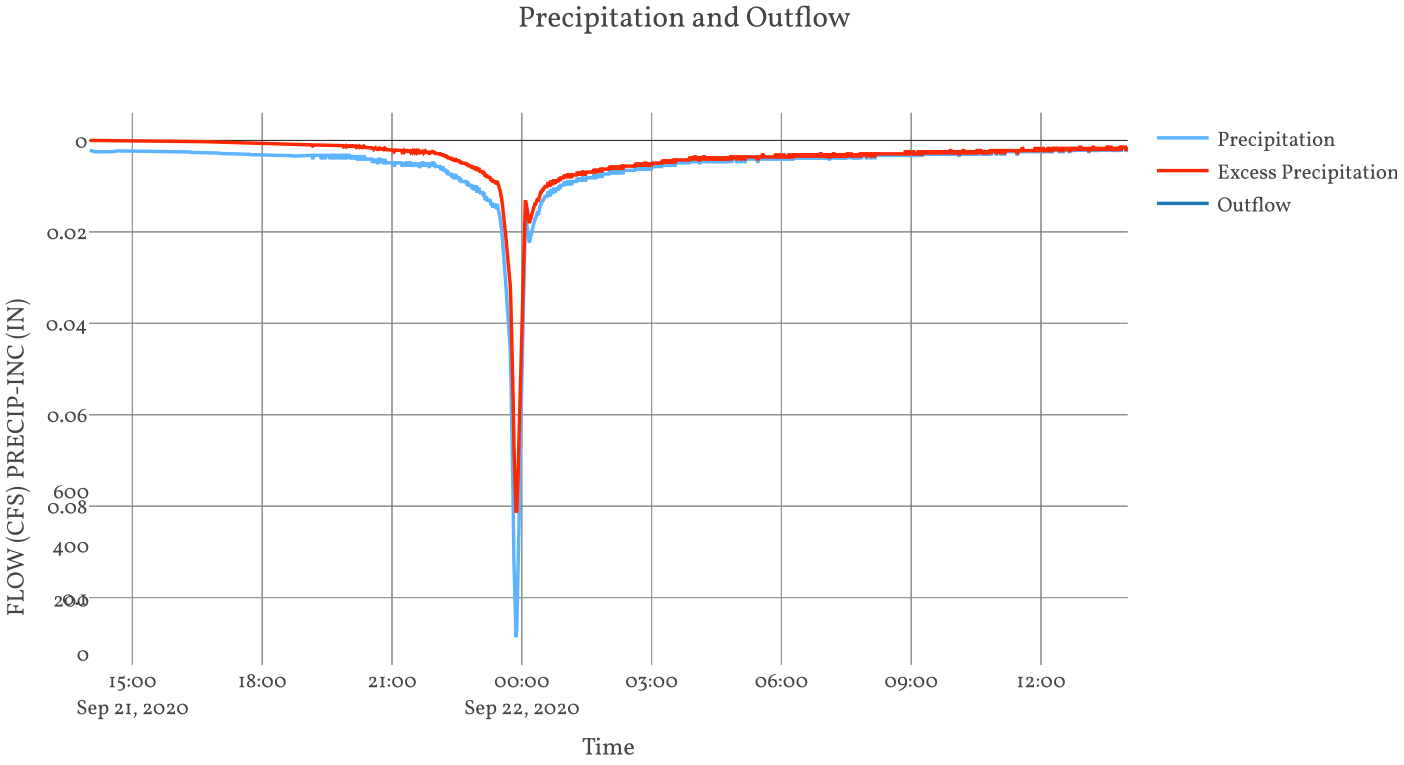
Subbasin: 61B

Area : 0.61
Downstream : J 60b 61b

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	75
Initial Abstraction	0.2

Transform: User - Specified S - Graph	
S - graph	Ellsworth S - Graph
Lag Method	Specified
Lag	0.37

Results: 61B	
Peak Discharge (CFS)	755.86
Time of Peak Discharge	22Sep2020, 00:15
Volume (IN)	5.56
Precipitation Volume (AC - FT)	264.05
Loss Volume (AC - FT)	82.43
Excess Volume (AC - FT)	181.63
Direct Runoff Volume (AC - FT)	179.55
Baseflow Volume (AC - FT)	0

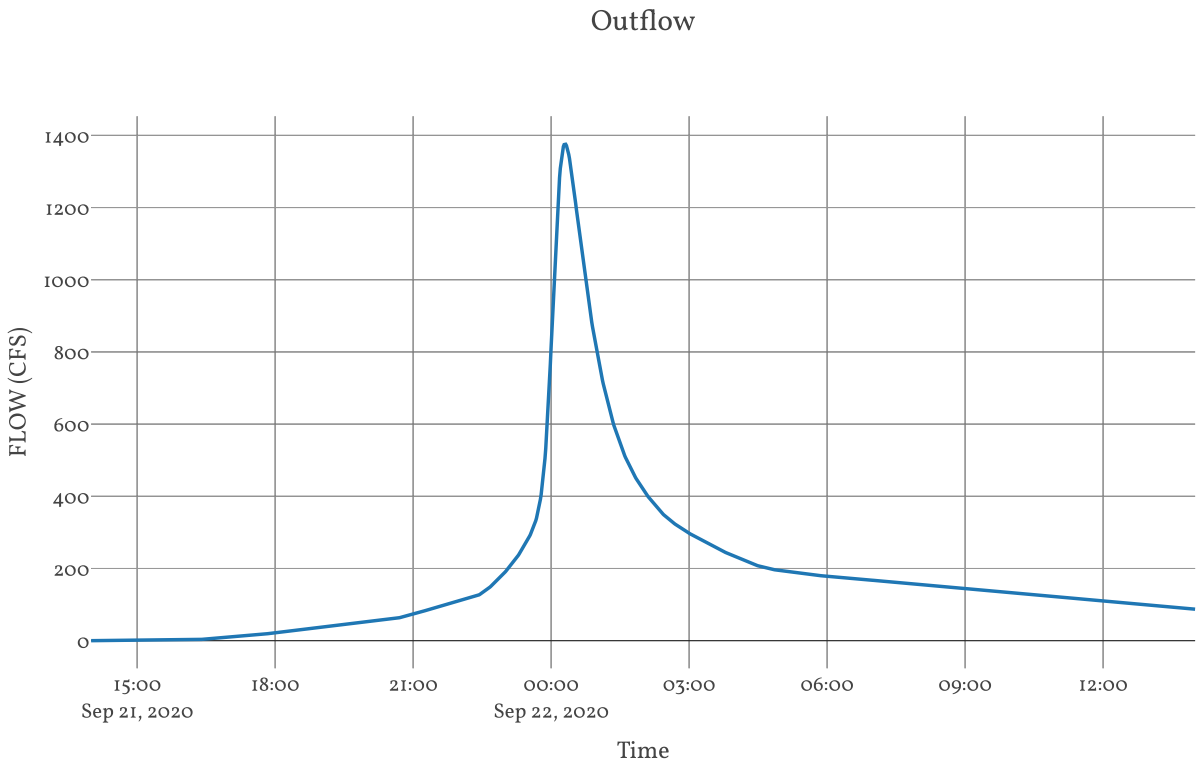

Precipitation and Outflow
FLOW (CFS) PRECIP-INC (IN)
0
0.02
0.04
0.06
0.08
600
400
200
0
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
Sep 21, 2020
Sep 22, 2020
Time
Precipitation
Excess Precipitation
Outflow

Junction: J 60B 61B

Downstream : 18r

Results: J 60B 61B

Peak Discharge (CFS)	1376.41
Time of Peak Discharge	22Sep2020, 00:18
Volume (IN)	5.54



Reach: 18R

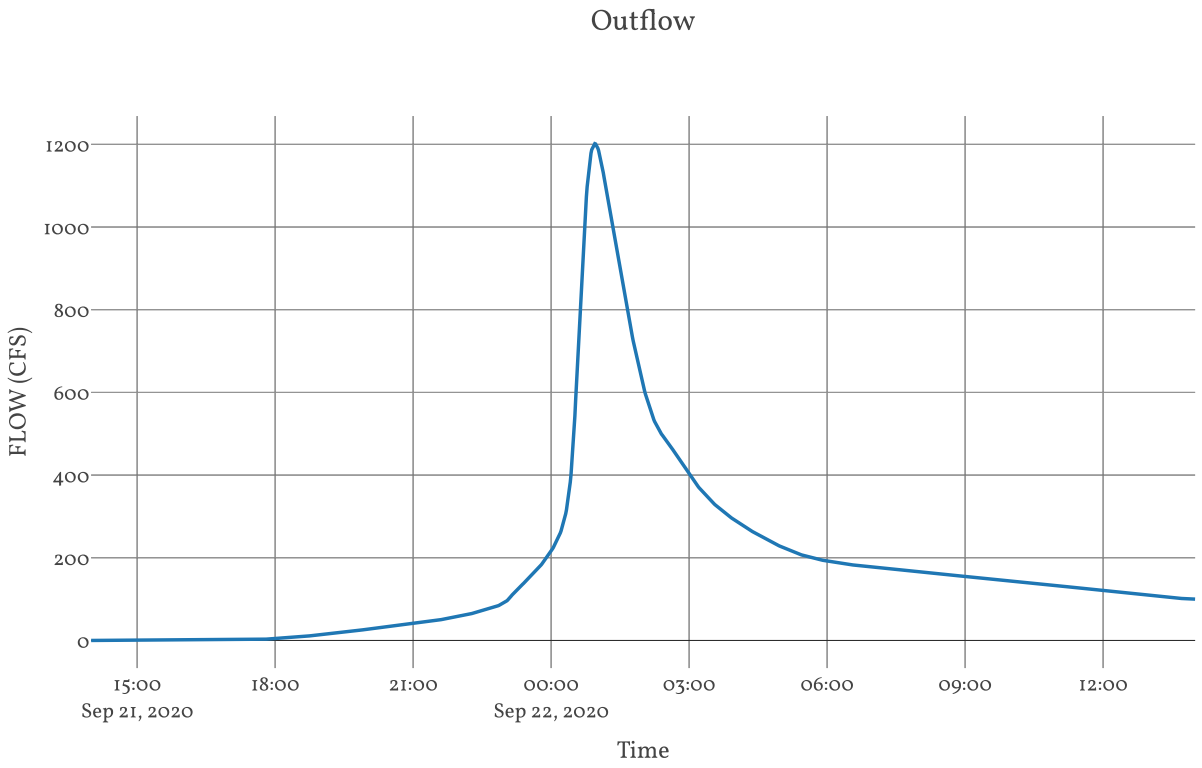
Downstream : 17c

Route: Modified Puls

Method	Modified Puls
Initial Variable	Combined Inflow
Number of Reaches	8
Storage Outflow Table Name	18r

Results: 18R

Peak Discharge (CFS)	1201.59
Time of Peak Discharge	22Sep2020, 00:57
Volume (IN)	5.35
Peak Inflow (CFS)	1376.41
Inflow Volume (AC - FT)	369.68



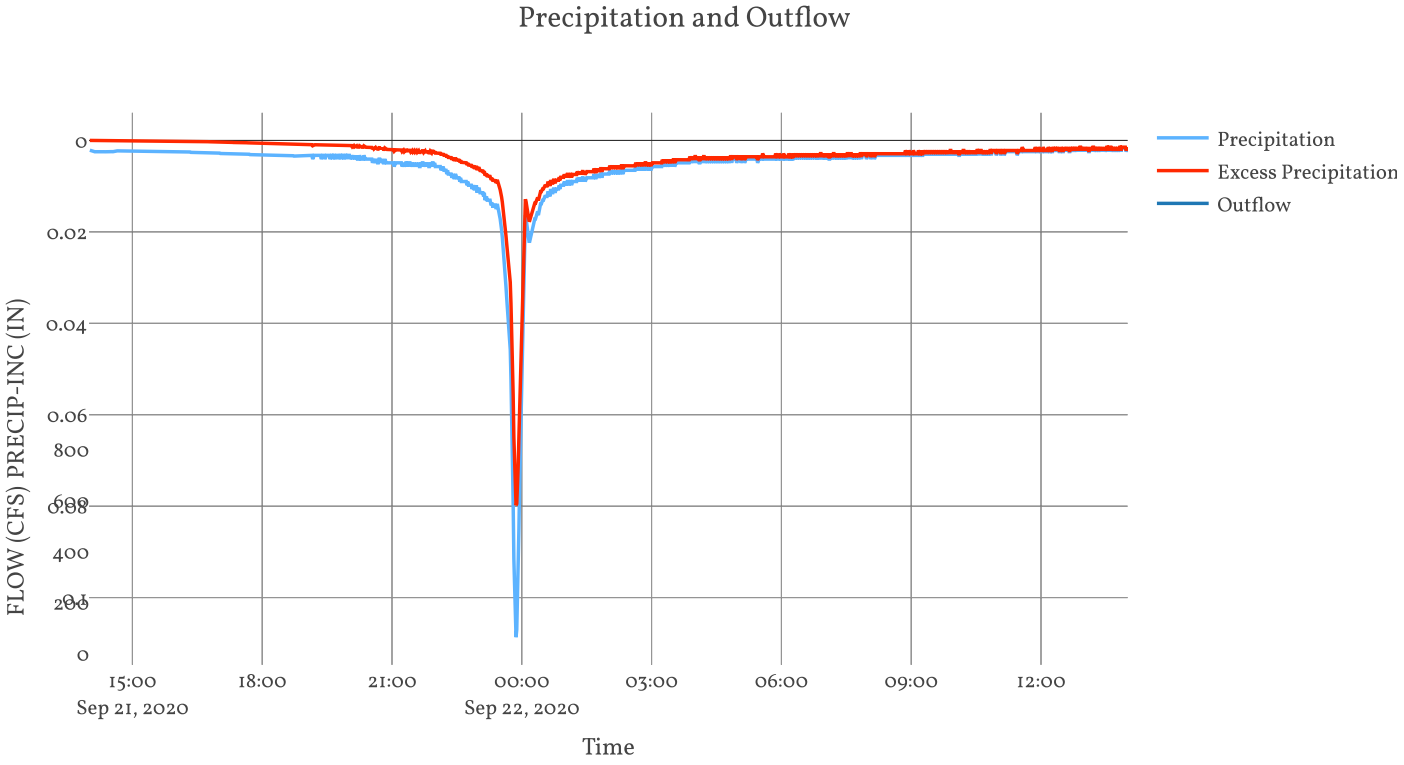
Subbasin: 62B

Area : 0.53
Downstream : 17c

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	73.9
Initial Abstraction	0.2

Transform: User - Specified S - Graph	
S - graph	Ellsworth S - Graph
Lag Method	Specified
Lag	0.25

Results: 62B	
Peak Discharge (CFS)	801.86
Time of Peak Discharge	22Sep2020, 00:08
Volume (IN)	5.48
Precipitation Volume (AC - FT)	229.02
Loss Volume (AC - FT)	74.21
Excess Volume (AC - FT)	154.81
Direct Runoff Volume (AC - FT)	153.63
Baseflow Volume (AC - FT)	0

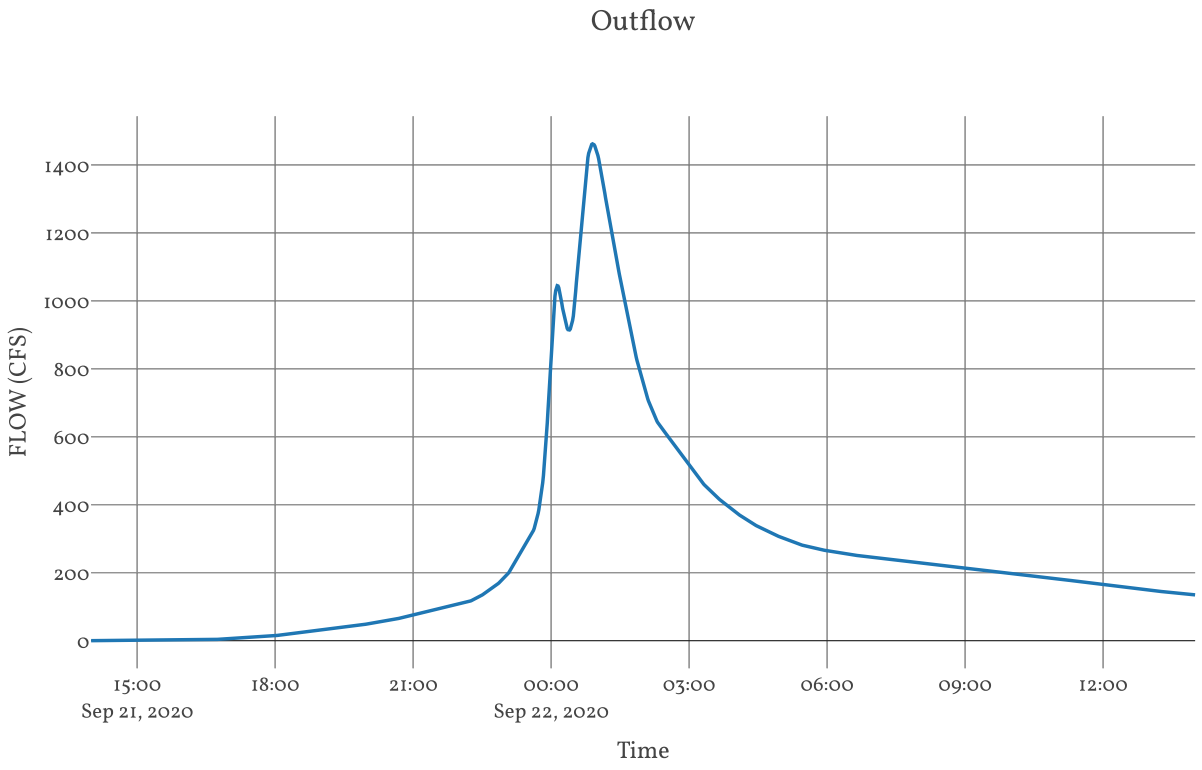

Precipitation and Outflow
FLOW (CFS) PRECIP-INC (IN)
0
0.02
0.04
0.06
800
0.08
400
200
0
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
Sep 21, 2020
Sep 22, 2020
Time
Precipitation
Excess Precipitation
Outflow

Junction: 17C

Downstream : 17r

Results: 17C

Peak Discharge (CFS)	1461.83
Time of Peak Discharge	22Sep2020, 00:54
Volume (IN)	5.39



Reach: 17R

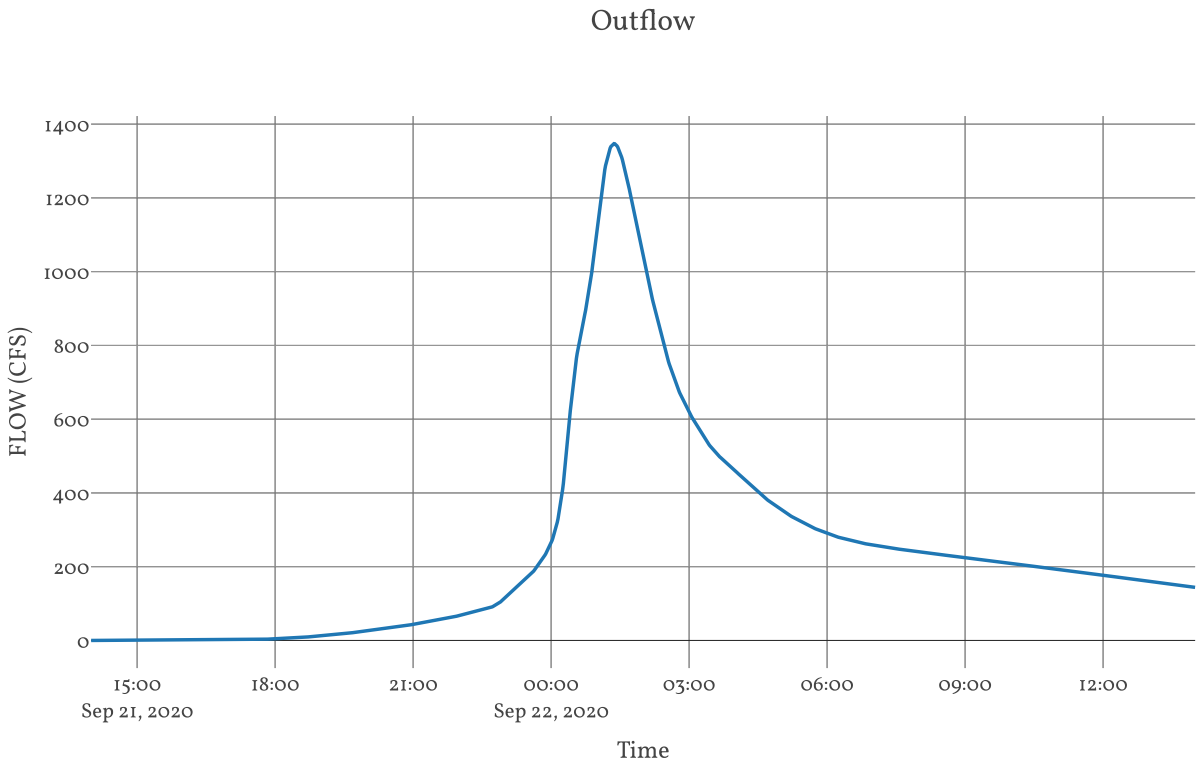
Downstream : 16c

Route: Modified Puls

Method	Modified Puls
Initial Variable	Combined Inflow
Number of Reaches	4
Storage Outflow Table Name	17r

Results: 17R

Peak Discharge (CFS)	1346.99
Time of Peak Discharge	22Sep2020, 01:22
Volume (IN)	5.25
Peak Inflow (CFS)	1461.83
Inflow Volume (AC - FT)	510.31



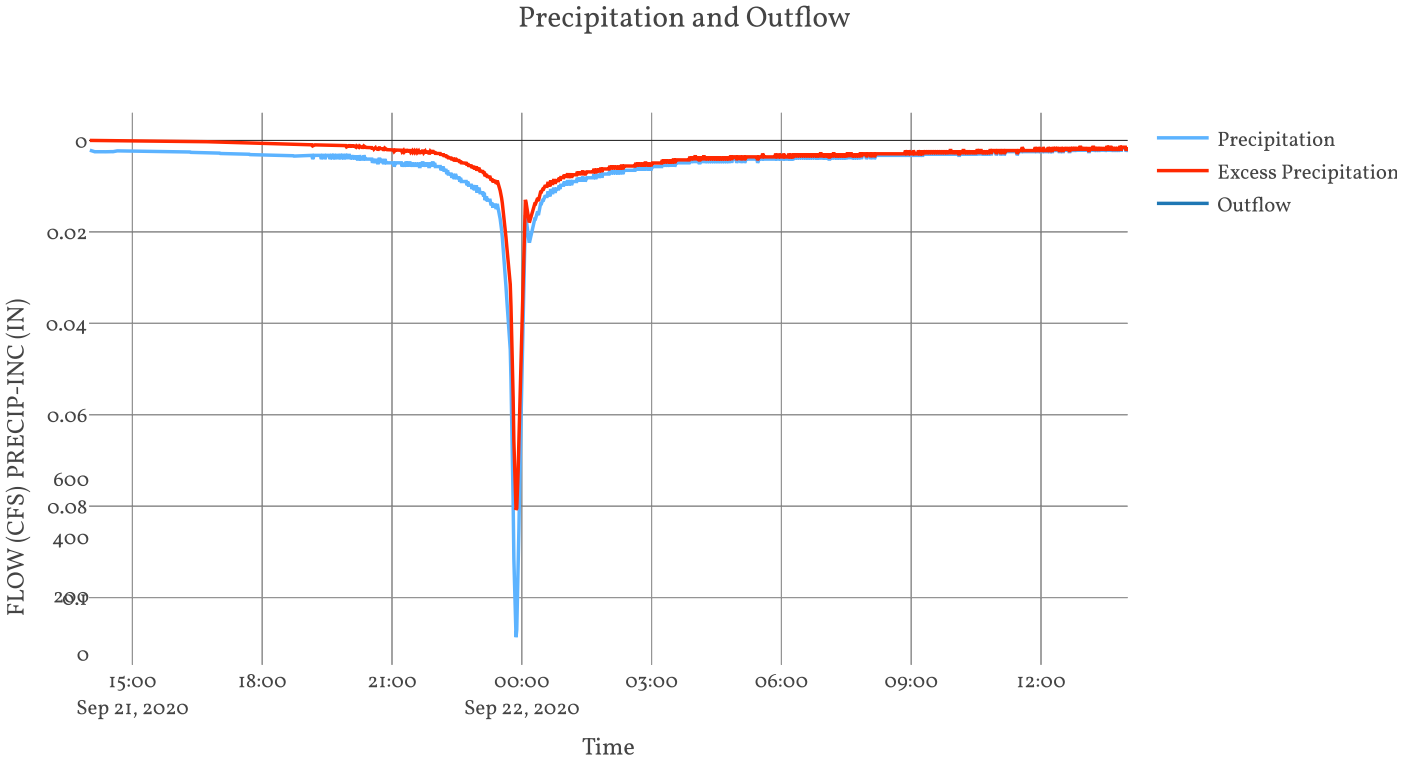
Subbasin: 63B

Area : 0.6
Downstream : 16c

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	74.6
Initial Abstraction	0.2

Transform: User - Specified S - Graph	
S - graph	Ellsworth S - Graph
Lag Method	Specified
Lag	0.41

Results: 63B	
Peak Discharge (CFS)	702.15
Time of Peak Discharge	22Sep2020, 00:17
Volume (IN)	5.51
Precipitation Volume (AC - FT)	262.31
Loss Volume (AC - FT)	83.02
Excess Volume (AC - FT)	179.29
Direct Runoff Volume (AC - FT)	177
Baseflow Volume (AC - FT)	0

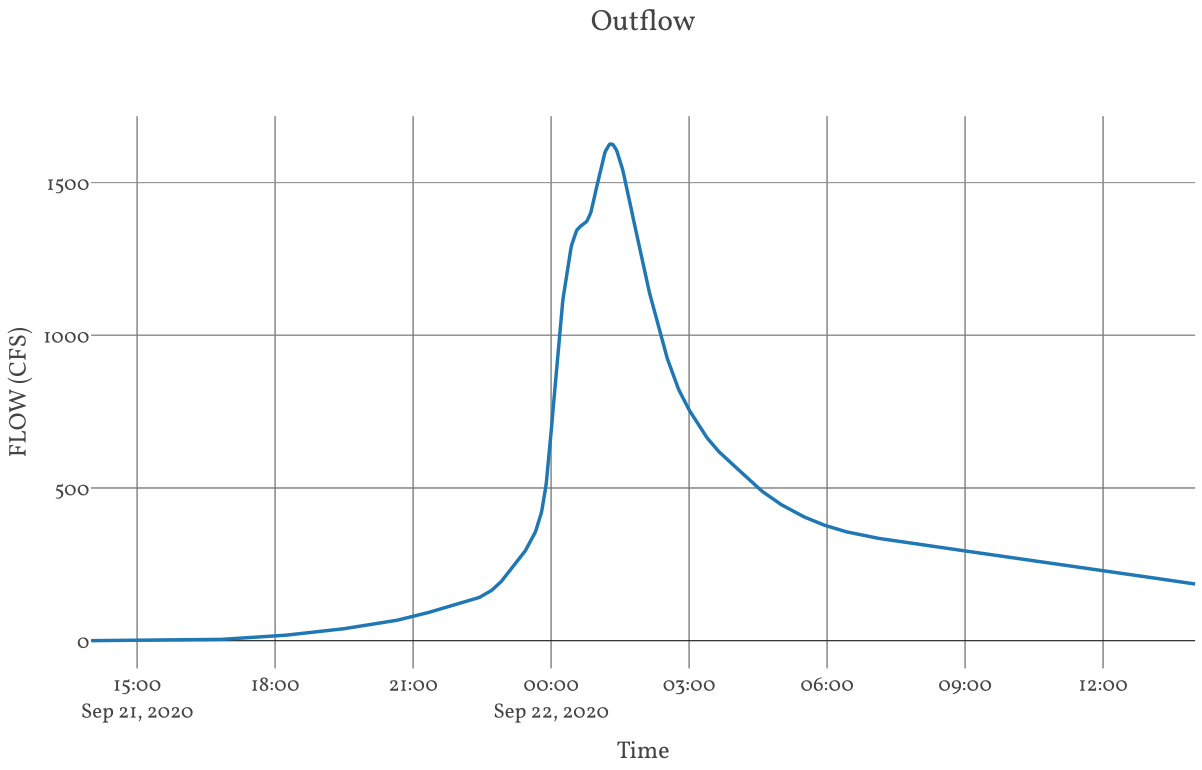

Precipitation and Outflow
FLOW (CFS) PRECIP-INC (IN)
0
0.02
0.04
0.06
600
0.08
400
200
0
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
Sep 21, 2020
Sep 22, 2020
Time
Precipitation
Excess Precipitation
Outflow

Junction: 16C

Downstream : 16r

Results: 16C

Peak Discharge (CFS)	1626.68
Time of Peak Discharge	22Sep2020, 01:18
Volume (IN)	5.31



Reach: 16R

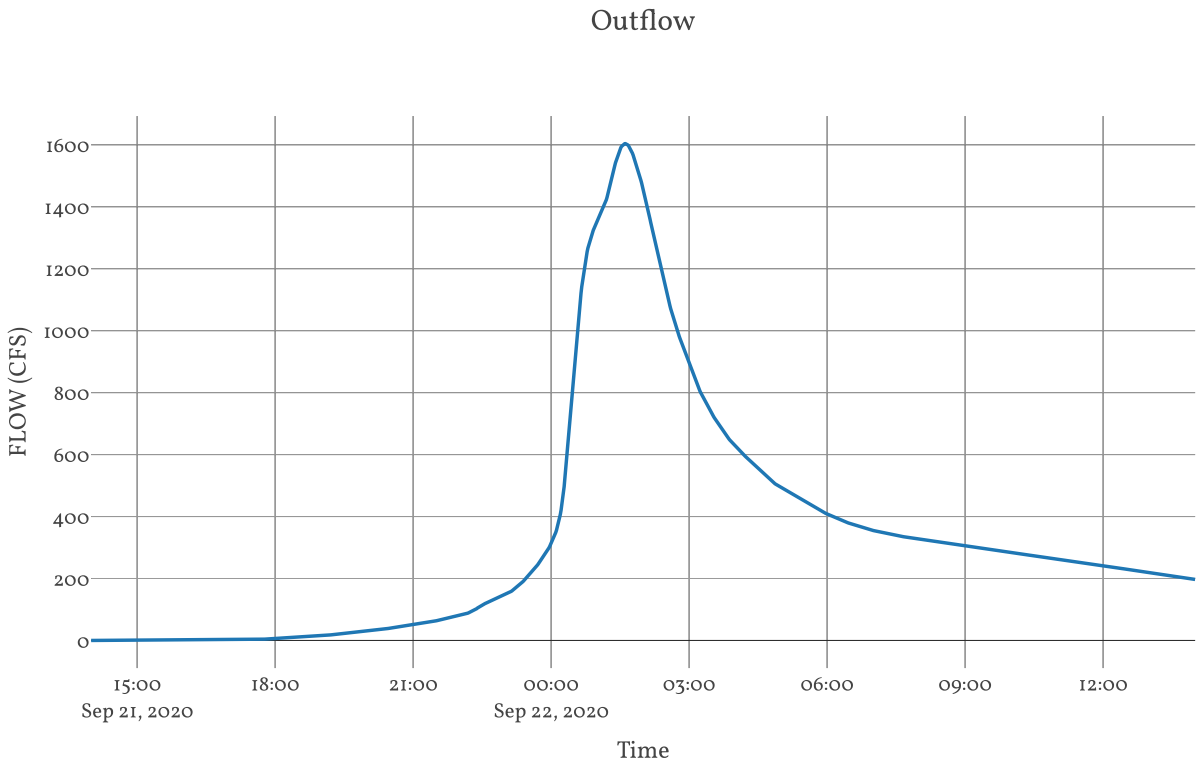
Downstream : 20C

Route: Modified Puls

Method	Modified Puls
Initial Variable	Combined Inflow
Number of Reaches	6
Storage Outflow Table Name	16r

Results: 16R

Peak Discharge (CFS)	1603.52
Time of Peak Discharge	22Sep2020, 01:37
Volume (IN)	5.22
Peak Inflow (CFS)	1626.68
Inflow Volume (AC - FT)	674.12



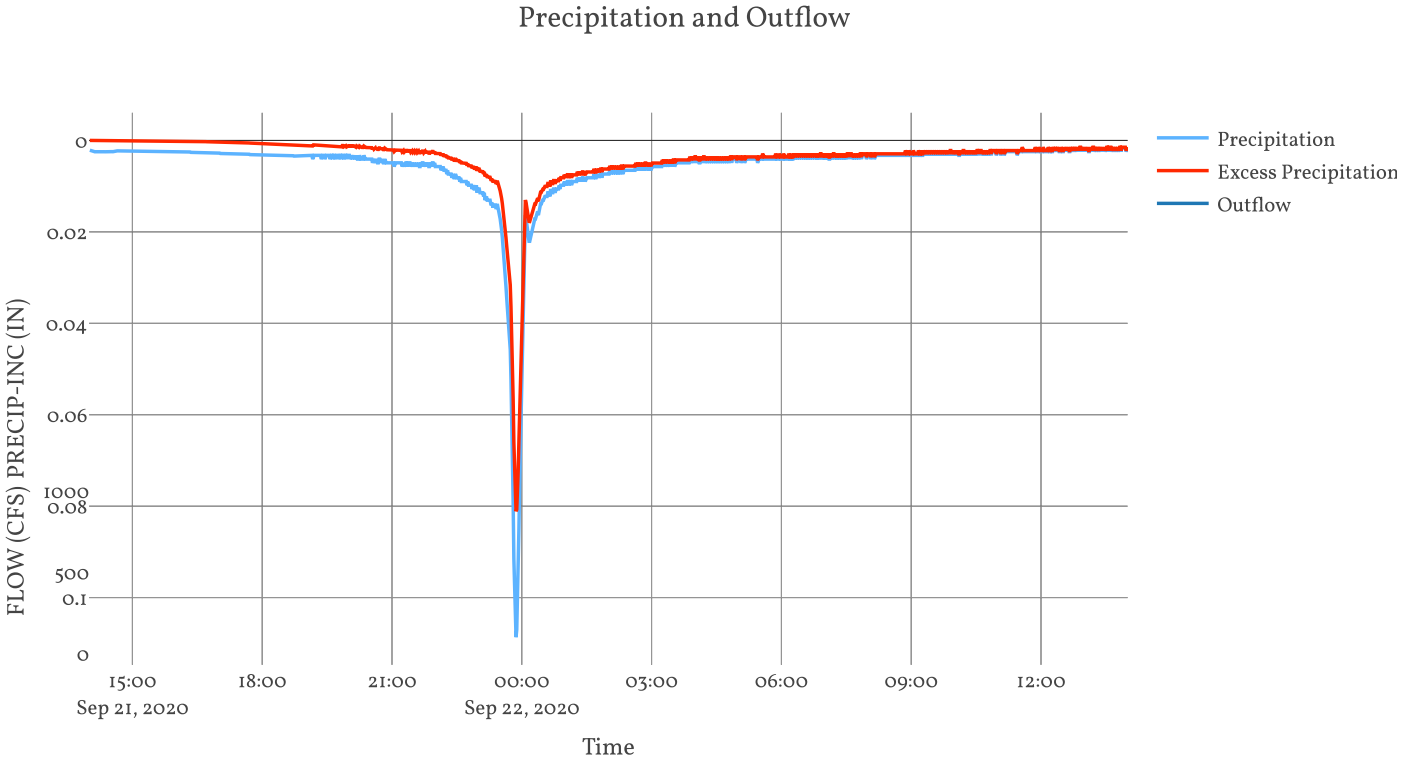
Subbasin: 64B

Area : 1.09
Downstream : 20c

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	74.8
Initial Abstraction	0.2

Transform: User - Specified S - Graph	
S - graph	Ellsworth S - Graph
Lag Method	Specified
Lag	0.42

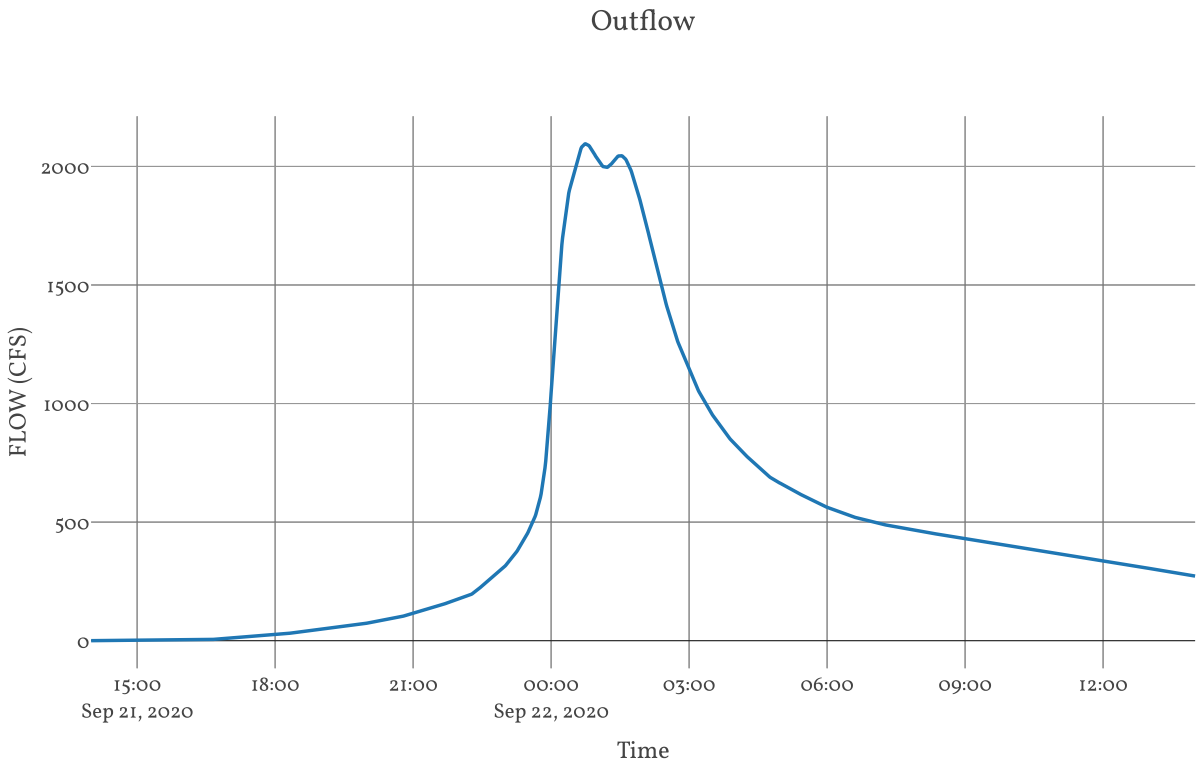
Results: 64B	
Peak Discharge (CFS)	1257.72
Time of Peak Discharge	22Sep2020, 00:18
Volume (IN)	5.53
Precipitation Volume (AC - FT)	474.95
Loss Volume (AC - FT)	149.29
Excess Volume (AC - FT)	325.66
Direct Runoff Volume (AC - FT)	321.39
Baseflow Volume (AC - FT)	0


Precipitation and Outflow
FLOW (CFS) PRECIP-INC (IN)
0
0.02
0.04
0.06
1000
0.08
500
0.1
0
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
Sep 21, 2020
Sep 22, 2020
Time
Precipitation
Excess Precipitation
Outflow

Junction: 20C

Downstream : 20r

Results: 20C	
Peak Discharge (CFS)	2095.06
Time of Peak Discharge	22Sep2020, 00:45
Volume (IN)	5.31

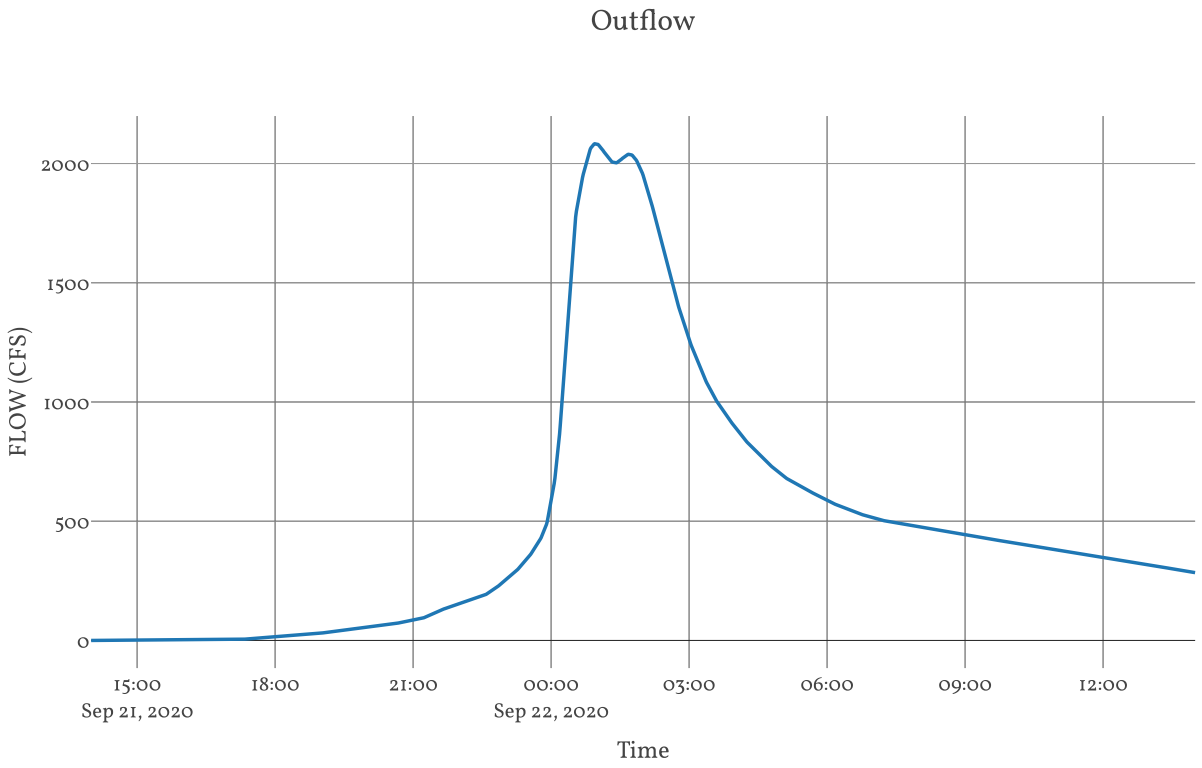


Reach: 20R

Downstream : 15c

Route: Modified Puls	
Method	Modified Puls
Initial Variable	Combined Inflow
Number of Reaches	6
Storage Outflow Table Name	20r

Results: 20R	
Peak Discharge (CFS)	2083.23
Time of Peak Discharge	22Sep2020, 00:58
Volume (IN)	5.25
Peak Inflow (CFS)	2095.06
Inflow Volume (AC - FT)	983.19



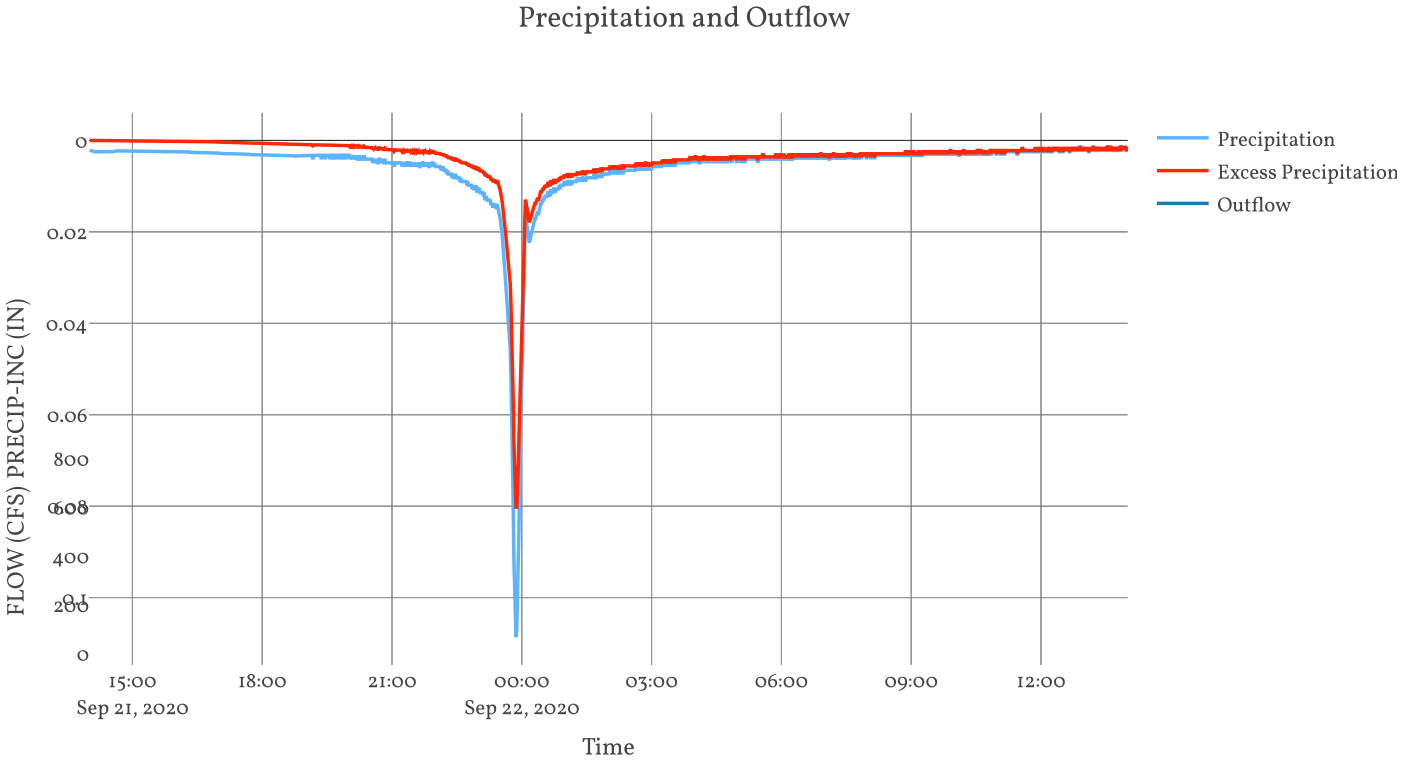
Subbasin: 65B

Area : 0.53
Downstream : 15c

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	74.4
Initial Abstraction	0.2

Transform: User - Specified S - Graph	
S - graph	Ellsworth S - Graph
Lag Method	Specified
Lag	0.24

Results: 65B	
Peak Discharge (CFS)	839.53
Time of Peak Discharge	22Sep2020, 00:07
Volume (IN)	5.53
Precipitation Volume (AC - FT)	232.25
Loss Volume (AC - FT)	74
Excess Volume (AC - FT)	158.24
Direct Runoff Volume (AC - FT)	157.09
Baseflow Volume (AC - FT)	0

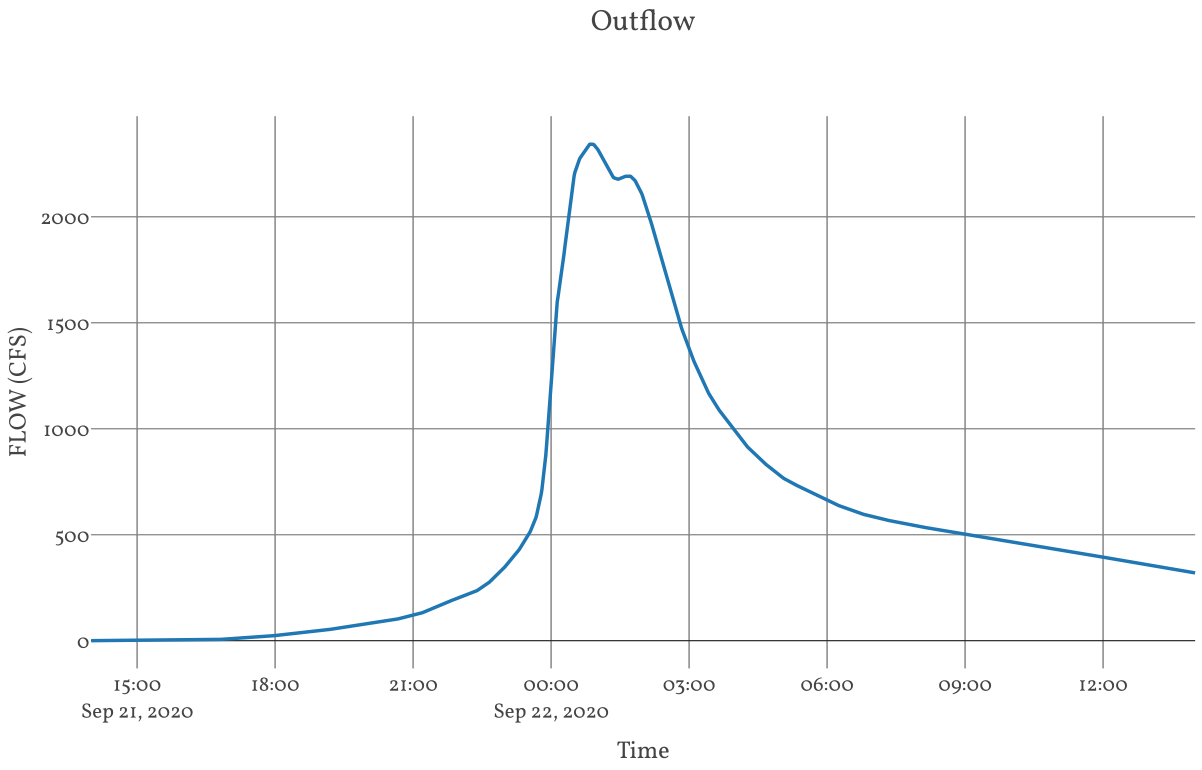

Precipitation and Outflow
FLOW (CFS) PRECIP-INC (IN)
0
0.02
0.04
0.06
800
600
400
200
0
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
Sep 21, 2020
Sep 22, 2020
Time
Precipitation
Excess Precipitation
Outflow

Junction: 15C

Downstream : 15r

Results: 15C

Peak Discharge (CFS)	2343.64
Time of Peak Discharge	22Sep2020, 00:53
Volume (IN)	5.29



Reach: 15R

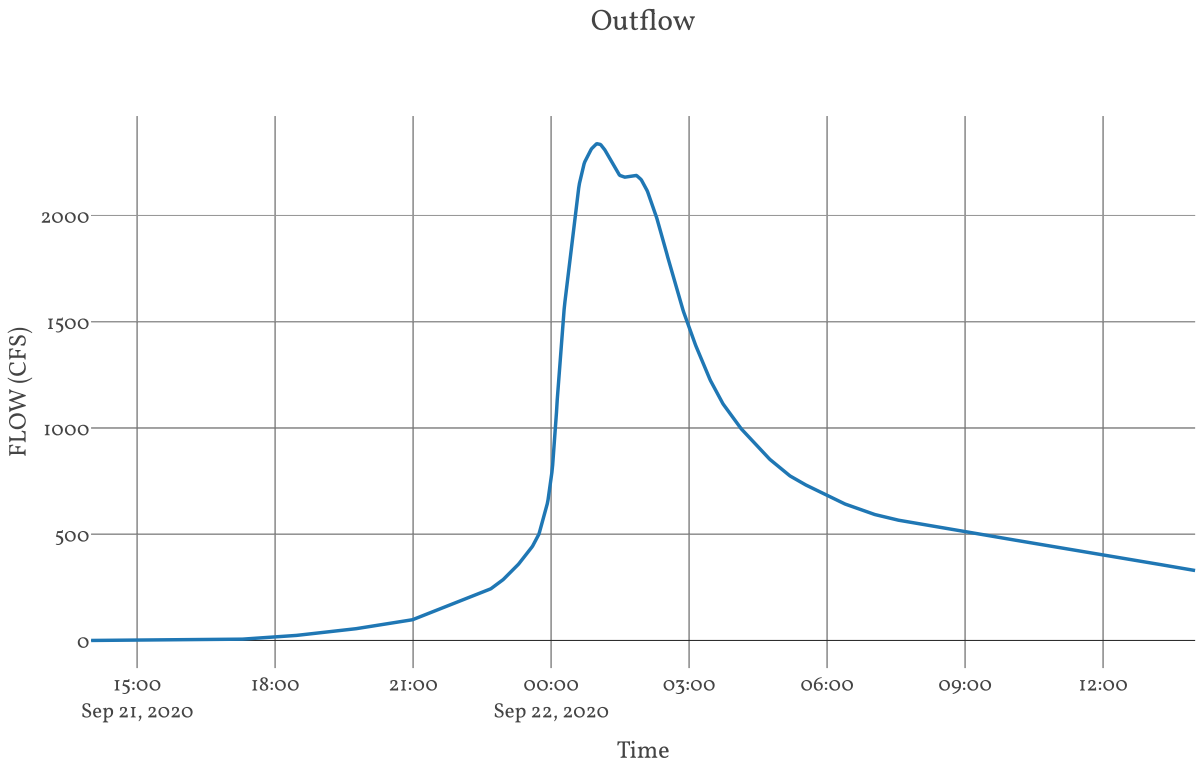
Downstream : 14c

Route: Modified Puls

Method	Modified Puls
Initial Variable	Combined Inflow
Number of Reaches	5
Storage Outflow Table Name	15r

Results: 15R

Peak Discharge (CFS)	2337.96
Time of Peak Discharge	22Sep2020, 01:01
Volume (IN)	5.25
Peak Inflow (CFS)	2343.64
Inflow Volume (AC - FT)	1128.91



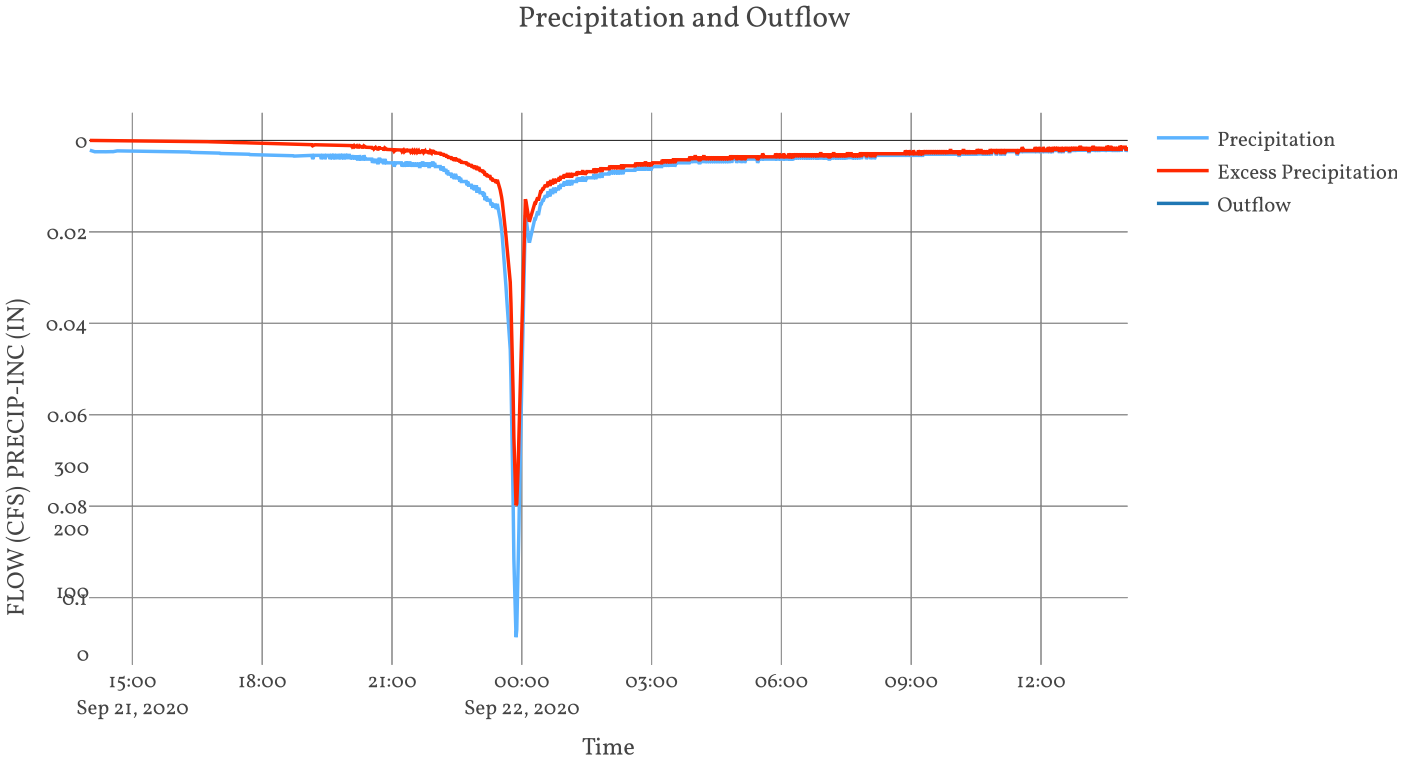
Subbasin: 66B

Area : 0.16
Downstream : 14c

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	73.9
Initial Abstraction	0.2

Transform: User - Specified S - Graph	
S - graph	Ellsworth S - Graph
Lag Method	Specified
Lag	0.14

Results: 66B	
Peak Discharge (CFS)	326.61
Time of Peak Discharge	22Sep2020, 00:02
Volume (IN)	5.5
Precipitation Volume (AC - FT)	70.59
Loss Volume (AC - FT)	22.87
Excess Volume (AC - FT)	47.72
Direct Runoff Volume (AC - FT)	47.52
Baseflow Volume (AC - FT)	0

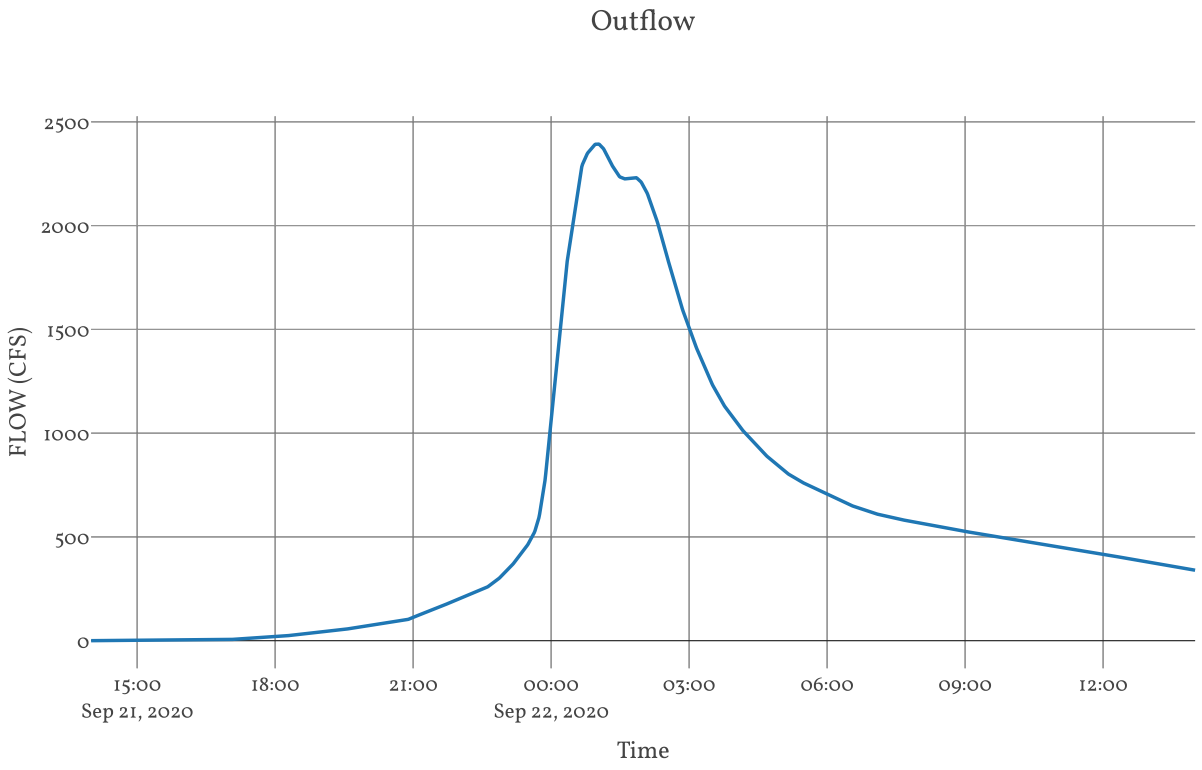

Precipitation and Outflow
FLOW (CFS) PRECIP-INC (IN)
0
0.02
0.04
0.06
300
0.08
200
100
0.1
0
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
Sep 21, 2020
Sep 22, 2020
Time
Precipitation
Excess Precipitation
Outflow

Junction: 14C

Downstream : 14r

Results: 14C

Peak Discharge (CFS)	2393.85
Time of Peak Discharge	22Sep2020, 01:00
Volume (IN)	5.26



Reach: 14R

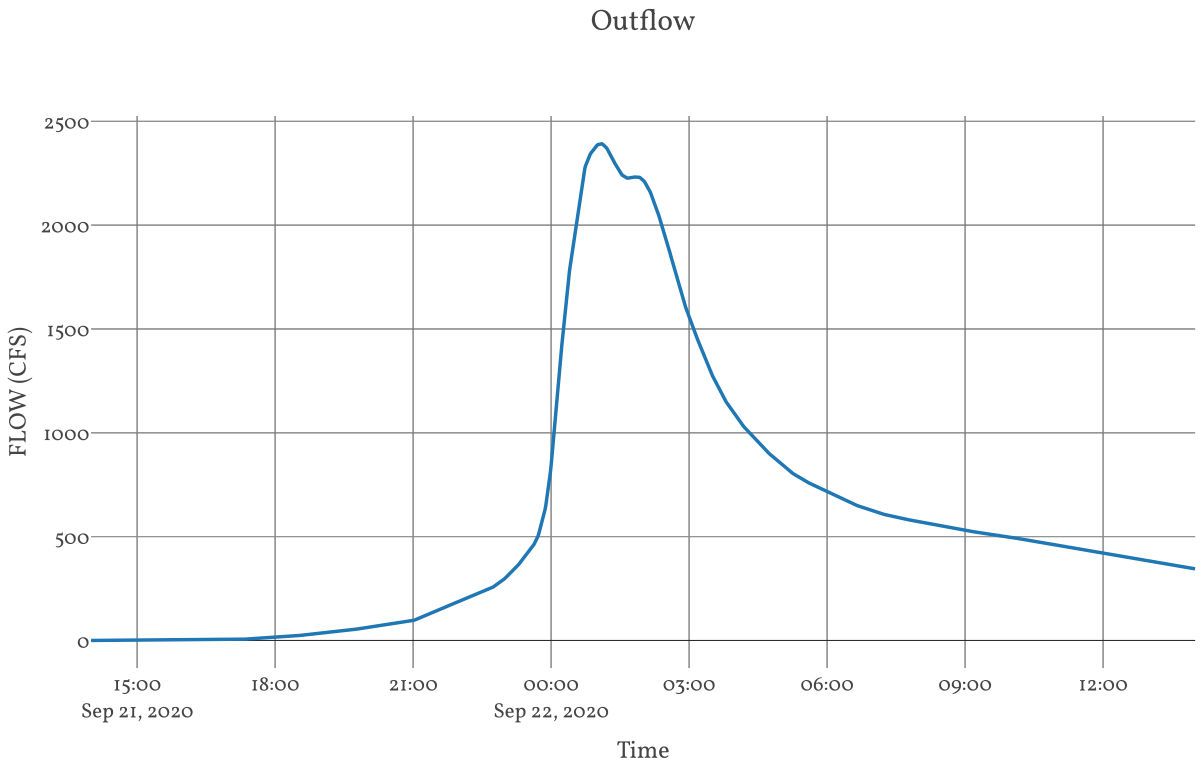
Downstream : 13c

Route: Modified Puls

Method	Modified Puls
Initial Variable	Combined Inflow
Number of Reaches	5
Storage Outflow Table Name	14r

Results: 14R

Peak Discharge (CFS)	2392.33
Time of Peak Discharge	22Sep2020, 01:05
Volume (IN)	5.24
Peak Inflow (CFS)	2393.85
Inflow Volume (AC - FT)	1167.67



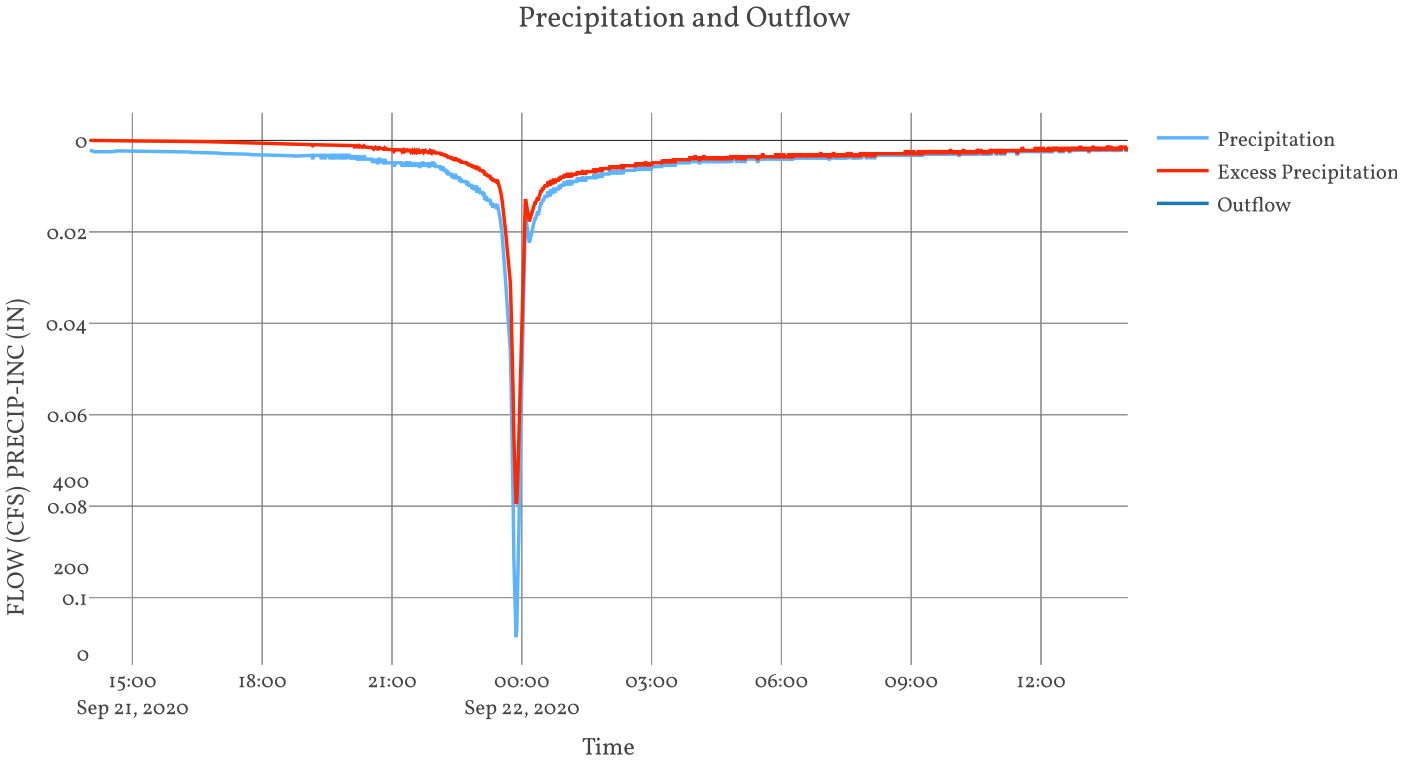
Subbasin: 67B

Area : 0.43
Downstream : 13c

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	73.7
Initial Abstraction	0.2

Transform: User - Specified S - Graph	
S - graph	Ellsworth S - Graph
Lag Method	Specified
Lag	0.44

Results: 67B	
Peak Discharge (CFS)	472.93
Time of Peak Discharge	22Sep2020, 00:19
Volume (IN)	5.43
Precipitation Volume (AC - FT)	187.37
Loss Volume (AC - FT)	61.11
Excess Volume (AC - FT)	126.25
Direct Runoff Volume (AC - FT)	124.49
Baseflow Volume (AC - FT)	0

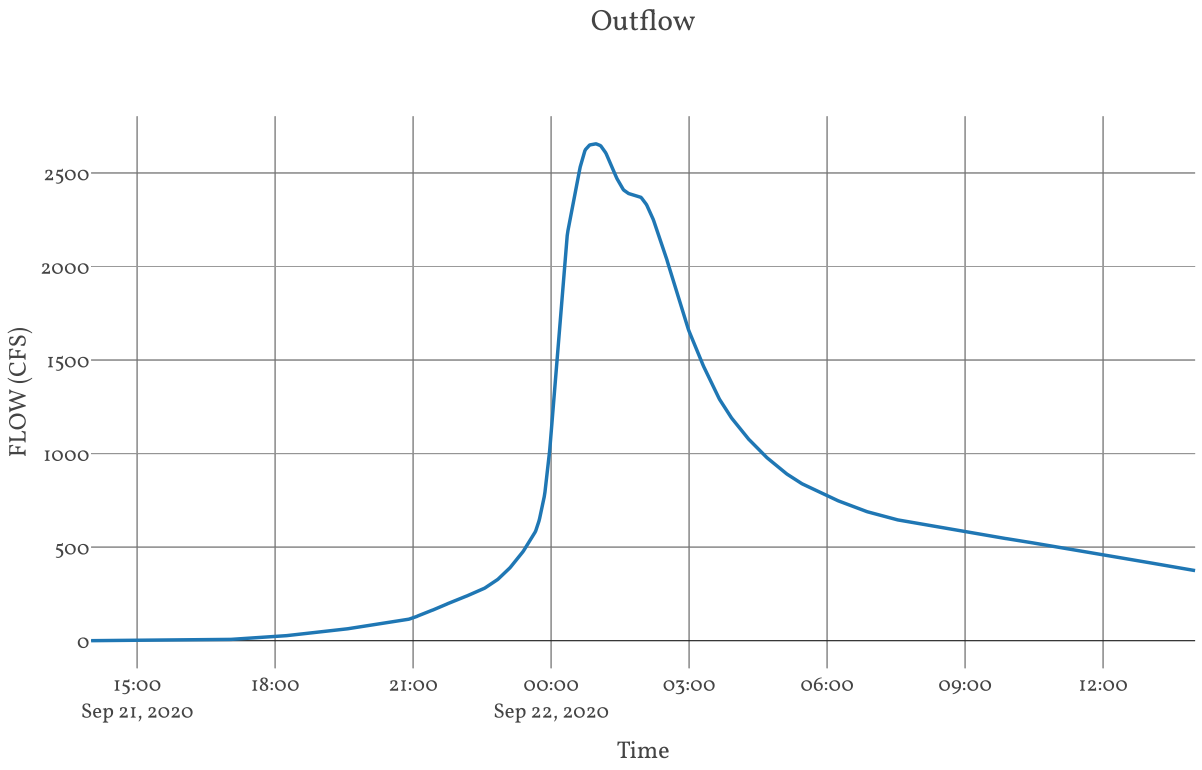

Precipitation and Outflow
FLOW (CFS) PRECIP-INC (IN)
0
0.02
0.04
0.06
400
0.08
200
0.1
0
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
Sep 21, 2020
Sep 22, 2020
Time
Precipitation
Excess Precipitation
Outflow

Junction: 13C

Downstream : 13r

Results: 13C

Peak Discharge (CFS)	2655.4
Time of Peak Discharge	22Sep2020, 00:58
Volume (IN)	5.25



Reach: 13R

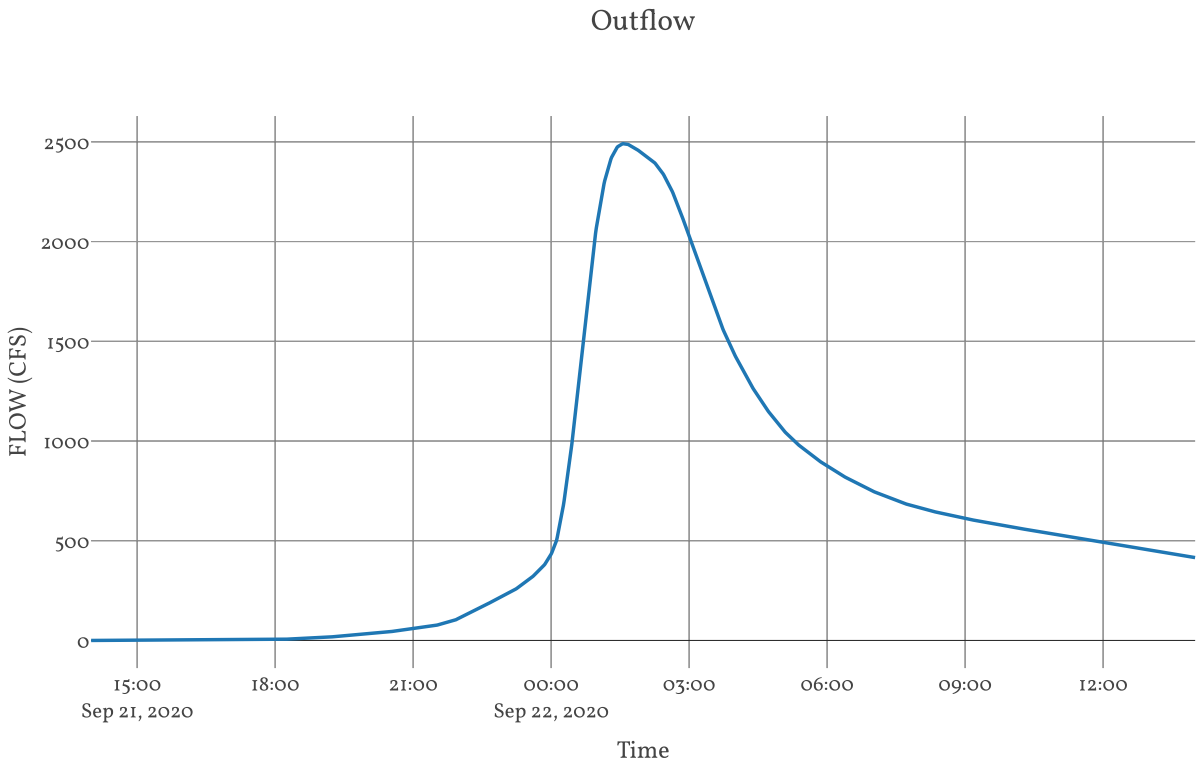
Downstream : 12C

Route: Modified Puls

Method	Modified Puls
Initial Variable	Combined Inflow
Number of Reaches	2
Storage Outflow Table Name	13r

Results: 13R

Peak Discharge (CFS)	2490.9
Time of Peak Discharge	22Sep2020, 01:35
Volume (IN)	5.09
Peak Inflow (CFS)	2655.4
Inflow Volume (AC - FT)	1287.19



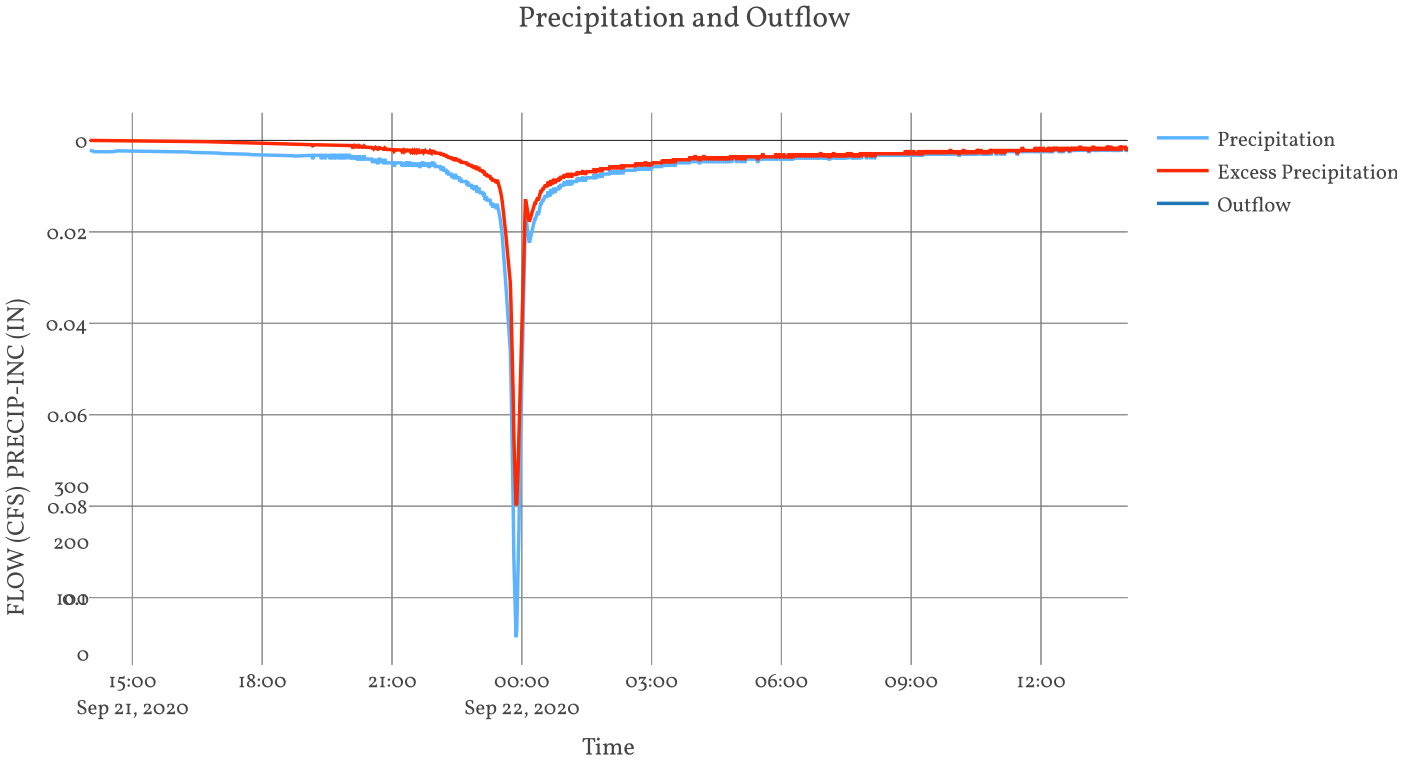
Subbasin: 68B

Area : 0.26
Downstream : 12c

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	73.9
Initial Abstraction	0.2

Transform: User - Specified S - Graph	
S - graph	Ellsworth S - Graph
Lag Method	Specified
Lag	0.28

Results: 68B	
Peak Discharge (CFS)	365.55
Time of Peak Discharge	22Sep2020, 00:09
Volume (IN)	5.48
Precipitation Volume (AC - FT)	111.11
Loss Volume (AC - FT)	36
Excess Volume (AC - FT)	75.11
Direct Runoff Volume (AC - FT)	74.46
Baseflow Volume (AC - FT)	0

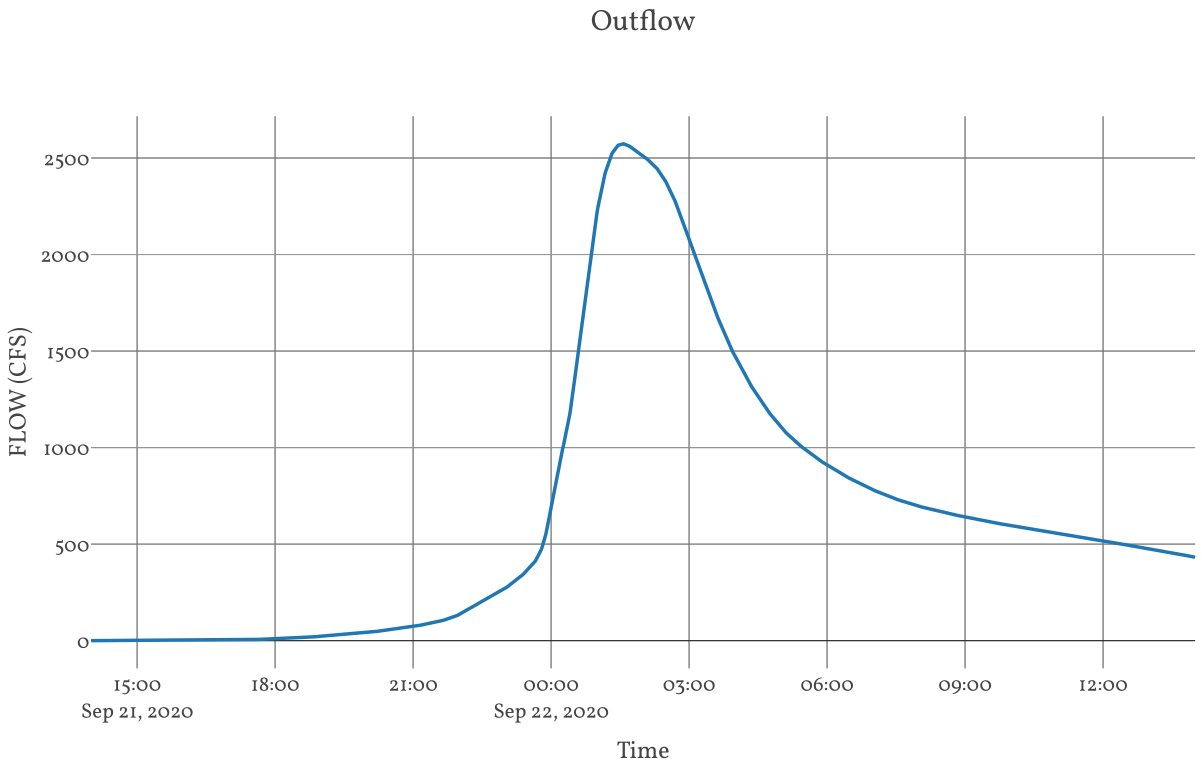

Precipitation and Outflow
FLOW (CFS) PRECIP-INC (IN)
0
0.02
0.04
0.06
300
0.08
200
0
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
Sep 21, 2020
Sep 22, 2020
Time
Precipitation
Excess Precipitation
Outflow

Junction: 12C

Downstream : Pacific Ocean

Results: 12C

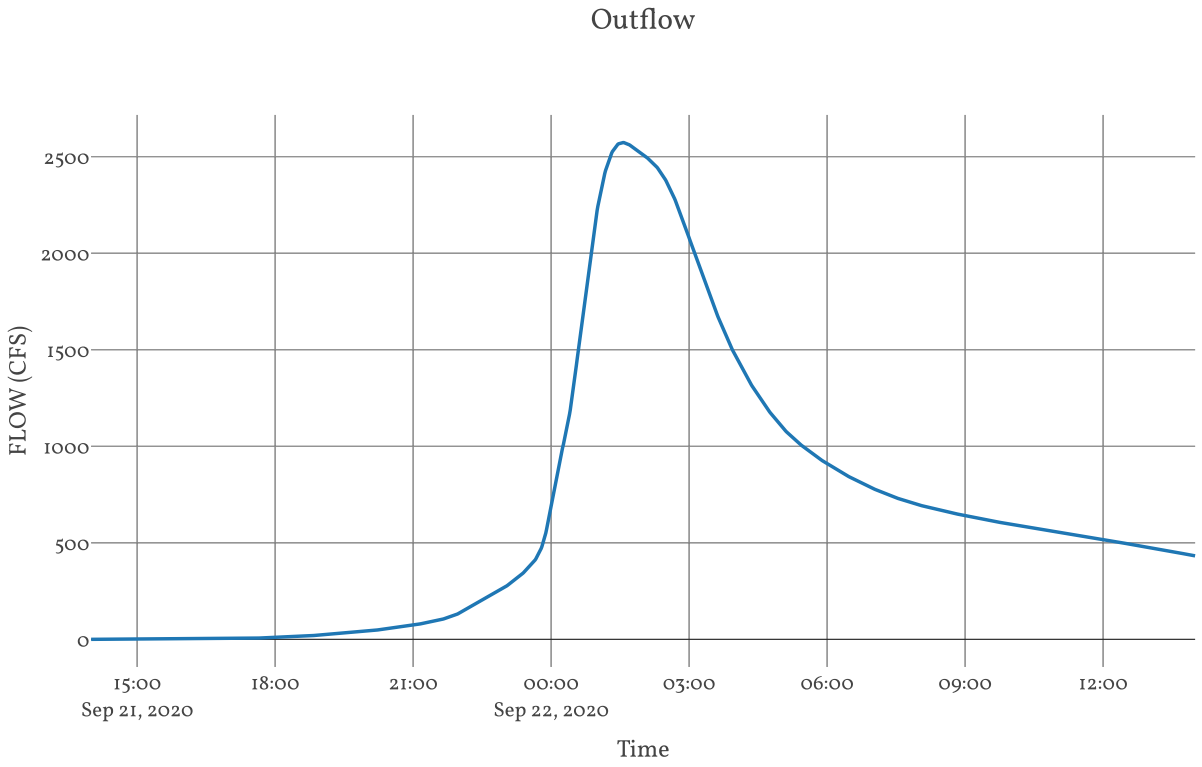
Peak Discharge (CFS)	2573.16
Time of Peak Discharge	22Sep2020, 01:33
Volume (IN)	5.11



Sink: Pacific Ocean

Results: Pacific Ocean

Peak Discharge (CFS)	2573.16
Time of Peak Discharge	22Sep2020, 01:33
Volume (IN)	5.11
Observed Flow Gage	Not specified
Observed Flow Volume (AC - FT)	Not specified
Observed Flow's RMSE Stdev	Not specified
Observed Flow's Percent Bias	Not specified
Observed Flow's Nash Sutcliffe	Not specified



Project: Little_Sycamore_May2021
Simulation Run: 100-mp-Post Fire
Simulation Start: 21 September 2020, 14:00
Simulation End: 22 September 2020, 14:00

HMS Version: 4.6.1
Executed: 29 April 2021, 23:04

Global Parameter Summary - Subbasin

Area

Element Name	Area
60b	0.65
61b	0.61
62b	0.53
63b	0.6
64b	1.09
65b	0.53
66b	0.16
67b	0.43
68b	0.26

Downstream

Element Name	Downstream
60b	J 60b 61b
61b	J 60b 61b
62b	17c
63b	16c
64b	20c
65b	15c
66b	14c
67b	13c
68b	12c

Loss Rate: Scs

Element Name	Percent Impervious Area	Curve Number	Initial Abstraction
60b	0	75	0.2
61b	0	75	0.2
62b	0	73.9	0.2
63b	0	74.6	0.2
64b	0	74.8	0.2
65b	0	74.4	0.2
66b	0	73.9	0.2
67b	0	73.7	0.2
68b	0	73.9	0.2

Transform: User - Specified S - Graph

Element Name	S - graph	Lag Method	Lag
60b	Ellsworth S - Graph	Specified	0.52
61b	Ellsworth S - Graph	Specified	0.37
62b	Ellsworth S - Graph	Specified	0.25
63b	Ellsworth S - Graph	Specified	0.41
64b	Ellsworth S - Graph	Specified	0.42
65b	Ellsworth S - Graph	Specified	0.24
66b	Ellsworth S - Graph	Specified	0.14
67b	Ellsworth S - Graph	Specified	0.44
68b	Ellsworth S - Graph	Specified	0.28

Global Parameter Summary - Reach

Downstream

Element Name	Downstream
18r	17c
17r	16c
16r	20c
20r	15c
15r	14c
14r	13c
13r	12c

Route: Modified Puls

Element Name	Method	Initial Variable	Number of Reaches	Storage Outflow Table Name
18r	Modified Puls	Combined Inflow	8	18r
17r	Modified Puls	Combined Inflow	4	17r
16r	Modified Puls	Combined Inflow	6	16r
20r	Modified Puls	Combined Inflow	6	20r
15r	Modified Puls	Combined Inflow	5	15r
14r	Modified Puls	Combined Inflow	5	14r
13r	Modified Puls	Combined Inflow	2	13r

Global Results Summary

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
60b	0.65	780.97	22Sep2020, 00:24	6.53
61b	0.61	896.67	22Sep2020, 00:14	6.56
J 60b 61b	1.25	1633.26	22Sep2020, 00:18	6.54
18r	1.25	1438.27	22Sep2020, 00:56	6.33
62b	0.53	952.41	22Sep2020, 00:08	6.48
17c	1.78	1753.66	22Sep2020, 00:52	6.37
17r	1.78	1634.93	22Sep2020, 01:18	6.22
63b	0.6	833.58	22Sep2020, 00:17	6.51
16c	2.38	1981.11	22Sep2020, 01:14	6.3
16r	2.38	1949.71	22Sep2020, 01:33	6.19
64b	1.09	1492.76	22Sep2020, 00:17	6.53
20c	3.47	2556.55	22Sep2020, 00:45	6.3
20r	3.47	2544.52	22Sep2020, 00:57	6.23
65b	0.53	996.31	22Sep2020, 00:07	6.53
15c	4	2859.17	22Sep2020, 00:51	6.27
15r	4	2853.59	22Sep2020, 00:59	6.22
66b	0.16	387.56	22Sep2020, 00:02	6.5
14c	4.16	2920.92	22Sep2020, 00:58	6.23
14r	4.16	2919.54	22Sep2020, 01:02	6.21
67b	0.43	562.44	22Sep2020, 00:19	6.42
13c	4.59	3247.98	22Sep2020, 00:53	6.23
13r	4.59	3059.42	22Sep2020, 01:31	6.05
68b	0.26	434.38	22Sep2020, 00:09	6.47

12c	4.85	3159.83	22Sep2020, 01:29	6.07
Pacific Ocean	4.85	3159.83	22Sep2020, 01:29	6.07

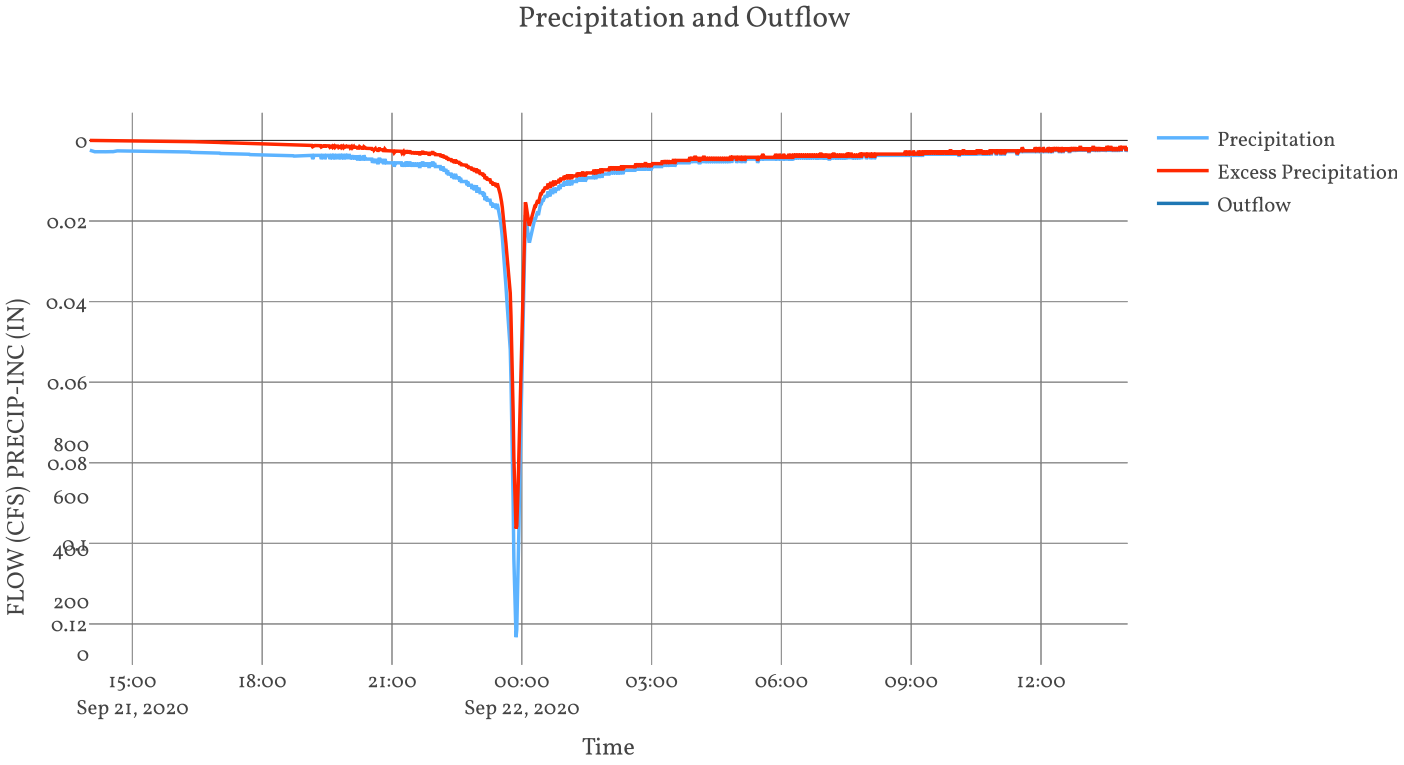
Subbasin: 60B

Area : 0.65
Downstream : J 60b 61b

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	75
Initial Abstraction	0.2

Transform: User - Specified S - Graph	
S - graph	Ellsworth S - Graph
Lag Method	Specified
Lag	0.52

Results: 60B	
Peak Discharge (CFS)	780.97
Time of Peak Discharge	22Sep2020, 00:24
Volume (IN)	6.53
Precipitation Volume (AC - FT)	318.89
Loss Volume (AC - FT)	90.73
Excess Volume (AC - FT)	228.16
Direct Runoff Volume (AC - FT)	224.48
Baseflow Volume (AC - FT)	0


Precipitation and Outflow
FLOW (CFS) PRECIP-INC (IN)
0
0.02
0.04
0.06
800
0.08
600
400
200
0.12
0
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
Sep 21, 2020
Sep 22, 2020
Time
Precipitation
Excess Precipitation
Outflow

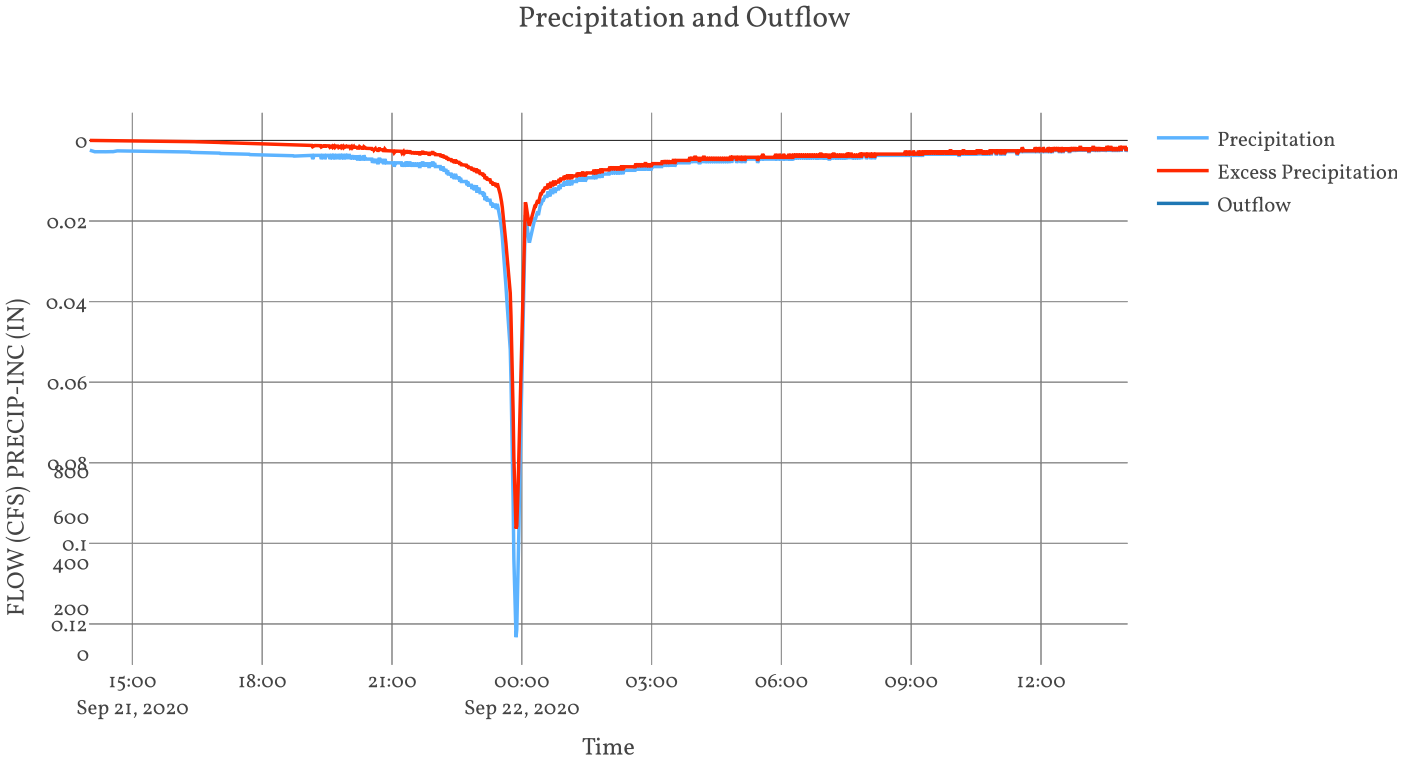
Subbasin: 61B

Area : 0.61
Downstream : J 60b 61b

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	75
Initial Abstraction	0.2

Transform: User - Specified S - Graph	
S - graph	Ellsworth S - Graph
Lag Method	Specified
Lag	0.37

Results: 61B	
Peak Discharge (CFS)	896.67
Time of Peak Discharge	22Sep2020, 00:14
Volume (IN)	6.56
Precipitation Volume (AC - FT)	299.61
Loss Volume (AC - FT)	85.24
Excess Volume (AC - FT)	214.36
Direct Runoff Volume (AC - FT)	211.97
Baseflow Volume (AC - FT)	0

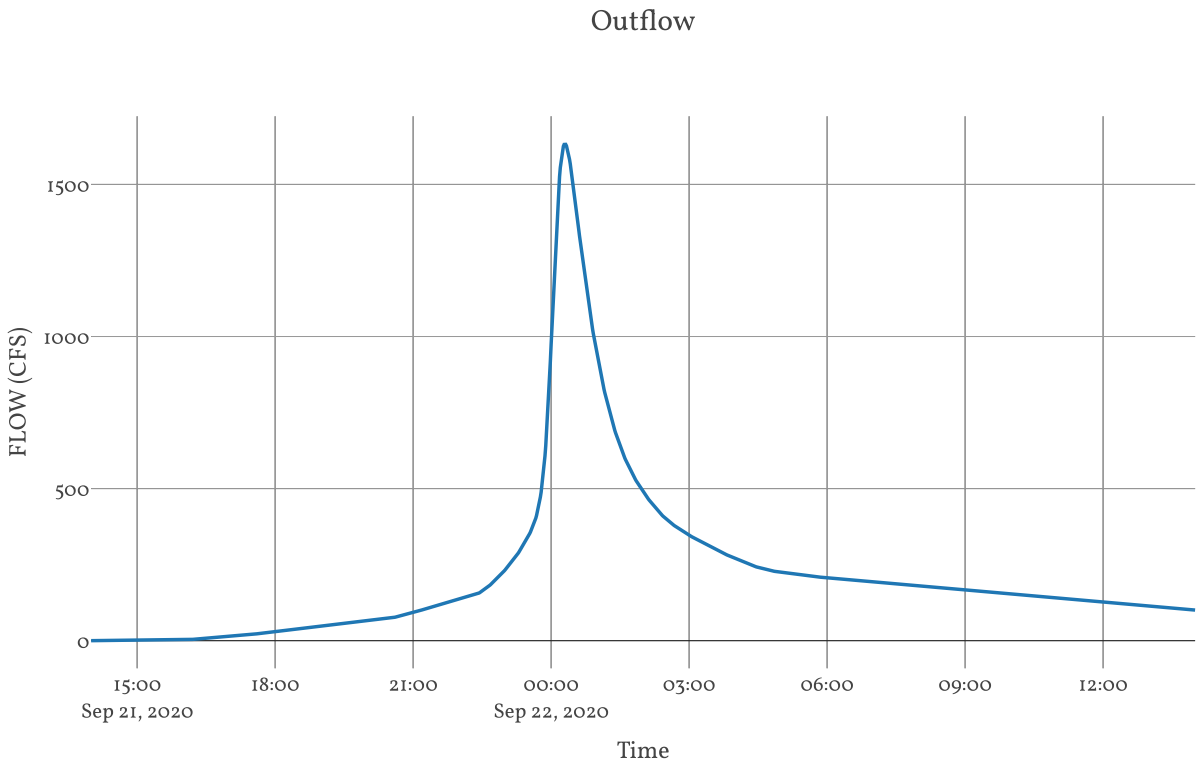

Precipitation and Outflow
FLOW (CFS) PRECIP-INC (IN)
0
0.02
0.04
0.06
0.08
800
600
0.1
400
200
0.12
0
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
Sep 21, 2020
Sep 22, 2020
Time
Precipitation
Excess Precipitation
Outflow

Junction: J 60B 61B

Downstream : 18r

Results: J 60B 61B

Peak Discharge (CFS)	1633.26
Time of Peak Discharge	22Sep2020, 00:18
Volume (IN)	6.54



Reach: 18R

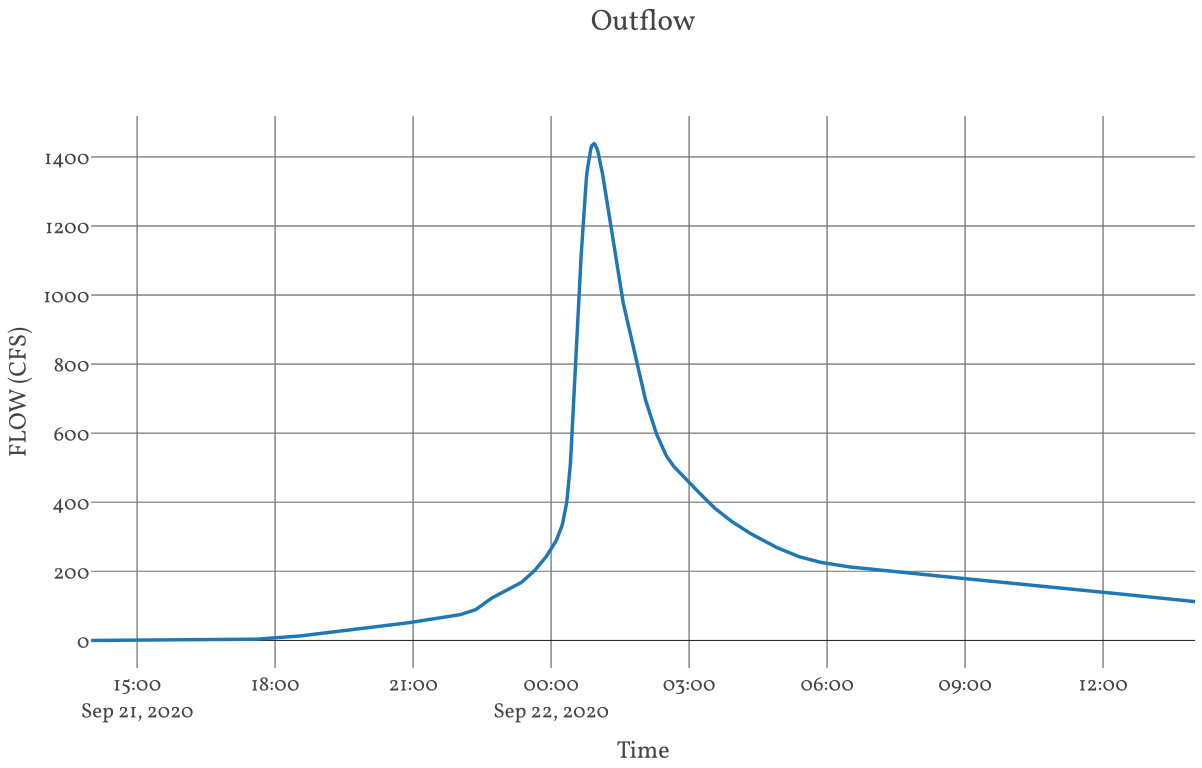
Downstream : 17c

Route: Modified Puls

Method	Modified Puls
Initial Variable	Combined Inflow
Number of Reaches	8
Storage Outflow Table Name	18r

Results: 18R

Peak Discharge (CFS)	1438.27
Time of Peak Discharge	22Sep2020, 00:56
Volume (IN)	6.33
Peak Inflow (CFS)	1633.26
Inflow Volume (AC - FT)	436.45



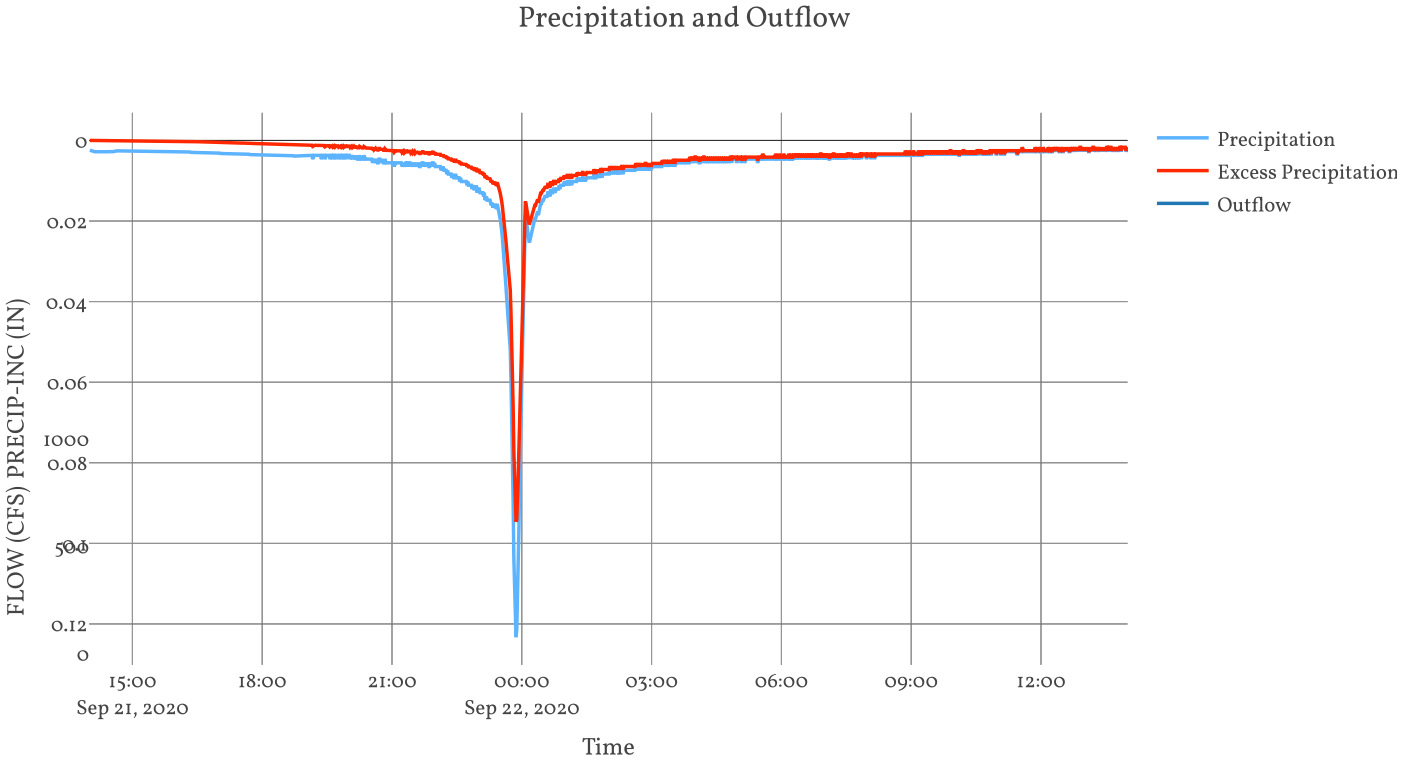
Subbasin: 62B

Area : 0.53
Downstream : 17c

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	73.9
Initial Abstraction	0.2

Transform: User - Specified S - Graph	
S - graph	Ellsworth S - Graph
Lag Method	Specified
Lag	0.25

Results: 62B	
Peak Discharge (CFS)	952.41
Time of Peak Discharge	22Sep2020, 00:08
Volume (IN)	6.48
Precipitation Volume (AC - FT)	259.86
Loss Volume (AC - FT)	76.86
Excess Volume (AC - FT)	182.99
Direct Runoff Volume (AC - FT)	181.63
Baseflow Volume (AC - FT)	0

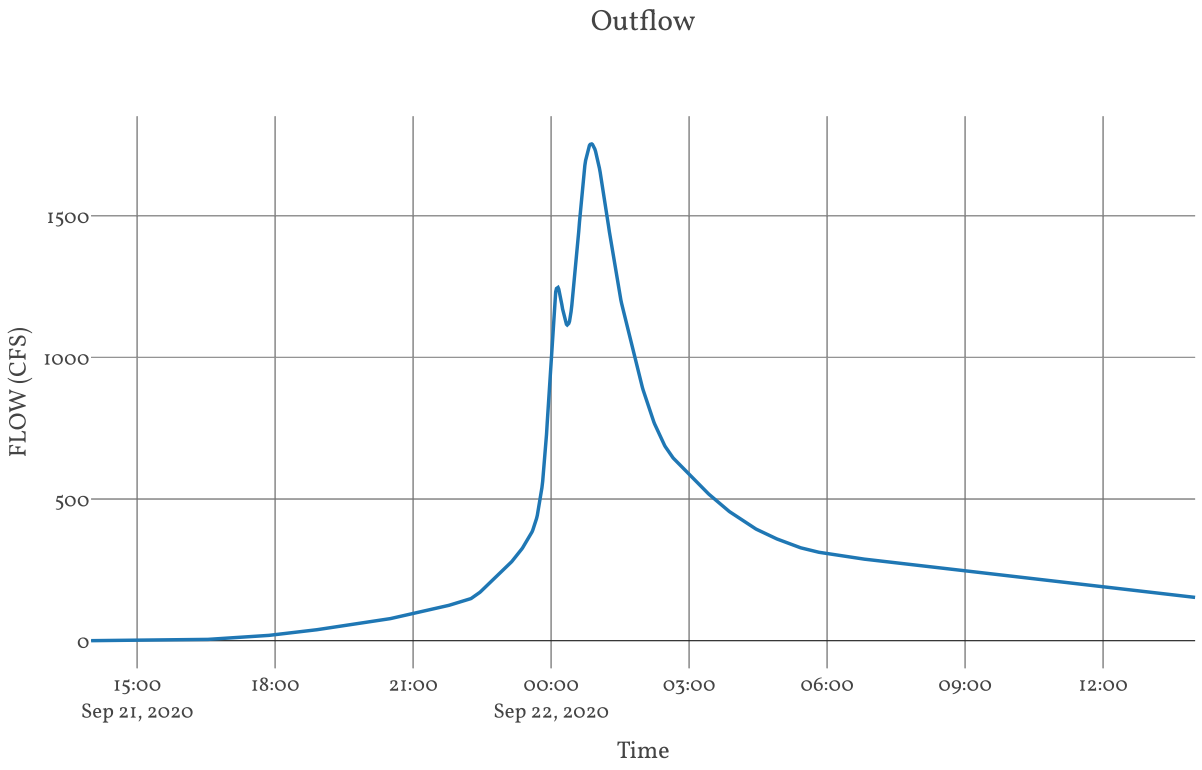

Precipitation and Outflow
FLOW (CFS) PRECIP-INC (IN)
0
0.02
0.04
0.06
1000
0.08
500
0.12
0
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
Sep 21, 2020
Sep 22, 2020
Time
Precipitation
Excess Precipitation
Outflow

Junction: 17C

Downstream : 17r

Results: 17C

Peak Discharge (CFS)	1753.66
Time of Peak Discharge	22Sep2020, 00:52
Volume (IN)	6.37



Reach: 17R

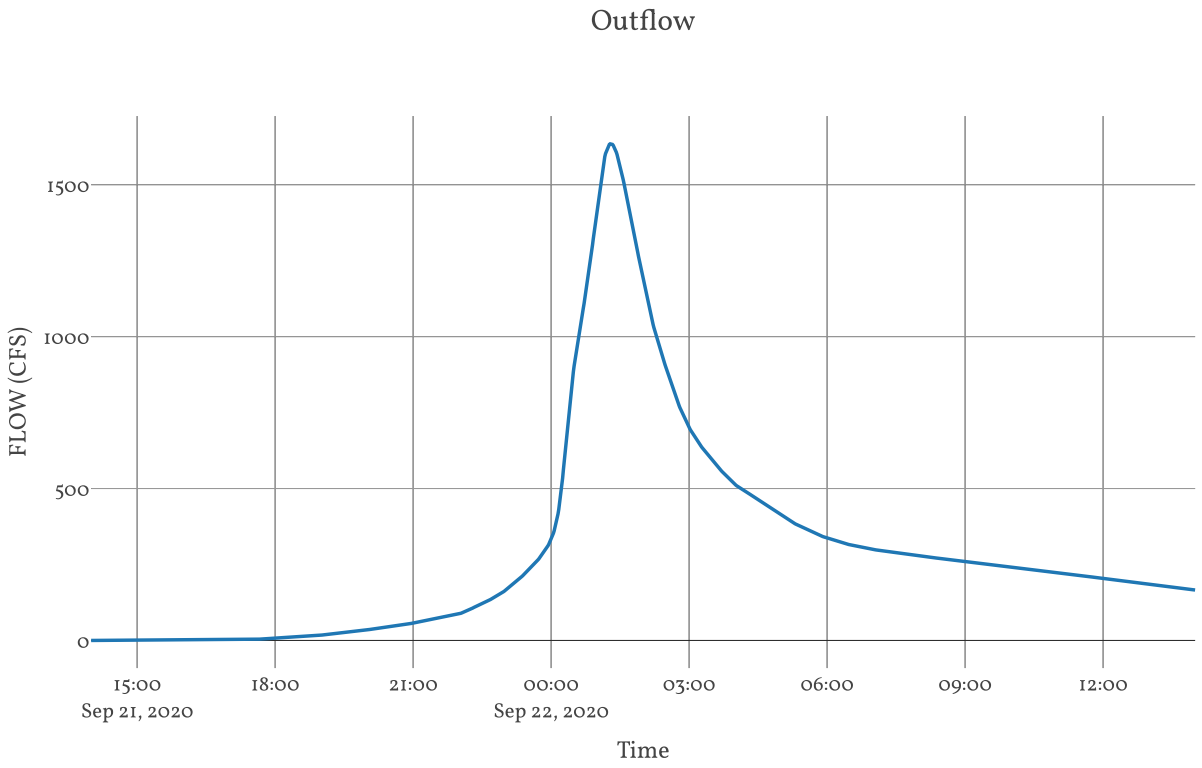
Downstream : 16c

Route: Modified Puls

Method	Modified Puls
Initial Variable	Combined Inflow
Number of Reaches	4
Storage Outflow Table Name	17r

Results: 17R

Peak Discharge (CFS)	1634.93
Time of Peak Discharge	22Sep2020, 01:18
Volume (IN)	6.22
Peak Inflow (CFS)	1753.66
Inflow Volume (AC - FT)	604.01



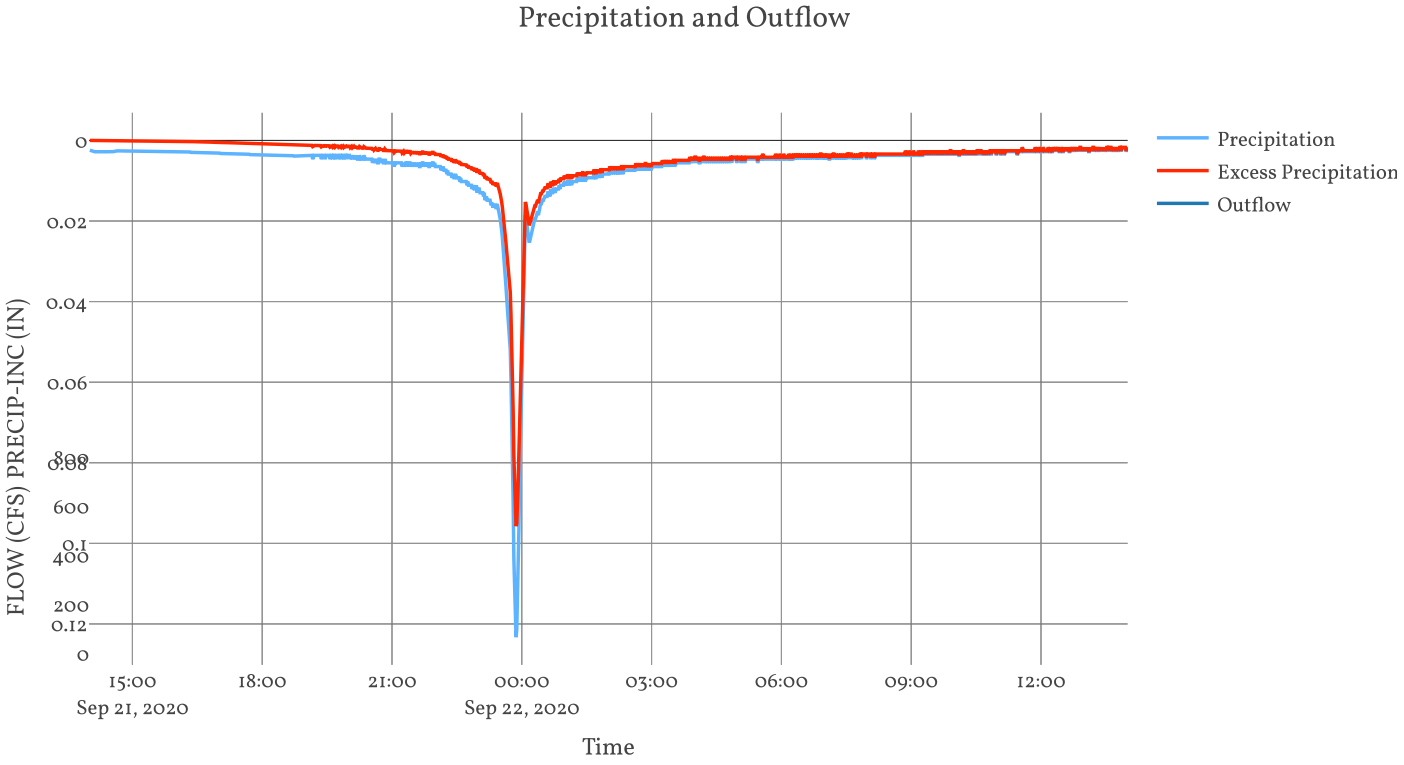
Subbasin: 63B

Area : 0.6
Downstream : 16c

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	74.6
Initial Abstraction	0.2

Transform: User - Specified S - Graph	
S - graph	Ellsworth S - Graph
Lag Method	Specified
Lag	0.41

Results: 63B	
Peak Discharge (CFS)	833.58
Time of Peak Discharge	22Sep2020, 00:17
Volume (IN)	6.51
Precipitation Volume (AC - FT)	297.63
Loss Volume (AC - FT)	85.9
Excess Volume (AC - FT)	211.73
Direct Runoff Volume (AC - FT)	209.08
Baseflow Volume (AC - FT)	0

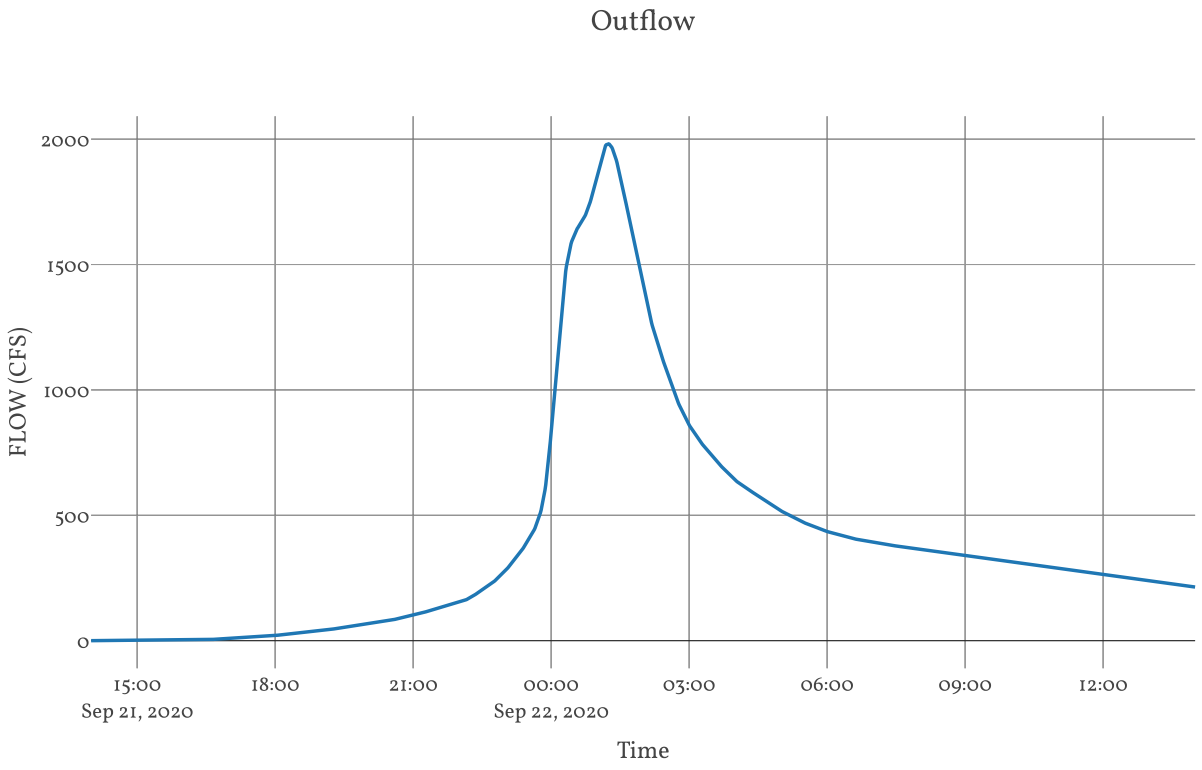

Precipitation and Outflow
FLOW (CFS) PRECIP-INC (IN)
0
0.02
0.04
0.06
0.08
0.1
0.12
800
600
400
200
0
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
Sep 21, 2020
Sep 22, 2020
Time
Precipitation
Excess Precipitation
Outflow

Junction: 16C

Downstream : 16r

Results: 16C

Peak Discharge (CFS)	1981.11
Time of Peak Discharge	22Sep2020, 01:14
Volume (IN)	6.3



Reach: 16R

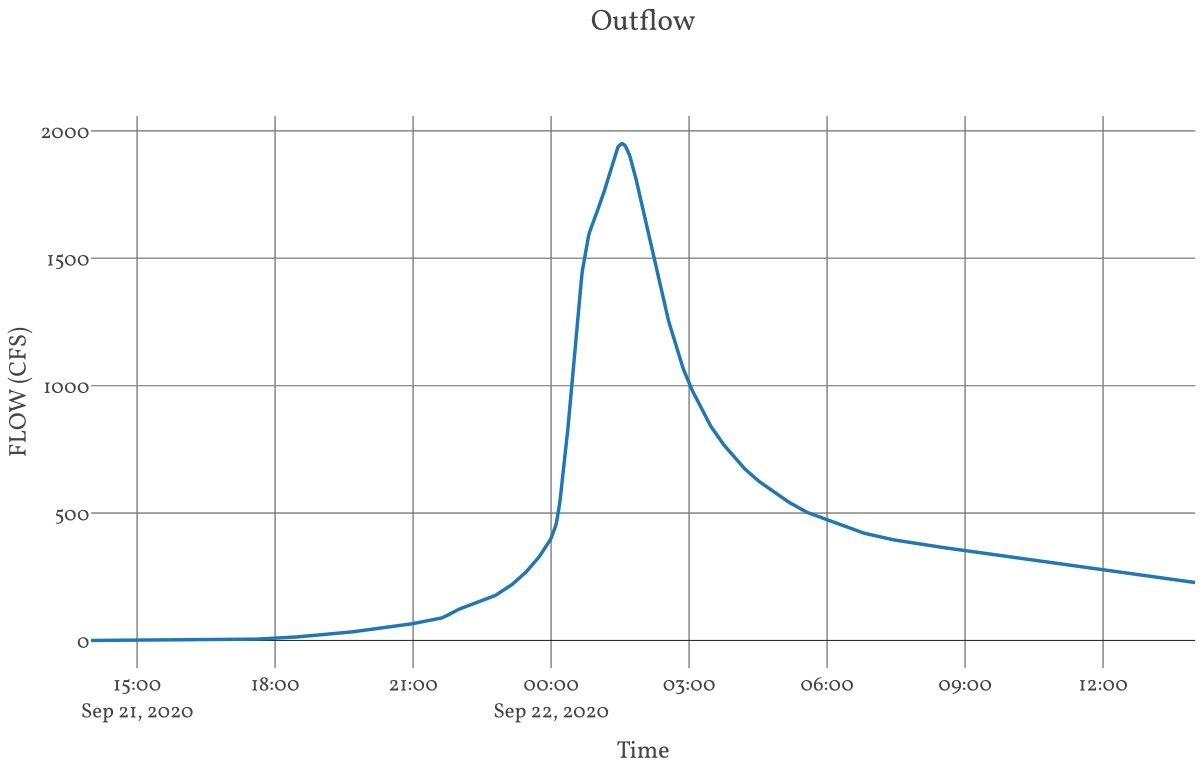
Downstream : 20C

Route: Modified Puls

Method	Modified Puls
Initial Variable	Combined Inflow
Number of Reaches	6
Storage Outflow Table Name	16r

Results: 16R

Peak Discharge (CFS)	1949.71
Time of Peak Discharge	22Sep2020, 01:33
Volume (IN)	6.19
Peak Inflow (CFS)	1981.11
Inflow Volume (AC - FT)	798.7



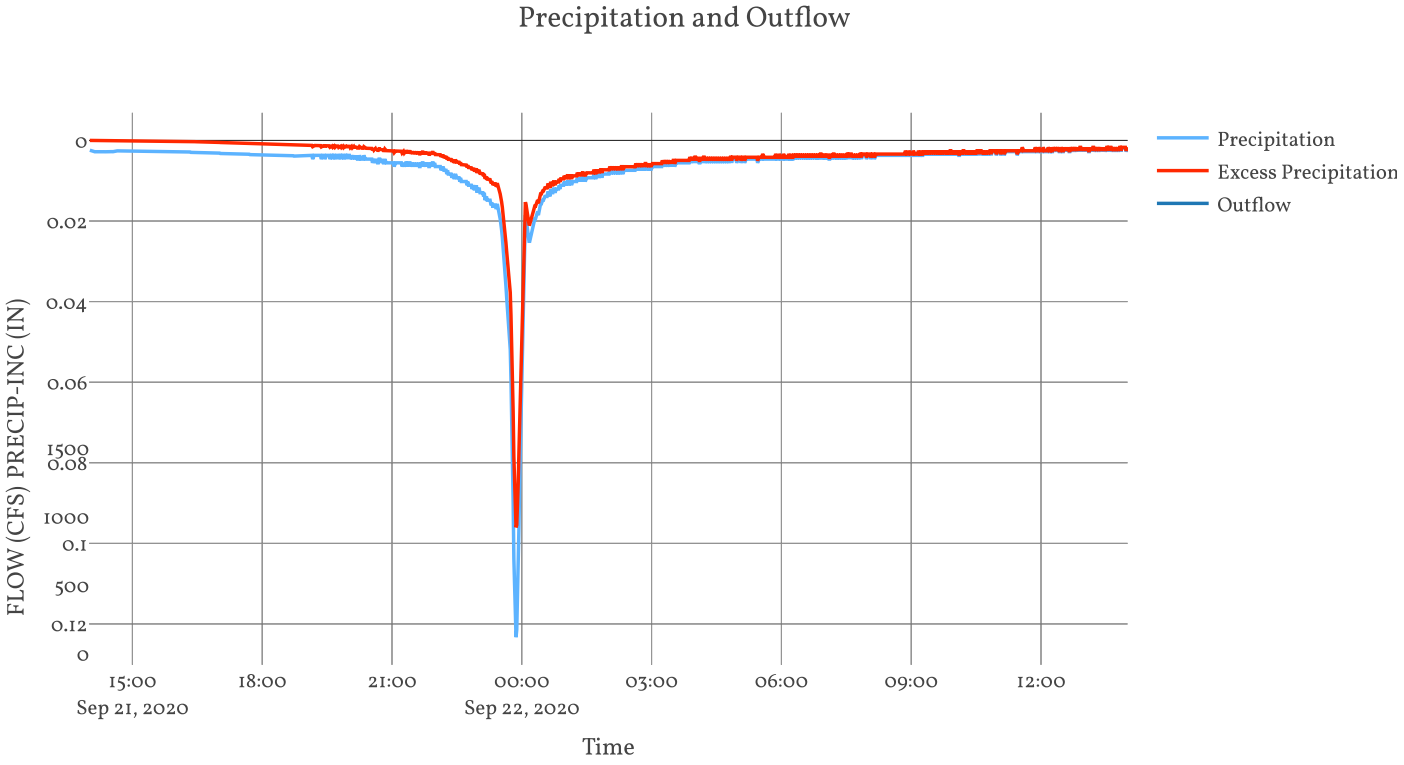
Subbasin: 64B

Area : 1.09
Downstream : 20c

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	74.8
Initial Abstraction	0.2

Transform: User - Specified S - Graph	
S - graph	Ellsworth S - Graph
Lag Method	Specified
Lag	0.42

Results: 64B	
Peak Discharge (CFS)	1492.76
Time of Peak Discharge	22Sep2020, 00:17
Volume (IN)	6.53
Precipitation Volume (AC - FT)	538.9
Loss Volume (AC - FT)	154.43
Excess Volume (AC - FT)	384.46
Direct Runoff Volume (AC - FT)	379.54
Baseflow Volume (AC - FT)	0

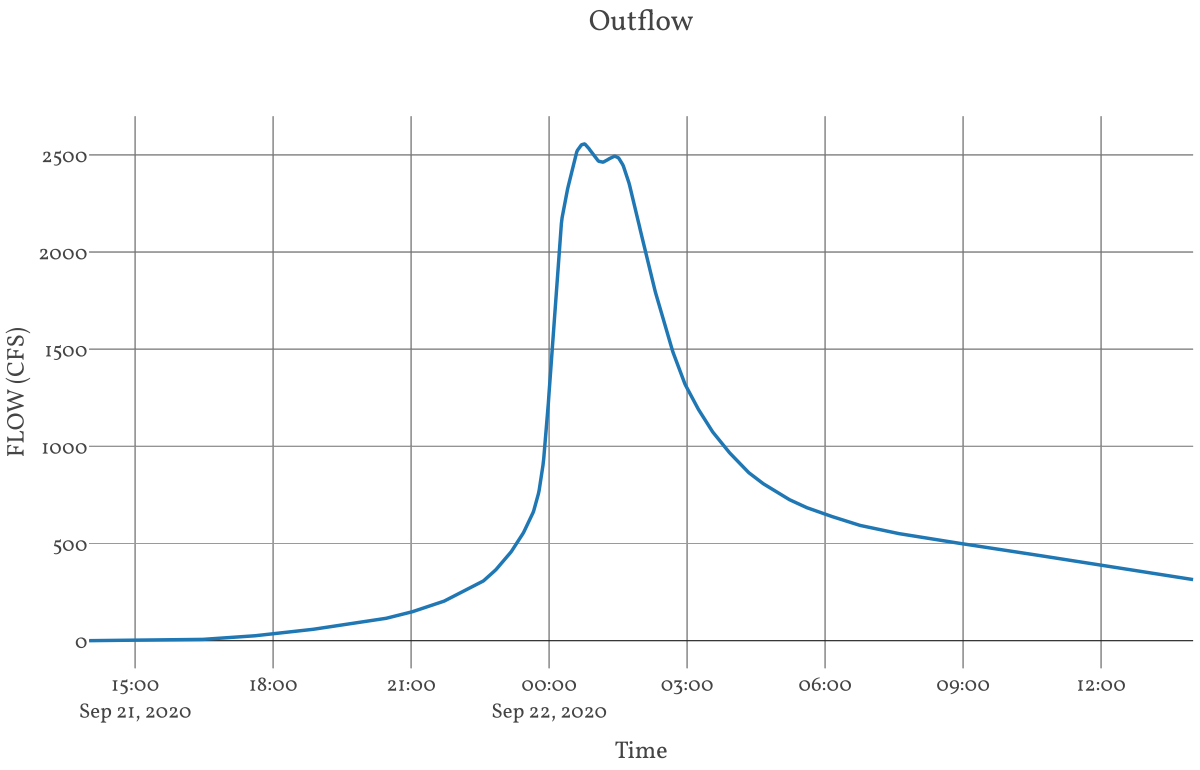

Precipitation and Outflow
FLOW (CFS) PRECIP-INC (IN)
0
0.02
0.04
0.06
1500
0.08
1000
0.1
500
0.12
0
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
Sep 21, 2020
Sep 22, 2020
Time
Precipitation
Excess Precipitation
Outflow

Junction: 20C

Downstream : 20r

Results: 20C

Peak Discharge (CFS)	2556.55
Time of Peak Discharge	22Sep2020, 00:45
Volume (IN)	6.3

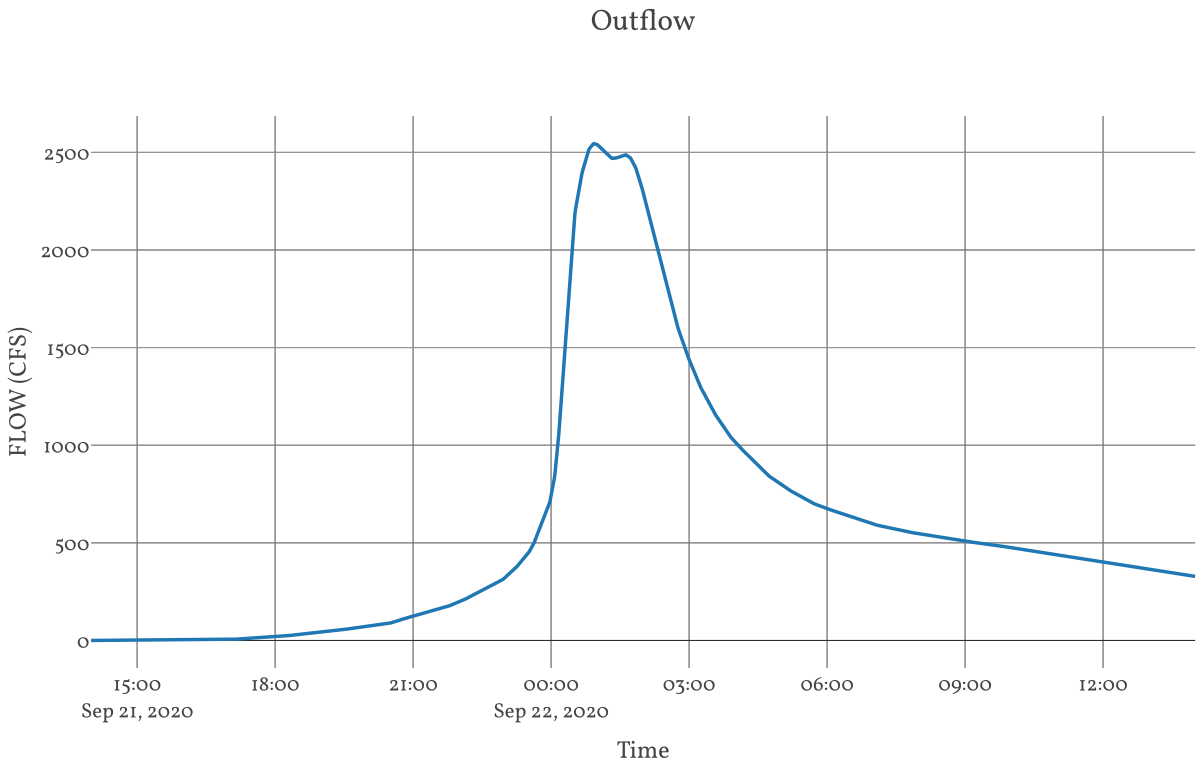


Reach: 20R

Downstream : 15C

Route: Modified Puls	
Method	Modified Puls
Initial Variable	Combined Inflow
Number of Reaches	6
Storage Outflow Table Name	20r

Results: 20R	
Peak Discharge (CFS)	2544.52
Time of Peak Discharge	22Sep2020, 00:57
Volume (IN)	6.23
Peak Inflow (CFS)	2556.55
Inflow Volume (AC - FT)	1164.63



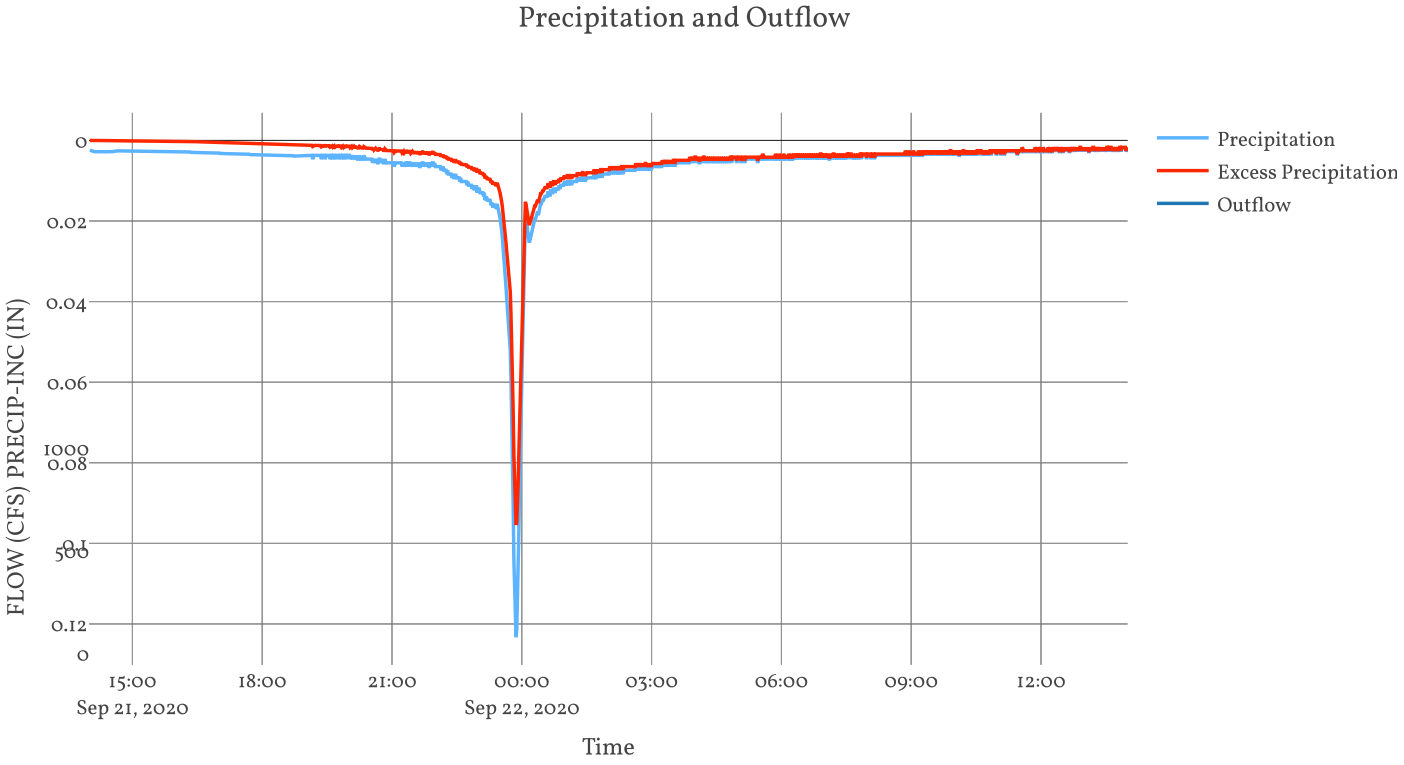
Subbasin: 65B

Area : 0.53
Downstream : 15c

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	74.4
Initial Abstraction	0.2

Transform: User - Specified S - Graph	
S - graph	Ellsworth S - Graph
Lag Method	Specified
Lag	0.24

Results: 65B	
Peak Discharge (CFS)	996.31
Time of Peak Discharge	22Sep2020, 00:07
Volume (IN)	6.53
Precipitation Volume (AC - FT)	263.52
Loss Volume (AC - FT)	76.6
Excess Volume (AC - FT)	186.92
Direct Runoff Volume (AC - FT)	185.59
Baseflow Volume (AC - FT)	0

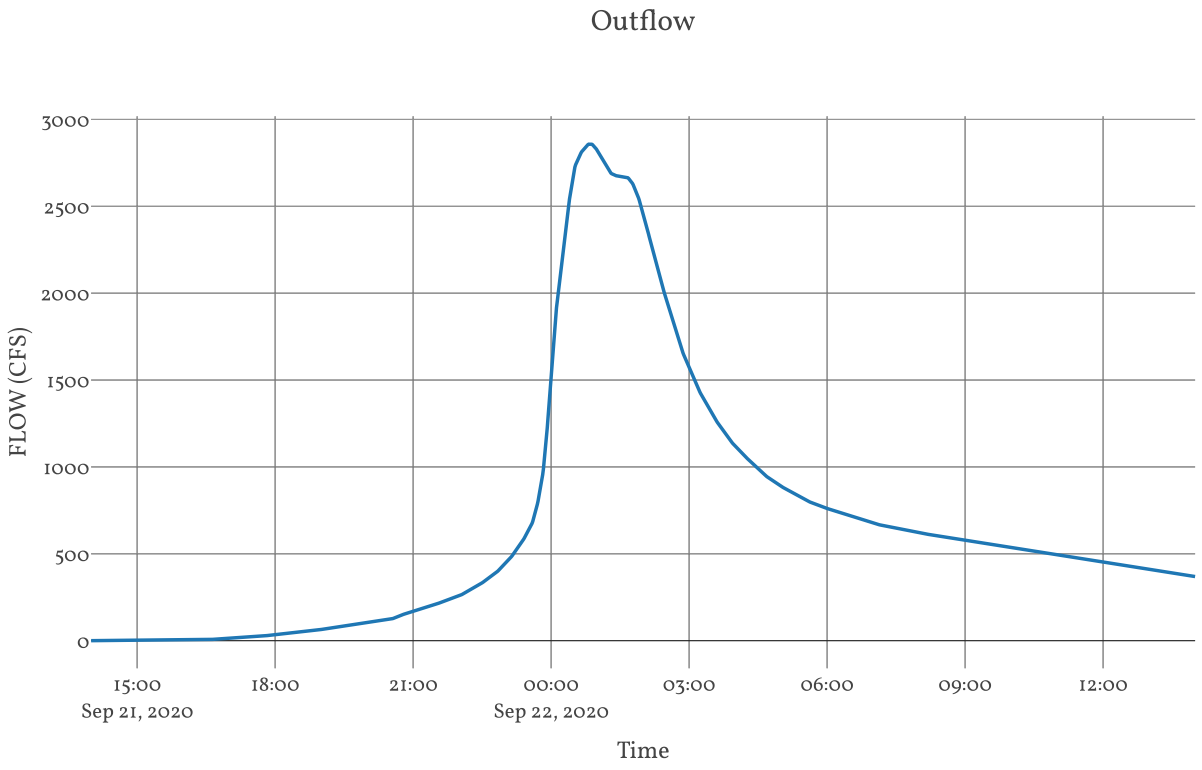

Precipitation and Outflow
FLOW (CFS) PRECIP-INC (IN)
0
0.02
0.04
0.06
1000
0.08
500
0.1
0.12
0
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
Sep 21, 2020
Sep 22, 2020
Time
Precipitation
Excess Precipitation
Outflow

Junction: 15C

Downstream : 15r

Results: 15C

Peak Discharge (CFS)	2859.17
Time of Peak Discharge	22Sep2020, 00:51
Volume (IN)	6.27



Reach: 15R

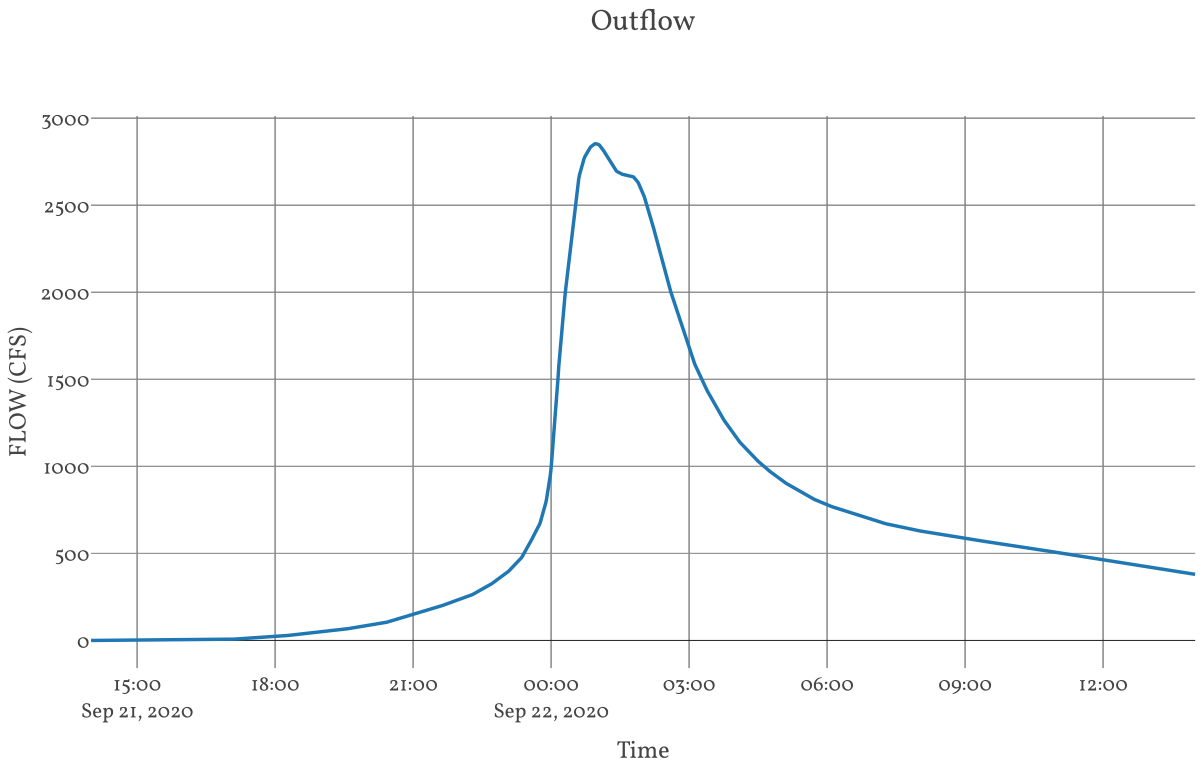
Downstream : 14c

Route: Modified Puls

Method	Modified Puls
Initial Variable	Combined Inflow
Number of Reaches	5
Storage Outflow Table Name	15r

Results: 15R

Peak Discharge (CFS)	2853.59
Time of Peak Discharge	22Sep2020, 00:59
Volume (IN)	6.22
Peak Inflow (CFS)	2859.17
Inflow Volume (AC - FT)	1337.53



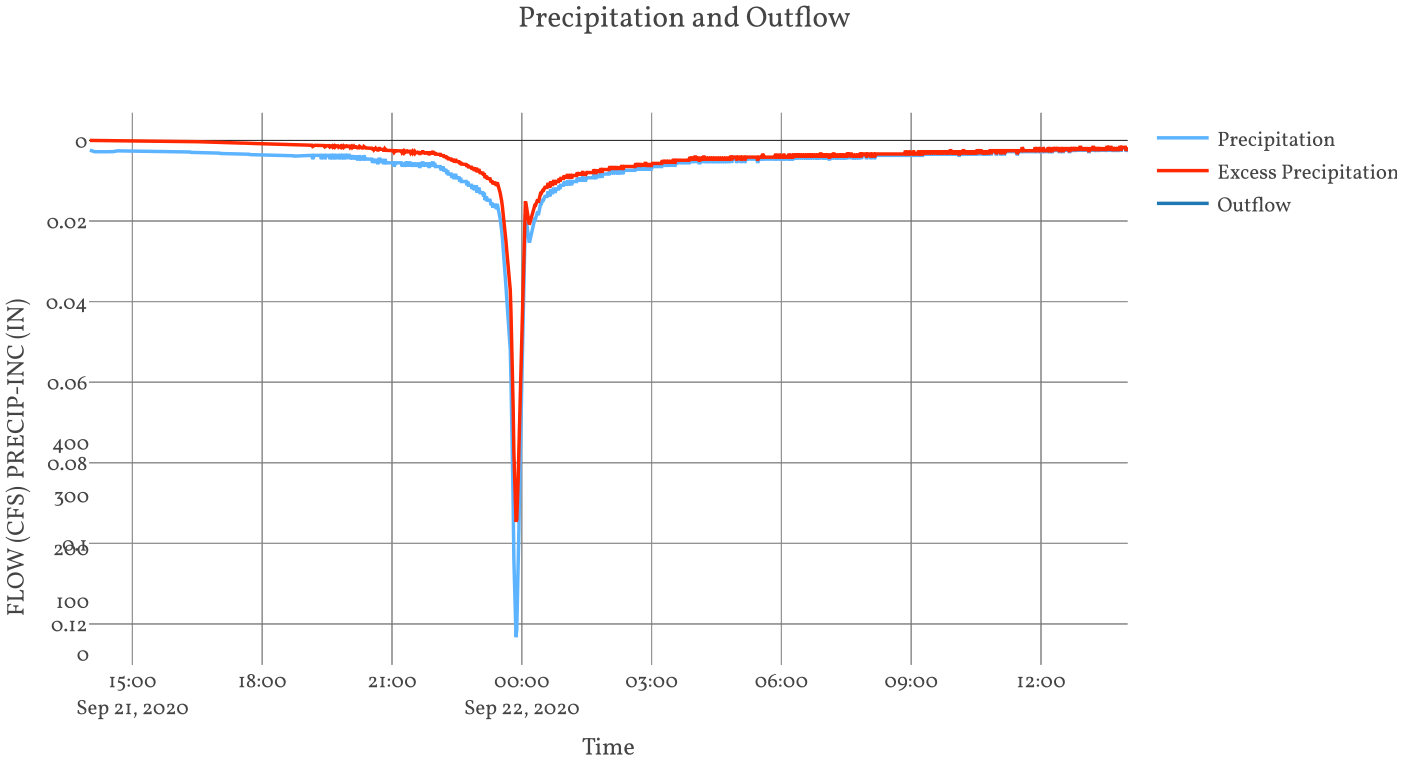
Subbasin: 66B

Area : 0.16
Downstream : 14c

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	73.9
Initial Abstraction	0.2

Transform: User - Specified S - Graph	
S - graph	Ellsworth S - Graph
Lag Method	Specified
Lag	0.14

Results: 66B	
Peak Discharge (CFS)	387.56
Time of Peak Discharge	22Sep2020, 00:02
Volume (IN)	6.5
Precipitation Volume (AC - FT)	80.09
Loss Volume (AC - FT)	23.69
Excess Volume (AC - FT)	56.4
Direct Runoff Volume (AC - FT)	56.17
Baseflow Volume (AC - FT)	0

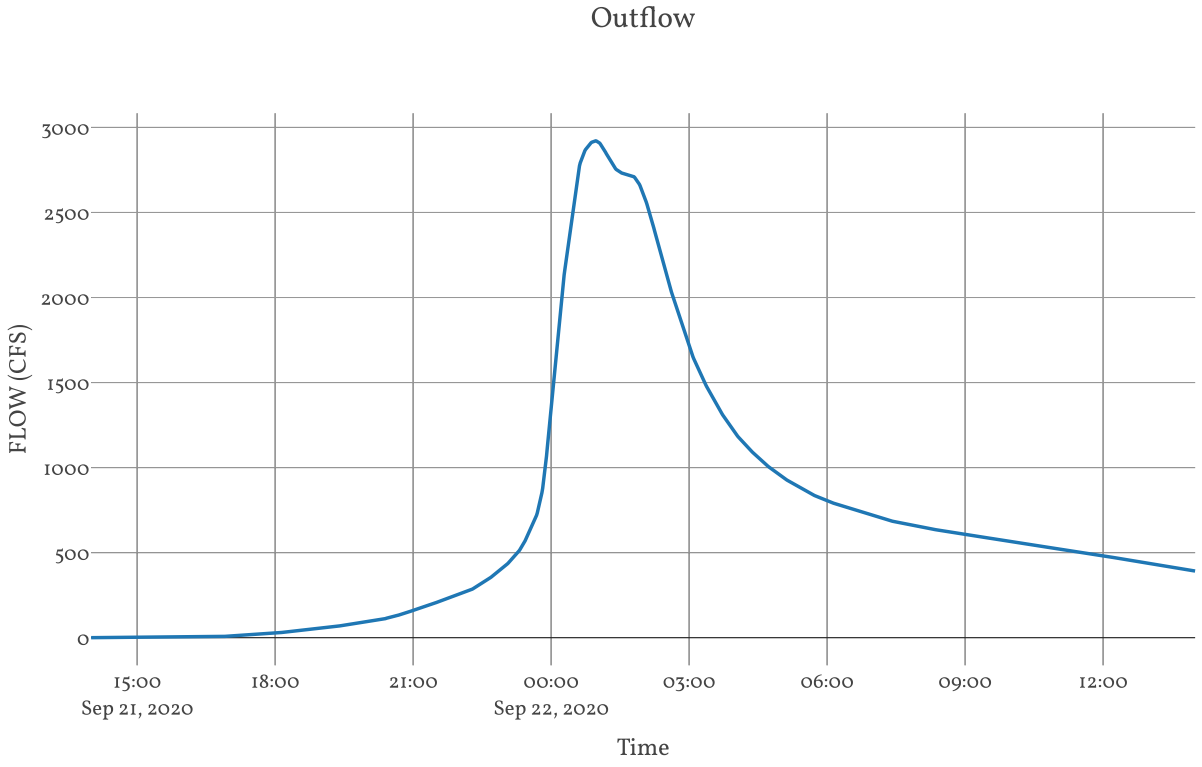

Precipitation and Outflow
FLOW (CFS) PRECIP-INC (IN)
0
0.02
0.04
0.06
400
0.08
300
200
100
0.12
0
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
Sep 21, 2020
Sep 22, 2020
Time
Precipitation
Excess Precipitation
Outflow

Junction: 14C

Downstream : 14r

Results: 14C

Peak Discharge (CFS)	2920.92
Time of Peak Discharge	22Sep2020, 00:58
Volume (IN)	6.23



Reach: 14R

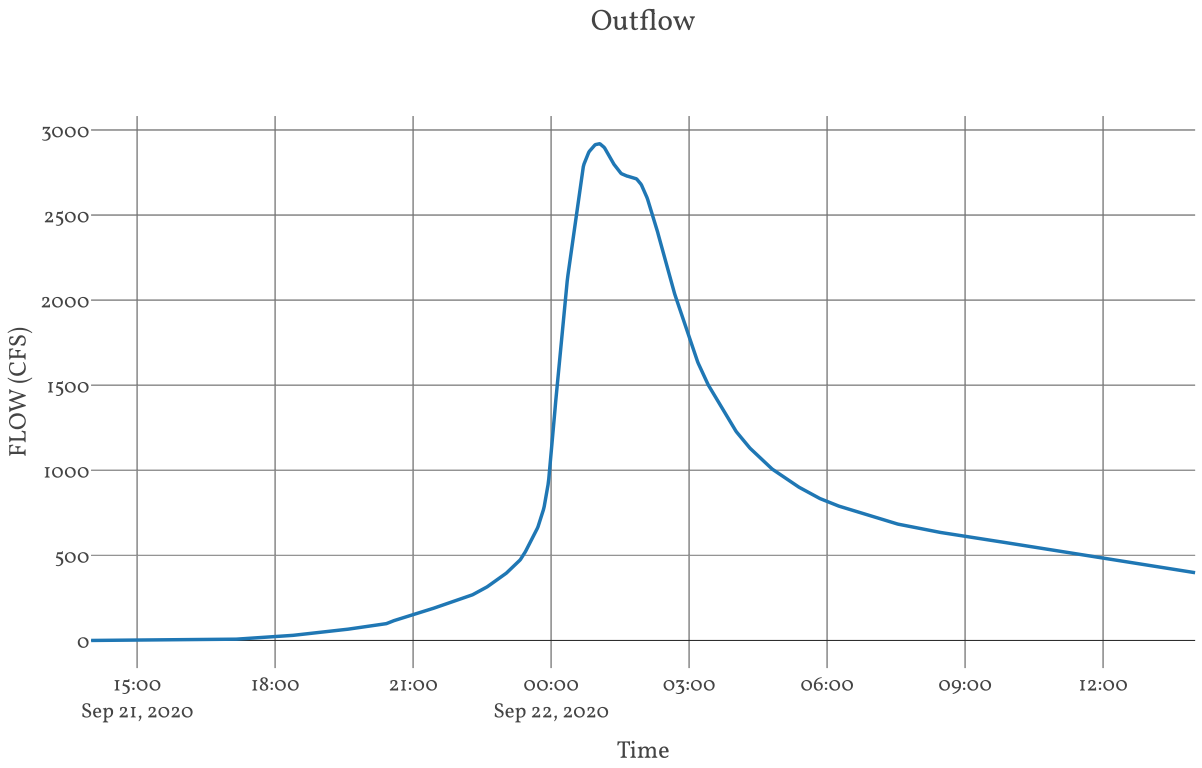
Downstream : 13c

Route: Modified Puls

Method	Modified Puls
Initial Variable	Combined Inflow
Number of Reaches	5
Storage Outflow Table Name	14r

Results: 14R

Peak Discharge (CFS)	2919.54
Time of Peak Discharge	22Sep2020, 01:02
Volume (IN)	6.21
Peak Inflow (CFS)	2920.92
Inflow Volume (AC - FT)	1383.9



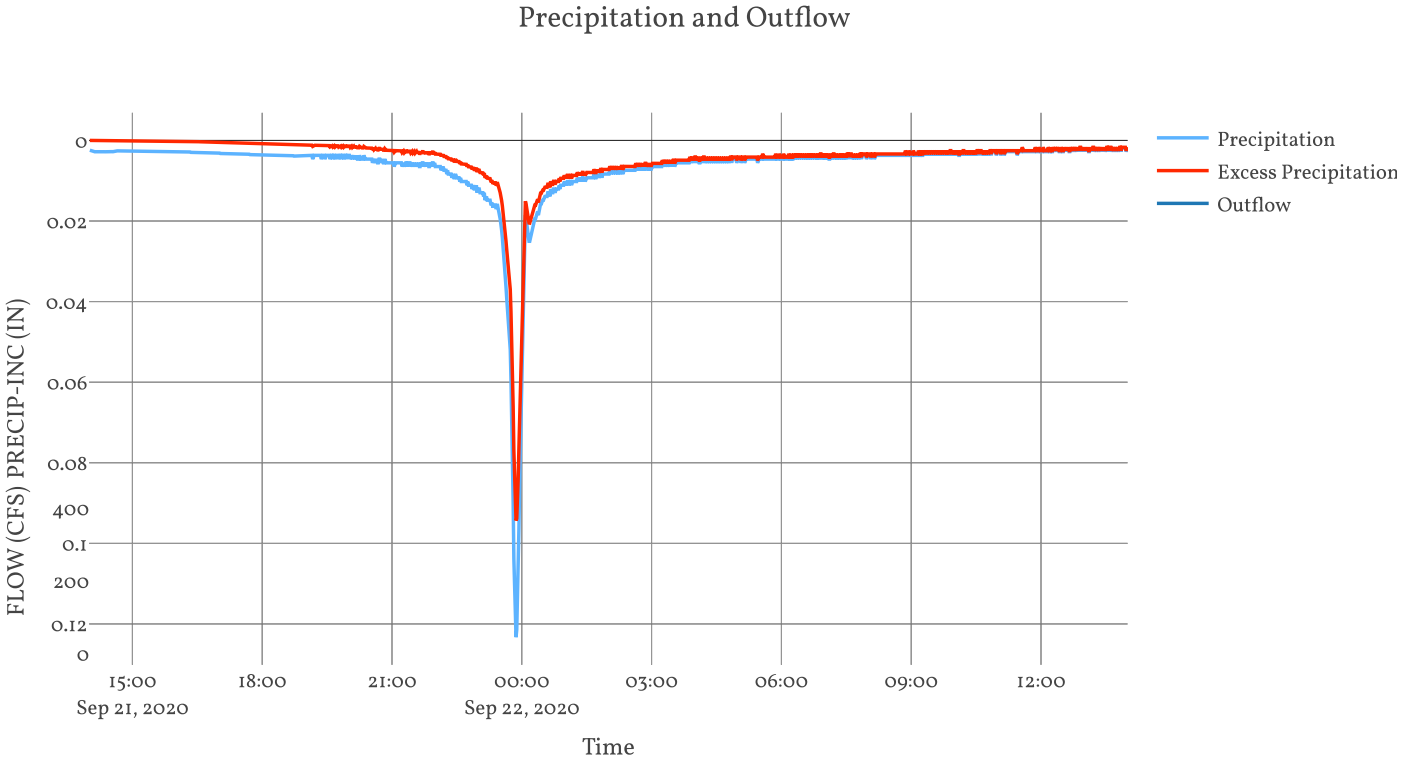
Subbasin: 67B

Area : 0.43
Downstream : 13c

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	73.7
Initial Abstraction	0.2

Transform: User - Specified S - Graph	
S - graph	Ellsworth S - Graph
Lag Method	Specified
Lag	0.44

Results: 67B	
Peak Discharge (CFS)	562.44
Time of Peak Discharge	22Sep2020, 00:19
Volume (IN)	6.42
Precipitation Volume (AC - FT)	212.59
Loss Volume (AC - FT)	63.32
Excess Volume (AC - FT)	149.27
Direct Runoff Volume (AC - FT)	147.24
Baseflow Volume (AC - FT)	0

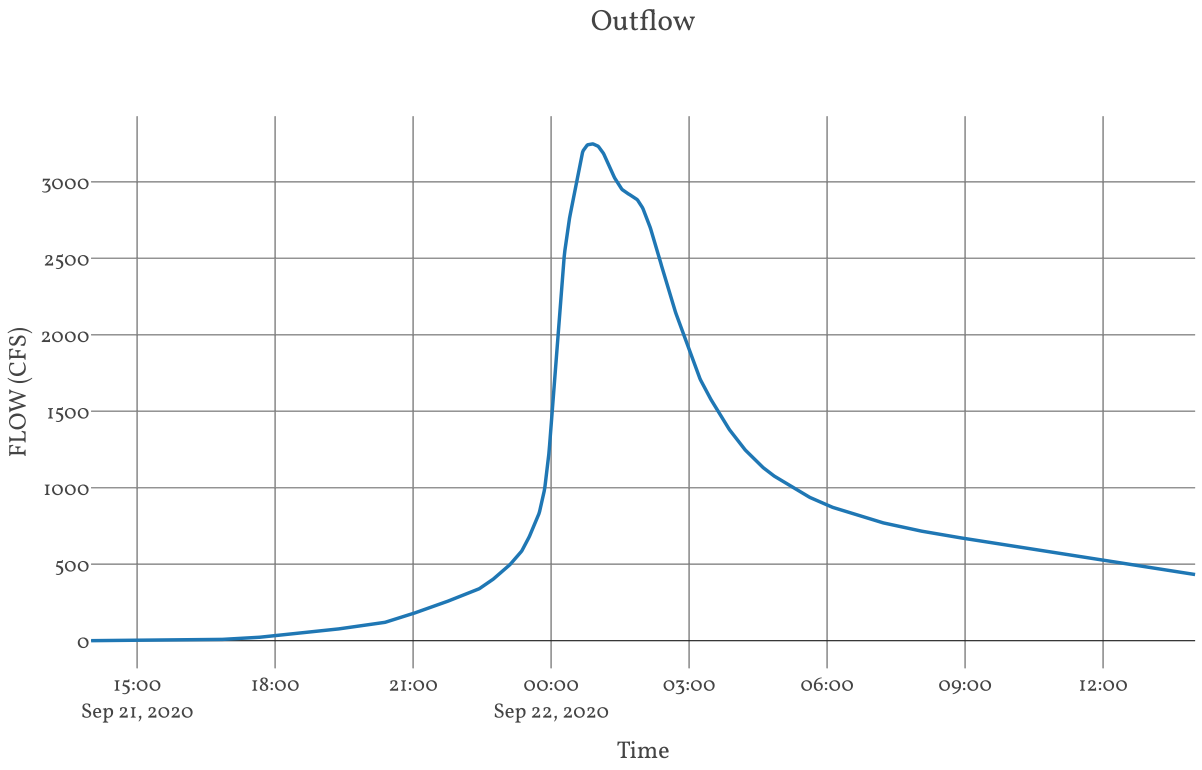

Precipitation and Outflow
FLOW (CFS) PRECIP-INC (IN)
0
0.02
0.04
0.06
0.08
400
0.1
200
0.12
0
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
Sep 21, 2020
Sep 22, 2020
Time
Precipitation
Excess Precipitation
Outflow

Junction: 13C

Downstream : 13r

Results: 13C

Peak Discharge (CFS)	3247.98
Time of Peak Discharge	22Sep2020, 00:53
Volume (IN)	6.23

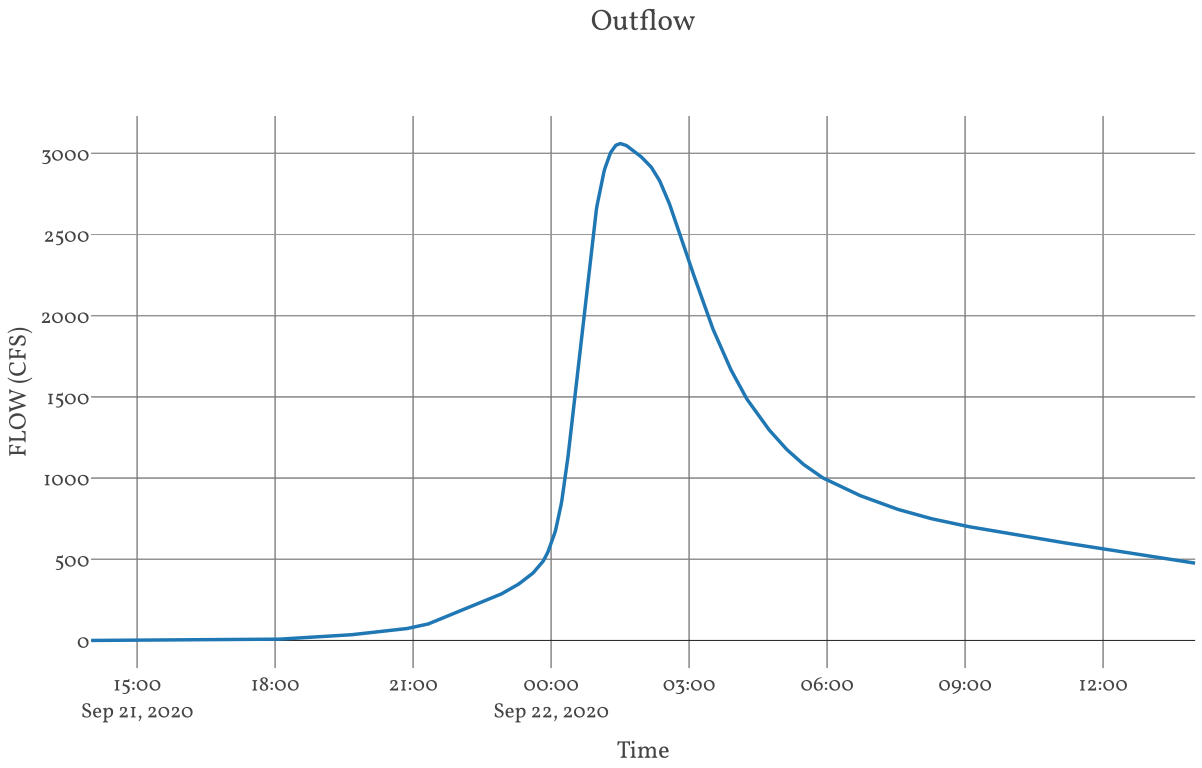


Reach: 13R

Downstream : 12C

Route: Modified Puls	
Method	Modified Puls
Initial Variable	Combined Inflow
Number of Reaches	2
Storage Outflow Table Name	13r

Results: 13R	
Peak Discharge (CFS)	3059.42
Time of Peak Discharge	22Sep2020, 01:31
Volume (IN)	6.05
Peak Inflow (CFS)	3247.98
Inflow Volume (AC - FT)	1525.57



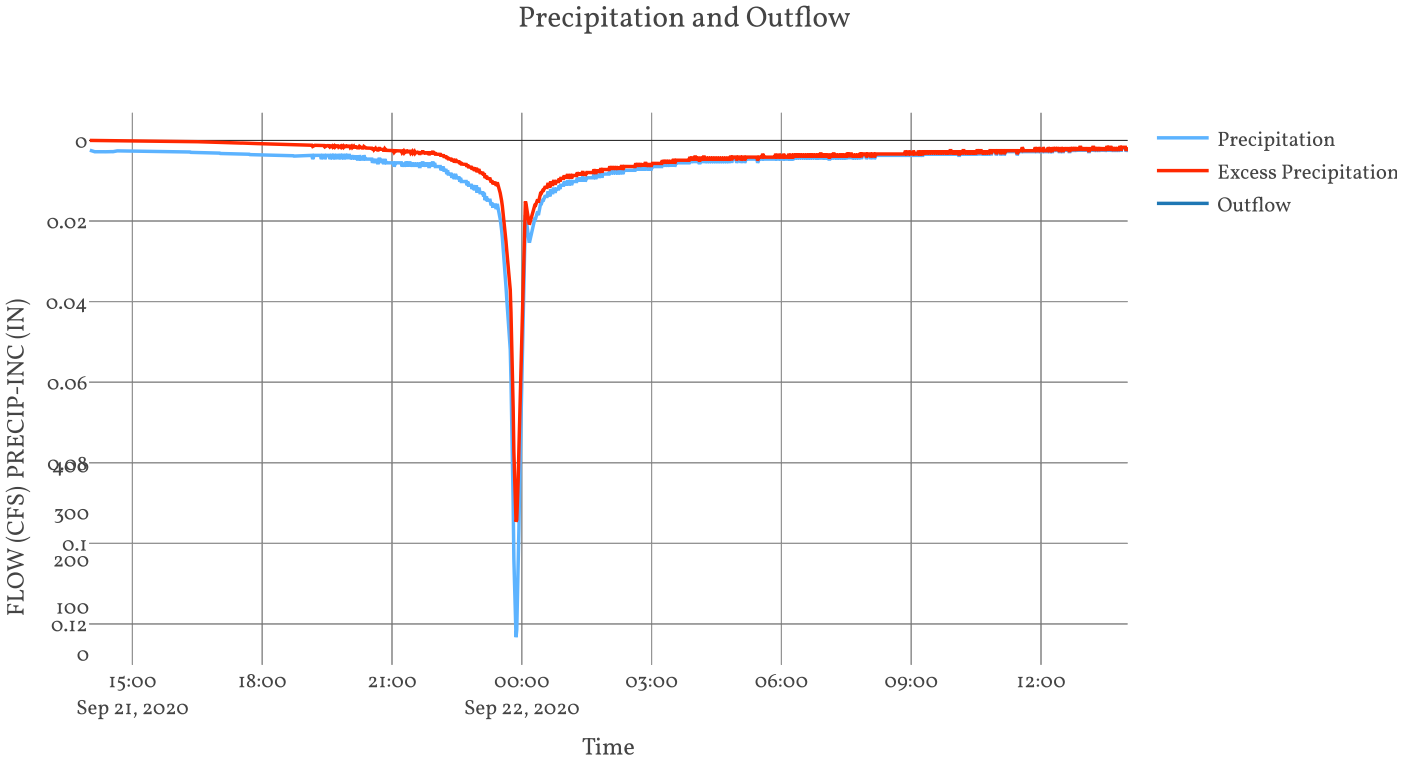
Subbasin: 68B

Area : 0.26
Downstream : 12c

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	73.9
Initial Abstraction	0.2

Transform: User - Specified S - Graph	
S - graph	Ellsworth S - Graph
Lag Method	Specified
Lag	0.28

Results: 68B	
Peak Discharge (CFS)	434.38
Time of Peak Discharge	22Sep2020, 00:09
Volume (IN)	6.47
Precipitation Volume (AC - FT)	126.07
Loss Volume (AC - FT)	37.29
Excess Volume (AC - FT)	88.78
Direct Runoff Volume (AC - FT)	88.04
Baseflow Volume (AC - FT)	0

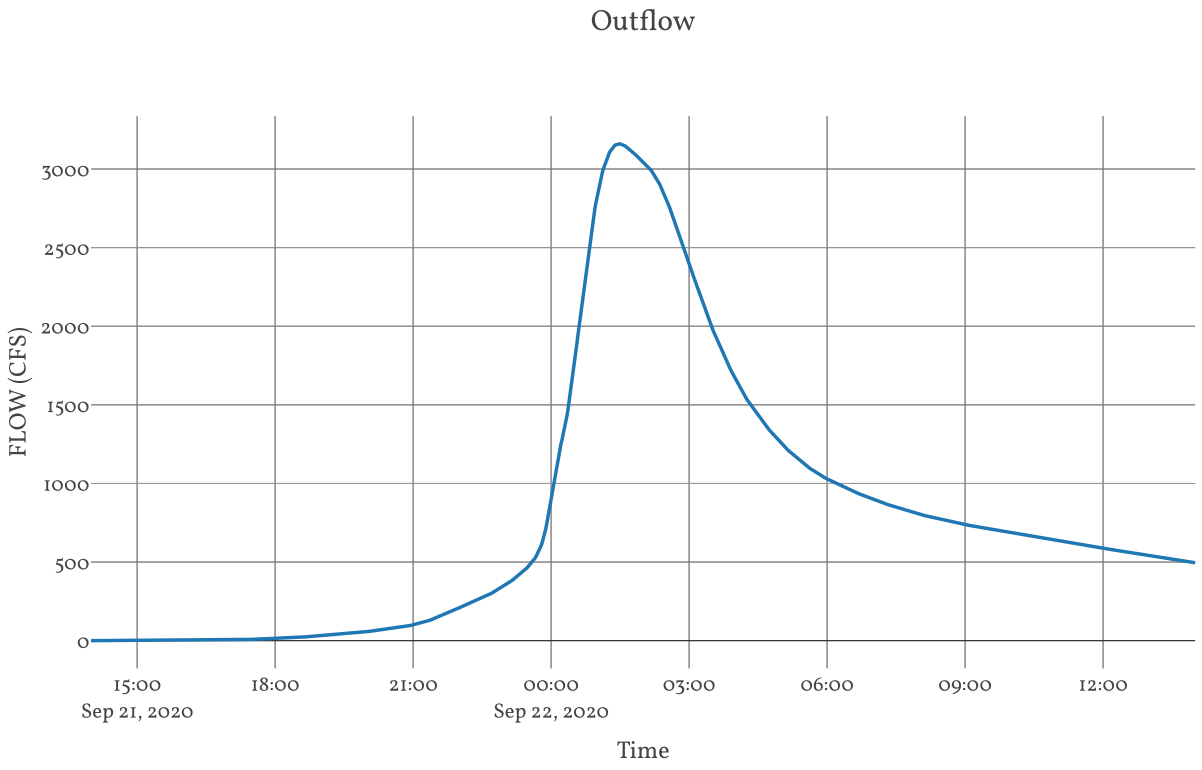

Precipitation and Outflow
FLOW (CFS) PRECIP-INC (IN)
0
0.02
0.04
0.06
0.08
0.1
0.12
400
300
200
100
0
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
Sep 21, 2020
Sep 22, 2020
Time
Precipitation
Excess Precipitation
Outflow

Junction: 12C

Downstream : Pacific Ocean

Results: 12C

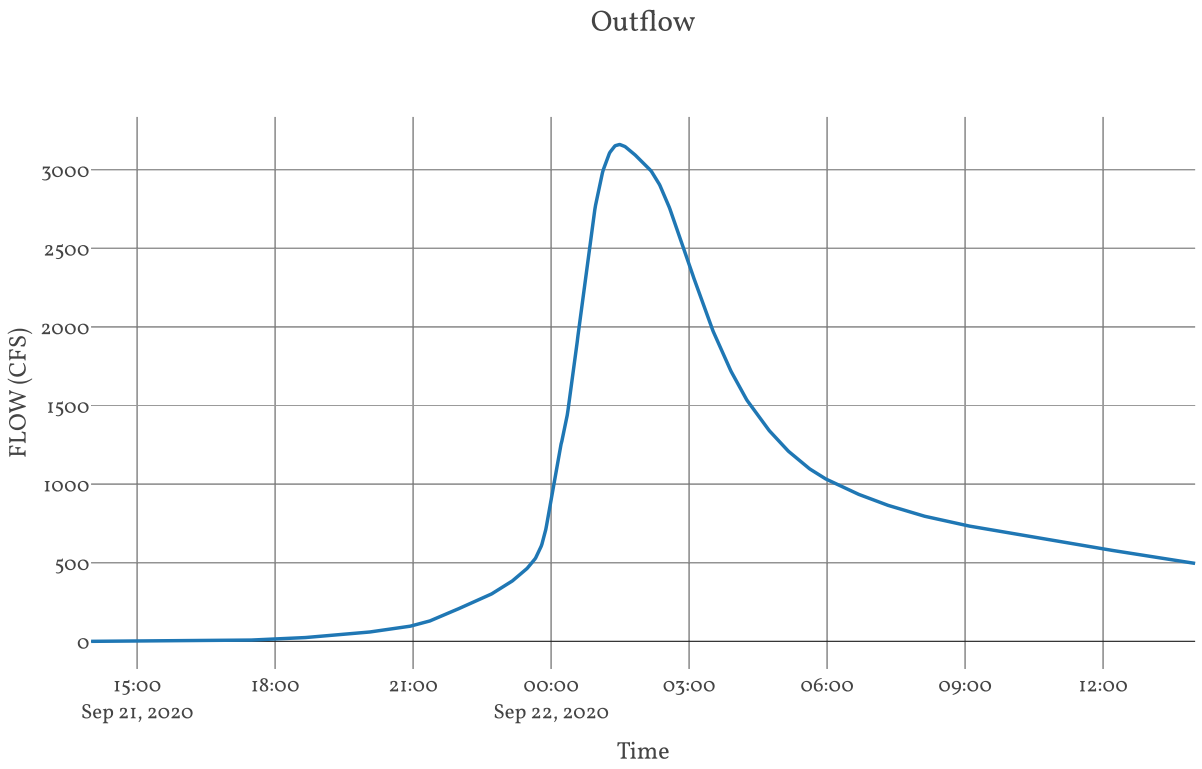
Peak Discharge (CFS)	3159.83
Time of Peak Discharge	22Sep2020, 01:29
Volume (IN)	6.07



Sink: Pacific Ocean

Results: Pacific Ocean

Peak Discharge (CFS)	3159.83
Time of Peak Discharge	22Sep2020, 01:29
Volume (IN)	6.07
Observed Flow Gage	Not specified
Observed Flow Volume (AC - FT)	Not specified
Observed Flow's RMSE Stdev	Not specified
Observed Flow's Percent Bias	Not specified
Observed Flow's Nash Sutcliffe	Not specified



Project: Little_Sycamore_May2021
Simulation Run: 002-yr Post-Dev
Simulation Start: 21 September 2020, 14:00
Simulation End: 22 September 2020, 14:00

HMS Version: 4.6.1
Executed: 29 April 2021, 23:40

Global Parameter Summary - Subbasin

Area

Element Name	Area
60b	0.65
61b	0.61
62b	0.53
63b	0.6
64b	1.09
65b	0.53
66b	0.16
67b	0.43
68b	0.26

Downstream

Element Name	Downstream
60b	J 60b 61b
61b	J 60b 61b
62b	17c
63b	16c
64b	20c
65b	15c
66b	14c
67b	13c
68b	12c

Loss Rate: Scs

Element Name	Percent Impervious Area	Curve Number	Initial Abstraction
60b	0	75	0.2
61b	0	75	0.2
62b	0	73.9	0.2
63b	0	74.6	0.2
64b	0	74.8	0.2
65b	0	74.4	0.2
66b	0	73.9	0.2
67b	0	73.7	0.2
68b	0	73.9	0.2

Transform: User - Specified S - Graph

Element Name	S - graph	Lag Method	Lag
60b	Ellsworth S - Graph	Specified	0.52
61b	Ellsworth S - Graph	Specified	0.37
62b	Ellsworth S - Graph	Specified	0.25
63b	Ellsworth S - Graph	Specified	0.41
64b	Ellsworth S - Graph	Specified	0.42
65b	Ellsworth S - Graph	Specified	0.24
66b	Ellsworth S - Graph	Specified	0.14
67b	Ellsworth S - Graph	Specified	0.44
68b	Ellsworth S - Graph	Specified	0.28

Global Parameter Summary - Reach

Downstream

Element Name	Downstream
18r	17c
17r	16c
16r	20c
20r	15c
15r	14c
14r	13c
13r	12c

Route: Modified Puls

Element Name	Method	Initial Variable	Number of Reaches	Storage Outflow Table Name
18r	Modified Puls	Combined Inflow	8	18r
17r	Modified Puls	Combined Inflow	4	17r
16r	Modified Puls	Combined Inflow	6	16r
20r	Modified Puls	Combined Inflow	6	20r
15r	Modified Puls	Combined Inflow	5	15r
14r	Modified Puls	Combined Inflow	5	14r
13r	Modified Puls	Combined Inflow	2	13r

Global Results Summary

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
60b	0.65	188.07	22Sep2020, 00:25	1.68
61b	0.61	216.56	22Sep2020, 00:15	1.69
J 60b 61b	1.25	393.35	22Sep2020, 00:19	1.69
18r	1.25	314.24	22Sep2020, 01:20	1.62
62b	0.53	227.32	22Sep2020, 00:08	1.65
17c	1.78	373.3	22Sep2020, 01:17	1.63
17r	1.78	333.71	22Sep2020, 02:01	1.56
63b	0.6	199.83	22Sep2020, 00:18	1.67
16c	2.38	395.47	22Sep2020, 01:58	1.59
16r	2.38	386.19	22Sep2020, 02:30	1.54
64b	1.09	358.99	22Sep2020, 00:18	1.68
20c	3.47	483.09	22Sep2020, 02:25	1.58
20r	3.47	479.54	22Sep2020, 02:46	1.55
65b	0.53	239.37	22Sep2020, 00:07	1.68
15c	4	519.57	22Sep2020, 01:08	1.57
15r	4	518.2	22Sep2020, 01:19	1.55
66b	0.16	93.22	22Sep2020, 00:02	1.66
14c	4.16	533.79	22Sep2020, 01:19	1.55
14r	4.16	533.43	22Sep2020, 01:25	1.54
67b	0.43	132.97	22Sep2020, 00:20	1.63
13c	4.59	595.2	22Sep2020, 01:16	1.55
13r	4.59	552.12	22Sep2020, 03:24	1.47
68b	0.26	103.68	22Sep2020, 00:10	1.65

12c	4.85	568.99	22Sep2020, 03:22	1.48
Pacific Ocean	4.85	568.99	22Sep2020, 03:22	1.48

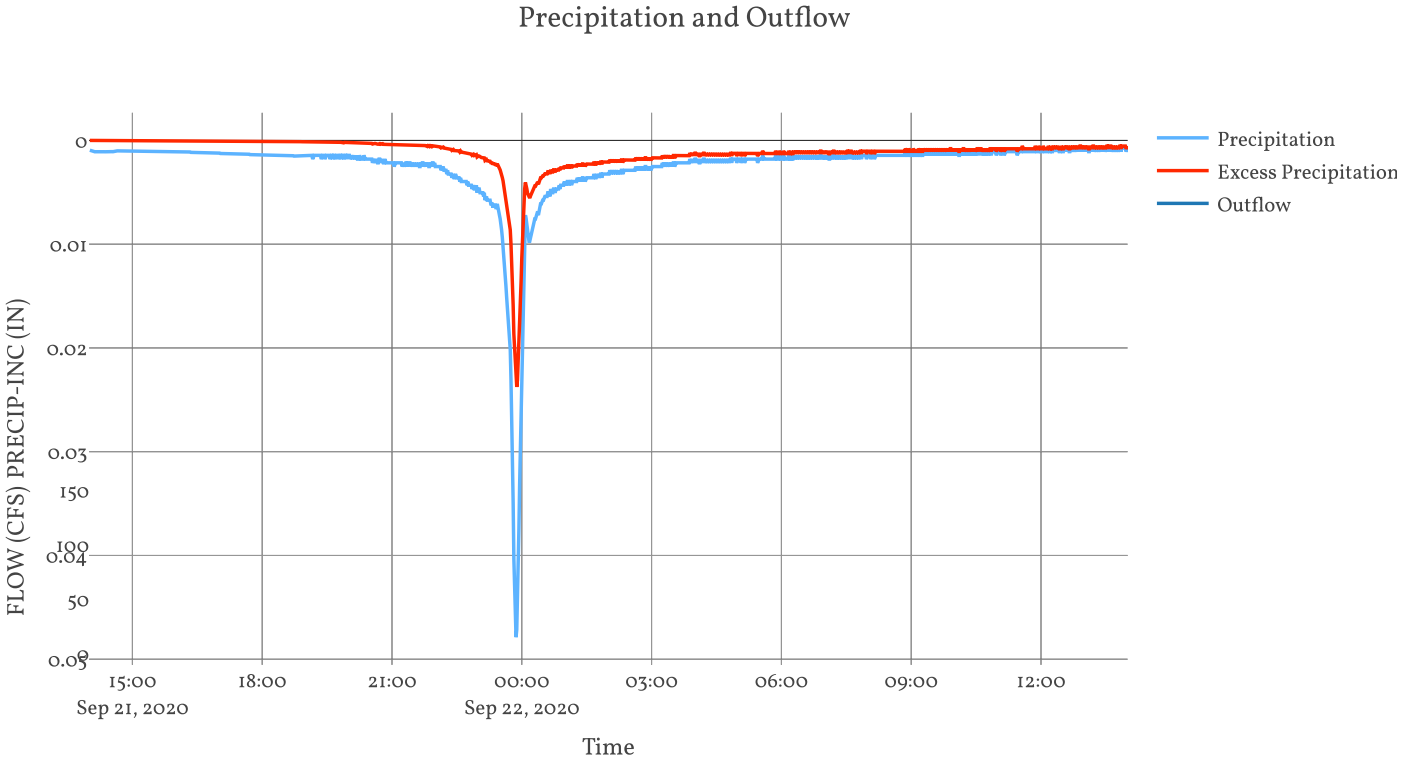
Subbasin: 60B

Area : 0.65
Downstream : J 60b 61b

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	75
Initial Abstraction	0.2

Transform: User - Specified S - Graph	
S - graph	Ellsworth S - Graph
Lag Method	Specified
Lag	0.52

Results: 60B	
Peak Discharge (CFS)	188.07
Time of Peak Discharge	22Sep2020, 00:25
Volume (IN)	1.68
Precipitation Volume (AC - FT)	123.84
Loss Volume (AC - FT)	64.78
Excess Volume (AC - FT)	59.06
Direct Runoff Volume (AC - FT)	57.9
Baseflow Volume (AC - FT)	0


Precipitation and Outflow
FLOW (CFS) PRECIP-INC (IN)
0
0.01
0.02
0.03
150
100
0.04
50
0.05
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
Sep 21, 2020
Sep 22, 2020
Time
Precipitation
Excess Precipitation
Outflow

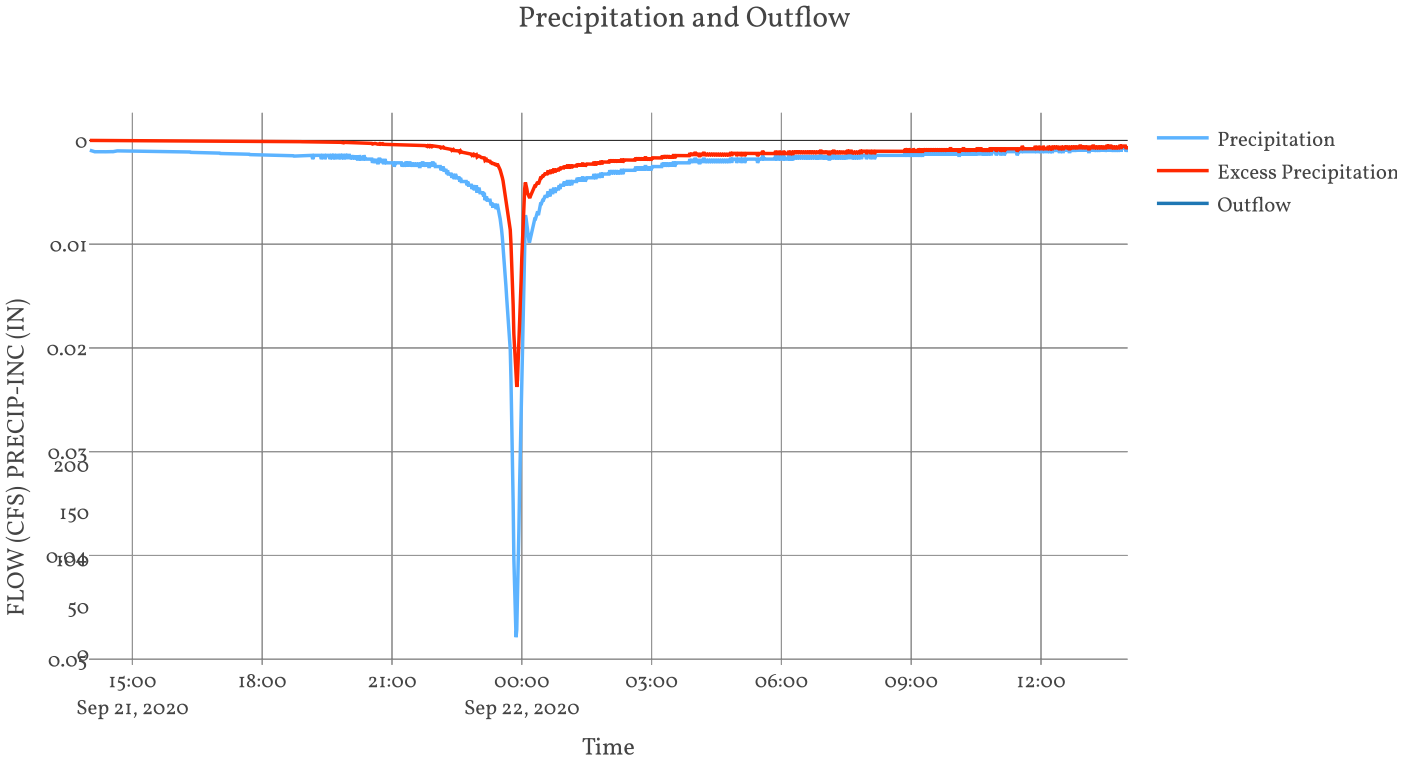
Subbasin: 61B

Area : 0.61
Downstream : J 60b 61b

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	75
Initial Abstraction	0.2

Transform: User - Specified S - Graph	
S - graph	Ellsworth S - Graph
Lag Method	Specified
Lag	0.37

Results: 61B	
Peak Discharge (CFS)	216.56
Time of Peak Discharge	22Sep2020, 00:15
Volume (IN)	1.69
Precipitation Volume (AC - FT)	116.35
Loss Volume (AC - FT)	60.86
Excess Volume (AC - FT)	55.49
Direct Runoff Volume (AC - FT)	54.73
Baseflow Volume (AC - FT)	0

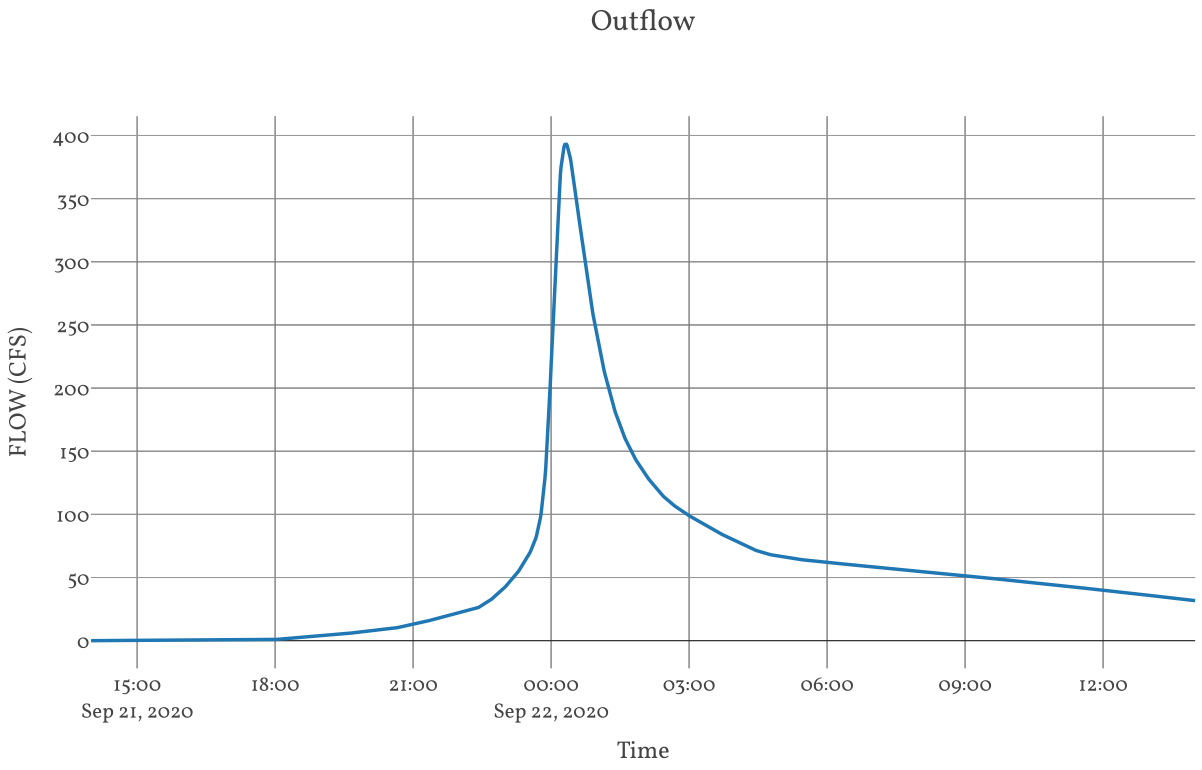

Precipitation and Outflow
FLOW (CFS) PRECIP-INC (IN)
0
0.01
0.02
0.03
200
150
100
50
0
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
Sep 21, 2020
Sep 22, 2020
Time
Precipitation
Excess Precipitation
Outflow

Junction: J 60B 61B

Downstream : 18r

Results: J 60B 61B

Peak Discharge (CFS)	393.35
Time of Peak Discharge	22Sep2020, 00:19
Volume (IN)	1.69



Reach: 18R

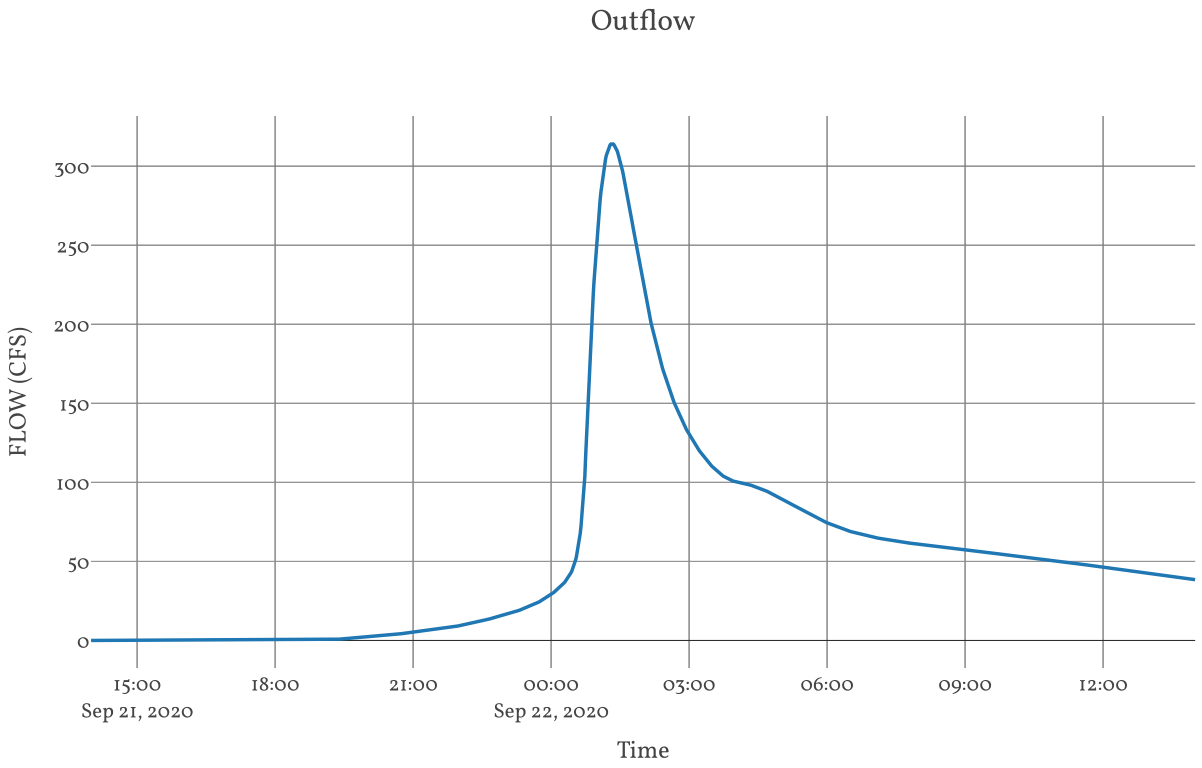
Downstream : 17c

Route: Modified Puls

Method	Modified Puls
Initial Variable	Combined Inflow
Number of Reaches	8
Storage Outflow Table Name	18r

Results: 18R

Peak Discharge (CFS)	314.24
Time of Peak Discharge	22Sep2020, 01:20
Volume (IN)	1.62
Peak Inflow (CFS)	393.35
Inflow Volume (AC - FT)	112.63



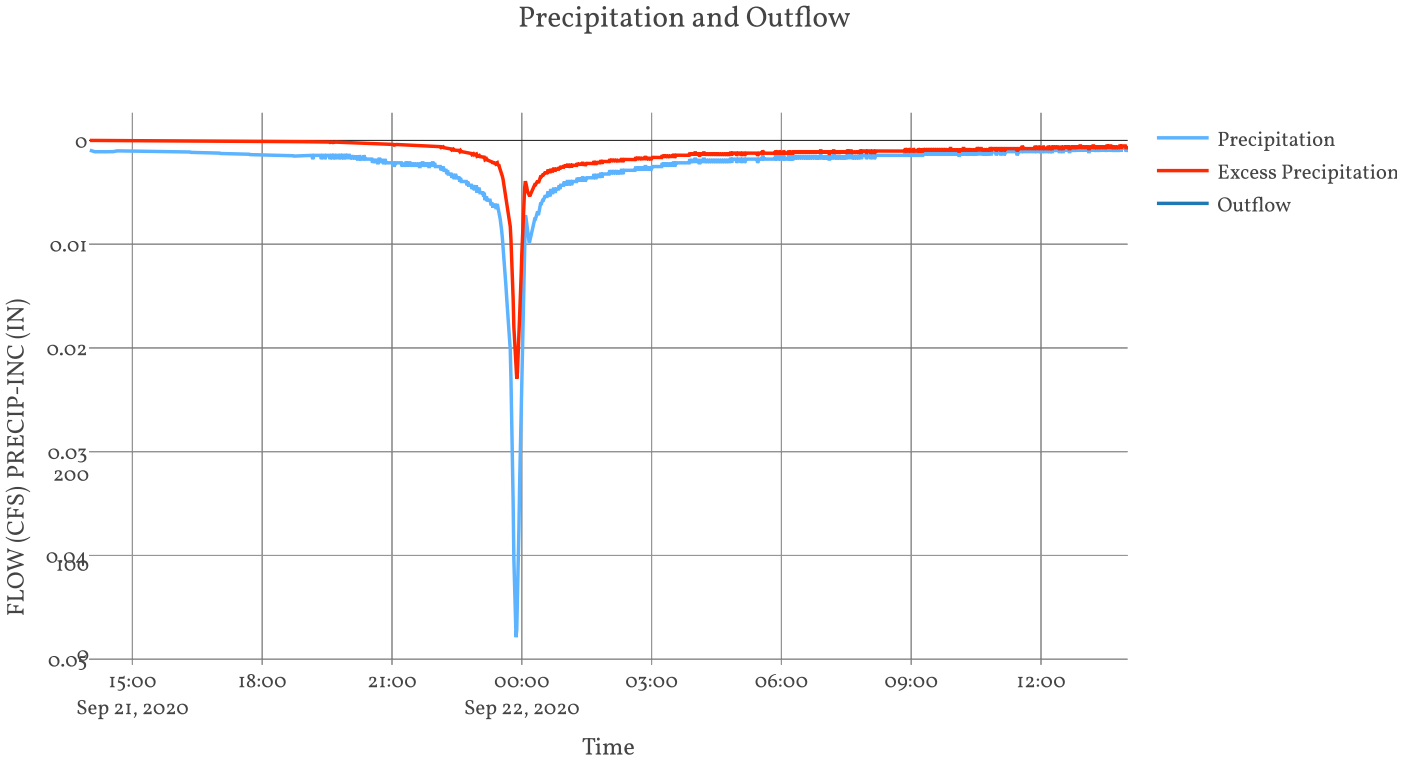
Subbasin: 62B

Area : 0.53
Downstream : 17c

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	73.9
Initial Abstraction	0.2

Transform: User - Specified S - Graph	
S - graph	Ellsworth S - Graph
Lag Method	Specified
Lag	0.25

Results: 62B	
Peak Discharge (CFS)	227.32
Time of Peak Discharge	22Sep2020, 00:08
Volume (IN)	1.65
Precipitation Volume (AC - FT)	100.92
Loss Volume (AC - FT)	54.17
Excess Volume (AC - FT)	46.75
Direct Runoff Volume (AC - FT)	46.32
Baseflow Volume (AC - FT)	0

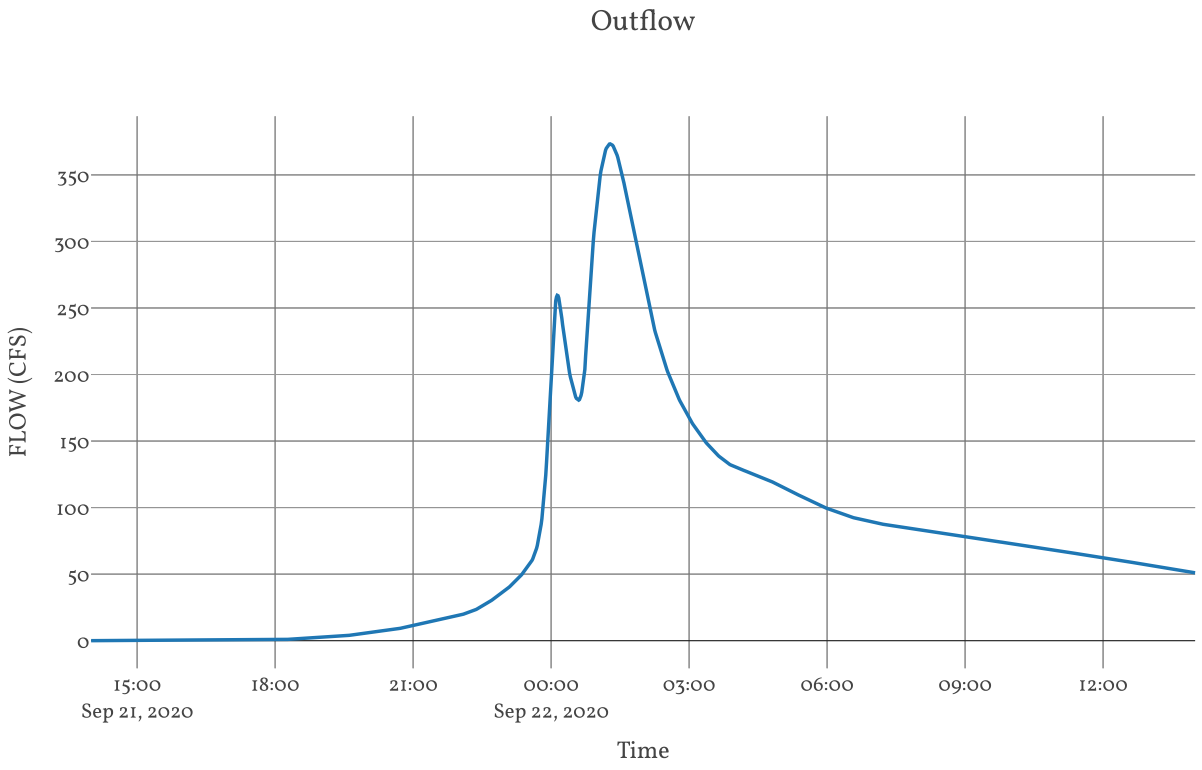

Precipitation and Outflow
FLOW (CFS) PRECIP-INC (IN)
0
0.01
0.02
0.03
200
0.04
100
0.05
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
Sep 21, 2020
Sep 22, 2020
Time
Precipitation
Excess Precipitation
Outflow

Junction: 17C

Downstream : 17r

Results: 17C

Peak Discharge (CFS)	373.3
Time of Peak Discharge	22Sep2020, 01:17
Volume (IN)	1.63



Reach: 17R

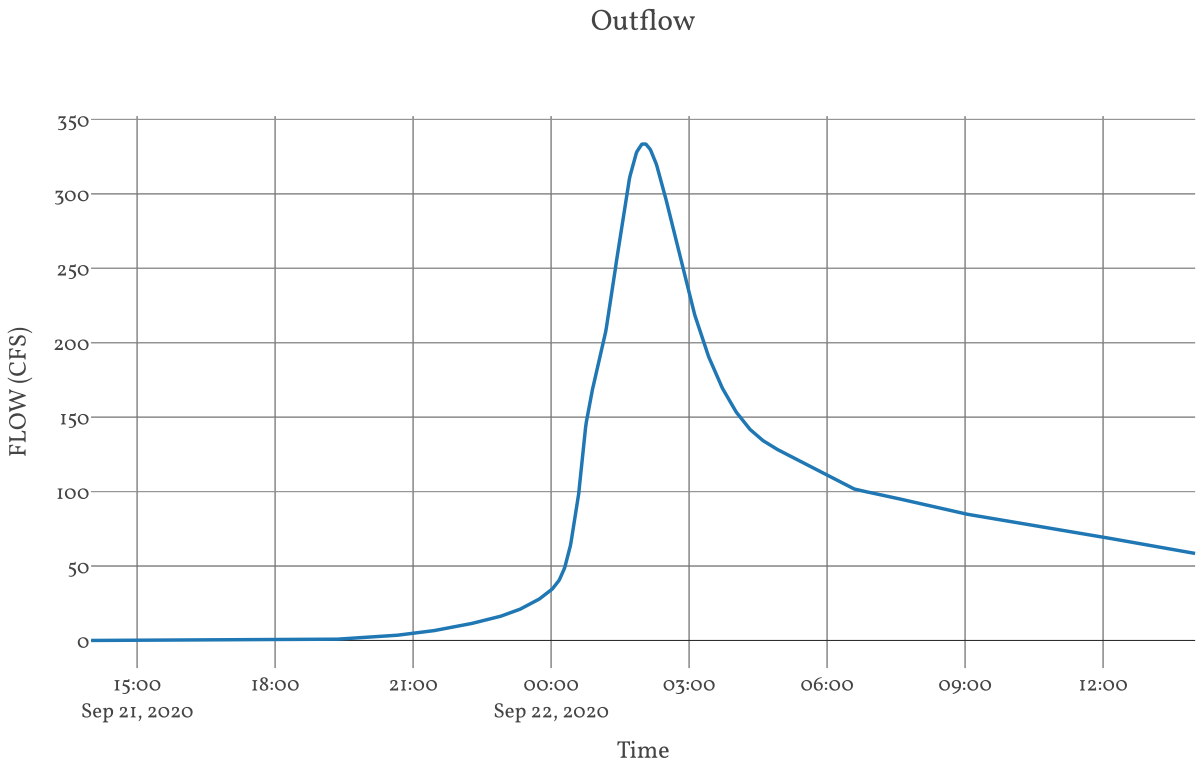
Downstream : 16c

Route: Modified Puls

Method	Modified Puls
Initial Variable	Combined Inflow
Number of Reaches	4
Storage Outflow Table Name	17r

Results: 17R

Peak Discharge (CFS)	333.71
Time of Peak Discharge	22Sep2020, 02:01
Volume (IN)	1.56
Peak Inflow (CFS)	373.3
Inflow Volume (AC - FT)	154.15



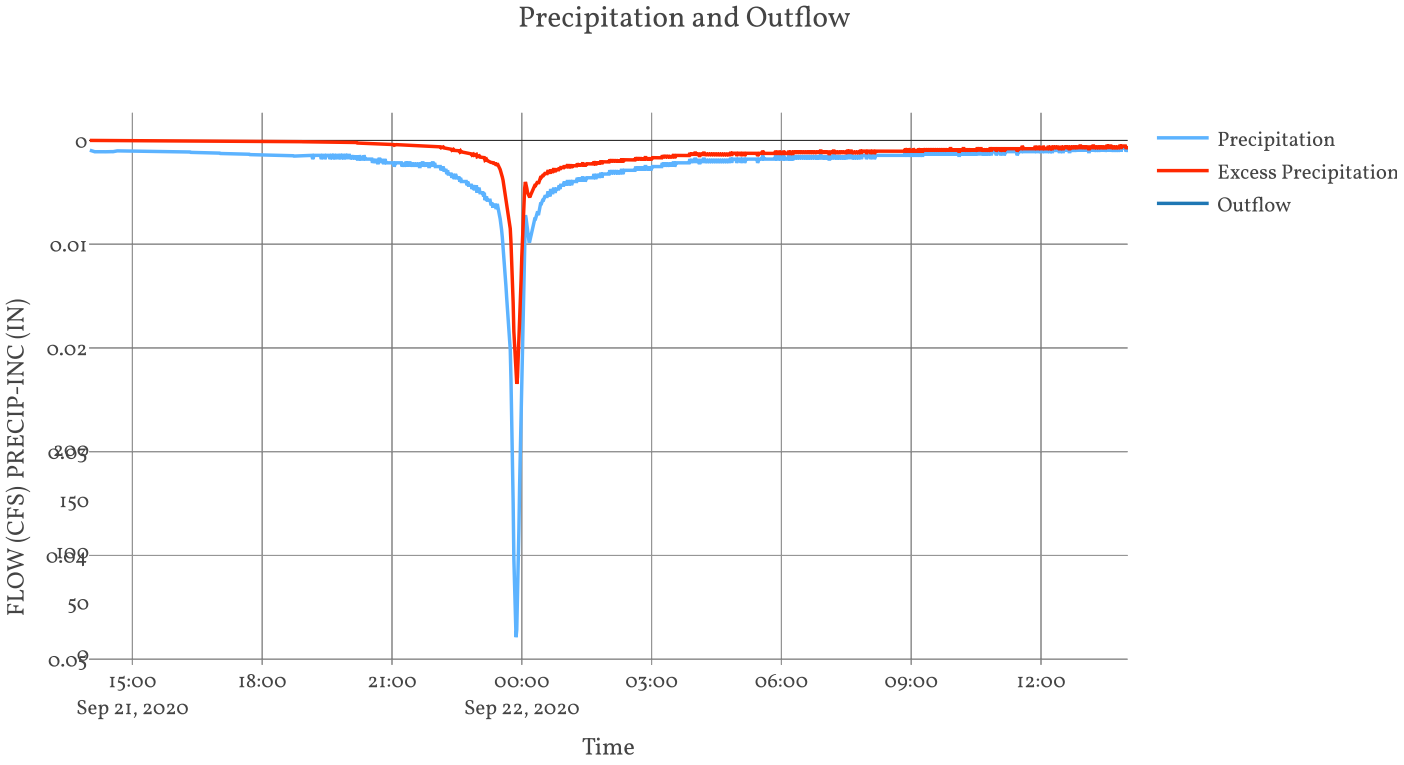
Subbasin: 63B

Area : 0.6
Downstream : 16c

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	74.6
Initial Abstraction	0.2

Transform: User - Specified S - Graph	
S - graph	Ellsworth S - Graph
Lag Method	Specified
Lag	0.41

Results: 63B	
Peak Discharge (CFS)	199.83
Time of Peak Discharge	22Sep2020, 00:18
Volume (IN)	1.67
Precipitation Volume (AC - FT)	115.58
Loss Volume (AC - FT)	61.04
Excess Volume (AC - FT)	54.54
Direct Runoff Volume (AC - FT)	53.71
Baseflow Volume (AC - FT)	0

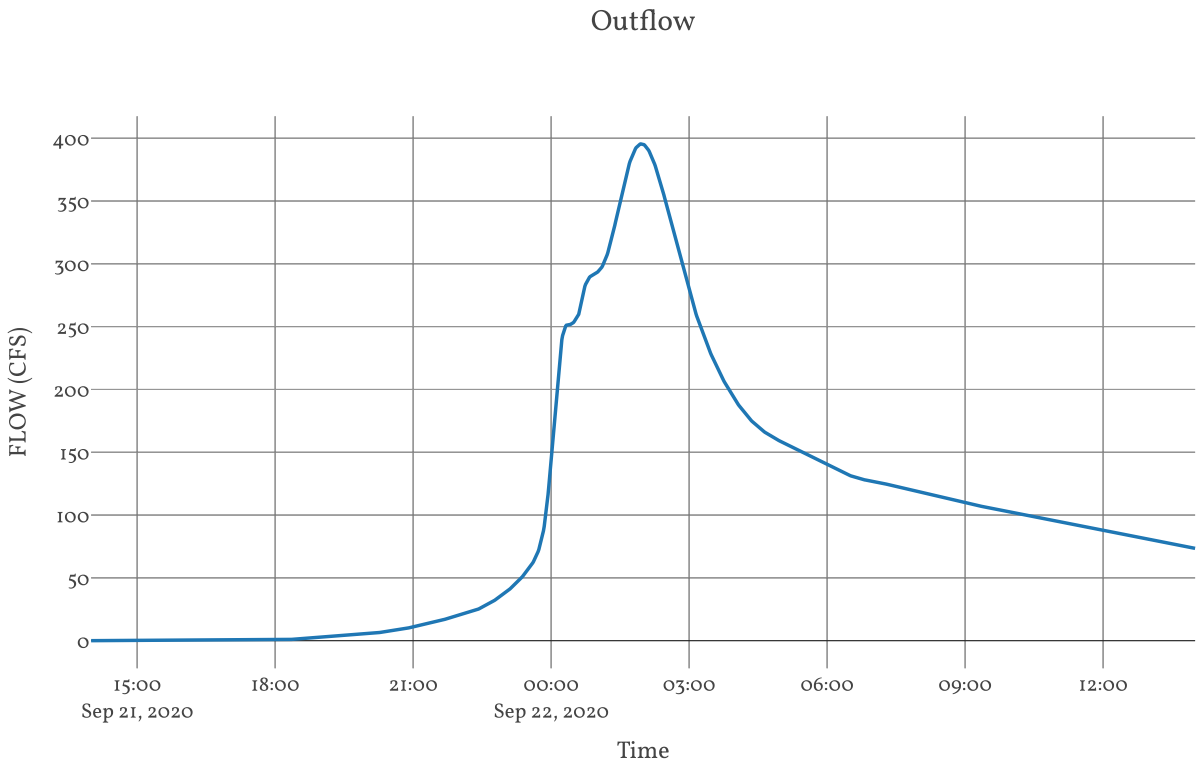

Precipitation and Outflow
FLOW (CFS) PRECIP-INC (IN)
0
0.01
0.02
150
50
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
Sep 21, 2020
Sep 22, 2020
Time
Precipitation
Excess Precipitation
Outflow

Junction: 16C

Downstream : 16r

Results: 16C

Peak Discharge (CFS)	395.47
Time of Peak Discharge	22Sep2020, 01:58
Volume (IN)	1.59



Reach: 16R

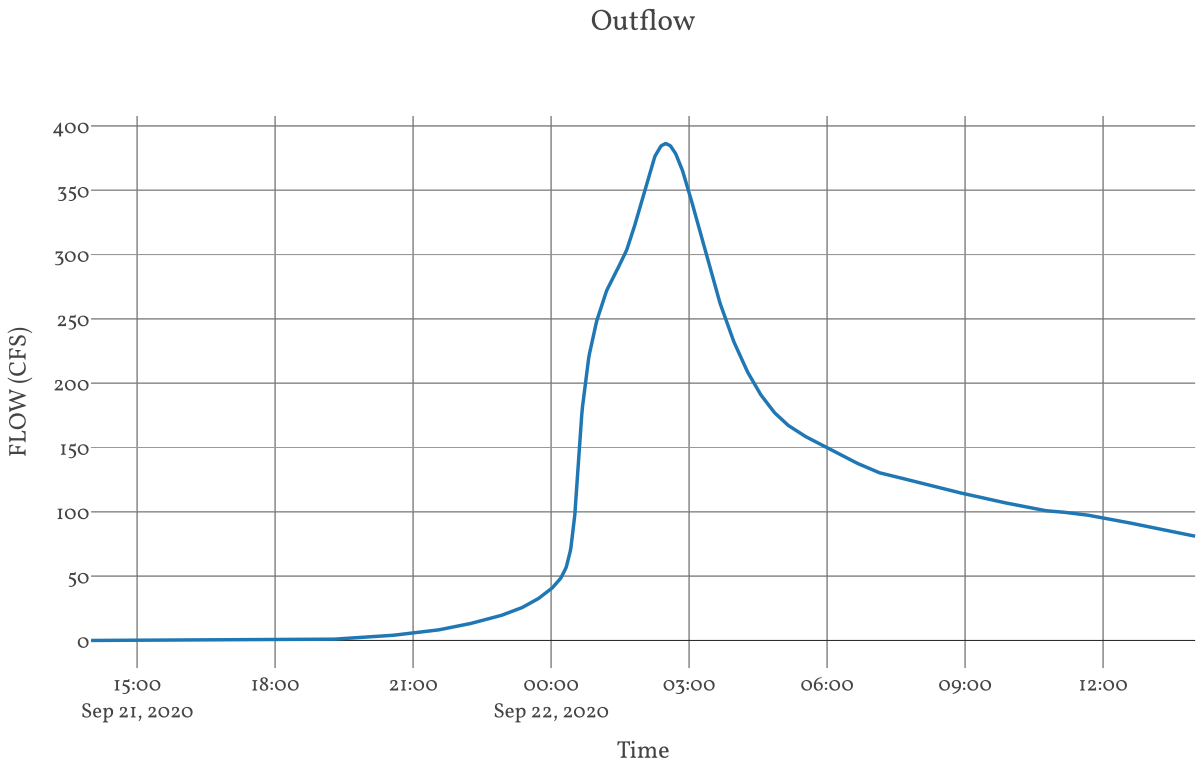
Downstream : 20C

Route: Modified Puls

Method	Modified Puls
Initial Variable	Combined Inflow
Number of Reaches	6
Storage Outflow Table Name	16r

Results: 16R

Peak Discharge (CFS)	386.19
Time of Peak Discharge	22Sep2020, 02:30
Volume (IN)	1.54
Peak Inflow (CFS)	395.47
Inflow Volume (AC - FT)	201.8



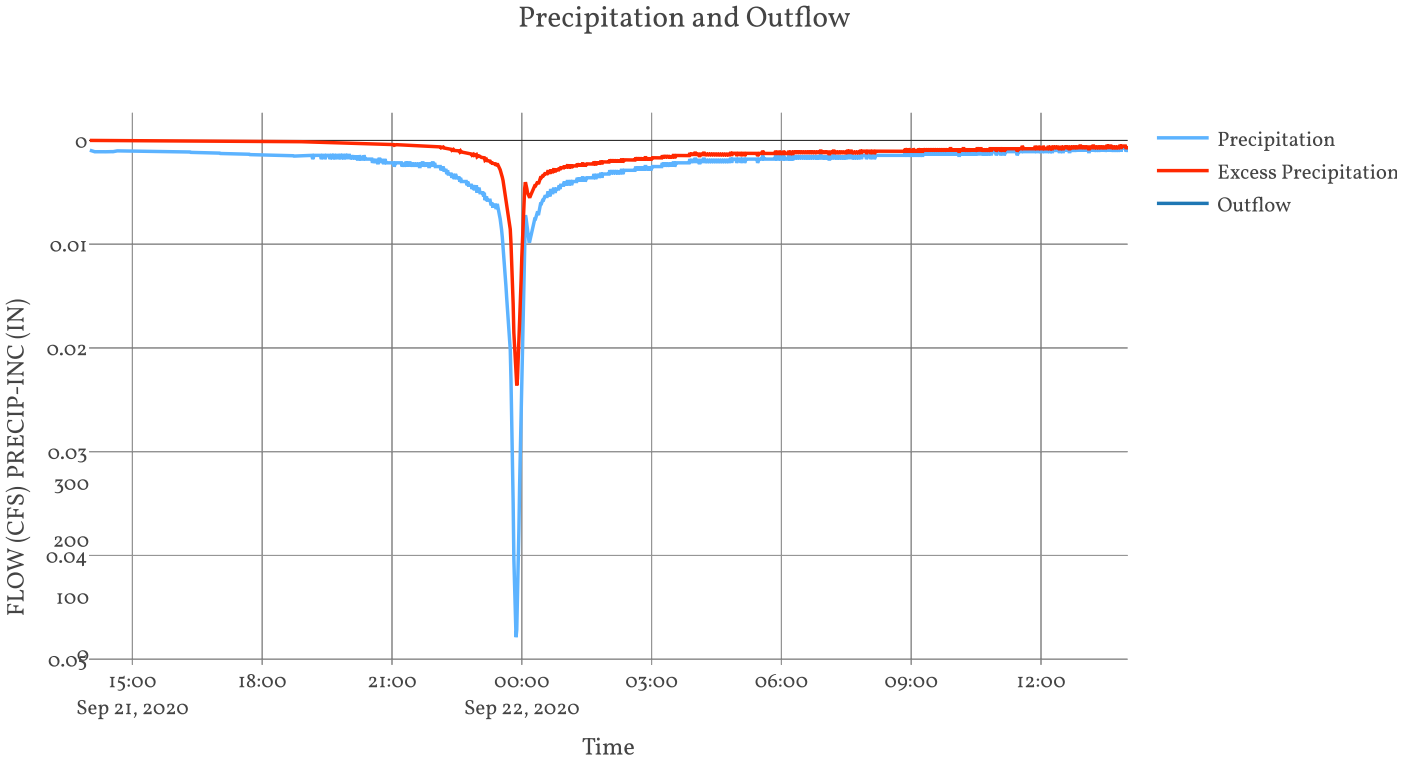
Subbasin: 64B

Area : 1.09
Downstream : 20c

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	74.8
Initial Abstraction	0.2

Transform: User - Specified S - Graph	
S - graph	Ellsworth S - Graph
Lag Method	Specified
Lag	0.42

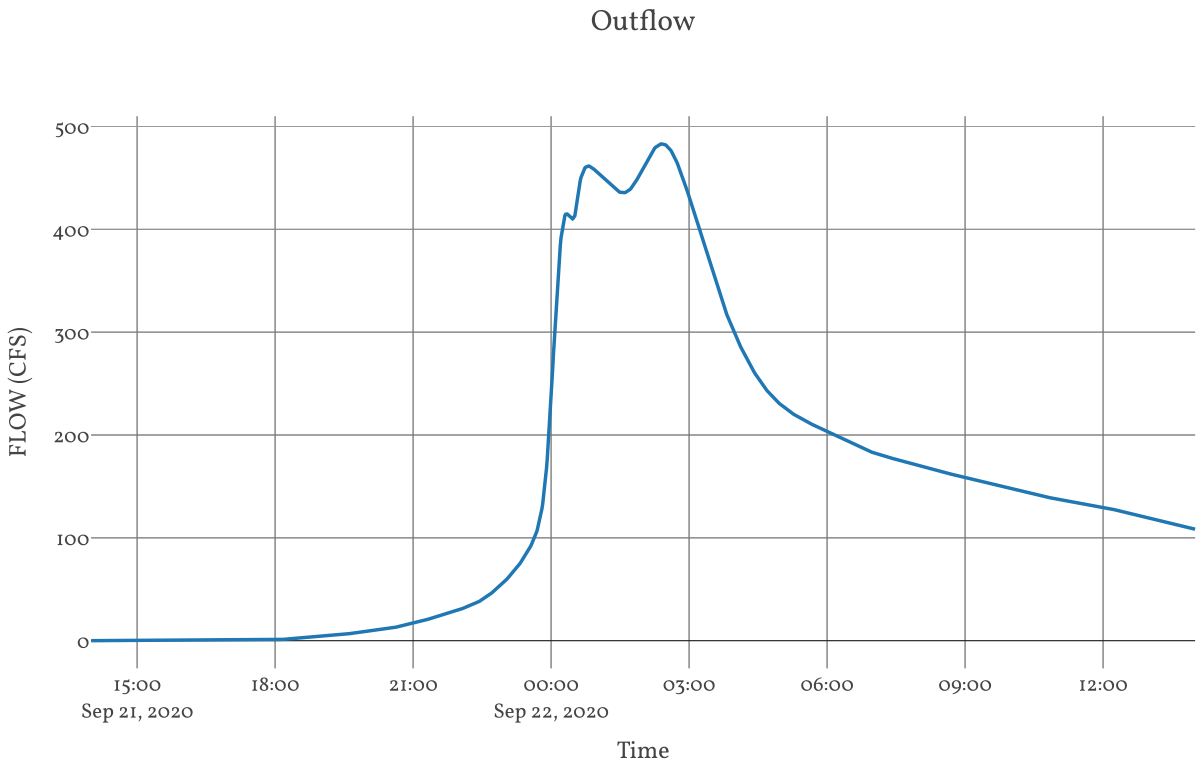
Results: 64B	
Peak Discharge (CFS)	358.99
Time of Peak Discharge	22Sep2020, 00:18
Volume (IN)	1.68
Precipitation Volume (AC - FT)	209.28
Loss Volume (AC - FT)	110
Excess Volume (AC - FT)	99.28
Direct Runoff Volume (AC - FT)	97.73
Baseflow Volume (AC - FT)	0


Precipitation and Outflow
FLOW (CFS) PRECIP-INC (IN)
0
0.01
0.02
0.03
300
200
0.04
100
0.05
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
Sep 21, 2020
Sep 22, 2020
Time
Precipitation
Excess Precipitation
Outflow

Junction: 20C

Downstream : 20r

Results: 20C	
Peak Discharge (CFS)	483.09
Time of Peak Discharge	22Sep2020, 02:25
Volume (IN)	1.58



Reach: 20R

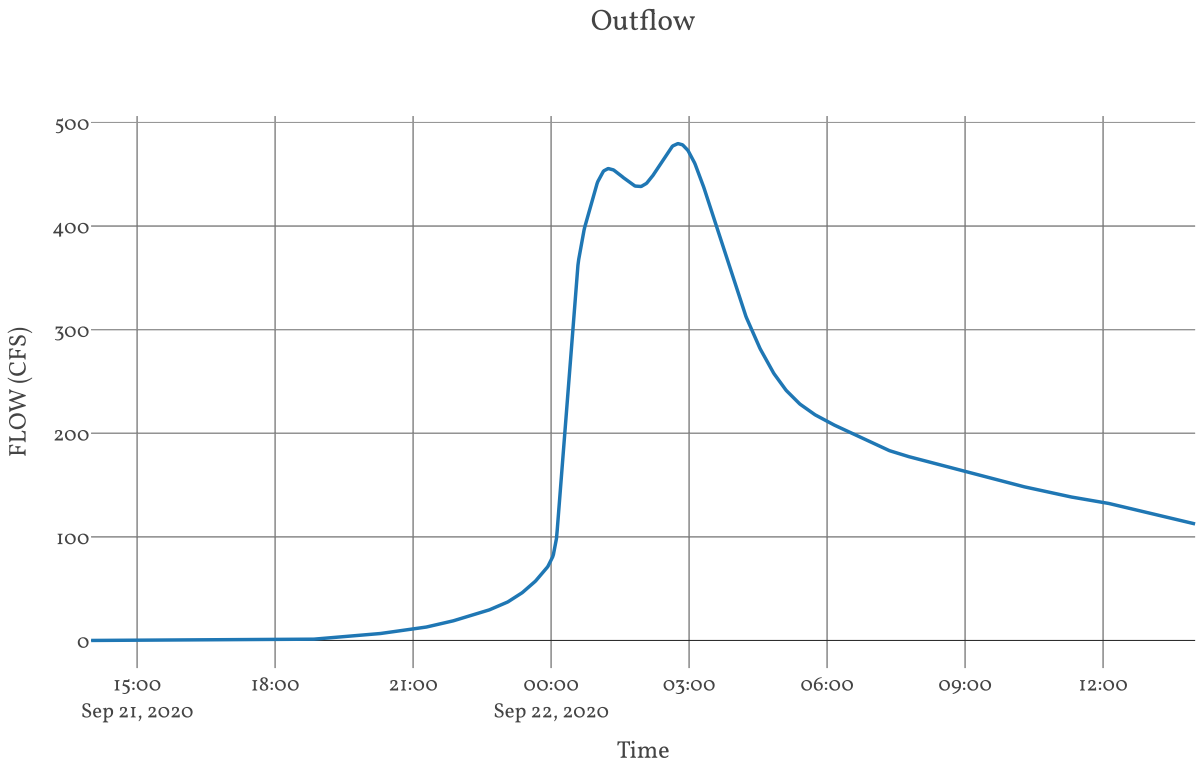
Downstream : 15C

Route: Modified Puls

Method	Modified Puls
Initial Variable	Combined Inflow
Number of Reaches	6
Storage Outflow Table Name	20r

Results: 20R

Peak Discharge (CFS)	479.54
Time of Peak Discharge	22Sep2020, 02:46
Volume (IN)	1.55
Peak Inflow (CFS)	483.09
Inflow Volume (AC - FT)	293.05



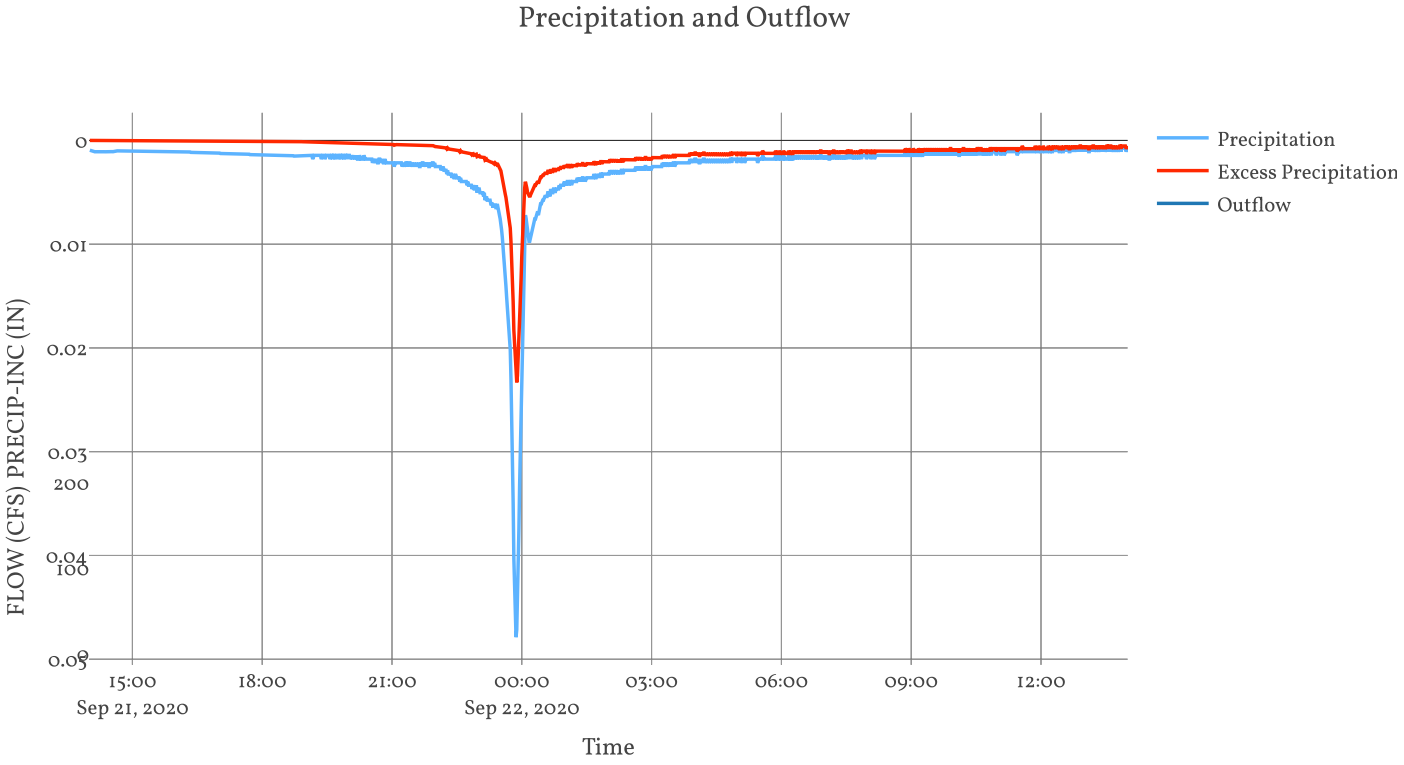
Subbasin: 65B

Area : 0.53
Downstream : 15c

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	74.4
Initial Abstraction	0.2

Transform: User - Specified S - Graph	
S - graph	Ellsworth S - Graph
Lag Method	Specified
Lag	0.24

Results: 65B	
Peak Discharge (CFS)	239.37
Time of Peak Discharge	22Sep2020, 00:07
Volume (IN)	1.68
Precipitation Volume (AC - FT)	102.34
Loss Volume (AC - FT)	54.3
Excess Volume (AC - FT)	48.04
Direct Runoff Volume (AC - FT)	47.62
Baseflow Volume (AC - FT)	0

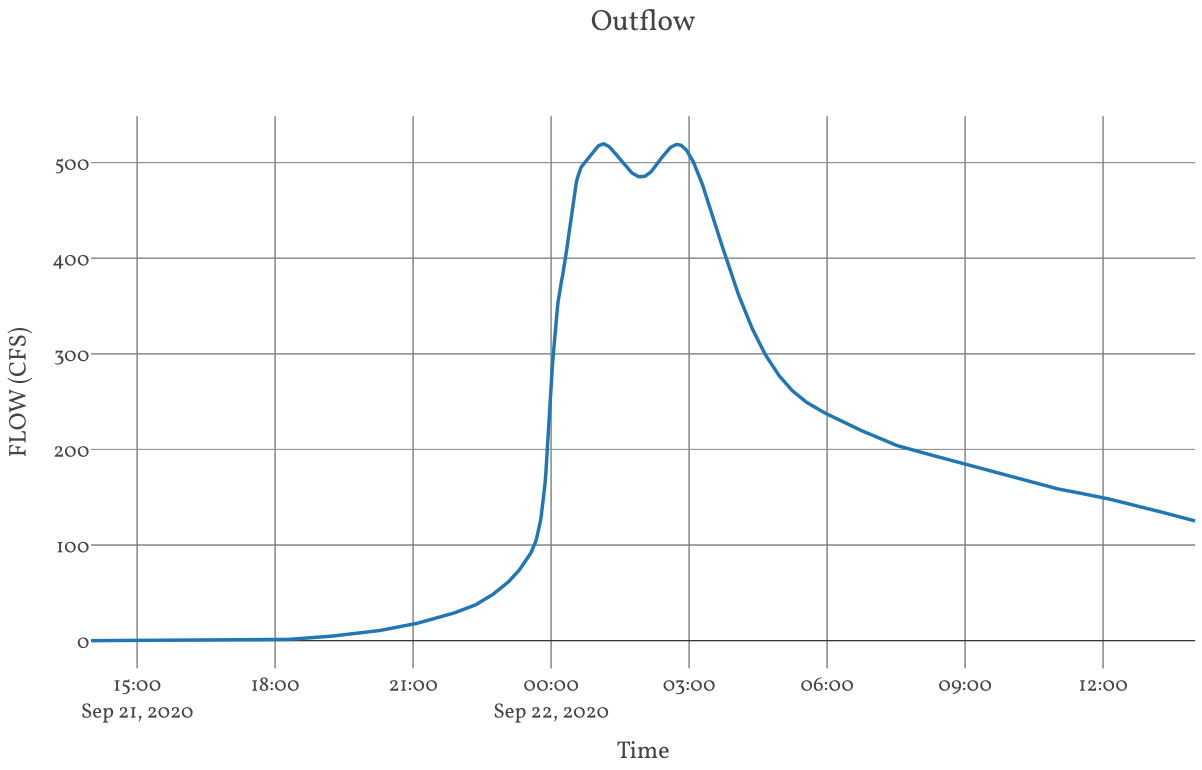

Precipitation and Outflow
FLOW (CFS) PRECIP-INC (IN)
0
0.01
0.02
0.03
200
0.04
100
0.05
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
Sep 21, 2020
Sep 22, 2020
Time
Precipitation
Excess Precipitation
Outflow

Junction: 15C

Downstream : 15r

Results: 15C

Peak Discharge (CFS)	519.57
Time of Peak Discharge	22Sep2020, 01:08
Volume (IN)	1.57



Reach: 15R

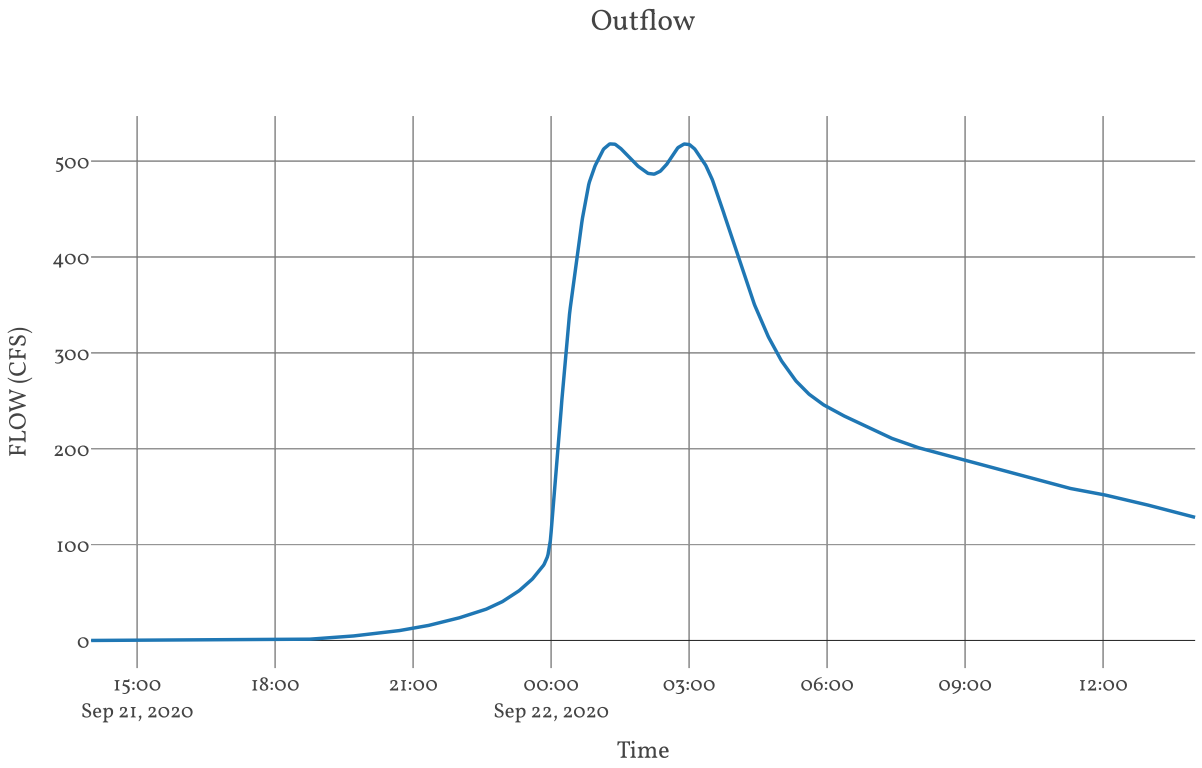
Downstream : 14c

Route: Modified Puls

Method	Modified Puls
Initial Variable	Combined Inflow
Number of Reaches	5
Storage Outflow Table Name	15r

Results: 15R

Peak Discharge (CFS)	518.2
Time of Peak Discharge	22Sep2020, 01:19
Volume (IN)	1.55
Peak Inflow (CFS)	519.57
Inflow Volume (AC - FT)	334.44



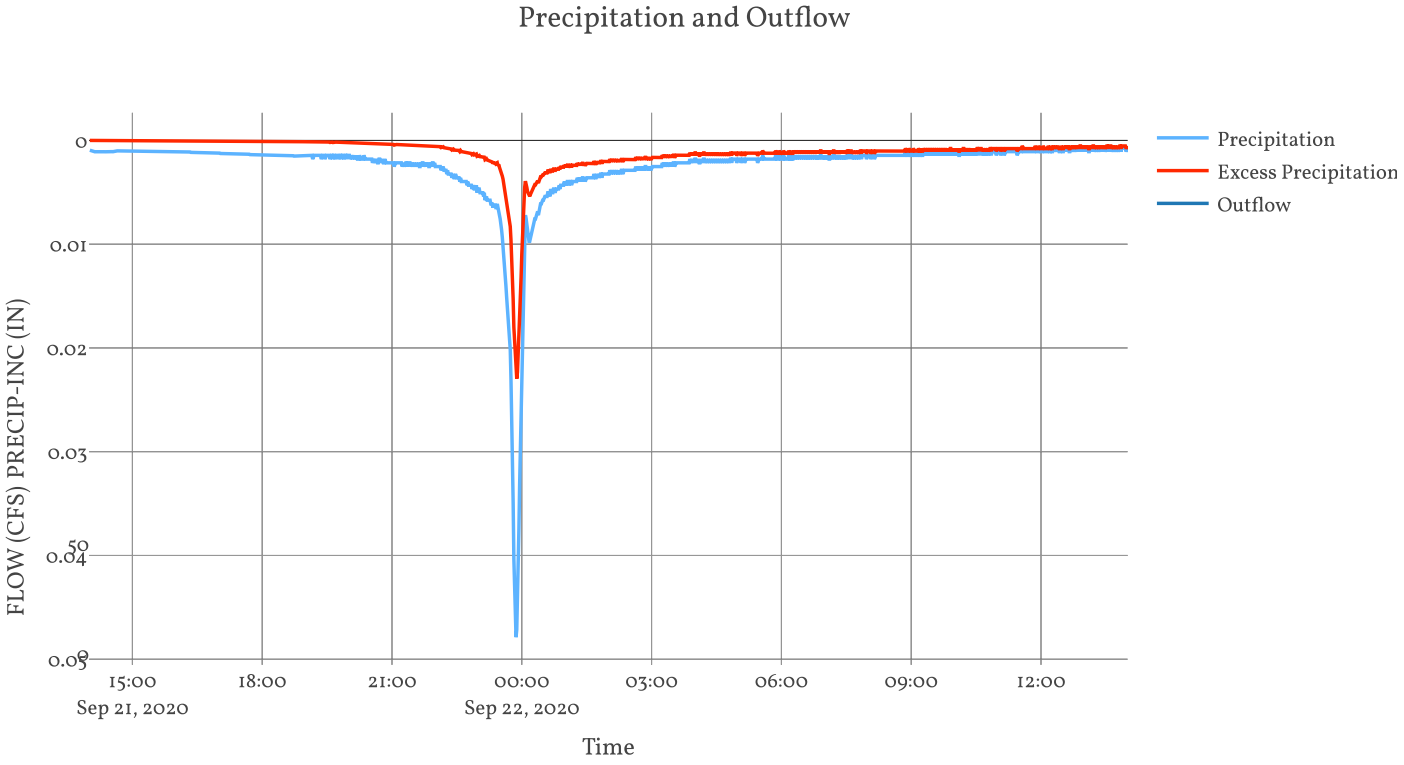
Subbasin: 66B

Area : 0.16
Downstream : 14c

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	73.9
Initial Abstraction	0.2

Transform: User - Specified S - Graph	
S - graph	Ellsworth S - Graph
Lag Method	Specified
Lag	0.14

Results: 66B	
Peak Discharge (CFS)	93.22
Time of Peak Discharge	22Sep2020, 00:02
Volume (IN)	1.66
Precipitation Volume (AC - FT)	31.1
Loss Volume (AC - FT)	16.7
Excess Volume (AC - FT)	14.41
Direct Runoff Volume (AC - FT)	14.34
Baseflow Volume (AC - FT)	0

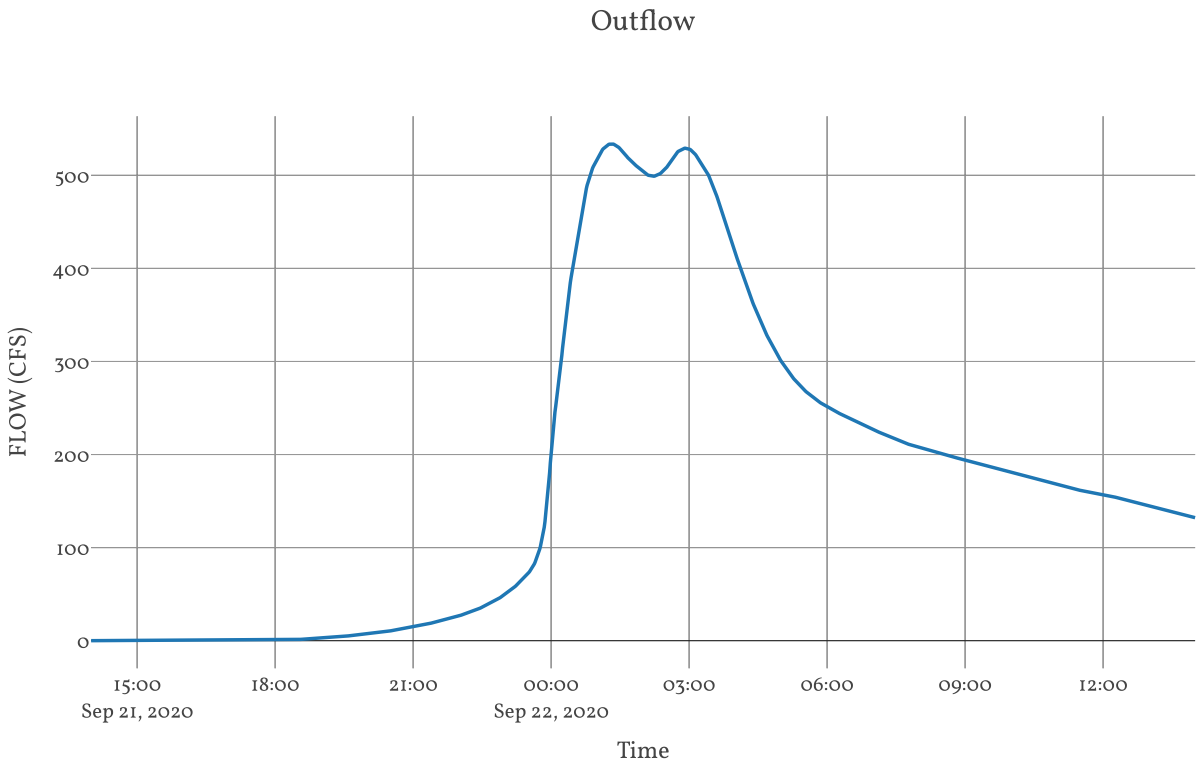

Precipitation and Outflow
FLOW (CFS) PRECIP-INC (IN)
0
0.01
0.02
0.03
0.04
0.05
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
Sep 21, 2020
Sep 22, 2020
Time
Precipitation
Excess Precipitation
Outflow

Junction: 14C

Downstream : 14r

Results: 14C

Peak Discharge (CFS)	533.79
Time of Peak Discharge	22Sep2020, 01:19
Volume (IN)	1.55



Reach: 14R

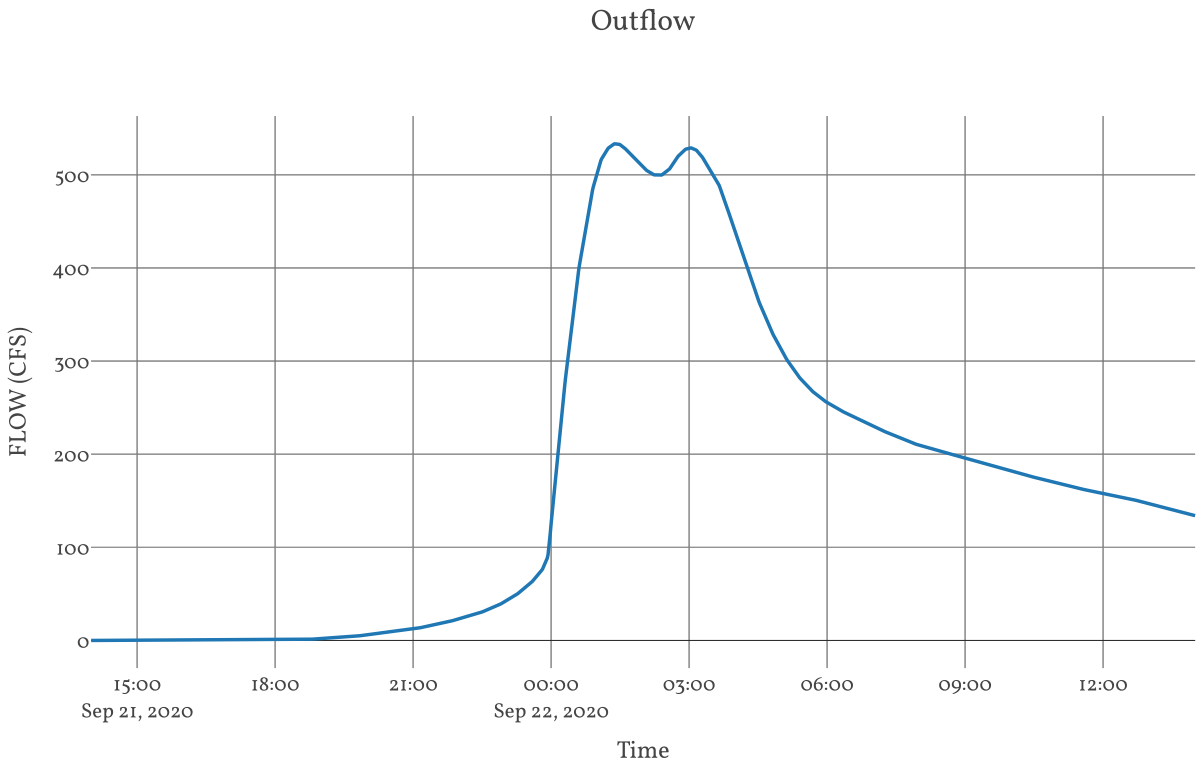
Downstream : 13c

Route: Modified Puls

Method	Modified Puls
Initial Variable	Combined Inflow
Number of Reaches	5
Storage Outflow Table Name	14r

Results: 14R

Peak Discharge (CFS)	533.43
Time of Peak Discharge	22Sep2020, 01:25
Volume (IN)	1.54
Peak Inflow (CFS)	533.79
Inflow Volume (AC - FT)	344.17



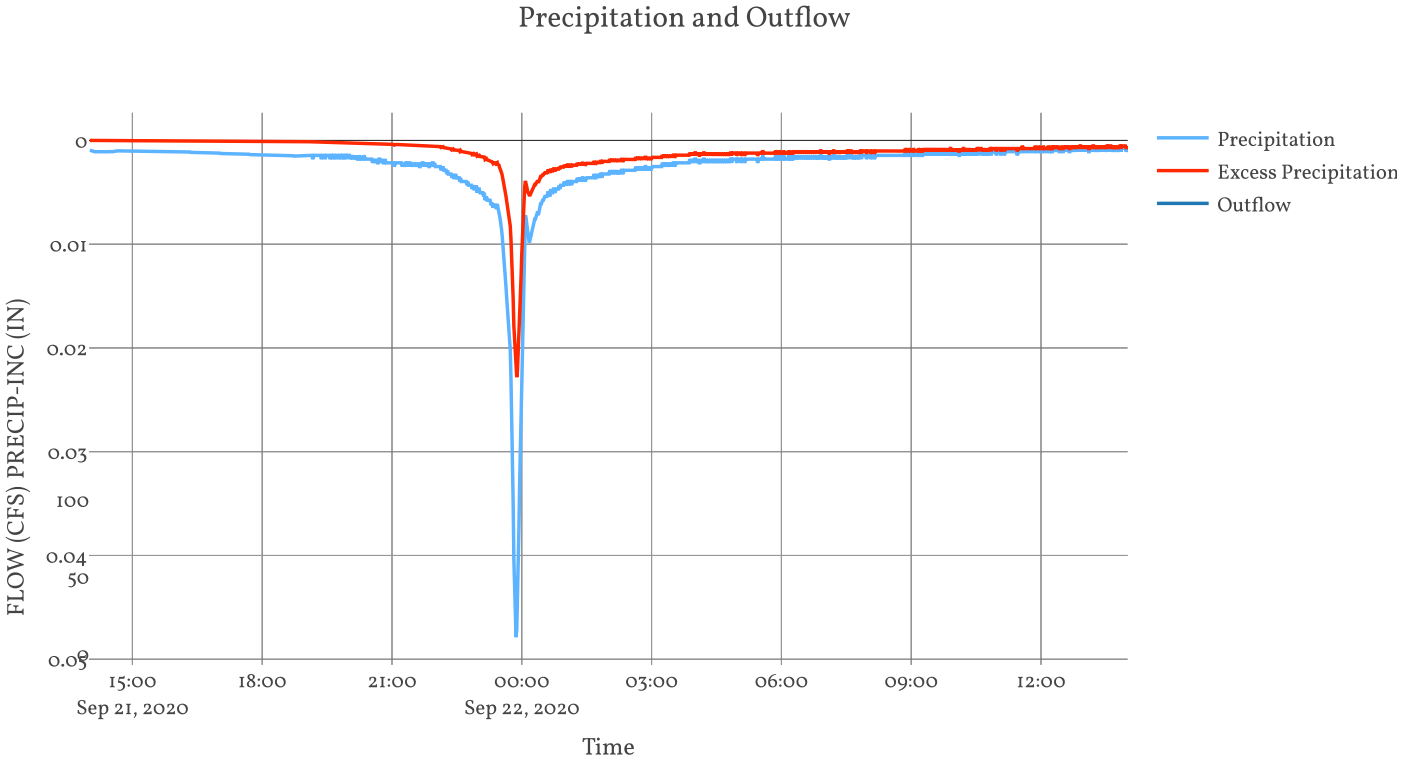
Subbasin: 67B

Area : 0.43
Downstream : 13c

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	73.7
Initial Abstraction	0.2

Transform: User - Specified S - Graph	
S - graph	Ellsworth S - Graph
Lag Method	Specified
Lag	0.44

Results: 67B	
Peak Discharge (CFS)	132.97
Time of Peak Discharge	22Sep2020, 00:20
Volume (IN)	1.63
Precipitation Volume (AC - FT)	82.56
Loss Volume (AC - FT)	44.52
Excess Volume (AC - FT)	38.04
Direct Runoff Volume (AC - FT)	37.41
Baseflow Volume (AC - FT)	0

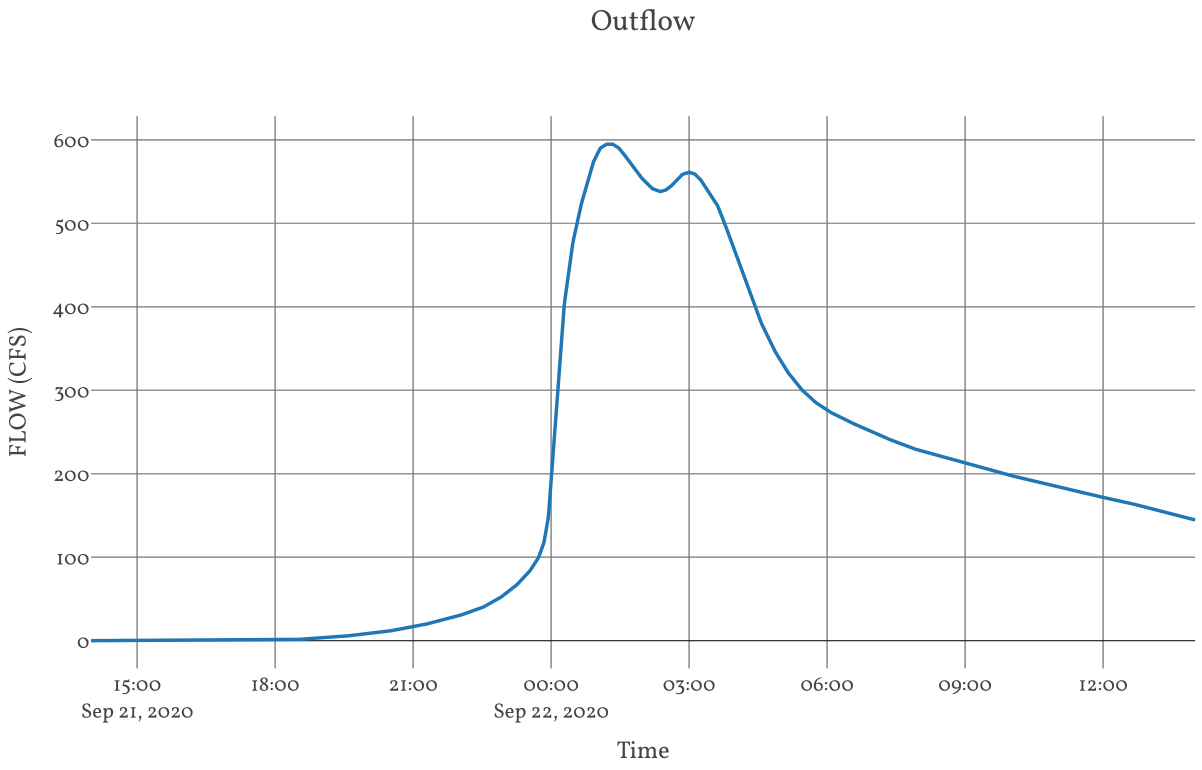

Precipitation and Outflow
FLOW (CFS) PRECIP-INC (IN)
0
0.01
0.02
0.03
100
0.04
50
0.05
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
Sep 21, 2020
Sep 22, 2020
Time
Precipitation
Excess Precipitation
Outflow

Junction: 13C

Downstream : 13r

Results: 13C

Peak Discharge (CFS)	595.2
Time of Peak Discharge	22Sep2020, 01:16
Volume (IN)	1.55



Reach: 13R

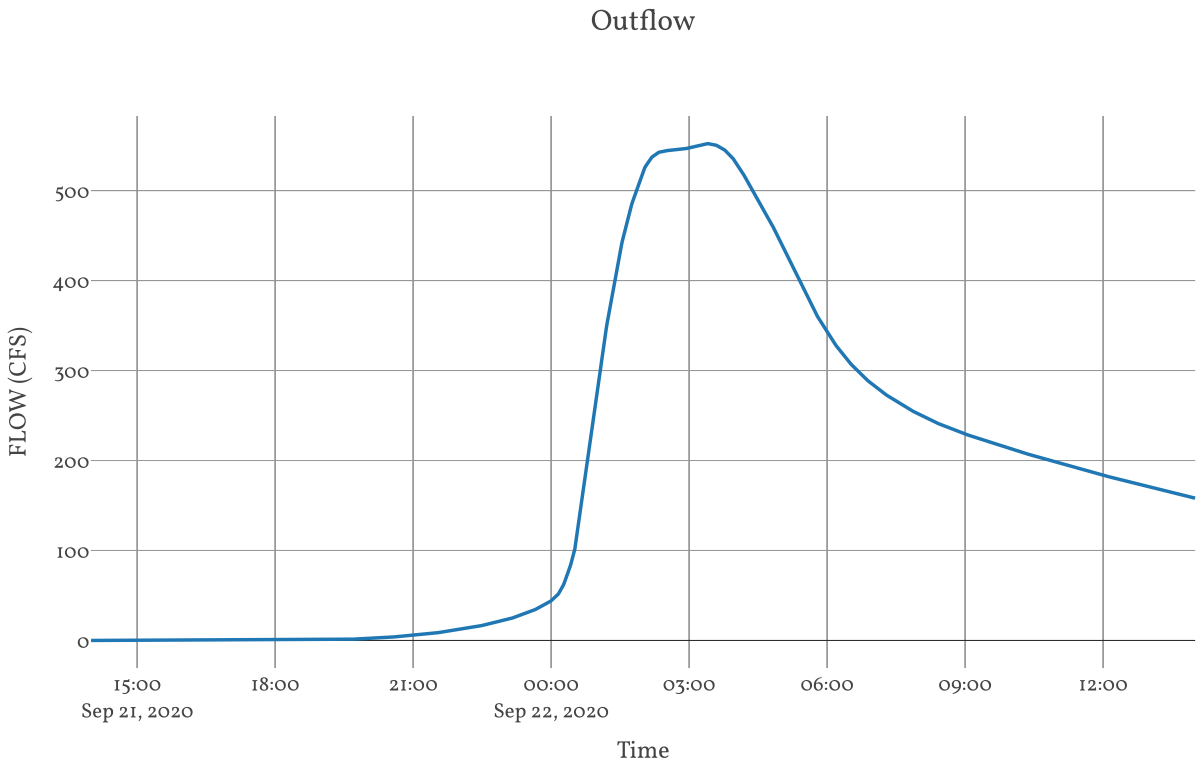
Downstream : 12C

Route: Modified Puls

Method	Modified Puls
Initial Variable	Combined Inflow
Number of Reaches	2
Storage Outflow Table Name	13r

Results: 13R

Peak Discharge (CFS)	552.12
Time of Peak Discharge	22Sep2020, 03:24
Volume (IN)	1.47
Peak Inflow (CFS)	595.2
Inflow Volume (AC - FT)	378.99



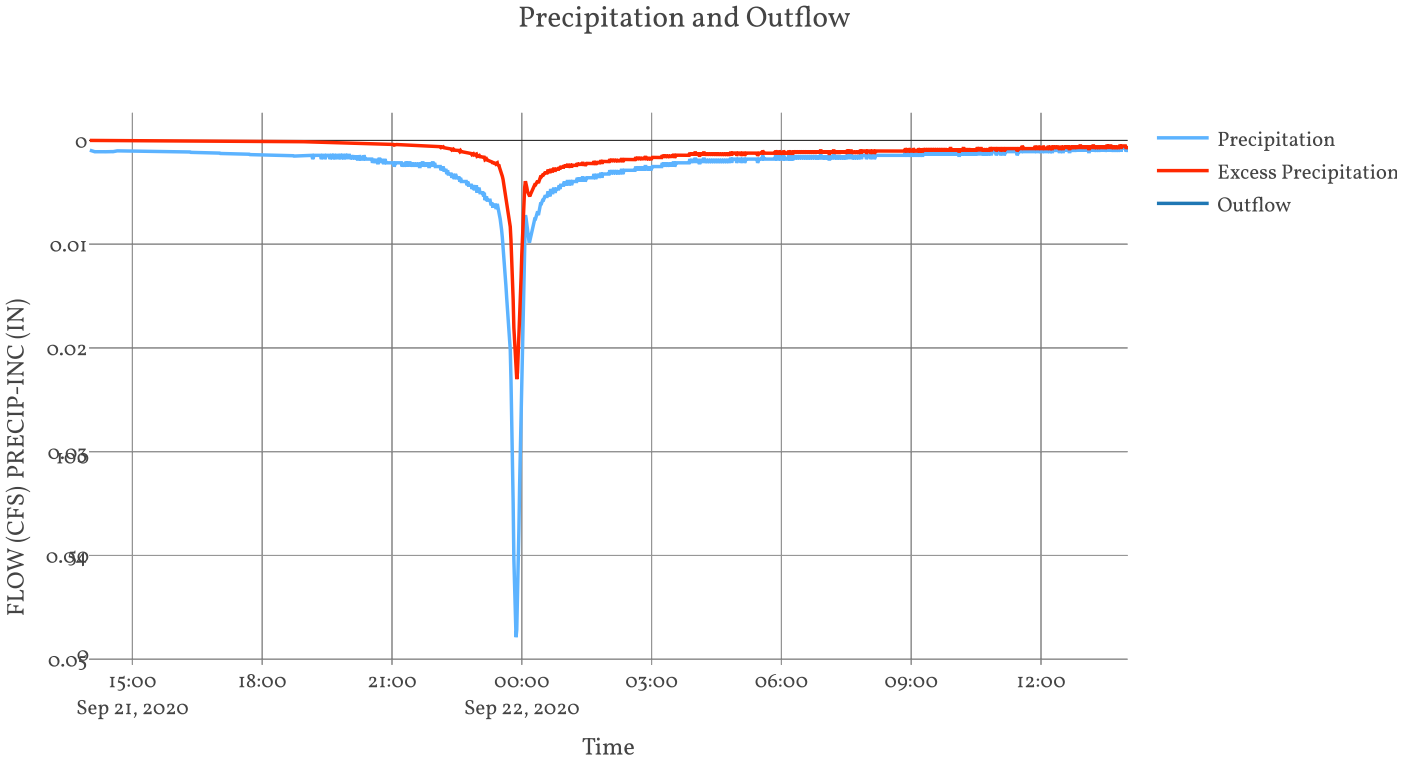
Subbasin: 68B

Area : 0.26
Downstream : 12c

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	73.9
Initial Abstraction	0.2

Transform: User - Specified S - Graph	
S - graph	Ellsworth S - Graph
Lag Method	Specified
Lag	0.28

Results: 68B	
Peak Discharge (CFS)	103.68
Time of Peak Discharge	22Sep2020, 00:10
Volume (IN)	1.65
Precipitation Volume (AC - FT)	48.96
Loss Volume (AC - FT)	26.23
Excess Volume (AC - FT)	22.73
Direct Runoff Volume (AC - FT)	22.5
Baseflow Volume (AC - FT)	0

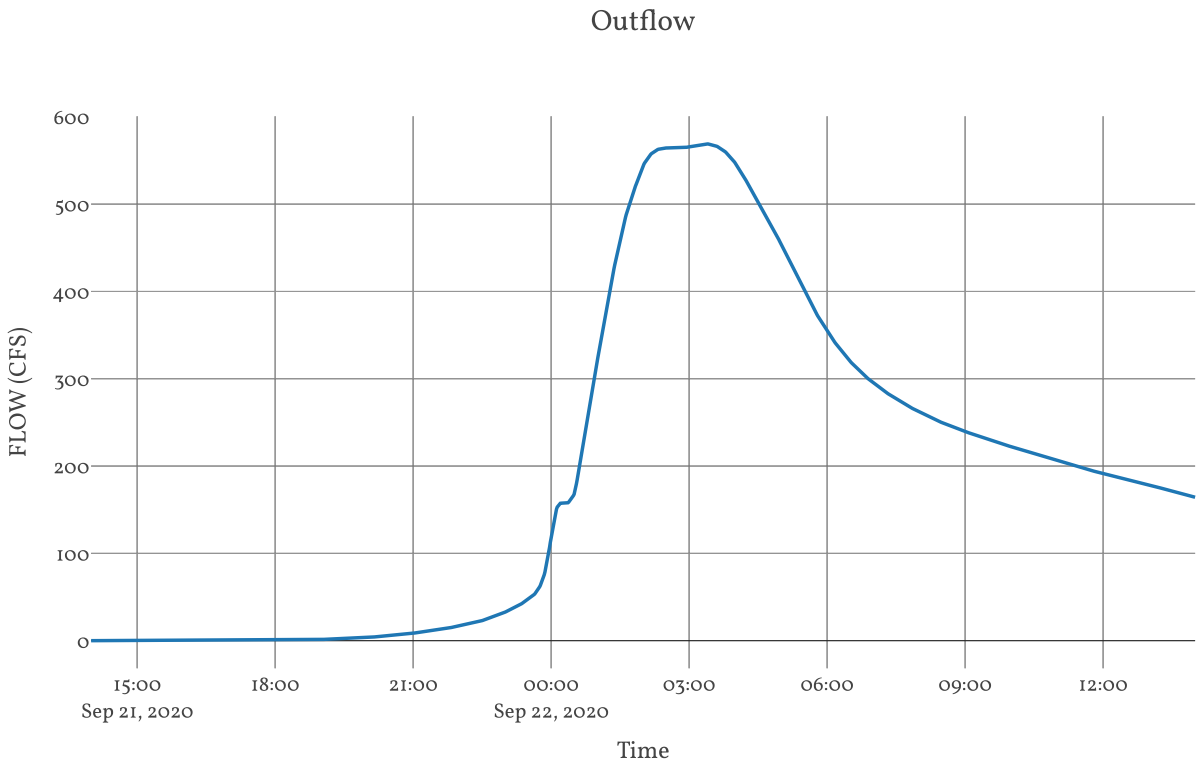

Precipitation and Outflow
FLOW (CFS) PRECIP-INC (IN)
0
0.01
0.02
0.03
0.04
0.05
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
Sep 21, 2020
Sep 22, 2020
Time
Precipitation
Excess Precipitation
Outflow

Junction: 12C

Downstream : Pacific Ocean

Results: 12C

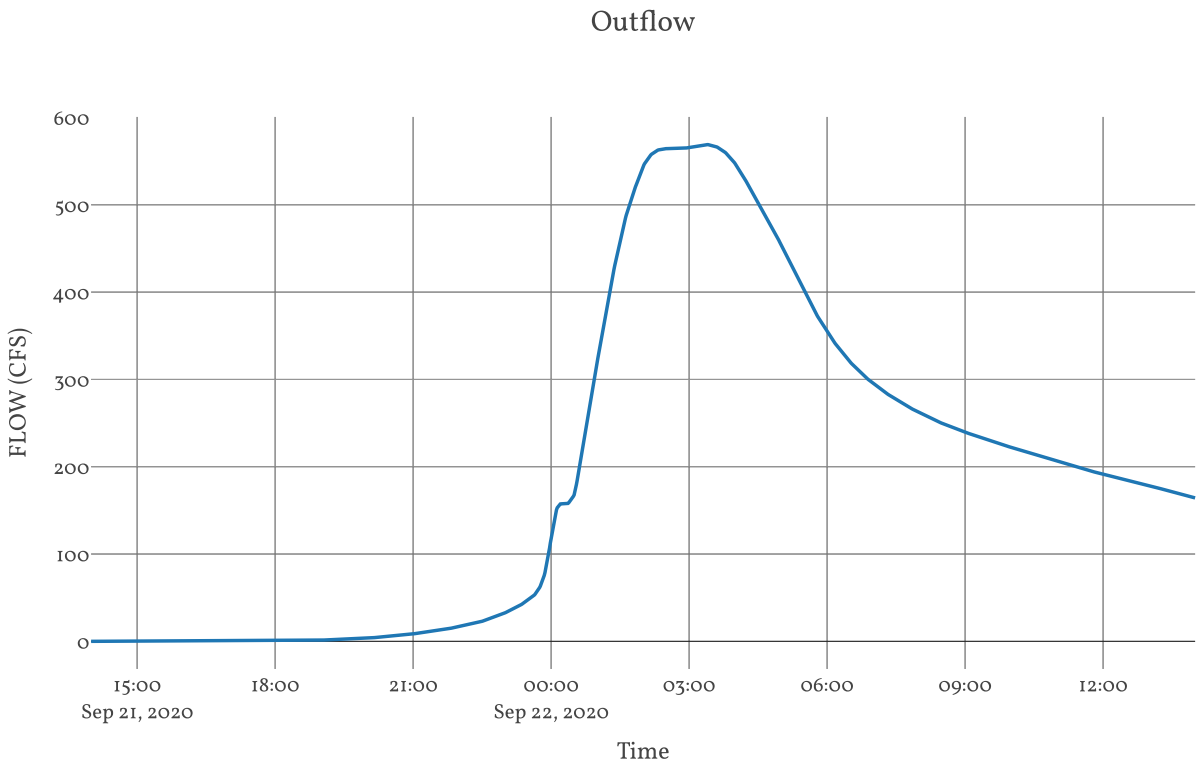
Peak Discharge (CFS)	568.99
Time of Peak Discharge	22Sep2020, 03:22
Volume (IN)	1.48



Sink: Pacific Ocean

Results: Pacific Ocean

Peak Discharge (CFS)	568.99
Time of Peak Discharge	22Sep2020, 03:22
Volume (IN)	1.48
Observed Flow Gage	Not specified
Observed Flow Volume (AC - FT)	Not specified
Observed Flow's RMSE Stdev	Not specified
Observed Flow's Percent Bias	Not specified
Observed Flow's Nash Sutcliffe	Not specified



Project: Little_Sycamore_May2021
Simulation Run: 005-yr Post-Dev
Simulation Start: 21 September 2020, 14:00
Simulation End: 22 September 2020, 14:00

HMS Version: 4.6.1
Executed: 29 April 2021, 23:41

Global Parameter Summary - Subbasin

Area

Element Name	Area
60b	0.65
61b	0.61
62b	0.53
63b	0.6
64b	1.09
65b	0.53
66b	0.16
67b	0.43
68b	0.26

Downstream

Element Name	Downstream
60b	J 60b 61b
61b	J 60b 61b
62b	17c
63b	16c
64b	20c
65b	15c
66b	14c
67b	13c
68b	12c

Loss Rate: Scs

Element Name	Percent Impervious Area	Curve Number	Initial Abstraction
60b	0	75	0.2
61b	0	75	0.2
62b	0	73.9	0.2
63b	0	74.6	0.2
64b	0	74.8	0.2
65b	0	74.4	0.2
66b	0	73.9	0.2
67b	0	73.7	0.2
68b	0	73.9	0.2

Transform: User - Specified S - Graph

Element Name	S - graph	Lag Method	Lag
60b	Ellsworth S - Graph	Specified	0.52
61b	Ellsworth S - Graph	Specified	0.37
62b	Ellsworth S - Graph	Specified	0.25
63b	Ellsworth S - Graph	Specified	0.41
64b	Ellsworth S - Graph	Specified	0.42
65b	Ellsworth S - Graph	Specified	0.24
66b	Ellsworth S - Graph	Specified	0.14
67b	Ellsworth S - Graph	Specified	0.44
68b	Ellsworth S - Graph	Specified	0.28

Global Parameter Summary - Reach

Downstream

Element Name	Downstream
18r	17c
17r	16c
16r	20c
20r	15c
15r	14c
14r	13c
13r	12c

Route: Modified Puls

Element Name	Method	Initial Variable	Number of Reaches	Storage Outflow Table Name
18r	Modified Puls	Combined Inflow	8	18r
17r	Modified Puls	Combined Inflow	4	17r
16r	Modified Puls	Combined Inflow	6	16r
20r	Modified Puls	Combined Inflow	6	20r
15r	Modified Puls	Combined Inflow	5	15r
14r	Modified Puls	Combined Inflow	5	14r
13r	Modified Puls	Combined Inflow	2	13r

Global Results Summary

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
60b	0.65	299.05	22Sep2020, 00:24	2.6
61b	0.61	344.07	22Sep2020, 00:15	2.62
J 60b 61b	1.25	625.34	22Sep2020, 00:19	2.61
18r	1.25	502.51	22Sep2020, 01:13	2.5
62b	0.53	362.49	22Sep2020, 00:08	2.56
17c	1.78	599.85	22Sep2020, 01:11	2.52
17r	1.78	552.97	22Sep2020, 01:47	2.43
63b	0.6	318.15	22Sep2020, 00:17	2.59
16c	2.38	656.9	22Sep2020, 01:44	2.47
16r	2.38	644.4	22Sep2020, 02:08	2.4
64b	1.09	571.11	22Sep2020, 00:18	2.6
20c	3.47	809.6	22Sep2020, 02:04	2.46
20r	3.47	805.05	22Sep2020, 02:20	2.42
65b	0.53	380.96	22Sep2020, 00:07	2.59
15c	4	897.56	22Sep2020, 00:44	2.45
15r	4	894.79	22Sep2020, 01:00	2.42
66b	0.16	148.29	22Sep2020, 00:02	2.57
14c	4.16	922.42	22Sep2020, 00:58	2.42
14r	4.16	921.68	22Sep2020, 01:05	2.41
67b	0.43	212.62	22Sep2020, 00:19	2.53
13c	4.59	1044.93	22Sep2020, 00:59	2.42
13r	4.59	947.29	22Sep2020, 02:07	2.32
68b	0.26	165.24	22Sep2020, 00:10	2.57

12c	4.85	980.23	22Sep2020, 02:04	2.33
Pacific Ocean	4.85	980.23	22Sep2020, 02:04	2.33

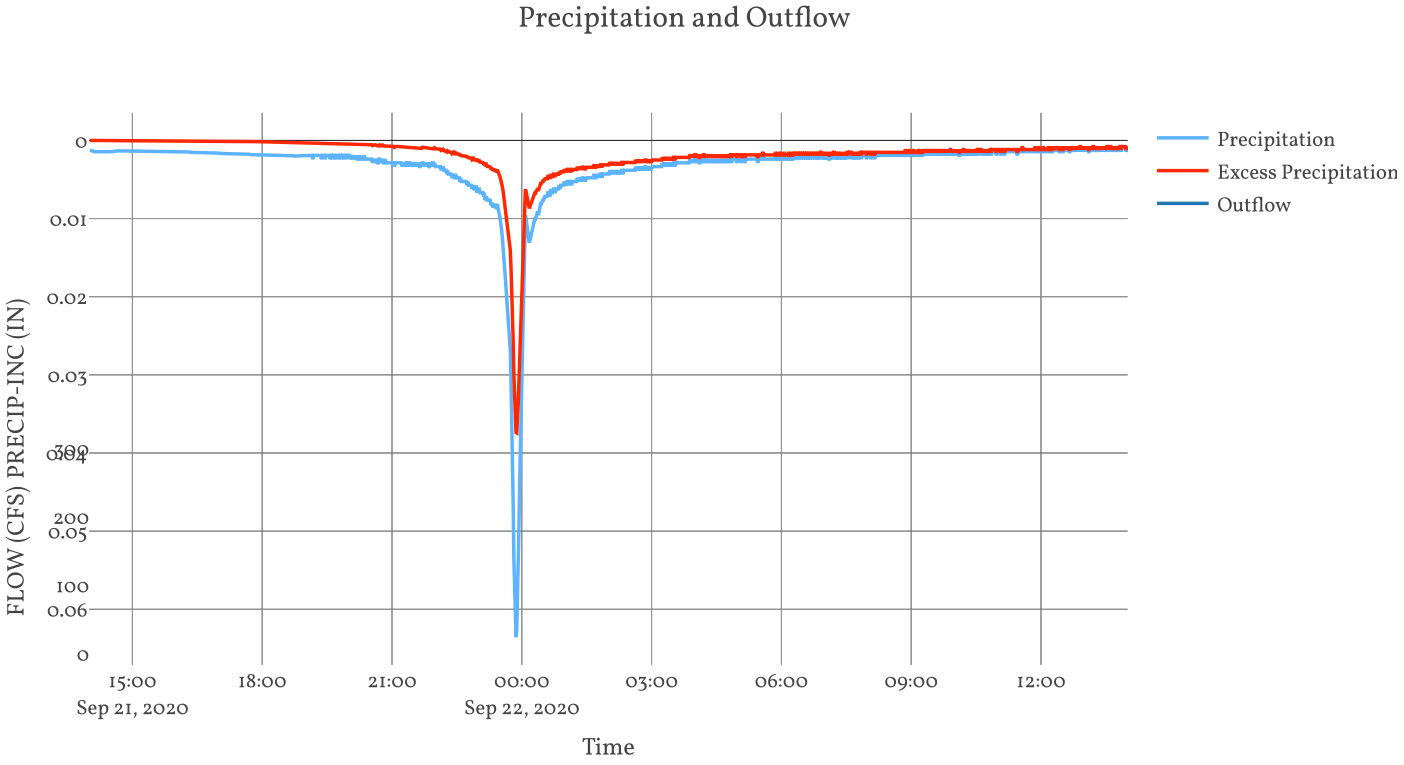
Subbasin: 60B

Area : 0.65
Downstream : J 60b 61b

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	75
Initial Abstraction	0.2

Transform: User - Specified S - Graph	
S - graph	Ellsworth S - Graph
Lag Method	Specified
Lag	0.52

Results: 60B	
Peak Discharge (CFS)	299.05
Time of Peak Discharge	22Sep2020, 00:24
Volume (IN)	2.6
Precipitation Volume (AC - FT)	164.43
Loss Volume (AC - FT)	73.25
Excess Volume (AC - FT)	91.19
Direct Runoff Volume (AC - FT)	89.51
Baseflow Volume (AC - FT)	0


Precipitation and Outflow
FLOW (CFS) PRECIP-INC (IN)
0
0.01
0.02
0.03
0.04
0.05
0.06
300
200
100
0
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
Sep 21, 2020
Sep 22, 2020
Time
Precipitation
Excess Precipitation
Outflow

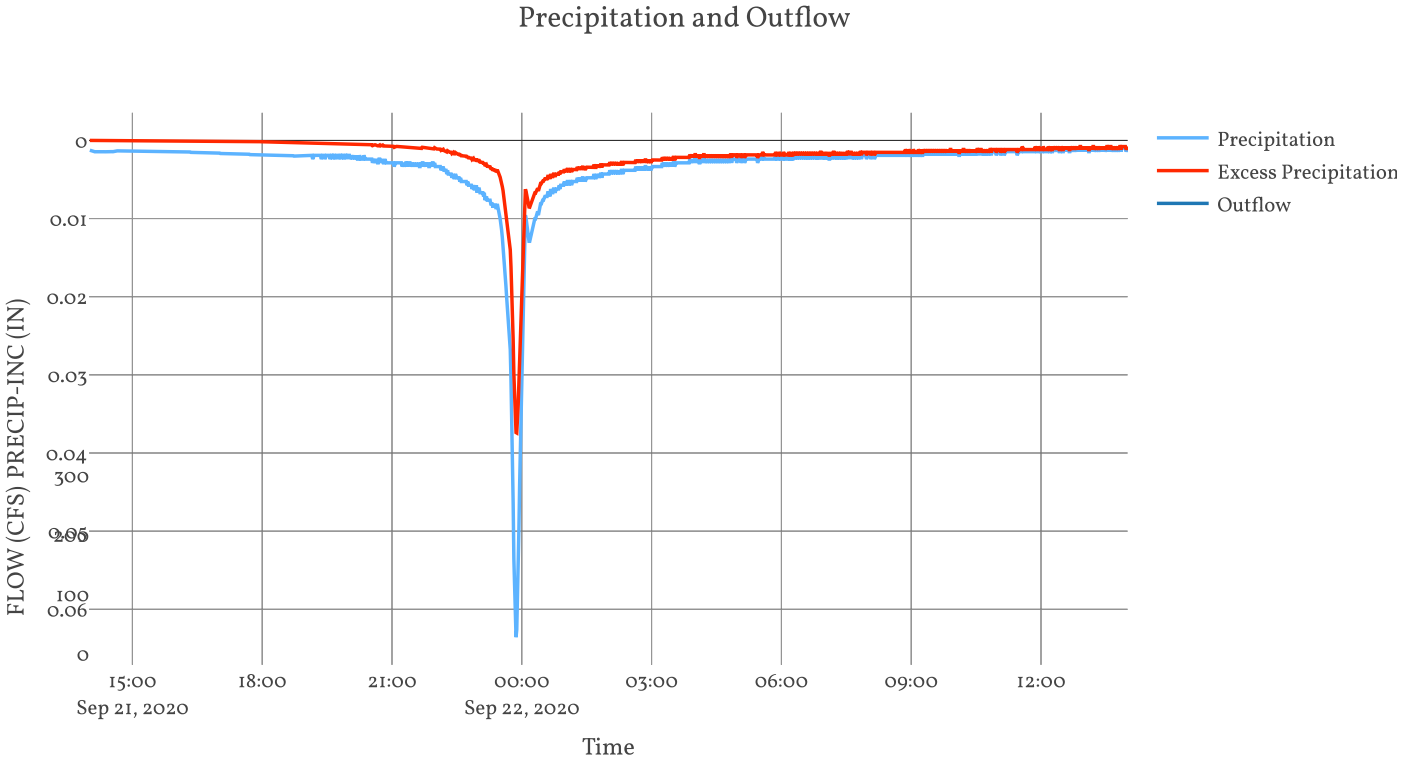
Subbasin: 61B

Area : 0.61
Downstream : J 60b 61b

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	75
Initial Abstraction	0.2

Transform: User - Specified S - Graph	
S - graph	Ellsworth S - Graph
Lag Method	Specified
Lag	0.37

Results: 61B	
Peak Discharge (CFS)	344.07
Time of Peak Discharge	22Sep2020, 00:15
Volume (IN)	2.62
Precipitation Volume (AC - FT)	154.49
Loss Volume (AC - FT)	68.82
Excess Volume (AC - FT)	85.67
Direct Runoff Volume (AC - FT)	84.58
Baseflow Volume (AC - FT)	0

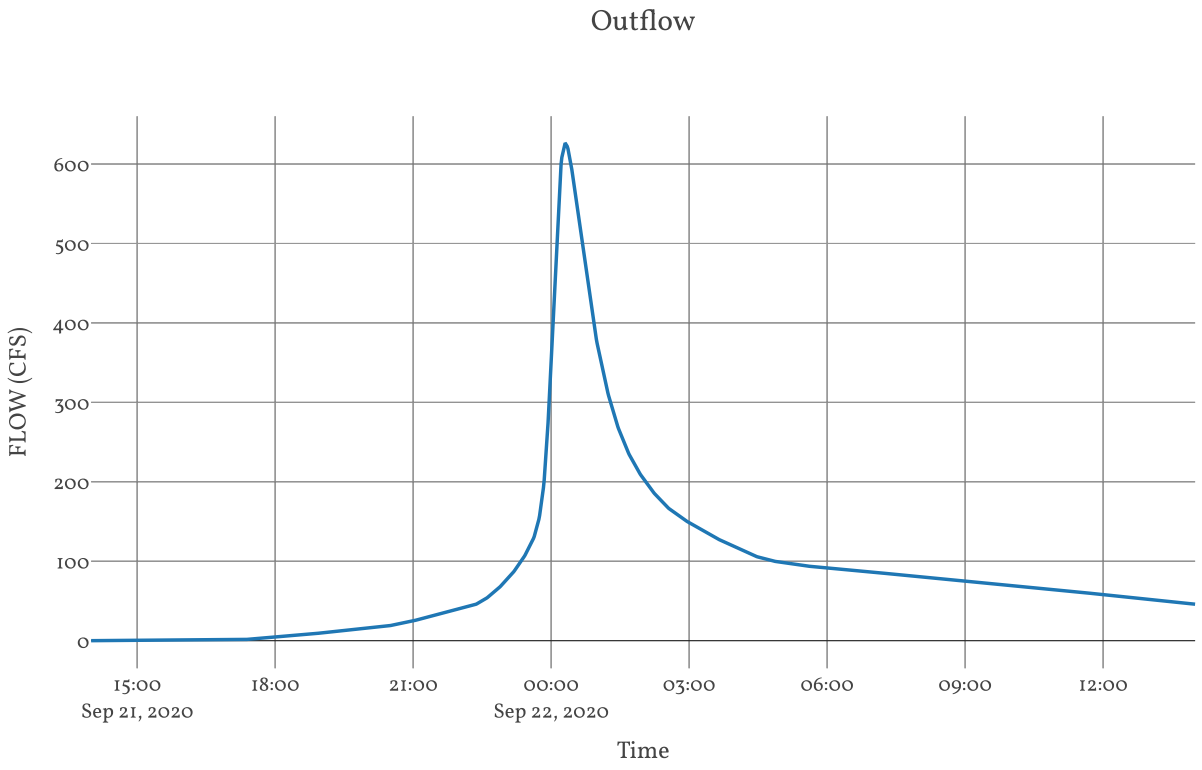

Precipitation and Outflow
FLOW (CFS) PRECIP-INC (IN)
0
0.01
0.02
0.03
0.04
300
200
100
0.06
0
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
Sep 21, 2020
Sep 22, 2020
Time
Precipitation
Excess Precipitation
Outflow

Junction: J 60B 61B

Downstream : 18r

Results: J 60B 61B

Peak Discharge (CFS)	625.34
Time of Peak Discharge	22Sep2020, 00:19
Volume (IN)	2.61



Reach: 18R

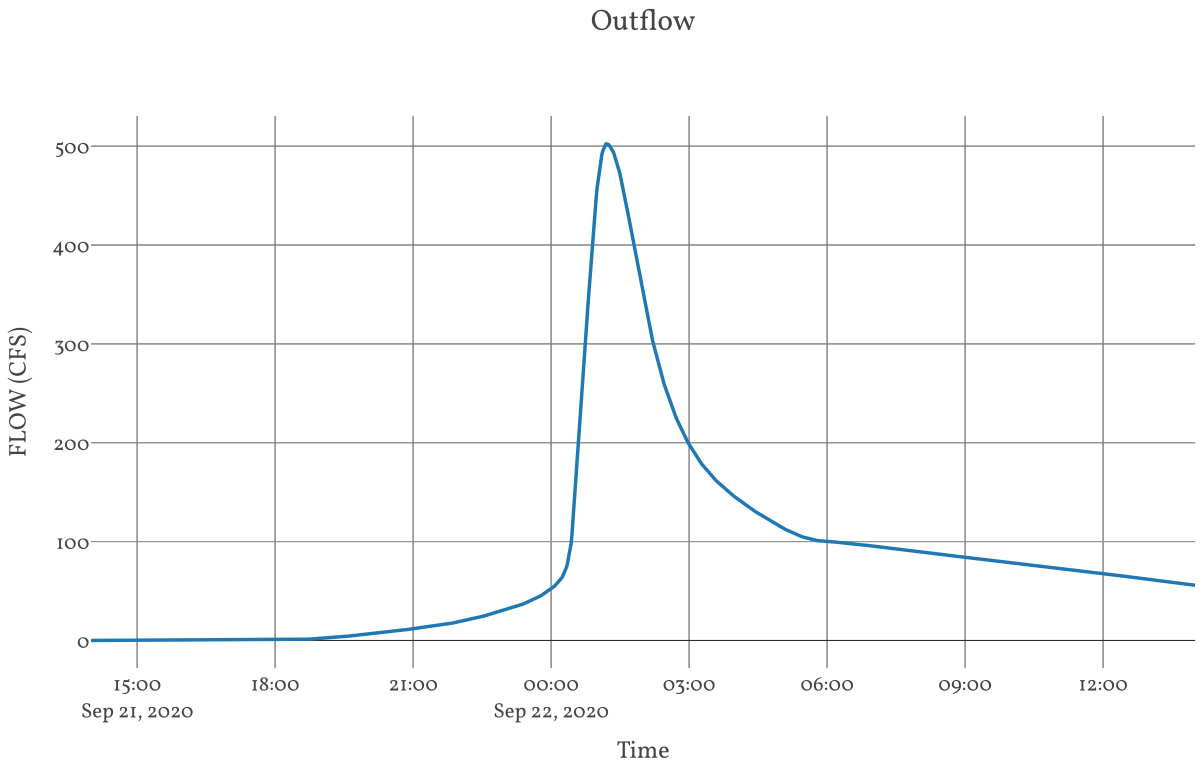
Downstream : 17c

Route: Modified Puls

Method	Modified Puls
Initial Variable	Combined Inflow
Number of Reaches	8
Storage Outflow Table Name	18r

Results: 18R

Peak Discharge (CFS)	502.51
Time of Peak Discharge	22Sep2020, 01:13
Volume (IN)	2.5
Peak Inflow (CFS)	625.34
Inflow Volume (AC - FT)	174.09



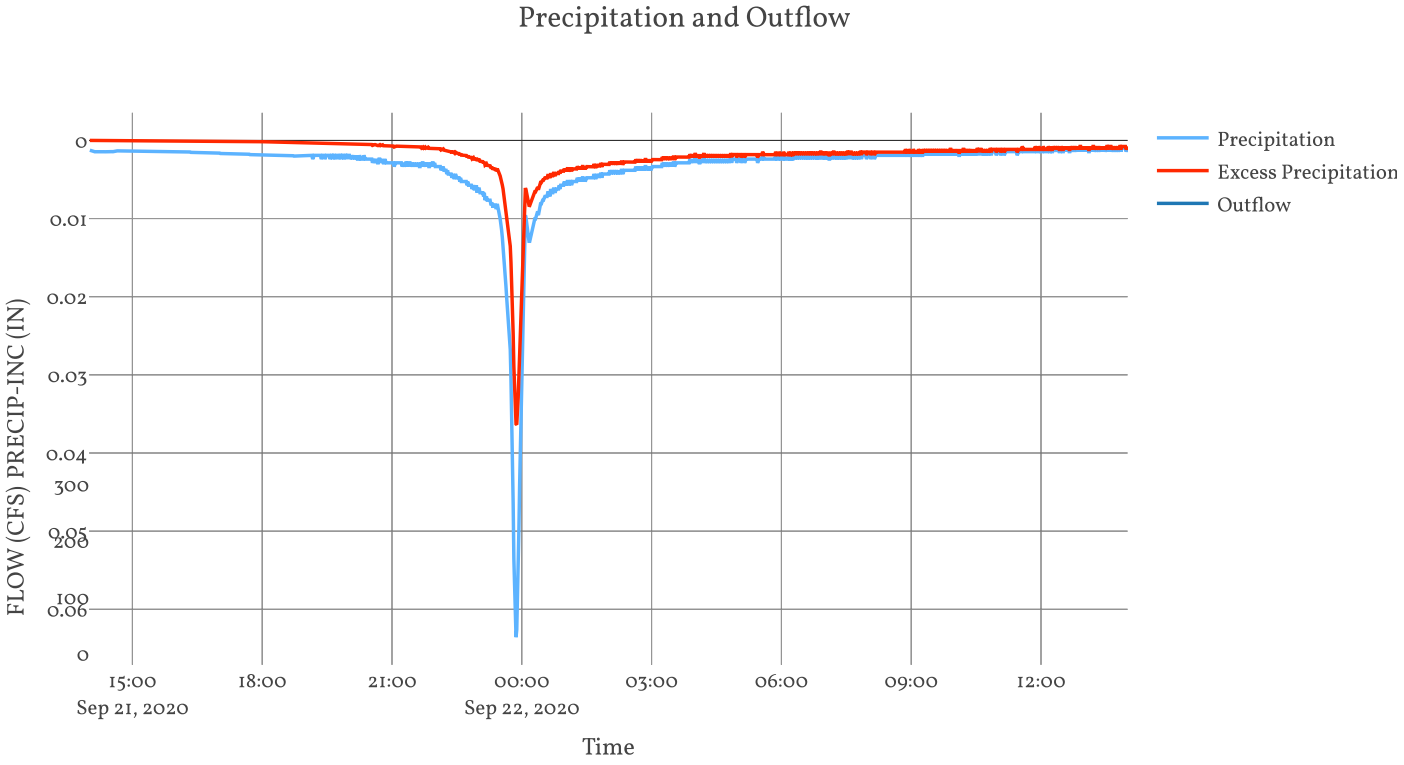
Subbasin: 62B

Area : 0.53
Downstream : 17c

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	73.9
Initial Abstraction	0.2

Transform: User - Specified S - Graph	
S - graph	Ellsworth S - Graph
Lag Method	Specified
Lag	0.25

Results: 62B	
Peak Discharge (CFS)	362.49
Time of Peak Discharge	22Sep2020, 00:08
Volume (IN)	2.56
Precipitation Volume (AC - FT)	133.99
Loss Volume (AC - FT)	61.5
Excess Volume (AC - FT)	72.49
Direct Runoff Volume (AC - FT)	71.87
Baseflow Volume (AC - FT)	0

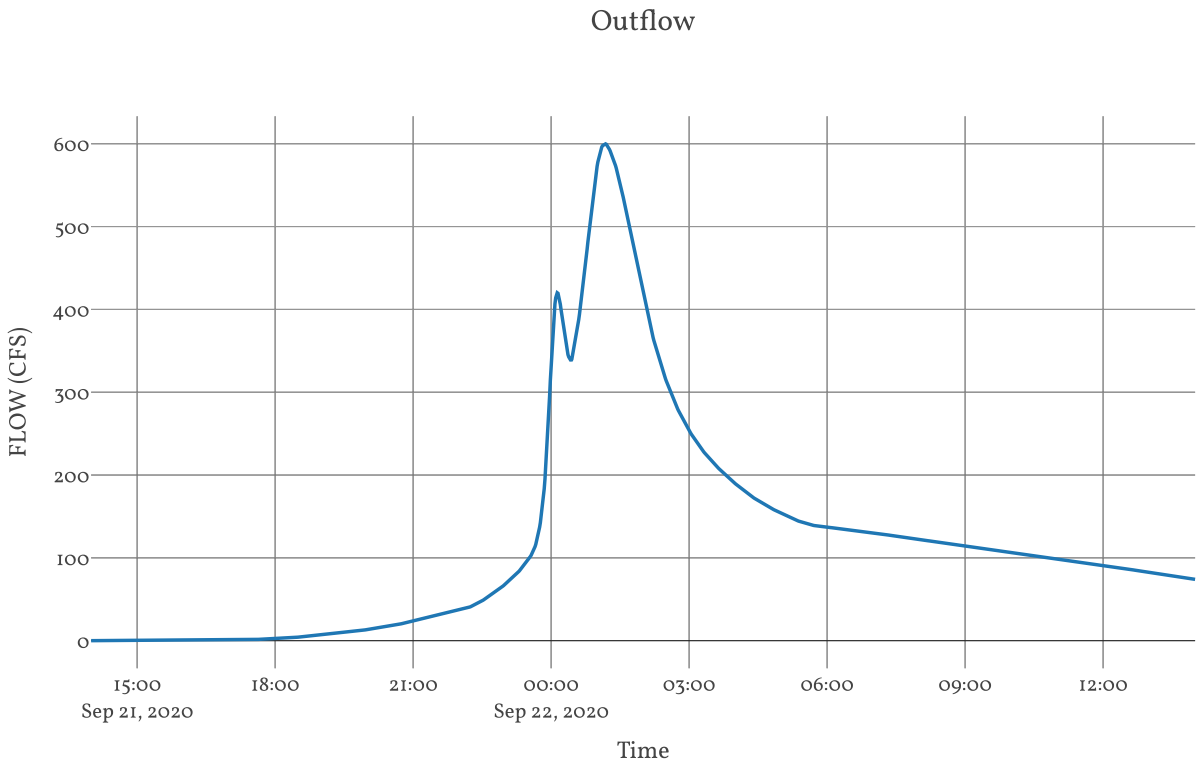

Precipitation and Outflow
FLOW (CFS) PRECIP-INC (IN)
0
0.01
0.02
0.03
0.04
300
0.05
200
100
0.06
0
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
Sep 21, 2020
Sep 22, 2020
Time
Precipitation
Excess Precipitation
Outflow

Junction: 17C

Downstream : 17r

Results: 17C

Peak Discharge (CFS)	599.85
Time of Peak Discharge	22Sep2020, 01:11
Volume (IN)	2.52



Reach: 17R

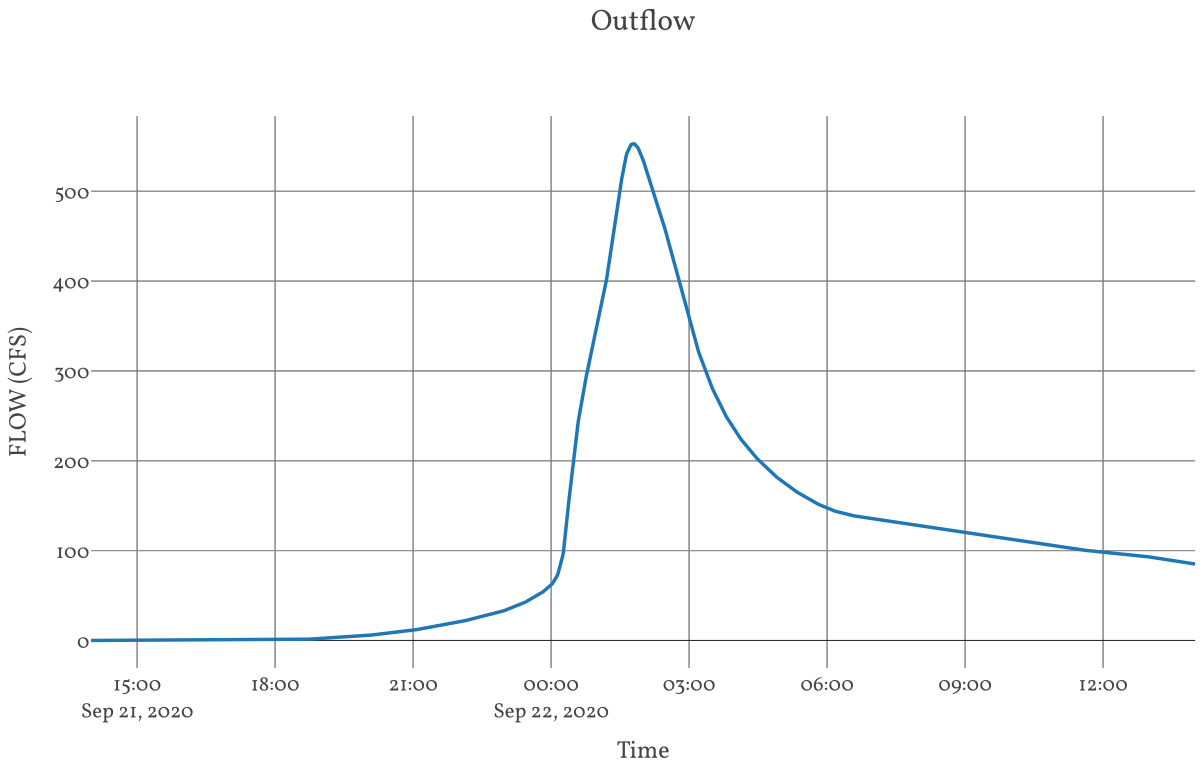
Downstream : 16c

Route: Modified Puls

Method	Modified Puls
Initial Variable	Combined Inflow
Number of Reaches	4
Storage Outflow Table Name	17r

Results: 17R

Peak Discharge (CFS)	552.97
Time of Peak Discharge	22Sep2020, 01:47
Volume (IN)	2.43
Peak Inflow (CFS)	599.85
Inflow Volume (AC - FT)	238.98



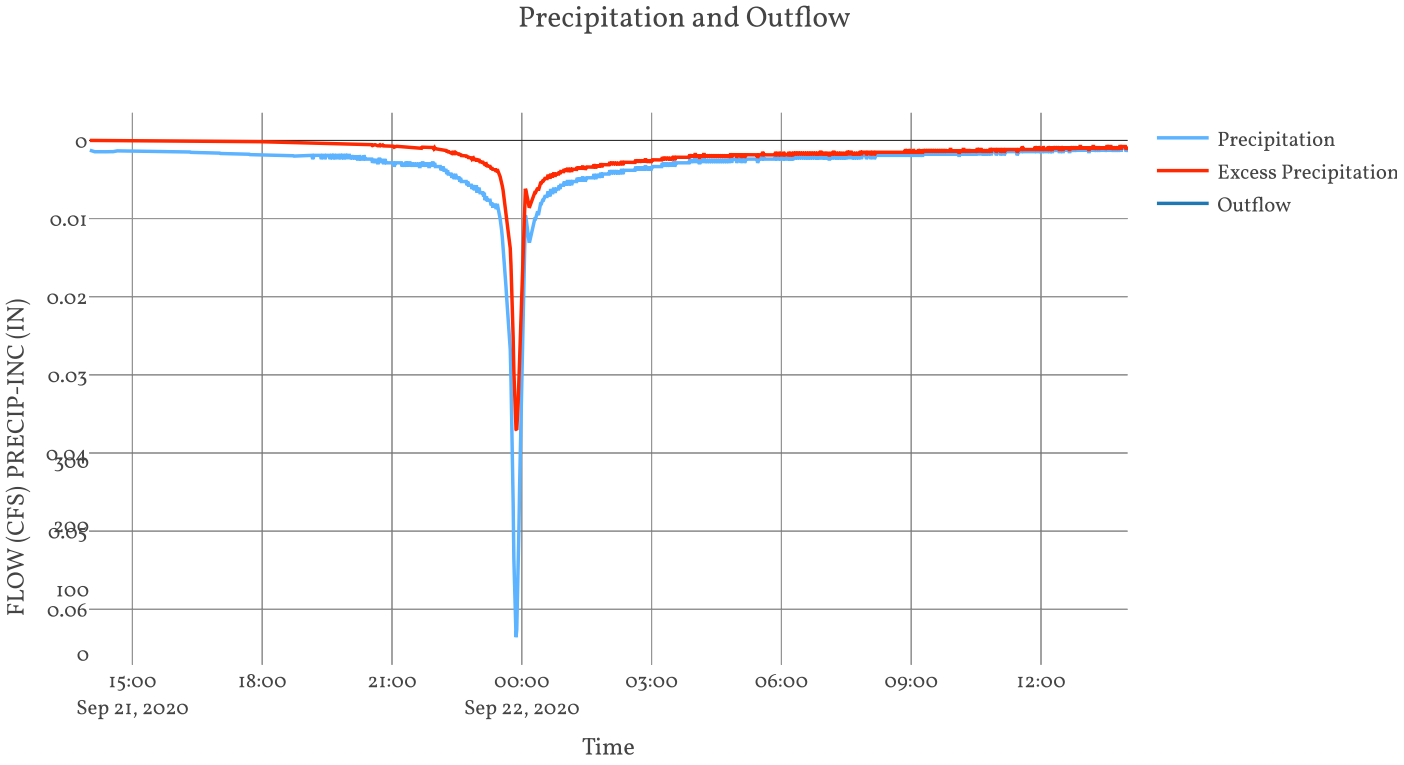
Subbasin: 63B

Area : 0.6
Downstream : 16c

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	74.6
Initial Abstraction	0.2

Transform: User - Specified S - Graph	
S - graph	Ellsworth S - Graph
Lag Method	Specified
Lag	0.41

Results: 63B	
Peak Discharge (CFS)	318.15
Time of Peak Discharge	22Sep2020, 00:17
Volume (IN)	2.59
Precipitation Volume (AC - FT)	153.47
Loss Volume (AC - FT)	69.12
Excess Volume (AC - FT)	84.35
Direct Runoff Volume (AC - FT)	83.14
Baseflow Volume (AC - FT)	0

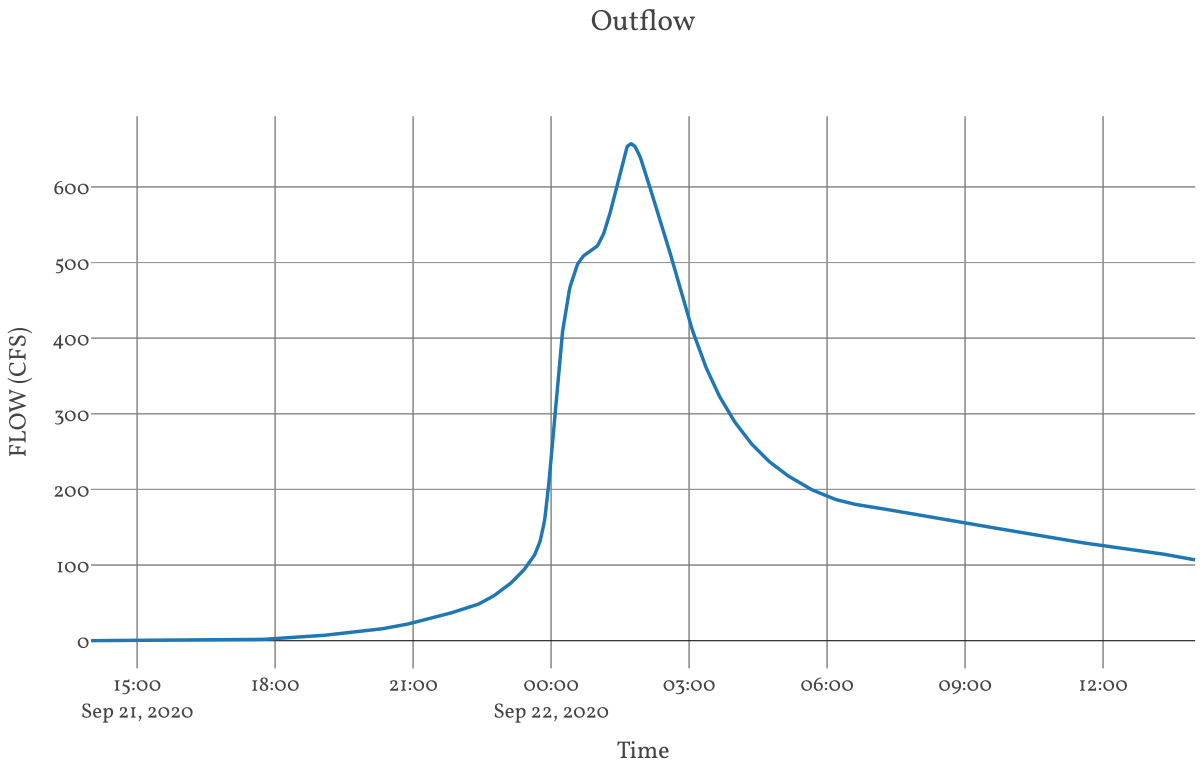

Precipitation and Outflow
FLOW (CFS) PRECIP-INC (IN)
0
0.01
0.02
0.03
0.04
0.05
0.06
300
200
100
0
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
Sep 21, 2020
Sep 22, 2020
Time
Precipitation
Excess Precipitation
Outflow

Junction: 16C

Downstream : 16r

Results: 16C

Peak Discharge (CFS)	656.9
Time of Peak Discharge	22Sep2020, 01:44
Volume (IN)	2.47



Reach: 16R

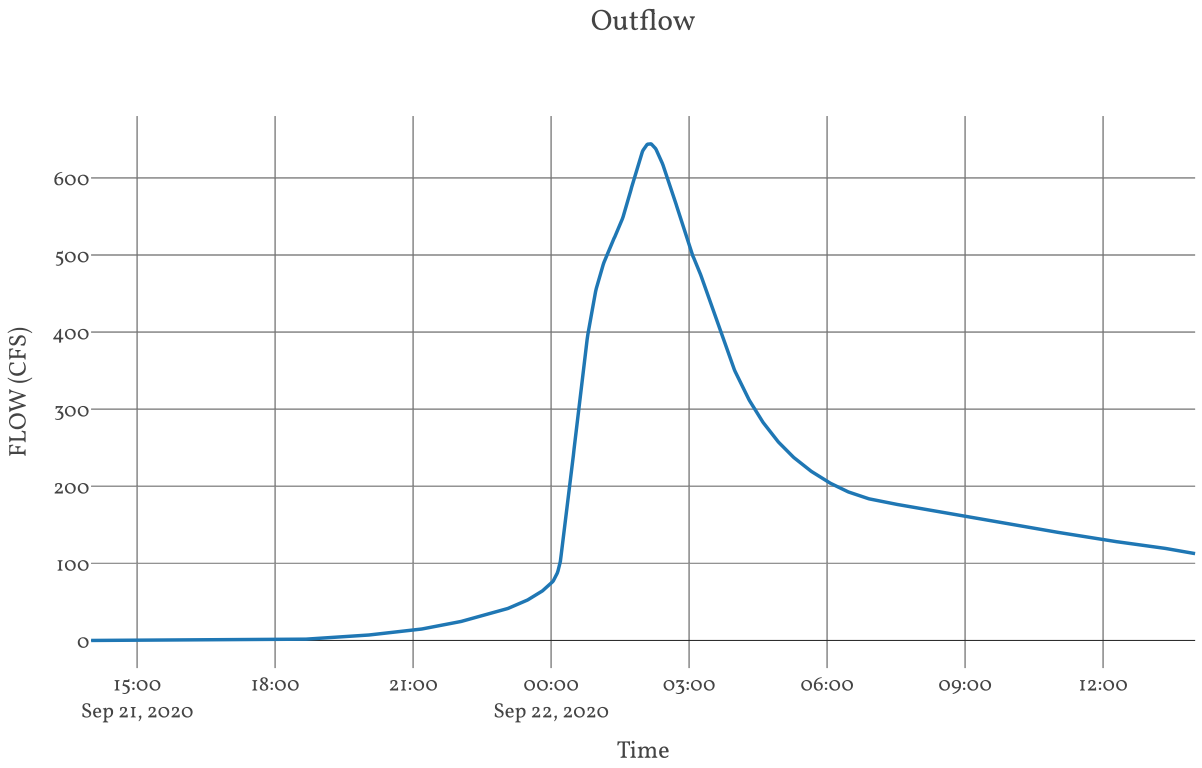
Downstream : 20C

Route: Modified Puls

Method	Modified Puls
Initial Variable	Combined Inflow
Number of Reaches	6
Storage Outflow Table Name	16r

Results: 16R

Peak Discharge (CFS)	644.4
Time of Peak Discharge	22Sep2020, 02:08
Volume (IN)	2.4
Peak Inflow (CFS)	656.9
Inflow Volume (AC - FT)	313.31



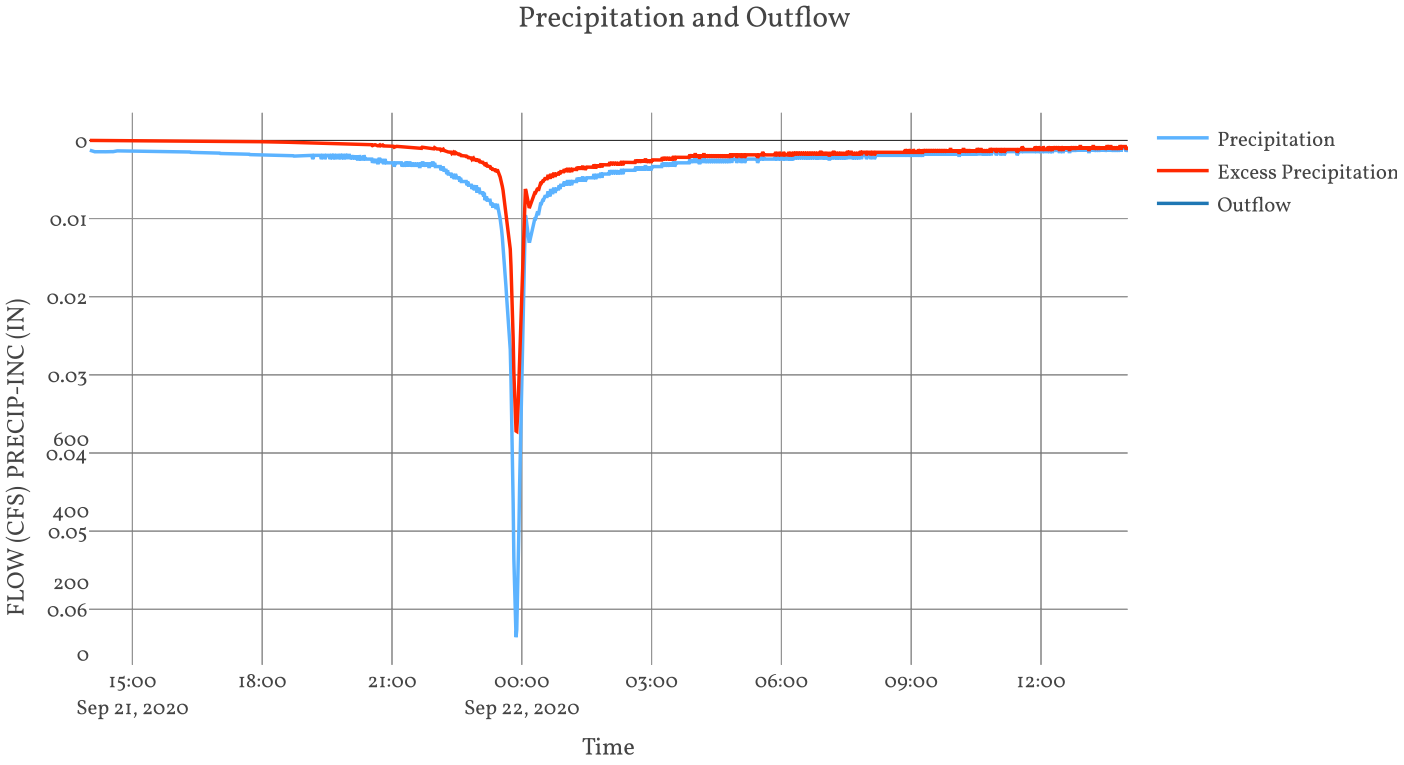
Subbasin: 64B

Area : 1.09
Downstream : 20c

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	74.8
Initial Abstraction	0.2

Transform: User - Specified S - Graph	
S - graph	Ellsworth S - Graph
Lag Method	Specified
Lag	0.42

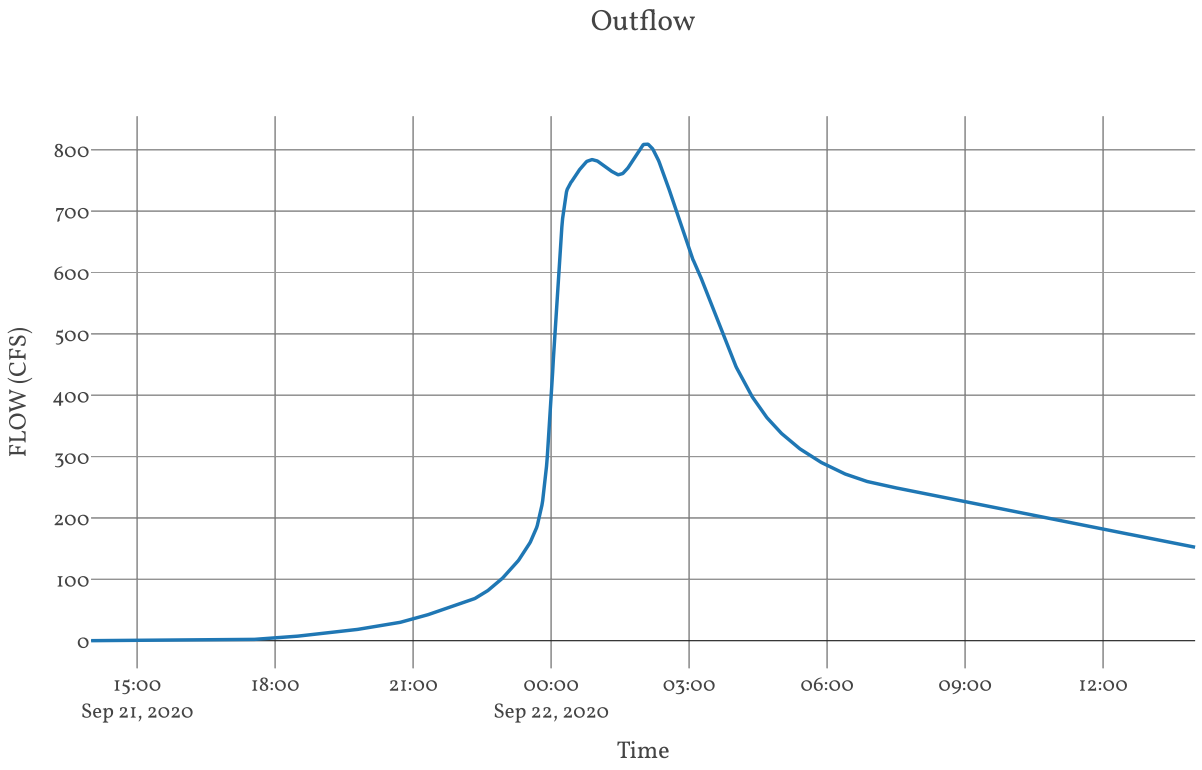
Results: 64B	
Peak Discharge (CFS)	571.11
Time of Peak Discharge	22Sep2020, 00:18
Volume (IN)	2.6
Precipitation Volume (AC - FT)	277.88
Loss Volume (AC - FT)	124.47
Excess Volume (AC - FT)	153.41
Direct Runoff Volume (AC - FT)	151.16
Baseflow Volume (AC - FT)	0


Precipitation and Outflow
FLOW (CFS) PRECIP-INC (IN)
0
0.01
0.02
0.03
600
0.04
400
0.05
200
0.06
0
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
Sep 21, 2020
Sep 22, 2020
Time
Precipitation
Excess Precipitation
Outflow

Junction: 20C

Downstream : 20r

Results: 20C	
Peak Discharge (CFS)	809.6
Time of Peak Discharge	22Sep2020, 02:04
Volume (IN)	2.46



Reach: 20R

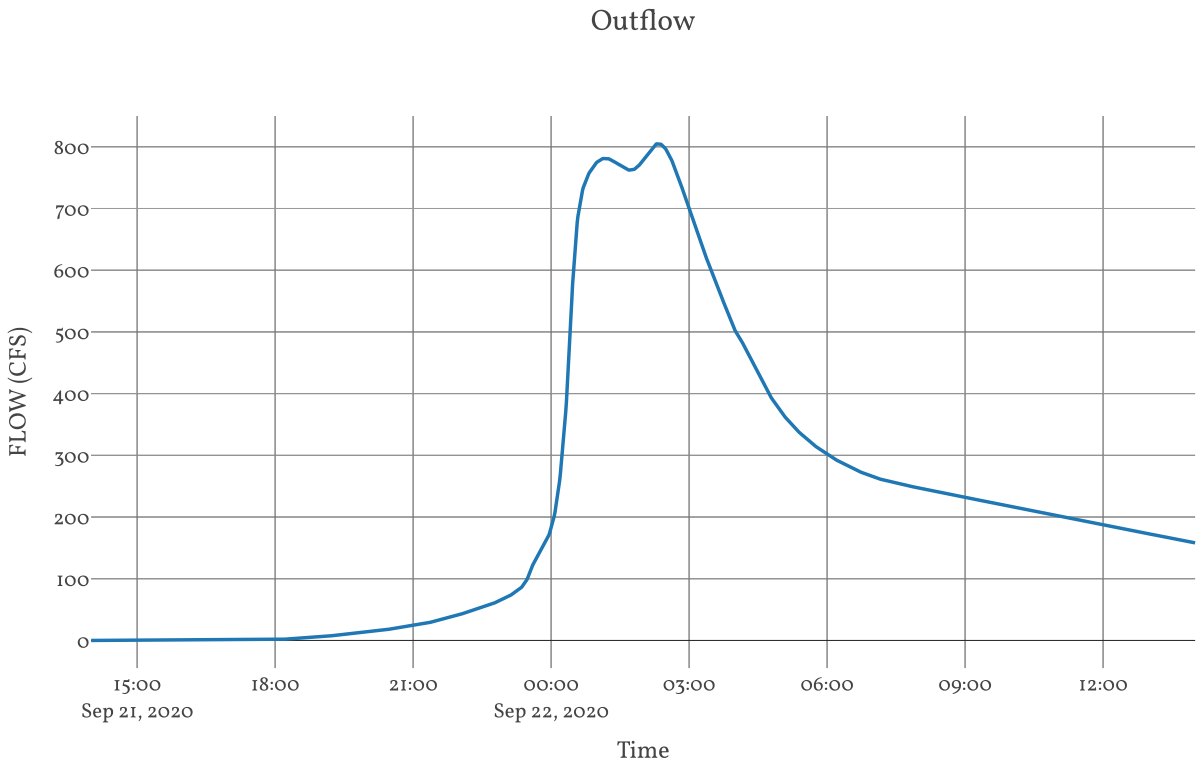
Downstream : 15C

Route: Modified Puls

Method	Modified Puls
Initial Variable	Combined Inflow
Number of Reaches	6
Storage Outflow Table Name	20r

Results: 20R

Peak Discharge (CFS)	805.05
Time of Peak Discharge	22Sep2020, 02:20
Volume (IN)	2.42
Peak Inflow (CFS)	809.6
Inflow Volume (AC - FT)	455.71



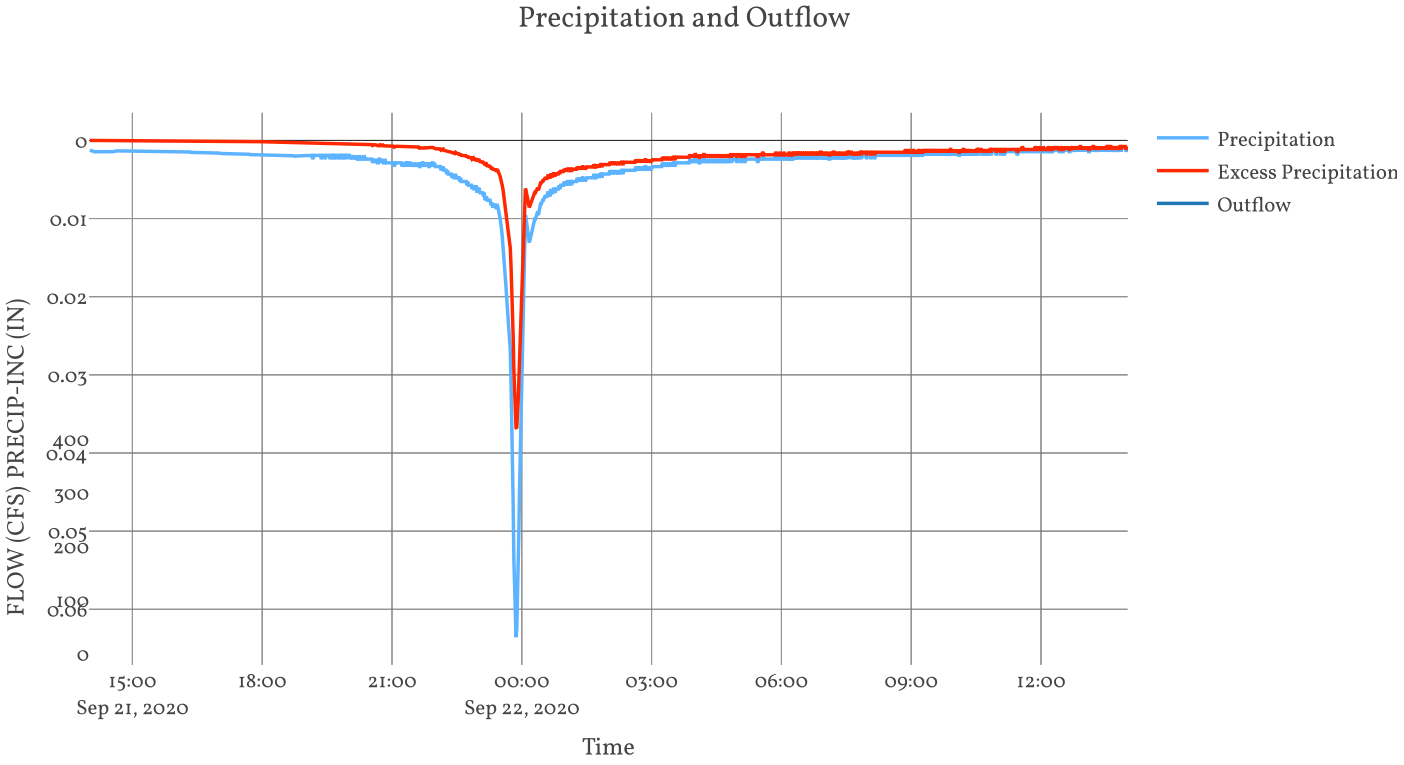
Subbasin: 65B

Area : 0.53
Downstream : 15c

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	74.4
Initial Abstraction	0.2

Transform: User - Specified S - Graph	
S - graph	Ellsworth S - Graph
Lag Method	Specified
Lag	0.24

Results: 65B	
Peak Discharge (CFS)	380.96
Time of Peak Discharge	22Sep2020, 00:07
Volume (IN)	2.59
Precipitation Volume (AC - FT)	135.88
Loss Volume (AC - FT)	61.54
Excess Volume (AC - FT)	74.34
Direct Runoff Volume (AC - FT)	73.74
Baseflow Volume (AC - FT)	0

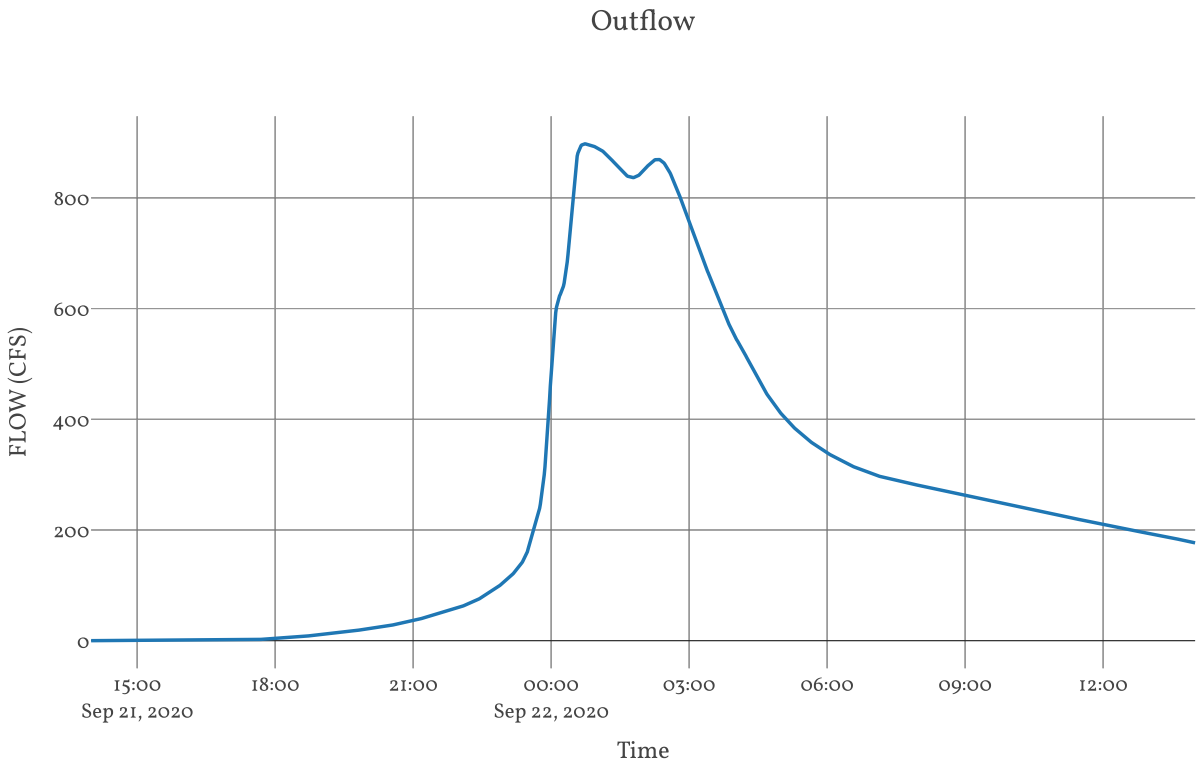

Precipitation and Outflow
FLOW (CFS) PRECIP-INC (IN)
0
0.01
0.02
0.03
400
0.04
300
0.05
200
100
0.06
0
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
Sep 21, 2020
Sep 22, 2020
Time
Precipitation
Excess Precipitation
Outflow

Junction: 15C

Downstream : 15r

Results: 15C

Peak Discharge (CFS)	897.56
Time of Peak Discharge	22Sep2020, 00:44
Volume (IN)	2.45



Reach: 15R

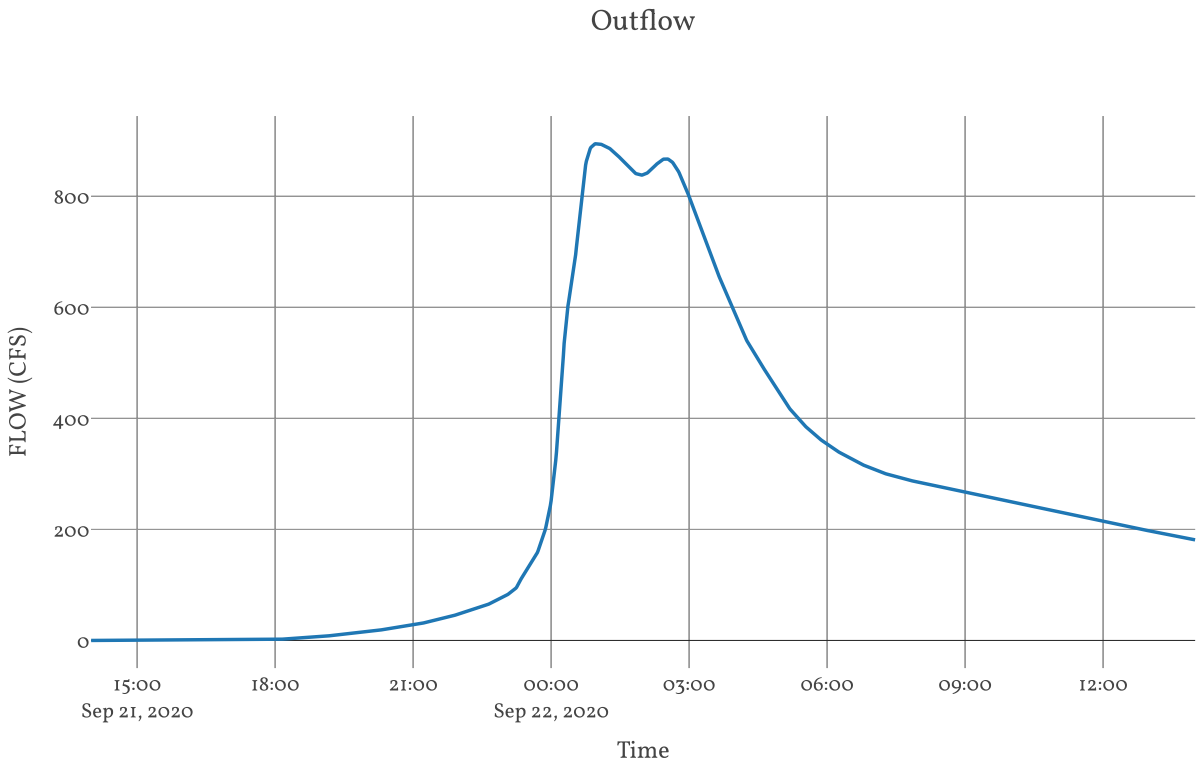
Downstream : 14c

Route: Modified Puls

Method	Modified Puls
Initial Variable	Combined Inflow
Number of Reaches	5
Storage Outflow Table Name	15r

Results: 15R

Peak Discharge (CFS)	894.79
Time of Peak Discharge	22Sep2020, 01:00
Volume (IN)	2.42
Peak Inflow (CFS)	897.56
Inflow Volume (AC - FT)	521.85



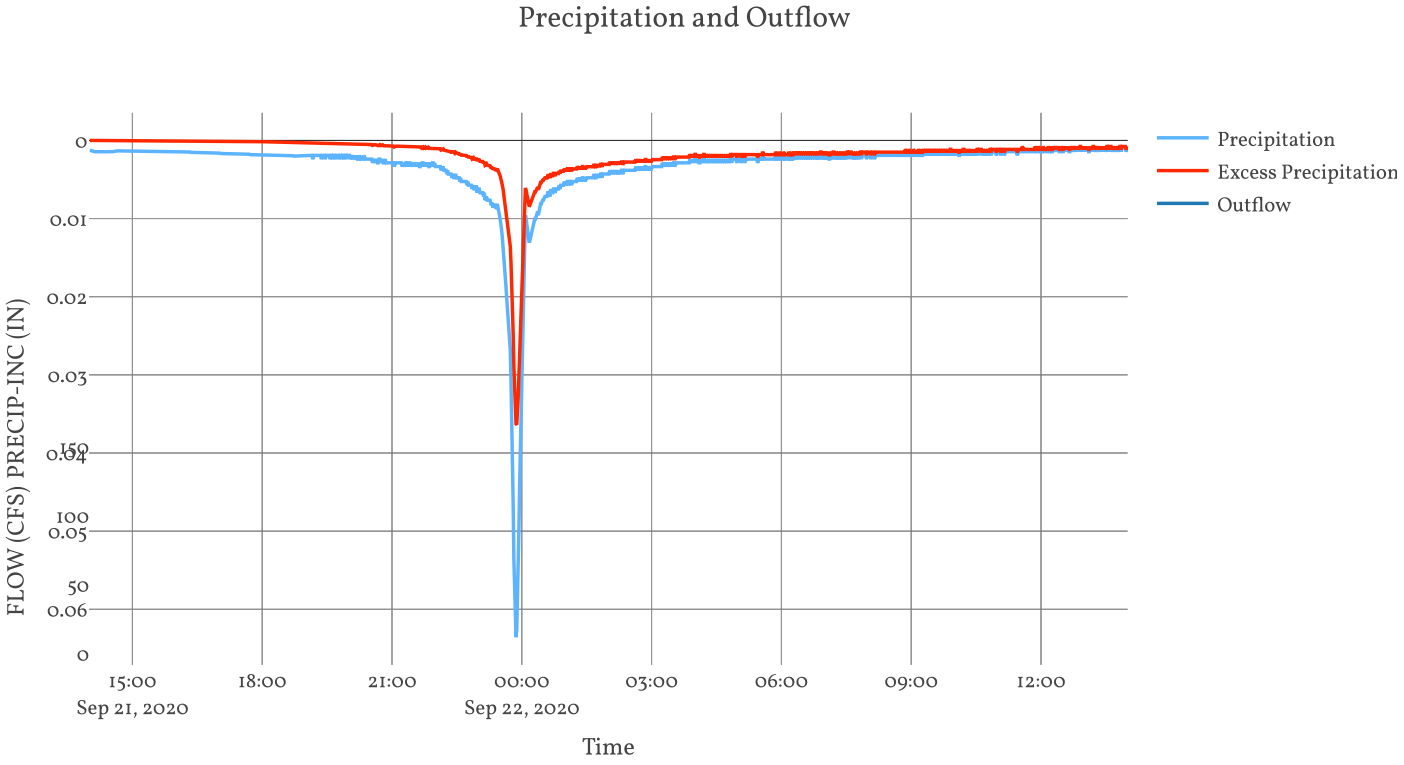
Subbasin: 66B

Area : 0.16
Downstream : 14c

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	73.9
Initial Abstraction	0.2

Transform: User - Specified S - Graph	
S - graph	Ellsworth S - Graph
Lag Method	Specified
Lag	0.14

Results: 66B	
Peak Discharge (CFS)	148.29
Time of Peak Discharge	22Sep2020, 00:02
Volume (IN)	2.57
Precipitation Volume (AC - FT)	41.3
Loss Volume (AC - FT)	18.96
Excess Volume (AC - FT)	22.34
Direct Runoff Volume (AC - FT)	22.24
Baseflow Volume (AC - FT)	0

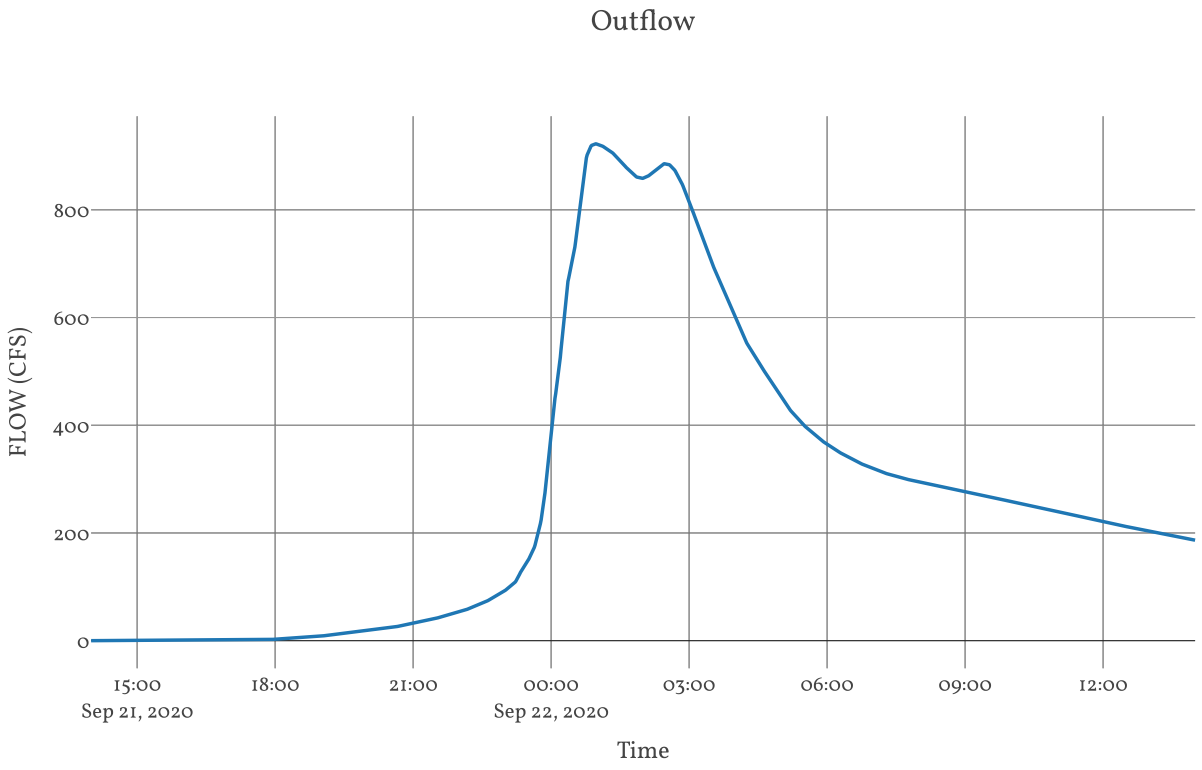

Precipitation and Outflow
FLOW (CFS) PRECIP-INC (IN)
0
0.01
0.02
0.03
0.04
0.05
0.06
0
150
100
50
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
Sep 21, 2020
Sep 22, 2020
Time
Precipitation
Excess Precipitation
Outflow

Junction: 14C

Downstream : 14r

Results: 14C

Peak Discharge (CFS)	922.42
Time of Peak Discharge	22Sep2020, 00:58
Volume (IN)	2.42



Reach: 14R

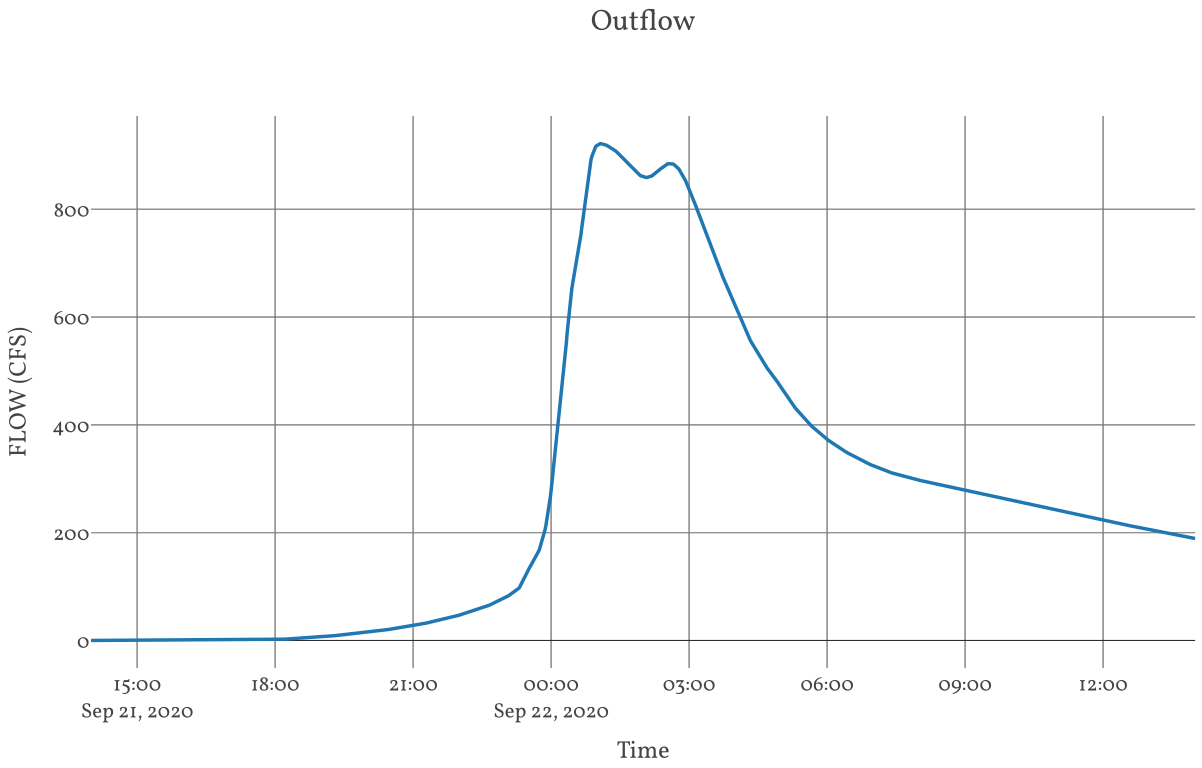
Downstream : 13c

Route: Modified Puls

Method	Modified Puls
Initial Variable	Combined Inflow
Number of Reaches	5
Storage Outflow Table Name	14r

Results: 14R

Peak Discharge (CFS)	921.68
Time of Peak Discharge	22Sep2020, 01:05
Volume (IN)	2.41
Peak Inflow (CFS)	922.42
Inflow Volume (AC - FT)	538.39



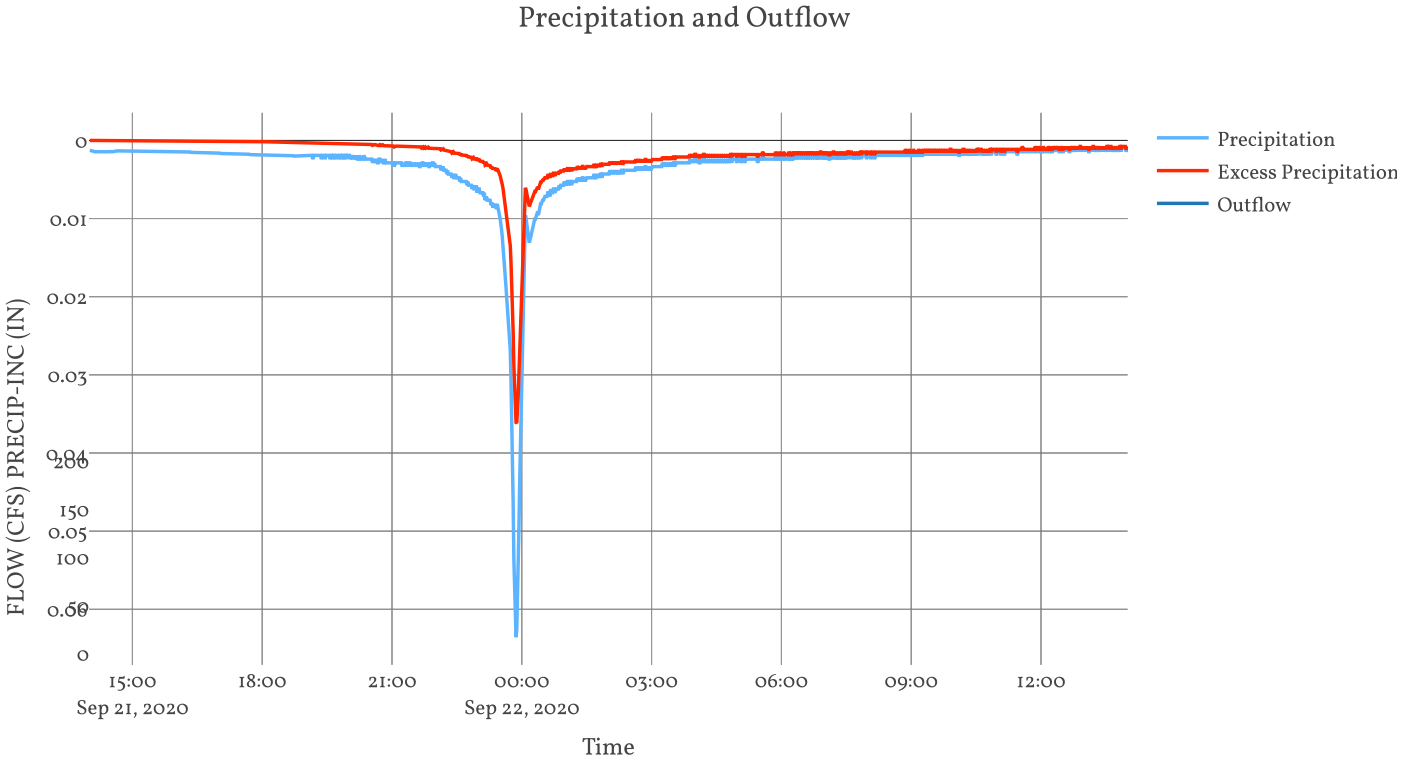
Subbasin: 67B

Area : 0.43
Downstream : 13c

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	73.7
Initial Abstraction	0.2

Transform: User - Specified S - Graph	
S - graph	Ellsworth S - Graph
Lag Method	Specified
Lag	0.44

Results: 67B	
Peak Discharge (CFS)	212.62
Time of Peak Discharge	22Sep2020, 00:19
Volume (IN)	2.53
Precipitation Volume (AC - FT)	109.62
Loss Volume (AC - FT)	50.59
Excess Volume (AC - FT)	59.04
Direct Runoff Volume (AC - FT)	58.12
Baseflow Volume (AC - FT)	0

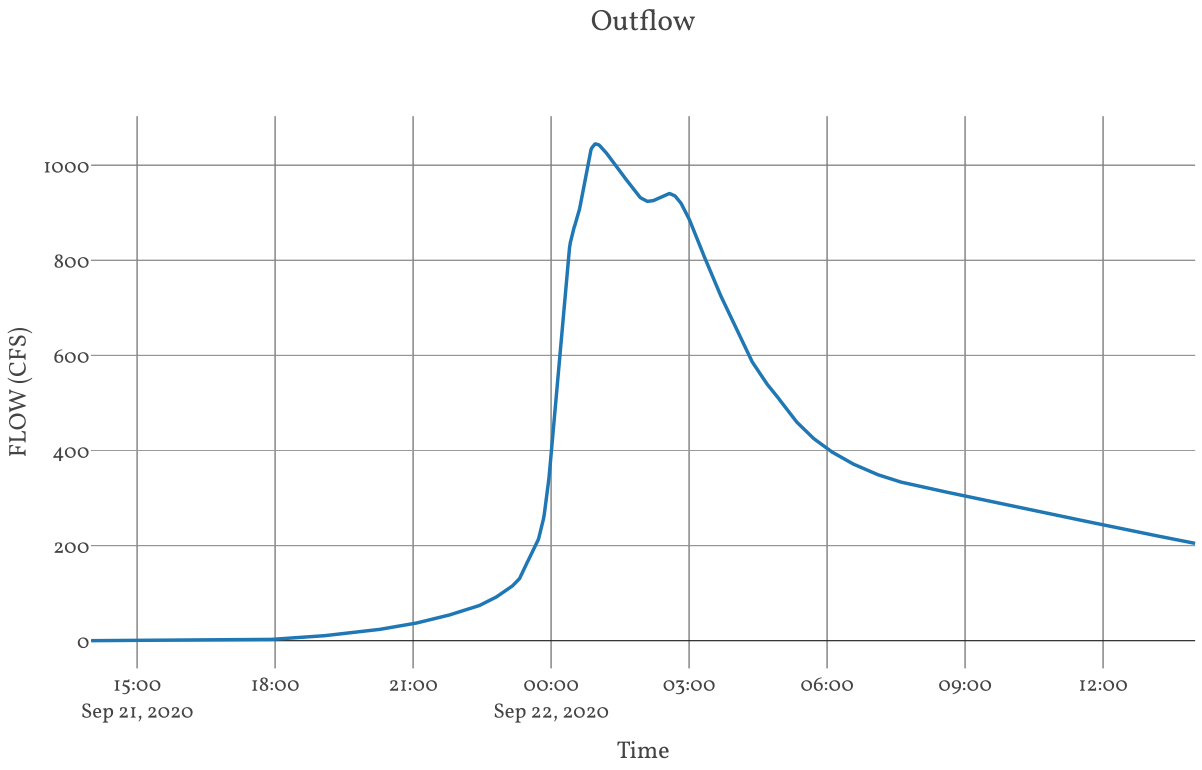

Precipitation and Outflow
FLOW (CFS) PRECIP-INC (IN)
0
0.01
0.02
0.03
0.04
0.05
0
200
150
100
50
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
Sep 21, 2020
Sep 22, 2020
Time
Precipitation
Excess Precipitation
Outflow

Junction: 13C

Downstream : 13r

Results: 13C

Peak Discharge (CFS)	1044.93
Time of Peak Discharge	22Sep2020, 00:59
Volume (IN)	2.42



Reach: 13R

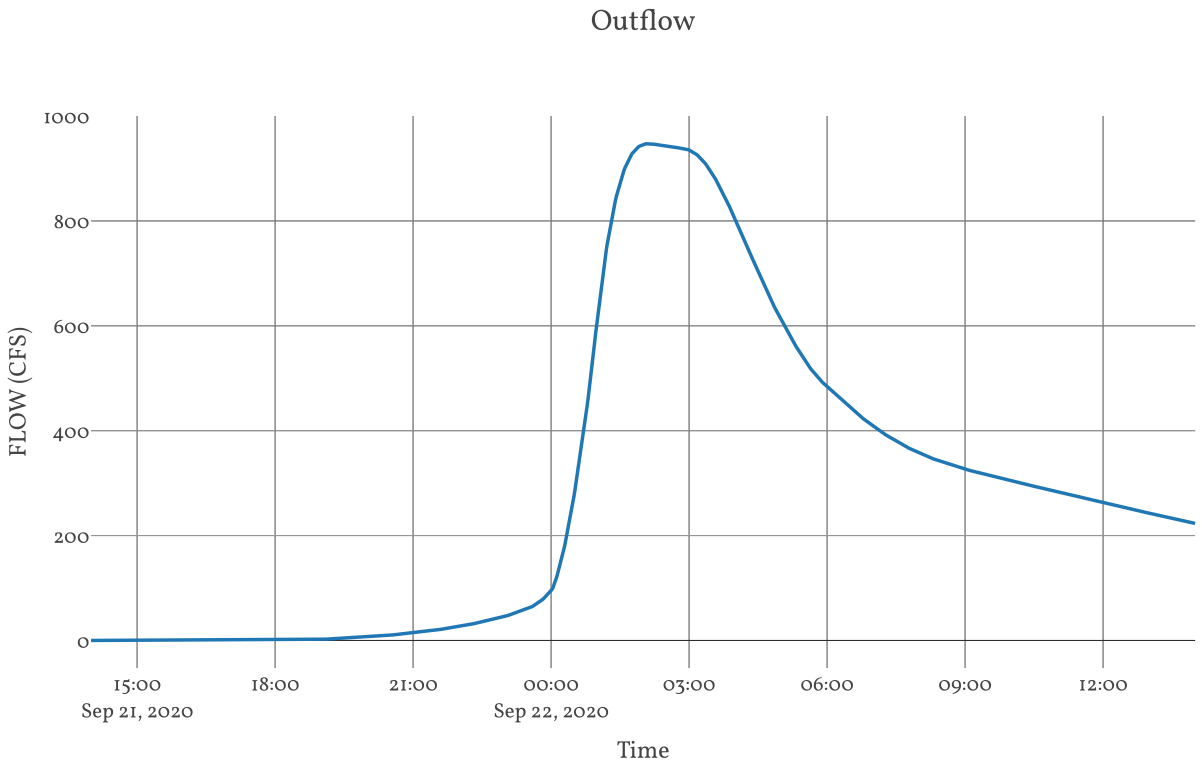
Downstream : 12C

Route: Modified Puls

Method	Modified Puls
Initial Variable	Combined Inflow
Number of Reaches	2
Storage Outflow Table Name	13r

Results: 13R

Peak Discharge (CFS)	947.29
Time of Peak Discharge	22Sep2020, 02:07
Volume (IN)	2.32
Peak Inflow (CFS)	1044.93
Inflow Volume (AC - FT)	593.29



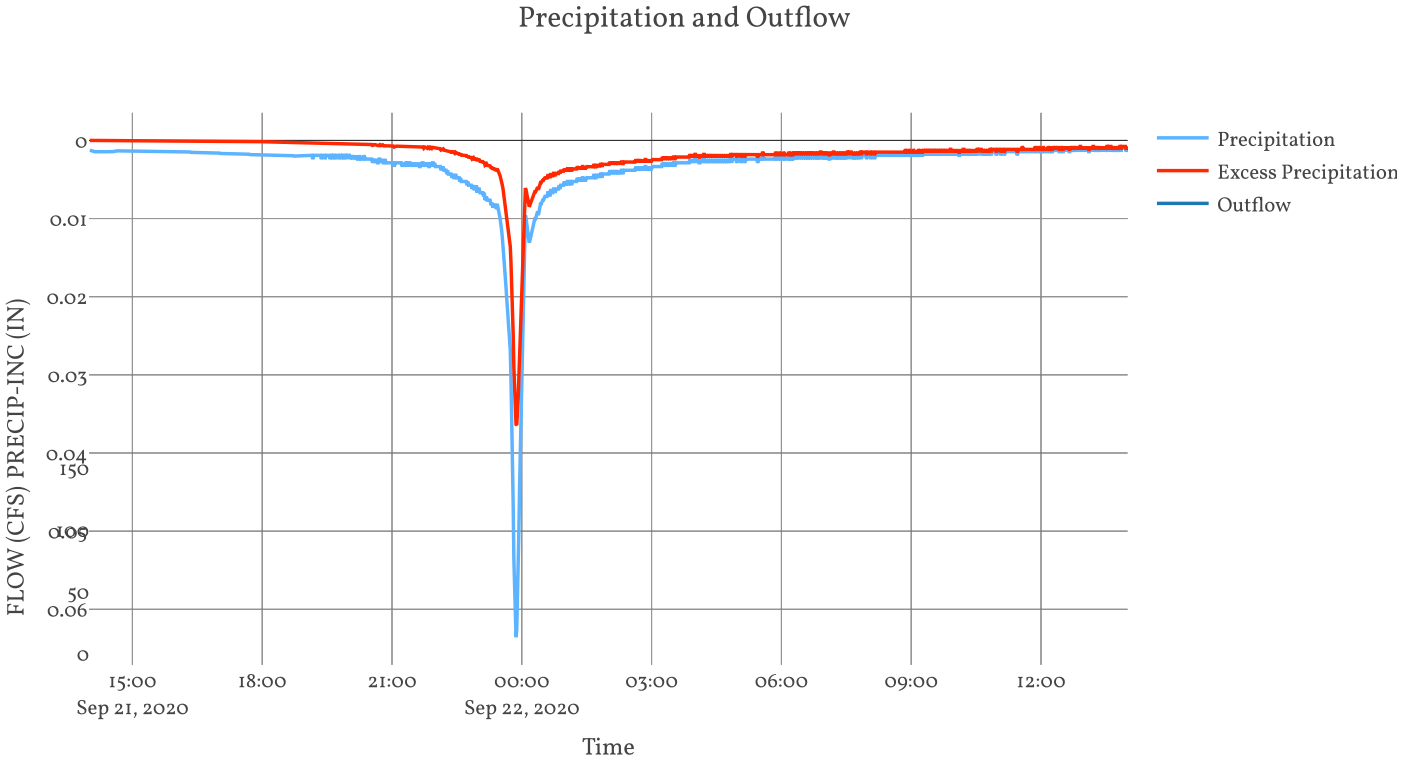
Subbasin: 68B

Area : 0.26
Downstream : 12c

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	73.9
Initial Abstraction	0.2

Transform: User - Specified S - Graph	
S - graph	Ellsworth S - Graph
Lag Method	Specified
Lag	0.28

Results: 68B	
Peak Discharge (CFS)	165.24
Time of Peak Discharge	22Sep2020, 00:10
Volume (IN)	2.57
Precipitation Volume (AC - FT)	65.01
Loss Volume (AC - FT)	29.78
Excess Volume (AC - FT)	35.23
Direct Runoff Volume (AC - FT)	34.89
Baseflow Volume (AC - FT)	0

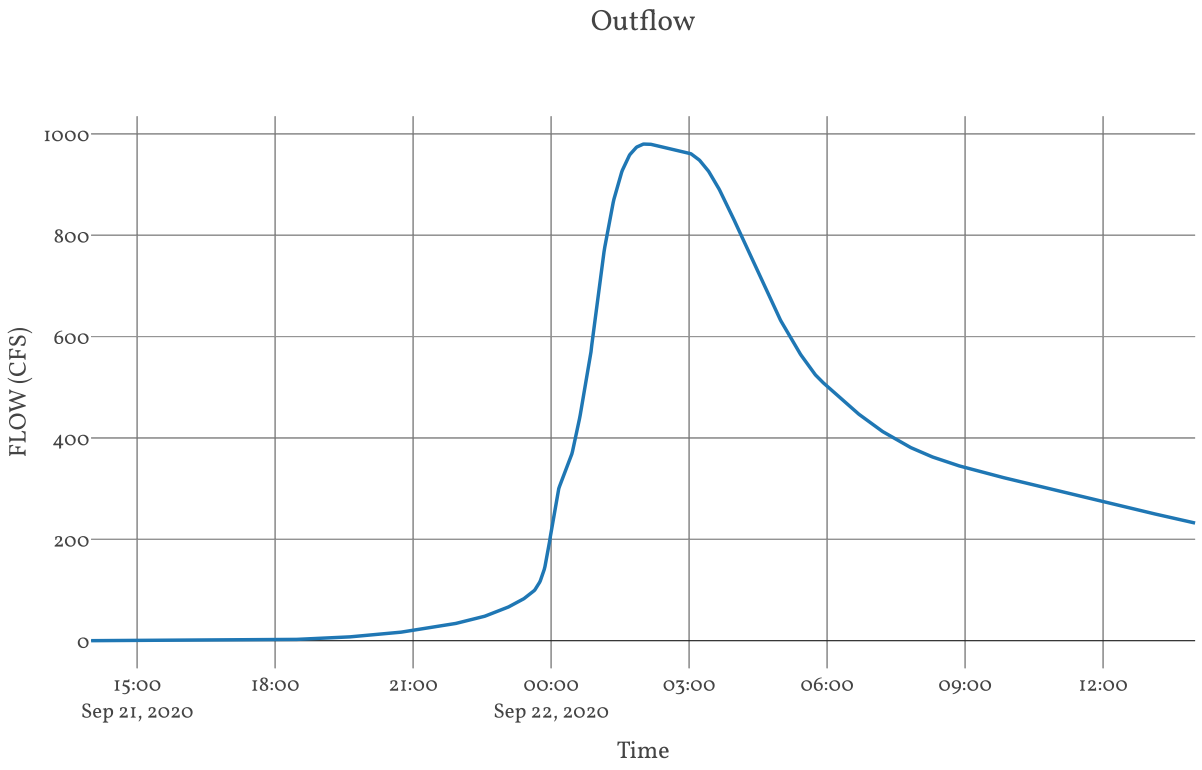

Precipitation and Outflow
FLOW (CFS) PRECIP-INC (IN)
0
0.01
0.02
0.03
0.04
150
100
50
0.06
0
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
Sep 21, 2020
Sep 22, 2020
Time
Precipitation
Excess Precipitation
Outflow

Junction: 12C

Downstream : Pacific Ocean

Results: 12C

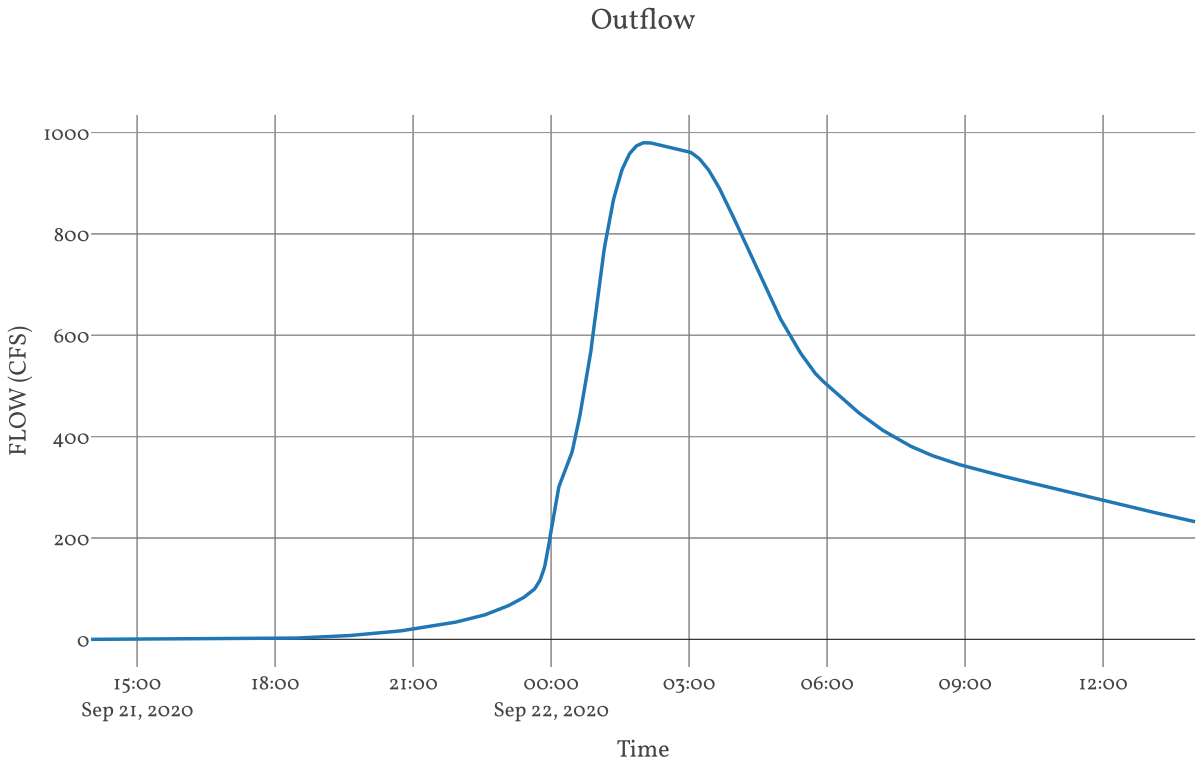
Peak Discharge (CFS)	980.23
Time of Peak Discharge	22Sep2020, 02:04
Volume (IN)	2.33



Sink: Pacific Ocean

Results: Pacific Ocean

Peak Discharge (CFS)	980.23
Time of Peak Discharge	22Sep2020, 02:04
Volume (IN)	2.33
Observed Flow Gage	Not specified
Observed Flow Volume (AC - FT)	Not specified
Observed Flow's RMSE Stdev	Not specified
Observed Flow's Percent Bias	Not specified
Observed Flow's Nash Sutcliffe	Not specified



Project: Little_Sycamore_May2021
Simulation Run: 010-yr Post Dev
Simulation Start: 21 September 2020, 14:00
Simulation End: 22 September 2020, 14:00

HMS Version: 4.6.1
Executed: 29 April 2021, 23:43

Global Parameter Summary - Subbasin

Area

Element Name	Area
60b	0.65
61b	0.61
62b	0.53
63b	0.6
64b	1.09
65b	0.53
66b	0.16
67b	0.43
68b	0.26

Downstream

Element Name	Downstream
60b	J 60b 61b
61b	J 60b 61b
62b	17c
63b	16c
64b	20c
65b	15c
66b	14c
67b	13c
68b	12c

Loss Rate: Scs

Element Name	Percent Impervious Area	Curve Number	Initial Abstraction
60b	0	75	0.2
61b	0	75	0.2
62b	0	73.9	0.2
63b	0	74.6	0.2
64b	0	74.8	0.2
65b	0	74.4	0.2
66b	0	73.9	0.2
67b	0	73.7	0.2
68b	0	73.9	0.2

Transform: User - Specified S - Graph

Element Name	S - graph	Lag Method	Lag
60b	Ellsworth S - Graph	Specified	0.52
61b	Ellsworth S - Graph	Specified	0.37
62b	Ellsworth S - Graph	Specified	0.25
63b	Ellsworth S - Graph	Specified	0.41
64b	Ellsworth S - Graph	Specified	0.42
65b	Ellsworth S - Graph	Specified	0.24
66b	Ellsworth S - Graph	Specified	0.14
67b	Ellsworth S - Graph	Specified	0.44
68b	Ellsworth S - Graph	Specified	0.28

Global Parameter Summary - Reach

Downstream

Element Name	Downstream
18r	17c
17r	16c
16r	20c
20r	15c
15r	14c
14r	13c
13r	12c

Route: Modified Puls

Element Name	Method	Initial Variable	Number of Reaches	Storage Outflow Table Name
18r	Modified Puls	Combined Inflow	8	18r
17r	Modified Puls	Combined Inflow	4	17r
16r	Modified Puls	Combined Inflow	6	16r
20r	Modified Puls	Combined Inflow	6	20r
15r	Modified Puls	Combined Inflow	5	15r
14r	Modified Puls	Combined Inflow	5	14r
13r	Modified Puls	Combined Inflow	2	13r

Global Results Summary

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
60b	0.65	398.39	22Sep2020, 00:24	3.41
61b	0.61	458.08	22Sep2020, 00:15	3.43
J 60b 61b	1.25	832.88	22Sep2020, 00:19	3.42
18r	1.25	702.52	22Sep2020, 01:04	3.29
62b	0.53	483.79	22Sep2020, 00:08	3.37
17c	1.78	845.88	22Sep2020, 01:02	3.32
17r	1.78	769.61	22Sep2020, 01:34	3.2
63b	0.6	424.27	22Sep2020, 00:17	3.4
16c	2.38	922.1	22Sep2020, 01:31	3.25
16r	2.38	904.53	22Sep2020, 01:54	3.18
64b	1.09	761.01	22Sep2020, 00:18	3.41
20c	3.47	1142.12	22Sep2020, 01:48	3.25
20r	3.47	1137.47	22Sep2020, 02:02	3.2
65b	0.53	507.77	22Sep2020, 00:07	3.41
15c	4	1274.95	22Sep2020, 01:00	3.23
15r	4	1270.86	22Sep2020, 01:10	3.2
66b	0.16	197.61	22Sep2020, 00:02	3.38
14c	4.16	1303.35	22Sep2020, 01:09	3.21
14r	4.16	1302.34	22Sep2020, 01:14	3.19
67b	0.43	284.32	22Sep2020, 00:19	3.34
13c	4.59	1446.43	22Sep2020, 00:55	3.2
13r	4.59	1349.74	22Sep2020, 01:54	3.09
68b	0.26	220.54	22Sep2020, 00:09	3.37

12c	4.85	1395.21	22Sep2020, 01:51	3.1
Pacific Ocean	4.85	1395.21	22Sep2020, 01:51	3.1

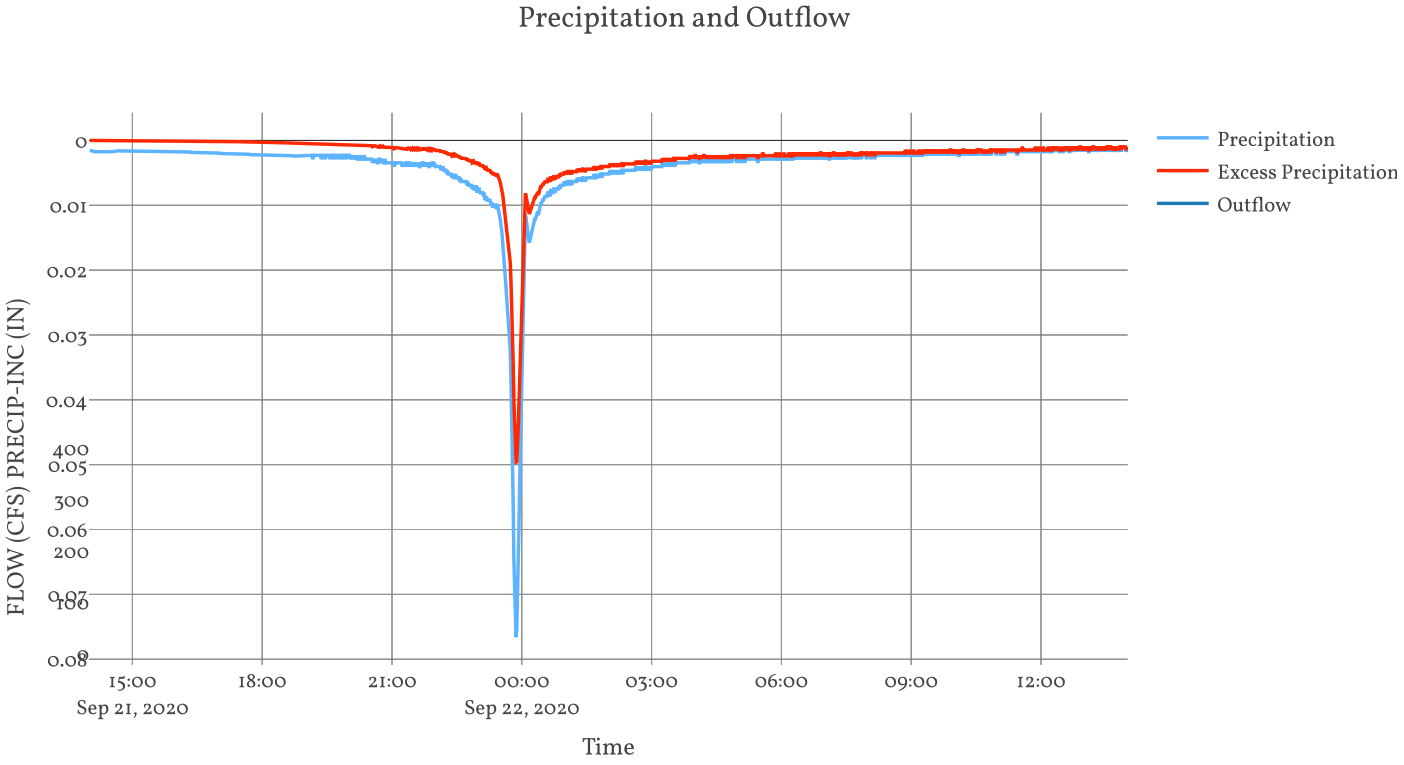
Subbasin: 60B

Area : 0.65
Downstream : J 60b 61b

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	75
Initial Abstraction	0.2

Transform: User - Specified S - Graph	
S - graph	Ellsworth S - Graph
Lag Method	Specified
Lag	0.52

Results: 60B	
Peak Discharge (CFS)	398.39
Time of Peak Discharge	22Sep2020, 00:24
Volume (IN)	3.41
Precipitation Volume (AC - FT)	198.14
Loss Volume (AC - FT)	78.57
Excess Volume (AC - FT)	119.58
Direct Runoff Volume (AC - FT)	117.46
Baseflow Volume (AC - FT)	0


Precipitation and Outflow
FLOW (CFS) PRECIP-INC (IN)
0
0.01
0.02
0.03
0.04
0.05
0.06
0.07
0.08
400
300
200
100
0
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
Sep 21, 2020
Sep 22, 2020
Time
Precipitation
Excess Precipitation
Outflow

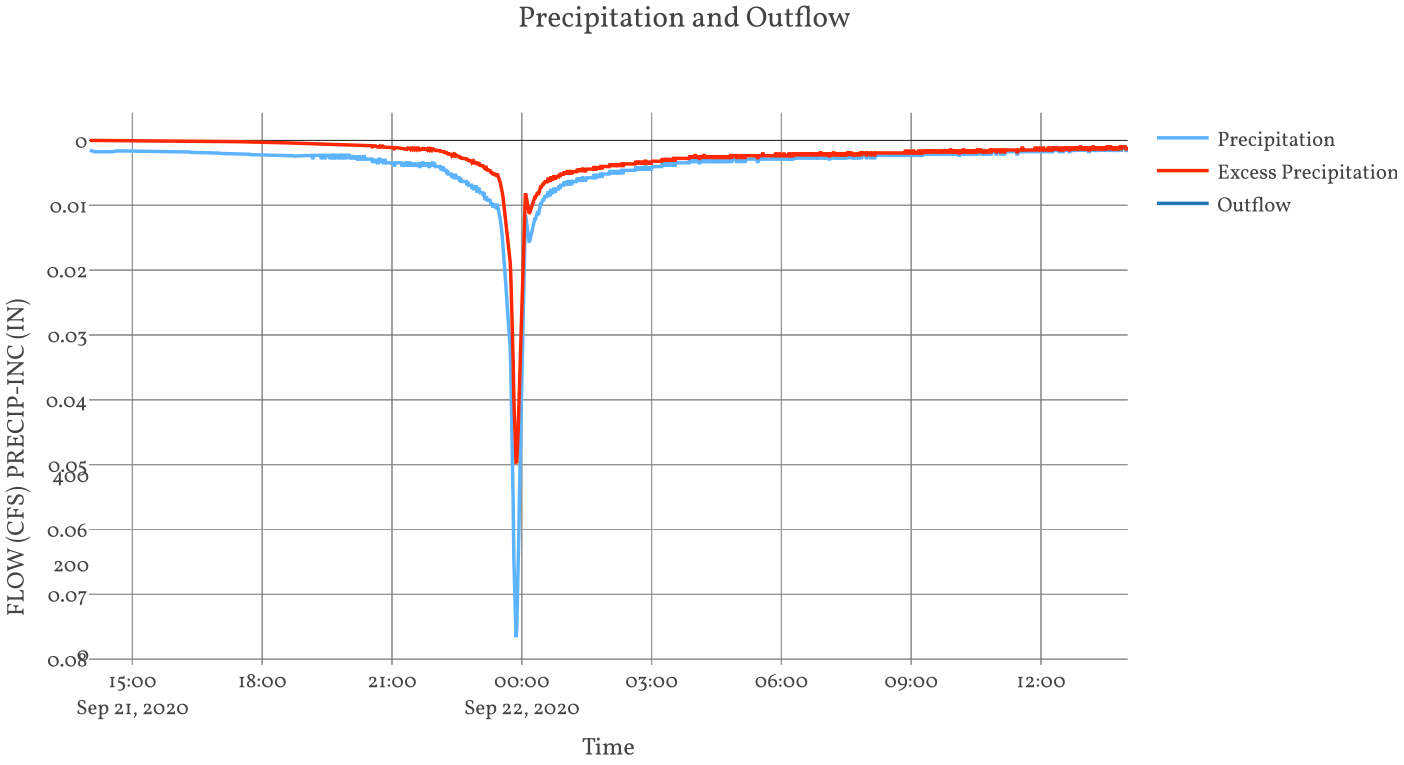
Subbasin: 61B

Area : 0.61
Downstream : J 60b 61b

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	75
Initial Abstraction	0.2

Transform: User - Specified S - Graph	
S - graph	Ellsworth S - Graph
Lag Method	Specified
Lag	0.37

Results: 61B	
Peak Discharge (CFS)	458.08
Time of Peak Discharge	22Sep2020, 00:15
Volume (IN)	3.43
Precipitation Volume (AC - FT)	186.16
Loss Volume (AC - FT)	73.82
Excess Volume (AC - FT)	112.35
Direct Runoff Volume (AC - FT)	110.97
Baseflow Volume (AC - FT)	0

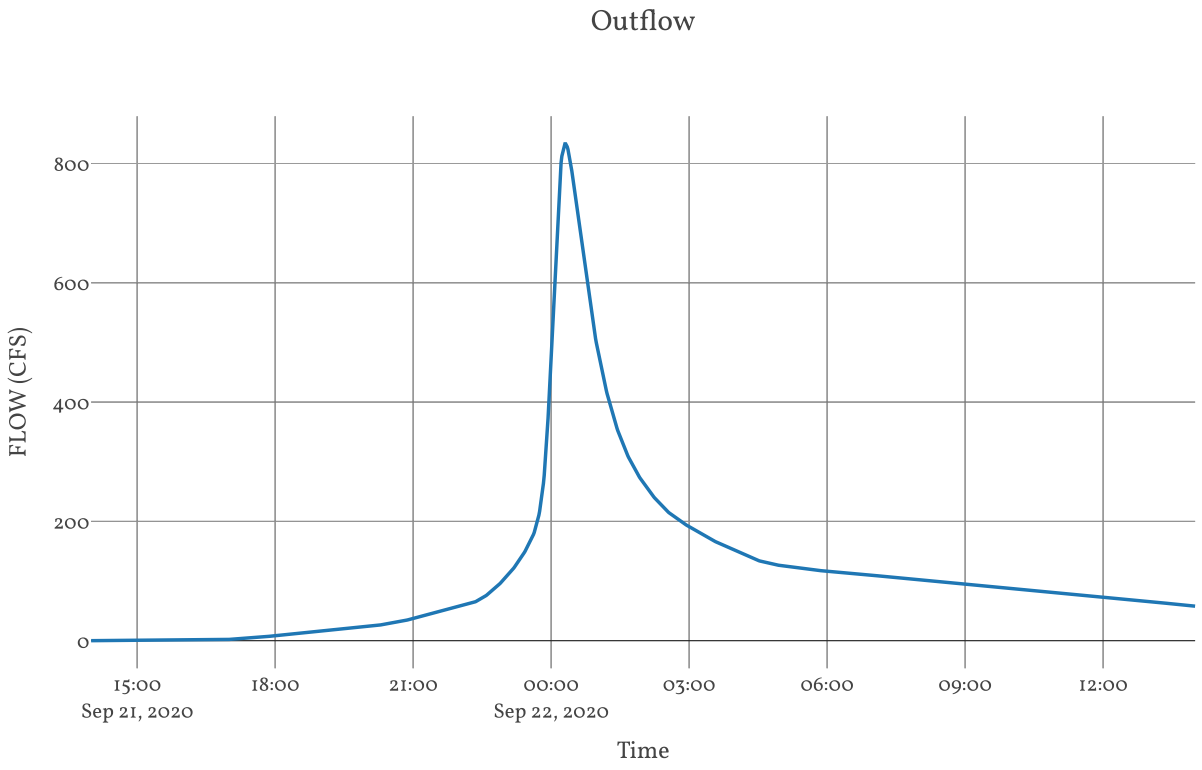

Precipitation and Outflow
FLOW (CFS) PRECIP-INC (IN)
0
0.01
0.02
0.03
0.04
0.05
0.06
0.07
0.08
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
Sep 21, 2020
Sep 22, 2020
Time
Precipitation
Excess Precipitation
Outflow

Junction: J 60B 61B

Downstream : 18r

Results: J 60B 61B

Peak Discharge (CFS)	832.88
Time of Peak Discharge	22Sep2020, 00:19
Volume (IN)	3.42



Reach: 18R

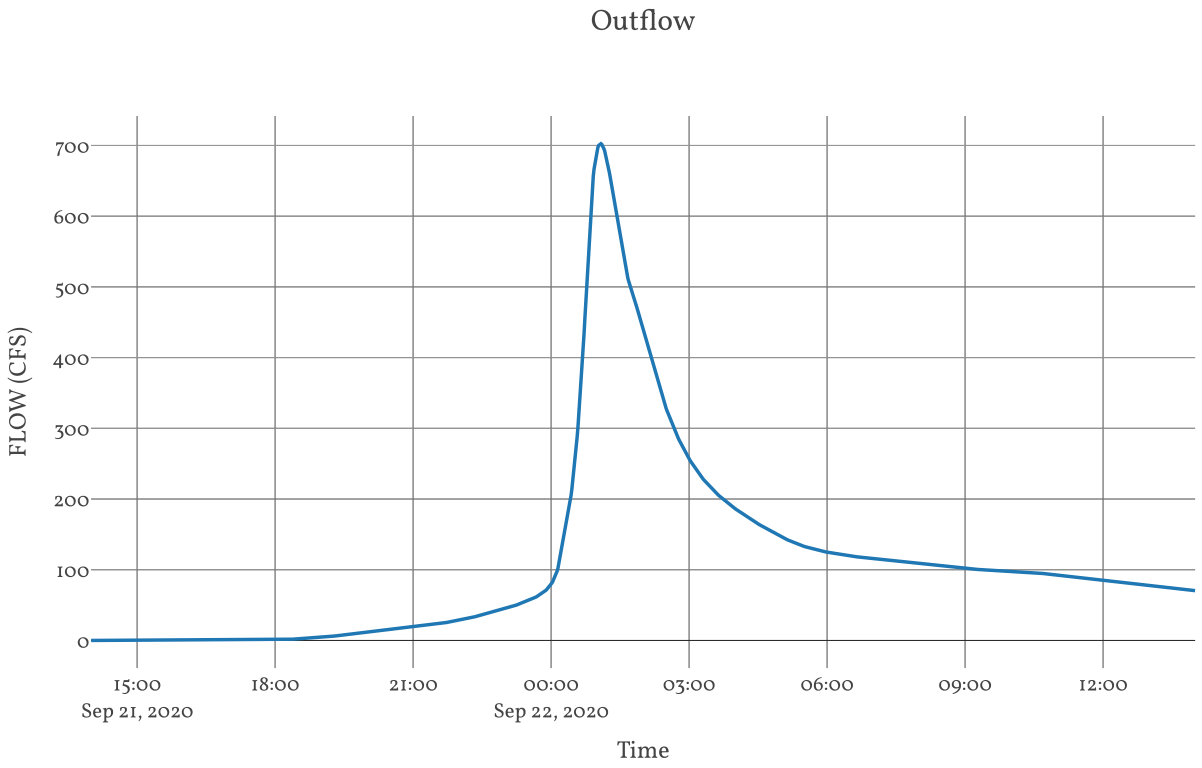
Downstream : 17c

Route: Modified Puls

Method	Modified Puls
Initial Variable	Combined Inflow
Number of Reaches	8
Storage Outflow Table Name	18r

Results: 18R

Peak Discharge (CFS)	702.52
Time of Peak Discharge	22Sep2020, 01:04
Volume (IN)	3.29
Peak Inflow (CFS)	832.88
Inflow Volume (AC - FT)	228.43



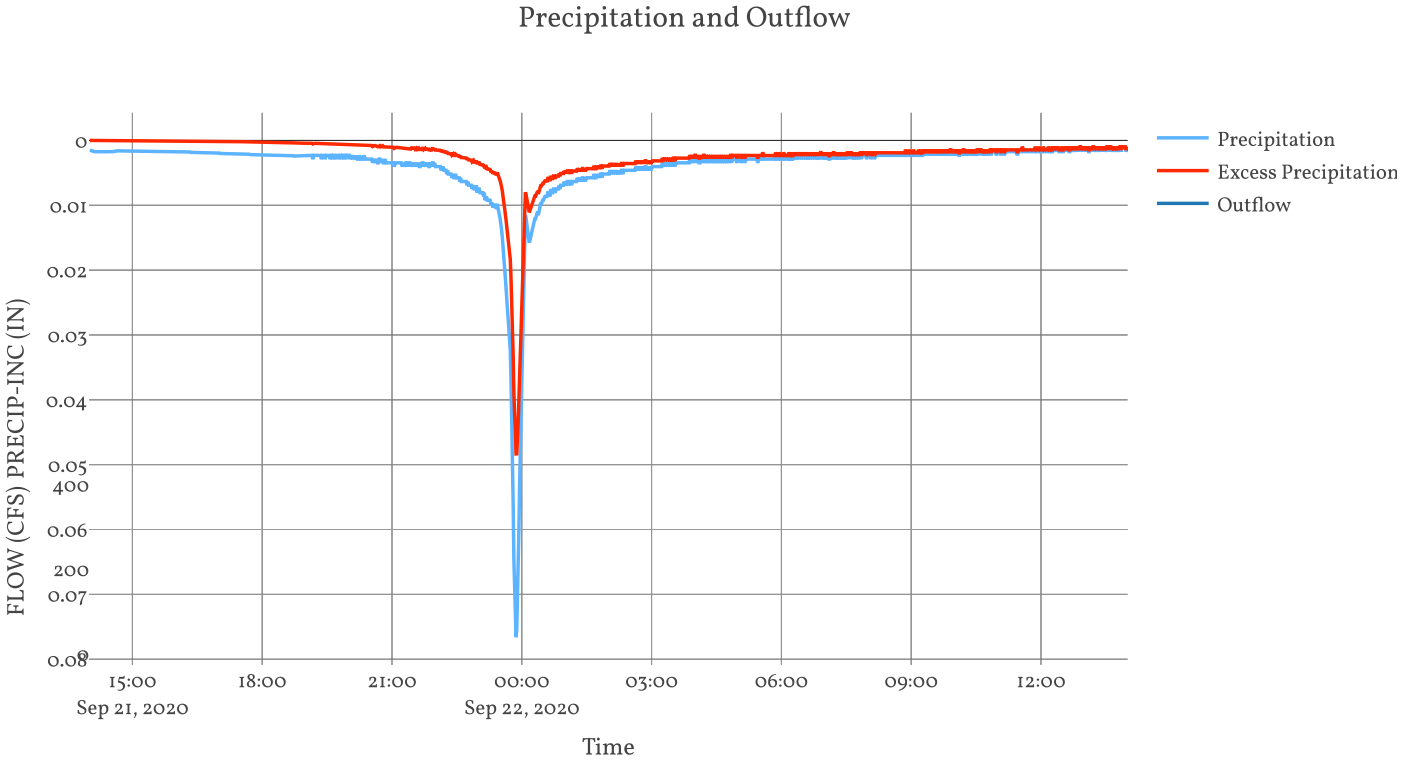
Subbasin: 62B

Area : 0.53
Downstream : 17c

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	73.9
Initial Abstraction	0.2

Transform: User - Specified S - Graph	
S - graph	Ellsworth S - Graph
Lag Method	Specified
Lag	0.25

Results: 62B	
Peak Discharge (CFS)	483.79
Time of Peak Discharge	22Sep2020, 00:08
Volume (IN)	3.37
Precipitation Volume (AC - FT)	161.46
Loss Volume (AC - FT)	66.15
Excess Volume (AC - FT)	95.31
Direct Runoff Volume (AC - FT)	94.53
Baseflow Volume (AC - FT)	0

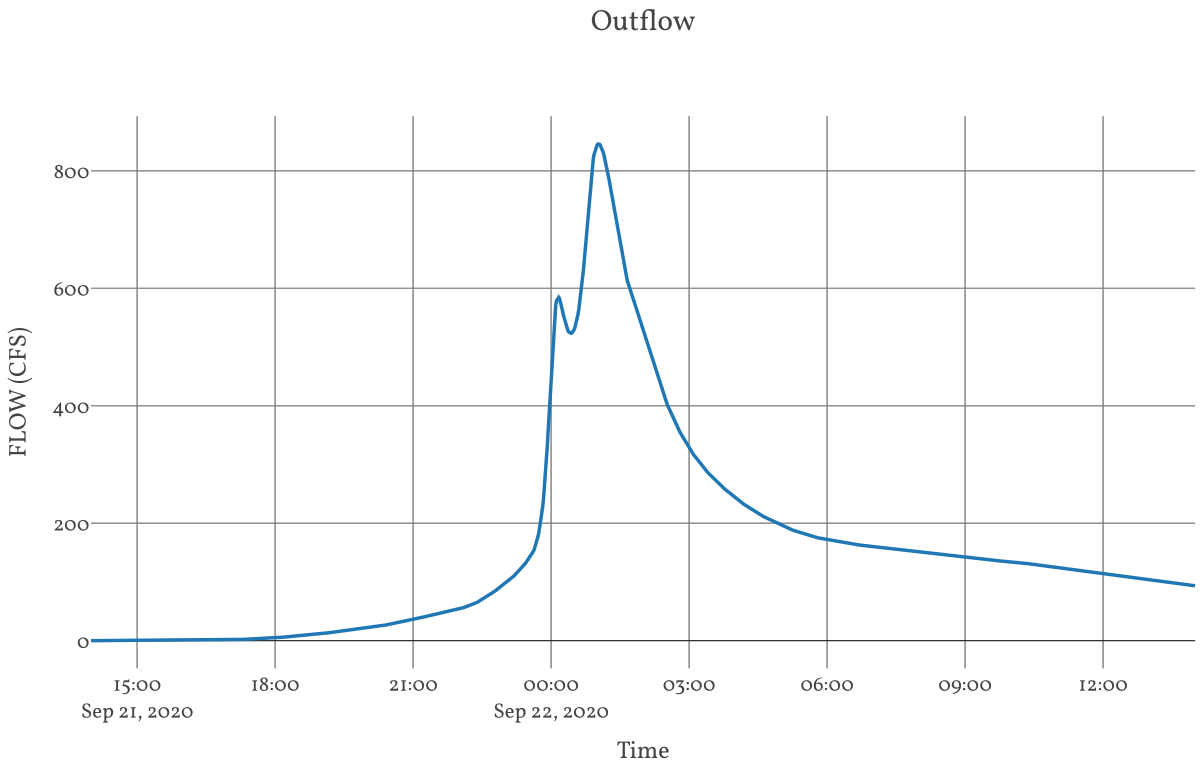

Precipitation and Outflow
FLOW (CFS) PRECIP-INC (IN)
0
0.01
0.02
0.03
0.04
0.05
400
0.06
200
0.07
0.08
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
Sep 21, 2020
Sep 22, 2020
Time
Precipitation
Excess Precipitation
Outflow

Junction: 17C

Downstream : 17r

Results: 17C

Peak Discharge (CFS)	845.88
Time of Peak Discharge	22Sep2020, 01:02
Volume (IN)	3.32



Reach: 17R

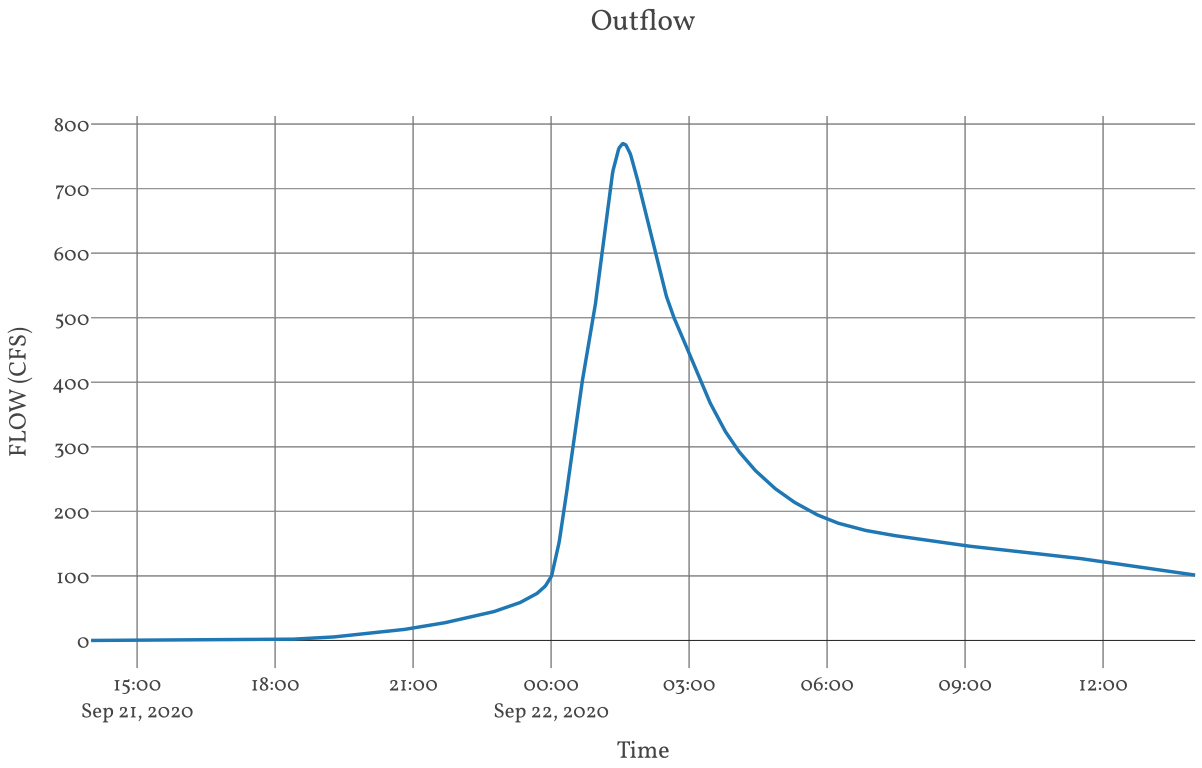
Downstream : 16c

Route: Modified Puls

Method	Modified Puls
Initial Variable	Combined Inflow
Number of Reaches	4
Storage Outflow Table Name	17r

Results: 17R

Peak Discharge (CFS)	769.61
Time of Peak Discharge	22Sep2020, 01:34
Volume (IN)	3.2
Peak Inflow (CFS)	845.88
Inflow Volume (AC - FT)	314.17



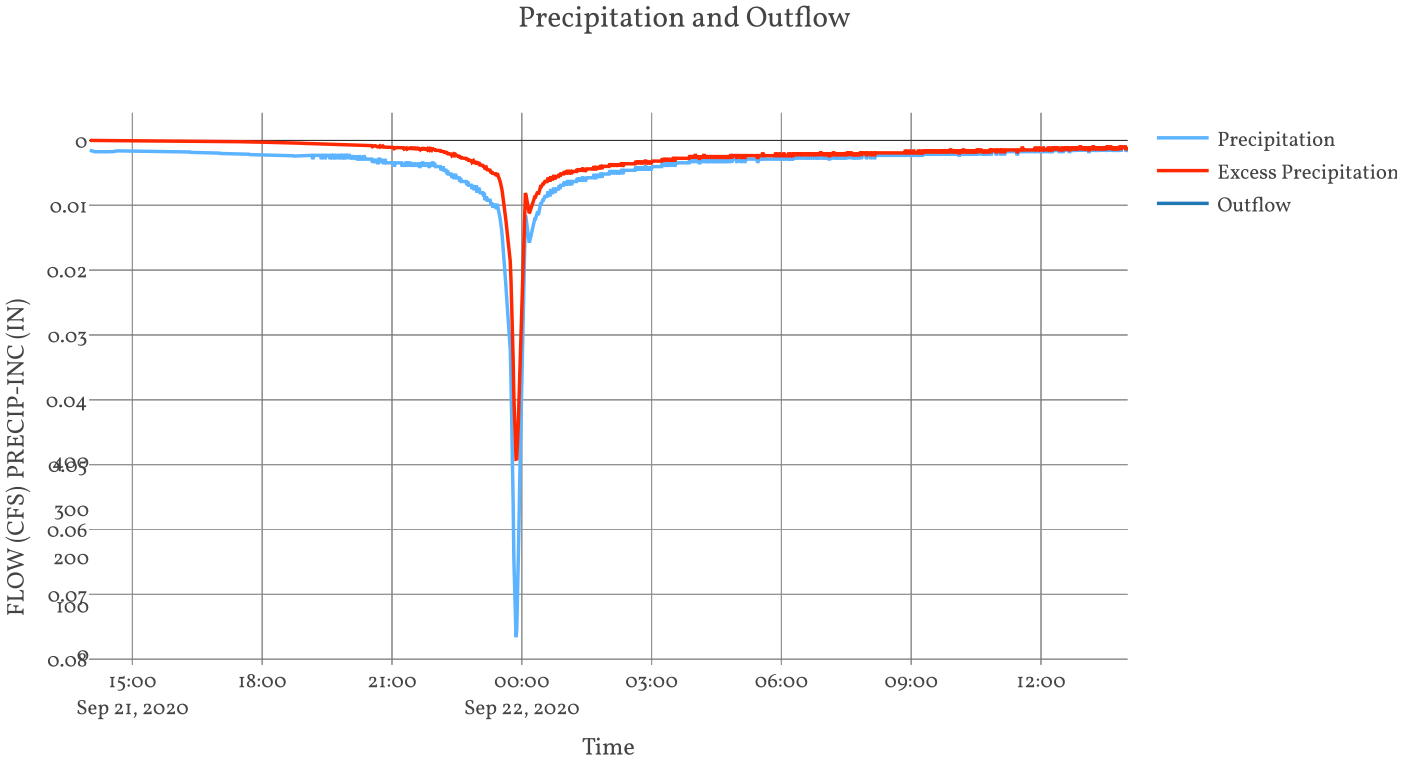
Subbasin: 63B

Area : 0.6
Downstream : 16c

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	74.6
Initial Abstraction	0.2

Transform: User - Specified S - Graph	
S - graph	Ellsworth S - Graph
Lag Method	Specified
Lag	0.41

Results: 63B	
Peak Discharge (CFS)	424.27
Time of Peak Discharge	22Sep2020, 00:17
Volume (IN)	3.4
Precipitation Volume (AC - FT)	184.93
Loss Volume (AC - FT)	74.22
Excess Volume (AC - FT)	110.71
Direct Runoff Volume (AC - FT)	109.19
Baseflow Volume (AC - FT)	0

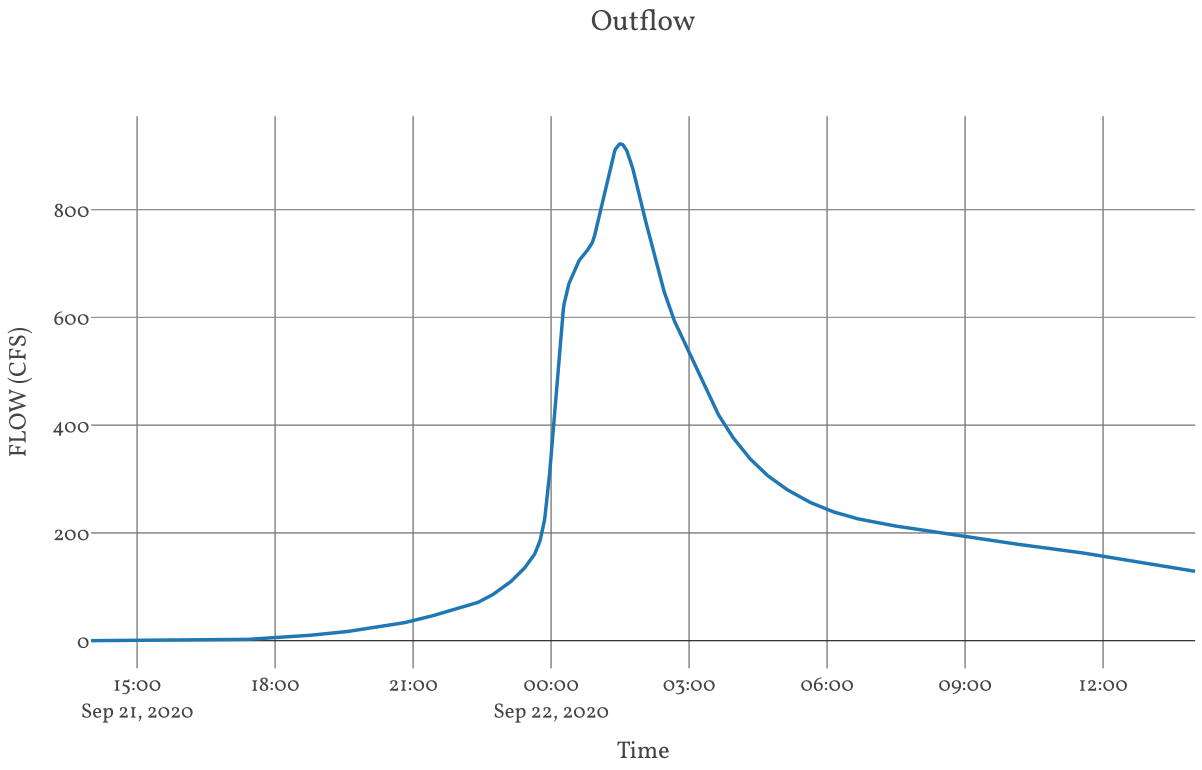

Precipitation and Outflow
FLOW (CFS) PRECIP-INC (IN)
0
0.01
0.02
0.03
0.04
0.05
0.06
0.07
0.08
400
300
200
100
0
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
Sep 21, 2020
Sep 22, 2020
Time
Precipitation
Excess Precipitation
Outflow

Junction: 16C

Downstream : 16r

Results: 16C

Peak Discharge (CFS)	922.1
Time of Peak Discharge	22Sep2020, 01:31
Volume (IN)	3.25



Reach: 16R

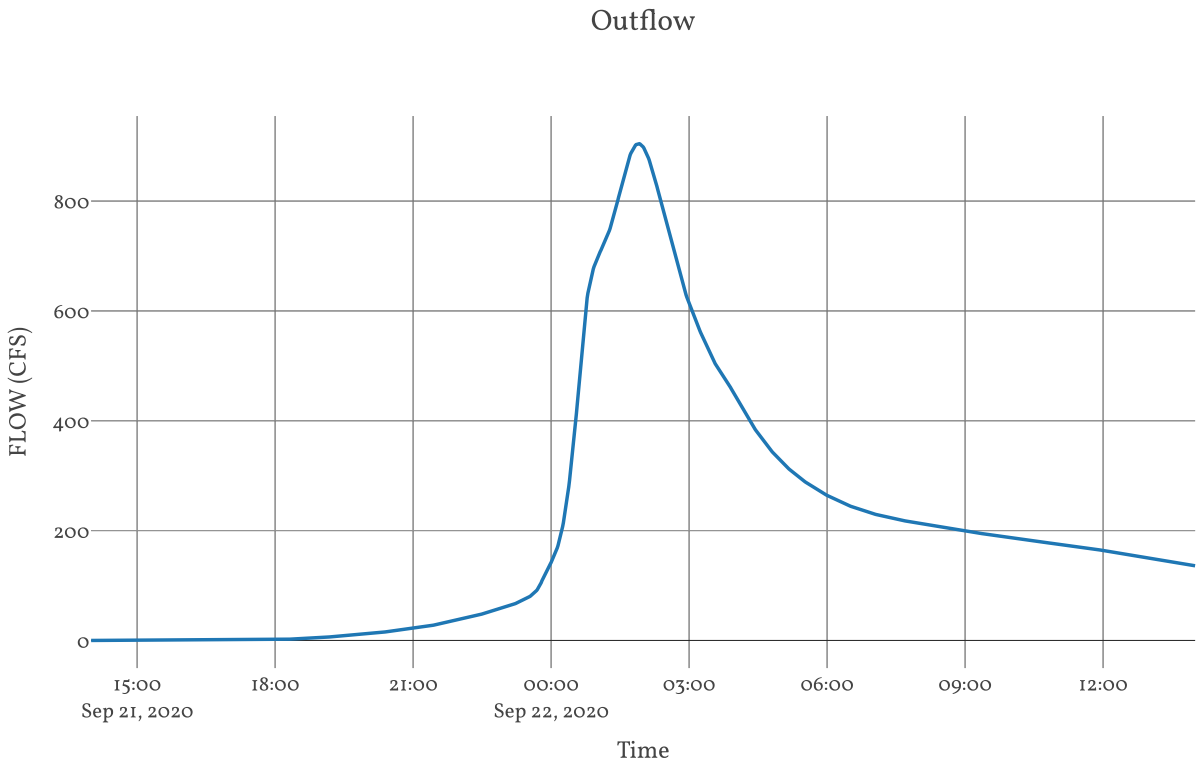
Downstream : 20C

Route: Modified Puls

Method	Modified Puls
Initial Variable	Combined Inflow
Number of Reaches	6
Storage Outflow Table Name	16r

Results: 16R

Peak Discharge (CFS)	904.53
Time of Peak Discharge	22Sep2020, 01:54
Volume (IN)	3.18
Peak Inflow (CFS)	922.1
Inflow Volume (AC - FT)	412.59



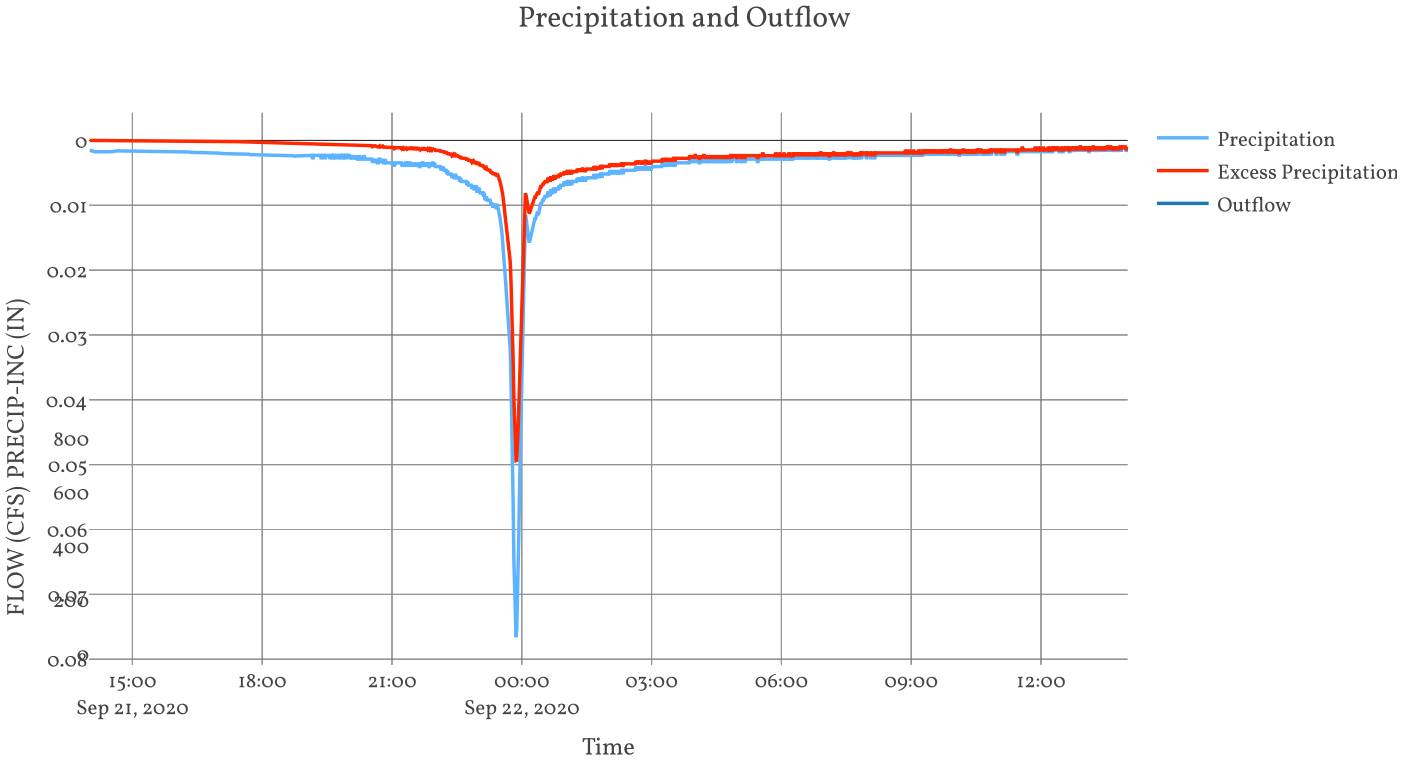
Subbasin: 64B

Area : 1.09
Downstream : 20c

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	74.8
Initial Abstraction	0.2

Transform: User - Specified S - Graph	
S - graph	Ellsworth S - Graph
Lag Method	Specified
Lag	0.42

Results: 64B	
Peak Discharge (CFS)	761.01
Time of Peak Discharge	22Sep2020, 00:18
Volume (IN)	3.41
Precipitation Volume (AC - FT)	334.85
Loss Volume (AC - FT)	133.58
Excess Volume (AC - FT)	201.27
Direct Runoff Volume (AC - FT)	198.44
Baseflow Volume (AC - FT)	0

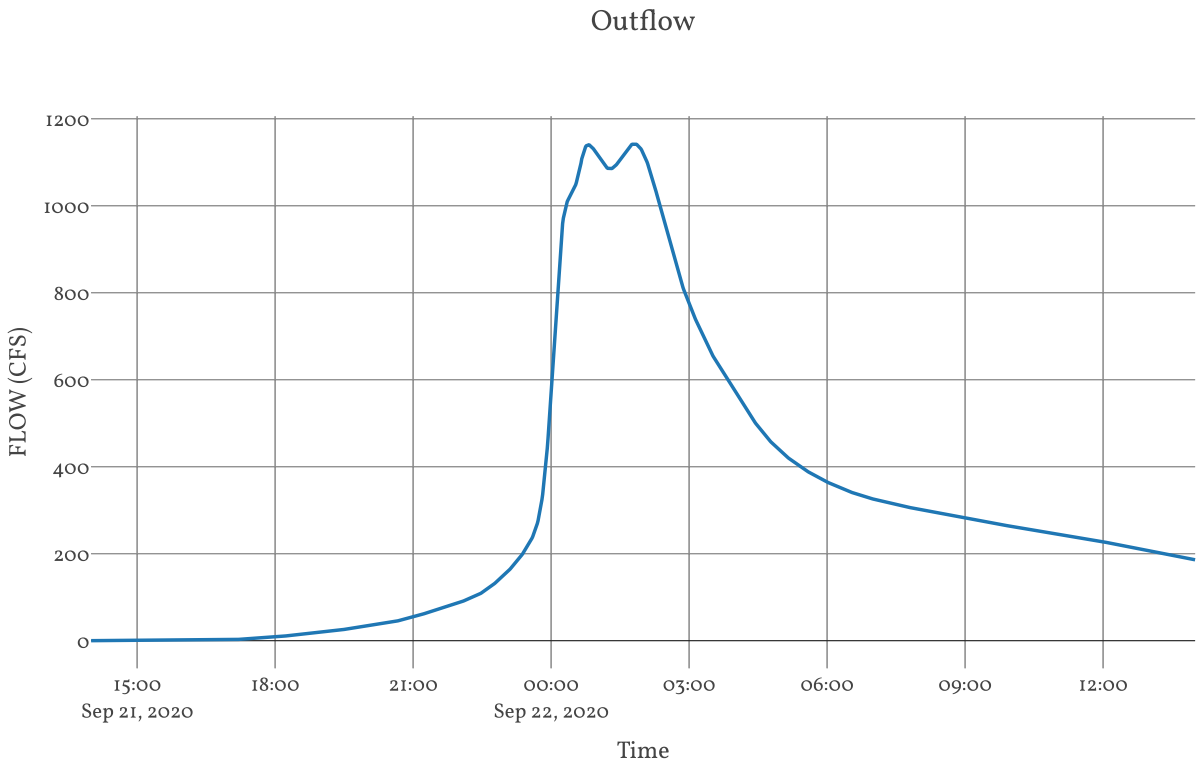

Precipitation and Outflow
FLOW (CFS) PRECIP-INC (IN)
0
0.01
0.02
0.03
0.04
800
0.05
600
0.06
400
0.07
200
0.08
0
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
Sep 21, 2020
Sep 22, 2020
Time
Precipitation
Excess Precipitation
Outflow

Junction: 20C

Downstream : 20r

Results: 20C

Peak Discharge (CFS)	1142.12
Time of Peak Discharge	22Sep2020, 01:48
Volume (IN)	3.25



Reach: 20R

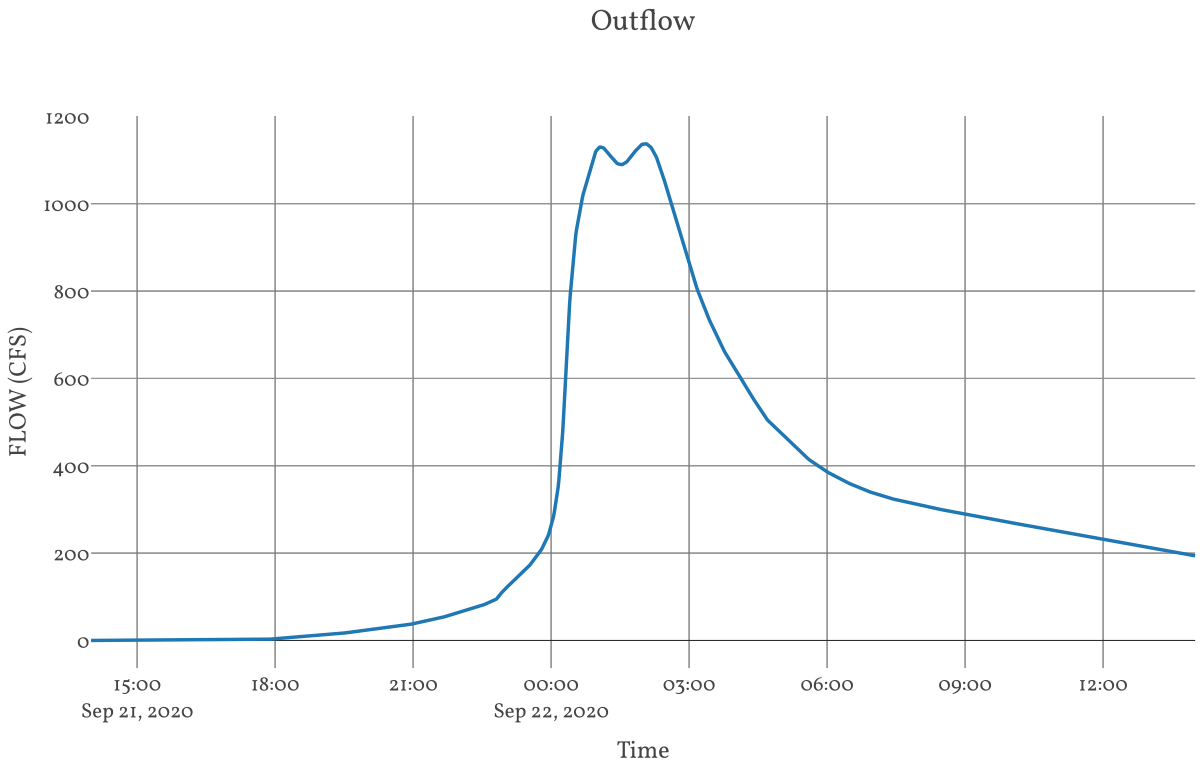
Downstream : 15C

Route: Modified Puls

Method	Modified Puls
Initial Variable	Combined Inflow
Number of Reaches	6
Storage Outflow Table Name	20r

Results: 20R

Peak Discharge (CFS)	1137.47
Time of Peak Discharge	22Sep2020, 02:02
Volume (IN)	3.2
Peak Inflow (CFS)	1142.12
Inflow Volume (AC - FT)	601.28



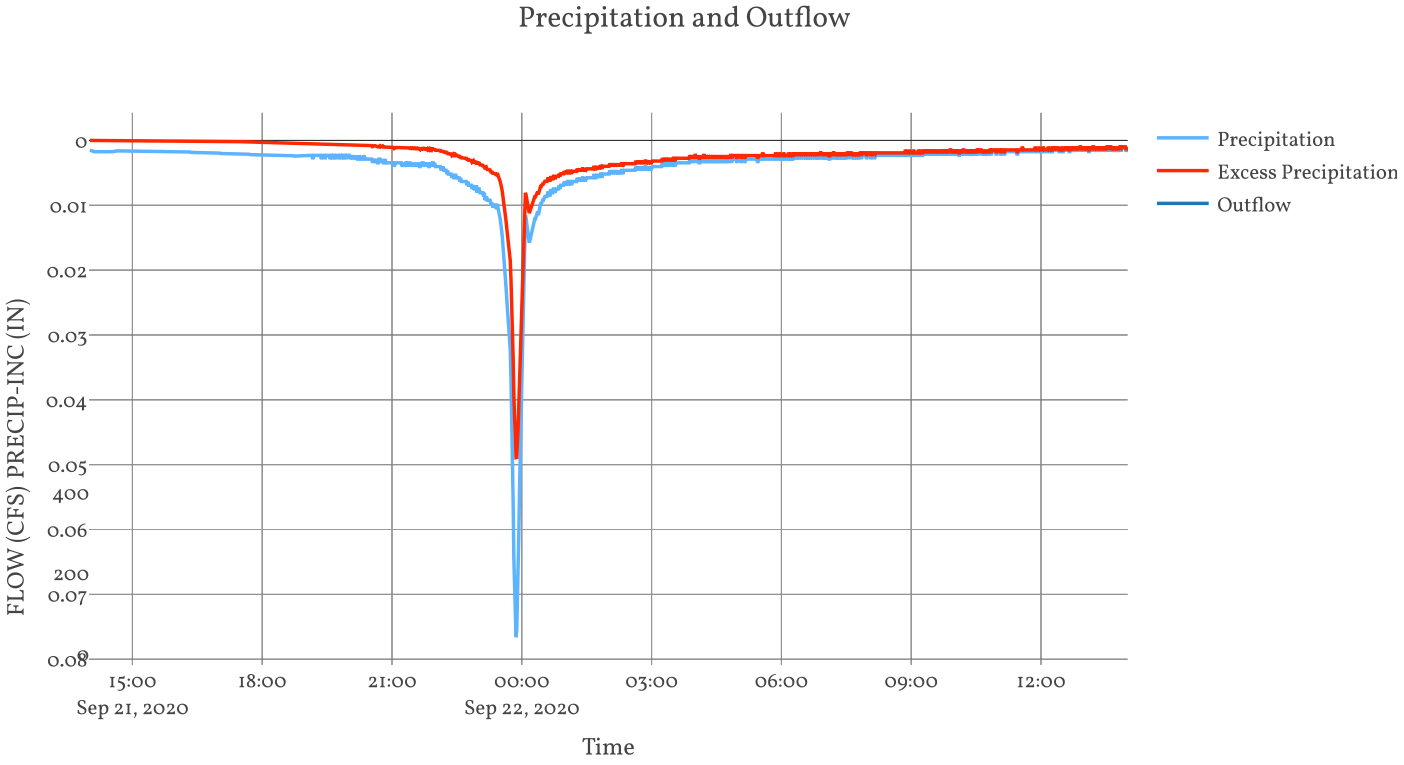
Subbasin: 65B

Area : 0.53
Downstream : 15c

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	74.4
Initial Abstraction	0.2

Transform: User - Specified S - Graph	
S - graph	Ellsworth S - Graph
Lag Method	Specified
Lag	0.24

Results: 65B	
Peak Discharge (CFS)	507.77
Time of Peak Discharge	22Sep2020, 00:07
Volume (IN)	3.41
Precipitation Volume (AC - FT)	163.74
Loss Volume (AC - FT)	66.11
Excess Volume (AC - FT)	97.63
Direct Runoff Volume (AC - FT)	96.87
Baseflow Volume (AC - FT)	0

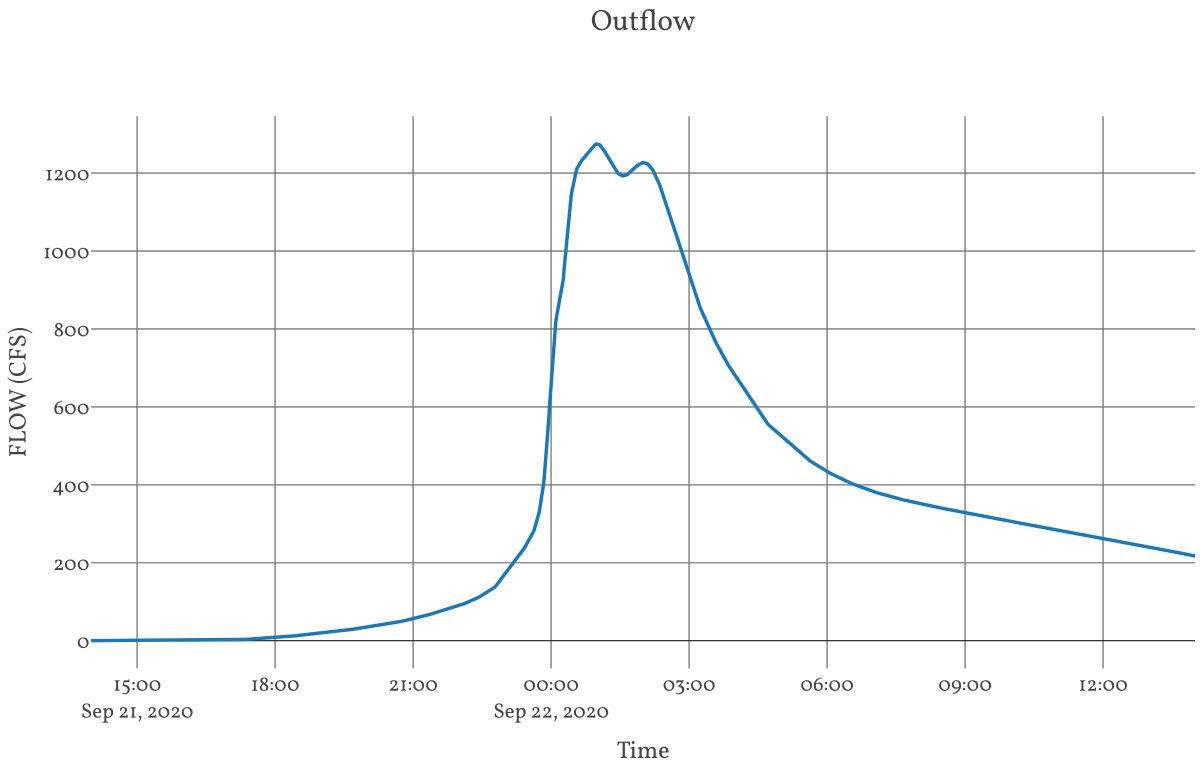

Precipitation and Outflow
FLOW (CFS) PRECIP-INC (IN)
0
0.01
0.02
0.03
0.04
0.05
400
0.06
200
0.07
0.08
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
Sep 21, 2020
Sep 22, 2020
Time
Precipitation
Excess Precipitation
Outflow

Junction: 15C

Downstream : 15r

Results: 15C

Peak Discharge (CFS)	1274.95
Time of Peak Discharge	22Sep2020, 01:00
Volume (IN)	3.23



Reach: 15R

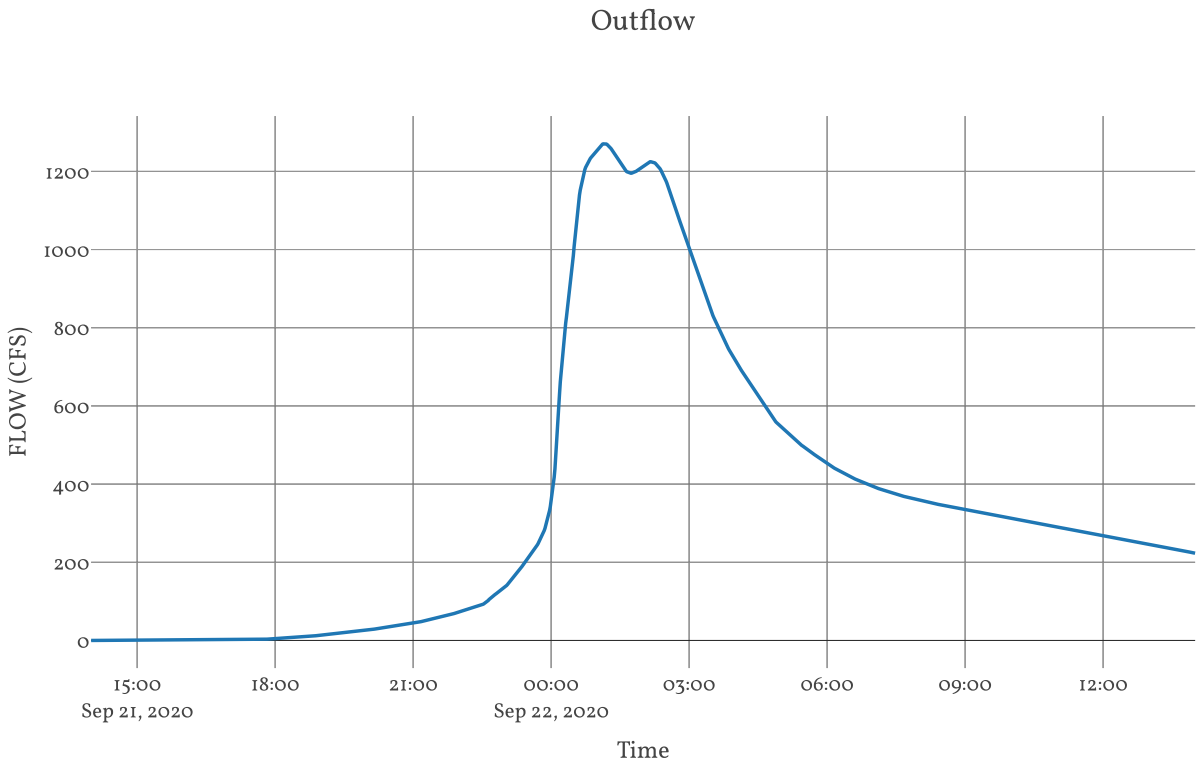
Downstream : 14c

Route: Modified Puls

Method	Modified Puls
Initial Variable	Combined Inflow
Number of Reaches	5
Storage Outflow Table Name	15r

Results: 15R

Peak Discharge (CFS)	1270.86
Time of Peak Discharge	22Sep2020, 01:10
Volume (IN)	3.2
Peak Inflow (CFS)	1274.95
Inflow Volume (AC - FT)	689.49



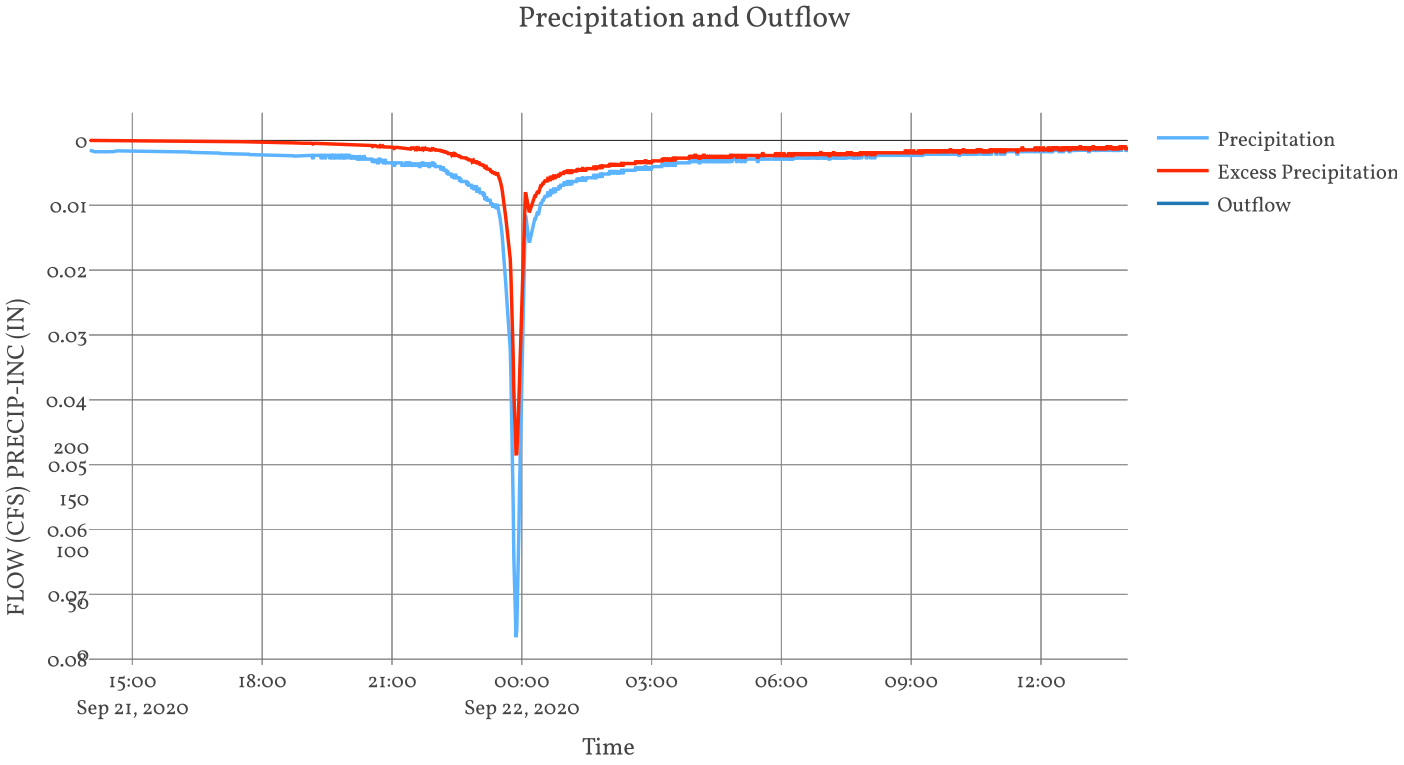
Subbasin: 66B

Area : 0.16
Downstream : 14c

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	73.9
Initial Abstraction	0.2

Transform: User - Specified S - Graph	
S - graph	Ellsworth S - Graph
Lag Method	Specified
Lag	0.14

Results: 66B	
Peak Discharge (CFS)	197.61
Time of Peak Discharge	22Sep2020, 00:02
Volume (IN)	3.38
Precipitation Volume (AC - FT)	49.77
Loss Volume (AC - FT)	20.39
Excess Volume (AC - FT)	29.38
Direct Runoff Volume (AC - FT)	29.25
Baseflow Volume (AC - FT)	0

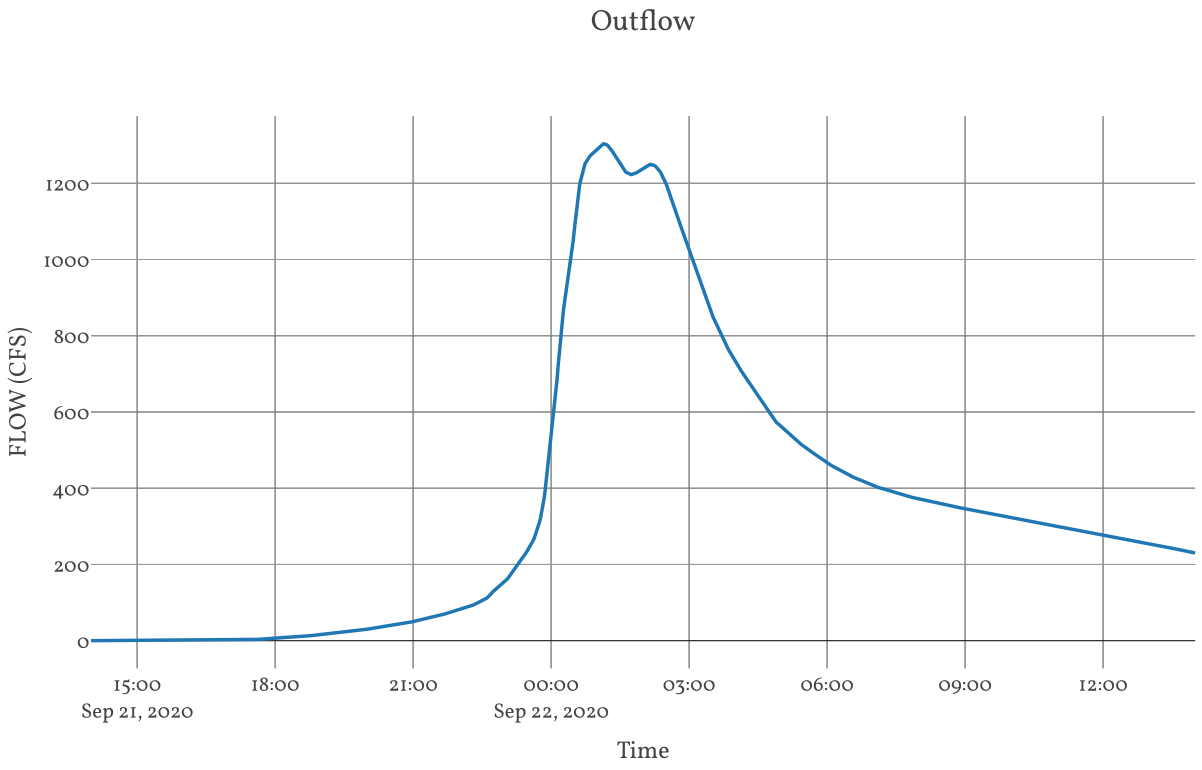

Precipitation and Outflow
FLOW (CFS) PRECIP-INC (IN)
0
0.01
0.02
0.03
0.04
200
0.05
150
0.06
100
0.07
50
0.08
0
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
Sep 21, 2020
Sep 22, 2020
Time
Precipitation
Excess Precipitation
Outflow

Junction: 14C

Downstream : 14r

Results: 14C

Peak Discharge (CFS)	1303.35
Time of Peak Discharge	22Sep2020, 01:09
Volume (IN)	3.21



Reach: 14R

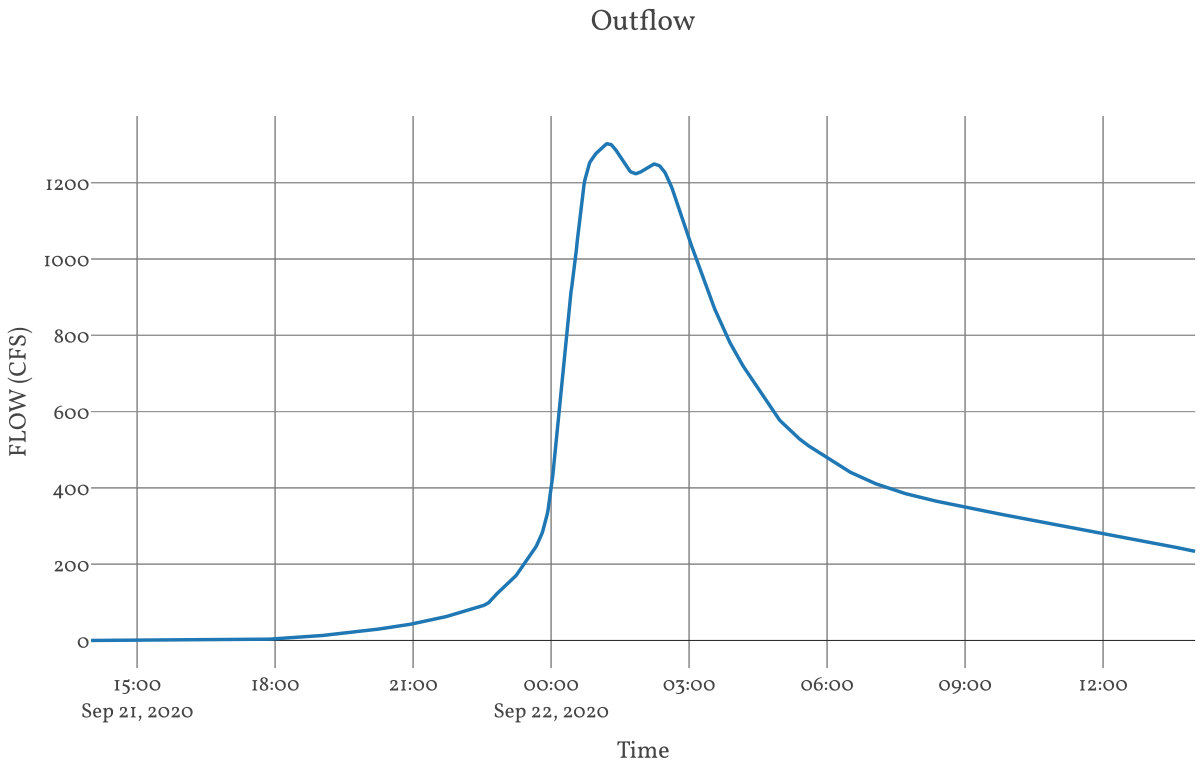
Downstream : 13c

Route: Modified Puls

Method	Modified Puls
Initial Variable	Combined Inflow
Number of Reaches	5
Storage Outflow Table Name	14r

Results: 14R

Peak Discharge (CFS)	1302.34
Time of Peak Discharge	22Sep2020, 01:14
Volume (IN)	3.19
Peak Inflow (CFS)	1303.35
Inflow Volume (AC - FT)	712.17



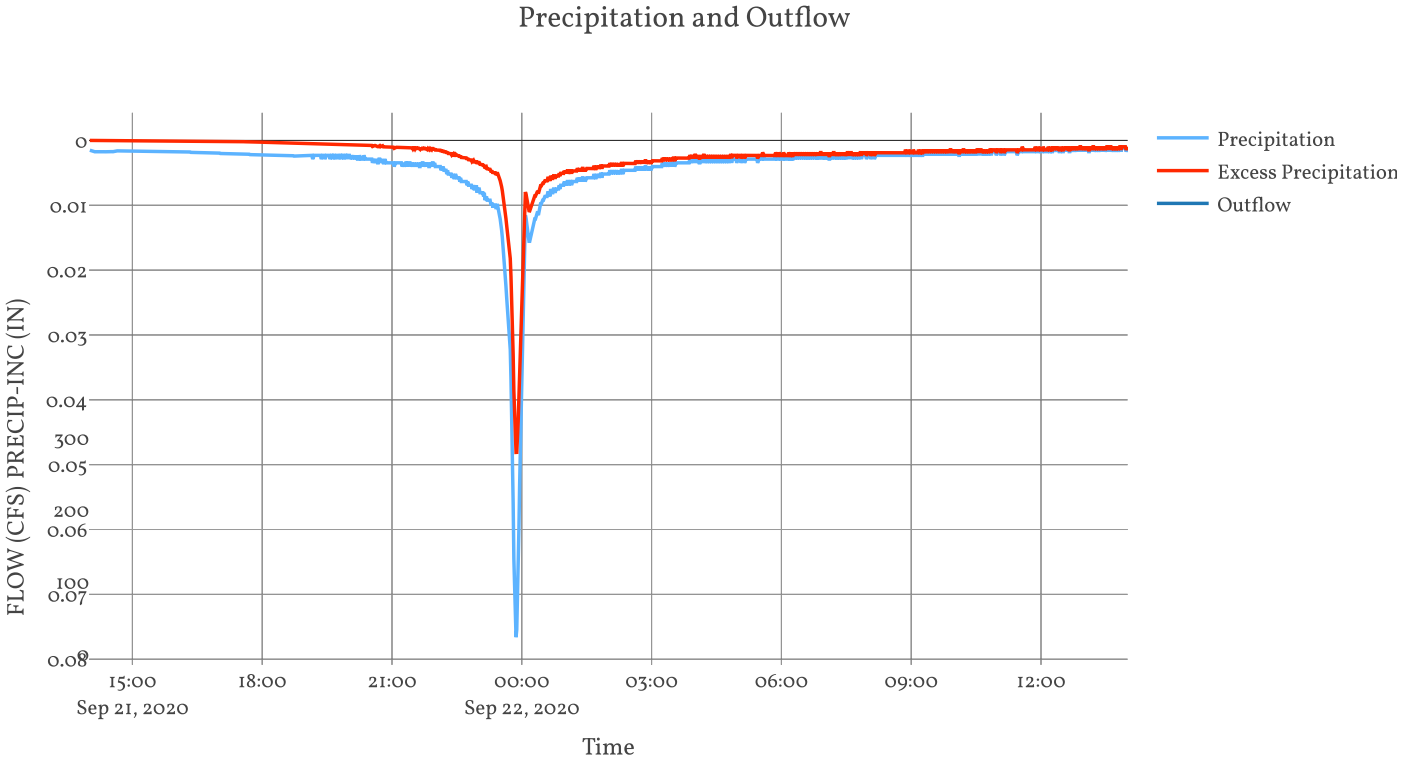
Subbasin: 67B

Area : 0.43
Downstream : 13c

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	73.7
Initial Abstraction	0.2

Transform: User - Specified S - Graph	
S - graph	Ellsworth S - Graph
Lag Method	Specified
Lag	0.44

Results: 67B	
Peak Discharge (CFS)	284.32
Time of Peak Discharge	22Sep2020, 00:19
Volume (IN)	3.34
Precipitation Volume (AC - FT)	132.1
Loss Volume (AC - FT)	54.43
Excess Volume (AC - FT)	77.66
Direct Runoff Volume (AC - FT)	76.5
Baseflow Volume (AC - FT)	0

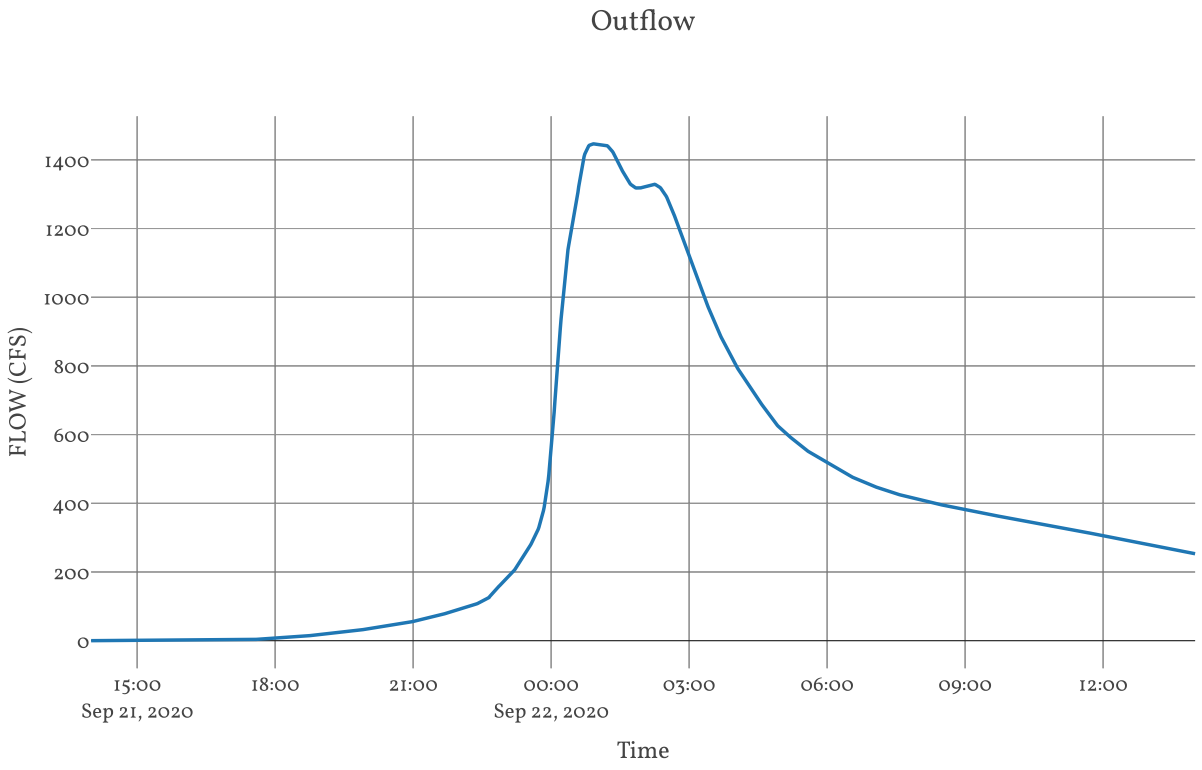

Precipitation and Outflow
FLOW (CFS) PRECIP-INC (IN)
0
0.01
0.02
0.03
0.04
300
0.05
200
0.06
100
0.07
0.08
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
Sep 21, 2020
Sep 22, 2020
Time
Precipitation
Excess Precipitation
Outflow

Junction: 13C

Downstream : 13r

Results: 13C

Peak Discharge (CFS)	1446.43
Time of Peak Discharge	22Sep2020, 00:55
Volume (IN)	3.2



Reach: 13R

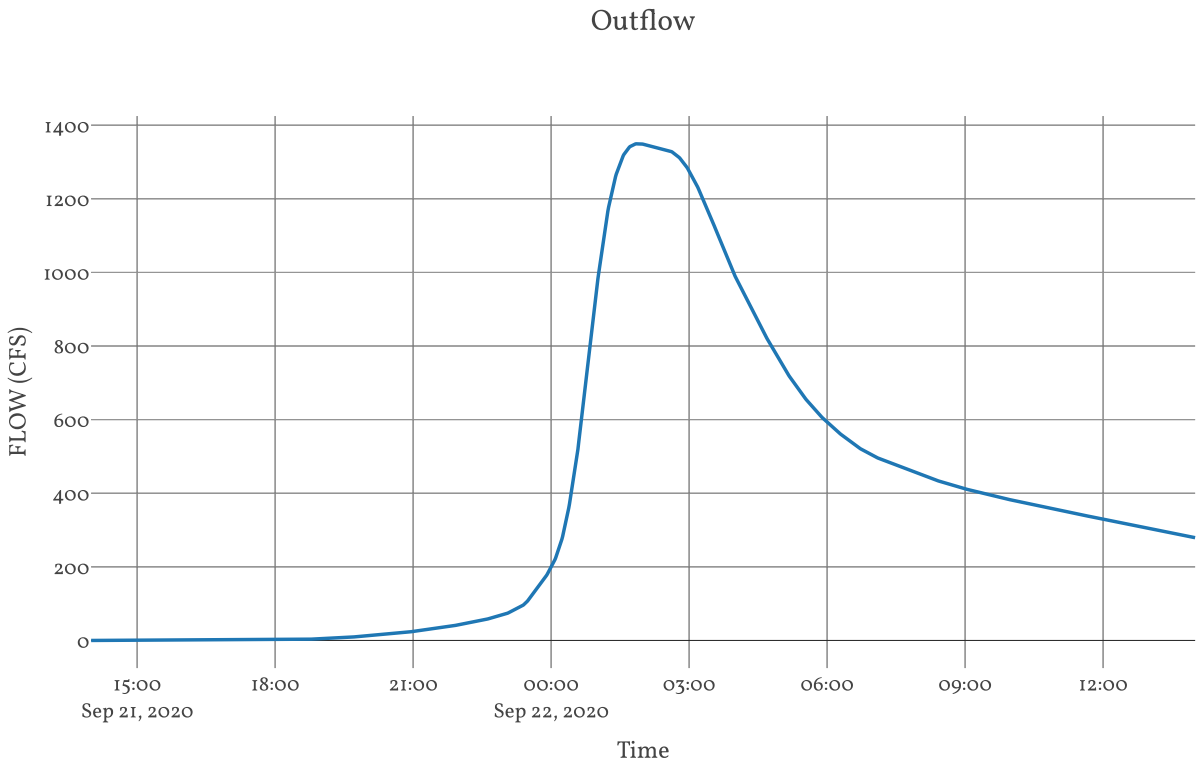
Downstream : 12C

Route: Modified Puls

Method	Modified Puls
Initial Variable	Combined Inflow
Number of Reaches	2
Storage Outflow Table Name	13r

Results: 13R

Peak Discharge (CFS)	1349.74
Time of Peak Discharge	22Sep2020, 01:54
Volume (IN)	3.09
Peak Inflow (CFS)	1446.43
Inflow Volume (AC - FT)	784.95



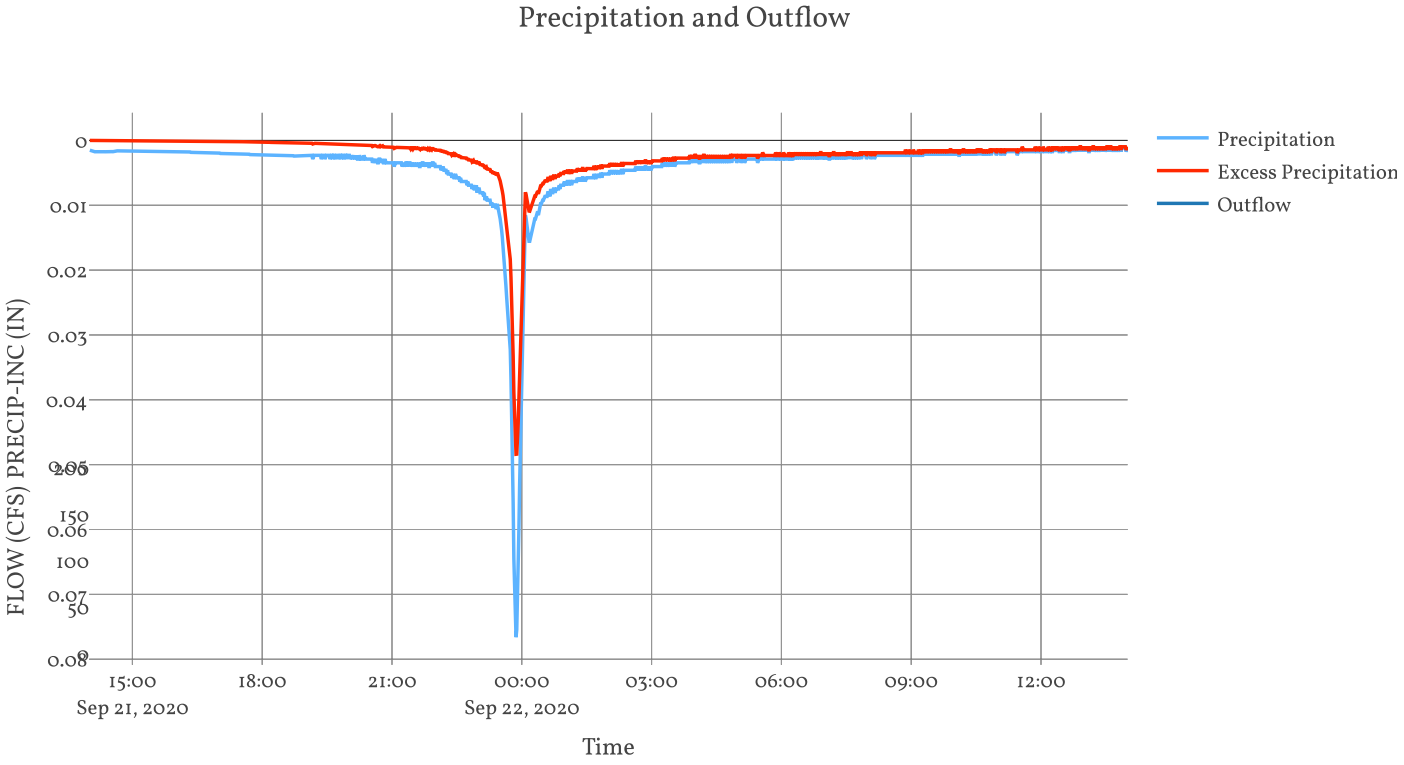
Subbasin: 68B

Area : 0.26
Downstream : 12C

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	73.9
Initial Abstraction	0.2

Transform: User - Specified S - Graph	
S - graph	Ellsworth S - Graph
Lag Method	Specified
Lag	0.28

Results: 68B	
Peak Discharge (CFS)	220.54
Time of Peak Discharge	22Sep2020, 00:09
Volume (IN)	3.37
Precipitation Volume (AC - FT)	78.34
Loss Volume (AC - FT)	32.03
Excess Volume (AC - FT)	46.31
Direct Runoff Volume (AC - FT)	45.88
Baseflow Volume (AC - FT)	0

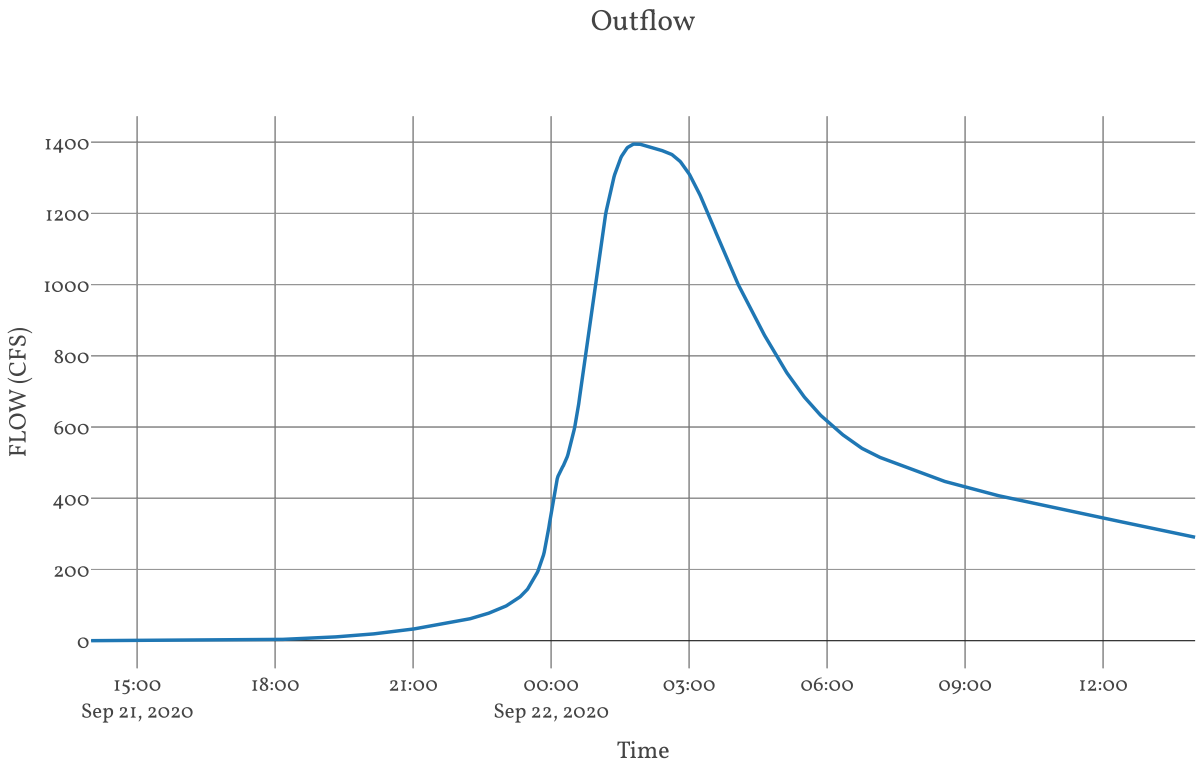

Precipitation and Outflow
FLOW (CFS) PRECIP-INC (IN)
0
0.01
0.02
0.03
0.04
0.05
0.06
0.07
0.08
200
150
100
50
0
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
Sep 21, 2020
Sep 22, 2020
Time
Precipitation
Excess Precipitation
Outflow

Junction: 12C

Downstream : Pacific Ocean

Results: 12C

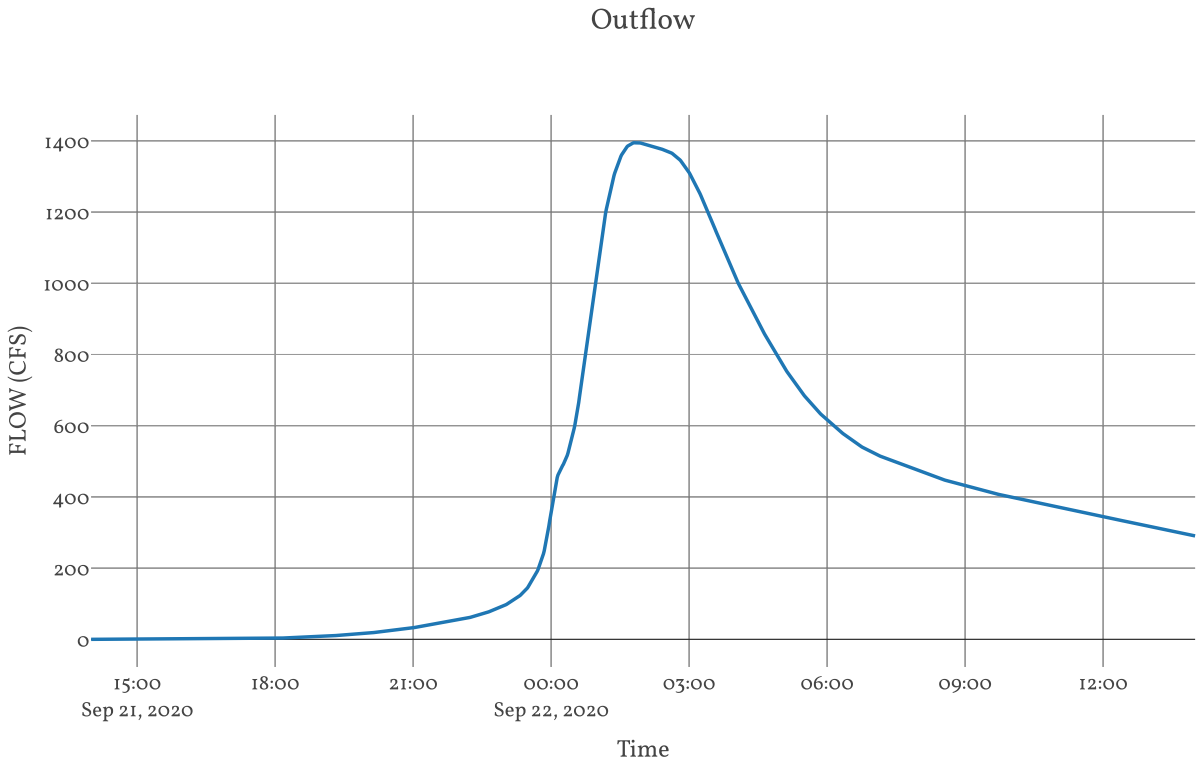
Peak Discharge (CFS)	1395.21
Time of Peak Discharge	22Sep2020, 01:51
Volume (IN)	3.1



Sink: Pacific Ocean

Results: Pacific Ocean

Peak Discharge (CFS)	1395.21
Time of Peak Discharge	22Sep2020, 01:51
Volume (IN)	3.1
Observed Flow Gage	Not specified
Observed Flow Volume (AC - FT)	Not specified
Observed Flow's RMSE Stdev	Not specified
Observed Flow's Percent Bias	Not specified
Observed Flow's Nash Sutcliffe	Not specified



Project: Little_Sycamore_May2021
Simulation Run: 025-yr Post Dev
Simulation Start: 21 September 2020, 14:00
Simulation End: 22 September 2020, 14:00

HMS Version: 4.6.1
Executed: 29 April 2021, 23:44

Global Parameter Summary - Subbasin

Area

Element Name	Area
60b	0.65
61b	0.61
62b	0.53
63b	0.6
64b	1.09
65b	0.53
66b	0.16
67b	0.43
68b	0.26

Downstream

Element Name	Downstream
60b	J 60b 61b
61b	J 60b 61b
62b	17c
63b	16c
64b	20c
65b	15c
66b	14c
67b	13c
68b	12c

Loss Rate: Scs

Element Name	Percent Impervious Area	Curve Number	Initial Abstraction
60b	0	75	0.2
61b	0	75	0.2
62b	0	73.9	0.2
63b	0	74.6	0.2
64b	0	74.8	0.2
65b	0	74.4	0.2
66b	0	73.9	0.2
67b	0	73.7	0.2
68b	0	73.9	0.2

Transform: User - Specified S - Graph

Element Name	S - graph	Lag Method	Lag
60b	Ellsworth S - Graph	Specified	0.52
61b	Ellsworth S - Graph	Specified	0.37
62b	Ellsworth S - Graph	Specified	0.25
63b	Ellsworth S - Graph	Specified	0.41
64b	Ellsworth S - Graph	Specified	0.42
65b	Ellsworth S - Graph	Specified	0.24
66b	Ellsworth S - Graph	Specified	0.14
67b	Ellsworth S - Graph	Specified	0.44
68b	Ellsworth S - Graph	Specified	0.28

Global Parameter Summary - Reach

Downstream

Element Name	Downstream
18r	17c
17r	16c
16r	20c
20r	15c
15r	14c
14r	13c
13r	12c

Route: Modified Puls

Element Name	Method	Initial Variable	Number of Reaches	Storage Outflow Table Name
18r	Modified Puls	Combined Inflow	8	18r
17r	Modified Puls	Combined Inflow	4	17r
16r	Modified Puls	Combined Inflow	6	16r
20r	Modified Puls	Combined Inflow	6	20r
15r	Modified Puls	Combined Inflow	5	15r
14r	Modified Puls	Combined Inflow	5	14r
13r	Modified Puls	Combined Inflow	2	13r

Global Results Summary

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
60b	0.65	541.94	22Sep2020, 00:24	4.58
61b	0.61	622.67	22Sep2020, 00:15	4.61
J 60b 61b	1.25	1133.19	22Sep2020, 00:18	4.59
18r	1.25	970.44	22Sep2020, 01:02	4.42
62b	0.53	659.42	22Sep2020, 00:08	4.54
17c	1.78	1171.23	22Sep2020, 00:58	4.46
17r	1.78	1084.81	22Sep2020, 01:28	4.33
63b	0.6	577.75	22Sep2020, 00:17	4.57
16c	2.38	1302.64	22Sep2020, 01:24	4.39
16r	2.38	1280.27	22Sep2020, 01:45	4.3
64b	1.09	1035.45	22Sep2020, 00:18	4.58
20c	3.47	1645.35	22Sep2020, 00:53	4.39
20r	3.47	1641.33	22Sep2020, 01:04	4.33
65b	0.53	691.07	22Sep2020, 00:07	4.58
15c	4	1848.15	22Sep2020, 00:53	4.37
15r	4	1844.61	22Sep2020, 01:03	4.33
66b	0.16	268.89	22Sep2020, 00:02	4.55
14c	4.16	1890.72	22Sep2020, 01:01	4.34
14r	4.16	1889.72	22Sep2020, 01:06	4.32
67b	0.43	388.37	22Sep2020, 00:19	4.49
13c	4.59	2103.7	22Sep2020, 01:00	4.33
13r	4.59	1968.98	22Sep2020, 01:43	4.19
68b	0.26	300.75	22Sep2020, 00:09	4.54

12c	4.85	2033.81	22Sep2020, 01:41	4.21
Pacific Ocean	4.85	2033.81	22Sep2020, 01:41	4.21

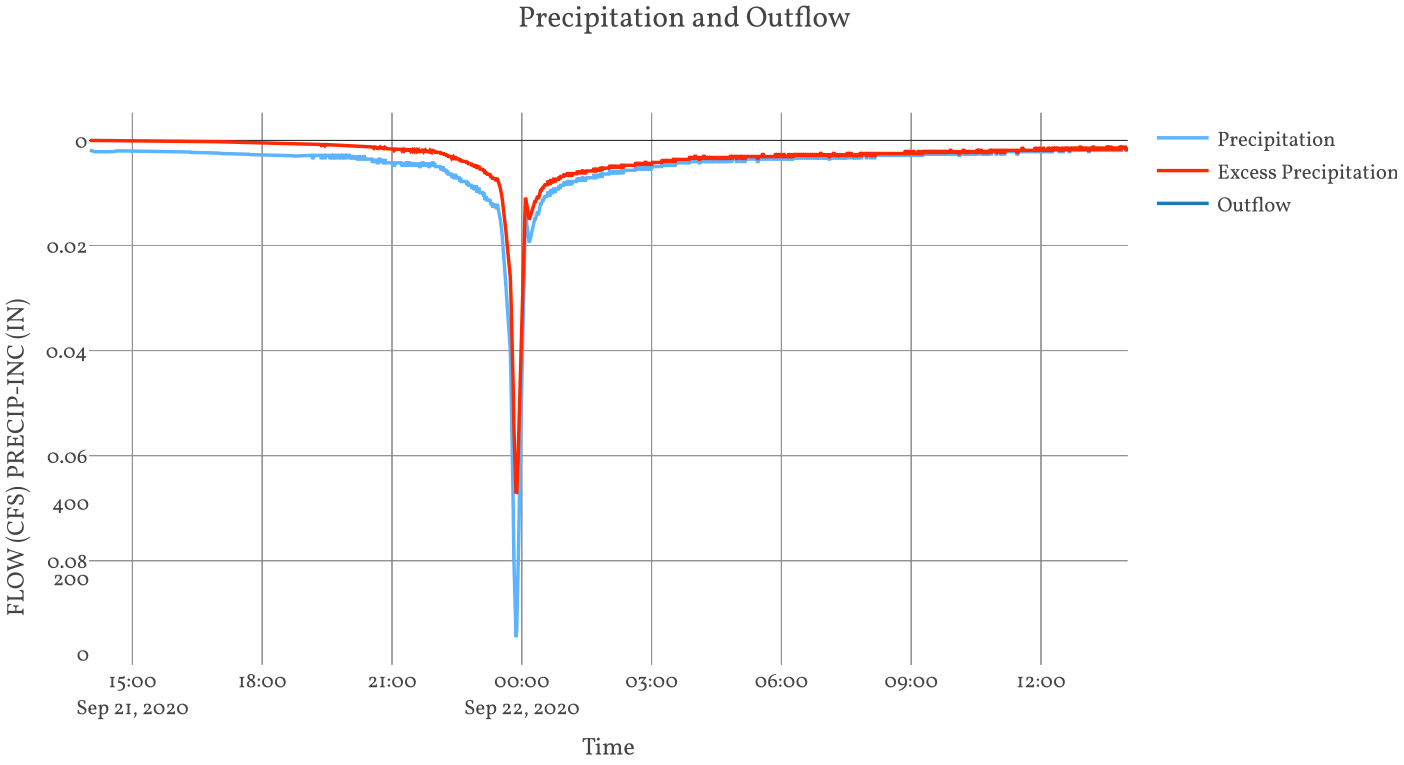
Subbasin: 60B

Area : 0.65
Downstream : J 60b 61b

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	75
Initial Abstraction	0.2

Transform: User - Specified S - Graph	
S - graph	Ellsworth S - Graph
Lag Method	Specified
Lag	0.52

Results: 60B	
Peak Discharge (CFS)	541.94
Time of Peak Discharge	22Sep2020, 00:24
Volume (IN)	4.58
Precipitation Volume (AC - FT)	244.58
Loss Volume (AC - FT)	84.23
Excess Volume (AC - FT)	160.35
Direct Runoff Volume (AC - FT)	157.64
Baseflow Volume (AC - FT)	0


Precipitation and Outflow
FLOW (CFS) PRECIP-INC (IN)
0
0.02
0.04
0.06
400
0.08
200
0
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
Sep 21, 2020
Sep 22, 2020
Time
Precipitation
Excess Precipitation
Outflow

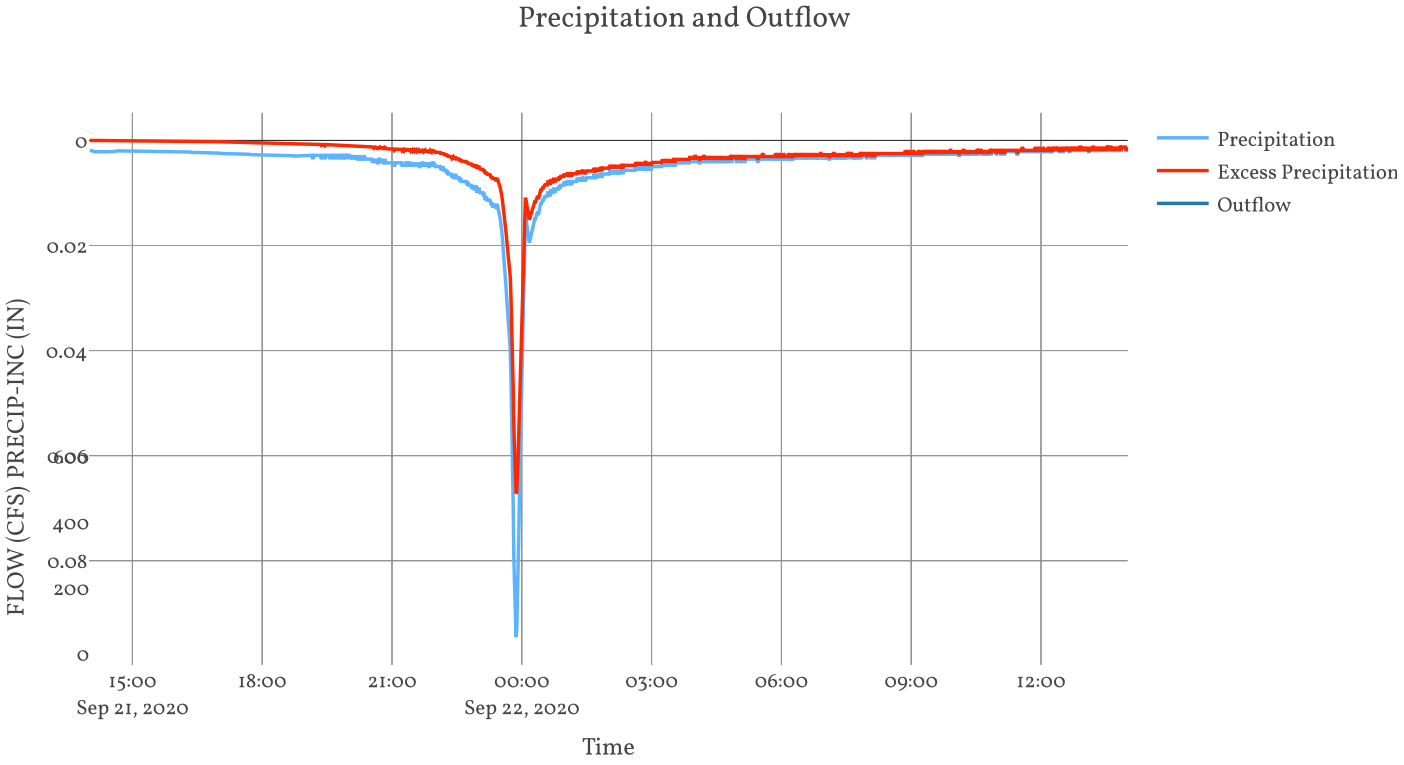
Subbasin: 61B

Area : 0.61
Downstream : J 60b 61b

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	75
Initial Abstraction	0.2

Transform: User - Specified S - Graph	
S - graph	Ellsworth S - Graph
Lag Method	Specified
Lag	0.37

Results: 61B	
Peak Discharge (CFS)	622.67
Time of Peak Discharge	22Sep2020, 00:15
Volume (IN)	4.61
Precipitation Volume (AC - FT)	229.8
Loss Volume (AC - FT)	79.14
Excess Volume (AC - FT)	150.66
Direct Runoff Volume (AC - FT)	148.89
Baseflow Volume (AC - FT)	0

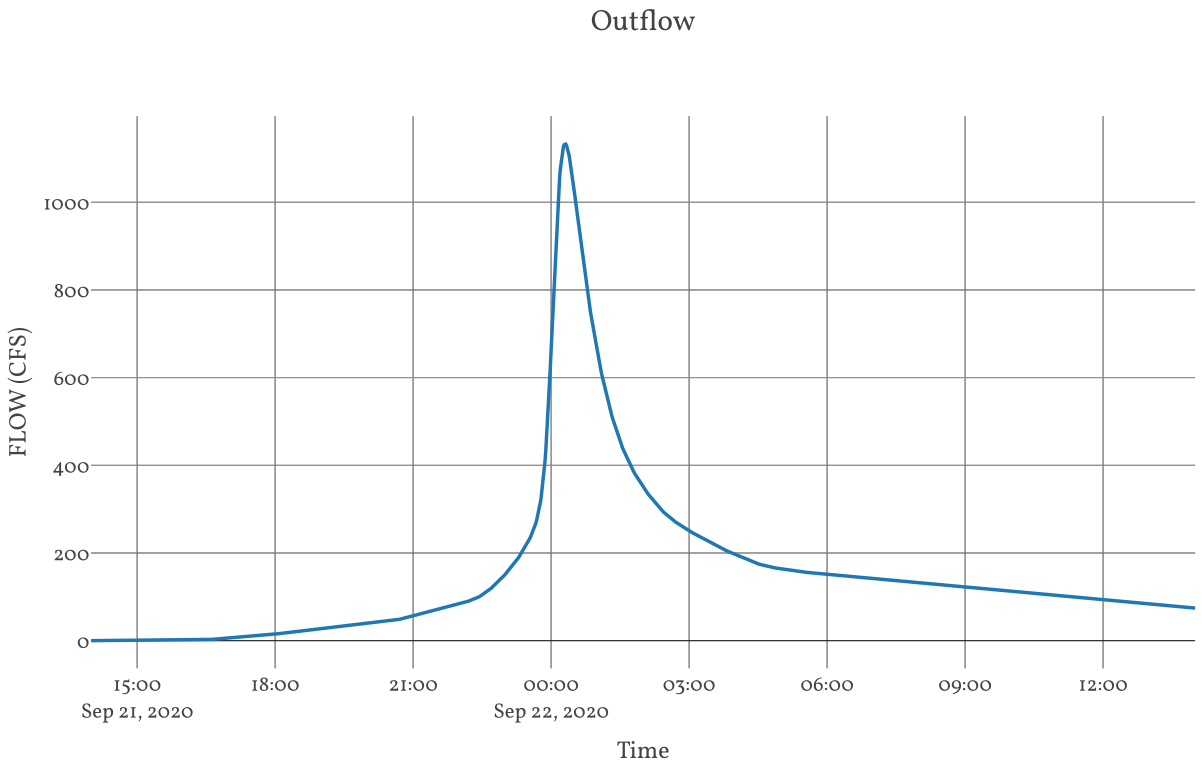

Precipitation and Outflow
FLOW (CFS) PRECIP-INC (IN)
0
0.02
0.04
606
400
0.08
200
0
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
Sep 21, 2020
Sep 22, 2020
Time
Precipitation
Excess Precipitation
Outflow

Junction: J 60B 61B

Downstream : 18r

Results: J 60B 61B

Peak Discharge (CFS)	1133.19
Time of Peak Discharge	22Sep2020, 00:18
Volume (IN)	4.59



Reach: 18R

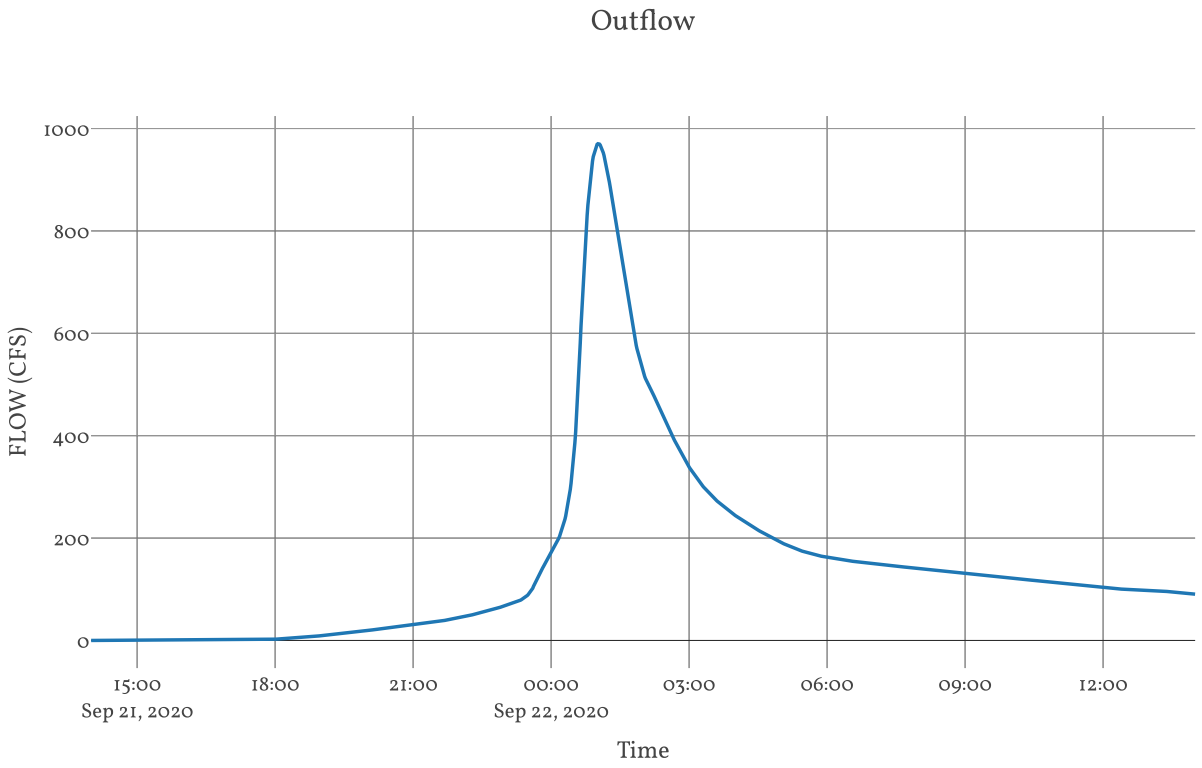
Downstream : 17c

Route: Modified Puls

Method	Modified Puls
Initial Variable	Combined Inflow
Number of Reaches	8
Storage Outflow Table Name	18r

Results: 18R

Peak Discharge (CFS)	970.44
Time of Peak Discharge	22Sep2020, 01:02
Volume (IN)	4.42
Peak Inflow (CFS)	1133.19
Inflow Volume (AC - FT)	306.52



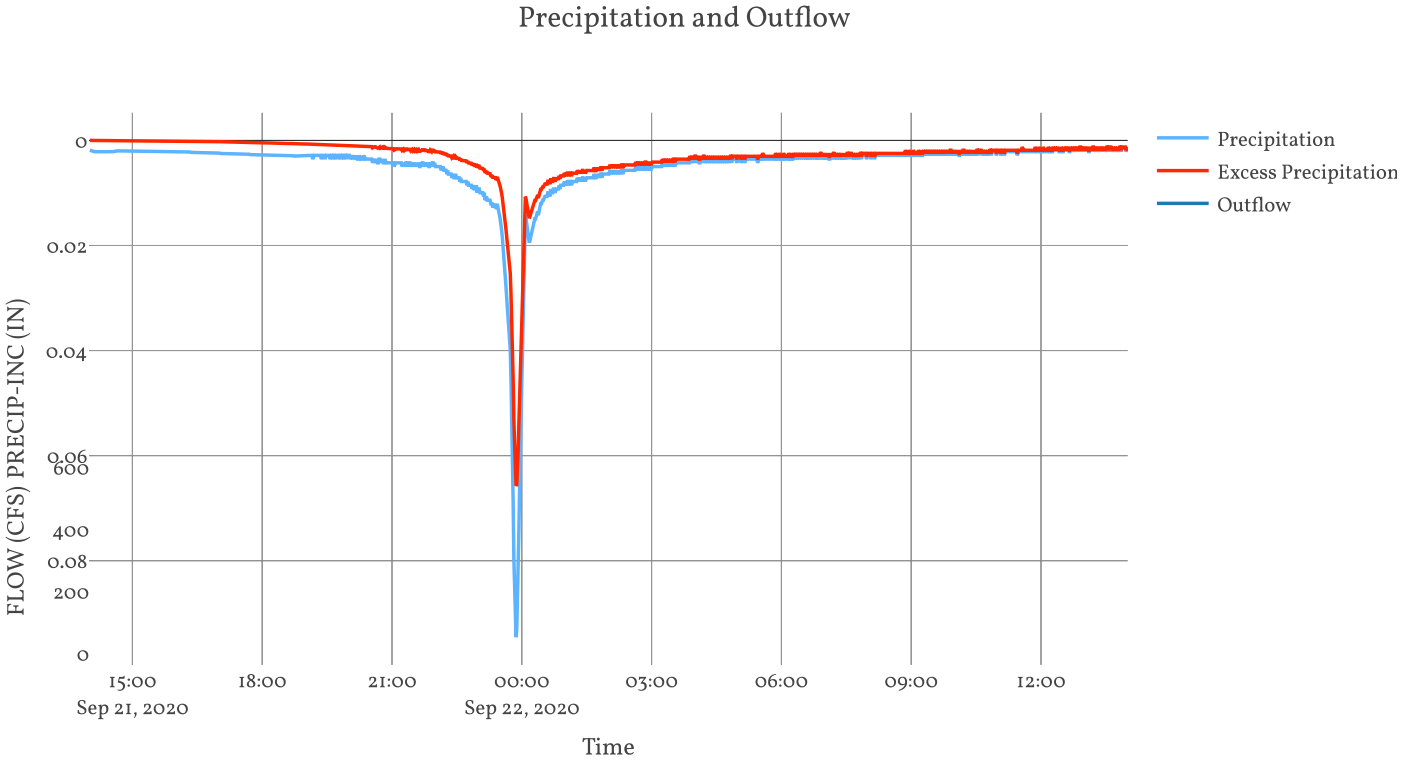
Subbasin: 62B

Area : 0.53
Downstream : 17c

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	73.9
Initial Abstraction	0.2

Transform: User - Specified S - Graph	
S - graph	Ellsworth S - Graph
Lag Method	Specified
Lag	0.25

Results: 62B	
Peak Discharge (CFS)	659.42
Time of Peak Discharge	22Sep2020, 00:08
Volume (IN)	4.54
Precipitation Volume (AC - FT)	199.31
Loss Volume (AC - FT)	71.12
Excess Volume (AC - FT)	128.18
Direct Runoff Volume (AC - FT)	127.18
Baseflow Volume (AC - FT)	0

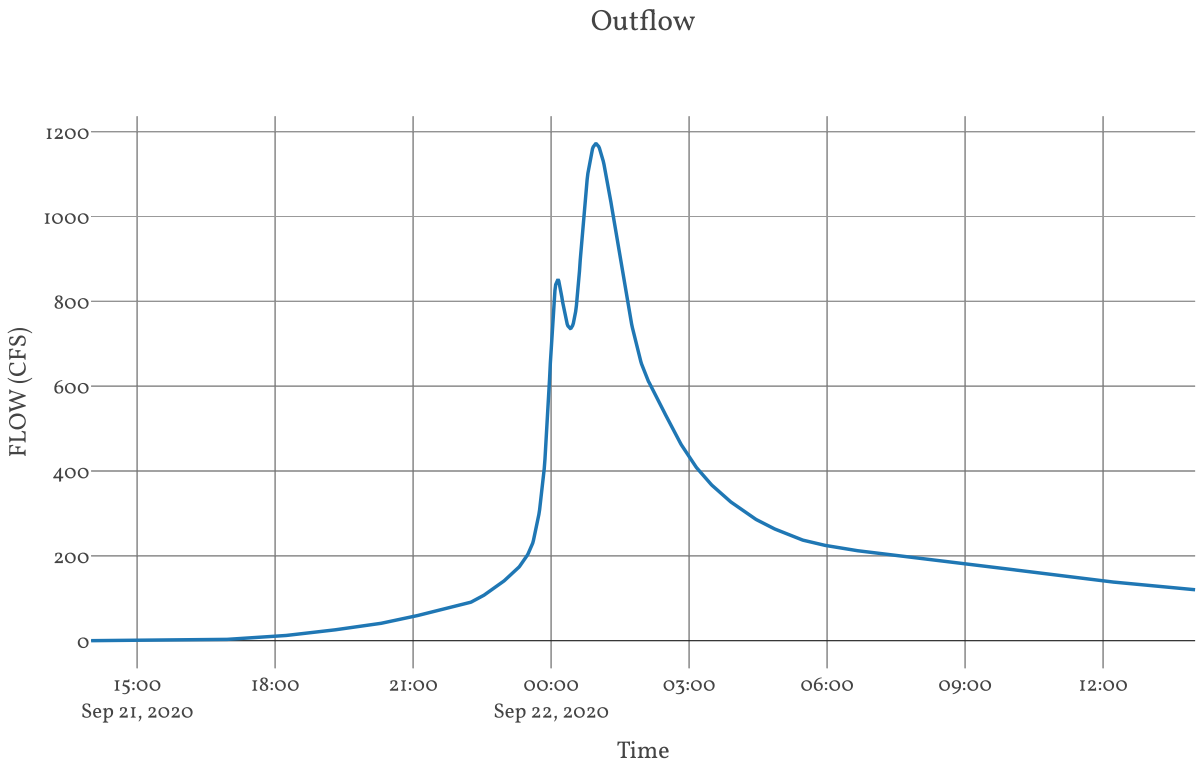

Precipitation and Outflow
FLOW (CFS) PRECIP-INC (IN)
0
0.02
0.04
0.06
600
400
0.08
200
0
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
Sep 21, 2020
Sep 22, 2020
Time
Precipitation
Excess Precipitation
Outflow

Junction: 17C

Downstream : 17r

Results: 17C

Peak Discharge (CFS)	1171.23
Time of Peak Discharge	22Sep2020, 00:58
Volume (IN)	4.46



Reach: 17R

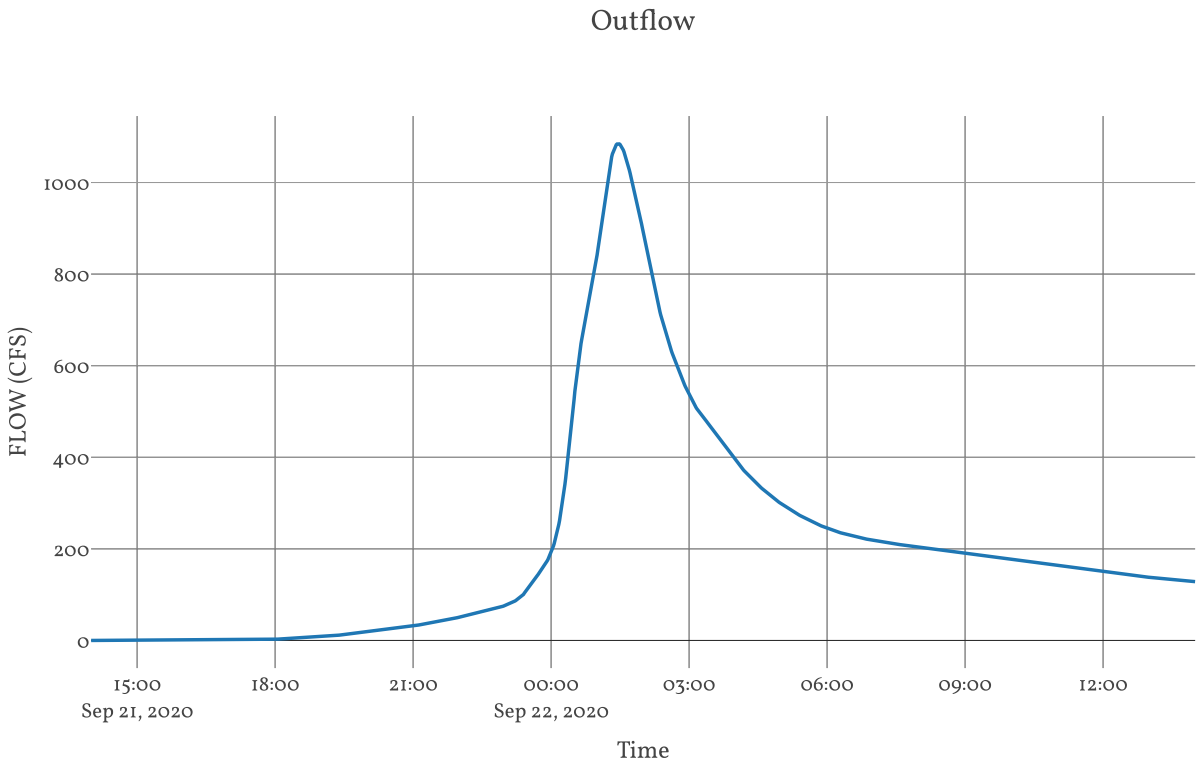
Downstream : 16c

Route: Modified Puls

Method	Modified Puls
Initial Variable	Combined Inflow
Number of Reaches	4
Storage Outflow Table Name	17r

Results: 17R

Peak Discharge (CFS)	1084.81
Time of Peak Discharge	22Sep2020, 01:28
Volume (IN)	4.33
Peak Inflow (CFS)	1171.23
Inflow Volume (AC - FT)	422.4



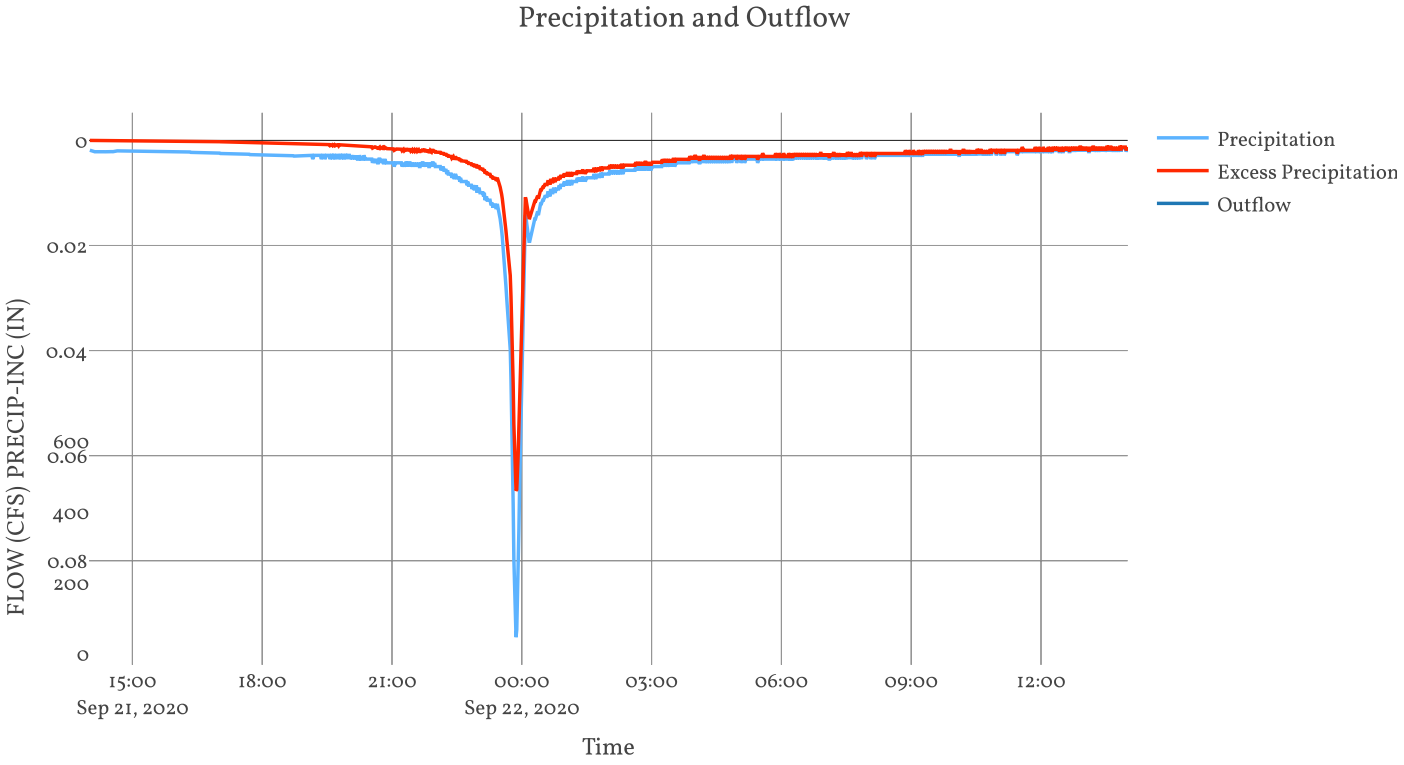
Subbasin: 63B

Area : 0.6
Downstream : 16c

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	74.6
Initial Abstraction	0.2

Transform: User - Specified S - Graph	
S - graph	Ellsworth S - Graph
Lag Method	Specified
Lag	0.41

Results: 63B	
Peak Discharge (CFS)	577.75
Time of Peak Discharge	22Sep2020, 00:17
Volume (IN)	4.57
Precipitation Volume (AC - FT)	228.28
Loss Volume (AC - FT)	79.65
Excess Volume (AC - FT)	148.62
Direct Runoff Volume (AC - FT)	146.67
Baseflow Volume (AC - FT)	0

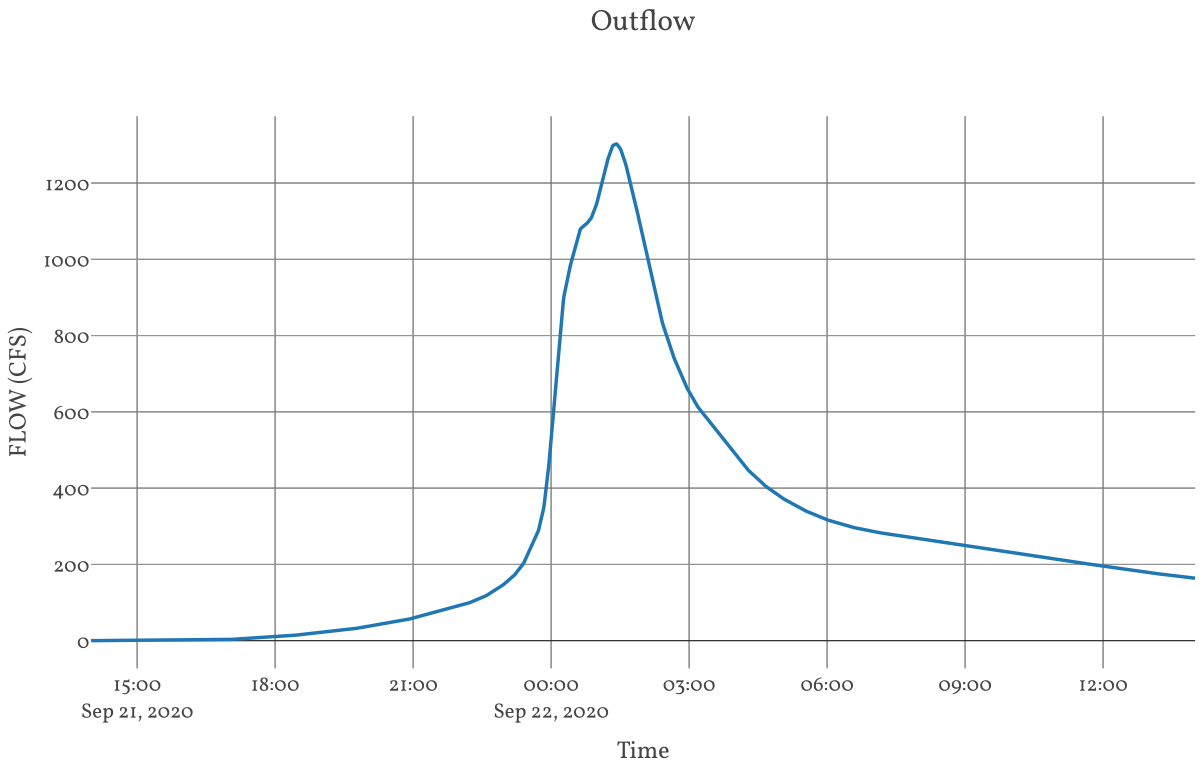

Precipitation and Outflow
FLOW (CFS) PRECIP-INC (IN)
0
0.02
0.04
600
0.06
400
0.08
200
0
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
Sep 21, 2020
Sep 22, 2020
Time
Precipitation
Excess Precipitation
Outflow

Junction: 16C

Downstream : 16r

Results: 16C

Peak Discharge (CFS)	1302.64
Time of Peak Discharge	22Sep2020, 01:24
Volume (IN)	4.39

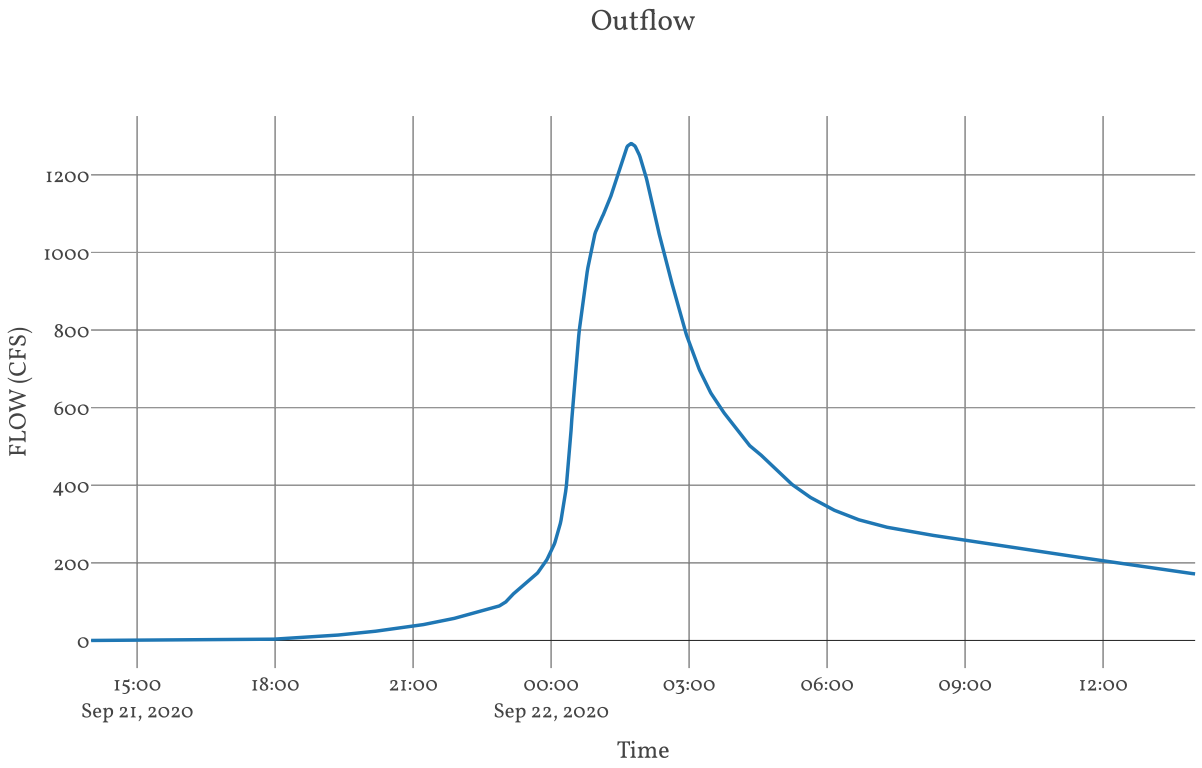


Reach: 16R

Downstream : 20C

Route: Modified Puls	
Method	Modified Puls
Initial Variable	Combined Inflow
Number of Reaches	6
Storage Outflow Table Name	16r

Results: 16R	
Peak Discharge (CFS)	1280.27
Time of Peak Discharge	22Sep2020, 01:45
Volume (IN)	4.3
Peak Inflow (CFS)	1302.64
Inflow Volume (AC - FT)	556.73



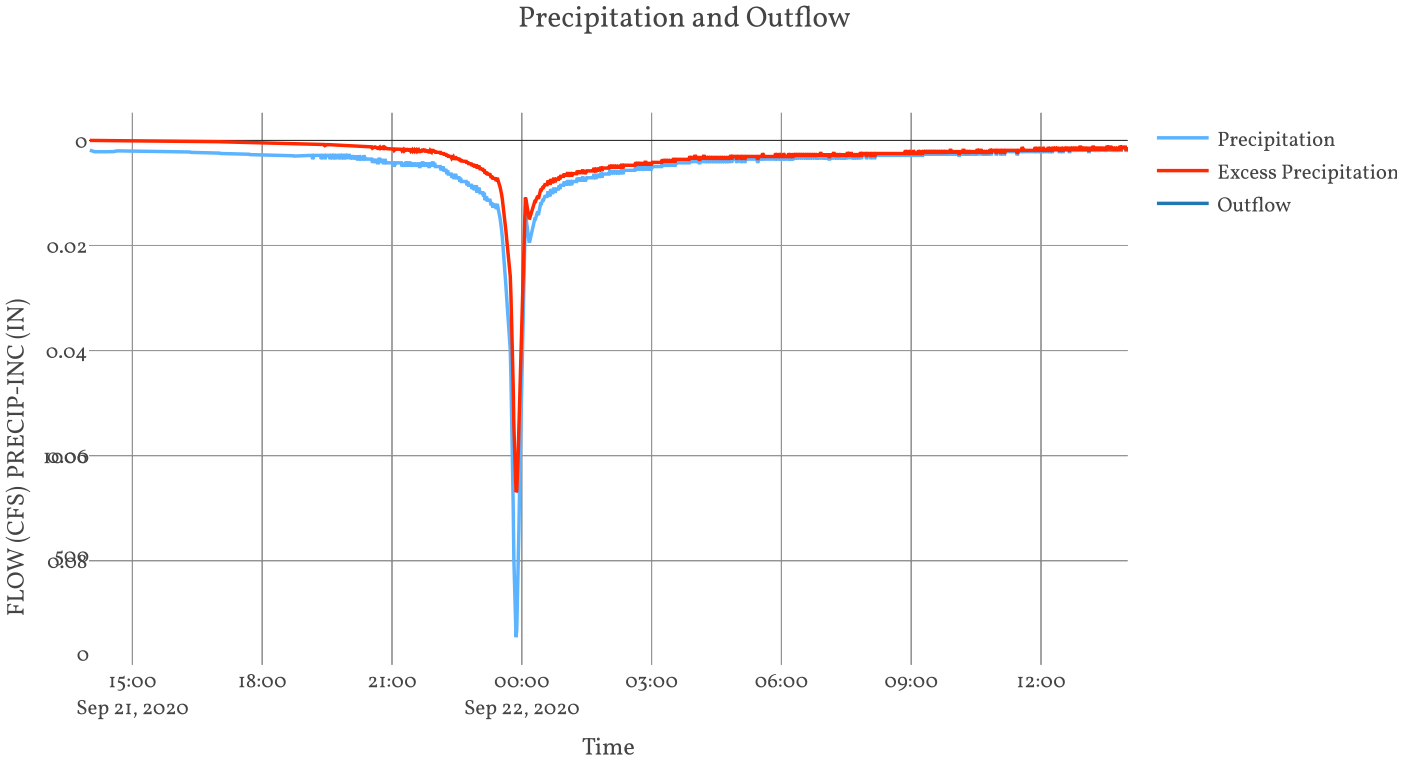
Subbasin: 64B

Area : 1.09
Downstream : 20c

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	74.8
Initial Abstraction	0.2

Transform: User - Specified S - Graph	
S - graph	Ellsworth S - Graph
Lag Method	Specified
Lag	0.42

Results: 64B	
Peak Discharge (CFS)	1035.45
Time of Peak Discharge	22Sep2020, 00:18
Volume (IN)	4.58
Precipitation Volume (AC - FT)	413.33
Loss Volume (AC - FT)	143.29
Excess Volume (AC - FT)	270.04
Direct Runoff Volume (AC - FT)	266.4
Baseflow Volume (AC - FT)	0

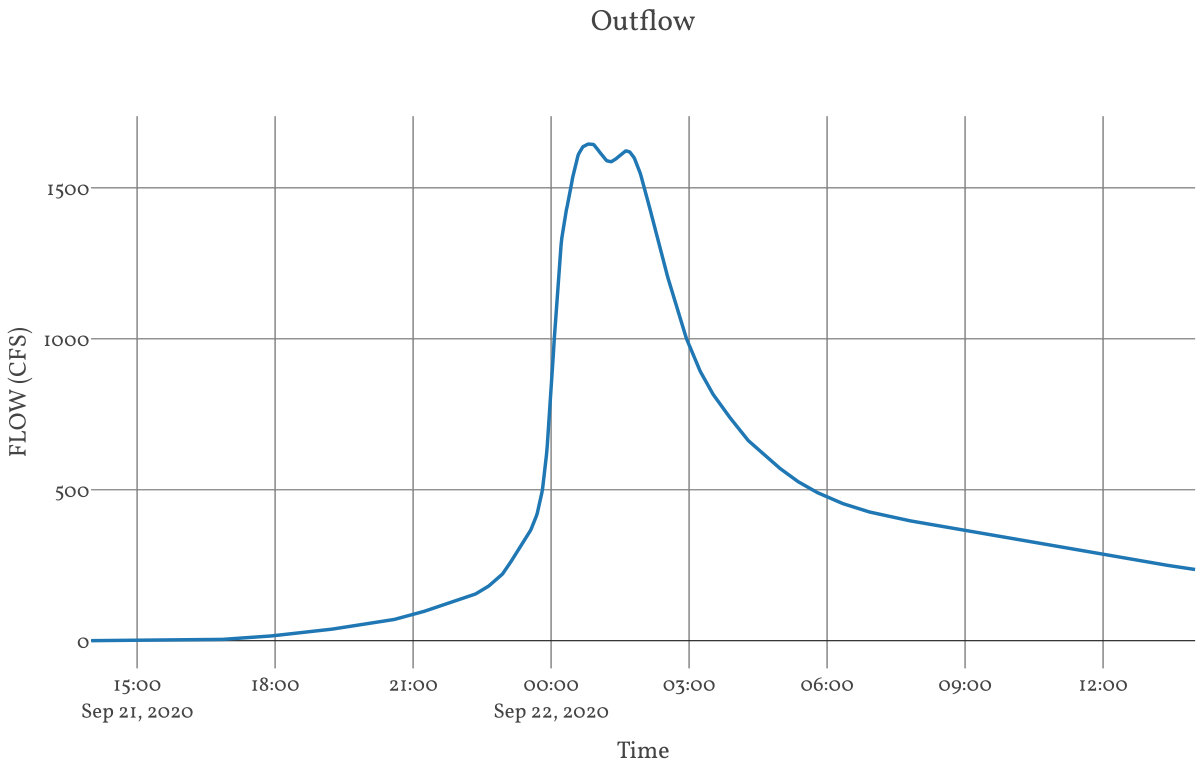

Precipitation and Outflow
FLOW (CFS) PRECIP-INC (IN)
0
0.02
0.04
0.06
0.08
0
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
Sep 21, 2020
Sep 22, 2020
Time
Precipitation
Excess Precipitation
Outflow

Junction: 20C

Downstream : 20r

Results: 20C

Peak Discharge (CFS)	1645.35
Time of Peak Discharge	22Sep2020, 00:53
Volume (IN)	4.39

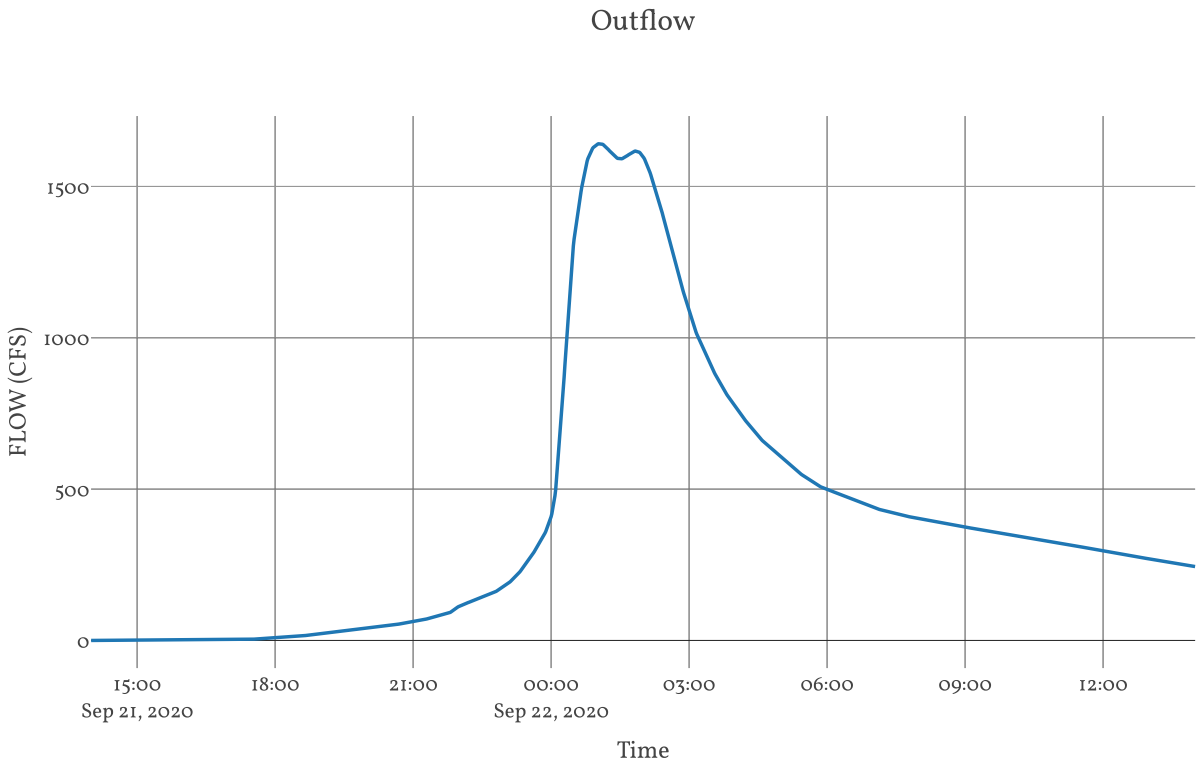


Reach: 20R

Downstream : 15c

Route: Modified Puls	
Method	Modified Puls
Initial Variable	Combined Inflow
Number of Reaches	6
Storage Outflow Table Name	20r

Results: 20R	
Peak Discharge (CFS)	1641.33
Time of Peak Discharge	22Sep2020, 01:04
Volume (IN)	4.33
Peak Inflow (CFS)	1645.35
Inflow Volume (AC - FT)	811.84



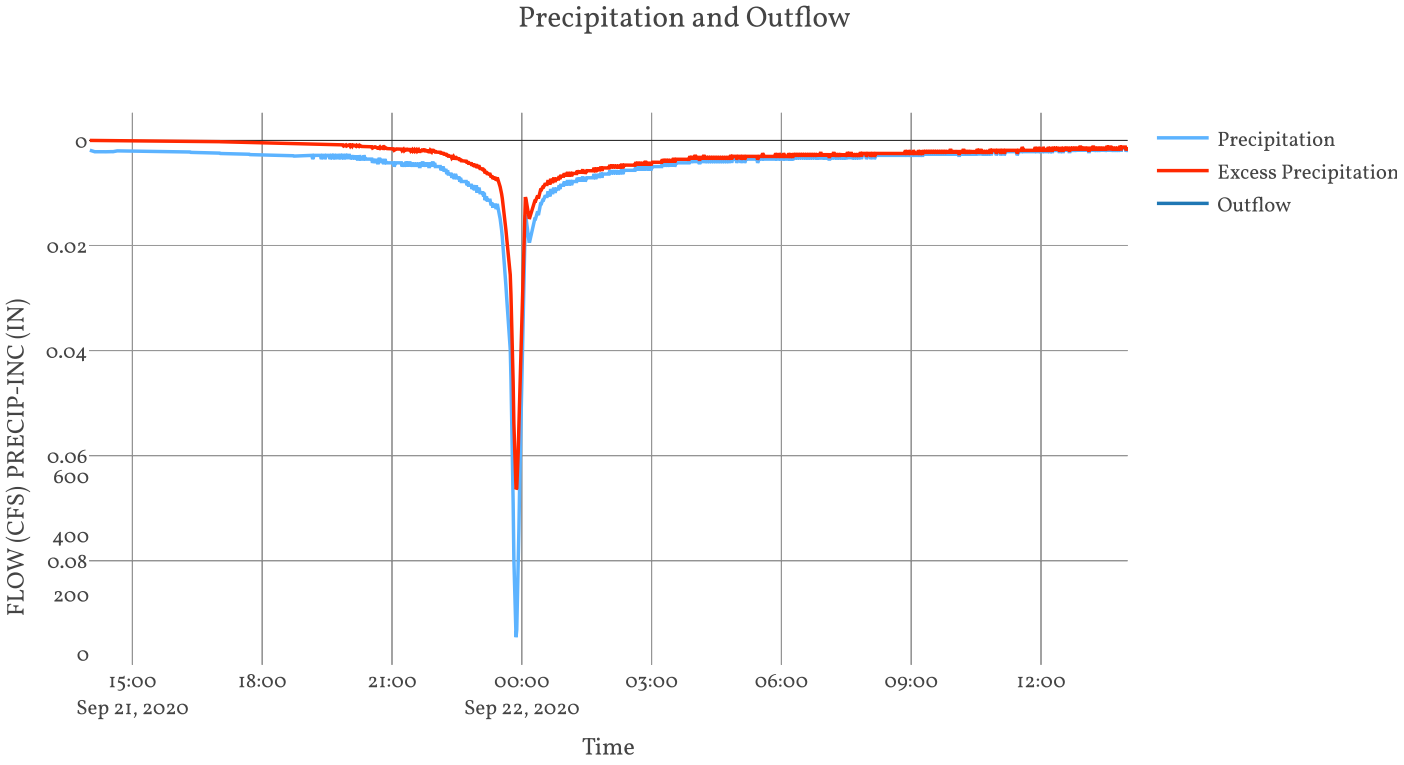
Subbasin: 65B

Area : 0.53
Downstream : 15c

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	74.4
Initial Abstraction	0.2

Transform: User - Specified S - Graph	
S - graph	Ellsworth S - Graph
Lag Method	Specified
Lag	0.24

Results: 65B	
Peak Discharge (CFS)	691.07
Time of Peak Discharge	22Sep2020, 00:07
Volume (IN)	4.58
Precipitation Volume (AC - FT)	202.11
Loss Volume (AC - FT)	70.98
Excess Volume (AC - FT)	131.13
Direct Runoff Volume (AC - FT)	130.15
Baseflow Volume (AC - FT)	0

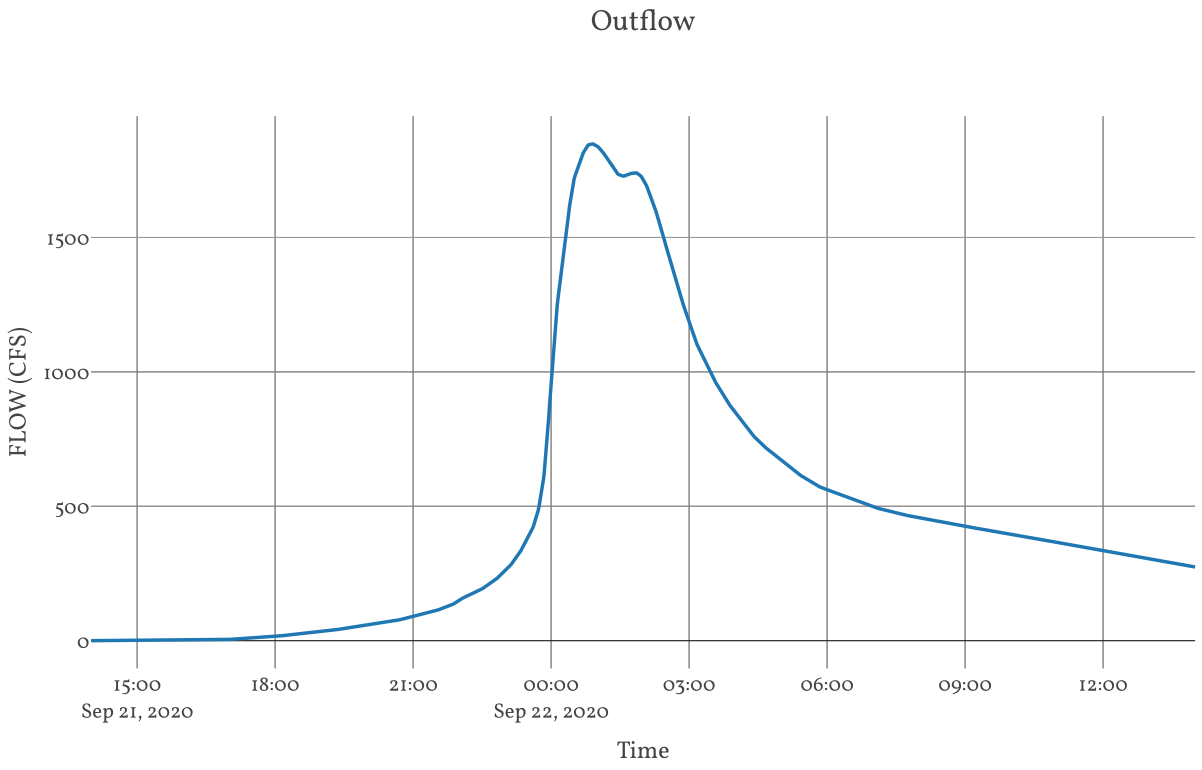

Precipitation and Outflow
FLOW (CFS) PRECIP-INC (IN)
0
0.02
0.04
0.06
600
400
0.08
200
0
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
Sep 21, 2020
Sep 22, 2020
Time
Precipitation
Excess Precipitation
Outflow

Junction: 15C

Downstream : 15r

Results: 15C

Peak Discharge (CFS)	1848.15
Time of Peak Discharge	22Sep2020, 00:53
Volume (IN)	4.37



Reach: 15R

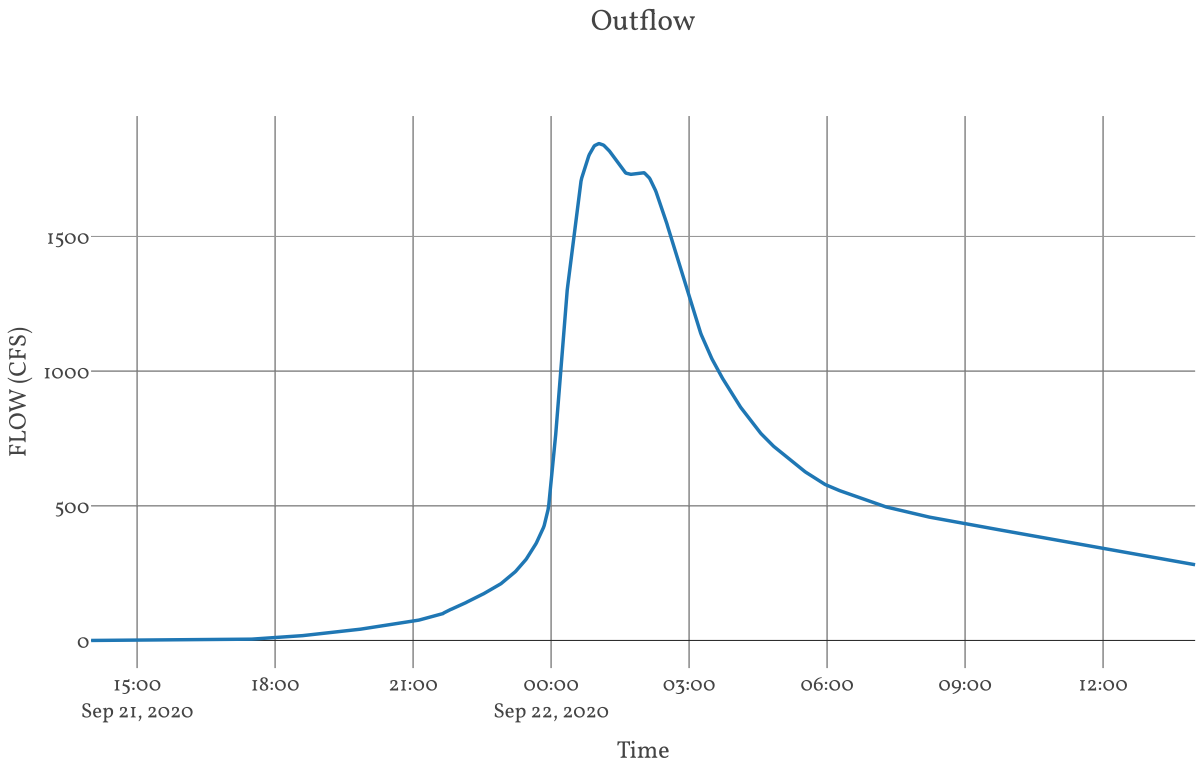
Downstream : 14c

Route: Modified Puls

Method	Modified Puls
Initial Variable	Combined Inflow
Number of Reaches	5
Storage Outflow Table Name	15r

Results: 15R

Peak Discharge (CFS)	1844.61
Time of Peak Discharge	22Sep2020, 01:03
Volume (IN)	4.33
Peak Inflow (CFS)	1848.15
Inflow Volume (AC - FT)	931.8



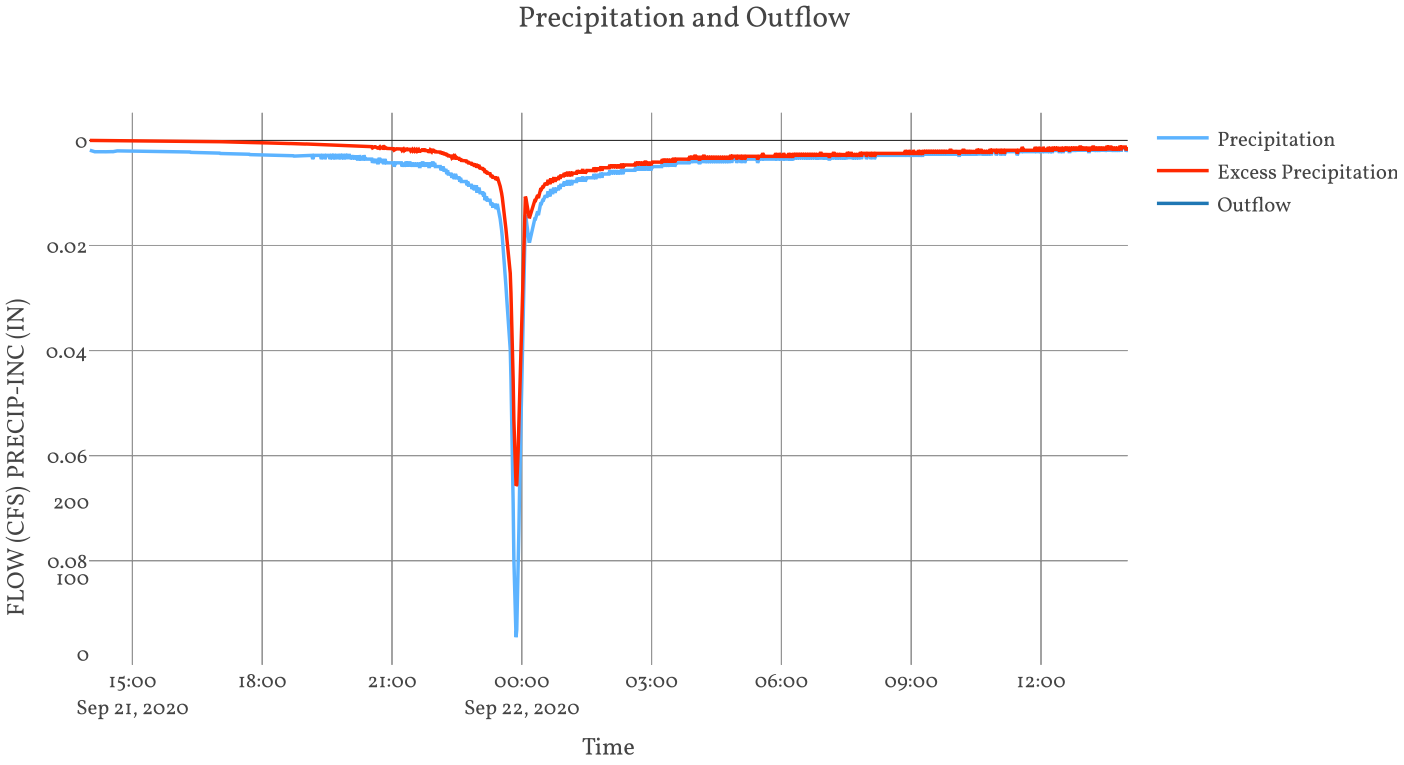
Subbasin: 66B

Area : 0.16
Downstream : 14c

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	73.9
Initial Abstraction	0.2

Transform: User - Specified S - Graph	
S - graph	Ellsworth S - Graph
Lag Method	Specified
Lag	0.14

Results: 66B	
Peak Discharge (CFS)	268.89
Time of Peak Discharge	22Sep2020, 00:02
Volume (IN)	4.55
Precipitation Volume (AC - FT)	61.43
Loss Volume (AC - FT)	21.92
Excess Volume (AC - FT)	39.51
Direct Runoff Volume (AC - FT)	39.34
Baseflow Volume (AC - FT)	0

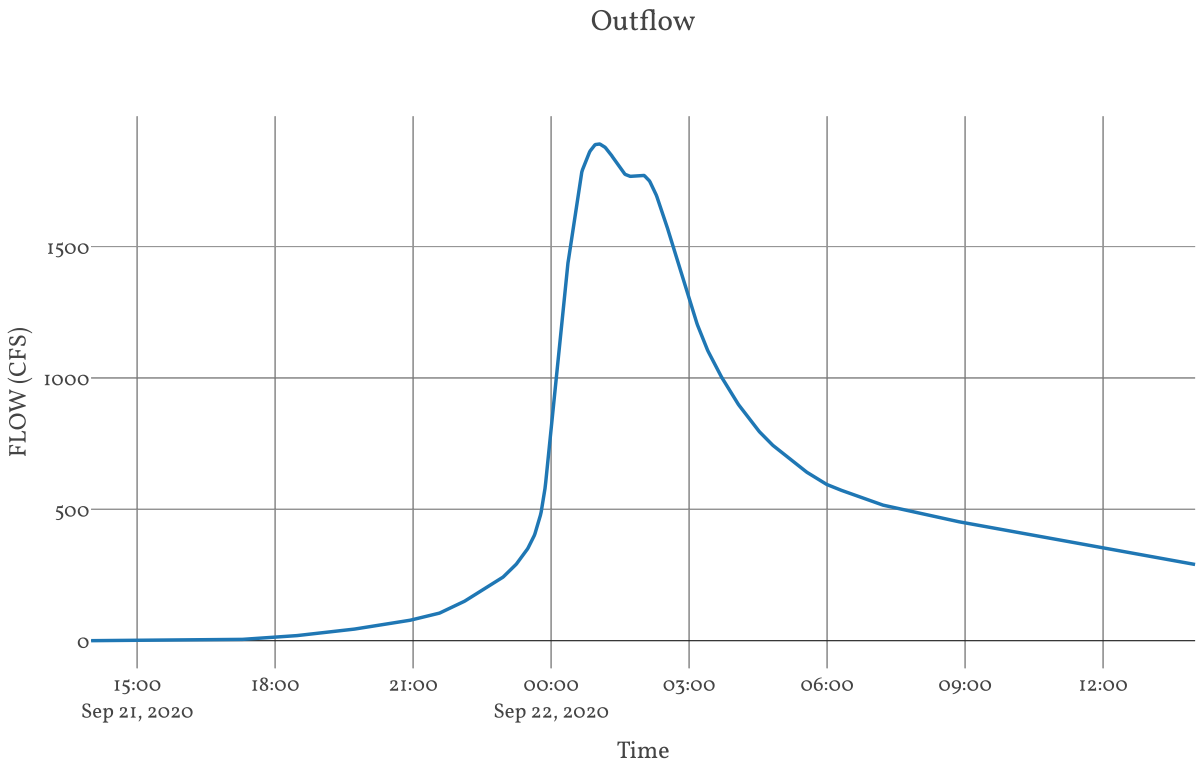

Precipitation and Outflow
FLOW (CFS) PRECIP-INC (IN)
0
0.02
0.04
0.06
200
0.08
100
0
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
Sep 21, 2020
Sep 22, 2020
Time
Precipitation
Excess Precipitation
Outflow

Junction: 14C

Downstream : 14r

Results: 14C

Peak Discharge (CFS)	1890.72
Time of Peak Discharge	22Sep2020, 01:01
Volume (IN)	4.34



Reach: 14R

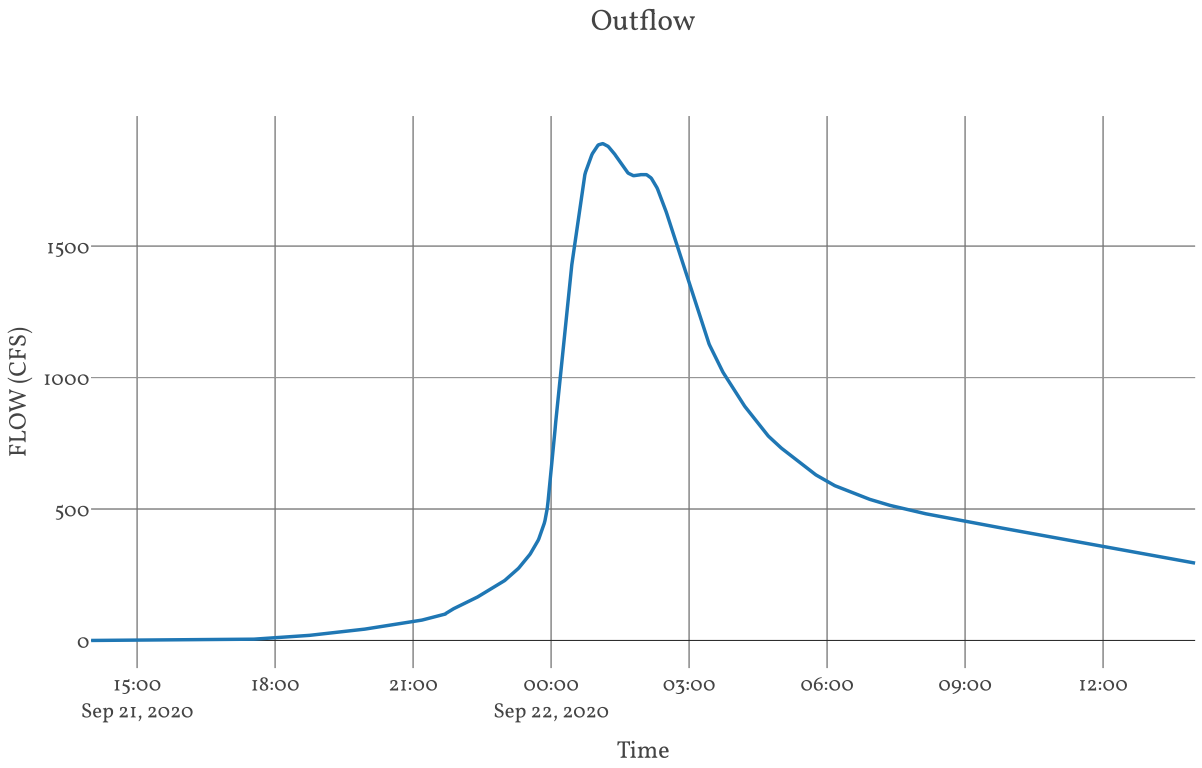
Downstream : 13c

Route: Modified Puls

Method	Modified Puls
Initial Variable	Combined Inflow
Number of Reaches	5
Storage Outflow Table Name	14r

Results: 14R

Peak Discharge (CFS)	1889.72
Time of Peak Discharge	22Sep2020, 01:06
Volume (IN)	4.32
Peak Inflow (CFS)	1890.72
Inflow Volume (AC - FT)	963.37



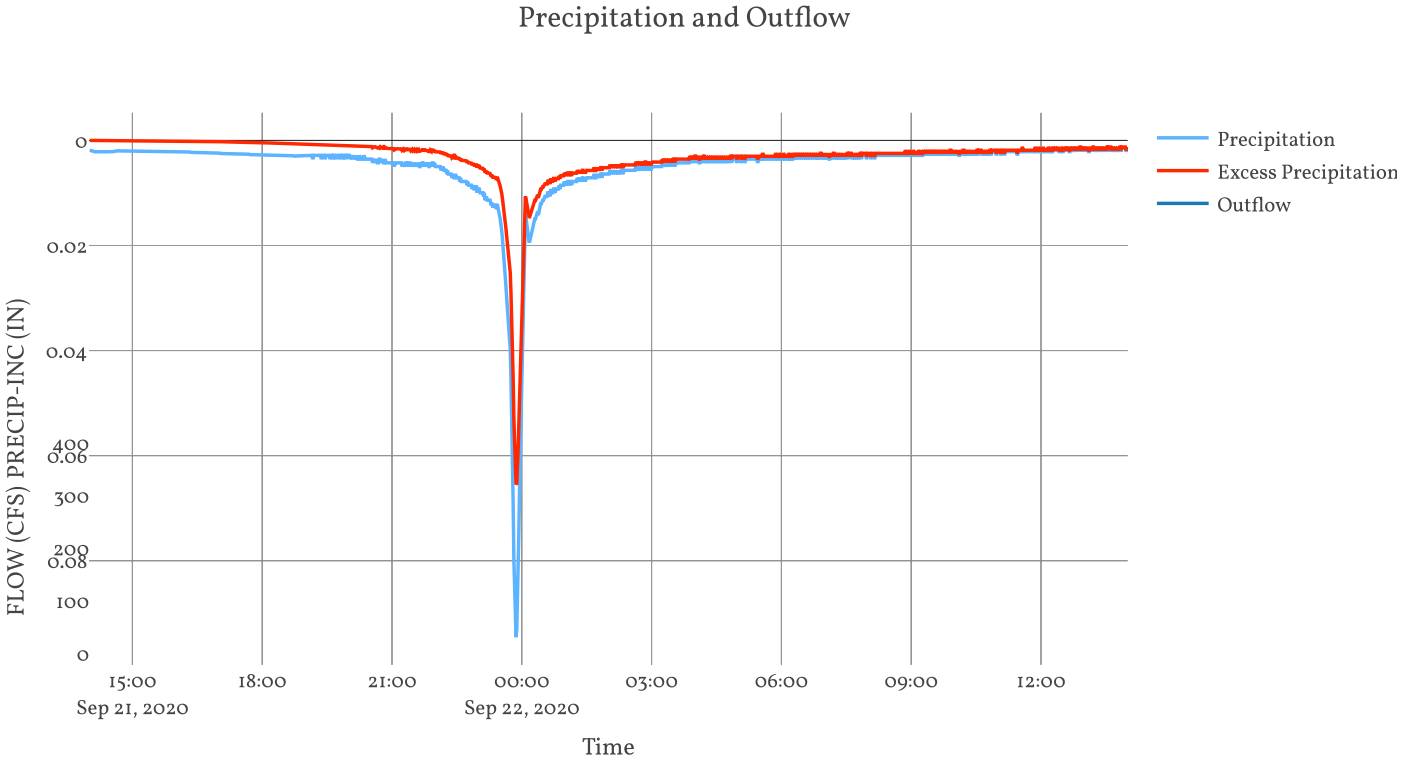
Subbasin: 67B

Area : 0.43
Downstream : 13c

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	73.7
Initial Abstraction	0.2

Transform: User - Specified S - Graph	
S - graph	Ellsworth S - Graph
Lag Method	Specified
Lag	0.44

Results: 67B	
Peak Discharge (CFS)	388.37
Time of Peak Discharge	22Sep2020, 00:19
Volume (IN)	4.49
Precipitation Volume (AC - FT)	163.06
Loss Volume (AC - FT)	58.55
Excess Volume (AC - FT)	104.5
Direct Runoff Volume (AC - FT)	103.01
Baseflow Volume (AC - FT)	0

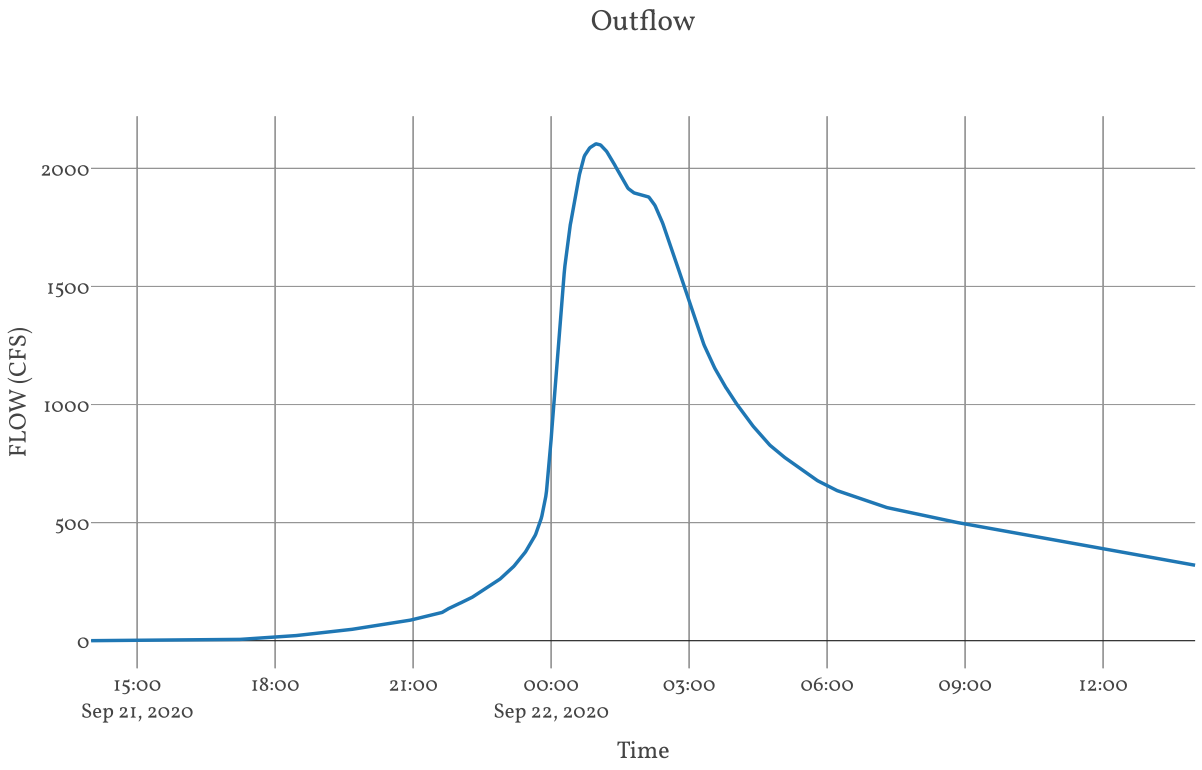

Precipitation and Outflow
FLOW (CFS) PRECIP-INC (IN)
0
0.02
0.04
400
0.06
300
200
0.08
100
0
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
Sep 21, 2020
Sep 22, 2020
Time
Precipitation
Excess Precipitation
Outflow

Junction: 13C

Downstream : 13r

Results: 13C

Peak Discharge (CFS)	2103.7
Time of Peak Discharge	22Sep2020, 01:00
Volume (IN)	4.33



Reach: 13R

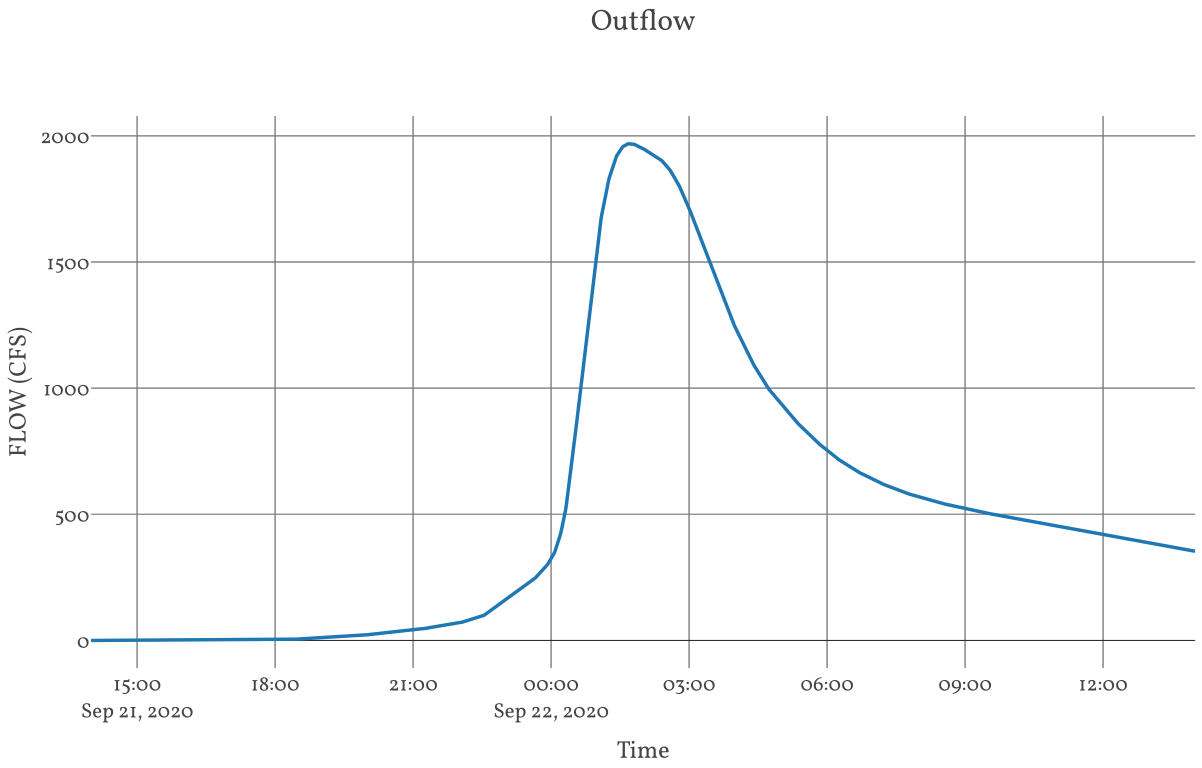
Downstream : 12C

Route: Modified Puls

Method	Modified Puls
Initial Variable	Combined Inflow
Number of Reaches	2
Storage Outflow Table Name	13r

Results: 13R

Peak Discharge (CFS)	1968.98
Time of Peak Discharge	22Sep2020, 01:43
Volume (IN)	4.19
Peak Inflow (CFS)	2103.7
Inflow Volume (AC - FT)	1061.97



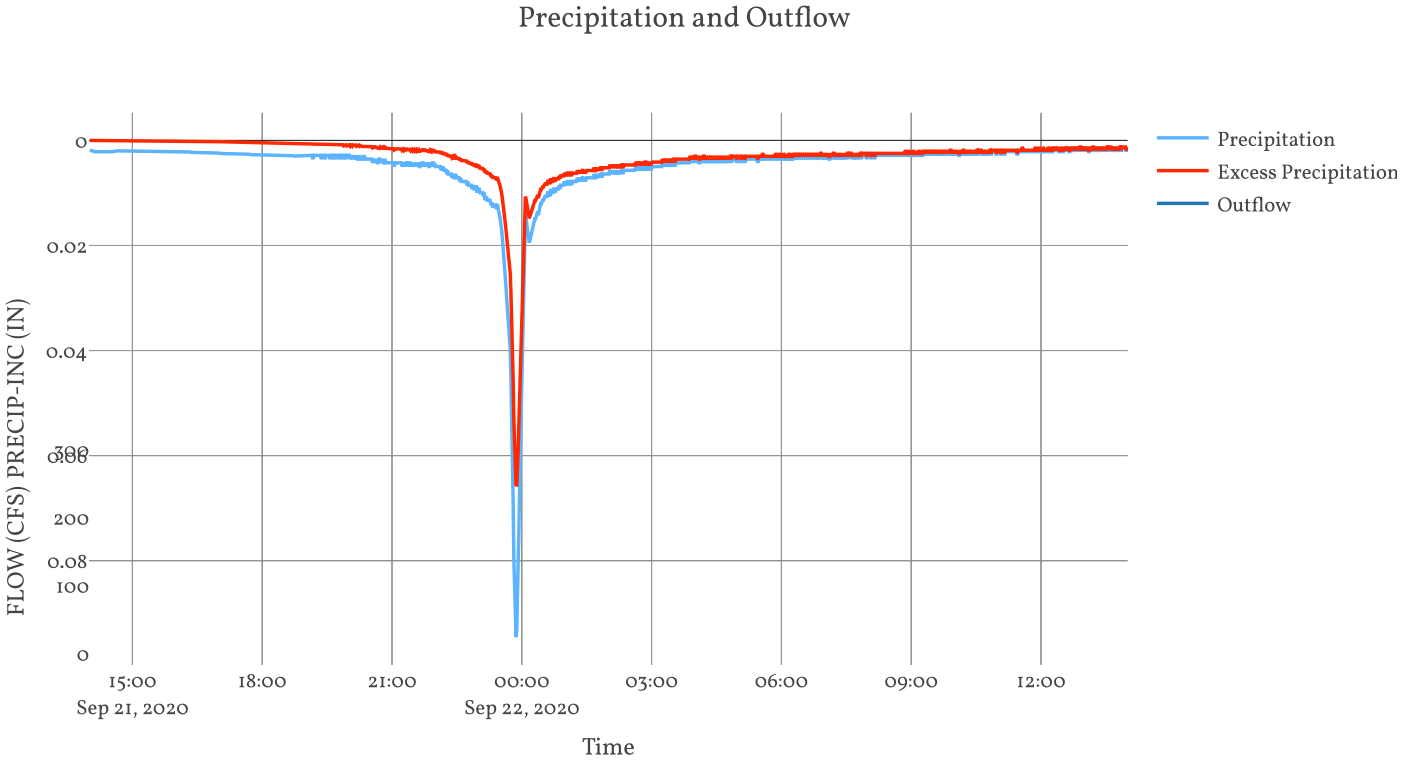
Subbasin: 68B

Area : 0.26
Downstream : 12c

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	73.9
Initial Abstraction	0.2

Transform: User - Specified S - Graph	
S - graph	Ellsworth S - Graph
Lag Method	Specified
Lag	0.28

Results: 68B	
Peak Discharge (CFS)	300.75
Time of Peak Discharge	22Sep2020, 00:09
Volume (IN)	4.54
Precipitation Volume (AC - FT)	96.7
Loss Volume (AC - FT)	34.44
Excess Volume (AC - FT)	62.26
Direct Runoff Volume (AC - FT)	61.71
Baseflow Volume (AC - FT)	0

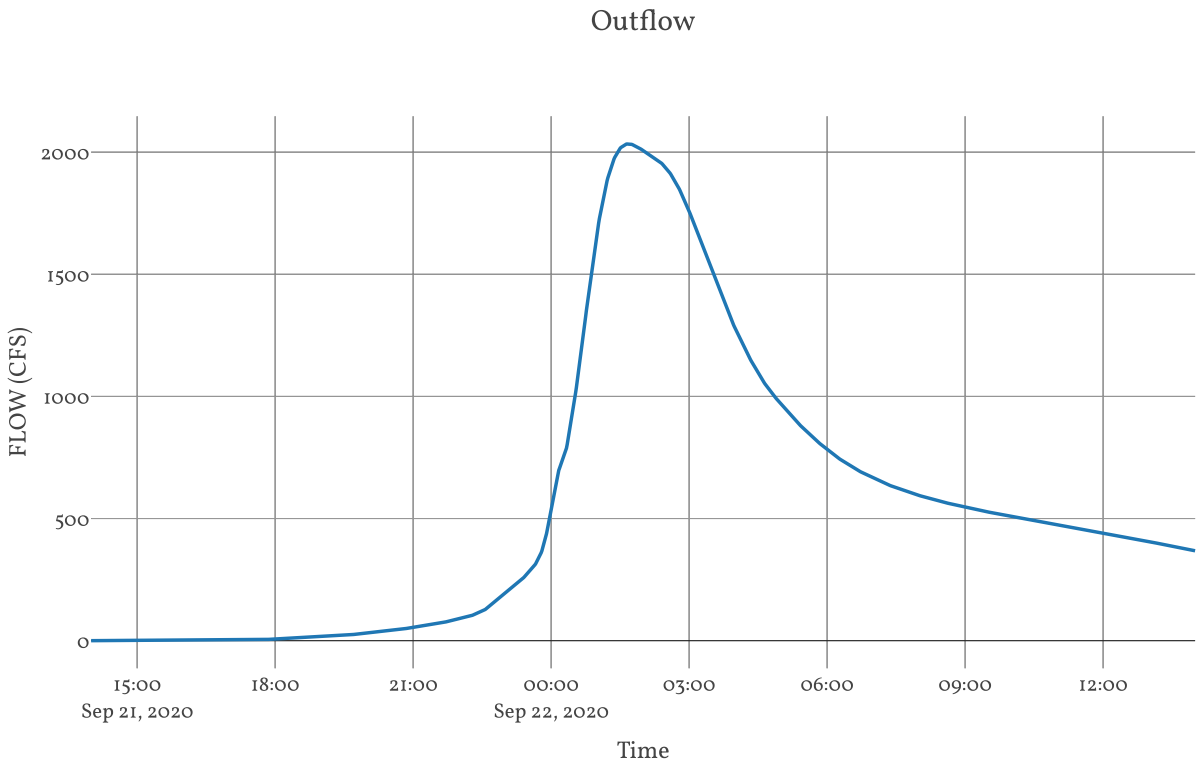

Precipitation and Outflow
FLOW (CFS) PRECIP-INC (IN)
0
0.02
0.04
300
200
0.08
100
0
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
Sep 21, 2020
Sep 22, 2020
Time
Precipitation
Excess Precipitation
Outflow

Junction: 12C

Downstream : Pacific Ocean

Results: 12C

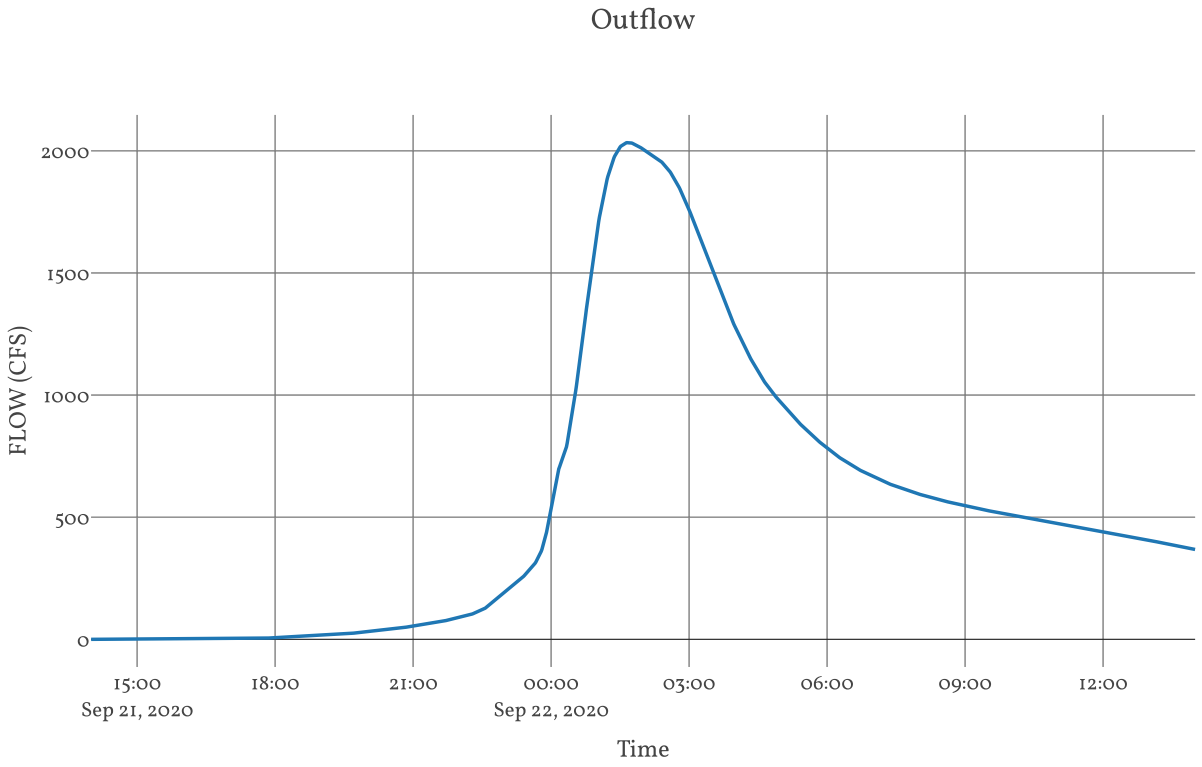
Peak Discharge (CFS)	2033.81
Time of Peak Discharge	22Sep2020, 01:41
Volume (IN)	4.21



Sink: Pacific Ocean

Results: Pacific Ocean

Peak Discharge (CFS)	2033.81
Time of Peak Discharge	22Sep2020, 01:41
Volume (IN)	4.21
Observed Flow Gage	Not specified
Observed Flow Volume (AC - FT)	Not specified
Observed Flow's RMSE Stdev	Not specified
Observed Flow's Percent Bias	Not specified
Observed Flow's Nash Sutcliffe	Not specified



Project: Little_Sycamore_May2021
Simulation Run: 050-yr Post Dev
Simulation Start: 21 September 2020, 14:00
Simulation End: 22 September 2020, 14:00

HMS Version: 4.6.1
Executed: 29 April 2021, 23:45

Global Parameter Summary - Subbasin

Area

Element Name	Area
60b	0.65
61b	0.61
62b	0.53
63b	0.6
64b	1.09
65b	0.53
66b	0.16
67b	0.43
68b	0.26

Downstream

Element Name	Downstream
60b	J 60b 61b
61b	J 60b 61b
62b	17c
63b	16c
64b	20c
65b	15c
66b	14c
67b	13c
68b	12c

Loss Rate: Scs

Element Name	Percent Impervious Area	Curve Number	Initial Abstraction
60b	0	75	0.2
61b	0	75	0.2
62b	0	73.9	0.2
63b	0	74.6	0.2
64b	0	74.8	0.2
65b	0	74.4	0.2
66b	0	73.9	0.2
67b	0	73.7	0.2
68b	0	73.9	0.2

Transform: User - Specified S - Graph

Element Name	S - graph	Lag Method	Lag
60b	Ellsworth S - Graph	Specified	0.52
61b	Ellsworth S - Graph	Specified	0.37
62b	Ellsworth S - Graph	Specified	0.25
63b	Ellsworth S - Graph	Specified	0.41
64b	Ellsworth S - Graph	Specified	0.42
65b	Ellsworth S - Graph	Specified	0.24
66b	Ellsworth S - Graph	Specified	0.14
67b	Ellsworth S - Graph	Specified	0.44
68b	Ellsworth S - Graph	Specified	0.28

Global Parameter Summary - Reach

Downstream

Element Name	Downstream
18r	17c
17r	16c
16r	20c
20r	15c
15r	14c
14r	13c
13r	12c

Route: Modified Puls

Element Name	Method	Initial Variable	Number of Reaches	Storage Outflow Table Name
18r	Modified Puls	Combined Inflow	8	18r
17r	Modified Puls	Combined Inflow	4	17r
16r	Modified Puls	Combined Inflow	6	16r
20r	Modified Puls	Combined Inflow	6	20r
15r	Modified Puls	Combined Inflow	5	15r
14r	Modified Puls	Combined Inflow	5	14r
13r	Modified Puls	Combined Inflow	2	13r

Global Results Summary

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
60b	0.65	658.2	22Sep2020, 00:24	5.53
61b	0.61	755.86	22Sep2020, 00:15	5.56
J 60b 61b	1.25	1376.41	22Sep2020, 00:18	5.54
18r	1.25	1201.59	22Sep2020, 00:57	5.35
62b	0.53	801.86	22Sep2020, 00:08	5.48
17c	1.78	1461.83	22Sep2020, 00:54	5.39
17r	1.78	1346.99	22Sep2020, 01:22	5.25
63b	0.6	702.15	22Sep2020, 00:17	5.51
16c	2.38	1626.68	22Sep2020, 01:18	5.31
16r	2.38	1603.52	22Sep2020, 01:37	5.22
64b	1.09	1257.72	22Sep2020, 00:18	5.53
20c	3.47	2095.06	22Sep2020, 00:45	5.31
20r	3.47	2083.23	22Sep2020, 00:58	5.25
65b	0.53	839.53	22Sep2020, 00:07	5.53
15c	4	2343.64	22Sep2020, 00:53	5.29
15r	4	2337.96	22Sep2020, 01:01	5.25
66b	0.16	326.61	22Sep2020, 00:02	5.5
14c	4.16	2393.85	22Sep2020, 01:00	5.26
14r	4.16	2392.33	22Sep2020, 01:05	5.24
67b	0.43	472.93	22Sep2020, 00:19	5.43
13c	4.59	2655.4	22Sep2020, 00:58	5.25
13r	4.59	2490.9	22Sep2020, 01:35	5.09
68b	0.26	365.84	22Sep2020, 00:09	5.48

12c	4.85	2573.2	22Sep2020, 01:33	5.11
Pacific Ocean	4.85	2573.2	22Sep2020, 01:33	5.11

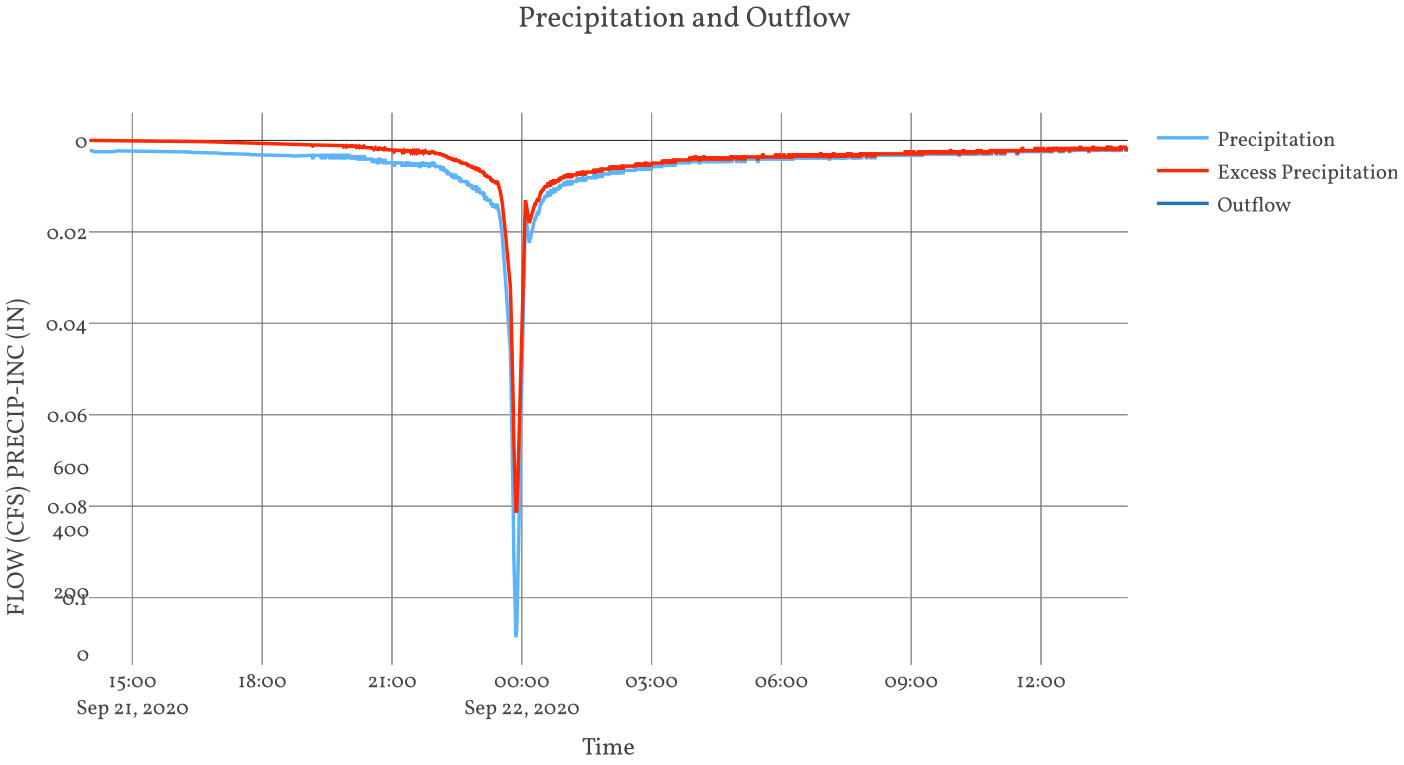
Subbasin: 60B

Area : 0.65
Downstream : J 60b 61b

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	75
Initial Abstraction	0.2

Transform: User - Specified S - Graph	
S - graph	Ellsworth S - Graph
Lag Method	Specified
Lag	0.52

Results: 60B	
Peak Discharge (CFS)	658.2
Time of Peak Discharge	22Sep2020, 00:24
Volume (IN)	5.53
Precipitation Volume (AC - FT)	281.05
Loss Volume (AC - FT)	87.73
Excess Volume (AC - FT)	193.32
Direct Runoff Volume (AC - FT)	190.13
Baseflow Volume (AC - FT)	0


Precipitation and Outflow
FLOW (CFS) PRECIP-INC (IN)
0
0.02
0.04
0.06
600
0.08
400
200
0.1
0
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
Sep 21, 2020
Sep 22, 2020
Time
Precipitation
Excess Precipitation
Outflow

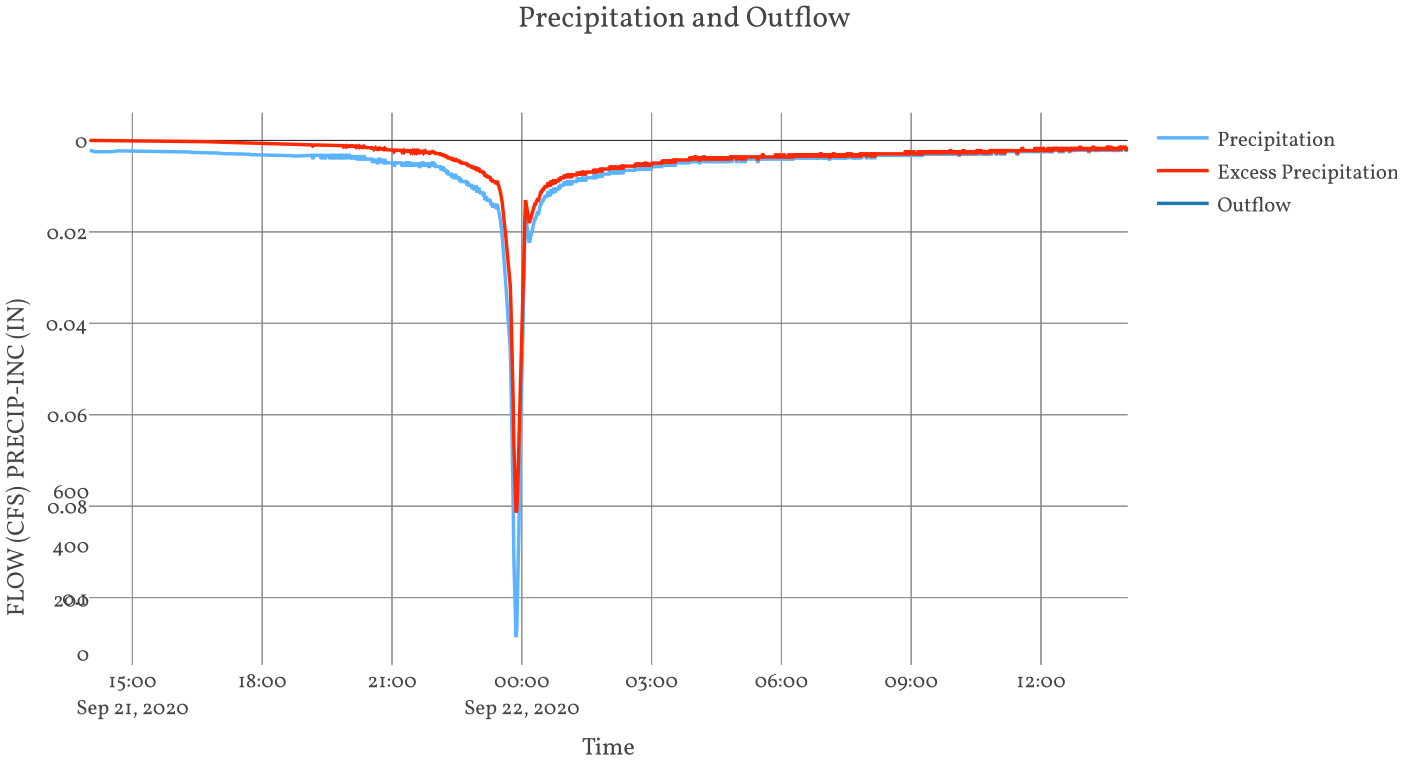
Subbasin: 61B

Area : 0.61
Downstream : J 60b 61b

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	75
Initial Abstraction	0.2

Transform: User - Specified S - Graph	
S - graph	Ellsworth S - Graph
Lag Method	Specified
Lag	0.37

Results: 61B	
Peak Discharge (CFS)	755.86
Time of Peak Discharge	22Sep2020, 00:15
Volume (IN)	5.56
Precipitation Volume (AC - FT)	264.05
Loss Volume (AC - FT)	82.43
Excess Volume (AC - FT)	181.63
Direct Runoff Volume (AC - FT)	179.55
Baseflow Volume (AC - FT)	0

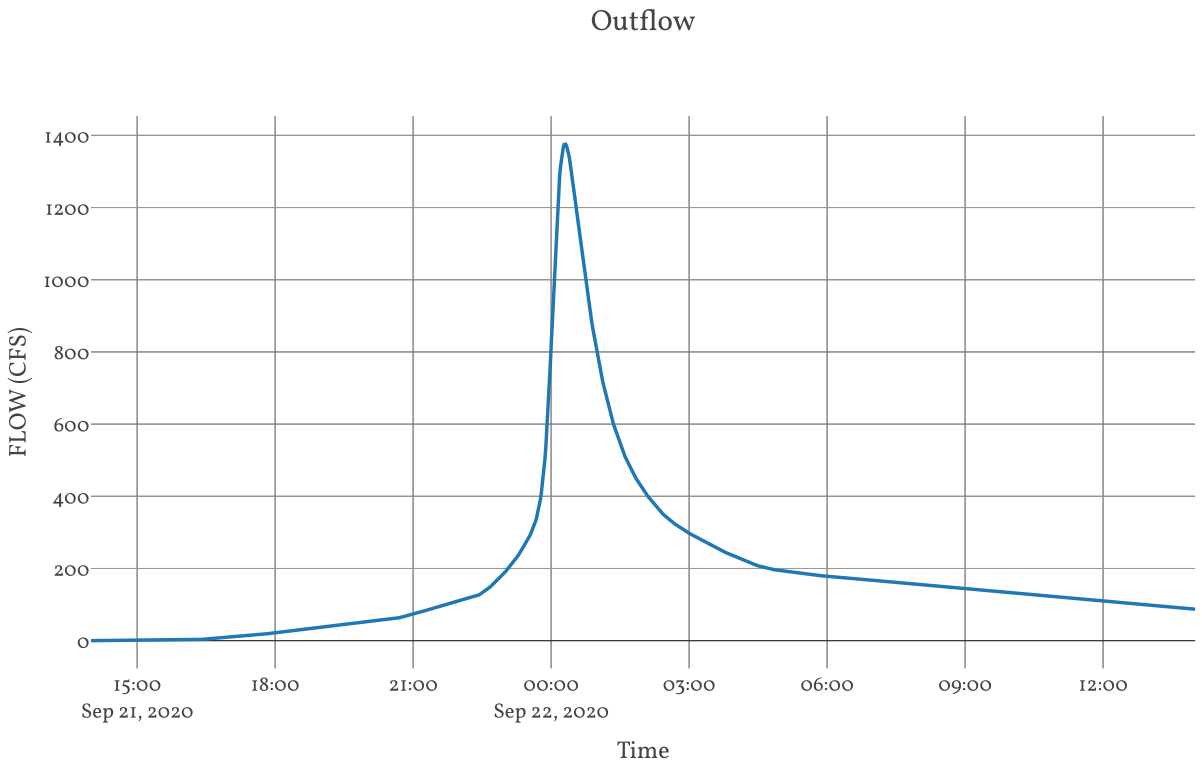

Precipitation and Outflow
FLOW (CFS) PRECIP-INC (IN)
0
0.02
0.04
0.06
0.08
600
400
200
0
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
Sep 21, 2020
Sep 22, 2020
Time
Precipitation
Excess Precipitation
Outflow

Junction: J 60B 61B

Downstream : 18r

Results: J 60B 61B

Peak Discharge (CFS)	1376.41
Time of Peak Discharge	22Sep2020, 00:18
Volume (IN)	5.54



Reach: 18R

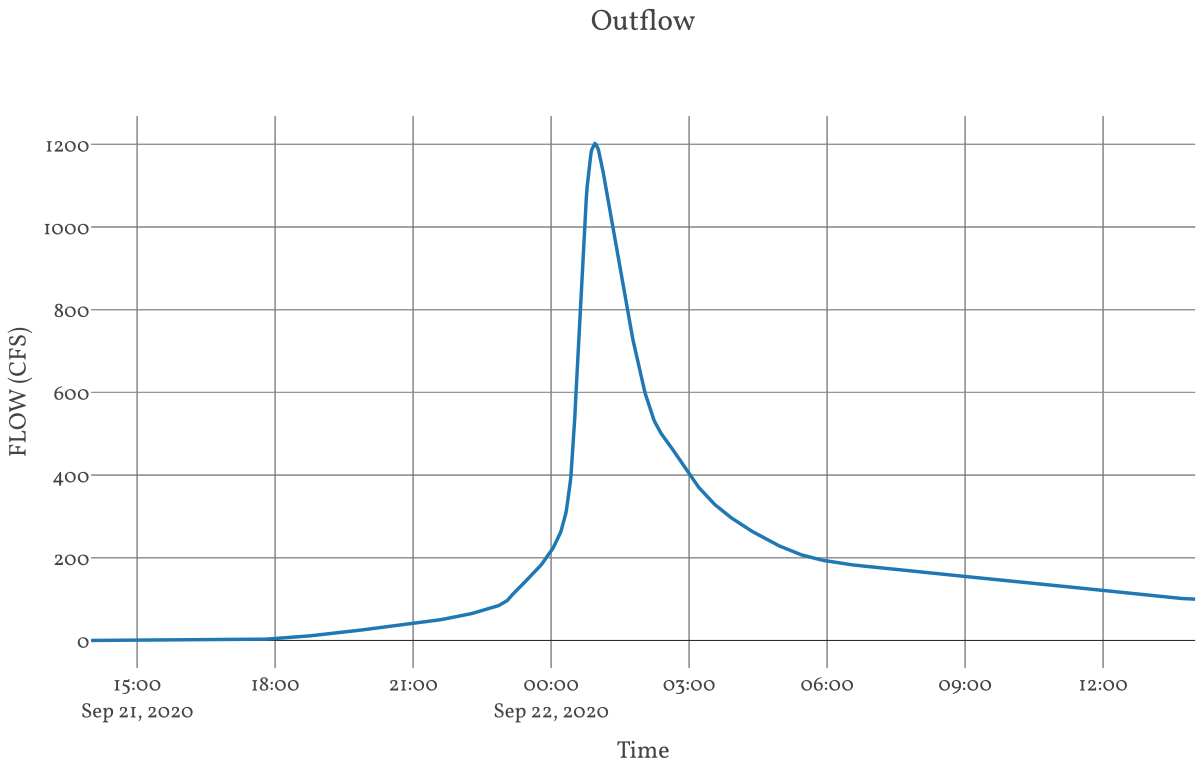
Downstream : 17c

Route: Modified Puls

Method	Modified Puls
Initial Variable	Combined Inflow
Number of Reaches	8
Storage Outflow Table Name	18r

Results: 18R

Peak Discharge (CFS)	1201.59
Time of Peak Discharge	22Sep2020, 00:57
Volume (IN)	5.35
Peak Inflow (CFS)	1376.41
Inflow Volume (AC - FT)	369.68



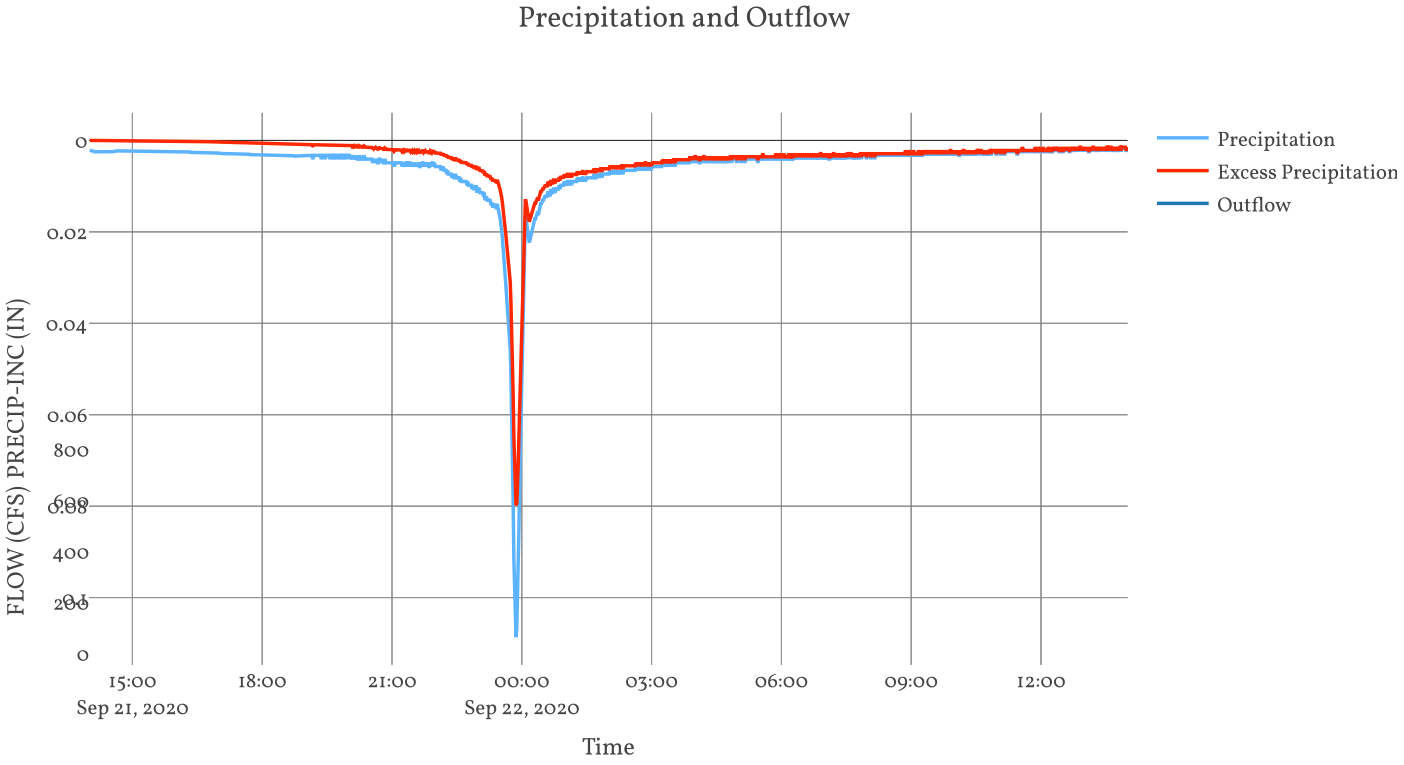
Subbasin: 62B

Area : 0.53
Downstream : 17c

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	73.9
Initial Abstraction	0.2

Transform: User - Specified S - Graph	
S - graph	Ellsworth S - Graph
Lag Method	Specified
Lag	0.25

Results: 62B	
Peak Discharge (CFS)	801.86
Time of Peak Discharge	22Sep2020, 00:08
Volume (IN)	5.48
Precipitation Volume (AC - FT)	229.02
Loss Volume (AC - FT)	74.21
Excess Volume (AC - FT)	154.81
Direct Runoff Volume (AC - FT)	153.63
Baseflow Volume (AC - FT)	0

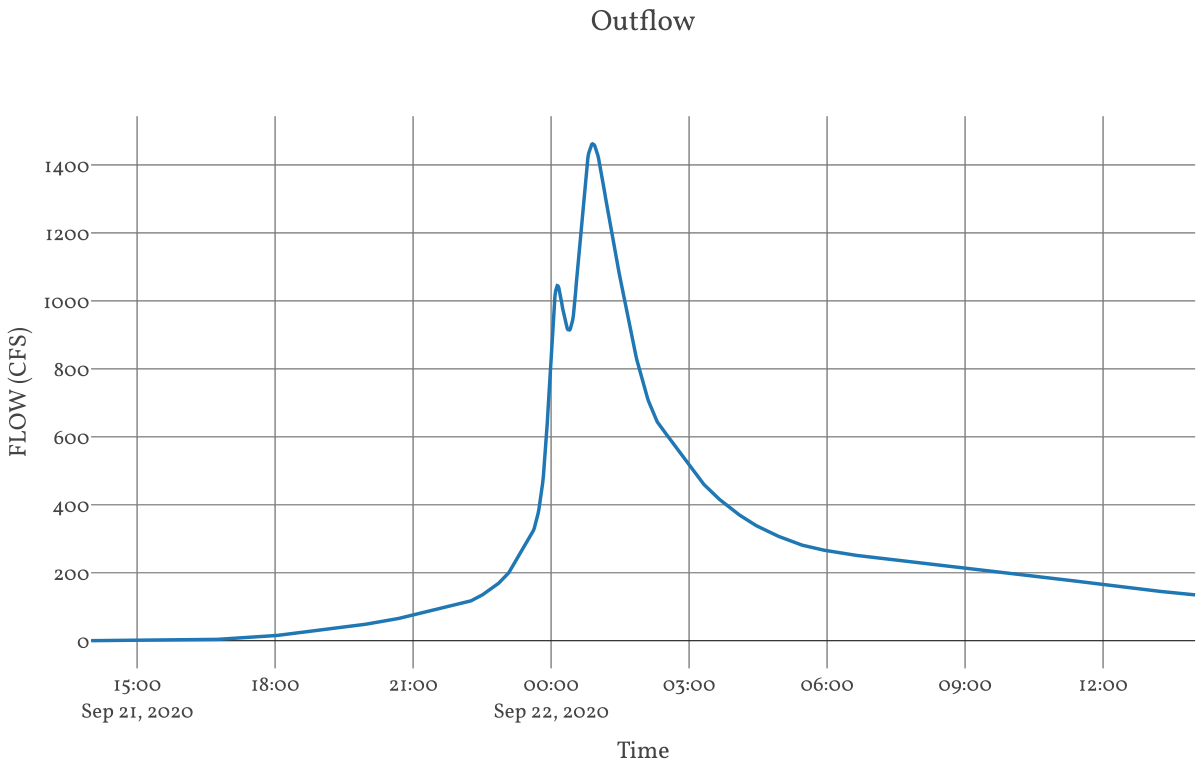

Precipitation and Outflow
FLOW (CFS) PRECIP-INC (IN)
0
0.02
0.04
0.06
800
0.08
400
200
0
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
Sep 21, 2020
Sep 22, 2020
Time
Precipitation
Excess Precipitation
Outflow

Junction: 17C

Downstream : 17r

Results: 17C

Peak Discharge (CFS)	1461.83
Time of Peak Discharge	22Sep2020, 00:54
Volume (IN)	5.39



Reach: 17R

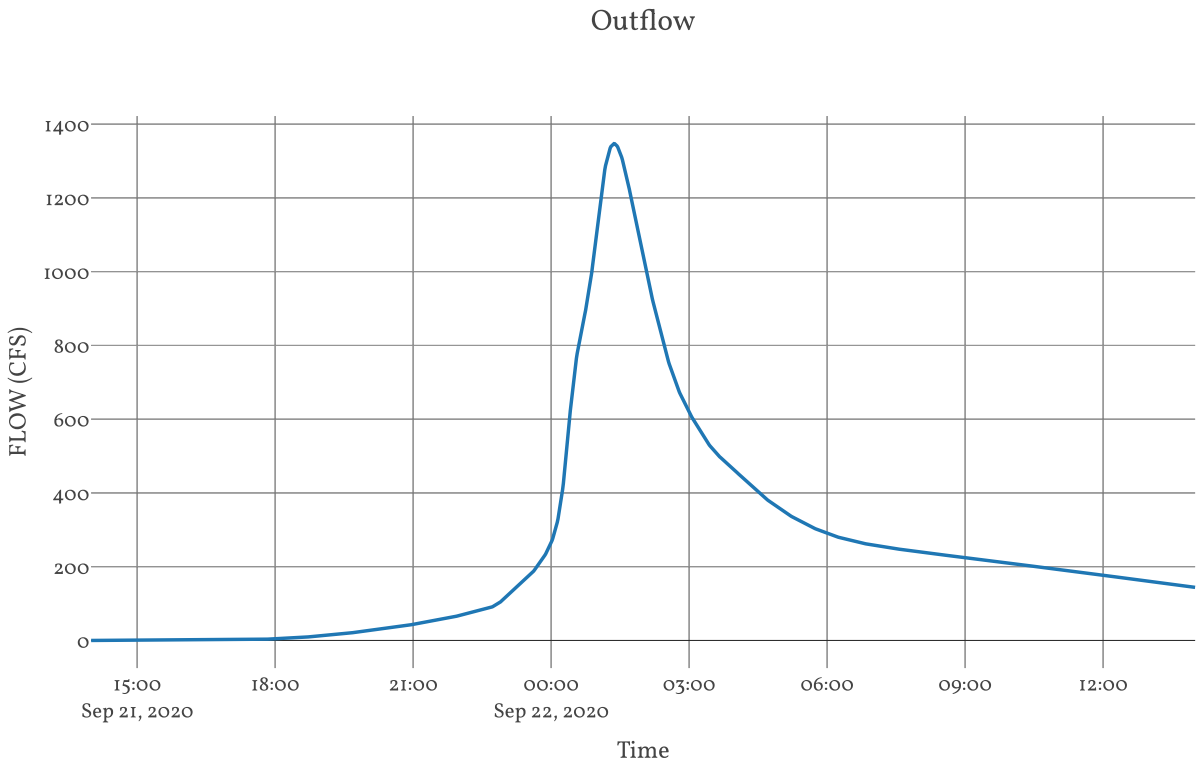
Downstream : 16c

Route: Modified Puls

Method	Modified Puls
Initial Variable	Combined Inflow
Number of Reaches	4
Storage Outflow Table Name	17r

Results: 17R

Peak Discharge (CFS)	1346.99
Time of Peak Discharge	22Sep2020, 01:22
Volume (IN)	5.25
Peak Inflow (CFS)	1461.83
Inflow Volume (AC - FT)	510.31



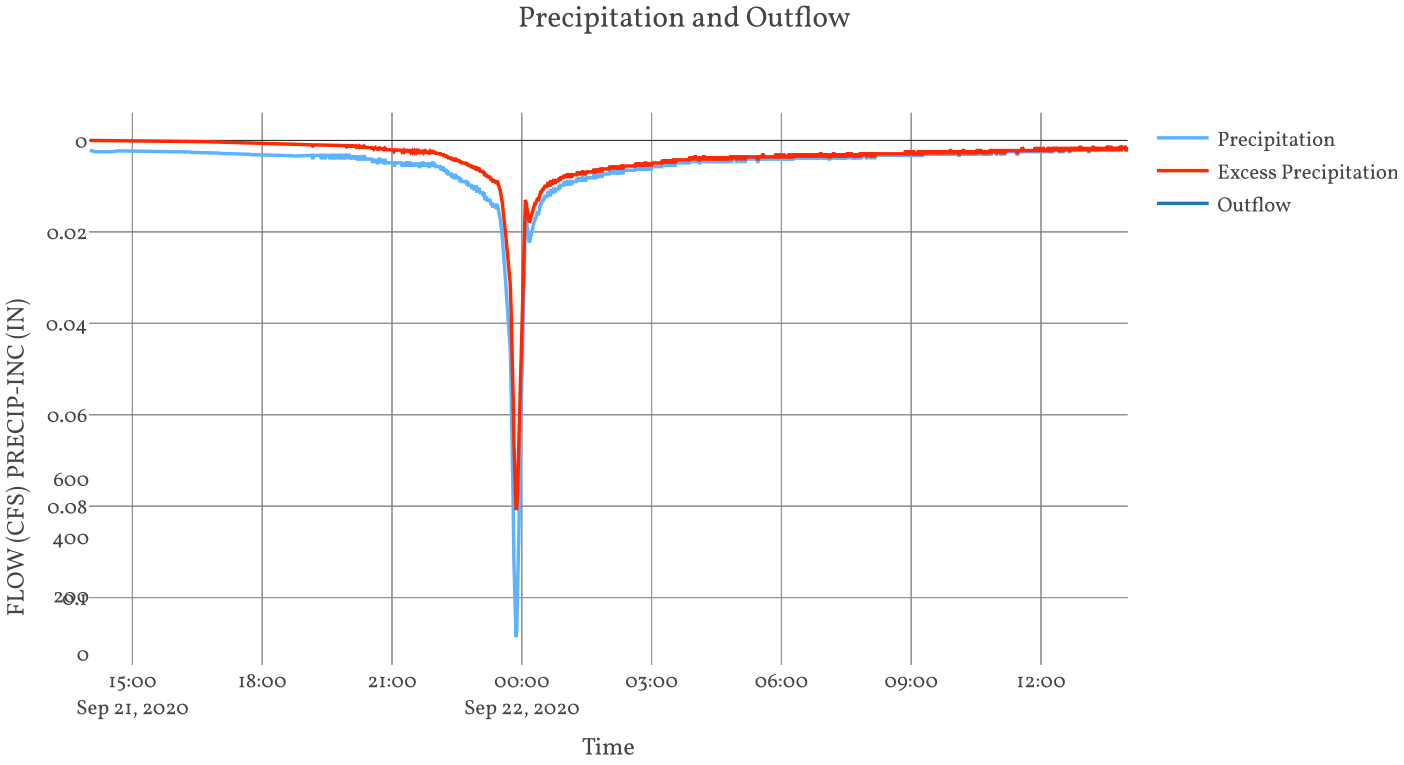
Subbasin: 63B

Area : 0.6
Downstream : 16c

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	74.6
Initial Abstraction	0.2

Transform: User - Specified S - Graph	
S - graph	Ellsworth S - Graph
Lag Method	Specified
Lag	0.41

Results: 63B	
Peak Discharge (CFS)	702.15
Time of Peak Discharge	22Sep2020, 00:17
Volume (IN)	5.51
Precipitation Volume (AC - FT)	262.31
Loss Volume (AC - FT)	83.02
Excess Volume (AC - FT)	179.29
Direct Runoff Volume (AC - FT)	177
Baseflow Volume (AC - FT)	0

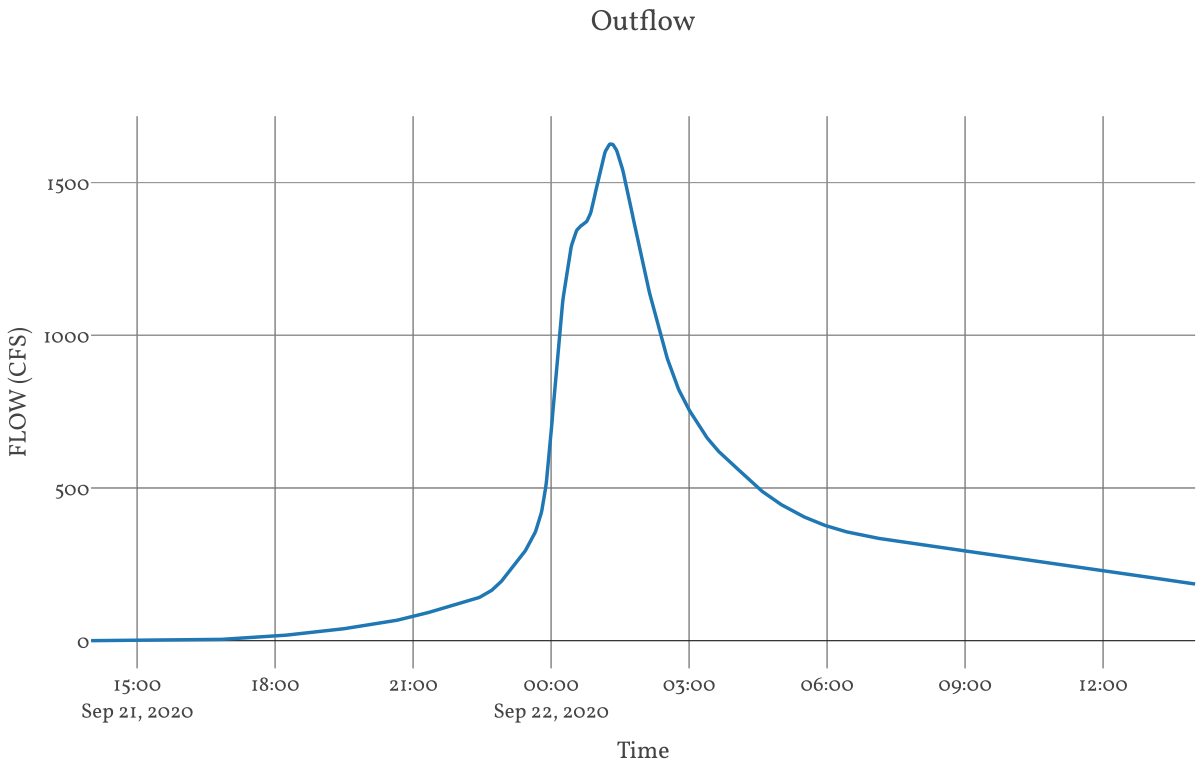

Precipitation and Outflow
FLOW (CFS) PRECIP-INC (IN)
0
0.02
0.04
0.06
600
0.08
400
200
0
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
Sep 21, 2020
Sep 22, 2020
Time
Precipitation
Excess Precipitation
Outflow

Junction: 16C

Downstream : 16r

Results: 16C

Peak Discharge (CFS)	1626.68
Time of Peak Discharge	22Sep2020, 01:18
Volume (IN)	5.31



Reach: 16R

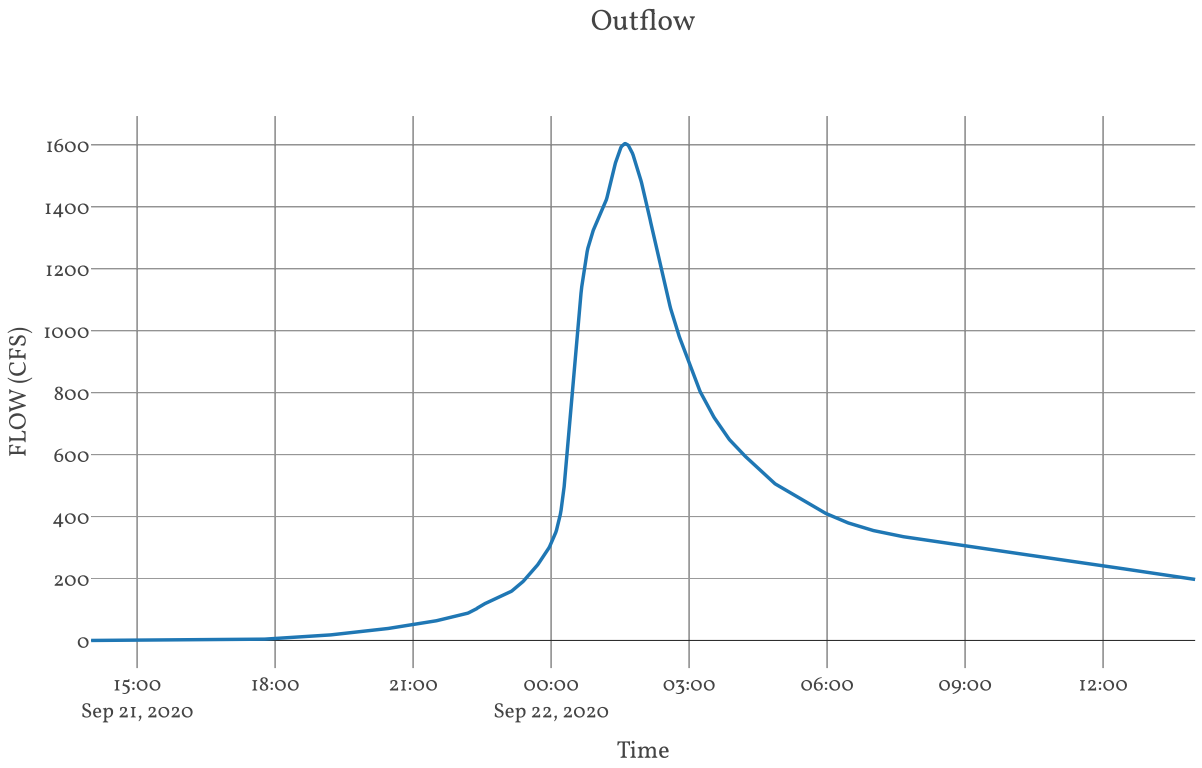
Downstream : 20C

Route: Modified Puls

Method	Modified Puls
Initial Variable	Combined Inflow
Number of Reaches	6
Storage Outflow Table Name	16r

Results: 16R

Peak Discharge (CFS)	1603.52
Time of Peak Discharge	22Sep2020, 01:37
Volume (IN)	5.22
Peak Inflow (CFS)	1626.68
Inflow Volume (AC - FT)	674.12



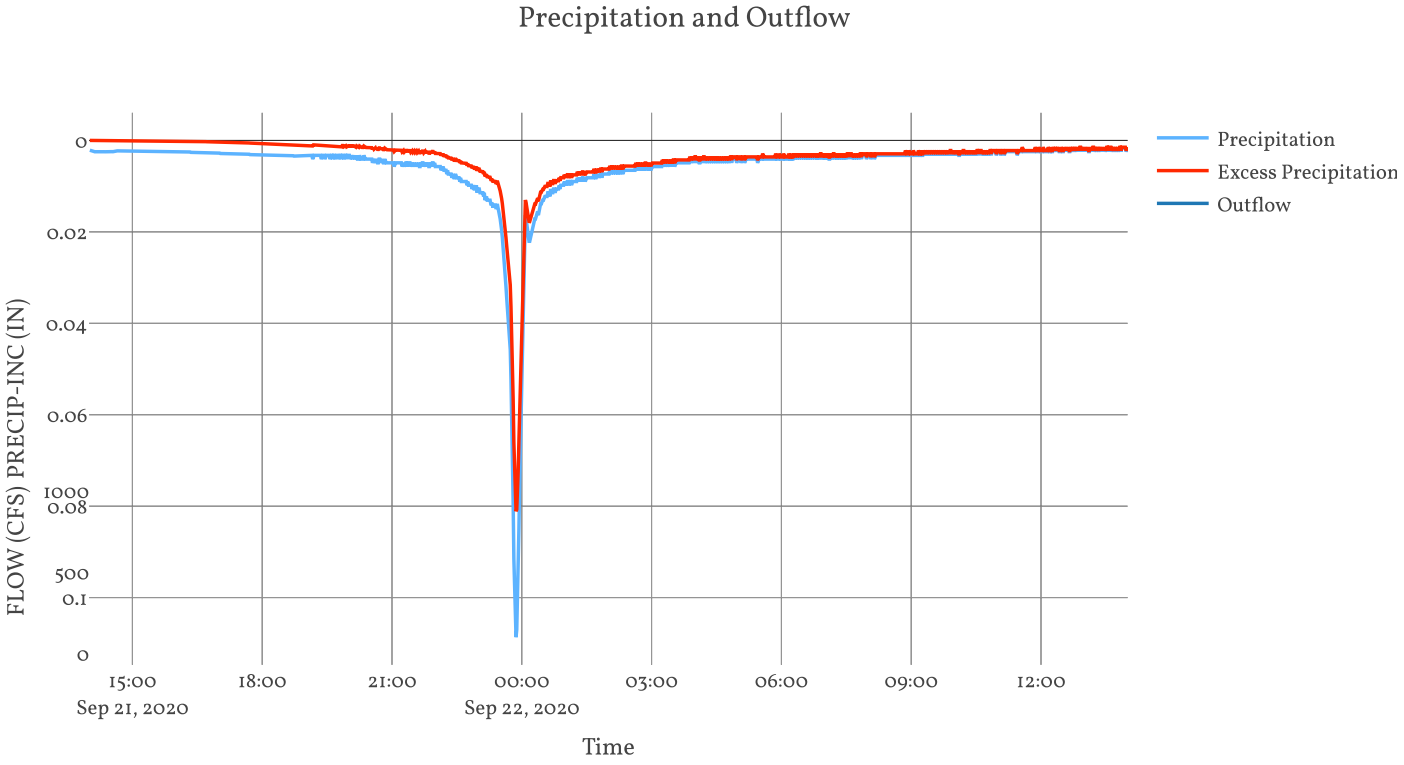
Subbasin: 64B

Area : 1.09
Downstream : 20c

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	74.8
Initial Abstraction	0.2

Transform: User - Specified S - Graph	
S - graph	Ellsworth S - Graph
Lag Method	Specified
Lag	0.42

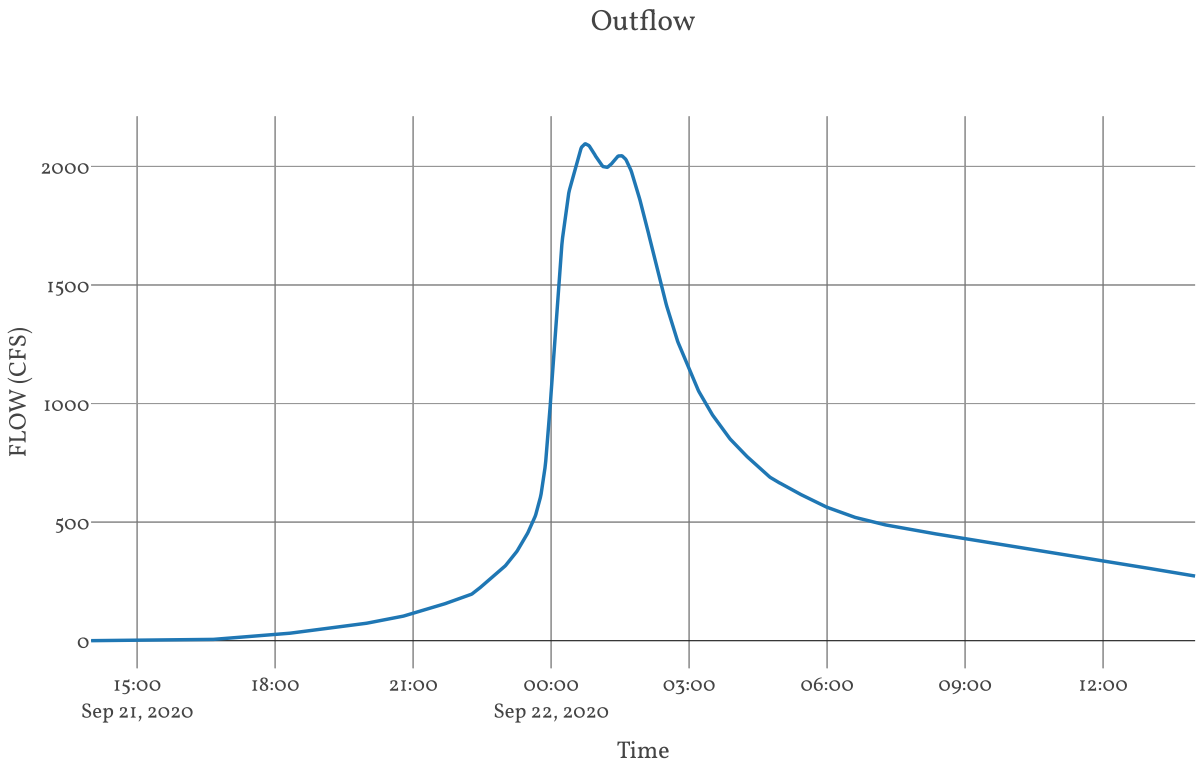
Results: 64B	
Peak Discharge (CFS)	1257.72
Time of Peak Discharge	22Sep2020, 00:18
Volume (IN)	5.53
Precipitation Volume (AC - FT)	474.95
Loss Volume (AC - FT)	149.29
Excess Volume (AC - FT)	325.66
Direct Runoff Volume (AC - FT)	321.39
Baseflow Volume (AC - FT)	0


Precipitation and Outflow
FLOW (CFS) PRECIP-INC (IN)
0
0.02
0.04
0.06
1000
0.08
500
0.1
0
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
Sep 21, 2020
Sep 22, 2020
Time
Precipitation
Excess Precipitation
Outflow

Junction: 20C

Downstream : 20r

Results: 20C	
Peak Discharge (CFS)	2095.06
Time of Peak Discharge	22Sep2020, 00:45
Volume (IN)	5.31

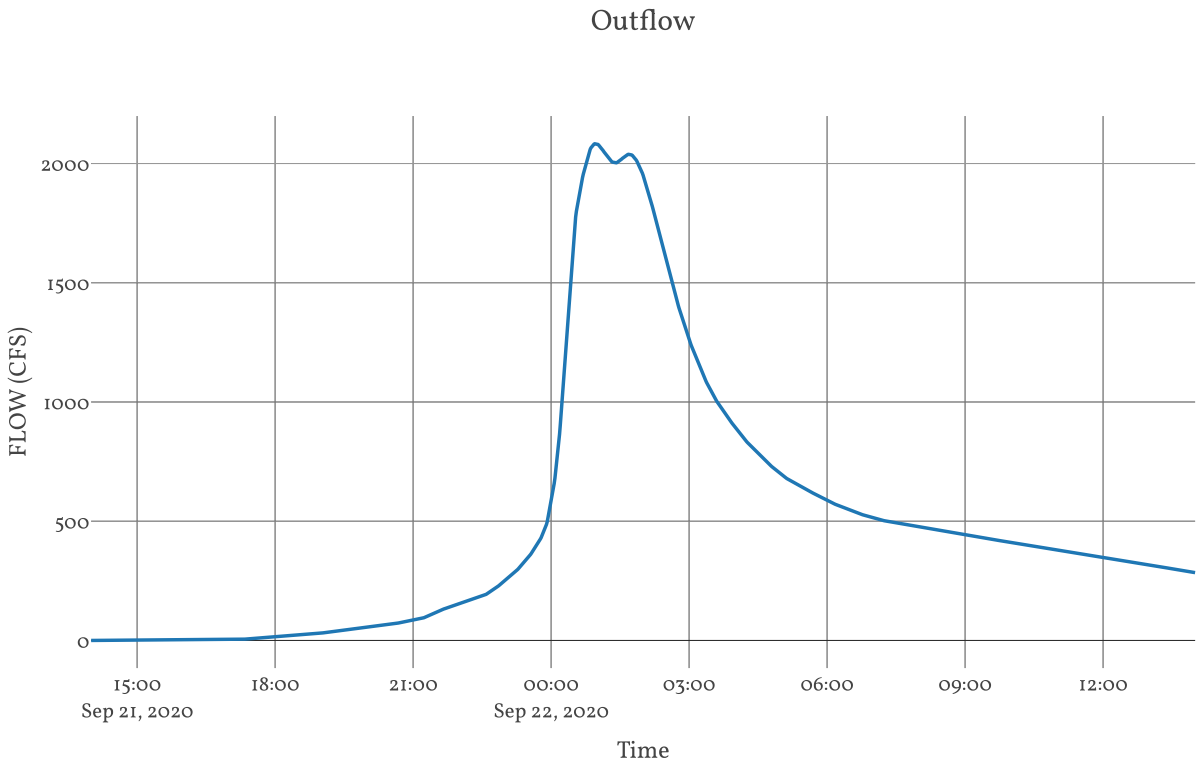


Reach: 20R

Downstream : 15c

Route: Modified Puls	
Method	Modified Puls
Initial Variable	Combined Inflow
Number of Reaches	6
Storage Outflow Table Name	20r

Results: 20R	
Peak Discharge (CFS)	2083.23
Time of Peak Discharge	22Sep2020, 00:58
Volume (IN)	5.25
Peak Inflow (CFS)	2095.06
Inflow Volume (AC - FT)	983.19



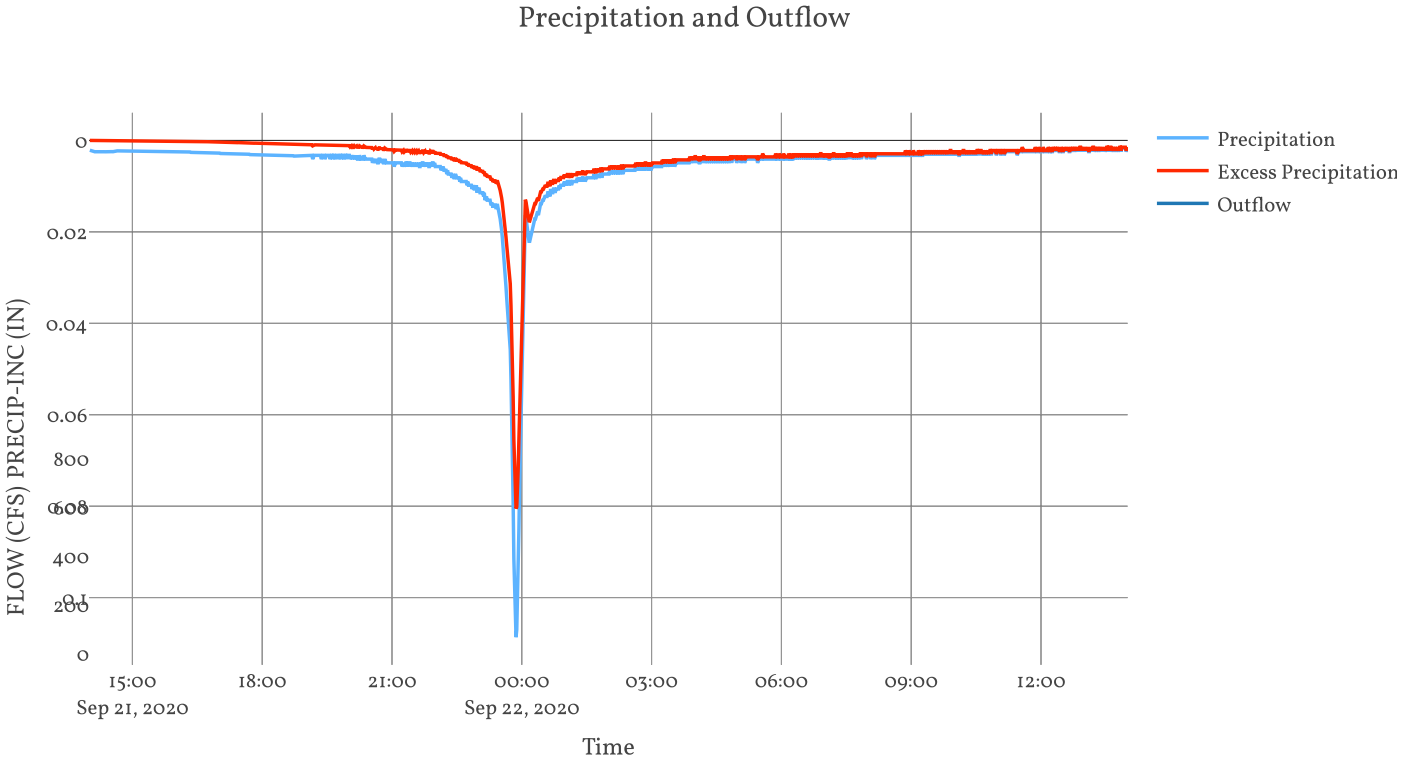
Subbasin: 65B

Area : 0.53
Downstream : 15c

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	74.4
Initial Abstraction	0.2

Transform: User - Specified S - Graph	
S - graph	Ellsworth S - Graph
Lag Method	Specified
Lag	0.24

Results: 65B	
Peak Discharge (CFS)	839.53
Time of Peak Discharge	22Sep2020, 00:07
Volume (IN)	5.53
Precipitation Volume (AC - FT)	232.25
Loss Volume (AC - FT)	74
Excess Volume (AC - FT)	158.24
Direct Runoff Volume (AC - FT)	157.09
Baseflow Volume (AC - FT)	0

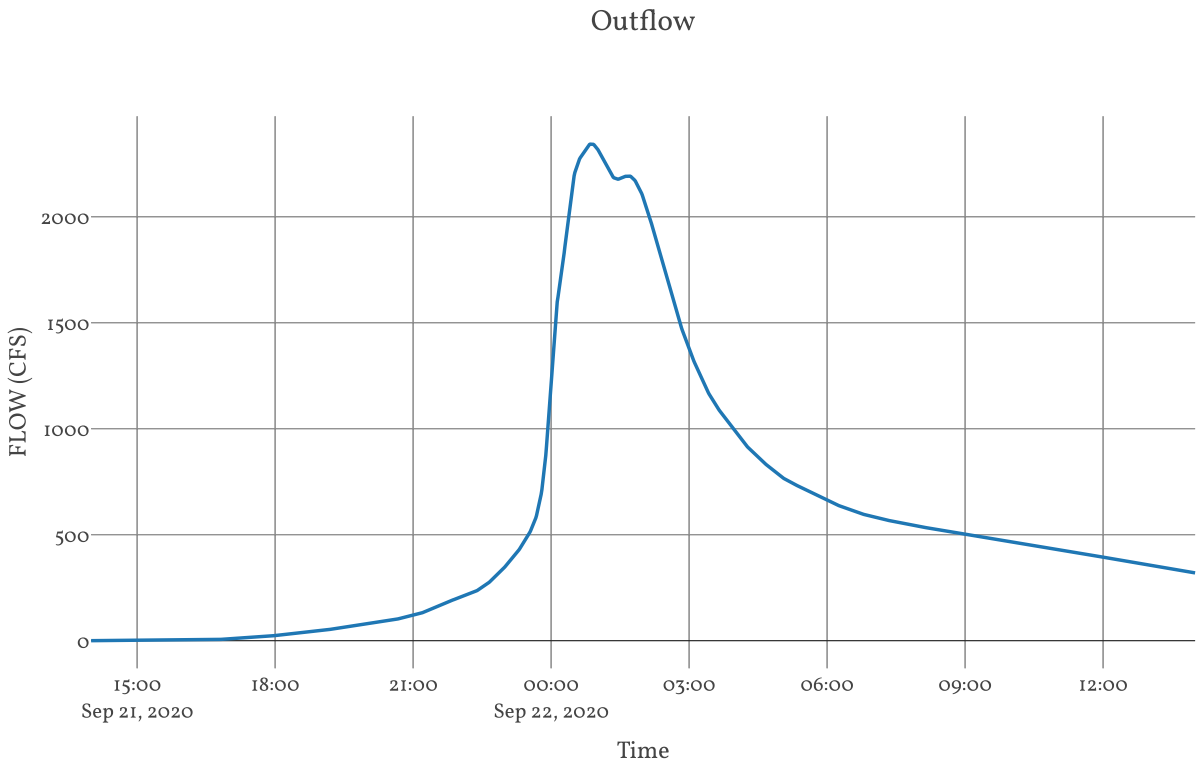

Precipitation and Outflow
FLOW (CFS) PRECIP-INC (IN)
0
0.02
0.04
0.06
800
600
400
200
0
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
Sep 21, 2020
Sep 22, 2020
Time
Precipitation
Excess Precipitation
Outflow

Junction: 15C

Downstream : 15r

Results: 15C

Peak Discharge (CFS)	2343.64
Time of Peak Discharge	22Sep2020, 00:53
Volume (IN)	5.29



Reach: 15R

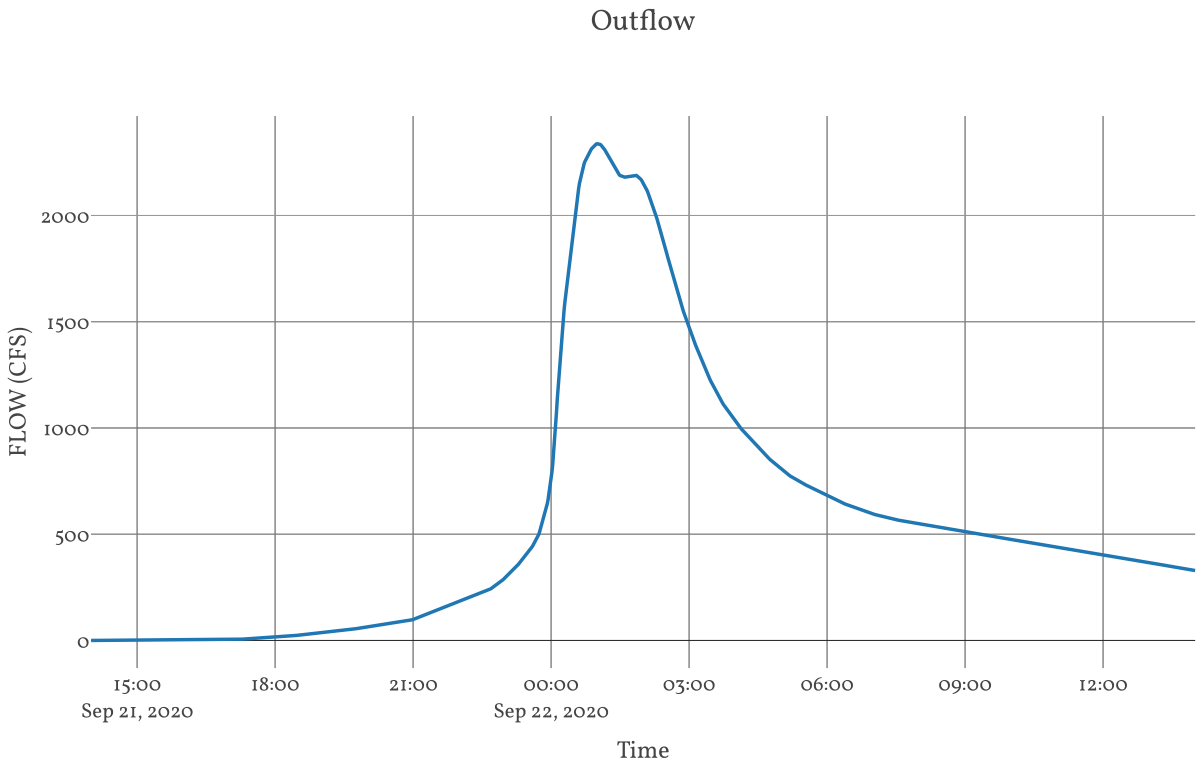
Downstream : 14c

Route: Modified Puls

Method	Modified Puls
Initial Variable	Combined Inflow
Number of Reaches	5
Storage Outflow Table Name	15r

Results: 15R

Peak Discharge (CFS)	2337.96
Time of Peak Discharge	22Sep2020, 01:01
Volume (IN)	5.25
Peak Inflow (CFS)	2343.64
Inflow Volume (AC - FT)	1128.91



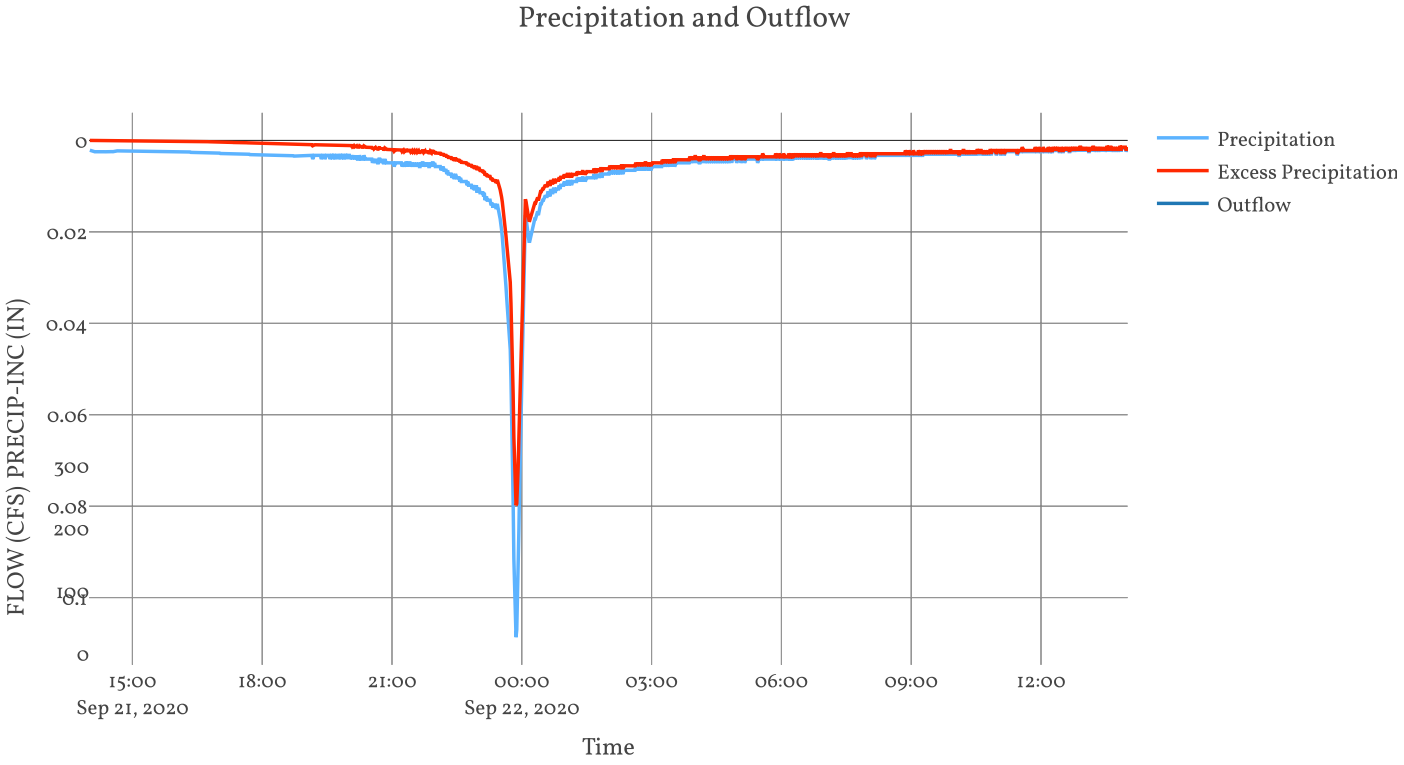
Subbasin: 66B

Area : 0.16
Downstream : 14c

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	73.9
Initial Abstraction	0.2

Transform: User - Specified S - Graph	
S - graph	Ellsworth S - Graph
Lag Method	Specified
Lag	0.14

Results: 66B	
Peak Discharge (CFS)	326.61
Time of Peak Discharge	22Sep2020, 00:02
Volume (IN)	5.5
Precipitation Volume (AC - FT)	70.59
Loss Volume (AC - FT)	22.87
Excess Volume (AC - FT)	47.72
Direct Runoff Volume (AC - FT)	47.52
Baseflow Volume (AC - FT)	0

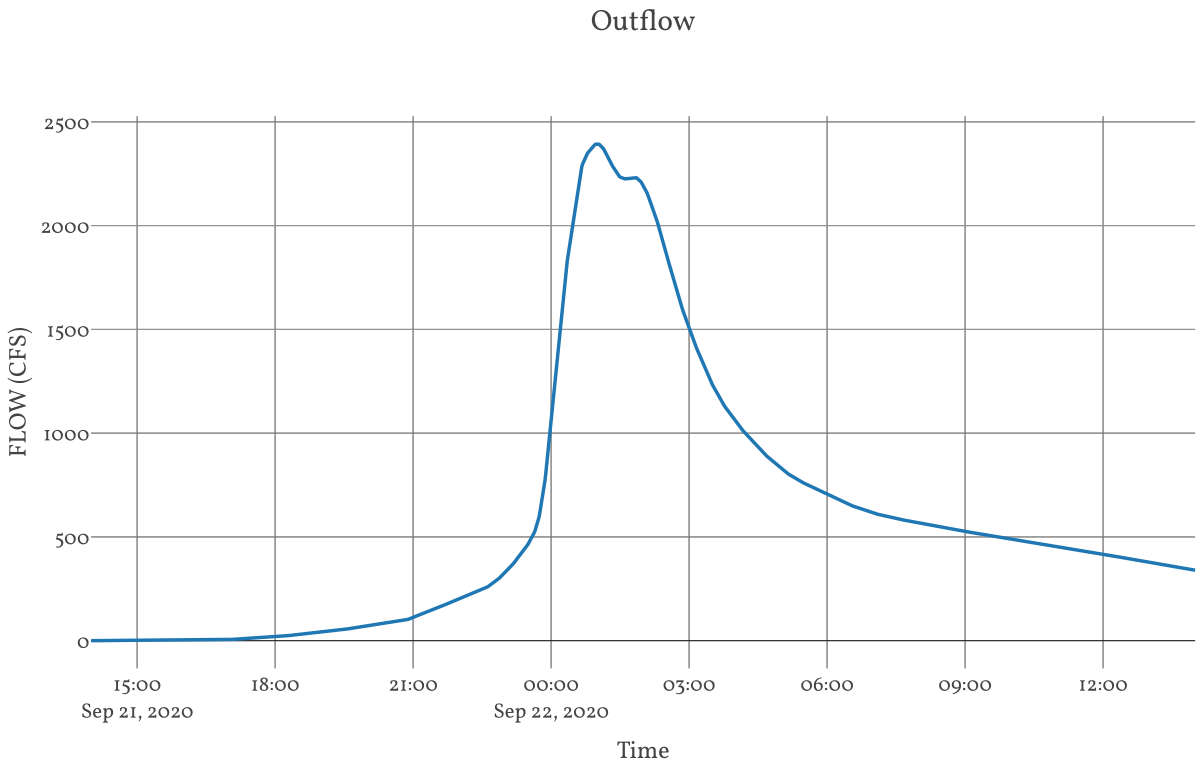

Precipitation and Outflow
FLOW (CFS) PRECIP-INC (IN)
0
0.02
0.04
0.06
300
0.08
200
100
0.1
0
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
Sep 21, 2020
Sep 22, 2020
Time
Precipitation
Excess Precipitation
Outflow

Junction: 14C

Downstream : 14r

Results: 14C

Peak Discharge (CFS)	2393.85
Time of Peak Discharge	22Sep2020, 01:00
Volume (IN)	5.26



Reach: 14R

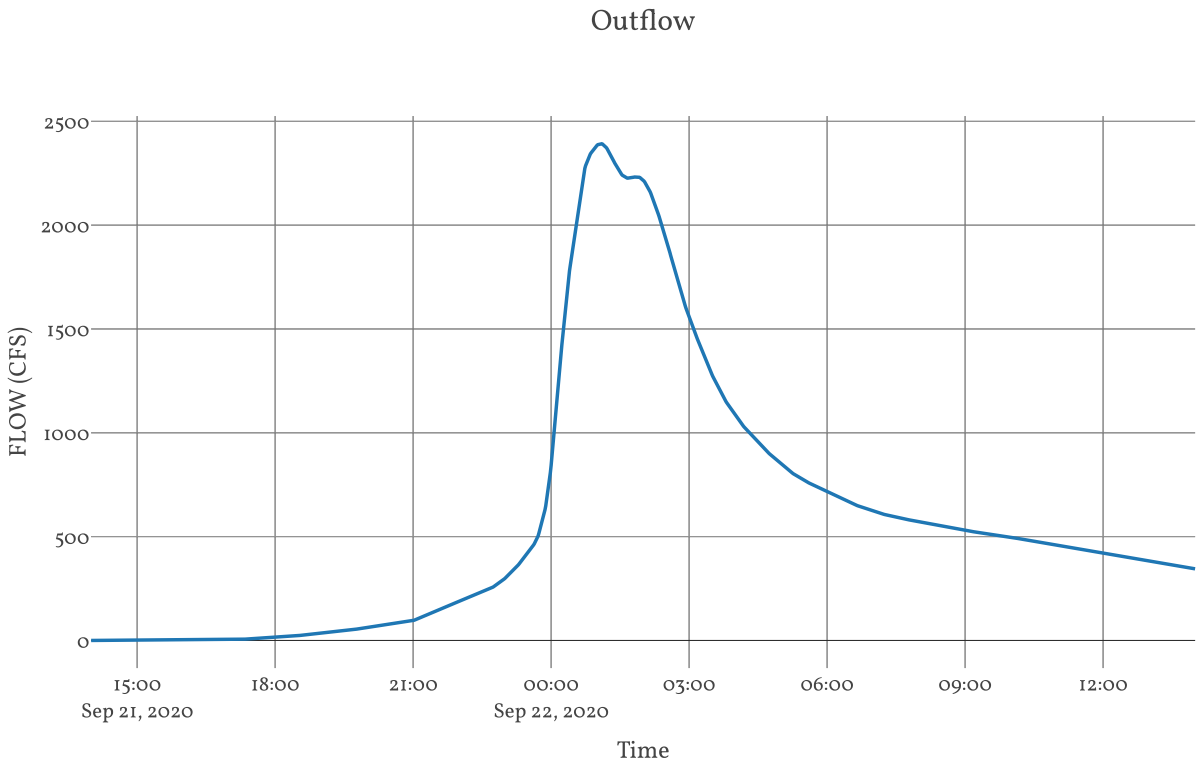
Downstream : 13c

Route: Modified Puls

Method	Modified Puls
Initial Variable	Combined Inflow
Number of Reaches	5
Storage Outflow Table Name	14r

Results: 14R

Peak Discharge (CFS)	2392.33
Time of Peak Discharge	22Sep2020, 01:05
Volume (IN)	5.24
Peak Inflow (CFS)	2393.85
Inflow Volume (AC - FT)	1167.67



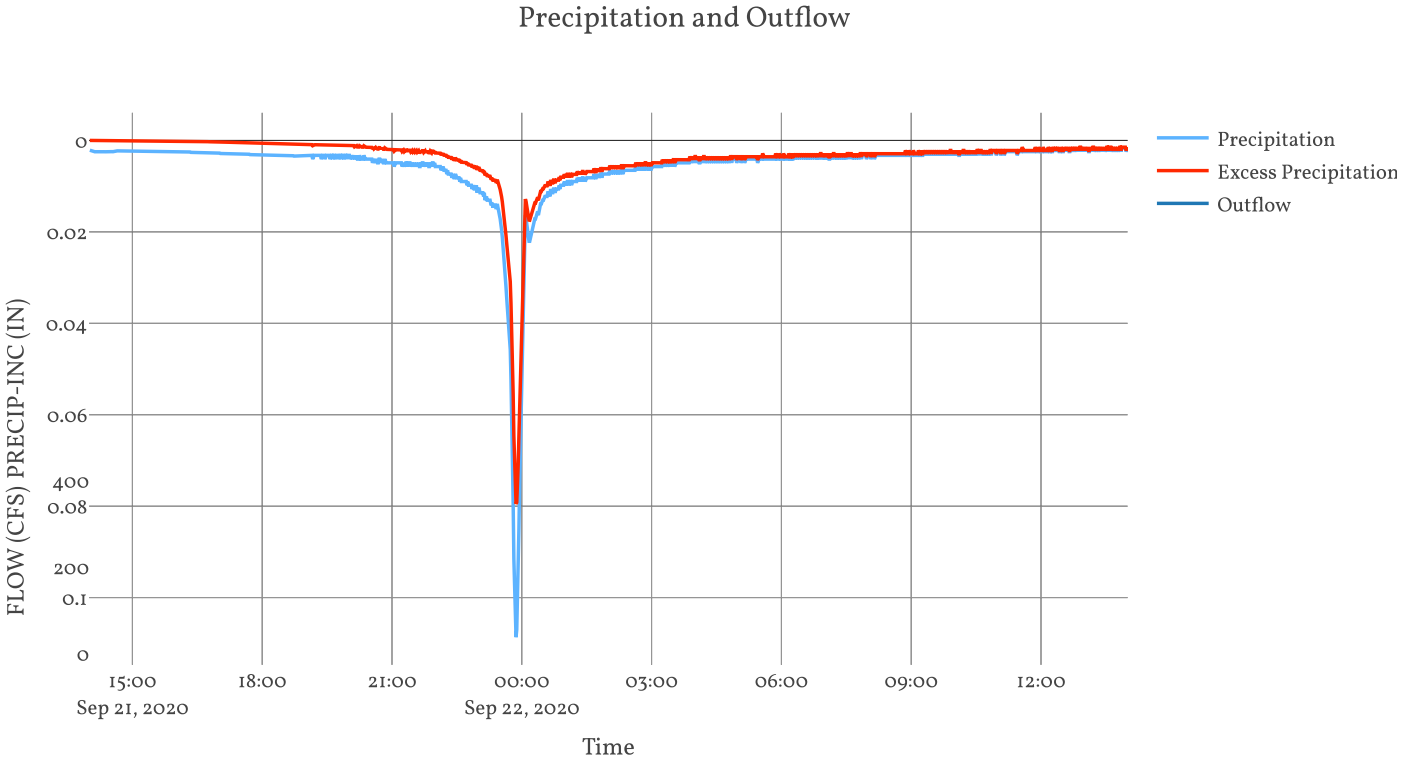
Subbasin: 67B

Area : 0.43
Downstream : 13c

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	73.7
Initial Abstraction	0.2

Transform: User - Specified S - Graph	
S - graph	Ellsworth S - Graph
Lag Method	Specified
Lag	0.44

Results: 67B	
Peak Discharge (CFS)	472.93
Time of Peak Discharge	22Sep2020, 00:19
Volume (IN)	5.43
Precipitation Volume (AC - FT)	187.37
Loss Volume (AC - FT)	61.11
Excess Volume (AC - FT)	126.25
Direct Runoff Volume (AC - FT)	124.49
Baseflow Volume (AC - FT)	0

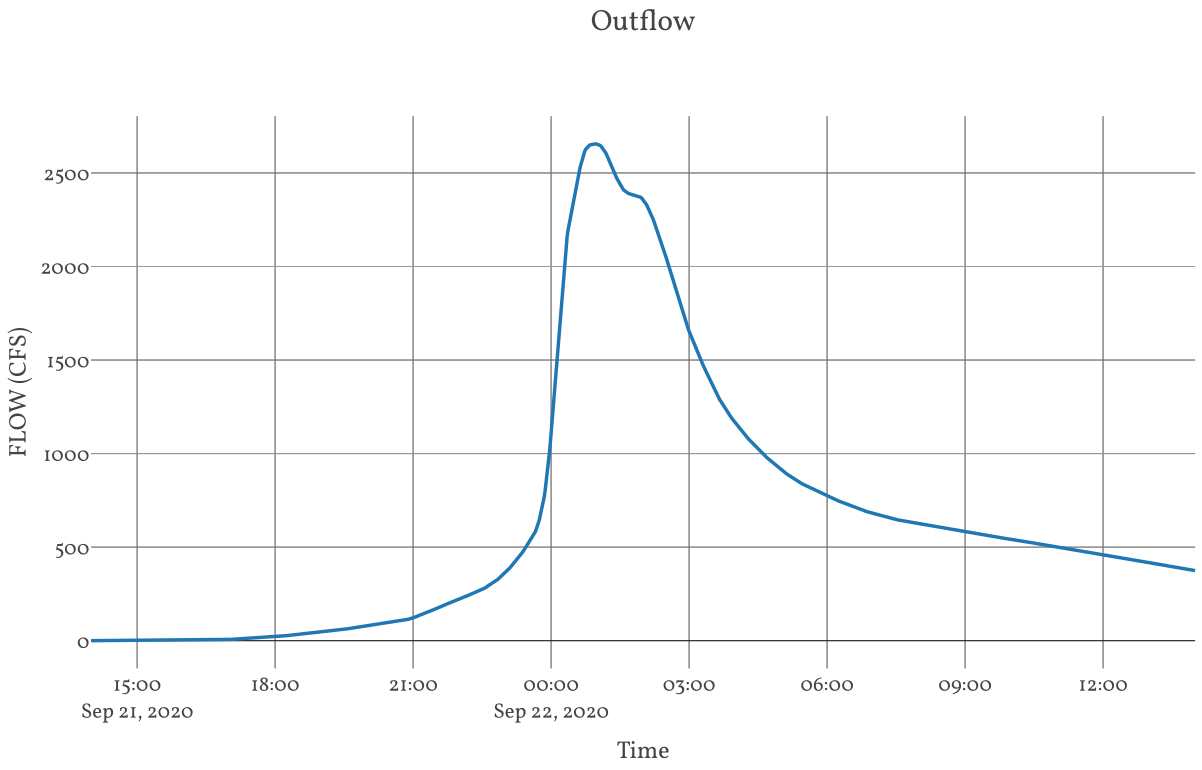

Precipitation and Outflow
FLOW (CFS) PRECIP-INC (IN)
0
0.02
0.04
0.06
400
0.08
200
0.1
0
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
Sep 21, 2020
Sep 22, 2020
Time
Precipitation
Excess Precipitation
Outflow

Junction: 13C

Downstream : 13r

Results: 13C

Peak Discharge (CFS)	2655.4
Time of Peak Discharge	22Sep2020, 00:58
Volume (IN)	5.25



Reach: 13R

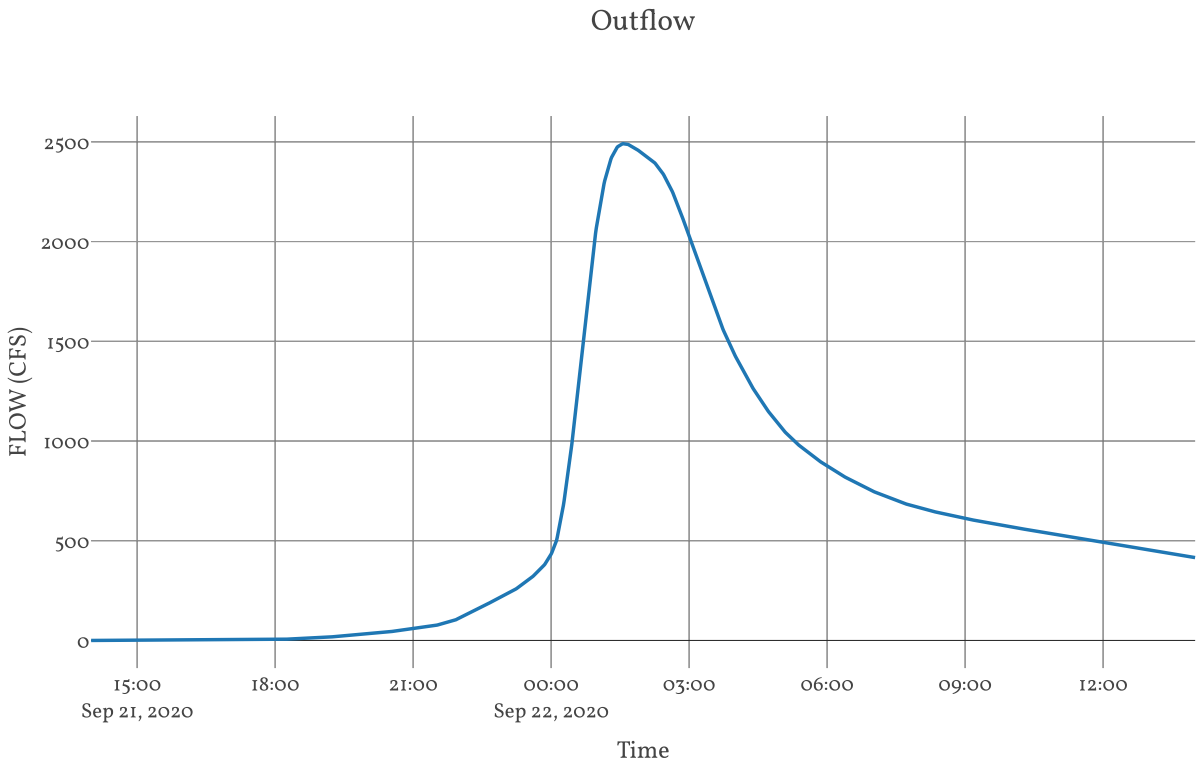
Downstream : 12C

Route: Modified Puls

Method	Modified Puls
Initial Variable	Combined Inflow
Number of Reaches	2
Storage Outflow Table Name	13r

Results: 13R

Peak Discharge (CFS)	2490.9
Time of Peak Discharge	22Sep2020, 01:35
Volume (IN)	5.09
Peak Inflow (CFS)	2655.4
Inflow Volume (AC - FT)	1287.19



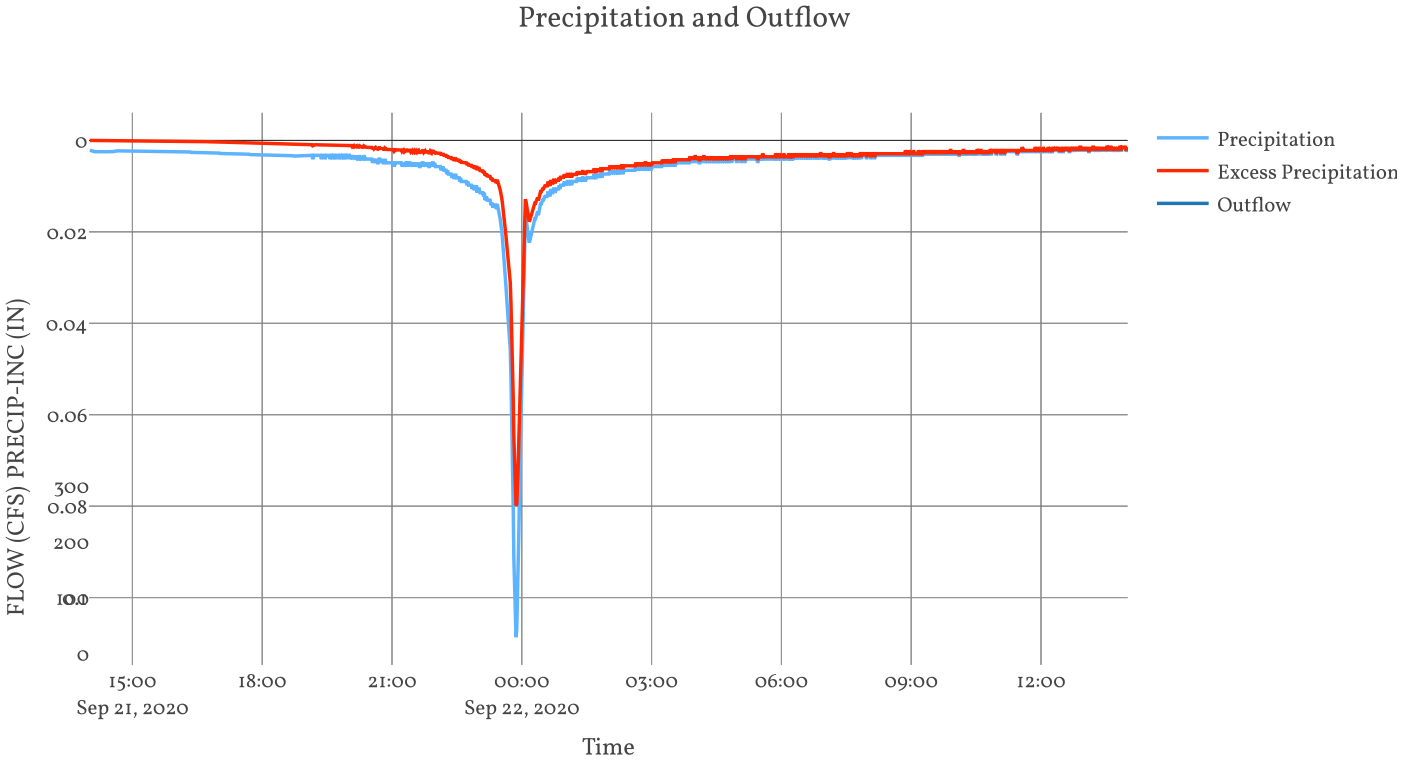
Subbasin: 68B

Area : 0.26
Downstream : 12c

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	73.9
Initial Abstraction	0.2

Transform: User - Specified S - Graph	
S - graph	Ellsworth S - Graph
Lag Method	Specified
Lag	0.28

Results: 68B	
Peak Discharge (CFS)	365.84
Time of Peak Discharge	22Sep2020, 00:09
Volume (IN)	5.48
Precipitation Volume (AC - FT)	111.11
Loss Volume (AC - FT)	35.93
Excess Volume (AC - FT)	75.18
Direct Runoff Volume (AC - FT)	74.53
Baseflow Volume (AC - FT)	0

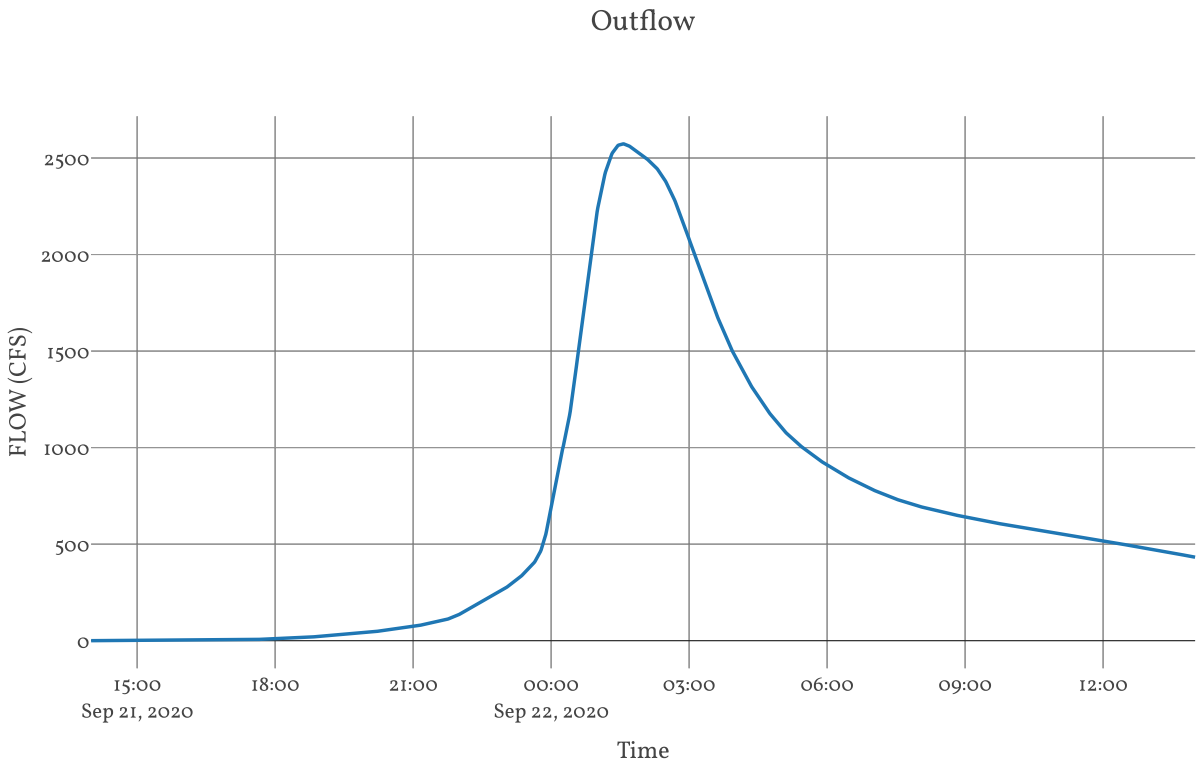

Precipitation and Outflow
FLOW (CFS) PRECIP-INC (IN)
0
0.02
0.04
0.06
300
0.08
200
0
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
Sep 21, 2020
Sep 22, 2020
Time
Precipitation
Excess Precipitation
Outflow

Junction: 12C

Downstream : Pacific Ocean

Results: 12C

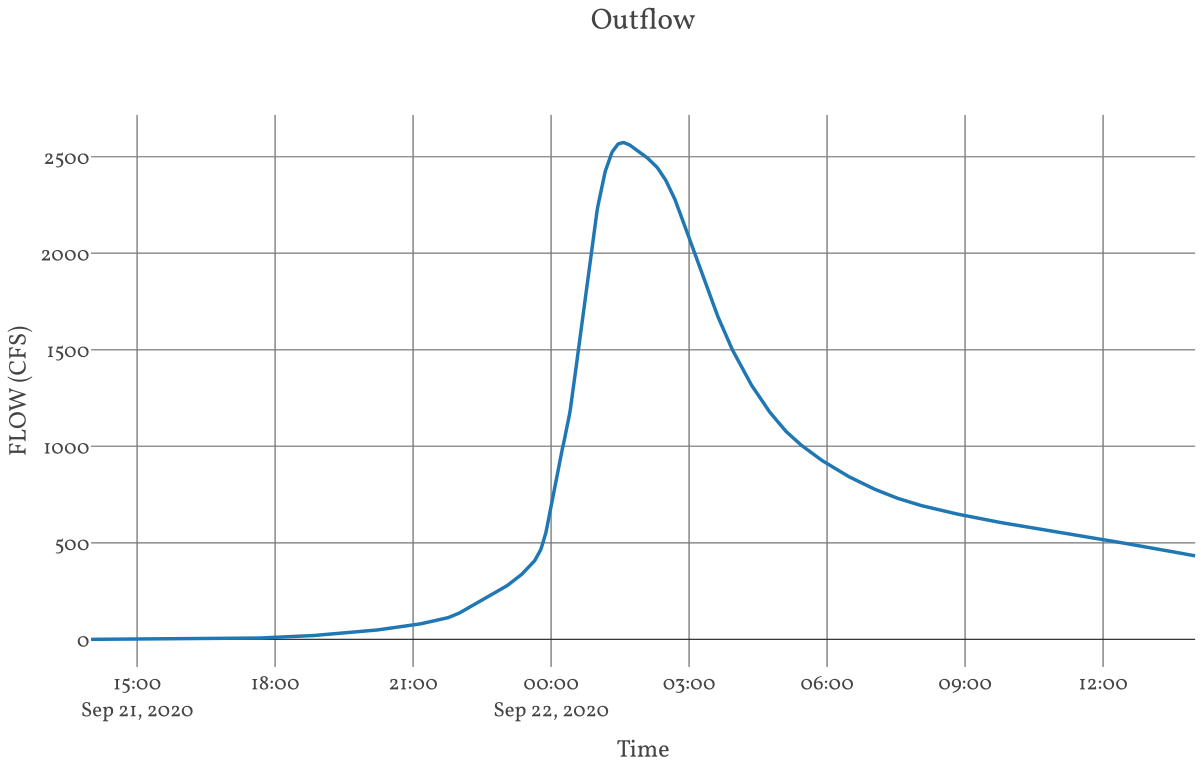
Peak Discharge (CFS)	2573.2
Time of Peak Discharge	22Sep2020, 01:33
Volume (IN)	5.11



Sink: Pacific Ocean

Results: Pacific Ocean

Peak Discharge (CFS)	2573.2
Time of Peak Discharge	22Sep2020, 01:33
Volume (IN)	5.11
Observed Flow Gage	Not specified
Observed Flow Volume (AC - FT)	Not specified
Observed Flow's RMSE Stdev	Not specified
Observed Flow's Percent Bias	Not specified
Observed Flow's Nash Sutcliffe	Not specified



Project: Little_Sycamore_May2021
Simulation Run: 100-yr Post-Dev
Simulation Start: 21 September 2020, 14:00
Simulation End: 22 September 2020, 14:00

HMS Version: 4.6.1
Executed: 29 April 2021, 21:34

Global Parameter Summary - Subbasin

Area

Element Name	Area
60b	0.65
61b	0.61
62b	0.53
63b	0.6
64b	1.09
65b	0.53
66b	0.16
67b	0.43
68b	0.26

Downstream

Element Name	Downstream
60b	J 60b 61b
61b	J 60b 61b
62b	17c
63b	16c
64b	20c
65b	15c
66b	14c
67b	13c
68b	12c

Loss Rate: Scs

Element Name	Percent Impervious Area	Curve Number	Initial Abstraction
60b	0	75	0.2
61b	0	75	0.2
62b	0	73.9	0.2
63b	0	74.6	0.2
64b	0	74.8	0.2
65b	0	74.4	0.2
66b	0	73.9	0.2
67b	0	73.7	0.2
68b	0	73.9	0.2

Transform: User - Specified S - Graph

Element Name	S - graph	Lag Method	Lag
60b	Ellsworth S - Graph	Specified	0.52
61b	Ellsworth S - Graph	Specified	0.37
62b	Ellsworth S - Graph	Specified	0.25
63b	Ellsworth S - Graph	Specified	0.41
64b	Ellsworth S - Graph	Specified	0.42
65b	Ellsworth S - Graph	Specified	0.24
66b	Ellsworth S - Graph	Specified	0.14
67b	Ellsworth S - Graph	Specified	0.44
68b	Ellsworth S - Graph	Specified	0.28

Global Parameter Summary - Reach

Downstream

Element Name	Downstream
18r	17c
17r	16c
16r	20c
20r	15c
15r	14c
14r	13c
13r	12c

Route: Modified Puls

Element Name	Method	Initial Variable	Number of Reaches	Storage Outflow Table Name
18r	Modified Puls	Combined Inflow	8	18r
17r	Modified Puls	Combined Inflow	4	17r
16r	Modified Puls	Combined Inflow	6	16r
20r	Modified Puls	Combined Inflow	6	20r
15r	Modified Puls	Combined Inflow	5	15r
14r	Modified Puls	Combined Inflow	5	14r
13r	Modified Puls	Combined Inflow	2	13r

Global Results Summary

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
60b	0.65	780.97	22Sep2020, 00:24	6.53
61b	0.61	896.67	22Sep2020, 00:14	6.56
J 60b 61b	1.25	1633.26	22Sep2020, 00:18	6.54
18r	1.25	1438.27	22Sep2020, 00:56	6.33
62b	0.53	952.41	22Sep2020, 00:08	6.48
17c	1.78	1753.66	22Sep2020, 00:52	6.37
17r	1.78	1634.93	22Sep2020, 01:18	6.22
63b	0.6	833.58	22Sep2020, 00:17	6.51
16c	2.38	1981.11	22Sep2020, 01:14	6.3
16r	2.38	1949.71	22Sep2020, 01:33	6.19
64b	1.09	1492.76	22Sep2020, 00:17	6.53
20c	3.47	2556.55	22Sep2020, 00:45	6.3
20r	3.47	2544.52	22Sep2020, 00:57	6.23
65b	0.53	996.31	22Sep2020, 00:07	6.53
15c	4	2859.17	22Sep2020, 00:51	6.27
15r	4	2853.59	22Sep2020, 00:59	6.22
66b	0.16	387.56	22Sep2020, 00:02	6.5
14c	4.16	2920.92	22Sep2020, 00:58	6.23
14r	4.16	2919.54	22Sep2020, 01:02	6.21
67b	0.43	562.44	22Sep2020, 00:19	6.42
13c	4.59	3247.98	22Sep2020, 00:53	6.23
13r	4.59	3059.42	22Sep2020, 01:31	6.05
68b	0.26	434.66	22Sep2020, 00:09	6.48

12c	4.85	3159.87	22Sep2020, 01:29	6.07
Pacific Ocean	4.85	3159.87	22Sep2020, 01:29	6.07

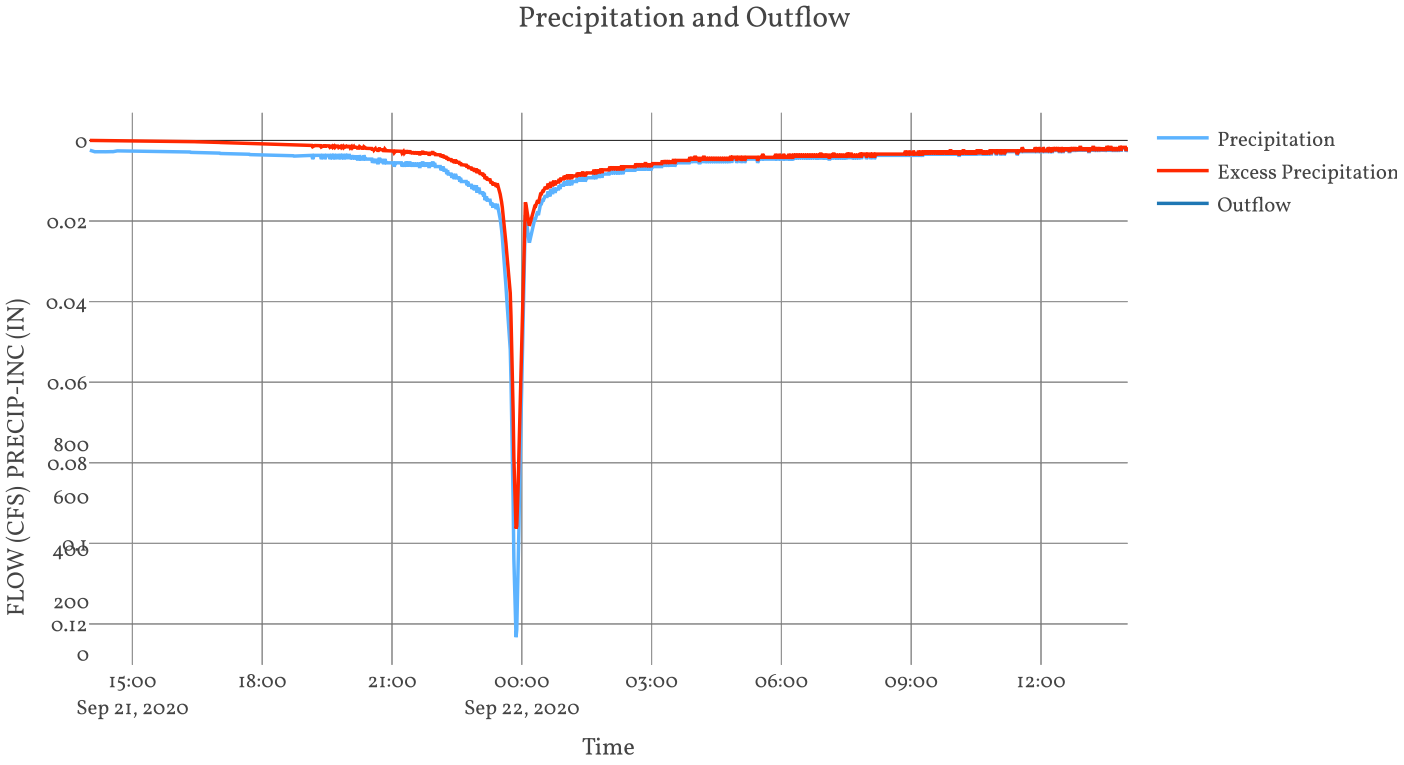
Subbasin: 60B

Area : 0.65
Downstream : J 60b 61b

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	75
Initial Abstraction	0.2

Transform: User - Specified S - Graph	
S - graph	Ellsworth S - Graph
Lag Method	Specified
Lag	0.52

Results: 60B	
Peak Discharge (CFS)	780.97
Time of Peak Discharge	22Sep2020, 00:24
Volume (IN)	6.53
Precipitation Volume (AC - FT)	318.89
Loss Volume (AC - FT)	90.73
Excess Volume (AC - FT)	228.16
Direct Runoff Volume (AC - FT)	224.48
Baseflow Volume (AC - FT)	0


Precipitation and Outflow
FLOW (CFS) PRECIP-INC (IN)
0
0.02
0.04
0.06
800
0.08
600
400
200
0.12
0
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
Sep 21, 2020
Sep 22, 2020
Time
Precipitation
Excess Precipitation
Outflow

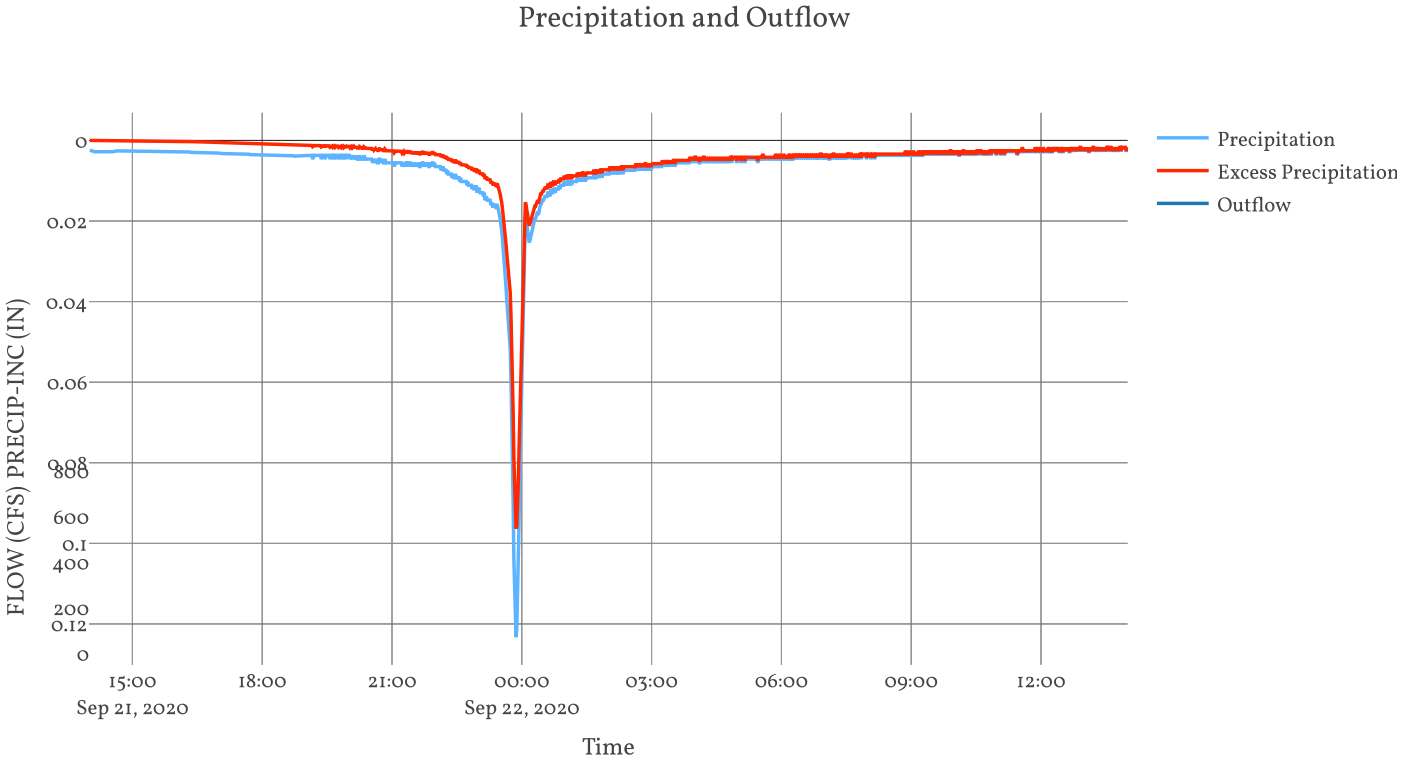
Subbasin: 61B

Area : 0.61
Downstream : J 60b 61b

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	75
Initial Abstraction	0.2

Transform: User - Specified S - Graph	
S - graph	Ellsworth S - Graph
Lag Method	Specified
Lag	0.37

Results: 61B	
Peak Discharge (CFS)	896.67
Time of Peak Discharge	22Sep2020, 00:14
Volume (IN)	6.56
Precipitation Volume (AC - FT)	299.61
Loss Volume (AC - FT)	85.24
Excess Volume (AC - FT)	214.36
Direct Runoff Volume (AC - FT)	211.97
Baseflow Volume (AC - FT)	0

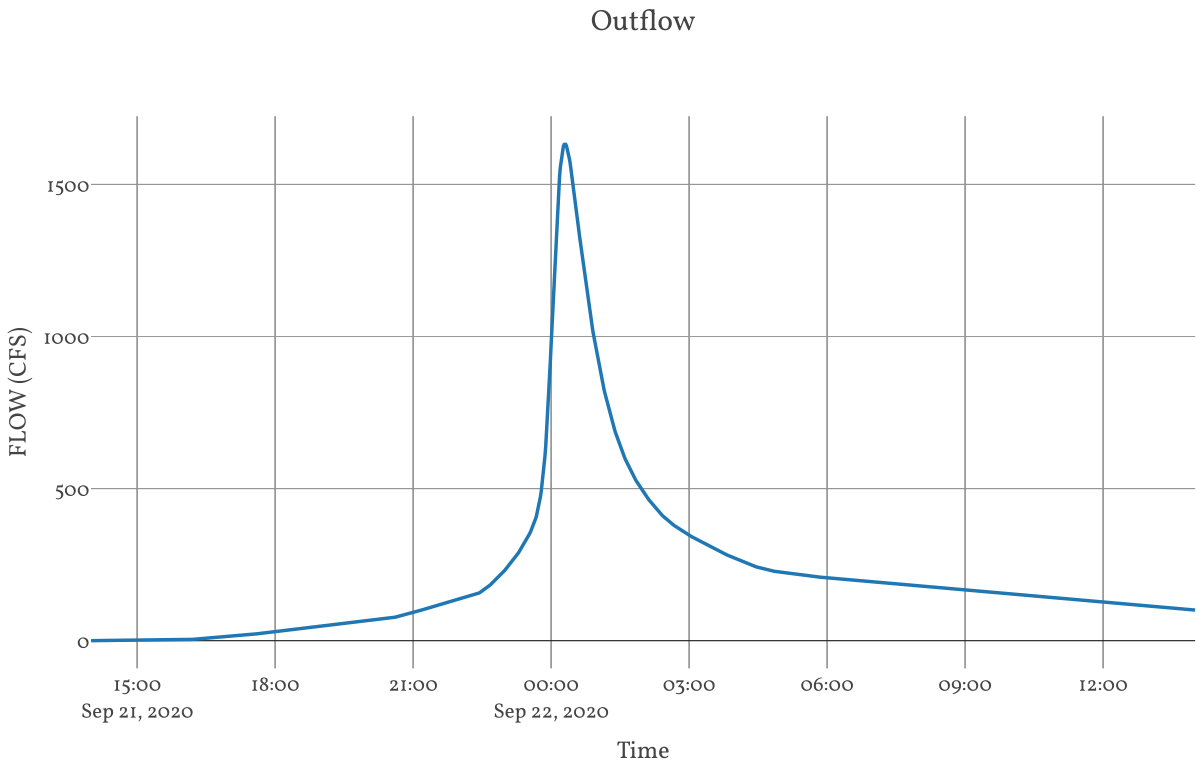

Precipitation and Outflow
FLOW (CFS) PRECIP-INC (IN)
0
0.02
0.04
0.06
0.08
800
600
0.1
400
200
0.12
0
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
Sep 21, 2020
Sep 22, 2020
Time
Precipitation
Excess Precipitation
Outflow

Junction: J 60B 61B

Downstream : 18r

Results: J 60B 61B

Peak Discharge (CFS)	1633.26
Time of Peak Discharge	22Sep2020, 00:18
Volume (IN)	6.54



Reach: 18R

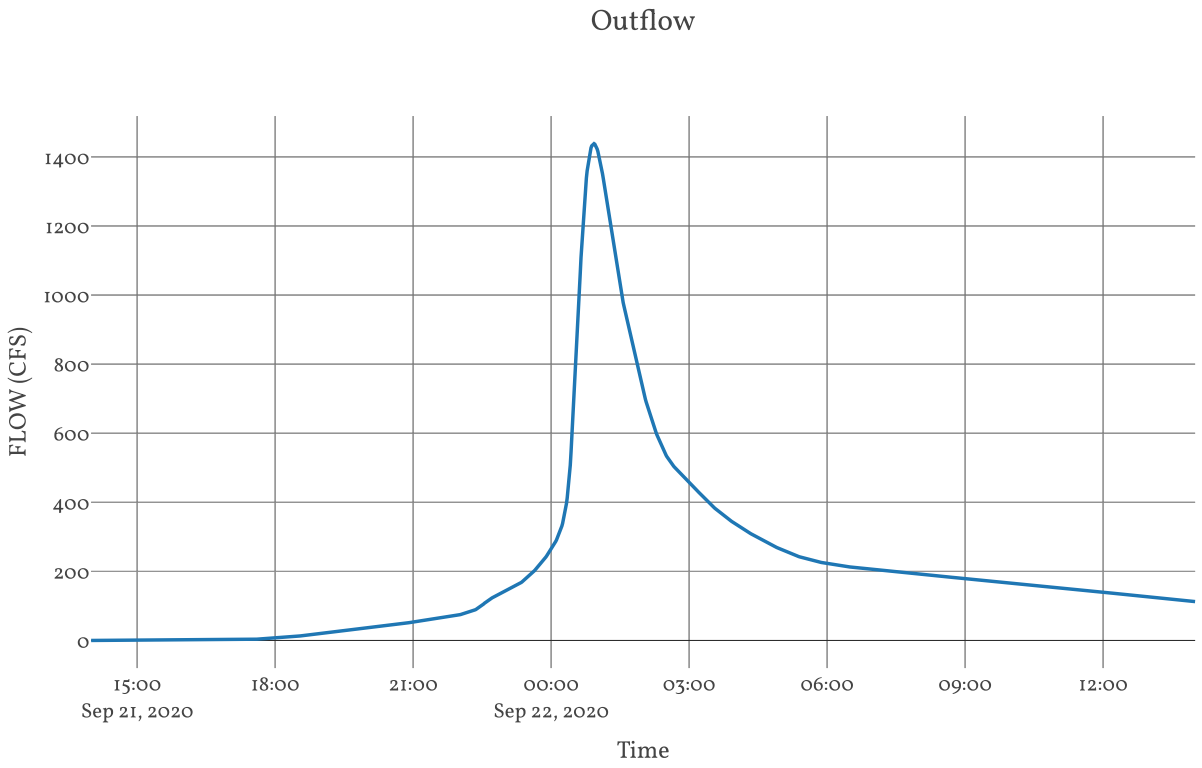
Downstream : 17c

Route: Modified Puls

Method	Modified Puls
Initial Variable	Combined Inflow
Number of Reaches	8
Storage Outflow Table Name	18r

Results: 18R

Peak Discharge (CFS)	1438.27
Time of Peak Discharge	22Sep2020, 00:56
Volume (IN)	6.33
Peak Inflow (CFS)	1633.26
Inflow Volume (AC - FT)	436.45



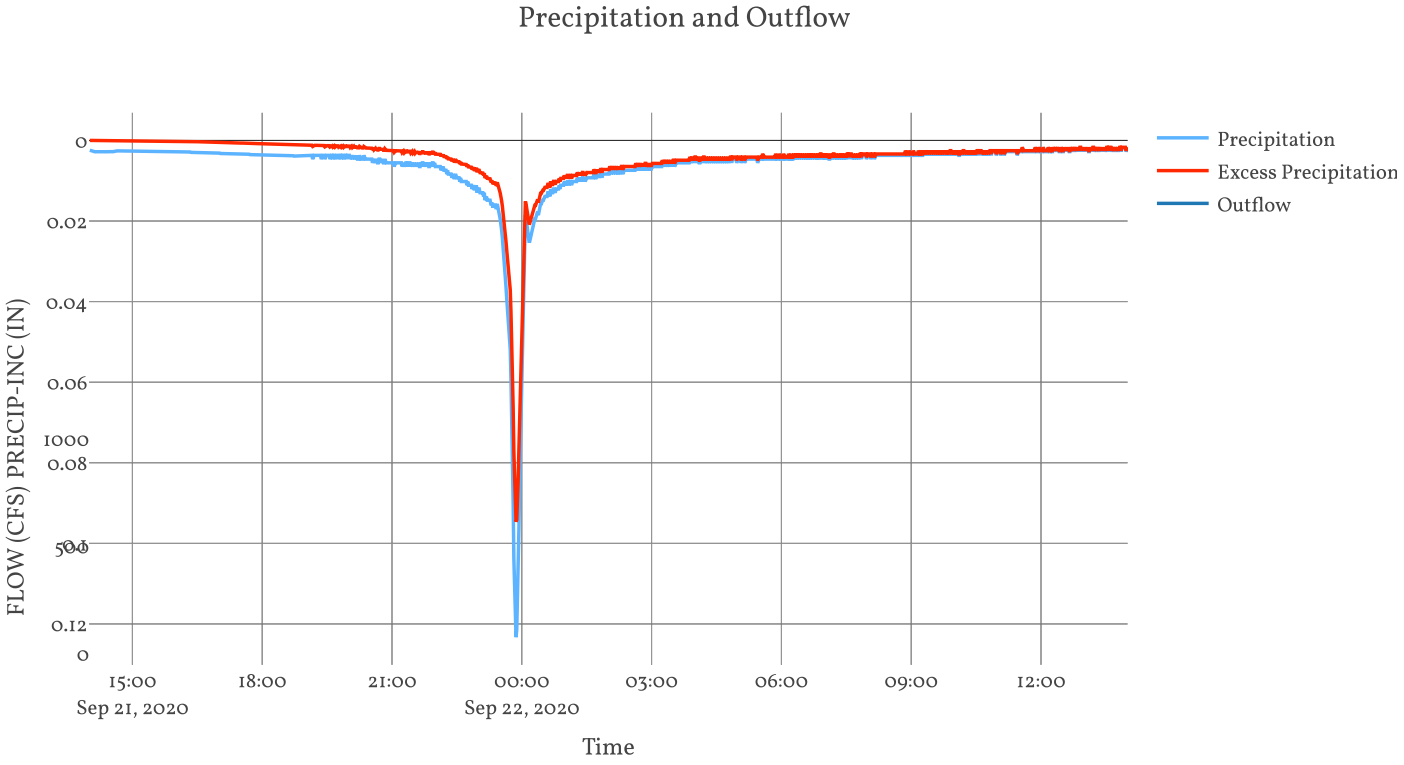
Subbasin: 62B

Area : 0.53
Downstream : 17c

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	73.9
Initial Abstraction	0.2

Transform: User - Specified S - Graph	
S - graph	Ellsworth S - Graph
Lag Method	Specified
Lag	0.25

Results: 62B	
Peak Discharge (CFS)	952.41
Time of Peak Discharge	22Sep2020, 00:08
Volume (IN)	6.48
Precipitation Volume (AC - FT)	259.86
Loss Volume (AC - FT)	76.86
Excess Volume (AC - FT)	182.99
Direct Runoff Volume (AC - FT)	181.63
Baseflow Volume (AC - FT)	0

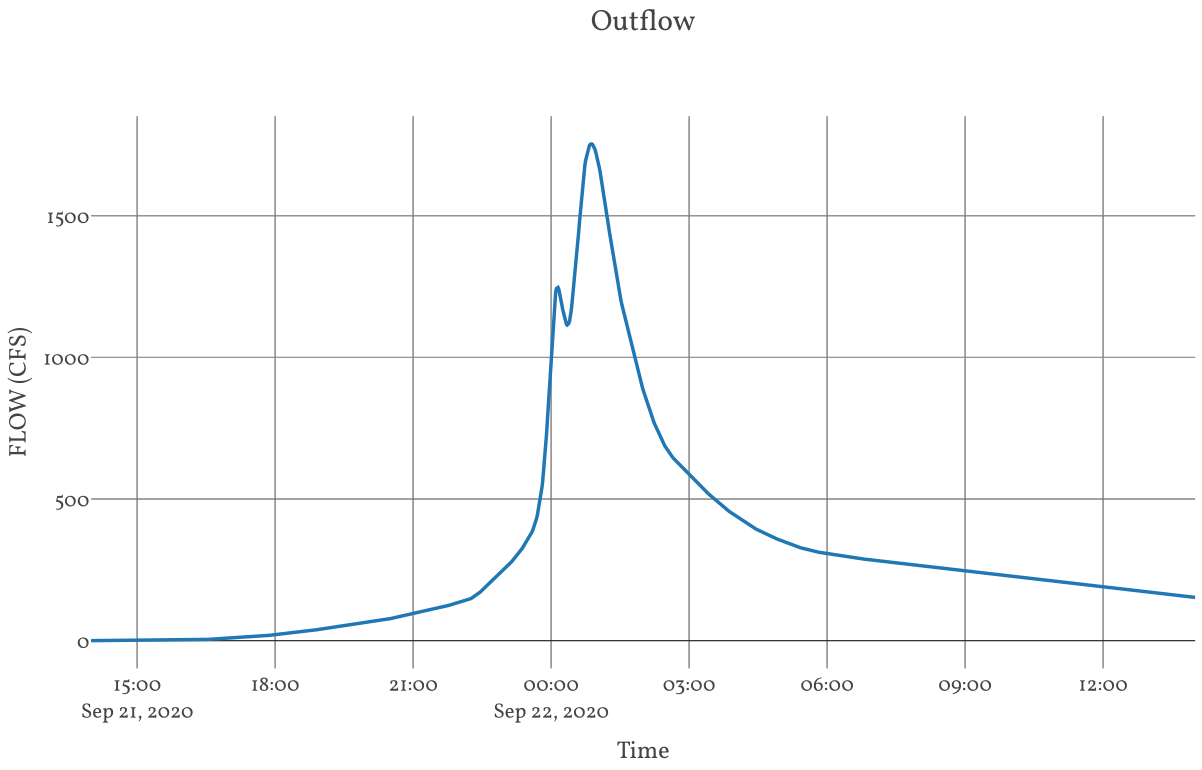

Precipitation and Outflow
FLOW (CFS) PRECIP-INC (IN)
0
0.02
0.04
0.06
1000
0.08
500
0.12
0
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
Sep 21, 2020
Sep 22, 2020
Time
Precipitation
Excess Precipitation
Outflow

Junction: 17C

Downstream : 17r

Results: 17C

Peak Discharge (CFS)	1753.66
Time of Peak Discharge	22Sep2020, 00:52
Volume (IN)	6.37



Reach: 17R

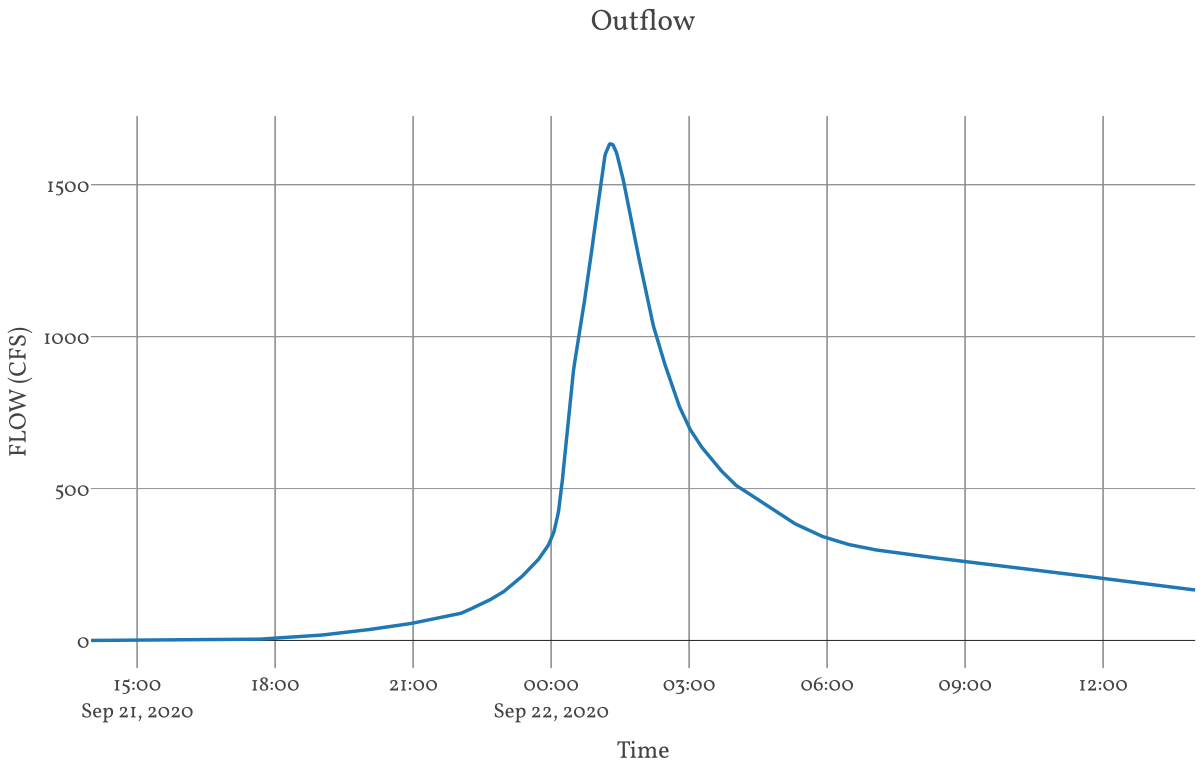
Downstream : 16c

Route: Modified Puls

Method	Modified Puls
Initial Variable	Combined Inflow
Number of Reaches	4
Storage Outflow Table Name	17r

Results: 17R

Peak Discharge (CFS)	1634.93
Time of Peak Discharge	22Sep2020, 01:18
Volume (IN)	6.22
Peak Inflow (CFS)	1753.66
Inflow Volume (AC - FT)	604.01



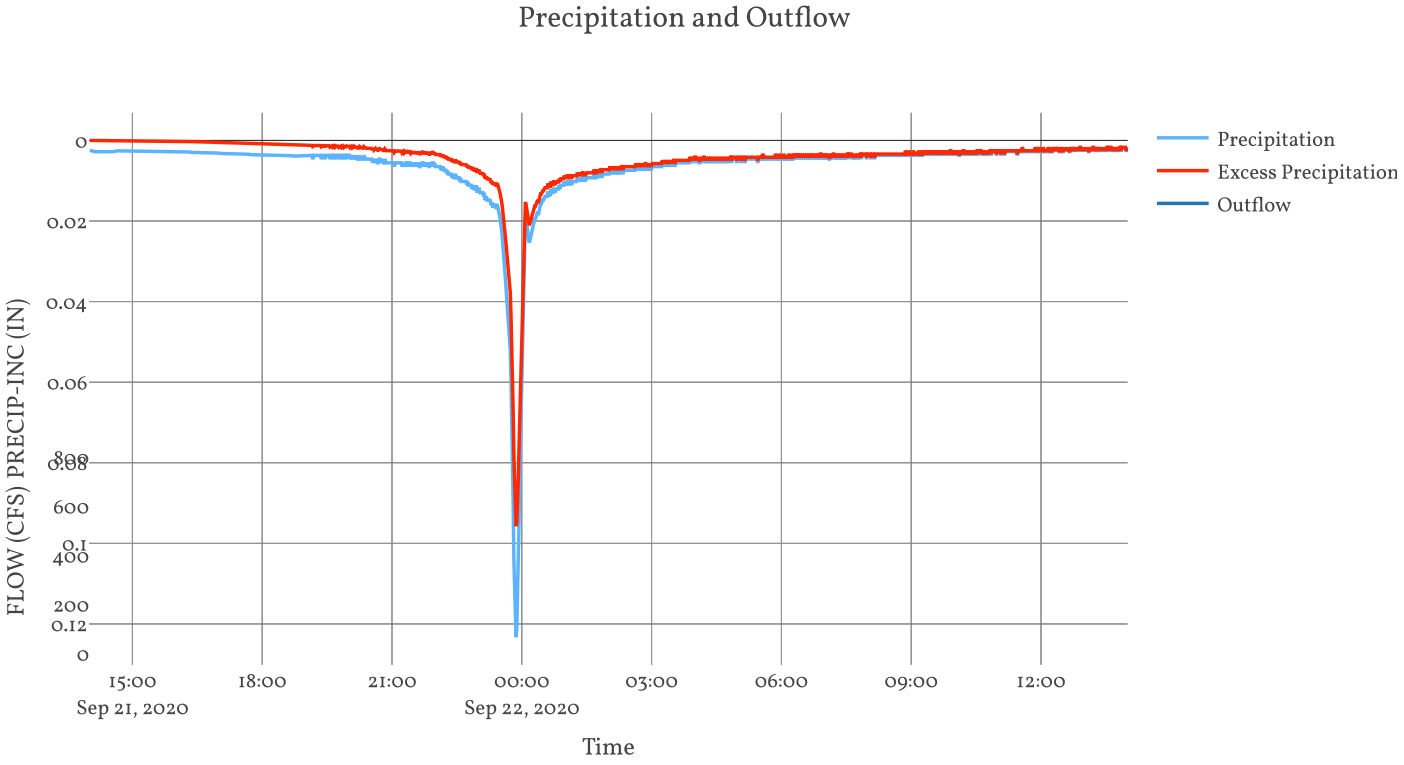
Subbasin: 63B

Area : 0.6
Downstream : 16c

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	74.6
Initial Abstraction	0.2

Transform: User - Specified S - Graph	
S - graph	Ellsworth S - Graph
Lag Method	Specified
Lag	0.41

Results: 63B	
Peak Discharge (CFS)	833.58
Time of Peak Discharge	22Sep2020, 00:17
Volume (IN)	6.51
Precipitation Volume (AC - FT)	297.63
Loss Volume (AC - FT)	85.9
Excess Volume (AC - FT)	211.73
Direct Runoff Volume (AC - FT)	209.08
Baseflow Volume (AC - FT)	0

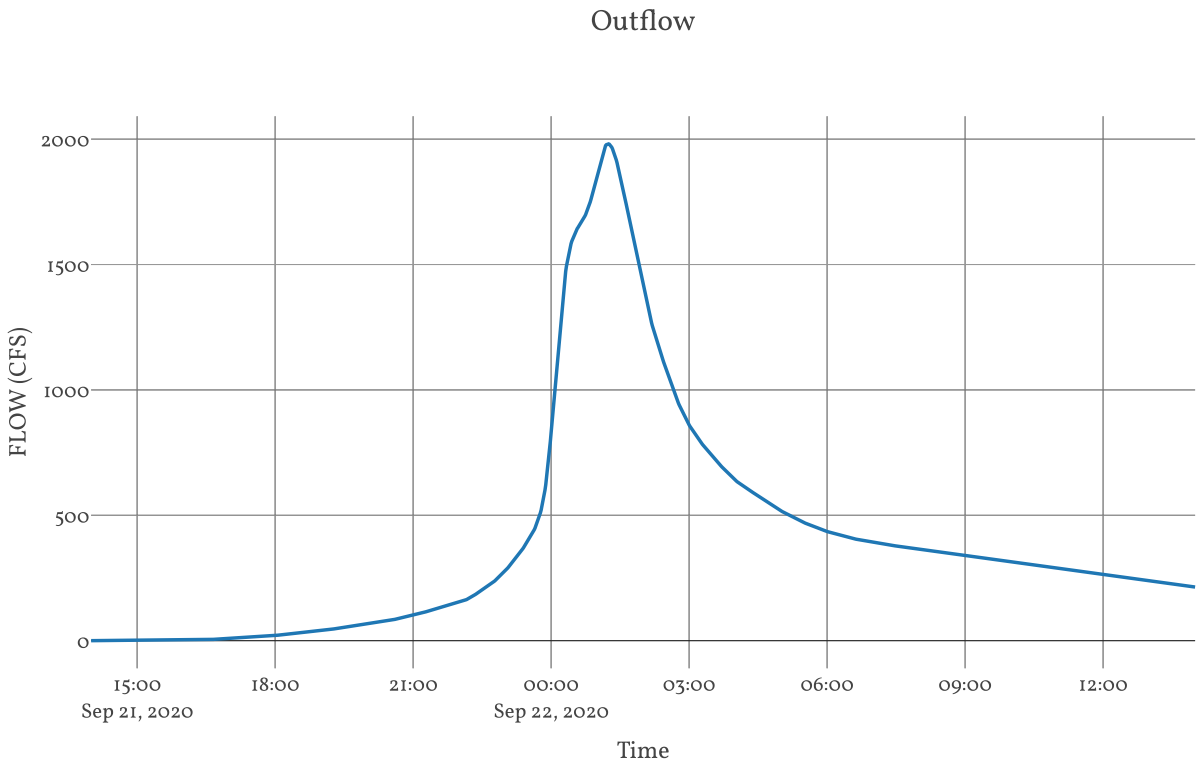

Precipitation and Outflow
FLOW (CFS) PRECIP-INC (IN)
0
0.02
0.04
0.06
0.08
0.1
0.12
800
600
400
200
0
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
Sep 21, 2020
Sep 22, 2020
Time
Precipitation
Excess Precipitation
Outflow

Junction: 16C

Downstream : 16r

Results: 16C

Peak Discharge (CFS)	1981.11
Time of Peak Discharge	22Sep2020, 01:14
Volume (IN)	6.3



Reach: 16R

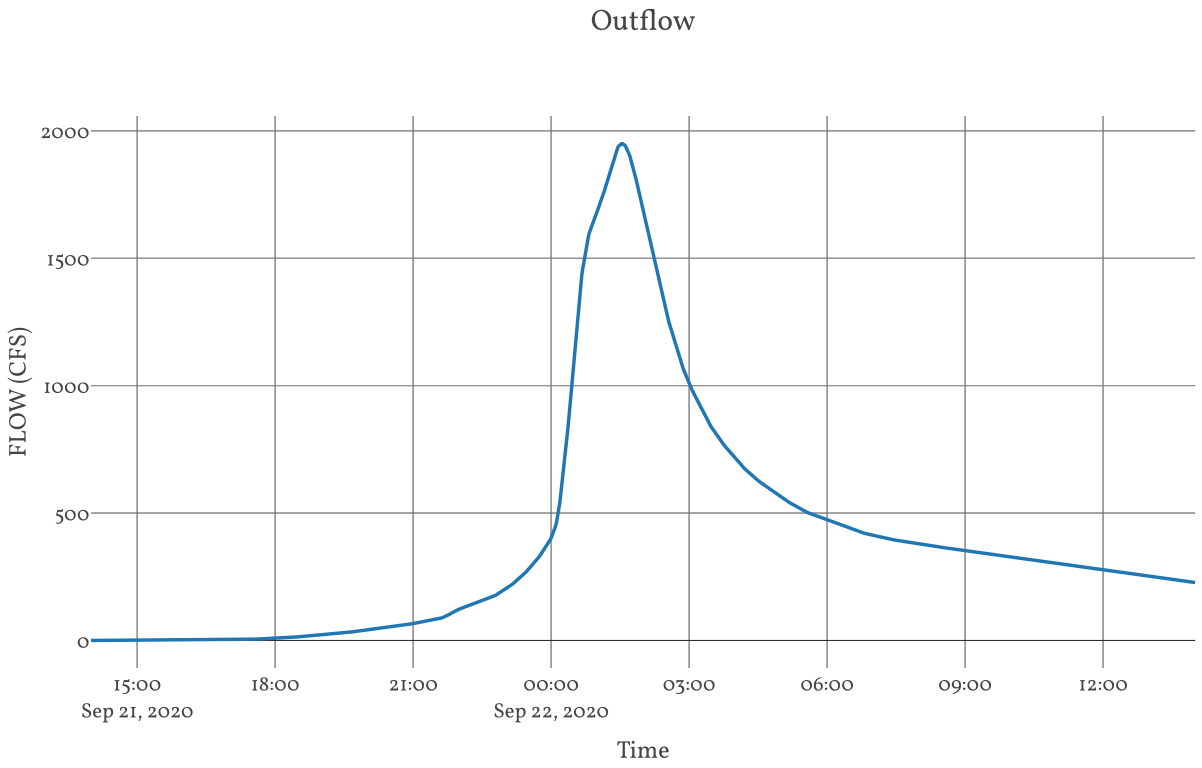
Downstream : 20C

Route: Modified Puls

Method	Modified Puls
Initial Variable	Combined Inflow
Number of Reaches	6
Storage Outflow Table Name	16r

Results: 16R

Peak Discharge (CFS)	1949.71
Time of Peak Discharge	22Sep2020, 01:33
Volume (IN)	6.19
Peak Inflow (CFS)	1981.11
Inflow Volume (AC - FT)	798.7



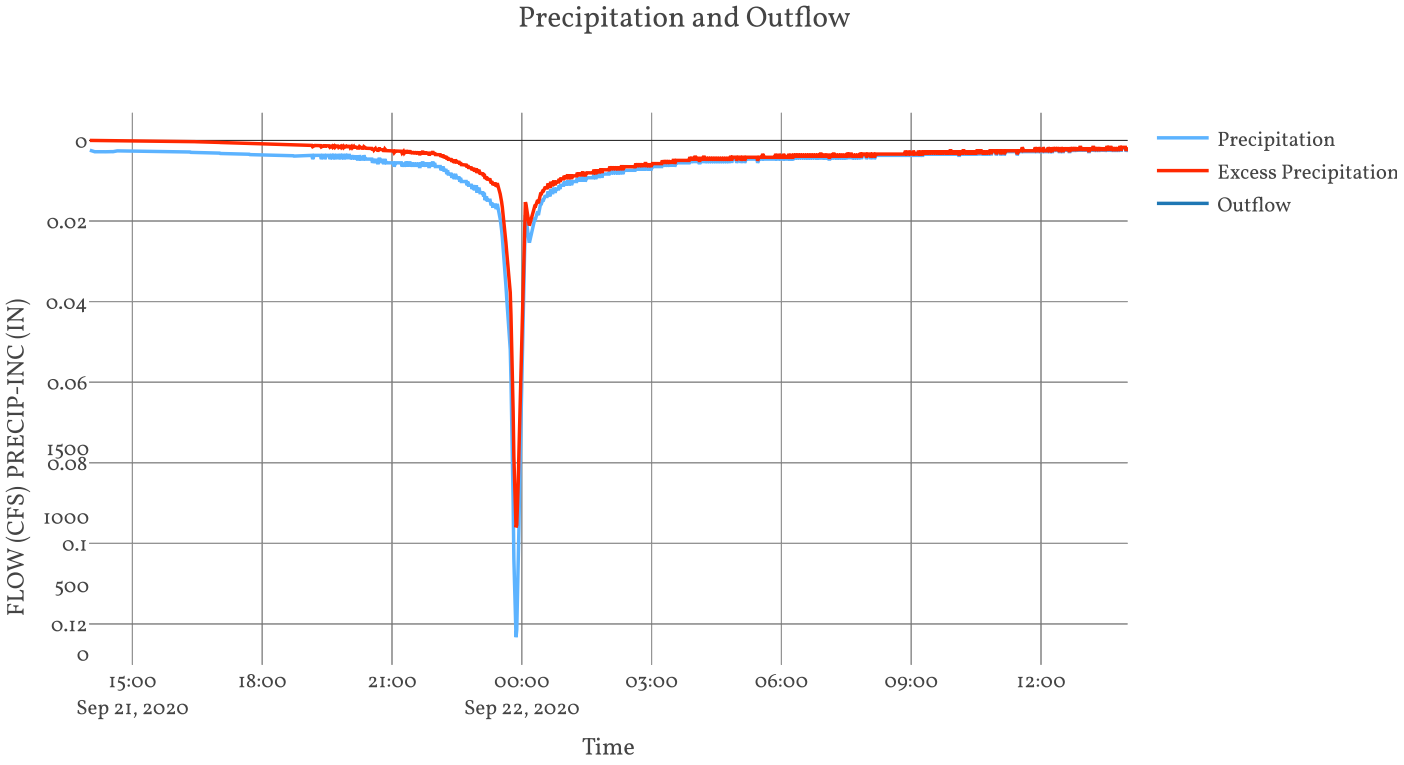
Subbasin: 64B

Area : 1.09
Downstream : 20c

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	74.8
Initial Abstraction	0.2

Transform: User - Specified S - Graph	
S - graph	Ellsworth S - Graph
Lag Method	Specified
Lag	0.42

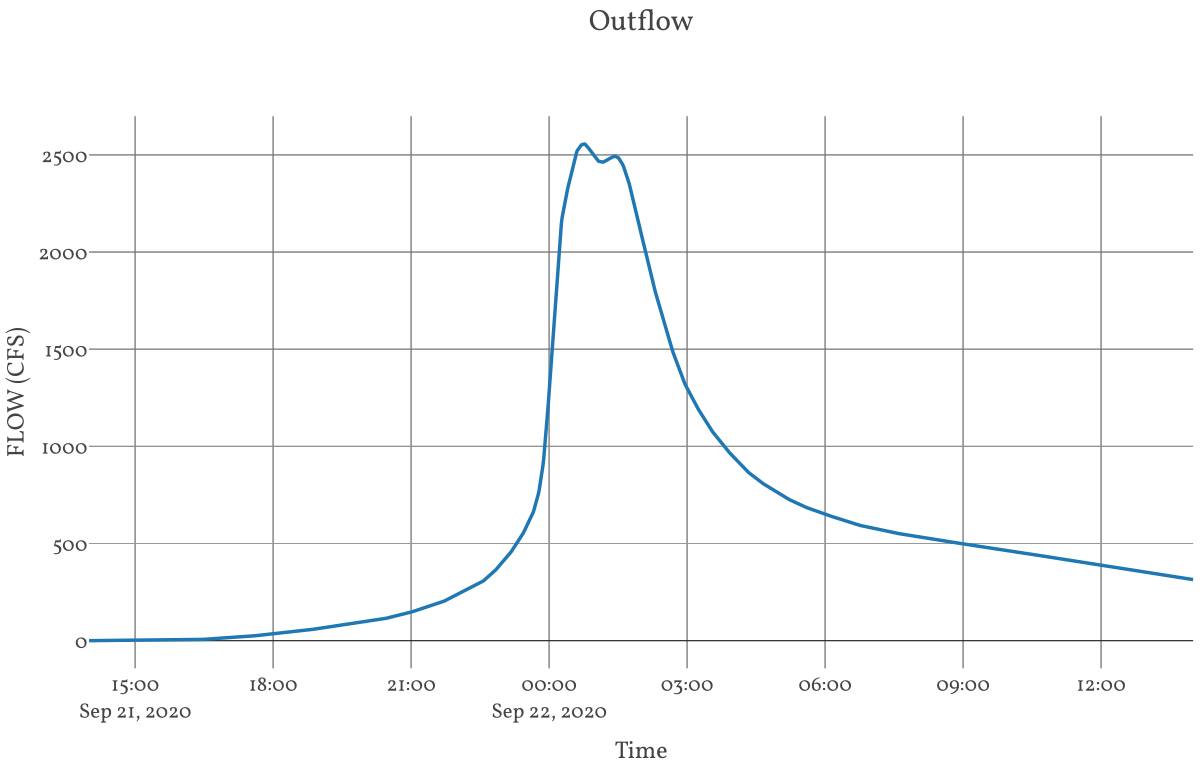
Results: 64B	
Peak Discharge (CFS)	1492.76
Time of Peak Discharge	22Sep2020, 00:17
Volume (IN)	6.53
Precipitation Volume (AC - FT)	538.9
Loss Volume (AC - FT)	154.43
Excess Volume (AC - FT)	384.46
Direct Runoff Volume (AC - FT)	379.54
Baseflow Volume (AC - FT)	0


Precipitation and Outflow
FLOW (CFS) PRECIP-INC (IN)
0
0.02
0.04
0.06
1500
0.08
1000
0.1
500
0.12
0
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
Sep 21, 2020
Sep 22, 2020
Time
Precipitation
Excess Precipitation
Outflow

Junction: 20C

Downstream : 20r

Results: 20C	
Peak Discharge (CFS)	2556.55
Time of Peak Discharge	22Sep2020, 00:45
Volume (IN)	6.3

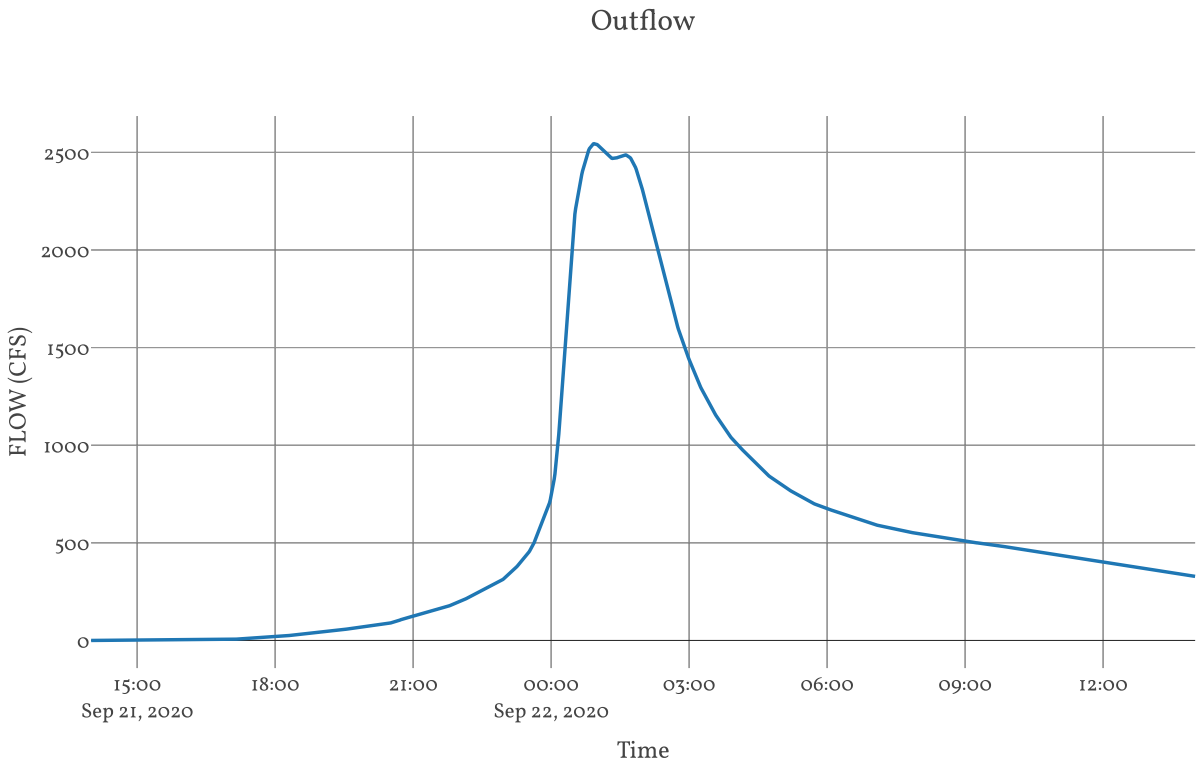


Reach: 20R

Downstream : 15C

Route: Modified Puls	
Method	Modified Puls
Initial Variable	Combined Inflow
Number of Reaches	6
Storage Outflow Table Name	20r

Results: 20R	
Peak Discharge (CFS)	2544.52
Time of Peak Discharge	22Sep2020, 00:57
Volume (IN)	6.23
Peak Inflow (CFS)	2556.55
Inflow Volume (AC - FT)	1164.63



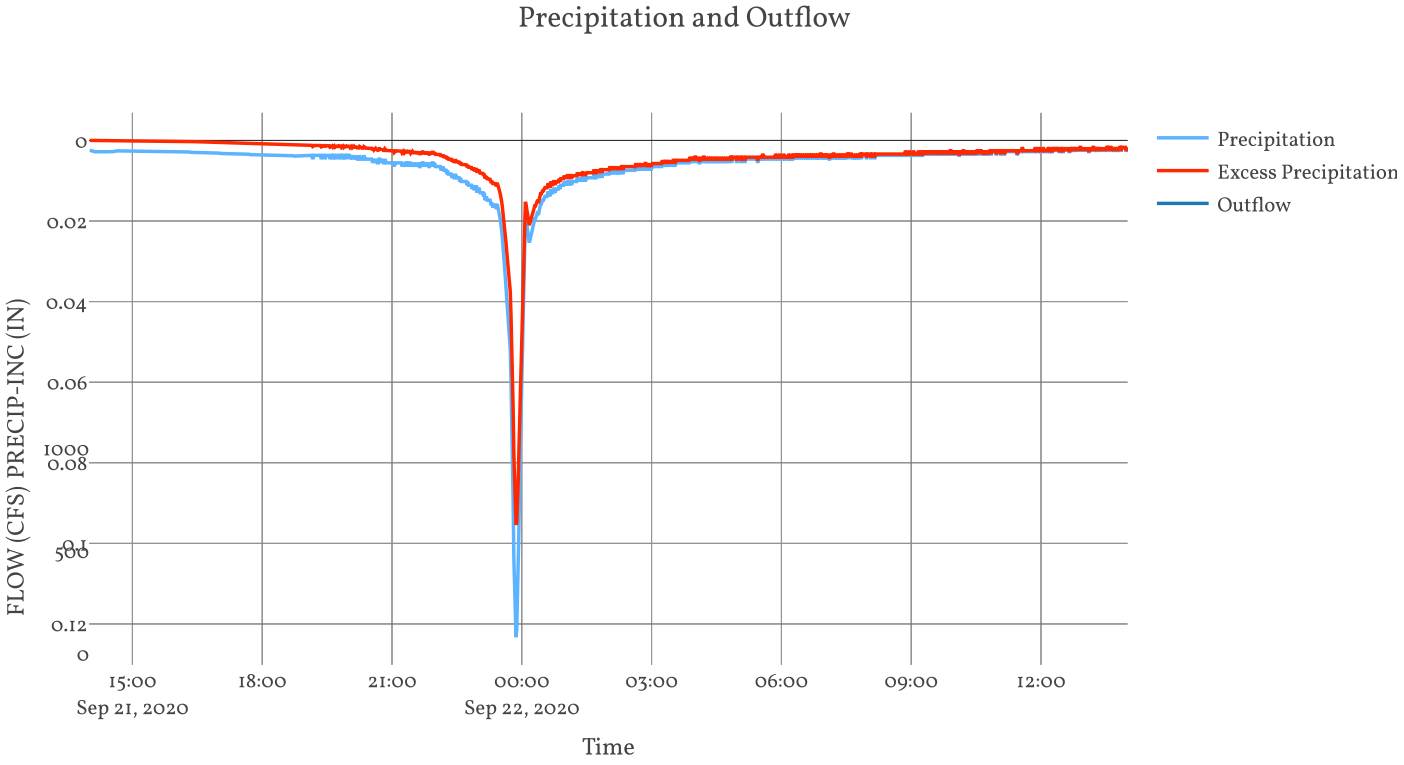
Subbasin: 65B

Area : 0.53
Downstream : 15c

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	74.4
Initial Abstraction	0.2

Transform: User - Specified S - Graph	
S - graph	Ellsworth S - Graph
Lag Method	Specified
Lag	0.24

Results: 65B	
Peak Discharge (CFS)	996.31
Time of Peak Discharge	22Sep2020, 00:07
Volume (IN)	6.53
Precipitation Volume (AC - FT)	263.52
Loss Volume (AC - FT)	76.6
Excess Volume (AC - FT)	186.92
Direct Runoff Volume (AC - FT)	185.59
Baseflow Volume (AC - FT)	0

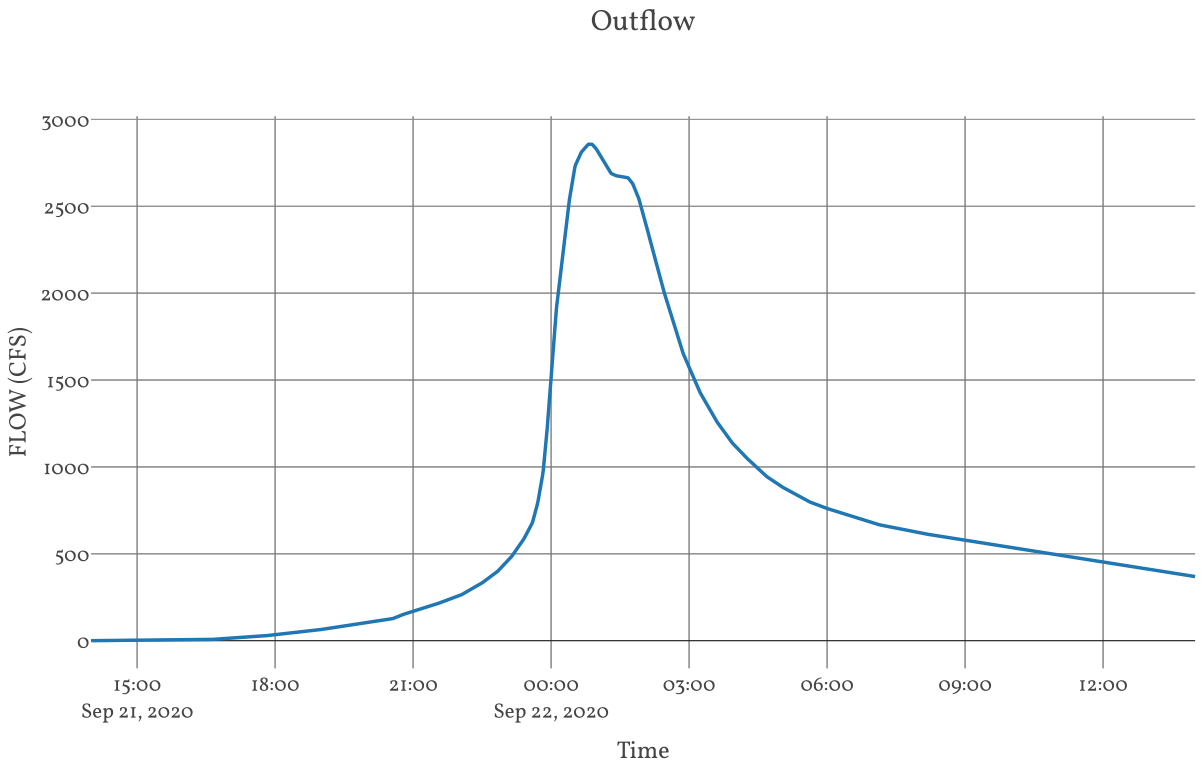

Precipitation and Outflow
FLOW (CFS) PRECIP-INC (IN)
0
0.02
0.04
0.06
1000
0.08
500
0.1
0.12
0
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
Sep 21, 2020
Sep 22, 2020
Time
Precipitation
Excess Precipitation
Outflow

Junction: 15C

Downstream : 15r

Results: 15C

Peak Discharge (CFS)	2859.17
Time of Peak Discharge	22Sep2020, 00:51
Volume (IN)	6.27



Reach: 15R

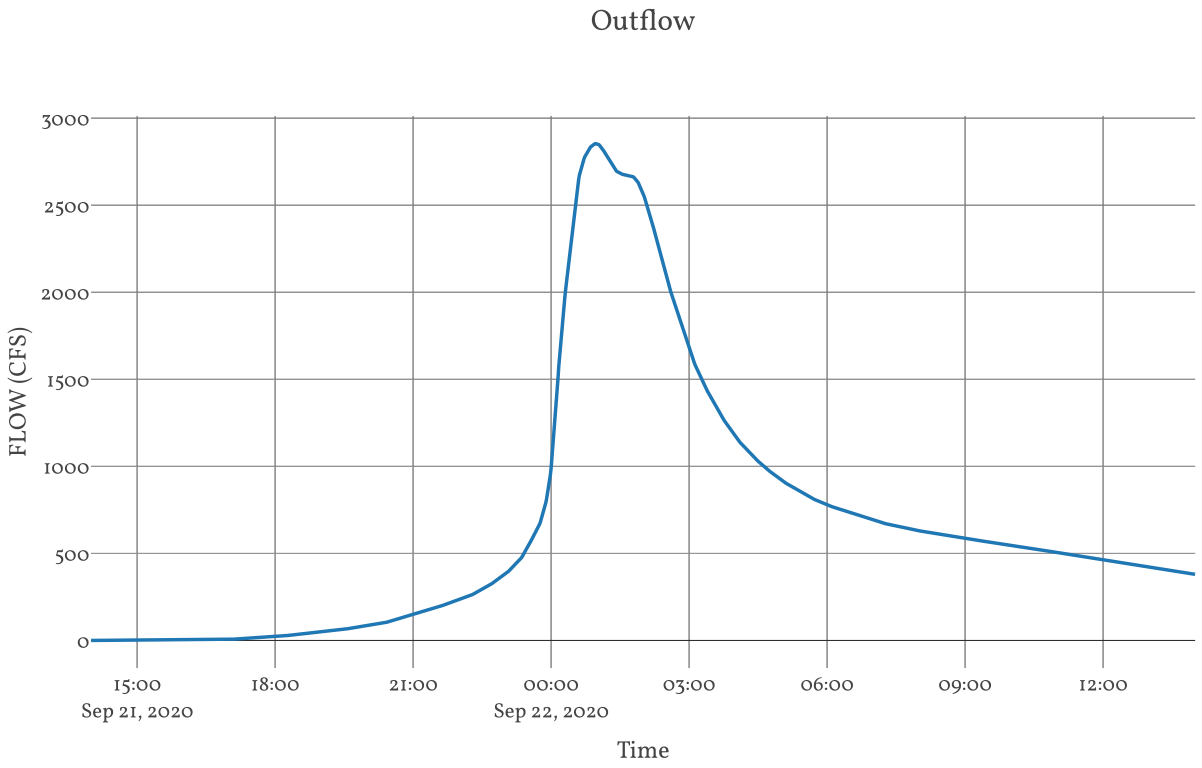
Downstream : 14c

Route: Modified Puls

Method	Modified Puls
Initial Variable	Combined Inflow
Number of Reaches	5
Storage Outflow Table Name	15r

Results: 15R

Peak Discharge (CFS)	2853.59
Time of Peak Discharge	22Sep2020, 00:59
Volume (IN)	6.22
Peak Inflow (CFS)	2859.17
Inflow Volume (AC - FT)	1337.53



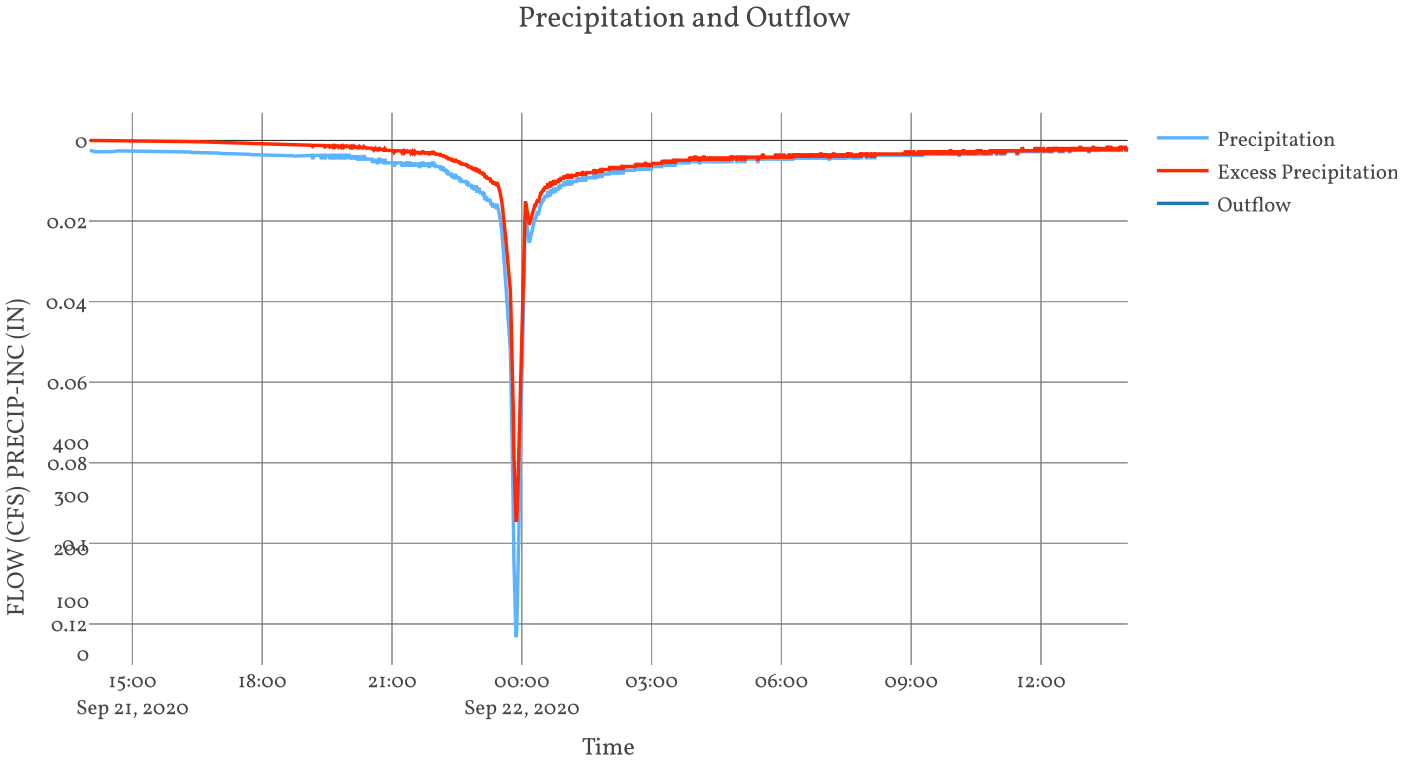
Subbasin: 66B

Area : 0.16
Downstream : 14c

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	73.9
Initial Abstraction	0.2

Transform: User - Specified S - Graph	
S - graph	Ellsworth S - Graph
Lag Method	Specified
Lag	0.14

Results: 66B	
Peak Discharge (CFS)	387.56
Time of Peak Discharge	22Sep2020, 00:02
Volume (IN)	6.5
Precipitation Volume (AC - FT)	80.09
Loss Volume (AC - FT)	23.69
Excess Volume (AC - FT)	56.4
Direct Runoff Volume (AC - FT)	56.17
Baseflow Volume (AC - FT)	0

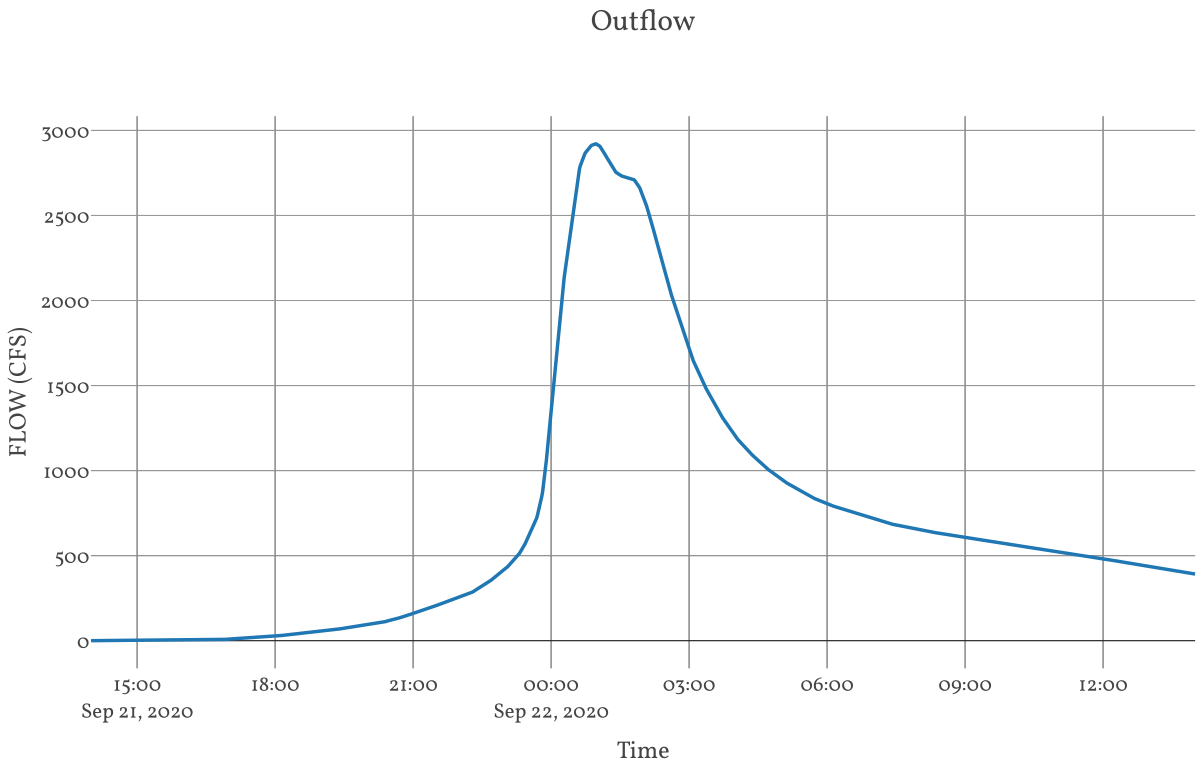

Precipitation and Outflow
FLOW (CFS) PRECIP-INC (IN)
0
0.02
0.04
0.06
400
0.08
300
200
100
0.12
0
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
Sep 21, 2020
Sep 22, 2020
Time
Precipitation
Excess Precipitation
Outflow

Junction: 14C

Downstream : 14r

Results: 14C

Peak Discharge (CFS)	2920.92
Time of Peak Discharge	22Sep2020, 00:58
Volume (IN)	6.23



Reach: 14R

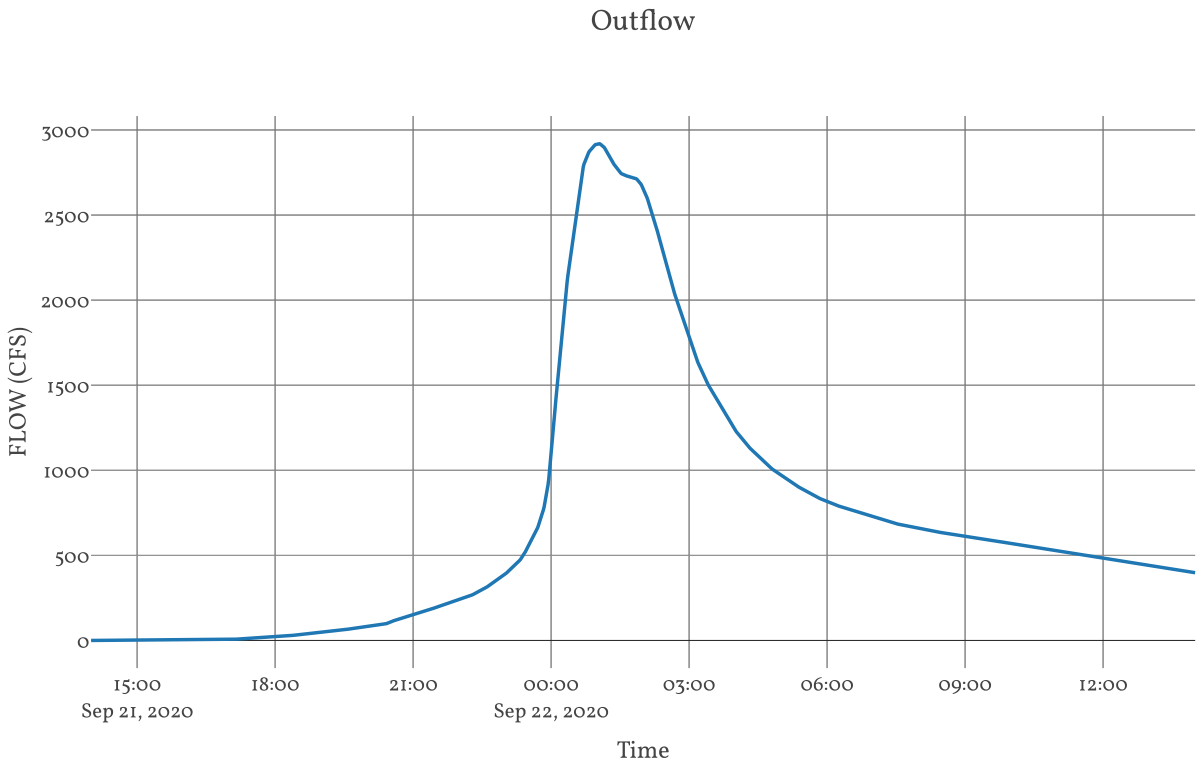
Downstream : 13c

Route: Modified Puls

Method	Modified Puls
Initial Variable	Combined Inflow
Number of Reaches	5
Storage Outflow Table Name	14r

Results: 14R

Peak Discharge (CFS)	2919.54
Time of Peak Discharge	22Sep2020, 01:02
Volume (IN)	6.21
Peak Inflow (CFS)	2920.92
Inflow Volume (AC - FT)	1383.9



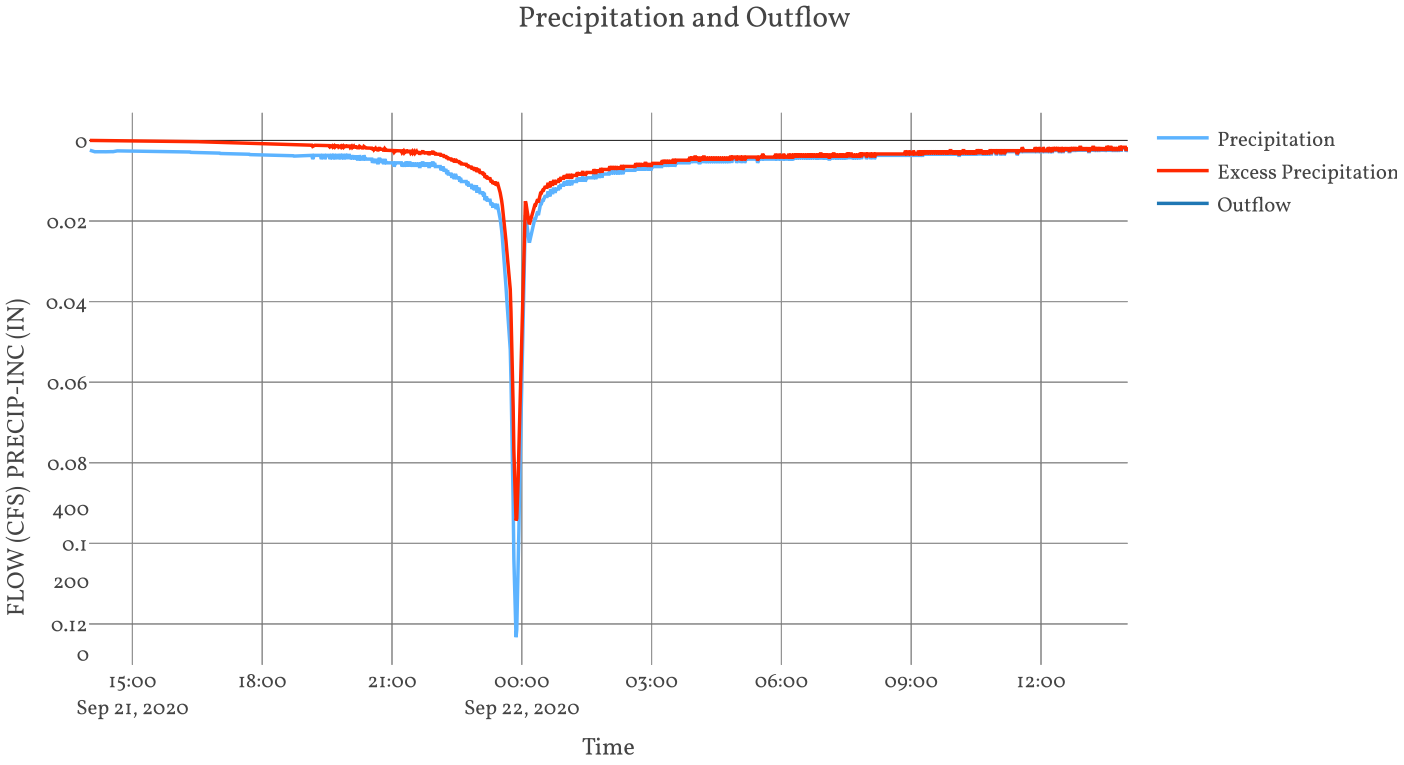
Subbasin: 67B

Area : 0.43
Downstream : 13c

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	73.7
Initial Abstraction	0.2

Transform: User - Specified S - Graph	
S - graph	Ellsworth S - Graph
Lag Method	Specified
Lag	0.44

Results: 67B	
Peak Discharge (CFS)	562.44
Time of Peak Discharge	22Sep2020, 00:19
Volume (IN)	6.42
Precipitation Volume (AC - FT)	212.59
Loss Volume (AC - FT)	63.32
Excess Volume (AC - FT)	149.27
Direct Runoff Volume (AC - FT)	147.24
Baseflow Volume (AC - FT)	0

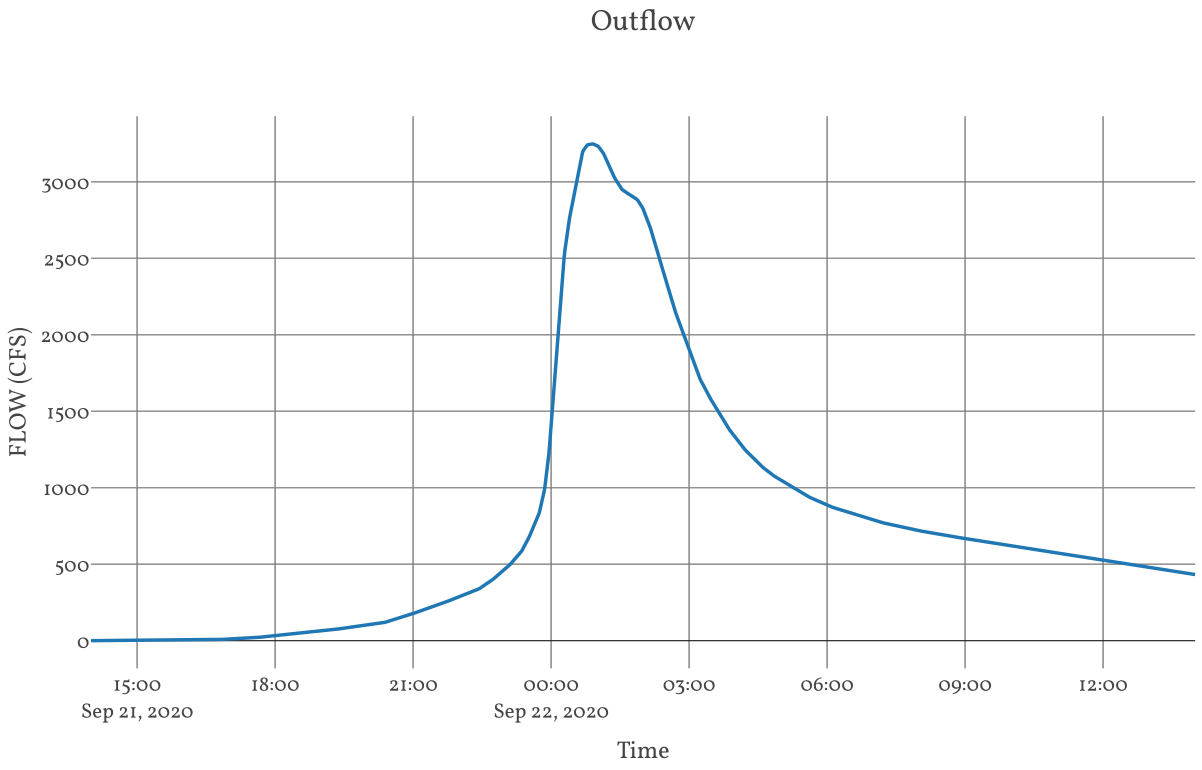

Precipitation and Outflow
FLOW (CFS) PRECIP-INC (IN)
0
0.02
0.04
0.06
0.08
400
0.1
200
0.12
0
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
Sep 21, 2020
Sep 22, 2020
Time
Precipitation
Excess Precipitation
Outflow

Junction: 13C

Downstream : 13r

Results: 13C

Peak Discharge (CFS)	3247.98
Time of Peak Discharge	22Sep2020, 00:53
Volume (IN)	6.23



Reach: 13R

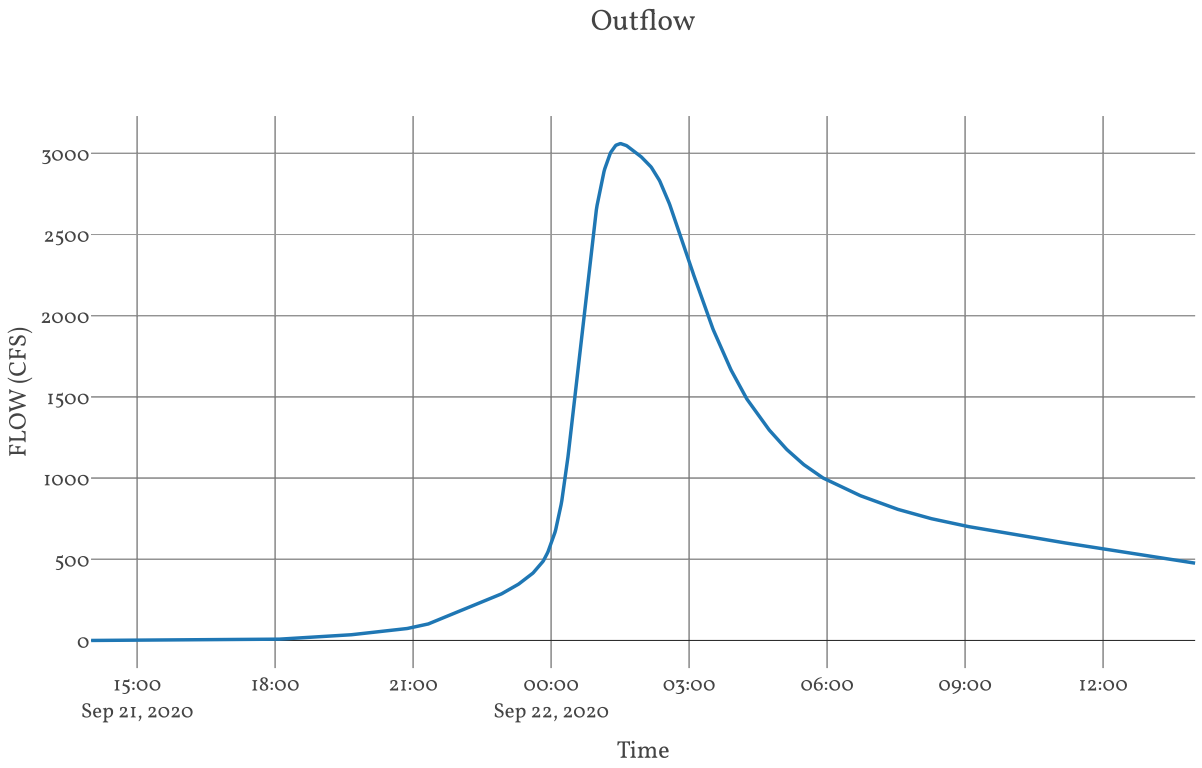
Downstream : 12C

Route: Modified Puls

Method	Modified Puls
Initial Variable	Combined Inflow
Number of Reaches	2
Storage Outflow Table Name	13r

Results: 13R

Peak Discharge (CFS)	3059.42
Time of Peak Discharge	22Sep2020, 01:31
Volume (IN)	6.05
Peak Inflow (CFS)	3247.98
Inflow Volume (AC - FT)	1525.57



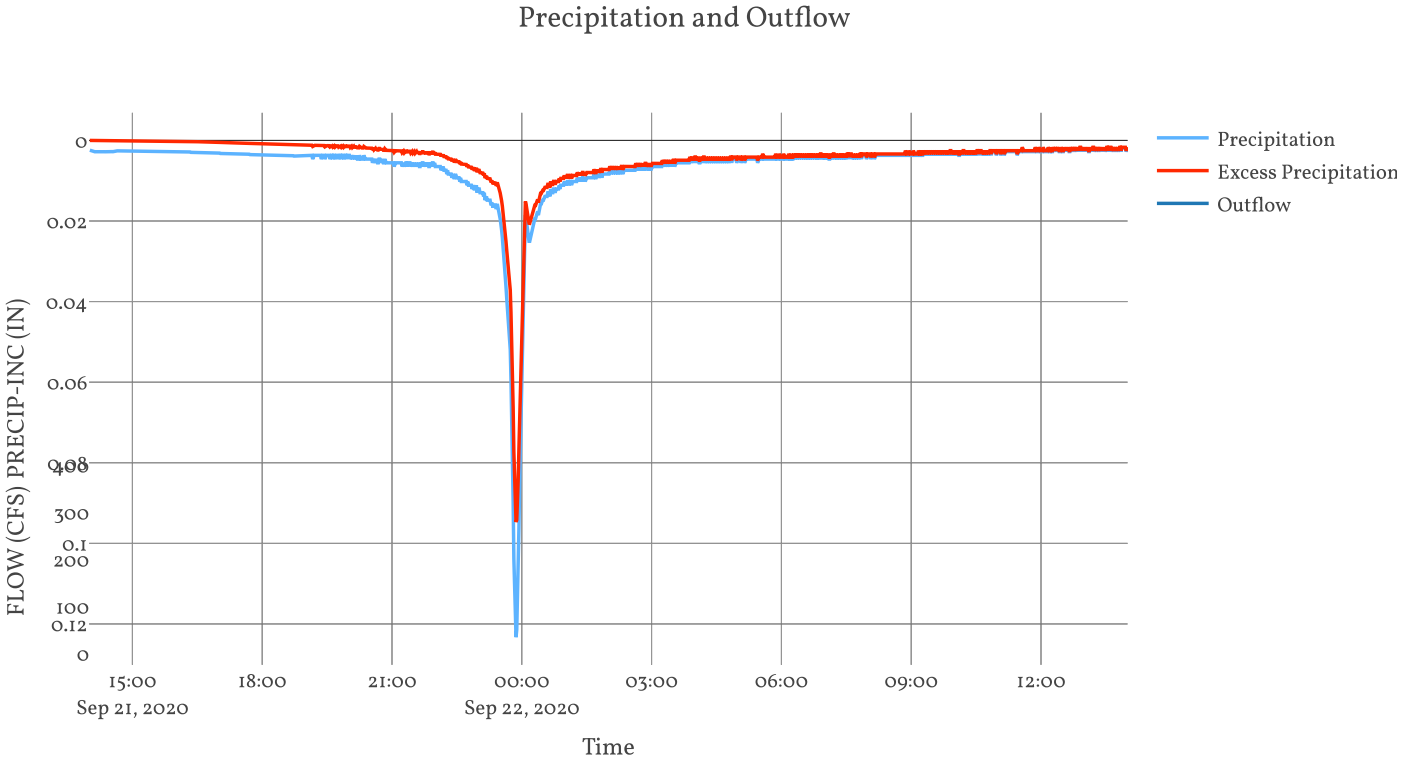
Subbasin: 68B

Area : 0.26
Downstream : 12c

Loss Rate: Scs	
Percent Impervious Area	0
Curve Number	73.9
Initial Abstraction	0.2

Transform: User - Specified S - Graph	
S - graph	Ellsworth S - Graph
Lag Method	Specified
Lag	0.28

Results: 68B	
Peak Discharge (CFS)	434.66
Time of Peak Discharge	22Sep2020, 00:09
Volume (IN)	6.48
Precipitation Volume (AC - FT)	126.07
Loss Volume (AC - FT)	37.22
Excess Volume (AC - FT)	88.86
Direct Runoff Volume (AC - FT)	88.11
Baseflow Volume (AC - FT)	0

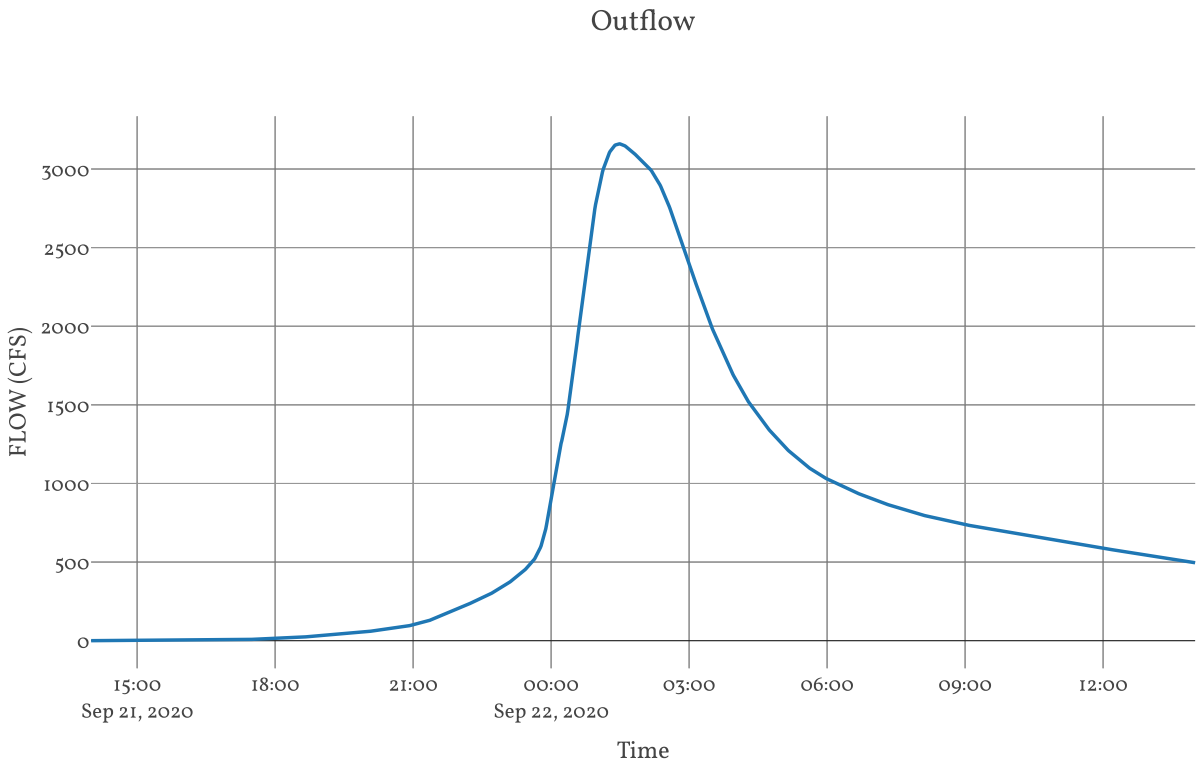

Precipitation and Outflow
FLOW (CFS) PRECIP-INC (IN)
0
0.02
0.04
0.06
0.08
0.1
0.12
400
300
200
100
0
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
Sep 21, 2020
Sep 22, 2020
Time
Precipitation
Excess Precipitation
Outflow

Junction: 12C

Downstream : Pacific Ocean

Results: 12C

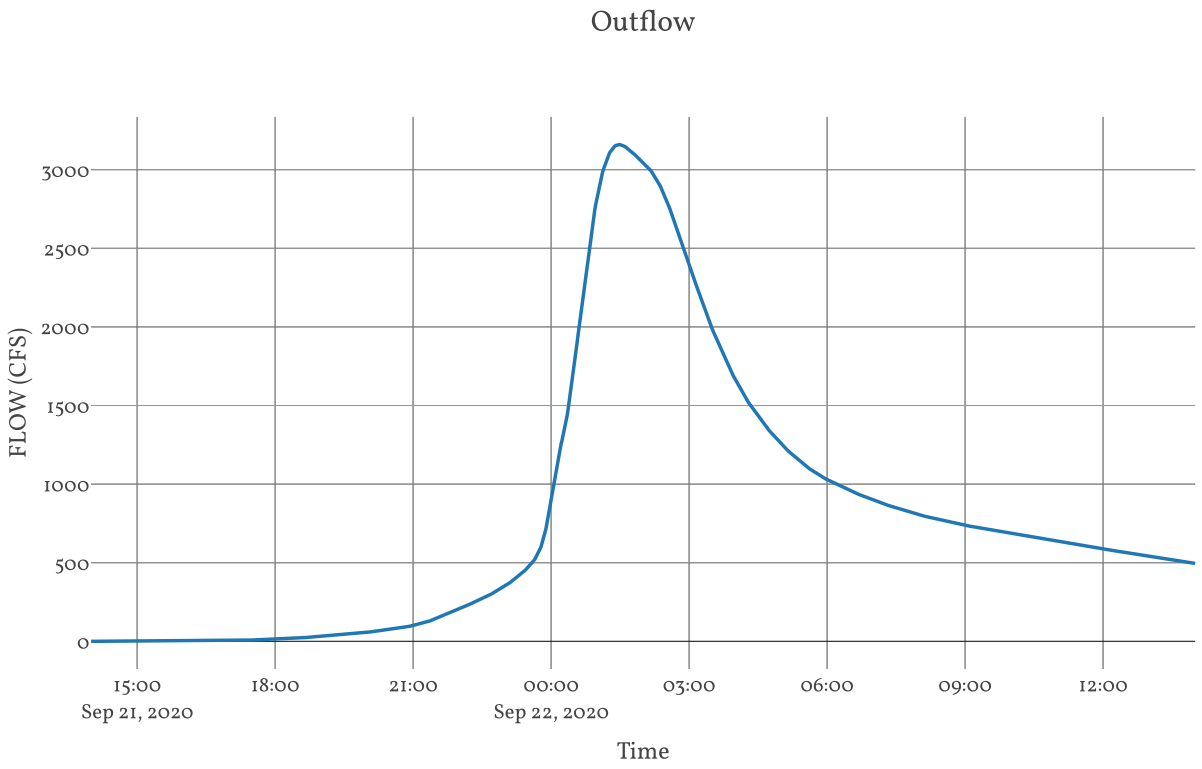
Peak Discharge (CFS)	3159.87
Time of Peak Discharge	22Sep2020, 01:29
Volume (IN)	6.07



Sink: Pacific Ocean

Results: Pacific Ocean

Peak Discharge (CFS)	3159.87
Time of Peak Discharge	22Sep2020, 01:29
Volume (IN)	6.07
Observed Flow Gage	Not specified
Observed Flow Volume (AC - FT)	Not specified
Observed Flow's RMSE Stdev	Not specified
Observed Flow's Percent Bias	Not specified
Observed Flow's Nash Sutcliffe	Not specified



36-EXB SAVE DATE: 3/31/2021 4:37:06 PM PLOT BY: Steward, Craig PLOT DATE: 3/31/2021 4:37:38 PM DRAWING: c:\users\csteward\documents\1-stantec\chk\drainage\impervious-comparision.dwg

DEVELOPMENT AREA 1

ROW

CAMP HESS KRAMER (LOWER CAMP)

YERBA BUENA ROAD

PACIFIC COAST HIGHWAY

PACIFIC OCEAN

CAMP HESS KRAMER (MIDDLE CAMP)

DEVELOPMENT AREA 1

YERBA BUENA ROAD

DEVELOPMENT AREA 3

CAMP ROAD

DEVELOPMENT AREA 2

YERBA BUENA ROAD

GINDLING HILLTOP CAMP (UPPER CAMP)

DEVELOPMENT AREA 4

POOL

POOL

LEGEND

EXISTING ROAD, PATH, COURTYARD (IMPERVIOUS)

PRE-FIRE EXISTING BUILDING (IMPERVIOUS)

N

1"=150'

DEVELOPMENT AREA 1 - 1,351,281 SF (31.0 ACRES)
IMPERVIOUS AREA- 398,500 SF (9.1 ACRES)

DEVELOPMENT AREA 2 - 1,173,726 SF (26.9 ACRES)
IMPERVIOUS AREA - 255,800 SF (5.9 ACRES)

DEVELOPMENT AREA 3 - 14,175 SF
IMPERVIOUS AREA - 3,600 SF (0.1 ACRES)

DEVELOPMENT AREA 4 - 24,485 SF
IMPERVIOUS AREA - 3,300 SF (0.1 ACRES)

ALL DEVELOPMENT AREAS - 2,564,000 SF (58.9 ACRES)
IMPERVIOUS AREA - 661,000 SF (15.2 ACRES)
EXISTING IMPERVIOUS AREA: 26%

IMPERVIOUS SURFACE EXHIBIT - PRE-FIRE 2017
CAMP HESS KRAMER / GINDLING HILLTOP CAMP
WOOLSEY FIRE REBUILD

COUNTY OF VENTURA, CALIFORNIA
MARCH 30, 2021

Stantec
111 East Victoria Street, Santa Barbara, CA 93101
Phone: (805) 963-9532

ATTENTION: IF THIS DOCUMENT IS PROVIDED AS A COURTESY IN AN ELECTRONIC FORMAT, THE DELIVERY OF THE ELECTRONIC FILE DOES NOT CONSTITUTE THE DELIVERY OF THE PROFESSIONAL WORK PRODUCT. ONLY A HARD COPY DOCUMENT THAT IS SIGNED AND SEALED BY AN AUTHORIZED PROFESSIONAL EMPLOYEE OF STANTEC CONSTITUTES THE PROFESSIONAL WORK PRODUCT. IN THE EVENT THE ELECTRONIC FILE IS ALTERED, THE HARD COPY MUST BE REFERRED TO FOR THE ORIGINAL AND CORRECT INFORMATION. STANTEC SHALL NOT BE RESPONSIBLE FOR ANY MODIFICATIONS MADE TO THE ELECTRONIC FILE, OR ANY PRODUCTS DERIVED FROM THE ELECTRONIC FILE WHICH ARE NOT REVIEWED, SIGNED AND SEALED BY AN AUTHORIZED PROFESSIONAL EMPLOYEE OF STANTEC. COPYRIGHT 2016, STANTEC CONSULTING SERVICES INC

DRAWING: c:\users\csteward\documents\1-stantec\chk\drainage\impervious-comparision.dwg
PLOT DATE: 3/31/2021 4:38:27 PM
PLOT BY: Steward, Craig
SAVE DATE: 3/31/2021 4:37:06 PM
36-EXB

DEVELOPMENT AREA 1

ROW

CAMP HESS KRAMER (LOWER CAMP)

YERBA BUENA ROAD

PACIFIC COAST HIGHWAY

PACIFIC OCEAN

CAMP HESS KRAMER (MIDDLE CAMP)

DEVELOPMENT AREA 1

YERBA BUENA ROAD

DEVELOPMENT AREA 3

CAMP FIRE ROAD

DEVELOPMENT AREA 2

YERBA BUENA ROAD

GINDLING HILLTOP CAMP (UPPER CAMP)

DEVELOPMENT AREA 4

POOL

POOL

LEGEND

- PROPOSED ROAD
- PROPOSED BUILDING
- PROPOSED IMPERVIOUS SITE (PATH/COURTYARD/ETC)
- EXISTING IMPERVIOUS

N

1"=150'

DEVELOPMENT AREA 1 - 1,351,281 SF (31.0 ACRES)
EXISTING IMPERVIOUS AREA - 124,000 SF (2.8 ACRES)
NEW/REPLACED IMPERVIOUS AREA - 212,500 SF (4.9 ACRES)
TOTAL IMPERVIOUS AREA - 336,000 SF (7.7 ACRES)

DEVELOPMENT AREA 2 - 1,173,726 SF (26.9 ACRES)
EXISTING IMPERVIOUS AREA - 220,500 SF (5.1 ACRES)
NEW/REPLACED IMPERVIOUS AREA - 28,000 SF (0.6 ACRES)
TOTAL IMPERVIOUS AREA - 228,500 SF (5.7 ACRES)

DEVELOPMENT AREA 3 - 14,175 SF (0.3 ACRES)
EXISTING IMPERVIOUS AREA -
NEW/REPLACED IMPERVIOUS AREA - 3,600 SF (0.1 ACRES)
TOTAL IMPERVIOUS AREA - 3,600 SF (0.1 ACRES)

DEVELOPMENT AREA 4 - 24,485 SF (0.6 ACRES)
EXISTING IMPERVIOUS AREA -
NEW/REPLACED IMPERVIOUS AREA - 3,300 SF (0.1 ACRES)
TOTAL IMPERVIOUS AREA - 3,300 SF (0.1 ACRES)

ALL DEVELOPMENT AREAS - 2,563,668 SF (58.9 ACRES)
EXISTING IMPERVIOUS AREA - 334,000 SF (7.9 ACRES)
NEW/REPLACED IMPERVIOUS AREA - 247,000 SF (5.7 ACRES)
TOTAL IMPERVIOUS AREA - 581,000 SF (13.6 ACRES)
TOTAL IMPERVIOUS AREA: 23%

IMPERVIOUS SURFACE EXHIBIT - PROPOSED 2021
CAMP HESS KRAMER / GINDLING HILLTOP CAMP
WOOLSEY FIRE REBUILD

COUNTY OF VENTURA, CALIFORNIA
MARCH 31, 2021

Stantec
111 East Victoria Street, Santa Barbara, CA 93101
Phone: (805) 963-9532

ATTENTION: IF THIS DOCUMENT IS PROVIDED AS A COURTESY IN AN ELECTRONIC FORMAT, THE DELIVERY OF THE ELECTRONIC FILE DOES NOT CONSTITUTE THE DELIVERY OF THE PROFESSIONAL WORK PRODUCT. ONLY A HARD COPY DOCUMENT THAT IS SIGNED AND SEALED BY AN AUTHORIZED PROFESSIONAL EMPLOYEE OF STANTEC CONSTITUTES THE PROFESSIONAL WORK PRODUCT. IN THE EVENT THE ELECTRONIC FILE IS ALTERED, THE HARD COPY MUST BE REFERRED TO FOR THE ORIGINAL AND CORRECT INFORMATION. STANTEC SHALL NOT BE RESPONSIBLE FOR ANY MODIFICATIONS MADE TO THE ELECTRONIC FILE, OR ANY PRODUCTS DERIVED FROM THE ELECTRONIC FILE WHICH ARE NOT REVIEWED, SIGNED AND SEALED BY AN AUTHORIZED PROFESSIONAL EMPLOYEE OF STANTEC. COPYRIGHT 2016, STANTEC CONSULTING SERVICES INC

POST-DEVELOPMENT INCREASED IMPERVIOUSNESS

Development Area 1	Total Site	Increased Imperviousness in Watersheds			
	sf	66B	67B	68B	Total
2017 Imperv	396,500				
2021 Dev Impervious	449,000	738	38,965	12,797	
Increased Impervious	52,500	738	38,965	12,797	52,500

Development Area 2	Total Site	Increased Imperviousness in Watersheds			
	sf	66B	67B	68B	Total
2017 Imperv	255,800				
2021 Dev Impervious	279,212		9,437		
Increased Impervious	23,412		9,437		9,437

Note: Not all of Development Area 2 drains to the Little Sycamore Creek watersheds.

Development Area 3	Total Site	Increased Imperviousness in Watersheds			
	sf	66B	67B	68B	Total
2017 Imperv	3,600		3,600		
2021 Dev Impervious	3,600		3,600		
Increased Impervious	0		0		0

Development Area 4	Total Site	Increased Imperviousness in Watersheds			
	sf	66B	67B	68B	Total
2017 Imperv	3,300		3,300		
2021 Dev Impervious	3,300				
Increased Impervious	0		0		0

Project Total New Impervious by Watershed (sf)		738	48,402	12,797	61,937
Project Total New Impervious by Watershed (sm)		0.00003	0.00174	0.00046	0.00222

Watershed Area, sm		0.162	0.43	0.255
Increased Percent Impervious		0.0%	0.4%	0.2%