MOJAVE RIVER WATERSHED

Water Quality Management Plan

For:

Victorville Retail Project

SWC US 395 & SR 18

CASE # PSUB18-00057; PLAN 18-0049, JOB NO. 30150021.0040. ID 00040, 3103-531-18-0-000 (AFFECTS PARCEL 2 OF PARCEL A) 3103-531-19-0-000 (AFFECTS PARCEL 3 OF PARCEL A) 3103-531-20-0-000(AFFECTS PARCEL B)

Prepared for:

Fraydoon Bral

Broadway Chinatown

PO Box 15813

Los Angeles, CA. 90015

310.925.1234

Prepared by:

Blue Peak Engineering, Inc.

18543 Yorba Linda Blvd. #235

Yorba Linda, CA. 92886

310.780.0386

Submittal Date: 11/13/2018

Revision No. and Date: 03/01/2019

Revision No. and Date: Insert No and Current Revision Date

Revision No. and Date: Insert No and Current Revision Date

Revision No. and Date: Insert No and Current Revision Date

Revision No. and Date: Insert No and Current Revision Date

Final Approval Date:______________________

Project Owner's Certification

This Mojave River Watershed Water Quality Management Plan (WQMP) has been prepared for Fraydoon Bral by Blue Peak Engineering. The WQMP is intended to comply with the requirements of the City of Victorville and the Phase II Small MS4 General Permit for the Mojave River Watershed. The undersigned, while it owns the subject property, is responsible for the implementation of the provisions of this plan and will ensure that this plan is amended as appropriate to reflect up-to-date conditions on the site consistent with the Phase II Small MS4 Permit and the intent of San Bernardino County (unincorporated areas of Phelan, Oak Hills, Spring Valley Lake and Victorville) and the incorporated cities of Hesperia and Victorville and the Town of Apple Valley. Once the undersigned transfers its interest in the property, its successors in interest and the city/county/town shall be notified of the transfer. The new owner will be informed of its responsibility under this WQMP. A copy of the approved WQMP shall be available on the subject site in perpetuity.

"I certify under a penalty of law that the provisions (implementation, operation, maintenance, and funding) of the WQMP have been accepted and that the plan will be transferred to future successors."

Project Data			
Permit/Application Number(s):	CASE # PSUB18-00057 PLAN 18-0049	Grading Permit Number(s):	TBD
Tract/Parcel Map Number(s):	TBD	Building Permit Number(s):	TBD
CUP, SUP, and/or APN (Specify Lot Numbers if Portions of Tract):			3103-531-18-0-000 (Affects Parcel 2 of Parcel A) 3103-531-19-0-000 (Affects Parcel 3 of Parcel A) 3103-531-20-0-000(Affects Parcel B)

Owner's Signature			
Owner Name: Fraydoon Bral			
Title	Owner		
Company	Broadway Chinatown		
Address	PO Box 15813, Los Angeles CA 90015		
Email	FBRAL@gamail.com		
Telephone #	310.925.1234		
Signature		Date	

Preparer's Certification

Project Data			
Permit/Application Number(s):	CASE # PSUB18-00057 PLAN 18-0049	Grading Permit Number(s):	
Tract/Parcel Map Number(s):		Building Permit Number(s):	
CUP, SUP, and/or APN (Specify Lot Numbers if Portions of Tract):			3103-531-18-0-000 (Affects Parcel 2 of Parcel A) 3103-531-19-0-000 (Affects Parcel 3 of Parcel A) 3103-531-20-0-000(Affects Parcel B)

"The selection, sizing and design of stormwater treatment and other stormwater quality and quantity control measures in this plan were prepared under my oversight and meet the requirements of the California State Water Resources Control Board Order No. 2013-0001-DWQ.

Engineer: Steven Johnson, P.E.		PE Stamp Below
Title	Proejct Manager	
Company	Blue Peak Engineering	
Address	18543 Yorba Linda Blvd #235, Yorba Linda CA.	
Email	sjohnson@bluepeakeng.com	
Telephone #	310.78.0386	
Signature	Steven Johnson	
Date	**03.01.2019**	

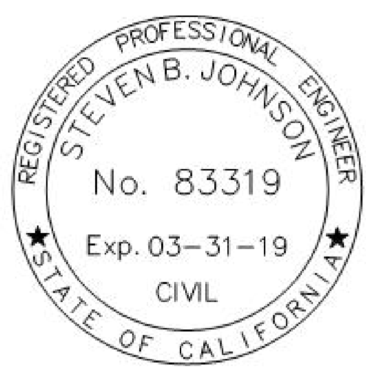


Table of Contents

Forms

Section I – Introduction

This WQMP template has been prepared specifically for the Phase II Small MS4 General Permit in the Mojave River Watershed. This location is within the jurisdiction of the Lahontan Regional Water Quality Control Board (LRWQCB). This document should not be confused with the WQMP template for the Santa Ana Phase I area of San Bernardino County.

WQMP preparers must refer to the MS4 Permit for the Mojave Watershed WQMP template and Technical Guidance (TGD) document found at: http://cms.sbcounty.gov/dpw/Land/NPDES.aspx to find pertinent arid region and Mojave River Watershed specific references and requirements.

Section 1 Discretionary Permit(s)

<table>
<tr><th colspan="6">Form 1-1 Project Information</th></tr>
<tr><td colspan="2">Project Name</td><td colspan="4">Victorville Retail Project- SWC US 395</td></tr>
<tr><td colspan="2">Project Owner Contact Name:</td><td colspan="4">Fraydoon Bra</td></tr>
<tr><td>Mailing Address:</td><td>PO Box 15813, Los Angeles CA 90015</td><td>E-mail Address:</td><td>FBRAL@gamail.com</td><td>Telephone:</td><td>310.925.1234</td></tr>
<tr><td colspan="2">Permit/Application Number(s):</td><td>CASE # PSUB18-00057
PLAN 18-0049</td><td>Tract/Parcel Map Number(s):</td><td colspan="2">3103-531-18-0-000 (Affects Parcel 2 of Parcel A) 3103-531-19-0-000 (Affects Parcel 3 of Parcel A) 3103-531-20-0-000(Affects Parcel B</td></tr>
<tr><td colspan="2">Additional Information/
Comments:</td><td colspan="4">TBD</td></tr>
<tr><td colspan="2">Description of Project:</td><td colspan="4">The proposed project will develop the previously vacant land for Parcels A, B, and C totaling 14.80 acres of new development, 10 Pads at a gross building area of approximately 96,300 square feet. The proposed development will also include new AC parking lots, drive isles, sidewalks, and landscape.

The proposed project will be developed in two phases, however both phases will address stormwater mitigation herein this report.

In addition, and as part of the proposed improvements and per Victorville Master Plan Drainage study, a City of Victorville regional storm drain will be installed in Highway 395, adjacent to the proposed project site, and sweep across the proposed site in a driange easement for the ultimate connection to the existing storm drain that connects downstream of the Caltrans drainage outlet structure, adjacent to Palmdale Road. The Caltrans drainage outlet structure will be removed as part of the improvements.

Additionally, offsite improvements including the ultimate development of the west side of Highway 395, in Caltrans jursdicition, will be included with this project development.</td></tr>
</table>

Provide summary of Conceptual WQMP conditions (if previously submitted and approved). Attach complete copy.	TBD

Section 2 Project Description

2.1 Project Information

The WQMP shall provide the information listed below. The information provided for Conceptual/ Preliminary WQMP should give sufficient detail to identify the major proposed site design and LID BMPs and other anticipated water quality features that impact site planning. Final Project WQMP must specifically identify all BMP incorporated into the final site design and provide other detailed information as described herein.

The purpose of this information is to help determine the applicable development category, pollutants of concern, watershed description, and long term maintenance responsibilities for the project, and any applicable water quality credits. This information will be used in conjunction with the information in Section 3, Site Description, to establish the performance criteria and to select the LID BMP or other BMP for the project or other alternative programs that the project will participate in, which are described in Section 4.

2.1.1 Project Sizing Categorization

If the Project is greater than 5,000 square feet, and not on the excluded list as found on Section 1.4 of the TGD, the Project is a Regulated Development Project.

If the Project is creating and/or replacing greater than 2,500 square feet but less than 5,000 square feet of impervious surface area, then it is considered a Site Design Only project. This criterion is applicable to all development types including detached single family homes that create and/or replace greater than 2,500 square feet of impervious area and are not part of a larger plan of development.

Form 2.1-1 Description of Proposed Project

[1] Regulated Development Project Category (Select all that apply):					
☒ #1 New development involving the creation of 5,000 ft^2 or more of impervious surface collectively over entire site	☐ #2 Significant re-development involving the addition or replacement of 5,000 ft^2 or more of impervious surface on an already developed site	☒ #3 Road Project – any road, sidewalk, or bicycle lane project that creates greater than 5,000 square feet of contiguous impervious surface	☐ #4 LUPs – linear underground/overhead projects that has a discrete location with 5,000 sq. ft. or more new constructed impervious surface		
☐ Site Design Only (Project Total Square Feet > 2,500 but < 5,000 sq.ft.) *Will require source control Site Design Measures. Use the "PCMP" Template. Do not use this WQMP Template.*					
[2] Project Area (ft2):	644,606 Ex. Impervious Area (0 sq.ft) Proposed Impervious Area (644,606 sq.ft)	[3] Number of Dwelling Units:	0	[4] SIC Code:	5812, 5331, 5541

5 Is Project going to be phased? Yes ☒ No ☐ *If yes, ensure that the WQMP evaluates each phase as a distinct DA, requiring LID BMPs to address runoff at time of completion.*

2.2 Property Ownership/Management

Describe the ownership/management of all portions of the project and site. State whether any infrastructure will transfer to public agencies (City, County, Caltrans, etc.) after project completion. State if a homeowners or property owners association will be formed and be responsible for the long-term maintenance of project stormwater facilities. Describe any lot-level stormwater features that will be the responsibility of individual property owners.

Form 2.2-1 Property Ownership/Management
Describe property ownership/management responsible for long-term maintenance of WQMP stormwater facilities:
Ownership will remain the same after development: Fraydoon Bral Broadway Chinatown LLC PO BOX 151813 Los Angeles, CA. 90015 310.925.1234 fbral126@gmail.com

2.3 Potential Stormwater Pollutants

Best Management Practices (BMP) measures for pollutant generating activities and sources shall be designed consistent with recommendations from the CASQA Stormwater BMP Handbook for New Development and Redevelopment (or an equivalent manual). Pollutant generating activities must be considered when determining the overall pollutants of concern for the Project as presented in Form 2.3-1.

Determine and describe expected stormwater pollutants of concern based on land uses and site activities (refer to Table 3-2 in the TGD for WQMP).

Form 2.3-1 Pollutants of Concern			
Pollutant	Please check: E=Expected, N=Not Expected		Additional Information and Comments
Pathogens (Bacterial / Virus)	E ☒	N ☐	Baterial Indictors, including petroleum hydrocarbons, are routinely detected in pavement runoff. The proposed site will have pavement runoff, however all pavement runoff will be treated via filter inserts prior to infiltrating runoff.
Nutrients - Phosphorous	E ☒	N ☐	Primary source of nutrients in urban runoff are from fertilizers and eroded soil. Site has been desigend to minimize the amount of runoff from landscape areas, in addition to installing drought tolerant plans and efficient irrigation methods, as well a curbs installed adjacent to all landscape areas to prevent runoff. However, in the event nutrients are in the urban runoff, the sheetflow will be treated via filter inserts prior to infiltrating said runoff.
Nutrients - Nitrogen	E ☐	N ☒	Only expected if the existing landscape remains on-site, however, our proposed site only has proposed landscape and therefore this pollutant is not anticipated.
Noxious Aquatic Plants	E ☐	N ☒	Only expected if the existing landscape remains on-site, however, our proposed site only has proposed landscape and therefore this pollutant is not anticipated.
Sediment	E ☐	N ☒	Only expected if the existing landscape remains on-site, however, our proposed site only has proposed landscape and therefore this pollutant is not anticipated.
Metals	E ☒	N ☐	Metals are anticpated since this site has proposed drive isles and parking lots. Metals are associated with brake pad, tire tread and emissions. Metals are also raw material components in non-metal products, such as fuels, adhesives, paints and other coatings. Because Metals are anticipated, all runoff from the site will be treated via filter inserts prior to infiltrating said runoff.
Oil and Grease	E ☒	N ☐	Oils and grease are anticipated since this site has proposed drive isles and parking lots. Oil and grease are associated with vehiclular use. Because oil and grease are anticipated, all runoff from the site will be treated via filter inserts prior to infiltrating said runoff.
Trash/Debris	E ☒	N ☐	Trash and debris is anticipated for the site and will be removed and treated by filter inserts and infiltrating the runoff.
Pesticides / Herbicides	E ☒	N ☐	Pesticides can be anticipated with urban landscaping. Pesticides will be removed from runoff via filter inserts and infiltration of runoff
Organic Compounds	E ☒	N ☐	Organic compounds are generated from vehicle and landscape maintenance areas. Organic compounds, as well as, petroleum

			hydrocarbonds and solvents, will be removed from runoff via filter inserts and infiltration of runoff.
Other:	E ☐	N ☐	
Other:	E ☐	N ☐	
Other:	E ☐	N ☐	

Section 3 Site and Watershed Description

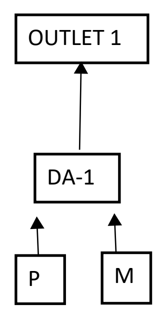
Describe the project site conditions that will facilitate the selection of BMPs through an analysis of the physical conditions and limitations of the site and its receiving waters. Identify distinct drainage areas (DA) that collect flow from a portion of the site and describe how runoff from each DA (and sub-watershed Drainage Management Areas (DMAs)) is conveyed to the site outlet(s). Refer to Section 3.2 in the TGD for WQMP. The form below is provided as an example. Then complete Forms 3.2 and 3.3 for each DA on the project site. ***If the project has more than one drainage area for stormwater management, then complete additional versions of these forms for each DA / outlet. A map presenting the DMAs must be included as an appendix to the WQMP document.***

Form 3-1 Site Location and Hydrologic Features

Site coordinates *take GPS measurement at approximate center of site*	Latitude 34.505089	Longitude -117.401452	Thomas Bros Map page 4385-C2

1 San Bernardino County climatic region: ☐ Valley ☐ Mountain ☒ Desert

2 Does the site have more than one drainage area (DA): Yes ☒ No ☐ *If no, proceed to Form 3-2. If yes, then use this form to show a conceptual schematic describing DMAs and hydrologic feature connecting DMAs to the site outlet(s). An example is provided below that can be modified for proposed project or a drawing clearly showing DMA and flow routing may be attached*



Conveyance	Briefly describe on-site drainage features to convey runoff that is not retained within a DMA
DMA P AND M TO DA-1	Drainage management areas P and M sheet flow to catch basins located within each DMA, and the 100-year storm event is piped to the proposed underground retention basin located in Drainage Area 1.
DA-1 TO OUTLET 1	Drainage Area 1 is designed to retain the entire 100-year post development flow. Any additional flow will have secondary overflow through the site, and discharge into Palmdale Road.

THE PROPOSED UNDERGROUND RETENTION UNIT FULLY CAPTURES AND MITIGATES THE REQUIRED DESIGN CAPTURE VOLUME (DCV), AS CALCULATED AND SHOWN HEREIN THIS REPORT. AS CALCULATED IN THE APPENDIX, AND AS PROVIDED IN THE HYDROLOGY STUDY, THE PROPOSED DEVELOPMENT WILL NOT INCREASE THE 100-YEAR POST DEVELOPMENT RUNOFF AND VOLUME RATE BY MORE THAN 90% THE PRE DEVELOPMENT.

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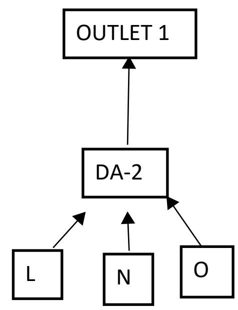

Conveyance	Briefly describe on-site drainage features to convey runoff that is not retained within a DMA
DMA L,N, AND O TO DA-2	Drainage management areas L,N AND O sheet flow to catch basins located within each DMA, and the 100-year storm event is piped to the proposed underground retention basin located in Drainage Area 1.
DA-2 TO OUTLET 1	Drainage Area 1 is designed to retain the entire 100-year post development flow for DMA N and O. A portion of the 100-year storm event from DMA L will additionally be retained, however, an overflow pipe will connect directly to the proposed 60" regional storm drain system, to Outlet 1.

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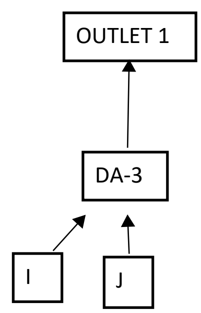

Conveyance	Briefly describe on-site drainage features to convey runoff that is not retained within a DMA
DMA I AND J TO DA-3	Drainage management areas I and J sheet flow to catch basins located within each DMA, and the 100-year storm event is piped to the proposed underground retention basin located in Drainage Area 3.
DA-2 TO OUTLET 1	Drainage Area 3 is designed to retain the entire 100-year post development flow for DMA I and J. In the event secondary overflow is required, the runoff will sheet flow across the site into Palmdale Road, at Outlet 1

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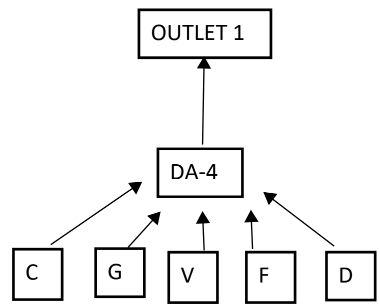

Conveyance	Briefly describe on-site drainage features to convey runoff that is not retained within a DMA
DMA C, D, G, F AND K TO DA-4	Drainage management areas C, D, G, V and F sheet flow to catch basins located within each DMA, and the 100-year storm event is piped to the proposed underground retention basin located in Drainage Area 4.
DA-4 TO OUTLET 1	Drainage Area 4 is designed to retain the required 100-year post development flow for each DMA. A high flow storm drain is provided at each DMA to convey and connect directly into the proposed regional 60" storm drain.

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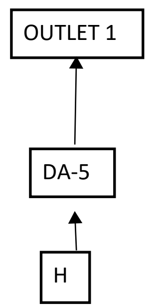

Conveyance	Briefly describe on-site drainage features to convey runoff that is not retained within a DMA
DMA H TO DA-5	Drainage management area H sheet flows in the future Fern Pine Street, DA-5.
DA-5 TO OUTLET 1	DA-5 sheet flows into the proposed riser pipe in the Future Fern Pine Street, which connects directly to the proposed 60" regional storm drain main, Outlet 1.

This proposed DMA-H is not directly captured and treated via underground retention system on site. DMA-H is all pervious landscape that sheetflows into Future Fern Pine Street. Due to site constraints, this runoff cannot be captured and therefore the proposed underground retention system has been up sized to accommodate DMA-H DCV, as well as not increase the 100-year pre to post development flow rate.

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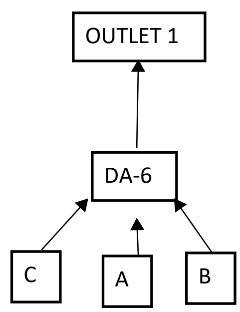

Conveyance	Briefly describe on-site drainage features to convey runoff that is not retained within a DMA
DMA A, B, AND C TO DA-6	Drainage management areas A, B, and C sheet flow to catch basins located within each DMA, and the 100-year storm event is piped to the proposed underground retention basin located in Drainage Area 6.
DA-6 TO OUTLET 1	Drainage Area 6 is designed to retain the required 100-year post development flow for DMA A, B, and C. A high flow pipe is provided at each DMA to collect and convey the overflow to the proposed Regional 60" storm drain, Outlet-1.

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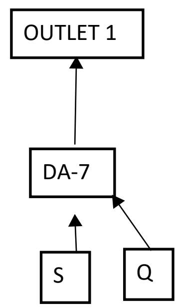

Conveyance	Briefly describe on-site drainage features to convey runoff that is not retained within a DMA
DMA S AND Q TO DA-7	DMA S will sheet flow to an inlet onsite, DA-7. DMA Q will sheet flow into Palmdale Road, which confluence at point DA-7.
DA-7 TO OUTLET 1	Drainage Area 7 will collect and connect the runoff directly into the proposed Regional 60" storm drain. The equivalent area offset has been included in the DCV calculations provided herein, therefore, these two DMAs will be treated as required.

This proposed DMA-Q and S is not directly captured and treated via underground retention system on site. Due to site constraints, this runoff cannot be captured prior to upstream underground retention units and therefore the proposed underground retention system has been up sized to accommodate DMA-Q and S DCV, as well as not increase the 100-year pre to post development flow rate.

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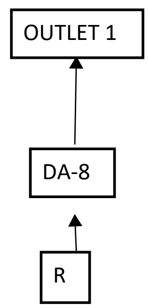


Conveyance	Briefly describe on-site drainage features to convey runoff that is not retained within a DMA
DMA R TO DA-8	DMA R will sheet flow to Highway 395, DA-8.
DA-8 TO OUTLET 1	Drainage Area 8 will sheet flow runoff into a street inlet, which connects directly to the proposed Regional 60" storm drain. The equivalent area offset has been included in the DCV calculations provided herein, therefore, these two DMAs will be treated as required.

This proposed DMA-R is not directly captured and treated via underground retention system on site. DMA-R is all pervious landscape that sheetflows into US ROUTE 395. Due to site constraints, this runoff cannot be captured and therefore the proposed underground retention system has been up sized to accommodate DMA-H DCV, as well as not increase the 100-year pre to post development flow rate.

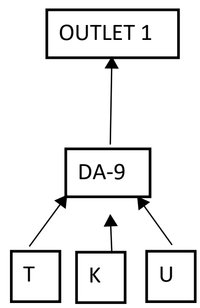
THE PROPOSED UNDERGROUND RETENTION UNIT FULLY CAPTURES AND MITIGATES THE REQUIRED DESIGN CAPTURE VOLUME (DCV), AS CALCULATED AND SHOWN HEREIN THIS REPORT. AS CALCULATED IN THE APPENDIX, AND AS PROVIDED IN THE HYDROLOGY STUDY, THE PROPOSED DEVELOPMENT WILL NOT INCREASE THE 100-YEAR POST DEVELOPMENT RUNOFF AND VOLUME RATE BY MORE THAN 90% THE PRE DEVELOPMENT.

Form 3-1 Site Location and Hydrologic Features

Site coordinates *take GPS measurement at approximate center of site*	Latitude 34.505089	Longitude -117.401452	Thomas Bros Map page 4385-C2

1 San Bernardino County climatic region: ☐ Valley ☐ Mountain ☒ Desert

2 Does the site have more than one drainage area (DA): Yes ☒ No ☐ *If no, proceed to Form 3-2. If yes, then use this form to show a conceptual schematic describing DMAs and hydrologic feature connecting DMAs to the site outlet(s). An example is provided below that can be modified for proposed project or a drawing clearly showing DMA and flow routing may be attached*



Conveyance	Briefly describe on-site drainage features to convey runoff that is not retained within a DMA
DMA T, K AND U TO DA-9	DMA T, K, and U will sheet flow to catch basins located within each DMA, and the 100-year storm event is piped to the proposed underground retention basins located within Drainage Area 9.
DA-9 TO OUTLET 1	DMA T and U have been designed to fully retain the entire 100-year post development flow by the use of the underground retention unit. DMA K has been designed to retain the required 100-year post development flow from each DMA. A high flow storm drain is provided at each DMA to convey and connect directly into the proposed regional storm drain.

This proposed DMA-R is not directly captured and treated via underground retention system on site. DMA-R is all pervious landscape that sheetflows into US ROUTE 395. Due to site constraints, this runoff cannot be captured and therefore the proposed underground retention system has been up sized to accommodate DMA-H DCV, as well as not increase the 100-year pre to post development flow rate.

THE PROPOSED UNDERGROUND RETENTION UNIT FULLY CAPTURES AND MITIGATES THE REQUIRED DESIGN CAPTURE VOLUME (DCV), AS CALCULATED AND SHOWN HEREIN THIS REPORT. AS CALCULATED IN THE APPENDIX, AND AS PROVIDED IN THE HYDROLOGY STUDY, THE PROPOSED DEVELOPMENT WILL NOT INCREASE THE 100-YEAR POST DEVELOPMENT RUNOFF AND VOLUME RATE BY MORE THAN 90% THE PRE DEVELOPMENT.

Form 3-2 Existing Hydrologic Characteristics (DA 1)
(use only as needed for additional DMA w/in DA 1)

For Drainage Area 1's sub-watershed DMA, provide the following characteristics	DMA M	DMA P
1 DMA drainage area (ft^2)	61873	15532
2 Existing site impervious area (ft^2)	0	0
3 Antecedent moisture condition *For desert areas, use* *http://www.sbcounty.gov/dpw/floodcontrol/pdf/20100412_map.pdf*	AMC II	AMC II
4 Hydrologic soil group *Refer to Watershed Mapping Tool – http://sbcounty.permitrack.com/WAP*	B	B
5 Longest flowpath length (ft)	329	164
6 Longest flowpath slope (ft/ft)	1.55%	1.55%
7 Current land cover type(s) *Select from Fig C-3 of Hydrology Manual*	Herbaceous Cover	Herbaceous Cover
8 Pre-developed pervious area condition: *Based on the extent of wet season vegetated cover good >75%; Fair 50-75%; Poor <50% Attach photos of site to support rating*	40	40

THE POST DEVELOPMENT CONDITION WILL NOT EXCEED THE PRE-DEVELOPMENT FLOW RATE AND VELOCITIES AS PROVIDED IN THE CALCULATIONS HEREIN. THERE WILL BE NO ADVERSE IMPACTS DOWNSTREAM OR ANY INCREASE IN EROSION OR SEDIMENT DOWNSTREAM .

Form 3-2 Existing Hydrologic Characteristics (DA 2				
For Drainage Area 2 sub-watershed DMA, provide the following characteristics	DMA L	DMA N	DMA O	DMA
1 DMA drainage area (ft^2)	10,620	22,074	13,565	
2 Existing site impervious area (ft^2)	0	0	0	
3 Antecedent moisture condition *For desert areas, use* *http://www.sbcounty.gov/dpw/floodcontrol/pdf/20100412_map.pdf*	AMC II	AMC II	AMC II	
4 Hydrologic soil group *Refer to Watershed Mapping Tool – http://sbcounty.permitrack.com/WAP*	B	B	B	
5 Longest flowpath length (ft)	122	215	190	
6 Longest flowpath slope (ft/ft)	1.55%	1.55%	1.55%	
7 Current land cover type(s) *Select from Fig C-3 of Hydrology Manual*	Herbaceous Cover	Herbaceous Cover	Herbaceous Cover	
8 Pre-developed pervious area condition: *Based on the extent of wet season vegetated cover good >75%; Fair 50-75%; Poor <50% Attach photos of site to support rating*	40	40	40	

THE POST DEVELOPMENT CONDITION WILL NOT EXCEED THE PRE-DEVELOPMENT FLOW RATE AND VELOCITIES AS PROVIDED IN THE CALCULATIONS HEREIN. THERE WILL BE NO ADVERSE IMPACTS DOWNSTREAM OR ANY INCREASE IN EROSION OR SEDIMENT DOWNSTREAM .

Form 3-2 Existing Hydrologic Characteristics (DA 3

For Drainage Area 3 sub-watershed DMA, provide the following characteristics	DMA I	DMA J	DMA	DMA
1 DMA drainage area (ft^2)	7000	61,554		
2 Existing site impervious area (ft^2)	0	0		
3 Antecedent moisture condition *For desert areas, use http://www.sbcounty.gov/dpw/floodcontrol/pdf/20100412_map.pdf*	AMC II	AMC II		
4 Hydrologic soil group *Refer to Watershed Mapping Tool – http://sbcounty.permitrack.com/WAP*	B	B		
5 Longest flowpath length (ft)	129	256		
6 Longest flowpath slope (ft/ft)	1.55%	1.55%		
7 Current land cover type(s) *Select from Fig C-3 of Hydrology Manual*	Herbaceous Cover	Herbaceous Cover		
8 Pre-developed pervious area condition: *Based on the extent of wet season vegetated cover good >75%; Fair 50-75%; Poor <50% Attach photos of site to support rating*	40	40		

THE POST DEVELOPMENT CONDITION WILL NOT EXCEED THE PRE-DEVELOPMENT FLOW RATE AND VELOCITIES AS PROVIDED IN THE CALCULATIONS HEREIN. THERE WILL BE NO ADVERSE IMPACTS DOWNSTREAM OR ANY INCREASE IN EROSION OR SEDIMENT DOWNSTREAM .

Form 3-2 Existing Hydrologic Characteristics (DA 4				
For Drainage Area 4 sub-watershed DMA, provide the following characteristics	DMA C	DMA D	DMA F	DMA G
1 DMA drainage area (ft^2)	18,427	79,106	110,870	33,938
2 Existing site impervious area (ft^2)	0	0	0	0
3 Antecedent moisture condition *For desert areas, use* *http://www.sbcounty.gov/dpw/floodcontrol/pdf/20100412_map.pdf*	AMC II	AMC II	AMC II	AMC II
4 Hydrologic soil group *Refer to Watershed Mapping Tool –* *http://sbcounty.permitrack.com/WAP*	B	B	B	B
5 Longest flowpath length (ft)	249	457	553	243
6 Longest flowpath slope (ft/ft)	1.55%	1.55%	1.55%	1.55%
7 Current land cover type(s) *Select from Fig C-3 of Hydrology Manual*	Herbaceous Cover	Herbaceous Cover	Herbaceous Cover	Herbaceous Cover
8 Pre-developed pervious area condition: *Based on the extent of wet season vegetated cover good >75%; Fair 50-75%; Poor <50% Attach photos of site to support rating*	40	40	40	40

THE POST DEVELOPMENT CONDITION WILL NOT EXCEED THE PRE-DEVELOPMENT FLOW RATE AND VELOCITIES AS PROVIDED IN THE CALCULATIONS HEREIN. THERE WILL BE NO ADVERSE IMPACTS DOWNSTREAM OR ANY INCREASE IN EROSION OR SEDIMENT DOWNSTREAM .

Form 3-2 Existing Hydrologic Characteristics (DA 4

For Drainage Area 4 sub-watershed DMA, provide the following characteristics	DMA V
1 DMA drainage area (ft²)	12,746
2 Existing site impervious area (ft²)	0
3 Antecedent moisture condition *For desert areas, use* *http://www.sbcounty.gov/dpw/floodcontrol/pdf/20100412_map.pdf*	AMC II
4 Hydrologic soil group *Refer to Watershed Mapping Tool – http://sbcounty.permitrack.com/WAP*	B
5 Longest flowpath length (ft)	185
6 Longest flowpath slope (ft/ft)	1.55%
7 Current land cover type(s) *Select from Fig C-3 of Hydrology Manual*	Herbaceous Cover
8 Pre-developed pervious area condition: *Based on the extent of wet season vegetated cover good >75%; Fair 50-75%; Poor <50% Attach photos of site to support rating*	40

THE POST DEVELOPMENT CONDITION WILL NOT EXCEED THE PRE-DEVELOPMENT FLOW RATE AND VELOCITIES AS PROVIDED IN THE CALCULATIONS HEREIN. THERE WILL BE NO ADVERSE IMPACTS DOWNSTREAM OR ANY INCREASE IN EROSION OR SEDIMENT DOWNSTREAM .

Form 3-2 Existing Hydrologic Characteristics (DA 5

For Drainage Area 5 sub-watershed DMA, provide the following characteristics	DMA H	DMA	DMA	DMA
1 DMA drainage area (ft^2)	13,720			
2 Existing site impervious area (ft^2)	0			
3 Antecedent moisture condition *For desert areas, use http://www.sbcounty.gov/dpw/floodcontrol/pdf/20100412_map.pdf*	AMC II			
4 Hydrologic soil group *Refer to Watershed Mapping Tool – http://sbcounty.permitrack.com/WAP*	B			
5 Longest flowpath length (ft)	50			
6 Longest flowpath slope (ft/ft)	1.55%			
7 Current land cover type(s) *Select from Fig C-3 of Hydrology Manual*	Herbaceous Cover			
8 Pre-developed pervious area condition: *Based on the extent of wet season vegetated cover good >75%; Fair 50-75%; Poor <50% Attach photos of site to support rating*	40			

THE POST DEVELOPMENT CONDITION WILL NOT EXCEED THE PRE-DEVELOPMENT FLOW RATE AND VELOCITIES AS PROVIDED IN THE CALCULATIONS HEREIN. THERE WILL BE NO ADVERSE IMPACTS DOWNSTREAM OR ANY INCREASE IN EROSION OR SEDIMENT DOWNSTREAM .

Form 3-2 Existing Hydrologic Characteristics (DA 6			
For Drainage Area 6 sub-watershed DMA, provide the following characteristics	DMA A	DMA B	DMA E
1 DMA drainage area (ft²)	32,357	9,876	14,100
2 Existing site impervious area (ft²)	0	0	0
3 Antecedent moisture condition *For desert areas, use* *http://www.sbcounty.gov/dpw/floodcontrol/pdf/20100412_map.pdf*	AMC II	AMC II	AMC II
4 Hydrologic soil group *Refer to Watershed Mapping Tool –* *http://sbcounty.permitrack.com/WAP*	B	B	B
5 Longest flowpath length (ft)	182	153'	394
6 Longest flowpath slope (ft/ft)	1.55%	1.55%	1.55%
7 Current land cover type(s) *Select from Fig C-3 of Hydrology Manual*	Herbaceous Cover	Herbaceous Cover	Herbaceous Cover
8 Pre-developed pervious area condition: *Based on the extent of wet season vegetated cover good >75%; Fair 50-75%; Poor <50% Attach photos of site to support rating*	40	40	40

THE POST DEVELOPMENT CONDITION WILL NOT EXCEED THE PRE-DEVELOPMENT FLOW RATE AND VELOCITIES AS PROVIDED IN THE CALCULATIONS HEREIN. THERE WILL BE NO ADVERSE IMPACTS DOWNSTREAM OR ANY INCREASE IN EROSION OR SEDIMENT DOWNSTREAM .

Form 3-2 Existing Hydrologic Characteristics (DA 7

For Drainage Area 7 sub-watershed DMA, provide the following characteristics	DMA S	DMA Q
1 DMA drainage area (ft²)	39,794	9,943
2 Existing site impervious area (ft²)	0	0
3 Antecedent moisture condition *For desert areas, use http://www.sbcounty.gov/dpw/floodcontrol/pdf/20100412_map.pdf*	AMC II	AMC II
4 Hydrologic soil group *Refer to Watershed Mapping Tool – http://sbcounty.permitrack.com/WAP*	B	B
5 Longest flowpath length (ft)	250	87
6 Longest flowpath slope (ft/ft)	1.55%	1.55%
7 Current land cover type(s) *Select from Fig C-3 of Hydrology Manual*	Herbaceous Cover	Herbaceous Cover
8 Pre-developed pervious area condition: *Based on the extent of wet season vegetated cover good >75%; Fair 50-75%; Poor <50% Attach photos of site to support rating*	40	40

THE POST DEVELOPMENT CONDITION WILL NOT EXCEED THE PRE-DEVELOPMENT FLOW RATE AND VELOCITIES AS PROVIDED IN THE CALCULATIONS HEREIN. THERE WILL BE NO ADVERSE IMPACTS DOWNSTREAM OR ANY INCREASE IN EROSION OR SEDIMENT DOWNSTREAM .

Form 3-2 Existing Hydrologic Characteristics (DA 8

For Drainage Area 8 sub-watershed DMA, provide the following characteristics	DMA R			
1 DMA drainage area (ft^2)	14,796			
2 Existing site impervious area (ft^2)	0			
3 Antecedent moisture condition *For desert areas, use* *http://www.sbcounty.gov/dpw/floodcontrol/pdf/20100412_map.pdf*	AMC II			
4 Hydrologic soil group *Refer to Watershed Mapping Tool – http://sbcounty.permitrack.com/WAP*	B			
5 Longest flowpath length (ft)	56			
6 Longest flowpath slope (ft/ft)	1.55%			
7 Current land cover type(s) *Select from Fig C-3 of Hydrology Manual*	Herbaceous Cover			
8 Pre-developed pervious area condition: *Based on the extent of wet season vegetated cover good >75%; Fair 50-75%; Poor <50% Attach photos of site to support rating*	40			

THE POST DEVELOPMENT CONDITION WILL NOT EXCEED THE PRE-DEVELOPMENT FLOW RATE AND VELOCITIES AS PROVIDED IN THE CALCULATIONS HEREIN. THERE WILL BE NO ADVERSE IMPACTS DOWNSTREAM OR ANY INCREASE IN EROSION OR SEDIMENT DOWNSTREAM .

Form 3-2 Existing Hydrologic Characteristics (DA 9

For Drainage Area 9 sub-watershed DMA, provide the following characteristics	DMA T	DMA U		DMA K
1 DMA drainage area (ft^2)	9,845	12,053		40,831
2 Existing site impervious area (ft^2)	0	0		0
3 Antecedent moisture condition *For desert areas, use http://www.sbcounty.gov/dpw/floodcontrol/pdf/20100412_map.pdf*	AMC II	AMC II		AMC II
4 Hydrologic soil group *Refer to Watershed Mapping Tool – http://sbcounty.permitrack.com/WAP*	B	B		B
5 Longest flowpath length (ft)	127	125		254
6 Longest flowpath slope (ft/ft)	1.55%	1.55%		1.55%
7 Current land cover type(s) *Select from Fig C-3 of Hydrology Manual*	Herbaceous Cover	Herbaceous Cover		Herbaceous Cover
8 Pre-developed pervious area condition: *Based on the extent of wet season vegetated cover good >75%; Fair 50-75%; Poor <50% Attach photos of site to support rating*	40	40		40

THE POST DEVELOPMENT CONDITION WILL NOT EXCEED THE PRE-DEVELOPMENT FLOW RATE AND VELOCITIES AS PROVIDED IN THE CALCULATIONS HEREIN. THERE WILL BE NO ADVERSE IMPACTS DOWNSTREAM OR ANY INCREASE IN EROSION OR SEDIMENT DOWNSTREAM .

Form 3-3 Watershed Description for Drainage Area

Receiving waters Refer to SWRCB site: http://www.waterboards.ca.gov/water_issues/programs/tmdl/integrated2010.shtml	Mojave River
Applicable TMDLs *http://www.waterboards.ca.gov/water_issues/programs/tmdl/integrated2010.shtml*	None
303(d) listed impairments *http://www.waterboards.ca.gov/water_issues/programs/tmdl/integrated2010.shtml*	None
Environmentally Sensitive Areas (ESA) *Refer to Watershed Mapping Tool –* *http://sbcounty.permitrack.com/WAP*	None
Hydromodification Assessment	☒ Yes *Complete Hydromodification Assessment. Include Forms 4.2-2 through Form 4.2-5 and Hydromodification BMP Form 4.3-9 in submittal* ☐ No

Section 4 Best Management Practices (BMP)

4.1 Source Control BMPs and Site Design BMP Measures

The information and data in this section are required for both Regulated Development and Site Design Only Projects. Source Control BMPs and Site Design BMP Measures are the basis of site-specific pollution management.

4.1.1 Source Control BMPs

Non-structural and structural source control BMP are required to be incorporated into all new development and significant redevelopment projects. Form 4.1-1 and 4.1-2 are used to describe specific source control BMPs used in the WQMP or to explain why a certain BMP is not applicable. Table 7-3 of the TGD for WQMP provides a list of applicable source control BMP for projects with specific types of potential pollutant sources or activities. The source control BMP in this table must be implemented for projects with these specific types of potential pollutant sources or activities.

The preparers of this WQMP have reviewed the source control BMP requirements for new development and significant redevelopment projects. The preparers have also reviewed the specific BMP required for project as specified in Forms 4.1-1 and 4.1-2. All applicable non-structural and structural source control BMP shall be implemented in the project.

The identified list of source control BMPs correspond to the CASQA Stormwater BMP Handbook for New Development and Redevelopment.

Form 4.1-1 Non-Structural Source Control BMPs

Identifier	Name	Check One		Describe BMP Implementation OR, if not applicable, state reason
		Included	Not Applicable	
N1	Education of Property Owners, Tenants and Occupants on Stormwater BMPs	☒	☐	Included in Appendix 6. Refer to form 5-1 herein for further information.
N2	Activity Restrictions	☒	☐	Any activity restrictions shall be provided by Owner to Tenant.
N3	Landscape Management BMPs	☒	☐	Included in Appendix 6
N4	BMP Maintenance	☒	☐	Included with Covenant and Agreement in Appendix 3. Refer to Form 5-1 herein for further information.
N5	Title 22 CCR Compliance (How development will comply)	☐	☒	Hazardous materials are not anticipated.
N6	Local Water Quality Ordinances	☐	☒	City of Victorville NPDES MS4 permit has been implemented.
N7	Spill Contingency Plan	☒	☐	The Spill Contingency Plan shall be prepared by building operator, however, CASAQ BMP SC-11 Spill Prevention, Control and Cleanup, has been provided for reference. Refer to Form 5-1 herein for further information.
N8	Underground Storage Tank Compliance	☒	☐	State regulations have been implemented for the underground fuel tanks at the gas station
N9	Hazardous Materials Disclosure Compliance	☐	☒	Hazardous materials are not anticipated.

Form 4.1-1 Non-Structural Source Control BMPs

Identifier	Name	Check One		Describe BMP Implementation OR, if not applicable, state reason
		Included	Not Applicable	
N10	Uniform Fire Code Implementation	☐	☒	Per referenced CFC Article 50-Hazardous Material, this project does not quality as implemented Hazardous Material and therefore does not need to comply with Article 50
N11	Litter/Debris Control Program	☒	☐	CASQA BMP SC-60 has been provided in Appendix 6 for reference. Also refer to Form 5-1 herein for further information
N12	Employee Training	☒	☐	Reference NS1. In addition, information is provided in Appendix 6 for reference. Also refer to Form 5-1 herein for further information.
N13	Housekeeping of Loading Docks	☒	☐	CASQA BMP SD-31 has been included in Appendix 6 for reference. Also refer to Form 5-1 herein for further information.
N14	Catch Basin Inspection Program	☒	☐	CASQA BMP SC-74 has been provided in Appendix 6 for reference. Also refer to Form 5-1 herein for further information.
N15	Vacuum Sweeping of Private Streets and Parking Lots	☒	☐	CASQA BMP SC-43 has been provided in Appendix 6 for reference. Also refer to Form 5-1 herein for further information
N16	Other Non-structural Measures for Public Agency Projects	☐	☒	Not a public agency project.
N17	Comply with all other applicable NPDES permits	☒	☐	This project additionally complies with the State Water Board NPDES Construction Permit. A SWPPP report has been provided for the project. Please refer to said report for further construction implemented BMP and maintenance.

Form 4.1-2 Structural Source Control BMPs

Identifier	Name	Check One: Included	Check One: Not Applicable	Describe BMP Implementation OR, If not applicable, state reason
S1	Provide storm drain system stencilling and signage (CASQA New Development BMP Handbook SD-13)	☒	☐	Provided on WQMP Site and Drainage Plan. However, additionally included on Form 5-1 herein as well as CASQA BMP SD-13 in Appendix 6.
S2	Design and construct outdoor material storage areas to reduce pollution introduction (CASQA New Development BMP Handbook SD-34)	☐	☒	Outdoor storage areas are not included within project scope.
S3	Design and construct trash and waste storage areas to reduce pollution introduction (CASQA New Development BMP Handbook SD-32)	☒	☐	Trash storage areas have been designed to comply with CASQA BMP SD-32 factsheet, as provided in Appendix 6. Pleases also reference Form 5-1, herein for further information
S4	Use efficient irrigation systems & landscape design, water conservation, smart controllers, and source control (Statewide Model Landscape Ordinance; CASQA New Development BMP Handbook SD-12)	☒	☐	Landscaping and irrigation will comply with Title 24 and will be drought tolerant. CASQA BMP SD-12 has been provided in Appendix 6 for reference for Efficient Irrigation implementation, as well as Form 5-1 herein.
S5	Finish grade of landscaped areas at a minimum of 1-2 inches below top of curb, sidewalk, or pavement	☒	☐	A detail has been provided on WQMP Site and Drainage Plan to further clarify implementation of S5. Please reference plan in Appendix 1.
S6	Protect slopes and channels and provide energy dissipation (CASQA New Development BMP Handbook SD-10)	☐	☒	Slopes or channels are not provided on site.
S7	Covered dock areas (CASQA New Development BMP Handbook SD-31)	☒	☐	CASQA BMP SD-31 is provided in Appendix 6 for reference. However, the truck docks provided onsite will not be covered.
S8	Covered maintenance bays with spill containment plans (CASQA New Development BMP Handbook SD-31)	☐	☒	Maintenance Bays are not provided onsite.
S9	Vehicle wash areas with spill containment plans (CASQA New Development BMP Handbook SD-33)	☒	☐	CASQA BMP SD-33 is provided in Appendix 6 for reference.
S10	Covered outdoor processing areas (CASQA New Development BMP Handbook SD-36)	☐	☒	Outdoor processing areas are not provided onsite.

Form 4.1-2 Structural Source Control BMPs				
Identifier	Name	Check One		Describe BMP Implementation OR, If not applicable, state reason
		Included	Not Applicable	
S11	Equipment wash areas with spill containment plans (CASQA New Development BMP Handbook SD-33)	☒	☐	CASQA BMP SD-33 is provided in Appendix 6 for reference
S12	Fueling areas (CASQA New Development BMP Handbook SD-30)	☒	☐	CASQA SD-30 is provided in Appendix 6 for reference.
S13	Hillside landscaping (CASQA New Development BMP Handbook SD-10)	☐	☒	Hillside landscapinig is anticipated
S14	Wash water control for food preparation areas	☐	☒	Outdoor food prep areas are not proposed.
S15	Community car wash racks (CASQA New Development BMP Handbook SD-33)	☒	☐	CASQA BMP SD-33 is provided in Appendix 6 for reference.

4.1.2 Site Design BMPs

As part of the planning phase of a project, the site design practices associated with new LID requirements in the Phase II Small MS4 Permit must be considered. Site design BMP measures can result in smaller Design Capture Volume (DCV) to be managed by both LID and hydromodification control BMPs by reducing runoff generation.

As is stated in the Permit, it is necessary to evaluate site conditions such as soil type(s), existing vegetation and flow paths will influence the overall site design.

Describe site design and drainage plan including:

- A narrative of site design practices utilized or rationale for not using practices
- A narrative of how site plan incorporates preventive site design practices
- Include an attached Site Plan layout which shows how preventative site design practices are included in WQMP

Refer to Section 5.2 of the TGD for WQMP for more details.

Form 4.1-3 Site Design Practices Checklist
Site Design Practices *If yes, explain how preventative site design practice is addressed in project site plan. If no, other LID BMPs must be selected to meet targets*
Minimize impervious areas: Yes ☒ No ☐ Explanation: The overall sidewalk, parking stalls, and drive isle widths were reduced as much as maximum extent practical allowed by building and planning code, in order to increase the landscape areas.
Maximize natural infiltration capacity; Including improvement and maintenance of soil: Yes ☒ No ☐ Explanation: Infiltration BMPs are being proposed onsite.
Preserve existing drainage patterns and time of concentration: Yes ☒ No ☐ Explanation: The existing drainage patterns and time of concentration are preserved to the maximum extent feasible.
Disconnect impervious areas. Including rerouting of rooftop drainage pipes to drain stormwater to storage or infiltration BMPs instead of to storm drain : Yes ☒ No ☐ Explanation: Runoff from impervious areas will sheet flow to inlets and flow into the proposed infiltration BMPs.
Use of Porous Pavement.: Yes ☐ No ☒ Explanation: Other infiltration BMP is proposed in lieu of porous pavement.
Protect existing vegetation and sensitive areas: Yes ☐ No ☒ Explanation: The existing vegetatetation in the scope of work area will be replaced with new vegetation. There are not senstitive areas onsite.
Re-vegetate disturbed areas. Including planting and preservation of drought tolerant vegetation. : Yes ☒ No ☐ Explanation: Disturbed areas will be re-vegetated.

Minimize unnecessary compaction in stormwater retention/infiltration basin/trench areas: Yes ☒ No ☐ Explanation: As required by the soils report (provided in Appendix 7), and the underground infiltration system manufacturer, to provide adequate stability for the infiltration isystem, the compacted subgrade shall be a minimum 90%.
Utilize naturalized/rock-lined drainage swales in place of underground piping or imperviously lined swales: Yes ☐ No ☒ Explanation: Due to site configuration and grading, storm drain pipes are necessary to convey the runoff.
Stake off areas that will be used for landscaping to minimize compaction during construction : Yes ☐ No ☒ Explanation:
Use of Rain Barrels and Cisterns, Including the use of on-site water collection systems.: Yes ☐ No ☒ Explanation: Infiltration BMPs will be used as part of the BMP hiearchy provided per the MS4 permit.
Stream Setbacks. Includes a specified distance from an adjacent steam: : Yes ☐ No ☒ Explanation: No streams adjacent to site.

It is noted that, in the Phase II Small MS4 Permit, site design elements for green roofs and vegetative swales are required. Due to the local climatology in the Mojave River Watershed, proactive measures are taken to maximize the amount of drought tolerant vegetation. It is not practical in this region to have green roofs or vegetative swales. As part of site design the project proponent should utilize locally recommended vegetation types for landscaping. Typical landscaping recommendations are found in following local references:

San Bernardino County Special Districts:

Guide to High Desert Landscaping -
http://www.specialdistricts.org/Modules/ShowDocument.aspx?documentid=795

Recommended High-Desert Plants -
http://www.specialdistricts.org/modules/showdocument.aspx?documentid=553

Mojave Water Agency:

Desert Ranch: http://www.mojavewater.org/files/desertranchgardenprototype.pdf

Summertree: http://www.mojavewater.org/files/Summertree-Native-Plant-Brochure.pdf

Thornless Garden: http://www.mojavewater.org/files/thornlessgardenprototype.pdf

Mediterranean Garden: http://www.mojavewater.org/files/mediterraneangardenprototype.pdf

Lush and Efficient Garden: http://www.mojavewater.org/files/lushandefficientgardenprototype.pdf

Alliance for Water Awareness and Conservation (AWAC) outdoor tips – http://hdawac.org/save-outdoors.html

4.2 Treatment BMPs

After implementation and design of both Source Control BMPs and Site Design BMP measures, any remaining runoff from impervious DMAs must be directed to one or more on-site, treatment BMPs (LID or biotreatment) designed to infiltrate, evaportranspire, and/or bioretain the amount of runoff specified in Permit Section E.12.e (ii)(c) Numeric Sizing Criteria for Storm Water Retention and Treatment.

4.2.1 Project Specific Hydrology Characterization

The purpose of this section of the Project WQMP is to establish targets for post-development hydrology based on performance criteria specified in Section E.12.e.ii.c and Section E.12.f of the Phase II Small MS4 Permit. These targets include runoff volume for water quality control (referred to as LID design capture volume), and runoff volume, time of concentration, and peak runoff for protection from hydromodification.

If the project has more than one outlet for stormwater runoff, then complete additional versions of these forms for each DA / outlet.

It is noted that in the Phase II Small MS4 Permit jurisdictions, the LID BMP Design Capture Volume criteria is based on the 2-year rain event. The hydromodification performance criterion is based on the 10-year rain event.

Methods applied in the following forms include:

- For LID BMP Design Capture Volume (DCV), San Bernardino County requires use of the P_6 method (Form 4.2-1) For pre- and post-development hydrologic calculation, San Bernardino County requires the use of the Rational Method (San Bernardino County Hydrology Manual Section D). Forms 4.2-2 through Form 4.2-5 calculate hydrologic variables including runoff volume, time of concentration, and peak runoff from the project site pre- and post-development using the Hydrology Manual Rational Method approach. For projects greater than 640 acres (1.0 mi^2), the Rational Method and these forms should not be used. For such projects, the Unit Hydrograph Method (San Bernardino County Hydrology Manual Section E) shall be applied for hydrologic calculations for hydromodification performance criteria.

Refer to Section 4 in the TGD for WQMP for detailed guidance and instructions.

Form 4.2-1 LID BMP Performance Criteria for Design Capture Volume (DA 1)		
[1] Project area DA 1 (ft^2): 77,405	[2] Imperviousness after applying preventative site design practices (Imp%): 85	[3] Runoff Coefficient (Rc): _0.66 *R_c = 0.858(Imp%)^3-0.78(Imp%)^2+0.774(Imp%)+0.04*
[4] Determine 1-hour rainfall depth for a 2-year return period $P_{2yr-1hr}$ (in): 0.377 http://hdsc.nws.noaa.gov/hdsc/pfds/sa/sca_pfds.html		
[5] Compute P_6, Mean 6-hr Precipitation (inches): 0.466 *P_6 = Item 4 *C_1, where C_1 is a function of site climatic region specified in Form 3-1 Item 1 (Desert = 1.2371)*		
[6] Drawdown Rate *Use 48 hours as the default condition. Selection and use of the 24 hour drawdown time condition is subject to approval by the local jurisdiction. The necessary BMP footprint is a function of drawdown time. While shorter drawdown times reduce the performance criteria for LID BMP design capture volume, the depth of water that can be stored is also reduced.*		24-hrs ☐ 48-hrs ☒
[7] Compute design capture volume, DCV (ft^3): 3,902 *DCV = 1/12 * [Item 1* Item 3 *Item 5 * C_2], where C_2 is a function of drawdown rate (24-hr = 1.582; 48-hr = 1.963)* *Compute separate DCV for each outlet from the project site per schematic drawn in Form 3-1 Item 2*		

Form 4.2-1 LID BMP Performance Criteria for Design Capture Volume (DA 2)

1 Project area DA 2 (ft^2): 46,259	**2** Imperviousness after applying preventative site design practices (Imp%): 0.85	**3** Runoff Coefficient (Rc): 0.66 *R_c = 0.858(Imp%)^3-0.78(Imp%)^2+0.774(Imp%)+0.04*

4 Determine 1-hour rainfall depth for a 2-year return period $P_{2yr-1hr}$ (in): 0.377 http://hdsc.nws.noaa.gov/hdsc/pfds/sa/sca_pfds.html

5 Compute P_6, Mean 6-hr Precipitation (inches): 0.466

*P_6 = Item 4 *C_1, where C_1 is a function of site climatic region specified in Form 3-1 Item 1 (Valley = 1.4807; Mountain = 1.909; Desert = 1.2371)*

6 Drawdown Rate *Use 48 hours as the default condition. Selection and use of the 24 hour drawdown time condition is subject to approval by the local jurisdiction. The necessary BMP footprint is a function of drawdown time. While shorter drawdown times reduce the performance criteria for LID BMP design capture volume, the depth of water that can be stored is also reduced.*	24-hrs ☐ 48-hrs ☒

7 Compute design capture volume, DCV (ft^3): 2,331

*DCV = 1/12 * [Item 1* Item 3 *Item 5 * C_2], where C_2 is a function of drawdown rate (24-hr = 1.582; 48-hr = 1.963)*

Compute separate DCV for each outlet from the project site per schematic drawn in Form 3-1 Item 2

Form 4.2-1 LID BMP Performance Criteria for Design Capture Volume (DA 3)

1 Project area DA 3 (ft^2): 68,554	**2** Imperviousness after applying preventative site design practices (Imp%): 0.85	**3** Runoff Coefficient (Rc): 0.66 *R_c = 0.858(Imp%)^3-0.78(Imp%)^2+0.774(Imp%)+0.04*
4 Determine 1-hour rainfall depth for a 2-year return period $P_{2yr-1hr}$ (in): 0.377 http://hdsc.nws.noaa.gov/hdsc/pfds/sa/sca_pfds.html		
5 Compute P_6, Mean 6-hr Precipitation (inches): 0.466 *P_6 = Item 4 *C_1, where C_1 is a function of site climatic region specified in Form 3-1 Item 1 (Valley = 1.4807; Mountain = 1.909; Desert = 1.2371)*		
6 Drawdown Rate *Use 48 hours as the default condition. Selection and use of the 24 hour drawdown time condition is subject to approval by the local jurisdiction. The necessary BMP footprint is a function of drawdown time. While shorter drawdown times reduce the performance criteria for LID BMP design capture volume, the depth of water that can be stored is also reduced.*	24-hrs ☐ 48-hrs ☒	
7 Compute design capture volume, DCV (ft^3): 3456 *DCV = 1/12 * [Item 1* Item 3 *Item 5 * C_2], where C_2 is a function of drawdown rate (24-hr = 1.582; 48-hr = 1.963)* *Compute separate DCV for each outlet from the project site per schematic drawn in Form 3-1 Item 2*		

Form 4.2-1 LID BMP Performance Criteria for Design Capture Volume (DA 4)

1 Project area DA 4 (ft^2): 255,087	2 Imperviousness after applying preventative site design practices (Imp%): 0.85	3 Runoff Coefficient (Rc): 0.66 *R_c = 0.858(Imp%)^3-0.78(Imp%)^2+0.774(Imp%)+0.04*
4 Determine 1-hour rainfall depth for a 2-year return period $P_{2yr-1hr}$ (in): 0.377 http://hdsc.nws.noaa.gov/hdsc/pfds/sa/sca_pfds.html		
5 Compute P_6, Mean 6-hr Precipitation (inches): 0.466 *P_6 = Item 4 *C_1, where C_1 is a function of site climatic region specified in Form 3-1 Item 1 (Valley = 1.4807; Mountain = 1.909; Desert = 1.2371)*		
6 Drawdown Rate *Use 48 hours as the default condition. Selection and use of the 24 hour drawdown time condition is subject to approval by the local jurisdiction. The necessary BMP footprint is a function of drawdown time. While shorter drawdown times reduce the performance criteria for LID BMP design capture volume, the depth of water that can be stored is also reduced.*		24-hrs ☐ 48-hrs ☒
7 Compute design capture volume, DCV (ft^3): 12,859 *DCV = 1/12 * [Item 1* Item 3 *Item 5 * C_2], where C_2 is a function of drawdown rate (24-hr = 1.582; 48-hr = 1.963)* *Compute separate DCV for each outlet from the project site per schematic drawn in Form 3-1 Item 2*		

Form 4.2-1 LID BMP Performance Criteria for Design Capture Volume (DA 5

1 Project area DA 4 (ft^2): 13,720	2 Imperviousness after applying preventative site design practices (Imp%): 0.85	3 Runoff Coefficient (Rc): 0.66 *R_c = 0.858(Imp%)^3-0.78(Imp%)^2+0.774(Imp%)+0.04*
4 Determine 1-hour rainfall depth for a 2-year return period $P_{2yr-1hr}$ (in): 0.377 http://hdsc.nws.noaa.gov/hdsc/pfds/sa/sca_pfds.html		
5 Compute P_6, Mean 6-hr Precipitation (inches): 0.466 *P_6 = Item 4 *C_1, where C_1 is a function of site climatic region specified in Form 3-1 Item 1 (Valley = 1.4807; Mountain = 1.909; Desert = 1.2371)*		
6 Drawdown Rate *Use 48 hours as the default condition. Selection and use of the 24 hour drawdown time condition is subject to approval by the local jurisdiction. The necessary BMP footprint is a function of drawdown time. While shorter drawdown times reduce the performance criteria for LID BMP design capture volume, the depth of water that can be stored is also reduced.*		24-hrs ☐ 48-hrs ☒
7 Compute design capture volume, DCV (ft^3): 692 *DCV = 1/12 * [Item 1* Item 3 *Item 5 * C_2], where C_2 is a function of drawdown rate (24-hr = 1.582; 48-hr = 1.963)* *Compute separate DCV for each outlet from the project site per schematic drawn in Form 3-1 Item 2*		

Form 4.2-1 LID BMP Performance Criteria for Design Capture Volume (DA 6

1 Project area DA (ft²): 56,333	2 Imperviousness after applying preventative site design practices (Imp%): 0.85	3 Runoff Coefficient (Rc): 0.66 *R_c = 0.858(Imp%)^3-0.78(Imp%)^2+0.774(Imp%)+0.04*
4 Determine 1-hour rainfall depth for a 2-year return period $P_{2yr\text{-}1hr}$ (in): 0.377 http://hdsc.nws.noaa.gov/hdsc/pfds/sa/sca_pfds.html		
5 Compute P_6, Mean 6-hr Precipitation (inches): 0.466 *P_6 = Item 4 *C_1, where C_1 is a function of site climatic region specified in Form 3-1 Item 1 (Valley = 1.4807; Mountain = 1.909; Desert = 1.2371)*		
6 Drawdown Rate *Use 48 hours as the default condition. Selection and use of the 24 hour drawdown time condition is subject to approval by the local jurisdiction. The necessary BMP footprint is a function of drawdown time. While shorter drawdown times reduce the performance criteria for LID BMP design capture volume, the depth of water that can be stored is also reduced.*		24-hrs ☐ 48-hrs ☒
7 Compute design capture volume, DCV (ft³): 2,840 *DCV = 1/12 * [Item 1* Item 3 *Item 5 * C_2], where C_2 is a function of drawdown rate (24-hr = 1.582; 48-hr = 1.963)* *Compute separate DCV for each outlet from the project site per schematic drawn in Form 3-1 Item 2*		

Form 4.2-1 LID BMP Performance Criteria for Design Capture Volume (DA 7

1 Project area DA (ft²): 78,253	2 Imperviousness after applying preventative site design practices (Imp%): 0.85	3 Runoff Coefficient (Rc): 0.66 *R_c = 0.858(Imp%)^3-0.78(Imp%)^2+0.774(Imp%)+0.04*
4 Determine 1-hour rainfall depth for a 2-year return period $P_{2yr-1hr}$ (in): 0.377 http://hdsc.nws.noaa.gov/hdsc/pfds/sa/sca_pfds.html		
5 Compute P_6, Mean 6-hr Precipitation (inches): 0.466 *P_6 = Item 4 *C_1, where C_1 is a function of site climatic region specified in Form 3-1 Item 1 (Valley = 1.4807; Mountain = 1.909; Desert = 1.2371)*		
6 Drawdown Rate *Use 48 hours as the default condition. Selection and use of the 24 hour drawdown time condition is subject to approval by the local jurisdiction. The necessary BMP footprint is a function of drawdown time. While shorter drawdown times reduce the performance criteria for LID BMP design capture volume, the depth of water that can be stored is also reduced.*		24-hrs ☐ 48-hrs ☒
7 Compute design capture volume, DCV (ft³): 3,945 *DCV = 1/12 * [Item 1* Item 3 *Item 5 * C_2], where C_2 is a function of drawdown rate (24-hr = 1.582; 48-hr = 1.963)* *Compute separate DCV for each outlet from the project site per schematic drawn in Form 3-1 Item 2*		

Form 4.2-1 LID BMP Performance Criteria for Design Capture Volume (DA 8)

1 Project area DA (ft²): 14,796	**2** Imperviousness after applying preventative site design practices (Imp%): 0.10	**3** Runoff Coefficient (Rc): 0.11 *R_c = 0.858(Imp%)^3-0.78(Imp%)^2+0.774(Imp%)+0.04*
4 Determine 1-hour rainfall depth for a 2-year return period $P_{2yr-1hr}$ (in): 0.377 http://hdsc.nws.noaa.gov/hdsc/pfds/sa/sca_pfds.html		
5 Compute P_6, Mean 6-hr Precipitation (inches): 0.466 *P_6 = Item 4 *C_1, where C_1 is a function of site climatic region specified in Form 3-1 Item 1 (Valley = 1.4807; Mountain = 1.909; Desert = 1.2371)*		
6 Drawdown Rate *Use 48 hours as the default condition. Selection and use of the 24 hour drawdown time condition is subject to approval by the local jurisdiction. The necessary BMP footprint is a function of drawdown time. While shorter drawdown times reduce the performance criteria for LID BMP design capture volume, the depth of water that can be stored is also reduced.*		24-hrs ☐ 48-hrs ☒
7 Compute design capture volume, DCV (ft³): 125 *DCV = 1/12 * [Item 1* Item 3 *Item 5 * C_2], where C_2 is a function of drawdown rate (24-hr = 1.582; 48-hr = 1.963)* *Compute separate DCV for each outlet from the project site per schematic drawn in Form 3-1 Item 2*		

Form 4.2-1 LID BMP Performance Criteria for Design Capture Volume (DA 9

1 Project area DA (ft²): 62,729	2 Imperviousness after applying preventative site design practices (Imp%): 0.85	3 Runoff Coefficient (Rc): 0.66 *$R_c = 0.858(Imp\%)^{3} - 0.78(Imp\%)^{2} + 0.774(Imp\%) + 0.04$*
4 Determine 1-hour rainfall depth for a 2-year return period $P_{2yr\text{-}1hr}$ (in): 0.377 http://hdsc.nws.noaa.gov/hdsc/pfds/sa/sca_pfds.html		
5 Compute P_6, Mean 6-hr Precipitation (inches): 0.466 *P_6 = Item 4 *C_1, where C_1 is a function of site climatic region specified in Form 3-1 Item 1 (Valley = 1.4807; Mountain = 1.909; Desert = 1.2371)*		
6 Drawdown Rate *Use 48 hours as the default condition. Selection and use of the 24 hour drawdown time condition is subject to approval by the local jurisdiction. The necessary BMP footprint is a function of drawdown time. While shorter drawdown times reduce the performance criteria for LID BMP design capture volume, the depth of water that can be stored is also reduced.*		24-hrs ☐ 48-hrs ☒
7 Compute design capture volume, DCV (ft³): 3,162 *DCV = 1/12 * [Item 1* Item 3 *Item 5 * C_2], where C_2 is a function of drawdown rate (24-hr = 1.582; 48-hr = 1.963)* *Compute separate DCV for each outlet from the project site per schematic drawn in Form 3-1 Item 2*		

Form 4.2-2 Summary of Hydromodification Assessment (DA-1 - DA-9)

Is the change in post- and pre- condition flows captured on-site? : Yes ☒ No ☐

If "Yes", then complete Hydromodification assessment of site hydrology for 10yr storm event using Forms 4.2-3 through 4.2-5 and insert results below *(Forms 4.2-3 through 4.2-5 may be replaced by computer software analysis based on the San Bernardino County Hydrology Manual- Addendum 1)*

If "No," then proceed to Section 4.3 BMP Selection and Sizing

Condition	Runoff Volume (ft^3)	Time of Concentration (min)	Peak Runoff (cfs)
Pre-developed	1 **80,717** *Form 4.2-3 Item 12*	2 **24** *Form 4.2-4 Item 13*	3 **22.24** *Form 4.2-5 Item 10*
Post-developed	4 **24,350** *Form 4.2-3 Item 13*	5 **11.3*** *Form 4.2-4 Item 14*	6 **19.47** *Form 4.2-5 Item 14*
Difference	7 **-56,367** *Item 4 – Item 1*	8 - **12.7** *Item 2 – Item 5*	9 **-2.77** *Item 6 – Item 3*
Difference (as % of pre-developed)	10 **-69.8** *%* *Item 7 / Item 1*	11 **-52.9** *%* *Item 8 / Item 2*	12 **-12.4** *%* *Item 9 / Item 3*

*** The time of concentration shown above is only for overland flow and does not consider the Tc for the proposed underground retention units which will further increase the time of concentration.**

Form 4.2-3 Hydromodification Assessment for Runoff Volume (DA-1 - DA-9)

Weighted Curve Number Determination for: <u>Pre</u>-developed DA	DMA A	DMA B	DMA C	DMA D	DMA E	DMA F	DMA G	DMA H
1a Land Cover type								
2a Hydrologic Soil Group (HSG)								
3a DMA Area, ft^2 *sum of areas of DMA should equal area of DA*								
4a Curve Number (CN) *use Items 1 and 2 to select the appropriate CN from Appendix C-2 of the TGD for WQMP*								
Weighted Curve Number Determination for: <u>Post</u>-developed DA	DMA A	DMA B	DMA C	DMA D	DMA E	DMA F	DMA G	DMA H
1b Land Cover type								
2b Hydrologic Soil Group (HSG)								
3b DMA Area, ft^2 *sum of areas of DMA should equal area of DA*								
4b Curve Number (CN) *use Items 5 and 6 to select the appropriate CN from Appendix C-2 of the TGD for WQMP*								

5 Pre-Developed area-weighted CN:	**7** Pre-developed soil storage capacity, S (in): *S = (1000 / Item 5) - 10*	**9** Initial abstraction, I_a (in): *I_a = 0.2 * Item 7*
6 Post-Developed area-weighted CN:	**8** Post-developed soil storage capacity, S (in): *S = (1000 / Item 6) - 10*	**10** Initial abstraction, I_a (in): *I_a = 0.2 * Item 8*

11 Precipitation for 10 yr, 24 hr storm (in):
Go to: http://hdsc.nws.noaa.gov/hdsc/pfds/sa/sca_pfds.html

12 Pre-developed Volume (ft^3):
*V_{pre} =(1 / 12) * (Item sum of Item 3) * [(Item 11 – Item 9)^2 / ((Item 11 – Item 9 + Item 7)*

13 Post-developed Volume (ft^3):
*V_{pre} =(1 / 12) * (Item sum of Item 3) * [(Item 11 – Item 10)^2 / ((Item 11 – Item 10 + Item 8)*

14 Volume Reduction needed to meet hydromodification requirement, (ft^3):
*Vhydro = (Item 13 * 0.95) – Item 12*

Form 4.2-4 Hydromodification Assessment for Time of Concentration (DA-1 - DA-9)

Compute time of concentration for pre and post developed conditions for each DA *(For projects using the Hydrology Manual complete the form below)*

Variables	Pre-developed DA1 *Use additional forms if there are more than 4 DMA*				Post-developed DA1 *Use additional forms if there are more than 4 DMA*			
	DMA A	DMA B	DMA C	DMA D	DMA A	DMA B	DMA C	DMA D
1 Length of flowpath (ft) *Use Form 3-2 Item 5 for pre-developed condition*								
2 Change in elevation (ft)								
3 Slope (ft/ft), S_o *= Item 2 / Item 1*								
4 Land cover								
5 Initial DMA Time of Concentration (min) *Appendix C-1 of the TGD for WQMP*								
6 Length of conveyance from DMA outlet to project site outlet (ft) *May be zero if DMA outlet is at project site outlet*								
7 Cross-sectional area of channel (ft^2)								
8 Wetted perimeter of channel (ft)								
9 Manning's roughness of channel (n)								
10 Channel flow velocity (ft/sec) V_{fps} *= (1.49 / Item 9) * (Item 7/Item 8)^0.67 * (Item 3)^0.5*								
11 Travel time to outlet (min) T_t *= Item 6 / (Item 10 * 60)*								
12 Total time of concentration (min) T_c *= Item 5 + Item 11*								
13 Pre-developed time of concentration (min): *Minimum of Item 12 pre-developed DMA*								
14 Post-developed time of concentration (min): *Minimum of Item 12 post-developed DMA*								
15 Additional time of concentration needed to meet hydromodification requirement (min): $T_{C-Hydro}$ *= (Item 13 * 0.95) – Item 14*								

Form 4.2-5 Hydromodification Assessment for Peak Runoff (DA-1 - DA-9)

Compute peak runoff for pre- and post-developed conditions

Variables		Pre-developed DA to Project Outlet (*Use additional forms if more than 3 DMA*)			Post-developed DA to Project Outlet (*Use additional forms if more than 3 DMA*)		
		DMA A	DMA B	DMA C	DMA A	DMA B	DMA C
1 Rainfall Intensity for storm duration equal to time of concentration *I_{peak} = 10^(LOG Form 4.2-1 Item 4 - 0.7 LOG Form 4.2-4 Item 5 /60)*							
2 Drainage Area of each DMA (Acres) *For DMA with outlet at project site outlet, include upstream DMA (Using example schematic in Form 3-1, DMA A will include drainage from DMA C)*							
3 Ratio of pervious area to total area *For DMA with outlet at project site outlet, include upstream DMA (Using example schematic in Form 3-1, DMA A will include drainage from DMA C)*							
4 Pervious area infiltration rate (in/hr) *Use pervious area CN and antecedent moisture condition with Appendix C-3 of the TGD for WQMP*							
5 Maximum loss rate (in/hr) *F_m = Item 3 * Item 4* *Use area-weighted F_m from DMA with outlet at project site outlet, include upstream DMA (Using example schematic in Form 3-1, DMA A will include drainage from DMA C)*							
6 Peak Flow from DMA (cfs) *Q_p =Item 2 * 0.9 * (Item 1 - Item 5)*							
7 Time of concentration adjustment factor for other DMA to site discharge point *Form 4.2-4 Item 12 DMA / Other DMA upstream of site discharge point (If ratio is greater than 1.0, then use maximum value of 1.0)*	DMA A	*n/a*			*n/a*		
	DMA B		*n/a*			*n/a*	
	DMA C			*n/a*			*n/a*

8 Pre-developed Q_p at T_c for DMA A: *Q_p = Item 6_{DMAA} + [Item 6_{DMAB} * (Item 1_{DMAA} - Item 5_{DMAB})/(Item 1_{DMAB} - Item 5_{DMAB})* Item $7_{DMAA/2}$] + [Item 6_{DMAC} * (Item 1_{DMAA} - Item 5_{DMAC})/(Item 1_{DMAC} - Item 5_{DMAC})* Item $7_{DMAA/3}$]*	9 Pre-developed Q_p at T_c for DMA B: *Q_p = Item 6_{DMAB} + [Item 6_{DMAA} * (Item 1_{DMAB} - Item 5_{DMAA})/(Item 1_{DMAA} - Item 5_{DMAA})* Item $7_{DMAB/1}$] + [Item 6_{DMAC} * (Item 1_{DMAB} - Item 5_{DMAC})/(Item 1_{DMAC} - Item 5_{DMAC})* Item $7_{DMAB/3}$]*	10 Pre-developed Q_p at T_c for DMA C: *Q_p = Item 6_{DMAC} + [Item 6_{DMAA} * (Item 1_{DMAC} - Item 5_{DMAA})/(Item 1_{DMAA} - Item 5_{DMAA})* Item $7_{DMAC/1}$] + [Item 6_{DMAB} * (Item 1_{DMAC} - Item 5_{DMAB})/(Item 1_{DMAB} - Item 5_{DMAB})* Item $7_{DMAC/2}$]*
10 Peak runoff from pre-developed condition confluence analysis (cfs): *Maximum of Item 8, 9, and 10 (including additional forms as needed)*		
11 Post-developed Q_p at T_c for DMA A: *Same as Item 8 for post-developed values*	12 Post-developed Q_p at T_c for DMA B: *Same as Item 9 for post-developed values*	13 Post-developed Q_p at T_c for DMA C: *Same as Item 10 for post-developed values*
14 Peak runoff from post-developed condition confluence analysis (cfs): *Maximum of Item 11, 12, and 13 (including additional forms as needed)*		
15 Peak runoff reduction needed to meet Hydromodification Requirement (cfs): $Q_{p\text{-}hydro}$ = *(Item 14 * 0.95) – Item 10*		

4.3 BMP Selection and Sizing

Complete the following forms for each project site DA to document that the proposed treatment (LID/Bioretention) BMPs conform to the project DCV developed to meet performance criteria specified in the Phase II Small MS4 Permit (WQMP Template Section 4.2). For the LID DCV, the forms are ordered according to hierarchy of BMP selection as required by the Phase II Small MS4 Permit (see Section 5.3 in the TGD for WQMP). The forms compute the following for on-site LID BMP:

- Site Design Measures (Form 4.3-2)
- Retention and Infiltration BMPs (Form 4.3-3) or
- Biotreatment BMPs (Form 4.3-4).

Please note that the selected BMPs may also be used as dual purpose for on-site, hydromodification mitigation and management.

At the end of each form, additional fields facilitate the determination of the extent of mitigation provided by the specific BMP category, allowing for use of the next category of BMP in the hierarchy, if necessary.

The first step in the analysis, using Section 5.3.2 of the TGD for WQMP, is to complete Forms 4.3-1 and 4.3-3) to determine if retention and infiltration BMPs are infeasible for the project. For each feasibility criterion in Form 4.3-1, if the answer is “Yes,” provide all study findings that includes relevant calculations, maps, data sources, etc. used to make the determination of infeasibility.

Next, complete Form 4.3-2 to determine the feasibility of applicable Site Design BMPs, and, if their implementation is feasible, the extent of mitigation of the DCV.

If no site constraints exist that would limit the type of BMP to be implemented in a DA, evaluate the use of combinations of LID BMPs, including all applicable Site Design BMPs to maximize on-site retention of the DCV. If no combination of BMP can mitigate the entire DCV, implement the single BMP type, or combination of BMP types, that maximizes on-site retention of the DCV within the minimum effective area.

If the combination of site design, retention and/or infiltration BMPs is unable to mitigate the entire DCV, then the remainder of the volume-based performance criteria that cannot be achieved with site design, retention and/or infiltration BMPs must be managed through biotreatment BMPs. If biotreatment BMPs are used, then they must be sized to provide equivalent effectiveness based on Template Section 4.3.4.

4.3.1 Exceptions to Requirements for Bioretention Facilities

Contingent on a demonstration that use of bioretention or a facility of equivalent effectiveness is infeasible, other types of biotreatment or media filters (such as tree-box-type biofilters or in-vault media filters) may be used for the following categories of Regulated Projects:

1) Projects creating or replacing an acre or less of impervious area, and located in a designated pedestrian-oriented commercial district (i.e., smart growth projects), and having at least 85% of the entire project site covered by permanent structures;

2) Facilities receiving runoff solely from existing (pre-project) impervious areas; and

3) Historic sites, structures or landscapes that cannot alter their original configuration in order to maintain their historic integrity.

Form 4.3-1 Infiltration BMP Feasibility (DA-1 - DA-9)
Feasibility Criterion – Complete evaluation for each DA on the Project Site
[1] Would infiltration BMP pose significant risk for groundwater related concerns? Yes ☐ No ☒ *Refer to Section 5.3.2.1 of the TGD for WQMP*
If Yes, Provide basis: (attach)
[2] Would installation of infiltration BMP significantly increase the risk of geotechnical hazards? Yes ☐ No ☒ (Yes, if the answer to any of the following questions is yes, as established by a geotechnical expert): • The location is less than 50 feet away from slopes steeper than 15 percent • The location is less than ten feet from building foundations or an alternative setback. • A study certified by a geotechnical professional or an available watershed study determines that stormwater infiltration would result in significantly increased risks of geotechnical hazards.
If Yes, Provide basis: (attach)
[3] Would infiltration of runoff on a Project site violate downstream water rights? Yes ☐ No ☒
If Yes, Provide basis: (attach)
[4] Is proposed infiltration facility located on hydrologic soil group (HSG) D soils or does the site geotechnical investigation indicate presence of soil characteristics, which support categorization as D soils? Yes ☐ No ☒
If Yes, Provide basis: (attach)
[5] Is the design infiltration rate, after accounting for safety factor of 2.0, below proposed facility less than 0.3 in/hr (accounting for soil amendments)? Yes ☐ No ☒
If Yes, Provide basis: (attach)
[6] Would on-site infiltration or reduction of runoff over pre-developed conditions be partially or fully inconsistent with watershed management strategies as defined in the WAP, or impair beneficial uses? Yes ☐ No ☒ *See Section 3.5 of the TGD for WQMP and WAP*
If Yes, Provide basis: (attach)
[7] Any answer from Item 1 through Item 3 is "Yes": Yes ☐ No ☒ *If yes, infiltration of any volume is not feasible onsite. Proceed to Form 4.3-4, Selection and Evaluation of Biotreatment BMP.* *If no, then proceed to Item 8 below.* [8] Any answer from Item 4 through Item 6 is "Yes": Yes ☐ No ☒ *If yes, infiltration is permissible but is not required to be considered. Proceed to Form 4.3-2, Site Design BMP.* *If no, then proceed to Item 9, below.* [9] All answers to Item 1 through Item 6 are "No": *Infiltration of the full DCV is potentially feasible, LID infiltration BMP must be designed to infiltrate the full DCV to the MEP.* *Proceed to Form 4.3-2, Site Design BMPs.*

4.3.2 Site Design BMP

Section E.12.e. of the Small Phase II MS4 Permit emphasizes the use of LID preventative measures; and the use of Site Design Measures reduces the portion of the DCV that must be addressed in downstream BMPs. Therefore, all applicable Site Design Measures shall be provided except where they are mutually exclusive with each other, or with other BMPs. Mutual exclusivity may result from overlapping BMP footprints such that either would be potentially feasible by itself, but both could not be implemented. Please note that while there are no numeric standards regarding the use of Site Design BMPs. If a project cannot feasibly meet BMP sizing requirements or cannot fully address hydromodification, feasibility of all applicable Site Design BMPs must be part of demonstrating that the BMP system has been designed to retain the maximum feasible portion of the DCV. Complete Form 4.3-2 to identify and calculate estimated retention volume from implementing site design BMP. Refer to Section 5.4 in the TGD for more detailed guidance.

Form 4.3-2 Site Design BMPs (DA-1 - DA-9)			
1 Implementation of Impervious Area Dispersion BMP (i.e. routing runoff from impervious to pervious areas), excluding impervious areas planned for routing to on-lot infiltration BMP: Yes ☐ No ☒ *If yes, complete Items 2-5; If no, proceed to Item 6*	DA DMA BMP Type	DA DMA BMP Type	DA DMA BMP Type *(Use additional forms for more BMPs)*
2 Total impervious area draining to pervious area (ft^2)			
3 Ratio of pervious area receiving runoff to impervious area			
4 Retention volume achieved from impervious area dispersion (ft^3) *V = Item2 * Item 3 * (0.5/12), assuming retention of 0.5 inches of runoff*			
5 Sum of retention volume achieved from impervious area dispersion (ft^3): *$V_{retention}$ =Sum of Item 4 for all BMPs*			
6 Implementation of Localized On-lot Infiltration BMPs (e.g. on-lot rain gardens): Yes ☐ No ☒ *If yes, complete Items 7-13 for aggregate of all on-lot infiltration BMP in each DA; If no, proceed to Item 14*	DA DMA BMP Type	DA DMA BMP Type	DA DMA BMP Type *(Use additional forms for more BMPs)*
7 Ponding surface area (ft^2)			
8 Ponding depth (ft) (min. 0.5 ft.)			
9 Surface area of amended soil/gravel (ft^2)			
10 Average depth of amended soil/gravel (ft) (min. 1 ft.)			
11 Average porosity of amended soil/gravel			
12 Retention volume achieved from on-lot infiltration (ft^3) *$V_{retention}$ = (Item 7 *Item 8) + (Item 9 * Item 10 * Item 11)*			
13 Runoff volume retention from on-lot infiltration (ft^3): *$V_{retention}$ =Sum of Item 12 for all BMPs*			

Form 4.3-2 cont. Site Design BMPs (DA-1 - DA-9)

14 Implementation of Street Trees: Yes ☐ No ☒ *If yes, complete Items 14-18. If no, proceed to Item 19*	DA DMA BMP Type	DA DMA BMP Type	DA DMA BMP Type *(Use additional forms for more BMPs)*
15 Number of Street Trees			
16 Average canopy cover over impervious area (ft^2)			
17 Runoff volume retention from street trees (ft^3) *$V_{retention}$ = Item 15 * Item 16 * (0.05/12) assume runoff retention of 0.05 inches*			
18 Runoff volume retention from street tree BMPs (ft^3): *$V_{retention}$ = Sum of Item 17 for all BMPs*			
19 Total Retention Volume from Site Design BMPs: *Sum of Items 5, 13 and 18*			

4.3.3 Infiltration BMPs

Use Form 4.3-3 to compute on-site retention of runoff from proposed retention and infiltration BMPs. Volume retention estimates are sensitive to the percolation rate used, which determines the amount of runoff that can be infiltrated within the specified drawdown time. The infiltration safety factor reduces field measured percolation to account for potential inaccuracy associated with field measurements, declining BMP performance over time, and compaction during construction. Appendix C of the TGD for WQMP provides guidance on estimating an appropriate safety factor to use in Form 4.3-3.

If site constraints limit the use of BMPs to a single type and implementation of retention and infiltration BMPs mitigate no more than 40% of the DCV, then they are considered infeasible and the Project Proponent may evaluate the effectiveness of BMPs lower in the LID hierarchy of use (Section 5.5 of the TGD for WQMP)

If implementation of infiltrations BMPs is feasible as determined using Form 4.3-1, then LID infiltration BMPs shall be implemented to the MEP (section 4.1 of the TGD for WQMP).

4.3.3.1 Allowed Variations for Special Site Conditions

The bioretention system design parameters of this Section may be adjusted for the following special site conditions:

1) Facilities located within 10 feet of structures or other potential geotechnical hazards established by the geotechnical expert for the project may incorporate an impervious cutoff wall between the bioretention facility and the structure or other geotechnical hazard.

2) Facilities with documented high concentrations of pollutants in underlying soil or groundwater, facilities located where infiltration could contribute to a geotechnical hazard, and facilities located on elevated plazas or other structures may incorporate an impervious liner and may locate the underdrain discharge at the bottom of the subsurface drainage/storage layer (this configuration is commonly known as a “flow-through planter”).

3) Facilities located in areas of high groundwater, highly infiltrative soils or where connection of underdrain to a surface drain or to a subsurface storm drain are infeasible, may omit the underdrain.

4) Facilities serving high-risk areas such as fueling stations, truck stops, auto repairs, and heavy industrial sites may be required to provide adequate pretreatment to address pollutants of concern unless these high-risk areas are isolated from storm water runoff or bioretention areas with no chance of spill migration.

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Form 4.3-3 Infiltration LID BMP - including underground BMPs (DA 1)

1 Remaining LID DCV not met by site design BMP (ft³): 3,902 *V_{unmet} = Form 4.2-1 Item 7 - Form 4.3-2 Item19*			
BMP Type *Use columns to the right to compute runoff volume retention from proposed infiltration BMP (select BMP from Table 5-4 in TGD for WQMP) - Use additional forms for more BMPs*	DA 1 DMA - BMP Type Underground Infiltration	DA DMA BMP Type	DA DMA BMP Type *(Use additional forms for more BMPs)*
2 Infiltration rate of underlying soils (in/hr) *See Section 5.4.2 and Appendix C of the TGD for WQMP for minimum requirements for assessment methods*	1.7		
3 Infiltration safety factor *See TGD Section 5.4.2 and Appendix D*	2		
4 Design percolation rate (in/hr) *P_{design} = Item 2 / Item 3*	0.85		
5 Ponded water drawdown time (hr) *Copy Item 6 in Form 4.2-1*	48		
6 Maximum ponding depth (ft) *BMP specific, see Table 5-4 of the TGD for WQMP for BMP design details*	2.5		
7 Ponding Depth (ft) *d_{BMP} = Minimum of (1/12*Item 4*Item 5) or Item 6*	2.5		
8 Infiltrating surface area, SA_{BMP} (ft²) *the lesser of the area needed for infiltration of full DCV or minimum space requirements from Table 5.7 of the TGD for WQMP*	9,177		
9 Amended soil depth, d_{media} (ft) *Only included in certain BMP types, see Table 5-4 in the TGD for WQMP for reference to BMP design details*	0		
10 Amended soil porosity	0		
11 Gravel depth, d_{media} (ft) *Only included in certain BMP types, see Table 5-4 of the TGD for WQMP for BMP design details*	0		
12 Gravel porosity	0		
13 Duration of storm as basin is filling (hrs) *Typical ~ 3hrs*	3		
14 Above Ground Retention Volume (ft³) *$V_{retention}$ = Item 8 * [Item7 + (Item 9 * Item 10) + (Item 11 * Item 12) + (Item 13 * (Item 4 / 12))]*	0		
15 Underground Retention Volume (ft³) *Volume determined using manufacturer's specifications and calculations*	27,101		
16 Total Retention Volume from LID Infiltration BMPs: 27,101 *(Sum of Items 14 and 15 for all infiltration BMP included in plan)*			
17 Fraction of DCV achieved with infiltration BMP: 695%% *Retention% = Item 16 / Form 4.2-1 Item 7*			
18 Is full LID DCV retained onsite with combination of hydrologic source control and LID retention/infiltration BMPs? Yes ☒ No ☐ *If yes, demonstrate conformance using Form 4.3-10; If no, then reduce Item 3, Factor of Safety to 2.0 and increase Item 8, Infiltrating Surface Area, such that the portion of the site area used for retention and infiltration BMPs equals or exceeds the minimum effective area thresholds (Table 5-7 of the TGD for WQMP) for the applicable category of development and repeat all above calculations.*			

Form 4.3-3 Infiltration LID BMP - including underground BMPs (DA 2)

1 Remaining LID DCV not met by site design HSC BMP (ft³): 2,332 *V_{unmet} = Form 4.2-1 Item 7 - Form 4.3-2 Item 30*			
BMP Type *Use columns to the right to compute runoff volume retention from proposed infiltration BMP (select BMP from Table 5-4 in TGD for WQMP) - Use additional forms for more BMPs*	DA 2 DMA - BMP Type Underground Detention	DA DMA BMP Type	DA DMA BMP Type *(Use additional forms for more BMPs)*
2 Infiltration rate of underlying soils (in/hr) *See Section 5.4.2 and Appendix D of the TGD for WQMP for minimum requirements for assessment methods*	1.7		
3 Infiltration safety factor *See TGD Section 5.4.2 and Appendix D*	2		
4 Design percolation rate (in/hr) *P_{design} = Item 2 / Item 3*	0.85		
5 Ponded water drawdown time (hr) *Copy Item 6 in Form 4.2-1*	48		
6 Maximum ponding depth (ft) *BMP specific, see Table 5-4 of the TGD for WQMP for BMP design details*	2.5		
7 Ponding Depth (ft) *d_{BMP} = Minimum of (1/12*Item 4*Item 5) or Item 6*	2.5		
8 Infiltrating surface area, SA_{BMP} (ft²) *the lesser of the area needed for infiltration of full DCV or minimum space requirements from Table 5.7 of the TGD for WQMP*	4,864		
9 Amended soil depth, d_{media} (ft) *Only included in certain BMP types, see Table 5-4 in the TGD for WQMP for reference to BMP design details*	0		
10 Amended soil porosity	0		
11 Gravel depth, d_{media} (ft) *Only included in certain BMP types, see Table 5-4 of the TGD for WQMP for BMP design details*	0		
12 Gravel porosity	0		
13 Duration of storm as basin is filling (hrs) *Typical ~ 3hrs*	3		
14 Above Ground Retention Volume (ft³) *$V_{retention}$ = Item 8 * [Item7 + (Item 9 * Item 10) + (Item 11 * Item 12) + (Item 13 * (Item 4 / 12))]*	0		
15 Underground Retention Volume (ft³) *Volume determined using manufacturer's specifications and calculations*	14,223		
16 Total Retention Volume from LID Infiltration BMPs: 14,223 *(Sum of Items 14 and 15 for all infiltration BMP included in plan)*			
17 Fraction of DCV achieved with infiltration BMP: 610% *Retention% = Item 16 / Form 4.2-1 Item 7*			
18 Is full LID DCV retained on-site with combination of hydrologic source control and LID retention and infiltration BMPs? Yes ☒ No ☐ *If yes, demonstrate conformance using Form 4.3-10; If no, then reduce Item 3, Factor of Safety to 2.0 and increase Item 8, Infiltrating Surface Area, such that the portion of the site area used for retention and infiltration BMPs equals or exceeds the minimum effective area thresholds (Table 5-7 of the TGD for WQMP) for the applicable category of development and repeat all above calculations.*			

Form 4.3-3 Infiltration LID BMP - including underground BMPs (DA 3)

1 Remaining LID DCV not met by site design HSC BMP (ft³) 3,456 *V_{unmet} = Form 4.2-1 Item 7 - Form 4.3-2 Item 30*			
BMP Type *Use columns to the right to compute runoff volume retention from proposed infiltration BMP (select BMP from Table 5-4 in TGD for WQMP) - Use additional forms for more BMPs*	DA 3 DMA - BMP Type Underground Detention	DA DMA BMP Type	DA DMA BMP Type *(Use additional forms for more BMPs)*
2 Infiltration rate of underlying soils (in/hr) *See Section 5.4.2 and Appendix D of the TGD for WQMP for minimum requirements for assessment methods*	1.7		
3 Infiltration safety factor *See TGD Section 5.4.2 and Appendix D*	2		
4 Design percolation rate (in/hr) *P_{design} = Item 2 / Item 3*	0.85		
5 Ponded water drawdown time (hr) *Copy Item 6 in Form 4.2-1*	48		
6 Maximum ponding depth (ft) *BMP specific, see Table 5-4 of the TGD for WQMP for BMP design details*	2.5		
7 Ponding Depth (ft) *d_{BMP} = Minimum of (1/12*Item 4*Item 5) or Item 6*	2.5		
8 Infiltrating surface area, SA_{BMP} (ft²) *the lesser of the area needed for infiltration of full DCV or minimum space requirements from Table 5.7 of the TGD for WQMP*	3,456		
9 Amended soil depth, d_{media} (ft) *Only included in certain BMP types, see Table 5-4 in the TGD for WQMP for reference to BMP design details*	0		
10 Amended soil porosity	0		
11 Gravel depth, d_{media} (ft) *Only included in certain BMP types, see Table 5-4 of the TGD for WQMP for BMP design details*	0		
12 Gravel porosity	0		
13 Duration of storm as basin is filling (hrs) *Typical ~ 3hrs*	3		
14 Above Ground Retention Volume (ft³) *$V_{retention}$ = Item 8 * [Item7 + (Item 9 * Item 10) + (Item 11 * Item 12) + (Item 13 * (Item 4 / 12))]*	0		
15 Underground Retention Volume (ft³) *Volume determined using manufacturer's specifications and calculations*	27,005		
16 Total Retention Volume from LID Infiltration BMPs: 27,005 *(Sum of Items 14 and 15 for all infiltration BMP included in plan)*			
17 Fraction of DCV achieved with infiltration BMP: 781% *:ention% = Item 16 / Form 4.2-1 Item 7*			
18 Is full LID DCV retained on-site with combination of hydrologic source control and LID retention and infiltration BMPs? Yes ☒ No ☐ *If yes, demonstrate conformance using Form 4.3-10; If no, then reduce Item 3, Factor of Safety to 2.0 and increase Item 8, Infiltrating Surface Area, such that the portion of the site area used for retention and infiltration BMPs equals or exceeds the minimum effective area thresholds (Table 5-7 of the TGD for WQMP) for the applicable category of development and repeat all above calculations.*			

Form 4.3-3 Infiltration LID BMP - including underground BMPs (DA 4)

1 Remaining LID DCV not met by site design HSC BMP (ft^3): 12,859 *V_{unmet} = Form 4.2-1 Item 7 - Form 4.3-2 Item 30*			
BMP Type *Use columns to the right to compute runoff volume retention from proposed infiltration BMP (select BMP from Table 5-4 in TGD for WQMP) - Use additional forms for more BMPs*	DA 3 DMA - BMP Type Underground Detention	DA DMA BMP Type	DA DMA BMP Type *(Use additional forms for more BMPs)*
2 Infiltration rate of underlying soils (in/hr) *See Section 5.4.2 and Appendix D of the TGD for WQMP for minimum requirements for assessment methods*	1.7		
3 Infiltration safety factor *See TGD Section 5.4.2 and Appendix D*	2		
4 Design percolation rate (in/hr) *P_{design} = Item 2 / Item 3*	0.85		
5 Ponded water drawdown time (hr) *Copy Item 6 in Form 4.2-1*	48		
6 Maximum ponding depth (ft) *BMP specific, see Table 5-4 of the TGD for WQMP for BMP design details*	2.5		
7 Ponding Depth (ft) *d_{BMP} = Minimum of (1/12*Item 4*Item 5) or Item 6*	2.5		
8 Infiltrating surface area, SA_{BMP} (ft^2) *the lesser of the area needed for infiltration of full DCV or minimum space requirements from Table 5.7 of the TGD for WQMP*	19,184		
9 Amended soil depth, d_{media} (ft) *Only included in certain BMP types, see Table 5-4 in the TGD for WQMP for reference to BMP design details*	0		
10 Amended soil porosity	0		
11 Gravel depth, d_{media} (ft) *Only included in certain BMP types, see Table 5-4 of the TGD for WQMP for BMP design details*	0		
12 Gravel porosity	0		
13 Duration of storm as basin is filling (hrs) *Typical ~ 3hrs*	3		
14 Above Ground Retention Volume (ft^3) *$V_{retention}$ = Item 8 * [Item7 + (Item 9 * Item 10) + (Item 11 * Item 12) + (Item 13 * (Item 4 / 12))]*	0		
15 Underground Retention Volume (ft^3) *Volume determined using manufacturer's specifications and calculations*	57,073		
16 Total Retention Volume from LID Infiltration BMPs: 57,073 *(Sum of Items 14 and 15 for all infiltration BMP included in plan)*			
17 Fraction of DCV achieved with infiltration BMP: 444% *Retention% = Item 16 / Form 4.2-1 Item 7*			
18 Is full LID DCV retained on-site with combination of hydrologic source control and LID retention and infiltration BMPs? Yes ☒ No ☐ *If yes, demonstrate conformance using Form 4.3-10; If no, then reduce Item 3, Factor of Safety to 2.0 and increase Item 8, Infiltrating Surface Area, such that the portion of the site area used for retention and infiltration BMPs equals or exceeds the minimum effective area thresholds (Table 5-7 of the TGD for WQMP) for the applicable category of development and repeat all above calculations.*			

Form 4.3-3 Infiltration LID BMP - including underground BMPs (DA 6)

[1] Remaining LID DCV not met by site design HSC BMP (ft^3): 2,840 *V_{unmet} = Form 4.2-1 Item 7 - Form 4.3-2 Item 30*

BMP Type *Use columns to the right to compute runoff volume retention from proposed infiltration BMP (select BMP from Table 5-4 in TGD for WQMP) - Use additional forms for more BMPs*	DA 6 DMA - BMP Type Underground Detention	DA DMA BMP Type	DA DMA BMP Type *(Use additional forms for more BMPs)*
[2] Infiltration rate of underlying soils (in/hr) *See Section 5.4.2 and Appendix D of the TGD for WQMP for minimum requirements for assessment methods*	1.7		
[3] Infiltration safety factor *See TGD Section 5.4.2 and Appendix D*	2		
[4] Design percolation rate (in/hr) *P_{design} = Item 2 / Item 3*	0.85		
[5] Ponded water drawdown time (hr) *Copy Item 6 in Form 4.2-1*	48		
[6] Maximum ponding depth (ft) *BMP specific, see Table 5-4 of the TGD for WQMP for BMP design details*	2.5		
[7] Ponding Depth (ft) *d_{BMP} = Minimum of (1/12*Item 4*Item 5) or Item 6*	2.5		
[8] Infiltrating surface area, SA_{BMP} (ft^2) *the lesser of the area needed for infiltration of full DCV or minimum space requirements from Table 5.7 of the TGD for WQMP*	3,368		
[9] Amended soil depth, d_{media} (ft) *Only included in certain BMP types, see Table 5-4 in the TGD for WQMP for reference to BMP design details*	0		
[10] Amended soil porosity	0		
[11] Gravel depth, d_{media} (ft) *Only included in certain BMP types, see Table 5-4 of the TGD for WQMP for BMP design details*	0		
[12] Gravel porosity	0		
[13] Duration of storm as basin is filling (hrs) *Typical ~ 3hrs*	3		
[14] Above Ground Retention Volume (ft^3) *$V_{retention}$ = Item 8 * [Item7 + (Item 9 * Item 10) + (Item 11 * Item 12) + (Item 13 * (Item 4 / 12))]*	0		
[15] Underground Retention Volume (ft^3) *Volume determined using manufacturer's specifications and calculations*	9,921		

[16] Total Retention Volume from LID Infiltration BMPs: 9,921 *(Sum of Items 14 and 15 for all infiltration BMP included in plan)*

[17] Fraction of DCV achieved with infiltration BMP: 349% *Retention% = Item 16 / Form 4.2-1 Item 7*

[18] Is full LID DCV retained on-site with combination of hydrologic source control and LID retention and infiltration BMPs? Yes ☒ No ☐

If yes, demonstrate conformance using Form 4.3-10; If no, then reduce Item 3, Factor of Safety to 2.0 and increase Item 8, Infiltrating Surface Area, such that the portion of the site area used for retention and infiltration BMPs equals or exceeds the minimum effective area thresholds (Table 5-7 of the TGD for WQMP) for the applicable category of development and repeat all above calculations.

Form 4.3-3 Infiltration LID BMP - including underground BMPs (DA 9)

1 Remaining LID DCV not met by site design HSC BMP (ft^3): 3,162 *V_{unmet} = Form 4.2-1 Item 7 - Form 4.3-2 Item 30*			
BMP Type *Use columns to the right to compute runoff volume retention from proposed infiltration BMP (select BMP from Table 5-4 in TGD for WQMP) - Use additional forms for more BMPs*	DA 6 DMA - BMP Type Underground Detention	DA DMA BMP Type	DA DMA BMP Type *(Use additional forms for more BMPs)*
2 Infiltration rate of underlying soils (in/hr) *See Section 5.4.2 and Appendix D of the TGD for WQMP for minimum requirements for assessment methods*	1.7		
3 Infiltration safety factor *See TGD Section 5.4.2 and Appendix D*	2		
4 Design percolation rate (in/hr) *P_{design} = Item 2 / Item 3*	0.85		
5 Ponded water drawdown time (hr) *Copy Item 6 in Form 4.2-1*	48		
6 Maximum ponding depth (ft) *BMP specific, see Table 5-4 of the TGD for WQMP for BMP design details*	2.5		
7 Ponding Depth (ft) *d_{BMP} = Minimum of (1/12*Item 4*Item 5) or Item 6*	2.5		
8 Infiltrating surface area, SA_{BMP} (ft^2) *the lesser of the area needed for infiltration of full DCV or minimum space requirements from Table 5.7 of the TGD for WQMP*	5,344		
9 Amended soil depth, d_{media} (ft) *Only included in certain BMP types, see Table 5-4 in the TGD for WQMP for reference to BMP design details*	0		
10 Amended soil porosity	0		
11 Gravel depth, d_{media} (ft) *Only included in certain BMP types, see Table 5-4 of the TGD for WQMP for BMP design details*	0		
12 Gravel porosity	0		
13 Duration of storm as basin is filling (hrs) *Typical ~ 3hrs*	3		
14 Above Ground Retention Volume (ft^3) *$V_{retention}$ = Item 8 * [Item7 + (Item 9 * Item 10) + (Item 11 * Item 12) + (Item 13 * (Item 4 / 12))]*	0		
15 Underground Retention Volume (ft^3) *Volume determined using manufacturer's specifications and calculations*	15,621		
16 Total Retention Volume from LID Infiltration BMPs: 15,621 *(Sum of Items 14 and 15 for all infiltration BMP included in plan)*			
17 Fraction of DCV achieved with infiltration BMP: 494% *Retention% = Item 16 / Form 4.2-1 Item 7*			
18 Is full LID DCV retained on-site with combination of hydrologic source control and LID retention and infiltration BMPs? Yes ☒ No ☐ *If yes, demonstrate conformance using Form 4.3-10; If no, then reduce Item 3, Factor of Safety to 2.0 and increase Item 8, Infiltrating Surface Area, such that the portion of the site area used for retention and infiltration BMPs equals or exceeds the minimum effective area thresholds (Table 5-7 of the TGD for WQMP) for the applicable category of development and repeat all above calculations.*			

SECTION 4.0 SUMMARY

EQUIVALENT AREA OFFSET

DA-5, DA-7 and DA-8

DA-5

DMA H

DESGIN CAPTURE VOLUME (DCV)= 692 CF

DA-7

DMA S
DMA Q

DESIGN CAPTURE VOLUME (DCV) = 3,945 CF

DA-8

DMA R

DESIGN CAPTURE VOLUME (DCV) = 125 CF

TOTAL RUNOFF DCV = 4,762 CF

SUMMARY OF CAPTURED VOLUME

AREA	DCV	UNDERGROUND RETENTION VOLUME
DA-1	3901 CF	27,101 CF
DA-2	2,332 CF	14,223 CF
DA-3	3,456 CF	27,005 CF
DA-4	12,859 CF	57,073 CF
DA-6	2,840 CF	9,921 CF
DA-9	3,162 CF	15,621 CF
TOTAL	**28,550 CF**	**150,944 CF**
TOTAL RUNOFF DCV	**4,762 CF**	
TOTAL	**33,312 CF**	**150,944 CF**

33,312 CF < 15,944 CF --> OKAY

In summary, not only have the underground retention systems been adequately sized to capture the design volume but also sized to reduce the pollutants of concern by infiltrating the volume in amount of 150,944 cf. The proposed site development will not have any negative impacts downstream.

REFER TO APPENDIX 4 FOR MANUFACTURER CALCULATIONS AND SIZING OF THE UNDERGROUND RETENTION UNITS.

4.3.4 Biotreatment BMP

Biotreatment BMPs may be considered if the full LID DCV cannot be met by maximizing retention and infiltration. A key consideration when using biotreatment BMP is the effectiveness of the proposed BMP in addressing the pollutants of concern for the project (see Table 5-5 of the TGD for WQMP).

Use Form 4.3-4 to summarize the potential for volume based and/or flow based biotreatment options to biotreat the remaining unmet LID DCV. Biotreatment computations are included as follows:

- Use Form 4.3-5 to compute biotreatment in small volume based biotreatment BMP (e.g. bioretention w/underdrains);
- Use Form 4.3-6 to compute biotreatment in large volume based biotreatment BMP (e.g. constructed wetlands);
- Use Form 4.3-7 to compute sizing criteria for flow-based biotreatment BMP (e.g. bioswales)

Form 4.3-4 Selection and Evaluation of Biotreatment BMP (DA-1 - DA-9)		
1 Remaining LID DCV not met by site design , or infiltration, BMP for potential biotreatment (ft^3): 0 *Form 4.2-1 Item 7 - Form 4.3-2 Item 19 – Form 4.3-3 Item 16*	List pollutants of concern *Copy from Form 2.3-1.*	
2 Biotreatment BMP Selected *(Select biotreatment BMP(s) necessary to ensure all pollutants of concern are addressed through Unit Operations and Processes, described in Table 5-5 of the TGD for WQMP)*	Volume-based biotreatment *Use Forms 4.3-5 and 4.3-6 to compute treated volume* ☐ Bioretention with underdrain ☐ Planter box with underdrain ☐ Constructed wetlands ☐ Wet extended detention ☐ Dry extended detention	Flow-based biotreatment *Use Form 4.3-7 to compute treated flow* ☐ Vegetated swale ☐ Vegetated filter strip ☐ Proprietary biotreatment
3 Volume biotreated in volume based biotreatment BMP (ft^3): *Form 4.3-5 Item 15 + Form 4.3-6 Item 13*	4 Compute remaining LID DCV with implementation of volume based biotreatment BMP (ft^3): *Item 1 – Item 3*	5 Remaining fraction of LID DCV for sizing flow based biotreatment BMP: % *Item 4 / Item 1*
6 Flow-based biotreatment BMP capacity provided (cfs): *Use Figure 5-2 of the TGD for WQMP to determine flow capacity required to provide biotreatment of remaining percentage of unmet LID DCV (Item 5), for the project's precipitation zone (Form 3-1 Item 1)*		
7 Metrics for MEP determination: • Provided a WQMP with the portion of site area used for suite of LID BMP equal to minimum thresholds in Table 5-7 of the TGD for WQMP for the proposed category of development: ☐ *If maximized on-site retention BMPs is feasible for partial capture, then LID BMP implementation must be optimized to retain and infiltrate the maximum portion of the DCV possible within the prescribed minimum effective area. The remaining portion of the DCV shall then be mitigated using biotreatment BMP.*		

Form 4.3-5 Volume Based Biotreatment (DA-1 - DA-9)
Bioretention and Planter Boxes with Underdrains

Biotreatment BMP Type *(Bioretention w/underdrain, planter box w/underdrain, other comparable BMP)*	DA DMA BMP Type	DA DMA BMP Type	DA DMA BMP Type *(Use additional forms for more BMPs)*
1 Pollutants addressed with BMP *List all pollutant of concern that will be effectively reduced through specific Unit Operations and Processes described in Table 5-5 of the TGD for WQMP*			
2 Amended soil infiltration rate *Typical ~ 5.0*			
3 Amended soil infiltration safety factor *Typical ~ 2.0*			
4 Amended soil design percolation rate (in/hr) *P_{design} = Item 2 / Item 3*			
5 Ponded water drawdown time (hr) *Copy Item 6 from Form 4.2-1*			
6 Maximum ponding depth (ft) *see Table 5-6 of the TGD for WQMP for reference to BMP design details*			
7 Ponding Depth (ft) *d_{BMP} = Minimum of (1/12 * Item 4 * Item 5) or Item 6*			
8 Amended soil surface area (ft^2)			
9 Amended soil depth (ft) *see Table 5-6 of the TGD for WQMP for reference to BMP design details*			
10 Amended soil porosity, *n*			
11 Gravel depth (ft) *see Table 5-6 of the TGD for WQMP for reference to BMP design details*			
12 Gravel porosity, *n*			
13 Duration of storm as basin is filling (hrs) *Typical ~ 3hrs*			
14 Biotreated Volume (ft^3) *$V_{biotreated}$ = Item 8 * [(Item 7/2) + (Item 9 * Item 10) +(Item 11 * Item 12) + (Item 13 * (Item 4 / 12))]*			
15 Total biotreated volume from bioretention and/or planter box with underdrains BMP: *Sum of Item 14 for all volume-based BMPs included in this form*			

Form 4.3-6 Volume Based Biotreatment (DA-1 - DA-9)
Constructed Wetlands and Extended Detention

Biotreatment BMP Type *Constructed wetlands, extended wet detention, extended dry detention, or other comparable proprietary BMP. If BMP includes multiple modules (E.g. forebay and main basin), provide separate estimates for storage and pollutants treated in each module.*	DA DMA BMP Type		DA DMA BMP Type *(Use additional forms for more BMPs)*	
	Forebay	Basin	Forebay	Basin
1 Pollutants addressed with BMP forebay and basin *List all pollutant of concern that will be effectively reduced through specific Unit Operations and Processes described in Table 5-5 of the TGD for WQMP*				
2 Bottom width (ft)				
3 Bottom length (ft)				
4 Bottom area (ft^2) A_{bottom} *= Item 2 * Item 3*				
5 Side slope (ft/ft)				
6 Depth of storage (ft)				
7 Water surface area (ft^2) $A_{surface}$ *=(Item 2 + (2 * Item 5 * Item 6)) * (Item 3 + (2 * Item 5 * Item 6))*				
8 Storage volume (ft^3) *For BMP with a forebay, ensure fraction of total storage is within ranges specified in BMP specific fact sheets, see Table 5-6 of the TGD for WQMP for reference to BMP design details* V *=Item 6 / 3 * [Item 4 + Item 7 + (Item 4 * Item 7)^0.5]*				
9 Drawdown Time (hrs) *Copy Item 6 from Form 2.1*				
10 Outflow rate (cfs) Q_{BMP} *= (Item* $8_{forebay}$ *+ Item* 8_{basin}*) / (Item 9 * 3600)*				
11 Duration of design storm event (hrs)				
12 Biotreated Volume (ft^3) $V_{biotreated}$ *= (Item* $8_{forebay}$ *+ Item* 8_{basin}*) +(Item 10 * Item 11 * 3600)*				

13 Total biotreated volume from constructed wetlands, extended dry detention, or extended wet detention :
(Sum of Item 12 for all BMP included in plan)

Form 4.3-7 Flow Based Biotreatment (DA-1 - DA-9)			
Biotreatment BMP Type *Vegetated swale, vegetated filter strip, or other comparable proprietary BMP*	DA DMA BMP Type	DA DMA BMP Type	DA DMA BMP Type *(Use additional forms for more BMPs)*
1 Pollutants addressed with BMP *List all pollutant of concern that will be effectively reduced through specific Unit Operations and Processes described in TGD Table 5-5*			
2 Flow depth for water quality treatment (ft) *BMP specific, see Table 5-6 of the TGD for WQMP for reference to BMP design details*			
3 Bed slope (ft/ft) *BMP specific, see Table 5-6 of the TGD for WQMP for reference to BMP design details*			
4 Manning's roughness coefficient			
5 Bottom width (ft) *b_w = (Form 4.3-5 Item 6 * Item 4) / (1.49 * Item $2^{1.67}$ * Item $3^{0.5}$)*			
6 Side Slope (ft/ft) *BMP specific, see Table 5-6 of the TGD for WQMP for reference to BMP design details*			
7 Cross sectional area (ft^2) *A = (Item 5 * Item 2) + (Item 6 * Item 2^2)*			
8 Water quality flow velocity (ft/sec) *V = Form 4.3-5 Item 6 / Item 7*			
9 Hydraulic residence time (min) *Pollutant specific, see Table 5-6 of the TGD for WQMP for reference to BMP design details*			
10 Length of flow based BMP (ft) *L = Item 8 * Item 9 * 60*			
11 Water surface area at water quality flow depth (ft^2) *SA_{top} = (Item 5 + (2 * Item 2 * Item 6)) * Item 10*			

4.3.5 Conformance Summary

Complete Form 4.3-8 to demonstrate how on-site LID DCV is met with proposed site design, infiltration, and/or biotreatment BMP. The bottom line of the form is used to describe the basis for infeasibility determination for on-site LID BMP to achieve full LID DCV, and provides methods for computing remaining volume to be addressed in an alternative compliance plan. If the project has more than one outlet, then complete additional versions of this form for each outlet.

Form 4.3-8 Conformance Summary and Alternative Compliance Volume Estimate (DA-1 - DA-9)

1 Total LID DCV for the Project DA-1 (ft^3): *Copy Item 7 in Form 4.2-1*

2 On-site retention with site design BMP (ft^3): *Copy Item18 in Form 4.3-2*

3 On-site retention with LID infiltration BMP (ft^3): *Copy Item 16 in Form 4.3-3*

4 On-site biotreatment with volume based biotreatment BMP (ft^3): *Copy Item 3 in Form 4.3-4*

5 Flow capacity provided by flow based biotreatment BMP (cfs): *Copy Item 6 in Form 4.3-4*

6 LID BMP performance criteria are achieved if answer to any of the following is "Yes":

- Full retention of LID DCV with site design or infiltration BMP: Yes ☐ No ☐
  If yes, sum of Items 2, 3, and 4 is greater than Item 1
- Combination of on-site retention BMPs for a portion of the LID DCV and volume-based biotreatment BMP that address all pollutants of concern for the remaining LID DCV: Yes ☐ No ☐
  If yes, a) sum of Items 2, 3, 4, and 5 is greater than Item 1, and Items 2, 3 and 4 are maximized; or b) Item 6 is greater than Form 4.3--5 Item 6 and Items 2, 3 and 4 are maximized
- On-site retention and infiltration is determined to be infeasible; therefore biotreatment BMP provides biotreatment for all pollutants of concern for full LID DCV: Yes ☐ No ☐
  If yes, Form 4.3-1 Items 7 and 8 were both checked yes

7 If the LID DCV is not achieved by any of these means, then the project may be allowed to develop an alternative compliance plan. Check box that describes the scenario which caused the need for alternative compliance:

- Combination of Site Design, retention and infiltration, , and biotreatment BMPs provide less than full LID DCV capture: ☐
  Checked yes if Form 4.3-4 Item 7is checked yes, Form 4.3-4 Item 6 is zero, and sum of Items 2, 3, 4, and 5 is less than Item 1. If so, apply water quality credits and calculate volume for alternative compliance, V_{alt} *= (Item 1 – Item 2 – Item 3 – Item 4 – Item 5) * (100 - Form 2.4-1 Item 2)%*

- Facilities, or a combination of facilities, of a different design than in Section E.12.e.(ii)(f) may be permitted if all of the following Phase II Small MS4 General Permit 2013-0001-DWQ 55 February 5, 2013 measures of equivalent effectiveness are demonstrated:
  1) Equal or greater amount of runoff infiltrated or evapotranspired; ☐
  2) Equal or lower pollutant concentrations in runoff that is discharged after biotreatment; ☐
  3) Equal or greater protection against shock loadings and spills; ☐
  4) Equal or greater accessibility and ease of inspection and maintenance. ☐

4.3.6 Hydromodification Control BMP

Use Form 4.3-9 to compute the remaining runoff volume retention, after Site Design BMPs are implemented, needed to address hydromodification, and the increase in time of concentration and decrease in peak runoff necessary to meet targets for protection of waterbodies with a potential hydromodification. Describe the proposed hydromodification treatment control BMP. Section 5.6 of the TGD for WQMP provides additional details on selection and evaluation of hydromodification control BMP.

Form 4.3-9 Hydromodification Control BMPs (DA-1 - DA-9)	
1 Volume reduction needed for hydromodification performance criteria (ft³): *(Form 4.2-2 Item 4 * 0.95) – Form 4.2-2 Item 1*	2 On-site retention with site design and infiltration, BMP (ft³): *Sum of Form 4.3-8 Items 2, 3, and 4. Evaluate option to increase implementation of on-site retention in Forms 4.3-2, 4.3-3, and 4.3-4 in excess of LID DCV toward achieving hydromodification volume reduction*
3 Remaining volume for hydromodification volume capture (ft³): *Item 1 – Item 2*	4 Volume capture provided by incorporating additional on-site BMPs (ft³):
5 Is Form 4.2-2 Item 11 less than or equal to 5%: Yes ☐ No ☐ *If yes, hydromodification performance criteria is achieved. If no, select one or more mitigation options below:* • Demonstrate increase in time of concentration achieved by proposed LID site design, LID BMP, and additional on-site BMP ☐ • Increase time of concentration by preserving pre-developed flow path and/or increase travel time by reducing slope and increasing cross-sectional area and roughness for proposed on-site conveyance facilities ☐	
6 Form 4.2-2 Item 12 less than or equal to 5%: Yes ☐ No ☐ *If yes, hydromodification performance criteria is achieved. If no, select one or more mitigation options below:* • Demonstrate reduction in peak runoff achieved by proposed LID site design, LID BMPs, and additional on-site retention BMPs ☐	

4.4 Alternative Compliance Plan (if applicable)

Describe an alternative compliance plan (if applicable) for projects not fully able to infiltrate, or biotreat the DCV via on-site LID practices. A project proponent must develop an alternative compliance plan to address the remainder of the LID DCV. Depending on project type some projects may qualify for water quality credits that can be applied to reduce the DCV that must be treated prior to development of an alternative compliance plan (see Form 2.4-1, Water Quality Credits). Form 4.3-9 Item 8 includes instructions on how to apply water quality credits when computing the DCV that must be met through alternative compliance.

Alternative Designs — Facilities, or a combination of facilities, of a different design than in Permit Section E.12.e.(ii)(f) may be permitted if all of the following measures of equivalent effectiveness are demonstrated:

1) Equal or greater amount of runoff infiltrated or evapotranspired;

2) Equal or lower pollutant concentrations in runoff that is discharged after biotreatment;

3) Equal or greater protection against shock loadings and spills;

4) Equal or greater accessibility and ease of inspection and maintenance.

The Project Proponent will need to obtain written approval for an alternative design from the Lahontan Regional Water Board Executive Officer (see Section 6 of the TGD for WQMP).

Section 5 Inspection and Maintenance Responsibility for Post Construction BMP

All BMPs included as part of the project WQMP are required to be maintained through regular scheduled inspection and maintenance (refer to Section 8, Post Construction BMP Requirements, in the TGD for WQMP). Fully complete Form 5-1 summarizing all BMP included in the WQMP. Attach additional forms as needed. The WQMP shall also include a detailed Operation and Maintenance Plan for all BMP and a Maintenance Agreement. The Maintenance Agreement must also be attached to the WQMP.

Note that at time of Project construction completion, the Maintenance Agreement must be completed, signed, notarized and submitted to the County Stormwater Department

Form 5-1 BMP Inspection and Maintenance (use additional forms as necessary)

BMP	Reponsible Party(s)	Inspection/ Maintenance Activities Required	Minimum Frequency of Activities
Undergro und Retention S System	OWNER: Broadway Chinatown LLC PO Box 151813 Los Angeles CA 90015 Fraydoon Bral 310-925-1234 fbral126@gmail.com Owner as listed above	1. Inspect system after initial installation to establish a baseline condition. 2. Initial and subsequent inspection data should be recorded and filed for reference. 3. Inspect access ports. Insert a measuring device into the opening making note of a point of reference to determine the quantity of sediment and other accumulated material. If access is required to measure, ensure only certified space entry personal having appropriate equipment are allowed to enter system. 4. Remove any debris, trash and obstructions. 5. Cleanout of system should be considered if there is sediment buildup of two or more inches at over 50% of inspection orts. Cleaning shall be performed if sediment buildup is two inches or more over 75% of the system floor. Cleaning shall be performed by either a vacuum truck or manual method. 6. Refer to attached CUDO O&M Plan in	Inspect in January and June, and before and after any rainfall events.

		Appendix 3 for further information.	
N1-Education for Property Owners	Owner as listed above	1. Train employees janitorial staff to dispose of floor cleaning in sewer line, not into parking lot. 2. Discontinue all non-stormwater discharges to the storm drain system. It is prohibited to discharge any chemicals, wastes or wastewater into the gutter, street or storm drain. 3. Store material safely. 4. Properly cleanup and dispose of material per San Bernardino County recycling and disposal information, 909.386.8401. 5. Refer to attached Education Owner Information in Appendix 6 for further clarification.	Train staff once a year in January, and train new staff as hired.
N2-Activity Restrictions	Owner as listed above	1. Refer to attached CC&Rs in Appendix 8 for activity restrictions.	Throughout life of project.
N3-Landscape Management	Owner as listed above.	1. Keep landscaping materials away from street, gutter and storm drains. Stockpiles shall be covered with plastic sheeting. 2. Conserve water and prevent runoff. Periodically inspect, fix leaks. 3. Recycle yard waste. 4. Refer to Landscape Maintenance Handout provided in Appendix 6 for further information.	Practice throughout life of project.
N7-Spill Contingency Plan	Owner as listed above	1. Develop a Spill Prevention Control and Countermeasure Plan (SPCC); including said items as listed on the CASQA BMP SC-11 handout in Appendix 6. 2. Recycle, reclaim, or reuse materials whenever possible. 3. Store and contain liquid materials in	Sweep and clean the storage area at the first of each month. Practice Spill Prevention measures throughout the life

		such a manner that if a tank is ruptured, the contents will not discharge, flow, or be washed into the storm drainage system, surface waters or groundwater. 4. Place drip pans or absorbent materials beneath all mounted taps and at all potential drip and spill locations during filing and unloading of tanks. Any collected liquids or soiled absorbent materials must be reused/recycled properly. 5. Provide routine maintenance. Sweep and clean area, do not hose down. 6. Report spills that pose an immediate threat to human health or the environment to the Regional Water Quality Control Board. 7. Federal regulations require that any oil spill into a water body be reported to the national response center at 800.424.8802 8. Report spills to local agencies that can assist in cleanup. 9. Establish a tracking system that identifies; types and quantities of wastes, patterns in time of occurrence, mode of dumping and responsible parties. 10. Refer to CASQA BMP SC-11 handout in Appendix 6 for further information.	of the project.
N11-Litter Control	Owner as listed above.	1. Remove debris in a timely manner. 2. Establish a daily checklist of office, yard and plant areas to confirm cleanliness and adherence to proper storage and security. Specific employees should be assigned specific inspection responsibilities and given the authority to remedy the problem. 3. Dispose of wash water, sweeping and sediment properly. 4. Train employees per N-1 listed above. 5. Cleanup any spills per N-7 listed above.	Sweep and clean at the first of each month.

		6. Refer to CASQA BMP SC-60 handout in Appendix 6 for further information.	
N-12 Employee Training	Owner as listed above	1. Refer to N-1 listed above	Train staff once a year in January, and train new staff as hired.
N-13 Housekeeping of Loading Docks	Owner as listed above	1. Cleanup procedures shall minimize the use of water and was water shall not discharge into the storm drain system. 2. Refer to N7 and N11 above. 3. Refer to CASQA BMP SD-31 listed above.	Sweep and clean at the first of each month. Spill prevention shall be implemented throughout the life of the project.
Catch Basin Filter Inserts	Owner as listed above	1.Clear trash and debris located immediately in front of curb opening or side opening of CB, and on top or between metal grates or grated CB. 2.Remove vegetation growing across and or blocking the basin opening. 3.Remove Trash and debris in the connector pipe opening, upstream or downstream. 4.Knock off/remove all debris that covers the perforated openings of the connector pipe screen. 5.Ensure there is no standing water inside of catch basin.	Quarterly

Section 6 WQMP Attachments

6.1. Site Plan and Drainage Plan

Include a site plan and drainage plan sheet set containing the following minimum information:

- Project location
- Site boundary
- Land uses and land covers, as applicable
- Suitability/feasibility constraints
- Structural Source Control BMP locations
- Site Design Hydrologic Source Control BMP locations
- LID BMP details
- Drainage delineations and flow information
- Drainage connections

6.2 Electronic Data Submittal

Minimum requirements include submittal of PDF exhibits in addition to hard copies. Format must not require specialized software to open. If the local jurisdiction requires specialized electronic document formats (as described in their Local Implementation Plan), this section will describe the contents (e.g., layering, nomenclature, geo-referencing, etc.) of these documents so that they may be interpreted efficiently and accurately.

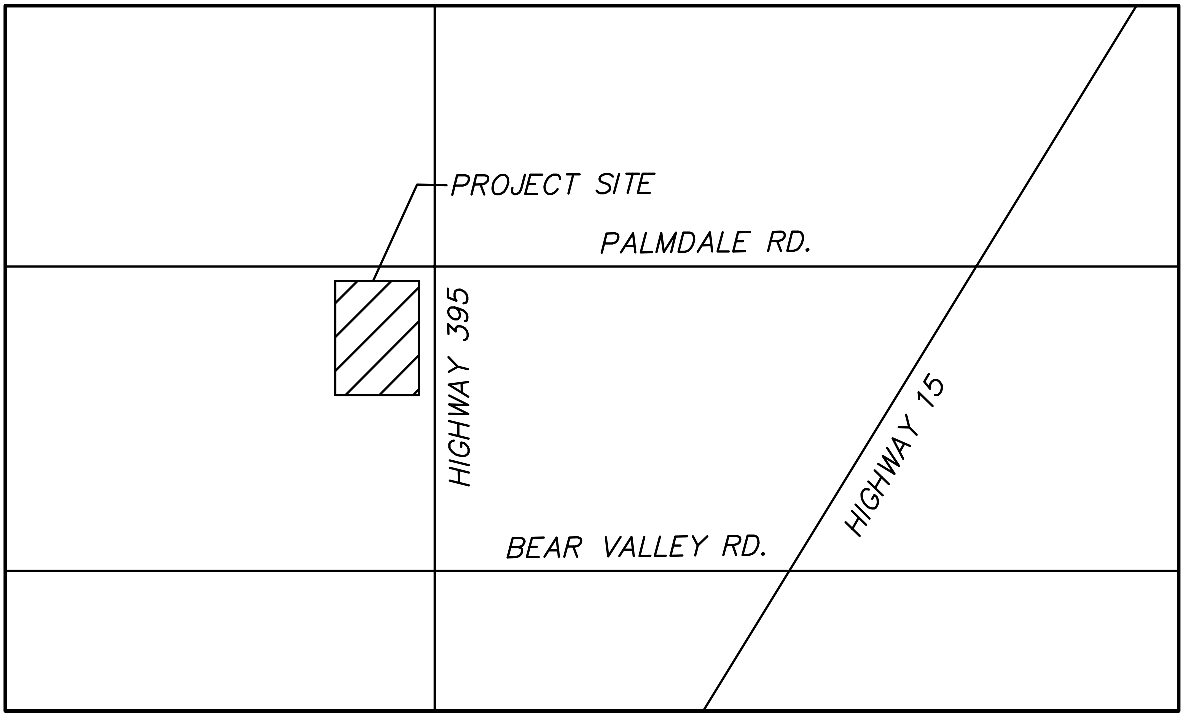
6.3 Post Construction

Attach all O&M Plans and Maintenance Agreements for BMP to the WQMP.

6.4 Other Supporting Documentation

- BMP Educational Materials
- Activity Restriction – C,C&R's & Lease Agreements

APPENDIX 1



VICINITY MAP

NTS

PRELIMINARY IMPROVEMENT PLANS
FOR
DESERT GROVE
SWC US ROUTE 395 & PALMDALE ROAD (S.R. 18)
VICTORVILLE, CA

LEGAL DESCRIPTION

PARCEL A:
PARCELS 2 AND 3 OF PARCEL MAP NO. 14750, IN THE CITY OF VICTORVILLE, COUNTY OF SAN BERNARDINO, STATE OF CALIFORNIA, AS PER PLAT RECORDED IN BOOK 178 OF PARCEL MAPS, PAGES 63 AND 64, RECORDS OF SAID COUNTY.

PARCEL B:
THAT PORTION OF THE EAST 925.38 FEET OF THE NORTH 1/2 OF THE NORTHEAST 1/4 OF THE SOUTHEAST 1/4 AND THE NORTH 396 FEET OF THE SOUTHEAST ¼ OF THE NORTHEAST 1/4 OF THE SOUTHEAST 1/4 OF SECTION 21 , TOWNSHIP 5 NORTH, RANGE 5 WEST, SAN BERNARDINO BASE AND MERIDIAN, IN THE COUNTY OF SAN BERNARDINO, STATE OF CALIFORNIA, DESCRIBED AS FOLLOWS:
COMMENCING AT THE EAST 1/4 CORNER OF SAID SECTION 21 , THENCE SOUTH 89° 23' 23" WEST, ALONG THE EAST-WEST CENTER SECTION LINE, A DISTANCE OF 925.38 FEET;
THENCE SOUTH 0° 13' 05' EAST, A DISTANCE OF 70.00 FEET TO THE TRUE POINT OF BEGINNING;
THENCE CONTINUING SOUTH 00° 13' 05" EAST, A DISTANCE OF 590.30 FEET;

THENCE NORTH 89° 24' 57" EAST, A DISTANCE OF 262.40 FEET;
THENCE SOUTH 0° 10' 38" EAST, A DISTANCE OF 396.01 FEET;
THENCE NORTH 89° 24' 57" EAST, A DISTANCE OF 592.84 FEET;
THENCE NORTH 1° 13' 57" WEST, A DISTANCE OF 513.92FEET;
THENCE NORTH 89° 56' 37" WEST, A DISTANCE OF 149.83;
THENCE NORTH 1° 13' 57" WEST, A DISTANCE OF 409.92 FEET;
THENCE NORTH 0° 03' 23" EAST, A DISTANCE OF 50.00 FEET;
THENCE NORTH 89° 56' 37" WEST, A DISTANCE OF 140.30 FEET;
THENCE SOUTH 0° 03' 23" WEST, A DISTANCE OF 150.00 FEET;
THENCE NORTH 89DEG. 56' 37" WEST, A DISTANCE OF 204.38 FEET
THENCE NORTH 0° 03' 23" EAST, A DISTANCE OF 150 FEET;
THENCE NORTH 89° 56' 37" WEST, A DISTANCE OF 327.65 FEET;
THENCE NORTH 0° 03' 23" WEST, A DISTANCE OF 3.00 FEET;
THENCE NORTH 89° 28" 07" WEST, A DISTANCE OF 16.70 FEET TO THE TRUE POINT OF BEGINNING.

PARCEL C:
A NON-EXCLUSIVE RECIPROCAL ACCESS EASEMENT FOR INGRESS AND EGRESS AS SHOWN ON PARCEL MAP NO. 14750 RECORDED IN BOOK 178 OF PARCEL MAPS, PAGES 63 AND 64, AND BY DOCUMENT RECORDED JULY 20, 1995, INSTRUMENT NO. 95-249758, OFFICIAL RECORDS.

NOTE: BOUNDARY SHOWN HEREON IS COMPILED FROM RECORD DATA

EASEMENT NOTES:

1. AND 2. TAXES; NOT SURVEY MATTERS

3. A RIGHT OF WAY FOR DITCHES AND CANALS BY THE UNITED STATES OF AMERICA IN PATENT RECORDED NOVEMBER 21, 1924 IN BOOK O OF PATENTS, PAGE 83.
AFFECTS: BLANKET IN NATURE

4. AN EASEMENT FOR POLE LINES AND INCIDNEITAL PURPOSES, RECORDED APRIL 29, 1931 AS BOOK 718, PAGE 69 OF OFFICIAL RECORDS.
IN FAVOR OF: SOUTHERN SIERRAS POWER COMPANY
AFFECTS: DOES NOT AFFECT SUBJECT PROPERTY; WITHIN U.S. ROUTE 395

5. AN EASEMENT FOR POLE LINES AND INCIDENTAL PURPOSES, RECORDED APRIL 10, 1933 AS BOOK 878, PAGE 267 OF OFFICIAL RECORDS.
IN FAVOR OF: SOUTHERN SIERRAS POWER COMPANY
AFFECTS: DOES NOT AFFECT SUBJECT PROPERTY; WITHIN STATE ROUTE 18

6. ITEM HAS BEEN INTENTIONALLY DELETED BY TITLE.

7. AN EASEMENT FOR ELECTRIC TRANSMISSION, DISTRIBUTION AND COMMUNICATION PURPOSES AND INCIDENTAL PURPOSES, RECORDED NOVEMBER 9, 1994 AS INSTRUMENT NO. 94-454474 OF OFFICIAL RECORDS.
IN FAVOR OF: SOUTHERN CALIFORNIA EDISON COMPANY, A CORPORATION.
AFFECTS: DOES NOT AFFECT SUBJECT PROPERTY

8. AN EASEMENT SHOWN OR DEDICATED ON THE MAP OF PARCEL MAP 14750 RECORDED JULY 20, 1995 ON FILE IN BOOK 178, PAGE 63 AND 64 OF PARCEL MAPS.
FOR: INGRESS AND EGRESS AND RECIPROCAL ACCESS EASEMENTS AND INCIDENTAL PURPOSES.
AFFECTS: SHOWN HEREON.

9. THE TERMS AND PROVISIONS CONTAINED IN THE DOCUMENT ENTITLED "LAND DIVISION IMPROVEMENT CONSTRUCTION AGREEMENT" RECORDED JULY 20, 1995 AS INSTRUMENT NO. 95-249755 OF OFFICIAL RECORDS.
AFFECTS: NOT A SURVEY MATTER.

10. THE TERMS AND PROVISIONS CONTAINED IN THE DOCUMENT ENTITLED "UTILITY UNDERGROUNDING SUSPENSION AGREEMENT" RECORDED JULY 20, 1995 AS INSTRUMENT NO. 95-249756 OF OFFICIAL RECORDS.
A CONDITIONAL CERTIFICATE OF COMPLIANCE NO. P-94-181 RECORDED JULY 20, 1995, INSTRUMENT NO. 95-249757 OFFICIAL RECORDS, EXECUTED BY THE PLANNING COMMISSION OF THE CITY OF VICTORVILLE, RECITES IN PART:
"PURSUANT TO SECTION 66499.35 OF THE GOVERNMENT CODE OF THE STATE OF CALIFORNIA, THE PLANNING COMMISSION OF THE CITY OF VICTORVILLE ON THE 11TH DATE OF JAN. 1995, MADE A FINDING THAT THE FOLLOWING DESCRIBED REAL PROPERTY DOES NOT COMPLY WITH THE CALIFORNIA SUBDIVISION MAP ACT AND LOCAL ORDINANCES ADOPTED PURSUANT TO THAT ACT."
AFFECTS: NOT A SURVEY MATTER.

11. THE TERMS, PROVISIONS, AND EASEMENT CONTAINED IN THE DOCUMENT ENTITLED "EASEMENT AND MAINTEANCE AGREEMENT" RECORDED JULY 20, 1995 AS INSTRUMENT NO 95-249758 OF OFFICIAL RECORDS.
AFFECTS: SHOWN HEREON.

12. THE TERMS AND PROVISIONS CONTAINED IN THE DOCUMENT ENTITLED "UTILITY UNDERGROUNDING SUSPENSION AGREEMENT" RECORDED AUGUST 15, 1995 AS INSTRUMENT NO. 95-280812 OF OFFICIAL RECORDS.
AFFECTS: NOT A SURVEY MATTER.

13. AN EASEMENT FOR SEWER LINE AND INCIDENTAL PURPOSES, RECORDED FEBRUARY 5, 2002 AS INSTRUMENT NO. 2002-058015 OF OFFICIAL RECORDS.
IN FAVOR OF: THE CITY OF VICTORVILLE
AFFECTS: SHOWN HEREON.

14. THE TERMS AND PROVISIONS CONTAINED IN THE DOCUMENT ENTITLED "MASTER AGREEMENT" RECORDED OCTOBER 6, 2003 AS INSTRUMENT NO. 2003-0753603 OF OFFICIAL RECORDS.
AFFECTS: NOT A SURVEY MATTER.

15. REDEVELOPMENT PROJECT AREA; NOT A SURVEY MATTER.

16. THE EFFECT OF DEED: NOT A SURVEY MATTER.

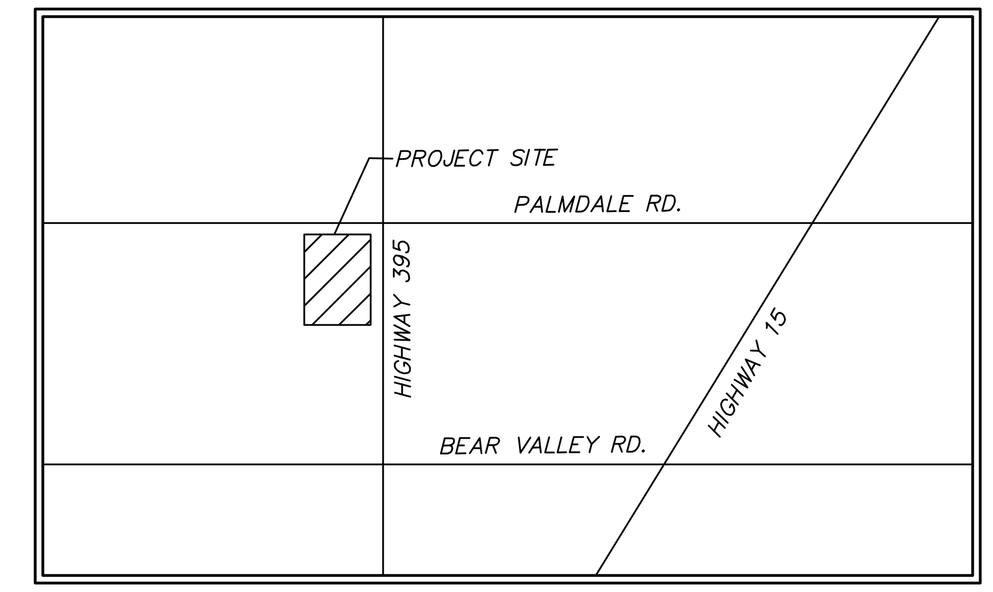
17. THE EFFECT OF DEED: NOT A SURVEY MATTER.

18. WATER RIGHTS; NOT A SURVEY MATTER.

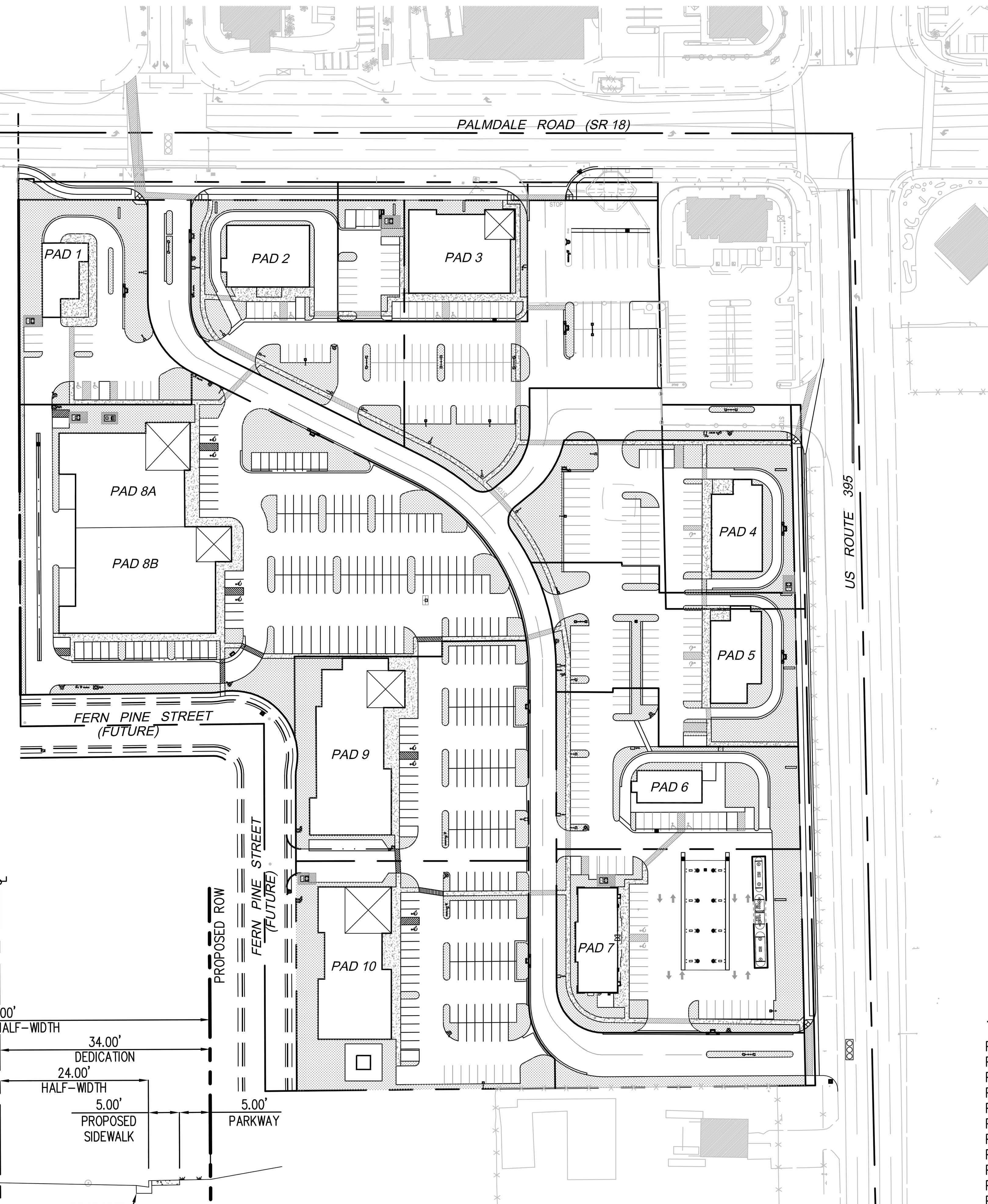
19. RIGHTS OF PARTIES IN POSSESSION; NOT A SURVEY MATTER.

20. AN EASEMENT FOR DRAINAGE PURPOSES, TEMPORARY EASEMENT FOR HIGHWAY CONSTRUCTION PURPOSES AND INCIDENTAL PURPOSES, RECORDED APRIL 11, 1994 AS INSTRUMENT NO. 94-168485 OF OFFICIAL RECORDS.
IN FAVOR OF: THE PEOPLE OF THE STATE OF CALIFORNIA, ACTING BY AND THROUGH THE DEPARTMENT OF TRANSPORTATION.
AFFECTS: SHOWN HEREON.

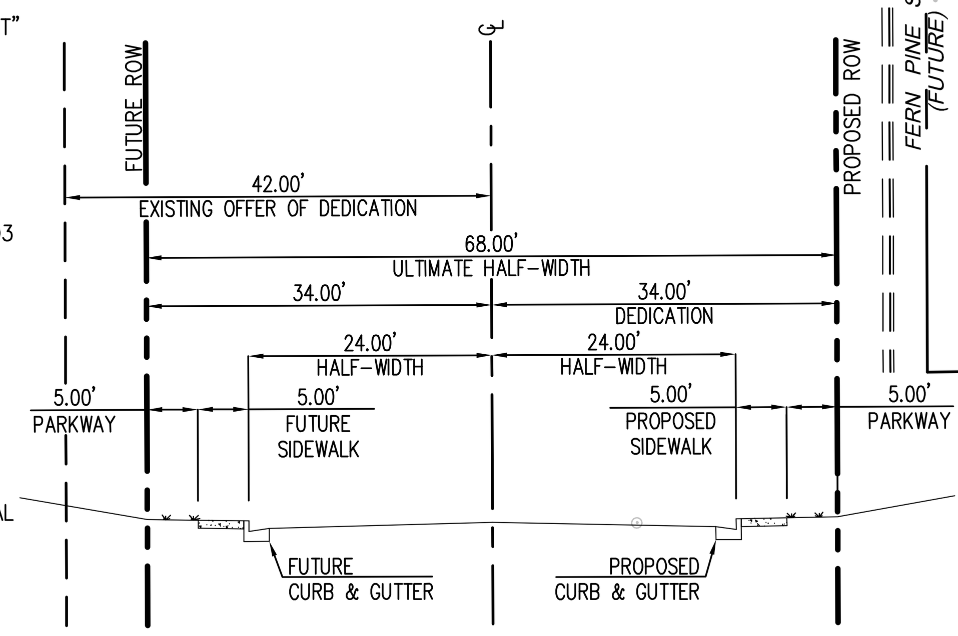
21. AN EASEMENT FOR INGRESS AND EGRESS TO A WATER WELL SITE AND INCIDENTAL PURPOSES RECORDED JULY 20, 1995 AS INSTRUMENT NO. 95249759 OF OFFICIAL RECORDS.
IN FAVOR OF: MNBY CORPORATION, INCORPORATED, A CALIFORNIA CORPORATION.
AFFECTS: SHOWN HEREON. TITLE NOTE; NOT A SURVEY MATTER.



VICINITY MAP
NTS

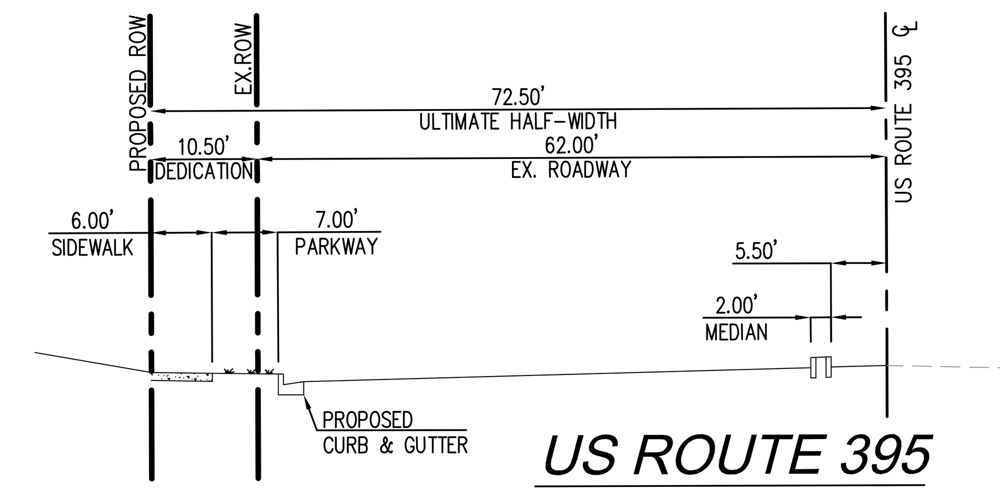


INDEX MAP
NTS



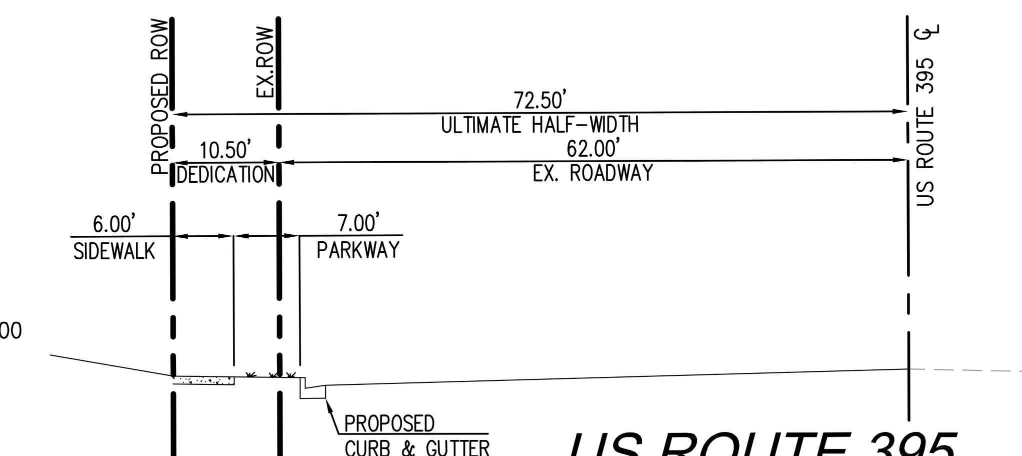
FERN PINE STREET
NTS

SHEET INDEX:



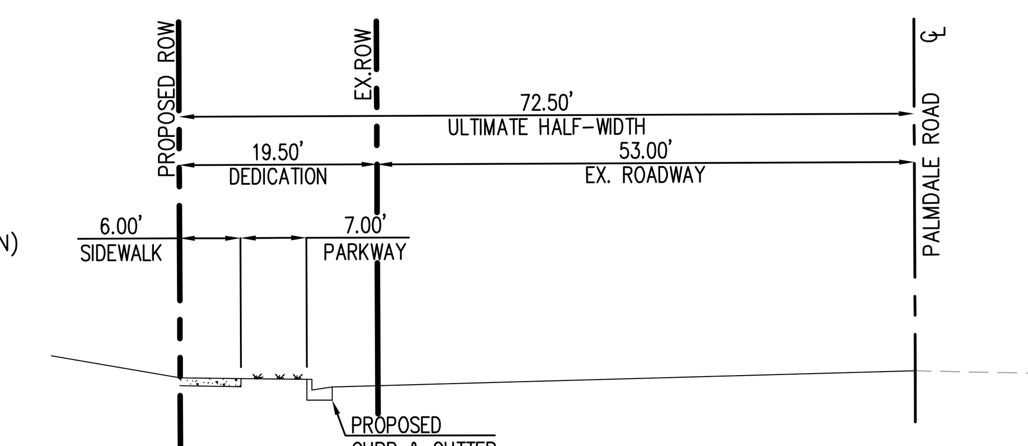
US ROUTE 395
NTS

*FROM APPROXIMATELY 60' SOUTH OF THE INTERSECTION OF PALMDALE ROAD AND US ROUTE 395 TO APPROXIMATELY 350' SOUTH OF THE INTERSECTION OF PALMDALE ROAD AND US ROUTE 395.



US ROUTE 395
NTS

*FROM APPROXIMATELY 350' SOUTH OF THE INTERSECTION OF PALMDALE ROAD AND US ROUTE 395 TO SOUTHERN PROJECT BORDER.



PALMDALE ROAD
NTS

SITE SUMMARY:

APN: 3103-531-18-0-000,-19-0-000, -20-0-000

EXISTING LAND USE: VACANT LAND

PROPOSED LAND USE: COMMERCIAL

PROPOSED BUILDING AREAS:

PAD 1	3,000 SF
PAD 2	6,000 SF
PAD 3	9,700 SF
PAD 4	5,000 SF
PAD 5	5,000 SF
PAD 6	2,800 SF
PAD 7	4,968 SF
PAD 8	32,000 SF
PAD 9	15,560 SF
PAD 10	12,272 SF
TOTAL	96,300 SF

ZONING DESIGNATION: C-2 COMMERCIAL (TO REMAIN)

PARCEL SIZE SUMMARY:

PARCEL 1:	33,349 SQ.FT
PARCEL 2:	47,714 SQ.FT
PARCEL 3:	67,813 SQ.FT
PARCEL 4:	41,883 SQ.FT
PARCEL 5:	40,803 SQ.FT
PARCEL 6:	35,623 SQ.FT
PARCEL 7:	51,933 SQ.FT
PARCEL 8:	136,463 SQ.FT
PARCEL 9:	56,854 SQ.FT
PARCEL 10:	63,148 SQ.FT
PARCEL 11:	68,891 SQ.FT
TOTAL:	644,474 SQ.FT

DIGALERT

CALL BEFORE YOU DIG
1-800-227-2600
AT LEAST
2 WORKING DAY
NOTICE REQUIRED

PROJECT BENCH MARK:

CITY OF VICTORVILLE BM NO. V-239.

ELEVATION: 3139.74

CONCRETE MONUMENT WITH BRASS CAP STAMPED "CA DIV HWY ADOBE 1972" 145 FT. NORTH OF HWY 395.

BASIS OF BEARINGS:

THE BEARING OF N89°29'38"E OF THE SOUTHERLY LINE OF HTE NORTHEAST QUARTER OF SECTION 21, TWP. 5 NORTH, RGE 5 WEST, SBBM PER PARCEL MAP NO. 14750 FILED IN BOOK 178 PAGES 63 AND 64 OF PARCEL MAPS, RECORDS OF SAN BERNARDINO COUNTY WAS TAKEN AS THE BASIS OF BEARINGS FOR THIS SURVEY.

ENGINEER
STEVEN JOHNSON, PE
BLUE PEAK ENGINEERING, INC.
18543 YORBA LINDA BLVD. #235
YORBA LINDA, CA. 92886
310.780.0386

ARCHITECT
THOMAS STEWART
AVALON ARCHITECTURAL, INC.
18006 SKY PARK CIRCLE, SUITE 100
IRVINE, CA. 92614
949.640.0606

LANDSCAPE ARCHITECT
ROBERT CURLEY
CUMMINGS CURLEY & ASSOCIATES, INC.
3633 LONG BEACH BLVD., SUITE 300
LONG BEACH, CA 90807
562.424.8182

OWNER'S CONTACT
FRAYDOON BRAL
BROADWAY CHINATOWN
PO BOX. 15813
LOS ANGELES, CA. 90015
310.925.1234

TRAFFIC ENGINEER
THOMAS WHEAT, PE
TJW ENGINEERING, INC
6 VENTURA, SUITE 225
IRVINE, CA. 92618
949.878.3509

SURVEYOR
PETER GRAY
DRG, INC
621 VIA ALONDRA, SUITE 609
CAMARILLO, CA 93012
805.987.3945

EARTHWORK:

CUT:	30,000 CY
FILL:	16,000 CY
EXPORT:	14,000 CY

FIGURES SHOWN ABOVE ARE FOR PERMITTING PROCESS ONLY. CONTRACTOR TO PERFORM OWN QUANTITY CHECK.

PUBLIC UTILITIES:

WATER:
VICTORVILLE WATER DISTRICT
17185 YUMA STREET
VICTORVILLE, CA. 92395
760.245.6424

SEWER AND DRAINAGE:
CITY OF VICTORVILLE
14343 CIVIC DRIVE
PB BOX 5001
VICTORVILLE, CA. 92393
760.243.6365

ELECTRIC:
SOUTHERN CALIFORNAI EDISON
PO BOX 11962
SANTA ANA, CA. 92711
760.243.6340

GAS:
SOUTHWEST GAS CORPORATION
13471 MARIPOSA ROAD
VICTORVILLE, CA. 92393
760.951.4033

CLIENT:

BROADWAY CHINATOWN, LLC
PO BOX 15813
LOS ANGELES 15813

BLUE PEAK ENGINEERING, INC.
18543 YORBA LINDA BL., #235
YORBA LINDA, CA 92886
714.749.3077

REGISTERED PROFESSIONAL ENGINEER
STEVEN B. JOHNSON
No. 83319
Exp. 03-31-21
CIVIL
STATE OF CALIFORNIA

CITY CASE NO. 18-00049

CITY OF VICTORVILLE
DEVELOPMENT DEPARTMENT
Approved By:
, Building Official
DATE

CITY OF VICTORVILLE
ENGINEERING DEPARTMENT
Approved By:
Brian Gengler
City Engineer
RCE 44730 Exp. 03-31-20
DATE

NO.	REVISIONS	BY	DATE

VICTORVILLE RETAIL PROJECT
SWC US 395 & SR-18

COVER SHEET

DESIGN BY: S.J.
DRAWN BY: S.J.
CHECKED BY: T.H.
DATE: 03/28/2019

C-01
SHEET NO.
1 OF 10

MATCHLINE - SEE SHEET C-03

SCALE: 1"=30'

DIGALERT

CALL BEFORE YOU DIG

1-800-227-2600
AT LEAST
2 WORKING DAY
NOTICE REQUIRED

CITY CASE NO. 18-00049

CITY OF VICTORVILLE DEVELOPMENT DEPARTMENT	CITY OF VICTORVILLE ENGINEERING DEPARTMENT
Approved By: ____, Building Official DATE	Approved By: Brian Gengler, City Engineer, RCE 44730 Exp. 03-31-20 DATE

CLIENT:
BROADWAY CHINATOWN, LLC
PO BOX 15813
LOS ANGELES 15813

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YORBA LINDA, CA 92886
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REGISTERED PROFESSIONAL ENGINEER
STEVEN B. JOHNSON
No. 83319
Exp. 03-31-21
CIVIL
STATE OF CALIFORNIA

NO.	REVISIONS	BY	DATE

VICTORVILLE RETAIL PROJECT
SWC US 395 & SR-18

PRELIMINARY GRADING PLAN

DESIGN BY: S.J.
DRAWN BY: S.J.
CHECKED BY: T.H.
DATE: 03/28/2019

C-02
SHEET NO. 2 OF 10

MATCHLINE - SEE SHEET C-02

CITY CASE NO. 18-00049

CITY OF VICTORVILLE DEVELOPMENT DEPARTMENT	CITY OF VICTORVILLE ENGINEERING DEPARTMENT
Approved By: ______ , Building Official DATE	Approved By: Brian Gengler City Engineer RCE 44730 Exp. 03-31-20 DATE

DIGALERT

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NOTICE REQUIRED

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YORBA LINDA, CA 92886
714.749.3077

REGISTERED PROFESSIONAL ENGINEER STEVEN B. JOHNSON No. 83319 Exp. 03-31-21 CIVIL STATE OF CALIFORNIA

NO.	REVISIONS	BY	DATE

VICTORVILLE RETAIL PROJECT
SWC US 395 & SR-18

PRELIMINARY GRADING PLAN

DESIGN BY: S.J.
DRAWN BY: S.J.
CHECKED BY: T.H.
DATE: 03/28/2019

C-03
SHEET NO.
3 of 10

DIGALERT

CALL BEFORE YOU DIG

1-800-227-2600
AT LEAST
2 WORKING DAY
NOTICE REQUIRED

REFER TO PRELIMINARY STORM DRAIN PLAN SHEETS C-7 & C-8 OR PRELIMINARY GRADING PLAN C-2 & C-3 FOR STORM DRAIN AND DRAINAGE DEVICE DESIGN

30 15 0 30 60
SCALE: 1"=30'

CITY CASE NO. 18-00049

CITY OF VICTORVILLE DEVELOPMENT DEPARTMENT	CITY OF VICTORVILLE ENGINEERING DEPARTMENT
Approved By: , Building Official DATE	Approved By: Brian Gengler, City Engineer, RCE 44730 Exp. 03-31-20 DATE

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714.749.3077

REGISTERED PROFESSIONAL ENGINEER STEVEN B. JOHNSON No. 83319 Exp. 03-31-21 CIVIL STATE OF CALIFORNIA

NO.	REVISIONS	BY	DATE

VICTORVILLE RETAIL PROJECT
SWC US 395 & SR-18

PRELIMINARY WET UTILITY PLAN

DESIGN BY: S.J.
DRAWN BY: S.J.
CHECKED BY: T.H.
DATE: 03/28/2019

C-04
SHEET NO. 4 of 10

DIGALERT

CALL BEFORE YOU DIG

1-800-227-2600
AT LEAST
2 WORKING DAY
NOTICE REQUIRED

REFER TO PRELIMINARY STORM DRAIN PLAN SHEETS C-7 & C-8 OR PRELIMINARY GRADING PLAN C-2 & C-3 FOR STORM DRAIN AND DRAINAGE DEVICE DESIGN

CLIENT:
BROADWAY CHINATOWN, LLC
PO BOX 15813
LOS ANGELES 15813

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YORBA LINDA, CA 92886
714.749.3077

REGISTERED PROFESSIONAL ENGINEER STEVEN B. JOHNSON No. 83319 Exp. 03-31-21 CIVIL STATE OF CALIFORNIA

CITY CASE NO. 18-00049

CITY OF VICTORVILLE DEVELOPMENT DEPARTMENT	CITY OF VICTORVILLE ENGINEERING DEPARTMENT
Approved By: , Building Official DATE	Approved By: Brian Gengler City Engineer RCE 44730 Exp. 03-31-20 DATE

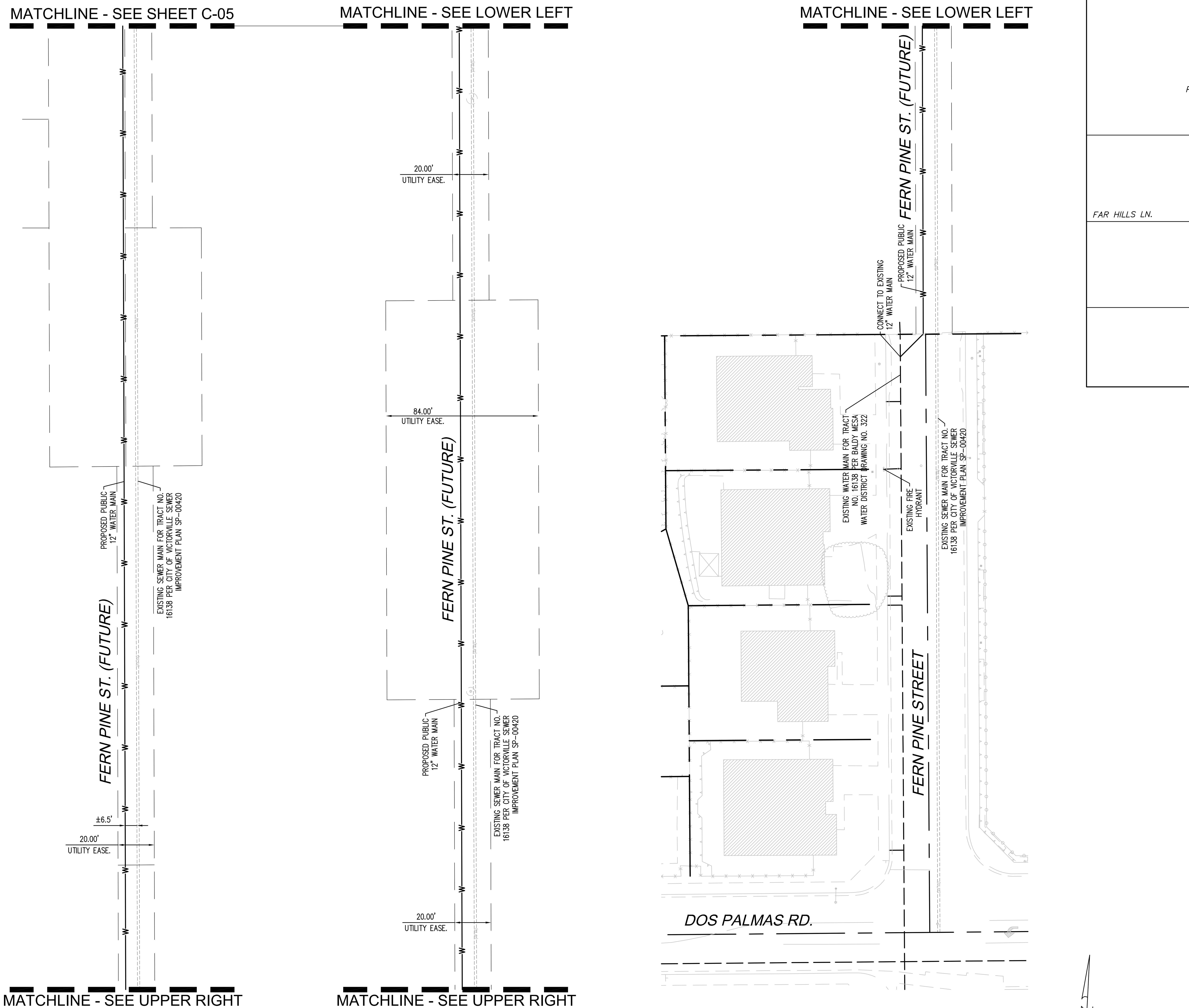
NO.	REVISIONS	BY	DATE

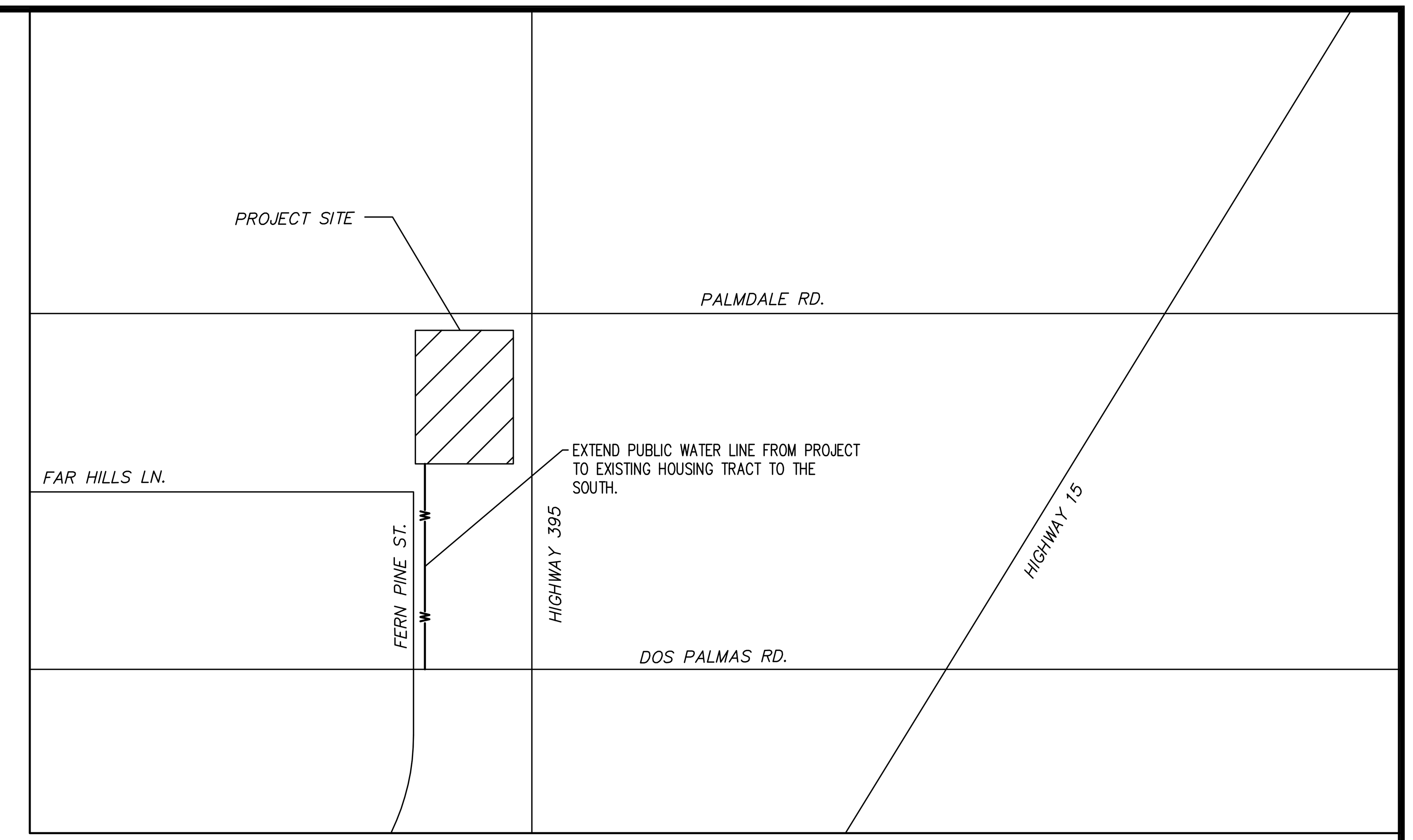
VICTORVILLE RETAIL PROJECT
SWC US 395 & SR-18

PRELIMINARY WET UTILITY PLAN

DESIGN BY: S.J.
DRAWN BY: S.J.
CHECKED BY: T.H.
DATE: 03/28/2019

C-05
SHEET NO.
5 OF 10





INDEX PLAN
NTS

DIGALERT

CALL BEFORE YOU DIG

1-800-227-2600
AT LEAST
2 WORKING DAY
NOTICE REQUIRED

CITY CASE NO. 18-00049

CITY OF VICTORVILLE DEVELOPMENT DEPARTMENT	CITY OF VICTORVILLE ENGINEERING DEPARTMENT
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LOS ANGELES 15813

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YORBA LINDA, CA 92886
714.749.3077
714.281.1640 FAX

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Exp. 03-31-21
CIVIL
STATE OF CALIFORNIA

NO.	REVISIONS	BY	DATE

VICTORVILLE RETAIL PROJECT
SWC US 395 & SR-18

PRELIMINARY WET UTILITY PLAN

DESIGN BY: S.J.
DRAWN BY: S.J.
CHECKED BY: T.H.
DATE: 03/28/2019

C-06
SHEET NO.
6 OF 10

DIGALERT

CALL BEFORE YOU DIG

1-800-227-2600
AT LEAST
2 WORKING DAY
NOTICE REQUIRED

CITY CASE NO. 18-00049

CITY OF VICTORVILLE DEVELOPMENT DEPARTMENT	CITY OF VICTORVILLE ENGINEERING DEPARTMENT
Approved By: , Building Official — DATE	Approved By: Brian Gengler, City Engineer, RCE 44730 Exp. 03-31-20 — DATE

CLIENT:
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YORBA LINDA, CA 92886
714.749.3077

REGISTERED PROFESSIONAL ENGINEER
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No. 83319
Exp. 03-31-21
CIVIL
STATE OF CALIFORNIA

NO.	REVISIONS	BY	DATE

VICTORVILLE RETAIL PROJECT
SWC US 395 & SR-18

PRELIMINARY DRAINAGE PLAN

DESIGN BY: S.J.
DRAWN BY: S.J.
CHECKED BY: T.H.
DATE: 03/28/2019

C-07
SHEET NO.
7 of 10

DIGALERT
CALL BEFORE YOU DIG
1-800-227-2600
AT LEAST 2 WORKING DAY NOTICE REQUIRED

CITY CASE NO. 18-00049

CITY OF VICTORVILLE
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, Building Official
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ENGINEERING DEPARTMENT
Approved By:
Brian Gengler
City Engineer
RCE 44730 Exp. 03-31-20
DATE

CLIENT:
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714.749.3077

STEVEN B. JOHNSON
No. 83319
Exp. 03-31-21
CIVIL
STATE OF CALIFORNIA

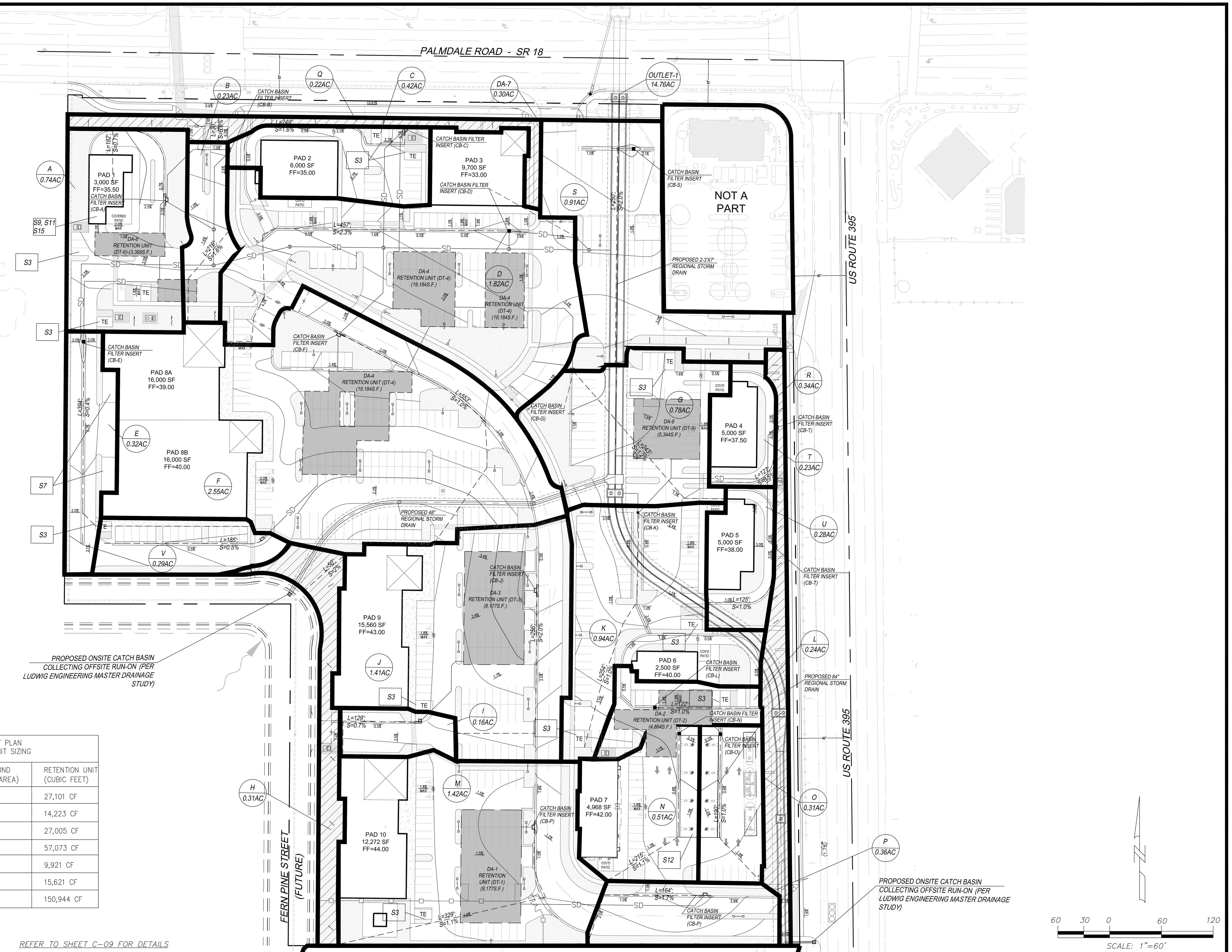
NO.	REVISIONS	BY	DATE

VICTORVILLE RETAIL PROJECT
SWC US 395 & SR-18

PRELIMINARY DRAINAGE PLAN

DESIGN BY: S.J.
DRAWN BY: S.J.
CHECKED BY: T.H.
DATE: 03/28/2019

C-08
SHEET NO. 8 OF 10



STRUCTURAL SOURCE CONTROL BMPS	
S1– STORM DRAIN STENCIL	PER DETAIL AND NOTE HEREON
S3– TRASH AND WASTE STORAGE	CALLOUT S3
S4– EFFICIENT IRRIGATION	PER NOTE HEREON
S5– FINISH GRADE AT LANDSCAPE	PER NOTE HEREON
S7– COVERED DOCK AREAS	CALLOUT S7
S9– VEHICLE WASH AREAS	CALLOUT S9
S11– EQUIPMENT WASH AREAS	CALLOUT S11
S12– FUELING AREAS	CALLOUT S12
S15– CAR WASH RACKS	CALLOUT S15

WATER QUALITY MANAGEMENT PLAN UNDERGROUND RETENTION UNIT SIZING

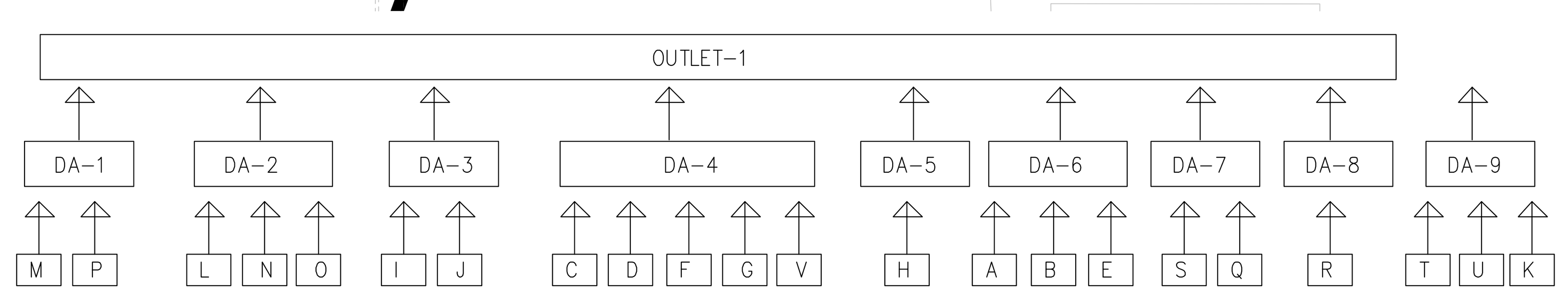
AREA	UNDERGROUND (SURFACE AREA)	RETENTION UNIT (CUBIC FEET)
DA–1	9,177 SF	27,101 CF
DA–2	4,864 SF	14,223 CF
DA–3	3,456 SF	27,005 CF
DA–4	19,184 SF	57,073 CF
DA–6	3,368 SF	9,921 CF
DA–9	5,344 SF	15,621 CF
TOTAL	127,993 SF	150,944 CF

GENERAL NOTES:

UPON FINAL DESIGN AND PER SEPARATE LANDSCAPE PLANS, THE PROPOSED LANDSCAPE WILL USE EFFICIENT IRRIGATION SYSTEMS AND DESIGNED TO CONSERVE WATER WITH SMART CONTROLLERS AND SOURCE CONTROLS PER CASQA BMP SD–12 AND PER CITY ORDINANCE.

ALL PROPOSED LANDSCAPE SHALL BE RECESSED 2" BELOW THE TOP OF CURB PER INDUSTRY STANDARD.

REFER TO SHEET C–09 FOR DETAILS



DIGALERT

CALL BEFORE YOU DIG

1-800-227-2600
AT LEAST
2 WORKING DAY
NOTICE REQUIRED

WATER QUALITY MANAGEMENT PLAN FIGURES:

AREA	ACRES	DCV (CF)
DA–1	1.77 AC.	3,902 CF
DA–2	1.61 AC.	2,332 CF
DA–3	1.60 AC.	3,456 CF
DA–4	6.46 AC.	12,859 CF
DA–5	0.27 AC.	691 CF
DA–6	1.56 AC.	2,839 CF
DA–7	1.76 AC.	3,944 CF
DA–8	0.35 AC.	124 CF
DA–9	1.0 AC.	3,162 CF
TOTAL	14.80 AC.	33,312 CF

LEGEND

- TRAVEL PATH
- DRAINAGE AREA
- AREA / ACRE — DRAINAGE CALLOUT
- LANDSCAPE
- RUNOFF AREA
- UNDERGROUND RETENTION AREA
- SX — SOURCE CONTROL BMPS

NO DUMPING! ¡NO CONTAMINE! DRAINS TO WATERWAYS

S1– STORM DRAIN STENCIL

STENCIL TO BE PROVIDED AT ALL CATCH BASIN/GRATES/AREA DRAIN INLETS

CITY CASE NO. 18-00049

CITY OF VICTORVILLE
DEVELOPMENT DEPARTMENT
Approved By:
, Building Official
DATE

CITY OF VICTORVILLE
ENGINEERING DEPARTMENT
Approved By:
Brian Gengler
City Engineer
RCE 44730 Exp. 03–31–20
DATE

CLIENT:
BROADWAY CHINATOWN, LLC
PO BOX 15813
LOS ANGELES 15813

BLUE PEAK ENGINEERING, INC.
18543 YORBA LINDA BL., #235
YORBA LINDA, CA 92886
714.749.3077
714.281.1640 FAX

REGISTERED PROFESSIONAL ENGINEER STEVEN B. JOHNSON No. 83319 Exp. 03–31–21 CIVIL STATE OF CALIFORNIA

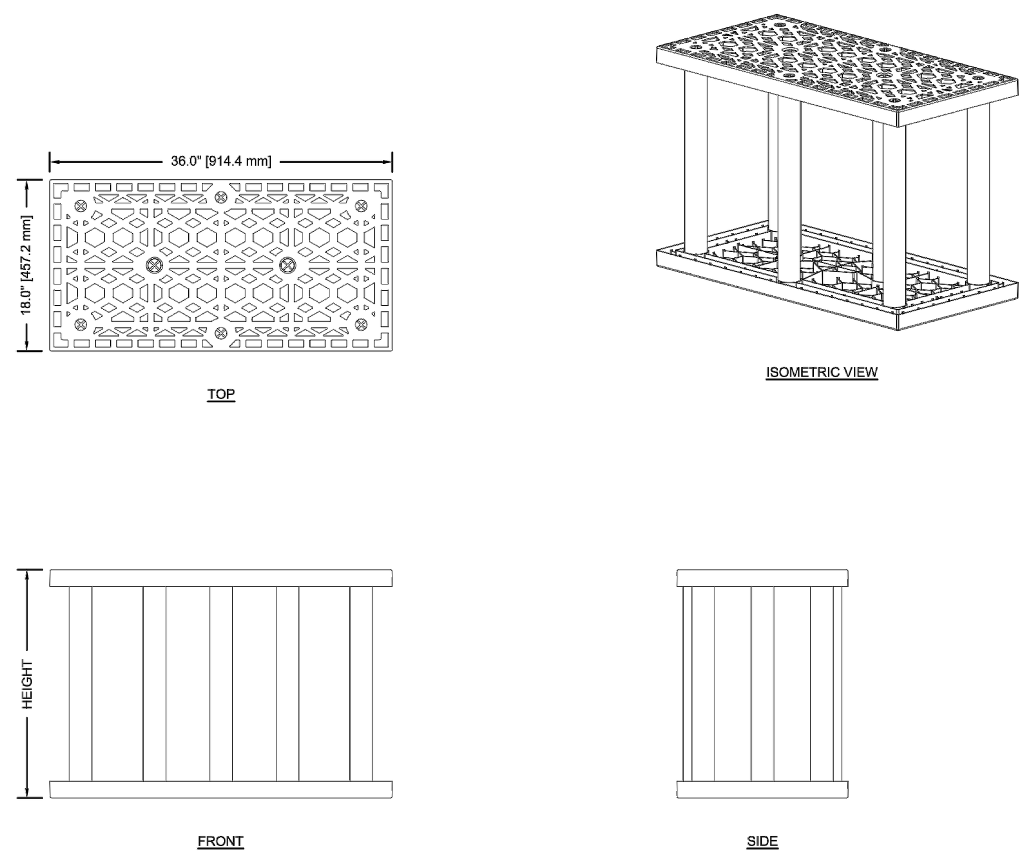
NO.	REVISIONS	BY	DATE

VICTORVILLE RETAIL PROJECT
SWC US 395 & SR-18

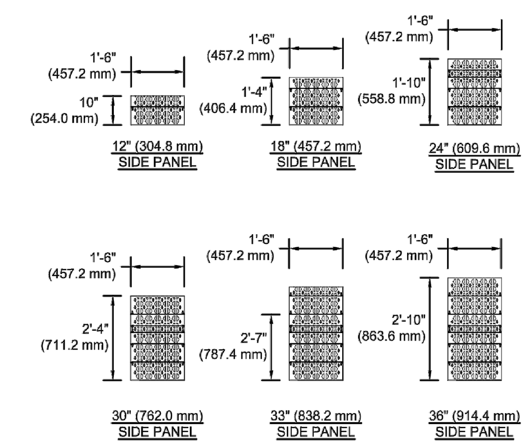
PRELIMINARY WQMP PLAN

DESIGN BY: S.J.
DRAWN BY: S.J.
CHECKED BY: T.H.
DATE: 03/28/2019

C-09
SHEET NO. 9 OF 10



MODULE DETAIL



NOTES:
1. SIDE PANELS TO BE INSTALLED ALONG SYSTEM PERIMETER, UNLESS OTHERWISE SPECIFIED.
2. ALL HEIGHTS TO BE CUT FROM A 36" (914.4 mm) SIDE PANEL AT PRE-SCRIBED LOCATIONS, EXCEPT 33" (838.2 mm) & 12" (304.8 mm) SIDE PANEL.

SIDE PANEL DETAIL

STORMTANK® MODULE

NAME	HEIGHT (mm)	CAPACITY (m^3)	VOID RATIO	NOMINAL WEIGHT (kg)
ST-12	12" (304.8)	4.22 cf (0.1194)	93.70%	17.56 lbs. (7.965)
ST-18	18" (457.2)	6.44 cf (0.1824)	95.50%	22.70 lbs. (10.29)
ST-24	24" (609.6)	8.66 cf (0.2452)	96.00%	26.30 lbs. (11.92)
ST-30	30" (762.0)	10.88 cf (0.3081)	96.50%	29.50 lbs. (13.38)
ST-33	33" (838.2)	11.99 cf (0.3395)	96.90%	29.82 lbs. (13.53)
ST-36	36" (914.4)	13.10 cf (0.3710)	97.00%	33.10 lbs. (15.01)

NOTES:
a. REFERENCE CURRENT INSTALLATION INSTRUCTIONS FOR PROPER ASSEMBLY AND INSTALLATION PRACTICES.
b. SIDE PANELS REQUIRED AROUND THE PERIMETER OF THE INSTALLATION ONLY, UNLESS OTHERWISE NOTED.
c. SIDE PANELS ARE TO BE CUT FROM A 36" PANEL AT THE PRE-SCRIBED LOCATIONS.

REV.	DATE	RECORD OF CHANGES	BY	APPRV.
D	2/17/17	ST-12 MODULE ADDED, METRIC DIMENSIONS UPDATED	CGB	
C	9/12/13	NOTE REVISION, FORMATTING UPDATE & DWG. NO. UPDATE	JKB	JKB
B	9/11/12	FORMATTING & DWG. NO. UPDATE	JKB	FK
A	4/5/12	INITIAL RELEASE	BLL	FK

BRENTWOOD®
610 Morgantown Road
Reading, PA 19611 U.S.A.
Phone: (610) 374-5109
Fax: (610) 376-6022
www.brentwoodindustries.com

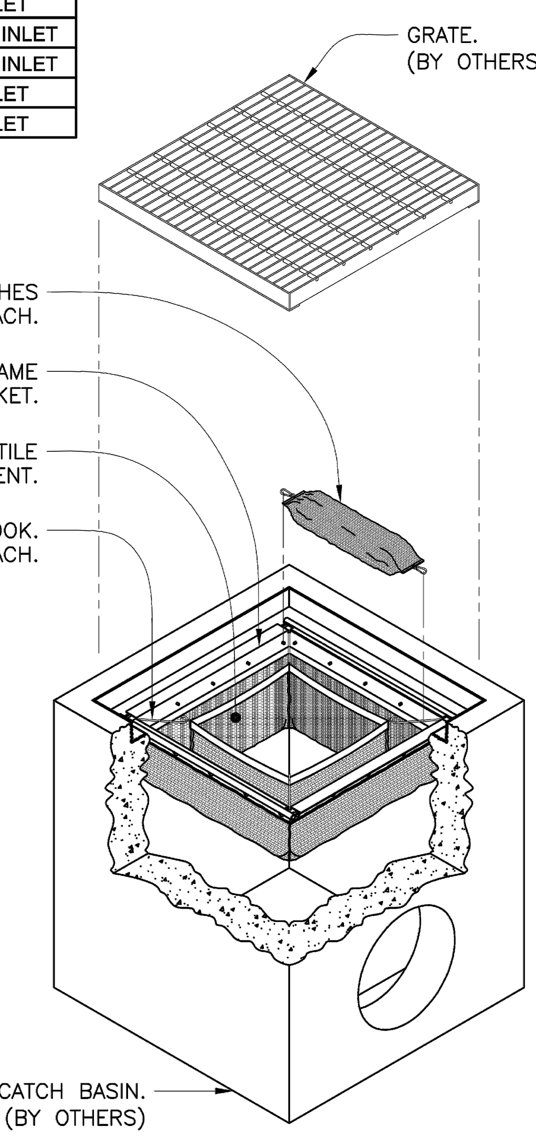
Project Name: MODULE DETAIL
Title: STORMTANK® MODULE
Drawn By: B.LINE | Date: 4/5/12
Drawing No.: STM-000-00 | Sheet: 1 of 2 | Scale: NTS

UNDERGROUND RETENTION DETAIL

FG-0001

SPECIFIER CHART

MODEL	INLET ID	GRATE OD	COMMENTS
FF-12D	12" X 12"	15" X 15"	GRATED INLET
FF-16D	16" X 16"	18" X 18"	GRATED INLET
FF-18D	18" X 18"	20" X 20"	GRATED INLET
FF-1836SD	18" X 36"	18" X 40"	GRATED INLET
FF-1836DGO	18" X 36"	18" X 40"	COMBINATION INLET
FF-24D	24" X 24"	26" X 26"	GRATED INLET
FF-2436SD	24" X 36"	24" X 40"	GRATED INLET
FF-24DGO	24" X 24"	18" X 26"	COMBINATION INLET
FF-2436DGO	24" X 36"	24" X 40"	COMBINATION INLET
FF-36D (2 PIECE)	36" X 36"	36" X 40"	GRATED INLET
FF-3648D (2 PIECE)	36" X 48"	40" X 48"	GRATED INLET



NOTES:

1. Filter insert shall have a high flow bypass feature.
2. Filter support frame shall be constructed from stainless steel Type 304.
3. Filter medium shall be *Fossil Rock* ™, installed and maintained in accordance with manufacturer specifications.
4. Storage capacity reflects 80% of maximum solids collection prior to impeding filtering bypass.

FloGard®
Catch Basin Insert Filter
Grated Inlet Style
Inlet Filtration

Oldcastle® Stormwater Solutions
7921 Southpark Plaza, Suite 200 | Littleton, CO | 80120 | Ph: 800.579.8819 | oldcastlestormwater.com

DRAWING NO.	REV	ECO	DATE	
FG-0001	E	ECO-0142 JPR 7/13/16	JPR 12/18/06	SHEET 1 OF 2

CATCH BASIN FILTER INSERT DETAIL

60 30 0 60 120
SCALE: 1"=60'

DIGALERT
CALL BEFORE YOU DIG
1-800-227-2600
AT LEAST
2 WORKING DAY
NOTICE REQUIRED

CITY CASE NO. 18-00049

CITY OF VICTORVILLE DEVELOPMENT DEPARTMENT	CITY OF VICTORVILLE ENGINEERING DEPARTMENT
Approved By:	Approved By:
, Building Official — DATE	Brian Gengler, City Engineer, RCE 44730 Exp. 03-31-20 — DATE

CLIENT:
BROADWAY CHINATOWN, LLC
PO BOX 15813
LOS ANGELES 15813

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18543 YORBA LINDA BL., #235
YORBA LINDA, CA 92886
714.749.3077
714.281.1640 FAX

REGISTERED PROFESSIONAL ENGINEER STEVEN B. JOHNSON No. 83319 Exp. 03-31-21 CIVIL STATE OF CALIFORNIA

NO.	REVISIONS	BY	DATE

VICTORVILLE RETAIL PROJECT
SWC US 395 & SR-18

WQMP DETAILS SHEET

DESIGN BY: S.J.
DRAWN BY: S.J.
CHECKED BY: T.H.
DATE: 03/28/2019

C-10
SHEET NO. 10 OF 10

APPENDIX 2- CONDITIONS OF APPROVAL

TO BE PROVIDED WITH FINAL WQMP

APPENDIX 3- COVENANT AND AGREEMENT AND OPERATION AND MAINTEANNCE PLAN (O&M) PLAN

Section 5 Inspection and Maintenance Responsibility for Post Construction BMP

OWNER: BROADWAY CHINATOWN LLC
PO BOX 15183
LOS ANGELES, CA. 90015
ATTN: FRAYDOON BRAL
310.925.1234
FRAL126@GMAIL.COM

____

Form 5-1 BMP Inspection and Maintenance (use additional forms as necessary)			
BMP	Reponsible Party(s)	Inspection/ Maintenance Activities Required	Minimum Frequency of Activities
Undergro und Retention S System	OWNER: Broadway Chinatown LLC PO Box 151813 Los Angeles CA 90015 Fraydoon Bral 310-925-1234 fbral126@gmail.com Owner as listed above	1. Inspect system after initial installation to establish a baseline condition. 2. Initial and subsequent inspection data should be recorded and filed for reference. 3. Inspect access ports. Insert a measuring device into the opening making note of a point of reference to determine the quantity of sediment and other accumulated material. If access is required to measure, ensure only certified space entry personal having appropriate equipment are allowed to enter system. 4. Remove any debris, trash and obstructions. 5. Cleanout of system should be considered if there is sediment buildup of two or more inches at over 50% of inspection orts. Cleaning shall be performed if sediment buildup is two inches or more over 75% of the system floor. Cleaning shall be performed by either a vacuum truck or manual method. 6. Refer to attached CUDO O&M Plan in	Inspect in January and June, and before and after any rainfall events.

		Appendix 3 for further information.	
N1-Education for Property Owners	Owner as listed above	1. Train employees janitorial staff to dispose of floor cleaning in sewer line, not into parking lot. 2. Discontinue all non-stormwater discharges to the storm drain system. It is prohibited to discharge any chemicals, wastes or wastewater into the gutter, street or storm drain. 3. Store material safely. 4. Properly cleanup and dispose of material per San Bernardino County recycling and disposal information, 909.386.8401. 5. Refer to attached Education Owner Information in Appendix 6 for further clarification.	Train staff once a year in January, and train new staff as hired.
N2-Activity Restrictions	Owner as listed above	1. Refer to attached CC&Rs in Appendix 8 for activity restrictions.	Throughout life of project.
N3-Landscape Management	Owner as listed above.	1. Keep landscaping materials away from street, gutter and storm drains. Stockpiles shall be covered with plastic sheeting. 2. Conserve water and prevent runoff. Periodically inspect, fix leaks. 3. Recycle yard waste. 4. Refer to Landscape Maintenance Handout provided in Appendix 6 for further information.	Practice throughout life of project.
N7-Spill Contingency Plan	Owner as listed above	1. Develop a Spill Prevention Control and Countermeasure Plan (SPCC); including said items as listed on the CASQA BMP SC-11 handout in Appendix 6. 2. Recycle, reclaim, or reuse materials whenever possible. 3. Store and contain liquid materials in	Sweep and clean the storage area at the first of each month. Practice Spill Prevention measures throughout the life

		such a manner that if a tank is ruptured, the contents will not discharge, flow, or be washed into the storm drainage system, surface waters or groundwater. 4. Place drip pans or absorbent materials beneath all mounted taps and at all potential drip and spill locations during filing and unloading of tanks. Any collected liquids or soiled absorbent materials must be reused/recycled properly. 5. Provide routine maintenance. Sweep and clean area, do not hose down. 6. Report spills that pose an immediate threat to human health or the environment to the Regional Water Quality Control Board. 7. Federal regulations require that any oil spill into a water body be reported to the national response center at 800.424.8802 8. Report spills to local agencies that can assist in cleanup. 9. Establish a tracking system that identifies; types and quantities of wastes, patterns in time of occurrence, mode of dumping and responsible parties. 10. Refer to CASQA BMP SC-11 handout in Appendix 6 for further information.	of the project.
N11-Litter Control	Owner as listed above.	1. Remove debris in a timely manner. 2. Establish a daily checklist of office, yard and plant areas to confirm cleanliness and adherence to proper storage and security. Specific employees should be assigned specific inspection responsibilities and given the authority to remedy the problem. 3. Dispose of wash water, sweeping and sediment properly. 4. Train employees per N-1 listed above. 5. Cleanup any spills per N-7 listed above.	Sweep and clean at the first of each month.

		6. Refer to CASQA BMP SC-60 handout in Appendix 6 for further information.	
N-12 Employee Training	Owner as listed above	1. Refer to N-1 listed above	Train staff once a year in January, and train new staff as hired.
N-13 Housekeeping of Loading Docks	Owner as listed above	1. Cleanup procedures shall minimize the use of water and was water shall not discharge into the storm drain system. 2. Refer to N7 and N11 above. 3. Refer to CASQA BMP SD-31 listed above.	Sweep and clean at the first of each month. Spill prevention shall be implemented throughout the life of the project.
Catch Basin Filter Inserts	Owner as listed above	1.Clear trash and debris located immediately in front of curb opening or side opening of CB, and on top or between metal grates or grated CB. 2.Remove vegetation growing across and or blocking the basin opening. 3.Remove Trash and debris in the connector pipe opening, upstream or downstream. 4.Knock off/remove all debris that covers the perforated openings of the connector pipe screen. 5.Ensure there is no standing water inside of catch basin.	Quarterly

APPENDIX 4- CALCULATIONS

NOAA Atlas 14, Volume 6, Version 2
Location name: Adelanto, California, USA*
Latitude: 34.5067°, Longitude: -117.3995°
Elevation: 3129.85 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sarah Dietz, Sarah Heim, Lillian Hiner, Kazungu Maitaria, Deborah Martin, Sandra Pavlovic, Ishani Roy, Carl Trypaluk, Dale Unruh, Fenglin Yan, Michael Yekta, Tan Zhao, Geoffrey Bonnin, Daniel Brewer, Li-Chuan Chen, Tye Parzybok, John Yarchoan

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.080 (0.066-0.098)	0.114 (0.094-0.140)	0.160 (0.131-0.196)	0.197 (0.161-0.244)	0.249 (0.197-0.319)	0.290 (0.224-0.378)	0.331 (0.250-0.443)	0.375 (0.275-0.516)	0.434 (0.306-0.623)	0.481 (0.327-0.714)
10-min	0.114 (0.095-0.140)	0.163 (0.135-0.200)	0.229 (0.188-0.281)	0.283 (0.231-0.350)	0.357 (0.282-0.457)	0.415 (0.321-0.542)	0.475 (0.358-0.635)	0.537 (0.394-0.739)	0.622 (0.438-0.893)	0.689 (0.469-1.02)
15-min	0.138 (0.114-0.169)	0.198 (0.163-0.242)	0.277 (0.228-0.340)	0.342 (0.279-0.423)	0.432 (0.341-0.552)	0.502 (0.388-0.656)	0.574 (0.433-0.768)	0.649 (0.477-0.894)	0.753 (0.530-1.08)	0.833 (0.567-1.24)
30-min	0.203 (0.167-0.248)	0.289 (0.239-0.354)	0.405 (0.333-0.497)	0.500 (0.408-0.619)	0.632 (0.499-0.809)	0.735 (0.568-0.960)	0.841 (0.634-1.13)	0.951 (0.698-1.31)	1.10 (0.776-1.58)	1.22 (0.830-1.81)
60-min	0.264 (0.218-0.322)	0.377 (0.311-0.461)	0.527 (0.434-0.647)	0.651 (0.532-0.806)	0.823 (0.650-1.05)	0.956 (0.740-1.25)	1.09 (0.826-1.46)	1.24 (0.908-1.70)	1.43 (1.01-2.06)	1.59 (1.08-2.36)
2-hr	0.369 (0.305-0.451)	0.500 (0.413-0.612)	0.679 (0.559-0.834)	0.831 (0.678-1.03)	1.05 (0.826-1.34)	1.22 (0.942-1.59)	1.40 (1.06-1.87)	1.59 (1.17-2.19)	1.85 (1.31-2.66)	2.07 (1.41-3.07)
3-hr	0.458 (0.378-0.560)	0.611 (0.504-0.748)	0.823 (0.677-1.01)	1.00 (0.820-1.24)	1.26 (0.997-1.62)	1.47 (1.14-1.92)	1.70 (1.28-2.27)	1.93 (1.42-2.66)	2.27 (1.60-3.26)	2.54 (1.73-3.77)
6-hr	0.623 (0.514-0.761)	0.824 (0.680-1.01)	1.11 (0.911-1.36)	1.35 (1.10-1.67)	1.71 (1.35-2.18)	2.00 (1.54-2.61)	2.31 (1.74-3.09)	2.65 (1.94-3.64)	3.13 (2.21-4.49)	3.53 (2.40-5.24)
12-hr	0.776 (0.641-0.949)	1.06 (0.877-1.30)	1.47 (1.21-1.80)	1.81 (1.48-2.24)	2.31 (1.83-2.96)	2.73 (2.11-3.56)	3.17 (2.39-4.24)	3.64 (2.68-5.02)	4.33 (3.05-6.22)	4.90 (3.33-7.28)
24-hr	1.05 (0.929-1.21)	1.49 (1.32-1.72)	2.11 (1.87-2.44)	2.64 (2.32-3.08)	3.41 (2.89-4.11)	4.04 (3.35-4.96)	4.70 (3.81-5.93)	5.43 (4.28-7.03)	6.47 (4.89-8.74)	7.33 (5.35-10.2)
2-day	1.13 (1.00-1.30)	1.61 (1.43-1.86)	2.29 (2.02-2.64)	2.87 (2.51-3.34)	3.71 (3.15-4.47)	4.40 (3.65-5.41)	5.14 (4.17-6.48)	5.95 (4.69-7.71)	7.12 (5.38-9.61)	8.09 (5.91-11.3)
3-day	1.21 (1.07-1.39)	1.72 (1.52-1.98)	2.44 (2.15-2.81)	3.05 (2.68-3.56)	3.95 (3.35-4.76)	4.69 (3.89-5.76)	5.48 (4.44-6.90)	6.35 (5.00-8.22)	7.60 (5.75-10.3)	8.65 (6.32-12.1)
4-day	1.30 (1.15-1.49)	1.84 (1.63-2.12)	2.60 (2.30-3.01)	3.26 (2.86-3.80)	4.21 (3.57-5.07)	5.00 (4.15-6.14)	5.84 (4.73-7.36)	6.76 (5.32-8.75)	8.09 (6.12-10.9)	9.20 (6.72-12.9)
7-day	1.39 (1.24-1.60)	1.96 (1.74-2.26)	2.77 (2.44-3.20)	3.46 (3.03-4.03)	4.45 (3.77-5.36)	5.27 (4.37-6.47)	6.13 (4.97-7.72)	7.07 (5.57-9.15)	8.41 (6.36-11.4)	9.52 (6.95-13.3)
10-day	1.48 (1.31-1.71)	2.08 (1.84-2.40)	2.92 (2.58-3.38)	3.65 (3.20-4.25)	4.70 (3.98-5.66)	5.55 (4.60-6.82)	6.45 (5.22-8.12)	7.42 (5.84-9.61)	8.81 (6.66-11.9)	9.94 (7.26-13.9)
20-day	1.76 (1.56-2.02)	2.47 (2.19-2.85)	3.48 (3.07-4.02)	4.35 (3.81-5.07)	5.61 (4.75-6.75)	6.63 (5.51-8.15)	7.72 (6.25-9.73)	8.89 (7.00-11.5)	10.5 (7.96-14.2)	11.9 (8.66-16.6)
30-day	2.03 (1.80-2.34)	2.84 (2.52-3.27)	4.00 (3.53-4.62)	5.01 (4.39-5.84)	6.48 (5.49-7.80)	7.67 (6.37-9.44)	8.94 (7.24-11.3)	10.3 (8.11-13.3)	12.2 (9.23-16.5)	13.7 (10.0-19.2)
45-day	2.37 (2.10-2.73)	3.30 (2.92-3.80)	4.62 (4.08-5.34)	5.79 (5.07-6.75)	7.51 (6.36-9.04)	8.92 (7.40-11.0)	10.4 (8.43-13.1)	12.0 (9.46-15.6)	14.3 (10.8-19.3)	16.1 (11.7-22.5)
60-day	2.65 (2.35-3.05)	3.64 (3.23-4.20)	5.09 (4.50-5.88)	6.37 (5.58-7.42)	8.26 (7.00-9.95)	9.83 (8.16-12.1)	11.5 (9.32-14.5)	13.3 (10.5-17.2)	15.8 (12.0-21.3)	17.8 (13.0-24.9)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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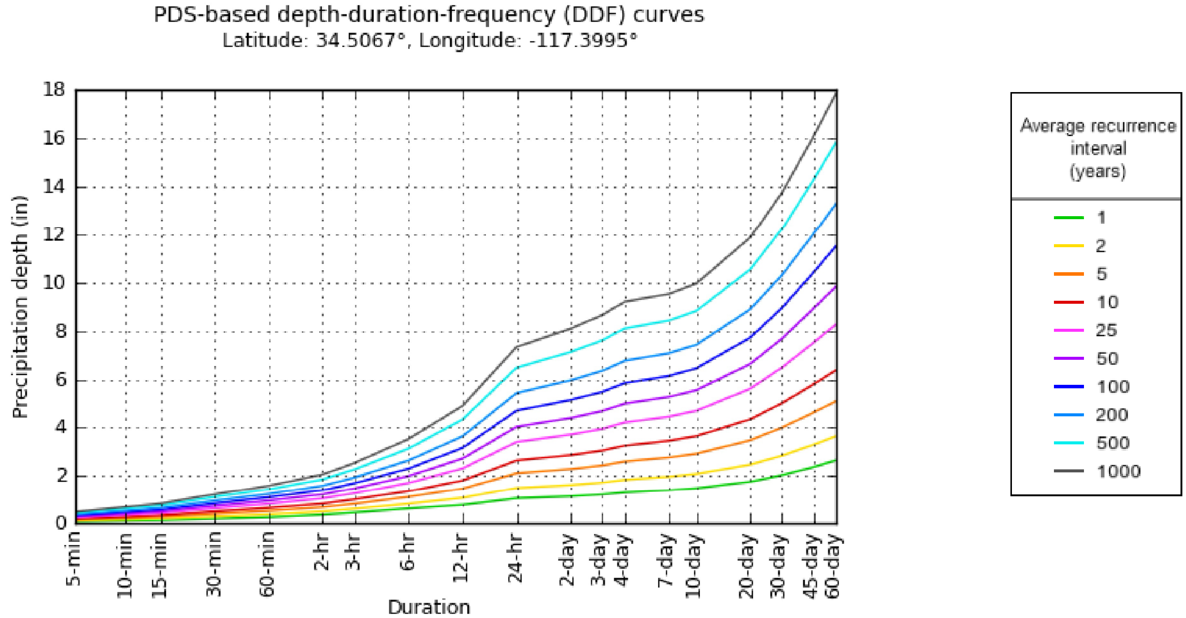
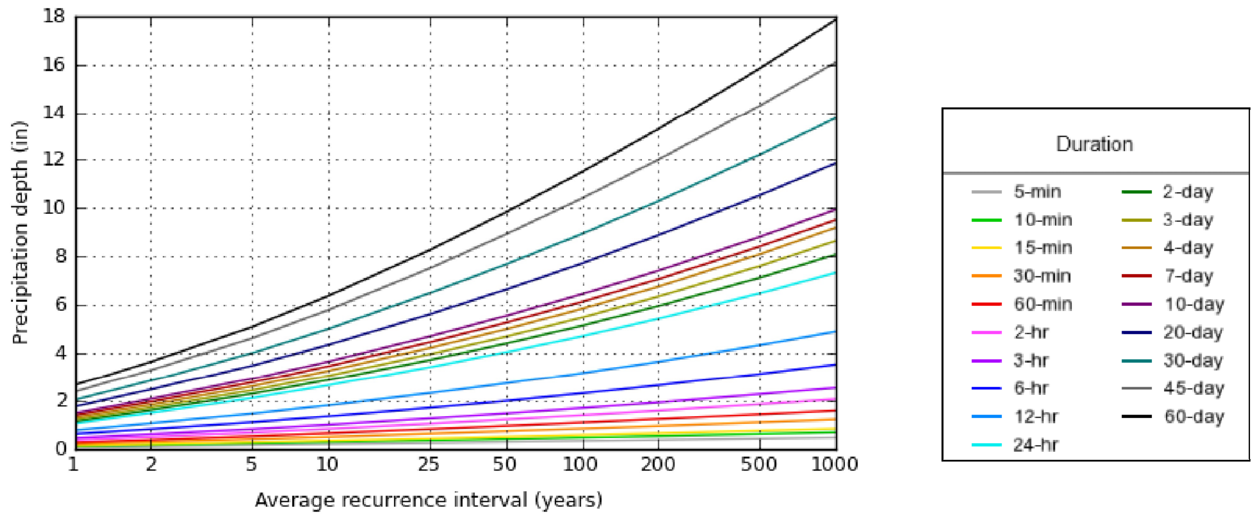
PF graphical





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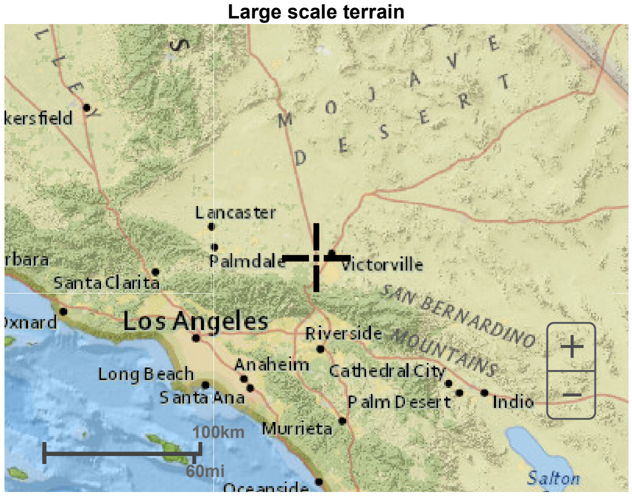
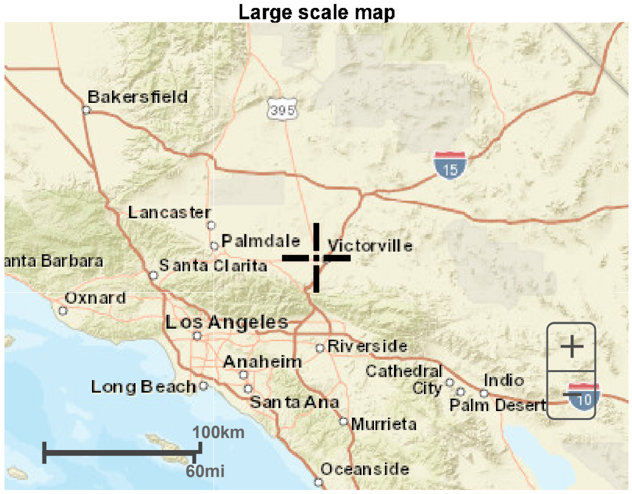
Maps & aerials

Small scale terrain

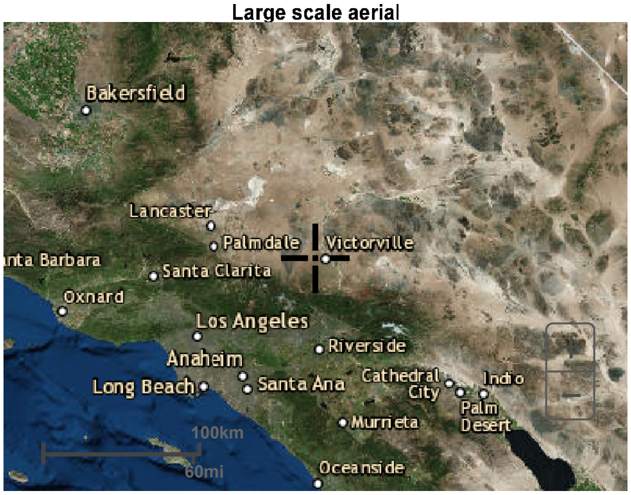
Large scale terrain



Large scale map



Large scale aerial



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[US Department of Commerce](#)
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[National Weather Service](#)
[National Water Center](#)
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

Worksheet H: Factor of Safety and Design Infiltration Rate and Worksheet

Factor Category		Factor Description	Assigned Weight (w)	Factor Value (v)	Product (p) $p = w \times v$
A	Suitability Assessment	Soil assessment methods	0.25	*1*	***0.25***
		Predominant soil texture	0.25	*1*	***0.25***
		Site soil variability	0.25	*1*	***0.25***
		Depth to groundwater / impervious layer	0.25	*1*	***0.25***
		Suitability Assessment Safety Factor, $S_A = \Sigma p$			***1***
B	Design	Tributary area size	0.25	*3*	***0.75***
		Level of pretreatment/ expected sediment loads	0.25	*2*	***0.5***
		Redundancy	0.25	*2*	***0.5***
		Compaction during construction	0.25	*1*	***0.25***
		Design Safety Factor, $S_B = \Sigma p$			***2***
Combined Safety Factor, $S_{TOT} = S_A \times S_B$					***2 =2; therefore 2 shall be used.***
Measured Infiltration Rate, inch/hr, K_M (corrected for test-specific bias)					***1.23in/hr***
Design Infiltration Rate, in/hr, $K_{DESIGN} = S_{TOT} \times K_M$					***0.62in/hr***
Supporting Data					
Briefly describe infiltration test and provide reference to test forms:					

Note: The minimum combined adjustment factor shall not be less than 2.0 and the maximum combined adjustment factor shall not exceed 9.0.

STORMTANK® Module Volume Calculator

Inputs

Project Name:	DA-1		
Engineer:	Blue Peak Engineering	Date:	1-Mar
Units:	US	Shape:	Square/Rectangle
Liner:	No	Location:	N/A
Stacking:	Single	Height:	30
Stone Storage:	All	Porosity:	40%

Dimensions

Module

Length:	129	ft
Width:	68	ft

Excavation

Length:	131	ft
Width:	70	ft

Stone

Leveling Bed:	0.5	ft
Top Backfill:	1	ft
Compacted Fill:	1	ft

Results

Capacity:

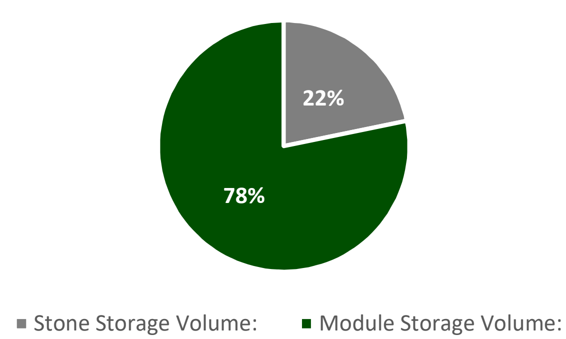
Stone Storage Volume:	5,900.00	ft^3
Module Storage Volume:	21,200.95	ft^3
Total Storage Volume:	27,100.95	ft^3

Quantities:

Required Excavation:	1,698.15	y^3
Required Stone Volume:	546.30	y^3
Estimated Geotextile:	4,750.25	y^2
Estimated Liner:	0.00	ft^2

(Estimations include 10% for scrap and overlap)

Storage Capacity Ratio

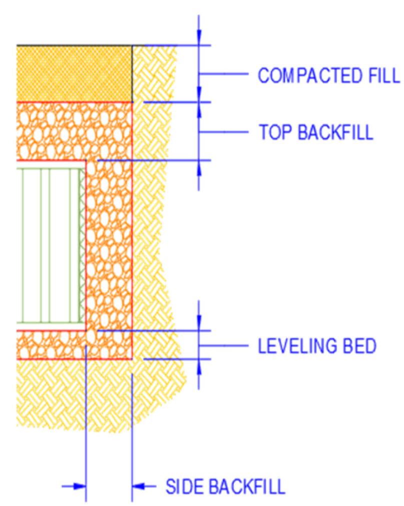


Basin Detail

Component Quantities:

	Bottom Layer	Top Layer	Total
Height	30.0	N/A	30.0
# of Modules	1,949	N/A	1,949
# of Platens	3,899	N/A	3,899
# of Side Panels	263	N/A	263
# of Columns	15,595	N/A	15,595
# of Stacking Pins	0	N/A	0

Cross-Section:



STORMTANK® Module Volume Calculator

Inputs

Project Name:	DA-2		
Engineer:	Blue Peak Engineering	Date:	1-Mar
Units:	US	Shape:	Square/Rectangle
Liner:	No	Location:	N/A
Stacking:	Single	Height:	30
Stone Storage:	All	Porosity:	40%

Dimensions

Module		
Length:	111	ft
Width:	41	ft
Excavation		
Length:	113	ft
Width:	43	ft
Stone		
Leveling Bed:	0.5	ft
Top Backfill:	1	ft
Compacted Fill:	1	ft

Results

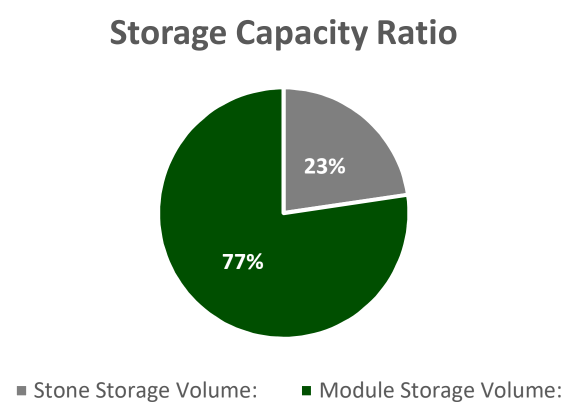
Capacity:

Stone Storage Volume:	3,223.40	ft^3
Module Storage Volume:	10,999.26	ft^3
Total Storage Volume:	14,222.66	ft^3

Quantities:

Required Excavation:	899.81	y^3
Required Stone Volume:	298.46	y^3
Estimated Geotextile:	2,571.36	y^2
Estimated Liner:	0.00	ft^2

(Estimations include 10% for scrap and overlap)

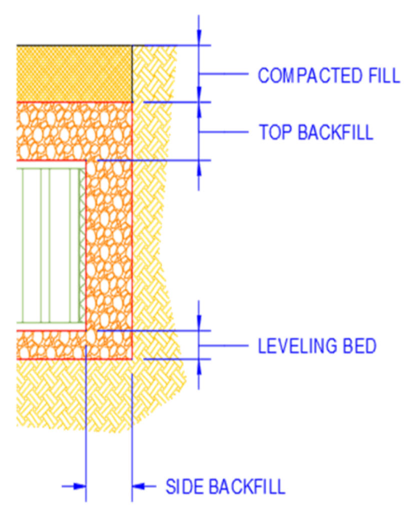


Basin Detail

Component Quantities:

	Bottom Layer	Top Layer	Total
Height	30.0	N/A	30.0
# of Modules	1,011	N/A	1,011
# of Platens	2,023	N/A	2,023
# of Side Panels	203	N/A	203
# of Columns	8,091	N/A	8,091
# of Stacking Pins	0	N/A	0

Cross-Section:



STORMTANK® Module Volume Calculator

Inputs

Project Name:	DA-3		
Engineer:	Blue Peak Engineering	Date:	1-Mar
Units:	US	Shape:	Square/Rectangle
Liner:	No	Location:	N/A
Stacking:	Single	Height:	30
Stone Storage:	All	Porosity:	40%

Dimensions

Module		
Length:	128	ft
Width:	68	ft
Excavation		
Length:	131	ft
Width:	70	ft
Stone		
Leveling Bed:	0.5	ft
Top Backfill:	1	ft
Compacted Fill:	1	ft

Results

Capacity:

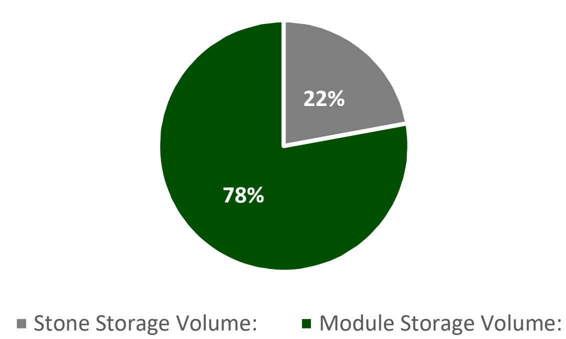
Stone Storage Volume:	5,968.00	ft^3
Module Storage Volume:	21,036.60	ft^3
Total Storage Volume:	27,004.60	ft^3

Quantities:

Required Excavation:	1,698.15	y^3
Required Stone Volume:	552.59	y^3
Estimated Geotextile:	4,732.84	y^2
Estimated Liner:	0.00	ft^2

(Estimations include 10% for scrap and overlap)

Storage Capacity Ratio

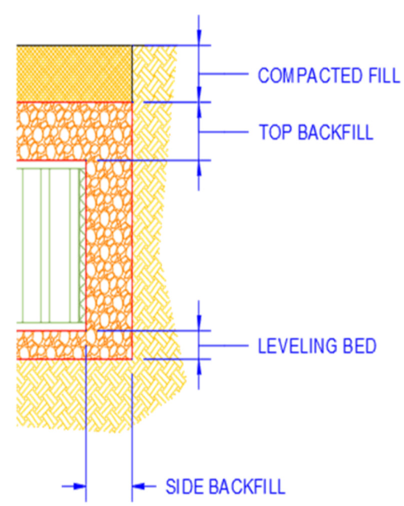


Basin Detail

Component Quantities:

	Bottom Layer	Top Layer	Total
Height	30.0	N/A	30.0
# of Modules	1,934	N/A	1,934
# of Platens	3,868	N/A	3,868
# of Side Panels	261	N/A	261
# of Columns	15,474	N/A	15,474
# of Stacking Pins	0	N/A	0

Cross-Section:



STORMTANK® Module **Volume Calculator**

Inputs

Project Name:	DA-4		
Engineer:	Blue Peak Engineering	Date:	1-Mar
Units:	US	Shape:	Square/Rectangle
Liner:	No	Location:	N/A
Stacking:	Single	Height:	30
Stone Storage:	All	Porosity:	40%

Dimensions

Module

Length:	134	ft
Width:	139	ft

Excavation

Length:	136	ft
Width:	141	ft

Stone

Leveling Bed:	0.5	ft
Top Backfill:	1	ft
Compacted Fill:	1	ft

Results

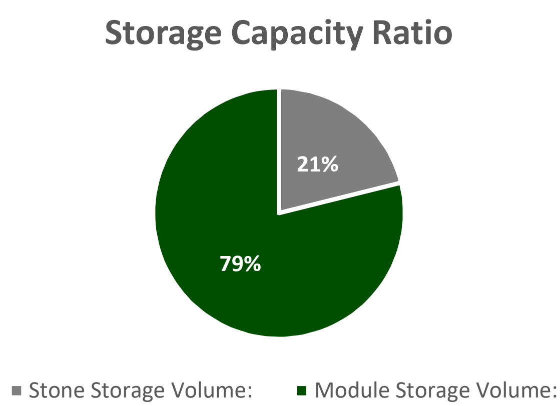
Capacity:

Stone Storage Volume:	12,055.60	ft^3
Module Storage Volume:	45,016.97	ft^3
Total Storage Volume:	57,072.57	ft^3

Quantities:

Required Excavation:	3,551.11	y^3
Required Stone Volume:	1,116.26	y^3
Estimated Geotextile:	9,775.93	y^2
Estimated Liner:	0.00	ft^2

(Estimations include 10% for scrap and overlap)

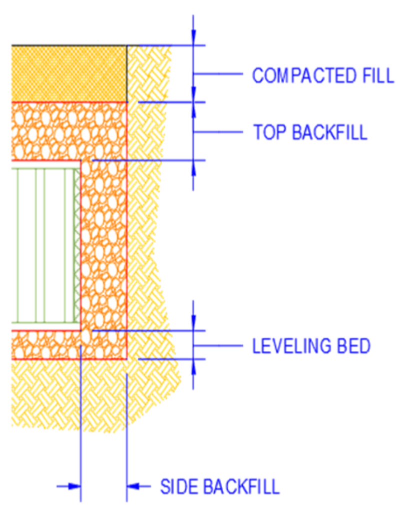


Basin Detail

Component Quantities:

	Bottom Layer	Top Layer	Total
Height	30.0	N/A	30.0
# of Modules	4,139	N/A	4,139
# of Platens	8,278	N/A	8,278
# of Side Panels	364	N/A	364
# of Columns	33,113	N/A	33,113
# of Stacking Pins	0	N/A	0

Cross-Section:



STORMTANK® Module Volume Calculator

Inputs

Project Name:	DA-6		
Engineer:	Blue Peak Engineering	Date:	1-Mar
Units:	US	Shape:	Square/Rectangle
Liner:	No	Location:	N/A
Stacking:	Single	Height:	30
Stone Storage:	All	Porosity:	40%

Dimensions

Module

Length:	79	ft
Width:	40	ft

Excavation

Length:	81	ft
Width:	42	ft

Stone

Leveling Bed:	0.5	ft
Top Backfill:	1	ft
Compacted Fill:	1	ft

Results

Capacity:

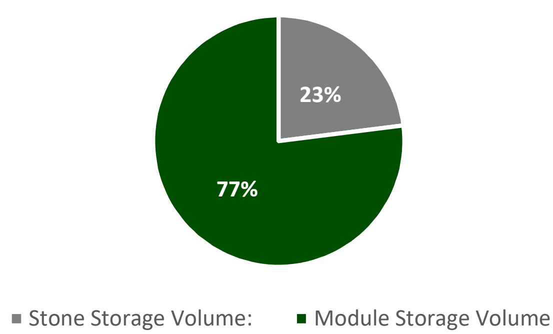
Stone Storage Volume:	2,283.20	ft^3
Module Storage Volume:	7,637.37	ft^3
Total Storage Volume:	9,920.57	ft^3

Quantities:

Required Excavation:	630.00	y^3
Required Stone Volume:	211.41	y^3
Estimated Geotextile:	1,815.19	y^2
Estimated Liner:	0.00	ft^2

(Estimations include 10% for scrap and overlap)

Storage Capacity Ratio

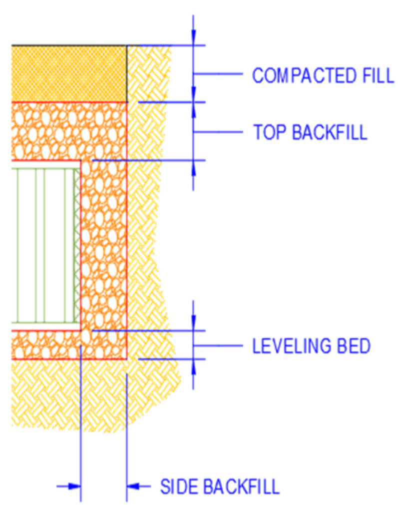


Basin Detail

Component Quantities:

	Bottom Layer	Top Layer	Total
Height	30.0	N/A	30.0
# of Modules	702	N/A	702
# of Platens	1,404	N/A	1,404
# of Side Panels	159	N/A	159
# of Columns	5,618	N/A	5,618
# of Stacking Pins	0	N/A	0

Cross-Section:



STORMTANK® Module Volume Calculator

Inputs

Project Name:	DA-9		
Engineer:	Blue Peak Engineering	Date:	1-Mar
Units:	US	Shape:	Square/Rectangle
Liner:	No	Location:	N/A
Stacking:	Single	Height:	30
Stone Storage:	All	Porosity:	40%

Dimensions

Module		
Length:	67	ft
Width:	75	ft
Excavation		
Length:	69	ft
Width:	77	ft
Stone		
Leveling Bed:	0.5	ft
Top Backfill:	1	ft
Compacted Fill:	1	ft

Results

Capacity:

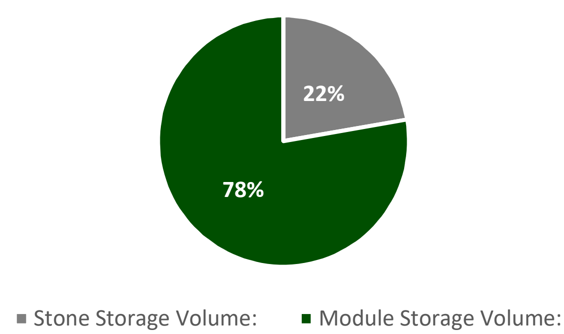
Stone Storage Volume:	3,475.80	ft^3
Module Storage Volume:	12,144.87	ft^3
Total Storage Volume:	15,620.67	ft^3

Quantities:

Required Excavation:	983.89	y^3
Required Stone Volume:	321.83	y^3
Estimated Geotextile:	2,784.44	y^2
Estimated Liner:	0.00	ft^2

(Estimations include 10% for scrap and overlap)

Storage Capacity Ratio

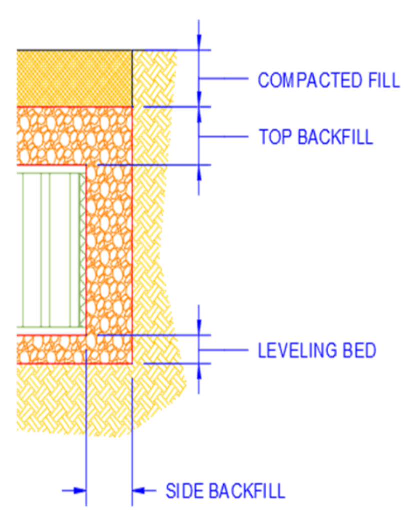


Basin Detail

Component Quantities:

	Bottom Layer	Top Layer	Total
Height	30.0	N/A	30.0
# of Modules	1,117	N/A	1,117
# of Platens	2,233	N/A	2,233
# of Side Panels	189	N/A	189
# of Columns	8,933	N/A	8,933
# of Stacking Pins	0	N/A	0

Cross-Section:



APPENDIX 5- HYDROMODIFICATION

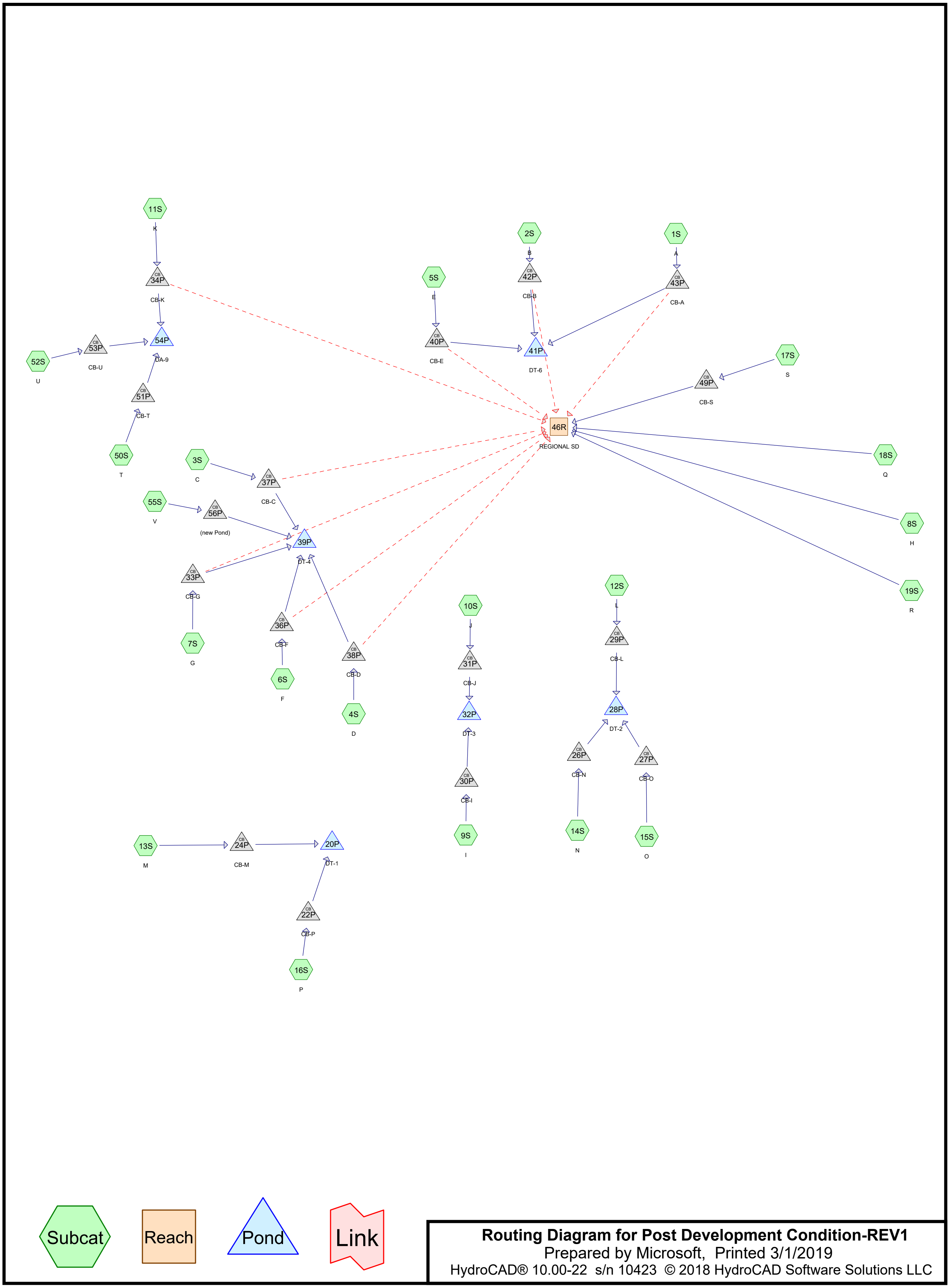
Hydromodification Summary

Below is a summary of the calculations provided herein, performed by HydroCAD computer software.

At ultimate outfall location (Outlet 1- Ex. Caltrans Structure/Regional SD)

Pre-Development 10-Year Volume:	1.853 ac.ft = 80,717 cf.
Pre-Development 10-Year Flow Rate:	22.24 cfs
Pre-Development Time of Concentration:	24 min.
Post Development 10-Year Volume:	0.559ac.ft = 24,350 cf
Post Development 10-Year Flow Rate:	19.47 cfs
Post-Development Time of Concentration:	Tc(initial)=11.3 min. *

*The post-development time of concentration provided above is only for the overland flow and does not take into consideration the additional time of concentration provided by the underground retention units on-site which significantly if not completely reduce the site runoff for the 10-year storm event in the provided sub-areas.



Routing Diagram for Post Development Condition-REV1
Prepared by Microsoft, Printed 3/1/2019
HydroCAD® 10.00-22 s/n 10423 © 2018 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
12.300	98	(1S, 2S, 3S, 4S, 5S, 6S, 7S, 8S, 9S, 10S, 11S, 12S, 13S, 14S, 15S, 16S, 17S, 18S, 19S, 50S, 52S, 55S)
2.470	56	(1S, 2S, 3S, 4S, 5S, 6S, 7S, 8S, 9S, 10S, 11S, 12S, 13S, 14S, 15S, 16S, 17S, 18S, 19S, 50S, 52S, 55S)
14.770	**91**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
0.000	HSG C	
0.000	HSG D	
14.770	Other	1S, 2S, 3S, 4S, 5S, 6S, 7S, 8S, 9S, 10S, 11S, 12S, 13S, 14S, 15S, 16S, 17S, 18S, 19S, 50S, 52S, 55S
14.770		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	0.000	0.000	0.000	14.770	14.770		1S, 2S, 3S, 4S, 5S, 6S, 7S, 8S, 9S, 10S, 11S, 12S, 13S, 14S, 15S, 16S, 17S, 18S, 19S, 50S, 52S, 55S
0.000	**0.000**	**0.000**	**0.000**	**14.770**	**14.770**	**TOTAL AREA**	

Time span=1.00-48.00 hrs, dt=0.05 hrs, 941 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1S: A Runoff Area=0.740 ac 85.14% Impervious Runoff Depth=2.30"
Flow Length=182' Slope=0.0070 '/' Tc=4.4 min AMC Adjusted CN=97 Runoff=2.79 cfs 0.142 af

Subcatchment2S: B Runoff Area=0.230 ac 82.61% Impervious Runoff Depth=2.30"
Flow Length=153' Slope=0.0160 '/' Tc=2.7 min AMC Adjusted CN=97 Runoff=0.89 cfs 0.044 af

Subcatchment3S: C Runoff Area=0.420 ac 85.71% Impervious Runoff Depth=2.30"
Flow Length=216' Slope=0.0160 '/' Tc=3.6 min AMC Adjusted CN=97 Runoff=1.62 cfs 0.081 af

Subcatchment4S: D Runoff Area=1.810 ac 85.08% Impervious Runoff Depth=2.30"
Flow Length=457' Slope=0.0230 '/' Tc=6.4 min AMC Adjusted CN=97 Runoff=6.31 cfs 0.347 af

Subcatchment5S: E Runoff Area=0.320 ac 84.38% Impervious Runoff Depth=2.30"
Flow Length=394' Slope=0.0040 '/' Tc=11.3 min AMC Adjusted CN=97 Runoff=0.97 cfs 0.061 af

Subcatchment6S: F Runoff Area=2.540 ac 85.04% Impervious Runoff Depth=2.30"
Flow Length=553' Slope=0.0100 '/' Tc=10.5 min AMC Adjusted CN=97 Runoff=7.89 cfs 0.487 af

Subcatchment7S: G Runoff Area=0.780 ac 84.62% Impervious Runoff Depth=2.30"
Flow Length=340' Slope=0.0150 '/' Tc=5.8 min AMC Adjusted CN=97 Runoff=2.78 cfs 0.150 af

Subcatchment8S: H Runoff Area=0.310 ac 83.87% Impervious Runoff Depth=2.30"
Flow Length=50' Slope=0.0200 '/' Tc=1.0 min AMC Adjusted CN=97 Runoff=1.25 cfs 0.059 af

Subcatchment9S: I Runoff Area=0.160 ac 87.50% Impervious Runoff Depth=2.41"
Flow Length=129' Slope=0.0090 '/' Tc=3.0 min AMC Adjusted CN=98 Runoff=0.63 cfs 0.032 af

Subcatchment10S: J Runoff Area=1.410 ac 85.11% Impervious Runoff Depth=2.30"
Flow Length=256' Slope=0.0200 '/' Tc=3.8 min AMC Adjusted CN=97 Runoff=5.40 cfs 0.270 af

Subcatchment11S: K Runoff Area=0.940 ac 85.11% Impervious Runoff Depth=2.30"
Flow Length=254' Slope=0.0100 '/' Tc=4.9 min AMC Adjusted CN=97 Runoff=3.47 cfs 0.180 af

Subcatchment12S: L Runoff Area=0.240 ac 87.50% Impervious Runoff Depth=2.41"
Flow Length=254' Slope=0.0100 '/' Tc=4.9 min AMC Adjusted CN=98 Runoff=0.90 cfs 0.048 af

Subcatchment13S: M Runoff Area=1.420 ac 85.21% Impervious Runoff Depth=2.30"
Flow Length=329' Slope=0.0110 '/' Tc=6.2 min AMC Adjusted CN=97 Runoff=4.99 cfs 0.272 af

Subcatchment14S: N Runoff Area=0.510 ac 84.31% Impervious Runoff Depth=2.30"
Flow Length=215' Slope=0.0110 '/' Tc=4.2 min AMC Adjusted CN=97 Runoff=1.93 cfs 0.098 af

Subcatchment15S: O Runoff Area=0.310 ac 83.87% Impervious Runoff Depth=2.30"
Flow Length=190' Slope=0.0150 '/' Tc=3.3 min AMC Adjusted CN=97 Runoff=1.20 cfs 0.059 af

Subcatchment16S: P Runoff Area=0.360 ac 83.33% Impervious Runoff Depth=2.30"
Flow Length=164' Slope=0.0170 '/' Tc=2.8 min AMC Adjusted CN=97 Runoff=1.40 cfs 0.069 af

Subcatchment 17S: S Runoff Area=0.920 ac 84.78% Impervious Runoff Depth=2.30"
Flow Length=250' Slope=0.0200 '/' Tc=3.7 min AMC Adjusted CN=97 Runoff=3.53 cfs 0.176 af

Subcatchment 18S: Q Runoff Area=0.220 ac 86.36% Impervious Runoff Depth=2.30"
Flow Length=87' Slope=0.0400 '/' Tc=1.2 min AMC Adjusted CN=97 Runoff=0.88 cfs 0.042 af

Subcatchment 19S: R Runoff Area=0.340 ac 8.82% Impervious Runoff Depth=0.88"
Flow Length=56' Slope=0.0500 '/' Tc=6.3 min AMC Adjusted CN=78 Runoff=0.51 cfs 0.025 af

Subcatchment 50S: T Runoff Area=0.220 ac 86.36% Impervious Runoff Depth=2.30"
Flow Length=127' Slope=0.0050 '/' Tc=3.7 min AMC Adjusted CN=97 Runoff=0.84 cfs 0.042 af

Subcatchment 52S: U Runoff Area=0.280 ac 85.71% Impervious Runoff Depth=2.30"
Flow Length=125' Slope=0.0100 '/' Tc=2.8 min AMC Adjusted CN=97 Runoff=1.09 cfs 0.054 af

Subcatchment 55S: V Runoff Area=0.290 ac 86.21% Impervious Runoff Depth=2.30"
Flow Length=185' Slope=0.0050 '/' Tc=5.1 min AMC Adjusted CN=97 Runoff=1.06 cfs 0.056 af

Reach 46R: REGIONAL SD Avg. Flow Depth=0.75' Max Vel=8.51 fps Inflow=19.47 cfs 0.559 af
84.0" Round Pipe n=0.013 L=500.0' S=0.0150 '/' Capacity=782.41 cfs Outflow=18.36 cfs 0.559 af

Pond 20P: DT-1 Peak Elev=34.39' Storage=0.181 af Inflow=6.28 cfs 0.341 af
Outflow=0.19 cfs 0.341 af

Pond 22P: CB-P Peak Elev=37.80' Inflow=1.40 cfs 0.069 af
12.0" Round Culvert n=0.012 L=100.0' S=0.0100 '/' Outflow=1.40 cfs 0.069 af

Pond 24P: CB-M Peak Elev=37.26' Inflow=4.99 cfs 0.272 af
24.0" Round Culvert n=0.012 L=10.0' S=0.0100 '/' Outflow=4.99 cfs 0.272 af

Pond 26P: CB-N Peak Elev=37.66' Inflow=1.93 cfs 0.098 af
Outflow=1.93 cfs 0.098 af

Pond 27P: CB-O Peak Elev=37.33' Inflow=1.20 cfs 0.059 af
12.0" Round Culvert n=0.012 L=10.0' S=0.0100 '/' Outflow=1.20 cfs 0.059 af

Pond 28P: DT-2 Peak Elev=32.54' Storage=0.111 af Inflow=4.03 cfs 0.206 af
Outflow=0.10 cfs 0.206 af

Pond 29P: CB-L Peak Elev=34.72' Inflow=0.90 cfs 0.048 af
18.0" Round Culvert n=0.012 L=20.0' S=0.0100 '/' Outflow=0.90 cfs 0.048 af

Pond 30P: CB-I Peak Elev=39.00' Inflow=0.63 cfs 0.032 af
12.0" Round Culvert n=0.012 L=100.0' S=0.0100 '/' Outflow=0.63 cfs 0.032 af

Pond 31P: CB-J Peak Elev=36.63' Inflow=5.40 cfs 0.270 af
24.0" Round Culvert n=0.012 L=10.0' S=0.0100 '/' Outflow=5.40 cfs 0.270 af

Pond 32P: DT-3 Peak Elev=33.56' Storage=0.164 af Inflow=6.03 cfs 0.303 af
Outflow=0.15 cfs 0.303 af

Pond 33P: CB-G Peak Elev=30.97' Inflow=2.78 cfs 0.150 af
Primary=1.05 cfs 0.121 af Secondary=1.73 cfs 0.029 af Outflow=2.78 cfs 0.150 af

Pond 34P: CB-K Peak Elev=34.82' Inflow=3.47 cfs 0.180 af
Primary=1.40 cfs 0.148 af Secondary=2.08 cfs 0.032 af Outflow=3.47 cfs 0.180 af

Pond 36P: CB-F Peak Elev=32.98' Inflow=7.89 cfs 0.487 af
Primary=4.38 cfs 0.430 af Secondary=3.51 cfs 0.057 af Outflow=7.89 cfs 0.487 af

Pond 37P: CB-C Peak Elev=29.92' Inflow=1.62 cfs 0.081 af
Primary=1.08 cfs 0.075 af Secondary=0.53 cfs 0.005 af Outflow=1.62 cfs 0.081 af

Pond 38P: CB-D Peak Elev=30.26' Inflow=6.31 cfs 0.347 af
Primary=2.77 cfs 0.291 af Secondary=3.54 cfs 0.057 af Outflow=6.31 cfs 0.347 af

Pond 39P: DT-4 Peak Elev=26.43' Storage=0.524 af Inflow=10.11 cfs 0.972 af
Outflow=0.40 cfs 0.972 af

Pond 40P: CB-E Peak Elev=35.77' Inflow=0.97 cfs 0.061 af
Primary=0.24 cfs 0.045 af Secondary=0.73 cfs 0.017 af Outflow=0.97 cfs 0.061 af

Pond 41P: DT-6 Peak Elev=28.61' Storage=0.081 af Inflow=0.88 cfs 0.171 af
Outflow=0.07 cfs 0.171 af

Pond 42P: CB-B Peak Elev=33.59' Inflow=0.89 cfs 0.044 af
Primary=0.33 cfs 0.035 af Secondary=0.56 cfs 0.009 af Outflow=0.89 cfs 0.044 af

Pond 43P: CB-A Peak Elev=32.70' Inflow=2.79 cfs 0.142 af
Primary=0.33 cfs 0.091 af Secondary=2.45 cfs 0.051 af Outflow=2.79 cfs 0.142 af

Pond 49P: CB-S Peak Elev=27.97' Inflow=3.53 cfs 0.176 af
Outflow=3.53 cfs 0.176 af

Pond 51P: CB-T Peak Elev=38.12' Inflow=0.84 cfs 0.042 af
12.0" Round Culvert n=0.120 L=100.0' S=0.0100 '/' Outflow=0.84 cfs 0.042 af

Pond 53P: CB-U Peak Elev=34.48' Inflow=1.09 cfs 0.054 af
12.0" Round Culvert n=0.012 L=100.0' S=0.0100 '/' Outflow=1.09 cfs 0.054 af

Pond 54P: DA-9 Peak Elev=30.59' Storage=0.131 af Inflow=3.32 cfs 0.244 af
Outflow=0.10 cfs 0.244 af

Pond 56P: (new Pond) Peak Elev=36.08' Inflow=1.06 cfs 0.056 af
12.0" Round Culvert n=0.012 L=40.0' S=0.0100 '/' Outflow=1.06 cfs 0.056 af

Total Runoff Area = 14.770 ac Runoff Volume = 2.797 af Average Runoff Depth = 2.27"
16.72% Pervious = 2.470 ac 83.28% Impervious = 12.300 ac

Summary for Subcatchment 1S: A

[49] Hint: Tc<2dt may require smaller dt

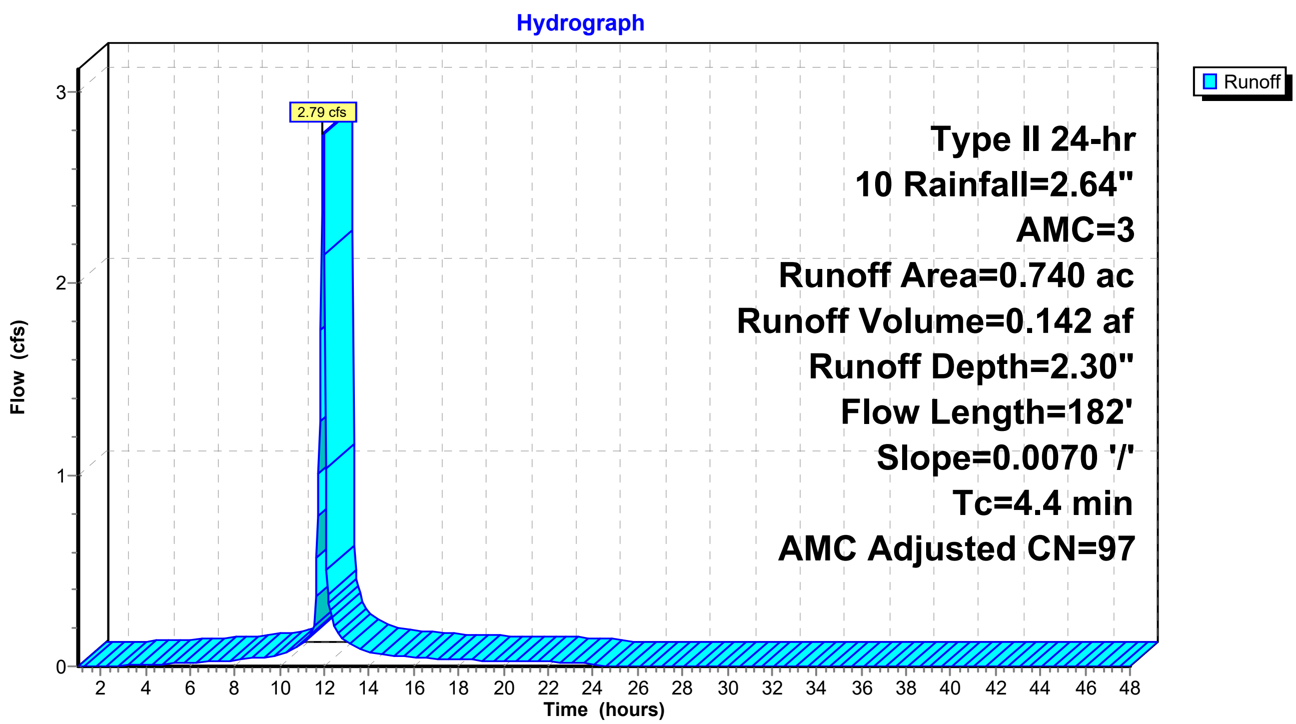
Runoff = 2.79 cfs @ 11.94 hrs, Volume= 0.142 af, Depth= 2.30"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 10 Rainfall=2.64", AMC=3

	Area (ac)	CN	Adj	Description
*	0.630	98		
*	0.110	56		
	0.740	92	97	Weighted Average, AMC Adjusted
	0.110			14.86% Pervious Area
	0.630			85.14% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.4	182	0.0070	0.70		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 1.49"

Subcatchment 1S: A



Summary for Subcatchment 2S: B

[49] Hint: Tc<2dt may require smaller dt

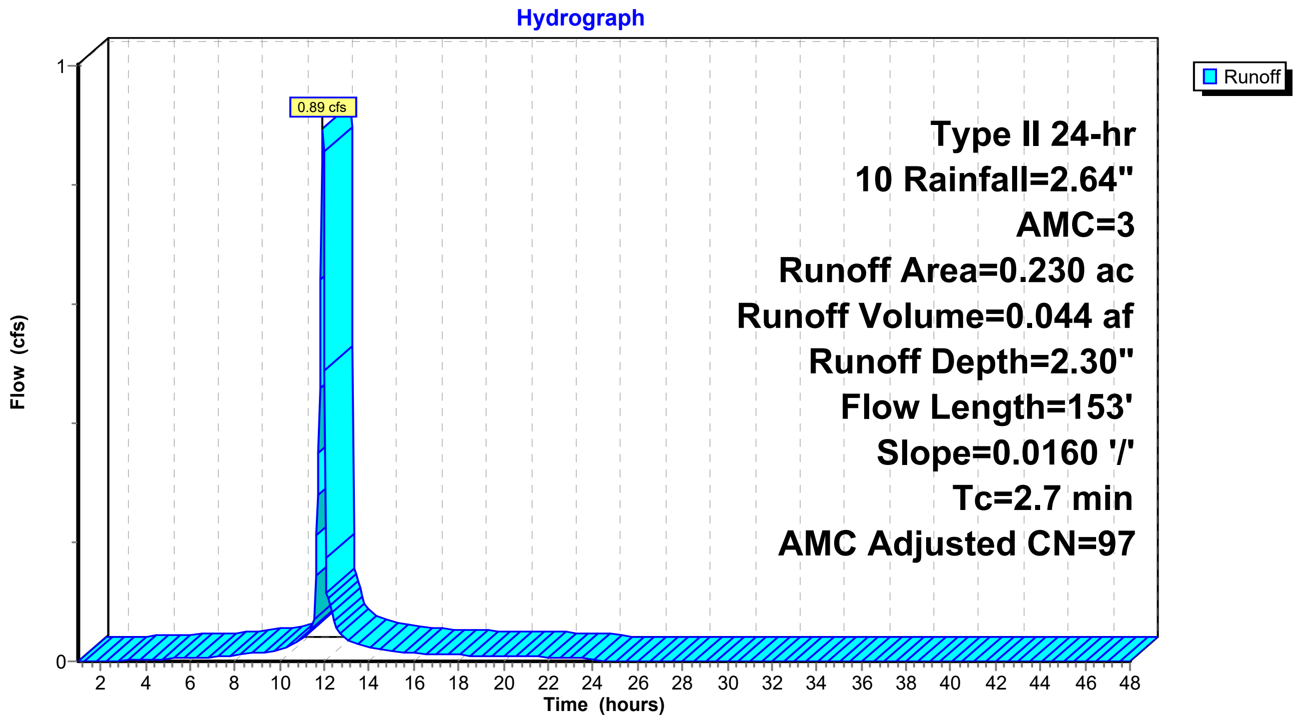
Runoff = 0.89 cfs @ 11.93 hrs, Volume= 0.044 af, Depth= 2.30"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 10 Rainfall=2.64", AMC=3

	Area (ac)	CN	Adj	Description
*	0.190	98		
*	0.040	56		
	0.230	91	97	Weighted Average, AMC Adjusted
	0.040			17.39% Pervious Area
	0.190			82.61% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.7	153	0.0160	0.93		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 1.49"

Subcatchment 2S: B



Summary for Subcatchment 3S: C

[49] Hint: Tc<2dt may require smaller dt

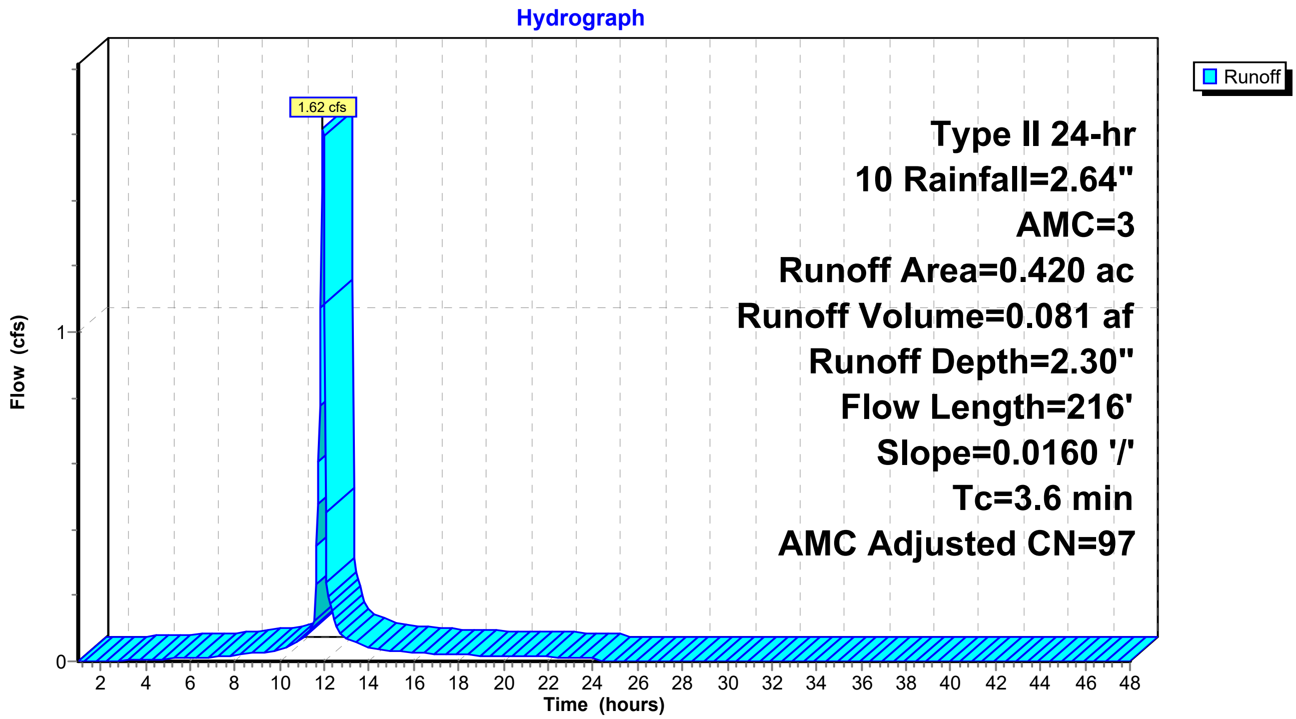
Runoff = 1.62 cfs @ 11.94 hrs, Volume= 0.081 af, Depth= 2.30"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 10 Rainfall=2.64", AMC=3

	Area (ac)	CN	Adj	Description
*	0.360	98		
*	0.060	56		
	0.420	92	97	Weighted Average, AMC Adjusted
	0.060			14.29% Pervious Area
	0.360			85.71% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.6	216	0.0160	1.00		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 1.49"

Subcatchment 3S: C



Summary for Subcatchment 4S: D

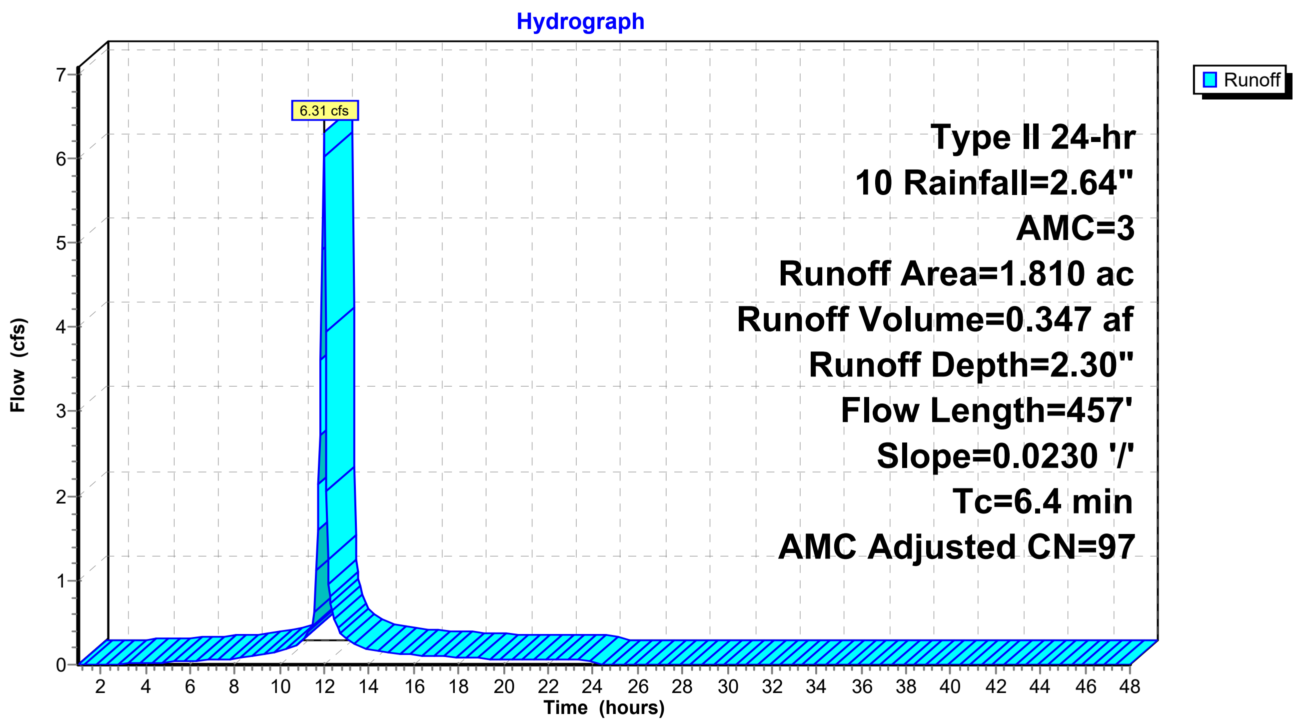
Runoff = 6.31 cfs @ 11.97 hrs, Volume= 0.347 af, Depth= 2.30"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 10 Rainfall=2.64", AMC=3

	Area (ac)	CN	Adj	Description
*	1.540	98		
*	0.270	56		
	1.810	92	97	Weighted Average, AMC Adjusted
	0.270			14.92% Pervious Area
	1.540			85.08% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.0	300	0.0230	1.24		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 1.49"
2.4	157	0.0230	1.09		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 1.49"
6.4	457	Total			

Subcatchment 4S: D



Summary for Subcatchment 5S: E

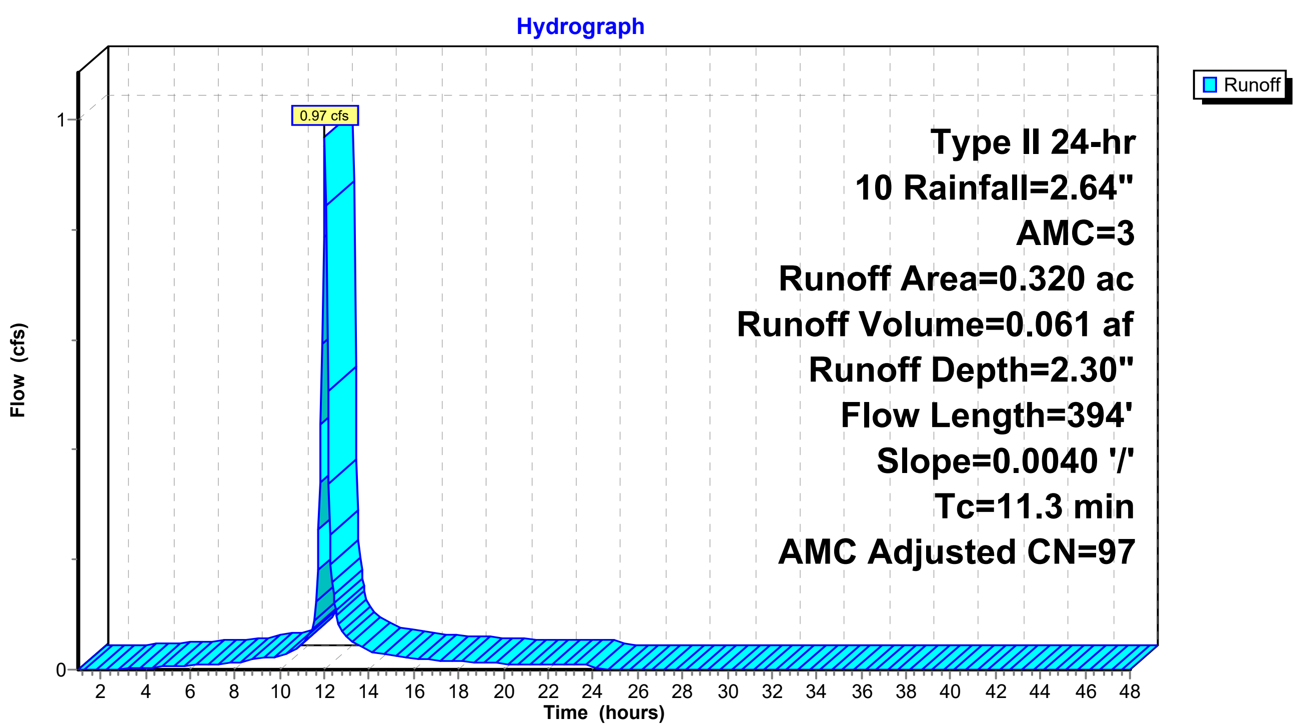
Runoff = 0.97 cfs @ 12.02 hrs, Volume= 0.061 af, Depth= 2.30"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 10 Rainfall=2.64", AMC=3

	Area (ac)	CN	Adj	Description
*	0.270	98		
*	0.050	56		
	0.320	91	97	Weighted Average, AMC Adjusted
	0.050			15.63% Pervious Area
	0.270			84.38% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.1	300	0.0040	0.61		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 1.49"
3.2	94	0.0040	0.49		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 1.49"
11.3	394	Total			

Subcatchment 5S: E



Summary for Subcatchment 6S: F

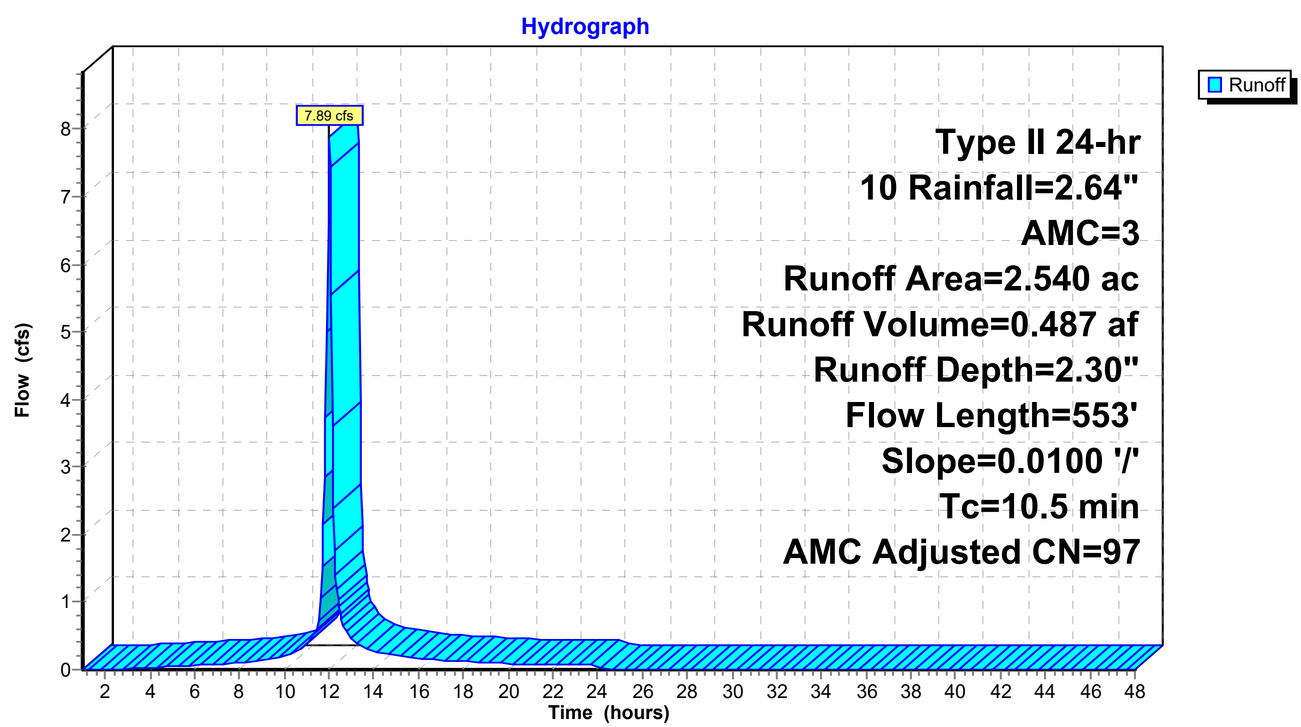
Runoff = 7.89 cfs @ 12.01 hrs, Volume= 0.487 af, Depth= 2.30"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 10 Rainfall=2.64", AMC=3

	Area (ac)	CN	Adj	Description
*	2.160	98		
*	0.380	56		
	2.540	92	97	Weighted Average, AMC Adjusted
	0.380			14.96% Pervious Area
	2.160			85.04% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.6	300	0.0100	0.89		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 1.49"
4.9	253	0.0100	0.86		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 1.49"
10.5	553	Total			

Subcatchment 6S: F



Summary for Subcatchment 7S: G

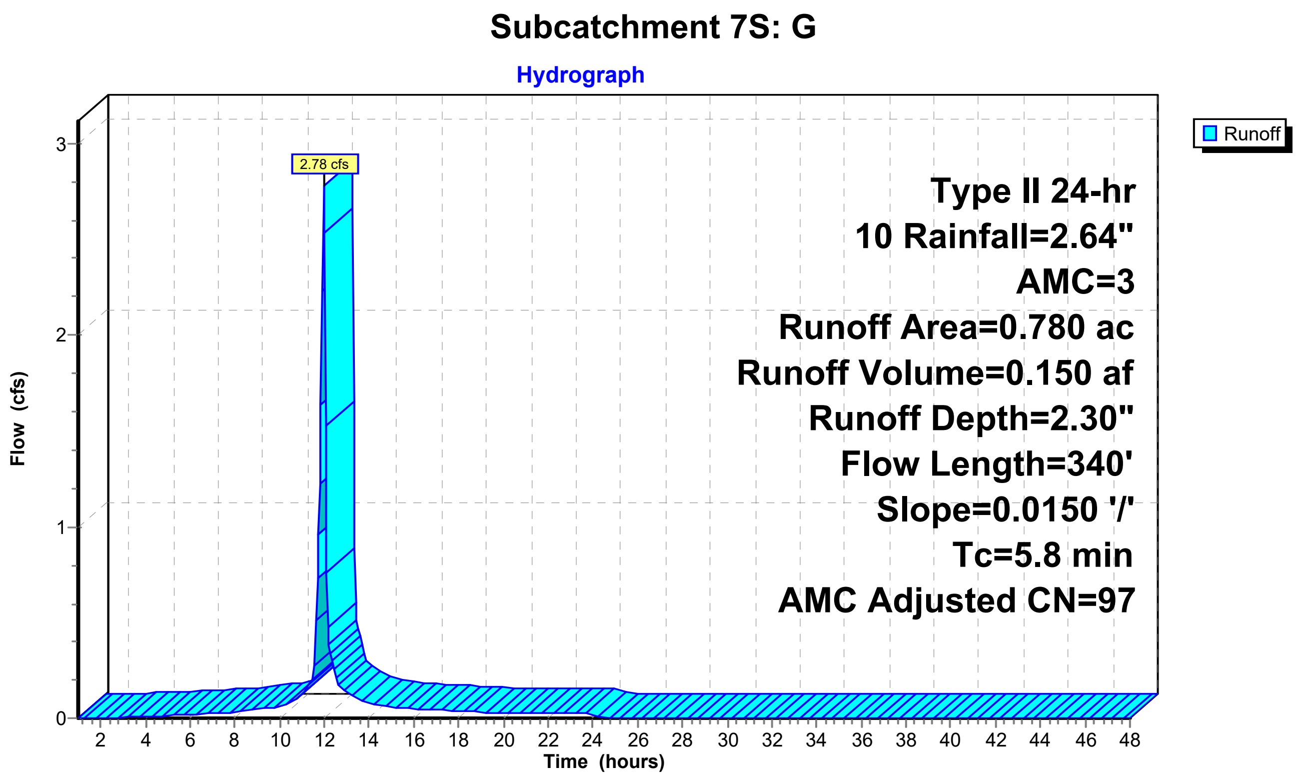
[49] Hint: Tc<2dt may require smaller dt

Runoff = 2.78 cfs @ 11.96 hrs, Volume= 0.150 af, Depth= 2.30"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 10 Rainfall=2.64", AMC=3

	Area (ac)	CN	Adj	Description
*	0.660	98		
*	0.120	56		
	0.780	92	97	Weighted Average, AMC Adjusted
	0.120			15.38% Pervious Area
	0.660			84.62% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.8	300	0.0150	1.04		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 1.49"
1.0	40	0.0150	0.70		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 1.49"
5.8	340	Total			



Summary for Subcatchment 8S: H

[49] Hint: Tc<2dt may require smaller dt

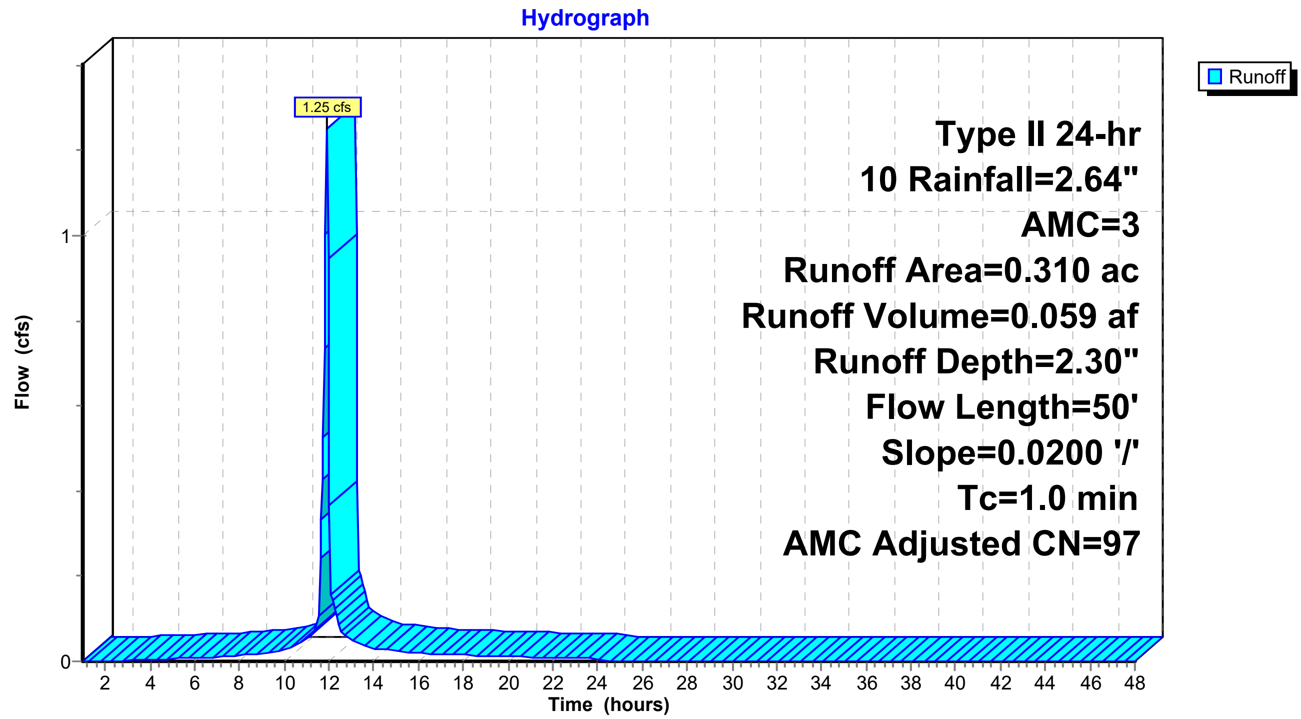
Runoff = 1.25 cfs @ 11.90 hrs, Volume= 0.059 af, Depth= 2.30"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 10 Rainfall=2.64", AMC=3

	Area (ac)	CN	Adj	Description
*	0.260	98		
*	0.050	56		
	0.310	91	97	Weighted Average, AMC Adjusted
	0.050			16.13% Pervious Area
	0.260			83.87% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.0	50	0.0200	0.82		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 1.49"

Subcatchment 8S: H



Summary for Subcatchment 9S: I

[49] Hint: Tc<2dt may require smaller dt

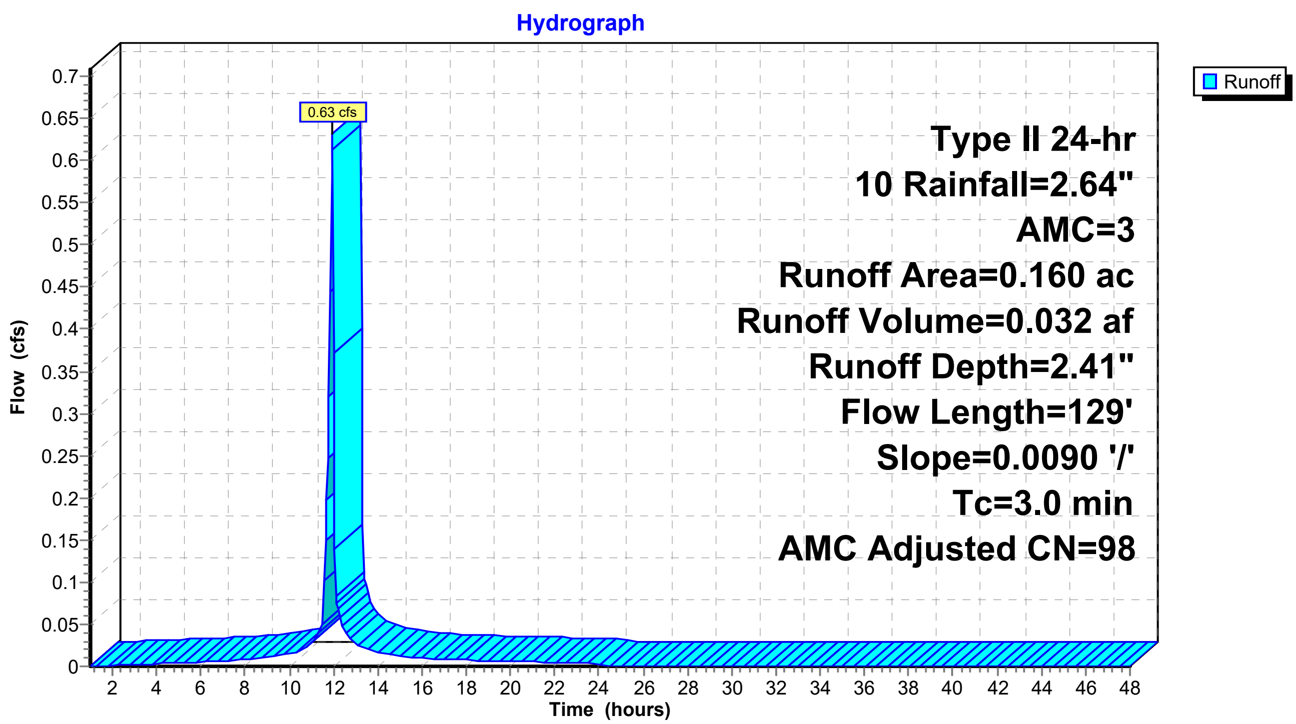
Runoff = 0.63 cfs @ 11.93 hrs, Volume= 0.032 af, Depth= 2.41"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 10 Rainfall=2.64", AMC=3

	Area (ac)	CN	Adj	Description
*	0.140	98		
*	0.020	56		
	0.160	93	98	Weighted Average, AMC Adjusted
	0.020			12.50% Pervious Area
	0.140			87.50% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.0	129	0.0090	0.72		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 1.49"

Subcatchment 9S: I



Summary for Subcatchment 10S: J

[49] Hint: Tc<2dt may require smaller dt

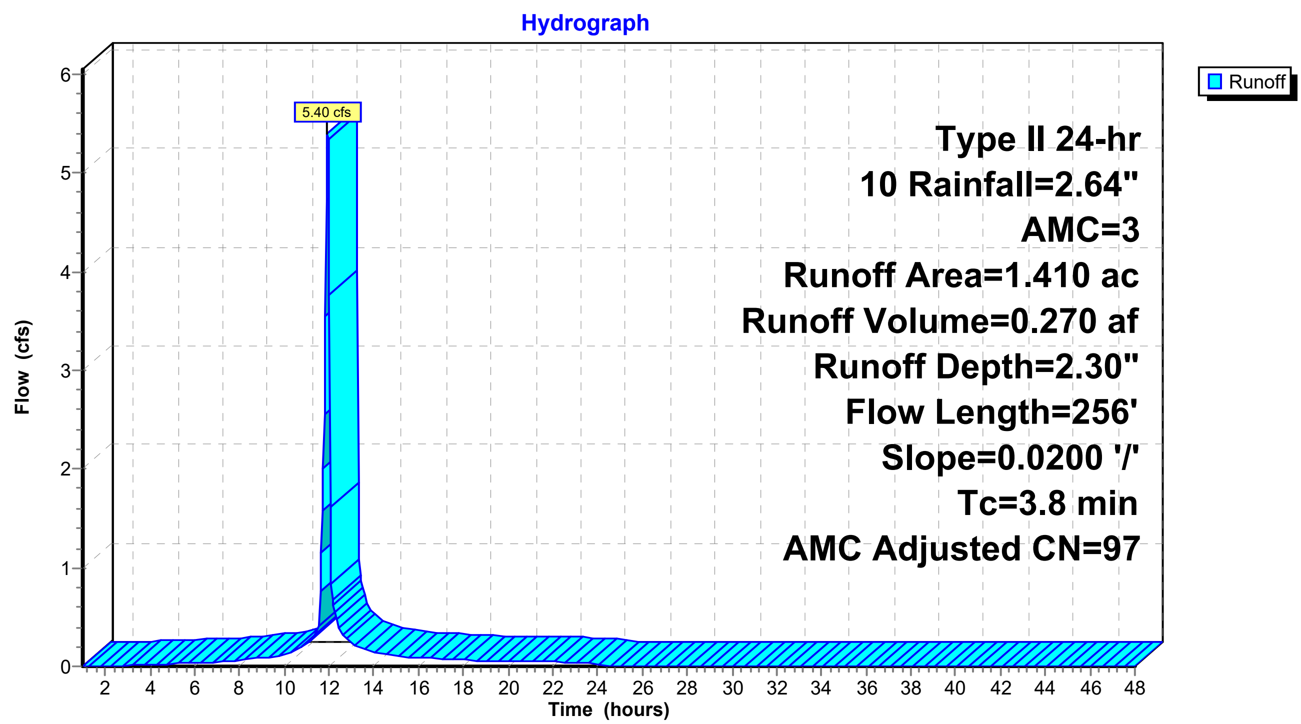
Runoff = 5.40 cfs @ 11.94 hrs, Volume= 0.270 af, Depth= 2.30"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 10 Rainfall=2.64", AMC=3

	Area (ac)	CN	Adj	Description
*	1.200	98		
*	0.210	56		
	1.410	92	97	Weighted Average, AMC Adjusted
	0.210			14.89% Pervious Area
	1.200			85.11% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.8	256	0.0200	1.13		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 1.49"

Subcatchment 10S: J



Summary for Subcatchment 11S: K

[49] Hint: Tc<2dt may require smaller dt

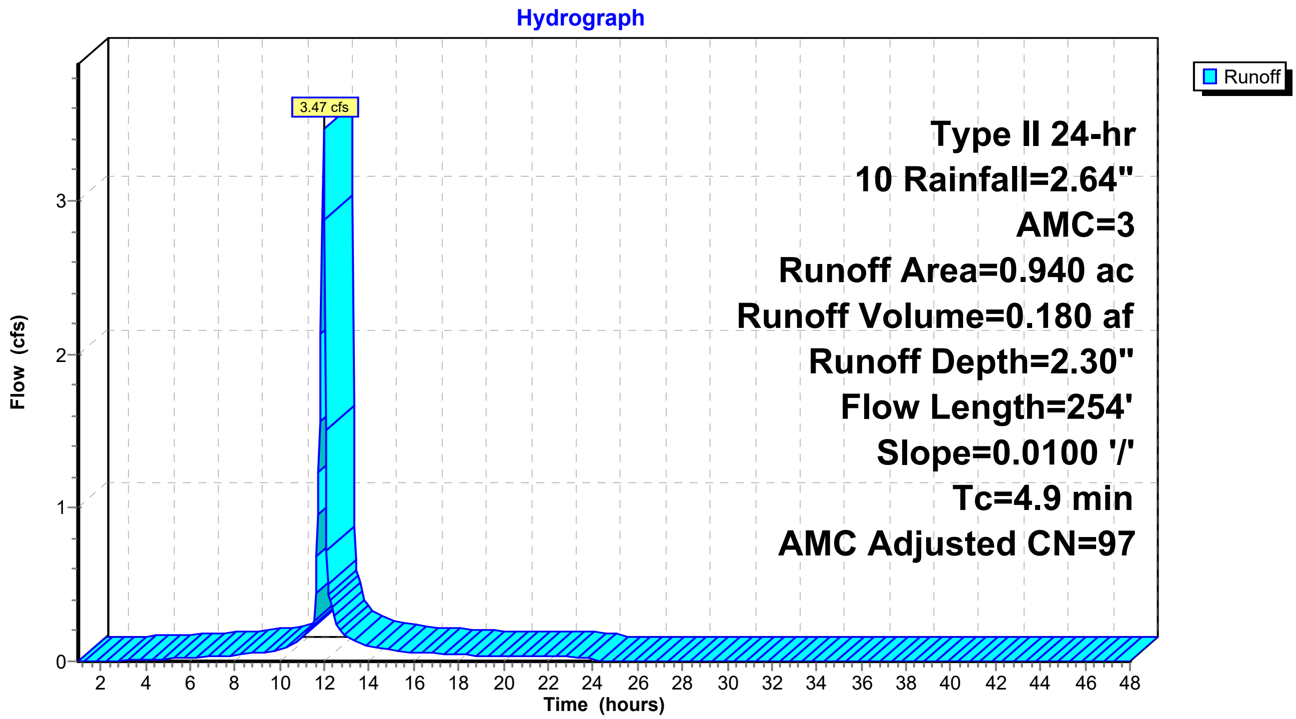
Runoff = 3.47 cfs @ 11.95 hrs, Volume= 0.180 af, Depth= 2.30"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 10 Rainfall=2.64", AMC=3

	Area (ac)	CN	Adj	Description
*	0.800	98		
*	0.140	56		
	0.940	92	97	Weighted Average, AMC Adjusted
	0.140			14.89% Pervious Area
	0.800			85.11% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.9	254	0.0100	0.86		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 1.49"

Subcatchment 11S: K



Summary for Subcatchment 12S: L

[49] Hint: Tc<2dt may require smaller dt

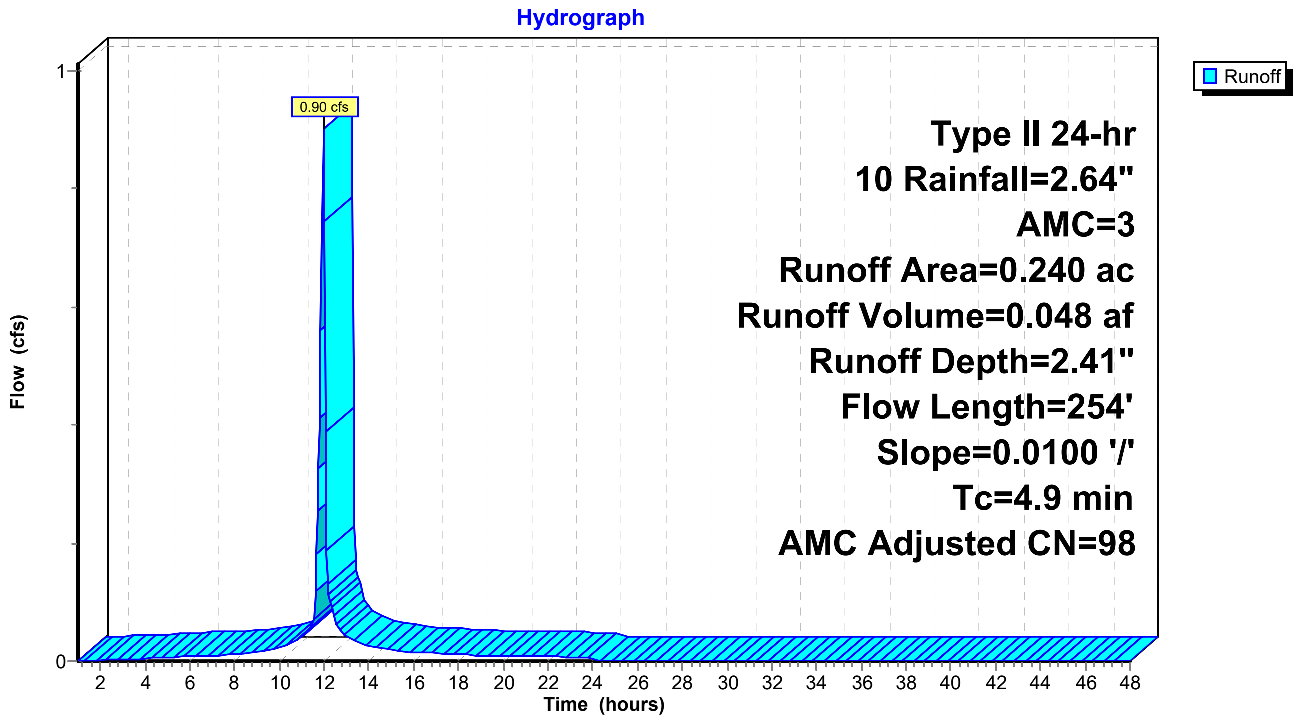
Runoff = 0.90 cfs @ 11.95 hrs, Volume= 0.048 af, Depth= 2.41"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 10 Rainfall=2.64", AMC=3

	Area (ac)	CN	Adj	Description
*	0.210	98		
*	0.030	56		
	0.240	93	98	Weighted Average, AMC Adjusted
	0.030			12.50% Pervious Area
	0.210			87.50% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.9	254	0.0100	0.86		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 1.49"

Subcatchment 12S: L



Summary for Subcatchment 13S: M

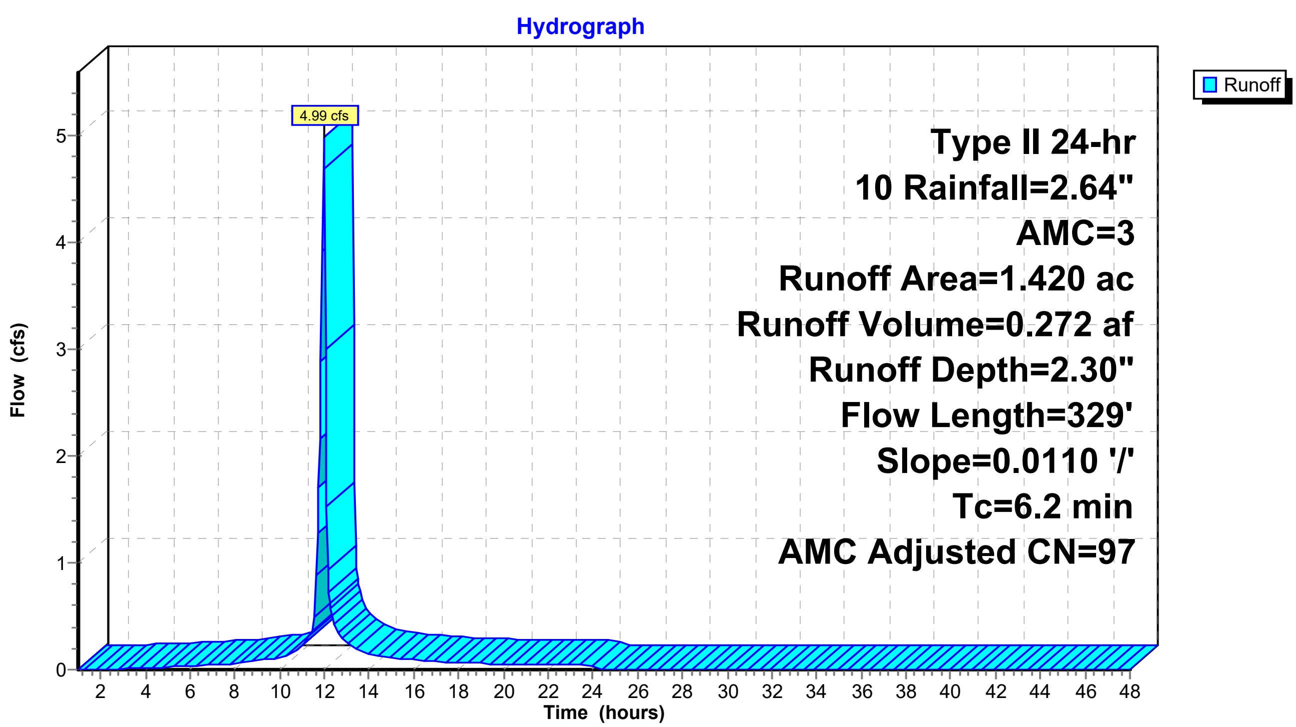
Runoff = 4.99 cfs @ 11.97 hrs, Volume= 0.272 af, Depth= 2.30"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 10 Rainfall=2.64", AMC=3

	Area (ac)	CN	Adj	Description
*	1.210	98		
*	0.210	56		
	1.420	92	97	Weighted Average, AMC Adjusted
	0.210			14.79% Pervious Area
	1.210			85.21% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.4	300	0.0110	0.92		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 1.49"
0.8	29	0.0110	0.58		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 1.49"
6.2	329	Total			

Subcatchment 13S: M



Summary for Subcatchment 14S: N

[49] Hint: Tc<2dt may require smaller dt

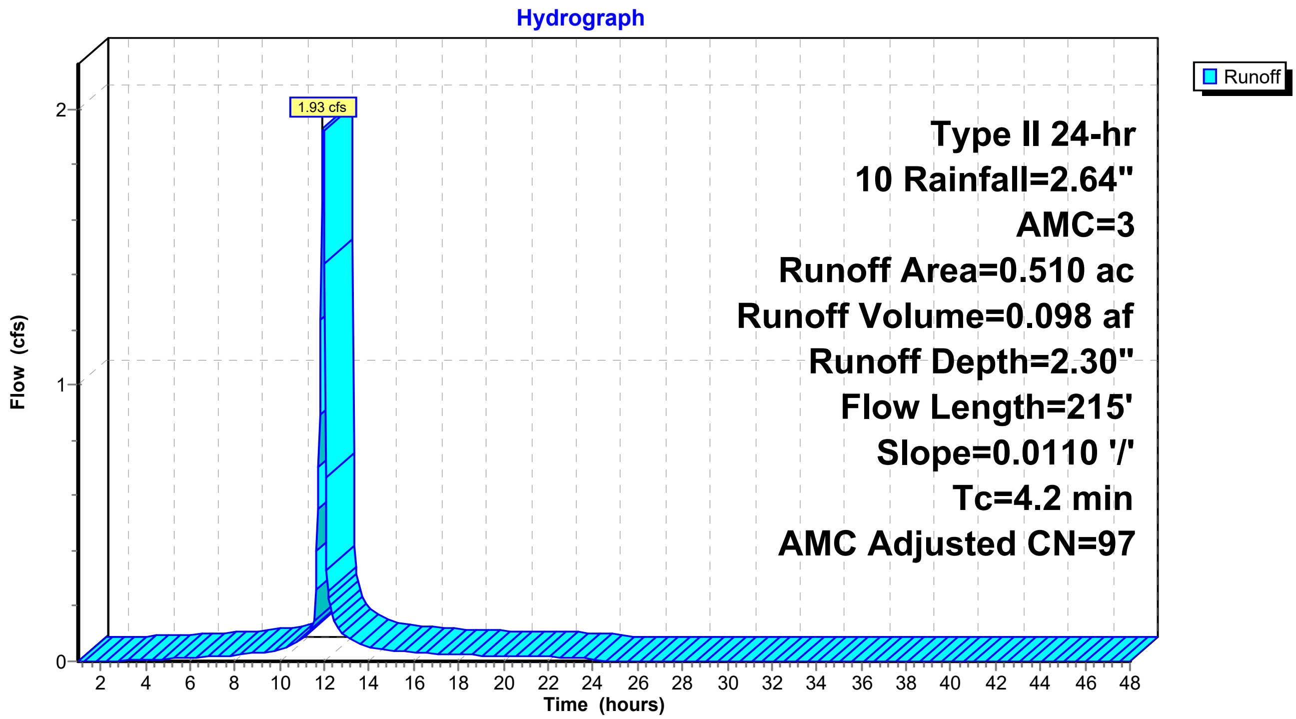
Runoff = 1.93 cfs @ 11.94 hrs, Volume= 0.098 af, Depth= 2.30"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 10 Rainfall=2.64", AMC=3

	Area (ac)	CN	Adj	Description
*	0.430	98		
*	0.080	56		
	0.510	91	97	Weighted Average, AMC Adjusted
	0.080			15.69% Pervious Area
	0.430			84.31% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.2	215	0.0110	0.86		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 1.49"

Subcatchment 14S: N



Summary for Subcatchment 15S: O

[49] Hint: Tc<2dt may require smaller dt

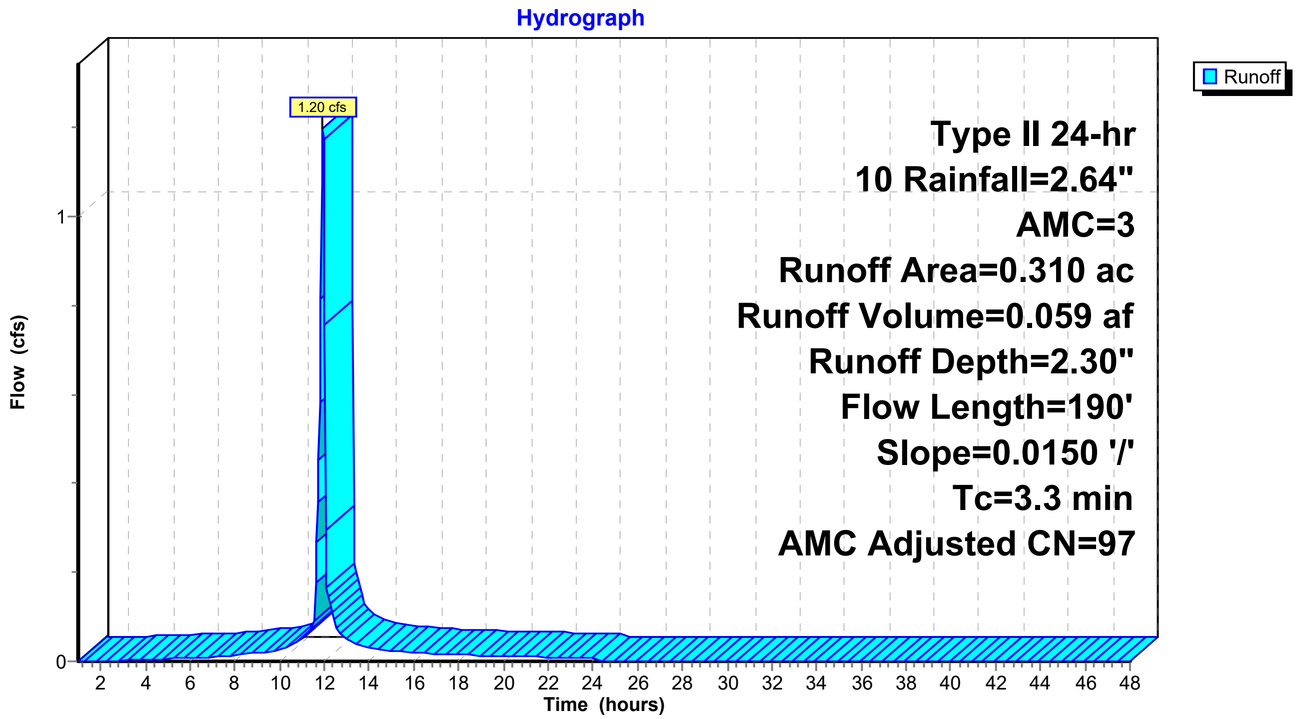
Runoff = 1.20 cfs @ 11.93 hrs, Volume= 0.059 af, Depth= 2.30"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 10 Rainfall=2.64", AMC=3

	Area (ac)	CN	Adj	Description
*	0.260	98		
*	0.050	56		
	0.310	91	97	Weighted Average, AMC Adjusted
	0.050			16.13% Pervious Area
	0.260			83.87% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.3	190	0.0150	0.95		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 1.49"

Subcatchment 15S: O



Summary for Subcatchment 16S: P

[49] Hint: Tc<2dt may require smaller dt

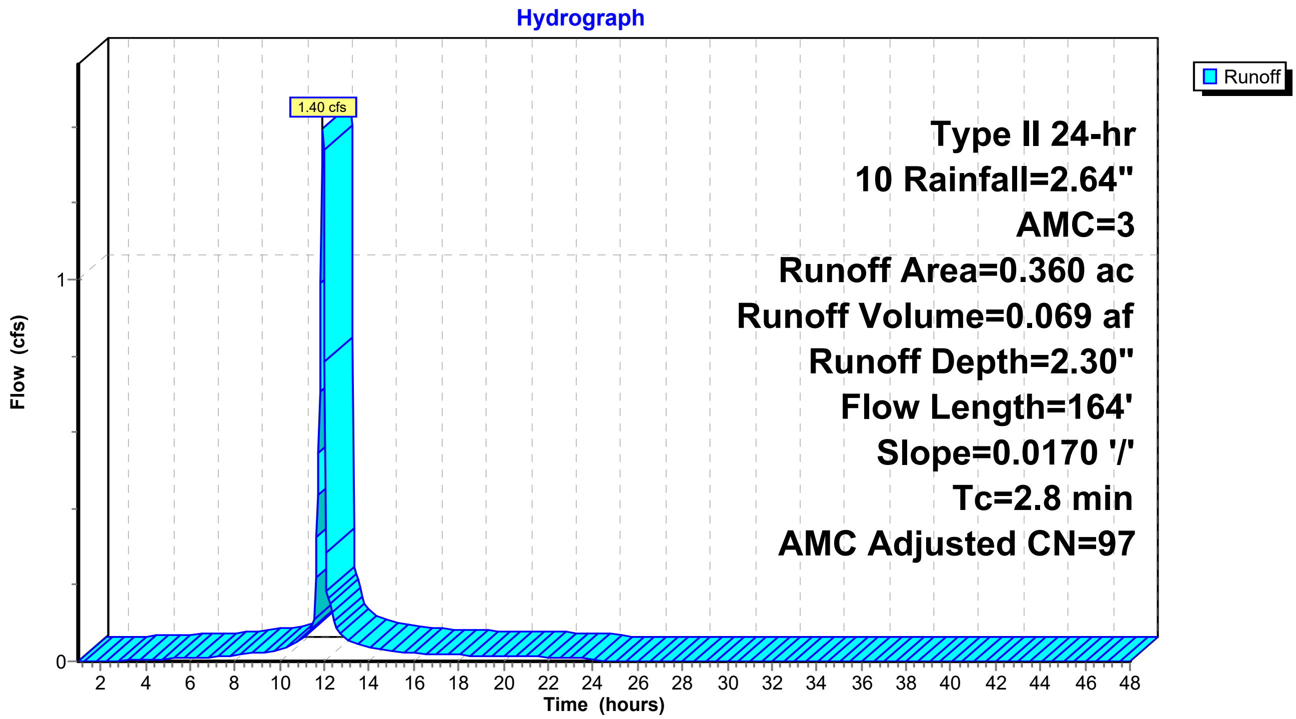
Runoff = 1.40 cfs @ 11.93 hrs, Volume= 0.069 af, Depth= 2.30"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 10 Rainfall=2.64", AMC=3

	Area (ac)	CN	Adj	Description
*	0.300	98		
*	0.060	56		
	0.360	91	97	Weighted Average, AMC Adjusted
	0.060			16.67% Pervious Area
	0.300			83.33% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.8	164	0.0170	0.97		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 1.49"

Subcatchment 16S: P



Summary for Subcatchment 17S: S

[49] Hint: Tc<2dt may require smaller dt

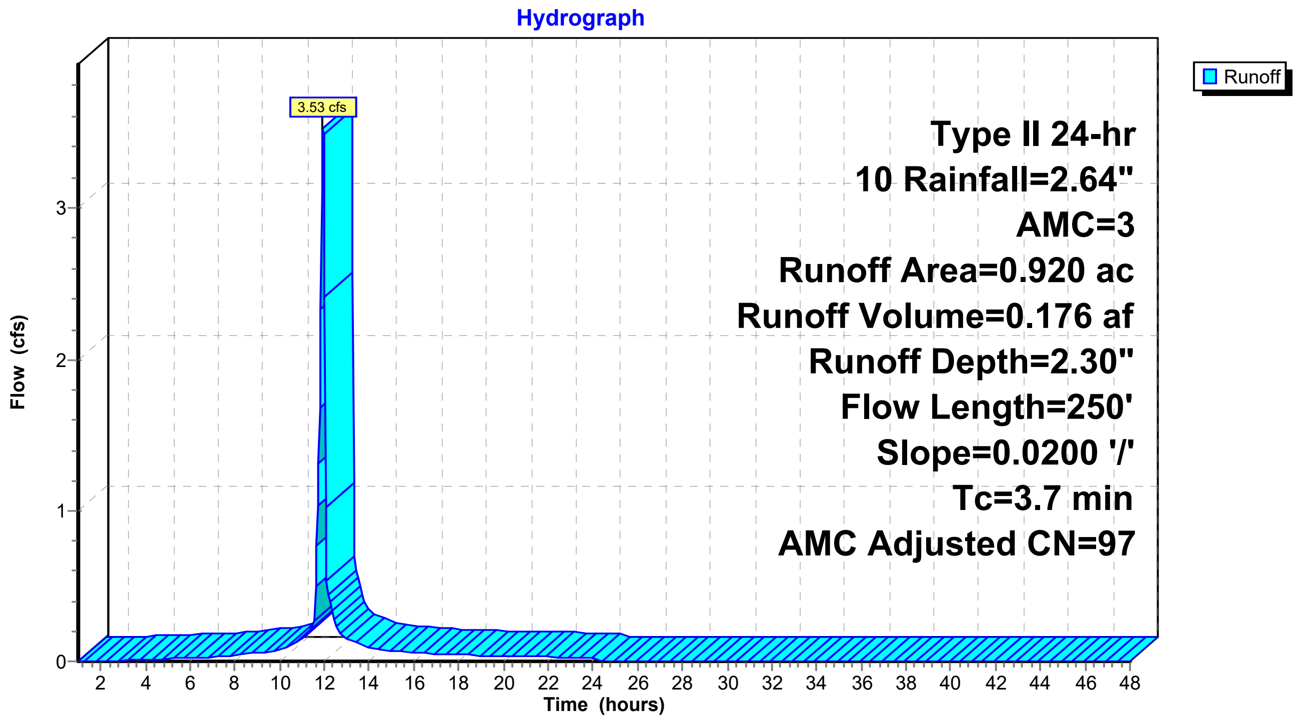
Runoff = 3.53 cfs @ 11.94 hrs, Volume= 0.176 af, Depth= 2.30"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 10 Rainfall=2.64", AMC=3

	Area (ac)	CN	Adj	Description
*	0.780	98		
*	0.140	56		
	0.920	92	97	Weighted Average, AMC Adjusted
	0.140			15.22% Pervious Area
	0.780			84.78% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.7	250	0.0200	1.13		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 1.49"

Subcatchment 17S: S



Summary for Subcatchment 18S: Q

[49] Hint: Tc<2dt may require smaller dt

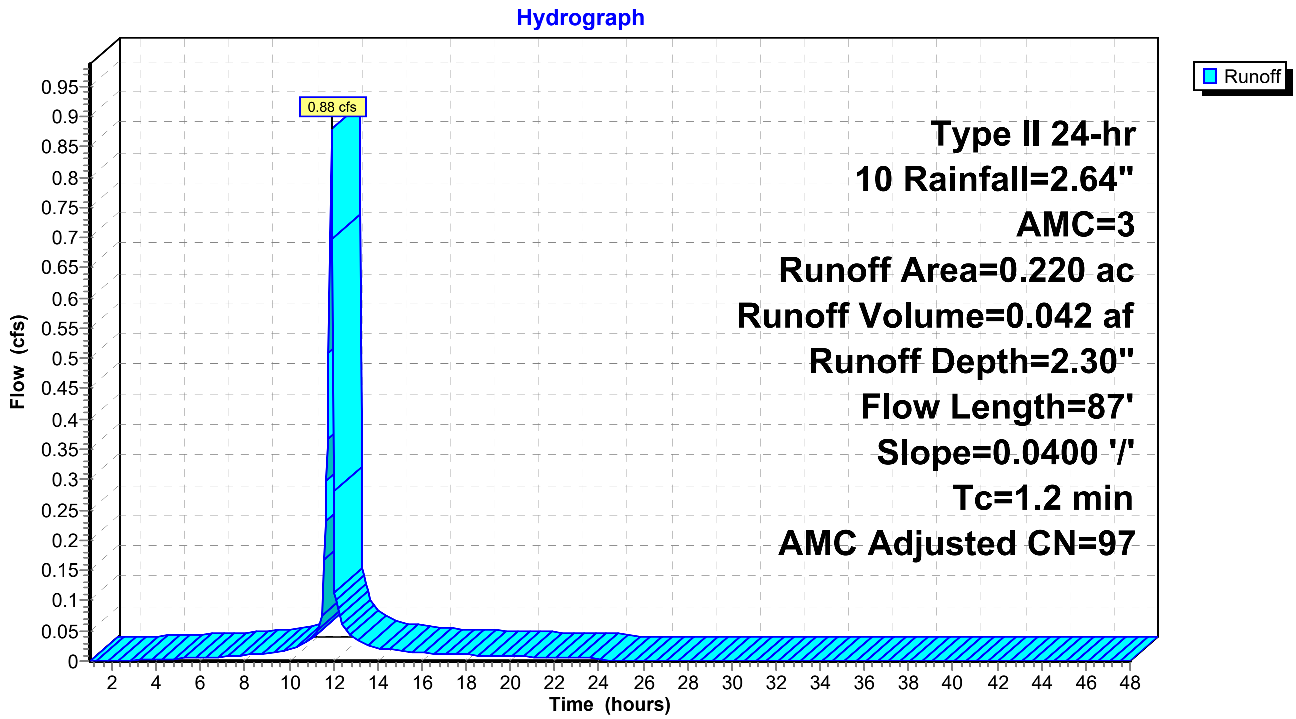
Runoff = 0.88 cfs @ 11.90 hrs, Volume= 0.042 af, Depth= 2.30"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 10 Rainfall=2.64", AMC=3

	Area (ac)	CN	Adj	Description
*	0.190	98		
*	0.030	56		
	0.220	92	97	Weighted Average, AMC Adjusted
	0.030			13.64% Pervious Area
	0.190			86.36% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	87	0.0400	1.20		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 1.49"

Subcatchment 18S: Q



Summary for Subcatchment 19S: R

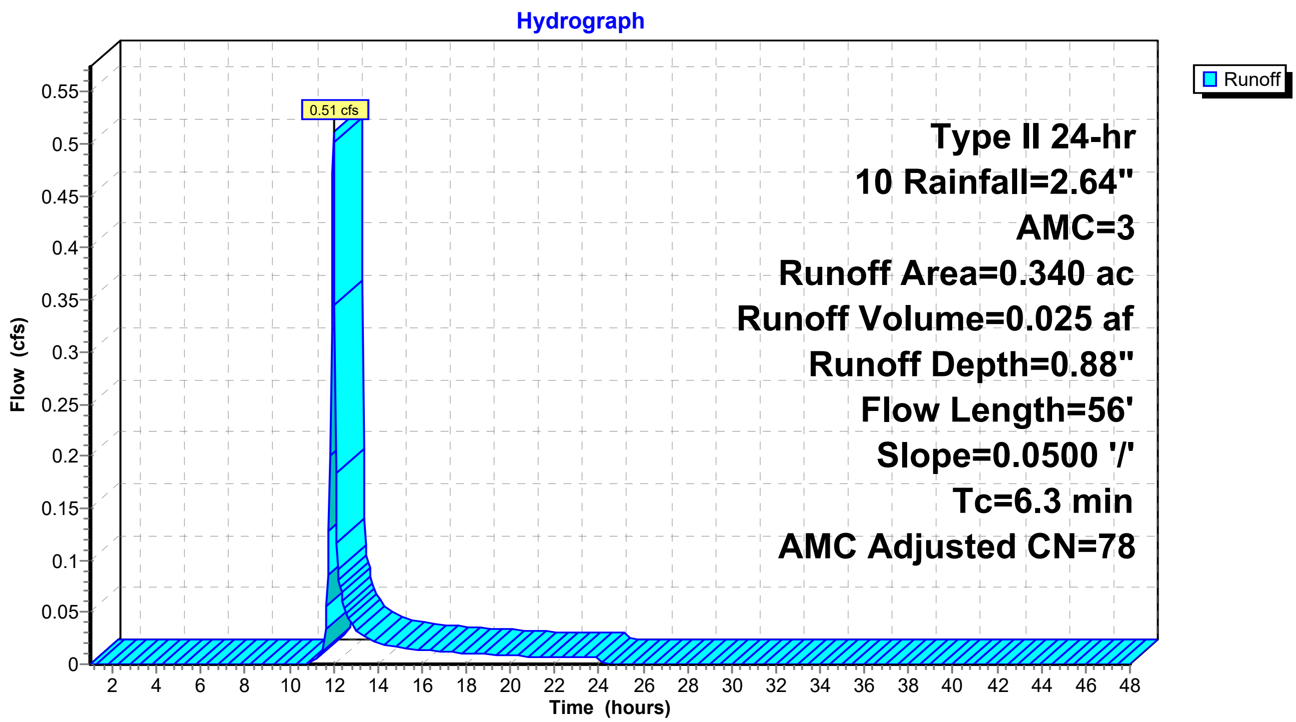
Runoff = 0.51 cfs @ 11.98 hrs, Volume= 0.025 af, Depth= 0.88"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 10 Rainfall=2.64", AMC=3

	Area (ac)	CN	Adj	Description
*	0.030	98		
*	0.310	56		
	0.340	60	78	Weighted Average, AMC Adjusted
	0.310			91.18% Pervious Area
	0.030			8.82% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.3	56	0.0500	0.15		**Sheet Flow,** Grass: Short n= 0.150 P2= 1.49"

Subcatchment 19S: R



Summary for Subcatchment 50S: T

[49] Hint: Tc<2dt may require smaller dt

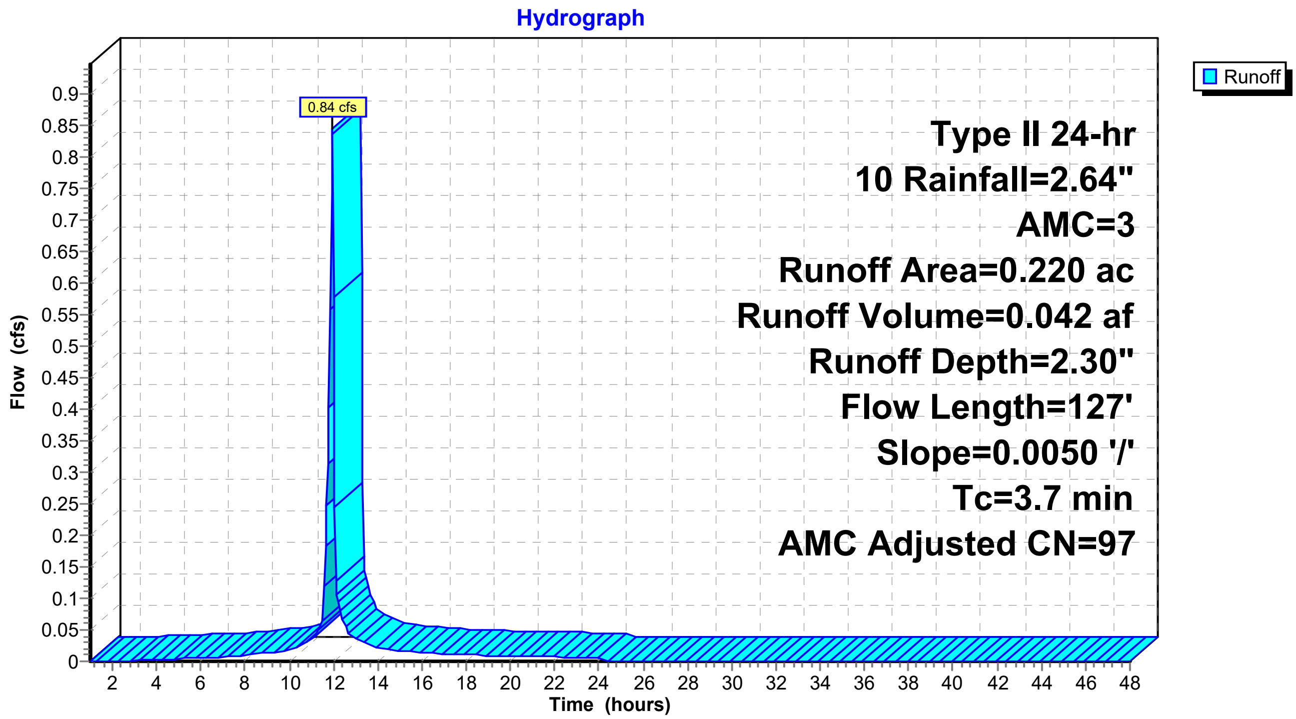
Runoff = 0.84 cfs @ 11.94 hrs, Volume= 0.042 af, Depth= 2.30"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 10 Rainfall=2.64", AMC=3

	Area (ac)	CN	Adj	Description
*	0.190	98		
*	0.030	56		
	0.220	92	97	Weighted Average, AMC Adjusted
	0.030			13.64% Pervious Area
	0.190			86.36% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.7	127	0.0050	0.57		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 1.49"

Subcatchment 50S: T



Summary for Subcatchment 52S: U

[49] Hint: Tc<2dt may require smaller dt

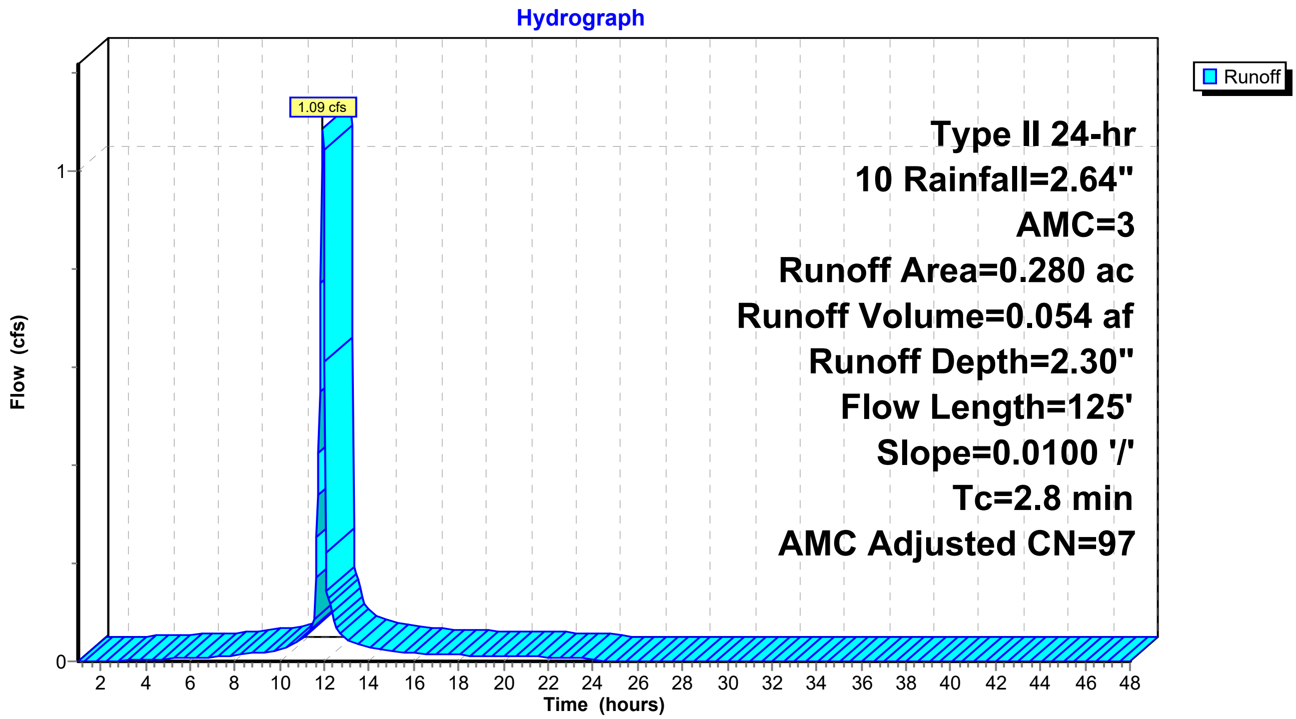
Runoff = 1.09 cfs @ 11.93 hrs, Volume= 0.054 af, Depth= 2.30"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 10 Rainfall=2.64", AMC=3

	Area (ac)	CN	Adj	Description
*	0.240	98		
*	0.040	56		
	0.280	92	97	Weighted Average, AMC Adjusted
	0.040			14.29% Pervious Area
	0.240			85.71% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.8	125	0.0100	0.74		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 1.49"

Subcatchment 52S: U



Summary for Subcatchment 55S: V

[49] Hint: Tc<2dt may require smaller dt

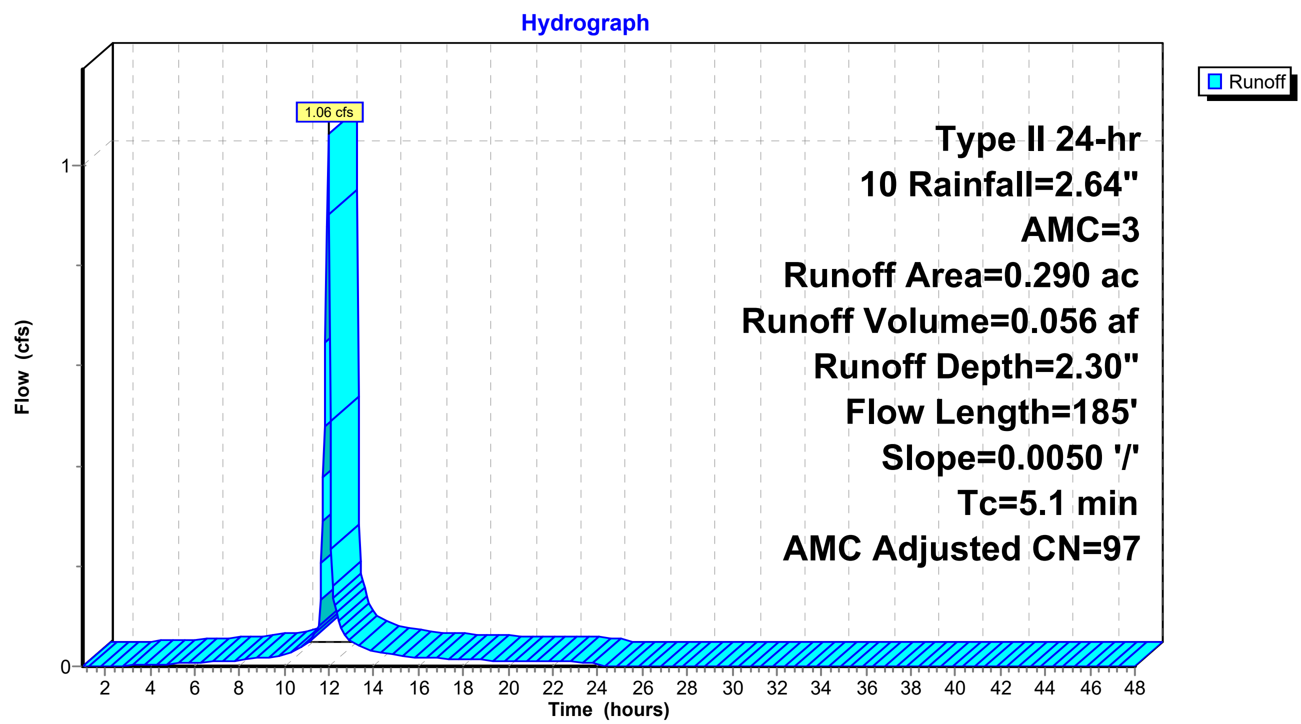
Runoff = 1.06 cfs @ 11.95 hrs, Volume= 0.056 af, Depth= 2.30"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 10 Rainfall=2.64", AMC=3

	Area (ac)	CN	Adj	Description
*	0.250	98		
*	0.040	56		
	0.290	92	97	Weighted Average, AMC Adjusted
	0.040			13.79% Pervious Area
	0.250			86.21% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.1	185	0.0050	0.61		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 1.49"

Subcatchment 55S: V



Summary for Reach 46R: REGIONAL SD

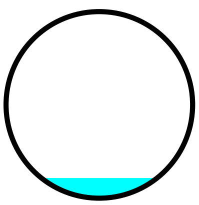
[52] Hint: Inlet/Outlet conditions not evaluated

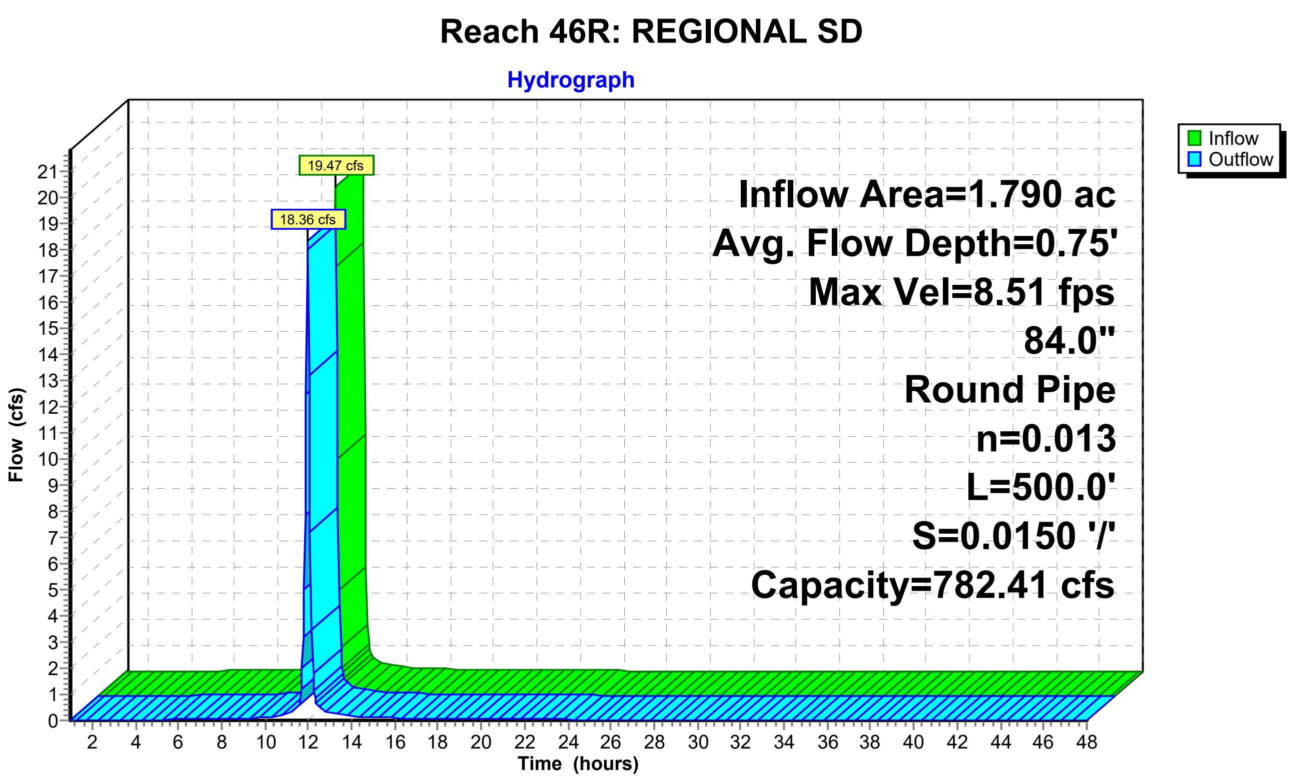
Inflow Area = 1.790 ac, 70.39% Impervious, Inflow Depth = 3.75" for 10 event
Inflow = 19.47 cfs @ 11.95 hrs, Volume= 0.559 af
Outflow = 18.36 cfs @ 11.98 hrs, Volume= 0.559 af, Atten= 6%, Lag= 1.7 min

Routing by Stor-Ind+Trans method, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Max. Velocity= 8.51 fps, Min. Travel Time= 1.0 min
Avg. Velocity = 2.03 fps, Avg. Travel Time= 4.1 min

Peak Storage= 1,113 cf @ 11.97 hrs
Average Depth at Peak Storage= 0.75'
Bank-Full Depth= 7.00' Flow Area= 38.5 sf, Capacity= 782.41 cfs

84.0" Round Pipe
n= 0.013
Length= 500.0' Slope= 0.0150 '/'
Inlet Invert= 25.10', Outlet Invert= 17.60'





Summary for Pond 20P: DT-1

Inflow Area = 1.780 ac, 84.83% Impervious, Inflow Depth = 2.30" for 10 event
Inflow = 6.28 cfs @ 11.95 hrs, Volume= 0.341 af
Outflow = 0.19 cfs @ 13.93 hrs, Volume= 0.341 af, Atten= 97%, Lag= 118.5 min
Discarded = 0.19 cfs @ 13.93 hrs, Volume= 0.341 af

Routing by Stor-Ind method, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 34.39' @ 13.93 hrs Surf.Area= 0.210 ac Storage= 0.181 af

Plug-Flow detention time= 382.1 min calculated for 0.341 af (100% of inflow)
Center-of-Mass det. time= 381.8 min (1,148.9 - 767.1)

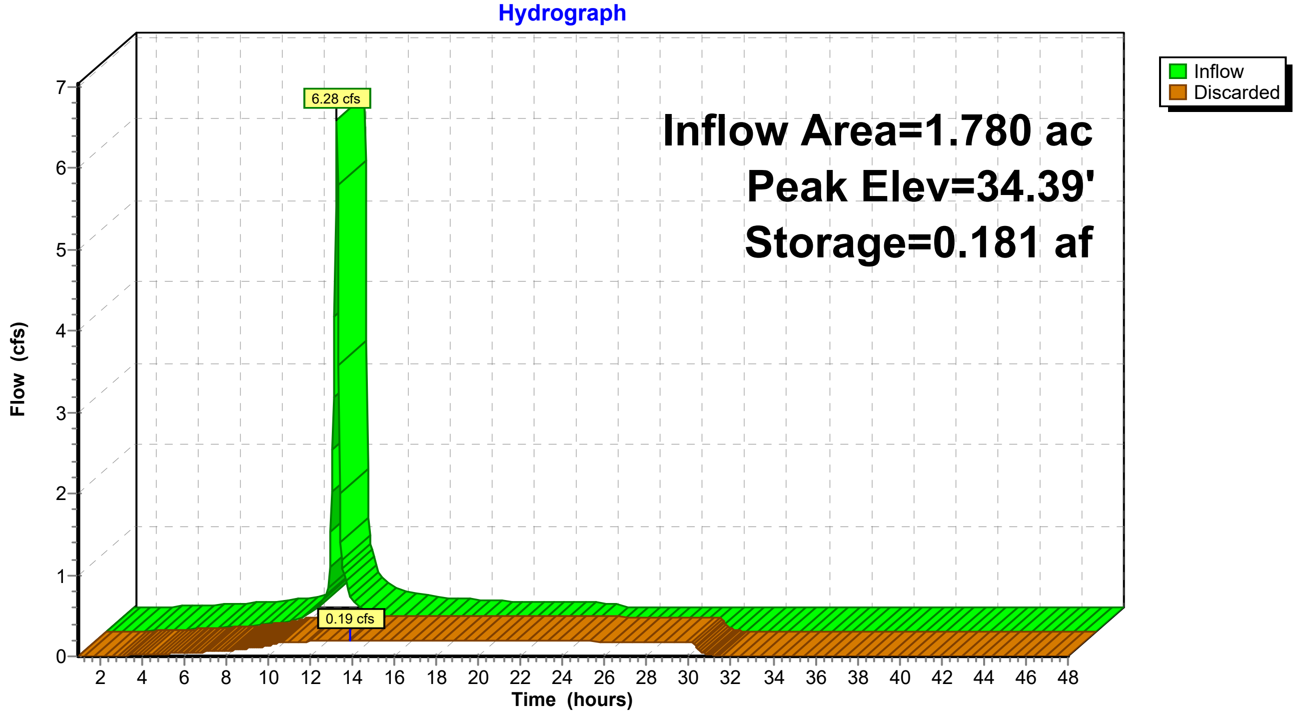
Volume	Invert	Avail.Storage	Storage Description
#1	33.50'	0.509 af	**Custom Stage Data (Irregular)** Listed below (Recalc) 0.525 af Overall x 97.0% Voids

Elevation (feet)	Surf.Area (acres)	Perim. (feet)	Inc.Store (acre-feet)	Cum.Store (acre-feet)	Wet.Area (acres)
33.50	0.210	402.0	0.000	0.000	0.210
36.00	0.210	402.0	0.525	0.525	0.233

Device	Routing	Invert	Outlet Devices
#1	Discarded	33.50'	**0.850 in/hr Exfiltration over Wetted area**

Discarded OutFlow Max=0.19 cfs @ 13.93 hrs HW=34.39' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.19 cfs)

Pond 20P: DT-1


Hydrograph
Inflow
Discarded
6.28 cfs
0.19 cfs
Inflow Area=1.780 ac
Peak Elev=34.39'
Storage=0.181 af
Flow (cfs)
0
1
2
3
4
5
6
7
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
44
46
48
Time (hours)

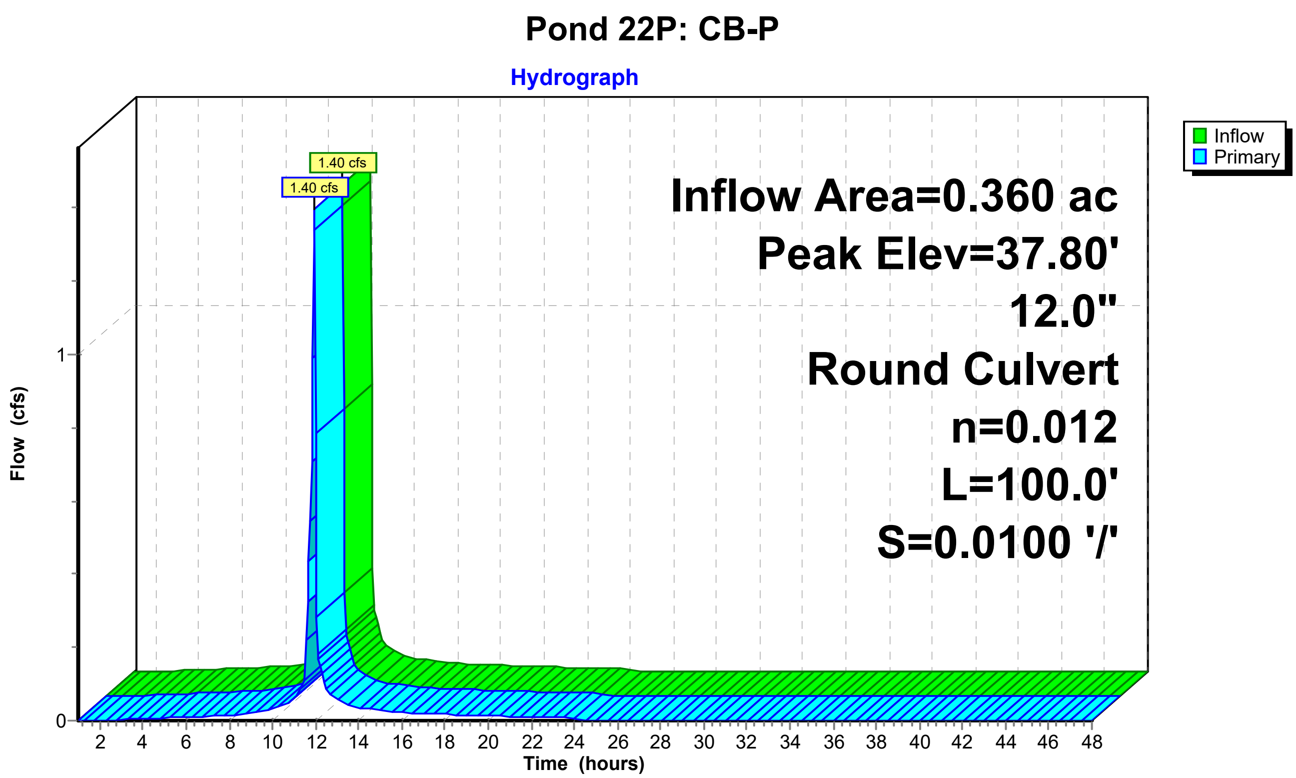
Summary for Pond 22P: CB-P

Inflow Area =	0.360 ac,	83.33% Impervious,	Inflow Depth = 2.30"	for 10 event
Inflow =	1.40 cfs @	11.93 hrs, Volume=	0.069 af	
Outflow =	1.40 cfs @	11.93 hrs, Volume=	0.069 af, Atten= 0%, Lag= 0.0 min	
Primary =	1.40 cfs @	11.93 hrs, Volume=	0.069 af	

Routing by Stor-Ind method, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 37.80' @ 11.93 hrs
Flood Elev= 40.50'

Device	Routing	Invert	Outlet Devices
#1	Primary	37.00'	**12.0" Round Culvert** L= 100.0' Ke= 1.200 Inlet / Outlet Invert= 37.00' / 36.00' S= 0.0100 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf

Primary OutFlow Max=1.33 cfs @ 11.93 hrs HW=37.77' (Free Discharge)
└─**1=Culvert** (Inlet Controls 1.33 cfs @ 2.04 fps)



Summary for Pond 24P: CB-M

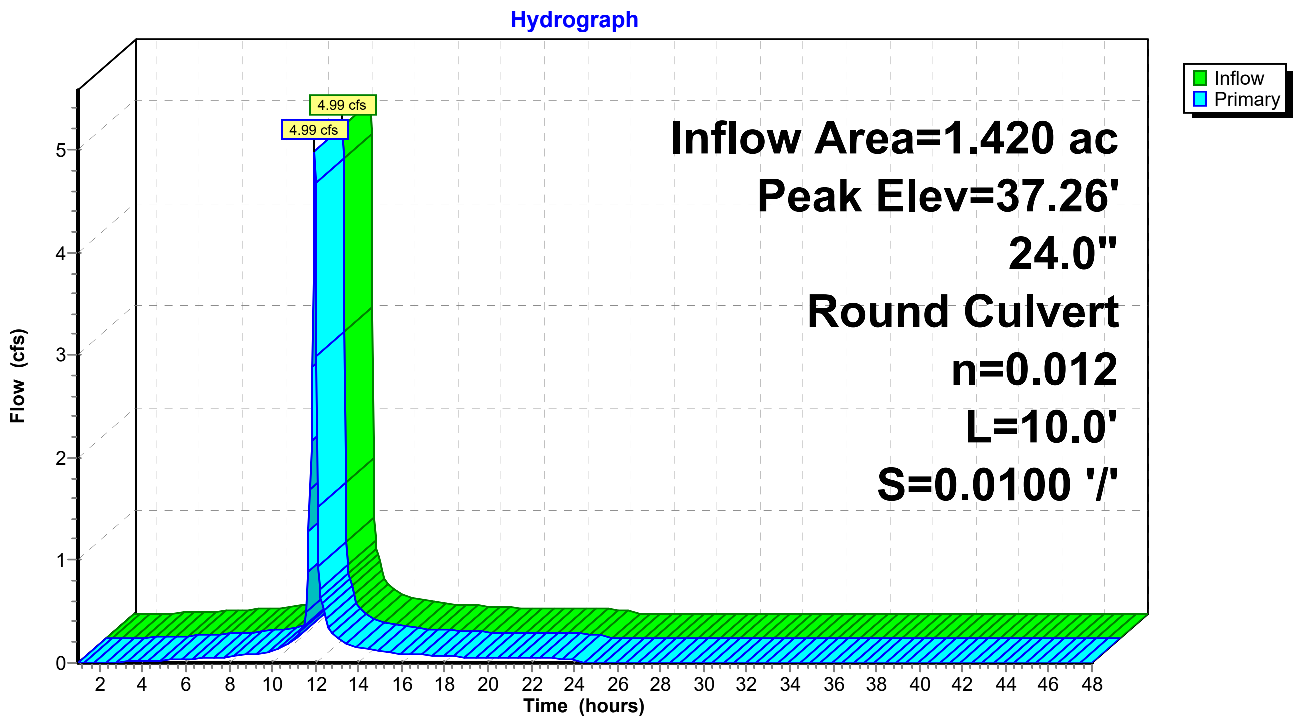
Inflow Area = 1.420 ac, 85.21% Impervious, Inflow Depth = 2.30" for 10 event
Inflow = 4.99 cfs @ 11.97 hrs, Volume= 0.272 af
Outflow = 4.99 cfs @ 11.97 hrs, Volume= 0.272 af, Atten= 0%, Lag= 0.0 min
Primary = 4.99 cfs @ 11.97 hrs, Volume= 0.272 af

Routing by Stor-Ind method, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 37.26' @ 11.97 hrs
Flood Elev= 40.89'

Device	Routing	Invert	Outlet Devices
#1	Primary	36.00'	**24.0" Round Culvert** L= 10.0' Ke= 1.200 Inlet / Outlet Invert= 36.00' / 35.90' S= 0.0100 '/' Cc= 0.900 n= 0.012, Flow Area= 3.14 sf

Primary OutFlow Max=4.86 cfs @ 11.97 hrs HW=37.24' (Free Discharge)
└─**1=Culvert** (Barrel Controls 4.86 cfs @ 3.38 fps)

Pond 24P: CB-M



Summary for Pond 26P: CB-N

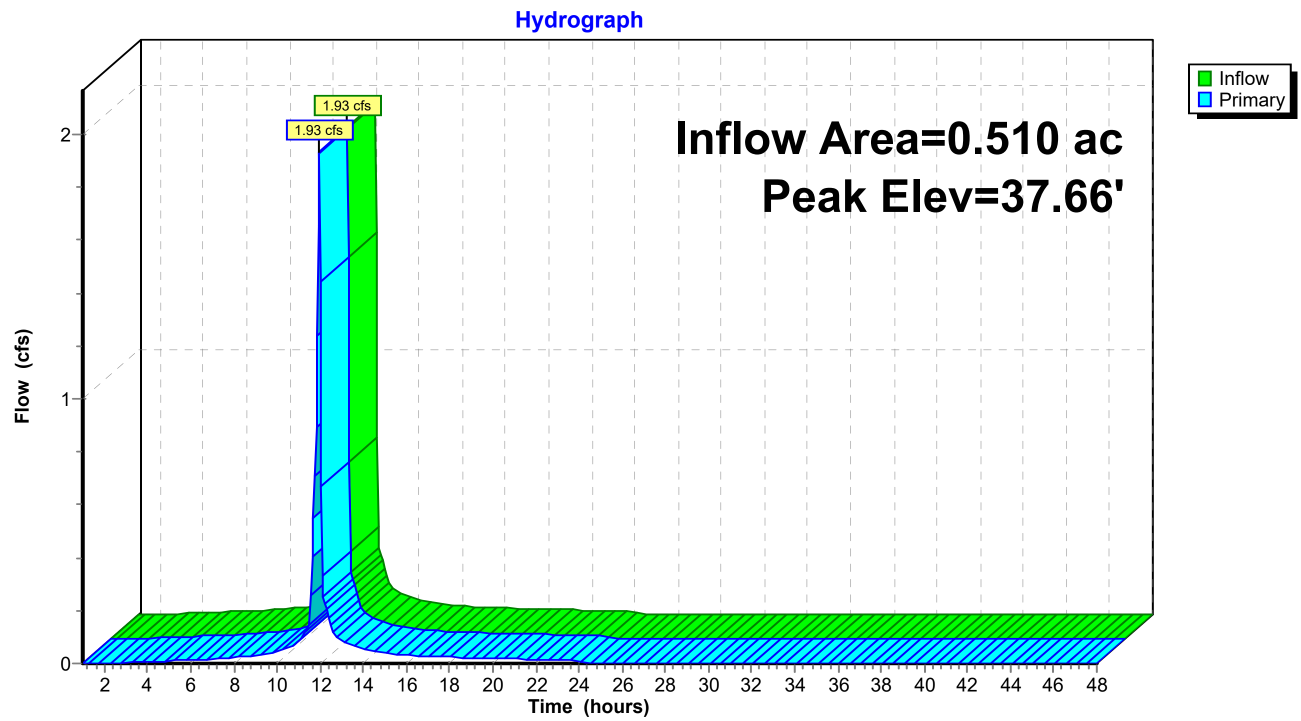
Inflow Area = 0.510 ac, 84.31% Impervious, Inflow Depth = 2.30" for 10 event
Inflow = 1.93 cfs @ 11.94 hrs, Volume= 0.098 af
Outflow = 1.93 cfs @ 11.94 hrs, Volume= 0.098 af, Atten= 0%, Lag= 0.0 min
Primary = 1.93 cfs @ 11.94 hrs, Volume= 0.098 af

Routing by Stor-Ind method, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 37.66' @ 11.94 hrs
Flood Elev= 39.50'

Device	Routing	Invert	Outlet Devices
#1	Primary	39.57'	**12.0" x 12.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#2	Primary	36.60'	**12.0" Round Culvert** L= 10.0' Ke= 1.200 Inlet / Outlet Invert= 36.60' / 36.50' S= 0.0100 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf

Primary OutFlow Max=1.89 cfs @ 11.94 hrs HW=37.64' (Free Discharge)
1=Orifice/Grate (Controls 0.00 cfs)
2=Culvert (Inlet Controls 1.89 cfs @ 2.40 fps)

Pond 26P: CB-N



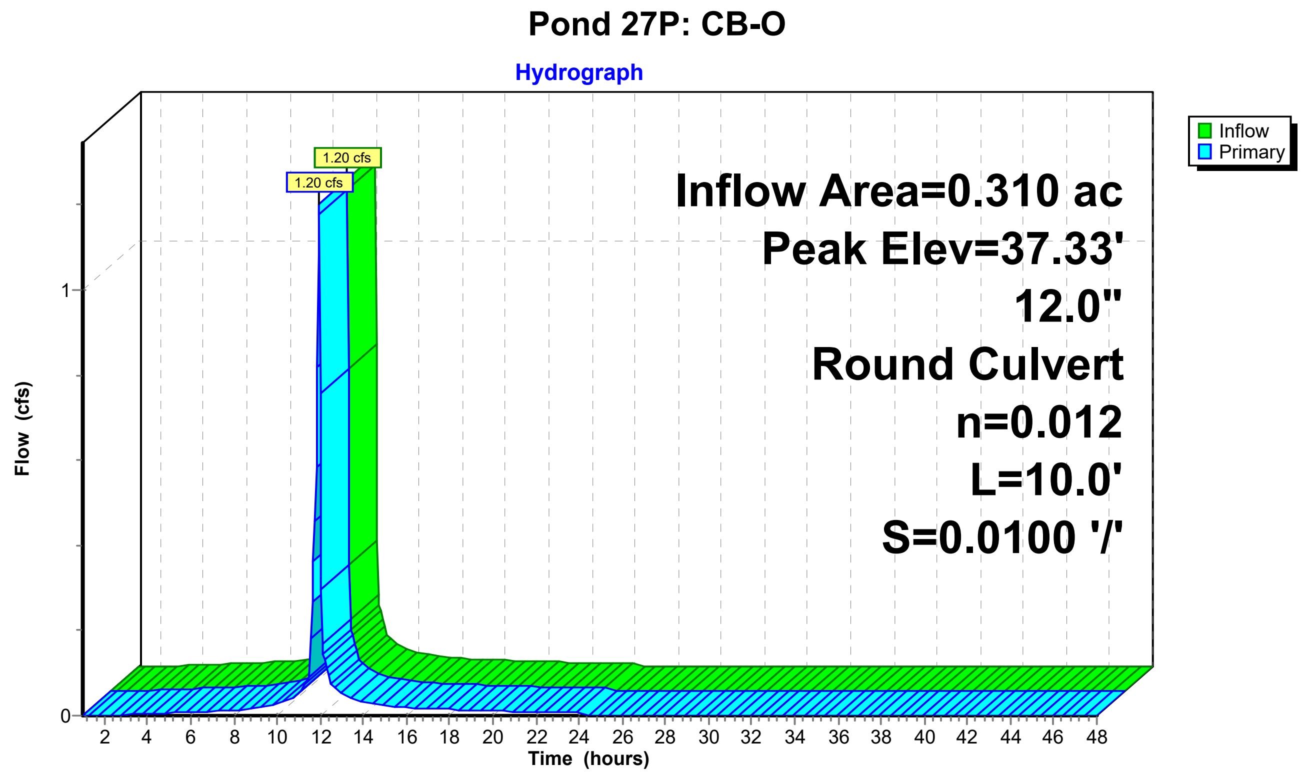
Summary for Pond 27P: CB-O

Inflow Area =	0.310 ac,	83.87% Impervious,	Inflow Depth = 2.30"	for 10 event	
Inflow =	1.20 cfs @	11.93 hrs,	Volume=	0.059 af	
Outflow =	1.20 cfs @	11.93 hrs,	Volume=	0.059 af,	Atten= 0%, Lag= 0.0 min
Primary =	1.20 cfs @	11.93 hrs,	Volume=	0.059 af	

Routing by Stor-Ind method, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 37.33' @ 11.93 hrs
Flood Elev= 39.50'

Device	Routing	Invert	Outlet Devices
#1	Primary	36.60'	**12.0" Round Culvert** L= 10.0' Ke= 1.200 Inlet / Outlet Invert= 36.60' / 36.50' S= 0.0100 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf

Primary OutFlow Max=1.14 cfs @ 11.93 hrs HW=37.31' (Free Discharge)
1=Culvert (Barrel Controls 1.14 cfs @ 2.70 fps)



Summary for Pond 28P: DT-2

Inflow Area = 1.060 ac, 84.91% Impervious, Inflow Depth = 2.33" for 10 event
Inflow = 4.03 cfs @ 11.94 hrs, Volume= 0.206 af
Outflow = 0.10 cfs @ 14.05 hrs, Volume= 0.206 af, Atten= 97%, Lag= 126.6 min
Discarded = 0.10 cfs @ 14.05 hrs, Volume= 0.206 af

Routing by Stor-Ind method, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 32.54' @ 14.05 hrs Surf.Area= 0.110 ac Storage= 0.111 af

Plug-Flow detention time= 429.6 min calculated for 0.205 af (100% of inflow)
Center-of-Mass det. time= 429.8 min (1,193.0 - 763.3)

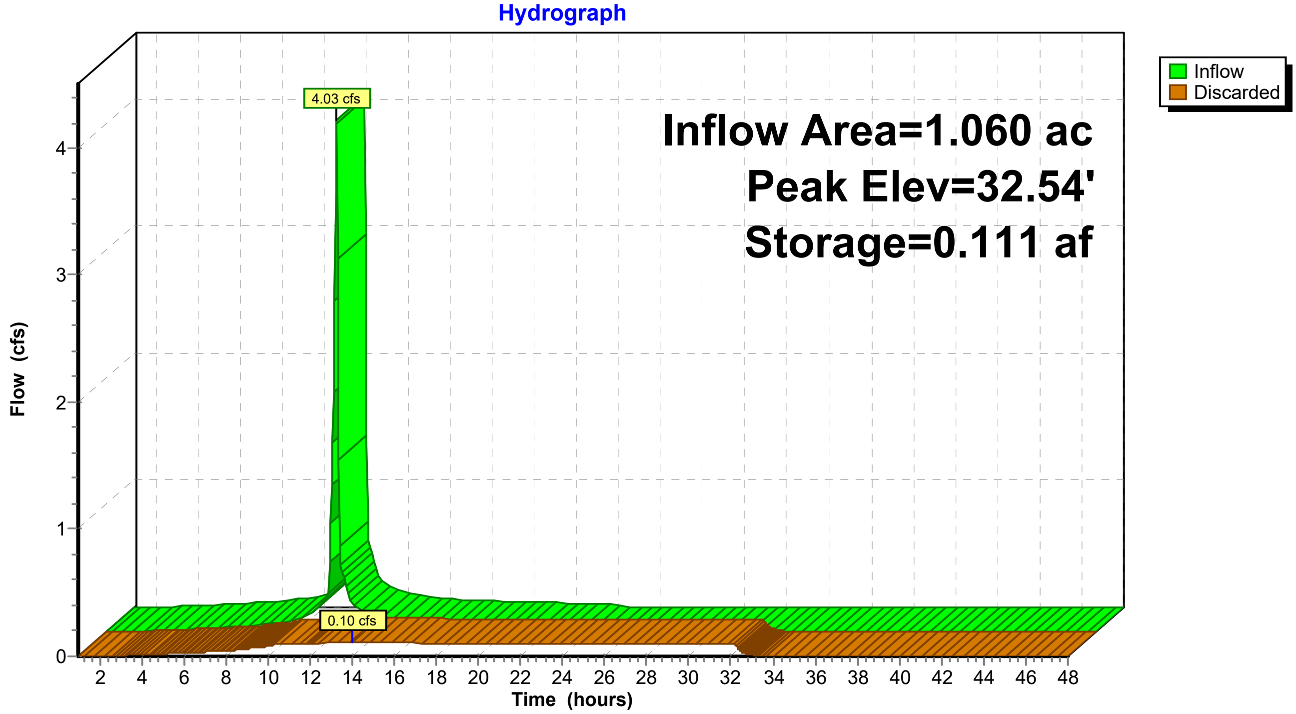
Volume	Invert	Avail.Storage	Storage Description
#1	31.50'	0.267 af	**Custom Stage Data (Irregular)** Listed below (Recalc) 0.275 af Overall x 97.0% Voids

Elevation (feet)	Surf.Area (acres)	Perim. (feet)	Inc.Store (acre-feet)	Cum.Store (acre-feet)	Wet.Area (acres)
31.50	0.110	477.0	0.000	0.000	0.110
34.00	0.110	477.0	0.275	0.275	0.137

Device	Routing	Invert	Outlet Devices
#1	Discarded	31.50'	**0.850 in/hr Exfiltration over Wetted area**

Discarded OutFlow Max=0.10 cfs @ 14.05 hrs HW=32.54' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.10 cfs)

Pond 28P: DT-2


Hydrograph
Inflow
Discarded
4.03 cfs
0.10 cfs
Inflow Area=1.060 ac
Peak Elev=32.54'
Storage=0.111 af
Flow (cfs)
Time (hours)
0
1
2
3
4
2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48

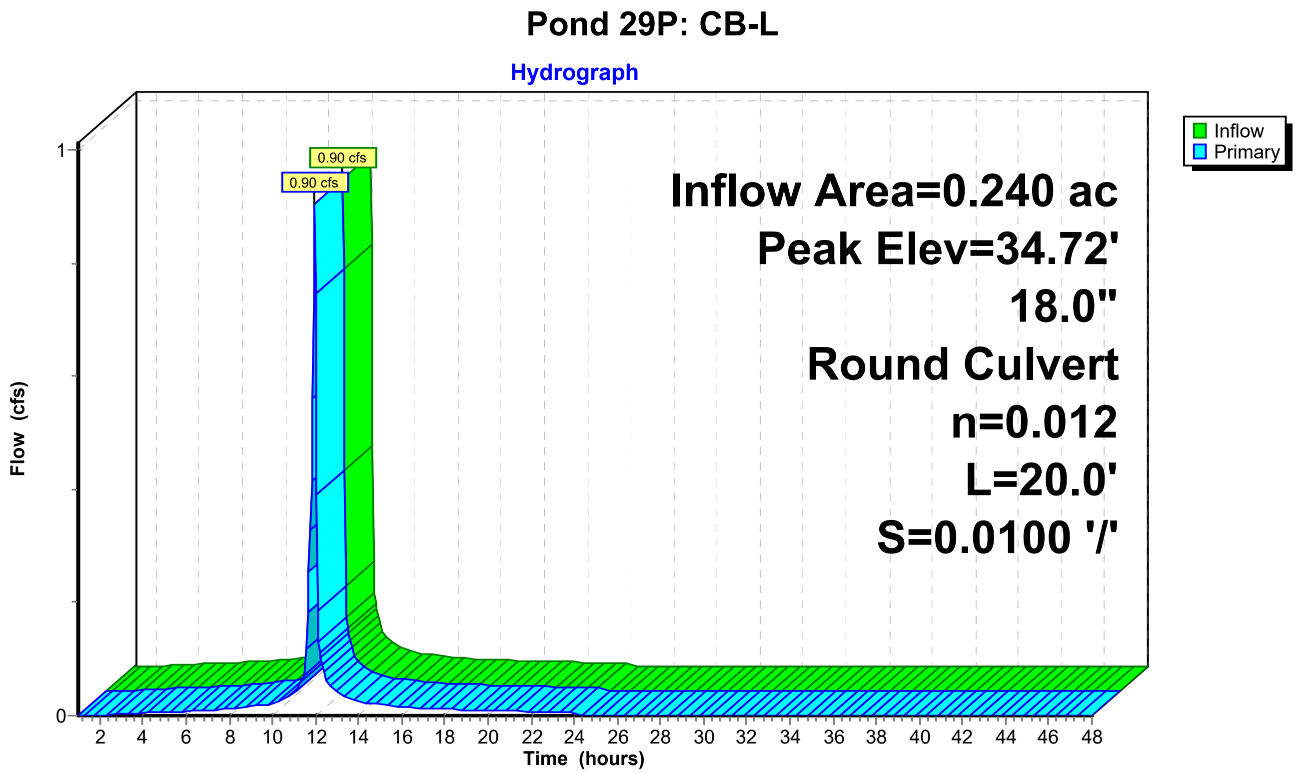
Summary for Pond 29P: CB-L

Inflow Area =	0.240 ac, 87.50% Impervious, Inflow Depth = 2.41" for 10 event			
Inflow =	0.90 cfs @	11.95 hrs, Volume=	0.048 af	
Outflow =	0.90 cfs @	11.95 hrs, Volume=	0.048 af,	Atten= 0%, Lag= 0.0 min
Primary =	0.90 cfs @	11.95 hrs, Volume=	0.048 af	

Routing by Stor-Ind method, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 34.72' @ 11.95 hrs
Flood Elev= 37.15'

Device	Routing	Invert	Outlet Devices
#1	Primary	34.20'	**18.0" Round Culvert** L= 20.0' Ke= 1.200 Inlet / Outlet Invert= 34.20' / 34.00' S= 0.0100 '/' Cc= 0.900 n= 0.012, Flow Area= 1.77 sf

Primary OutFlow Max=0.90 cfs @ 11.95 hrs HW=34.72' (Free Discharge)
└─**1=Culvert** (Inlet Controls 0.90 cfs @ 1.67 fps)



Summary for Pond 30P: CB-I

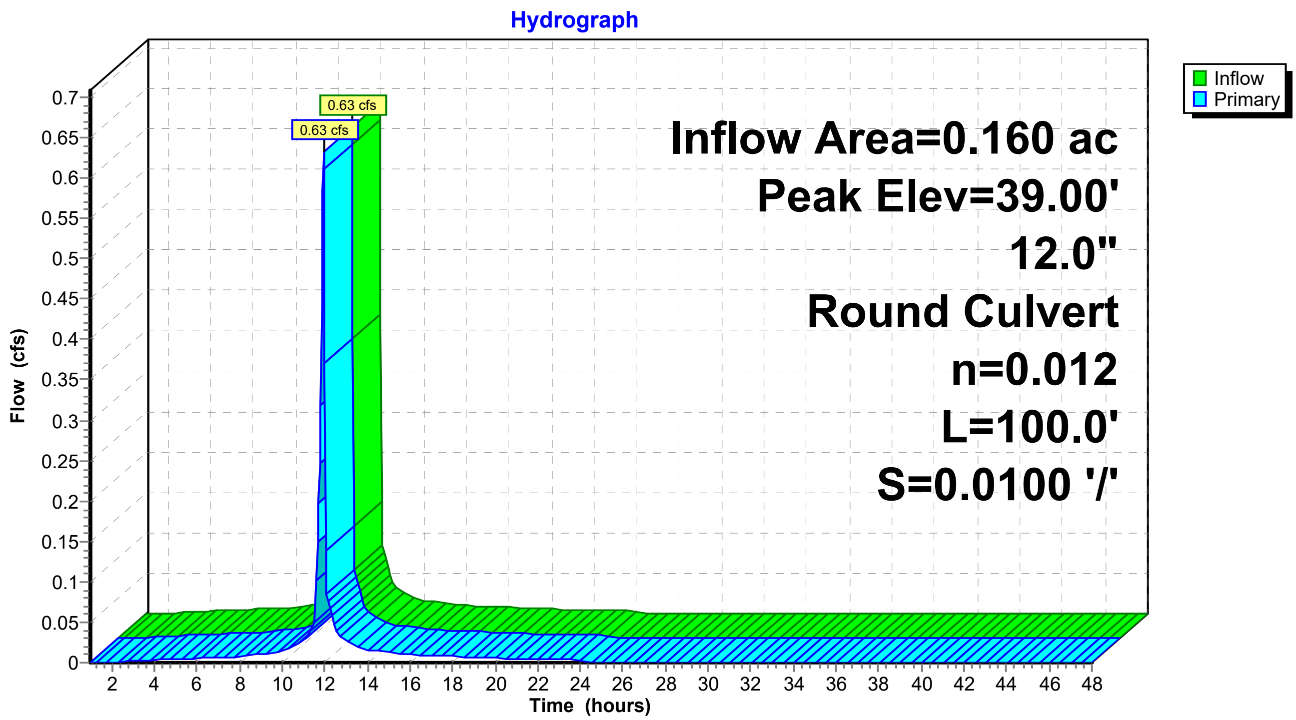
Inflow Area =	0.160 ac, 87.50% Impervious, Inflow Depth = 2.41" for 10 event			
Inflow =	0.63 cfs @	11.93 hrs, Volume=	0.032 af	
Outflow =	0.63 cfs @	11.93 hrs, Volume=	0.032 af,	Atten= 0%, Lag= 0.0 min
Primary =	0.63 cfs @	11.93 hrs, Volume=	0.032 af	

Routing by Stor-Ind method, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 39.00' @ 11.93 hrs
Flood Elev= 41.99'

Device	Routing	Invert	Outlet Devices
#1	Primary	38.50'	**12.0" Round Culvert** L= 100.0' Ke= 1.200 Inlet / Outlet Invert= 38.50' / 37.50' S= 0.0100 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf

Primary OutFlow Max=0.60 cfs @ 11.93 hrs HW=38.98' (Free Discharge)
└─**1=Culvert** (Inlet Controls 0.60 cfs @ 1.61 fps)

Pond 30P: CB-I



Summary for Pond 31P: CB-J

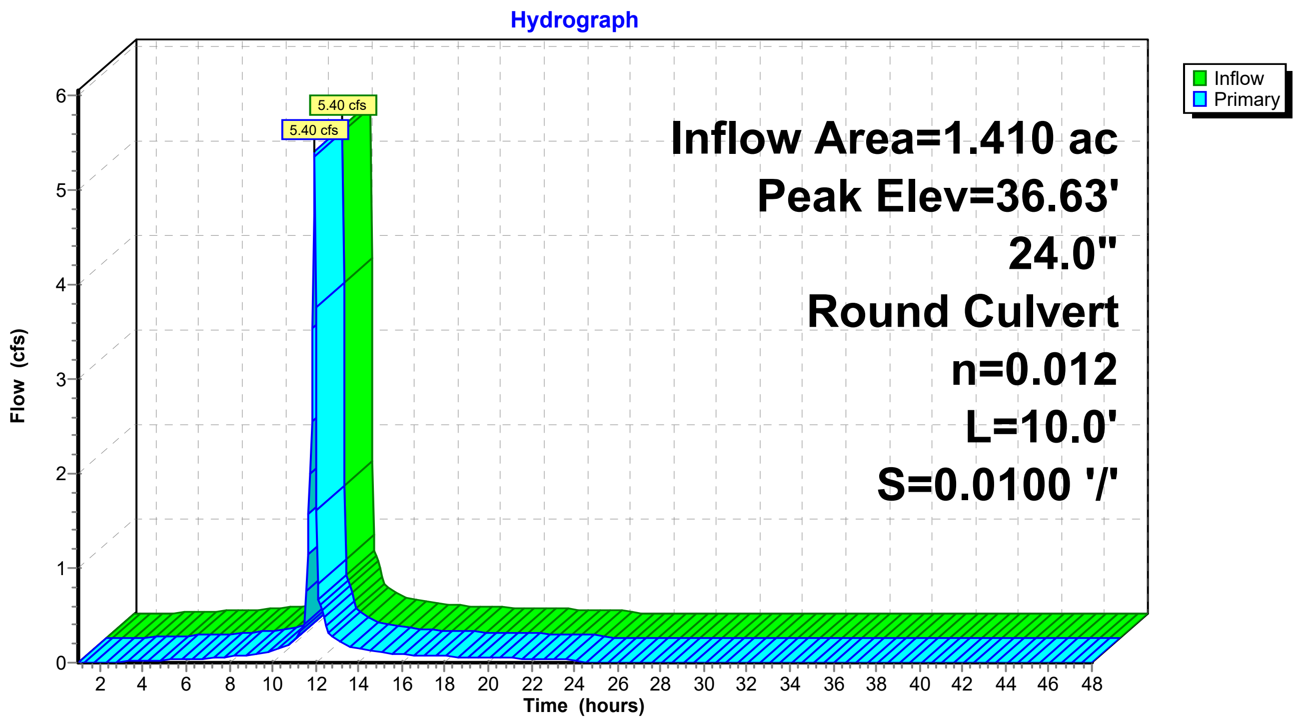
Inflow Area = 1.410 ac, 85.11% Impervious, Inflow Depth = 2.30" for 10 event
Inflow = 5.40 cfs @ 11.94 hrs, Volume= 0.270 af
Outflow = 5.40 cfs @ 11.94 hrs, Volume= 0.270 af, Atten= 0%, Lag= 0.0 min
Primary = 5.40 cfs @ 11.94 hrs, Volume= 0.270 af

Routing by Stor-Ind method, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 36.63' @ 11.94 hrs
Flood Elev= 38.26'

Device	Routing	Invert	Outlet Devices
#1	Primary	35.30'	**24.0" Round Culvert** L= 10.0' Ke= 1.200 Inlet / Outlet Invert= 35.30' / 35.20' S= 0.0100 '/' Cc= 0.900 n= 0.012, Flow Area= 3.14 sf

Primary OutFlow Max=5.21 cfs @ 11.94 hrs HW=36.60' (Free Discharge)
└—**1=Culvert** (Barrel Controls 5.21 cfs @ 3.44 fps)

Pond 31P: CB-J



Summary for Pond 32P: DT-3

Inflow Area = 1.570 ac, 85.35% Impervious, Inflow Depth = 2.31" for 10 event
Inflow = 6.03 cfs @ 11.94 hrs, Volume= 0.303 af
Outflow = 0.15 cfs @ 14.06 hrs, Volume= 0.303 af, Atten= 97%, Lag= 127.1 min
Discarded = 0.15 cfs @ 14.06 hrs, Volume= 0.303 af

Routing by Stor-Ind method, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 33.56' @ 14.06 hrs Surf.Area= 0.170 ac Storage= 0.164 af

Plug-Flow detention time= 424.8 min calculated for 0.302 af (100% of inflow)
Center-of-Mass det. time= 424.9 min (1,189.2 - 764.3)

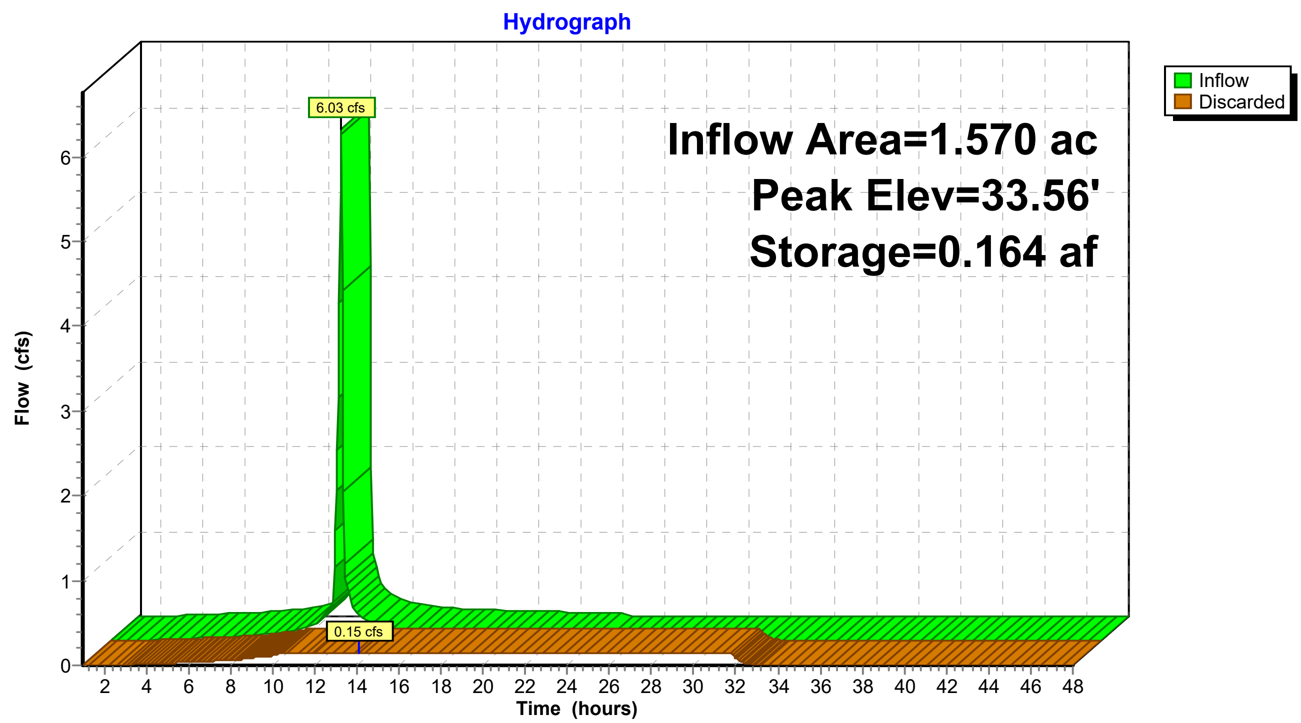
Volume	Invert	Avail.Storage	Storage Description
#1	32.60'	0.425 af	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Perim. (feet)	Inc.Store (acre-feet)	Cum.Store (acre-feet)	Wet.Area (acres)
32.60	0.170	403.0	0.000	0.000	0.170
35.10	0.170	403.0	0.425	0.425	0.193

Device	Routing	Invert	Outlet Devices
#1	Discarded	32.60'	**0.850 in/hr Exfiltration over Wetted area**

Discarded OutFlow Max=0.15 cfs @ 14.06 hrs HW=33.56' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.15 cfs)

Pond 32P: DT-3



Summary for Pond 33P: CB-G

Inflow Area = 0.780 ac, 84.62% Impervious, Inflow Depth = 2.30" for 10 event
Inflow = 2.78 cfs @ 11.96 hrs, Volume= 0.150 af
Outflow = 2.78 cfs @ 11.96 hrs, Volume= 0.150 af, Atten= 0%, Lag= 0.0 min
Primary = 1.05 cfs @ 11.96 hrs, Volume= 0.121 af
Secondary = 1.73 cfs @ 11.96 hrs, Volume= 0.029 af

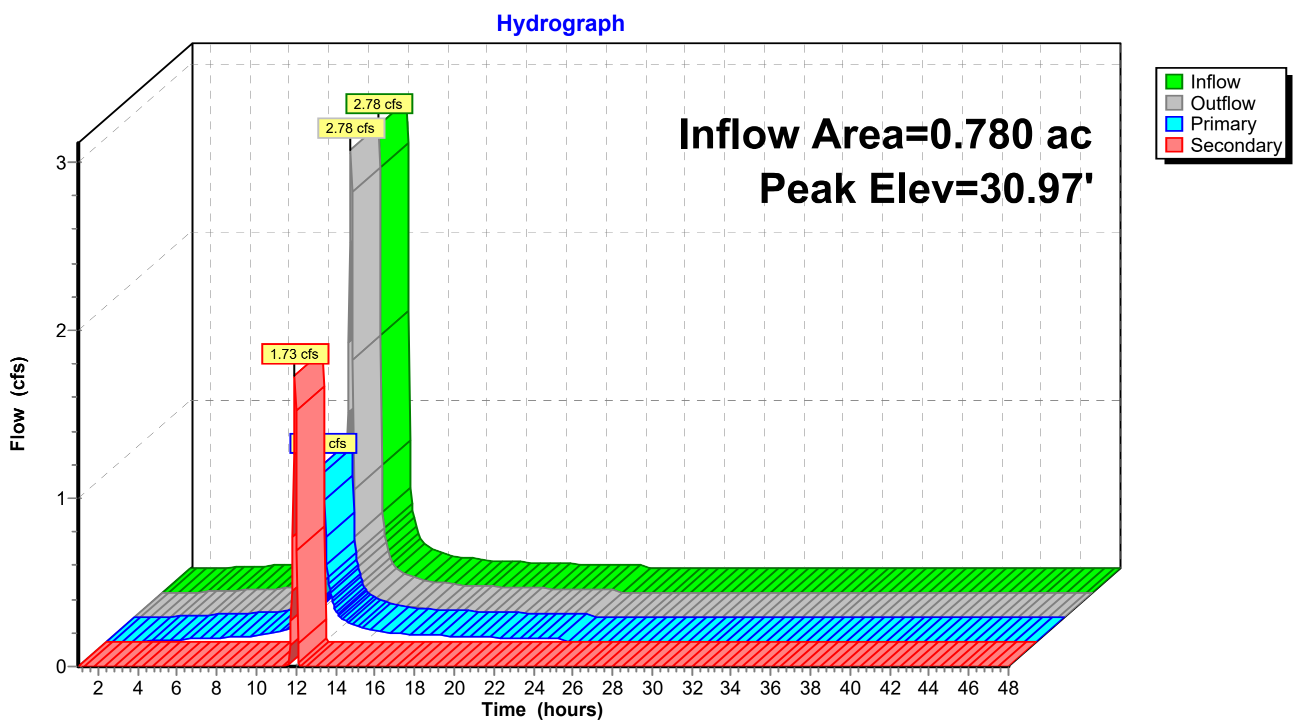
Routing by Stor-Ind method, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 30.97' @ 11.96 hrs
Flood Elev= 32.88'

Device	Routing	Invert	Outlet Devices
#1	Primary	29.80'	**8.0" Round Culvert** L= 100.0' Ke= 1.200 Inlet / Outlet Invert= 29.80' / 28.80' S= 0.0100 '/' Cc= 0.900 n= 0.012, Flow Area= 0.35 sf
#2	Secondary	30.23'	**18.0" Round Culvert** L= 15.0' Ke= 1.200 Inlet / Outlet Invert= 30.23' / 30.08' S= 0.0100 '/' Cc= 0.900 n= 0.012, Flow Area= 1.77 sf

Primary OutFlow Max=1.04 cfs @ 11.96 hrs HW=30.96' (Free Discharge)
↑—**1=Culvert** (Inlet Controls 1.04 cfs @ 2.98 fps)

Secondary OutFlow Max=1.68 cfs @ 11.96 hrs HW=30.96' (Free Discharge)
↑—**2=Culvert** (Inlet Controls 1.68 cfs @ 1.98 fps)

Pond 33P: CB-G



Summary for Pond 34P: CB-K

Inflow Area = 0.940 ac, 85.11% Impervious, Inflow Depth = 2.30" for 10 event
Inflow = 3.47 cfs @ 11.95 hrs, Volume= 0.180 af
Outflow = 3.47 cfs @ 11.95 hrs, Volume= 0.180 af, Atten= 0%, Lag= 0.0 min
Primary = 1.40 cfs @ 11.95 hrs, Volume= 0.148 af
Secondary = 2.08 cfs @ 11.95 hrs, Volume= 0.032 af

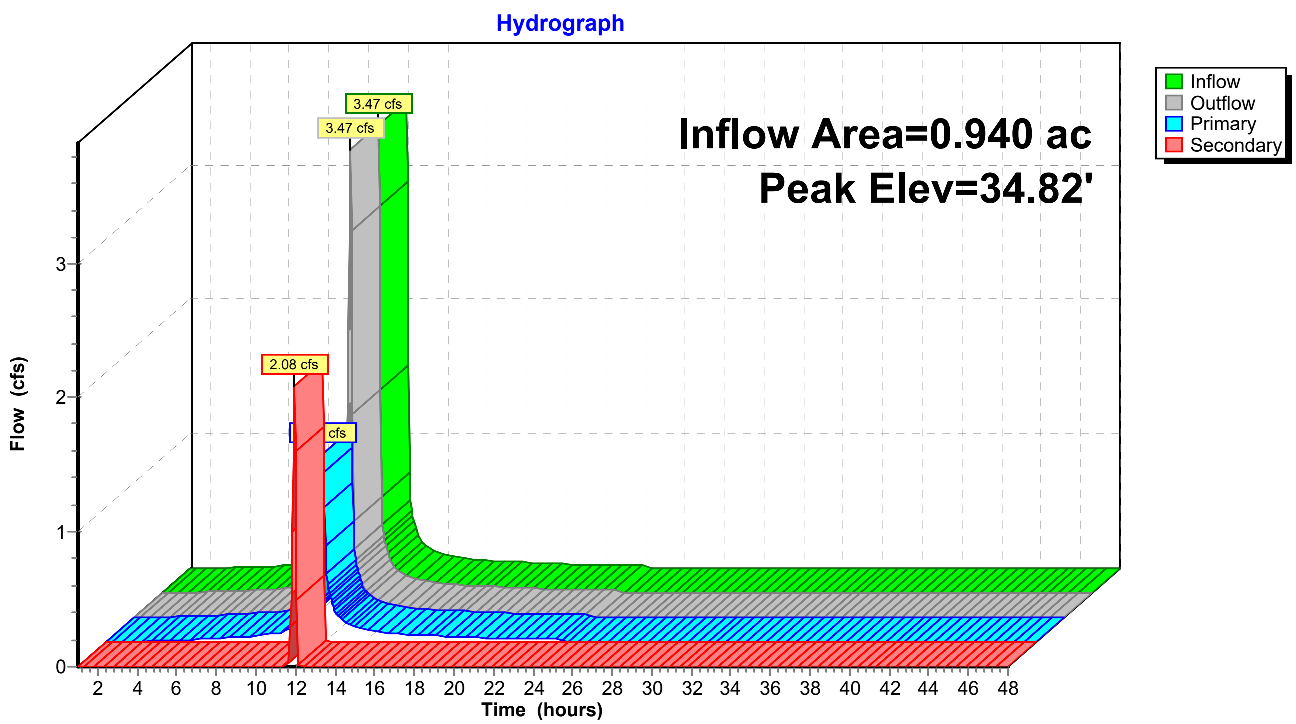
Routing by Stor-Ind method, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 34.82' @ 11.95 hrs
Flood Elev= 36.06'

Device	Routing	Invert	Outlet Devices
#1	Primary	33.00'	**8.0" Round Culvert** L= 100.0' Ke= 1.200 Inlet / Outlet Invert= 33.00' / 32.00' S= 0.0100 '/' Cc= 0.900 n= 0.012, Flow Area= 0.35 sf
#2	Secondary	33.67'	**12.0" Round Culvert** L= 20.0' Ke= 1.200 Inlet / Outlet Invert= 33.67' / 32.78' S= 0.0445 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf

Primary OutFlow Max=1.40 cfs @ 11.95 hrs HW=34.82' (Free Discharge)
└─**1=Culvert** (Inlet Controls 1.40 cfs @ 4.00 fps)

Secondary OutFlow Max=2.08 cfs @ 11.95 hrs HW=34.82' (Free Discharge)
└─**2=Culvert** (Inlet Controls 2.08 cfs @ 2.64 fps)

Pond 34P: CB-K



Summary for Pond 36P: CB-F

Inflow Area = 2.540 ac, 85.04% Impervious, Inflow Depth = 2.30" for 10 event
Inflow = 7.89 cfs @ 12.01 hrs, Volume= 0.487 af
Outflow = 7.89 cfs @ 12.01 hrs, Volume= 0.487 af, Atten= 0%, Lag= 0.0 min
Primary = 4.38 cfs @ 12.01 hrs, Volume= 0.430 af
Secondary = 3.51 cfs @ 12.01 hrs, Volume= 0.057 af

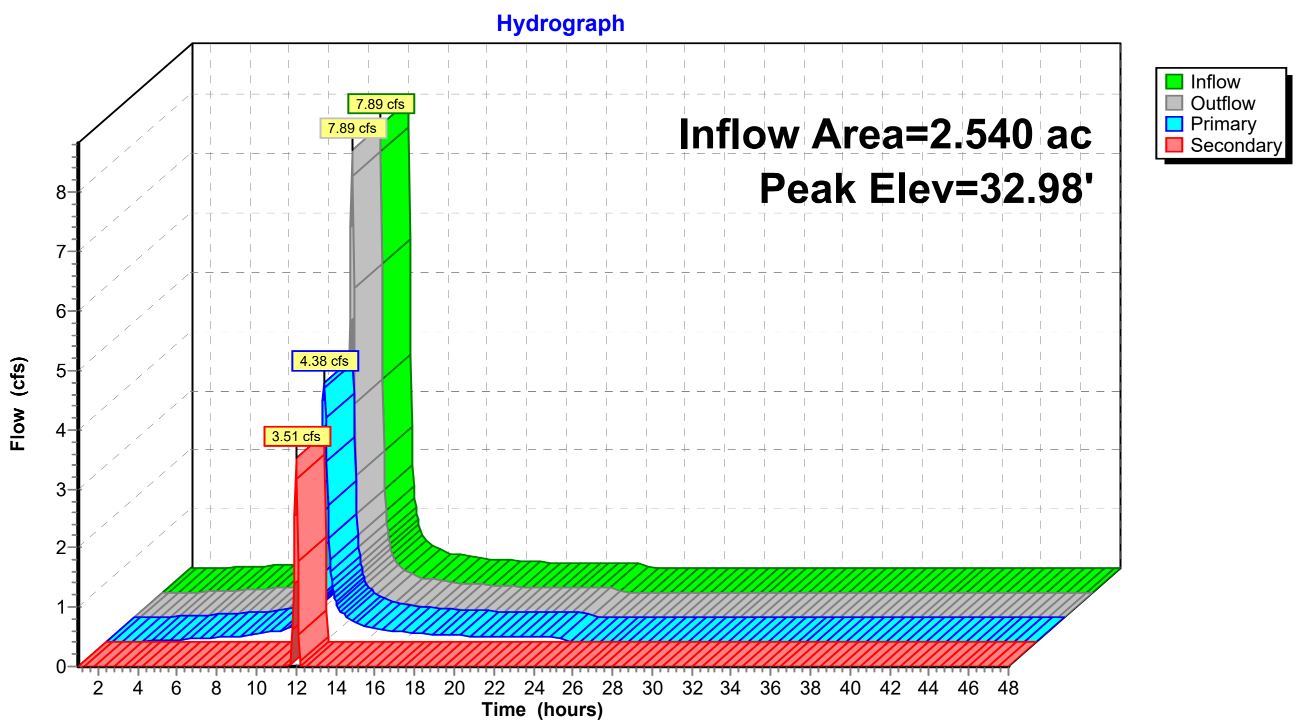
Routing by Stor-Ind method, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 32.98' @ 12.01 hrs
Flood Elev= 35.02'

Device	Routing	Invert	Outlet Devices
#1	Primary	31.17'	**15.0" Round Culvert** L= 100.0' Ke= 1.200 Inlet / Outlet Invert= 31.17' / 30.17' S= 0.0100 '/' Cc= 0.900 n= 0.012, Flow Area= 1.23 sf
#2	Secondary	32.00'	**24.0" Round Culvert** L= 200.0' Ke= 1.200 Inlet / Outlet Invert= 32.00' / 30.00' S= 0.0100 '/' Cc= 0.900 n= 0.012, Flow Area= 3.14 sf

Primary OutFlow Max=4.35 cfs @ 12.01 hrs HW=32.96' (Free Discharge)
↑—**1=Culvert** (Inlet Controls 4.35 cfs @ 3.54 fps)

Secondary OutFlow Max=3.39 cfs @ 12.01 hrs HW=32.96' (Free Discharge)
↑—**2=Culvert** (Inlet Controls 3.39 cfs @ 2.27 fps)

Pond 36P: CB-F



Summary for Pond 37P: CB-C

Inflow Area = 0.420 ac, 85.71% Impervious, Inflow Depth = 2.30" for 10 event
Inflow = 1.62 cfs @ 11.94 hrs, Volume= 0.081 af
Outflow = 1.62 cfs @ 11.94 hrs, Volume= 0.081 af, Atten= 0%, Lag= 0.0 min
Primary = 1.08 cfs @ 11.94 hrs, Volume= 0.075 af
Secondary = 0.53 cfs @ 11.94 hrs, Volume= 0.005 af

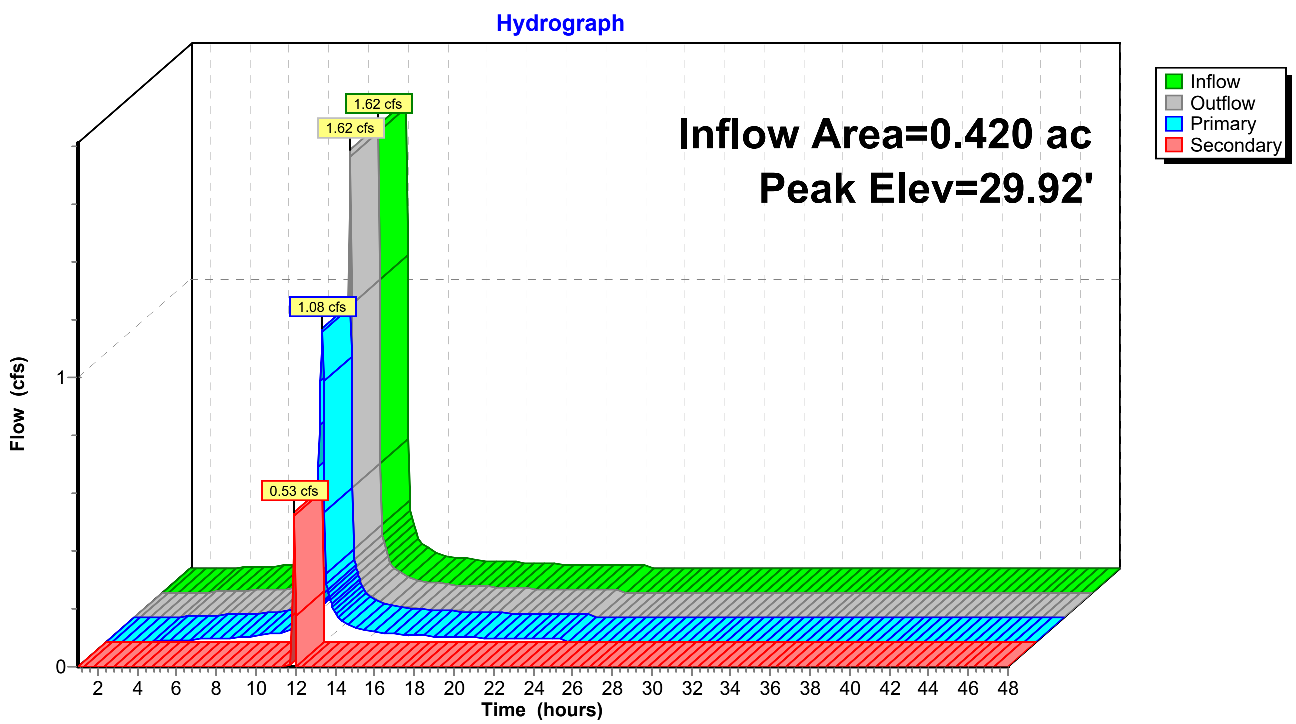
Routing by Stor-Ind method, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 29.92' @ 11.94 hrs
Flood Elev= 32.01'

Device	Routing	Invert	Outlet Devices
#1	Primary	28.70'	**8.0" Round Culvert** L= 100.0' Ke= 1.200 Inlet / Outlet Invert= 28.70' / 27.70' S= 0.0100 '/' Cc= 0.900 n= 0.012, Flow Area= 0.35 sf
#2	Secondary	29.37'	**8.0" Round Culvert** L= 200.0' Ke= 1.200 Inlet / Outlet Invert= 29.37' / 27.67' S= 0.0085 '/' Cc= 0.900 n= 0.012, Flow Area= 0.35 sf

Primary OutFlow Max=1.06 cfs @ 11.94 hrs HW=29.89' (Free Discharge)
└─**1=Culvert** (Inlet Controls 1.06 cfs @ 3.04 fps)

Secondary OutFlow Max=0.49 cfs @ 11.94 hrs HW=29.89' (Free Discharge)
└─**2=Culvert** (Inlet Controls 0.49 cfs @ 1.68 fps)

Pond 37P: CB-C



Summary for Pond 38P: CB-D

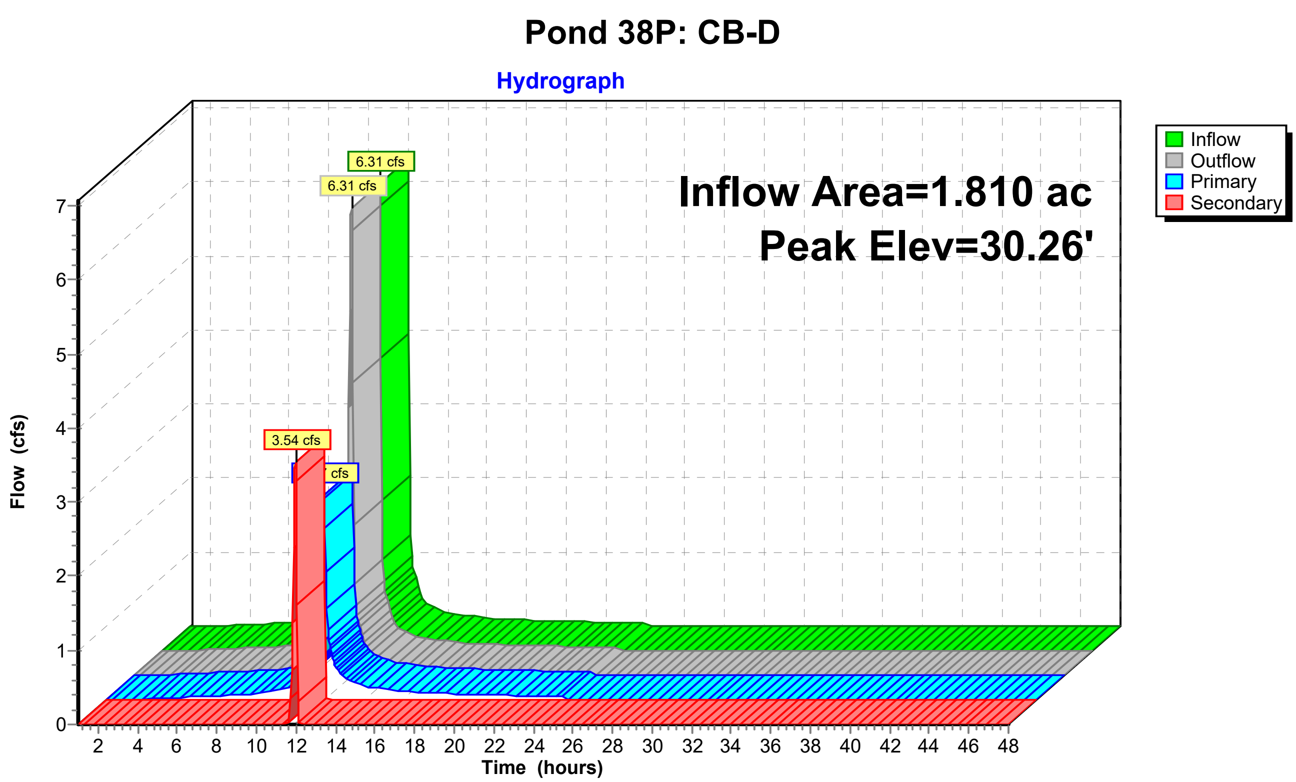
Inflow Area = 1.810 ac, 85.08% Impervious, Inflow Depth = 2.30" for 10 event
Inflow = 6.31 cfs @ 11.97 hrs, Volume= 0.347 af
Outflow = 6.31 cfs @ 11.97 hrs, Volume= 0.347 af, Atten= 0%, Lag= 0.0 min
Primary = 2.77 cfs @ 11.97 hrs, Volume= 0.291 af
Secondary = 3.54 cfs @ 11.97 hrs, Volume= 0.057 af

Routing by Stor-Ind method, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 30.26' @ 11.97 hrs
Flood Elev= 31.59'

Device	Routing	Invert	Outlet Devices
#1	Primary	28.60'	**12.0" Round Culvert** L= 40.0' Ke= 1.200 Inlet / Outlet Invert= 28.60' / 28.20' S= 0.0100 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf
#2	Secondary	29.27'	**24.0" Round Culvert** L= 100.0' Ke= 1.200 Inlet / Outlet Invert= 29.27' / 28.27' S= 0.0100 '/' Cc= 0.900 n= 0.012, Flow Area= 3.14 sf

Primary OutFlow Max=2.74 cfs @ 11.97 hrs HW=30.23' (Free Discharge)
└**1=Culvert** (Inlet Controls 2.74 cfs @ 3.49 fps)

Secondary OutFlow Max=3.40 cfs @ 11.97 hrs HW=30.23' (Free Discharge)
└**2=Culvert** (Inlet Controls 3.40 cfs @ 2.28 fps)



Summary for Pond 39P: DT-4

Inflow Area = 5.840 ac, 85.10% Impervious, Inflow Depth = 2.00" for 10 event
Inflow = 10.11 cfs @ 11.97 hrs, Volume= 0.972 af
Outflow = 0.40 cfs @ 15.69 hrs, Volume= 0.972 af, Atten= 96%, Lag= 223.3 min
Discarded = 0.40 cfs @ 15.69 hrs, Volume= 0.972 af

Routing by Stor-Ind method, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 26.43' @ 15.69 hrs Surf.Area= 0.440 ac Storage= 0.524 af

Plug-Flow detention time= 535.3 min calculated for 0.971 af (100% of inflow)
Center-of-Mass det. time= 535.6 min (1,312.6 - 777.1)

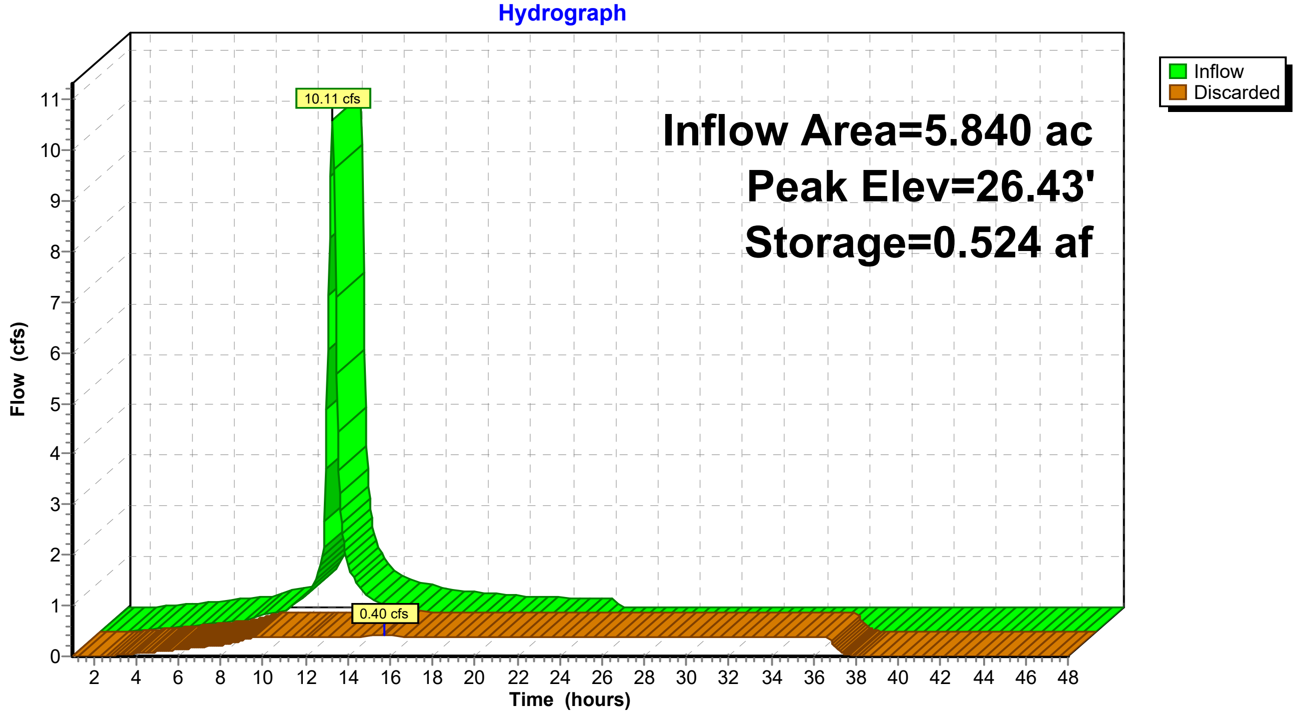
Volume	Invert	Avail.Storage	Storage Description
#1	25.20'	1.067 af	**Custom Stage Data (Irregular)** Listed below (Recalc) 1.100 af Overall x 97.0% Voids

Elevation (feet)	Surf.Area (acres)	Perim. (feet)	Inc.Store (acre-feet)	Cum.Store (acre-feet)	Wet.Area (acres)
25.20	0.440	871.0	0.000	0.000	0.440
27.70	0.440	871.0	1.100	1.100	0.490

Device	Routing	Invert	Outlet Devices
#1	Discarded	25.20'	**0.850 in/hr Exfiltration over Wetted area**

Discarded OutFlow Max=0.40 cfs @ 15.69 hrs HW=26.43' (Free Discharge)
└—**1=Exfiltration** (Exfiltration Controls 0.40 cfs)

Pond 39P: DT-4


Hydrograph
Inflow
Discarded
10.11 cfs
0.40 cfs
Inflow Area=5.840 ac
Peak Elev=26.43'
Storage=0.524 af
Flow (cfs)
0
1
2
3
4
5
6
7
8
9
10
11
2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48
Time (hours)

Summary for Pond 40P: CB-E

Inflow Area = 0.320 ac, 84.38% Impervious, Inflow Depth = 2.30" for 10 event
Inflow = 0.97 cfs @ 12.02 hrs, Volume= 0.061 af
Outflow = 0.97 cfs @ 12.02 hrs, Volume= 0.061 af, Atten= 0%, Lag= 0.0 min
Primary = 0.24 cfs @ 12.02 hrs, Volume= 0.045 af
Secondary = 0.73 cfs @ 12.02 hrs, Volume= 0.017 af

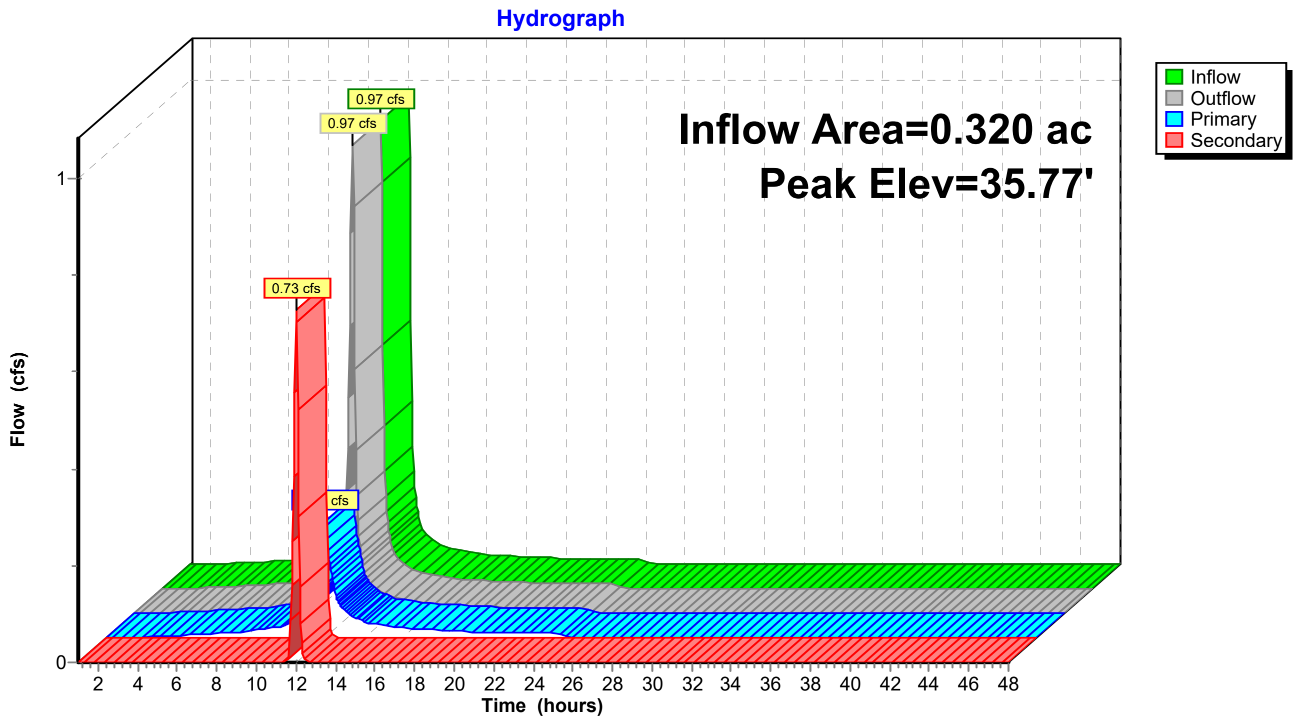
Routing by Stor-Ind method, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 35.77' @ 12.02 hrs
Flood Elev= 37.90'

Device	Routing	Invert	Outlet Devices
#1	Primary	34.90'	**4.0" Round Culvert** L= 75.0' Ke= 1.200 Inlet / Outlet Invert= 34.90' / 34.15' S= 0.0100 '/' Cc= 0.900 n= 0.012, Flow Area= 0.09 sf
#2	Secondary	35.23'	**12.0" Round Culvert** L= 200.0' Ke= 1.200 Inlet / Outlet Invert= 35.23' / 33.40' S= 0.0091 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf

Primary OutFlow Max=0.24 cfs @ 12.02 hrs HW=35.76' (Free Discharge)
└─**1=Culvert** (Inlet Controls 0.24 cfs @ 2.73 fps)

Secondary OutFlow Max=0.71 cfs @ 12.02 hrs HW=35.76' (Free Discharge)
└─**2=Culvert** (Inlet Controls 0.71 cfs @ 1.69 fps)

Pond 40P: CB-E



Summary for Pond 41P: DT-6

Inflow Area = 1.290 ac, 84.50% Impervious, Inflow Depth = 1.59" for 10 event
Inflow = 0.88 cfs @ 11.94 hrs, Volume= 0.171 af
Outflow = 0.07 cfs @ 16.45 hrs, Volume= 0.171 af, Atten= 92%, Lag= 270.4 min
Discarded = 0.07 cfs @ 16.45 hrs, Volume= 0.171 af

Routing by Stor-Ind method, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 28.61' @ 16.45 hrs Surf.Area= 0.075 ac Storage= 0.081 af

Plug-Flow detention time= 458.8 min calculated for 0.171 af (100% of inflow)
Center-of-Mass det. time= 459.1 min (1,249.5 - 790.3)

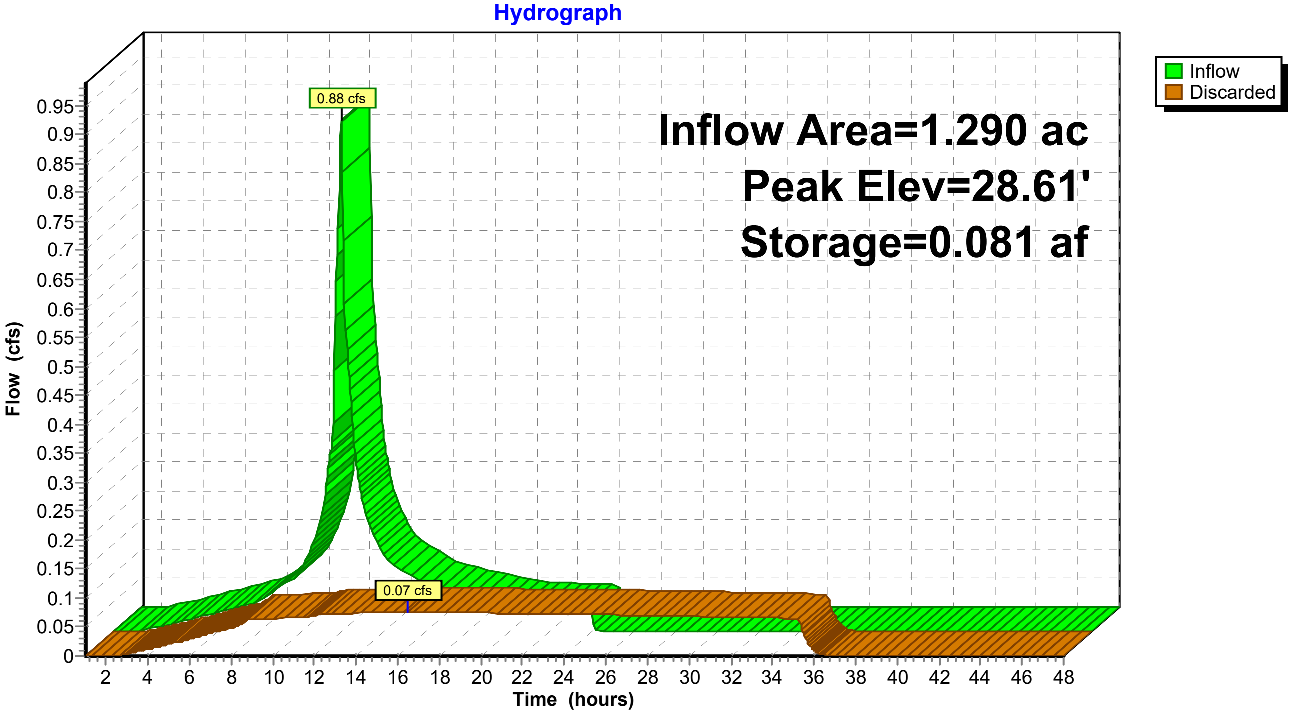
Volume	Invert	Avail.Storage	Storage Description
#1	27.50'	0.182 af	**Custom Stage Data (Irregular)** Listed below (Recalc) 0.187 af Overall x 97.0% Voids

Elevation (feet)	Surf.Area (acres)	Perim. (feet)	Inc.Store (acre-feet)	Cum.Store (acre-feet)	Wet.Area (acres)
27.50	0.075	482.0	0.000	0.000	0.075
30.00	0.075	482.0	0.187	0.187	0.103

Device	Routing	Invert	Outlet Devices
#1	Discarded	27.50'	**0.850 in/hr Exfiltration over Wetted area**

Discarded OutFlow Max=0.07 cfs @ 16.45 hrs HW=28.61' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.07 cfs)

Pond 41P: DT-6


Hydrograph
Inflow
Discarded
Inflow Area=1.290 ac
Peak Elev=28.61'
Storage=0.081 af
0.88 cfs
0.07 cfs
Flow (cfs)
Time (hours)
0.95
0.9
0.85
0.8
0.75
0.7
0.65
0.6
0.55
0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48

Summary for Pond 42P: CB-B

[57] Hint: Peaked at 33.59' (Flood elevation advised)

Inflow Area = 0.230 ac, 82.61% Impervious, Inflow Depth = 2.30" for 10 event
Inflow = 0.89 cfs @ 11.93 hrs, Volume= 0.044 af
Outflow = 0.89 cfs @ 11.93 hrs, Volume= 0.044 af, Atten= 0%, Lag= 0.0 min
Primary = 0.33 cfs @ 11.93 hrs, Volume= 0.035 af
Secondary = 0.56 cfs @ 11.93 hrs, Volume= 0.009 af

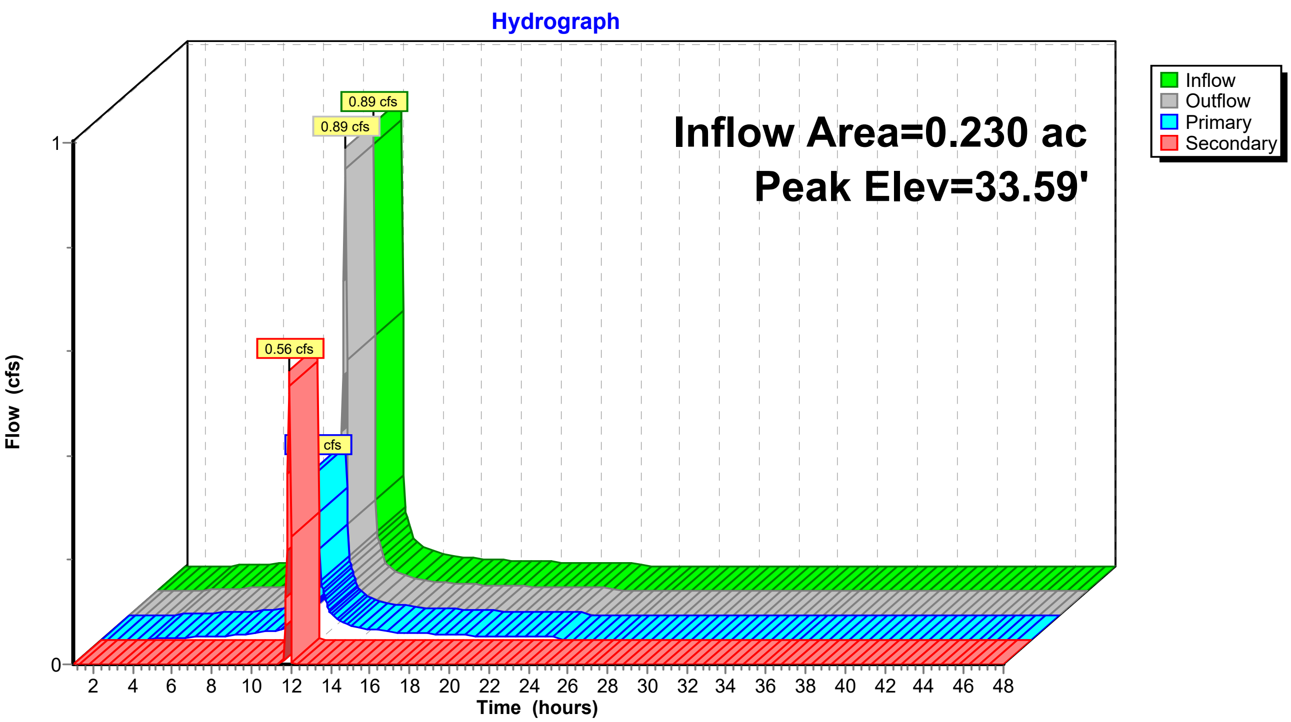
Routing by Stor-Ind method, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 33.59' @ 11.93 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	32.10'	**4.0" Round Culvert** L= 50.0' Ke= 1.200 Inlet / Outlet Invert= 32.10' / 31.20' S= 0.0180 '/' Cc= 0.900 n= 0.012, Flow Area= 0.09 sf
#2	Secondary	32.60'	**6.0" Round Culvert** L= 200.0' Ke= 1.200 Inlet / Outlet Invert= 32.60' / 30.60' S= 0.0100 '/' Cc= 0.900 n= 0.012, Flow Area= 0.20 sf

Primary OutFlow Max=0.32 cfs @ 11.93 hrs HW=33.52' (Free Discharge)
↑—**1=Culvert** (Inlet Controls 0.32 cfs @ 3.67 fps)

Secondary OutFlow Max=0.53 cfs @ 11.93 hrs HW=33.52' (Free Discharge)
↑—**2=Culvert** (Inlet Controls 0.53 cfs @ 2.68 fps)

Pond 42P: CB-B



Summary for Pond 43P: CB-A

Inflow Area = 0.740 ac, 85.14% Impervious, Inflow Depth = 2.30" for 10 event
Inflow = 2.79 cfs @ 11.94 hrs, Volume= 0.142 af
Outflow = 2.79 cfs @ 11.94 hrs, Volume= 0.142 af, Atten= 0%, Lag= 0.0 min
Primary = 0.33 cfs @ 11.94 hrs, Volume= 0.091 af
Secondary = 2.45 cfs @ 11.94 hrs, Volume= 0.051 af

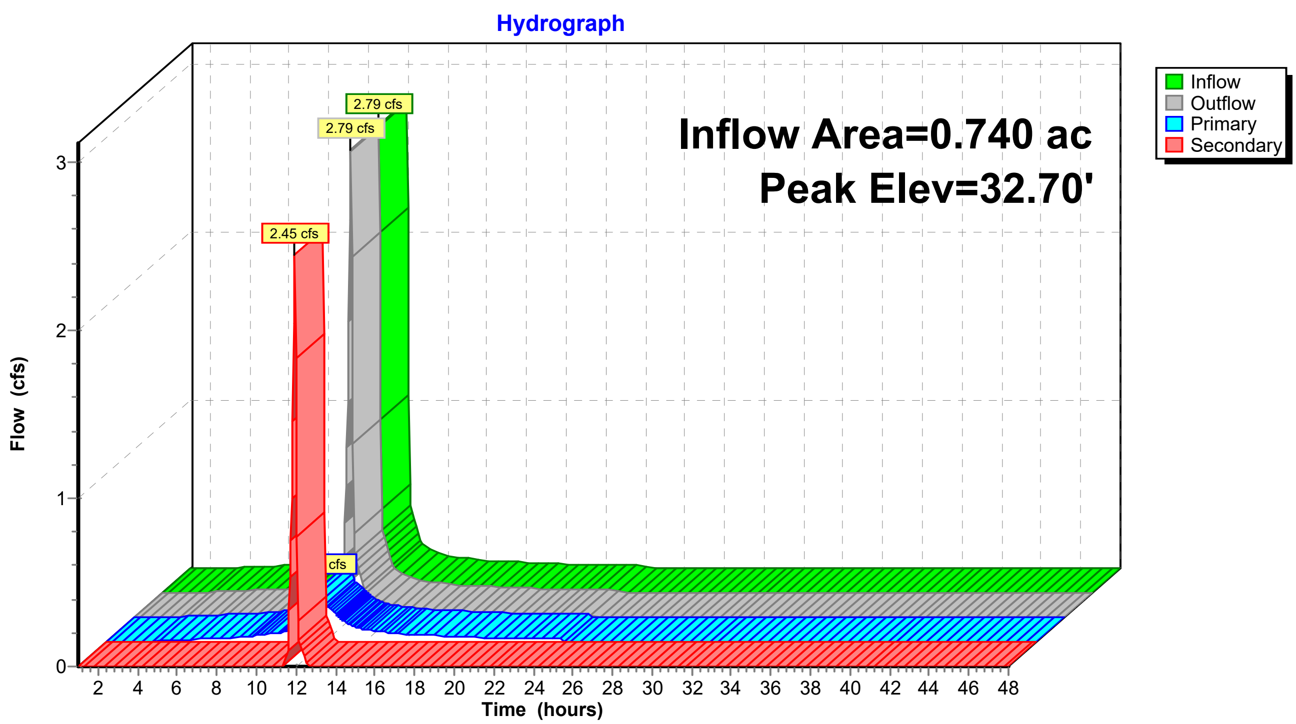
Routing by Stor-Ind method, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 32.70' @ 11.94 hrs
Flood Elev= 34.22'

Device	Routing	Invert	Outlet Devices
#1	Primary	31.20'	**4.0" Round Culvert** L= 30.0' Ke= 1.200 Inlet / Outlet Invert= 31.20' / 30.00' S= 0.0400 '/' Cc= 0.900 n= 0.012, Flow Area= 0.09 sf
#2	Secondary	31.70'	**15.0" Round Culvert** L= 200.0' Ke= 1.200 Inlet / Outlet Invert= 31.70' / 29.70' S= 0.0100 '/' Cc= 0.900 n= 0.012, Flow Area= 1.23 sf

Primary OutFlow Max=0.33 cfs @ 11.94 hrs HW=32.69' (Free Discharge)
└**1=Culvert** (Inlet Controls 0.33 cfs @ 3.78 fps)

Secondary OutFlow Max=2.41 cfs @ 11.94 hrs HW=32.69' (Free Discharge)
└**2=Culvert** (Inlet Controls 2.41 cfs @ 2.31 fps)

Pond 43P: CB-A



Summary for Pond 49P: CB-S

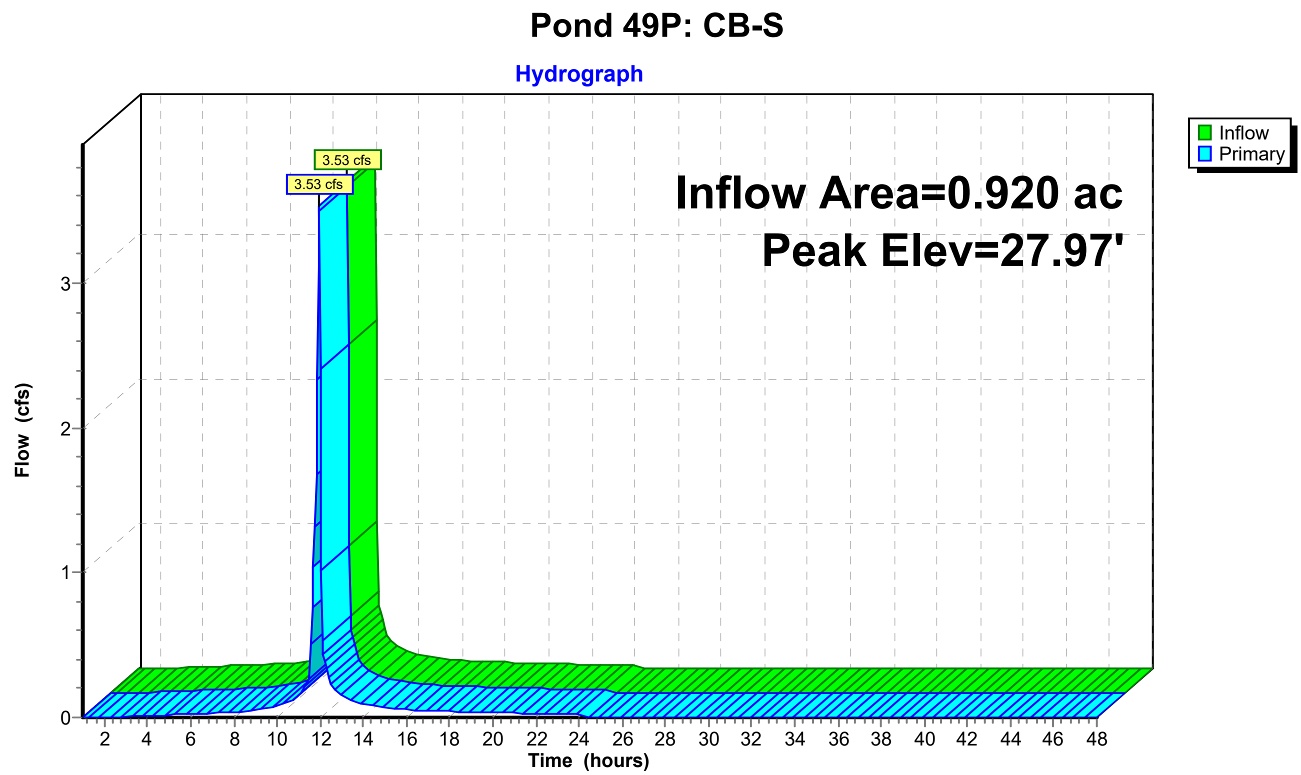
[57] Hint: Peaked at 27.97' (Flood elevation advised)

Inflow Area = 0.920 ac, 84.78% Impervious, Inflow Depth = 2.30" for 10 event
Inflow = 3.53 cfs @ 11.94 hrs, Volume= 0.176 af
Outflow = 3.53 cfs @ 11.94 hrs, Volume= 0.176 af, Atten= 0%, Lag= 0.0 min
Primary = 3.53 cfs @ 11.94 hrs, Volume= 0.176 af

Routing by Stor-Ind method, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 27.97' @ 11.94 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	26.60'	**12.0" Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=3.40 cfs @ 11.94 hrs HW=27.91' (Free Discharge)
└─**1=Orifice/Grate** (Orifice Controls 3.40 cfs @ 4.34 fps)



Summary for Pond 51P: CB-T

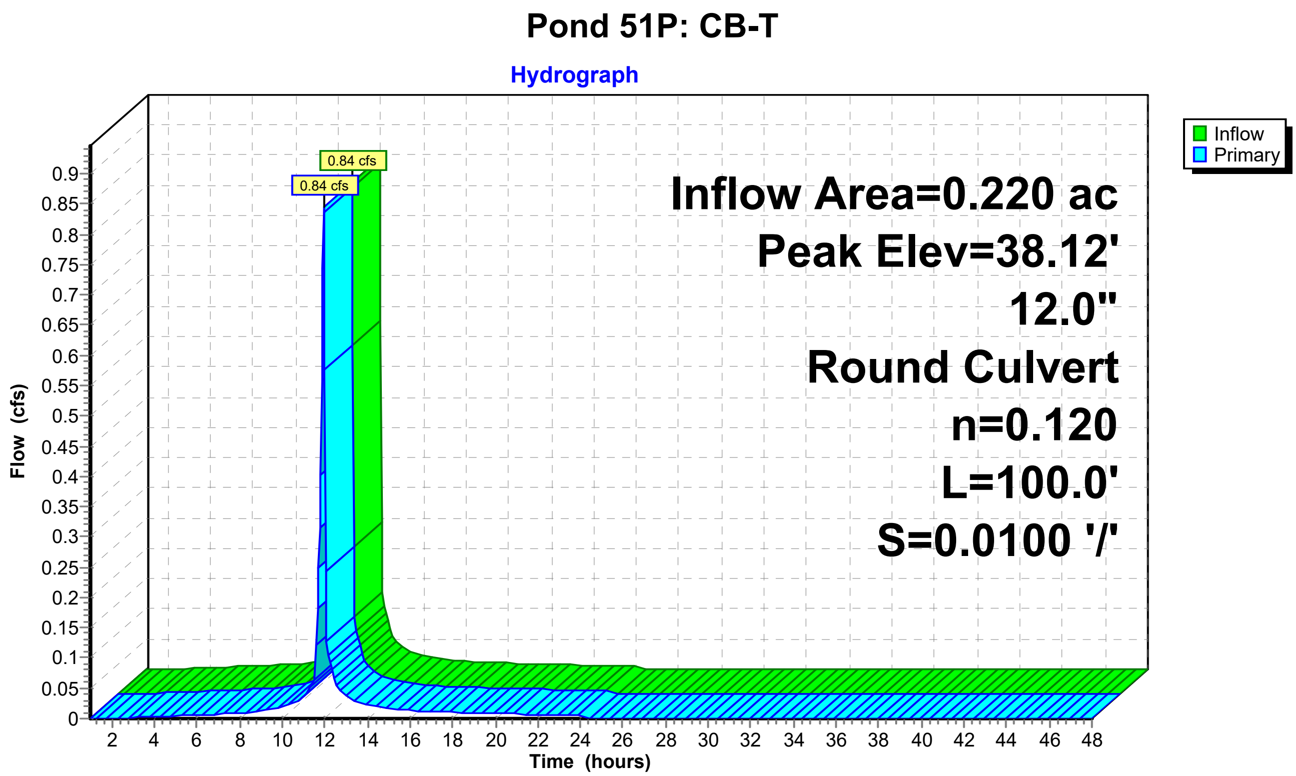
[58] Hint: Peaked 1.32' above defined flood level

Inflow Area =	0.220 ac,	86.36% Impervious,	Inflow Depth = 2.30"	for 10 event
Inflow =	0.84 cfs @	11.94 hrs, Volume=	0.042 af	
Outflow =	0.84 cfs @	11.94 hrs, Volume=	0.042 af, Atten= 0%, Lag= 0.0 min	
Primary =	0.84 cfs @	11.94 hrs, Volume=	0.042 af	

Routing by Stor-Ind method, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 38.12' @ 11.94 hrs
Flood Elev= 36.80'

Device	Routing	Invert	Outlet Devices
#1	Primary	33.30'	**12.0" Round Culvert** L= 100.0' Ke= 1.200 Inlet / Outlet Invert= 33.30' / 32.30' S= 0.0100 '/' Cc= 0.900 n= 0.120, Flow Area= 0.79 sf

Primary OutFlow Max=0.81 cfs @ 11.94 hrs HW=37.80' (Free Discharge)
└**1=Culvert** (Barrel Controls 0.81 cfs @ 1.04 fps)



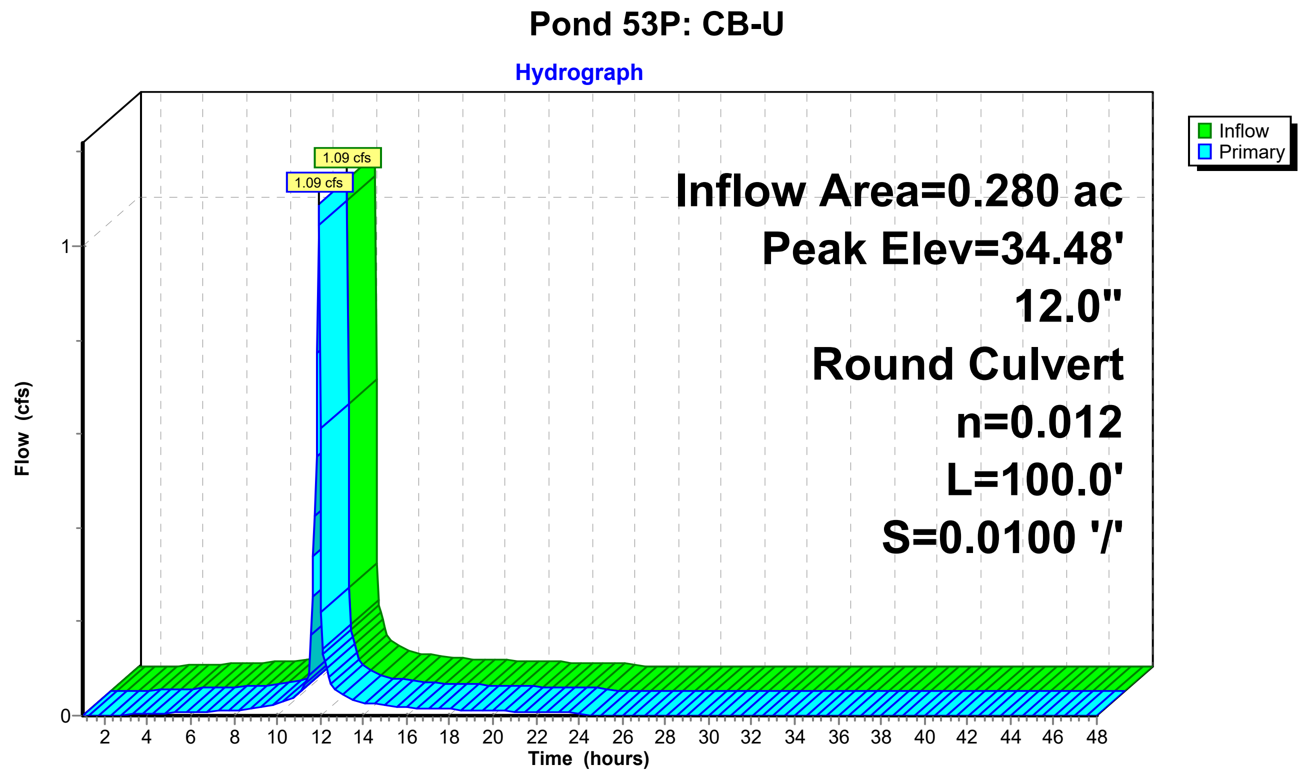
Summary for Pond 53P: CB-U

Inflow Area = 0.280 ac, 85.71% Impervious, Inflow Depth = 2.30" for 10 event
Inflow = 1.09 cfs @ 11.93 hrs, Volume= 0.054 af
Outflow = 1.09 cfs @ 11.93 hrs, Volume= 0.054 af, Atten= 0%, Lag= 0.0 min
Primary = 1.09 cfs @ 11.93 hrs, Volume= 0.054 af

Routing by Stor-Ind method, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 34.48' @ 11.93 hrs
Flood Elev= 36.80'

Device	Routing	Invert	Outlet Devices
#1	Primary	33.80'	**12.0" Round Culvert** L= 100.0' Ke= 1.200 Inlet / Outlet Invert= 33.80' / 32.80' S= 0.0100 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf

Primary OutFlow Max=1.03 cfs @ 11.93 hrs HW=34.46' (Free Discharge)
└**1=Culvert** (Inlet Controls 1.03 cfs @ 1.88 fps)



Summary for Pond 54P: DA-9

Inflow Area = 1.440 ac, 85.42% Impervious, Inflow Depth = 2.03" for 10 event
Inflow = 3.32 cfs @ 11.94 hrs, Volume= 0.244 af
Outflow = 0.10 cfs @ 9.95 hrs, Volume= 0.244 af, Atten= 97%, Lag= 0.0 min
Discarded = 0.10 cfs @ 9.95 hrs, Volume= 0.244 af

Routing by Stor-Ind method, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 30.59' @ 15.46 hrs Surf.Area= 0.120 ac Storage= 0.131 af

Plug-Flow detention time= 508.8 min calculated for 0.244 af (100% of inflow)
Center-of-Mass det. time= 508.6 min (1,281.2 - 772.6)

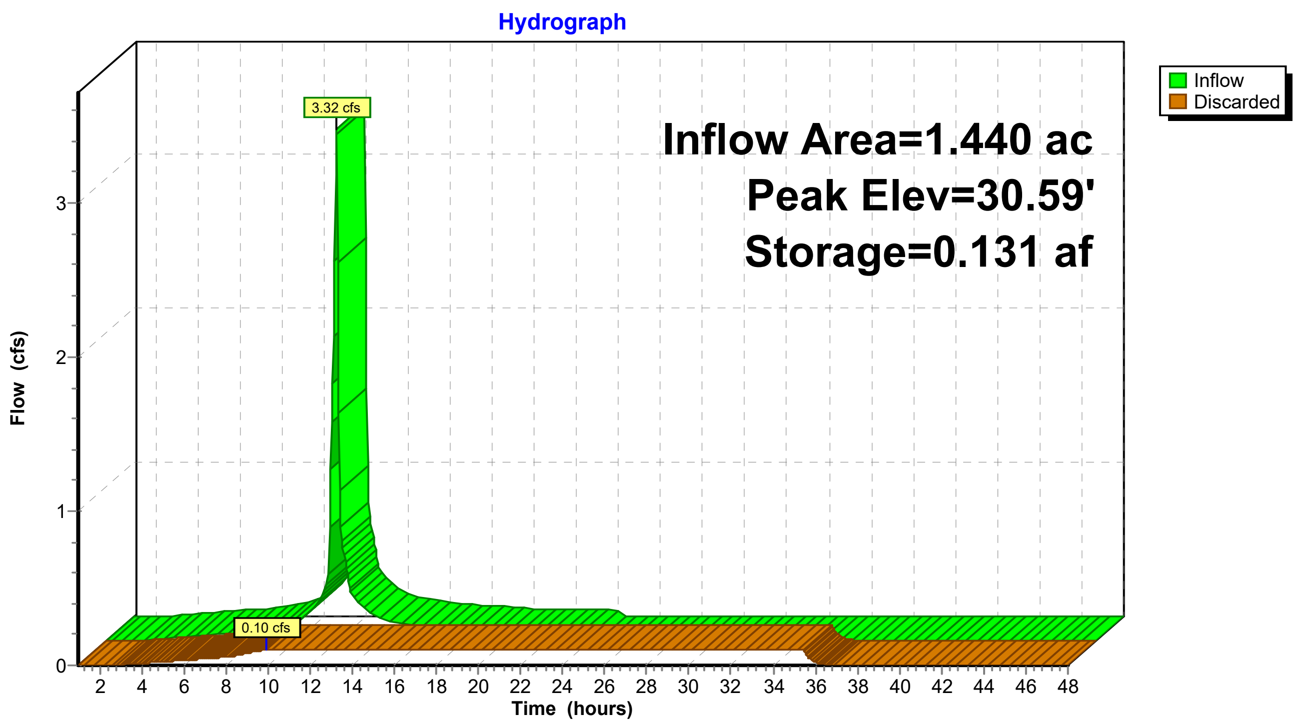
Volume	Invert	Avail.Storage	Storage Description
#1	29.50'	0.300 af	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
29.50	0.120	0.000	0.000
32.00	0.120	0.300	0.300

Device	Routing	Invert	Outlet Devices
#1	Discarded	29.50'	**0.850 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.10 cfs @ 9.95 hrs HW=29.53' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.10 cfs)

Pond 54P: DA-9



Summary for Pond 56P: (new Pond)

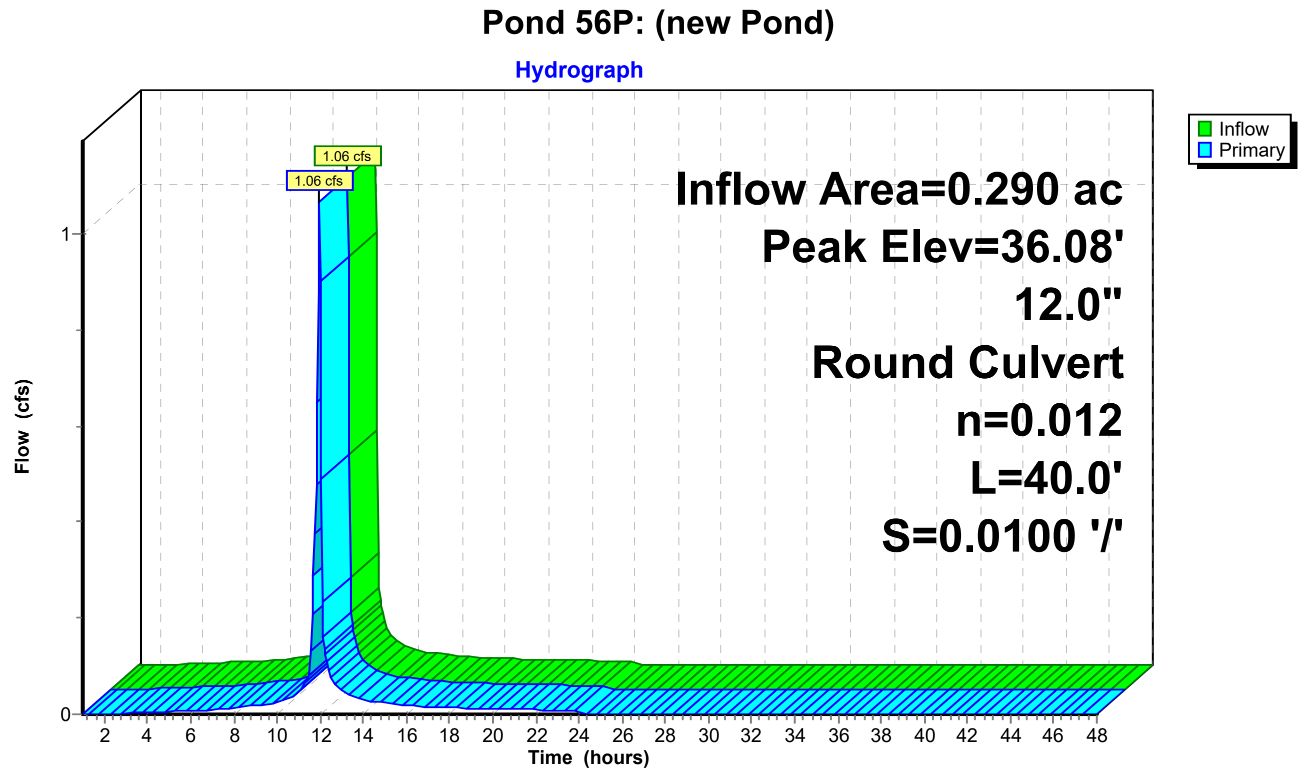
[57] Hint: Peaked at 36.08' (Flood elevation advised)

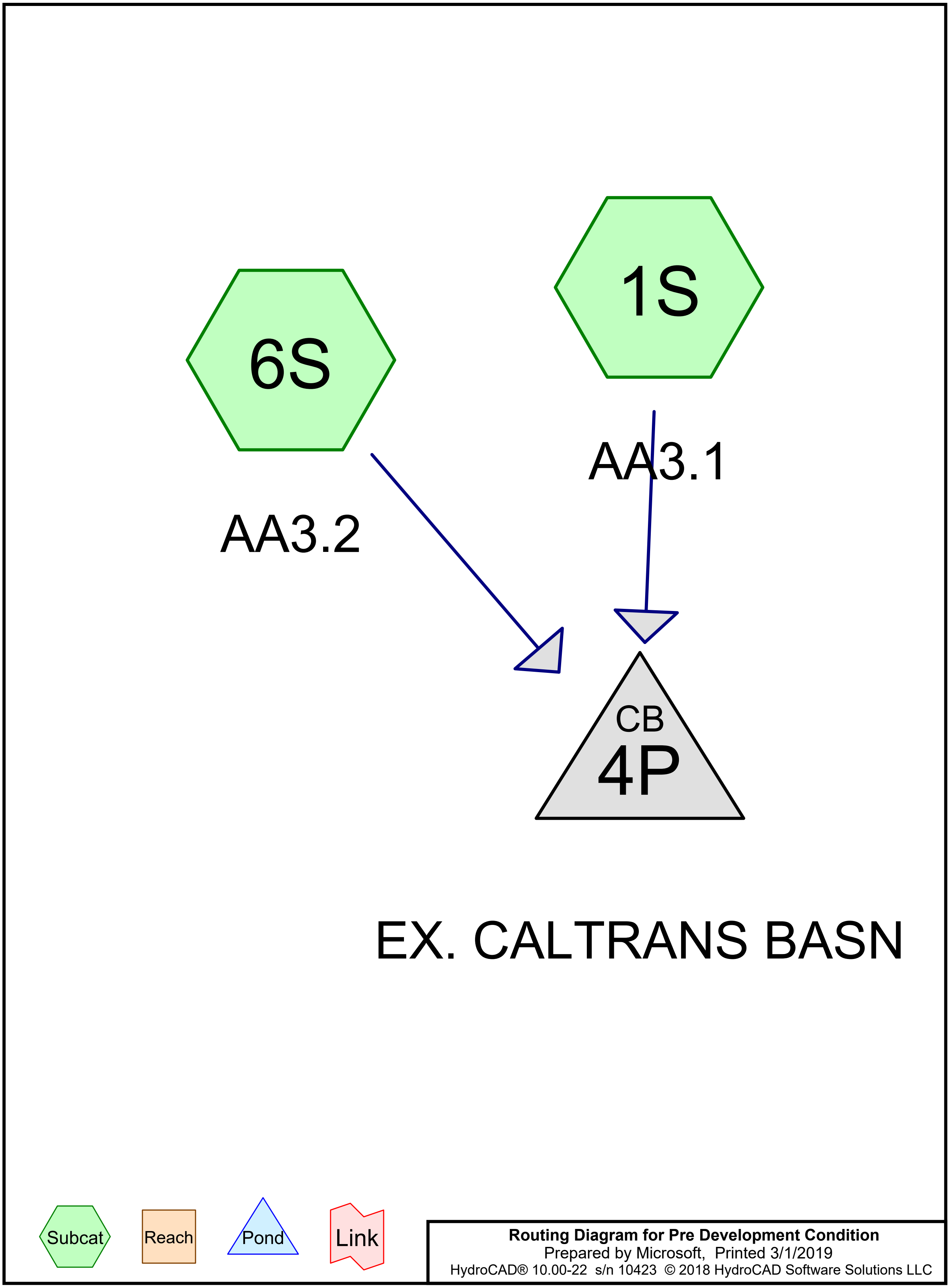
Inflow Area =	0.290 ac, 86.21% Impervious, Inflow Depth = 2.30" for 10 event		
Inflow =	1.06 cfs @ 11.95 hrs, Volume=	0.056 af	
Outflow =	1.06 cfs @ 11.95 hrs, Volume=	0.056 af, Atten= 0%, Lag= 0.0 min	
Primary =	1.06 cfs @ 11.95 hrs, Volume=	0.056 af	

Routing by Stor-Ind method, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 36.08' @ 11.95 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	35.41'	**12.0" Round Culvert** L= 40.0' Ke= 1.200 Inlet / Outlet Invert= 35.41' / 35.01' S= 0.0100 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf

Primary OutFlow Max=1.06 cfs @ 11.95 hrs HW=36.08' (Free Discharge)
└**1=Culvert** (Inlet Controls 1.06 cfs @ 1.90 fps)




6S
AA3.2
1S
AA3.1
CB
4P
EX. CALTRANS BASN
Subcat
Reach
Pond
Link
Routing Diagram for Pre Development Condition
Prepared by Microsoft, Printed 3/1/2019
HydroCAD® 10.00-22 s/n 10423 © 2018 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
14.800	74	(1S, 6S)
14.800	**74**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
0.000	HSG C	
0.000	HSG D	
14.800	Other	1S, 6S
14.800		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	0.000	0.000	0.000	14.800	14.800		1S, 6S
0.000	**0.000**	**0.000**	**0.000**	**14.800**	**14.800**	**TOTAL AREA**	

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Diam/Width (inches)	Height (inches)	Inside-Fill (inches)
1	4P	25.10	19.00	89.0	0.0685	0.012	36.0	0.0	0.0

Time span=5.00-48.00 hrs, dt=0.05 hrs, 861 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1S: AA3.1 Runoff Area=13.790 ac 0.00% Impervious Runoff Depth=1.50"
Flow Length=580' Tc=24.0 min AMC Adjusted CN=88 Runoff=20.63 cfs 1.726 af

Subcatchment6S: AA3.2 Runoff Area=1.010 ac 0.00% Impervious Runoff Depth=1.50"
Flow Length=870' Tc=18.5 min AMC Adjusted CN=88 Runoff=1.75 cfs 0.126 af

Pond 4P: EX. CALTRANSBASN Peak Elev=27.00' Inflow=22.24 cfs 1.853 af
36.0" Round Culvert n=0.012 L=89.0' S=0.0685 '/' Outflow=22.24 cfs 1.853 af

Total Runoff Area = 14.800 ac Runoff Volume = 1.853 af Average Runoff Depth = 1.50"
100.00% Pervious = 14.800 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment 1S: AA3.1

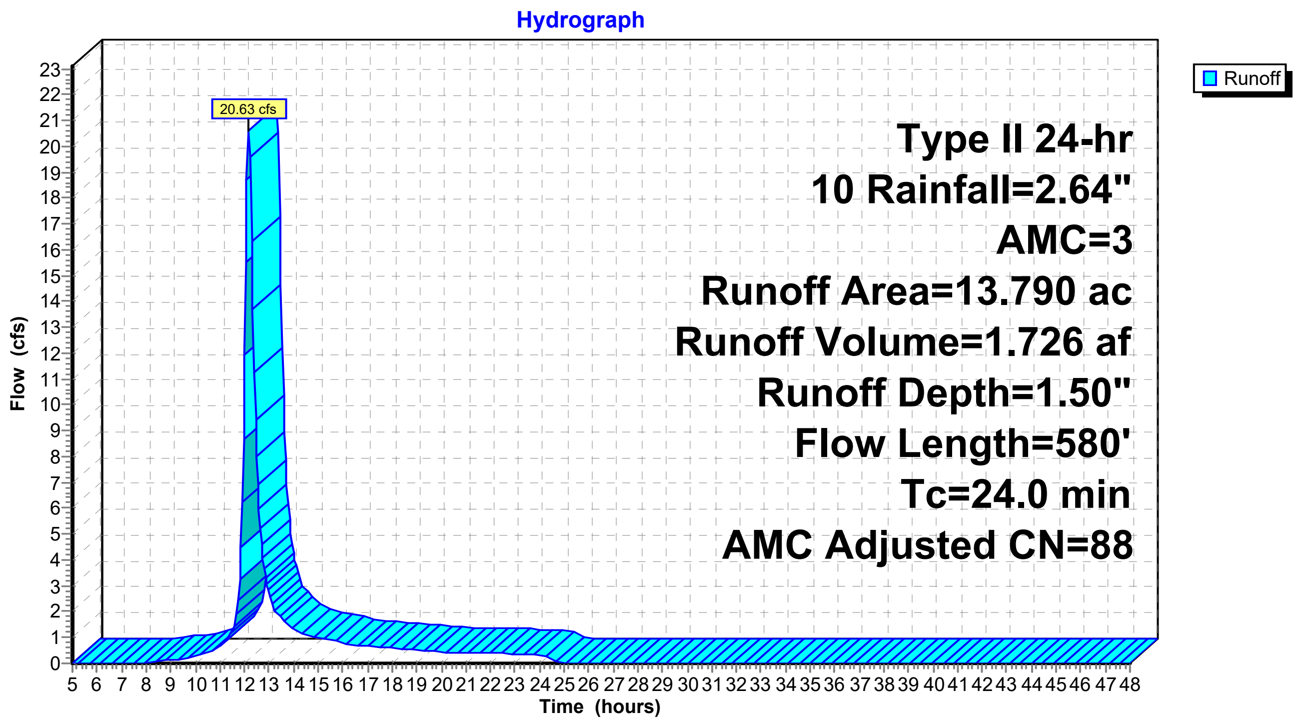
Runoff = 20.63 cfs @ 12.17 hrs, Volume= 1.726 af, Depth= 1.50"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 10 Rainfall=2.64", AMC=3

	Area (ac)	CN	Adj	Description
*	13.790	74		
	13.790	74	88	Weighted Average, AMC Adjusted
	13.790			100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
24.0	580		0.40		**Direct Entry,**

Subcatchment 1S: AA3.1



Summary for Subcatchment 6S: AA3.2

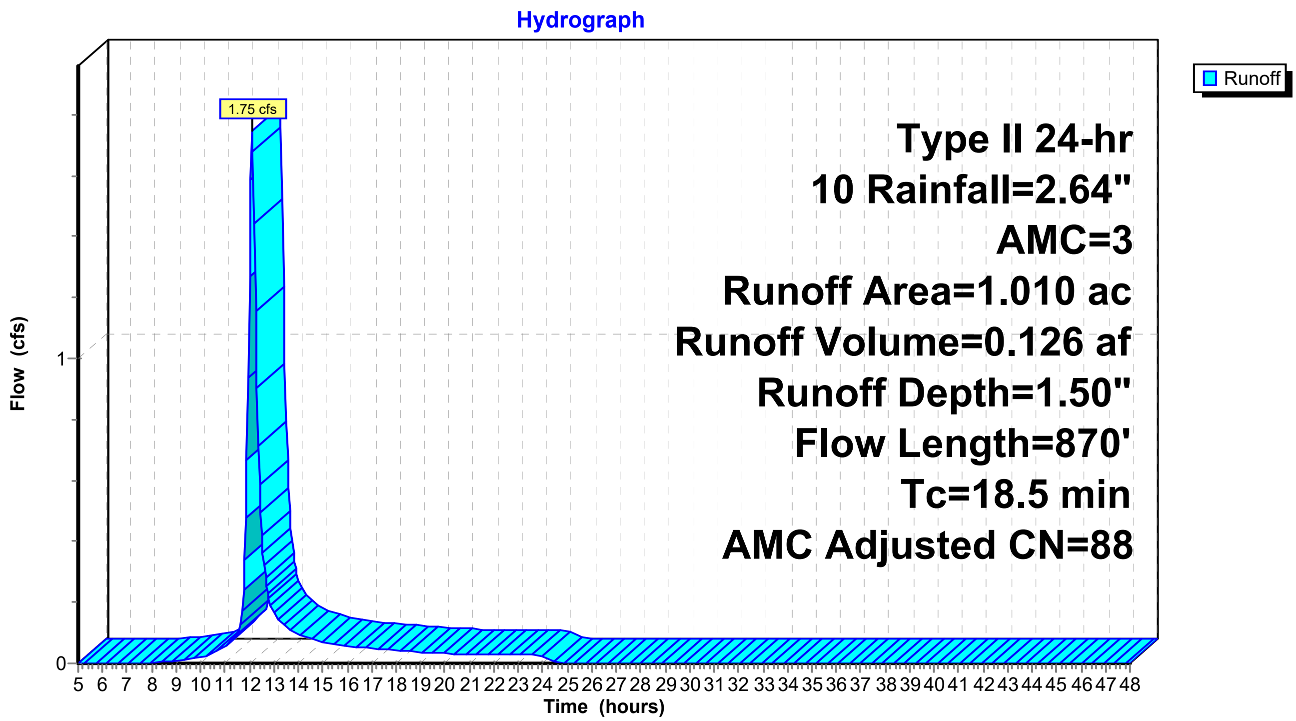
Runoff = 1.75 cfs @ 12.11 hrs, Volume= 0.126 af, Depth= 1.50"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 10 Rainfall=2.64", AMC=3

	Area (ac)	CN	Adj	Description
*	1.010	74		
	1.010	74	88	Weighted Average, AMC Adjusted
	1.010			100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
18.5	870		0.78		**Direct Entry,**

Subcatchment 6S: AA3.2



Summary for Pond 4P: EX. CALTRANS BASN

[57] Hint: Peaked at 27.00' (Flood elevation advised)

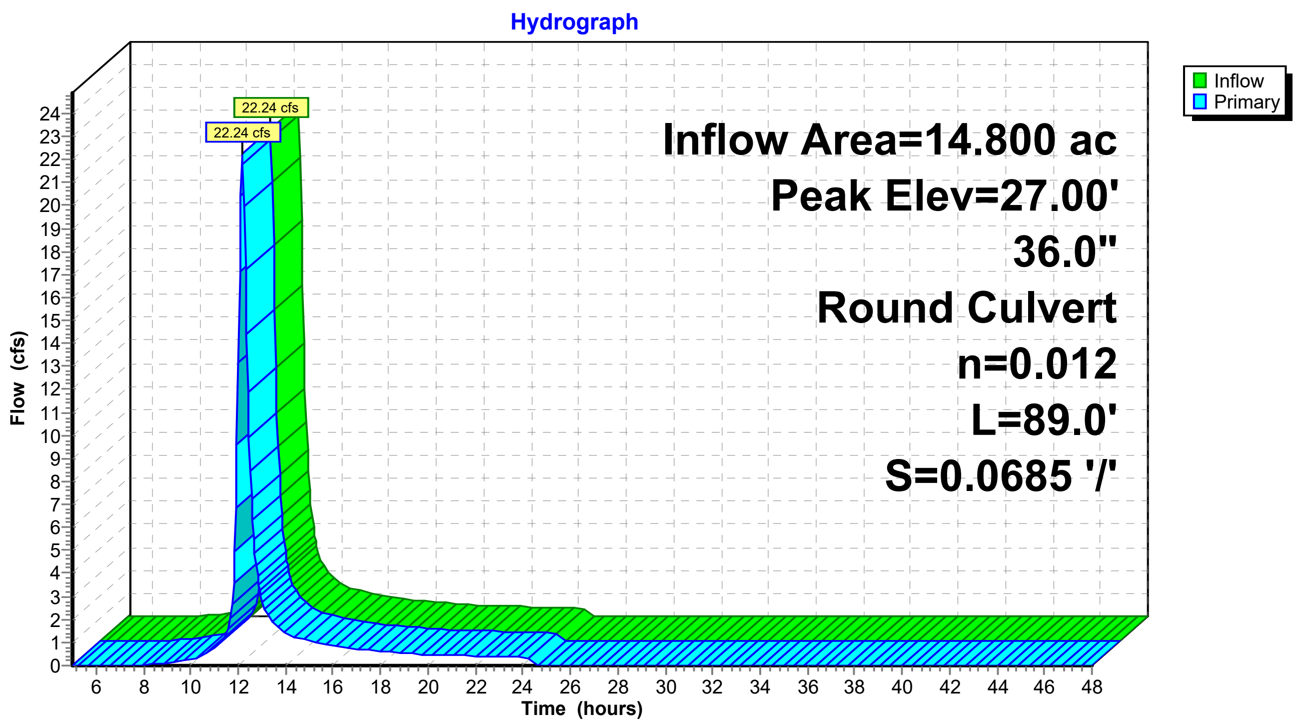
Inflow Area = 14.800 ac, 0.00% Impervious, Inflow Depth = 1.50" for 10 event
Inflow = 22.24 cfs @ 12.17 hrs, Volume= 1.853 af
Outflow = 22.24 cfs @ 12.17 hrs, Volume= 1.853 af, Atten= 0%, Lag= 0.0 min
Primary = 22.24 cfs @ 12.17 hrs, Volume= 1.853 af

Routing by Stor-Ind method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 27.00' @ 12.17 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	25.10'	**36.0" Round RCP_Round 36"** L= 89.0' Box, headwall w/3 square edges, Ke= 0.500 Inlet / Outlet Invert= 25.10' / 19.00' S= 0.0685 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 7.07 sf

Primary OutFlow Max=22.02 cfs @ 12.17 hrs HW=26.99' (Free Discharge)
↑—**1=RCP_Round 36"** (Inlet Controls 22.02 cfs @ 4.68 fps)

Pond 4P: EX. CALTRANS BASN



APPENDIX 6- NON-STRUCTURAL BMPS

Fueling Areas SD-30

Photo Credit: Geoff Brosseau

Design Objectives

- ☐ Maximize Infiltration
- ☐ Provide Retention
- ☐ Slow Runoff
- ☐ Minimize Impervious Land Coverage
- ☐ Prohibit Dumping of Improper Materials
- ☑ Contain Pollutants
- ☑ Collect and Convey

Description

Fueling areas have the potential to contribute oil and grease, solvents, car battery acid, coolant and gasoline to the stormwater conveyance system. Spills at vehicle and equipment fueling areas can be a significant source of pollution because fuels contain toxic materials and heavy metals that are not easily removed by stormwater treatment devices.

Approach

Project plans must be developed for cleaning near fuel dispensers, emergency spill cleanup, containment, and leak prevention.

Suitable Applications

Appropriate applications include commercial, industrial, and any other areas planned to have fuel dispensing equipment, including retail gasoline outlets, automotive repair shops, and major non-retail dispensing areas.

Design Considerations

Design requirements for fueling areas are governed by Building and Fire Codes and by current local agency ordinances and zoning requirements. Design requirements described in this fact sheet are meant to enhance and be consistent with these code and ordinance requirements.

Designing New Installations

Covering

Fuel dispensing areas should provide an overhanging roof structure or canopy. The cover's minimum dimensions must be equal to or greater than the area within the grade break. The cover must not drain onto the fuel dispensing area and the downspouts must be routed to prevent drainage across the fueling area. The fueling area should drain to the project's treatment control BMP(s) prior to discharging to the stormwater conveyance system. Note - If fueling large equipment or vehicles that would prohibit the use of covers or roofs, the fueling island should be designed to sufficiently accommodate the larger vehicles and equipment and to prevent stormwater run-on and runoff. Grade to direct stormwater to a dead-end sump.

Surfacing

Fuel dispensing areas should be paved with Portland cement concrete (or equivalent smooth impervious surface). The use of asphalt concrete should be prohibited. Use asphalt sealant to protect asphalt paved areas surrounding the fueling area. This provision may be made to sites that have pre-existing asphalt surfaces.

The concrete fuel dispensing area should be extended a minimum of 6.5 ft from the corner of each fuel dispenser, or the length at which the hose and nozzle assembly may be operated plus 1 ft, whichever is less.

Grading/Contouring

Dispensing areas should have an appropriate slope to prevent ponding, and be separated from the rest of the site by a grade break that prevents run-on of urban runoff. (Slope is required to be 2 to 4% in some jurisdictions' stormwater management and mitigation plans.)

Fueling areas should be graded to drain toward a dead-end sump. Runoff from downspouts/roofs should be directed away from fueling areas. Do not locate storm drains in the immediate vicinity of the fueling area.

Redeveloping Existing Installations

Various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.) define "redevelopment" in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land disturbing activities with structural or impervious surfaces. The definition of " redevelopment" must be consulted to determine whether or not the requirements for new development apply to areas intended for redevelopment. If the definition applies, the steps outlined under "designing new installations" above should be followed.

Additional Information

- In the case of an emergency, provide storm drain seals, such as isolation valves, drain plugs, or drain covers, to prevent spills or contaminated stormwater from entering the stormwater conveyance system.

Other Resources

A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

Model Standard Urban Storm Water Mitigation Plan (SUSMP) for San Diego County, Port of San Diego, and Cities in San Diego County, February 14, 2002.

Model Water Quality Management Plan (WQMP) for County of Orange, Orange County Flood Control District, and the Incorporated Cities of Orange County, Draft February 2003.

Ventura Countywide Technical Guidance Manual for Stormwater Quality Control Measures, July 2002.

Vehicle Washing Areas SD-33

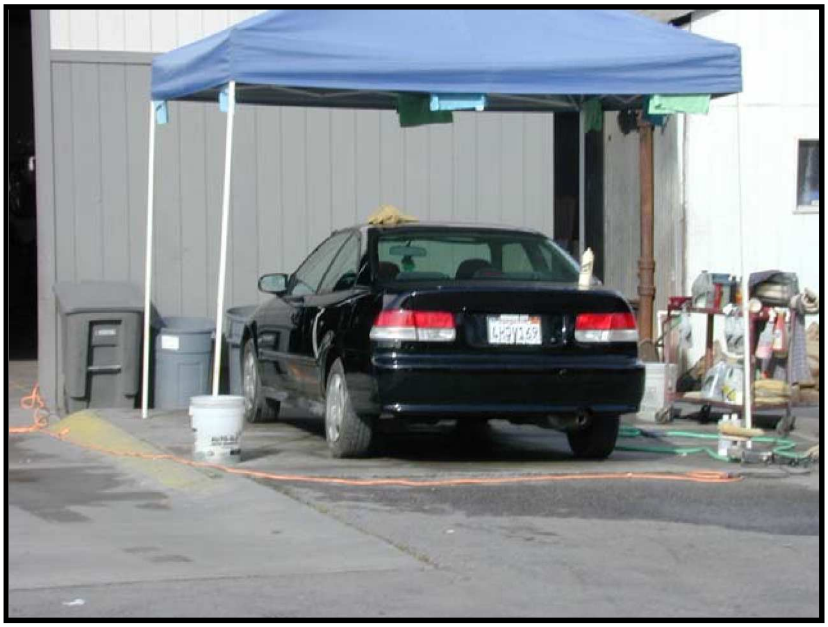


Photo Credit: Geoff Brosseau

Design Objectives

- ☑ Maximize Infiltration
- Provide Retention
- Slow Runoff
- Minimize Impervious Land Coverage
- Prohibit Dumping of Improper Materials
- ☑ Contain Pollutants
- ☑ Collect and Convey

Description

Vehicle washing, equipment washing, and steam cleaning may contribute high concentrations of metals, oil and grease, solvents, phosphates, and suspended solids to wash waters that drain to stormwater conveyance systems.

Approach

Project plans should include appropriately designed area(s) for washing-steam cleaning of vehicles and equipment. Depending on the size and other parameters of the wastewater facility, wash water may be conveyed to a sewer, an infiltration system, recycling system or other alternative. Pretreatment may be required for conveyance to a sanitary sewer.

Suitable Applications

Appropriate applications include commercial developments, restaurants, retail gasoline outlets, automotive repair shops and others.

Design Considerations

Design requirements for vehicle maintenance are governed by Building and Fire Codes, and by current local agency ordinances, and zoning requirements. Design criteria described in this fact sheet are meant to enhance and be consistent with these code requirements.

Designing New Installations

Areas for washing/steam cleaning should incorporate one of the following features:

- Be self-contained and/or covered with a roof or overhang
- Be equipped with a clarifier or other pretreatment facility
- Have a proper connection to a sanitary sewer

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- Include other features which are comparable and equally effective

CAR WASH AREAS - Some jurisdictions' stormwater management plans include vehicle-cleaning area source control design requirements for community car wash racks in complexes with a large number of dwelling units. In these cases, wash water from the areas may be directed to the sanitary sewer, to an engineered infiltration system, or to an equally effective alternative. Pre-treatment may also be required.

Depending on the jurisdiction, developers may be directed to divert surface water runoff away from the exposed area around the wash pad (parking lot, storage areas), and wash pad itself to alternatives other than the sanitary sewer. Roofing may be required for exposed wash pads.

It is generally advisable to cover areas used for regular washing of vehicles, trucks, or equipment, surround them with a perimeter berm, and clearly mark them as a designated washing area. Sumps or drain lines can be installed to collect wash water, which may be treated for reuse or recycling, or for discharge to the sanitary sewer. Jurisdictions may require some form of pretreatment, such as a trap, for these areas.

Redeveloping Existing Installations

Various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.) define "redevelopment" in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land disturbing activities with structural or impervious surfaces. The definition of " redevelopment" must be consulted to determine whether or not the requirements for new development apply to areas intended for redevelopment.

Additional Information

Maintenance Considerations

Stormwater and non-stormwater will accumulate in containment areas and sumps with impervious surfaces. Contaminated accumulated water must be disposed of in accordance with applicable laws and cannot be discharged directly to the storm drain or sanitary sewer system without the appropriate permit.

Other Resources

A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

Model Standard Urban Storm Water Mitigation Plan (SUSMP) for San Diego County, Port of San Diego, and Cities in San Diego County, February 14, 2002.

Model Water Quality Management Plan (WQMP) for County of Orange, Orange County Flood Control District, and the Incorporated Cities of Orange County, Draft February 2003.

Ventura Countywide Technical Guidance Manual for Stormwater Quality Control Measures, July 2002.

United States
Environmental Protection
Agency

UPDATED 2016

Operating And Maintaining Underground Storage Tank Systems

Practical Help And Checklists

EPA 510-K-16-001
February 2016

Printed on Recycled Paper

EPA wrote this booklet for owners and operators of underground storage tanks (USTs).

This booklet describes the 2015 revised *federal* UST regulation. Many states and territories (referred to as states in this booklet) have state program approval from EPA. To find a list of states with state program approval, see www.epa.gov/ust/state-underground-storage-tank-ust-programs.

If your UST systems are located in a state *with* state program approval, your requirements may be different from those identified in this booklet. To find information about your state's UST regulation, contact your implementing agency or visit its website. You can find links to state UST websites at www.epa.gov/ust/underground-storage-tank-ust-contacts#states.

If your UST systems are located in a state *without* state program approval, both the requirements in this booklet and the state requirements apply to you.

If your UST systems are located in Indian country, the requirements in this booklet apply to you.

Free Publications About UST Requirements

Download or read *Operating And Maintaining Underground Storage Tank Systems* on EPA's underground storage tank (UST) website at www.epa.gov/ust. Order printed copies of many, but not all, of our documents from the National Service Center for Environmental Publications (NSCEP), EPA's publication distributor: write to NSCEP, PO Box 42419, Cincinnati, OH 45242; call NSCEP's toll-free number 800-490-9198; or fax your order to NSCEP 301-604-3408.

Image credits:

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Highland Tank & Manufacturing Company (steel tanks on cover and in headers)
OPW (spill bucket on page 31, automatic shutoff device on page 35, ball float valve on page 39)
Federated Environmental Associates, Inc. (delivery and under-dispenser containment on cover)

Contents

Disclaimer

This document provides information on operating and maintaining underground storage tank (UST) systems. The document is not a substitute for U.S. Environmental Protection Agency regulations nor is it a regulation itself — it does not impose legally binding requirements.

For regulatory requirements regarding UST systems, refer to the federal regulation governing UST systems (40 CFR part 280).

How To Use This Booklet

Who Should Read This Booklet?

This booklet is for owners and operators of underground storage tank (UST) systems regulated under 40 CFR part 280.

You are responsible for making sure your USTs do not leak. This booklet can help you meet your UST responsibilities.

How Can This Booklet Help You?

This booklet can help you:

- Understand the 2015 UST regulation and its impact on regular operation and maintenance (O&M) procedures.
- Identify and understand the O&M procedures you should follow routinely to make sure your USTs do not leak and possibly damage the environment or endanger human health. These O&M procedures will help you avoid cleanup costs and liability concerns.
- Stay in compliance with EPA's UST O&M requirements.
- Identify O&M records you must keep on file.

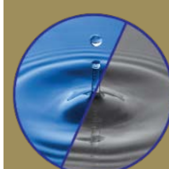
What Should You Do With Each Section Of This Booklet?

Read through each section carefully and use the checklists to help you establish clear O&M procedures.

By identifying and understanding the O&M tasks you should perform routinely, you will help ensure timely repair or replacement of components when problems are identified.

Throughout this document, bold type and orange updated boxes indicate new requirements in the 2015 UST regulation.

Releases from USTs can threaten human health and the environment, contaminating both soil and groundwater supplies. As of 2015, more than 525,000 UST releases have been confirmed.



About half of the United States population uses groundwater as a source of drinking water.

How Can You Use The Checklists Effectively?

You can select the specific mix of checklists that matches your UST facility. Once you identify your site-specific group of checklists, use them to perform operation and maintenance activities at your UST facility. Make several copies and complete them periodically.

By using these checklists, you can track your O&M activities and know you have done what was necessary to properly operate and maintain your UST system. Proper O&M activities help reduce releases of regulated substances to the environment.

Check With Your Implementing Agency

Many states and territories (referred to as states in this booklet) have state program approval from EPA. To find a list of states with state program approval, see www.epa.gov/ust/state-underground-storage-tank-ust-programs.

If your UST systems are located in a state *with* state program approval, your requirements may be different from those identified in this booklet. Check with the state UST program in the state where your USTs are located for your state's requirements.

If your UST systems are located in a state *without* state program approval, both the requirements in this booklet and the state requirements apply to you.

If your UST systems are located in Indian country, the requirements in this booklet apply to you.

Key Terms

An UST is a storage tank and underground piping connected to the tank that has at least 10 percent of its combined volume underground. The federal regulation applies only to USTs storing petroleum, including biofuel blends, and certain hazardous substances.

O&M ***means operation and maintenance procedures that owners and operators must follow to keep UST systems from leaking, which can result in costly cleanups.***

Your implementing agency may be the state UST agency, EPA, or a local UST agency.

A list of state contacts can be found at www.epa.gov/ust/underground-storage-tank-ust-contacts#states.

Section 1:
Identifying The Equipment At Your UST Facility

UST Equipment Checklist

Use the checklist on page 4 to identify UST equipment at your facility. Each part of the checklist refers you to the appropriate section of this O&M booklet for relevant information. After you identify your equipment, proceed to the appropriate sections and identify the O&M actions necessary for your specific UST system.

Problems Completing This Checklist

If you have trouble completing this checklist or others in this booklet, you can contact:

- Your UST contractor, the vendor of your UST equipment, and the manufacturer of your UST equipment for help. Look through your records for contact information. You may also use the contacts provided in Section 7.

- Your implementing agency may be able to help you identify equipment or sources of information about your UST equipment. Identify additional or different O&M procedures between those of your implementing agency and those presented in this booklet. See Section 7 for implementing agency contact information.

Remember Compatibility

If you store regulated substances containing greater than 10 percent ethanol or greater than 20 percent biodiesel (or any other regulated substance identified by your state UST agency), you must notify your implementing agency at least 30 days prior to switching to the fuel. You must also keep records demonstrating you meet the compatibility requirement. Keep these records for as long as the UST system stores the regulated substance.

General Facility Information (optional)

Facility Name	Facility ID #

Release Detection (Section 2)

Check at least one for each tank:		Tank 1	Tank 2	Tank 3	Tank 4
A. Release Detection For Tanks[1]					
	Automatic tank gauging (ATG) system				
	Interstitial monitoring (with secondary containment)				
	Statistical inventory reconciliation (SIR)				
	Continuous in-tank leak detection (CITLD)				
	Vapor monitoring				
	Groundwater monitoring				
	Inventory control and tank tightness testing (TTT)[2]				
	Manual tank gauging only[3]				
	Manual tank gauging and tank tightness testing (TTT)[4]				
	Other release detection method (please specify)				

1. If you install or replace a tank after April 11, 2016, it must have secondary containment and interstitial monitoring.
2. Allowed only for 10 years after the tank was installed. TTT required every five years.
3. Allowed only for tanks of 1,000 gallon capacity or less, with specified diameters.
4. Allowed only for tanks of 2,000 gallon capacity or less and only for 10 years after tank was installed. TTT required every five years.

B. Release Detection For Pressurized Piping[1]		Tank 1	Tank 2	Tank 3	Tank 4
A (Automatic Line Leak Detectors)	Automatic flow restrictor				
	Automatic shutoff device				
	Audible or visual alarm				
B	Annual line tightness test				
	Monthly monitoring[2]				

1. If you install or replace piping after April 11, 2016, it must have secondary containment and interstitial monitoring and have an automatic line leak detector.
2. Monthly monitoring for piping includes interstitial monitoring, vapor monitoring, groundwater monitoring, SIR, and CITLD.

C. Release Detection For Suction Piping[1]		Tank 1	Tank 2	Tank 3	Tank 4
	Line tightness testing every three years				
	Monthly monitoring[2]				
	No release detection (safe suction)[3]				

1. If you install or replace piping after April 11, 2016, it must have secondary containment and interstitial monitoring (except for safe suction piping).
2. Monthly monitoring for piping includes interstitial monitoring, vapor monitoring, groundwater monitoring, and other accepted methods (such as SIR and electronic line leak detectors).
3. No release detection required only if it can be verified that you have a safe suction piping system with the following characteristics: only one check valve per line located directly below the dispenser; piping sloping back to the tank; and system must operate under atmospheric pressure.

Spill And Overfill Protection (Section 4)

		Tank 1	Tank 2	Tank 3	Tank 4
	Spill catchment basin or spill bucket (check for each tank)				
	Automatic shutoff device				
	Overfill alarm				
	Ball float valve[1]				

1. Ball float valves may not be used to meet this requirement when overfill prevention is installed or replaced after October 13, 2015.

Corrosion Protection (Section 5)

		Tank 1	Tank 2	Tank 3	Tank 4
A. Corrosion Protection For Tanks					
	Coated and cathodically protected steel				
	Noncorrodible material (such as fiberglass reinforced plastic)				
	Steel jacketed or clad with noncorrodible material				
	Cathodically protected noncoated steel				
	Internally lined tank				
	Other method (please specify)				
B. Corrosion Protection For Piping					
	Coated and cathodically protected steel				
	Noncorrodible material (such as fiberglass reinforced plastic or flexible plastic)				
	Cathodically protected noncoated metal				
	Other method (please specify)				

Section 2: Release Detection

What Are Your Release Detection Options?

For tanks installed on or before April 11, 2016, you can use any of these release detection methods:

- Automatic tank gauging systems
- Interstitial monitoring (with secondary containment)
- Statistical inventory reconciliation
- Continuous in-tank leak detection
- Vapor monitoring
- Groundwater monitoring
- Inventory control with tank tightness testing
- Manual tank gauging
- Manual tank gauging with tank tightness testing
- Other methods meeting performance standards or approved by the implementing agency

For underground piping installed on or before April 11, 2016, you may use any of the release detection methods listed above that are appropriate for piping or conduct periodic line tightness testing. In addition, pressurized piping must have an automatic line leak detector.

UPDATED

Tanks and piping installed or replaced after April 11, 2016 must have secondary containment with interstitial monitoring, except for piping that is considered safe suction piping. Pressurized piping must continue to have an automatic line leak detector.

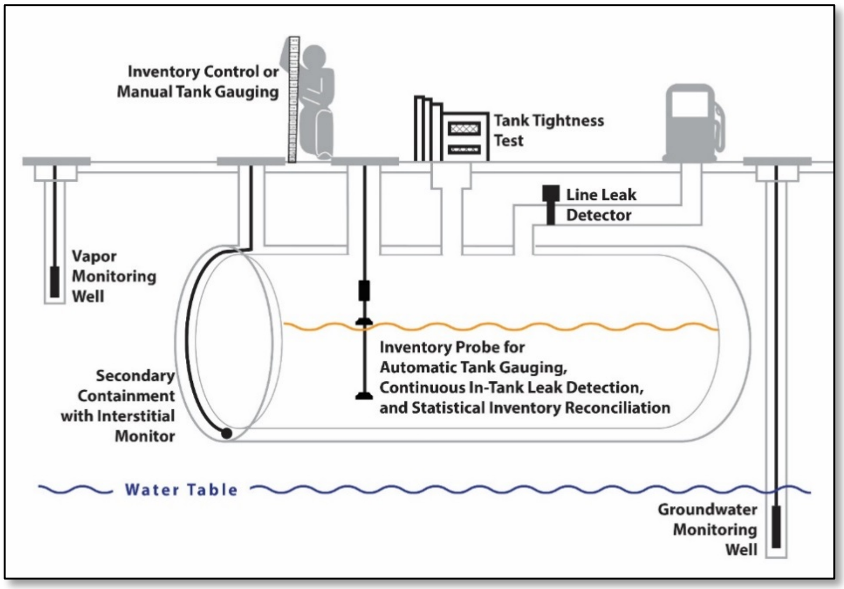
Suction piping is considered safe suction piping if it:

- Is below-grade piping that operates under atmospheric pressure;
- Slopes enough so that the product in the pipe can drain back into the tank when suction is released; and
- Has only one check valve, which is as close as possible beneath the pump in the dispensing unit.

Safe suction piping is not required to have release detection.

The 2015 UST regulation removes the deferral for field-constructed tanks and airport hydrant systems, making them subject to all of the UST requirements. Because these UST systems can be large and unique, some requirements are different from those described in this booklet. Therefore, these systems are not covered in this booklet. Please see EPA's field-constructed tanks and airport hydrant systems website at www.epa.gov/ust/field-constructed-tanks-and-airport-hydrant-systems-2015-requirements.

No later than October 13, 2018, emergency generator USTs installed on or before October 13, 2015 must meet the release detection requirements described in this booklet. Emergency generators installed after October 13, 2015 must meet the release detection requirements at installation.



What Are Your Existing Release Detection Requirements?

You must use proper release detection methods to determine at least every 30 days whether your tank and piping are leaking.

Your release detection method must be able to detect a leak from any portion of the tank and connected underground piping that routinely contains product.

You must keep the following records:

- Proof that performance claims, including probabilities of detection and false alarm, are met and the means by which performance was determined by either the equipment manufacturer or installer. You must maintain these records for at least five years.

- Results of any sampling, testing, or monitoring, except tank tightness tests, must be maintained for at least one year. You must maintain results of tank tightness tests until the next test is conducted.

- All calibration, maintenance, and repair of release detection equipment permanently located on site must be maintained for at least one year after servicing work is completed.

- Any schedules of required calibration and maintenance provided by equipment manufacturers must be retained for five years from the date of installation.

What Are Your Additional Release Detection Requirements?

UPDATED

No later than October 13, 2018, you must conduct your first annual test of your release detection equipment for proper operation. The testing must be conducted according to one of the following: manufacturer's instructions; a code of practice developed by a nationally recognized association or independent testing laboratory; or requirements your implementing agency determines are no less protective of human health and the environment than the other two options. Minimum requirements for testing various release detection components are covered under each release detection checklist. You must keep records of this testing for at least three years. See the sample annual release detection testing recordkeeping form on page 10.

Remember, your release detection method must meet specific performance requirements relating to its ability to detect a release. You must also ensure you use a method appropriate to your UST system and the product you store.

UPDATED

No later than October 13, 2018, you must conduct your first periodic walkthrough inspection of your release detection equipment. You must keep records of these inspections for at least one year. See more information about walkthrough inspections in Section 6.

UPDATED

No later than October 13, 2018, if you use groundwater or vapor monitoring for release detection, you must demonstrate proper installation and performance through a site assessment. You must maintain the site assessment for as long as the method is used for release detection at your facility. Site assessments completed after October 13, 2015, must be signed by a licensed professional.

What About Compatibility?

UPDATED

If you store regulated substances containing greater than 10 percent ethanol or greater than 20 percent biodiesel or any other regulated substance identified by your implementing agency, keep records demonstrating compatibility of the release detection components, such as probes and sensors, in contact with the regulated substance for as long as the UST system stores the regulated substance.

Do You Know If Your Release Detection Meets Performance Requirements?

Release detection must meet specific performance requirements. UST system owners and operators must keep written verification of equipment performance. Equipment manufacturers or installers provide this verification. Some equipment vendors or manufacturers supply their own performance documentation, but more often an impartial third party is paid to test the release detection equipment and certify that performance requirements are met. An independent workgroup of release detection experts periodically reviews and maintains a list of submitted third-party certifications, thus providing a free and reliable list of evaluations of third-party certifications for various release detection equipment. Frequently updated, this list is available at www.nwglde.org; the publication is *List Of Leak Detection Evaluations For Storage Tank Systems*. If you cannot find the performance documentation, contact your implementing agency; see Section 7 for contact information.

You should check the performance documentation to ensure your method is appropriate for use with your UST system equipment. By checking the documentation, you may discover the method you use has not been approved for use with the type of tank or piping you have. For example, you may learn from the documentation that your method will not work with manifolded tanks, certain products, high throughput, or certain tank sizes. That is why you must make sure your release detection method has clear performance documentation stating it will work effectively at your site with its specific characteristics.

What Are Your Release Detection O&M Responsibilities At Your UST Site?

If you do not understand your release detection O&M responsibilities and do not know what O&M tasks you must routinely perform, your UST site could become contaminated through spills, overfills, or releases from UST equipment. To avoid these problems use the checklists on the following pages, which describe each type of release detection method, discuss actions necessary for proper O&M, and note the records you should keep.

Locate the methods of release detection you are using at your facility, review these pages, and periodically review the checklists. You might want to print the checklists and periodically complete them later.

If you have questions about your release detection system, review your owner's manual or call the vendor of your system. Your implementing agency may be able to provide assistance as well.

You will find sample release detection recordkeeping forms in this section. Keeping these records increases the likelihood that you are conducting good O&M and providing effective release detection at your UST site. For example, the following page has a sample recordkeeping form for your required annual release detection testing.

If you ever suspect or confirm a release, refer to Section 3. Never ignore release detection alarms or failed release detection tests. Treat them as potential leaks.

Sample Annual Release Detection Testing Recordkeeping Form

Date(s) of annual release detection operation test: ______________________

Component Tested	Name Of Tester	Meets Criteria? (Y/N)	Needs Action? (Y/N)	Action Taken To Correct Issue
Automatic tank gauge and other controllers: test alarm; verify system configuration; test battery backup.				
Probes and sensors: inspect for residual buildup; ensure floats move freely; ensure shaft is not damaged; ensure accessible cables are free of kinks and breaks; test alarm operability and communication with controller.				
Automatic line leak detector: test to ensure device can detect 3 gallons per hour at 10 pounds per square inch (or equivalent) within one hour by simulating a leak.				
Vacuum pumps and pressure gauges: ensure proper communication with sensors and controller.				
Hand-held electronic sampling equipment associated with groundwater and vapor monitoring: ensure proper operation.				
Other Components Tested:				

Notes:

______________________________ ____________

Release Detection Tester Signature **Date**

Keep this record for three years.

Checklist For Automatic Tank Gauging Systems (For Tanks Only)

Automatic Tank Gauging Systems (For Tanks Only)	
Description	An automatic tank gauging (ATG) system consists of a probe permanently installed in a tank and wired to a monitor to provide information on product level and temperature. ATG systems automatically calculate the changes in product volume that can indicate a leaking tank.
Perform These O&M Actions	☐ Use your ATG system to test for leaks at least every 30 days. ☐ Make sure the amount of product in your tank is sufficient to run the ATG leak test. The tank must contain a minimum amount of product to perform a valid leak test. One source for determining that minimum amount is the performance documentation for your release detection equipment. UPDATED ☐ **No later than October 13, 2018, you must begin inspecting and testing your ATG system every year. At a minimum, test the alarm, battery back-up, and verify the system configuration. For probes and sensors, you must inspect for residual build-up, ensure floats move freely, ensure the shaft is not damaged, ensure accessible cables are free of kinks and breaks, and test alarm operability and communication with controller.** UPDATED ☐ **No later than October 13, 2018, you must begin performing periodic walkthrough inspections. See Section 6 for more information about these required walkthrough inspections.** ☐ If your ATG ever fails a test or indicates a release, see Section 3 for information on what to do next. UPDATED ☐ Make sure employees who run, monitor, or maintain the release detection system know exactly what they have to do and to whom to report problems. **No later than October 13, 2018, UST owners must have designated and trained operators. Most states already require operator training.**
Keep These O&M Records	☐ Keep results of your 30-day release detection monitoring for at least one year. Your monitoring equipment may provide printouts that can be used as records. See page 25 for a sample 30 day recordkeeping form. UPDATED ☐ **Keep results for your annual ATG system operation tests for at least three years.** ☐ Keep all records of calibration, maintenance, and repair of your release detection equipment for at least one year. ☐ Keep any schedules of required calibration and maintenance provided by the release detection equipment manufacturer for at least five years from the date of installation. ☐ Keep all performance claims supplied by the installer, vendor, or manufacturer for at least five years. UPDATED ☐ **Keep your periodic walkthrough inspection records for at least one year.** UPDATED ☐ **If you store regulated substances containing greater than 10 percent ethanol or greater than 20 percent biodiesel or any other regulated substance identified by your implementing agency, keep records demonstrating compatibility for as long as the UST system stores the regulated substance.**

Checklist For Secondary Containment With Interstitial Monitoring (For Tanks And Piping)

	Secondary Containment With Interstitial Monitoring (For Tanks And Piping)	
	Description	Secondarily-contained UST systems have an inner and outer barrier with an interstitial space that is monitored for leaks. This term includes containment sumps when used for interstitial monitoring of piping. Examples of secondary containment include an outer tank or piping wall, an excavation liner, and a bladder inside an UST.
	Perform These O&M Actions	☐ Use your release detection system to test for leaks at least every 30 days.
UPDATED		☐ **No later than October 13, 2018, you must begin inspecting and testing your release detection system every year. You must inspect probes and sensors for residual build-up, ensure floats move freely, ensure the shaft is not damaged, ensure accessible cables are free of kinks and breaks, and test alarm operability and communication with the controller.**
UPDATED		☐ **No later than October 13, 2018, you must begin testing all containment sumps used for piping interstitial monitoring every three years for liquid tightness or use a double-walled containment sump with annual interstitial monitoring.**
UPDATED		☐ **No later than October 13, 2018, you must begin performing periodic walkthrough inspections. See Section 6 for more information about these required walkthrough inspections.**
UPDATED		☐ **If you repair any secondary containment areas, you must test them for tightness within 30 days after the repair.**
		☐ If your release detection ever fails a test or indicates a release, see Section 3 for information on what to do next.
UPDATED		☐ Make sure employees who run, monitor, or maintain the release detection system know exactly what they have to do and to whom to report problems. **No later than October 13, 2018, UST owners must have designated and trained operators. Most states already require operator training.**
	Keep These O&M Records	☐ Keep results of your 30-day release detection monitoring for at least one year. Your monitoring equipment may provide printouts that can be used as records. See page 25 for a sample 30 day recordkeeping form.
UPDATED		☐ **Keep results for your annual release detection system operation tests for at least three years.**
		☐ Keep all records of calibration, maintenance, and repair of your release detection equipment for at least one year.
		☐ Keep any schedules of required calibration and maintenance provided by the release detection equipment manufacturer for at least five years from the date of installation.
		☐ Keep all performance claims supplied by the installer, vendor, or manufacturer for at least five years.
UPDATED		☐ **For containment sump and secondary containment equipment inspections that are part of the periodic walkthrough inspection requirement, keep records of the walkthrough inspection for at least one year.**
UPDATED		☐ **For containment sumps used for interstitial monitoring of piping, keep records of containment sump testing for three years or keep documentation showing the containment sump is double-walled and the integrity of both walls is periodically monitored for as long as containment sump testing is not performed.** See page 33 for a sample recordkeeping form for the test.
UPDATED		☐ **If you store regulated substances containing greater than 10 percent ethanol or greater than 20 percent biodiesel or any other regulated substance identified by your implementing agency, keep records demonstrating compatibility for as long as the UST system stores the regulated substance.**

Checklist For Statistical Inventory Reconciliation (For Tanks And Piping)

Statistical Inventory Reconciliation (For Tanks And Piping)	
Description	Statistical inventory reconciliation (SIR) is typically a method in which a trained professional uses sophisticated computer software to conduct a statistical analysis of inventory, delivery, and dispensing data. You must supply the professional with data every month. Computer programs enable an owner or operator to perform SIR. In either case, the result of the analysis may be pass, inconclusive, or fail.
UPDATED UPDATED **Perform These O&M Actions** UPDATED	☐ Supply daily inventory data to your SIR vendor at least every 30 days or use your computer software at least every 30 days to test your tank for leaks. ☐ If your SIR method ever fails a test or indicates a release, see Section 3 for information on what to do next. ☐ If you receive an inconclusive result, you and your SIR vendor must correct the problem and use another method of release detection if SIR results are inconclusive. An inconclusive result means that you have not performed release detection for that month. If you cannot resolve the problem, treat the inconclusive result as a suspected leak and refer to Section 3. ☐ **No later than October 13, 2018, you must begin performing periodic walkthrough inspections. See Section 6 for more information about these required walkthrough inspections.** ☐ **No later than October 13, 2018, you must begin inspecting and testing your release detection system every year. If you use an ATG system to gather SIR data, annually test your ATG system. At a minimum, test the alarm, battery backup, and verify the system configuration. For probes and sensors, you must inspect for residual buildup, ensure floats move freely, ensure the shaft is not damaged, ensure accessible cables are free of kinks and breaks, and test alarm operability and communication with controller.** ☐ If you stick your tank to gather data for the SIR vendor or your software, make sure your stick can measure to one-eighth of an inch and can measure the level of product over the full range of the tank's height. ☐ Make sure employees who run, monitor, or maintain the release detection system know exactly what they have to do and to whom to report problems. **No later than October 13, 2018, UST owners must have designated and trained operators. Most states already require operator training.**
UPDATED **Keep These O&M Records** UPDATED UPDATED	☐ Keep results of your 30-day release detection monitoring for at least one year. ☐ **Keep results for your annual release detection system operation tests for at least three years.** ☐ Keep all records of calibration, maintenance, and repair of your release detection equipment for at least one year. ☐ Keep any schedules of required calibration and maintenance provided by the release detection equipment manufacturer for at least five years from the date of installation. ☐ Keep all performance claims supplied by the installer, vendor, or manufacturer for at least five years. This includes the documentation of the SIR method discussed above. ☐ **Keep your periodic walkthrough inspection records for at least one year.** ☐ **If you store regulated substances containing greater than 10 percent ethanol or greater than 20 percent biodiesel or any other regulated substance identified by your implementing agency, keep records demonstrating compatibility for as long as the UST system stores the regulated substance.**

Checklist For Continuous In-Tank Leak Detection

Continuous In-Tank Leak Detection	
Description	Continuous in-tank leak detection (CITLD) encompasses all statistically based methods where the system incrementally gathers measurements on an uninterrupted or nearly uninterrupted basis to determine a tank's leak status. There are two major groups that fit into this category: continuous statistical leak detection (also referred to as continuous automatic tank gauging methods) and continual reconciliation. Both groups typically use sensors permanently installed in the tank to obtain inventory measurements. They are combined with a microprocessor in the ATG system or other control console that processes the data. Continual reconciliation methods are further distinguished by their connection to dispensing meters that allow for automatic recording and use of dispensing data in analyzing tanks' leak status. CITLD must operate on an uninterrupted basis or operate within a process that allows the system to gather incremental measurements to determine the leak status of the tank at least once every 30 days.
Perform These O&M Actions	UPDATED ☐ **No later than October 13, 2018, you must begin performing periodic walkthrough inspections. See Section 6 for more information about these required walkthrough inspections.** UPDATED ☐ **No later than October 13, 2018, you must begin inspecting and testing your release detection system every year. At a minimum, test the alarm, battery backup, and verify the system configuration. For probes and sensors, you must inspect for residual buildup, ensure floats move freely, ensure the shaft is not damaged, ensure accessible cables are free of kinks and breaks, and test alarm operability and communication with controller.** ☐ If your CITLD method ever fails a test or indicates a release, see Section 3 for information on what to do next. UPDATED ☐ Make sure employees who run, monitor, or maintain the release detection system know exactly what they have to do and to whom to report problems. **No later than October 13, 2018, UST owners must have designated and trained operators. Most states already require operator training.**
Keep These O&M Records	☐ Keep results of your 30-day release detection monitoring for at least one year. Your monitoring equipment may provide printouts that can be used as records. A sample 30 day recordkeeping form is provided on page 25. UPDATED ☐ **Keep results for your annual release detection system operation tests for at least three years.** ☐ Keep all records of calibration, maintenance, and repair of your release detection equipment for at least one year. ☐ Keep any schedules of required calibration and maintenance provided by the release detection equipment manufacturer for at least five years from the date of installation. ☐ Keep all performance claims supplied by the installer, vendor, or manufacturer for at least five years. UPDATED ☐ **Keep your periodic walkthrough inspection records for at least one year.** UPDATED ☐ **If you store regulated substances containing greater than 10 percent ethanol or greater than 20 percent biodiesel or any other regulated substance identified by your implementing agency, keep records demonstrating compatibility for as long as the UST system stores the regulated substance.**

Checklist For Vapor Monitoring (For Tanks And Piping)

Vapor Monitoring (For Tanks And Piping)	
Description	Vapor monitoring checks for leaks by measuring product vapors in the soil at the UST site. A site assessment determines the number and placement of monitoring wells. Please note that vapor monitoring will not work well with substances, such as diesel fuel, that do not easily vaporize.
Perform These O&M Actions	UPDATED: ☐ **No later than October 13, 2018, if you use vapor monitoring for release detection, you must demonstrate proper installation and performance through a site assessment. You must maintain a site assessment for as long as vapor monitoring is used for release detection at your facility. Site assessments completed after October 13, 2015 must be signed by a licensed professional.** UPDATED: ☐ **No later than October 13, 2018, you must begin performing periodic walkthrough inspections. These inspections include checking your hand-held equipment for operability and serviceability. See Section 6 for more information about these required walkthrough inspections.** ☐ Use your release detection system to test for leaks at least every 30 days. Testing more often than every 30 days can identify leaks sooner and reduce cleanup costs and problems. Check all of your vapor monitoring wells. ☐ If your vapor monitoring method ever fails a test or indicates a release, see Section 3 for information on what to do next. UPDATED: ☐ **No later than October 13, 2018, you must begin inspecting and testing your release detection system every year. If you use permanently installed electronic equipment for vapor monitoring, at a minimum, test the alarm, battery backup, and verify the system configuration. For probes and sensors, you must inspect for residual buildup, ensure floats move freely, ensure the shaft is not damaged, ensure accessible cables are free of kinks and breaks, and test alarm operability and communication with controller.** ☐ Clearly mark and secure your vapor monitoring wells. UPDATED: ☐ Make sure employees who run, monitor, or maintain the release detection system know exactly what they have to do and to whom to report problems. **No later than October 13, 2018, UST owners must have designated and trained operators. Most states already require operator training.**
Keep These O&M Records	☐ Keep results of your 30-day release detection monitoring for at least one year. Your monitoring equipment may provide printouts that can be used as records. See page 25 for a sample 30 day recordkeeping form. UPDATED: ☐ **Keep results for your annual release detection system operation tests for at least three years.** ☐ Keep all records of calibration, maintenance, and repair of your release detection equipment for at least one year. ☐ Keep any schedules of required calibration and maintenance provided by the release detection equipment manufacturer for at least five years from the date of installation. ☐ Keep all performance claims supplied by the installer, vendor, or manufacturer for at least five years. UPDATED: ☐ **Keep your periodic walkthrough inspection records for at least one year.** UPDATED: ☐ **If you store regulated substances containing greater than 10 percent ethanol or greater than 20 percent biodiesel or any other regulated substance identified by your implementing agency, keep records demonstrating compatibility for as long as the UST system stores the regulated substance.**

Checklist For Groundwater Monitoring (For Tanks And Piping)

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Groundwater Monitoring (For Tanks And Piping)	
Description	Groundwater monitoring looks for the presence of liquid product floating on groundwater at the UST site. To ensure a leak is detected, follow the site assessment plan, which determines the number and placement of monitoring wells. Note that this method cannot be used at sites where groundwater is more than 20 feet below the surface.
Perform These O&M Actions	☐ **No later than October 13, 2018, if you use groundwater monitoring for release detection, you must demonstrate proper installation and performance through a site assessment. You must maintain a site assessment for as long as groundwater monitoring is used for release detection at your facility. Site assessments completed after October 13, 2015 must be signed by a licensed professional.** ☐ **No later than October 13, 2018, you must begin performing periodic walkthrough inspections. These inspections include checking your hand-held equipment for operability and serviceability. See Section 6 for more information about these required walkthrough inspections.** ☐ Use your release detection system to test for leaks at least every 30 days. Testing more often than every 30 days can identify leaks sooner and reduce cleanup costs and problems. Check all of your groundwater monitoring wells. ☐ If your groundwater monitoring method ever fails a test or indicates a release, see Section 3 for information on what to do next. ☐ **No later than October 13, 2018, you must begin inspecting and testing your release detection system every year. If you use permanently installed electronic equipment for groundwater monitoring, at a minimum, test the alarm, battery backup, and verify the system configuration. For probes and sensors, you must inspect for residual buildup, ensure floats move freely, ensure the shaft is not damaged, ensure accessible cables are free of kinks and breaks, and test alarm operability and communication with controller.** ☐ Clearly mark and secure your groundwater monitoring wells. ☐ Make sure employees who run, monitor, or maintain the release detection system know exactly what they have to do and to whom to report problems. **No later than October 13, 2018, UST owners must have designated and trained operators. Most states already require operator training.**
Keep These O&M Records	☐ Keep results of your 30-day release detection monitoring for at least one year. Your monitoring equipment may provide printouts that can be used as records. See page 25 for a sample 30 day recordkeeping form. ☐ **Keep results for your annual release detection system operation tests for at least three years.** ☐ Keep all records of calibration, maintenance, and repair of your release detection equipment for at least one year. ☐ Keep any schedules of required calibration and maintenance provided by the release detection equipment manufacturer for at least five years from the date of installation. ☐ Keep all performance claims supplied by the installer, vendor, or manufacturer for at least five years. ☐ **Keep your periodic walkthrough inspection records for at least one year.** ☐ **If you store regulated substances containing greater than 10 percent ethanol or greater than 20 percent biodiesel or any other regulated substance identified by your implementing agency, keep records demonstrating compatibility for as long as the UST system stores the regulated substance.**

UPDATED

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Checklist For Inventory Control And Tank Tightness Testing (For Tanks)

Inventory Control And Tank Tightness Testing (For Tanks)	
Description	This temporary method combines monthly inventory control with periodic tank tightness testing. Inventory control involves taking measurements of tank contents and recording the amount of product pumped each operating day, measuring and recording tank deliveries, and reconciling all this data at least once a month. This combined method also includes tank tightness testing, a sophisticated test performed by trained professionals. Please note that this combination method can only be used temporarily, for up to 10 years after your UST was installed. **You may no longer use this method after April 11, 2026 because tanks and piping installed or replaced after April 11, 2016 must have secondary containment and interstitial monitoring.**
Perform These O&M Actions	☐ Take inventory readings and record the numbers at least each day that product is added to or taken out of the tank. You may use the sample daily inventory worksheet on page 18. ☐ Reconcile the fuel deliveries with delivery receipts by taking inventory readings before and after each delivery. Record these readings on a daily inventory worksheet on page 18. ☐ Reconcile all your data at least every 30 days. Use a monthly inventory record; see the sample on page 19. ☐ Conduct a tank tightness test at least every five years. A professional trained in performing tank tightness testing must conduct this test. ☐ See Section 3 if your tank fails a tightness test or fails two consecutive months of inventory control. ☐ Ensure that your measuring stick can measure to the nearest one-eighth inch and can measure the level of product over the full range of the tank's height. ☐ Ensure that your product dispenser is calibrated according to local standards or to an accuracy of 6 cubic inches for every 5 gallons of product withdrawn. ☐ Measure the water in your tank to the nearest one-eighth inch at least once a month and record the results on the reconciliation sheet. You can use a paste that changes color when it comes into contact with water. If you find water in your tank, you must investigate and determine the reason for its presence. The presence of water in your tank is an unusual operating condition. You should remove the water as soon as possible because it can cause problems such as corrosion and degrading fuel quality. ☐ **No later than October 13, 2018, you must begin performing periodic walkthrough inspections. These inspections include checking your tank gauging stick for operability and serviceability. See Section 6 for more information about these required walkthrough inspections.** ☐ Make sure employees who run, monitor, or maintain the release detection system know exactly what they have to do and to whom to report problems. **No later than October 13, 2018, UST owners must have designated and trained operators. Most states already require operator training.**
Keep These O&M Records	☐ Keep results of your 30-day release detection monitoring for at least one year. See the sample daily inventory worksheet and monthly inventory record on pages 18 and 19, respectively. ☐ Keep the results of your most recent tightness test. ☐ Keep all performance claim documentation for tank tightness tests performed at your UST site for at least five years. ☐ **Keep your periodic walkthrough inspection records for at least one year.**

Sample Daily Inventory Worksheet

Facility Name: ___________________________ Your Name: ______________________ Date: ________

Date					
Tank Identification					
Type Of Fuel					
Tank Size In Gallons					
End Stick Inches					
Amount Pumped					
Totalizer Reading					
Totalizer Reading					
Totalizer Reading					
Totalizer Reading					
Totalizer Reading					
Totalizer Reading					
Totalizer Reading					
Totalizer Reading					
Today's Sum Of Totalizers					
Previous Day's Sum Of Totalizers					
Amount Pumped Today					
Delivery Record					
Inches Of Fuel Before Delivery					
Gallons Of Fuel Before Delivery (from tank chart)					
Inches Of Fuel After Delivery					
Gallons Of Fuel After Delivery (from tank chart)					
Gallons Delivered (Stick) [Gallons After - Gallons Before]					
Gross Gallons Delivered (Receipt)					

Sample Monthly Inventory Record

Month/Year :_______/______

Tank Identification; Type Of Fuel: ____________________________

Facility Name: ____

Date Of Water Check: ________ Level Of Water (Inches): __________

Date	Start Stick Inventory (Gallons)	Gallons Delivered	Gallons Pumped	Book Inventory (Gallons)	End Stick Inventory		Daily Over (+) Or Short (–) [End – Book]	Initials
					(Inches)	(Gallons)		
1	(+)	(-)	(=)					
2	(+)	(-)	(=)					
3	(+)	(-)	(=)					
4	(+)	(-)	(=)					
5	(+)	(-)	(=)					
6	(+)	(-)	(=)					
7	(+)	(-)	(=)					
8	(+)	(-)	(=)					
9	(+)	(-)	(=)					
7	(+)	(-)	(=)					
8	(+)	(-)	(=)					
9	(+)	(-)	(=)					
10	(+)	(-)	(=)					
11	(+)	(-)	(=)					
12	(+)	(-)	(=)					
13	(+)	(-)	(=)					
14	(+)	(-)	(=)					
15	(+)	(-)	(=)					
16	(+)	(-)	(=)					
17	(+)	(-)	(=)					
18	(+)	(-)	(=)					
19	(+)	(-)	(=)					
20	(+)	(-)	(=)					
21	(+)	(-)	(=)					
22	(+)	(-)	(=)					
23	(+)	(-)	(=)					
24	(+)	(-)	(=)					
25	(+)	(-)	(=)					
26	(+)	(-)	(=)					
27	(+)	(-)	(=)					
28	(+)	(-)	(=)					
29	(+)	(-)	(=)					
30	(+)	(-)	(=)					
31	(+)	(-)	(=)					
		Total Gallons Pumped >				Total Gallons Over Or Short >		

Leak Check:
Drop the last two digits
from the Total Gallons
Pumped number and enter here: ___________ + 130 = ___________ gallons

Compare these numbers

Is the **total gallons over or short** larger than **leak check** result? **Yes** **No** (circle one)

If your answer is Yes for 2 months in a row, **notify your implementing agency** as soon as possible.

Keep this record for at least one year.

Checklist For Manual Tank Gauging (For Tanks 1,000 Gallons Or Less)

Manual Tank Gauging (For Tanks 1,000 Gallons Or Less)	
Description	Manual tank gauging involves taking your tank out of service for at least 36 hours during the test period each week. During that time, the contents of the tank are measured twice at the beginning and twice at the end of the test period. The measurements are then compared to weekly and monthly standards to determine if the tank is tight. This method may be used only for tanks of 1,000 gallons or less capacity meeting certain requirements. These requirements – tank size, tank dimension, and test time – are listed on page 21 in the sample manual tank gauging record.
Perform These O&M Actions	☐ Once a week, record two inventory readings at the beginning of the test, allow the tank to sit undisturbed for the time specified in the sample manual tank gauging record on page 21, and record two inventory readings at the end of the test. ☐ Reconcile the numbers weekly and record them on a manual tank gauging record; see page 21. ☐ At the end of four weeks, reconcile your records for the monthly standard and record the result on a manual tank gauging record; see page 21. ☐ See Section 3 if your tank fails the weekly standard or monthly standard. ☐ Ensure that your measuring stick can measure to the nearest one-eighth inch and can measure the level of product over the full range of the tank's height. ☐ **No later than October 13, 2018, you must begin performing periodic walkthrough inspections. These inspections include checking your tank gauging stick for operability and serviceability. See Section 6 for more information about these required walkthrough inspections.** ☐ Make sure employees who run, monitor, or maintain the release detection system know exactly what they have to do and to whom to report problems. **No later than October 13, 2018, UST owners must have designated and trained operators. Most states already require operator training.**
Keep These O&M Records	☐ Keep results of your 30-day release detection monitoring for at least one year. See the sample manual tank gauging record on page 21. ☐ **Keep your periodic walkthrough inspection records for at least one year.**

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UPDATED

Sample Manual Tank Gauging Record

Month: ______________ Year______________
Tank Identification: ______________________________
Person Completing Form:________________________
Facility Name: __________________________________

Tank Size	Minimum Duration Of Test	Weekly Standard (1 test)	Monthly Standard (4-test average)
Up to 550 gallons	36 hours	10 gallons	5 gallons
551-1,000 gallons (when tank diameter is 64")	44 hours	9 gallons	4 gallons
551-1,000 gallons (when tank diameter is 46")	58 hours	12 gallons	6 gallons
551-1,000 gallons (also requires periodic tank tightness testing)	36 hours	13 gallons	7 gallons
1,001-2,000 gallons (also requires periodic tank tightness testing)	36 hours	26 gallons	13 gallons

Compare your weekly readings and the monthly average of the 4 weekly readings with the standards shown in the table on the left.

If the calculated change exceeds the weekly standard, the UST may be leaking. Also, the monthly average of the 4 weekly test results must be compared to the monthly standard in the same way.

If either the weekly or the monthly standards have been exceeded, the UST may be leaking. As soon as possible, call your implementing agency to report the suspected leak and get further instructions.

Start Test (month, day, and time)	First Initial Stick Reading	Second Initial Stick Reading	Average Initial Reading	Initial Gallons (convert inches to gallons [a])	End Test (month, day, and time)	First End Stick Reading	Second End Stick Reading	Average End Reading	End Gallons (convert inches to gallons [b])	Change In Tank Volume In Gallons + or (-) [a – b]	Tank Passes Test (circle Yor N)
Date: Time: AM/PM					Date: Time: AM/PM						Y N
Date: Time: AM/PM					Date: Time: AM/PM						Y N
Date: Time: AM/PM					Date: Time: AM/PM						Y N
Date: Time: AM/PM					Date: Time: AM/PM						Y N
						To see how close you are to the monthly standard, divide the sum of the 4 weekly readings by 4 and enter result here					Y N

Keep this record for at least one year.

Checklist For Manual Tank Gauging And Tank Tightness Testing (For Tanks 2,000 Gallons Or Less)

	Manual Tank Gauging And Tank Tightness Testing (For Tanks 2,000 Gallons Or Less)	
UPDATED	**Description**	This method combines manual tank gauging with periodic tank tightness testing. It may be used only for tanks of 2,000 gallons or less capacity. Manual tank gauging involves taking your tank out of service for at least 36 hours during the test period each week. During that time, the contents of the tank are measured twice at the beginning and twice at the end of the test period. The measurements are then compared to weekly and monthly standards to determine if the tank is tight. This combined method also includes tank tightness testing, a sophisticated test performed by trained professionals. Please note that this combination method can only be used temporarily, for up to 10 years after your UST was installed. **You may no longer use this method after April 11, 2026 because tanks and piping installed or replaced after April 11, 2016 must have secondary containment and interstitial monitoring.**
UPDATED UPDATED	**Perform These O&M Actions**	☐ Once a week, record two inventory readings at the beginning of the test, allow the tank to sit undisturbed for the time specified in the sample manual tank gauging record on page 21, and record two inventory readings at the end of the test. ☐ Reconcile the numbers weekly and record them on a manual tank gauging record; see page 21. ☐ At the end of four weeks, reconcile your records for the monthly standard and record the result on a manual tank gauging record; see page 21. ☐ Conduct a tank tightness test at least every five years. This testing needs to be conducted by a professional trained in performing tank tightness testing. ☐ See Section 3 if your tank fails the tightness test, weekly standard, or monthly standard. ☐ Ensure that your measuring stick can measure to the nearest one-eighth inch and can measure the level of product over the full range of the tank's height. ☐ **No later than October 13, 2018, you must begin performing periodic walkthrough inspections. These inspections include checking your tank gauging stick for operability and serviceability. See Section 6 for more information about these required walkthrough inspections.** ☐ Make sure employees who run, monitor, or maintain the release detection system know exactly what they have to do and to whom to report problems. **No later than October 13, 2018, UST owners must have designated and trained operators. Most states already require operator training.**
UPDATED	**Keep These O&M Records**	☐ Keep results of your 30-day release detection monitoring for at least one year. See the sample manual tank gauging record on page 21. ☐ **Keep your periodic walkthrough inspection records for at least one year.**

Checklist For Automatic Line Leak Detection (For Pressurized Piping)

Automatic Line Leak Detection (For Pressurized Piping)	
Description	Automatic line leak detectors (LLDs) are designed to detect a catastrophic leak from pressurized piping. Automatic LLDs must be designed to detect a leak at least as small as 3 gallons per hour at a line pressure of 10 pounds per square inch within one hour. When a leak is detected, automatic LLDs must shut off the product flow, restrict the product flow, or trigger an audible or visual alarm. Please note that mechanical LLDs need to be installed and operated as close as possible to the tank. LLDs are designed to detect a leak, restrict flow, or trigger an alarm only between the detector and the dispenser.
Perform These O&M Actions	UPDATED ☐ **No later than October 13, 2018, you must begin inspecting and testing your release detection system, including LLDs, every year. You must test your LLDs by simulating a leak, which evaluates the LLDs' ability to detect a leak.** ☐ See Section 3 if your LLDs detect a release. UPDATED ☐ Make sure employees who run, monitor, or maintain the release detection system know exactly what they have to do and to whom to report problems. **No later than October 13, 2018, UST owners must have designated and trained operators. Most states already require operator training.**
Keep These O&M Records	UPDATED ☐ **Keep results for your annual release detection system operation tests for at least three years.** ☐ Keep all records of calibration, maintenance, and repair of your release detection equipment for at least one year. ☐ Keep any schedules of required calibration and maintenance provided by the release detection equipment manufacturer for at least five years from the date of installation. ☐ Keep all performance claims supplied by the installer, vendor, or manufacturer for at least five years. UPDATED ☐ **If you store regulated substances containing greater than 10 percent ethanol or greater than 20 percent biodiesel or any other regulated substance identified by your state UST agency, keep records demonstrating compatibility for as long as the UST system stores the regulated substance.**

Checklist For Line Tightness Testing (For Piping)

Line Tightness Testing (For Piping)	
Description	This method uses a periodic line tightness test to determine if your piping is leaking. Tightness testing can be performed by either a trained professional or by using a permanently installed electronic system, which is sometimes connected to an automatic tank gauging system.
Perform These O&M Actions	☐ If you have pressurized piping and use line tightness testing, you must conduct the test at least annually. ☐ If you have suction piping and use line tightness testing, you must conduct the test at least every three years. Safe suction piping, as described at the bottom of page 5, does not need release detection. ☐ You must have this tightness testing conducted by a professional trained in performing line tightness testing or use a permanently installed electronic system. ☐ See Section 3 if your piping fails the tightness test or if the electronic system indicates a release. UPDATED ☐ **No later than October 13, 2018, you must begin inspecting and testing your release detection system, including LLDs, every year. You must test your LLDs by simulating a leak, which evaluates the LLDs' ability to detect a leak.** UPDATED ☐ Make sure employees who run, monitor, or maintain the release detection system know exactly what they have to do and to whom to report problems. **No later than October 13, 2018, UST owners must have designated and trained operators. Most states already require operator training.**
Keep These O&M Records	☐ Keep results of your most recent line tightness test. Keep any results for your electronic release detection equipment operation and maintenance tests for at least three years. Your monitoring equipment may provide printouts, which can be used as records. UPDATED ☐ **If using an electronic line leak detector for tightness testing, keep results for your annual release detection system operation tests for at least three years.** ☐ Keep all records of calibration, maintenance, and repair of your release detection equipment for at least one year. ☐ Keep any schedules of required calibration and maintenance provided by the release detection equipment manufacturer for at least five years from the date of installation. ☐ Keep all performance claims supplied by the installer, vendor, or manufacturer for at least five years. UPDATED ☐ **If you store regulated substances containing greater than 10 percent ethanol or greater than 20 percent biodiesel or any other regulated substance identified by your implementing agency, keep records demonstrating compatibility for as long as the UST system stores the regulated substance.**

Sample 30-Day Release Detection Monitoring Record

(May be used for monitoring wells, interstitial monitoring, automatic tank gauging, and CITLD)

Release Detection Method:____________________________________

Facility Name:____________________________________

Date	Your Name	**UST System (Tank And Piping)** (Enter N for No Release Detected or Y for a Suspected Or Confirmed Release)			
		UST #	UST #	UST #	UST #

Keep this record and associated printouts for at least one year from the date of the last entry.

Section 3: Suspected Or Confirmed Releases

You must be fully prepared to respond to releases before they occur. You must know what to do when release detection methods indicate a suspected or confirmed release. Be ready to take the following steps, as appropriate, if you have a release.

Stop The Release

- Take immediate action to prevent the release of more product.
- Use the emergency shutoff switch to stop the flow of product. (Make sure you know where your emergency shutoff switch is located.)
- Turn off the power to the dispenser and place a bag over the nozzle.
- Identify any fire, explosion, or vapor hazards and take action to neutralize these hazards.
- Empty the tank, if necessary, without further contaminating the site. You may need the assistance of your supplier or distributor.

Call For Help

- Contact your local fire or emergency response authority. Make sure you have these crucial telephone numbers prominently posted where you and your employees can easily see them.

Contain The Release

Contain, absorb, and clean up any surface spills or overfills. You should keep enough absorbent material at your facility to contain a spill or overfill of petroleum products until emergency response personnel can respond to the incident. The suggested supplies include, but are not limited to:

- Containment devices, such as containment booms, dikes, and pillows.

Page 29 is a blank form to list names and phone numbers of important contacts. Fill out this information for your facility so that you will know who to call in case of an emergency. Print this page from the booklet, fill it out, and post it in a prominent place at your facility.

Print multiple copies of page 29 and update it often. Make sure everyone at your UST facility is familiar with this list of contacts.

- Absorbent material, such as kitty litter, chopped corn cob, sand, and sawdust. Be sure you properly dispose of used absorbent materials.
- Mats or other material capable of keeping spill or overfill out of nearby storm drains.
- Spark-free flash light.
- Spark-free shovel.
- Buckets.
- Reels of caution tape, traffic cones, and warning signs.
- Personal protective gear.

Report To Authorities

If you observe any of the following, contact your implementing agency to report a suspected or confirmed release as soon as possible or within 24 hours:

- Any spill or overfill of petroleum that exceeds 25 gallons or causes a sheen on nearby surface water. Spills and overfills under 25 gallons that are contained and immediately cleaned up do not have to be reported. If they cannot be quickly cleaned up, you must report them to your implementing agency.
- Any released regulated substances at the UST site or in the surrounding area — such as the presence of liquid petroleum; soil contamination; surface water or groundwater contamination; or petroleum vapors in sewer, basement, or utility lines.
- Any unusual operating conditions you observe — such as erratic behavior of the dispenser, a sudden loss of product, unexplained presence of water in the tank, or liquid in the interstitial space of secondarily-contained systems. However, you are not required to report if:
    - The system equipment is found to be defective, but did not have a release, and is immediately repaired or replaced.
    - For secondarily-contained systems, any liquid in the interstitial space not used as part of the interstitial monitoring method is immediately removed (for example, fuel in the interstitial space of a monitoring system intended to be operated with brine).
- Results from your release detection system, including investigation of an alarm, indicate a suspected release. However, you are not required to report if:
    - The monitoring device is found to be defective and is immediately repaired, recalibrated, or replaced and further monitoring does not confirm the initial suspected release; or

- The leak is contained in the secondary containment and any liquid in the interstitial space not used as part of the interstitial monitoring method is immediately removed and any defective system equipment or component is immediately repaired or replaced; or
- In the case of inventory control, a second month of data does not confirm the initial result or the investigation determines no release has occurred; or
- The alarm was investigated and determined to be a non-release event; for example, from a power surge or caused by filling the tank during release detection testing.

Release Response
Important Contact Information

	Contact Name	Phone #
Implementing UST Agency:	______________	______________
Local UST Agency:	______________	______________
Fire Department:	______________	______________
Ambulance:	______________	______________
Police Department:	______________	______________
Repair Contractor:	______________	______________
Other Contacts:	______________	______________
______________	______________	______________
______________	______________	______________
______________	______________	______________
______________	______________	______________
______________	______________	______________

Release Response Checklist

- ☐ Stop the release: Take immediate action to prevent the release of more product. Use the emergency shutoff switch to stop the flow of product. Turn off the power to the dispenser and place a bag over the nozzle. Empty the tank, if necessary, without further contaminating the site.
- ☐ Contain the release: Contain, absorb, and clean up any surface releases. Identify any fire, explosion, or vapor hazards and take action to neutralize these hazards.
- ☐ Call for help and to report suspected or confirmed releases: Contact your local fire or emergency response authority. Contact your implementing agency within 24 hours.

Section 4:
Spill And Overfill Protection

The purpose of spill and overfill protection equipment is to reduce the potential for a release during fuel deliveries. The equipment must be in working order and used properly to provide adequate protection from spills and overfills.

Even the best spill and overfill protection equipment can become faulty over time if not properly operated and maintained. Small fuel leaks from a poorly maintained spill bucket can result in large amounts of contaminated soil over time. And improperly operating overfill prevention equipment can result in tank overfills.

UPDATED

The 2015 federal UST regulation requires operability testing of spill buckets and inspections of overfill prevention equipment once every three years. The test must be conducted according to a code of practice, manufacturer's instructions, or requirements developed by the implementing agency. In addition, it requires walkthrough inspections that look at spill equipment at least every 30 days. Records of walkthrough inspections must be kept and must include a list of each area checked, whether each area checked was acceptable or needed action, and a description of actions taken to correct an issue. If owners and operators receive deliveries less frequently than every 30 days, spill prevention equipment may be checked prior to each delivery. Delivery records must be maintained if spill prevention equipment is checked less frequently than every 30 days.

UPDATED

If you repair your spill or overfill prevention equipment, you must test or inspect, as appropriate, the equipment within 30 days after the repair.

The following pages focus on how you can routinely make sure your spill and overfill equipment are operating effectively.

What Is The Difference?

Spill Protection
A spill bucket is installed at the fill pipe to contain the drips and spills of fuel that can occur when the delivery hose is uncoupled from the fill pipe after delivery.

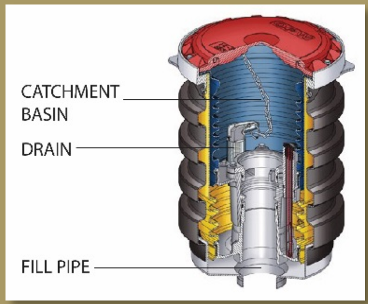
Overfill Protection
Equipment is installed on the UST and designed to stop product flow, reduce product flow, or alert the delivery person during delivery that the tank is nearing full capacity. This allows the person filling the tank to stop product delivery before the tank becomes full and begins releasing product into the environment.

What Are The Basics Of Spill Protection?

Your USTs must have spill buckets — also called catchment basins — installed at the fill pipe to contain small-volume spills that may occur as a result of fuel deliveries.

- Spill buckets are designed to temporarily contain product spills that might occur during fuel delivery. To contain a spill, the spill bucket must be liquid tight.
- Spill buckets are not designed to contain fuel for long periods. After each delivery, empty and dispose of contents properly.
- Spill buckets need to be large enough to contain any fuel that may spill when the delivery hose is uncoupled from the fill pipe. Spill buckets typically range in size from 5 gallons to 15 gallons.
- If you use correct delivery practices such as the ones described on page 41, spills should be eliminated or reduced to very small volumes that your spill bucket can easily handle.

The checklist on the next page provides information on properly maintaining your spill bucket.



Spill bucket

Your equipment supplier can help you choose the size and type of spill bucket that meets your needs.

If your UST only receives deliveries of 25 gallons or less at a time, the UST does not need to meet the spill and overfill protection requirements. Many used oil tanks fall into this category. Even though these USTs are not required to have spill and overfill protection, you should consider using spill and overfill protection as part of good UST system management.

Checklist For Spill Buckets

Spill Buckets	
Description	Spill buckets are basins installed at the fill pipe to temporarily contain product spills that may occur during fuel delivery.
Perform These O&M Actions	**UPDATED** ☐ **No later than October 13, 2018, you must conduct your first 30 day walkthrough inspection. Note that if you receive deliveries less frequently than every 30 days, you may check your spill bucket before each delivery.** o **Visually check for any damage to the spill bucket.** o **Remove any liquid or debris from the spill bucket.** o **Check for and remove any obstructions, such as tank gauging sticks, in the fill pipe.** o **Make sure your fill cap is securely fastened.** o **If you have a double-walled spill bucket with interstitial monitoring, check your interstitial monitoring device for a leak into the interstitial area.** **UPDATED** ☐ **No later than October 13, 2018, you must conduct the first 3 year test of your spill bucket. This test should be conducted by a person qualified to conduct spill bucket testing. If you use a double-walled spill bucket and check the interstitial space of your spill bucket for leaks during the walkthrough inspection, then this testing is not required.**
Keep These O&M Records	**UPDATED** ☐ **Keep records of your spill bucket testing for three years or keep documentation showing the spill bucket is double-walled and the integrity of both walls is periodically monitored for as long as spill bucket testing is not performed. See a sample recordkeeping form for this test on page 33.** **UPDATED** ☐ **Keep records of your periodic walkthrough inspections for one year.** **UPDATED** ☐ **Keep delivery records for one year if you conduct walkthrough inspections of your spill bucket less frequently than every 30 days.** **UPDATED** ☐ **If you store regulated substances containing greater than 10 percent ethanol or greater than 20 percent biodiesel (or any other regulated substance identified by your implementing agency), you must keep records demonstrating compatibility of all UST system components in contact with the regulated substance, including spill buckets, for as long as the UST system stores the regulated substance.**

Sample Recordkeeping Form For Liquid Tightness Tests For Spill Buckets And Containment Sumps (For Use By A Qualified Tester)

Test Date: ____/____/____ Facility Name/ID: ___________________________

Tank number					
Product stored					
Spill bucket/containment sump ID					
Spill bucket/containment sump manufacturer					
Liquid or debris removed from bucket/sump?* (circle one)	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No
Visual inspection (no cracks, loose parts, or separation) (circle one)	Pass / Fail	Pass / Fail	Pass / Fail	Pass / Fail	Pass / Fail
Starting water or vacuum level					
Test start time					
Ending water or vacuum level					
Test end time					
Test duration					
Water or vacuum level change					
Test results (circle one)**	Pass / Fail	Pass / Fail	Pass / Fail	Pass / Fail	Pass / Fail
Comments					

* All liquids and debris must be disposed of properly.
** Pass or fail criteria are based on the method used for testing. For example, EPA allows the Petroleum Equipment Institute's Recommended Practice 1200 to be used for this testing. This code of practice contains information about the pass or fail criteria.

Notes:

Testing company:__________________________

Tester's name:__________________________

Tester's signature:__________________________

Keep this record for three years.

What Are The Basics Of Overfill Protection?

Your USTs must have overfill protection installed to help prevent overfilling of tanks.

Three types of overfill protection devices are commonly used:

- Automatic shutoff devices
- Overfill alarms
- Ball float valves, also referred to as flow restrictors or float vent valves

These forms of overfill protection are discussed in detail on the following pages.

UPDATED

Note that ball float valves may not be installed or replaced for use as overfill protection after October 13, 2015.

How Can You Help The Delivery Person Avoid Overfills?

To protect your business, you must make every effort to help the delivery person avoid overfilling your UST.

- Use correct filling practices. If correct filling practices are used, you will not exceed the UST's capacity — see page 41 for a checklist of correct filling practices. Overfills can result when the delivery person makes a mistake, such as ignoring an overfill alarm.
- Use signs; alert your delivery person. The delivery person should know what type of overfill device is present on each tank at your facility and what action will occur if the overfill device is triggered — such as a visual or audible alarm or that the product flow into the tank will stop or slow significantly. Educate and alert your delivery person by placing a sign near your fill pipes, in plain view of the delivery person. See the example below.

Delivery Person – Avoid Overfills

- An overfill alarm is used for overfill protection at this facility.
- Do not tamper with this alarm or attempt to defeat its purpose.
- When the tank is 90% full, the overfill alarm whistles and a red light flashes.
- If you hear the alarm whistle or see the red light flashing, **stop the delivery immediately.**

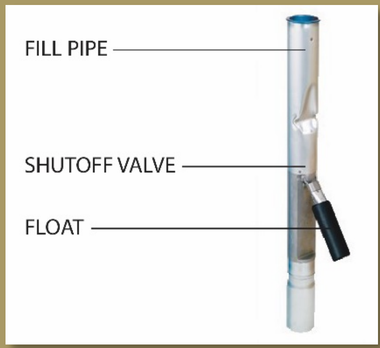
- Make sure you order the right amount of product. Order only the quantity of fuel that will fit into 90 percent of the tank. For example, if you have a 10,000 gallon tank with 2,000 gallons already in the tank, you would order at most a 7,000 gallon delivery (90 percent of 10,000 is 9,000 gallons; subtracting the 2,000 gallons already in the tank leaves a maximum delivery of 7,000 gallons). Use the formula on page 41. Calculate carefully and reduce the chance of overfills.

What Should You Do To Operate And Maintain Your Automatic Shutoff Device?

The automatic shutoff device is a mechanical device installed in line with the drop tube in the fill pipe riser. It slows down and stops delivery when product reaches a certain level in the tank. It must be positioned so that the float arm is unobstructed and can move through its full range of motion.

When installed and maintained properly, the shutoff valve will shut off the flow of fuel to the UST at 95 percent of the tank's capacity or before the fittings at the top of the tank are exposed to fuel.

The checklist on the next page provides information on properly maintaining your automatic shutoff device.



Automatic shutoff device

You should not use an automatic shutoff device for overfill protection if your UST receives pressurized deliveries.

Checklist For Automatic Shutoff Devices

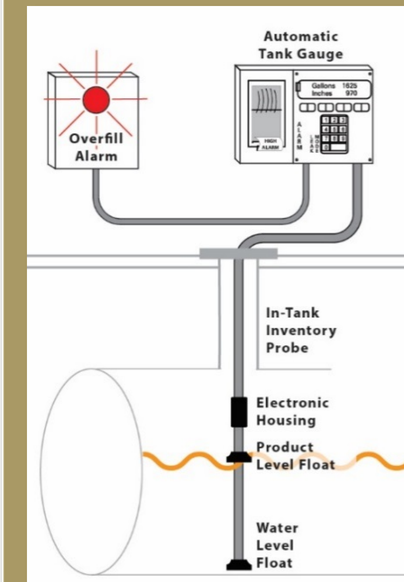
Automatic Shutoff Devices	
Description	Automatic shutoff devices are mechanical devices installed in the fill pipe riser to slow down and stop delivery when product reaches a certain level in the tank.
UPDATED **Perform These O&M Actions**	☐ **No later than October 13, 2018, you must conduct the first 3 year inspection of your overfill device. This inspection should be conducted by a person qualified to conduct overfill inspections. The purpose of the inspection is to make sure the automatic shutoff device is functioning properly and the device will shut off fuel flowing into the tank at 95 percent of the tank capacity or before the fittings at the top of the tank are exposed to fuel. See page 42 for a sample recordkeeping form for overfill equipment inspections.** o **Make sure the float operates properly.** o **Make sure there are no obstructions in the fill pipe that would keep the floating mechanism from working.** ☐ You should post signs that the delivery person can easily see and that alert the delivery person to the overfill warning devices and alarms in use at your facility.
UPDATED UPDATED **Keep These O&M Records**	☐ **You must maintain all records of the inspection for three years.** ☐ **If you store regulated substances containing greater than 10 percent ethanol or greater than 20 percent biodiesel (or any other regulated substance identified by your implementing agency), you must keep records demonstrating compatibility of all UST system components in contact with the regulated substance, including overfill prevention equipment, for as long as the UST system stores the regulated substance.**

What Should You Do To Operate And Maintain Your Electronic Overfill Alarm?

This type of overfill device activates an audible or visual warning to delivery personnel when the tank is either 90 percent full or is within one minute of being overfilled. The alarm must be located so it can be seen or heard from the UST delivery location. Once the electronic overfill alarm sounds, the delivery person has approximately one minute to stop the flow of fuel to the tank.

Electronic overfill alarm devices have no mechanism to shut off or restrict flow. Therefore, the fuel remaining in the delivery hose after the delivery has been stopped will flow into the tank as long as the tank is not yet full.

The checklist on the next page provides information on properly maintaining your overfill alarm.



Overfill alarm

Checklist For Overfill Alarms

Overfill Alarms	
Description	Overfill alarms activate an audible or visual warning to delivery personnel when the tank is either 90 percent full or is within one minute of being overfilled. Electronic overfill alarm devices have no mechanism to shut off or restrict flow.
UPDATED **Perform These O&M Actions**	☐ **No later than October 13, 2018, you must conduct the first 3 year inspection of your overfill device. This inspection should be conducted by a person qualified to conduct overfill inspections. The purpose of the inspection is to make sure the electronic overfill alarm is functioning properly and the alarm activates when the fuel reaches 90 percent of the tank capacity or is within one minute of being overfilled. See page 42 for a sample recordkeeping form for overfill equipment inspections.** o **Ensure that the alarm can be heard or seen from where the tank is fueled.** o **Make sure that the electronic device and probe are operating properly.** ☐ You should post signs that the delivery person can easily see and that alert the delivery person to the overfill warning devices and alarms in use at your facility.
UPDATED UPDATED **Keep These O&M Records**	☐ **You must maintain records of the inspection for three years.** ☐ **If you store regulated substances containing greater than 10 percent ethanol or greater than 20 percent biodiesel (or any other regulated substance identified by your implementing agency), you must keep records demonstrating compatibility of all UST system components in contact with the regulated substance, including overfill prevention equipment, for as long as the UST system stores the regulated substance.**

What Should You Do To Operate And Maintain Your Ball Float Valve?

UPDATED

Ball float valves cannot be installed or replaced for use as overfill protection after October 13, 2015. However, you may continue using ball float valves already installed as long as they operate properly.

The ball float valve — also called a flow restrictor or a float vent valve — is installed at the vent pipe in the tank and restricts vapor flow in an UST as the tank gets close to being full. The ball float valve must be set at a depth that will restrict vapor flow out of the vent line during delivery at 90 percent of the UST's capacity or 30 minutes prior to overfilling.

As the tank fills, the ball in the valve rises, restricting the flow of vapors out of the UST during delivery. The flow rate of the delivery will decrease noticeably and should alert the delivery person to stop the delivery.

For ball float valves to work properly, the top of the tank must be airtight so that vapors cannot escape from the tank. Everything from fittings to drain mechanisms on spill buckets must be tight and able to hold the pressure created when the ball float valve engages.

The checklist on the next page provides information on properly maintaining your ball float valves.

Ball float valve

You should not use a ball float value for overfill protection if your UST receives pressured deliveries or if your UST system has suction piping or single point (coaxial) stage 1 vapor recovery.

Checklist For Ball Float Valves

UPDATED

UPDATED

UPDATED

<table>
<tr><th colspan="2">Ball Float Valves</th></tr>
<tr><td>Description</td><td>Ball float valves are a type of overfill protection device that function by restricting vapor flow in an UST as the tank gets close to being full.</td></tr>
<tr><td>Perform These O&M Actions</td><td>☐ No later than October 13, 2018, you must conduct the first 3 year inspection of your overfill device. This inspection should be conducted by a person qualified to conduct overfill inspections. The purpose of the inspection is to make sure the ball float valve is functioning properly and will restrict fuel flowing into the tank at 90 percent of the tank capacity or 30 minutes prior to overfilling. See page 42 for a sample recordkeeping form for overfill equipment inspections.
o Ensure the air hole is not plugged.
o Make sure the ball cage is still intact.
o Ensure the ball still moves freely in the cage.
o Make sure the ball still seals tightly on the pipe.
☐ You should post signs that the delivery person can easily see and that alert the delivery person to the overfill warning devices and alarms in use at your facility.</td></tr>
<tr><td>Keep These O&M Records</td><td>☐ You must maintain records of the inspection for three years.
☐ If you store regulated substances containing greater than 10 percent ethanol or greater than 20 percent iodiesel (or any other regulated substance identified by your implementing agency), you must keep records demonstrating compatibility of all UST system components in contact with the regulated substance, including overfill prevention equipment, for as long as the UST system stores the regulated substance.</td></tr>
</table>

What Are Your Responsibilities For Correct Filling Practices?

As an owner or operator, you are responsible for ensuring that releases due to spilling or overfilling do not occur during fuel delivery. As part of this responsibility, you must:

- Ensure the amount of fuel to be delivered will fit into the available empty space in the tank; and
- Ensure the transfer operation is monitored constantly to prevent overfilling and spilling.

Correct Filling Practices Checklist	
What To Do Before Your USTs Are Filled	☐ Post clear signs that alert the delivery person to the overfill devices and alarms in use at your facility. ☐ Make and record accurate readings for product and water in the tank before fuel delivery. ☐ Order only the quantity of fuel that will fit into 90 percent of the tank. ☐ Remember, the formula for determining the maximum amount of gasoline to order is: (Tank capacity in gallons X 90%) – Product currently in tank = Maximum amount of fuel to order o Example: (10,000 gal X 0.9) – 2,000 gal = 7,000 gal maximum amount to order ☐ Ensure the delivery person knows the type of overfill device present at the tank and what actions to perform if it activates. ☐ Review and understand the spill response procedures. ☐ Verify that your spill bucket is empty, clean, and will contain spills.
What To Do While Your USTs Are Being Filled	☐ Keep fill ports locked until the delivery person requests access. ☐ Keep an accurate tank capacity chart available for the delivery person. ☐ The delivery person makes all hook-ups. ☐ The person responsible for monitoring the delivery should remain attentive and observe the entire fuel delivery; be prepared to stop the flow of fuel from the truck to the UST at any time; and respond to any unusual condition, leak, or spill that may occur during delivery. ☐ Keep response supplies readily available for use in case a spill or overfill occurs; see section 3. ☐ Provide safety barriers around the fueling zone. ☐ Make sure there is adequate lighting around the fueling zone.
What To Do After Your USTs Are Filled	☐ Following complete delivery, the delivery person is responsible for disconnecting all hook-ups. ☐ Return spill response kit and safety barriers to proper storage locations. ☐ Make and record accurate readings for product and water in the tank after fuel delivery.* ☐ Verify the amount of fuel received. ☐ Make sure fill ports are properly secured. ☐ Ensure the spill bucket is free of product and clean up any small spills.

*Note: The presence of water in your tank is an unusual operating condition. You should remove the water as soon as possible because it can cause problems such as corrosion and degrading fuel quality.

Sample Recordkeeping Form For Overfill Equipment Inspections (For Use By A Qualified Inspector)

Inspection Date: ____/____/____
Facility Name/ID: ___________________________________

Tank number					
Product stored					
Overfill equipment manufacturer					
Type (circle one)	Automatic shutoff device Ball float valve Overfill alarm	Automatic shutoff device Ball float valve Overfill alarm	Automatic shutoff device Ball float valve Overfill alarm	Automatic shutoff device Ball float valve Overfill alarm	Automatic shutoff device Ball float valve Overfill alarm
Automatic Shutoff Device Inspection					
Drop tube removed from tank?	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No
Drop tube and float mechanisms are free of debris?	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No
Float moves freely without binding and poppet moves into flow path?	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No
Bypass valve in the drop tube (if present) is open and free of blockage?	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No
Flapper is adjusted to shut off flow at 95% capacity?	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No
Overfill Alarm Inspection					
Electronic device and probe are operating properly?	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No
Alarm activates at 90% capacity or within one minute of overfill?	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No
Alarm can be heard or seen from where the tank is fueled?	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No
Ball Float Valve Inspection					
Tank top fittings are vapor-tight and leak-free?	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No
Ball float cage free of debris?	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No
Ball is free of holes and cracks and moves freely in cage?	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No
Vent hole in pipe is open and near top of tank?	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No
Ball float pipe is proper length to restrict flow at 90% capacity?	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No
Inspection Results (Circle One) (No to any question indicates a test failure.)	**Pass / Fail**	**Pass / Fail**	**Pass / Fail**	**Pass / Fail**	**Pass / Fail**
Comments					

Inspecting company: __________________ Inspector's signature: ____________________
Inspector's name: _____________________

Keep this record for three years.

Section 5: Corrosion Protection

To prevent leaks, all parts of your UST system that are in contact with the ground and routinely contain product must be protected from corrosion. The UST system includes the tank, piping, and ancillary equipment, such as flexible connectors, fittings, and pumps. Unprotected metal UST components can deteriorate and leak when underground electrical currents act upon them.

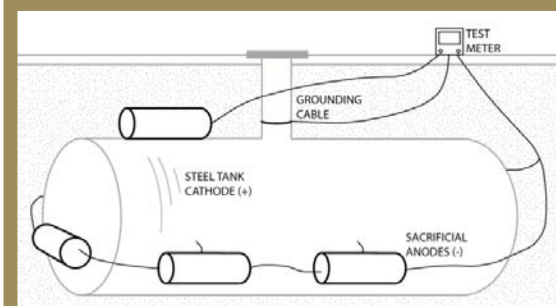
One way to protect UST components from corrosion is to make them with nonmetallic, noncorrodible materials, such as USTs made of or clad or jacketed with fiberglass reinforced plastic or other noncorrodible materials. Noncorrodible USTs like these do not require O&M for corrosion protection.

UST components made from metal that are not clad or jacketed with a noncorrodible material, and that routinely contain product and are in direct contact with the ground, must have corrosion protection, typically cathodic protection. In some cases, the interior of the tank may be lined. These options require O&M.

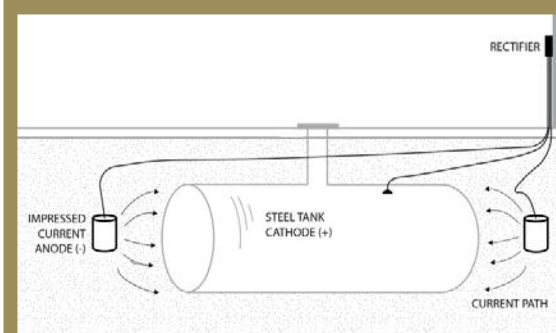
Cathodic protection using sacrificial anode systems – sacrificial anodes are buried and attached to UST components for corrosion protection by an anode attached to a tank. Anodes are pieces of metal that are more electrically active than steel, and thus they suffer the destructive effects of corrosion rather than the steel they are attached to.

Cathodic protection using impressed current systems – an impressed current system uses a rectifier to provide direct current through anodes to the tank or piping to achieve corrosion protection. The steel is protected because the current going to the steel overcomes the corrosion-causing current flowing away from it. The cathodic protection rectifier must always be

Corrosion results when bare metal and soil and moisture conditions combine to produce an underground electric current that destroys hard metal. Over time, unprotected USTs can corrode and leak.



Sacrificial anode system



Impressed current system

on and operating to protect your UST system from corrosion.

Corrosion protection using internal lining of the tank – this corrosion protection option applies only to tanks installed before December 22, 1988. These older tanks were internally lined by trained professionals to meet the corrosion protection requirements. Note that internal lining may still be used in tanks for purposes other than corrosion protection.

In addition to tanks and piping, all other metal components in direct contact with the ground that routinely hold product — such as flexible connectors, swing joints, fittings, and pumps — must also be protected from corrosion.

UPDATED

In the 2015 federal UST regulation, EPA revised the internal lining requirement. **Owners and operators must permanently close tanks using internal lining as the sole method of corrosion protection, if the internal lining fails the periodic inspection and cannot be repaired according to a code of practice.**

The table below contains your corrosion protection options.

UPDATED

Corrosion Protection Option	Description
Noncorrodible Material	The tank or piping is constructed of noncorrodible material.
Steel Tank Clad Or Jacketed With A Noncorrodible Material	Examples of cladding or jacket material include fiberglass and urethane. Does not apply to piping.
Coated And Cathodically Protected Steel Tanks Or Piping	Steel tank and piping are well coated with a dielectric material and cathodically protected. Cathodic protection may be provided by sacrificial anodes or impressed current.
Cathodically Protected Noncoated Steel Tanks Or Piping	This option is only for steel tanks and piping installed before December 22, 1988. Cathodic protection is usually provided by an impressed current system.
Internal Lining Of Tanks	In the 2015 federal UST regulation, EPA revised the internal lining requirement; **owners and operators must permanently close tanks using internal lining as the sole method of corrosion protection, if the internal lining fails the periodic inspection and cannot be repaired according to a code of practice.** This option only pertained to steel tanks installed before December 22, 1988. A lining is applied to the inside of the tank. Does not apply to piping.
Combination Of Cathodically Protected Steel And Internal Lining Of Tanks	This option is only for steel tanks installed before December 22, 1988. Cathodic protection is usually provided by an impressed current system. Does not apply to piping.
Other Methods Used To Achieve Corrosion Protection	If you have tanks or piping that do not meet any of the descriptions above, check with your implementing agency to see if your UST system meets the requirements for corrosion protection. You also will need to ask about the operation, maintenance, and recordkeeping requirements applicable to this type of UST system.

Checklist For Corrosion Protection Systems Using Sacrificial Anodes Or Impressed Current

<table>
<tr><th colspan="2">Corrosion Protection (Sacrificial Anode And Impressed Current Systems)</th></tr>
<tr><td>Description</td><td>Cathodic protection is one way to protect UST components from corrosion. Sacrificial anode systems have buried anodes attached to UST components; the anodes are more electrically active than steel, so they suffer the destructive effects of corrosion rather than the steel they are attached to.

Impressed current systems use a rectifier to provide direct current through anodes to the tank or piping to achieve corrosion protection. The steel is protected because the current going to the steel overcomes the corrosion-causing current flowing away from it.

Impressed current systems must also meet the additional requirements in the checklist on the following page.</td></tr>
<tr><td>Perform These O&M Actions</td><td>☐ You must have a periodic test conducted by a qualified cathodic protection tester to make sure your cathodic protection system is adequately protecting your UST system. This test needs to be conducted:
o Within six months of installation.
o At least every three years after the previous test.
o Within six months after any repairs to your UST system:
▪ Make sure the cathodic protection tester is qualified to perform the test and follows a standard code of practice to determine that test criteria are adequate.
▪ If any test indicates your tanks are not adequately protected, you must have a corrosion expert examine and fix your system.
▪ Testing more frequently can catch problems before they become big problems.</td></tr>
<tr><td>Keep These O&M Records</td><td>☐ You must keep the results of at least the last two tests. See pages 48-49 for a sample record for periodic testing of cathodic protection systems.</td></tr>
</table>

Checklist With Additional Requirements For Impressed Current Systems

<table>
<tr><th colspan="2">Corrosion Protection (Additional Requirements For Impressed Current Systems)</th></tr>
<tr><td>Description</td><td>Impressed current systems use a rectifier to provide direct current through anodes to the tank or piping to achieve corrosion protection. The steel is protected because the current going to the steel overcomes the corrosion-causing current flowing away from it.

Impressed current systems must also meet the requirements in the checklist on the previous page.</td></tr>
<tr><td>Perform These O&M Actions</td><td>☐ You must inspect your rectifier at least every 60 days to make sure that it is operating within normal limits.
o This inspection involves reading and recording the voltage and amperage readouts on the rectifier. You or your employees can perform this periodic inspection.
o Make sure your corrosion expert provided you with the rectifier's acceptable operating levels so you can compare the readings you take with an acceptable operating level. If your readings are not within acceptable levels, you must contact a corrosion expert to address the problem.
☐ You should have a trained professional periodically service your impressed current system.
☐ Never turn off your rectifier. If your rectifier is off, your UST system is not protected from corrosion.</td></tr>
<tr><td>Keep These O&M Records</td><td>☐ You must keep records of at least the last three rectifier readings. See page 50 for a sample 60-day impressed current cathodic protection system inspections form.</td></tr>
</table>

UPDATED

Checklist For Internally Lined Tanks

Corrosion Protection (Internally Lined Tanks)	
Description	Tanks installed before December 22, 1988, were internally lined by trained professionals to meet the corrosion protection requirements.
Perform These O&M Actions	☐ Within 10 years after lining and at least every five years thereafter, the lined tank must be inspected by a trained professional and found to be structurally sound with the lining still performing according to original design specifications. Make sure the professional performing the inspection follows a standard code of practice. ☐ **You must permanently close tanks using internal lining as the sole method of corrosion protection, if the internal lining fails the periodic inspection and cannot be repaired according to a code of practice.**
Keep These O&M Records	☐ Keep records of the inspection, as specified in industry standards for lining inspections.

Sample Record For Periodic Testing Of Cathodic Protection Systems
(For Use By A Qualified Cathodic Protection Tester)

Test Date:____/____/____   Facility Name/ID:_________________________

Note: Draw site sketch in the space provided on the next page.

Cathodic Protection (CP) Tester Information:
Name: ________________________________   Phone Number:______________________
Address: ____
A qualified CP tester must conduct testing. Indicate your qualifications as a CP tester:

____

____

Identify which of the following testing situations applies:

- ☐ Test required within six months of installation of CP system (installation date: __/__/__)
- ☐ Periodic three year test
- ☐ Test required within six months of any repair activity – note repair activity and date below:
  repair activity: ____repair date: __/__/__

Indicate which industry standard you used to determine that the cathodic protection test criteria are adequate:

____

Cathodic Protection Test Method Used (check one)

- ☐ 100 mV cathodic polarization test
- ☐ 850 mV test (circle one below)
  - Polarized potential (instant off)
  - Potential with CP applied, IR drop considered

  Note: All readings taken must meet the -850 mV criteria to pass
- ☐ Other accepted method (please describe):

Is the cathodic protection system working properly?   Yes   No   (circle one)

If answer is no, go to the directions at the bottom of the next page.

My signature below affirms that I have sufficient education and experience to be a cathodic protection tester; I am competent to perform the tests indicated above; and that the results on this form are a complete and truthful record of all testing at this location on the date shown.

CP Tester Signature: _______________________________   Date:_____________

Keep this record for at least six years.

Site Sketch: Draw a rough sketch of the tanks and piping, the location of each CP test, and each voltage value obtained (use space below or attach separate drawing). Voltage readings through concrete or asphalt do not provide accurate readings and are not acceptable. Perform sufficient testing to evaluate the entire UST system.

If the CP system fails the test and is not working properly, you must have a corrosion expert investigate and fix the problem. A corrosion expert has additional training, skills, and certification beyond the corrosion tester who filled out the bulk of this form. A corrosion expert must be:

- Accredited or certified by NACE International-The Corrosion Society as a corrosion specialist or cathodic protection specialist, or
- A registered professional engineer with certification or licensing in corrosion control.

As long as you have the UST, be sure you keep a record that clearly documents what the corrosion expert did to fix your CP system.

Keep this record for at least six years.

Sample Form For 60-Day Impressed Current Cathodic Protection System Inspections

Facility Name: ____

Amp Range Recommended: ____

Voltage Range Recommended: ____

Date	Name Of Person Conducting Inspection	Voltage Reading	Amp Reading	Is The System Running Properly? (Yes/No)

- **If the rectifier voltage or amperage outputs are outside the recommended operating levels, contact a cathodic protection expert to address the problem.**
- **Never turn off your rectifier.**

Keep this record for at least six months after the date of the last inspection.

What If You Combine Internal Lining And Cathodic Protection?

If you chose the combination of internal lining and cathodic protection for meeting corrosion protection requirements on your UST, you may not have to meet the periodic inspection requirement for the lined tank. However, you must always meet the requirements for checking and testing your cathodic protection system as described in the checklists on pages 45-46. The 10-year and subsequent five-year inspections of the lined tank are not required if the integrity of the tank was ensured when cathodic protection was added. You should be able to show an inspector documentation of the passed integrity assessment.

Example 1:
If cathodic protection and internal lining were applied to your tank at the same time, periodic inspections of the lined tank are not required because an integrity assessment of the tank is required prior to adding the cathodic protection and internal lining.

Example 2:
If cathodic protection was added to a tank in 1997 that was internally lined in 1994 and the contractor did not perform an integrity assessment of the tank at the time cathodic protection was added or you cannot show an inspector documentation of the passed integrity assessment, then periodic inspections of the lined tank are required. This is required because you cannot prove that the tank was structurally sound and free of corrosion holes when the cathodic protection was added. The lined tank needs to be periodically inspected because the lining may be the only barrier between your product and the surrounding environment.

Do All UST Sites Need Corrosion Protection?

A corrosion expert may be able to determine the soil at an UST site is not conducive to corrosion and will not cause the tank or piping to leak during its operating life. If so, you must keep a record of that corrosion expert's analysis for the life of the tank or piping to demonstrate why your UST has no corrosion protection.

Section 6:
Walkthrough Inspections

UPDATED

No later than October 13, 2018, you must conduct your first walkthrough inspection. Below we provide details and frequency of the inspection.

Every 30 days

- **Check your spill prevention equipment for damage and remove liquid or debris.**
- **Check for and remove obstructions in the fill pipe.**
- **Check the fill cap to ensure it is securely on the fill pipe.**
- **For double-walled spill prevention equipment with interstitial monitoring, check for a leak in the interstitial area.**

Exception: if your UST system receives deliveries at intervals greater than 30 days, you may check your spill prevention equipment prior to each delivery.

- **Check your release detection equipment to ensure it is operating with no alarms or unusual operating conditions present (for example ATG consoles or pressure or vacuum gauges). You do not have to check release detection equipment in containment sumps. Release detection equipment in these areas is tested annually.**
- **Review your release detection records and ensure they are current.**

Annually

- **Check your containment sumps for damage and leaks to the containment area or releases to the environment.**
- **Remove liquid in contained sumps or debris.**
- **For double-walled containment sumps with interstitial monitoring, check for leaks in the interstitial area.**

Inspecting a containment sump

- **Check your hand-held release detection equipment, such as groundwater bailers and tank gauge sticks, for operability and serviceability.**

In addition, the 2015 federal UST regulation allows owners and operators to conduct O&M walkthrough inspections according to a standard code of practice developed by a nationally recognized association or independent testing laboratory or according to requirements developed by your implementing agency. The inspections must check equipment in a manner comparable to the walkthrough inspection requirements described above. Note that owners and operators must use the entire code of practice if choosing this option for meeting the walkthrough inspection requirement.

In addition to the requirements listed above, you may also want to perform these good site management practices during your walkthrough inspections:

- Fill and monitoring ports: Are covers and caps tightly sealed and locked?
- Spill and overfill response supplies: Do you have the appropriate supplies for cleaning up a spill or overfill?
- Containment areas: Is there significant corrosion on the UST equipment in these areas? Corrosion could result in equipment in the containment area not working properly.
- Dispenser hoses, nozzles, and breakaways: Are they in good condition and working properly?

If you find problems during the inspection, you or your UST contractor must take action quickly to resolve these problems and avoid serious releases.

See the sample walkthrough inspection checklist on the next page.

Sample Walkthrough Inspection Checklist

Date Of Inspection							
Required Every 30 Days (exception: if your UST system receives deliveries at intervals greater than 30 days, you may check your spill prevention equipment prior to each delivery.							
Visually check spill prevention equipment for damage. Remove liquid or debris.							
Check for and remove obstructions in fill pipe.							
Check fill cap to ensure it is securely on fill pipe.							
For double-walled spill prevention equipment with interstitial monitoring, check for a leak in the interstitial area.							
Check release detection equipment to ensure it is operating with no alarms or unusual operating conditions present.							
Review and keep current release detection records.							
Required Annually							
Visually check containment sumps for damage and leaks to the containment area or releases to the environment.							
Remove liquid in contained sumps or debris.							
For double-walled containment sumps with interstitial monitoring, check for leaks in the interstitial area.							
Check hand-held release detection equipment, such as groundwater bailers and tank gauge sticks, for operability and serviceability.							
Recommended Activities							
Fill and monitoring ports: Inspect all fill or monitoring ports and other access points to make sure that the covers and caps are tightly sealed and locked.							
Spill and overfill response supplies: Inventory and inspect the emergency spill response supplies. If the supplies are low, restock the supplies. Inspect supplies for deterioration and improper functioning.							
Containment sump areas: Look for significant corrosion on the UST equipment.							
Dispenser hoses, nozzles, and breakaways: Inspect for loose fittings, deterioration, obvious signs of leaks, and improper functioning.							

Your initials in each box below the date of the inspection indicate the device or system was inspected and satisfactory on that date.

In the following table, explain actions taken to fix issues.

Date	Action Taken

Keep this record for at least one year after last inspection date on the form.

Section 7: For More Information

Government Links

- U.S. Environmental Protection Agency's Office of Underground Storage Tanks: www.epa.gov/ust. EPA's UST compliance assistance: www.epa.gov/ust/resources-owners-and-operators
- State UST program contact information: www.epa.gov/ust/underground-storage-tank-ust-contacts#states
- Tanks Subcommittee of the Association of State and Territorial Solid Waste Management Officials (ASTSWMO): www.astswmo.org
- New England Interstate Water Pollution Control Commission (NEIWPCC): www.neiwpcc.org

Industry Codes And Standards

www.epa.gov/ust/underground-storage-tanks-usts-laws-regulations#code

Other Organizations To Contact For UST Information

www.epa.gov/ust/underground-storage-tank-ust-contacts#other

United States Environmental Protection Agency
5401R
Washington, DC 20460

EPA 510-K-16-001
February 2016

APPENDIX 7- GEOTECHNICAL REPORT

GEOTECHNICAL INVESTIGATION

PROPOSED VICTORVILLE RETAIL SHOPPING CENTER
SWC PALMDALE ROAD AND HIGHWAY 395
VICTORVILLE, CALIFORNIA

GEOCON
WEST, INC.

GEOTECHNICAL
ENVIRONMENTAL
MATERIALS

PREPARED FOR

BROADWAY CHINATOWN, LLC
LOS ANGLES, CALIFORNIA

PROJECT NO. A9817-06-01

AUGUST 15, 2018

GEOCON
WEST, INC.
GEOTECHNICAL ■ ENVIRONMENTAL ■ MATERIALS

Project No. A9817-06-01
August 15, 2018

Broadway Chinatown, LLC.
P.O. Box 151813
Los Angeles, California 90015

Attn: David Kim, Fraydeon Bral

Subject: GEOTECHNICAL INVESTIGATION
PROPOSED VICTORVILLE RETAIL SHOPPING CENTER
SWC PALMDALE ROAD AND HIGHWAY 395
VICTORVILLE, CALIFORNIA

Dear Sirs:

In accordance with your authorization of our proposal dated May 8, 2018, we have performed a geotechnical investigation for the proposed retail shopping center located at the southwest corner of the intersection of Palmdale Road and US Highway 395 the City of Victorville, California. The accompanying report presents the findings of our study, and our conclusions and recommendations pertaining to the geotechnical aspects of proposed design and construction. Based on the results of our investigation, it is our opinion that the site can be developed as proposed, provided the recommendations of this report are followed and implemented during design and construction.

If you have any questions regarding this report, or if we may be of further service, please contact the undersigned.

Very truly yours,

GEOCON WEST, INC.

PROFESSIONAL GEOLOGIST MICHAEL DAVID STRANE No. 9160 STATE OF CALIFORNIA

REGISTERED PROFESSIONAL ENGINEER H. HARRY DERKALOUSDIAN C79694 CIVIL STATE OF CALIFORNIA

PROFESSIONAL GEOLOGIST GERALD KASMAN NO. 2251 CERTIFIED ENGINEERING GEOLOGIST STATE OF CALIFORNIA

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PG 9160	PE 79694	CEG 2251

(EMAIL) Addressee

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GEOTECHNICAL INVESTIGATION

1. PURPOSE AND SCOPE

This report presents the results of a geotechnical investigation for the proposed shopping center located at southwest corner of the intersection of Palmdale Road and US Highway 395 in the City of Victorville, California (see Vicinity Map, Figure 1). The purpose of the investigation was to evaluate subsurface soil and geologic conditions underlying the site and, based on conditions encountered, to provide conclusions and recommendations pertaining to the geotechnical aspects of design and construction.

The scope of this investigation included a site reconnaissance, field exploration, laboratory testing, engineering analysis, and the preparation of this report. The site was explored on July 6, 2018, by excavating twelve 8-inch diameter borings to depths between 5 and 40½ feet below the existing ground surface utilizing a truck-mounted hollow stem auger drilling machine. The approximate locations of the exploratory borings are depicted on the Site Plan (see Figure 2). A detailed discussion of the field investigation, including boring logs, is presented in Appendix A.

Laboratory tests were performed on selected soil samples obtained during the investigation to determine pertinent physical and chemical soil properties. Appendix B presents a summary of the laboratory test results.

The recommendations presented herein are based on analysis of the data obtained during the investigation and our experience with similar soil and geologic conditions. References reviewed to prepare this report are provided in the *List of References* section.

If project details vary significantly from those described herein, Geocon should be contacted to determine the necessity for review and possible revision of this report.

2. SITE AND PROJECT DESCRIPTION

The subject site is located at the southwest corner of the intersection of Palmdale Road and US Highway 395 in the City of Victorville, California. The site is currently vacant land. The site is bounded by an existing Burger King restaurant in the northeast corner of the parcel (not a part of this study), by Palmdale Road to the north, by US Highway 395 to the east, by vacant land to the west, and by vacant land and an RV restoration business to the south. In addition, a residential development lies south and southwest of the development. The site is relatively level with no pronounced highs or lows. Surface water drainage at the site appears to be by drainage channels running across the site. Vegetation onsite consists of native grasses and bushes scattered throughout the site.

It is our understanding that the proposed project consists of nine one-story commercial/retail structures constructed at or near present grade, and associated parking lots.

Based on the preliminary nature of the design at this time, wall and column loads were not available. It is anticipated that column loads for the proposed structure will be up to 200 kips, and wall loads will be up to 2 kips per linear foot.

Once the design phase and foundation loading configuration proceeds to a more finalized plan, the recommendations within this report should be reviewed and revised, if necessary. Any changes in the design, location or elevation of any structure, as outlined in this report, should be reviewed by this office. Geocon should be contacted to determine the necessity for review and possible revision of this report.

3. GEOLOGIC SETTING

The site is located within the central portion of the Mojave Desert. The Mojave Desert is bounded by the Owens Valley to the north, the Tehachapi Mountains and the San Gabriel mountains to the west, the Basin and Range Province to the east, and San Bernardino Mountains to the south. Regionally, the site is located within the Eastern California Shear Zone geomorphic province. This geomorphic province is characterized by northwest-trending physiographic and geologic features such as the Helendale fault located approximately 16.0 miles to the northeast.

4. SOIL AND GEOLOGIC CONDITIONS

Based on our field investigation and published geologic maps of the area the site is underlain by Quaternary alluvium (Dibblee, 2008). Detailed stratigraphic profiles of the materials encountered at the site are provided on the boring logs in Appendix A.

4.1 Alluvium

Quaternary age alluvium was encountered in our field explorations to a maximum depth of 40½ feet below existing ground surface. The alluvium generally consists of light yellowish brown to brown sand and silty sand with minor amounts of sandy silt. The alluvium is characterized dry to slightly moist and medium dense to very dense or firm to hard.

5. GROUNDWATER

The site is located in the Upper Mojave River Valley groundwater basin. There are several active water wells proximal to the site. The closest of these is state well number 345075N1173990W001 located approximately 500 feet northeast of the site (California Department of Water Resources, 2018). The most recent measurement from this well was taken on March 24, 2006 with a depth to groundwater surface of 383 feet below the existing ground surface.

Groundwater was not encountered in our field explorations drilled to a maximum depth of 40½ feet below the existing ground surface. Considering the lack of groundwater in our borings, the depth of the proposed construction, and the depth to groundwater in local wells it is not anticipated that groundwater will be encountered during construction. However, it is not uncommon for groundwater levels to vary seasonally or for groundwater seepage conditions to develop where none previously existed, especially in impermeable fine-grained soils which are heavily irrigated or after seasonal rainfall. In addition, recent requirements for storm water infiltration could result in shallower seepage conditions in the immediate site vicinity. Proper surface drainage of irrigation and precipitation will be critical for future performance of the project. Recommendations for drainage are provided in the S*urface Drainage* section of this report (see Section 7.25).

6. GEOLOGIC HAZARDS

6.1 Surface Fault Rupture

The numerous faults in Southern California include active, potentially active, and inactive faults. The criteria for these major groups are based on criteria developed by the California Geological Survey (CGS, formerly known as CDMG) for the Alquist-Priolo Earthquake Fault Zone Program (CGS, 2018a). By definition, an active fault is one that has had surface displacement within Holocene time (about the last 11,700 years). A potentially active fault has demonstrated surface displacement during Quaternary time (approximately the last 1.6 million years), but has had no known Holocene movement. Faults that have not moved in the last 1.6 million years are considered inactive.

The site is not within a currently established state-designated Alquist-Priolo Earthquake Fault Zone (CGS, 2018b) for surface fault rupture hazards. No active or potentially active faults with the potential for surface fault rupture are known to pass directly beneath the site. Therefore, the potential for surface rupture due to faulting occurring beneath the site during the design life of the proposed development is considered low. However, the site is located in the seismically active Southern California region, and could be subjected to moderate to strong ground shaking in the event of an earthquake on one of the many active Southern California faults. The faults in the vicinity of the site are shown in Figure 3, Regional Fault Map.

The closest active fault to the site is the Ord Mountains Fault located approximately 13.8 miles to the southeast (Ziony and Jones, 1989). Other nearby active faults are the San Andreas Fault, the Helendale Fault, Llano Fault located approximately 15.6 miles southwest, 16.0 miles northeast, and 20.6 miles west of the site, respectively (Ziony and Jones, 1989).

Buried thrust faults, commonly referred to as blind thrusts, are not exposed at the ground surface and are typically identified at depths greater than 3.0 kilometers. The October 1, 1987 M_w 5.9 Whittier Narrows earthquake and the January 17, 1994, M_w 6.7 Northridge earthquake were a result of movement on the Puente Hills Blind Thrust and the Northridge Thrust, respectively. These thrust faults are not exposed at the surface and do not present a potential surface fault rupture hazard at the site; however, these deep thrust faults are considered active features capable of generating future earthquakes that could result in moderate to significant ground shaking at the site. The site is not underlain by any known blind thrust faults.

6.2 Seismicity

As with all of Southern California, the site has experienced historic earthquakes from various regional faults. The seismicity of the region surrounding the site was formulated based on research of an electronic database of earthquake data. The epicenters of recorded earthquakes with magnitudes equal to or greater than 5.0 in the site vicinity are depicted on Figure 4, Regional Seismicity Map. A partial list of moderate to major magnitude earthquakes that have occurred in the Southern California area within the last 100 years is included in the following table.

LIST OF HISTORIC EARTHQUAKES

Earthquake (Oldest to Youngest)	Date of Earthquake	Magnitude	Distance to Epicenter (Miles)	Direction to Epicenter
San Jacinto-Hemet area	April 21, 1918	6.8	57	SSE
Near Redlands	July 23, 1923	6.3	36	SSE
Long Beach	March 10, 1933	6.4	69	SW
Tehachapi	July 21, 1952	7.5	98	WNW
San Fernando	February 9, 1971	6.6	57	W
Whittier Narrows	October 1, 1987	5.9	49	SW
Sierra Madre	June 28, 1991	5.8	38	WSW
Landers	June 28, 1992	7.3	59	ESE
Big Bear	June 28, 1992	6.4	39	ESE
Northridge	January 17, 1994	6.7	68	WSW
Hector Mine	October 16, 1999	7.1	65	E

The site could be subjected to strong ground shaking in the event of an earthquake. However, this hazard is common in Southern California and the effects of ground shaking can be mitigated if the proposed structure is designed and constructed in conformance with current building codes and engineering practices.

6.3 Seismic Design Criteria

The following table summarizes summarizes site-specific design criteria obtained from the 2016 California Building Code (CBC; Based on the 2015 International Building Code [IBC] and ASCE 7-10), Chapter 16 Structural Design, Section 1613 Earthquake Loads. The data was calculated using the computer program *U.S. Seismic Design Maps*, provided by the USGS. The short spectral response uses a period of 0.2 second. We evaluated the Site Class based on the discussion in Section 1613.3.2 of the 2016 CBC and Table 20.3-1 of ASCE 7-10. The values presented below are for the risk-targeted maximum considered earthquake (MCE_R).

2016 CBC SEISMIC DESIGN PARAMETERS

Parameter	Value	2016 CBC Reference
Site Class	D	Section 1613.3.2
MCE_R Ground Motion Spectral Response Acceleration – Class B (short), S_S	1.500g	Figure 1613.3.1(1)
MCE_R Ground Motion Spectral Response Acceleration – Class B (1 sec), S_1	0.600g	Figure 1613.3.1(2)
Site Coefficient, F_A	1.0	Table 1613.3.3(1)
Site Coefficient, F_V	1.5	Table 1613.3.3(2)
Site Class Modified MCE_R Spectral Response Acceleration (short), S_{MS}	1.500g	Section 1613.3.3 (Eqn 16-37)
Site Class Modified MCE_R Spectral Response Acceleration – (1 sec), S_{M1}	0.900g	Section 1613.3.3 (Eqn 16-38)
5% Damped Design Spectral Response Acceleration (short), S_{DS}	1.000g	Section 1613.3.4 (Eqn 16-39)
5% Damped Design Spectral Response Acceleration (1 sec), S_{D1}	0.600g	Section 1613.3.4 (Eqn 16-40)

The table below presents the mapped maximum considered geometric mean (MCE_G) seismic design parameters for projects located in Seismic Design Categories of D through F in accordance with ASCE 7-10.

ASCE 7-10 PEAK GROUND ACCELERATION

Parameter	Value	ASCE 7-10 Reference
Mapped MCE_G Peak Ground Acceleration, PGA	0.500g	Figure 22-7
Site Coefficient, F_{PGA}	1.0	Table 11.8-1
Site Class Modified MCE_G Peak Ground Acceleration, PGA_M	0.500g	Section 11.8.3 (Eqn 11.8-1)

The Maximum Considered Earthquake Ground Motion (MCE) is the level of ground motion that has a 2 percent chance of exceedance in 50 years, with a statistical return period of 2,475 years. According to the 2016 California Building Code and ASCE 7-10, the MCE is to be utilized for the evaluation of liquefaction, lateral spreading, seismic settlements, and it is our understanding that the intent of the Building code is to maintain “Life Safety” during a MCE event. The Design Earthquake Ground Motion (DE) is the level of ground motion that has a 10 percent chance of exceedance in 50 years, with a statistical return period of 475 years.

Deaggregation of the MCE peak ground acceleration was performed using the USGS online Unified Hazard Tool, 2008 Conterminous U.S. Dynamic edition. The result of the deaggregation analysis indicates that the predominant earthquake contributing to the MCE peak ground acceleration is characterized as a 6.91 magnitude event occurring at a hypocentral distance of 19.4 kilometers from the site.

Deaggregation was also performed for the Design Earthquake (DE) peak ground acceleration, and the result of the analysis indicates that the predominant earthquake contributing to the DE peak ground acceleration is characterized as a 6.95 magnitude occurring at a hypocentral distance of 22.97 kilometers from the site.

Conformance to the criteria in the above tables for seismic design does not constitute any kind of guarantee or assurance that significant structural damage or ground failure will not occur if a large earthquake occurs. The primary goal of seismic design is to protect life, not to avoid all damage, since such design may be economically prohibitive.

6.4 Liquefaction Potential

Liquefaction is a phenomenon in which loose, saturated, relatively cohesionless soil deposits lose shear strength during strong ground motions. Primary factors controlling liquefaction include intensity and duration of ground motion, gradation characteristics of the subsurface soils, in-situ stress conditions, and the depth to groundwater. Liquefaction is typified by a loss of shear strength in the liquefied layers due to rapid increases in pore water pressure generated by earthquake accelerations.

The current standard of practice, as outlined in the “Recommended Procedures for Implementation of DMG Special Publication 117, Guidelines for Analyzing and Mitigating Liquefaction in California” and “Special Publication 117A, Guidelines for Evaluating and Mitigating Seismic Hazards in California” requires liquefaction analysis to a depth of 50 feet below the lowest portion of the proposed structure. Liquefaction typically occurs in areas where the soils below the water table are composed of poorly consolidated, fine to medium-grained, primarily sandy soil. In addition to the requisite soil conditions, the ground acceleration and duration of the earthquake must also be of a sufficient level to induce liquefaction.

The Geologic Hazard Map for San Bernardino County (SBC, 2010) indicates that the site is not located within an area designated as having a potential for liquefaction. The site is underlain by dense Quaternary age alluvial deposits that are not prone to liquefaction. Additionally, the depth to groundwater is deeper than 50 feet beneath the existing ground surface. Based on these considerations, it is our opinion that the potential for liquefaction and associated ground deformations beneath the site is very low.

6.5 Slope Stability

The topography at the site is level. Additionally, the site is not located within an area identified as having a potential for seismic slope instability (SBC, 2010). There are no known landslides near the site, nor is the site in the path of any known or potential landslides. Therefore, the potential for slope stability hazards to adversely affect the proposed development is considered low.

6.6 Earthquake-Induced Flooding

Earthquake-induced flooding is inundation caused by failure of dams or other water-retaining structures due to earthquakes. The site is not located within a potential inundation area for any known earthquake-induced dam failure. Therefore, the probability of earthquake-induced flooding is considered very low.

6.7 Tsunamis, Seiches, and Flooding

The site is not located within a coastal area. Therefore, tsunamis are not considered a significant hazard at the site.

Seiches are large waves generated in enclosed bodies of water in response to ground shaking. No major water-retaining structures are located immediately up gradient from the project site. Therefore, flooding resulting from a seismically-induced seiche is considered unlikely.

The site is within an area of minimal flooding (Zone X) as defined by the Federal Emergency Management Agency (FEMA, 2018).

6.8 Oil Fields & Methane Potential

Based on a review of the California Division of Oil, Gas and Geothermal Resources (DOGGR) Well Finder website, the site is not located within any known oil field, nor is there any known oil wells within the vicinity of the site (DOGGR, 2018). Due to the voluntary nature of record reporting by the oil well drilling companies, wells may be improperly located or not shown on the DOGGR location map and undocumented wells could be encountered during construction. Any wells encountered during construction will need to be properly abandoned in accordance with the current requirements of the DOGGR.

As previously indicated, the site is not located within an oilfield. Therefore, the potential for methane or other volatile gases at the site is considered very low. However, should it be determined that a methane study is required for the proposed development it is recommended that a qualified methane consultant be retained to perform the study and provide mitigation measures as necessary.

6.9 Subsidence

Subsidence occurs when a large portion of land is displaced vertically, usually due to the withdrawal of groundwater, oil, or natural gas. Soils that are particularly subject to subsidence include those with high silt or clay content. No large-scale extraction of groundwater, gas, oil, or geothermal energy is occurring or planned at the site or in the general site vicinity. Therefore, the potential for ground subsidence due to withdrawal of fluids or gases at the site is considered low.

CONCLUSIONS AND RECOMMENDATIONS

6.10 General

6.10.1 It is our opinion that neither soil nor geologic conditions were encountered during the investigation that would preclude construction of the proposed project provided the recommendations presented herein are followed and implemented during design and construction.

6.10.2 No existing artificial fill was encountered during site exploration. Future demolition of the existing structure that occupies the site will likely disturb the upper soils. Artificial fill may exist in other areas of the site that were not directly explored. If encountered, existing fill materials is not considered suitable for support of proposed building foundations or floor slabs.

6.10.3 The results of our laboratory testing indicate that the existing alluvial soils are subject to hydro-consolidation upon saturation (see Figures B3 through B5). Hydro-consolidation is the tendency of a soil structure to collapse upon saturation, resulting in the overall settlement of the effected soils and any overlying soils or foundations supported therein.

6.10.4 It is our opinion that the upper alluvial soils, in its present condition, is not suitable for direct support of proposed foundations, slabs, or additional fill. The site soils are suitable for re-use as engineered fill provided the recommendations in the *Grading* section of this report are followed (see Section 7.5).

6.10.5 Based on these considerations, it is recommended that the upper 5 feet of existing earth materials within the building footprint areas be excavated and properly compacted for foundation and slab support. Deeper excavations should be conducted as needed to remove any encountered fill or soft soils as necessary at the direction of the Geotechnical Engineer (a representative of Geocon). The excavation should extend laterally a minimum distance of 3 feet beyond the building footprint areas, including building appurtenances, or a distance equal to the depth of fill below the foundation, whichever is greater. The limits of existing fill and/or soft soil removal will be verified by the Geocon representative during site grading activities. Recommendations for earthwork are provided in the *Grading* section of this report (see Section 7.4).

6.10.6 Subsequent to the recommended grading, the proposed structure may be supported on a conventional shallow spread foundation system deriving support in newly placed engineered fill.

6.10.7 All excavations must be observed and approved in writing by the Geotechnical Engineer (a representative of Geocon). Prior to placing any fill, the excavation bottom must be proof-rolled with heavy equipment in the presence of the Geotechnical Engineer (a representative of Geocon West, Inc.).

6.10.8 It is anticipated that stable excavations for the recommended grading associated with the proposed structures can be achieved with sloping measures. However, if excavations in close proximity to an adjacent property line and/or structure are required, special excavation measures may be necessary in order to maintain lateral support of offsite improvements. Excavation recommendations are provided in the *Temporary Excavations* section of this report (Section 7.18).

6.10.9 Due to the granular nature of the soils and potential for caving, the contractor should be prepared to form foundation excavations into granular alluvial soils, if necessary.

6.10.10 Foundations for small outlying structures, such as block walls up to 6 feet in height, planter walls or trash enclosures, which will not be tied to the proposed structure, may be supported on conventional foundations deriving support on a minimum of 12 inches of newly placed engineered fill which extends laterally at least 12 inches beyond the foundation area. Where excavation and compaction cannot be performed or is undesirable, foundations may derive support directly in the competent undisturbed alluvial soils at or below a depth of 12 inches, and should be deepened as necessary to maintain a minimum 12-inch embedment into the recommended bearing materials. If the soils exposed in the excavation bottom are soft or loose, compaction of the soils will be required prior to placing steel or concrete. Compaction of the foundation excavation bottom is typically accomplished with a compaction wheel or mechanical whacker and must be observed and approved by a Geocon representative.

6.10.11 Where new paving is to be placed, it is recommended that all existing fill and soft alluvial soils be excavated and properly compacted for paving support. The client should be aware that excavation and compaction of all existing fill and soft alluvial soils in the area of new paving is not required; however, paving constructed over existing uncertified fill or unsuitable alluvial soil may experience increased settlement and/or cracking, and may therefore have a shorter design life and increased maintenance costs. As a minimum, the upper 12 inches of subgrade soil should be scarified and properly compacted for paving support. Paving recommendations are provided in *Preliminary Pavement Recommendations* section of this report (see Section 7.12).

6.10.12 Based on the results of percolation testing performed at the site, a stormwater infiltration system is considered feasible for this project. Recommendations for infiltration are provided in the *Stormwater Infiltration* section of this report (see Section 7.17).

6.10.13 Once the design and foundation loading configuration for the proposed structure proceeds to a more finalized plan, the recommendations within this report should be reviewed and revised, if necessary. Based on the final foundation loading configurations, the potential for settlement should be re-evaluated by this office.

6.10.14 Any changes in the design, location or elevation, as outlined in this report, should be reviewed by this office. Geocon should be contacted to determine the necessity for review and possible revision of this report.

6.11 Soil and Excavation Characteristics

6.11.1 The in-situ soils can be excavated with moderate effort using conventional excavation equipment. Some caving should be anticipated in unshored excavations, especially where granular soils are encountered. In addition, the contractor should also be aware that formwork may be required to prevent caving of shallow spread foundation excavations.

6.11.2 It is the responsibility of the contractor to ensure that all excavations and trenches are properly sloped, shored and maintained in accordance with applicable OSHA rules and regulations to maintain safety and maintain the stability of adjacent existing improvements.

6.11.3 All onsite excavations must be conducted in such a manner that potential surcharges from existing structures, construction equipment, and vehicle loads are resisted. The surcharge area may be defined by a 1:1 projection down and away from the bottom of an existing foundation or vehicle load. Penetrations below this 1:1 projection will require special excavation measures such as sloping and possibly shoring. Excavation recommendations are provided in the *Temporary Excavations* section of this report (see Section 7.18).

6.11.4 The soils encountered at proposed foundation elevations during the investigation are considered to have a "very low" (EI=0) expansive potential and are classified as "non-expansive, based on the 2016 California Building Code (CBC) Section 1802.35.3. The recommendations presented in this report assume that foundations and slabs will derive support in these materials. and slabs will derive support in these materials.

6.12 Minimum Resistivity, pH and Water-Soluble Sulfate

6.12.1 Potential of Hydrogen (pH) and resistivity testing, as well as chloride content testing, were performed on representative samples of on-site soil to generally evaluate the corrosion potential to surface utilities. The tests were performed in accordance with California Test Method Nos. 643 and 422 and indicate that the soils are considered "mildly corrosive" with respect to corrosion of buried ferrous metals on site. The results are presented in Appendix B (Figure B6) and should be considered for design of underground structures.

6.12.2 Laboratory tests were previously performed on representative samples of the site materials to measure the percentage of water-soluble sulfate content. Results from the laboratory water-soluble sulfate tests are presented in Appendix B (Figure B9) and indicate that the on-site materials possess "negligible" sulfate exposure to concrete structures as defined by 2016 CBC Section 1904.3 and ACI 318-08 Sections 4.2 and 4.3.

6.12.3 Geocon West, Inc. does not practice in the field of corrosion engineering and mitigation. If corrosion sensitive improvements are planned, it is recommended that a corrosion engineer be retained to evaluate corrosion test results and incorporate the necessary precautions to avoid premature corrosion of buried metal pipes and concrete structures in direct contact with the soils.

6.13 Grading

6.13.1 Grading is anticipated to include preparation of building pads, excavation of site soils for proposed foundations, utility trenches, and placement of backfill for walls and trenches.

6.13.2 Earthwork should be observed, and compacted fill tested by representatives of Geocon West, Inc. The existing fill encountered during exploration is suitable for re-use as an engineered fill, provided any encountered oversize material (greater than 6 inches) and any encountered deleterious debris is removed.

6.13.3 A preconstruction conference should be held at the site prior to the beginning of grading operations with the owner, contractor, civil engineer, geotechnical engineer, and, if applicable, building official in attendance. Special soil handling requirements can be discussed at that time.

6.13.4 Grading should commence with the removal of all existing vegetation and existing improvements from the area to be graded. Deleterious debris such as wood and root structures should be exported from the site and should not be mixed with the fill soils. Asphalt and concrete should not be mixed with the fill soils unless approved by the Geotechnical Engineer. All existing underground improvements planned for removal should be completely excavated and the resulting depressions properly backfilled in accordance with the procedures described herein. Once a clean excavation bottom has been established it must be observed and approved in writing by the Geotechnical Engineer (a representative of Geocon West, Inc.).

6.13.5 As a minimum, it is recommended that the upper 5 feet of existing earth materials within the proposed building footprint areas be excavated and properly compacted for foundation and slab support. Deeper excavations should be conducted as necessary to remove deeper artificial fill or soft alluvial soil at the direction of the Geotechnical Engineer (a representative of Geocon). The excavation should extend laterally a minimum distance of 3 feet beyond the building footprint area, including building appurtenances, or a distance equal to the depth of fill below the foundation, whichever is greater. The limits of existing fill and/or soft alluvial soils removal will be verified by the Geocon representative during site grading activities.

6.13.6 Subsequent to the recommended grading, a conventional foundation system bearing in newly placed engineered fill may be utilized for support of proposed structures.

6.13.7 All excavations must be observed and approved in writing by the Geotechnical Engineer (a representative of Geocon). Prior to placing any fill, the excavation bottom must be proof-rolled in the presence of the Geotechnical Engineer (a representative of Geocon) and approved in writing.

6.13.8 It is anticipated that stable excavations for the recommended grading associated with the proposed structures can be achieved with sloping measures. However, if excavations in close proximity to an adjacent property line and/or structure are required, special excavation measures may be necessary in order to maintain lateral support of offsite improvements. Excavation recommendations are provided in the *Temporary Excavations* section of this report (Section 7.18).

6.13.9 All fill and backfill soils should be placed in horizontal loose layers approximately 6 to 8 inches thick, moisture conditioned to near optimum moisture content, and compacted to at least 90 percent relative compaction, as determined by ASTM Test Method D 1557 (latest edition).

7.4.8 Where new paving is to be placed, it is recommended that all existing fill and soft alluvial soils be excavated and properly compacted for paving support. The client should be aware that excavation and compaction of all existing fill and soft soils in the area of new paving is not required; however, paving constructed over existing artificial fill or unsuitable alluvial soil may experience increased settlement and/or cracking, and may therefore have a shorter design life and increased maintenance costs. As a minimum, the upper 12 inches of soil should be scarified, moisture conditioned to near optimum moisture content, and compacted to at least 95 percent relative compaction for paving support. Paving recommendations are provided in *Preliminary Pavement Recommendations* section of this report (see Section 7.12).

6.13.10 Foundations for small outlying structures, such as block walls up to 6 feet high, planter walls or trash enclosures, which will not be tied to the proposed building, may be supported on conventional foundations deriving support on a minimum of 12 inches of newly placed engineered fill which extends laterally at least 12 inches beyond the foundation area. Where excavation and proper compaction cannot be performed or is undesirable, foundations may derive support directly in the undisturbed alluvial soils at or below a depth of 12 inches, and should be deepened as necessary to maintain a minimum 12-inch embedment into the recommended bearing materials. If the soils exposed in the excavation bottom are soft or loose, compaction of the soils will be required prior to placing steel or concrete. Compaction of the foundation excavation bottom is typically accomplished with a compaction wheel or mechanical whacker and must be observed and approved by a Geocon representative.

7.4.11 All imported fill shall be observed, tested, and approved by Geocon West, Inc. prior to bringing soil to the site. Rocks larger than 6 inches in diameter shall not be used in the fill. If necessary, import soils used as structural fill should have an expansion index less than 20 and corrosivity properties that are equally or less detrimental to that of the existing onsite soils (see Figure B6). If import soils will be utilized in the building pad, the soils must be placed uniformly and at equal thickness at the direction of the Geotechnical Engineer (a representative of Geocon West, Inc.). Soils can be borrowed from non-building pad areas and later replaced with imported soils.

6.13.11 Utility trenches should be properly backfilled in accordance with the requirements of the Green Book (latest edition). The pipe should be bedded with clean sands (Sand Equivalent greater than 30) to a depth of at least 1 foot over the pipe, and the bedding material must be inspected and approved in writing by the Geotechnical Engineer (a representative of Geocon). The use of gravel is not acceptable unless used in conjunction with filter fabric to prevent the gravel from having direct contact with soil. The remainder of the trench backfill may be derived from onsite soil or approved import soil, compacted as necessary, until the required compaction is obtained. The use of 2-sack slurry is also acceptable as backfill (see Section 7.5). Prior to placing any bedding materials or pipes, the excavation bottom must be observed and approved in writing by the Geotechnical Engineer (a representative of Geocon).

6.13.12 All trench and foundation excavation bottoms must be observed and approved in writing by the Geotechnical Engineer (a representative of Geocon), prior to placing bedding materials, fill, steel, gravel, or concrete.

6.14 Shrinkage

6.14.1 Shrinkage results when a volume of material removed at one density is compacted to a higher density. A shrinkage factor of between 7 and 12 percent should be anticipated when excavating and compacting the upper 5 feet of existing earth materials on the site to an average relative compaction of 90 percent.

7.4.2 If import soils will be utilized in the building pad, the soils must be placed uniformly and at equal thickness at the direction of the Geotechnical Engineer (a representative of Geocon West, Inc.). Soils can be borrowed from non-building pad areas and later replaced with imported soils.

6.15 Foundation Design

6.15.1 Subsequent to the recommended grading, a conventional shallow spread foundation system may be utilized for support of the proposed structures provided foundations derive support in newly placed engineered fill.

6.15.2 Continuous footings may be designed for an allowable bearing capacity of 2,500 pounds per square foot (psf), and should be a minimum of 12 inches in width, 18 inches in depth below the lowest adjacent grade, and 12 inches into the recommended bearing material.

6.15.3 Isolated spread foundations may be designed for an allowable bearing capacity of 3,000 psf, and should be a minimum of 24 inches in width, 18 inches in depth below the lowest adjacent grade, and 12 inches into the recommended bearing material.

6.15.4 The allowable soil bearing pressure above may be increased by 500 psf and 1,000 psf for each additional foot of foundation width and depth, respectively, up to a maximum allowable soil bearing pressure of 4,000 psf.

6.15.5 The allowable bearing pressures may be increased by one-third for transient loads due to wind or seismic forces.

6.15.6 If depth increases are utilized for the perimeter foundations, this office should be provided a copy of the final construction plans so that the excavation recommendations presented herein could be properly reviewed and revised if necessary.

6.15.7 Continuous footings should be reinforced with four No. 4 steel reinforcing bars, two placed near the top of the footing and two near the bottom. Reinforcement for spread footings should be designed by the project structural engineer.

6.15.8 The above foundation dimensions and minimum reinforcement recommendations are based on soil conditions and building code requirements only, and are not intended to be used in lieu of those required for structural purposes.

6.15.9 No special subgrade presaturation is required prior to placement of concrete. However, the slab and foundation subgrade should be sprinkled as necessary; to maintain a moist condition as would be expected in any concrete placement.

6.15.10 Foundation excavations should be observed and approved in writing by the Geotechnical Engineer (a representative of Geocon West, Inc.), prior to the placement of reinforcing steel and concrete to verify that the excavations and exposed soil conditions are consistent with those anticipated. If unanticipated soil conditions are encountered, foundation modifications may be required.

6.15.11 This office should be provided a copy of the final construction plans so that the excavation recommendations presented herein could be properly reviewed and revised if necessary.

6.16 Miscellaneous Foundations

6.16.1 Foundations for small outlying structures, such as block walls up to 6 feet in height, planter walls or trash enclosures which will not be tied to the proposed structure may be supported on conventional foundations bearing on a minimum of 12 inches of newly placed engineered fill which extends laterally at least 12 inches beyond the foundation area. Where excavation and compaction cannot be performed or is undesirable, such as adjacent to property lines, foundations may derive support in the undisturbed alluvial soils at or below a depth of 1 2 inches, and should be deepened as necessary to maintain a minimum 12 inch embedment into the recommended bearing materials.

6.16.2 If the soils exposed in the excavation bottom are soft, compaction of the soft soils will be required prior to placing steel or concrete. Compaction of the foundation excavation bottom is typically accomplished with a compaction wheel or mechanical whacker and must be observed and approved by a Geocon representative. Miscellaneous foundations may be designed for a bearing value of 1,500 psf, and should be a minimum of 12 inches in width, 24 inches in depth below the lowest adjacent grade and 12 inches into the recommended bearing material. The allowable bearing pressure may be increased by up to one-third for transient loads due to wind or seismic forces.

6.16.3 Foundation excavations should be observed and approved in writing by the Geotechnical Engineer (a representative of Geocon West, Inc.), prior to the placement of reinforcing steel and concrete to verify that the excavations and exposed soil conditions are consistent with those anticipated.

6.17 Foundation Settlement

6.17.1 The maximum expected static settlement for a structure supported on a conventional foundation system deriving support in the newly placed engineered fill and designed with a maximum bearing pressure of 4,000 psf is estimated to be less than 1 inch and occur below the heaviest loaded structural element. Settlement of the foundation system is expected to occur on initial application of loading. Differential settlement is not expected to exceed ½ inch over a distance of 20 feet.

6.17.2 Once the design and foundation loading configurations for the proposed structures proceeds to a more finalized plan, the estimated settlements presented in this report should be reviewed and revised, if necessary. If the final foundation loading configurations are greater than the assumed loading conditions, the potential for settlement should be reevaluated by this office.

6.18 Lateral Design

6.18.1 Resistance to lateral loading may be provided by friction acting at the base of foundations, slabs and by passive earth pressure. An allowable coefficient of friction of 0.40 may be used with the dead load forces in the properly compacted engineered fill or competent undisturbed alluvial soils.

6.18.2 Passive earth pressure for the sides of foundations and slabs poured against properly compacted engineered fill or competent undisturbed alluvial soils may be computed as an equivalent fluid having a density of 280 pounds per cubic foot (pcf) with a maximum earth pressure of 2,800 psf. When combining passive and friction for lateral resistance, the passive component should be reduced by one-third.

6.19 Concrete Slabs-On-Grade

6.19.1 Concrete slabs-on-grade subject to vehicle loading should be designed in accordance with the recommendations in the *Preliminary Pavement Recommendations* section of this report (Section 7.12).

6.19.2 Subsequent to the recommended grading, concrete slabs-on-grade for structures, not subject to vehicle loading, should be a minimum of 4-inches thick and minimum slab reinforcement should consist of No. 3 steel reinforcing bars placed 18 inches on center in both horizontal directions. Steel reinforcing should be positioned vertically near the slab midpoint. The finished subgrade for the concrete slab-on-grade must be approved in writing prior to placement of a vapor retarder, reinforcing steel, or concrete.

6.19.3 Slabs-on-grade at the ground surface that may receive moisture-sensitive floor coverings or may be used to store moisture-sensitive materials should be underlain by a vapor retarder placed directly beneath the slab. The vapor retarder and acceptable permeance should be specified by the project architect or developer based on the type of floor covering that will be installed. The vapor retarder design should be consistent with the guidelines presented in Section 9.3 of the American Concrete Institute's (ACI) *Guide for Concrete Slabs that Receive Moisture-Sensitive Flooring Materials* (ACI 302.2R-06) and should be installed in general conformance with ASTM E 1643 (latest edition) and the manufacturer's recommendations. A minimum thickness of 15 mils extruded polyolefin plastic is recommended; vapor retarders which contain recycled content or woven materials are not recommended. The vapor retarder should have a permeance of less than 0.01 perms demonstrated by testing before and after mandatory conditioning is recommended. The vapor retarder should be installed in direct contact with the concrete slab with proper perimeter seal. If the California Green Building Code requirements apply to this project, the vapor retarder should be underlain by 4 inches of clean aggregate. It is important that the vapor retarder be puncture resistant since it will be in direct contact with angular gravel. As an alternative to the clean aggregate suggested in the California Green Building Code, it is our opinion that the concrete slab-on-grade may be underlain by a vapor retarder over 4 inches of clean sand (sand equivalent greater than 30), since the sand will serve a capillary break and will minimize the potential for punctures and damage to the vapor barrier.

6.19.4 For seismic design purposes, a coefficient of friction of 0.40 may be utilized between concrete slabs and subgrade soils without a moisture barrier, and 0.15 for slabs underlain by a moisture barrier.

6.19.5 Exterior slabs for walkways or flatwork, not subject to traffic loads, should be at least 4 inches thick and reinforced with No. 3 steel reinforcing bars placed 18 inches on center in both horizontal directions, positioned near the slab midpoint. Prior to construction of slabs, the upper 12 inches of subgrade should be moistened to optimum moisture content and properly compacted to at least 95 percent relative compaction, as determined by ASTM Test Method D 1557 (latest edition). Crack control joints should be spaced at intervals not greater than 10 feet and should be constructed using saw-cuts or other methods as soon as practical following concrete placement. Crack control joints should extend a minimum depth of one-fourth the slab thickness. The project structural engineer should design construction joints as necessary.

6.19.6 The recommendations of this report are intended to reduce the potential for cracking of slabs due to settlement. However, even with the incorporation of the recommendations presented herein, foundations, stucco walls, and slabs-on-grade may exhibit some cracking due to minor soil movement and/or concrete shrinkage. The occurrence of concrete shrinkage cracks is independent of the supporting soil characteristics. Their occurrence may be reduced and/or controlled by limiting the slump of the concrete, proper concrete placement and curing, and by the placement of crack control joints at periodic intervals, in particular, where re-entrant slab corners occur.

6.20 Preliminary Pavement Recommendations

6.20.1 Where new paving is to be placed, it is recommended that all existing fill and soft or unsuitable alluvial materials be excavated and properly compacted for paving support. The client should be aware that excavation and compaction of all existing artificial fill and soft alluvium in the area of new paving is not required; however, paving constructed over existing unsuitable material may experience increased settlement and/or cracking, and may therefore have a shorter design life and increased maintenance costs. As a minimum, the upper 12 inches of paving subgrade should be scarified, moisture conditioned to optimum moisture content, and properly compacted to at least 95 percent relative compaction, as determined by ASTM Test Method D 1557 (latest edition).

6.20.2 The following pavement sections are based on an assumed R-Value of 35. Once site grading activities are complete, it is recommended that laboratory testing confirm the properties of the soils serving as paving subgrade prior to placing pavement.

6.20.3 The Traffic Indices listed below are estimates. Geocon does not practice in the field of traffic engineering. The actual Traffic Index for each area should be determined by the project civil engineer. If pavement sections for Traffic Indices other than those listed below are required, Geocon should be contacted to provide additional recommendations. Pavement thicknesses were determined following procedures outlined in the *California Highway Design Manual* (Caltrans). It is anticipated that the majority of traffic will consist of automobile and large truck traffic.

PRELIMINARY PAVEMENT DESIGN SECTIONS

Location	Estimated Traffic Index (TI)	Asphalt Concrete (inches)	Class 2 Aggregate Base (inches)
Automobile Parking and Driveways	4	3.0	4.0
Trash Truck & Fire Lanes	7	4.0	8.5

6.20.4 Asphalt concrete should conform to Section 203-6 of the "*Standard Specifications for Public Works Construction*" (Green Book). Class 2 aggregate base materials should conform to Section 26-1.02A of the "*Standard Specifications of the State of California, Department of Transportation*" (Caltrans). Crushed Miscellaneous Base should conform to Section 200-2.4 of the "*Standard Specifications for Public Works Construction*" (Green Book).

6.20.5 Unless specifically designed and evaluated by the project structural engineer, where exterior concrete paving will be utilized for support of vehicles, it is recommended that the concrete be a minimum of 5 inches of concrete reinforced with No. 3 steel reinforcing bars placed 18 inches on center in both horizontal directions. Concrete paving supporting vehicular traffic should be underlain by a minimum of 4 inches of aggregate base and a properly compacted subgrade. The subgrade and base material should be compacted to 95 percent relative compactions as determined by ASTM Test Method D 1557 (latest edition).

6.20.6 The performance of pavements is highly dependent upon providing positive surface drainage away from the edge of pavements. Ponding of water on or adjacent to the pavement will likely result in saturation of the subgrade materials and subsequent cracking, subsidence and pavement distress. If planters are planned adjacent to paving, it is recommended that the perimeter curb be extended at least 12 inches below the bottom of the aggregate base to minimize the introduction of water beneath the paving.

6.21 Retaining Wall Design

6.21.1 The recommendations presented below are generally applicable to the design of rigid concrete or masonry retaining walls having a maximum height of 6 feet. In the event that walls significantly higher than 6 feet are planned, Geocon should be contacted for additional recommendations.

6.21.2 Retaining wall foundations may be designed in accordance with the recommendations provided in the *Foundation Design* sections of this report (see Section 7.6).

6.21.3 Retaining walls with a level backfill surface that are not restrained at the top should be designed utilizing a triangular distribution of pressure (active pressure). Restrained walls are those that are not allowed to rotate more than 0.001H (where H equals the height of the retaining portion of the wall in feet) at the top of the wall. Where walls are restrained from movement at the top, walls may be designed utilizing a triangular distribution of pressure (at-rest pressure). The table below presents recommended pressures to be used in retaining wall design, assuming that proper drainage will be maintained.

RETAINING WALL WITH LEVEL BACKFILL SURFACE

HEIGHT OF RETAINING WALL (Feet)	ACTIVE PRESSURE EQUIVALENT FLUID PRESSURE (Pounds Per Cubic Foot)	AT-REST PRESSURE EQUIVALENT FLUID PRESSURE (Pounds Per Cubic Foot)
Up to 6	36	58

6.21.4 The wall pressures provided above assume that the retaining wall will be properly drained preventing the buildup of hydrostatic pressure. If retaining wall drainage is not implemented, the equivalent fluid pressure to be used in design of undrained walls is 90 pcf. The value includes hydrostatic pressures plus buoyant lateral earth pressures.

6.21.5 Additional active pressure should be added for a surcharge condition due to sloping ground, vehicular traffic or adjacent structures and should be designed for each condition as the project progresses.

6.21.6 It is recommended that line-load surcharges from adjacent wall footings, use horizontal pressures generated from NAV-FAC DM 7.2. The governing equations are:

$$For\ {}^{x}/_{H} \leq 0.4$$

$$\sigma_H(z) = \frac{0.20 \times \left(\frac{z}{H}\right)}{\left[0.16 + \left(\frac{z}{H}\right)^2\right]^2} \times \frac{Q_L}{H}$$

and

$$For\ {}^{x}/_{H} > 0.4$$

$$\sigma_H(z) = \frac{1.28 \times \left(\frac{x}{H}\right)^2 \times \left(\frac{z}{H}\right)}{\left[\left(\frac{x}{H}\right)^2 + \left(\frac{z}{H}\right)^2\right]^2} \times \frac{Q_L}{H}$$

where x is the distance from the face of the excavation or wall to the vertical line-load, H is the distance from the bottom of the footing to the bottom of excavation or wall, z is the depth at which the horizontal pressure is desired, Q_L is the vertical line-load and $\sigma_H(z)$ is the horizontal pressure at depth z.

6.21.7 It is recommended that vertical point-loads, from construction equipment outriggers or adjacent building columns use horizontal pressures generated from NAV-FAC DM 7.2. The governing equations are:

$$For\ {}^{x}/_{H} \leq 0.4$$

$$\sigma_H(z) = \frac{0.28 \times \left(\frac{z}{H}\right)^2}{\left[0.16 + \left(\frac{z}{H}\right)^2\right]^3} \times \frac{Q_P}{H^2}$$

and

$$For\ {}^{x}/_{H} > 0.4$$

$$\sigma_H(z) = \frac{1.77 \times \left(\frac{x}{H}\right)^2 \times \left(\frac{z}{H}\right)^2}{\left[\left(\frac{x}{H}\right)^2 + \left(\frac{z}{H}\right)^2\right]^3} \times \frac{Q_P}{H^2}$$

then

$$\sigma'_H(z) = \sigma_H(z)cos^2(1.1\theta)$$

where x is the distance from the face of the excavation/wall to the vertical point-load, H is distance from the outrigger/bottom of column footing to the bottom of excavation, z is the depth at which the horizontal pressure is desired, Q_P is the vertical point-load, $\sigma_H(z)$ is the horizontal pressure at depth z, θ is the angle between a line perpendicular to the excavation/wall and a line from the point-load to location on the excavation/wall where the surcharge is being evaluated, and $\sigma_H(z)$ is the horizontal pressure at depth z.

6.21.8 In addition to the recommended earth pressure, the upper 10 feet of the subterranean wall adjacent to the street and parking lot should be designed to resist a uniform lateral pressure of 100 psf, acting as a result of an assumed 300 psf surcharge behind the walls due to normal street traffic. If the traffic is kept back at least 10 feet from the subterranean walls, the traffic surcharge may be neglected.

6.22 Retaining Wall Drainage

6.22.1 Retaining walls should be provided with a drainage system. At the base of the drain system, a subdrain covered with a minimum of 12 inches of gravel should be installed, and a compacted fill blanket or other seal placed at the surface (see Figure 5). The clean bottom and subdrain pipe, behind a retaining wall, should be observed by the Geotechnical Engineer (a representative of Geocon), prior to placement of gravel or compacting backfill.

6.22.2 As an alternative, a plastic drainage composite such as Miradrain or equivalent may be installed in continuous, 4-foot-wide columns along the entire back face of the wall, at 8 feet on center. The top of these drainage composite columns should terminate approximately 18 inches below the ground surface, where either hardscape or a minimum of 18 inches of relatively cohesive material should be placed as a cap (see Figure 6). These vertical columns of drainage material would then be connected at the bottom of the wall to a collection panel or a 1-cubic-foot rock pocket drained by a 4-inch subdrain pipe.

6.22.3 Subdrainage pipes at the base of the retaining wall drainage system should outlet to an acceptable location via controlled drainage structures.

6.22.4 Moisture affecting below grade walls is one of the most common post-construction complaints. Poorly applied or omitted waterproofing can lead to efflorescence or standing water. Particular care should be taken in the design and installation of waterproofing to avoid moisture problems, or actual water seepage into the structure through any normal shrinkage cracks which may develop in the concrete walls, floor slab, foundations and/or construction joints. The design and inspection of the waterproofing is not the responsibility of the geotechnical engineer. A waterproofing consultant should be retained in order to recommend a product or method, which would provide protection to subterranean walls, floor slabs and foundations.

6.23 Temporary Excavations

6.23.1 Excavations of up to 5 feet in vertical height may be required during grading operations and foundation excavations. The excavations are expected to expose artificial fill and alluvial soils, which are suitable for vertical excavations up to 5 feet, where loose soils or caving sands are not present and where not surcharged by adjacent traffic or structures. Due to the granular nature of soils and potential for caving, the contractor should also be prepared to form foundation excavations at the excavation bottom.

6.23.2 Vertical excavations greater than 5 feet will require sloping, shoring, or other special excavation measures in order to provide a stable excavation. Where sufficient space is available, temporary unsurcharged embankments could be sloped back at a uniform 1:1 (H:V) slope gradient or flatter. A uniform slope does not have a vertical portion.

6.23.3 Where sloped embankments are utilized, the top of the slope should be barricaded to prevent vehicles and storage loads at the top of the slope within a horizontal distance equal to the height of the slope. If the temporary construction embankments are to be maintained during the rainy season, berms are suggested along the tops of the slopes where necessary to prevent runoff water from entering the excavation and eroding the slope faces. The soils exposed in the cut slopes should be inspected during excavation by our personnel so that modifications of the slopes can be made if variations in the soil conditions occur. All excavations should be stabilized within 30 days of initial excavation.

6.24 Stormwater Infiltration

6.24.1 During the July 6, 2018 site exploration, borings P1, P2 and P3 were utilized to perform percolation testing. The borings were advanced to the depth listed in the table below. Slotted casing was placed in the boring, and the annular space between the casing and excavation was filled with gravel. The boring was then filled with water to pre-saturate the soils, and the casing was refilled with water and percolation test readings were performed after repeated flooding of the cased excavation. Based on the test results, the measured percolation rate and design infiltration rate, for the earth materials encountered, are provided in the following table.

Boring	Soil Type	Infiltration Depth (ft)	Measured Percolation Rate (in / hour)	Design Infiltration Rate (in / hour)
P1	Sand with Silt (SP-SM)	35-40.5	9.0	4.5
P2	Silty Sand (Sm)	5-10.5	1.51	0.76
P3	Sand (SP)	1-5	3.39	1.7

6.24.2 Based on the test method utilized (Boring Percolation Test), the reduction factor RF_t may be taken as 2.0 in the infiltration system design. Based on the number of tests performed and consistency of the soils throughout the site, it is suggested that the reduction factor RF_v be taken as 1.0. In addition, provided proper maintenance is performed to minimize long-term siltation and plugging, the reduction factor RF_s may be taken as 1.0. Additional reduction factors may be required and should be applied by the engineer in responsible charge of the design of the stormwater infiltration system and based on applicable guideline.

6.24.3 The results of the percolation testing indicate that soils at the locations and depths listed in the table above are minimally conductive to infiltration. These infiltration rates are likely the result of the dense to very dense fine-grained sand and silty sand layers encountered. Based on these considerations, a stormwater infiltration system is likely not feasible at the location and depths as provided in the table above however, the project civil engineer should evaluate these results.

6.24.4 If determined by the project civil engineer that the infiltration rates provided are feasible for use in the design of an infiltration system, it is our opinion that the introduction of stormwater at the depths and locations indicated above will not induce excessive hydro-consolidation will not create a perched groundwater condition, will not affect soil structure interaction of existing or proposed foundations due to expansive soils, will not saturate soils supported by existing or proposed retaining walls, and will not increase the potential for liquefaction. Resulting settlements are anticipated to be less than ¼ inch, if any.

6.24.5 The infiltration system must be located such that the closest distance between an adjacent foundation is at least 10 feet in all directions from the zone of saturation. The zone of saturation may be assumed to project downward from the discharge of the infiltration facility at a gradient of 1:1. Additional property line or foundation setbacks may be required by the governing jurisdiction and should be incorporated into the stormwater infiltration system design as necessary.

6.24.6 Where the 10-foot horizontal setback cannot be maintained between the infiltration system and an adjacent footing, and the infiltration system penetrates below the foundation influence line, the proposed stormwater infiltration system must be designed to resist the surcharge from the adjacent foundation. The foundation surcharge line may be assumed to project down away from the bottom of the foundation at a 1:1 gradient. The stormwater infiltration system must still be sufficiently deep to maintain the 10-foot vertical offset between the bottom of the footing and the zone of saturation.

6.24.7 Subsequent to the placement of the infiltration system, it is acceptable to backfill the resulting void space between the excavation sidewalls and the infiltration system with minimum two-sack slurry provided the slurry is not placed in the infiltration zone. It is recommended that pea gravel be utilized adjacent to the infiltration zone so communication of water to the soil is not hindered.

6.24.8 The final design drawings should be reviewed and approved by the Geotechnical Engineer. The installation of the stormwater infiltration system should be observed and approved in writing by the Geotechnical Engineer (a representative of Geocon).

6.25 Surface Drainage

6.25.1 Proper surface drainage is critical to the future performance of the project. Uncontrolled infiltration of irrigation excess and storm runoff into the soils can adversely affect the performance of the planned improvements. Saturation of a soil can cause it to lose internal shear strength and increase its compressibility, resulting in a change in the original designed engineering properties. Proper drainage should be maintained at all times.

6.25.2 All site drainage should be collected and controlled in non-erosive drainage devices. Drainage should not be allowed to pond anywhere on the site, and especially not against any foundation or retaining wall. The site should be graded and maintained such that surface drainage is directed away from structures in accordance with 2013 CBC 1804.3 or other applicable standards. In addition, drainage should not be allowed to flow uncontrolled over any descending slope. Discharge from downspouts, roof drains and scuppers are not recommended onto unprotected soils within 5 feet of the building perimeter. Planters which are located adjacent to foundations should be sealed to prevent moisture intrusion into the soils providing foundation support. Landscape irrigation is not recommended within 5 feet of the building perimeter footings except when enclosed in protected planters.

6.25.3 Positive site drainage should be provided away from structures, pavement, and the tops of slopes to swales or other controlled drainage structures. The building pad and pavement areas should be fine graded such that water is not allowed to pond.

6.25.4 Landscaping planters immediately adjacent to paved areas are not recommended due to the potential for surface or irrigation water to infiltrate the pavement's subgrade and base course. Either a subdrain, which collects excess irrigation water and transmits it to drainage structures, or an impervious above-grade planter boxes should be used. In addition, where landscaping is planned adjacent to the pavement, it is recommended that consideration be given to providing a cutoff wall along the edge of the pavement that extends at least 12 inches below the base material.

6.26 Plan Review

6.26.1 Grading, foundation, and shoring plans should be reviewed by the Geotechnical Engineer (a representative of Geocon West, Inc.), prior to finalization to verify that the plans have been prepared in substantial conformance with the recommendations of this report and to provide additional analyses or recommendations.

LIMITATIONS AND UNIFORMITY OF CONDITIONS

1. The recommendations of this report pertain only to the site investigated and are based upon the assumption that the soil conditions do not deviate from those disclosed in the investigation. If any variations or undesirable conditions are encountered during construction, or if the proposed construction will differ from that anticipated herein, Geocon West, Inc. should be notified so that supplemental recommendations can be given. The evaluation or identification of the potential presence of hazardous or corrosive materials was not part of the scope of services provided by Geocon West, Inc.

2. This report is issued with the understanding that it is the responsibility of the owner, or of his representative, to ensure that the information and recommendations contained herein are brought to the attention of the architect and engineer for the project and incorporated into the plans, and the necessary steps are taken to see that the contractor and subcontractors carry out such recommendations in the field.

3. The findings of this report are valid as of the date of this report. However, changes in the conditions of a property can occur with the passage of time, whether they are due to natural processes or the works of man on this or adjacent properties. In addition, changes in applicable or appropriate standards may occur, whether they result from legislation or the broadening of knowledge. Accordingly, the findings of this report may be invalidated wholly or partially by changes outside our control. Therefore, this report is subject to review and should not be relied upon after a period of three years.

4. The firm that performed the geotechnical investigation for the project should be retained to provide testing and observation services during construction to provide continuity of geotechnical interpretation and to check that the recommendations presented for geotechnical aspects of site development are incorporated during site grading, construction of improvements, and excavation of foundations. If another geotechnical firm is selected to perform the testing and observation services during construction operations, that firm should prepare a letter indicating their intent to assume the responsibilities of project Geotechnical Engineer of Record. A copy of the letter should be provided to the regulatory agency for their records. In addition, that firm should provide revised recommendations concerning the geotechnical aspects of the proposed development, or a written acknowledgement of their concurrence with the recommendations presented in our report. They should also perform additional analyses deemed necessary to assume the role of Geotechnical Engineer of Record.

LIST OF REFERENCES

California Department of Water Resources, 2018, *Groundwater Level Data by Township, Range, and Section,* Web Site Address: http://www.water.ca.gov/waterdatalibrary/groundwater/hydrographs/index_trs.cfm.

California Division of Oil, Gas and Geothermal Resources, 2018, Division of Oil, Gas, and Geothermal Resources Well Finder, http://maps.conservation.ca.gov.doggr/index.html#close.

California Geological Survey, 2018a, *Earthquake Fault Zones, A Guide for Government Agencies, Property Owners/Developers, and Geoscience Practitioners for Assessing Fault Rupture Hazards in California*, Special Publication 42, Revised 2018.

California Geological Survey, 2018b, CGS Information Warehouse, Regulatory Map Portal, http://maps.conservation.ca.gov/cgs/informationwarehouse/index.html?map=regulatorymaps.

County of San Bernardino, 2010, *Geologic Hazard Map.*

Dibblee, T. W., Jr., 2008, *Geologic map of the Shadow Mountains & Victorville 15 minute quadrangles, San Bernardino & Los Angeles Counties, California*, Dibblee Geological Foundation Map #DF-387.

FEMA, 2018, Online Flood Hazard Maps, http://www.esri.com/hazards/index.html.

Jennings, C. W. and Bryant, W. A., 2010, *Fault Activity Map of California*, California Geological Survey Geologic Data Map No. 6.

Toppozada, T., Branum, D., Petersen, M, Hallstrom, C., and Reichle, M., 2000, *Epicenters and Areas Damaged by M> 5 California Earthquakes, 1800 – 1999*, California Geological Survey, Map Sheet 49.

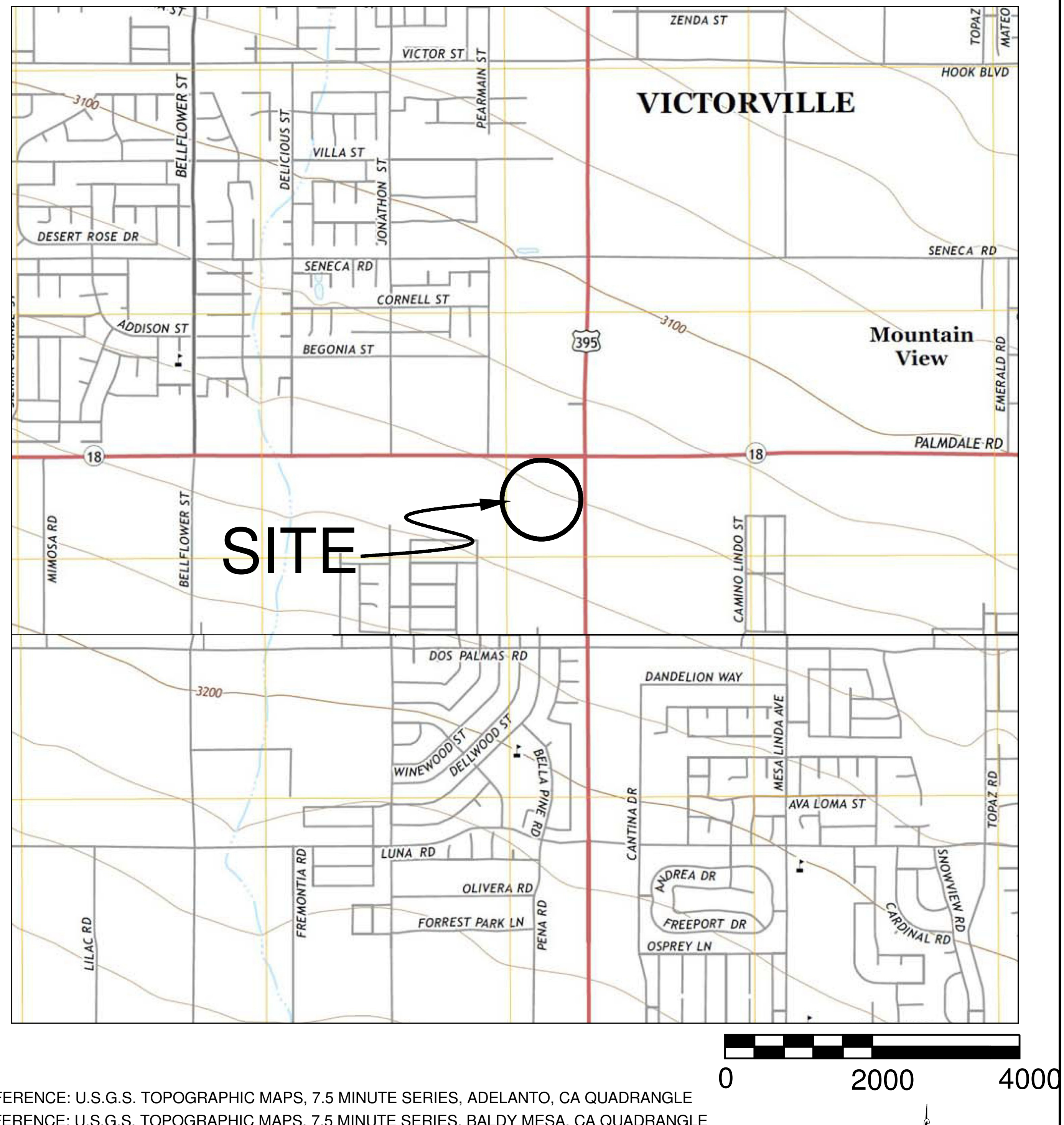
U.S. Geological Survey, 2015, *Adelanto 7.5-Minute Topographic Map*.

U.S. Geological Survey, 2015, *Baldy Mesa 7.5-Minute Topographic Map*.

U.S. Geological Survey, 2015, *Hesperia 7.5-Minute Topographic Map*.

U.S. Geological Survey, 205, *Victorville 7.5-Minute Topographic Map*.

Ziony, J. I., and Jones, L. M., 1989, *Map Showing Late Quaternary Faults and 1978–1984 Seismicity of the Los Angeles Region, California*, U.S. Geological Survey Miscellaneous Field Studies Map MF-1964.



REFERENCE: U.S.G.S. TOPOGRAPHIC MAPS, 7.5 MINUTE SERIES, ADELANTO, CA QUADRANGLE
REFERENCE: U.S.G.S. TOPOGRAPHIC MAPS, 7.5 MINUTE SERIES, BALDY MESA, CA QUADRANGLE
REFERENCE: U.S.G.S. TOPOGRAPHIC MAPS, 7.5 MINUTE SERIES, HESPERIA, CA QUADRANGLE
REFERENCE: U.S.G.S. TOPOGRAPHIC MAPS, 7.5 MINUTE SERIES, VICTORVILLE, CA QUADRANGLE

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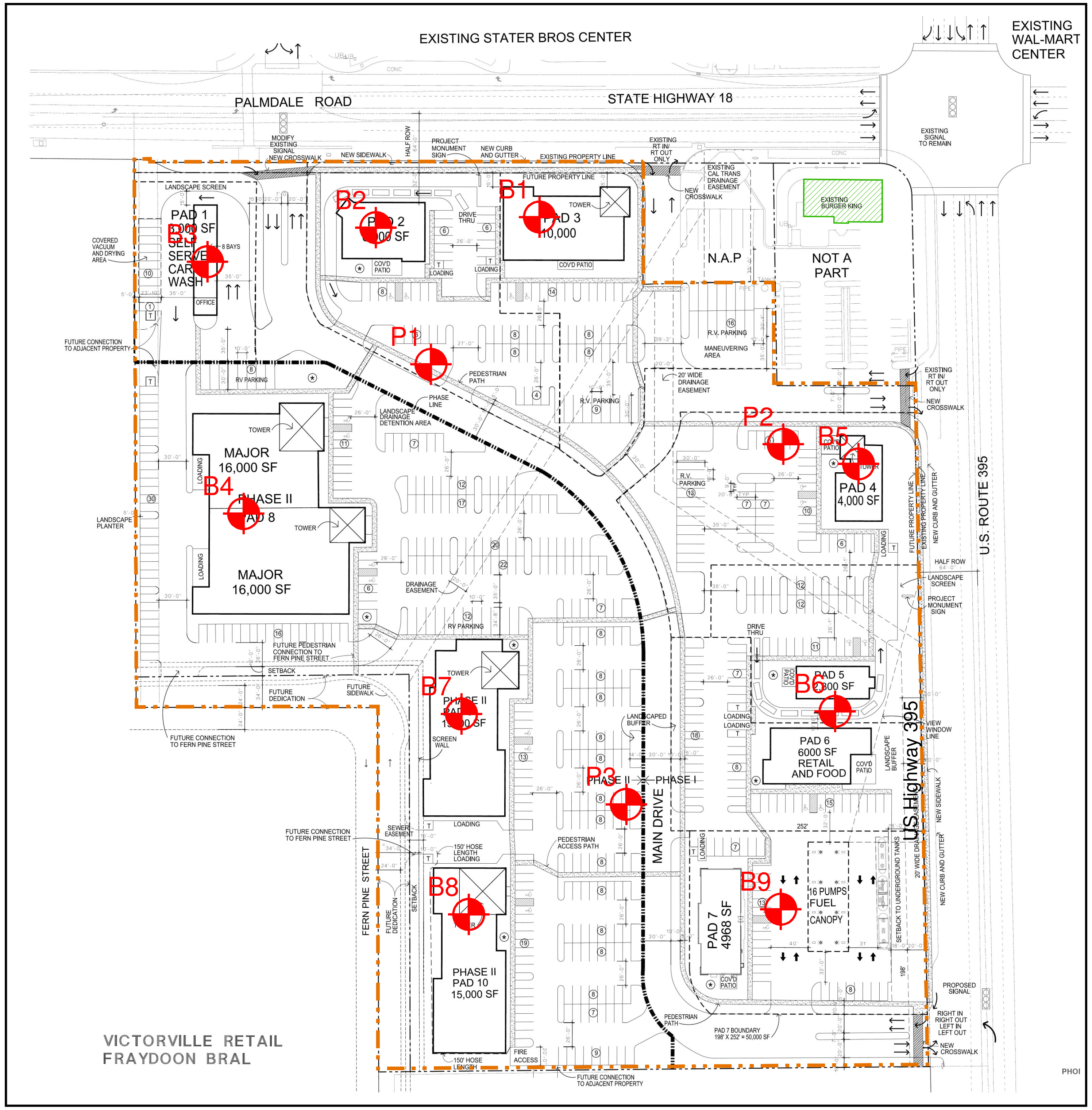
VICINITY MAP

PALMDALE ROAD & US 395
VICTORVILLE, CALIFORNIA

DRAFTED BY: MDS	CHECKED BY: GAK	AUG 2018	PROJECT NO. A9817-06-01	FIG. 1



LEGEND

- B9 Approximate Location of Boring
- Approximate Property Boundary
- Approximate Location of Offsite Structures

0 150' 300'

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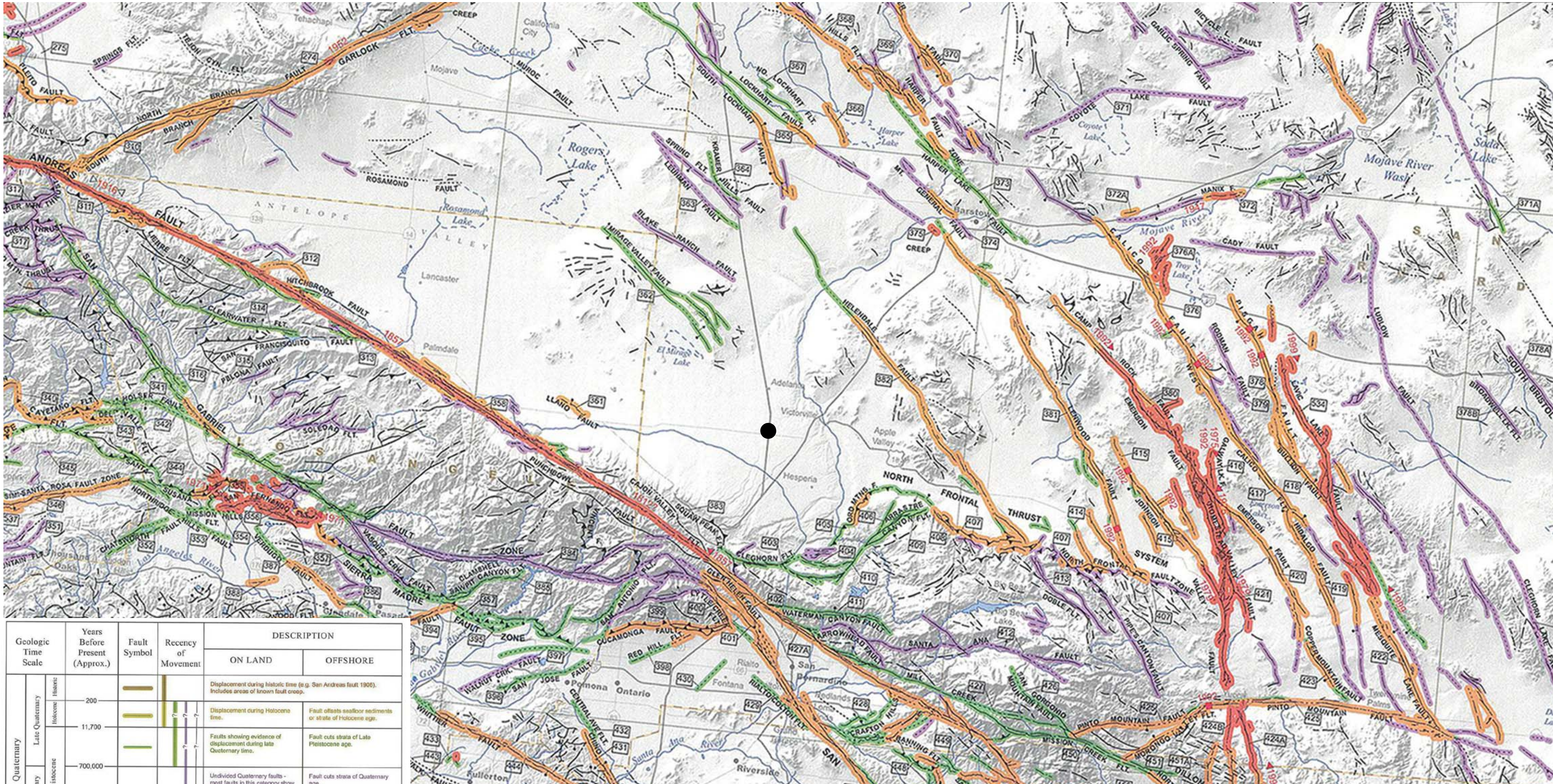
SITE PLAN

PALMDALE ROAD & US 395
VICTORVILLE, CALIFORNIA

AUG 2018 | PROJECT NO. A9817-06-01 | FIG. 2

Reference: Jennings, C.W. and Bryant, W. A., 2010, Fault Activity Map of California, California Geological Survey Geologic Data Map No. 6.



Geologic Time Scale			Years Before Present (Approx.)	Fault Symbol	Recency of Movement	DESCRIPTION: ON LAND	DESCRIPTION: OFFSHORE
Quaternary	Late Quaternary	Historic				Displacement during historic time (e.g. San Andreas fault 1906). Includes areas of known fault creep.	
			200				
		Holocene			? ? ?	Displacement during Holocene time.	Fault offsets seafloor sediments or strata of Holocene age.
			11,700				
		Pleistocene			? ?	Faults showing evidence of displacement during late Quaternary time.	Fault cuts strata of Late Pleistocene age.
			700,000				
	Early Quaternary				?	Undivided Quaternary faults - most faults in this category show evidence of displacement during the last 1,600,000 years; possible exceptions are faults which displace rocks of undifferentiated Plio-Pleistocene age.	Fault cuts strata of Quaternary age.
			1,600,000*				
Pre-Quaternary			4.5 billion (Age of Earth)			Faults without recognized Quaternary displacement or showing evidence of no displacement during Quaternary time. Not necessarily inactive.	Fault cuts strata of Pliocene or older age.

* Quaternary now recognized as extending to 2.6 Ma (Walker and Geissman, 2009). Quaternary faults in this map were established using the previous 1.6 Ma criterion.

0 12 24 Miles

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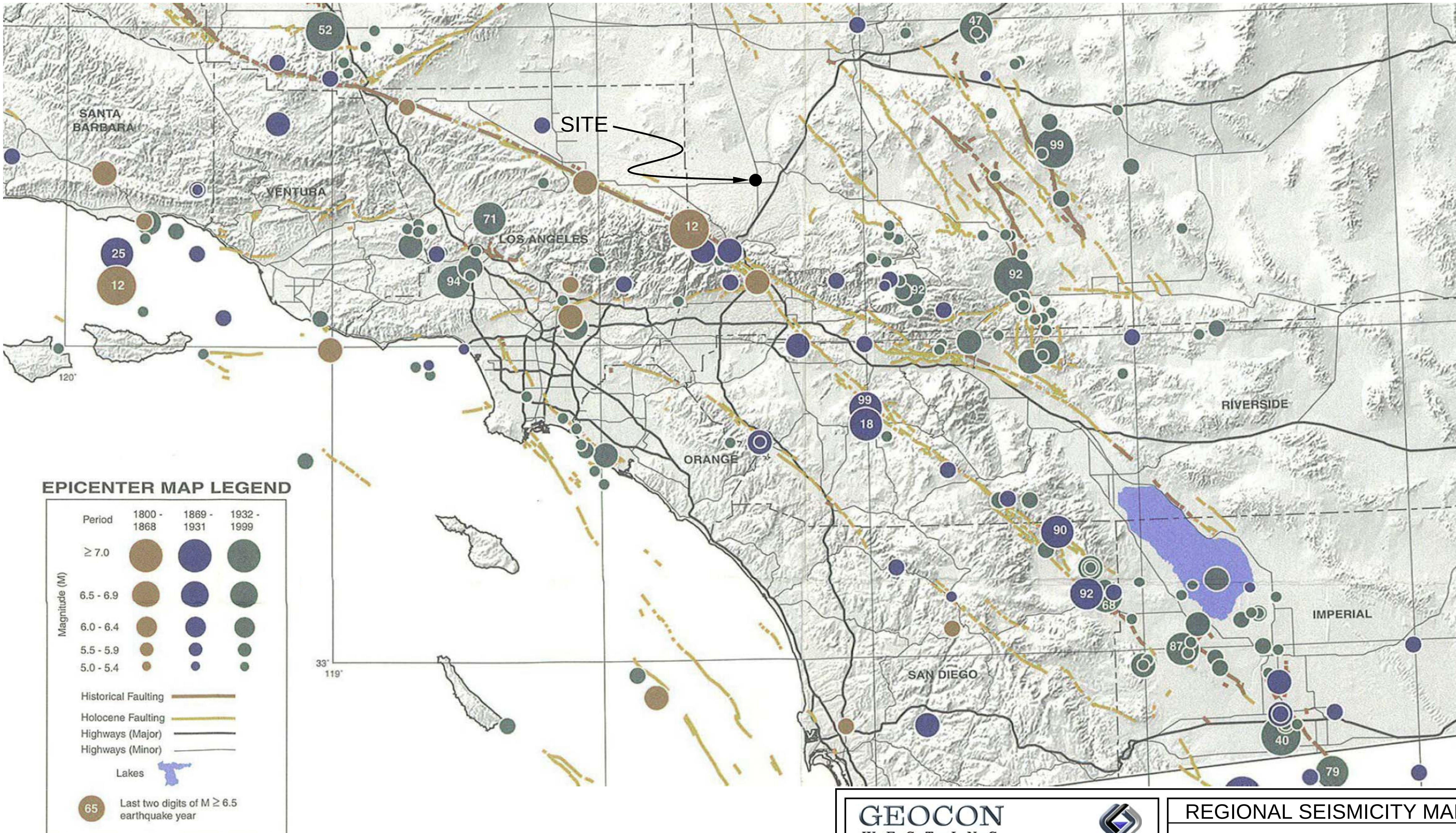
REGIONAL FAULT MAP

PALMDALE ROAD & US 395

VICTORVILLE, CALIFORNIA

DRAFTED BY: MDS	CHECKED BY: GAK	AUG 2018	PROJECT NO. A9817-06-01	FIG. 3



Reference: Toppozada, T., Branum, D., Petersen, M., Hallstrom, C., Cramer, C., and Reichle, M., 2000, Epicenters and Areas Damaged by M≥5 California Earthquakes, 1800 - 1999, California Geological Survey, Map Sheet 49.

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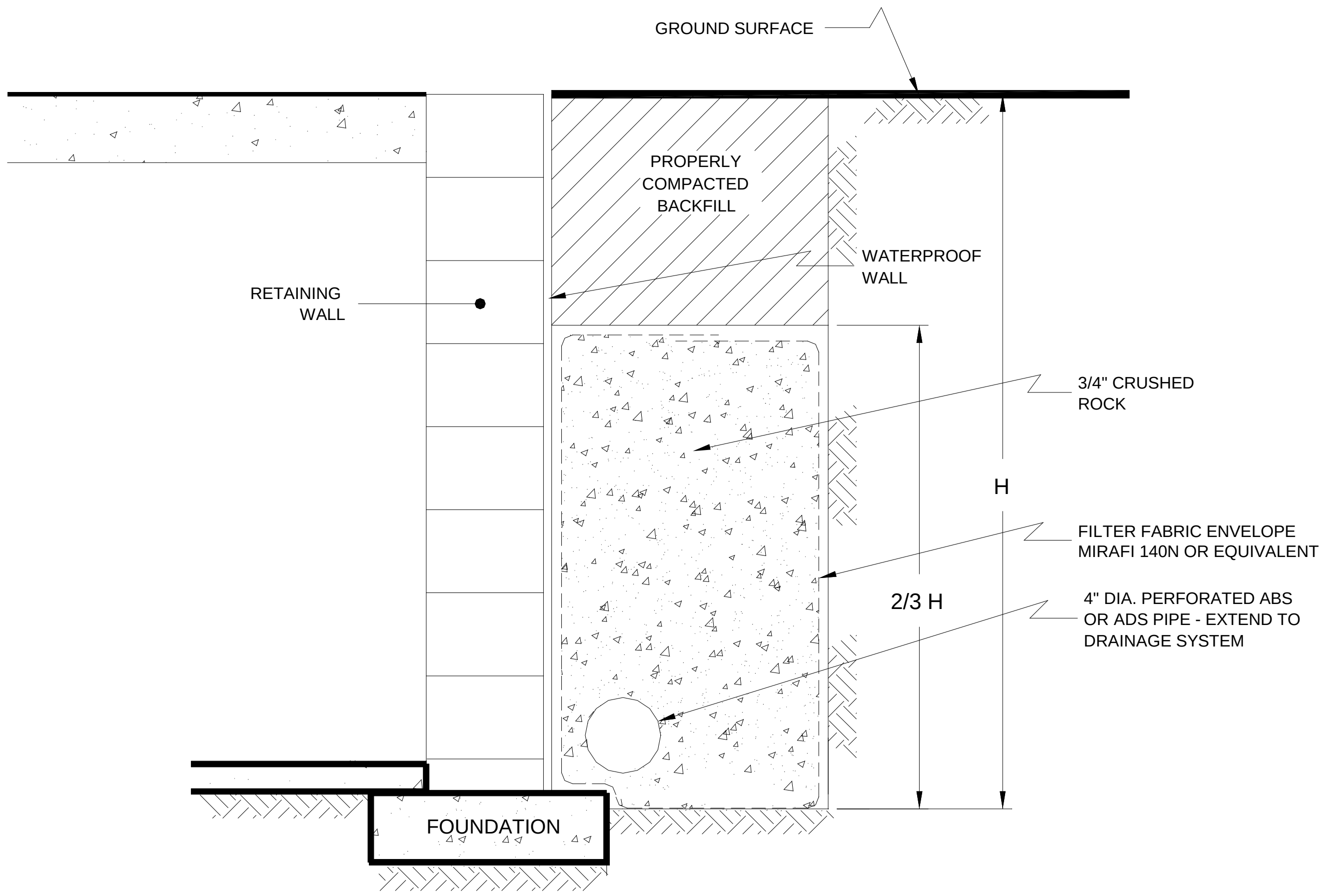
REGIONAL SEISMICITY MAP

PALMDALE ROAD & US 395

VICTORVILLE, CALIFORNIA

AUG 2018	PROJECT NO. A9817-06-01	FIG.4



NO SCALE

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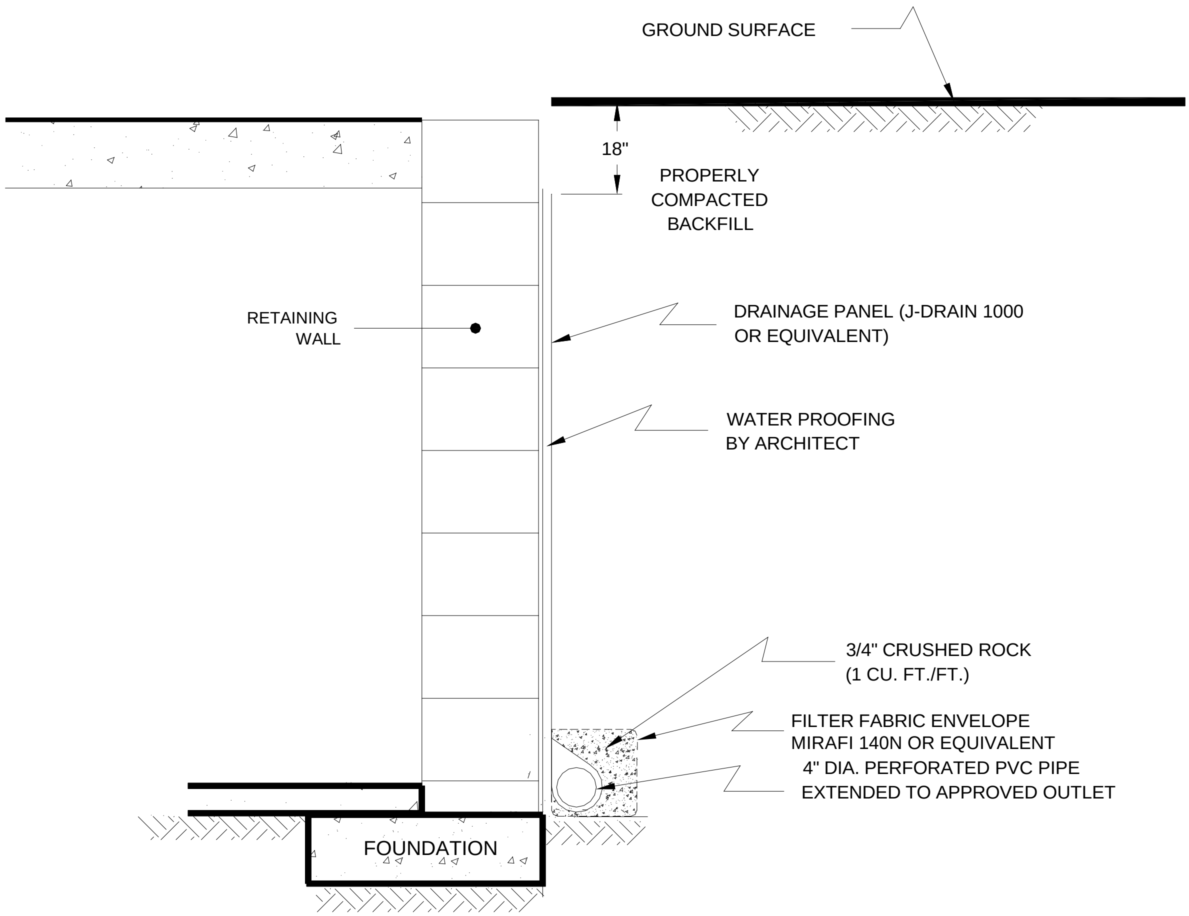
RETAINING WALL DRAIN DETAIL

PALMDALE ROAD & US 395
VICTORVILLE, CALIFORNIA

DRAFTED BY: HHD	CHECKED BY: NDB	AUG 2018	PROJECT NO. A9817-06-01	FIG. 5



NO SCALE

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RETAINING WALL DRAIN DETAIL

PALMDALE ROAD & US 395
VICTORVILLE, CALIFORNIA

AUG 2018	PROJECT NO. A9817-06-01	FIG. 6

APPENDIX A

APPENDIX A

FIELD INVESTIGATION

The site was explored on July 6, 2018, by excavating twelve 8-inch diameter borings to depths between 5 and 40½ feet below the existing ground surface utilizing a truck-mounted bucket auger drilling machine. Representative and relatively undisturbed samples were obtained by driving a 3 inch, O. D., California Modified Sampler into the "undisturbed" soil mass with blows from a 140-pound auto-hammer falling 30 inches. The California Modified Sampler was equipped with 1-inch high by 2 3/8-inch diameter brass sampler rings to facilitate soil removal and testing. Bulk samples were also obtained.

The soil conditions encountered in the borings were visually examined, classified and logged in general accordance with the Unified Soil Classification System (USCS). The logs of the borings are presented on Figures A1 through A12. The logs depict the soil and geologic conditions encountered and the depth at which samples were obtained. The logs also include our interpretation of the conditions between sampling intervals. Therefore, the logs contain both observed and interpreted data. We determined the lines designating the interface between soil materials on the logs using visual observations, penetration rates, excavation characteristics and other factors. The transition between materials may be abrupt or gradual. Where applicable, the boring logs were revised based on subsequent laboratory testing. The location of the borings are shown on Figure 2.

PROJECT NO. A9817-06-01

BORING B1

ELEV. (MSL.) - - DATE COMPLETED 7/6/18

EQUIPMENT HOLLOW STEM AUGER BY: MDS

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT*)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0					**ALLUVIUM** Silty Sand, medium dense, dry, light yellowish brown, fine- to medium-grained.			
2	B1@2'					32	118.5	5.2
4				SM				
6	B1@5'					30	141.6	1.3
8	B1@7'				- slightly moist, brown	43	117.5	2.4
10	B1@9.5'				Sand, well-graded, very dense, slightly moist, brown, fine- to coarse-grained, trace gravel (to 1").	50 (5")	118.2	4.3
12								
14				SW				
16	B1@15'					74	121.0	7.7
18								
20	B1@20'			ML	Sandy Silt, stiff, dry, light yellowish brown, fine-grained.	36		

Total depth of boring: 20.5 feet
No fill.
No groundwater encountered.
Backfilled with soil cuttings and tamped.

*Penetration resistance for 140-pound hammer falling 30 inches by auto-hammer.

A9817-06-01 B1-B9 BORING LOGS.GPJ

Figure A1,
Log of Boring B1, Page 1 of 1

SAMPLE SYMBOLS			
	... SAMPLING UNSUCCESSFUL	... STANDARD PENETRATION TEST	... DRIVE SAMPLE (UNDISTURBED)
	... DISTURBED OR BAG SAMPLE	... CHUNK SAMPLE	... WATER TABLE OR SEEPAGE

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	BORING B2 ELEV. (MSL.) - - DATE COMPLETED 7/6/18 EQUIPMENT HOLLOW STEM AUGER BY: MDS	PENETRATION RESISTANCE (BLOWS/FT*)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
0					**ALLUVIUM** Silty Sand, medium dense, dry, light yellowish brown, fine- to coarse-grained, trace gravel (to 2").			
2	B2@2'					32	128.5	1.1
4								
6	B2@5'			SM		31	120.1	0.9
8	B2@7'				- very dense	85	122.8	2.5
10	B2@10'				- slightly moist	72	125.4	3.0
12								
14	B2@14'			SW	Sand, well-graded, very dense, slightly moist, brown to reddish brown, fine- to coarse-grained.	50 (6")	101.9	2.9

Total depth of boring: 14.5 feet
No fill.
No groundwater encountered.
Backfilled with soil cuttings and tamped.

*Penetration resistance for 140-pound hammer falling 30 inches by auto-hammer.

A9817-06-01 B1-B9 BORING LOGS.GPJ

Figure A2,
Log of Boring B2, Page 1 of 1

SAMPLE SYMBOLS
- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. A9817-06-01

BORING B3

ELEV. (MSL.) - - DATE COMPLETED 7/6/18

EQUIPMENT HOLLOW STEM AUGER BY: MDS

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT*)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0					**ALLUVIUM** Silty Sand, medium dense, dry, light yellowish brown, fine- to coarse-grained, trace gravel (to 2").			
2	B3@2'					36	129.2	1.1
4								
	B3@5'					44	116.7	2.3
6				SM				
	B3@7'				- dense	40	123.3	2.1
8								
10	B3@10'					69	123.3	1.5
12								
14	B3@14'				- very dense	50 (6")	106.6	3.6

Total depth of boring: 14.5 feet
No fill.
No groundwater encountered.
Backfilled with soil cuttings and tamped.

*Penetration resistance for 140-pound hammer falling 30 inches by auto-hammer.

Figure A3,
Log of Boring B3, Page 1 of 1

A9817-06-01 B1-B9 BORING LOGS.GPJ

SAMPLE SYMBOLS			
	... SAMPLING UNSUCCESSFUL	... STANDARD PENETRATION TEST	... DRIVE SAMPLE (UNDISTURBED)
	... DISTURBED OR BAG SAMPLE	... CHUNK SAMPLE	... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

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PROJECT NO. A9817-06-01

BORING B4

ELEV. (MSL.) - - DATE COMPLETED 7/6/18

EQUIPMENT HOLLOW STEM AUGER BY: MDS

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT*)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0					**ALLUVIUM** Silty Sand, medium dense, dry, light yellowish brown, fine- to coarse-grained, trace gravel (to 1").			
2	B4@2'					34	114.2	4.8
4				SM				
	B4@5'					38	121.4	1.0
6	B4@6.5'					50 (5")	110.3	2.1
8								
10	B4@10'				Sand, well graded, dense, slightly moist, reddish brown, fine- to coarse-grained.	63	118.9	1.8
12				SW				
14	B4@14.5'			ML	Sandy Silt, hard, dry, light yellowish brown, fine-grained, abundant calcium.	50 (6")	99.2	8.2

Total depth of boring: 15 feet
No Fill.
No groundwater encountered.
Backfilled with soil cuttings and tamped.

*Penetration resistance for 140-pound hammer falling 30 inches by auto-hammer.

A9817-06-01 B1-B9 BORING LOGS.GPJ

Figure A4,
Log of Boring B4, Page 1 of 1

SAMPLE SYMBOLS			
	☐ ... SAMPLING UNSUCCESSFUL	◧ ... STANDARD PENETRATION TEST	■ ... DRIVE SAMPLE (UNDISTURBED)
	⊠ ... DISTURBED OR BAG SAMPLE	◪ ... CHUNK SAMPLE	▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

BORING B5

ELEV. (MSL.) - - DATE COMPLETED 7/6/18

EQUIPMENT HOLLOW STEM AUGER BY: MDS

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT*)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0					**ALLUVIUM** Silty Sand, medium dense, dry, yellowish brown, fine- to coarse-grained.			
2	B5@2'			SM		28	114.2	6.3
5	B5@5'			SM		27	111.0	3.3
7	B5@7'			SM	- slightly moist, yellowish brown	43	118.2	3.3
9				SW	Sand, well-graded, medium dense, dry, brown, fine- to coarse-grained.			
10	B5@10'			SW		41	115.8	2.6
15	B5@15'			SW	- dense	68	122.4	2.0
20	B5@20'			SW		72	125.7	1.2

Total depth of boring: 20.5 feet
No fill.
No groundwater encountered.
Backfilled with soil cuttings and tamped.

*Penetration resistance for 140-pound hammer falling 30 inches by auto-hammer.

Figure A5,
Log of Boring B5, Page 1 of 1

A9817-06-01 B1-B9 BORING LOGS.GPJ

SAMPLE SYMBOLS
... SAMPLING UNSUCCESSFUL ... STANDARD PENETRATION TEST ... DRIVE SAMPLE (UNDISTURBED)
... DISTURBED OR BAG SAMPLE ... CHUNK SAMPLE ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

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PROJECT NO. A9817-06-01

BORING B6

ELEV. (MSL.) **- -** DATE COMPLETED **7/6/18**

EQUIPMENT **HOLLOW STEM AUGER** BY: **MDS**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT*)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				SM	**ALLUVIUM** Silty Sand, medium dense, dry, yellowish brown, fine- to coarse-grained.			
2	B6@2'					24	121.2	2.1
5	B6@5'					22	119.9	2.5
7	B6@7'			SW	Sand, well-graded, medium dense, slightly moist, brown, fine- to coarse-grained.	27	107.7	2.1
10	B6@10'			ML	Silt with Sand, stiff, slightly moist, brown, dark brown, fine- to coarse-grained.	39	127.1	14.2
15	B6@15'			SW	Sand, well-graded, medium dense, slightly moist, brown, fine- to coarse-grained.	30	114.9	1.9
20	B6@20'				- very dense, no recovery	50 (6")		

Total depth of boring: 20.5 feet
No fill.
No groundwater encountered.
Backfilled with soil cuttings and tamped.

*Penetration resistance for 140-pound hammer falling 30 inches by auto-hammer.

A9817-06-01 B1-B9 BORING LOGS.GPJ

Figure A6,
Log of Boring B6, Page 1 of 1

SAMPLE SYMBOLS
- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

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PROJECT NO. A9817-06-01

BORING B7

ELEV. (MSL.) - - DATE COMPLETED 7/6/18

EQUIPMENT HOLLOW STEM AUGER BY: MDS

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT*)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0					**ALLUVIUM** Silty Sand, medium dense, dry, light yellowish brown, fine- to coarse-grained, trace gravel (to 1").			
2	B7@2'					36	124.0	1.2
4								
	B7@5'					29	112.2	0.8
6				SM				
	B7@7'					46		
8								
10	B7@10'					45	116.7	1.0
12								
14								
	B7@14.5'				- very dense	50 (6")	114.3	2.6

Total depth of boring: 15 feet
No fill.
No groundwater encountered.
Backfilled with soil cuttings and tamped.

*Penetration resistance for 140-pound hammer falling 30 inches by auto-hammer.

A9817-06-01 B1-B9 BORING LOGS.GPJ

Figure A7,
Log of Boring B7, Page 1 of 1

SAMPLE SYMBOLS
... SAMPLING UNSUCCESSFUL ... STANDARD PENETRATION TEST ... DRIVE SAMPLE (UNDISTURBED)
... DISTURBED OR BAG SAMPLE ... CHUNK SAMPLE ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

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BORING B8

ELEV. (MSL.) - - DATE COMPLETED 7/6/18

EQUIPMENT HOLLOW STEM AUGER BY: MDS

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT*)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0					**ALLUVIUM** Sand, well-graded, medium dense, dry, yellowish brown, fine- to coarse-grained.			
				SW				
5	B8@5'					31	120.9	3.1
7	B8@7'			ML	Sandy Silt, hard, dry, yellowish brown, fine-grained.	38	117.5	3.7
9.5					Silty Sand, dense, slightly moist, brown, fine- to coarse-grained.			
10	B8@10'			SM		56		
14					Silt, hard, slightly moist, brown to dark brown, trace fine-grained sand, cemented.			
14.5	B8@14.5'			ML		50 (6")	116.1	2.4
18.5				ML	Sandy Silt, hard, dry, light yellowish brown, fine-grained.			
20	B8@20'					51	119.8	2.4

Total depth of boring: 20.5 feet
No fill.
No groundwater encountered.
Backfilled with soil cuttings and tamped.

*Penetration resistance for 140-pound hammer falling 30 inches by auto-hammer.

A9817-06-01 B1-B9 BORING LOGS.GPJ

Figure A8,
Log of Boring B8, Page 1 of 1

SAMPLE SYMBOLS
- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. A9817-06-01

BORING B9

ELEV. (MSL.) **- -** DATE COMPLETED **7/6/18**

EQUIPMENT **HOLLOW STEM AUGER** BY: **MDS**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT*)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0					**ALLUVIUM** Silty Sand, medium dense, dry, yellowish brown, fine- to coarse-grained, trace gravel (to 1").			
2	B9@2'					26	126.2	1.2
4								
6	B9@5'				- no recovery	17		
8	B9@7'			SM	- dense	65	121.2	1.9
10	B9@10'				- very dense, cemented, abundant calcium	50 (6")	120.5	1.2
12								
14	B9@15"				- dense	59	121.8	2.4

Total depth of boring: 15.5 feet
No Fill.
No groundwater encountered.
Backfilled with soil cuttings and tamped.

*Penetration resistance for 140-pound hammer falling 30 inches by auto-hammer.

A9817-06-01 B1-B9 BORING LOGS.GPJ

Figure A9,
Log of Boring B9, Page 1 of 1

SAMPLE SYMBOLS			
	☐ ... SAMPLING UNSUCCESSFUL	◧ ... STANDARD PENETRATION TEST	■ ... DRIVE SAMPLE (UNDISTURBED)
	⊠ ... DISTURBED OR BAG SAMPLE	◩ ... CHUNK SAMPLE	▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. A9817-06-01

BORING P1

ELEV. (MSL.) - - DATE COMPLETED 7/6/18

EQUIPMENT HOLLOW STEM AUGER BY: MDS

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT*)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0					**ALLUVIUM** Silty Sand, medium dense, dry, light yellowish brown, fine- to coarse-grained, trace gravel (to 2").			
2								
4				SM				
	P1@5'					28	120.3	1.9
6								
8								
10	P1@10'				Sand, well-graded, very dense, slightly moist, reddish brown, fine- to coarse-grained, cemented.	92	124.4	2.0
12								
14								
	P1@15'					50 (1")	110.5	3.3
16								
				SW				
18								
20	P1@20'					50 (4")	123.3	4.8
22								
24								
	P1@25'				Silty Sand, dense, slightly moist, light yellowish brown, fine-grained.	86	122.4	3.8
26								
28				SM				

Figure A10,
Log of Boring P1, Page 1 of 2

A9817-06-01 P1-P3 BORING LOGS.GPJ

SAMPLE SYMBOLS

- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

BORING P1

ELEV. (MSL.) - - DATE COMPLETED 7/6/18

EQUIPMENT HOLLOW STEM AUGER BY: MDS

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT*)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
30	P1@30'			SM	- brown, cemented, trace medium-grained	50 (4")	113.7	4.4
32								
34								
36	P1@35'			SP-SM	Sand with Silt, poorly graded, dense, dry, very light yellowish brown, fine-grained, cemented.	83	116.5	3.4
38								
40	P1@40'			SP	Sand, poorly graded, dense, dry, light yellowish brown, fine-grained.	78	110.4	1.2

Total depth of boring: 40.5 feet
No fill.
No groundwater encountered.

*Penetration resistance for 140-pound hammer falling 30 inches by auto-hammer.

Figure A10,
Log of Boring P1, Page 2 of 2

A9817-06-01 P1-P3 BORING LOGS.GPJ

SAMPLE SYMBOLS

- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

BORING P2

ELEV. (MSL.) - - DATE COMPLETED 7/6/18

EQUIPMENT HOLLOW STEM AUGER BY: MDS

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT*)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0					**ALLIUVIUM** Silty Sand, medium dense, dry, light yellowish brown, fine- to coarse-grained.			
2								
4				SM				
6	P2@5'					43	122.9	1.6
8								
10	P2@10'				- very dense, cemented	50 (5")	122.0	4.0

Total depth of boring: 10.5 feet
No fill.
No groundwater encountered.
Percolation testing performed.

*Penetration resistance for 140-pound hammer falling 30 inches by auto-hammer.

A9817-06-01 P1-P3 BORING LOGS.GPJ

Figure A11,
Log of Boring P2, Page 1 of 1

SAMPLE SYMBOLS
- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

BORING P3

ELEV. (MSL.) **- -** DATE COMPLETED **7/31/18**

EQUIPMENT **HOLLOW STEM AUGER** BY: **MDS**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT*)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0					**ALLUVIUM**			
					Sand, poorly graded, medium dense, dry, yellowish brown, fine- to medium-grained.			
2				SP				
4								
					Total depth of boring: 5 feet No fill. No groundwater encountered. Prepped for percolation testing.			

Figure A12,
Log of Boring P3, Page 1 of 1

A9817-06-01 P1-P3 BORING LOGS.GPJ

SAMPLE SYMBOLS			
	☐ ... SAMPLING UNSUCCESSFUL	◧ ... STANDARD PENETRATION TEST	■ ... DRIVE SAMPLE (UNDISTURBED)
	⊠ ... DISTURBED OR BAG SAMPLE	◪ ... CHUNK SAMPLE	▼ ... WATER TABLE OR SEEPAGE

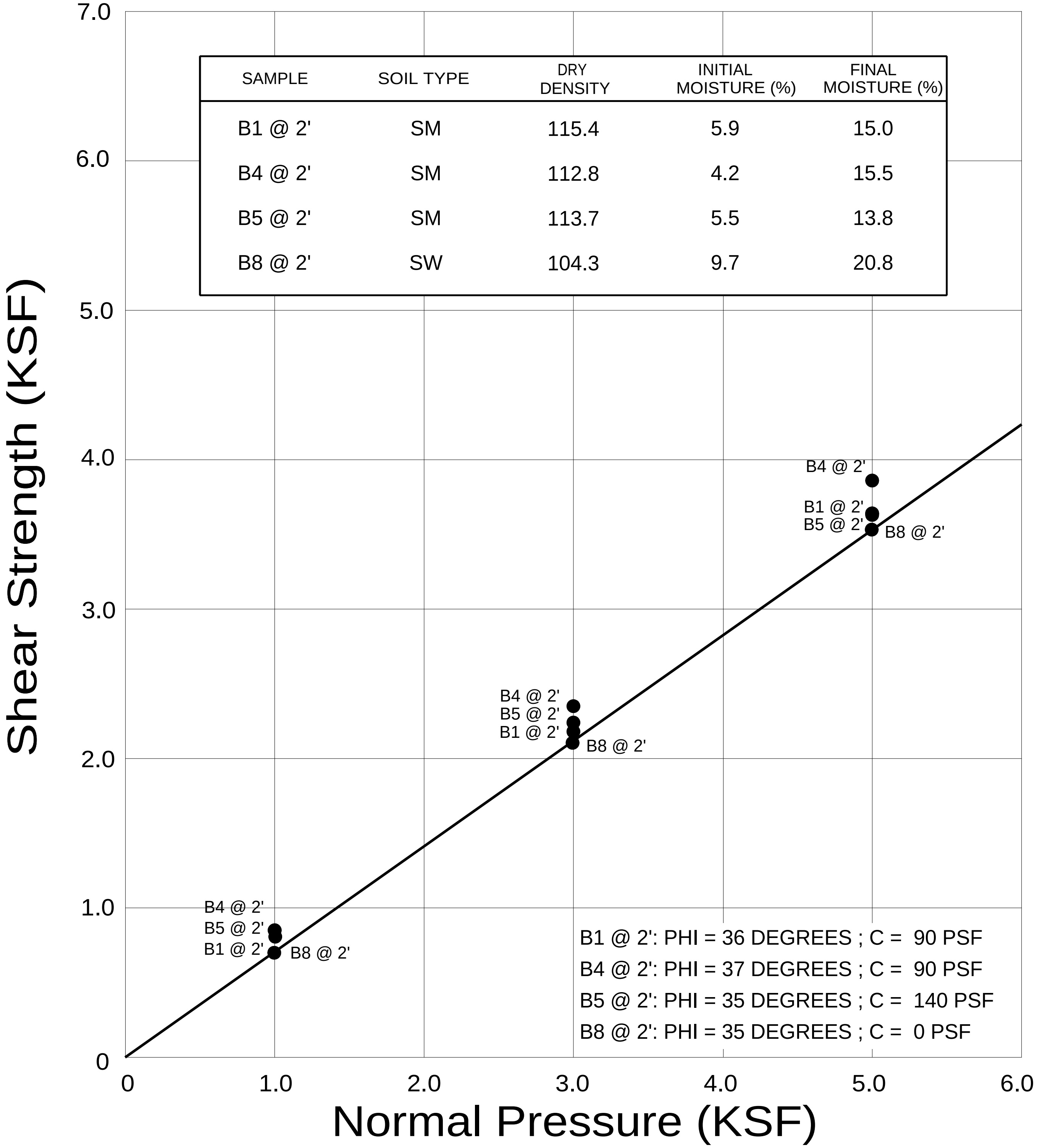
NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

APPENDIX B

APPENDIX B

LABORATORY TESTING

Laboratory tests were performed in accordance with generally accepted test methods of the “American Society for Testing and Materials (ASTM)”, or other suggested procedures. Selected samples were tested for direct shear strength, corrosivity, in-place dry density and moisture content. The results of the laboratory tests are summarized in Figures B1 through B3. The in-place dry density and moisture content of the samples tested are presented on the boring logs, Appendix A.



SAMPLE	SOIL TYPE	DRY DENSITY	INITIAL MOISTURE (%)	FINAL MOISTURE (%)
B1 @ 2'	SM	115.4	5.9	15.0
B4 @ 2'	SM	112.8	4.2	15.5
B5 @ 2'	SM	113.7	5.5	13.8
B8 @ 2'	SW	104.3	9.7	20.8

● Direct Shear, Saturated

GEOCON WEST, INC.
ENVIRONMENTAL GEOTECHNICAL MATERIALS
3303 N. SAN FERNANDO BLVD. - SUITE 100 - BURBANK, CA 91504
PHONE (818) 841-8388 - FAX (818) 841-1704

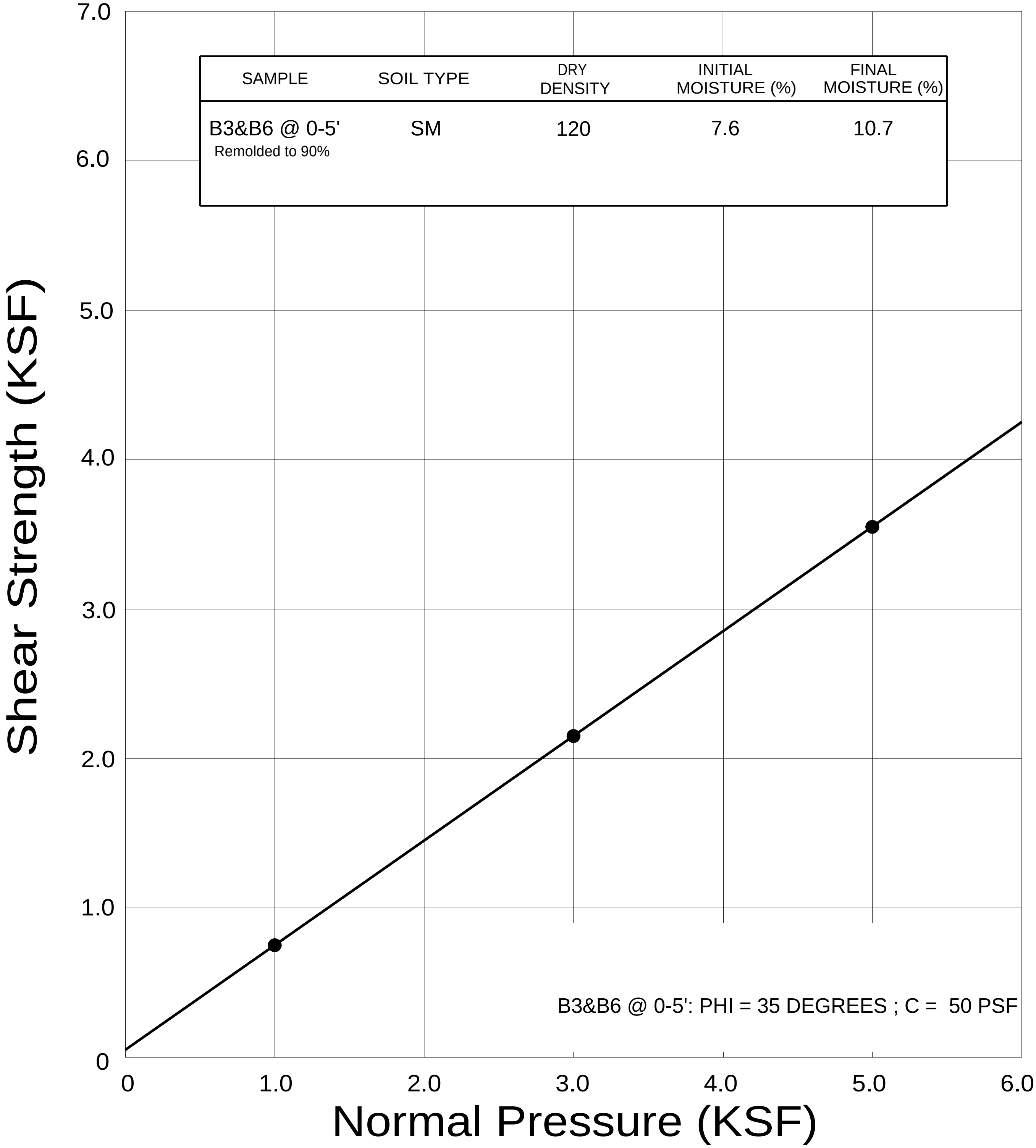
DRAFTED BY: JS	CHECKED BY: HHD

DIRECT SHEAR TEST RESULTS

PALMDALE ROAD & US 395

VICTORVILLE, CALIFORNIA

AUG 2018	PROJECT NO. A9817-06-01	FIG. B1



SAMPLE	SOIL TYPE	DRY DENSITY	INITIAL MOISTURE (%)	FINAL MOISTURE (%)
B3&B6 @ 0-5' Remolded to 90%	SM	120	7.6	10.7

● Direct Shear, Saturated

GEOCON WEST, INC.

ENVIRONMENTAL GEOTECHNICAL MATERIALS

3303 N. SAN FERNANDO BLVD. - SUITE 100 - BURBANK, CA 91504

PHONE (818) 841-8388 - FAX (818) 841-1704

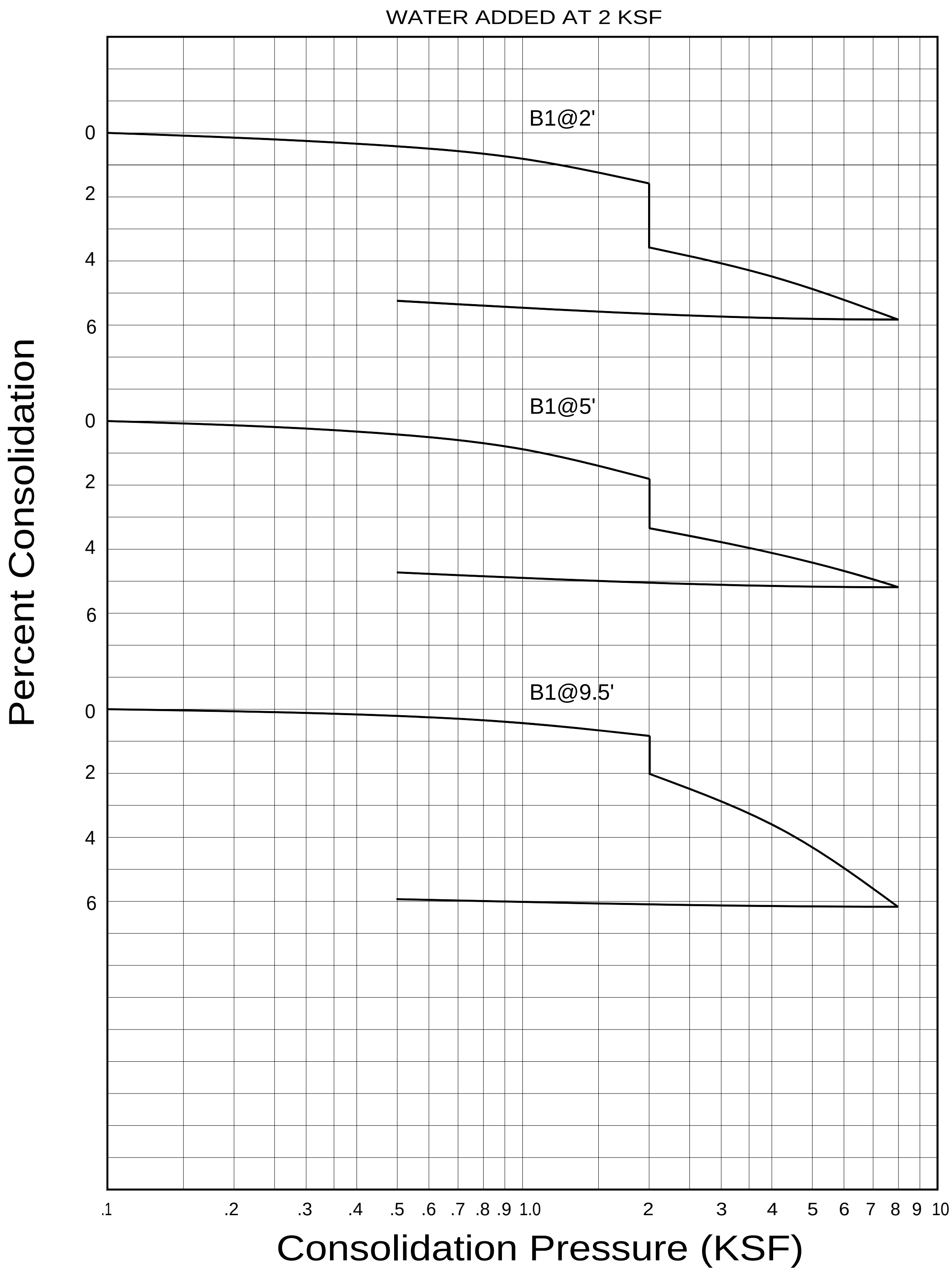
DRAFTED BY: JS | CHECKED BY: HHD

DIRECT SHEAR TEST RESULTS

PALMDALE ROAD & US 395

VICTORVILLE, CALIFORNIA

AUG 2018 | PROJECT NO. A9817-06-01 | FIG. B2



GEOCON WEST, INC.

ENVIRONMENTAL GEOTECHNICAL MATERIALS

3303 N. SAN FERNANDO BLVD. - SUITE 100 - BURBANK, CA 91504

PHONE (818) 841-8388 - FAX (818) 841-1704

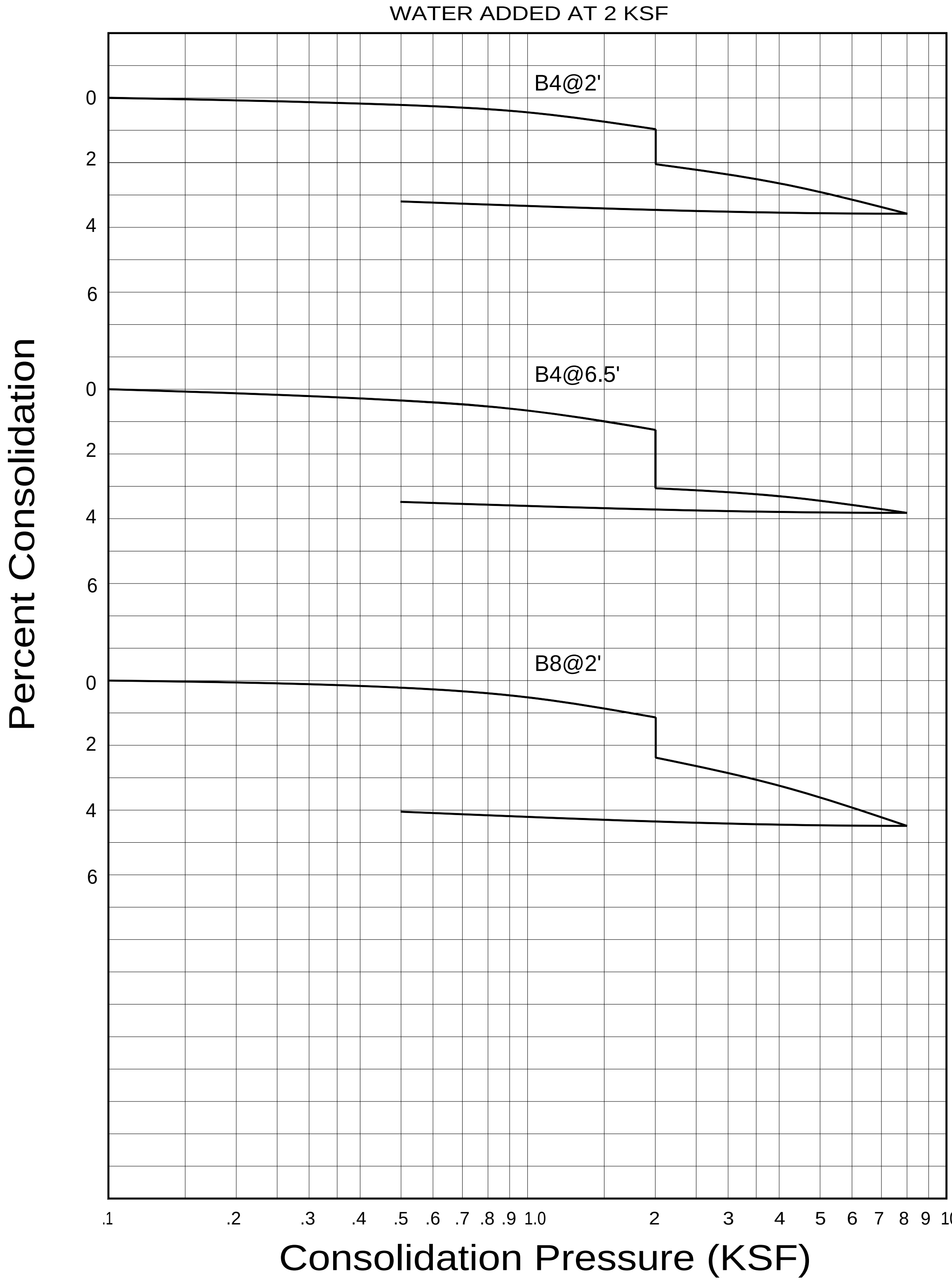
Drafted by: JS	Checked by: HHD

CONSOLIDATION TEST RESULTS

PALMDALE ROAD & US 395

VICTORVILLE, CALIFORNIA

AUG 2018	PROJECT NO. A9817-06-01	FIG. B3



GEOCON
W E S T, I N C.

ENVIRONMENTAL GEOTECHNICAL MATERIALS
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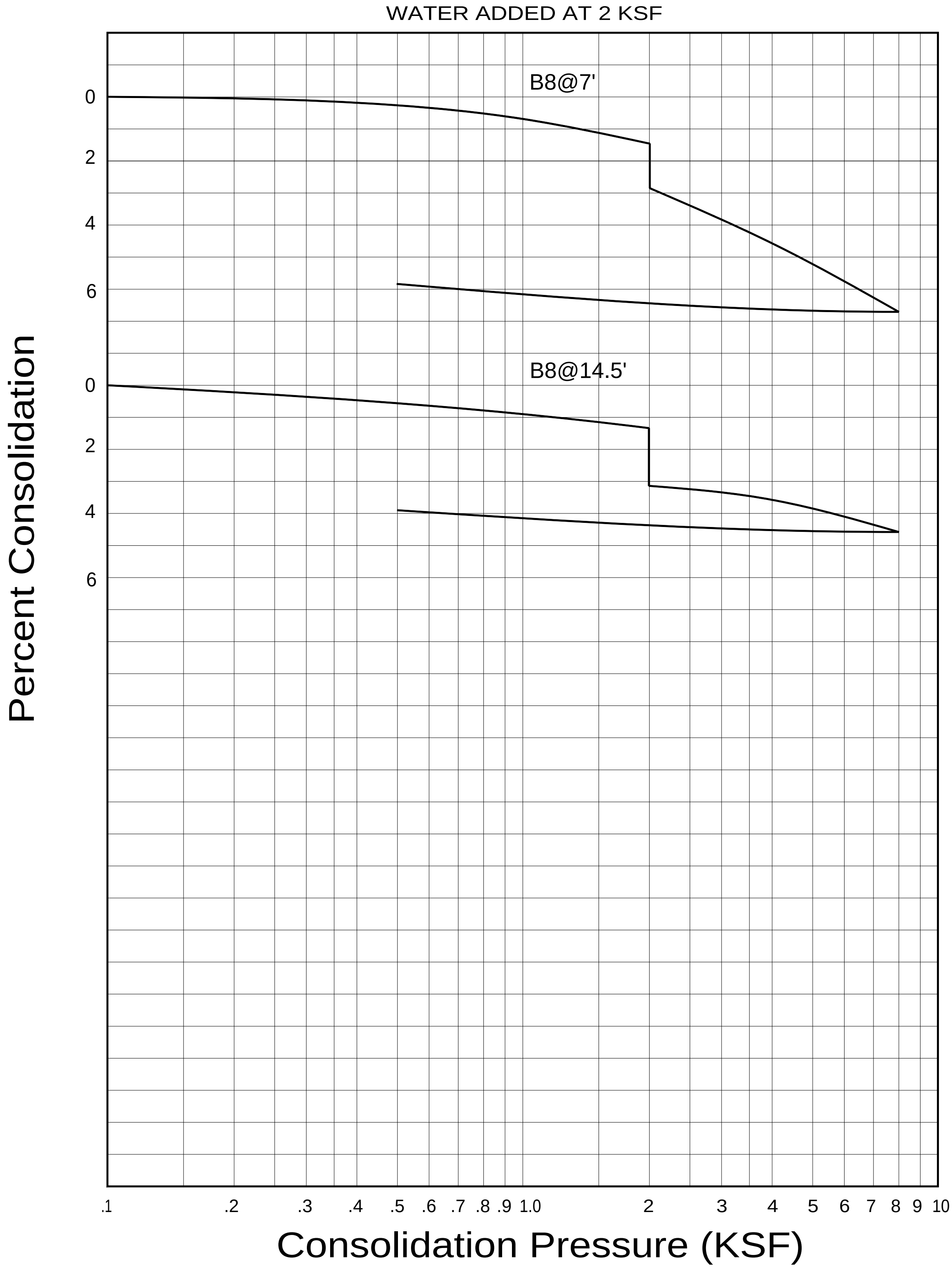
CONSOLIDATION TEST RESULTS

PALMDALE ROAD & US 395

VICTORVILLE, CALIFORNIA

AUG 2018 | PROJECT NO. A9817-06-01 | FIG. B4



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CONSOLIDATION TEST RESULTS

PALMDALE ROAD & US 395

VICTORVILLE, CALIFORNIA

AUG 2018	PROJECT NO. A9817-06-01	FIG. B5

SUMMARY OF LABORATORY EXPANSION INDEX TEST RESULTS
ASTM D 4829-11

Sample No.	Moisture Content (%)		Dry Density (pcf)	Expansion Index	*UBC Classification	**CBC Classification
	Before	After				
B3&B6 @ 0-5'	7.9	12.1	117.7	0	Very Low	Non-Expansive

* Reference: 1997 Uniform Building Code, Table 18-I-B.

** Reference: 2016 California Building Code, Section 1803.5.3

SUMMARY OF LABORATORY MAXIMUM DENSITY AND
AND OPTIMUM MOISTURE CONTENT TEST RESULTS
ASTM D 1557-12

Sample No.	Soil Description	Maximum Dry Density (pcf)	Optimum Moisture (%)
B3&B6 @ 0-5'	Light Brown Silty Sand	133.0	8.0

SUMMARY OF LABORATORY POTENTIAL OF HYDROGEN (pH) AND RESISTIVITY TEST RESULTS CALIFORNIA TEST NO. 643

Sample No.	pH	Resistivity (ohm centimeters)
B3&B6 @ 0-5'	8.36	18000 (Mildly Corrosive)

SUMMARY OF LABORATORY CHLORIDE CONTENT TEST RESULTS EPA NO. 325.3

Sample No.	Chloride Ion Content (%)
B3&B6 @ 0-5'	0.004

SUMMARY OF LABORATORY WATER SOLUBLE SULFATE TEST RESULTS CALIFORNIA TEST NO. 417

Sample No.	Water Soluble Sulfate (% SO_4)	Sulfate Exposure*
B3&B6 @ 0-5'	0.000	Negligible

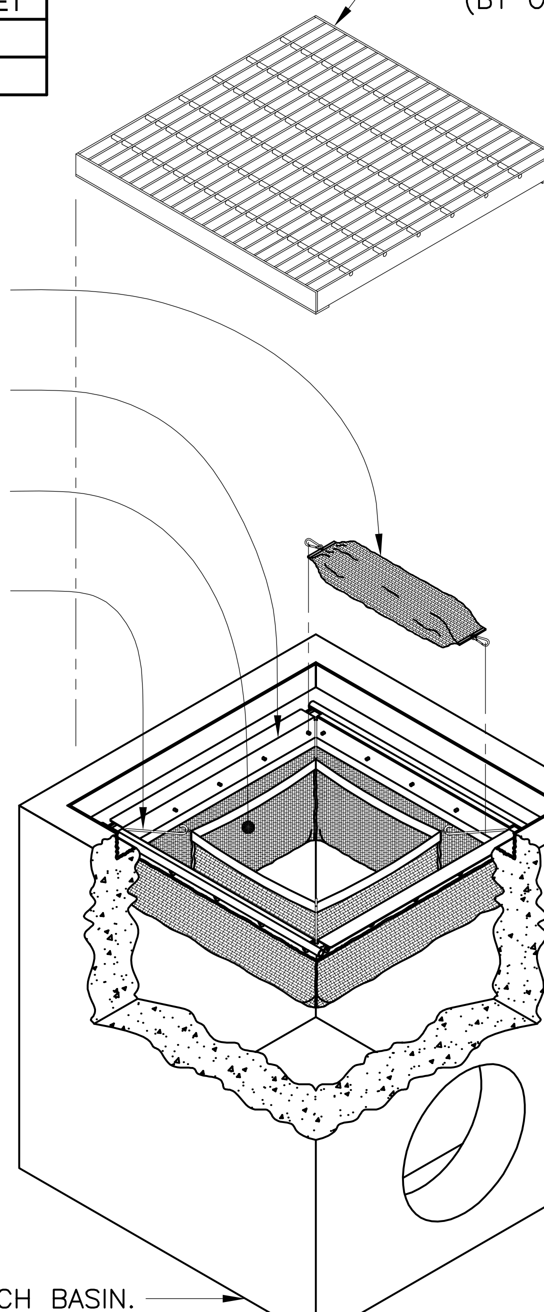
* Reference: 2016 California Building Code, Section 1904.3 and ACI 318-11 Section 4.3.

APPENDIX 8- PROPERITOR DEVICE PRODUCT INFORMATION

FG-0001

SPECIFIER CHART

MODEL	INLET ID	GRATE OD	COMMENTS
FF-12D	12" X 12"	15" X 15"	GRATED INLET
FF-16D	16" X 16"	18" X 18"	GRATED INLET
FF-18D	18" X 18"	20" X 20"	GRATED INLET
FF-1836SD	18" X 36"	18" X 40"	GRATED INLET
FF-1836DGO	18" X 36"	18" X 40"	COMBINATION INLET
FF-24D	24" X 24"	26" X 26"	GRATED INLET
FF-2436SD	24" X 36"	24" X 40"	GRATED INLET
FF-24DGO	24" X 24"	18" X 26"	COMBINATION INLET
FF-2436DGO	24" X 36"	24" X 40"	COMBINATION INLET
FF-36D (2 PIECE)	36" X 36"	36" X 40"	GRATED INLET
FF-3648D (2 PIECE)	36" X 48"	40" X 48"	GRATED INLET



NOTES:

1. Filter insert shall have a high flow bypass feature.
2. Filter support frame shall be constructed from stainless steel Type 304.
3. Filter medium shall be *Fossil Rock* ™, installed and maintained in accordance with manufacturer specifications.
4. Storage capacity reflects 80% of maximum solids collection prior to impeding filtering bypass.

Inlet Filtration

FloGard®

Catch Basin Insert Filter

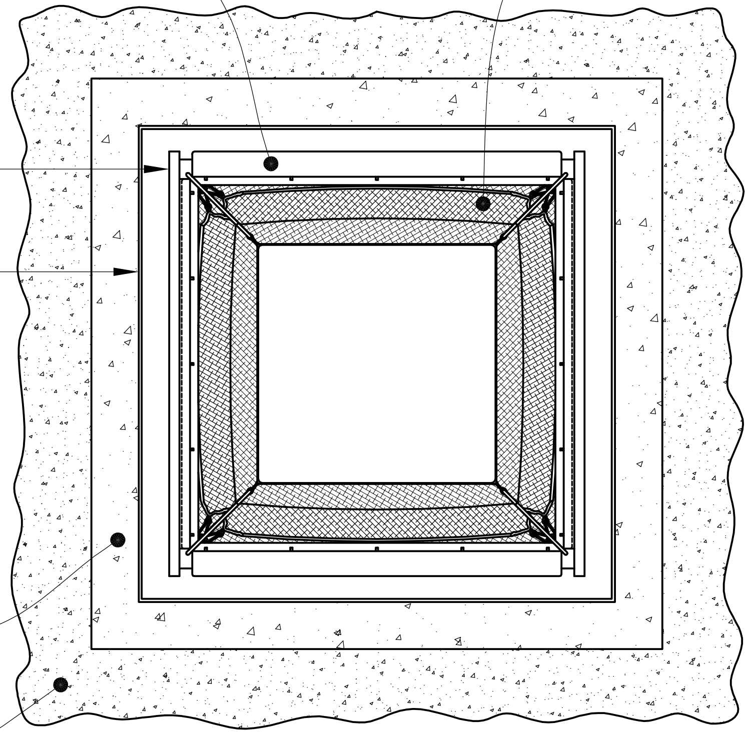
Grated Inlet Style

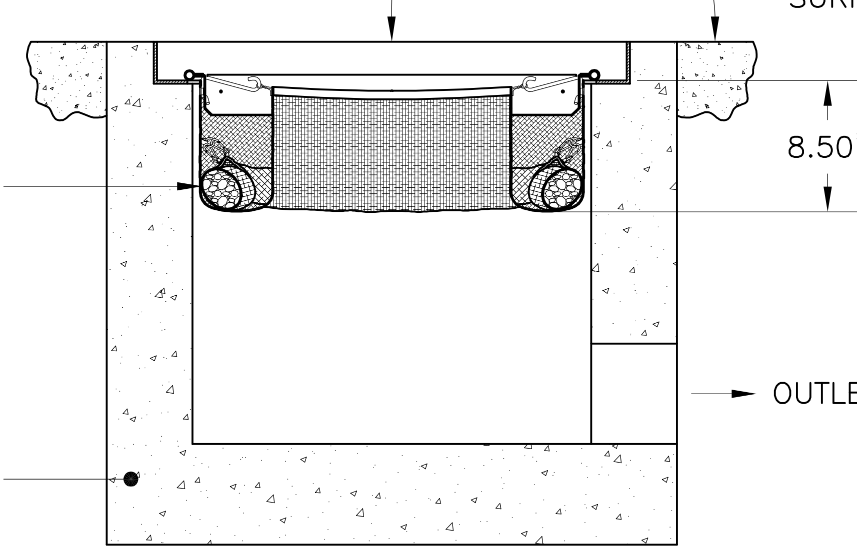
Oldcastle® Stormwater Solutions

7921 Southpark Plaza, Suite 200 | Littleton, CO | 80120 | Ph: 800.579.8819 | oldcastlestormwater.com

DRAWING NO.	REV	ECO	DATE	
FG-0001	E	ECO-0142 JPR 7/13/16	JPR 12/18/06	SHEET 1 OF 2

FG-0001





SECTION VIEW

Inlet Filtration

FloGard®

Catch Basin Insert Filter

Grated Inlet Style

Oldcastle® Stormwater Solutions

7921 Southpark Plaza, Suite 200 | Littleton, CO | 80120 | Ph: 800.579.8819 | oldcastlestormwater.com

DRAWING NO.	REV	ECO	DATE	
FG-0001	E	ECO-0142 JPR 7/13/16	JPR 12/18/06	SHEET 2 OF 2

STORMTANK®

THE PREMIER
MULTI-SOLUTION PROVIDER

CASE STUDY:
Leinenkugel 10th Street Brewery

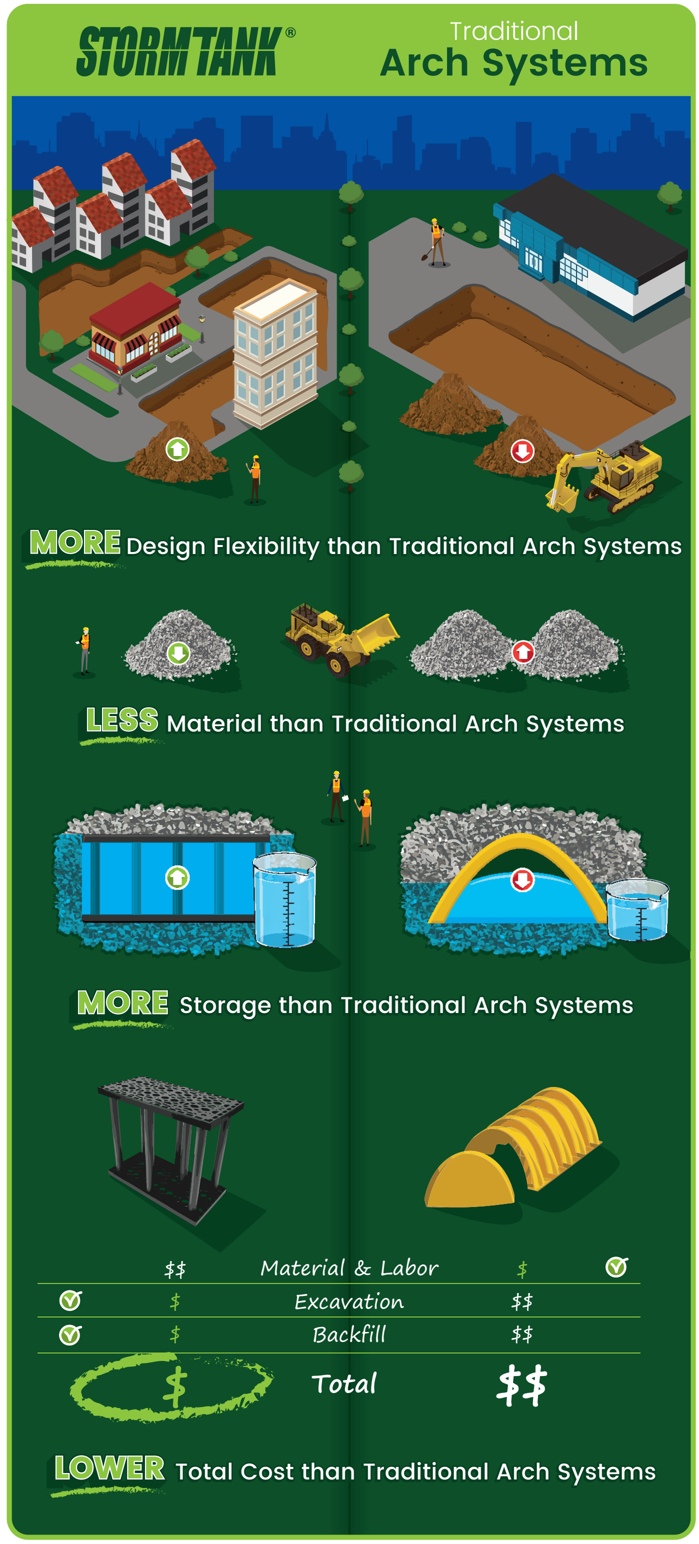
The Leinenkugel plant in Milwaukee, Wisconsin, took on a $50 million project to expand the 10th Street Brewery. The goal of the expansion was to enlarge both the brewhouse and the tank cellar, with the expectation of growing operations by ten-fold and multiplying the number of local jobs.

Leinekugel enlisted the help of a well-known engineering firm: Systems Design Engineering, Inc. (SDEI). Having designed expansions for other breweries and been recognized by the MillerCoors company as a valued partner, SDEI was the clear choice for this project.

Similarly, SDEI knew the site plan would require significant stormwater storage and reached out to a trusted partner: Brentwood's StormTank team. SDEI knew from experience that they could count on Brentwood for assistance with developing a stormwater management system to both fit within site constraints and meet the necessary storage requirements.

The StormTank team collaborated with SDEI to draft system design options, assisted the designer in locating an impermeable liner that would provide maximum storage capacity, and provided a local distributor contact for contractors bidding the project. The distributor, American Infrastructure, Inc., sold the material and assisted with the StormTank Module system installation by providing on-site support during the construction phase.

Brentwood's responsiveness allowed SDEI to develop a site plan that would go from concept to full-on installation in less than a year. Successfully installed in August 2017, the StormTank Module system offered a large amount of void space and load-bearing capacity to support the Leinenkugel expansion and kept the project on track. These features ultimately enabled the brewer to expand operations and meet growing demands... Cheers!



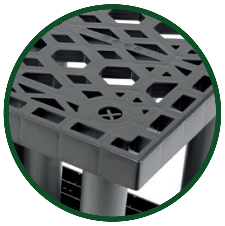
MADE IN THE USA

BRENTWOOD®

STORMTANK® THE PREMIER MULTI-SOLUTION PROVIDER

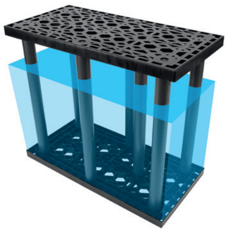
The Module

The Brentwood StormTank Module is a subsurface stormwater storage unit load-rated for use under surfaces such as parking lots, athletic fields, and parks. Its design provides maximum storage while minimizing the installation footprint to reduce construction costs and allow for utilization of valuable land. The Module is commonly used for detention, infiltration, and rainwater harvesting applications but can also be utilized for flood mitigation and bio-retention.



Top & Bottom Panels

The Module's top and bottom panels are injection molded from polypropylene. They are engineered for strength and uniformly distribute load to the columns.

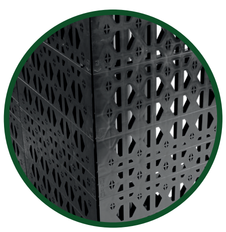


High Void Space

The Module offers up to the largest void space of any subsurface stormwater management system currently on the market, with models providing as much as 97 percent.

Reinforced Columns

Extruded from PVC and designed with reinforcing structural ribs, the Module's columns maximize strength. System stackability and variable column height accommodate tight site constraints.



Side Panels

Side panels are used around the perimeter of the Module system to prevent fill material from entering and are injection molded from polypropylene.

Height	Nominal Void Space
18 in (457 mm)	95.5%
24 in (610 mm)	96.0%
30 in (762 mm)	96.5%
33 in (838 mm)	96.9%
36 in (914 mm)	97.0%

Additional StormTank Products:

The Shield

Brentwood's StormTank Shield provides a low-cost solution for stormwater pretreatment by reducing pollutant discharge.

The Pack

The StormTank Pack is the light-duty solution for subsurface stormwater management.

BRENTWOOD®

BRENTWOOD INDUSTRIES, INC.
brentwoodindustries.com
stormtank@brentw.com
+1.610.374.5109

APPENDIX 9- HYDROLOGY ANALYSIS (FOR REFERENCE)

BLUE PEAK ENGINEERING

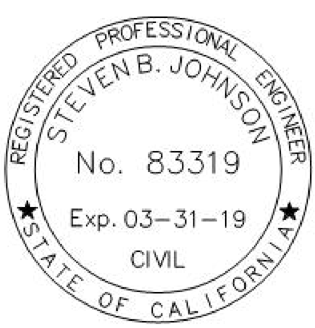
PRELIMINARY DRAINAGE STUDY

For:
Victorville Retail Project
SWC US 395 & SR-18
Victorville, CA.

Prepared by:
Blue Peak Engineering, Inc.
18543 Yorba Linda Blvd., #235
Yorba Linda, CA 92886
(714) 749-3077

Date: November 26, 2018
Revised: 03/01/2019

This study was prepared under my responsible charge:



	03/01/2019
Steven Johnson, P.E.	**Date**

Section I **Project Description**

INTRODUCTION

This report has been prepared to analyze the hydrological and hydraulic effects of the Victorville Retail Project at the SWC of US 395 & SR 18.

IMPROVEMENTS

The subject property is currently undeveloped. The existing burger king building at the northeast corner of the site is not a part of the scope.

The proposed development for 15.39 acres. The new development will include street dedications resulting in a total onsite area of 14.80 acres, which includes, 10 buildings at a total gross building area of approximately 96,300 square feet. The project will be divided into two main phases; phase 1 will includes 36,500 square feet of building, the Master Storm Drain Line E-01, the onsite storm drain systems, and all water quality BMPs, phase 2 will include the construction of 60,000 square feet of building. Both phases will also include the development of new AC parking lots, drive isles, sidewalks, and landscaping.

EXISTING DRAINAGE PATTERN

The existing drainage pattern within the proposed development area sheet flows from the southwest to the northeast, towards an existing Caltrans drainage outlet structure located adjacent to Palmdale Road in a Caltrans Easement, tributary to two 7'x3' RCB culverts that cross Palmdale Road and connect into the existing 8'x7' box culvert master storm drain north of Palmdale Road.

As part of the proposed improvements and per Victorville Master Plan Drainage Study, a proposed regional 84" RCP storm drain will be installed in Highway 395, adjacent to the proposed project site, and sweep across the proposed site in a drainage easement, at which point the storm drain transitions to 2-7'x3' RCB culverts, for the ultimate connection to the existing two 7'x3' RCB culverts.

As part of the preliminary drainage study, Victorville's proposed regional 84" RCP storm drain and 2-7'x3' RCB culvert sizing will be confirmed given the already calculated flow rates provided by Ludwig Engineering's Drainage Study and Exhibit attached in the Appendix.

For analyzing the pre and post development runoff rate, there are two existing onsite drainage sub-areas, Areas AA3.1 and AA3.2.

Subarea AA3.1:
This area is 13.75 acres onsite, that sheet flows from the southwest to the northeast Caltrans drainage outlet structure located adjacent to Palmdale Rd. Currently this entire sub-area is undeveloped, however there are two natural drainage flowlines conveying the majority of the undeveloped runoff to the existing Caltrans drainage outlet structure, tributary to the two 7'x3' RCB which crosses Palmdale Road and connects to the drainage inlet structure north of Palmdale Road.

Subarea AA3.2:
This area is 1.01 acres located at the northwest corner of the site. Currently the runoff sheet flows from the site into Palmdale Road curb and gutter, and discharges into the grated inlet at the existing Burger King driveway entrance, in Palmdale Road. The grated inlet discharges into an existing 18" storm drain line crossing Palmdale Road and connecting into the existing drainage inlet structure on the north side of Palmdale Road.

DEVELOPED DRAINAGE PATTERN

Generally, the developed drainage pattern is consistent with the existing drainage pattern. The developed site drainage is divided into eight drainage areas (DA-1 to DA-9) with twenty two subareas (A-V), all tributary to one ultimate outfall location (Outlet 1).

Drainage Area 1:
Subareas P and M contribute to Drainage Area 1, which collects the 100-year storm event in an underground retention system, promoting the natural soils infiltration rate.

Subarea Area P:
This subarea is 0.36 acres located at the southeast corner of the site. This area is designed to sheet flow and collect the subarea's runoff via curb and gutter, tributary to the curb inlet basin (CB-P) which connects directly to the underground retention system (DT-1) located in subarea M.

Subarea Area M:
This subarea is 1.42 acres located at the southeast corner of the site. This area is designed to sheet flow and collect the subarea's runoff via curb inlet basin (CB-M) which connects directly to the underground retention system (DT-1) located within this subarea.

Drainage Area 2:
Subareas L, N, and O contribute to Drainage Area 2, which collects the 100-year storm event in an underground retention system, promoting the natural soils infiltration rate.

Subarea Area L:
This subarea is 0.24 acres located at the southeast corner of the site. This area is designed to sheet flow and collect the subarea's runoff via curb and gutter, tributary to the curb inlet basin (CB-L) which connects directly to the underground retention system (DT-2) located in subarea L.

Subarea Area N:
This subarea is 0.51 acres located at the southeast corner of the site, within the proposed gas station parcel. This area is designed to collect the runoff via grated catch basin inlet (CB-N) and connect directly into the underground retention system (DT-2) located in Subarea L.

Subarea Area O:
This subarea is 0.31 acres located at the southeast corner of the site, within the proposed gas station parcel. This area is designed to collect the runoff via grated catch basin inlet (CB-O) and connect directly into the underground retention system (DT-2) located in Subarea L.

Drainage Area 3:
Subareas I and J contribute to Drainage Area 3, which collects the 100-year storm event in an underground retention system, promoting the natural soils infiltration rate.

Subarea Area I:
This subarea is 0.16 acres located west, in between Pads 9 and 10. This subarea will sheet flow to curb inlet (CB-I) that connects directly to the underground retention system (DT-3) located in subarea J.

Subarea Area J:
This subarea is 1.41 acres located west, adjacent to Pad 9. This subarea will sheet flow to a curb inlet (CB-J) that connects directly to the underground retention system (DT-3) located within this subarea.

Drainage Area 4:
Subareas C, D, F, G and V contribute to Drainage Area 4, which collects the 100-year storm event in an underground retention system, promoting the natural soils infiltration rate.

Subarea Area C:
This subarea is 0.42 acres located north, in between Pads 2 and 3. This subarea will sheet flow to a curb inlet (CB-C) that connects directly to the underground retention system (DT-4) located within this subarea D and F. The curb inlet acts as a diversion structure, diverting the necessary 100-year storm event (low-flow) to the underground retention system. The high-flow will be piped via storm drain and connect directly into the proposed Regional storm drain main.

Subarea Area D:
This subarea is 1.87 acres located north, south of Pad 3. This subarea will sheet flow to a curb inlet (CB-D) that connects directly to the underground retention system (DT-4) located within this subarea D and F. The curb inlet acts as a diversion structure, diverting the necessary 100-year storm event (low-flow) to the underground retention system. The high-flow will be piped via storm drain and connect directly into the proposed Regional storm drain main.

Subarea Area F:
This subarea is 2.55 acres located at the center of the site, east of Pad 8. This subarea will sheet flow to a curb inlet (CB-F) that connects directly to the underground retention system (DT-4) located within this subarea D and F. The curb inlet acts as a diversion structure, diverting the necessary 100-year storm event (low-flow) to the underground

retention system. The high-flow will be piped via storm drain and connect directly into the proposed Regional storm drain main.

Subarea Area G:
This subarea is 0.78 acres located at the center of the site, west of Pad 4. This subarea will sheet flow to a curb inlet (CB-G) that connects directly to the underground retention system (DT-4) located within this subarea D and F. The curb inlet acts as a diversion structure, diverting the necessary 100-year storm event (low-flow) to the underground retention system. The high-flow will be piped via storm drain and connect directly into the proposed Regional storm drain main.

Subarea Area V:
This subarea is 0.29 acres located west of the site, adjacent to the right of way and future Fern Hill Street. This subarea will sheet flow to a curb inlet (CB-V) that connects directly to the underground retention system (DT-4) located within this subarea D and F.

Drainage Area 5:
Subareas H contributes to Drainage Area 5.

Subarea Area H:
This subarea is 0.31 acres located at the west of the site, adjacent to the right of way and the future Fern Hill Street. This subarea will sheet flow offsite into the future Fern Hill Street. This subarea is small in comparison to the entire site area, therefore, has minimal offsite impacts. In addition, this subarea has been included in the overall site discharge calculations, therefore equivalently accounting for this subarea to not increase 90% of the 100-year storm event.

Drainage Area 6:
Subareas A, B and E contribute to Drainage Area 6, which collects the 100-year storm event in an underground retention system, promoting the natural soils infiltration rate.

Subarea Area A:
This subarea is 0.74 acres located at the northwest, including Pads 1. This subarea will sheet flow to a curb inlet (CB-A) that connects directly to the underground retention system (DT-6) located within this subarea A. The curb inlet acts as a diversion structure, diverting the necessary 100-year storm event (low-flow) to the underground retention system. The high-flow will be piped via storm drain and connect directly into the proposed Regional storm drain main.

Subarea Area B:
This subarea is 0.23 acres located at the main drive entrance, in between Pads 1 and 2. This subarea will sheet flow to a curb inlet (CB-B) that connects directly to the underground retention system (DT-6) located within this subarea A. The curb inlet acts as a diversion structure, diverting the necessary 100-year storm event (low-flow) to the underground retention system. The high-flow will be piped via storm drain and connect directly into the proposed Regional storm drain main.

Subarea Area E:
This subarea is 0.32 acres located east, adjacent to Pad 8. This subarea will sheet flow to a grated inlet (CB-E) that connects directly to the underground retention system (DT-6) located within this subarea A. The curb inlet acts as a diversion structure, diverting the necessary 100-year storm event (low-flow) to the underground retention system. The high-flow will be piped via storm drain and connect directly into the proposed Regional storm drain main.

Drainage Area 7:
Subareas S and Q contribute to Drainage Area 7, which sheet flows the runoff offsite.

Subarea Area S:
This subarea is 0.91 acres located north of the site, adjacent to the existing burger king site. This subarea will sheet flow into a proposed grated inlet (CB-S), adjacent to the existing Caltrans Drainage Structure. This subarea is located at the site's low point and cannot connect directly to an onsite underground retention system; therefore, the runoff from this area will be collected via grated inlet and discharged directly into the proposed 60" Regional storm drain system. This subarea is small in comparison to the entire site area, therefore, has minimal offsite impacts. In addition, this subarea has been included in the overall site discharge calculations, therefore equivalently accounting for this subarea to not increase 90% of the 100-year storm event.

Subarea Area Q:
This subarea is 0.23 acres located at the north of the site, adjacent to the right of way in Highway 18. This subarea will sheet flow offsite into Palmdale Road. This subarea is small in comparison to the entire site area, therefore, has minimal offsite impacts. In addition, this subarea has been included in the overall site discharge calculations, therefore equivalently accounting for this subarea to not increase 90% of the 100-year storm event.

Drainage Area 8:
Subarea R contributes to Drainage Area 8, which sheet flows the runoff offsite.

Subarea Area R:
This subarea is 0.34 acres located at the east of the site, adjacent to the right of way in Highway 395. This subarea will sheet flow offsite into Highway 395. This subarea is small in comparison to the entire site area, therefore, has minimal offsite impacts. In addition, this subarea has been included in the overall site discharge calculations, therefore equivalently accounting for this subarea to not increase 90% of the 100-year storm event.

Drainage Area 9:
Subarea K, U, and T contribute to Drainage Area 9, which collects the 100-year storm event in an underground retention system, promoting the natural soils infiltration rate.

Subarea Area K:
This subarea is 0.94 acres located at the center of the site, west of Pad 5. This subarea will sheet flow the runoff into a flowline within the finger island planter and will be collected by a downstream grated inlet within the landscape area. The grated inlet acts as a diversion structure, diverting the necessary 100-year storm event (low-flow) to the underground retention system. The high-flow will be piped via storm drain and connect directly into the proposed Regional storm drain main.

Subarea Area U:
This subarea is 0.28 acres located east of Pad 5, adjacent to US Route 395. This subarea will sheet flow the runoff to a curb inlet located within the proposed drive-thru. The curb inlet (CB-U) will connect directly into the underground retention system (DT-8) located in Subarea G.

Subarea Area T:
This subarea is 0.23 acres located east of Pad 4, adjacent to US Route 395. This subarea will sheet flow the runoff to a curb inlet located within the proposed drive-thru. The curb inlet (CB-T) will connect directly into the underground retention system (DT-8) located in Subarea G.

HYDROMODIFICATION

As required by the City of Victorville, the runoff from the developed site must not be greater than 90% of the pre-development 100-year storm event. Per the San Bernardino County Technical Guideance Document, Hydromodification shall not exceed the 10-year storm event from pre to post development volume and flow rate.

Both of these design parameters were used in the HydroCAD calculations included in the Appendix and as summarized below.

Project Area (643,066sf)	100-Year			10-Year		
	Runoff Volume (cf)	Peak Flow Rate (cfs)		Runoff Volume (cf)	Peak Flow Rate (cfs)	
Existing Conditions	181,340	49.27		86,162	23.17	
Proposed Conditions	55,539	41.70		24,437	19.52	

As concluded, the site has reduced the post-development peak flow rate and runoff volumes by implementing onsite underground retention systems; therefore, the site will have no negative impacts downstream.

RUN-ON

As described above, site run-on is anticipated from the undeveloped site located south of the proposed development, as well as site run-on from the developed housing Tract 16677 southwest of the proposed Victorville Retail project. Per Ludwig Engineering's Hydrology Analysis, the total run-on for the adjacent lots south and southeast of the proposed Fern Pine Street, tributary to Highway 395, results in a peak 100 year flow rate of 47 cfs (portion of AA2 plus AA3 as provided on Ludgwig Engineering's Exhibit).

Additional site run-on is additionally anticipated for the developed and undeveloped lots west of Fern Pine Street, tributary to Palmdale Road. Per Ludwig Engineering's Hydrology Analysis, the total run-on is 94 cfs (portions of AA1, AA6, AA7, and AA8 as provided on Ludwig Engineering's Exhibit).

As part of the proposed development, catch basin inlets or riser inlet pipes are placed onsite, at two locations; one adjacent to Highway 395 to collect the run-on from east of the proposed Fern Pine Street, and one in the knuckle of the proposed Fern Pine Street to collect run-on from west of the future road. Currently there is no existing inlet within Highway 395 or the proposed Fern Pine Street.

This run-on has been included in sizing the Regional Master Storm Drain System.

MASTER STORM DRAIN LINE E-01

As part of the proposed improvements and per Victorville Master Plan Drainage Study, a proposed regional 84" RCP storm drain E-01 will be installed adjacent to Highway 395, on the proposed development within a dedicated easement, and sweep across the proposed site at which point the storm drain will transition to 2-7'x3' RCB culverts, for the ultimate connection to the existing two 7'x3' RCB culverts at the north end of the site.

As part of the preliminary drainage study, Victorville's proposed regional 84" RCP storm drain and 2-7'x3' RCB culvert sizing will be confirmed given the already calculated flow rates provided by Ludwig Engineer's Drainage Study and Exhibits provided in the Appendix. Additional refer to Section V herein for further information.

As described above, run-on is anticipated for the lots south of the proposed development. A temporary inlet will be placed in highway 395, at the southwest corner of the site and within the existing flowline, to collect site run-on and convey to the proposed Master Storm Drain Line E-01.

RUN-ON PUBLIC STORM DRAIN LINE E-01.A

As described above, run-on is anticipated from the lots west of the future Fern Pine Street. As part of the proposed development and phase 1 construction, a public storm drain line will be installed to collect the existing site run-on at the future Fern Pine Street knuckle. This un-on storm drain line E-01.A will collect and convey the runoff to the Master Storm Drain Line E-01.

The pipe has been sized accordingly herein this report.

OFFSITE FACILITIES:

There is an existing drop inlet basin just west of the existing Caltrans Outlet Structure, within the gutter of Palmdale Road. As part of the road widening on Palmdale Road, the existing gutter flowline will be relocated as well as the existing drop inlet. The relocated inlet will be south of the existing condition and the existing 18" storm drain will be extended to the new inlet location.

Section II **Methodology**

RUNOFF DETERMINATION METHODS
(ONSITE ONLY)

Two main methods are used in the San Bernardino County area to determine design discharges, the Rational Method and the Unit Hydrograph method.

The Rational Method is used for determining the peak runoff values for the pre-developed conditions.

The Rational Method is also used for calculating the time of concentration values for the post-developed conditions.

The Unit-Hydrograph Method is used for creating the runoff hydrographs for the post-developed conditions. These hydrographs are then routed through the proposed retention basin. The 2, 10, and 100 Year storms are analyzed and routed through the proposed detention basin to ensure that the outflow from the basin will not exceed 90% of the pre-developed peak flow.

RATIONAL METHOD
(ONSITE ONLY)

The Rational method is based on the following equation:

Q = C I A

Where:
Q = peak discharge, in cubic feet per second (cfs)

C = runoff coefficient, proportion of the rainfall that runs off the surface (no units)

C=0.9*(ai+((I-Fp)*ap)/I); for I greater than Fp
C=0.90*ai; for I less than or equal to Fp

I = average rainfall intensity for a duration equal to the Tc for the area, in inches per hour (Note: If the computed Tc is less than 5 minutes, use 5 minutes for computing the peak discharge, Q). I is obtained from the Intensity-Duration Curves from the SB Manual.

A = drainage area contributing to the design location, in acres

a_i = Impervious area percentage

a_p = Pervious area percentage

F_p = Loss rate for Soils Group B (in/hr) from San Bernardino County Hydrology Manual

Curve Numbers:
Curve numbers are obtained from Figure C-8 of the San Bernardino County Hydrology Manual, for Herbaceous Cover, Soil B, 40% cover density, undeveloped; CN=74.

The value for developed commercial is obtained from Figure C-3, Urban Landscape, Soil B; CN=56.

AMC III will be used.

Section III Rational Method Hydrology Calculations

Runoff Calculations
(Onsite)

The San Bernardino County Hydrology Methodology was used, and the HydroCAD program calculated the existing and proposed runoff for the project for the 2-, 10-, and 100-Year Storm Events. Below is a summary of the calculations concluded. Refer to the appendix for the complete calculations performed.

Existing Condition

SUBBAREA AA3.1
Tc=24 Min.
0% Impervious
Flow Length=580'
CN=88
A=13.79 Acres

Storm Event	Rainfall Depth	Q (cfs)
2	1.49	7.63
10	2.64	20.63
100	4.70	45.84

SUBBAREA AA3.2
Tc=18.5 Min.
0% Impervious
Flow Length=870'
CN=88
A=1.010 Acres

Storm Event	Rainfall Depth	Q (cfs)
2	1.49	0.66
10	2.64	1.75
100	4.70	3.88

Total Q100 Pre Development = 49.41 cfs

Proposed Condition

Storm Event (2-Year)
Rainfall Depth=1.49”

DA	DMA	Area (ac).	Impervious	Slope (ft/ft)	Length	Q (cfs)
DA-1 (Dt-1)	P	0.36	0.85	1.7	164	0.75
	M	1.42	0.85	1.1	329	2.66
DA-2 (Dt-2)	L	0.24	0.85	1	122	0.5
	N	0.51	0.85	1.1	215	1.03
	O	0.31	0.85	1.5	190	0.64
DA-3 (Dt-3)	I	0.16	0.85	0.7	129	0.35
	J	1.41	0.85	2	256	2.88
DA-4 (Dt-4)	V	0.29	0.85	0.5	185	0.57
	D	1.82	0.85	2.3	457	3.38
	G	0.78	0.85	1.2	243	1.48
	F	2.55	0.85	1.5	553	4.21
	C	0.42	0.85	1.6	249	0.86
DA-6 (Dt-6)	A	**0.74**	0.85	0.7	182	1.49
	B	**0.23**	0.85	1.6	153	0.48
	E	**0.32**	0.85	0.4	394	0.51
DA-9 (Dt-9)	T	**0.23**	0.85	0.5	127	0.47
	U	**0.28**	0.85	1	125	0.58
	K	**0.94**	0.85	1	254	1.85
SUBTOTAL		**13.01**				**24.69**

Runoff

DA	DMA	Area (ac).	Impervious	Q(cfs)
DA-5	H	0.31	0.85	0.67
DA-7	S	0.91	0.85	1.87
	Q	0.23	0.85	0.49
DA-8	R	0.34	0.1	0.11
SUBTOTAL		**1.79**		**3.14**

Storm Event (10-Year)

Rainfall Depth=2.64"

DA	DMA	Area (ac).	Impervious	Slope (ft/ft)	Length	Q (cfs)
DA-1 (Dt-1)	P	0.36	0.85	1.7	164	1.4
	M	1.42	0.85	1.1	329	4.99
DA-2 (Dt-2)	L	0.24	0.85	1	122	0.9
	N	0.51	0.85	1.1	215	1.93
	O	0.31	0.85	1.5	190	1.2
DA-3 (Dt-3)	I	0.16	0.85	0.7	129	0.63
	J	1.41	0.85	2	256	5.4
DA-4 (Dt-4)	V	0.29	0.85	0.5	185	1.06
	D	1.82	0.85	2.3	457	6.35
	G	0.78	0.85	1.2	243	2.78
	F	2.55	0.85	1.5	553	7.92
	C	0.42	0.85	1.6	249	1.62
DA-6 (Dt-6)	A	**0.74**	0.85	0.7	182	2.79
	B	**0.23**	0.85	1.6	153	0.89
	E	**0.32**	0.85	0.4	394	0.97
DA-9 (Dt-9)	T	**0.23**	0.85	0.5	127	0.88
	U	**0.28**	0.85	1	125	1.09
	K	**0.94**	0.85	1	254	3.47
SUBTOTAL		**13.01**				**46.27**

Runoff

DA	DMA	Area (ac).	Impervious	Q(cfs)
DA-5	H	0.31	0.85	1.25
DA-7	S	0.91	0.85	3.5
	Q	0.23	0.85	0.92
DA-8	R	0.34	0.1	0.51
SUBTOTAL		**1.79**		**6.18**

Storm Event (100-Year)
Rainfall Depth=4.70"

DA	DMA	Area (ac).	Impervious	Slope (ft/ft)	Length	Q (cfs)
DA-1 (Dt-1)	P	0.36	0.85	1.7	164	2.55
	M	1.42	0.85	1.1	329	9.1
DA-2 (Dt-2)	L	0.24	0.85	1	122	1.63
	N	0.51	0.85	1.1	215	3.52
	O	0.31	0.85	1.5	190	2.18
DA-3 (Dt-3)	I	0.16	0.85	0.7	129	1.14
	J	1.41	0.85	2	256	9.84
DA-4 (Dt-4)	V	0.29	0.85	0.5	185	1.94
	D	1.82	0.85	2.3	457	11.58
	G	0.78	0.85	1.2	243	5.07
	F	2.55	0.85	1.5	553	14.46
	C	0.42	0.85	1.6	249	2.94
DA-6 (Dt-6)	A	**0.74**	0.85	0.7	182	5.07
	B	**0.23**	0.85	1.6	153	1.63
	E	**0.32**	0.85	0.4	394	1.77
DA-9 (Dt-9)	T	**0.23**	0.85	0.5	127	1.61
	U	**0.28**	0.85	1	125	1.98
	K	**0.94**	0.85	1	254	6.33
SUBTOTAL		**13.01**				**84.34**

Runoff

DA	DMA	Area (ac).	Impervious	Q(cfs)
DA-5	H	0.31	0.85	2.28
DA-7	S	0.91	0.85	6.36
	Q	0.23	0.85	1.68
DA-8	R	0.34	0.1	1.44
SUBTOTAL		**1.79**		**11.76**

Total Proposed Flow Generated (Q_{100}) = 96.1 cfs

Per the City of Victorville Hydrology requirements, the post-development runoff rate from the site shall be 90% of the pre-developed runoff rate. In order to comply with this requirement, and in order to address water quality and Hydromodification requirements set forth by the WQMP

Technical Guideance Document, underground retention units will be implemented. Further calculations are provided in the Appendix, however, after implementing these BMPs and promoting the natural infiltration, the total site runoff rate for the 100-year storm event is reduced to 41.70 cfs.

Total Flow Reduction by Retention Units: 54.4 cfs
Total Proposed Flow Discharged (Q_{100}): 41.70cfs

(Pre-Development Rate) 49.27 cfs *0.90= 44.34 cfs
(Post-Development Rate) 41.70< 44.34cfs →Okay

Section IV **Hydrograph Calculations**

The San Bernardino County Hydrograph Methodology was used, and the HydroCAD program calculated the existing and proposed runoff for the project for the 2-, 10-, and 100-Year Storm Events. Below is a summary of the calculations concluded. Refer to the appendix for the complete calculations performed.

Existing Condition

SUBBAREA AA3.1

Tc=24 Min.
0% Impervious
Flow Length=580’
CN=88
A=13.75 Acres

Storm Event	Rainfall Depth	V (af)
2	1.49	0.66
10	2.64	1.73
100	4.70	2.51

SUBBAREA AA3.2

Tc=18.5 Min.
0% Impervious
Flow Length=870’
CN=88
A=1.010 Acres

Storm Event	Rainfall Depth	V (af)
2	1.49	0.048
10	2.64	0.126
100	4.70	0.18

Total V100 Pre Development = 2.697 af

Post-Development

Storm Event (2-Year)

Rainfall Depth=1.49”

DA	DMA	Area (ac).	Impervious	Slope (ft/ft)	Length	V(ac.ft)
DA-1	P	0.36	0.85	1.7	164	0.035

(Dt-1)	M	1.42	0.85	1.1	329	0.139
DA-2	L	0.24	0.85	1	122	0.025
(Dt-2)	N	0.51	0.85	1.1	215	0.05
	O	0.31	0.85	1.5	190	0.03
DA-3	I	0.16	0.85	0.7	129	0.017
(Dt-3)	J	1.41	0.85	2	256	0.138
DA-4	V	0.29	0.85	0.5	185	0.028
(Dt-4)	D	1.82	0.85	2.3	457	0.178
	G	0.78	0.85	1.2	243	0.076
	F	2.55	0.85	1.5	553	0.249
	C	0.42	0.85	1.6	249	0.041
DA-6	A	**0.74**	0.85	0.7	182	0.072
(Dt-6)	B	**0.23**	0.85	1.6	153	0.023
	E	**0.32**	0.85	0.4	394	0.031
DA-9	T	**0.23**	0.85	0.5	127	0.023
(Dt-9)	U	**0.28**	0.85	1	125	0.027
	K	**0.94**	0.85	1	254	0.092
SUBTOTAL		**13.01**				**1.274**

Runoff

DA	DMA	Area (ac).	Impervious	Q(cfs)
DA-5	H	0.31	0.85	0.03
DA-7	S	0.91	0.85	0.089
	Q	0.23	0.85	0.023
DA-8	R	0.34	0.1	0.006
SUBTOTAL		**1.79**		**0.148**

Storm Event (10-Year)
Rainfall Depth=2.64”

DA	DMA	Area (ac).	Impervious	Slope (ft/ft)	Length	V(ac.ft)
DA-1	P	0.36	0.85	1.7	164	0.069
(Dt-1)	M	1.42	0.85	1.1	329	0.272
DA-2	L	0.24	0.85	1	122	0.048
(Dt-2)	N	0.51	0.85	1.1	215	0.098
	O	0.31	0.85	1.5	190	0.059
DA-3	I	0.16	0.85	0.7	129	0.032

(Dt-3)	J	1.41	0.85	2	256	0.27
DA-4	V	0.29	0.85	0.5	185	0.056
(Dt-4)	D	1.82	0.85	2.3	457	0.349
	G	0.78	0.85	1.2	243	0.15
	F	2.55	0.85	1.5	553	0.489
	C	0.42	0.85	1.6	249	0.081
DA-6	A	**0.74**	0.85	0.7	182	0.142
(Dt-6)	B	**0.23**	0.85	1.6	153	0.044
	E	**0.32**	0.85	0.4	394	0.061
DA-9	T	**0.23**	0.85	0.5	127	0.044
(Dt-9)	U	**0.28**	0.85	1	125	0.054
	K	**0.94**	0.85	1	254	0.18
SUBTOTAL		**13.01**				**2.498**

Runoff

DA	DMA	Area (ac).	Impervious	Q(cfs)
DA-5	H	0.31	0.85	0.059
DA-7	S	0.91	0.85	0.175
	Q	0.23	0.85	0.044
DA-8	R	0.34	0.1	0.025
SUBTOTAL		**1.79**		**0.303**

Storm Event (100-Year)

Rainfall Depth=4.70"

DA	DMA	Area (ac).	Impervious	Slope (ft/ft)	Length	V(ac.ft)
DA-1	P	0.36	0.85	1.7	164	0.13
(Dt-1)	M	1.42	0.85	1.1	329	0.515
DA-2	L	0.24	0.85	1	122	0.089
(Dt-2)	N	0.51	0.85	1.1	215	0.185
	O	0.31	0.85	1.5	190	0.112
DA-3	I	0.16	0.85	0.7	129	0.06
(Dt-3)	J	1.41	0.85	2	256	0.511
DA-4	V	0.29	0.85	0.5	185	0.105
(Dt-4)	D	1.82	0.85	2.3	457	0.659
	G	0.78	0.85	1.2	243	0.283

	F	2.55	0.85	1.5	553	0.924
	C	0.42	0.85	1.6	249	0.152
DA-6 (Dt-6)	A	**0.74**	0.85	0.7	182	0.268
	B	**0.23**	0.85	1.6	153	0.083
	E	**0.32**	0.85	0.4	394	0.116
DA-9 (Dt-9)	T	**0.23**	0.85	0.5	127	0.083
	U	**0.28**	0.85	1	125	0.101
	K	**0.94**	0.85	1	254	0.341
SUBTOTAL		**13.01**				**4.717**

Runoff

DA	DMA	Area (ac).	Impervious	Q(cfs)
DA-5	H	0.31	0.85	0.112
DA-7	S	0.91	0.85	0.33
	Q	0.23	0.85	0.083
DA-8	R	0.34	0.1	0.07
SUBTOTAL		**1.79**		**0.595**

Total Proposed Volume Generated (V100) = 5.31 ac.ft.

Per the City of Victorville Hydrology requirements, the post-development volume shall be 90% of the pre-developed volume. In order to comply with this requirement, and in order to address water quality and Hydromodification requirements set forth by the WQMP Technical Guideance Document, underground retention units will be implemented. Further calculations are provided in the Appendix, however, after implementing these BMPs and promoting the natural infiltration, the total site runoff rate for the 100-year storm event is reduced to 1.275 ac.ft.

Total Volume Reduction by Retention Units: 4.04 ac.ft.
Total Proposed Volume Discharged (V100): 1.275 ac.ft.

(Pre-Development Rate) 2.70 ac.ft *0.90= 2.43 ac.ft
(Post-Development Rate) 1.275< 2.43 ac.ft →Okay

Section V City of Victorville Line E-01 Analysis

STORM DRAIN E-01 ANALYSIS:
As part of this hydrology analysis, the City of Victorville will condition the property to install the new Regional Storm Drain Line E-01 as part of the proposed developments. The Regional Storm Drain will start at the south corner of the property, and traverse through the site and connect to the existing 2-7'x3' RCB culverts to the north. An inlet will be installed at the southeast corner of the site, within Highway 395, to collect all the existing run-on and discharge directly into the proposed Regional Storm Drain Main E-01.

An overall Master Drainage Study performed by Ludwig Engineering shows the total Regional Storm Drain E-01 shall be designed for the peak flow rate Q_{100} of 424 cfs.

Using the FHWA Hydraulic Toolbox Calculator, and inputting the following parameters:

Input:
Type: Circular
Pipe Diameter: 7'
Longitudinal Slope (assumed slope of existing Highway 395): 0.005
Manning's Roughness for RCP Storm Drain: 0.012
Flow Rate: 424 cfs

The results, provided in the Attachment, show the 7' RCP can adequately convey the 424 cfs required.

Due to site constraints, a portion of the proposed 7' RCP storm drain pipe will not maintain adequate cover; therefore a RCB will be required. Using the FHWA Hydraulic Toolbox Calculator, and inputting the following parameters:

Input:
Type: Rectangular
Pipe Width: 7'
Longitudinal Slope (assumed slope of existing Highway 395): 0.005
Manning's Roughness for RCB Storm Drain: 0.012
Flow Rate: 300 cfs

The results, provided in the Attachment, show a 7'x3' RCB can convey 242 cfs. A double 7'x3' RCB will be required for a total flow capacity of 484 cfs. In conclusion, a double 7'x3' RCB culvert will be installed upstream of the existing double 7'x3' RCB culvert. Once the onsite minimum pipe cover can be maintained, the proposed RCB will covert to the 7' RCP pipe for the remaining Regional Storm Drain segment. See the provided preliminary storm drain plans located within the Appendix.

STORM DRAIN E-01.A ANALYSIS:

An additional City storm drain main is proposed to collect and convey site run-on from the future corner of Fern Pine Street to the City of Victorville Master storm drain line E-01. For the purposes of this report, the proposed storm drain line shall be referenced as line E-01.A. As provided above, the site run-on anticipated for this location is 94 cfs. Using the FHWA Hydraulic Toolbox Calculator, and inputting the following parameters:

Input:
Type: Circular
Pipe Diameter: 48"
Longitudinal Slope (assumed slope of existing site): 0.01
Manning's Roughness for RCP Storm Drain: 0.012
Flow Rate: 94 cfs

The results, provided in the Attachment, show the 48" RCP can adequately convey the 94 cfs required. In conclusion, a proposed 48" RCP storm drain is required for Line E-01.A.

Section IV Conclusion

Per Ludwig Engineer's Master drainage Study, Exhibit A-1 Post Developed Condition, the Q100 of 424 cfs was used to confirm the sizing of the City of Victorville 84" Regional storm drain main.

Additionally, it was concluded the post-development 100-year storm event will not exceed more than 90% of the pre-development 100-year storm event with the mitigation outlined in this study. Therefore, this site will have no negative impacts downstream and hydromodification requirements are not applicable for the site.

In addition, BMP's will be installed that satisfy the City's water quality requirements, which will reduce the pollutants generated from the project.

Appendix

PRE-HYDROLOGY EXHIBIT

CITY CASE NO.

CITY OF VICTORVILLE
DEVELOPMENT DEPARTMENT
Approved By:
, Building Official
DATE

CITY OF VICTORVILLE
ENGINEERING DEPARTMENT
Approved By:
Brian Gengler
City Engineer
RCE 44730 Exp. 03-31-20
DATE

DIGALERT
CALL BEFORE YOU DIG
1-800-227-2600
AT LEAST
2 WORKING DAY
NOTICE REQUIRED

PRE-DEVELOPMENT HYDROLOGY ANALYSIS
(ONSITE ONLY)

AREA	ACRES	TC	Q100	Q10	Q2
AREA AA3.1	13.79 AC.	24	45.84 CFS	20.63CFS	7.63CFS
AREA AA3.2	1.01 AC.	18.5	3.88 CFS	1.75CFS	0.66CFS
TOTAL	14.80 AC.		49.41CFS	22.38CFS	8.29CFS

CLIENT:
BROADWAY CHINATOWN, LLC
PO BOX 15813
LOS ANGELES 15813

BLUE PEAK ENGINEERING, INC.
18543 YORBA LINDA BL., #235
YORBA LINDA, CA 92886
714.749.3077
714.281.1640 FAX

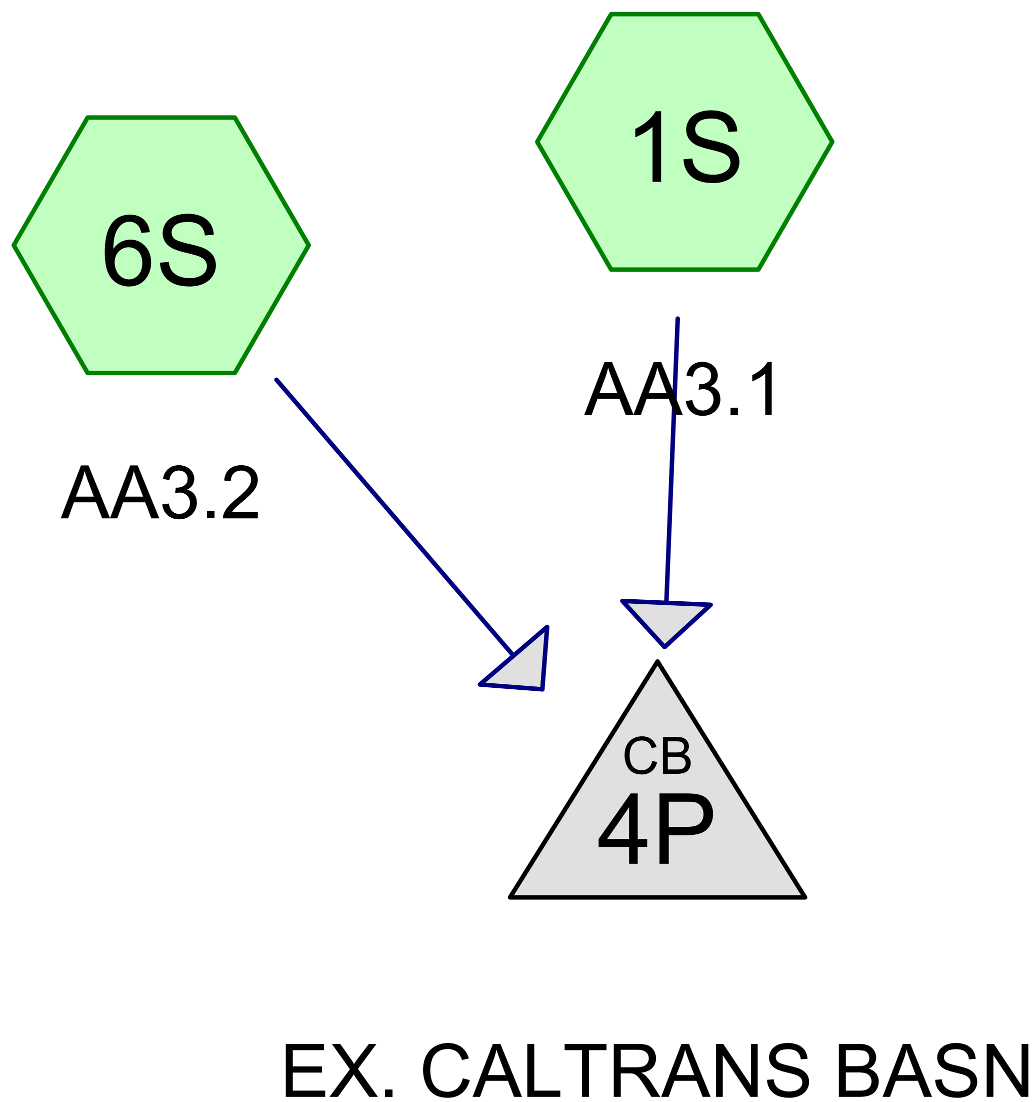
REGISTERED PROFESSIONAL ENGINEER
STEVEN B. JOHNSON
No. 83319
Exp. 03-31-19
CIVIL
STATE OF CALIFORNIA

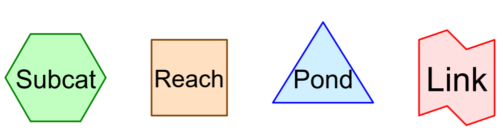
NO.	REVISIONS	BY	DATE

VICTORVILLE RETAIL PROJECT
SWC US 395 & SR-18

DESIGN BY: S.J.
DRAWN BY: S.J.
CHECKED BY: T.H.
DATE: 03/01/2019

SHEET NO.
___ OF 8





Routing Diagram for Pre Development Condition
Prepared by Microsoft, Printed 2/26/2019
HydroCAD® 10.00-22 s/n 10423 © 2018 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
14.800	74	(1S, 6S)
14.800	**74**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
0.000	HSG C	
0.000	HSG D	
14.800	Other	1S, 6S
14.800		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	0.000	0.000	0.000	14.800	14.800		1S, 6S
0.000	**0.000**	**0.000**	**0.000**	**14.800**	**14.800**	**TOTAL AREA**	

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Diam/Width (inches)	Height (inches)	Inside-Fill (inches)
1	4P	25.10	19.00	89.0	0.0685	0.012	36.0	0.0	0.0

Time span=5.00-48.00 hrs, dt=0.05 hrs, 861 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1S: AA3.1 Runoff Area=13.790 ac 0.00% Impervious Runoff Depth=0.57"
Flow Length=580' Tc=24.0 min AMC Adjusted CN=88 Runoff=7.63 cfs 0.660 af

Subcatchment6S: AA3.2 Runoff Area=1.010 ac 0.00% Impervious Runoff Depth=0.57"
Flow Length=870' Tc=18.5 min AMC Adjusted CN=88 Runoff=0.66 cfs 0.048 af

Pond 4P: EX. CALTRANSBASN Peak Elev=26.19' Inflow=8.22 cfs 0.708 af
36.0" Round Culvert n=0.012 L=89.0' S=0.0685 '/' Outflow=8.22 cfs 0.708 af

Total Runoff Area = 14.800 ac Runoff Volume = 0.708 af Average Runoff Depth = 0.57"
100.00% Pervious = 14.800 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment 1S: AA3.1

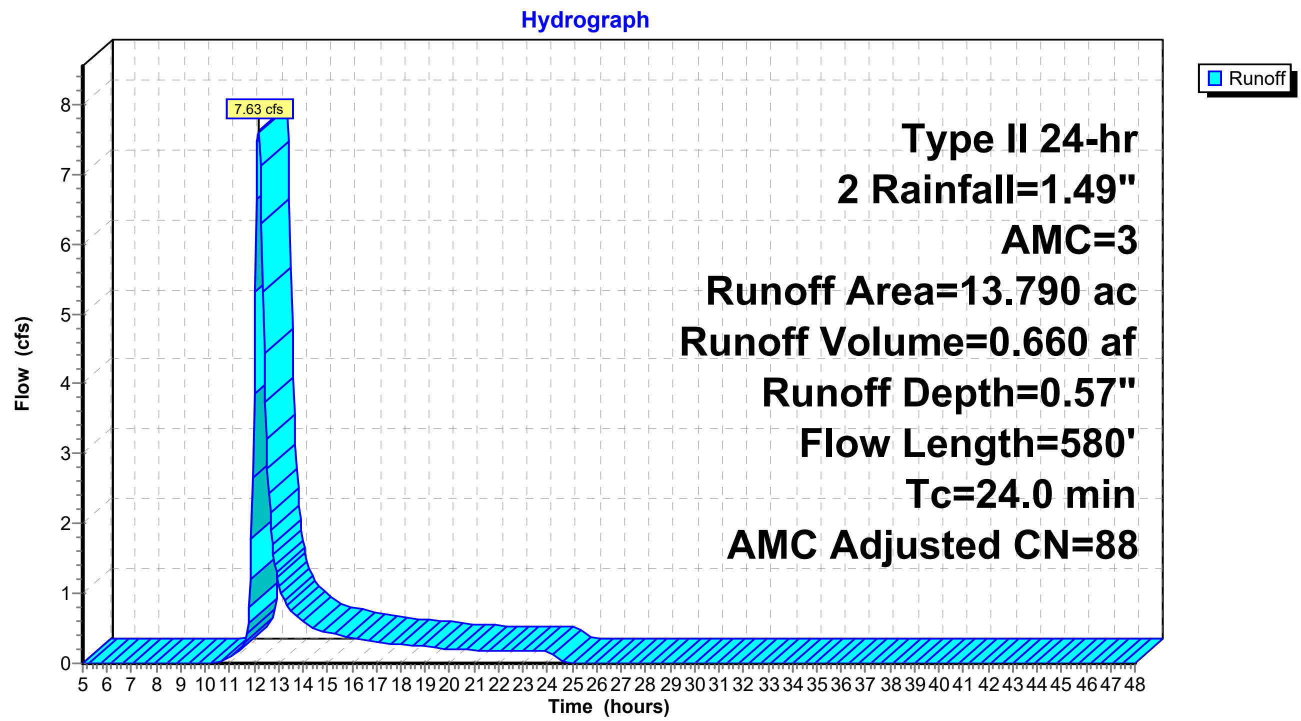
Runoff = 7.63 cfs @ 12.19 hrs, Volume= 0.660 af, Depth= 0.57"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 2 Rainfall=1.49", AMC=3

	Area (ac)	CN	Adj	Description
*	13.790	74		
	13.790	74	88	Weighted Average, AMC Adjusted
	13.790			100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
24.0	580		0.40		**Direct Entry,**

Subcatchment 1S: AA3.1



Summary for Subcatchment 6S: AA3.2

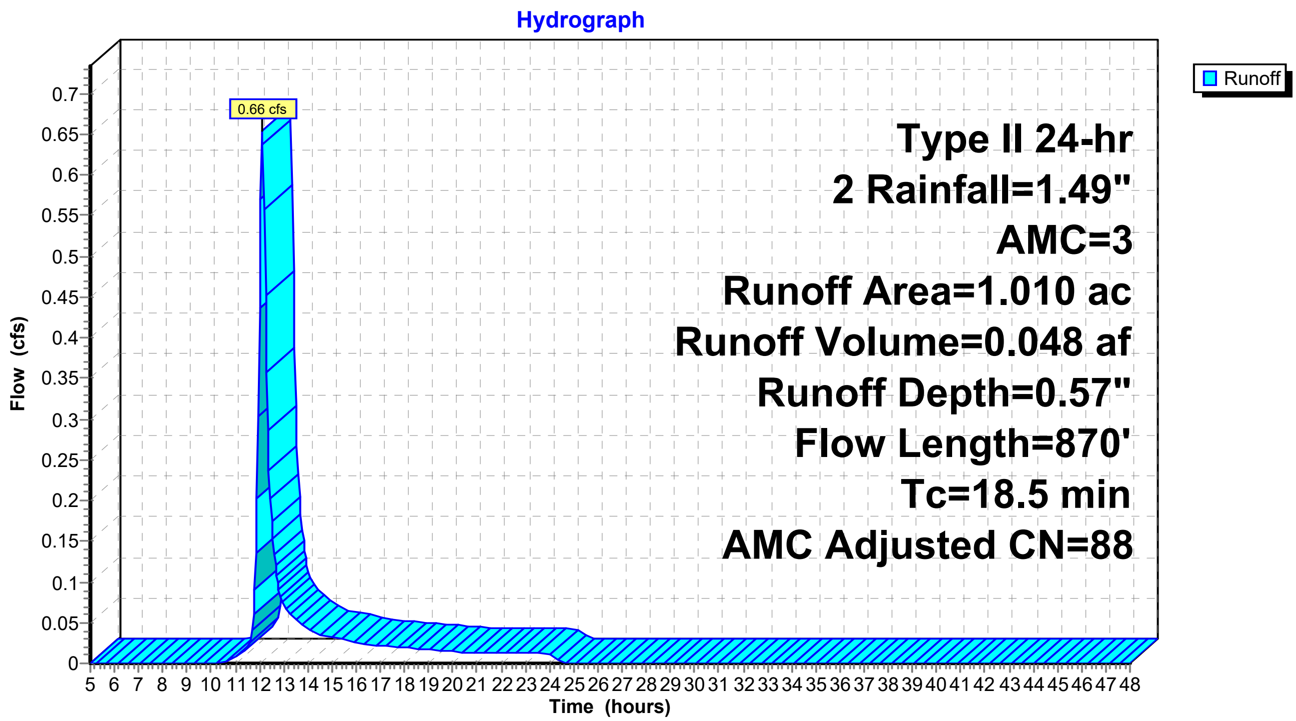
Runoff = 0.66 cfs @ 12.12 hrs, Volume= 0.048 af, Depth= 0.57"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 2 Rainfall=1.49", AMC=3

	Area (ac)	CN	Adj	Description
*	1.010	74		
	1.010	74	88	Weighted Average, AMC Adjusted
	1.010			100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
18.5	870		0.78		**Direct Entry,**

Subcatchment 6S: AA3.2



Summary for Pond 4P: EX. CALTRANS BASN

[57] Hint: Peaked at 26.19' (Flood elevation advised)

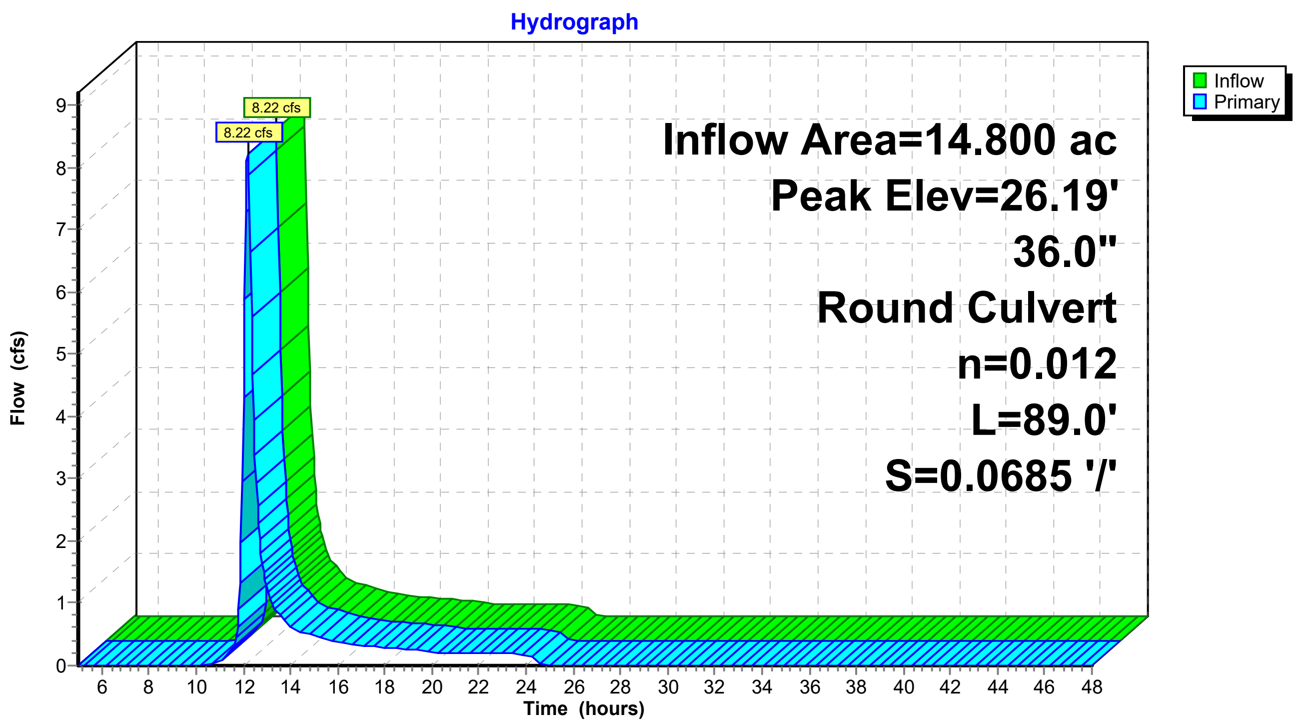
Inflow Area =	14.800 ac,	0.00% Impervious, Inflow Depth =	0.57"	for 2 event
Inflow =	8.22 cfs @	12.18 hrs, Volume=	0.708 af	
Outflow =	8.22 cfs @	12.18 hrs, Volume=	0.708 af,	Atten= 0%, Lag= 0.0 min
Primary =	8.22 cfs @	12.18 hrs, Volume=	0.708 af	

Routing by Stor-Ind method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 26.19' @ 12.18 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	25.10'	**36.0" Round RCP_Round 36"** L= 89.0' Box, headwall w/3 square edges, Ke= 0.500 Inlet / Outlet Invert= 25.10' / 19.00' S= 0.0685 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 7.07 sf

Primary OutFlow Max=8.15 cfs @ 12.18 hrs HW=26.18' (Free Discharge)
└─**1=RCP_Round 36"** (Inlet Controls 8.15 cfs @ 3.54 fps)

Pond 4P: EX. CALTRANS BASN



Time span=5.00-48.00 hrs, dt=0.05 hrs, 861 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1S: AA3.1 Runoff Area=13.790 ac 0.00% Impervious Runoff Depth=1.50"
Flow Length=580' Tc=24.0 min AMC Adjusted CN=88 Runoff=20.63 cfs 1.726 af

Subcatchment6S: AA3.2 Runoff Area=1.010 ac 0.00% Impervious Runoff Depth=1.50"
Flow Length=870' Tc=18.5 min AMC Adjusted CN=88 Runoff=1.75 cfs 0.126 af

Pond 4P: EX. CALTRANSBASN Peak Elev=27.00' Inflow=22.24 cfs 1.853 af
36.0" Round Culvert n=0.012 L=89.0' S=0.0685 '/' Outflow=22.24 cfs 1.853 af

Total Runoff Area = 14.800 ac Runoff Volume = 1.853 af Average Runoff Depth = 1.50"
100.00% Pervious = 14.800 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment 1S: AA3.1

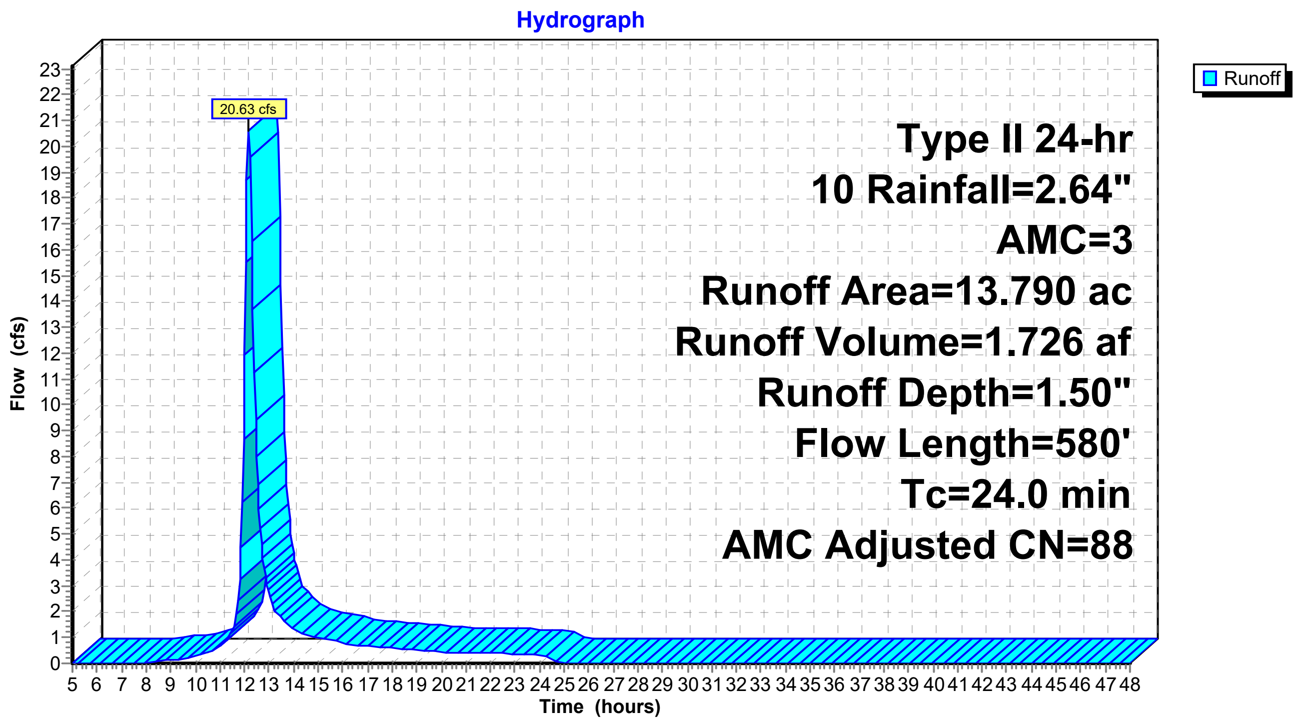
Runoff = 20.63 cfs @ 12.17 hrs, Volume= 1.726 af, Depth= 1.50"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 10 Rainfall=2.64", AMC=3

	Area (ac)	CN	Adj	Description
*	13.790	74		
	13.790	74	88	Weighted Average, AMC Adjusted
	13.790			100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
24.0	580		0.40		**Direct Entry,**

Subcatchment 1S: AA3.1



Summary for Subcatchment 6S: AA3.2

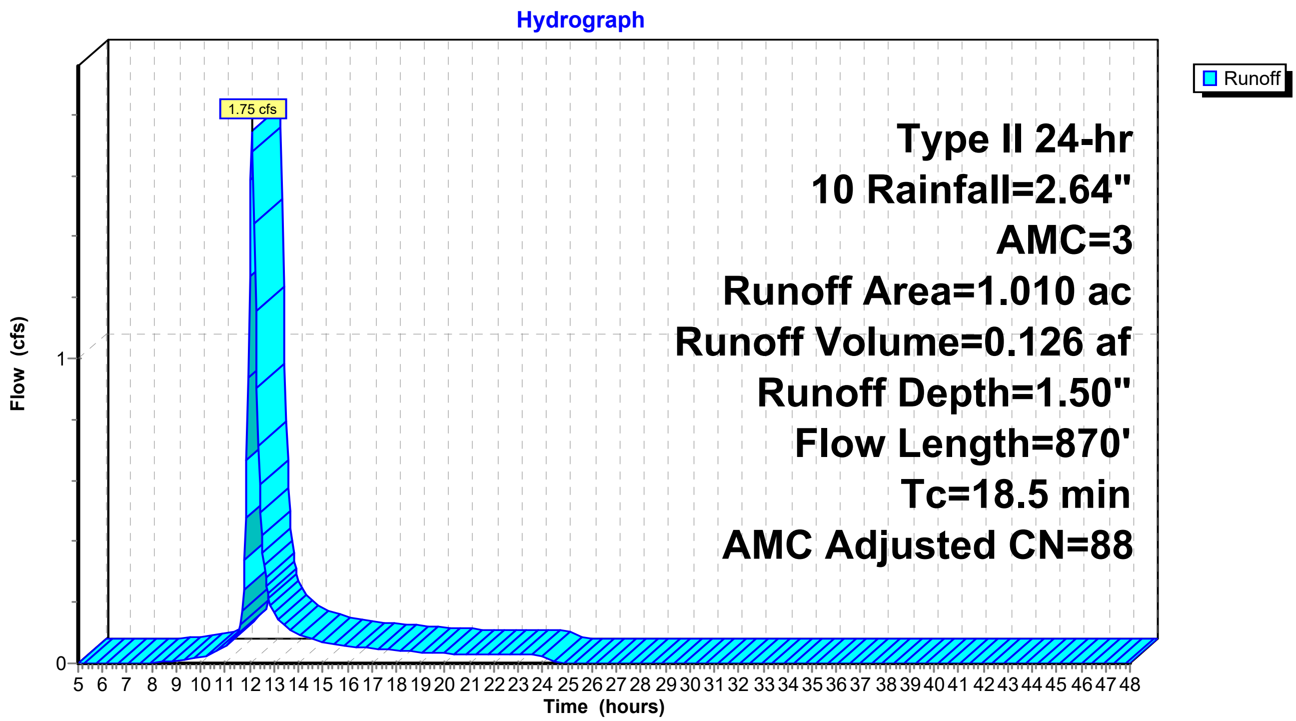
Runoff = 1.75 cfs @ 12.11 hrs, Volume= 0.126 af, Depth= 1.50"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 10 Rainfall=2.64", AMC=3

	Area (ac)	CN	Adj	Description
*	1.010	74		
	1.010	74	88	Weighted Average, AMC Adjusted
	1.010			100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
18.5	870		0.78		**Direct Entry,**

Subcatchment 6S: AA3.2



Summary for Pond 4P: EX. CALTRANS BASN

[57] Hint: Peaked at 27.00' (Flood elevation advised)

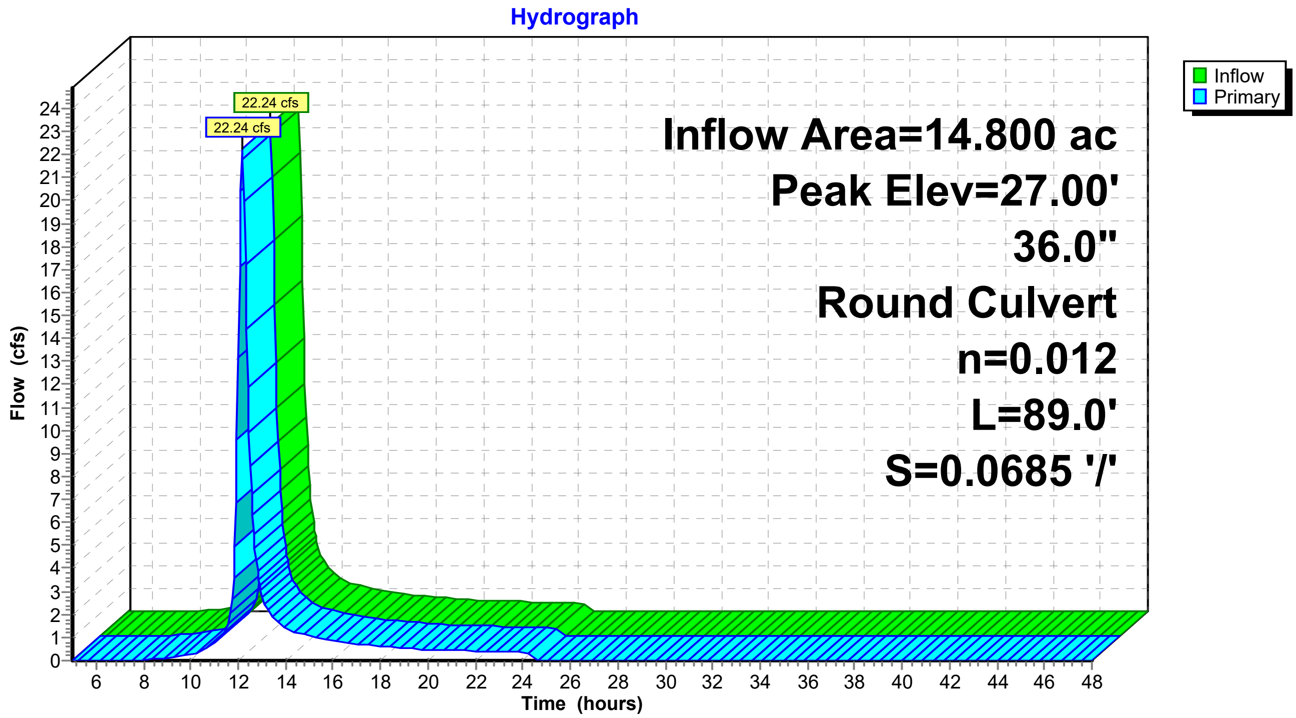
Inflow Area = 14.800 ac, 0.00% Impervious, Inflow Depth = 1.50" for 10 event
Inflow = 22.24 cfs @ 12.17 hrs, Volume= 1.853 af
Outflow = 22.24 cfs @ 12.17 hrs, Volume= 1.853 af, Atten= 0%, Lag= 0.0 min
Primary = 22.24 cfs @ 12.17 hrs, Volume= 1.853 af

Routing by Stor-Ind method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 27.00' @ 12.17 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	25.10'	**36.0" Round RCP_Round 36"** L= 89.0' Box, headwall w/3 square edges, Ke= 0.500 Inlet / Outlet Invert= 25.10' / 19.00' S= 0.0685 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 7.07 sf

Primary OutFlow Max=22.02 cfs @ 12.17 hrs HW=26.99' (Free Discharge)
└─**1=RCP_Round 36"** (Inlet Controls 22.02 cfs @ 4.68 fps)

Pond 4P: EX. CALTRANS BASN



Time span=5.00-48.00 hrs, dt=0.05 hrs, 861 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1S: AA3.1 Runoff Area=13.790 ac 0.00% Impervious Runoff Depth=2.19"
Flow Length=580' Tc=24.0 min AMC Adjusted CN=88 Runoff=29.95 cfs 2.513 af

Subcatchment6S: AA3.2 Runoff Area=1.010 ac 0.00% Impervious Runoff Depth=2.19"
Flow Length=870' Tc=18.5 min AMC Adjusted CN=88 Runoff=2.54 cfs 0.184 af

Pond 4P: EX. CALTRANSBASN Peak Elev=27.52' Inflow=32.29 cfs 2.697 af
36.0" Round Culvert n=0.012 L=89.0' S=0.0685 '/' Outflow=32.29 cfs 2.697 af

Total Runoff Area = 14.800 ac Runoff Volume = 2.697 af Average Runoff Depth = 2.19"
100.00% Pervious = 14.800 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment 1S: AA3.1

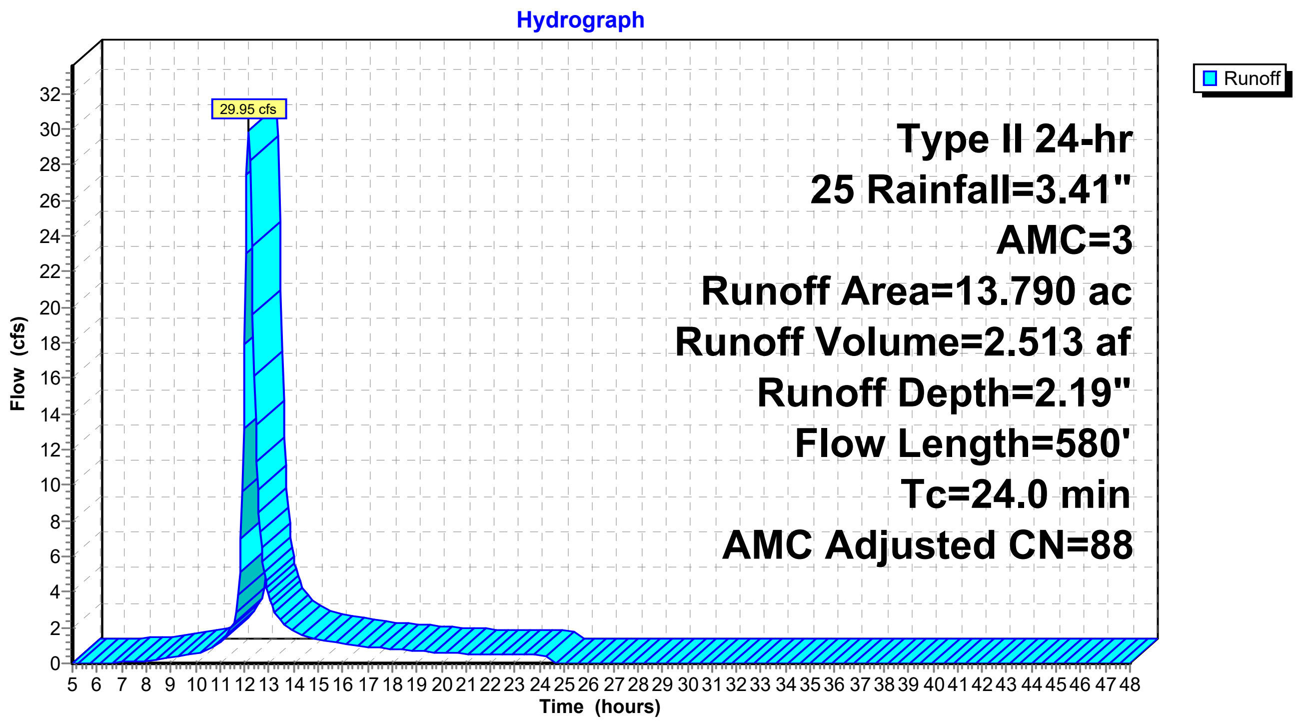
Runoff = 29.95 cfs @ 12.17 hrs, Volume= 2.513 af, Depth= 2.19"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 25 Rainfall=3.41", AMC=3

	Area (ac)	CN	Adj	Description
*	13.790	74		
	13.790	74	88	Weighted Average, AMC Adjusted
	13.790			100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
24.0	580		0.40		**Direct Entry,**

Subcatchment 1S: AA3.1



Summary for Subcatchment 6S: AA3.2

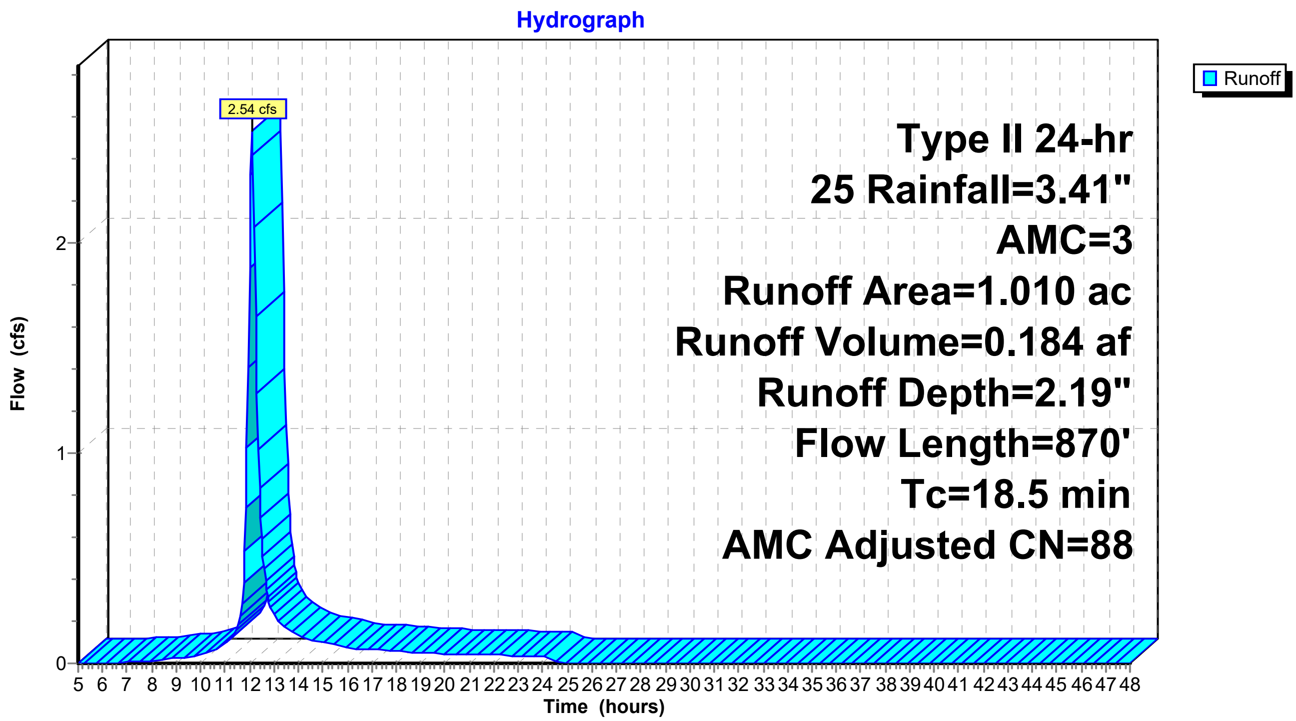
Runoff = 2.54 cfs @ 12.11 hrs, Volume= 0.184 af, Depth= 2.19"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 25 Rainfall=3.41", AMC=3

	Area (ac)	CN	Adj	Description
*	1.010	74		
	1.010	74	88	Weighted Average, AMC Adjusted
	1.010			100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
18.5	870		0.78		**Direct Entry,**

Subcatchment 6S: AA3.2



Summary for Pond 4P: EX. CALTRANS BASN

[57] Hint: Peaked at 27.52' (Flood elevation advised)

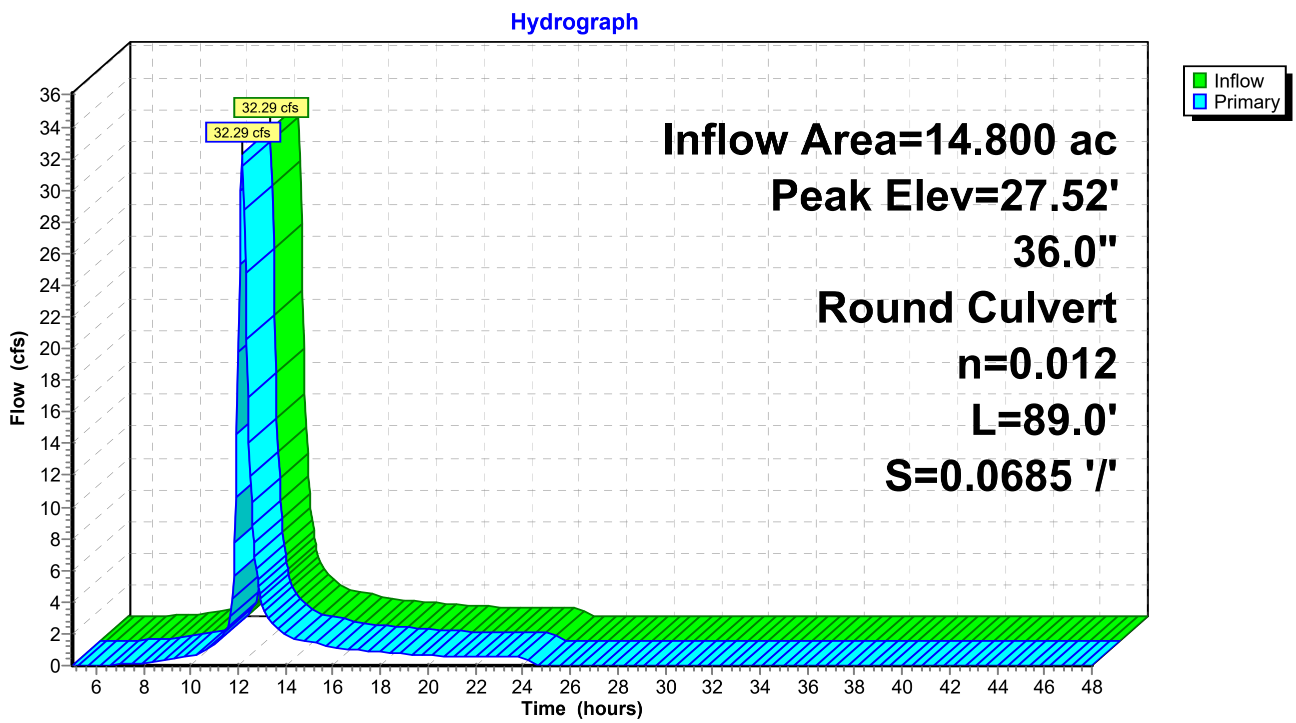
Inflow Area =	14.800 ac,	0.00% Impervious, Inflow Depth = 2.19"	for 25 event
Inflow =	32.29 cfs @	12.16 hrs, Volume=	2.697 af
Outflow =	32.29 cfs @	12.16 hrs, Volume=	2.697 af, Atten= 0%, Lag= 0.0 min
Primary =	32.29 cfs @	12.16 hrs, Volume=	2.697 af

Routing by Stor-Ind method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 27.52' @ 12.16 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	25.10'	**36.0" Round RCP_Round 36"** L= 89.0' Box, headwall w/3 square edges, Ke= 0.500 Inlet / Outlet Invert= 25.10' / 19.00' S= 0.0685 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 7.07 sf

Primary OutFlow Max=32.00 cfs @ 12.16 hrs HW=27.50' (Free Discharge)
└─**1=RCP_Round 36"** (Inlet Controls 32.00 cfs @ 5.28 fps)

Pond 4P: EX. CALTRANS BASN



Time span=5.00-48.00 hrs, dt=0.05 hrs, 861 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1S: AA3.1 Runoff Area=13.790 ac 0.00% Impervious Runoff Depth>3.38"
Flow Length=580' Tc=24.0 min AMC Adjusted CN=88 Runoff=45.84 cfs 3.890 af

Subcatchment6S: AA3.2 Runoff Area=1.010 ac 0.00% Impervious Runoff Depth>3.38"
Flow Length=870' Tc=18.5 min AMC Adjusted CN=88 Runoff=3.88 cfs 0.285 af

Pond 4P: EX. CALTRANSBASN Peak Elev=28.71' Inflow=49.41 cfs 4.174 af
36.0" Round Culvert n=0.012 L=89.0' S=0.0685 '/' Outflow=49.41 cfs 4.174 af

Total Runoff Area = 14.800 ac Runoff Volume = 4.174 af Average Runoff Depth = 3.38"
100.00% Pervious = 14.800 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment 1S: AA3.1

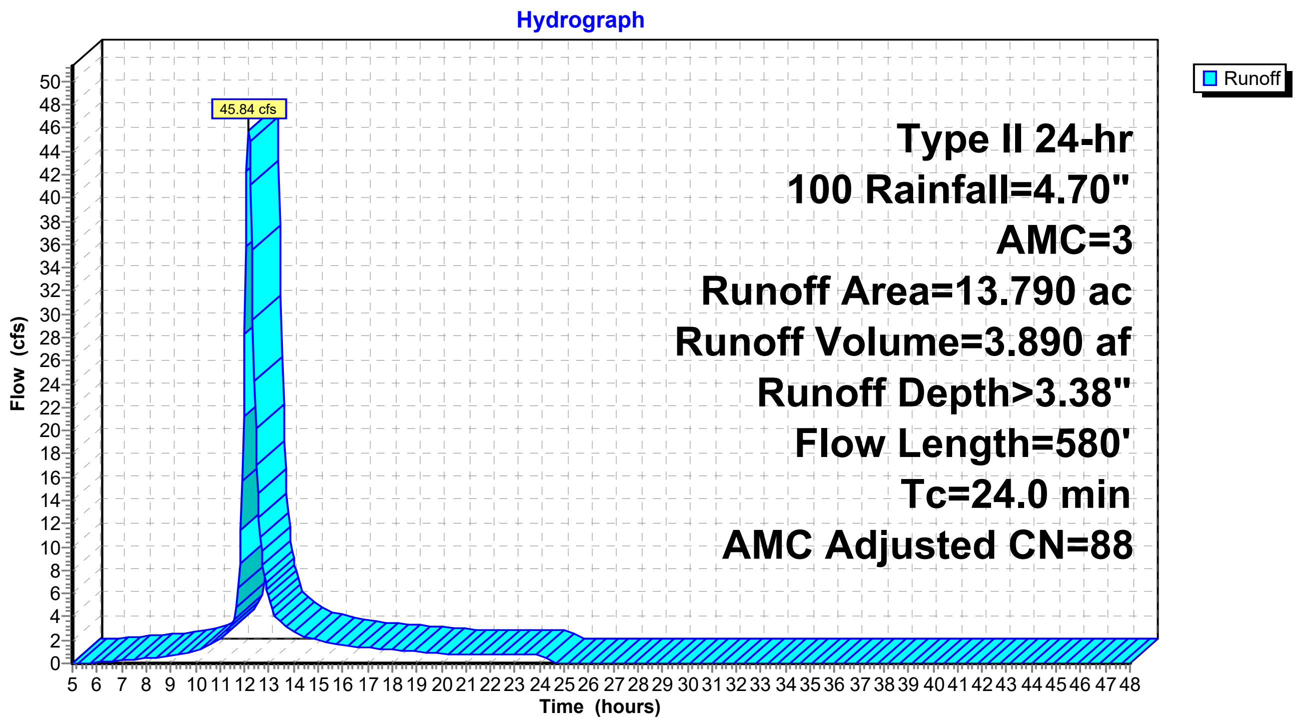
Runoff = 45.84 cfs @ 12.17 hrs, Volume= 3.890 af, Depth> 3.38"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 100 Rainfall=4.70", AMC=3

	Area (ac)	CN	Adj	Description
*	13.790	74		
	13.790	74	88	Weighted Average, AMC Adjusted
	13.790			100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
24.0	580		0.40		**Direct Entry,**

Subcatchment 1S: AA3.1



Summary for Subcatchment 6S: AA3.2

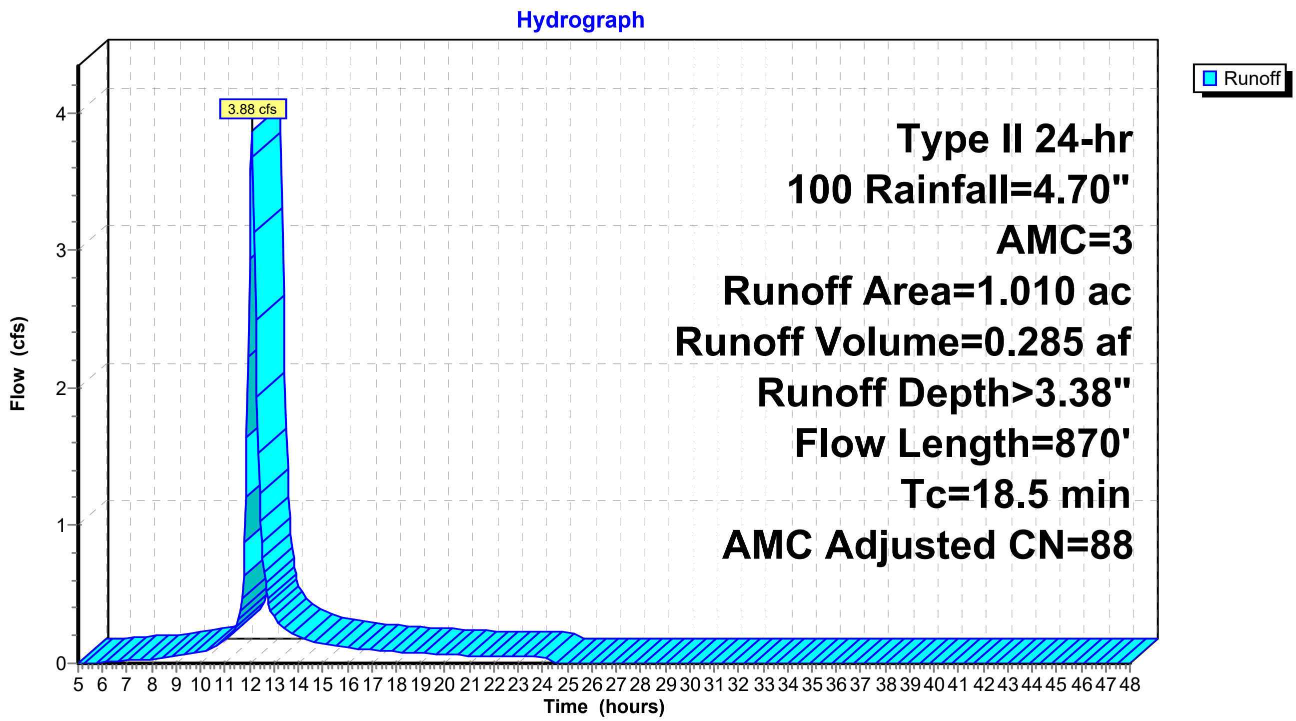
Runoff = 3.88 cfs @ 12.10 hrs, Volume= 0.285 af, Depth> 3.38"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 100 Rainfall=4.70", AMC=3

	Area (ac)	CN	Adj	Description
*	1.010	74		
	1.010	74	88	Weighted Average, AMC Adjusted
	1.010			100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
18.5	870		0.78		**Direct Entry,**

Subcatchment 6S: AA3.2



Summary for Pond 4P: EX. CALTRANS BASN

[57] Hint: Peaked at 28.71' (Flood elevation advised)

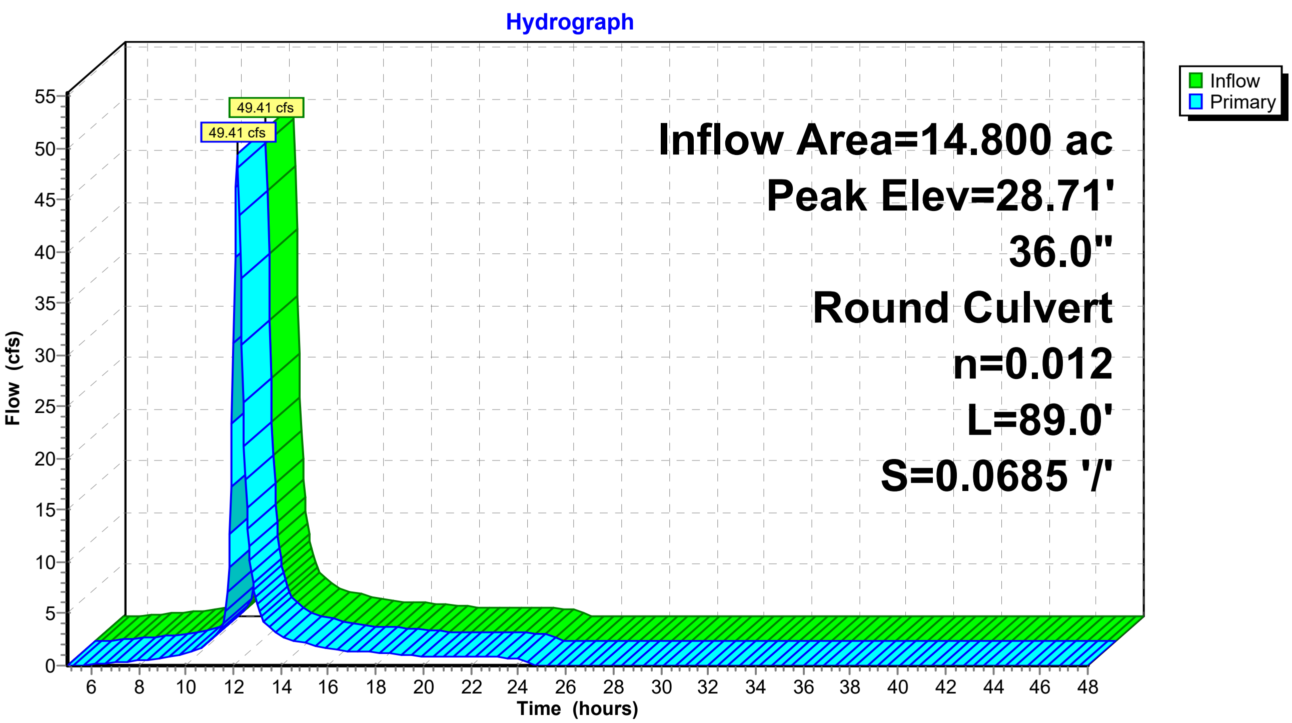
Inflow Area =	14.800 ac,	0.00% Impervious, Inflow Depth > 3.38"	for 100 event	
Inflow =	49.41 cfs @	12.16 hrs, Volume=	4.174 af	
Outflow =	49.41 cfs @	12.16 hrs, Volume=	4.174 af,	Atten= 0%, Lag= 0.0 min
Primary =	49.41 cfs @	12.16 hrs, Volume=	4.174 af	

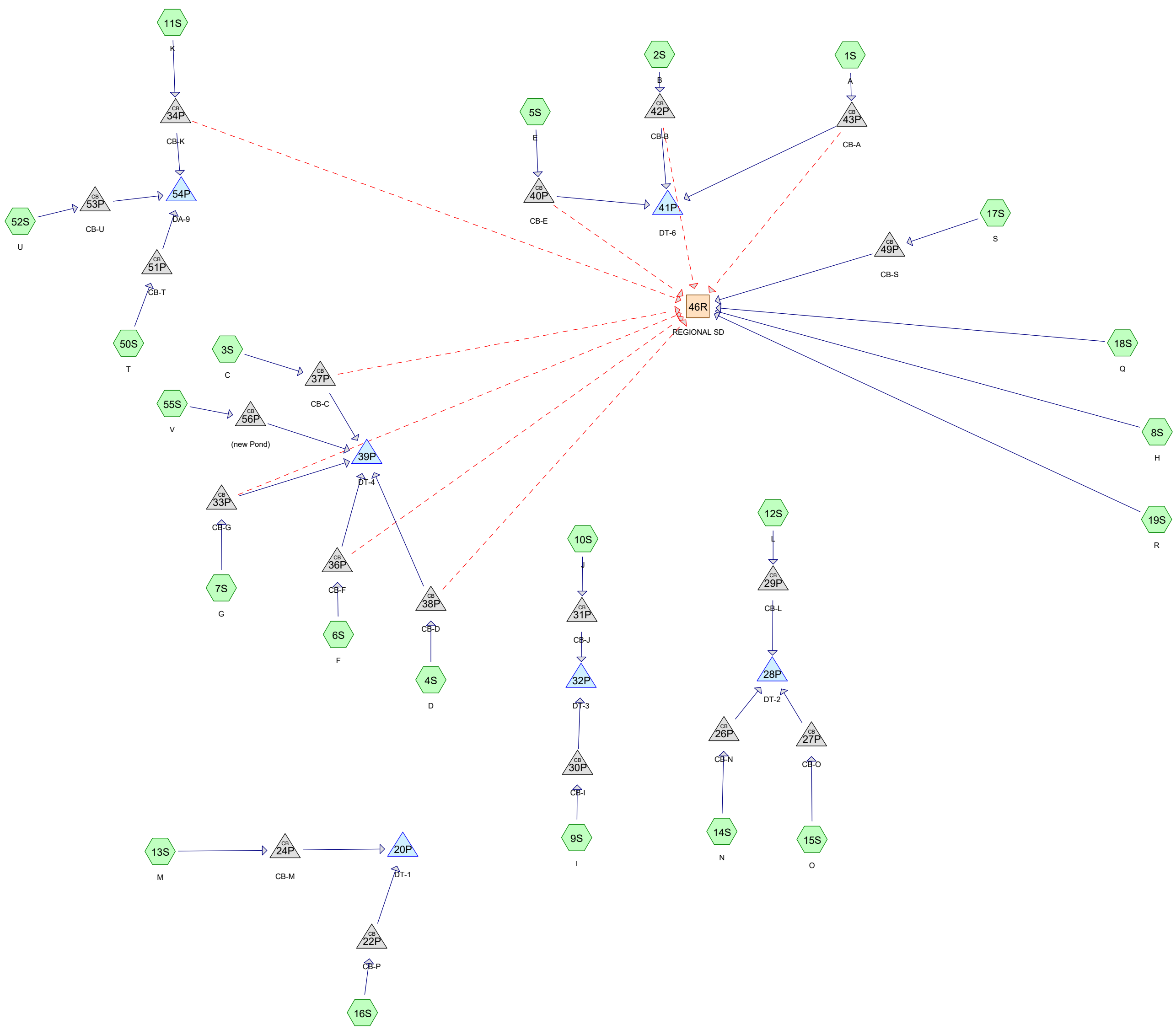
Routing by Stor-Ind method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 28.71' @ 12.16 hrs

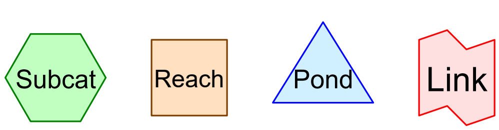
Device	Routing	Invert	Outlet Devices
#1	Primary	25.10'	**36.0" Round RCP_Round 36"** L= 89.0' Box, headwall w/3 square edges, Ke= 0.500 Inlet / Outlet Invert= 25.10' / 19.00' S= 0.0685 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 7.07 sf

Primary OutFlow Max=49.05 cfs @ 12.16 hrs HW=28.68' (Free Discharge)
└─**1=RCP_Round 36"** (Inlet Controls 49.05 cfs @ 6.94 fps)

Pond 4P: EX. CALTRANS BASN







Routing Diagram for Post Development Condition-REV1
Prepared by Microsoft, Printed 2/26/2019
HydroCAD® 10.00-22 s/n 10423 © 2018 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
12.310	98	(1S, 2S, 3S, 4S, 5S, 6S, 7S, 8S, 9S, 10S, 11S, 12S, 13S, 14S, 15S, 16S, 17S, 18S, 19S, 50S, 52S, 55S)
2.490	56	(1S, 2S, 3S, 4S, 5S, 6S, 7S, 8S, 9S, 10S, 11S, 12S, 13S, 14S, 15S, 16S, 17S, 18S, 19S, 50S, 52S, 55S)
14.800	**91**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
0.000	HSG C	
0.000	HSG D	
14.800	Other	1S, 2S, 3S, 4S, 5S, 6S, 7S, 8S, 9S, 10S, 11S, 12S, 13S, 14S, 15S, 16S, 17S, 18S, 19S, 50S, 52S, 55S
14.800		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	0.000	0.000	0.000	14.800	14.800		1S, 2S, 3S, 4S, 5S, 6S, 7S, 8S, 9S, 10S, 11S, 12S, 13S, 14S, 15S, 16S, 17S, 18S, 19S, 50S, 52S, 55S
0.000	**0.000**	**0.000**	**0.000**	**14.800**	**14.800**	**TOTAL AREA**	

Time span=1.00-48.00 hrs, dt=0.05 hrs, 941 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1S: A Runoff Area=0.740 ac 85.14% Impervious Runoff Depth=1.17"
Flow Length=182' Slope=0.0070 '/' Tc=4.4 min AMC Adjusted CN=97 Runoff=1.49 cfs 0.072 af

Subcatchment2S: B Runoff Area=0.230 ac 82.61% Impervious Runoff Depth=1.17"
Flow Length=153' Slope=0.0160 '/' Tc=2.7 min AMC Adjusted CN=97 Runoff=0.48 cfs 0.023 af

Subcatchment3S: C Runoff Area=0.420 ac 85.71% Impervious Runoff Depth=1.17"
Flow Length=216' Slope=0.0160 '/' Tc=3.6 min AMC Adjusted CN=97 Runoff=0.86 cfs 0.041 af

Subcatchment4S: D Runoff Area=1.820 ac 85.16% Impervious Runoff Depth=1.17"
Flow Length=457' Slope=0.0230 '/' Tc=6.4 min AMC Adjusted CN=97 Runoff=3.38 cfs 0.178 af

Subcatchment5S: E Runoff Area=0.320 ac 84.38% Impervious Runoff Depth=1.17"
Flow Length=394' Slope=0.0040 '/' Tc=11.3 min AMC Adjusted CN=97 Runoff=0.51 cfs 0.031 af

Subcatchment6S: F Runoff Area=2.550 ac 85.10% Impervious Runoff Depth=1.17"
Flow Length=553' Slope=0.0100 '/' Tc=10.5 min AMC Adjusted CN=97 Runoff=4.21 cfs 0.249 af

Subcatchment7S: G Runoff Area=0.780 ac 84.62% Impervious Runoff Depth=1.17"
Flow Length=340' Slope=0.0150 '/' Tc=5.8 min AMC Adjusted CN=97 Runoff=1.48 cfs 0.076 af

Subcatchment8S: H Runoff Area=0.310 ac 83.87% Impervious Runoff Depth=1.17"
Flow Length=50' Slope=0.0200 '/' Tc=1.0 min AMC Adjusted CN=97 Runoff=0.67 cfs 0.030 af

Subcatchment9S: I Runoff Area=0.160 ac 87.50% Impervious Runoff Depth=1.27"
Flow Length=129' Slope=0.0090 '/' Tc=3.0 min AMC Adjusted CN=98 Runoff=0.35 cfs 0.017 af

Subcatchment10S: J Runoff Area=1.410 ac 85.11% Impervious Runoff Depth=1.17"
Flow Length=256' Slope=0.0200 '/' Tc=3.8 min AMC Adjusted CN=97 Runoff=2.88 cfs 0.138 af

Subcatchment11S: K Runoff Area=0.940 ac 85.11% Impervious Runoff Depth=1.17"
Flow Length=254' Slope=0.0100 '/' Tc=4.9 min AMC Adjusted CN=97 Runoff=1.85 cfs 0.092 af

Subcatchment12S: L Runoff Area=0.240 ac 87.50% Impervious Runoff Depth=1.27"
Flow Length=254' Slope=0.0100 '/' Tc=4.9 min AMC Adjusted CN=98 Runoff=0.50 cfs 0.025 af

Subcatchment13S: M Runoff Area=1.420 ac 85.21% Impervious Runoff Depth=1.17"
Flow Length=329' Slope=0.0110 '/' Tc=6.2 min AMC Adjusted CN=97 Runoff=2.66 cfs 0.139 af

Subcatchment14S: N Runoff Area=0.510 ac 84.31% Impervious Runoff Depth=1.17"
Flow Length=215' Slope=0.0110 '/' Tc=4.2 min AMC Adjusted CN=97 Runoff=1.03 cfs 0.050 af

Subcatchment15S: O Runoff Area=0.310 ac 83.87% Impervious Runoff Depth=1.17"
Flow Length=190' Slope=0.0150 '/' Tc=3.3 min AMC Adjusted CN=97 Runoff=0.64 cfs 0.030 af

Subcatchment16S: P Runoff Area=0.360 ac 83.33% Impervious Runoff Depth=1.17"
Flow Length=164' Slope=0.0170 '/' Tc=2.8 min AMC Adjusted CN=97 Runoff=0.75 cfs 0.035 af

Subcatchment 17S: S Runoff Area=0.910 ac 84.62% Impervious Runoff Depth=1.17"
Flow Length=250' Slope=0.0200 '/' Tc=3.7 min AMC Adjusted CN=97 Runoff=1.87 cfs 0.089 af

Subcatchment 18S: Q Runoff Area=0.230 ac 82.61% Impervious Runoff Depth=1.17"
Flow Length=87' Slope=0.0400 '/' Tc=1.2 min AMC Adjusted CN=97 Runoff=0.49 cfs 0.023 af

Subcatchment 19S: R Runoff Area=0.340 ac 8.82% Impervious Runoff Depth=0.23"
Flow Length=56' Slope=0.0500 '/' Tc=6.3 min AMC Adjusted CN=78 Runoff=0.11 cfs 0.006 af

Subcatchment 50S: T Runoff Area=0.230 ac 82.61% Impervious Runoff Depth=1.17"
Flow Length=127' Slope=0.0050 '/' Tc=3.7 min AMC Adjusted CN=97 Runoff=0.47 cfs 0.023 af

Subcatchment 52S: U Runoff Area=0.280 ac 85.71% Impervious Runoff Depth=1.17"
Flow Length=125' Slope=0.0100 '/' Tc=2.8 min AMC Adjusted CN=97 Runoff=0.58 cfs 0.027 af

Subcatchment 55S: V Runoff Area=0.290 ac 86.21% Impervious Runoff Depth=1.17"
Flow Length=185' Slope=0.0050 '/' Tc=5.1 min AMC Adjusted CN=97 Runoff=0.57 cfs 0.028 af

Reach 46R: REGIONAL SD Avg. Flow Depth=0.48' Max Vel=6.35 fps Inflow=7.57 cfs 0.221 af
84.0" Round Pipe n=0.013 L=500.0' S=0.0150 '/' Capacity=782.41 cfs Outflow=6.95 cfs 0.221 af

Pond 20P: DT-1 Peak Elev=33.89' Storage=0.080 af Inflow=3.34 cfs 0.174 af
Outflow=0.18 cfs 0.174 af

Pond 22P: CB-P Peak Elev=37.55' Inflow=0.75 cfs 0.035 af
12.0" Round Culvert n=0.012 L=100.0' S=0.0100 '/' Outflow=0.75 cfs 0.035 af

Pond 24P: CB-M Peak Elev=36.88' Inflow=2.66 cfs 0.139 af
24.0" Round Culvert n=0.012 L=10.0' S=0.0100 '/' Outflow=2.66 cfs 0.139 af

Pond 26P: CB-N Peak Elev=37.26' Inflow=1.03 cfs 0.050 af
Outflow=1.03 cfs 0.050 af

Pond 27P: CB-O Peak Elev=37.10' Inflow=0.64 cfs 0.030 af
12.0" Round Culvert n=0.012 L=10.0' S=0.0100 '/' Outflow=0.64 cfs 0.030 af

Pond 28P: DT-2 Peak Elev=31.97' Storage=0.050 af Inflow=2.16 cfs 0.106 af
Outflow=0.10 cfs 0.106 af

Pond 29P: CB-L Peak Elev=34.58' Inflow=0.50 cfs 0.025 af
18.0" Round Culvert n=0.012 L=20.0' S=0.0100 '/' Outflow=0.50 cfs 0.025 af

Pond 30P: CB-I Peak Elev=38.86' Inflow=0.35 cfs 0.017 af
12.0" Round Culvert n=0.012 L=100.0' S=0.0100 '/' Outflow=0.35 cfs 0.017 af

Pond 31P: CB-J Peak Elev=36.22' Inflow=2.88 cfs 0.138 af
24.0" Round Culvert n=0.012 L=10.0' S=0.0100 '/' Outflow=2.88 cfs 0.138 af

Pond 32P: DT-3 Peak Elev=33.03' Storage=0.073 af Inflow=3.23 cfs 0.155 af
Outflow=0.15 cfs 0.155 af

Pond 33P: CB-G Peak Elev=30.66' Inflow=1.48 cfs 0.076 af
Primary=0.84 cfs 0.068 af Secondary=0.65 cfs 0.009 af Outflow=1.48 cfs 0.076 af

Pond 34P: CB-K Peak Elev=34.22' Inflow=1.85 cfs 0.092 af
Primary=1.08 cfs 0.083 af Secondary=0.77 cfs 0.009 af Outflow=1.85 cfs 0.092 af

Pond 36P: CB-F Peak Elev=32.47' Inflow=4.21 cfs 0.249 af
Primary=3.31 cfs 0.239 af Secondary=0.90 cfs 0.010 af Outflow=4.21 cfs 0.249 af

Pond 37P: CB-C Peak Elev=29.53' Inflow=0.86 cfs 0.041 af
Primary=0.81 cfs 0.041 af Secondary=0.05 cfs 0.000 af Outflow=0.86 cfs 0.041 af

Pond 38P: CB-D Peak Elev=29.82' Inflow=3.38 cfs 0.178 af
Primary=2.19 cfs 0.163 af Secondary=1.19 cfs 0.015 af Outflow=3.38 cfs 0.178 af

Pond 39P: DT-4 Peak Elev=25.81' Storage=0.262 af Inflow=7.47 cfs 0.539 af
Outflow=0.39 cfs 0.539 af

Pond 40P: CB-E Peak Elev=35.57' Inflow=0.51 cfs 0.031 af
Primary=0.20 cfs 0.026 af Secondary=0.31 cfs 0.006 af Outflow=0.51 cfs 0.031 af

Pond 41P: DT-6 Peak Elev=28.04' Storage=0.040 af Inflow=0.71 cfs 0.097 af
Outflow=0.07 cfs 0.097 af

Pond 42P: CB-B Peak Elev=32.99' Inflow=0.48 cfs 0.023 af
Primary=0.24 cfs 0.020 af Secondary=0.23 cfs 0.003 af Outflow=0.48 cfs 0.023 af

Pond 43P: CB-A Peak Elev=32.35' Inflow=1.49 cfs 0.072 af
Primary=0.28 cfs 0.051 af Secondary=1.20 cfs 0.021 af Outflow=1.49 cfs 0.072 af

Pond 49P: CB-S Peak Elev=27.35' Inflow=1.87 cfs 0.089 af
Outflow=1.87 cfs 0.089 af

Pond 51P: CB-T Peak Elev=34.51' Inflow=0.47 cfs 0.023 af
12.0" Round Culvert n=0.120 L=100.0' S=0.0100 '/' Outflow=0.47 cfs 0.023 af

Pond 53P: CB-U Peak Elev=34.27' Inflow=0.58 cfs 0.027 af
12.0" Round Culvert n=0.012 L=100.0' S=0.0100 '/' Outflow=0.58 cfs 0.027 af

Pond 54P: DA-9 Peak Elev=30.03' Storage=0.063 af Inflow=2.13 cfs 0.133 af
Outflow=0.10 cfs 0.133 af

Pond 56P: (new Pond) Peak Elev=35.88' Inflow=0.57 cfs 0.028 af
12.0" Round Culvert n=0.012 L=40.0' S=0.0100 '/' Outflow=0.57 cfs 0.028 af

Total Runoff Area = 14.800 ac Runoff Volume = 1.424 af Average Runoff Depth = 1.15"
16.82% Pervious = 2.490 ac 83.18% Impervious = 12.310 ac

Summary for Subcatchment 1S: A

[49] Hint: Tc<2dt may require smaller dt

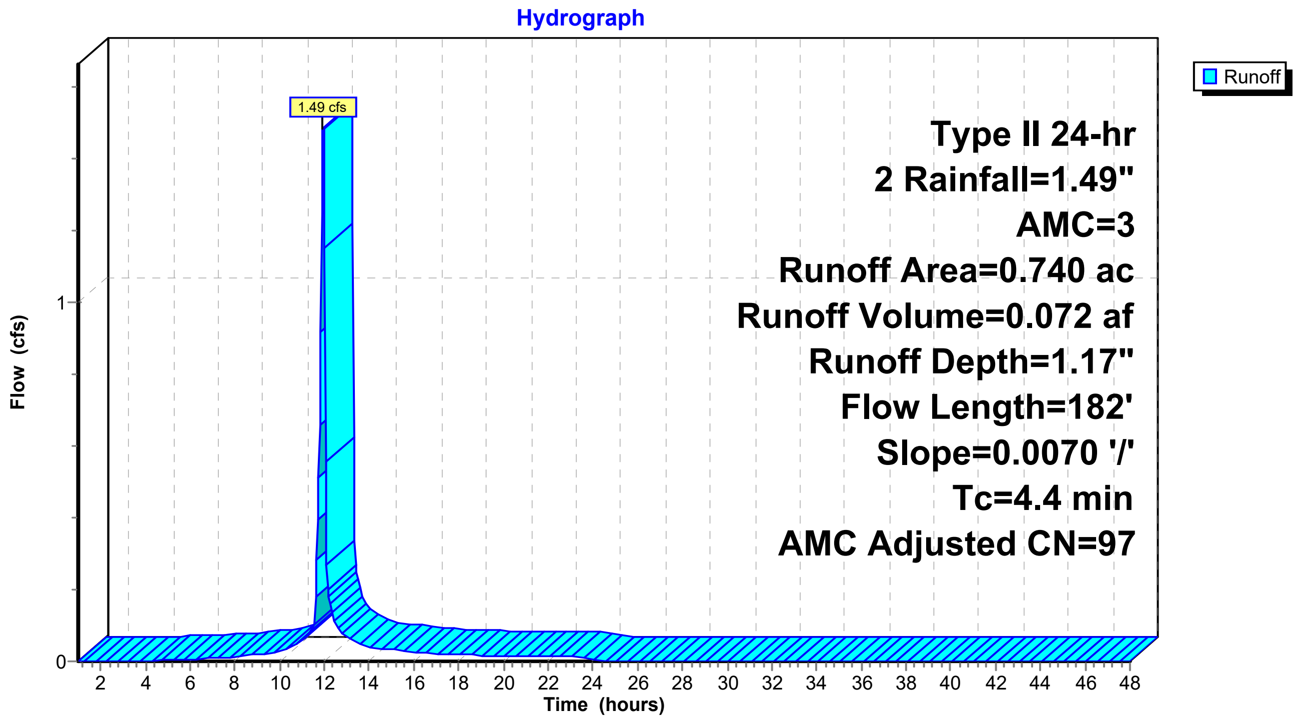
Runoff = 1.49 cfs @ 11.95 hrs, Volume= 0.072 af, Depth= 1.17"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 2 Rainfall=1.49", AMC=3

	Area (ac)	CN	Adj	Description
*	0.630	98		
*	0.110	56		
	0.740	92	97	Weighted Average, AMC Adjusted
	0.110			14.86% Pervious Area
	0.630			85.14% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.4	182	0.0070	0.70		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 1.49"

Subcatchment 1S: A



Summary for Subcatchment 2S: B

[49] Hint: Tc<2dt may require smaller dt

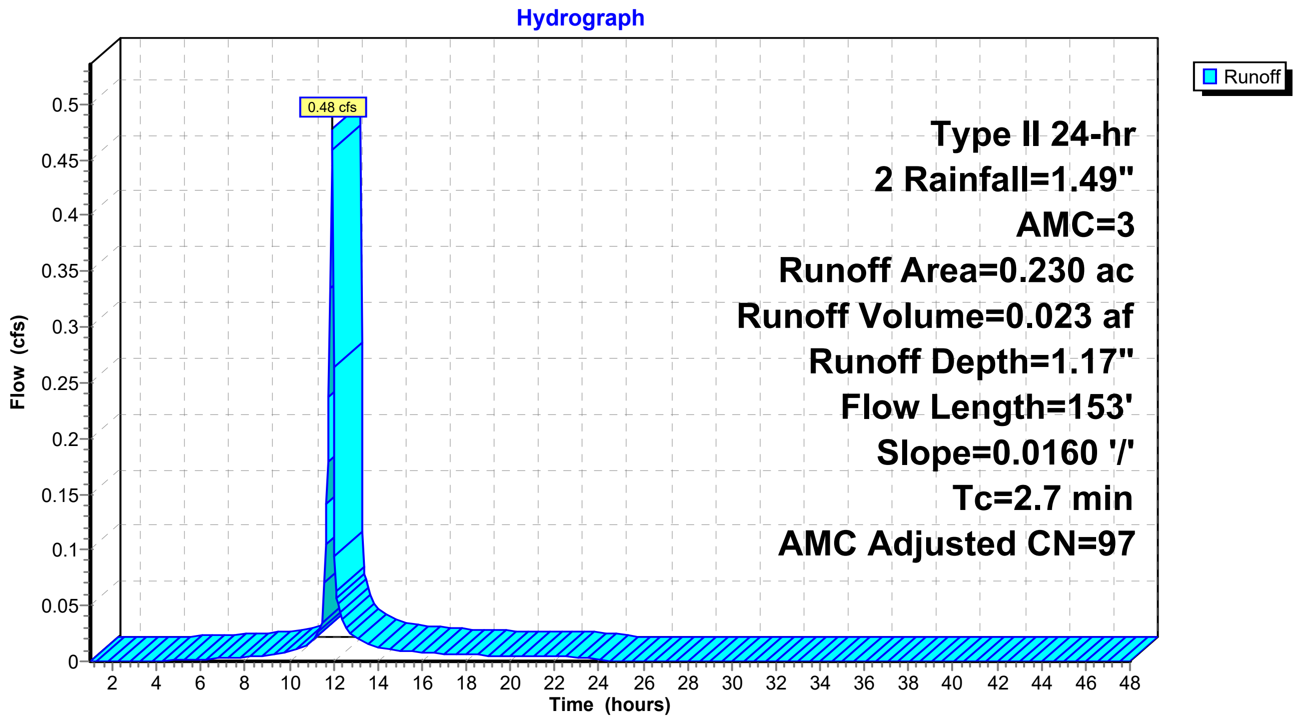
Runoff = 0.48 cfs @ 11.93 hrs, Volume= 0.023 af, Depth= 1.17"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 2 Rainfall=1.49", AMC=3

	Area (ac)	CN	Adj	Description
*	0.190	98		
*	0.040	56		
	0.230	91	97	Weighted Average, AMC Adjusted
	0.040			17.39% Pervious Area
	0.190			82.61% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.7	153	0.0160	0.93		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 1.49"

Subcatchment 2S: B



Summary for Subcatchment 3S: C

[49] Hint: Tc<2dt may require smaller dt

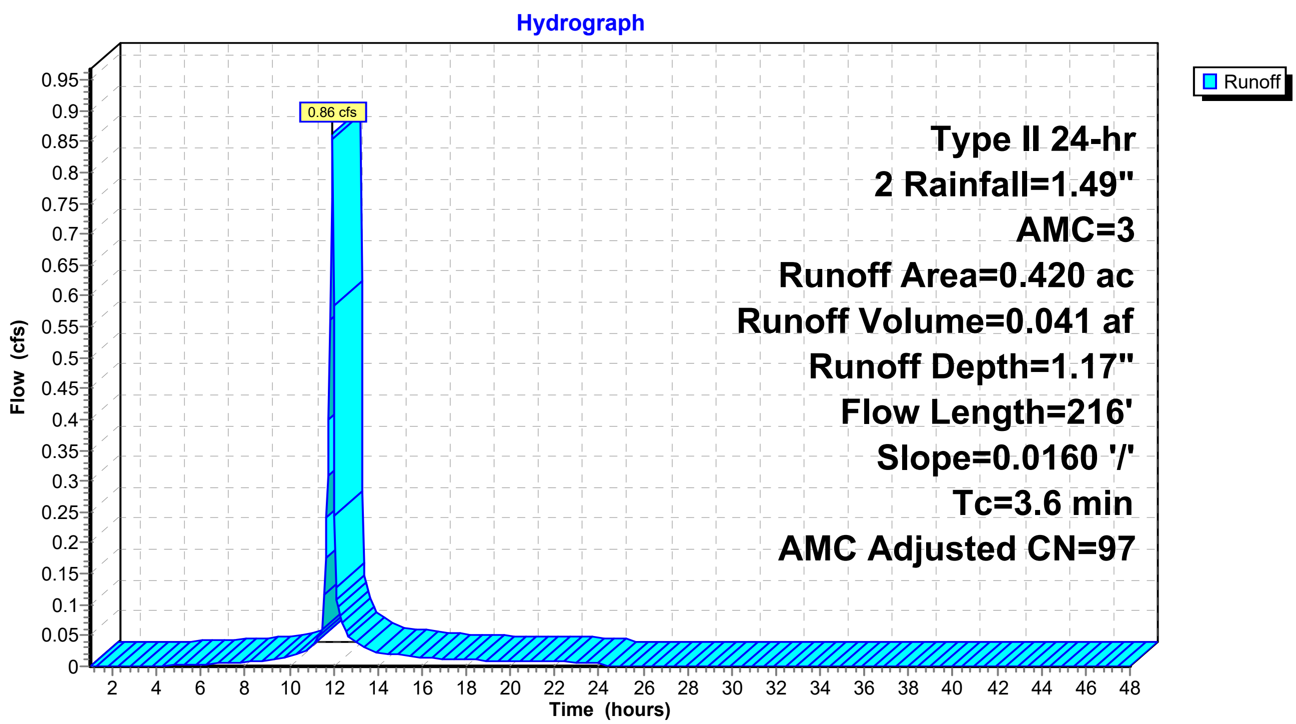
Runoff = 0.86 cfs @ 11.94 hrs, Volume= 0.041 af, Depth= 1.17"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 2 Rainfall=1.49", AMC=3

	Area (ac)	CN	Adj	Description
*	0.360	98		
*	0.060	56		
	0.420	92	97	Weighted Average, AMC Adjusted
	0.060			14.29% Pervious Area
	0.360			85.71% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.6	216	0.0160	1.00		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 1.49"

Subcatchment 3S: C



Summary for Subcatchment 4S: D

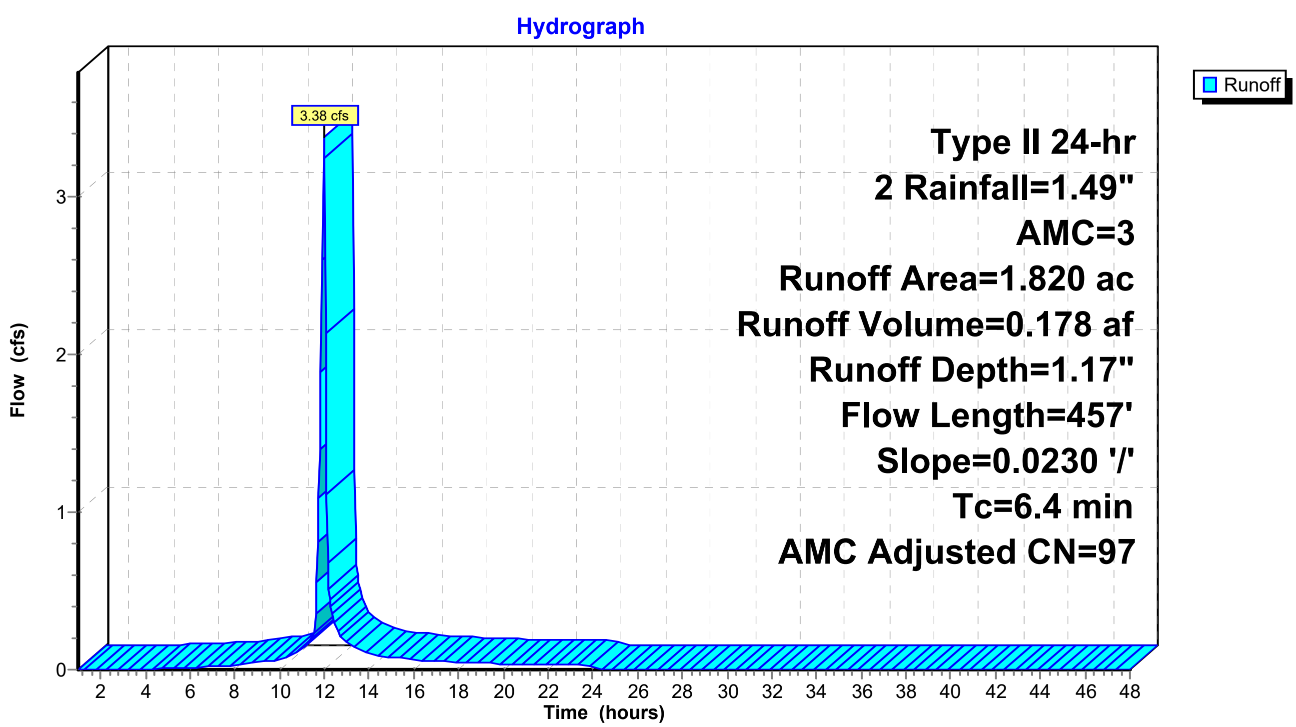
Runoff = 3.38 cfs @ 11.97 hrs, Volume= 0.178 af, Depth= 1.17"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 2 Rainfall=1.49", AMC=3

	Area (ac)	CN	Adj	Description
*	1.550	98		
*	0.270	56		
	1.820	92	97	Weighted Average, AMC Adjusted
	0.270			14.84% Pervious Area
	1.550			85.16% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.0	300	0.0230	1.24		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 1.49"
2.4	157	0.0230	1.09		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 1.49"
6.4	457	Total			

Subcatchment 4S: D



Summary for Subcatchment 5S: E

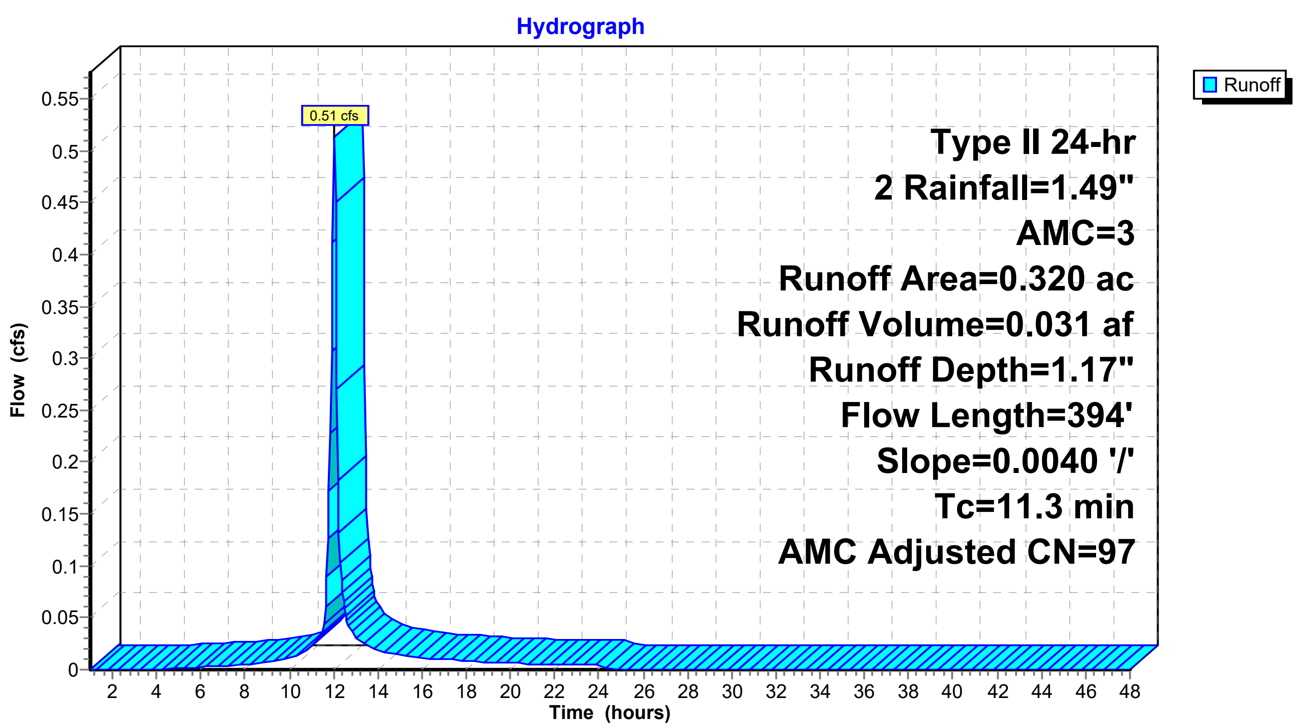
Runoff = 0.51 cfs @ 12.02 hrs, Volume= 0.031 af, Depth= 1.17"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 2 Rainfall=1.49", AMC=3

	Area (ac)	CN	Adj	Description
*	0.270	98		
*	0.050	56		
	0.320	91	97	Weighted Average, AMC Adjusted
	0.050			15.63% Pervious Area
	0.270			84.38% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.1	300	0.0040	0.61		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 1.49"
3.2	94	0.0040	0.49		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 1.49"
11.3	394	Total			

Subcatchment 5S: E



Summary for Subcatchment 6S: F

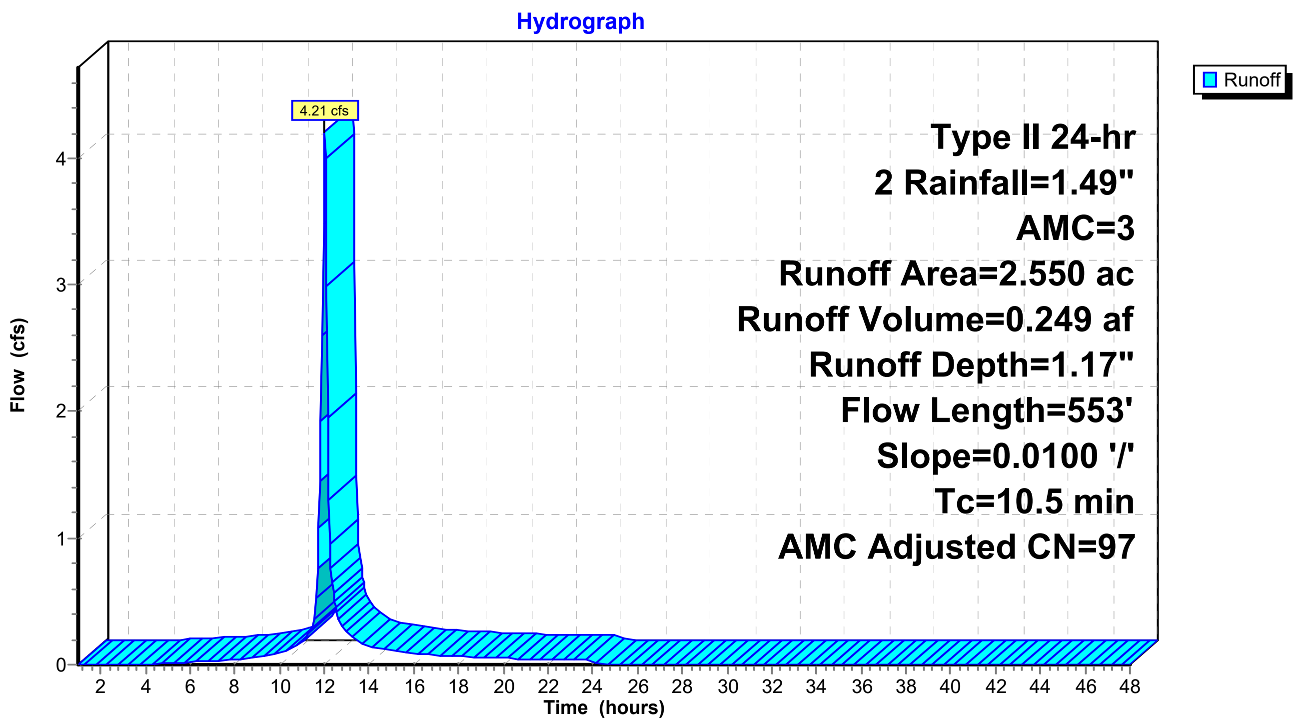
Runoff = 4.21 cfs @ 12.01 hrs, Volume= 0.249 af, Depth= 1.17"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 2 Rainfall=1.49", AMC=3

	Area (ac)	CN	Adj	Description
*	2.170	98		
*	0.380	56		
	2.550	92	97	Weighted Average, AMC Adjusted
	0.380			14.90% Pervious Area
	2.170			85.10% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.6	300	0.0100	0.89		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 1.49"
4.9	253	0.0100	0.86		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 1.49"
10.5	553	Total			

Subcatchment 6S: F



Summary for Subcatchment 7S: G

[49] Hint: Tc<2dt may require smaller dt

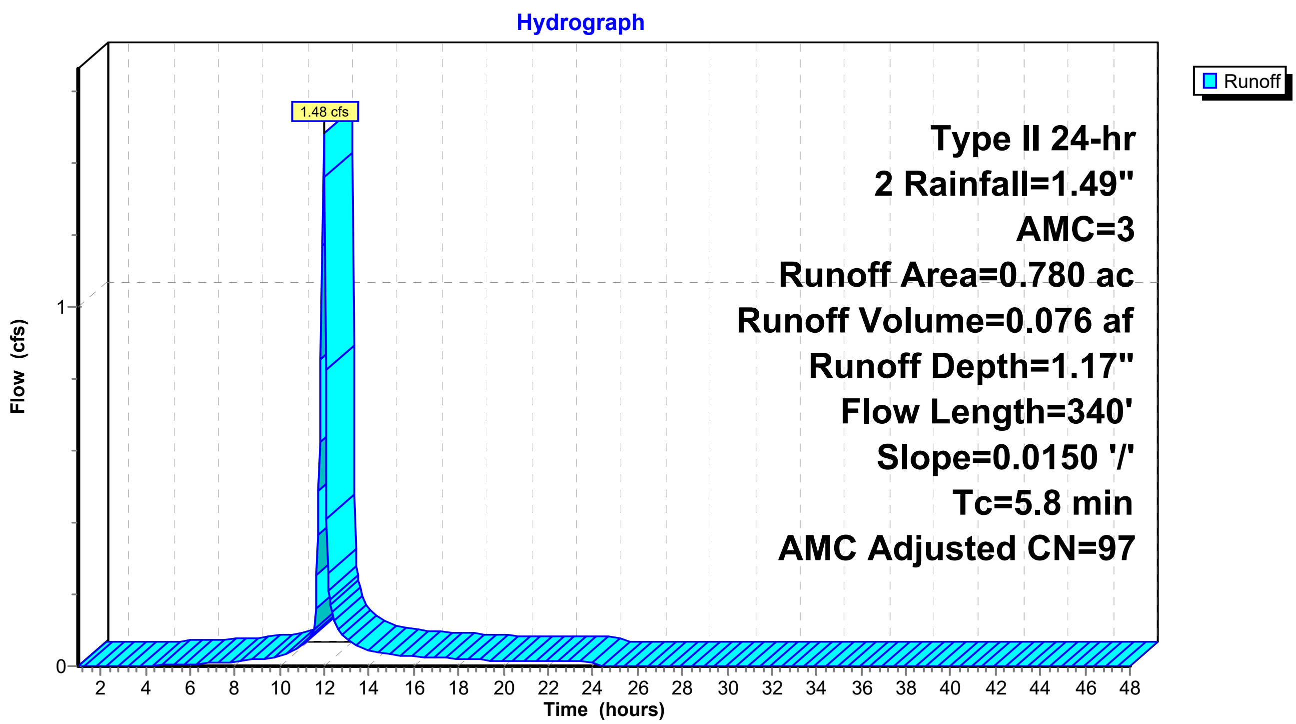
Runoff = 1.48 cfs @ 11.96 hrs, Volume= 0.076 af, Depth= 1.17"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 2 Rainfall=1.49", AMC=3

	Area (ac)	CN	Adj	Description
*	0.660	98		
*	0.120	56		
	0.780	92	97	Weighted Average, AMC Adjusted
	0.120			15.38% Pervious Area
	0.660			84.62% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.8	300	0.0150	1.04		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 1.49"
1.0	40	0.0150	0.70		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 1.49"
5.8	340	Total			

Subcatchment 7S: G



Summary for Subcatchment 8S: H

[49] Hint: Tc<2dt may require smaller dt

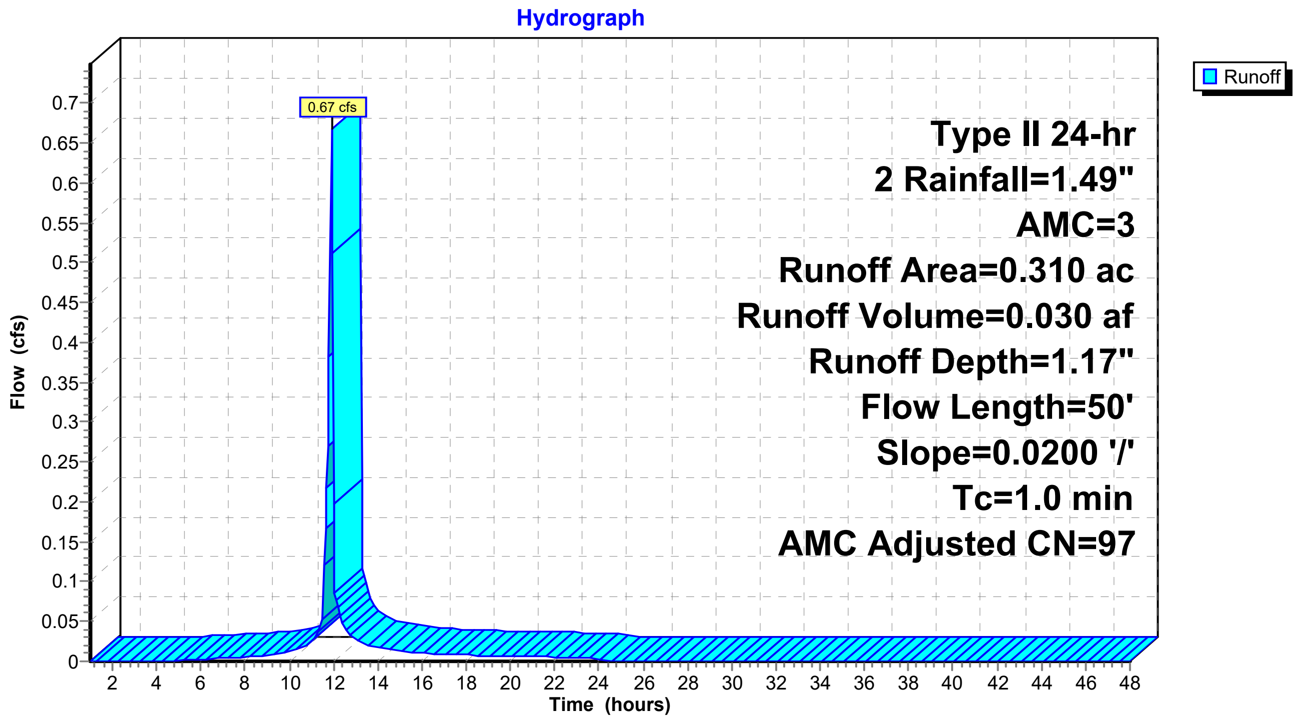
Runoff = 0.67 cfs @ 11.90 hrs, Volume= 0.030 af, Depth= 1.17"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 2 Rainfall=1.49", AMC=3

	Area (ac)	CN	Adj	Description
*	0.260	98		
*	0.050	56		
	0.310	91	97	Weighted Average, AMC Adjusted
	0.050			16.13% Pervious Area
	0.260			83.87% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.0	50	0.0200	0.82		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 1.49"

Subcatchment 8S: H



Summary for Subcatchment 9S: I

[49] Hint: Tc<2dt may require smaller dt

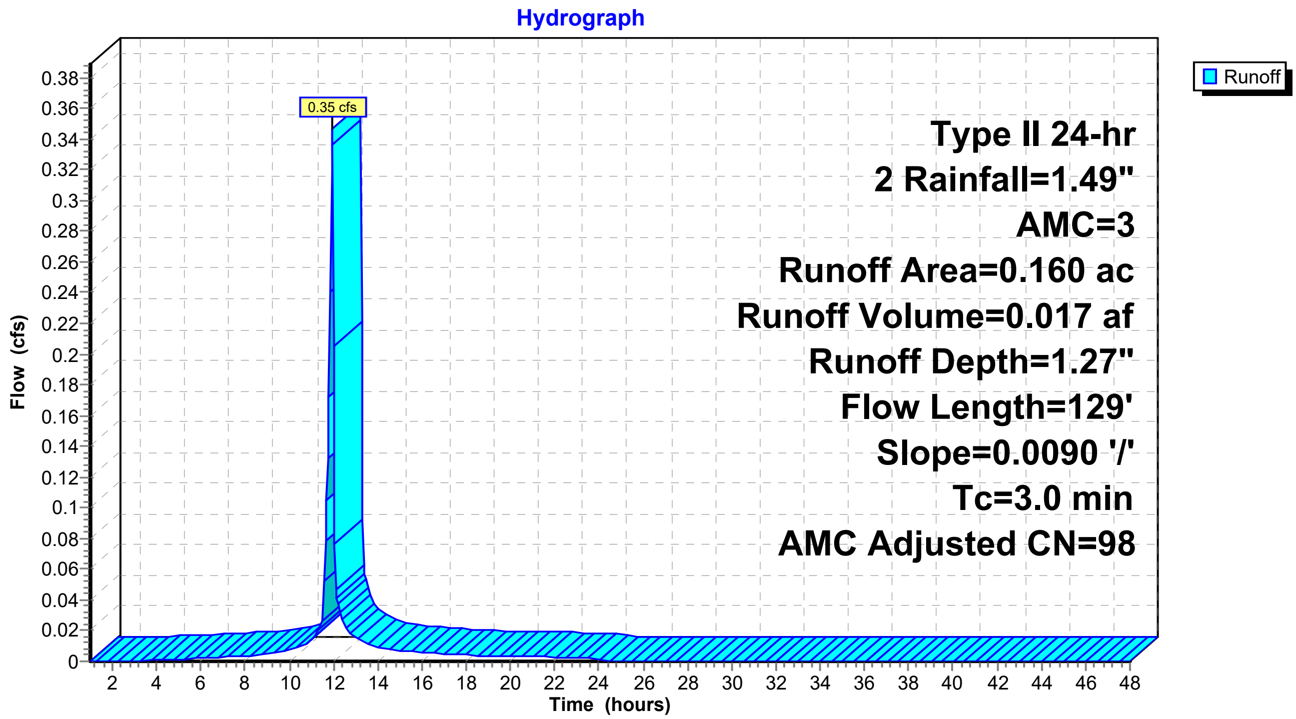
Runoff = 0.35 cfs @ 11.93 hrs, Volume= 0.017 af, Depth= 1.27"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 2 Rainfall=1.49", AMC=3

	Area (ac)	CN	Adj	Description
*	0.140	98		
*	0.020	56		
	0.160	93	98	Weighted Average, AMC Adjusted
	0.020			12.50% Pervious Area
	0.140			87.50% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.0	129	0.0090	0.72		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 1.49"

Subcatchment 9S: I



Summary for Subcatchment 10S: J

[49] Hint: Tc<2dt may require smaller dt

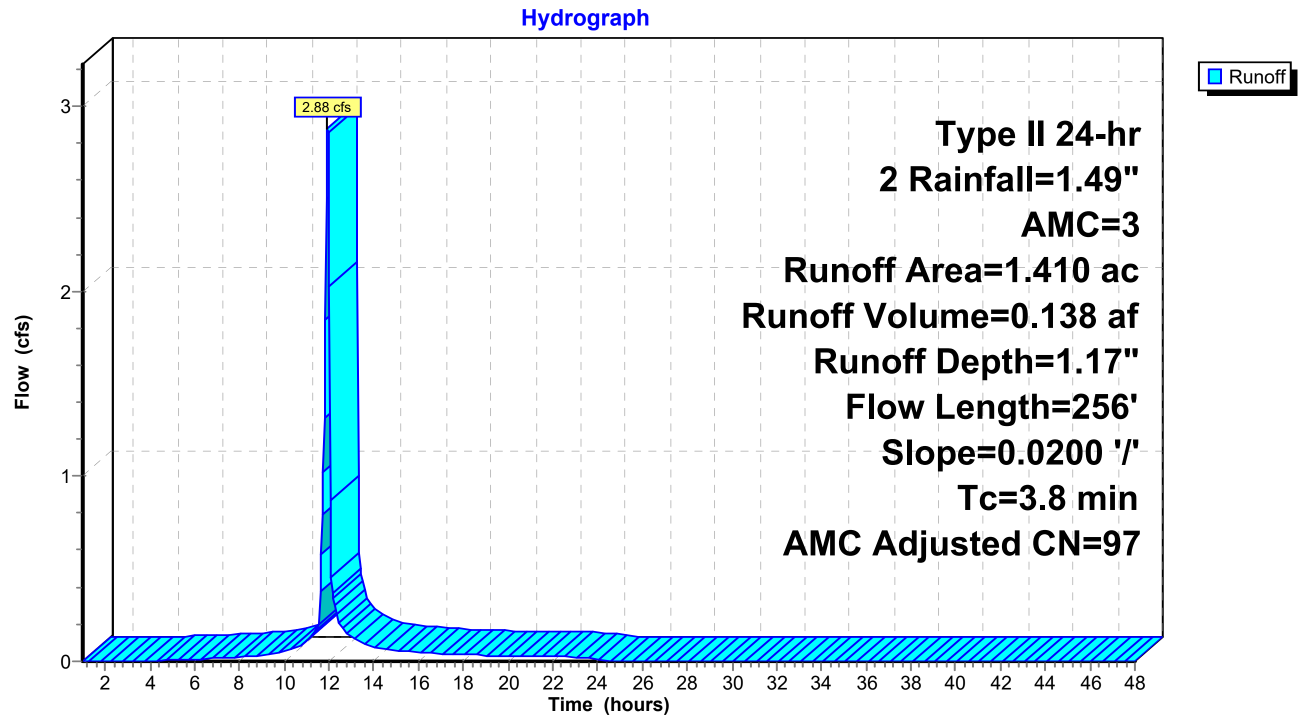
Runoff = 2.88 cfs @ 11.94 hrs, Volume= 0.138 af, Depth= 1.17"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 2 Rainfall=1.49", AMC=3

	Area (ac)	CN	Adj	Description
*	1.200	98		
*	0.210	56		
	1.410	92	97	Weighted Average, AMC Adjusted
	0.210			14.89% Pervious Area
	1.200			85.11% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.8	256	0.0200	1.13		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 1.49"

Subcatchment 10S: J



Summary for Subcatchment 11S: K

[49] Hint: Tc<2dt may require smaller dt

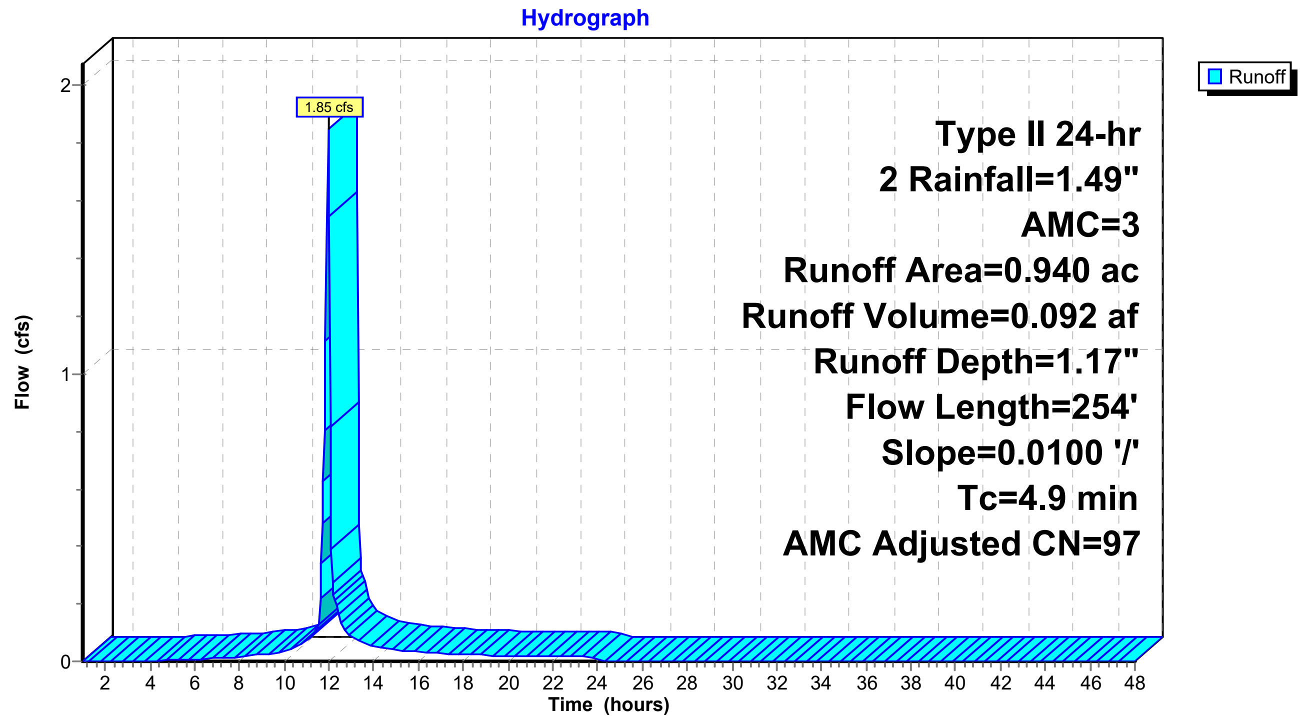
Runoff = 1.85 cfs @ 11.95 hrs, Volume= 0.092 af, Depth= 1.17"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 2 Rainfall=1.49", AMC=3

	Area (ac)	CN	Adj	Description
*	0.800	98		
*	0.140	56		
	0.940	92	97	Weighted Average, AMC Adjusted
	0.140			14.89% Pervious Area
	0.800			85.11% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.9	254	0.0100	0.86		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 1.49"

Subcatchment 11S: K



Summary for Subcatchment 12S: L

[49] Hint: Tc<2dt may require smaller dt

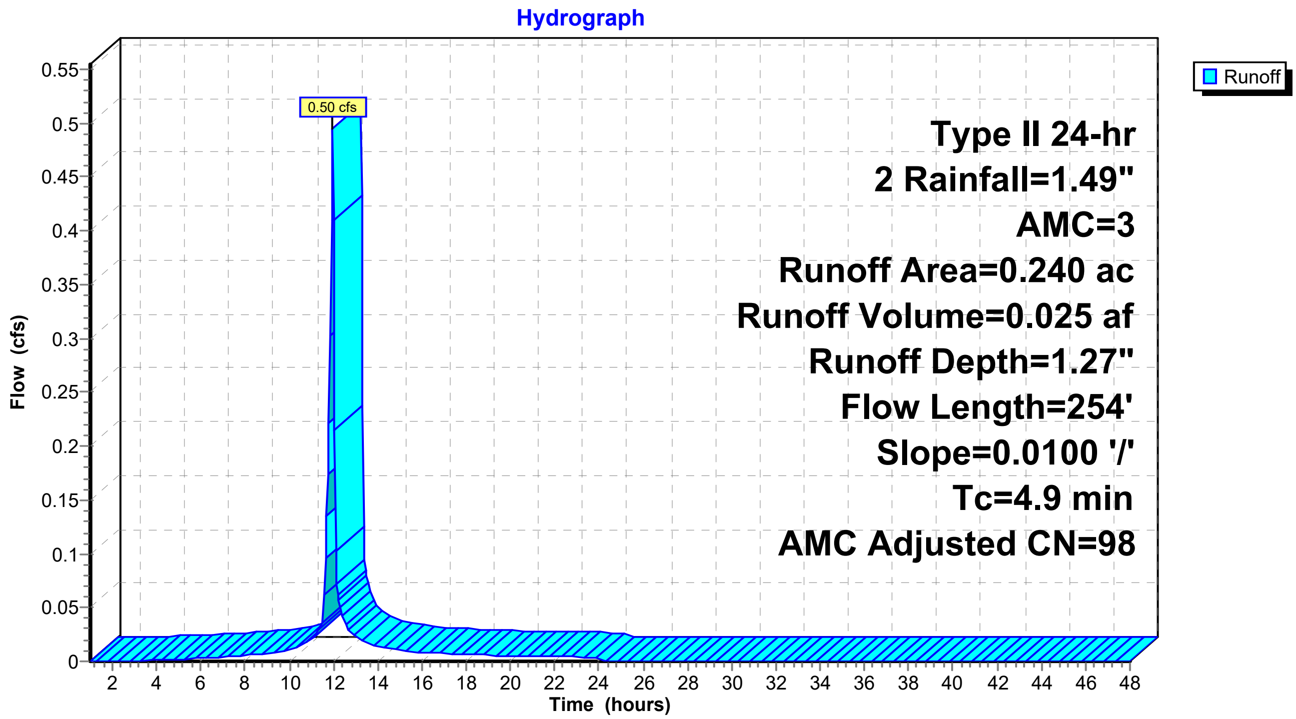
Runoff = 0.50 cfs @ 11.95 hrs, Volume= 0.025 af, Depth= 1.27"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 2 Rainfall=1.49", AMC=3

	Area (ac)	CN	Adj	Description
*	0.210	98		
*	0.030	56		
	0.240	93	98	Weighted Average, AMC Adjusted
	0.030			12.50% Pervious Area
	0.210			87.50% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.9	254	0.0100	0.86		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 1.49"

Subcatchment 12S: L



Summary for Subcatchment 13S: M

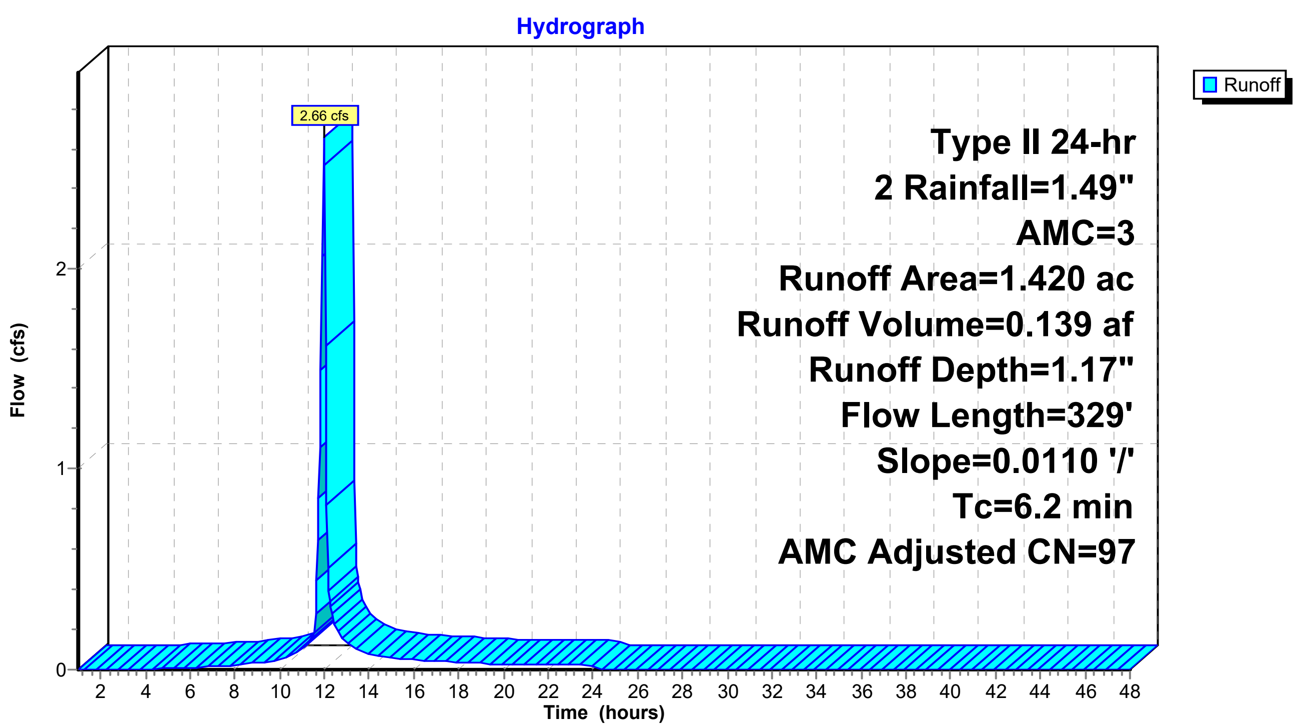
Runoff = 2.66 cfs @ 11.97 hrs, Volume= 0.139 af, Depth= 1.17"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 2 Rainfall=1.49", AMC=3

	Area (ac)	CN	Adj	Description
*	1.210	98		
*	0.210	56		
	1.420	92	97	Weighted Average, AMC Adjusted
	0.210			14.79% Pervious Area
	1.210			85.21% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.4	300	0.0110	0.92		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 1.49"
0.8	29	0.0110	0.58		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 1.49"
6.2	329	Total			

Subcatchment 13S: M



Summary for Subcatchment 14S: N

[49] Hint: Tc<2dt may require smaller dt

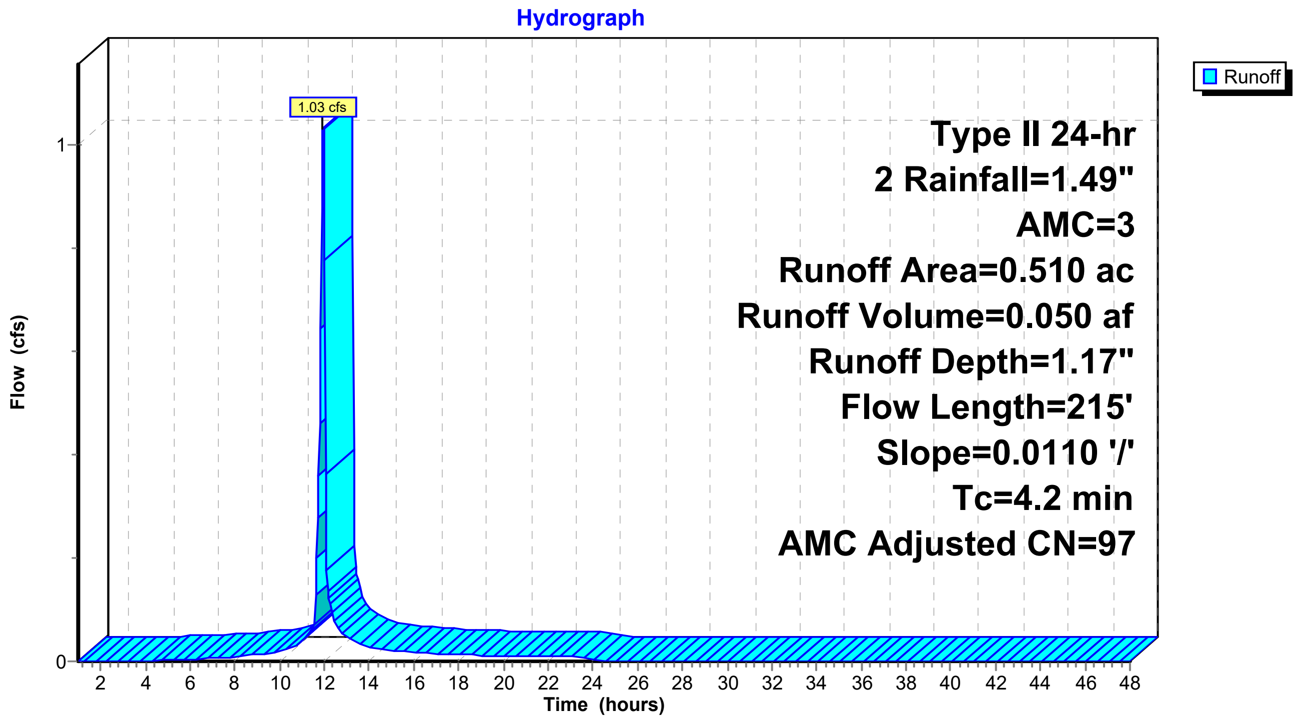
Runoff = 1.03 cfs @ 11.94 hrs, Volume= 0.050 af, Depth= 1.17"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 2 Rainfall=1.49", AMC=3

	Area (ac)	CN	Adj	Description
*	0.430	98		
*	0.080	56		
	0.510	91	97	Weighted Average, AMC Adjusted
	0.080			15.69% Pervious Area
	0.430			84.31% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.2	215	0.0110	0.86		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 1.49"

Subcatchment 14S: N



Summary for Subcatchment 15S: O

[49] Hint: Tc<2dt may require smaller dt

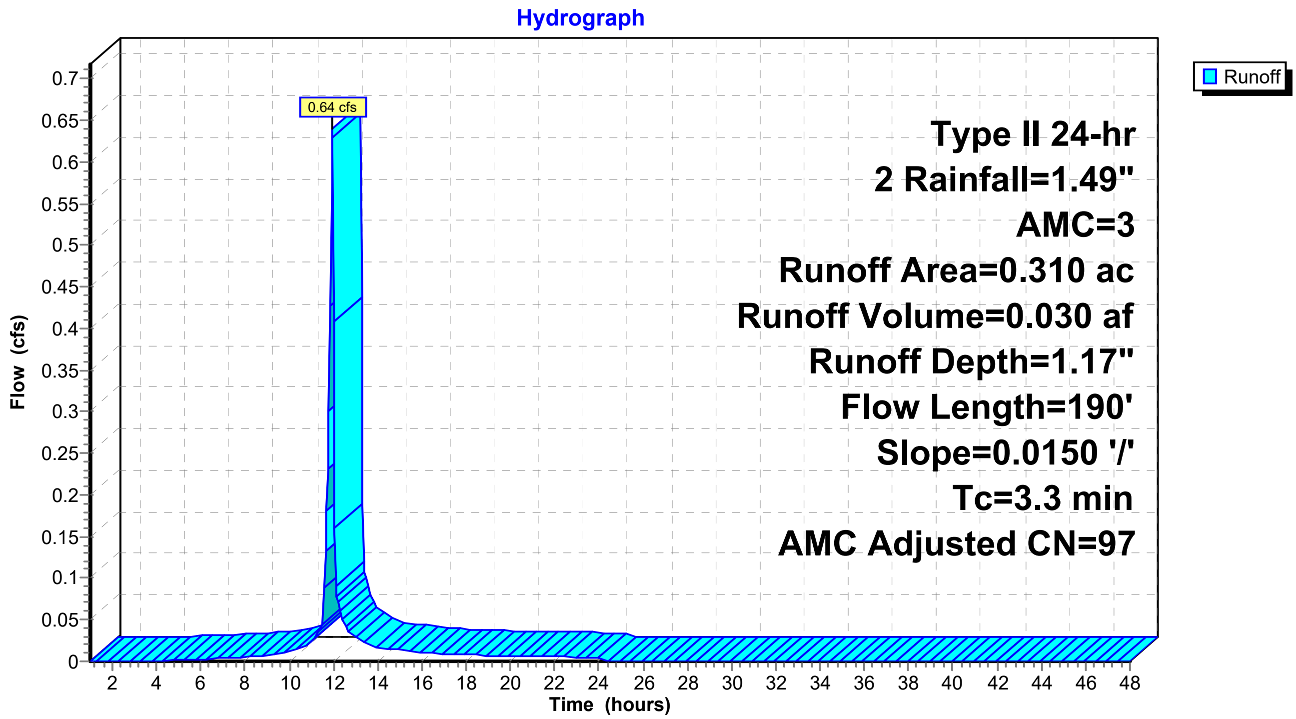
Runoff = 0.64 cfs @ 11.94 hrs, Volume= 0.030 af, Depth= 1.17"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 2 Rainfall=1.49", AMC=3

	Area (ac)	CN	Adj	Description
*	0.260	98		
*	0.050	56		
	0.310	91	97	Weighted Average, AMC Adjusted
	0.050			16.13% Pervious Area
	0.260			83.87% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.3	190	0.0150	0.95		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 1.49"

Subcatchment 15S: O



Summary for Subcatchment 16S: P

[49] Hint: Tc<2dt may require smaller dt

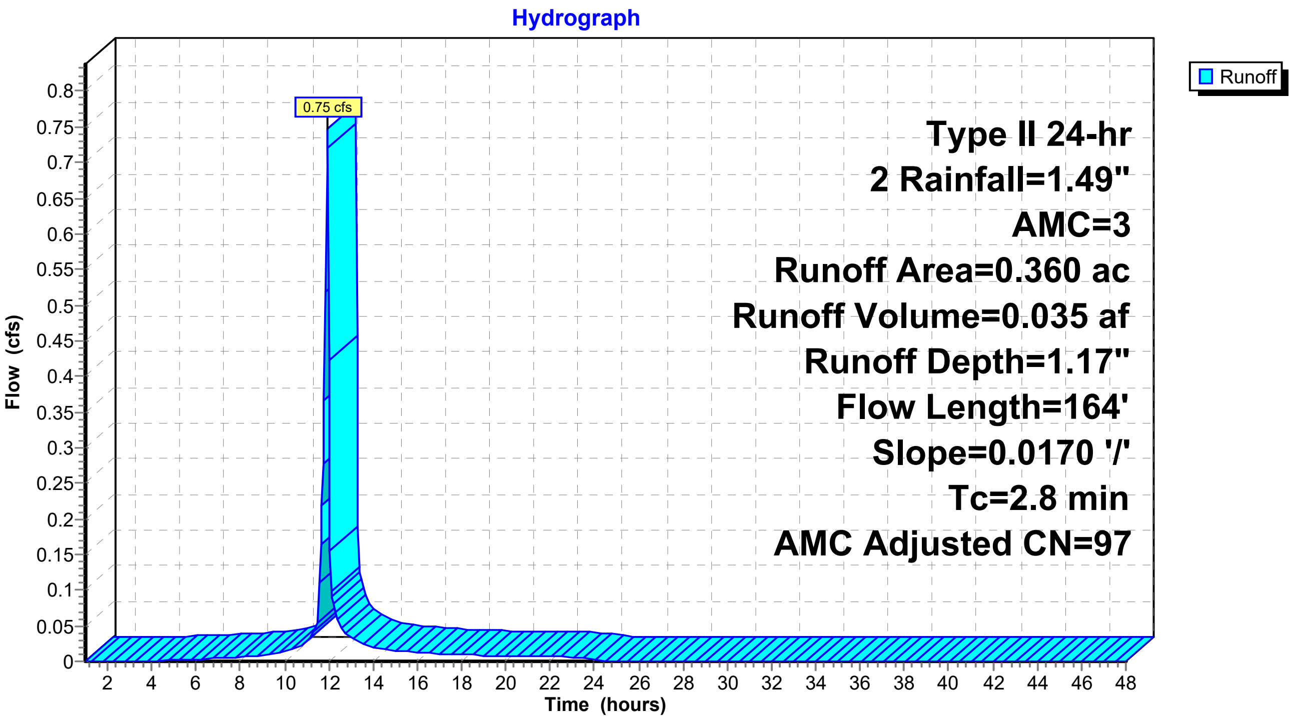
Runoff = 0.75 cfs @ 11.93 hrs, Volume= 0.035 af, Depth= 1.17"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 2 Rainfall=1.49", AMC=3

	Area (ac)	CN	Adj	Description
*	0.300	98		
*	0.060	56		
	0.360	91	97	Weighted Average, AMC Adjusted
	0.060			16.67% Pervious Area
	0.300			83.33% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.8	164	0.0170	0.97		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 1.49"

Subcatchment 16S: P



Summary for Subcatchment 17S: S

[49] Hint: Tc<2dt may require smaller dt

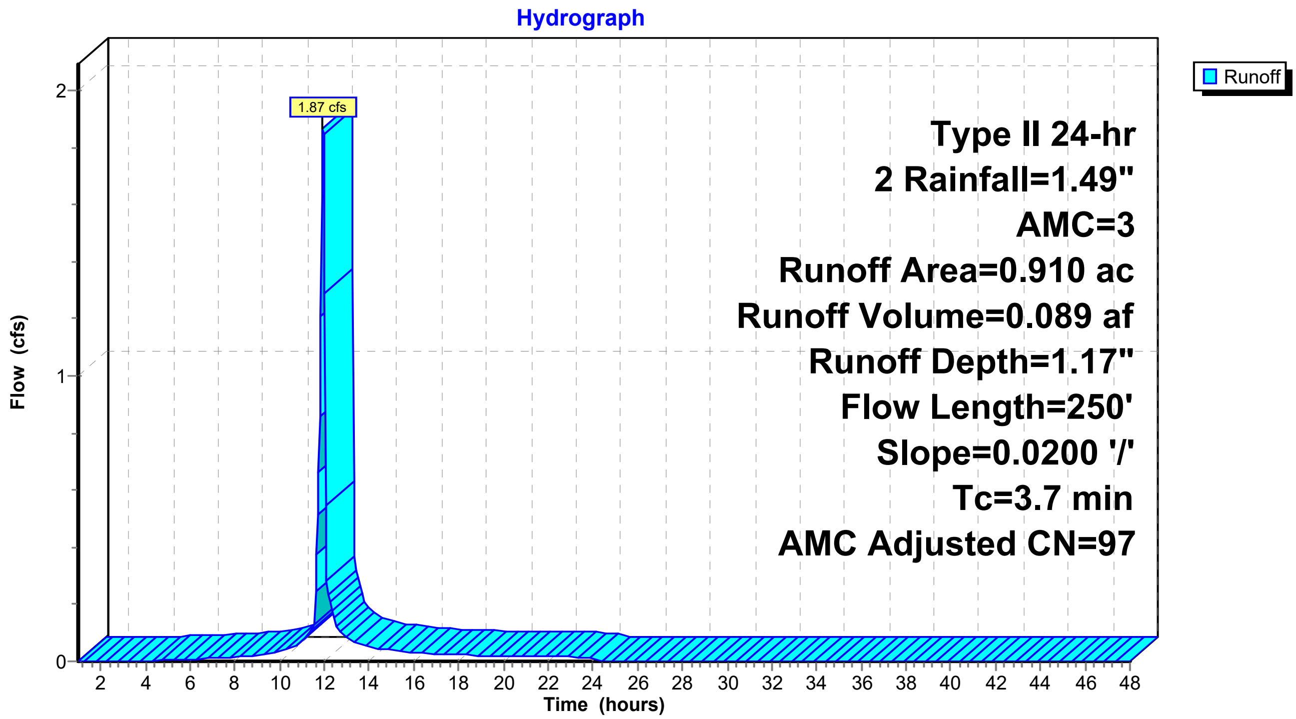
Runoff = 1.87 cfs @ 11.94 hrs, Volume= 0.089 af, Depth= 1.17"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 2 Rainfall=1.49", AMC=3

	Area (ac)	CN	Adj	Description
*	0.770	98		
*	0.140	56		
	0.910	92	97	Weighted Average, AMC Adjusted
	0.140			15.38% Pervious Area
	0.770			84.62% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.7	250	0.0200	1.13		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 1.49"

Subcatchment 17S: S



Summary for Subcatchment 18S: Q

[49] Hint: Tc<2dt may require smaller dt

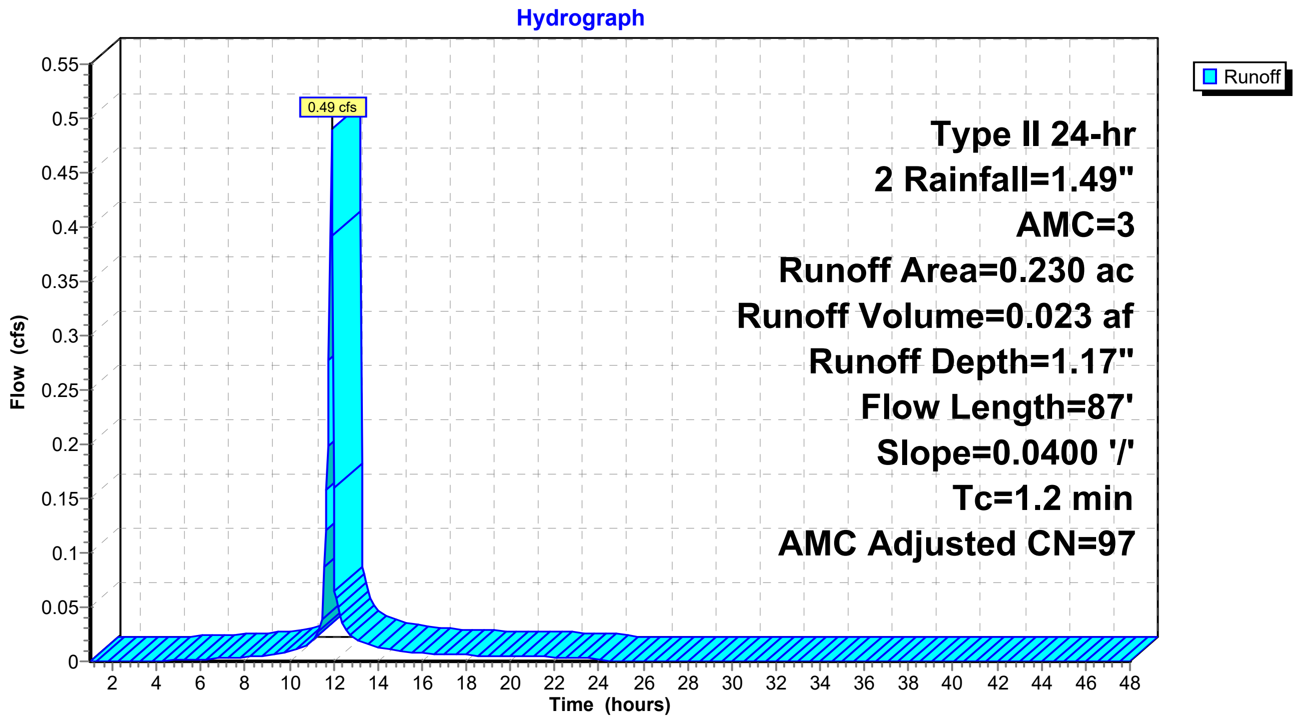
Runoff = 0.49 cfs @ 11.90 hrs, Volume= 0.023 af, Depth= 1.17"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 2 Rainfall=1.49", AMC=3

	Area (ac)	CN	Adj	Description
*	0.190	98		
*	0.040	56		
	0.230	91	97	Weighted Average, AMC Adjusted
	0.040			17.39% Pervious Area
	0.190			82.61% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	87	0.0400	1.20		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 1.49"

Subcatchment 18S: Q



Summary for Subcatchment 19S: R

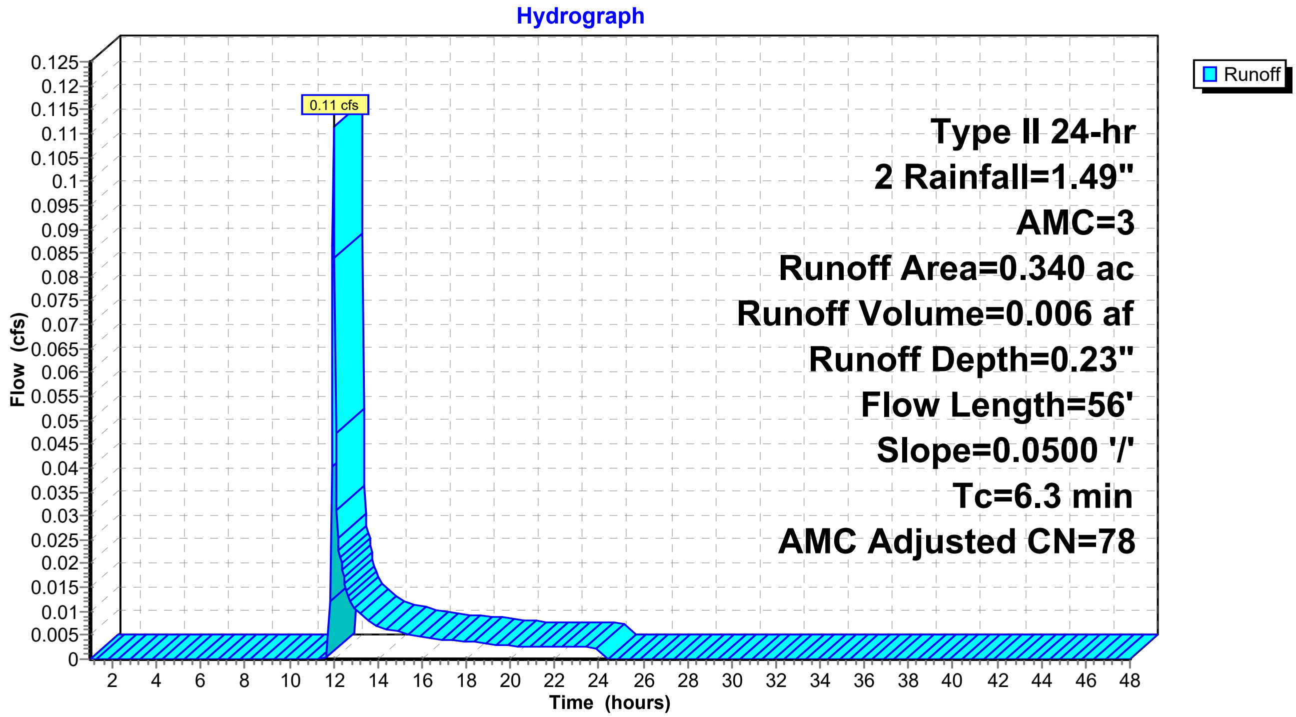
Runoff = 0.11 cfs @ 12.00 hrs, Volume= 0.006 af, Depth= 0.23"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 2 Rainfall=1.49", AMC=3

	Area (ac)	CN	Adj	Description
*	0.030	98		
*	0.310	56		
	0.340	60	78	Weighted Average, AMC Adjusted
	0.310			91.18% Pervious Area
	0.030			8.82% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.3	56	0.0500	0.15		**Sheet Flow,** Grass: Short n= 0.150 P2= 1.49"

Subcatchment 19S: R



Summary for Subcatchment 50S: T

[49] Hint: Tc<2dt may require smaller dt

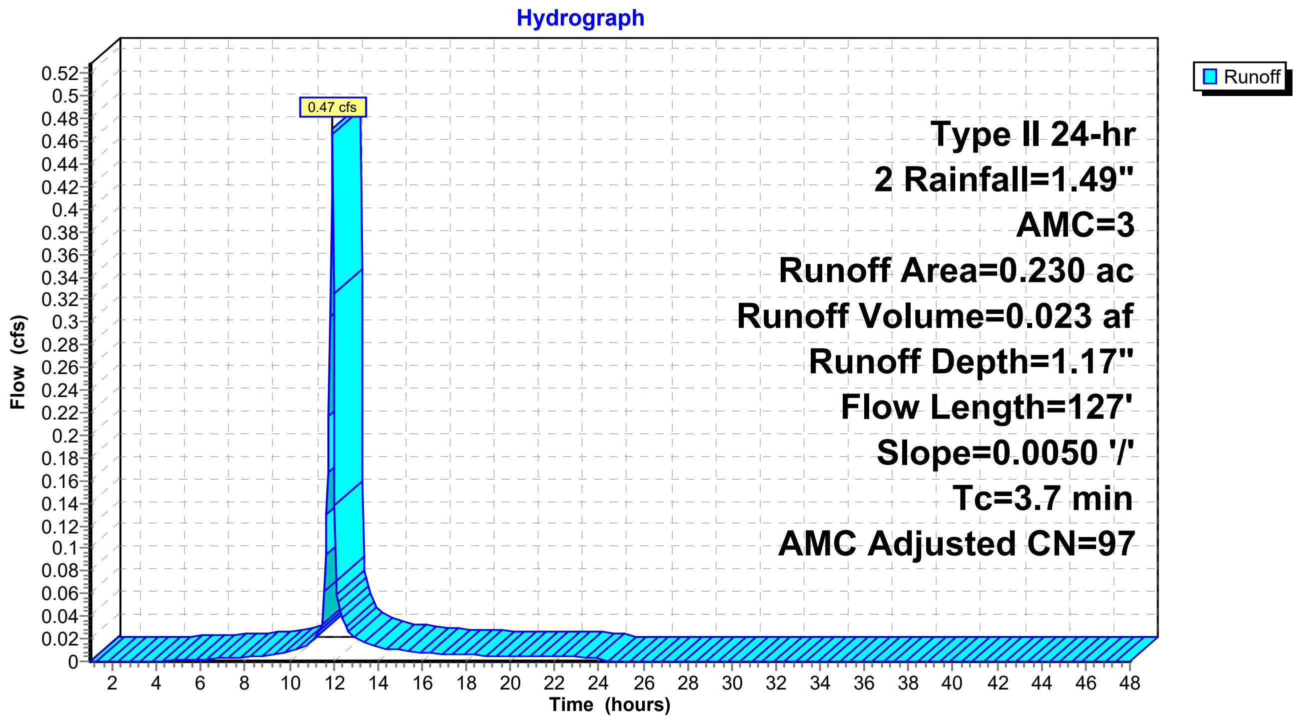
Runoff = 0.47 cfs @ 11.94 hrs, Volume= 0.023 af, Depth= 1.17"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 2 Rainfall=1.49", AMC=3

	Area (ac)	CN	Adj	Description
*	0.190	98		
*	0.040	56		
	0.230	91	97	Weighted Average, AMC Adjusted
	0.040			17.39% Pervious Area
	0.190			82.61% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.7	127	0.0050	0.57		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 1.49"

Subcatchment 50S: T



Summary for Subcatchment 52S: U

[49] Hint: Tc<2dt may require smaller dt

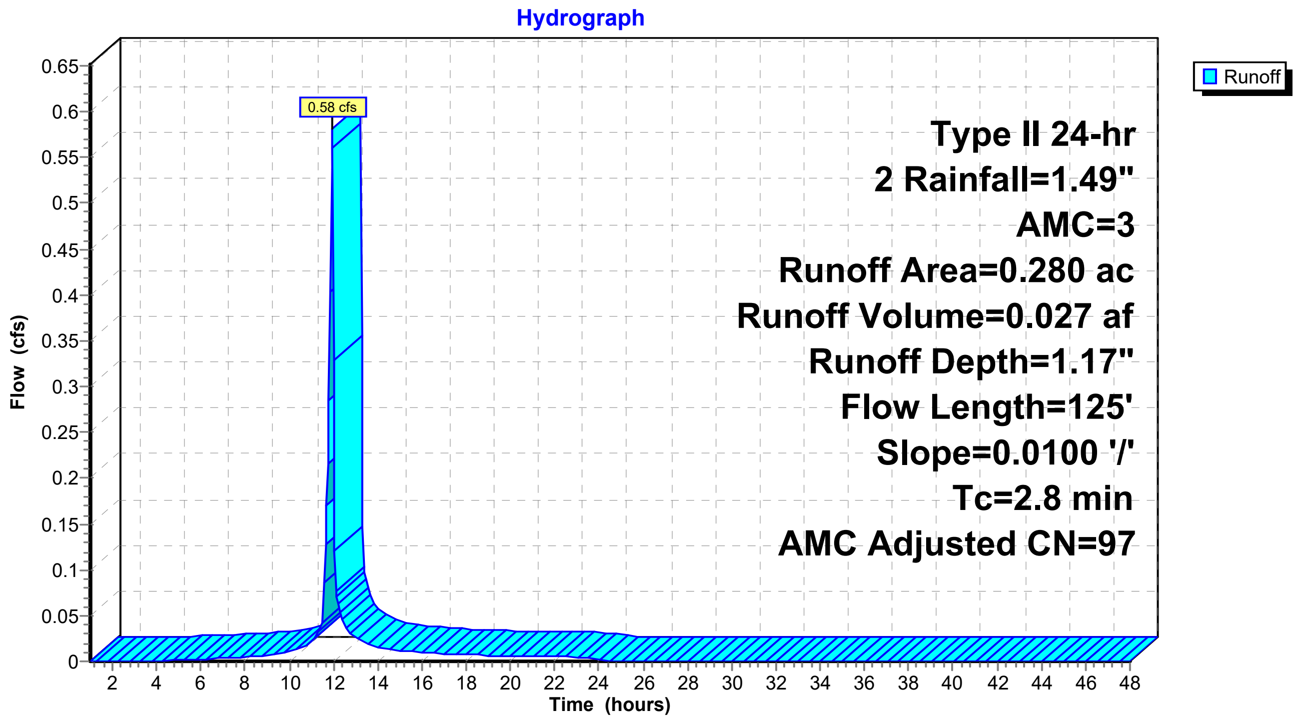
Runoff = 0.58 cfs @ 11.93 hrs, Volume= 0.027 af, Depth= 1.17"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 2 Rainfall=1.49", AMC=3

	Area (ac)	CN	Adj	Description
*	0.240	98		
*	0.040	56		
	0.280	92	97	Weighted Average, AMC Adjusted
	0.040			14.29% Pervious Area
	0.240			85.71% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.8	125	0.0100	0.74		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 1.49"

Subcatchment 52S: U



Summary for Subcatchment 55S: V

[49] Hint: Tc<2dt may require smaller dt

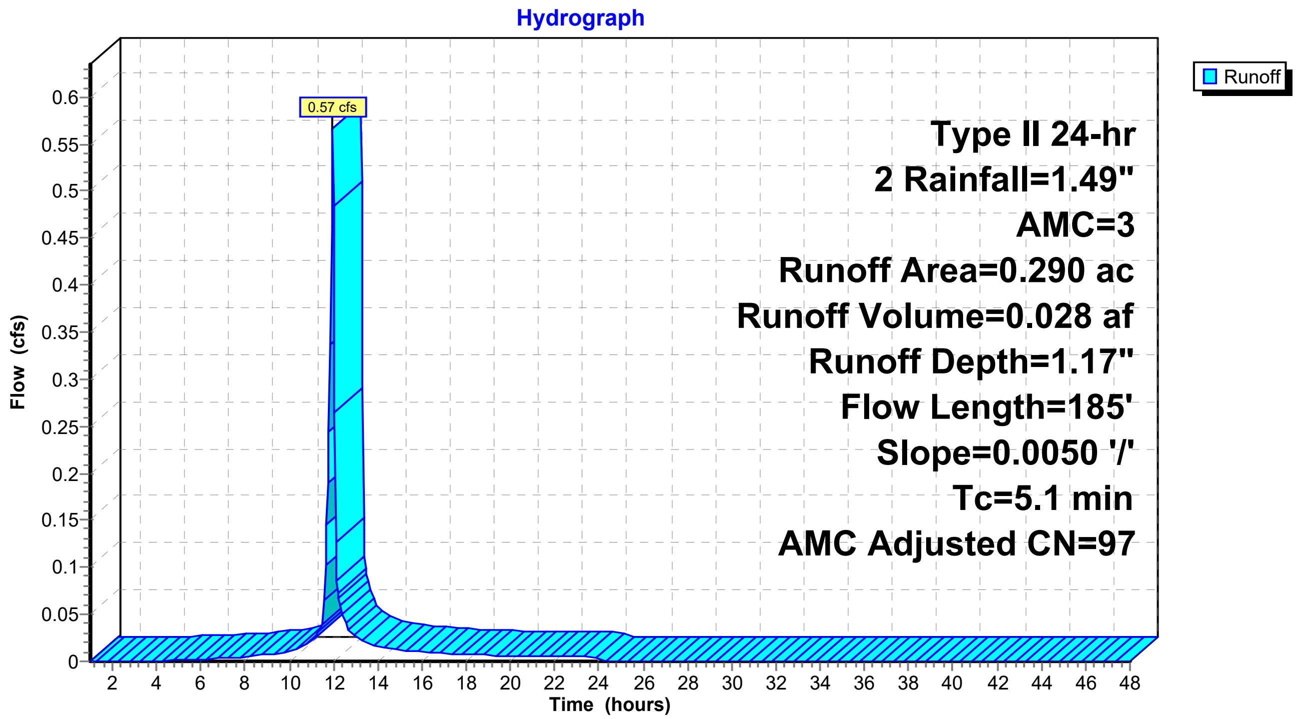
Runoff = 0.57 cfs @ 11.95 hrs, Volume= 0.028 af, Depth= 1.17"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 2 Rainfall=1.49", AMC=3

	Area (ac)	CN	Adj	Description
*	0.250	98		
*	0.040	56		
	0.290	92	97	Weighted Average, AMC Adjusted
	0.040			13.79% Pervious Area
	0.250			86.21% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.1	185	0.0050	0.61		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 1.49"

Subcatchment 55S: V



Summary for Reach 46R: REGIONAL SD

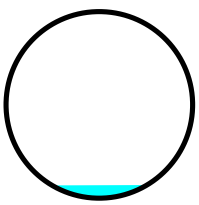
[52] Hint: Inlet/Outlet conditions not evaluated

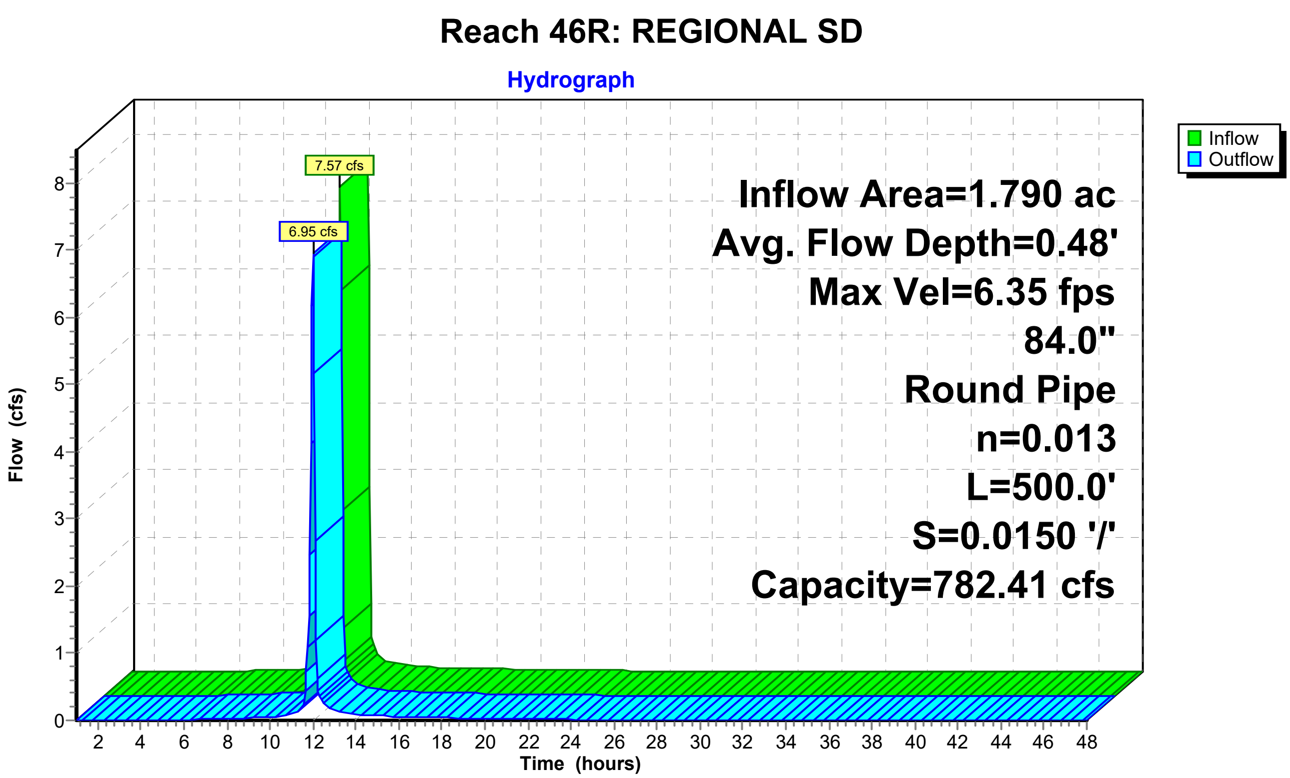
Inflow Area = 1.790 ac, 69.83% Impervious, Inflow Depth = 1.48" for 2 event
Inflow = 7.57 cfs @ 11.95 hrs, Volume= 0.221 af
Outflow = 6.95 cfs @ 11.99 hrs, Volume= 0.221 af, Atten= 8%, Lag= 2.3 min

Routing by Stor-Ind+Trans method, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Max. Velocity= 6.35 fps, Min. Travel Time= 1.3 min
Avg. Velocity = 1.91 fps, Avg. Travel Time= 4.4 min

Peak Storage= 567 cf @ 11.97 hrs
Average Depth at Peak Storage= 0.48'
Bank-Full Depth= 7.00' Flow Area= 38.5 sf, Capacity= 782.41 cfs

84.0" Round Pipe
n= 0.013
Length= 500.0' Slope= 0.0150 '/'
Inlet Invert= 25.10', Outlet Invert= 17.60'





Summary for Pond 20P: DT-1

Inflow Area = 1.780 ac, 84.83% Impervious, Inflow Depth = 1.17" for 2 event
Inflow = 3.34 cfs @ 11.95 hrs, Volume= 0.174 af
Outflow = 0.18 cfs @ 12.87 hrs, Volume= 0.174 af, Atten= 95%, Lag= 55.0 min
Discarded = 0.18 cfs @ 12.87 hrs, Volume= 0.174 af

Routing by Stor-Ind method, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 33.89' @ 12.87 hrs Surf.Area= 0.210 ac Storage= 0.080 af

Plug-Flow detention time= 159.7 min calculated for 0.174 af (100% of inflow)
Center-of-Mass det. time= 159.6 min (944.3 - 784.7)

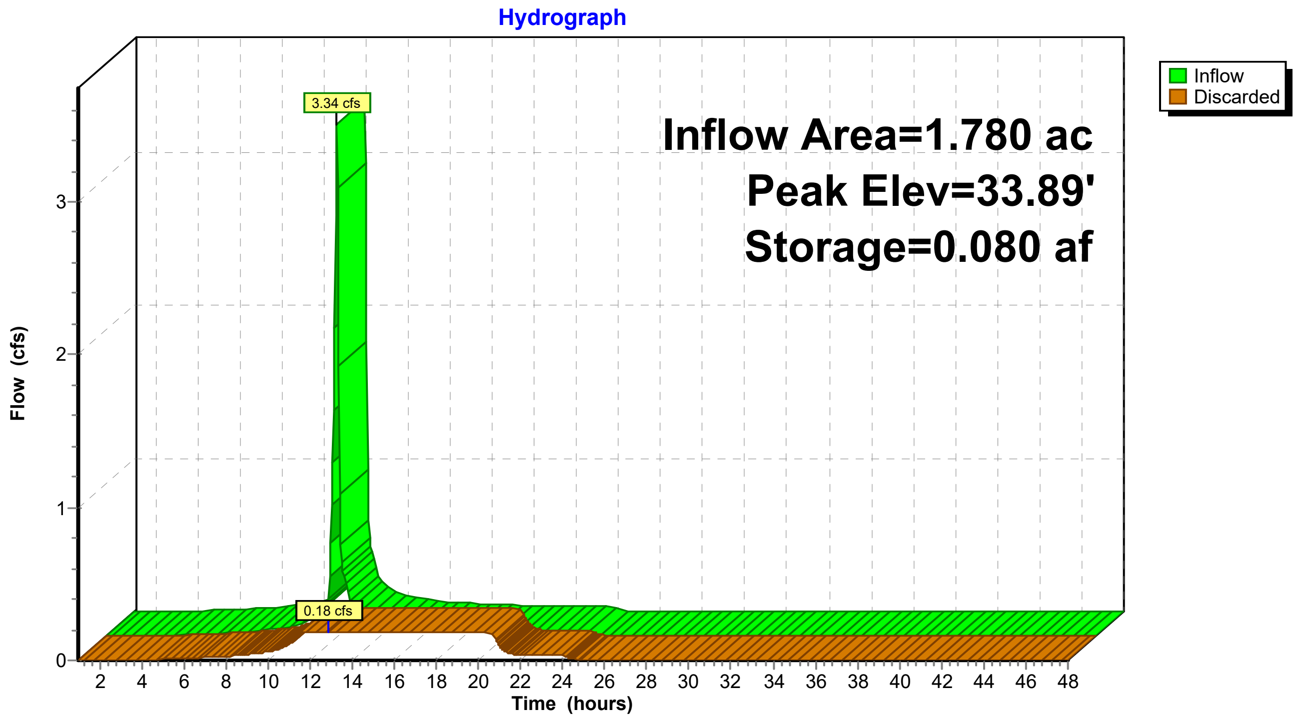
Volume	Invert	Avail.Storage	Storage Description
#1	33.50'	0.509 af	**Custom Stage Data (Irregular)** Listed below (Recalc) 0.525 af Overall x 97.0% Voids

Elevation (feet)	Surf.Area (acres)	Perim. (feet)	Inc.Store (acre-feet)	Cum.Store (acre-feet)	Wet.Area (acres)
33.50	0.210	402.0	0.000	0.000	0.210
36.00	0.210	402.0	0.525	0.525	0.233

Device	Routing	Invert	Outlet Devices
#1	Discarded	33.50'	**0.850 in/hr Exfiltration over Wetted area**

Discarded OutFlow Max=0.18 cfs @ 12.87 hrs HW=33.89' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.18 cfs)

Pond 20P: DT-1


Hydrograph
3.34 cfs
0.18 cfs
Inflow
Discarded
Inflow Area=1.780 ac
Peak Elev=33.89'
Storage=0.080 af
Flow (cfs)
0
1
2
3
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
44
46
48
Time (hours)

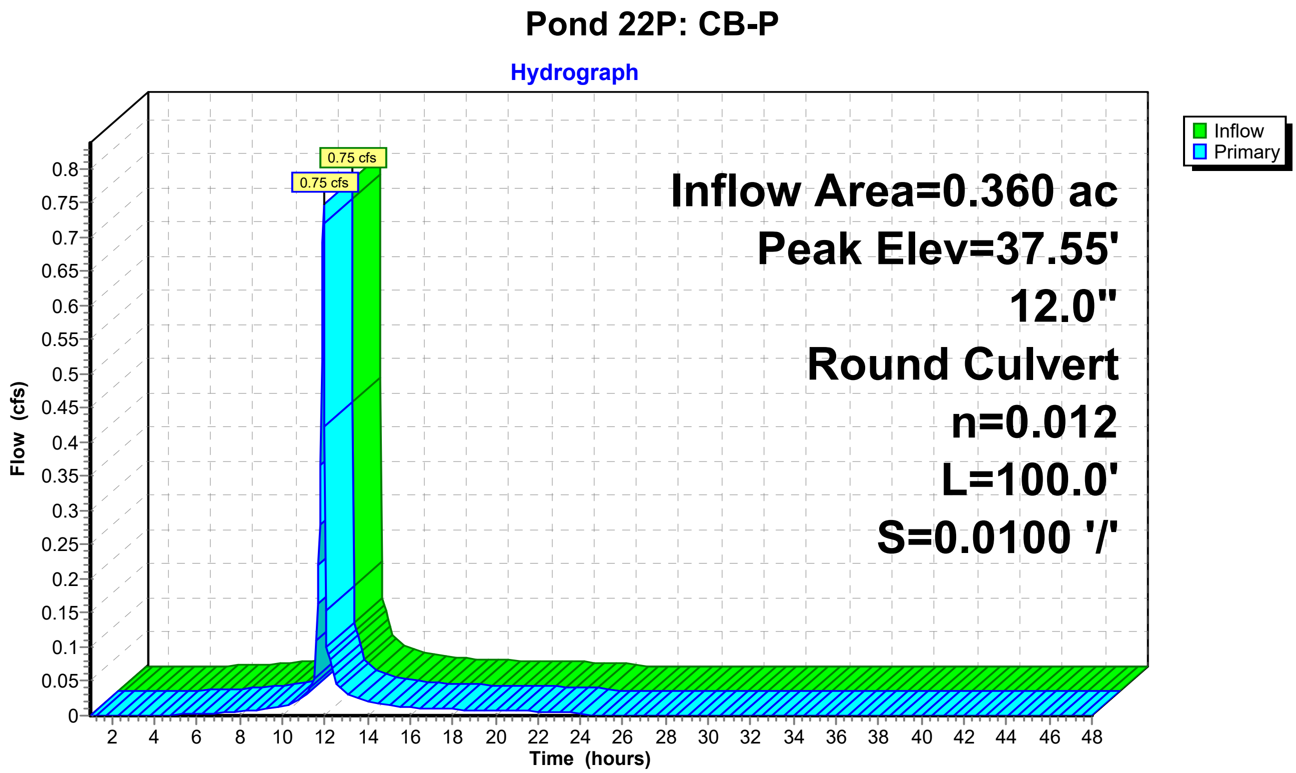
Summary for Pond 22P: CB-P

Inflow Area =	0.360 ac, 83.33% Impervious, Inflow Depth = 1.17" for 2 event		
Inflow =	0.75 cfs @ 11.93 hrs, Volume=	0.035 af	
Outflow =	0.75 cfs @ 11.93 hrs, Volume=	0.035 af,	Atten= 0%, Lag= 0.0 min
Primary =	0.75 cfs @ 11.93 hrs, Volume=	0.035 af	

Routing by Stor-Ind method, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 37.55' @ 11.93 hrs
Flood Elev= 40.50'

Device	Routing	Invert	Outlet Devices
#1	Primary	37.00'	**12.0" Round Culvert** L= 100.0' Ke= 1.200 Inlet / Outlet Invert= 37.00' / 36.00' S= 0.0100 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf

Primary OutFlow Max=0.71 cfs @ 11.93 hrs HW=37.53' (Free Discharge)
↑—**1=Culvert** (Inlet Controls 0.71 cfs @ 1.69 fps)



Summary for Pond 24P: CB-M

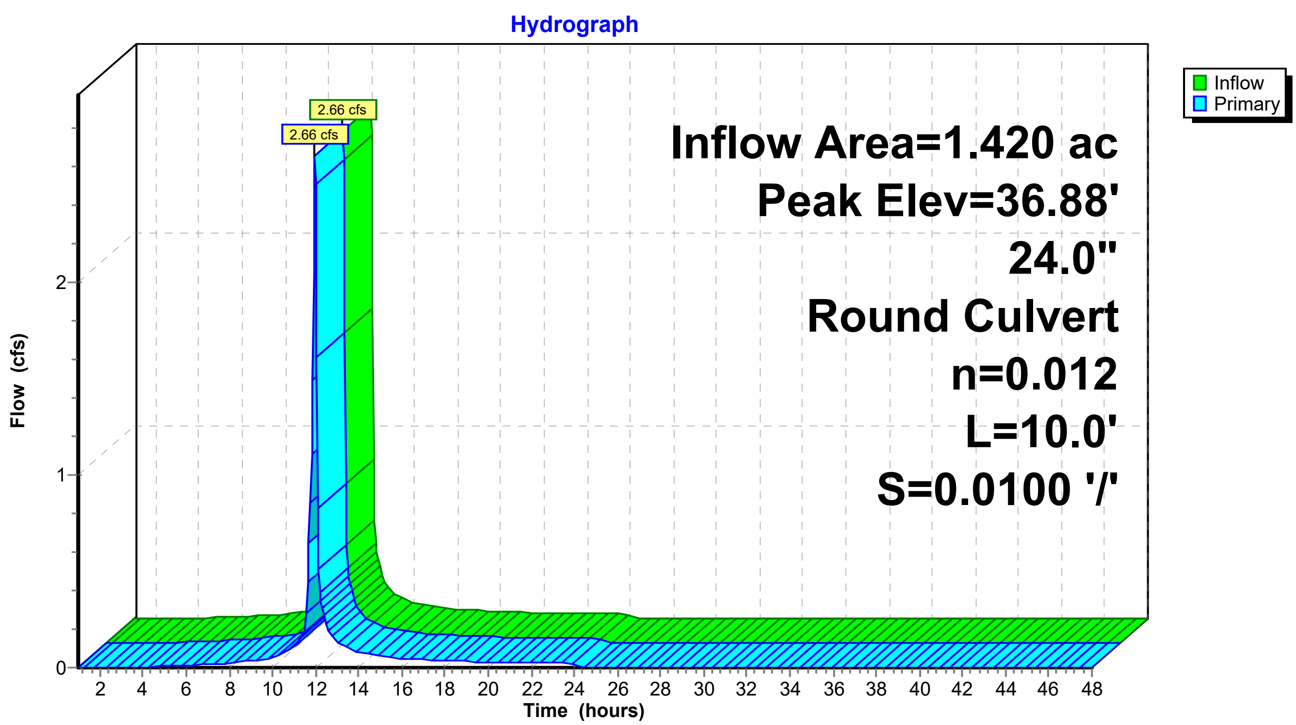
Inflow Area = 1.420 ac, 85.21% Impervious, Inflow Depth = 1.17" for 2 event
Inflow = 2.66 cfs @ 11.97 hrs, Volume= 0.139 af
Outflow = 2.66 cfs @ 11.97 hrs, Volume= 0.139 af, Atten= 0%, Lag= 0.0 min
Primary = 2.66 cfs @ 11.97 hrs, Volume= 0.139 af

Routing by Stor-Ind method, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 36.88' @ 11.97 hrs
Flood Elev= 40.89'

Device	Routing	Invert	Outlet Devices
#1	Primary	36.00'	**24.0" Round Culvert** L= 10.0' Ke= 1.200 Inlet / Outlet Invert= 36.00' / 35.90' S= 0.0100 '/' Cc= 0.900 n= 0.012, Flow Area= 3.14 sf

Primary OutFlow Max=2.58 cfs @ 11.97 hrs HW=36.86' (Free Discharge)
└─**1=Culvert** (Barrel Controls 2.58 cfs @ 2.93 fps)

Pond 24P: CB-M



Summary for Pond 26P: CB-N

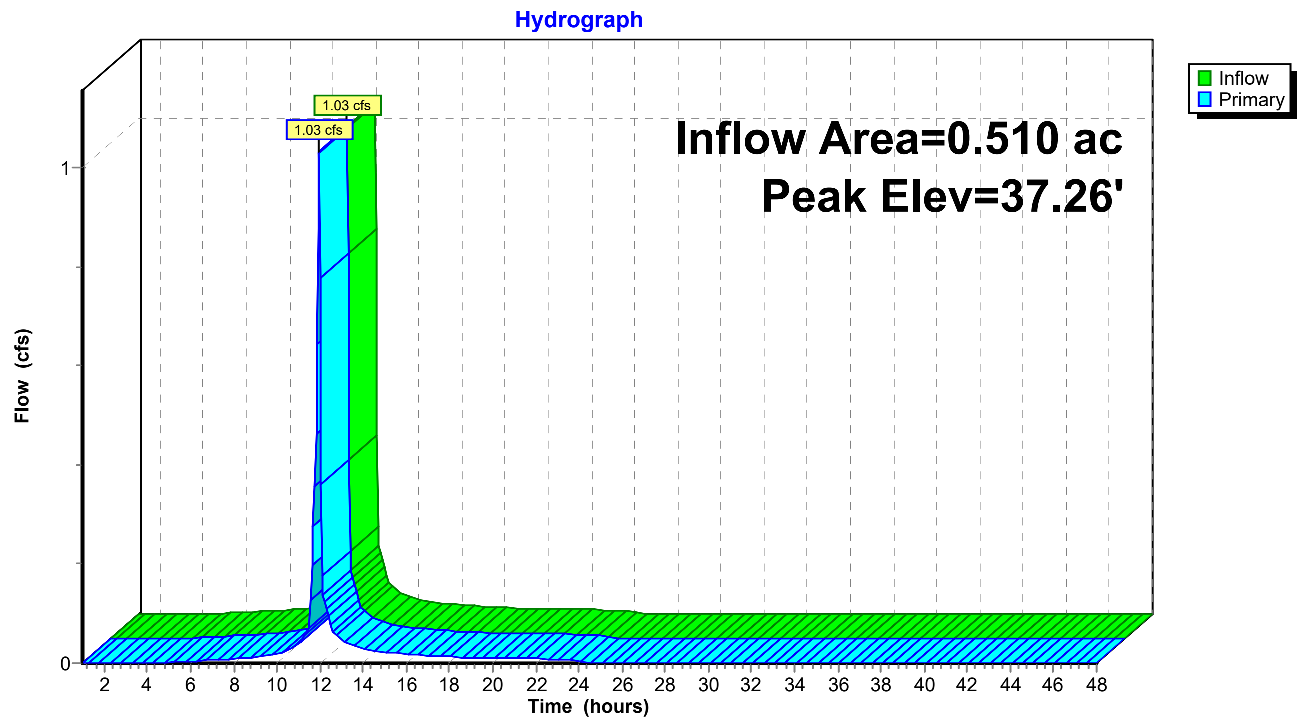
Inflow Area = 0.510 ac, 84.31% Impervious, Inflow Depth = 1.17" for 2 event
Inflow = 1.03 cfs @ 11.94 hrs, Volume= 0.050 af
Outflow = 1.03 cfs @ 11.94 hrs, Volume= 0.050 af, Atten= 0%, Lag= 0.0 min
Primary = 1.03 cfs @ 11.94 hrs, Volume= 0.050 af

Routing by Stor-Ind method, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 37.26' @ 11.94 hrs
Flood Elev= 39.50'

Device	Routing	Invert	Outlet Devices
#1	Primary	39.57'	**12.0" x 12.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#2	Primary	36.60'	**12.0" Round Culvert** L= 10.0' Ke= 1.200 Inlet / Outlet Invert= 36.60' / 36.50' S= 0.0100 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf

Primary OutFlow Max=1.01 cfs @ 11.94 hrs HW=37.26' (Free Discharge)
1=Orifice/Grate (Controls 0.00 cfs)
2=Culvert (Barrel Controls 1.01 cfs @ 2.62 fps)

Pond 26P: CB-N



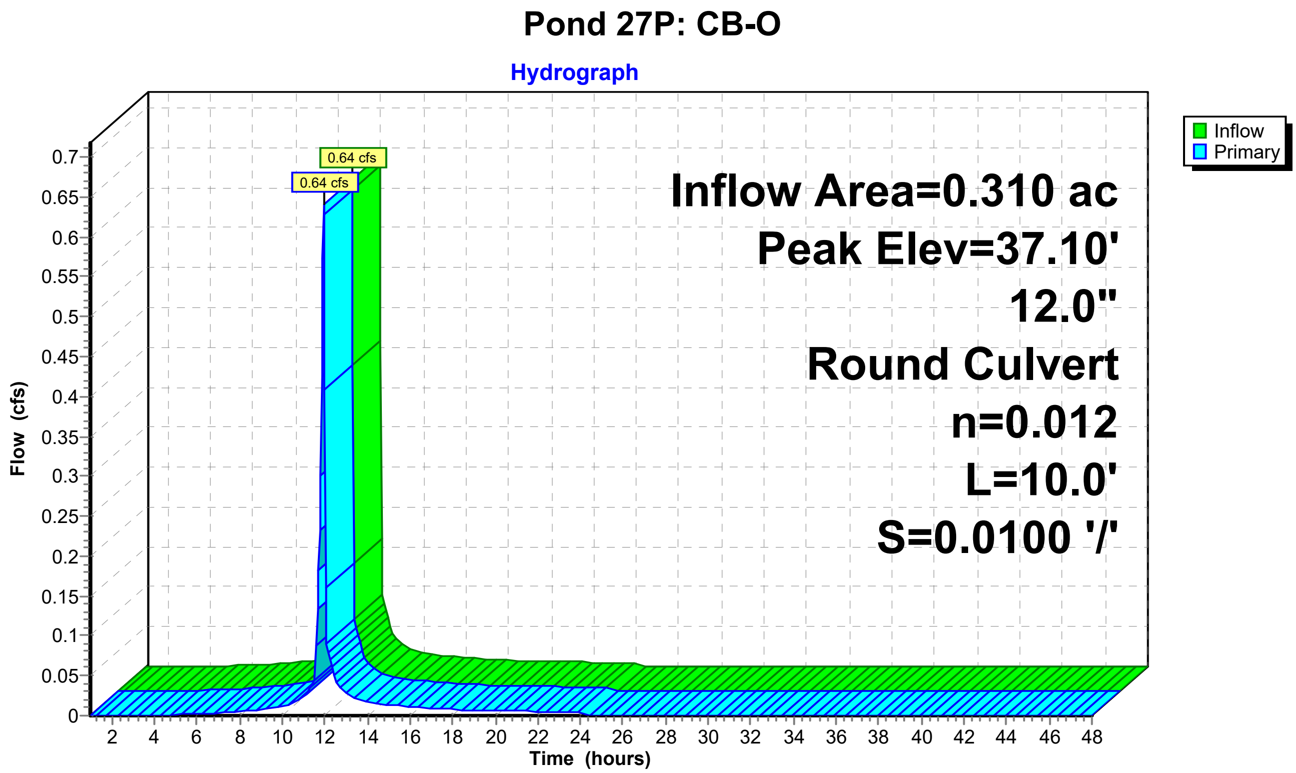
Summary for Pond 27P: CB-O

Inflow Area = 0.310 ac, 83.87% Impervious, Inflow Depth = 1.17" for 2 event
Inflow = 0.64 cfs @ 11.94 hrs, Volume= 0.030 af
Outflow = 0.64 cfs @ 11.94 hrs, Volume= 0.030 af, Atten= 0%, Lag= 0.0 min
Primary = 0.64 cfs @ 11.94 hrs, Volume= 0.030 af

Routing by Stor-Ind method, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 37.10' @ 11.93 hrs
Flood Elev= 39.50'

Device	Routing	Invert	Outlet Devices
#1	Primary	36.60'	**12.0" Round Culvert** L= 10.0' Ke= 1.200 Inlet / Outlet Invert= 36.60' / 36.50' S= 0.0100 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf

Primary OutFlow Max=0.61 cfs @ 11.94 hrs HW=37.09' (Free Discharge)
↑—**1=Culvert** (Barrel Controls 0.61 cfs @ 2.36 fps)



Summary for Pond 28P: DT-2

Inflow Area = 1.060 ac, 84.91% Impervious, Inflow Depth = 1.20" for 2 event
Inflow = 2.16 cfs @ 11.94 hrs, Volume= 0.106 af
Outflow = 0.10 cfs @ 12.99 hrs, Volume= 0.106 af, Atten= 95%, Lag= 62.9 min
Discarded = 0.10 cfs @ 12.99 hrs, Volume= 0.106 af

Routing by Stor-Ind method, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 31.97' @ 12.99 hrs Surf.Area= 0.110 ac Storage= 0.050 af

Plug-Flow detention time= 189.3 min calculated for 0.106 af (100% of inflow)
Center-of-Mass det. time= 189.2 min (969.4 - 780.3)

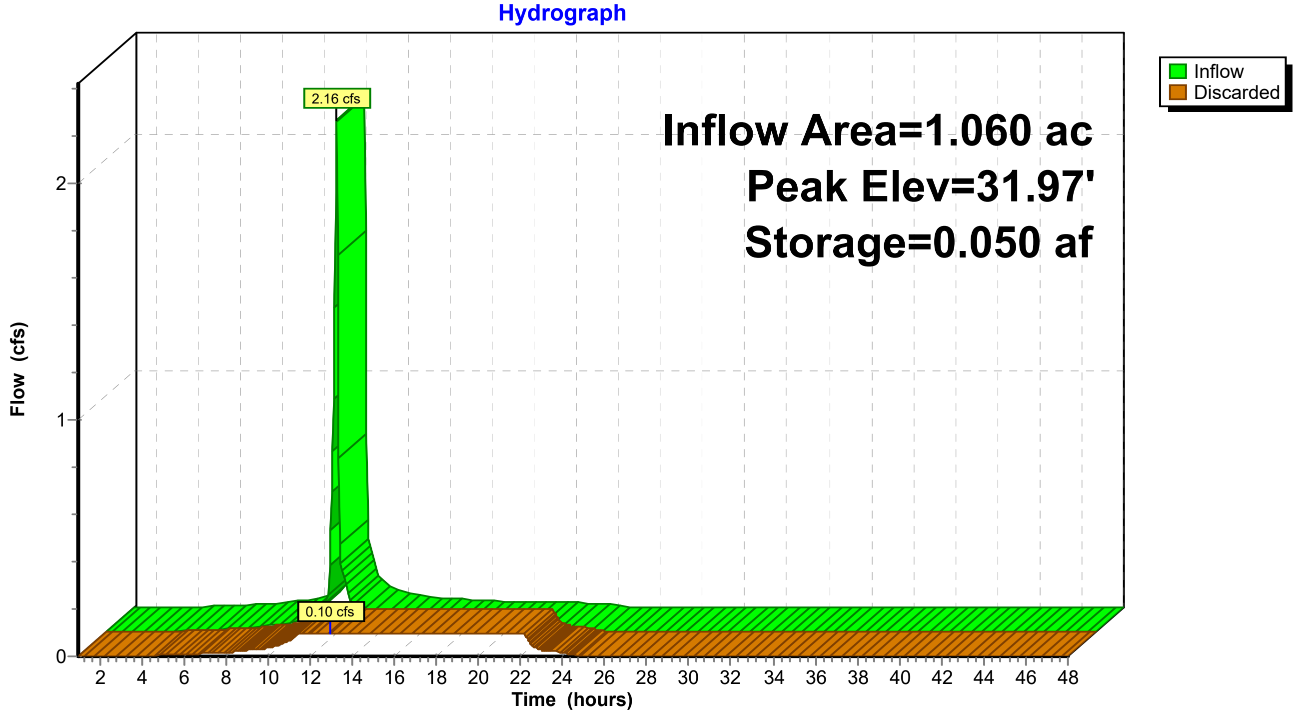
Volume	Invert	Avail.Storage	Storage Description
#1	31.50'	0.267 af	**Custom Stage Data (Irregular)** Listed below (Recalc) 0.275 af Overall x 97.0% Voids

Elevation (feet)	Surf.Area (acres)	Perim. (feet)	Inc.Store (acre-feet)	Cum.Store (acre-feet)	Wet.Area (acres)
31.50	0.110	477.0	0.000	0.000	0.110
34.00	0.110	477.0	0.275	0.275	0.137

Device	Routing	Invert	Outlet Devices
#1	Discarded	31.50'	**0.850 in/hr Exfiltration over Wetted area**

Discarded OutFlow Max=0.10 cfs @ 12.99 hrs HW=31.97' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.10 cfs)

Pond 28P: DT-2


Hydrograph
Inflow
Discarded
2.16 cfs
0.10 cfs
Inflow Area=1.060 ac
Peak Elev=31.97'
Storage=0.050 af
Flow (cfs)
0
1
2
2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48
Time (hours)

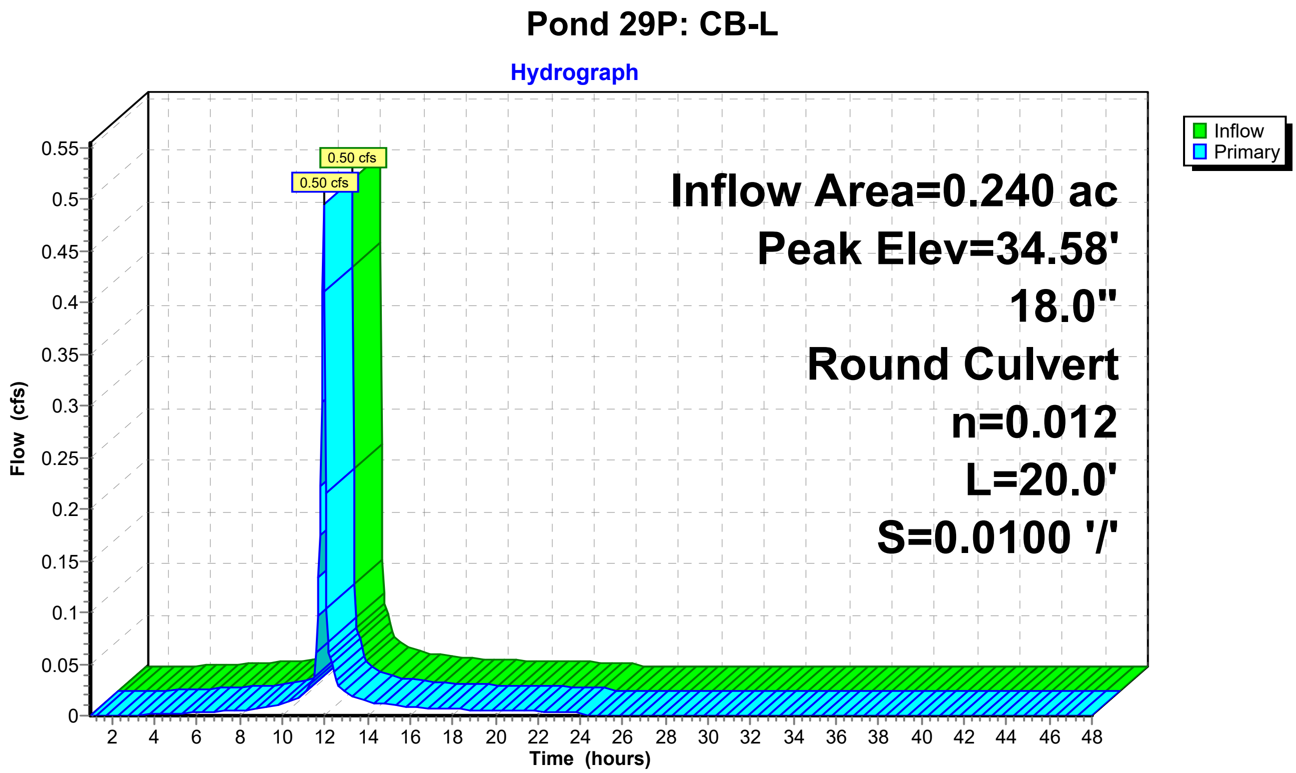
Summary for Pond 29P: CB-L

Inflow Area = 0.240 ac, 87.50% Impervious, Inflow Depth = 1.27" for 2 event
Inflow = 0.50 cfs @ 11.95 hrs, Volume= 0.025 af
Outflow = 0.50 cfs @ 11.95 hrs, Volume= 0.025 af, Atten= 0%, Lag= 0.0 min
Primary = 0.50 cfs @ 11.95 hrs, Volume= 0.025 af

Routing by Stor-Ind method, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 34.58' @ 11.95 hrs
Flood Elev= 37.15'

Device	Routing	Invert	Outlet Devices
#1	Primary	34.20'	**18.0" Round Culvert** L= 20.0' Ke= 1.200 Inlet / Outlet Invert= 34.20' / 34.00' S= 0.0100 '/' Cc= 0.900 n= 0.012, Flow Area= 1.77 sf

Primary OutFlow Max=0.49 cfs @ 11.95 hrs HW=34.58' (Free Discharge)
└─1=Culvert (Inlet Controls 0.49 cfs @ 1.42 fps)



Summary for Pond 30P: CB-I

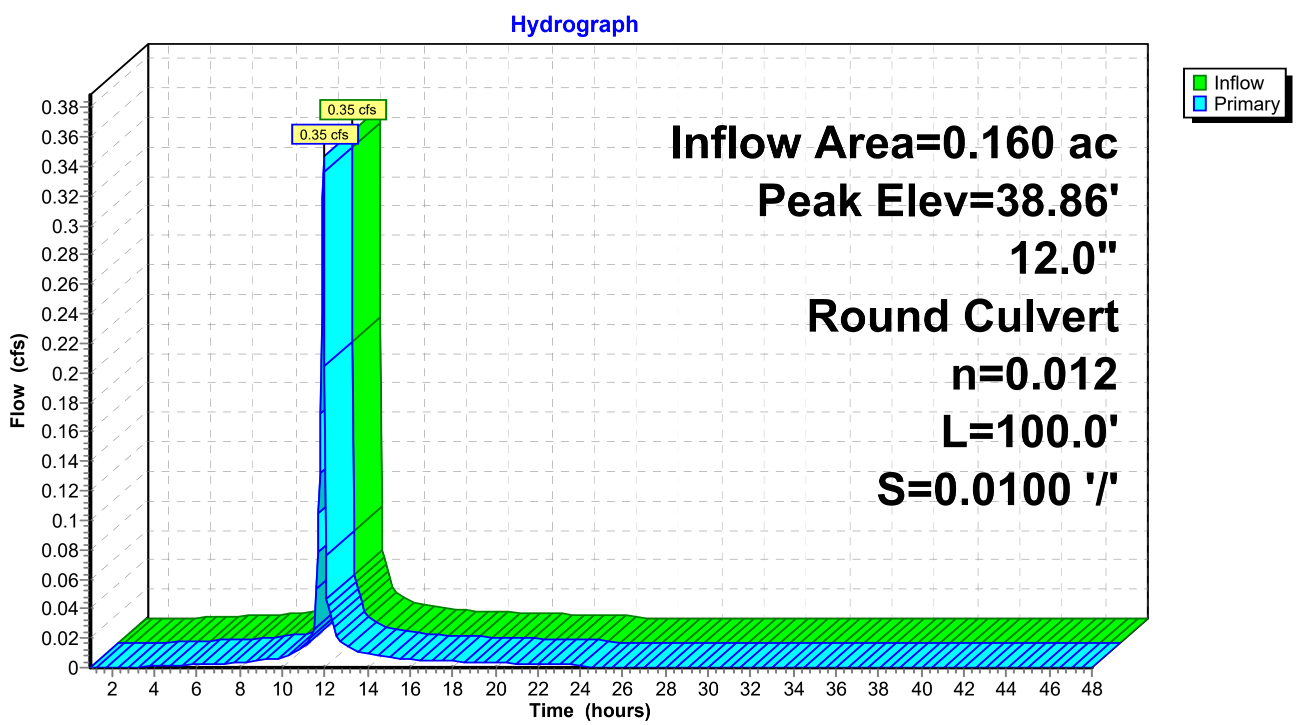
Inflow Area = 0.160 ac, 87.50% Impervious, Inflow Depth = 1.27" for 2 event
Inflow = 0.35 cfs @ 11.93 hrs, Volume= 0.017 af
Outflow = 0.35 cfs @ 11.93 hrs, Volume= 0.017 af, Atten= 0%, Lag= 0.0 min
Primary = 0.35 cfs @ 11.93 hrs, Volume= 0.017 af

Routing by Stor-Ind method, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 38.86' @ 11.93 hrs
Flood Elev= 41.99'

Device	Routing	Invert	Outlet Devices
#1	Primary	38.50'	**12.0" Round Culvert** L= 100.0' Ke= 1.200 Inlet / Outlet Invert= 38.50' / 37.50' S= 0.0100 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf

Primary OutFlow Max=0.33 cfs @ 11.93 hrs HW=38.85' (Free Discharge)
└─**1=Culvert** (Inlet Controls 0.33 cfs @ 1.37 fps)

Pond 30P: CB-I



Summary for Pond 31P: CB-J

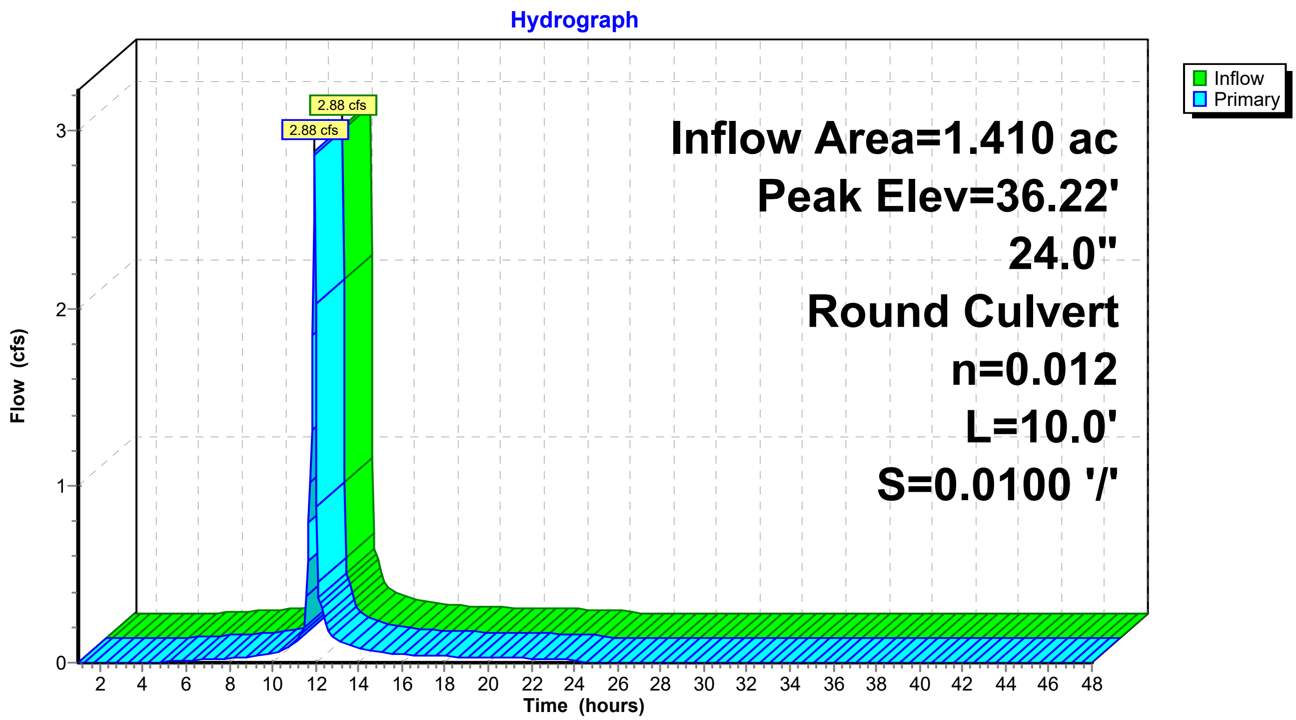
Inflow Area =	1.410 ac, 85.11% Impervious,	Inflow Depth = 1.17"	for 2 event	
Inflow =	2.88 cfs @	11.94 hrs, Volume=	0.138 af	
Outflow =	2.88 cfs @	11.94 hrs, Volume=	0.138 af,	Atten= 0%, Lag= 0.0 min
Primary =	2.88 cfs @	11.94 hrs, Volume=	0.138 af	

Routing by Stor-Ind method, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 36.22' @ 11.94 hrs
Flood Elev= 38.26'

Device	Routing	Invert	Outlet Devices
#1	Primary	35.30'	**24.0" Round Culvert** L= 10.0' Ke= 1.200 Inlet / Outlet Invert= 35.30' / 35.20' S= 0.0100 '/' Cc= 0.900 n= 0.012, Flow Area= 3.14 sf

Primary OutFlow Max=2.79 cfs @ 11.94 hrs HW=36.20' (Free Discharge)
└─**1=Culvert** (Barrel Controls 2.79 cfs @ 2.98 fps)

Pond 31P: CB-J



Summary for Pond 32P: DT-3

Inflow Area = 1.570 ac, 85.35% Impervious, Inflow Depth = 1.18" for 2 event
Inflow = 3.23 cfs @ 11.94 hrs, Volume= 0.155 af
Outflow = 0.15 cfs @ 12.95 hrs, Volume= 0.155 af, Atten= 95%, Lag= 61.0 min
Discarded = 0.15 cfs @ 12.95 hrs, Volume= 0.155 af

Routing by Stor-Ind method, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 33.03' @ 12.95 hrs Surf.Area= 0.170 ac Storage= 0.073 af

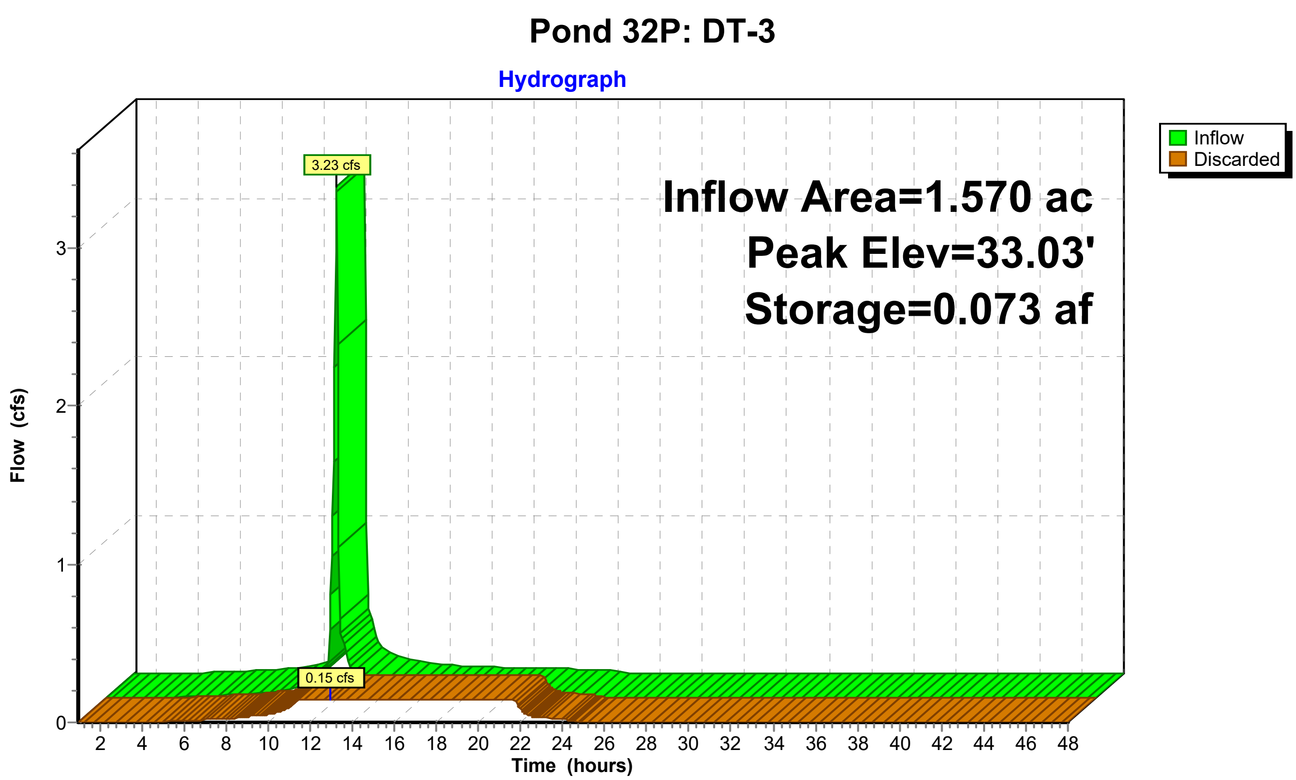
Plug-Flow detention time= 181.6 min calculated for 0.155 af (100% of inflow)
Center-of-Mass det. time= 181.3 min (962.9 - 781.6)

Volume	Invert	Avail.Storage	Storage Description
#1	32.60'	0.425 af	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Perim. (feet)	Inc.Store (acre-feet)	Cum.Store (acre-feet)	Wet.Area (acres)
32.60	0.170	403.0	0.000	0.000	0.170
35.10	0.170	403.0	0.425	0.425	0.193

Device	Routing	Invert	Outlet Devices
#1	Discarded	32.60'	**0.850 in/hr Exfiltration over Wetted area**

Discarded OutFlow Max=0.15 cfs @ 12.95 hrs HW=33.03' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.15 cfs)



Summary for Pond 33P: CB-G

Inflow Area = 0.780 ac, 84.62% Impervious, Inflow Depth = 1.17" for 2 event
Inflow = 1.48 cfs @ 11.96 hrs, Volume= 0.076 af
Outflow = 1.48 cfs @ 11.96 hrs, Volume= 0.076 af, Atten= 0%, Lag= 0.0 min
Primary = 0.84 cfs @ 11.96 hrs, Volume= 0.068 af
Secondary = 0.65 cfs @ 11.96 hrs, Volume= 0.009 af

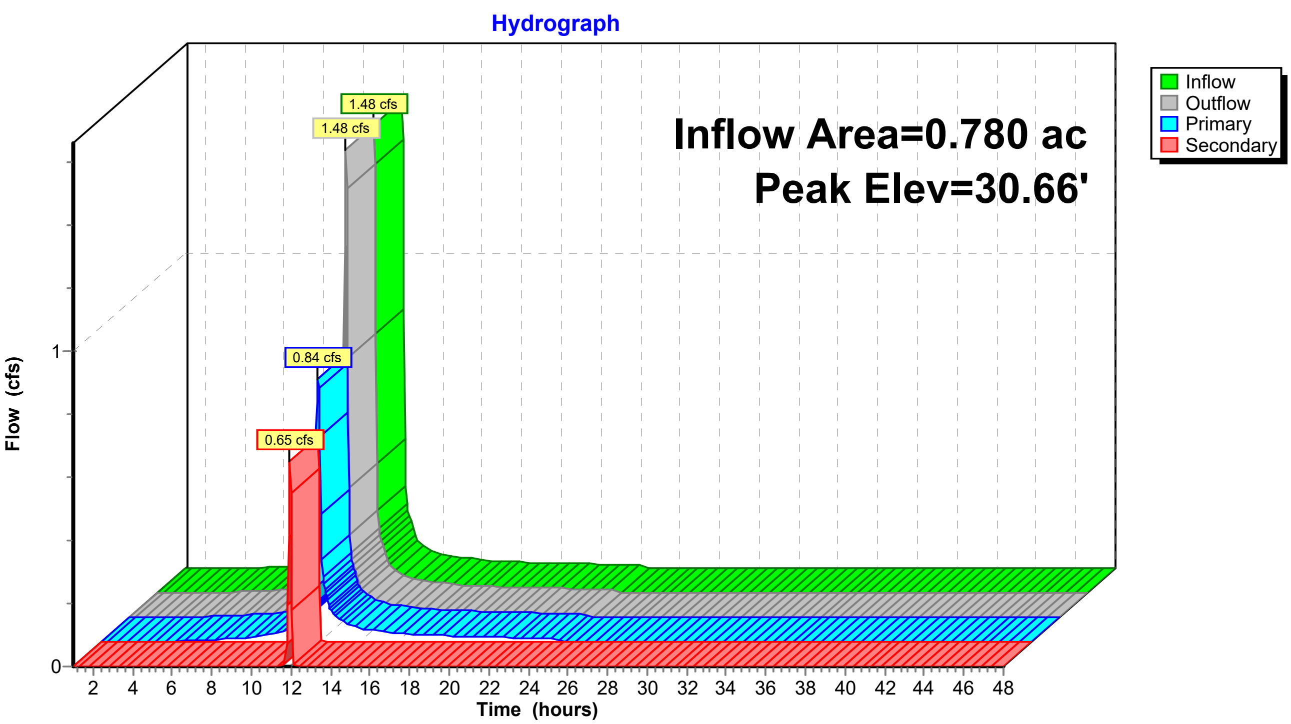
Routing by Stor-Ind method, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 30.66' @ 11.96 hrs
Flood Elev= 32.88'

Device	Routing	Invert	Outlet Devices
#1	Primary	29.80'	**8.0" Round Culvert** L= 100.0' Ke= 1.200 Inlet / Outlet Invert= 29.80' / 28.80' S= 0.0100 '/' Cc= 0.900 n= 0.012, Flow Area= 0.35 sf
#2	Secondary	30.23'	**18.0" Round Culvert** L= 15.0' Ke= 1.200 Inlet / Outlet Invert= 30.23' / 30.08' S= 0.0100 '/' Cc= 0.900 n= 0.012, Flow Area= 1.77 sf

Primary OutFlow Max=0.83 cfs @ 11.96 hrs HW=30.65' (Free Discharge)
└─**1=Culvert** (Inlet Controls 0.83 cfs @ 2.37 fps)

Secondary OutFlow Max=0.62 cfs @ 11.96 hrs HW=30.65' (Free Discharge)
└─**2=Culvert** (Inlet Controls 0.62 cfs @ 1.51 fps)

Pond 33P: CB-G



Summary for Pond 34P: CB-K

Inflow Area = 0.940 ac, 85.11% Impervious, Inflow Depth = 1.17" for 2 event
Inflow = 1.85 cfs @ 11.95 hrs, Volume= 0.092 af
Outflow = 1.85 cfs @ 11.95 hrs, Volume= 0.092 af, Atten= 0%, Lag= 0.0 min
Primary = 1.08 cfs @ 11.95 hrs, Volume= 0.083 af
Secondary = 0.77 cfs @ 11.95 hrs, Volume= 0.009 af

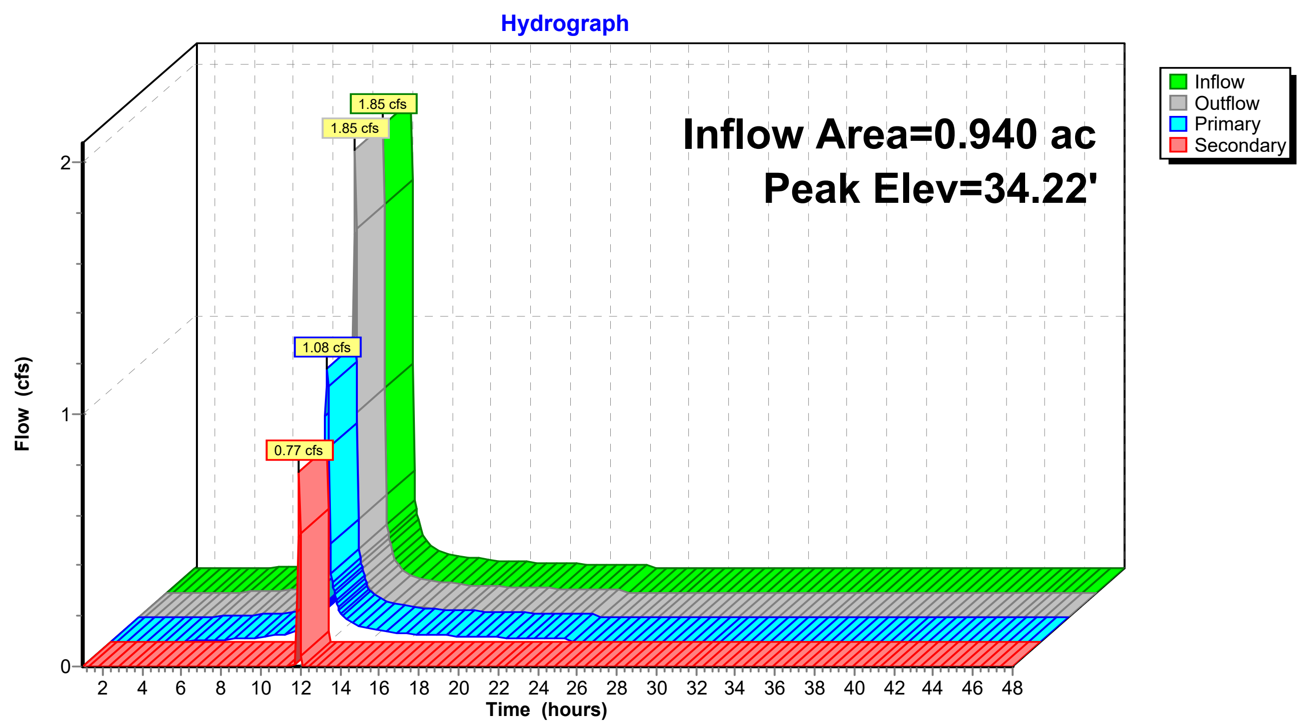
Routing by Stor-Ind method, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 34.22' @ 11.95 hrs
Flood Elev= 36.06'

Device	Routing	Invert	Outlet Devices
#1	Primary	33.00'	**8.0" Round Culvert** L= 100.0' Ke= 1.200 Inlet / Outlet Invert= 33.00' / 32.00' S= 0.0100 '/' Cc= 0.900 n= 0.012, Flow Area= 0.35 sf
#2	Secondary	33.67'	**12.0" Round Culvert** L= 20.0' Ke= 1.200 Inlet / Outlet Invert= 33.67' / 32.78' S= 0.0445 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf

Primary OutFlow Max=1.08 cfs @ 11.95 hrs HW=34.22' (Free Discharge)
↑—**1=Culvert** (Inlet Controls 1.08 cfs @ 3.09 fps)

Secondary OutFlow Max=0.77 cfs @ 11.95 hrs HW=34.22' (Free Discharge)
↑—**2=Culvert** (Inlet Controls 0.77 cfs @ 1.72 fps)

Pond 34P: CB-K



Summary for Pond 36P: CB-F

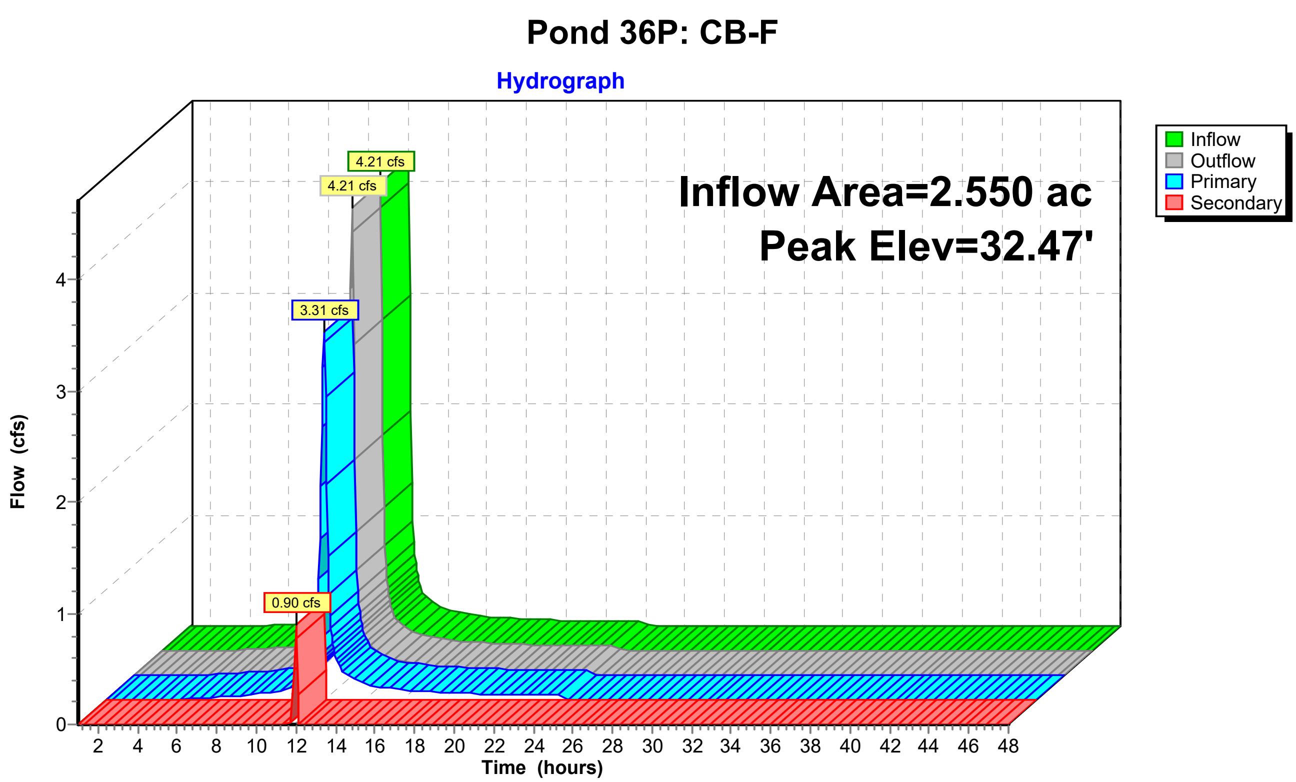
Inflow Area = 2.550 ac, 85.10% Impervious, Inflow Depth = 1.17" for 2 event
Inflow = 4.21 cfs @ 12.01 hrs, Volume= 0.249 af
Outflow = 4.21 cfs @ 12.01 hrs, Volume= 0.249 af, Atten= 0%, Lag= 0.0 min
Primary = 3.31 cfs @ 12.02 hrs, Volume= 0.239 af
Secondary = 0.90 cfs @ 12.01 hrs, Volume= 0.010 af

Routing by Stor-Ind method, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 32.47' @ 12.02 hrs
Flood Elev= 35.02'

Device	Routing	Invert	Outlet Devices
#1	Primary	31.17'	**15.0" Round Culvert** L= 100.0' Ke= 1.200 Inlet / Outlet Invert= 31.17' / 30.17' S= 0.0100 '/' Cc= 0.900 n= 0.012, Flow Area= 1.23 sf
#2	Secondary	32.00'	**24.0" Round Culvert** L= 200.0' Ke= 1.200 Inlet / Outlet Invert= 32.00' / 30.00' S= 0.0100 '/' Cc= 0.900 n= 0.012, Flow Area= 3.14 sf

Primary OutFlow Max=3.27 cfs @ 12.02 hrs HW=32.45' (Free Discharge)
└─**1=Culvert** (Inlet Controls 3.27 cfs @ 2.67 fps)

Secondary OutFlow Max=0.84 cfs @ 12.01 hrs HW=32.46' (Free Discharge)
└─**2=Culvert** (Inlet Controls 0.84 cfs @ 1.57 fps)



Summary for Pond 37P: CB-C

Inflow Area = 0.420 ac, 85.71% Impervious, Inflow Depth = 1.17" for 2 event
Inflow = 0.86 cfs @ 11.94 hrs, Volume= 0.041 af
Outflow = 0.86 cfs @ 11.94 hrs, Volume= 0.041 af, Atten= 0%, Lag= 0.0 min
Primary = 0.81 cfs @ 11.94 hrs, Volume= 0.041 af
Secondary = 0.05 cfs @ 11.95 hrs, Volume= 0.000 af

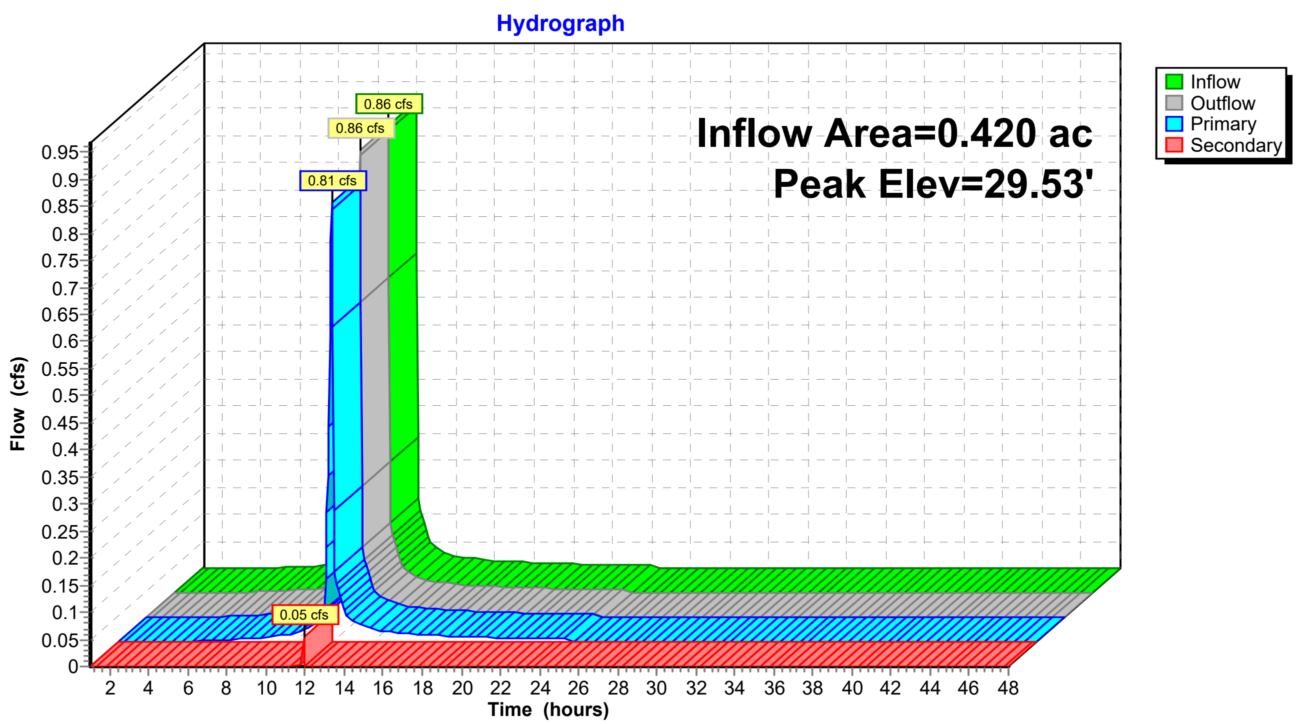
Routing by Stor-Ind method, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 29.53' @ 11.94 hrs
Flood Elev= 32.01'

Device	Routing	Invert	Outlet Devices
#1	Primary	28.70'	**8.0" Round Culvert** L= 100.0' Ke= 1.200 Inlet / Outlet Invert= 28.70' / 27.70' S= 0.0100 '/' Cc= 0.900 n= 0.012, Flow Area= 0.35 sf
#2	Secondary	29.37'	**8.0" Round Culvert** L= 200.0' Ke= 1.200 Inlet / Outlet Invert= 29.37' / 27.67' S= 0.0085 '/' Cc= 0.900 n= 0.012, Flow Area= 0.35 sf

Primary OutFlow Max=0.78 cfs @ 11.94 hrs HW=29.50' (Free Discharge)
└**1=Culvert** (Inlet Controls 0.78 cfs @ 2.24 fps)

Secondary OutFlow Max=0.05 cfs @ 11.95 hrs HW=29.51' (Free Discharge)
└**2=Culvert** (Inlet Controls 0.05 cfs @ 0.88 fps)

Pond 37P: CB-C



Summary for Pond 38P: CB-D

Inflow Area = 1.820 ac, 85.16% Impervious, Inflow Depth = 1.17" for 2 event
Inflow = 3.38 cfs @ 11.97 hrs, Volume= 0.178 af
Outflow = 3.38 cfs @ 11.97 hrs, Volume= 0.178 af, Atten= 0%, Lag= 0.0 min
Primary = 2.19 cfs @ 11.97 hrs, Volume= 0.163 af
Secondary = 1.19 cfs @ 11.97 hrs, Volume= 0.015 af

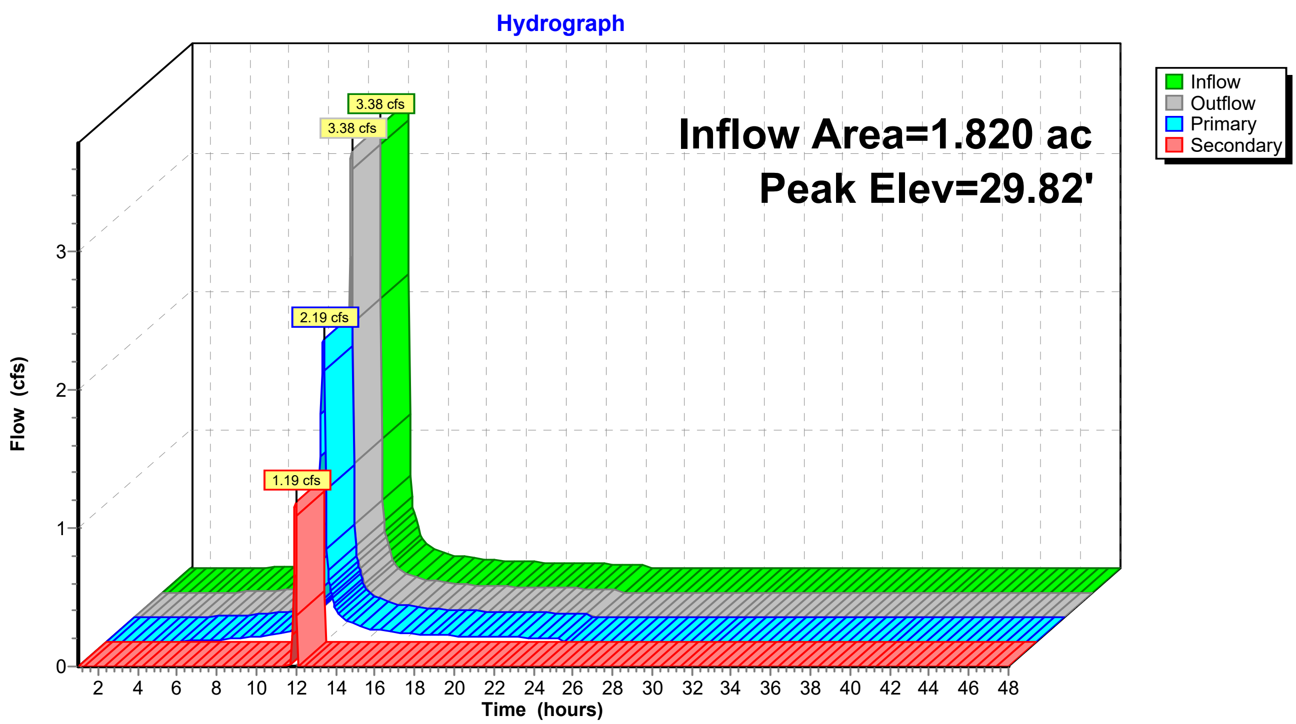
Routing by Stor-Ind method, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 29.82' @ 11.97 hrs
Flood Elev= 31.59'

Device	Routing	Invert	Outlet Devices
#1	Primary	28.60'	**12.0" Round Culvert** L= 40.0' Ke= 1.200 Inlet / Outlet Invert= 28.60' / 28.20' S= 0.0100 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf
#2	Secondary	29.27'	**24.0" Round Culvert** L= 100.0' Ke= 1.200 Inlet / Outlet Invert= 29.27' / 28.27' S= 0.0100 '/' Cc= 0.900 n= 0.012, Flow Area= 3.14 sf

Primary OutFlow Max=2.16 cfs @ 11.97 hrs HW=29.80' (Free Discharge)
↑—**1=Culvert** (Inlet Controls 2.16 cfs @ 2.75 fps)

Secondary OutFlow Max=1.13 cfs @ 11.97 hrs HW=29.80' (Free Discharge)
↑—**2=Culvert** (Inlet Controls 1.13 cfs @ 1.69 fps)

Pond 38P: CB-D



Summary for Pond 39P: DT-4

Inflow Area = 5.860 ac, 85.15% Impervious, Inflow Depth = 1.10" for 2 event
Inflow = 7.47 cfs @ 11.97 hrs, Volume= 0.539 af
Outflow = 0.39 cfs @ 13.67 hrs, Volume= 0.539 af, Atten= 95%, Lag= 101.8 min
Discarded = 0.39 cfs @ 13.67 hrs, Volume= 0.539 af

Routing by Stor-Ind method, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 25.81' @ 13.67 hrs Surf.Area= 0.440 ac Storage= 0.262 af

Plug-Flow detention time= 270.6 min calculated for 0.539 af (100% of inflow)
Center-of-Mass det. time= 270.3 min (1,061.5 - 791.2)

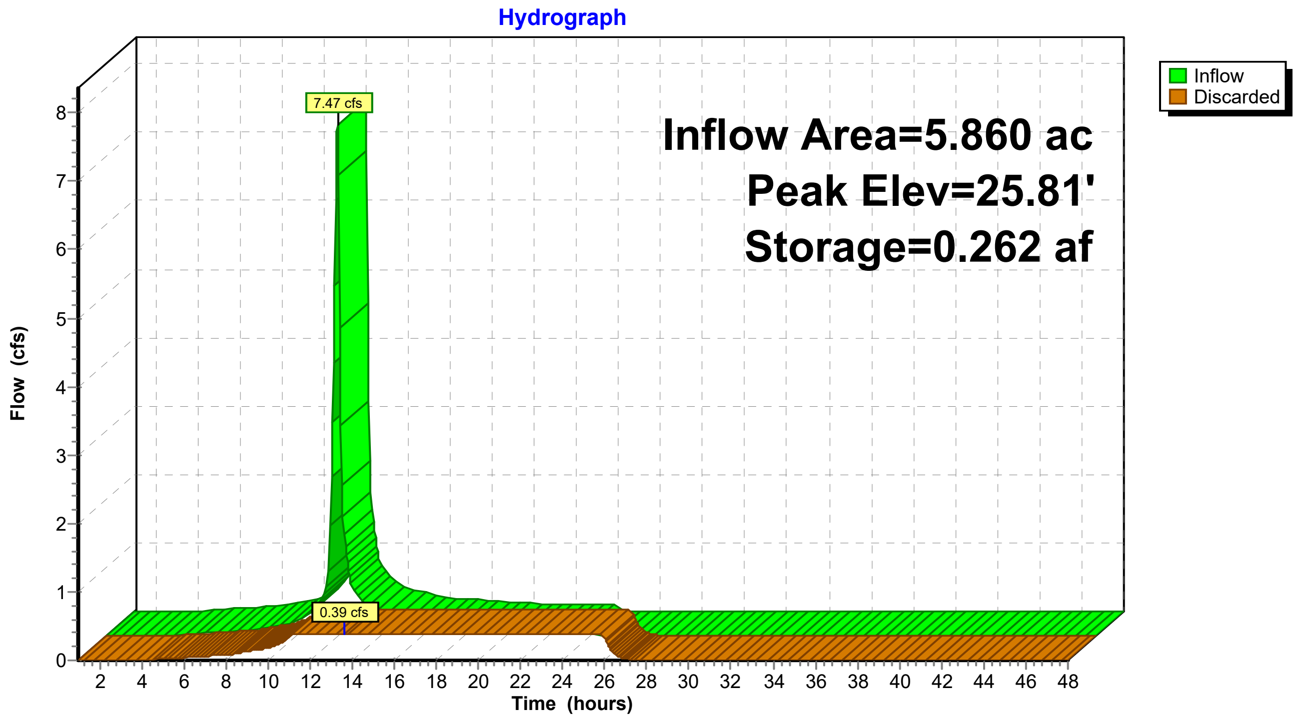
Volume	Invert	Avail.Storage	Storage Description
#1	25.20'	1.067 af	**Custom Stage Data (Irregular)** Listed below (Recalc) 1.100 af Overall x 97.0% Voids

Elevation (feet)	Surf.Area (acres)	Perim. (feet)	Inc.Store (acre-feet)	Cum.Store (acre-feet)	Wet.Area (acres)
25.20	0.440	871.0	0.000	0.000	0.440
27.70	0.440	871.0	1.100	1.100	0.490

Device	Routing	Invert	Outlet Devices
#1	Discarded	25.20'	**0.850 in/hr Exfiltration over Wetted area**

Discarded OutFlow Max=0.39 cfs @ 13.67 hrs HW=25.81' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.39 cfs)

Pond 39P: DT-4


Hydrograph
Inflow
Discarded
7.47 cfs
0.39 cfs
Inflow Area=5.860 ac
Peak Elev=25.81'
Storage=0.262 af
Flow (cfs)
0
1
2
3
4
5
6
7
8
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
44
46
48
Time (hours)

Summary for Pond 40P: CB-E

Inflow Area = 0.320 ac, 84.38% Impervious, Inflow Depth = 1.17" for 2 event
Inflow = 0.51 cfs @ 12.02 hrs, Volume= 0.031 af
Outflow = 0.51 cfs @ 12.02 hrs, Volume= 0.031 af, Atten= 0%, Lag= 0.0 min
Primary = 0.20 cfs @ 12.02 hrs, Volume= 0.026 af
Secondary = 0.31 cfs @ 12.02 hrs, Volume= 0.006 af

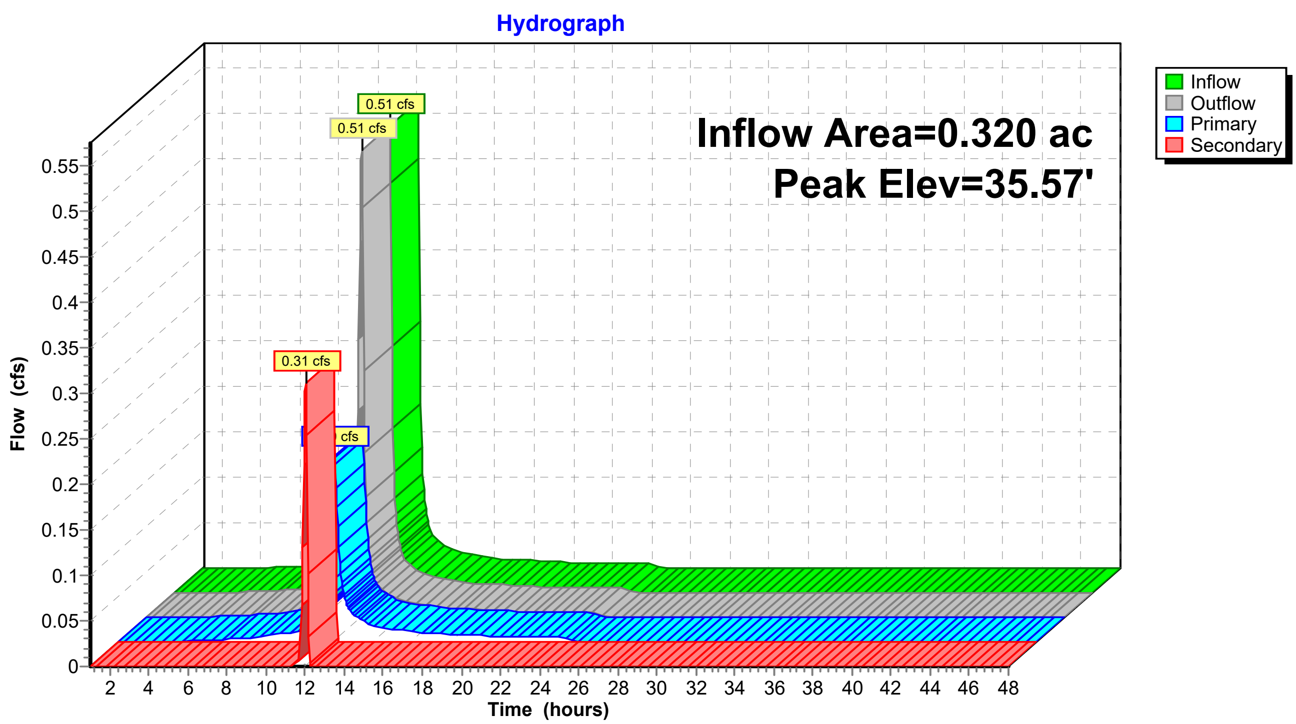
Routing by Stor-Ind method, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 35.57' @ 12.02 hrs
Flood Elev= 37.90'

Device	Routing	Invert	Outlet Devices
#1	Primary	34.90'	**4.0" Round Culvert** L= 75.0' Ke= 1.200 Inlet / Outlet Invert= 34.90' / 34.15' S= 0.0100 '/' Cc= 0.900 n= 0.012, Flow Area= 0.09 sf
#2	Secondary	35.23'	**12.0" Round Culvert** L= 200.0' Ke= 1.200 Inlet / Outlet Invert= 35.23' / 33.40' S= 0.0091 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf

Primary OutFlow Max=0.20 cfs @ 12.02 hrs HW=35.56' (Free Discharge)
└─**1=Culvert** (Inlet Controls 0.20 cfs @ 2.31 fps)

Secondary OutFlow Max=0.30 cfs @ 12.02 hrs HW=35.56' (Free Discharge)
└─**2=Culvert** (Inlet Controls 0.30 cfs @ 1.33 fps)

Pond 40P: CB-E



Summary for Pond 41P: DT-6

Inflow Area = 1.290 ac, 84.50% Impervious, Inflow Depth = 0.90" for 2 event
Inflow = 0.71 cfs @ 11.95 hrs, Volume= 0.097 af
Outflow = 0.07 cfs @ 14.08 hrs, Volume= 0.097 af, Atten= 90%, Lag= 128.0 min
Discarded = 0.07 cfs @ 14.08 hrs, Volume= 0.097 af

Routing by Stor-Ind method, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 28.04' @ 14.08 hrs Surf.Area= 0.075 ac Storage= 0.040 af

Plug-Flow detention time= 235.5 min calculated for 0.097 af (100% of inflow)
Center-of-Mass det. time= 235.4 min (1,041.6 - 806.2)

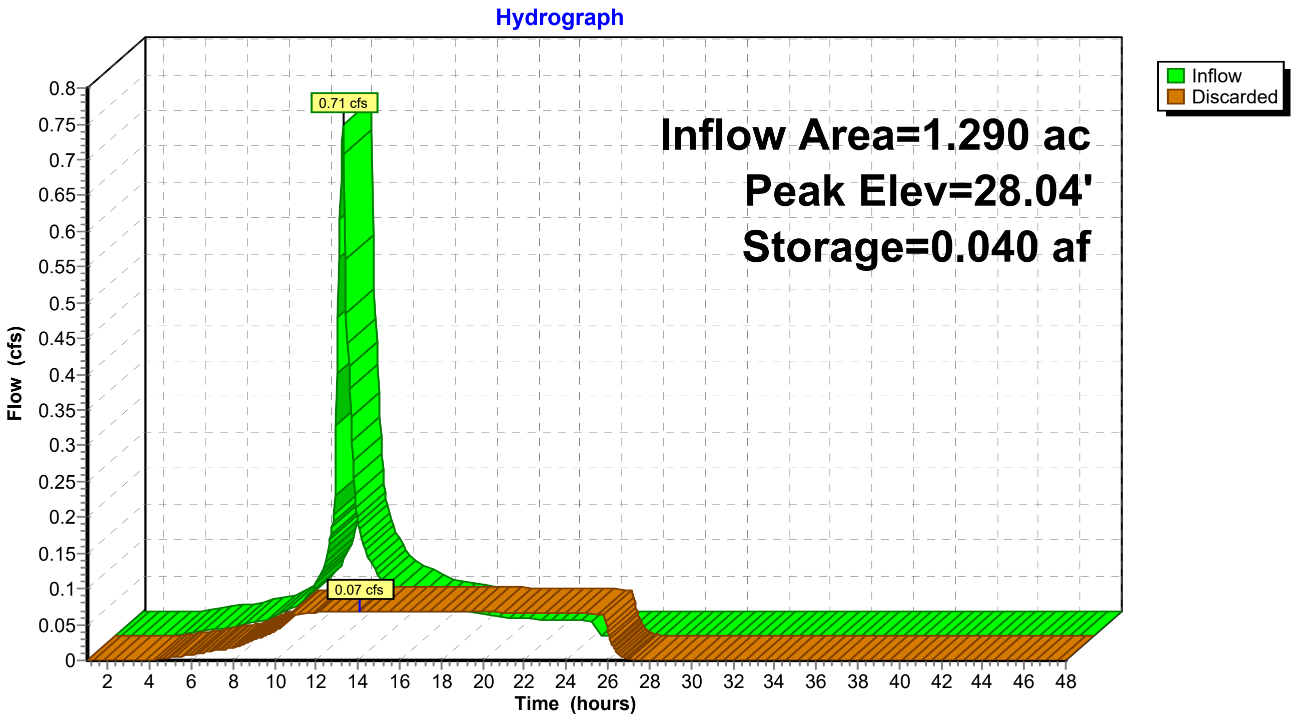
Volume	Invert	Avail.Storage	Storage Description
#1	27.50'	0.182 af	**Custom Stage Data (Irregular)** Listed below (Recalc) 0.187 af Overall x 97.0% Voids

Elevation (feet)	Surf.Area (acres)	Perim. (feet)	Inc.Store (acre-feet)	Cum.Store (acre-feet)	Wet.Area (acres)
27.50	0.075	482.0	0.000	0.000	0.075
30.00	0.075	482.0	0.187	0.187	0.103

Device	Routing	Invert	Outlet Devices
#1	Discarded	27.50'	**0.850 in/hr Exfiltration over Wetted area**

Discarded OutFlow Max=0.07 cfs @ 14.08 hrs HW=28.04' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.07 cfs)

Pond 41P: DT-6


Hydrograph
Inflow
Discarded
0.71 cfs
0.07 cfs
Inflow Area=1.290 ac
Peak Elev=28.04'
Storage=0.040 af
Flow (cfs)
0.8
0.75
0.7
0.65
0.6
0.55
0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48
Time (hours)

Summary for Pond 42P: CB-B

[57] Hint: Peaked at 32.99' (Flood elevation advised)

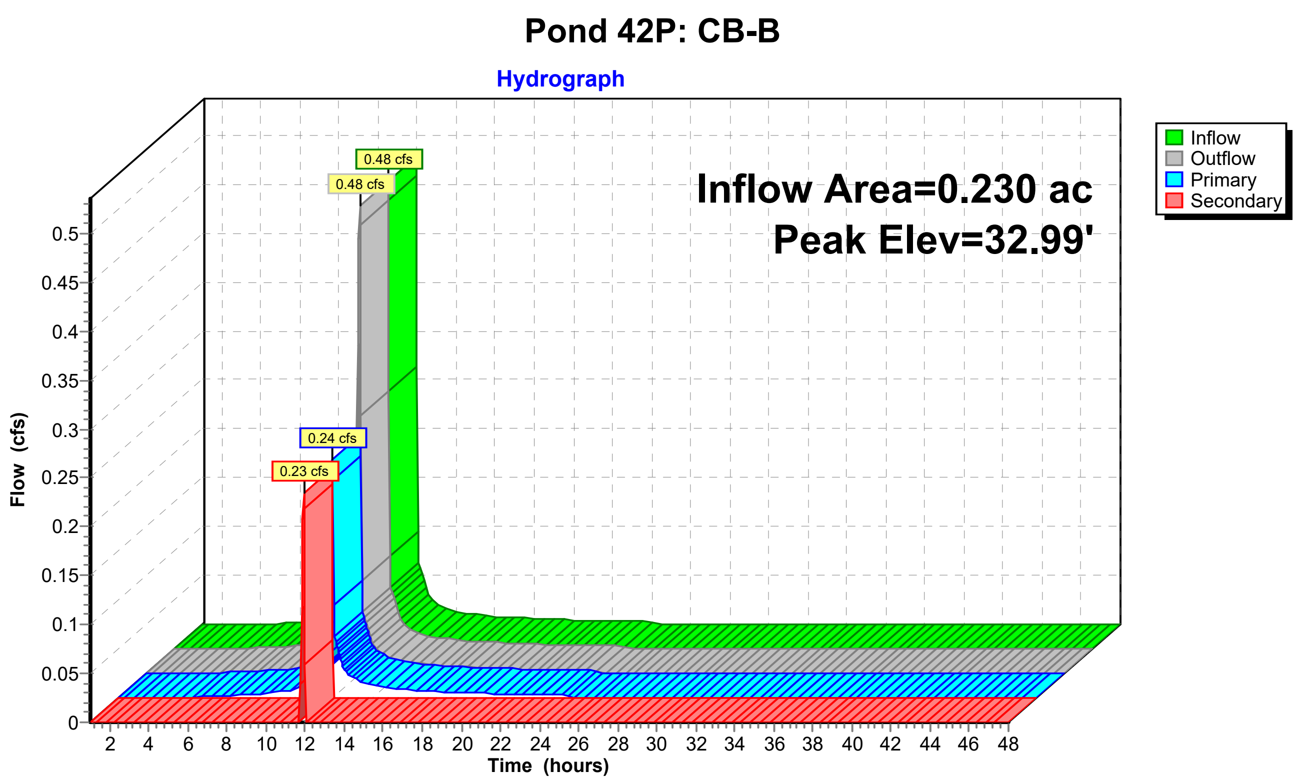
Inflow Area = 0.230 ac, 82.61% Impervious, Inflow Depth = 1.17" for 2 event
Inflow = 0.48 cfs @ 11.93 hrs, Volume= 0.023 af
Outflow = 0.48 cfs @ 11.93 hrs, Volume= 0.023 af, Atten= 0%, Lag= 0.0 min
Primary = 0.24 cfs @ 11.93 hrs, Volume= 0.020 af
Secondary = 0.23 cfs @ 11.93 hrs, Volume= 0.003 af

Routing by Stor-Ind method, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 32.99' @ 11.93 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	32.10'	**4.0" Round Culvert** L= 50.0' Ke= 1.200 Inlet / Outlet Invert= 32.10' / 31.20' S= 0.0180 '/' Cc= 0.900 n= 0.012, Flow Area= 0.09 sf
#2	Secondary	32.60'	**6.0" Round Culvert** L= 200.0' Ke= 1.200 Inlet / Outlet Invert= 32.60' / 30.60' S= 0.0100 '/' Cc= 0.900 n= 0.012, Flow Area= 0.20 sf

Primary OutFlow Max=0.24 cfs @ 11.93 hrs HW=32.96' (Free Discharge)
↑—**1=Culvert** (Inlet Controls 0.24 cfs @ 2.74 fps)

Secondary OutFlow Max=0.21 cfs @ 11.93 hrs HW=32.96' (Free Discharge)
↑—**2=Culvert** (Inlet Controls 0.21 cfs @ 1.40 fps)



Summary for Pond 43P: CB-A

Inflow Area = 0.740 ac, 85.14% Impervious, Inflow Depth = 1.17" for 2 event
Inflow = 1.49 cfs @ 11.95 hrs, Volume= 0.072 af
Outflow = 1.49 cfs @ 11.95 hrs, Volume= 0.072 af, Atten= 0%, Lag= 0.0 min
Primary = 0.28 cfs @ 11.95 hrs, Volume= 0.051 af
Secondary = 1.20 cfs @ 11.95 hrs, Volume= 0.021 af

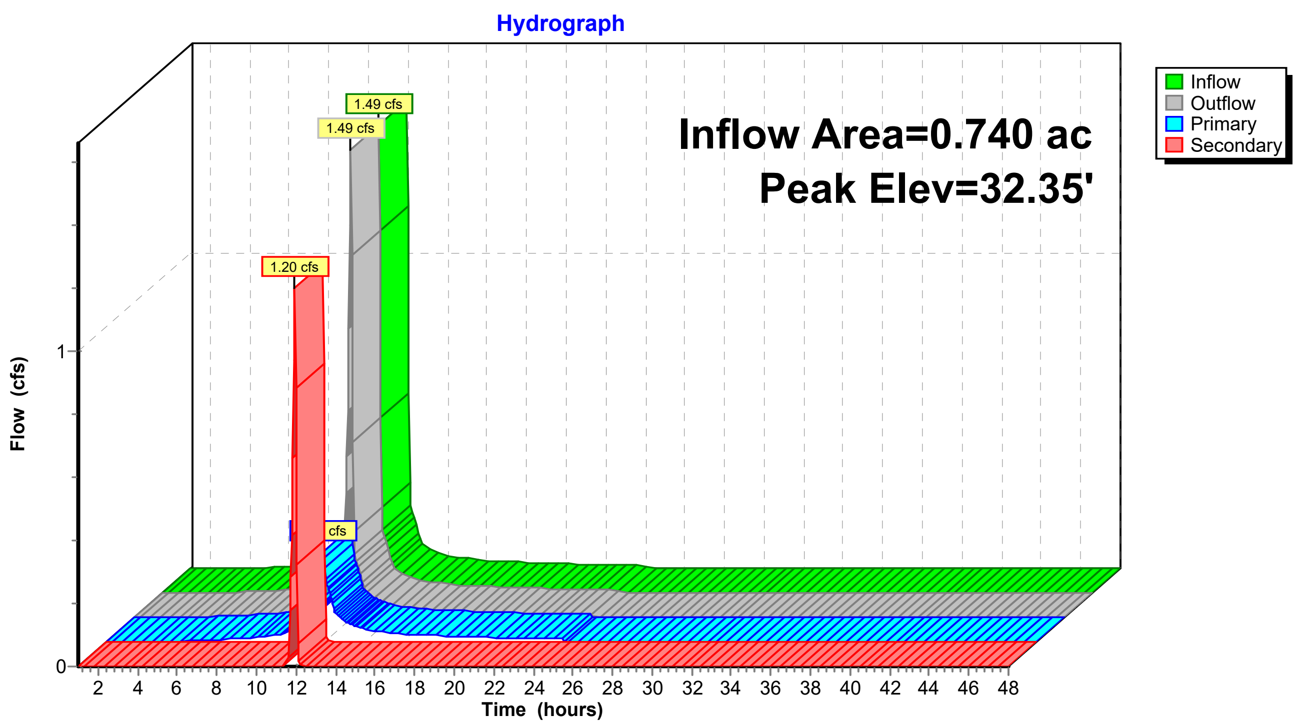
Routing by Stor-Ind method, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 32.35' @ 11.95 hrs
Flood Elev= 34.22'

Device	Routing	Invert	Outlet Devices
#1	Primary	31.20'	**4.0" Round Culvert** L= 30.0' Ke= 1.200 Inlet / Outlet Invert= 31.20' / 30.00' S= 0.0400 '/' Cc= 0.900 n= 0.012, Flow Area= 0.09 sf
#2	Secondary	31.70'	**15.0" Round Culvert** L= 200.0' Ke= 1.200 Inlet / Outlet Invert= 31.70' / 29.70' S= 0.0100 '/' Cc= 0.900 n= 0.012, Flow Area= 1.23 sf

Primary OutFlow Max=0.28 cfs @ 11.95 hrs HW=32.34' (Free Discharge)
└**1=Culvert** (Inlet Controls 0.28 cfs @ 3.24 fps)

Secondary OutFlow Max=1.18 cfs @ 11.95 hrs HW=32.34' (Free Discharge)
└**2=Culvert** (Inlet Controls 1.18 cfs @ 1.86 fps)

Pond 43P: CB-A



Summary for Pond 49P: CB-S

[57] Hint: Peaked at 27.35' (Flood elevation advised)

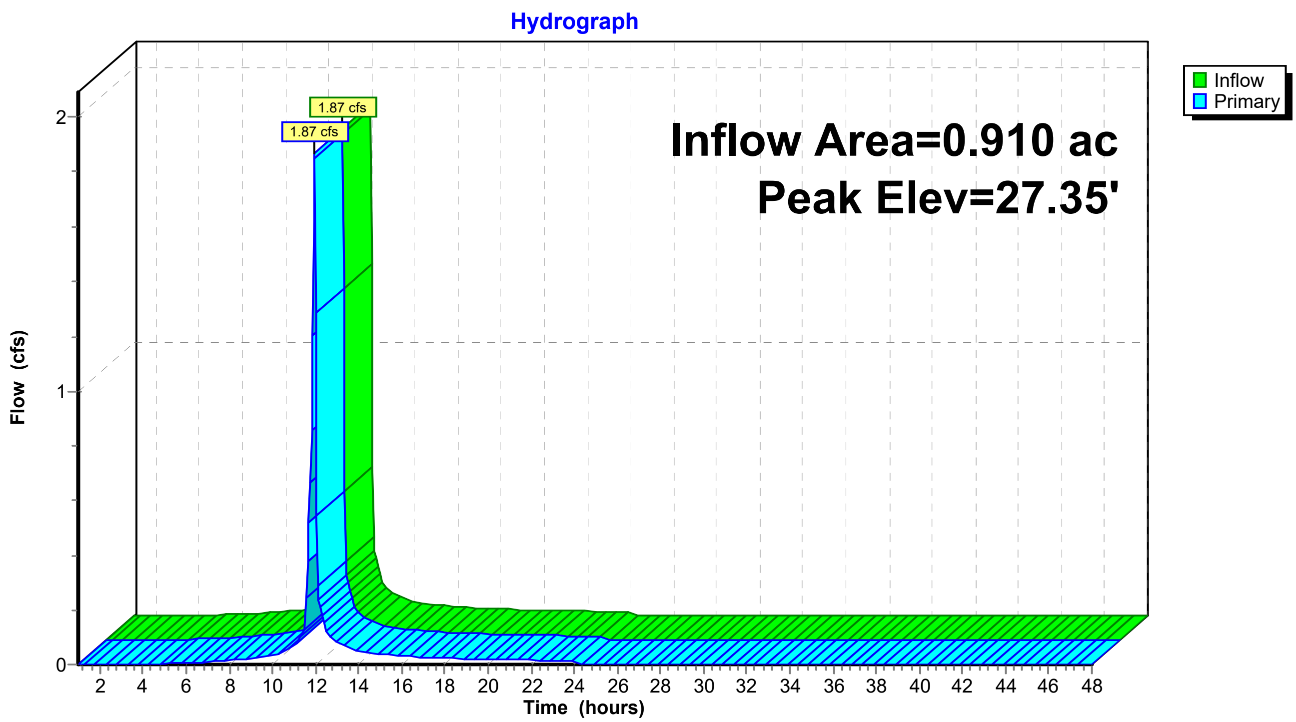
Inflow Area =	0.910 ac,	84.62% Impervious,	Inflow Depth = 1.17"	for 2 event
Inflow =	1.87 cfs @	11.94 hrs, Volume=	0.089 af	
Outflow =	1.87 cfs @	11.94 hrs, Volume=	0.089 af, Atten= 0%, Lag= 0.0 min	
Primary =	1.87 cfs @	11.94 hrs, Volume=	0.089 af	

Routing by Stor-Ind method, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 27.35' @ 11.94 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	26.60'	**12.0" Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=1.80 cfs @ 11.94 hrs HW=27.33' (Free Discharge)
↑—**1=Orifice/Grate** (Orifice Controls 1.80 cfs @ 2.92 fps)

Pond 49P: CB-S



Summary for Pond 51P: CB-T

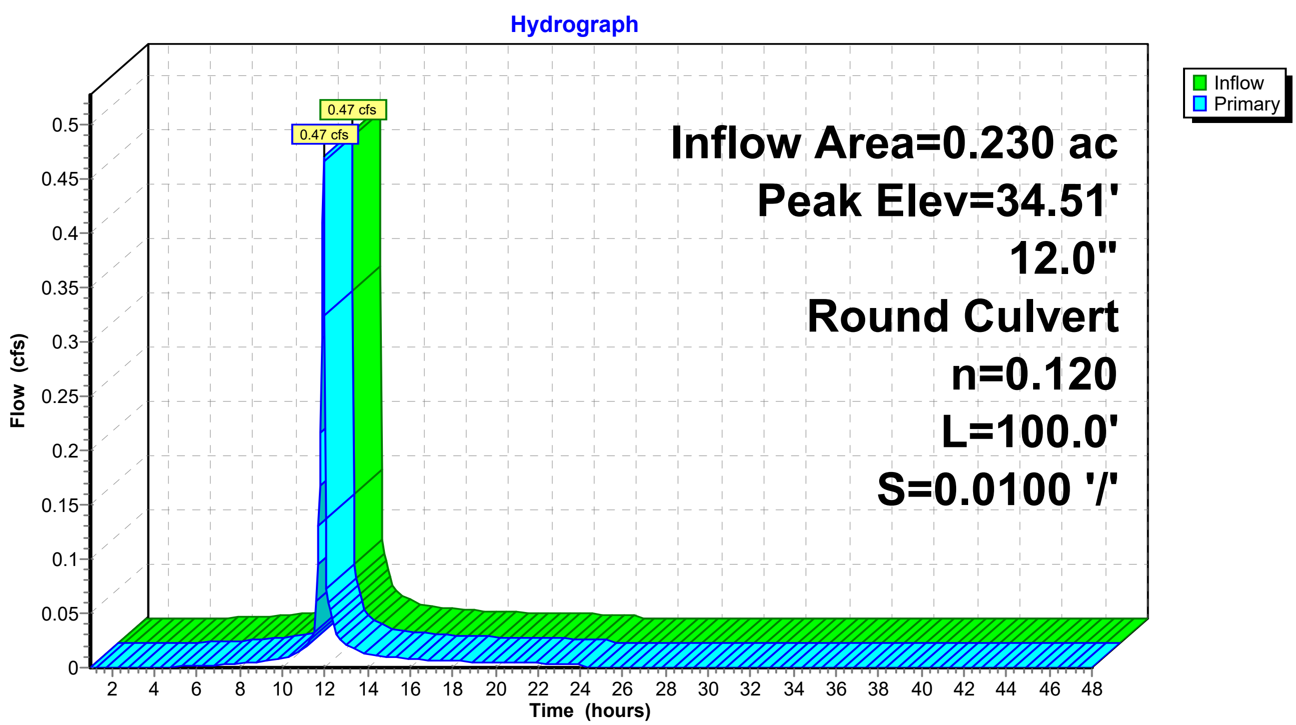
Inflow Area =	0.230 ac,	82.61% Impervious,	Inflow Depth = 1.17"	for 2 event
Inflow =	0.47 cfs @	11.94 hrs,	Volume=	0.023 af
Outflow =	0.47 cfs @	11.94 hrs,	Volume=	0.023 af, Atten= 0%, Lag= 0.0 min
Primary =	0.47 cfs @	11.94 hrs,	Volume=	0.023 af

Routing by Stor-Ind method, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 34.51' @ 11.94 hrs
Flood Elev= 36.80'

Device	Routing	Invert	Outlet Devices
#1	Primary	33.30'	**12.0" Round Culvert** L= 100.0' Ke= 1.200 Inlet / Outlet Invert= 33.30' / 32.30' S= 0.0100 '/' Cc= 0.900 n= 0.120, Flow Area= 0.79 sf

Primary OutFlow Max=0.46 cfs @ 11.94 hrs HW=34.47' (Free Discharge)
↑**1=Culvert** (Barrel Controls 0.46 cfs @ 0.63 fps)

Pond 51P: CB-T



Summary for Pond 53P: CB-U

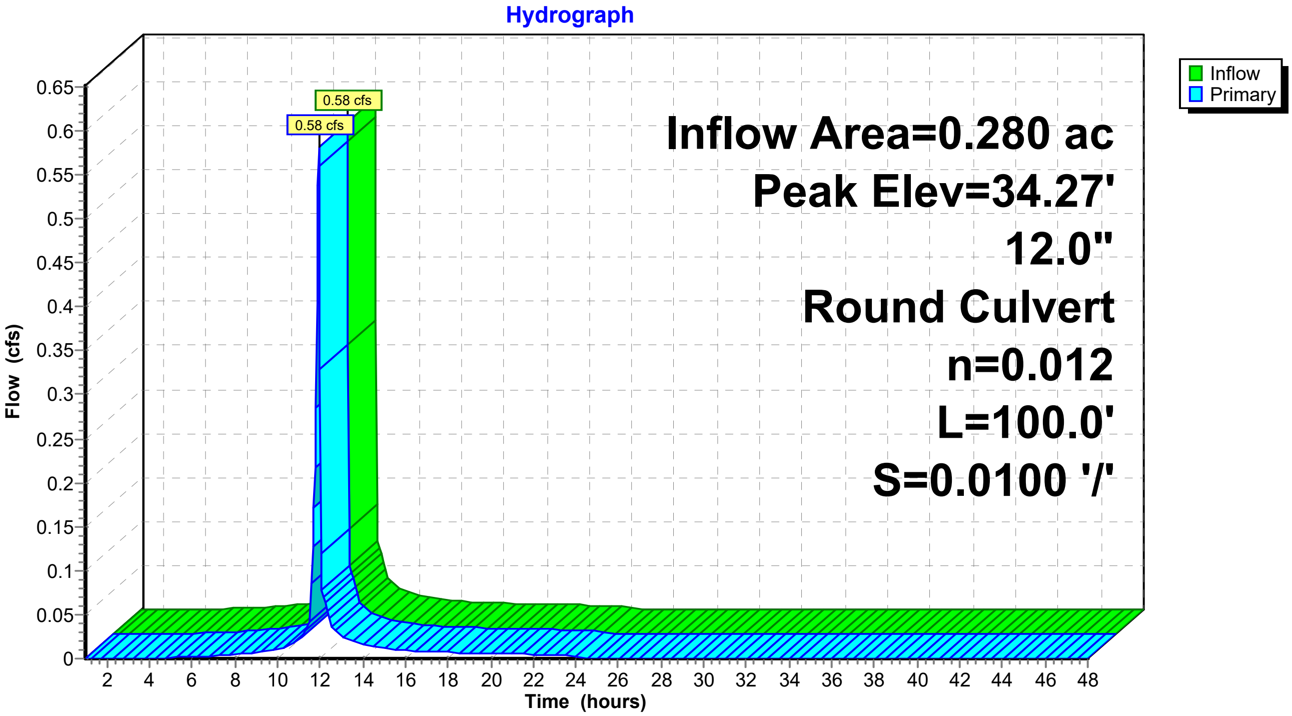
Inflow Area = 0.280 ac, 85.71% Impervious, Inflow Depth = 1.17" for 2 event
Inflow = 0.58 cfs @ 11.93 hrs, Volume= 0.027 af
Outflow = 0.58 cfs @ 11.93 hrs, Volume= 0.027 af, Atten= 0%, Lag= 0.0 min
Primary = 0.58 cfs @ 11.93 hrs, Volume= 0.027 af

Routing by Stor-Ind method, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 34.27' @ 11.93 hrs
Flood Elev= 36.80'

Device	Routing	Invert	Outlet Devices
#1	Primary	33.80'	**12.0" Round Culvert** L= 100.0' Ke= 1.200 Inlet / Outlet Invert= 33.80' / 32.80' S= 0.0100 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf

Primary OutFlow Max=0.55 cfs @ 11.93 hrs HW=34.26' (Free Discharge)
1=Culvert (Inlet Controls 0.55 cfs @ 1.57 fps)

Pond 53P: CB-U



Summary for Pond 54P: DA-9

Inflow Area =	1.450 ac, 84.83% Impervious,	Inflow Depth = 1.10"	for 2 event	
Inflow =	2.13 cfs @	11.94 hrs, Volume=	0.133 af	
Outflow =	0.10 cfs @	11.25 hrs, Volume=	0.133 af,	Atten= 95%, Lag= 0.0 min
Discarded =	0.10 cfs @	11.25 hrs, Volume=	0.133 af	

Routing by Stor-Ind method, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 30.03' @ 13.48 hrs Surf.Area= 0.120 ac Storage= 0.063 af

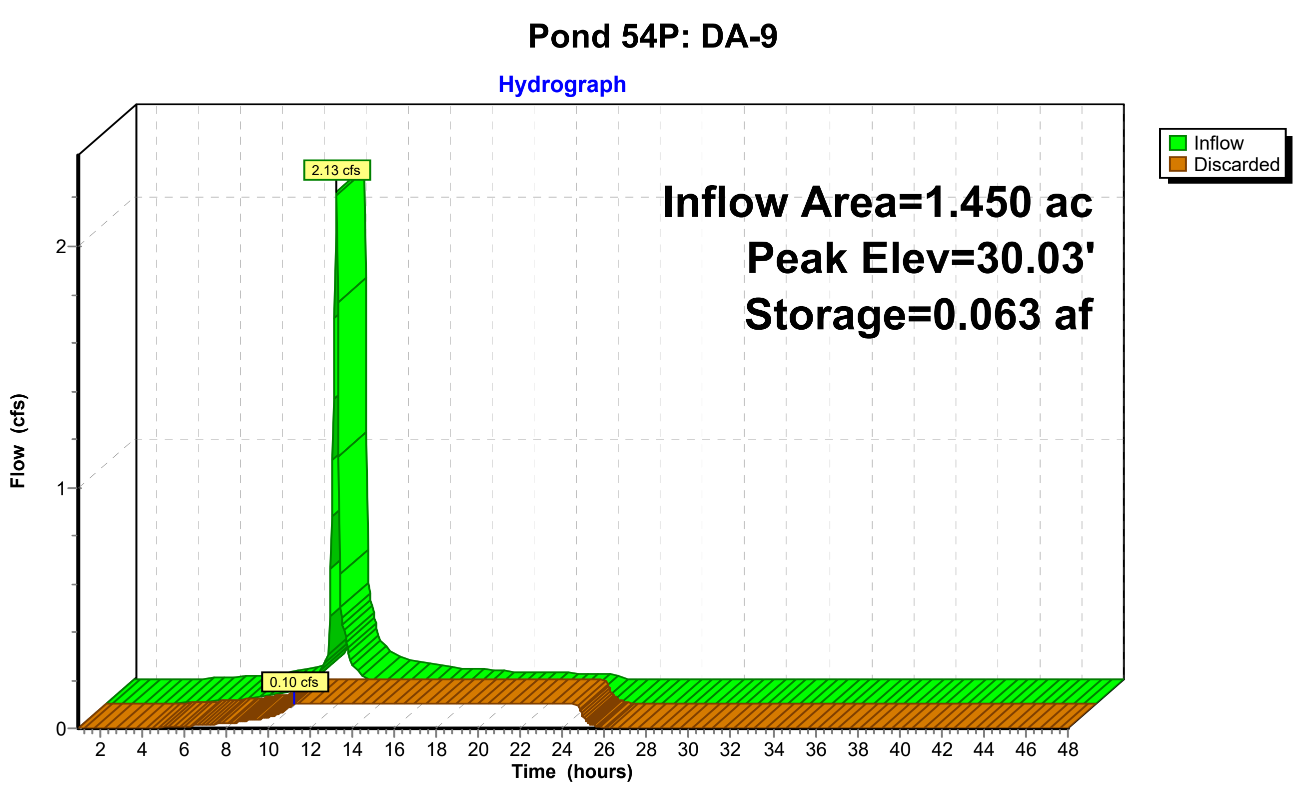
Plug-Flow detention time= 240.2 min calculated for 0.133 af (100% of inflow)
Center-of-Mass det. time= 240.0 min (1,028.0 - 788.0)

Volume	Invert	Avail.Storage	Storage Description
#1	29.50'	0.300 af	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
29.50	0.120	0.000	0.000
32.00	0.120	0.300	0.300

Device	Routing	Invert	Outlet Devices
#1	Discarded	29.50'	**0.850 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.10 cfs @ 11.25 hrs HW=29.53' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.10 cfs)



Summary for Pond 56P: (new Pond)

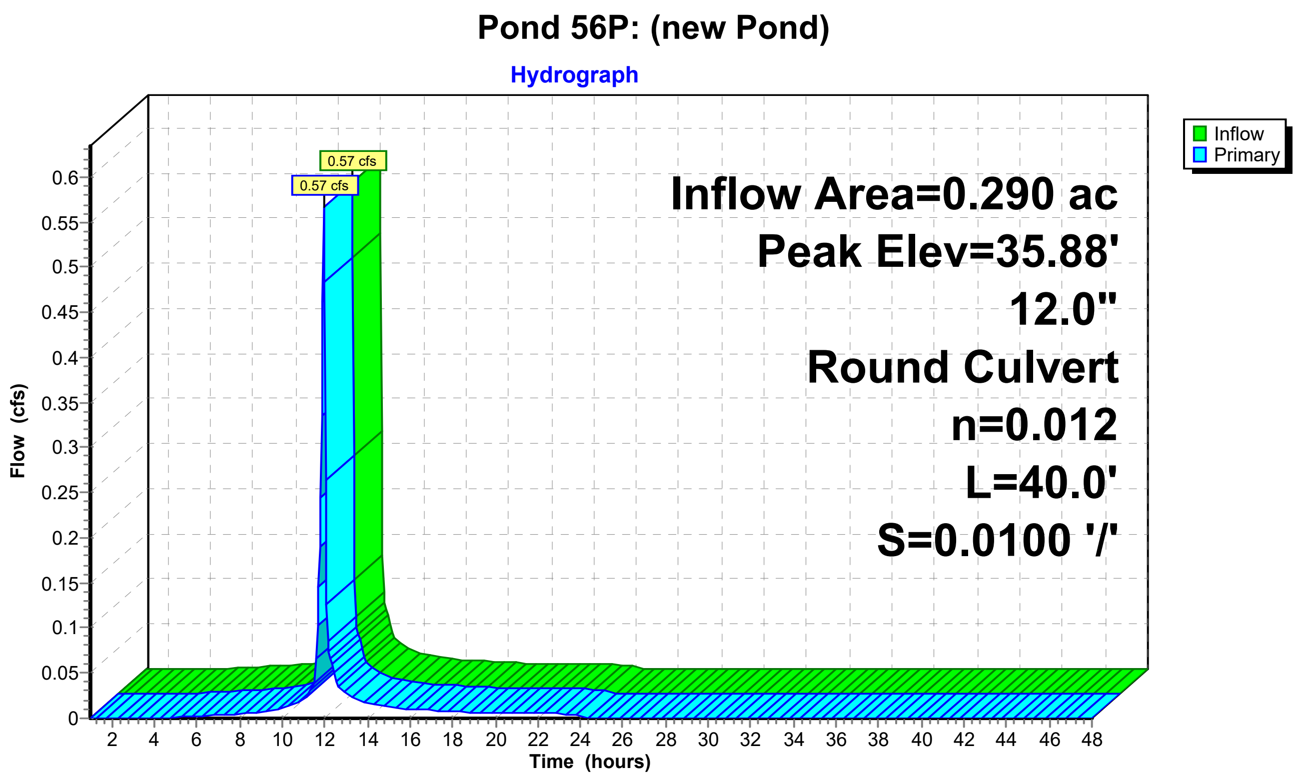
[57] Hint: Peaked at 35.88' (Flood elevation advised)

Inflow Area =	0.290 ac, 86.21% Impervious, Inflow Depth = 1.17" for 2 event			
Inflow =	0.57 cfs @	11.95 hrs, Volume=	0.028 af	
Outflow =	0.57 cfs @	11.95 hrs, Volume=	0.028 af,	Atten= 0%, Lag= 0.0 min
Primary =	0.57 cfs @	11.95 hrs, Volume=	0.028 af	

Routing by Stor-Ind method, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 35.88' @ 11.95 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	35.41'	**12.0" Round Culvert** L= 40.0' Ke= 1.200 Inlet / Outlet Invert= 35.41' / 35.01' S= 0.0100 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf

Primary OutFlow Max=0.56 cfs @ 11.95 hrs HW=35.87' (Free Discharge)
└─**1=Culvert** (Inlet Controls 0.56 cfs @ 1.58 fps)



Time span=1.00-48.00 hrs, dt=0.05 hrs, 941 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1S: A Runoff Area=0.740 ac 85.14% Impervious Runoff Depth=2.30"
Flow Length=182' Slope=0.0070 '/' Tc=4.4 min AMC Adjusted CN=97 Runoff=2.79 cfs 0.142 af

Subcatchment2S: B Runoff Area=0.230 ac 82.61% Impervious Runoff Depth=2.30"
Flow Length=153' Slope=0.0160 '/' Tc=2.7 min AMC Adjusted CN=97 Runoff=0.89 cfs 0.044 af

Subcatchment3S: C Runoff Area=0.420 ac 85.71% Impervious Runoff Depth=2.30"
Flow Length=216' Slope=0.0160 '/' Tc=3.6 min AMC Adjusted CN=97 Runoff=1.62 cfs 0.081 af

Subcatchment4S: D Runoff Area=1.820 ac 85.16% Impervious Runoff Depth=2.30"
Flow Length=457' Slope=0.0230 '/' Tc=6.4 min AMC Adjusted CN=97 Runoff=6.35 cfs 0.349 af

Subcatchment5S: E Runoff Area=0.320 ac 84.38% Impervious Runoff Depth=2.30"
Flow Length=394' Slope=0.0040 '/' Tc=11.3 min AMC Adjusted CN=97 Runoff=0.97 cfs 0.061 af

Subcatchment6S: F Runoff Area=2.550 ac 85.10% Impervious Runoff Depth=2.30"
Flow Length=553' Slope=0.0100 '/' Tc=10.5 min AMC Adjusted CN=97 Runoff=7.92 cfs 0.489 af

Subcatchment7S: G Runoff Area=0.780 ac 84.62% Impervious Runoff Depth=2.30"
Flow Length=340' Slope=0.0150 '/' Tc=5.8 min AMC Adjusted CN=97 Runoff=2.78 cfs 0.150 af

Subcatchment8S: H Runoff Area=0.310 ac 83.87% Impervious Runoff Depth=2.30"
Flow Length=50' Slope=0.0200 '/' Tc=1.0 min AMC Adjusted CN=97 Runoff=1.25 cfs 0.059 af

Subcatchment9S: I Runoff Area=0.160 ac 87.50% Impervious Runoff Depth=2.41"
Flow Length=129' Slope=0.0090 '/' Tc=3.0 min AMC Adjusted CN=98 Runoff=0.63 cfs 0.032 af

Subcatchment10S: J Runoff Area=1.410 ac 85.11% Impervious Runoff Depth=2.30"
Flow Length=256' Slope=0.0200 '/' Tc=3.8 min AMC Adjusted CN=97 Runoff=5.40 cfs 0.270 af

Subcatchment11S: K Runoff Area=0.940 ac 85.11% Impervious Runoff Depth=2.30"
Flow Length=254' Slope=0.0100 '/' Tc=4.9 min AMC Adjusted CN=97 Runoff=3.47 cfs 0.180 af

Subcatchment12S: L Runoff Area=0.240 ac 87.50% Impervious Runoff Depth=2.41"
Flow Length=254' Slope=0.0100 '/' Tc=4.9 min AMC Adjusted CN=98 Runoff=0.90 cfs 0.048 af

Subcatchment13S: M Runoff Area=1.420 ac 85.21% Impervious Runoff Depth=2.30"
Flow Length=329' Slope=0.0110 '/' Tc=6.2 min AMC Adjusted CN=97 Runoff=4.99 cfs 0.272 af

Subcatchment14S: N Runoff Area=0.510 ac 84.31% Impervious Runoff Depth=2.30"
Flow Length=215' Slope=0.0110 '/' Tc=4.2 min AMC Adjusted CN=97 Runoff=1.93 cfs 0.098 af

Subcatchment15S: O Runoff Area=0.310 ac 83.87% Impervious Runoff Depth=2.30"
Flow Length=190' Slope=0.0150 '/' Tc=3.3 min AMC Adjusted CN=97 Runoff=1.20 cfs 0.059 af

Subcatchment16S: P Runoff Area=0.360 ac 83.33% Impervious Runoff Depth=2.30"
Flow Length=164' Slope=0.0170 '/' Tc=2.8 min AMC Adjusted CN=97 Runoff=1.40 cfs 0.069 af

Subcatchment17S: S Runoff Area=0.910 ac 84.62% Impervious Runoff Depth=2.30"
Flow Length=250' Slope=0.0200 '/' Tc=3.7 min AMC Adjusted CN=97 Runoff=3.50 cfs 0.175 af

Subcatchment18S: Q Runoff Area=0.230 ac 82.61% Impervious Runoff Depth=2.30"
Flow Length=87' Slope=0.0400 '/' Tc=1.2 min AMC Adjusted CN=97 Runoff=0.92 cfs 0.044 af

Subcatchment19S: R Runoff Area=0.340 ac 8.82% Impervious Runoff Depth=0.88"
Flow Length=56' Slope=0.0500 '/' Tc=6.3 min AMC Adjusted CN=78 Runoff=0.51 cfs 0.025 af

Subcatchment50S: T Runoff Area=0.230 ac 82.61% Impervious Runoff Depth=2.30"
Flow Length=127' Slope=0.0050 '/' Tc=3.7 min AMC Adjusted CN=97 Runoff=0.88 cfs 0.044 af

Subcatchment52S: U Runoff Area=0.280 ac 85.71% Impervious Runoff Depth=2.30"
Flow Length=125' Slope=0.0100 '/' Tc=2.8 min AMC Adjusted CN=97 Runoff=1.09 cfs 0.054 af

Subcatchment55S: V Runoff Area=0.290 ac 86.21% Impervious Runoff Depth=2.30"
Flow Length=185' Slope=0.0050 '/' Tc=5.1 min AMC Adjusted CN=97 Runoff=1.06 cfs 0.056 af

Reach 46R: REGIONAL SD Avg. Flow Depth=0.75' Max Vel=8.51 fps Inflow=19.52 cfs 0.561 af
84.0" Round Pipe n=0.013 L=500.0' S=0.0150 '/' Capacity=782.41 cfs Outflow=18.40 cfs 0.561 af

Pond 20P: DT-1 Peak Elev=34.39' Storage=0.181 af Inflow=6.28 cfs 0.341 af
Outflow=0.19 cfs 0.341 af

Pond 22P: CB-P Peak Elev=37.80' Inflow=1.40 cfs 0.069 af
12.0" Round Culvert n=0.012 L=100.0' S=0.0100 '/' Outflow=1.40 cfs 0.069 af

Pond 24P: CB-M Peak Elev=37.26' Inflow=4.99 cfs 0.272 af
24.0" Round Culvert n=0.012 L=10.0' S=0.0100 '/' Outflow=4.99 cfs 0.272 af

Pond 26P: CB-N Peak Elev=37.66' Inflow=1.93 cfs 0.098 af
Outflow=1.93 cfs 0.098 af

Pond 27P: CB-O Peak Elev=37.33' Inflow=1.20 cfs 0.059 af
12.0" Round Culvert n=0.012 L=10.0' S=0.0100 '/' Outflow=1.20 cfs 0.059 af

Pond 28P: DT-2 Peak Elev=32.54' Storage=0.111 af Inflow=4.03 cfs 0.206 af
Outflow=0.10 cfs 0.206 af

Pond 29P: CB-L Peak Elev=34.72' Inflow=0.90 cfs 0.048 af
18.0" Round Culvert n=0.012 L=20.0' S=0.0100 '/' Outflow=0.90 cfs 0.048 af

Pond 30P: CB-I Peak Elev=39.00' Inflow=0.63 cfs 0.032 af
12.0" Round Culvert n=0.012 L=100.0' S=0.0100 '/' Outflow=0.63 cfs 0.032 af

Pond 31P: CB-J Peak Elev=36.63' Inflow=5.40 cfs 0.270 af
24.0" Round Culvert n=0.012 L=10.0' S=0.0100 '/' Outflow=5.40 cfs 0.270 af

Pond 32P: DT-3 Peak Elev=33.56' Storage=0.164 af Inflow=6.03 cfs 0.303 af
Outflow=0.15 cfs 0.303 af

Pond 33P: CB-G Peak Elev=30.97' Inflow=2.78 cfs 0.150 af
Primary=1.05 cfs 0.121 af Secondary=1.73 cfs 0.029 af Outflow=2.78 cfs 0.150 af

Pond 34P: CB-K Peak Elev=34.82' Inflow=3.47 cfs 0.180 af
Primary=1.40 cfs 0.148 af Secondary=2.08 cfs 0.032 af Outflow=3.47 cfs 0.180 af

Pond 36P: CB-F Peak Elev=32.98' Inflow=7.92 cfs 0.489 af
Primary=4.39 cfs 0.432 af Secondary=3.53 cfs 0.058 af Outflow=7.92 cfs 0.489 af

Pond 37P: CB-C Peak Elev=29.92' Inflow=1.62 cfs 0.081 af
Primary=1.08 cfs 0.075 af Secondary=0.53 cfs 0.005 af Outflow=1.62 cfs 0.081 af

Pond 38P: CB-D Peak Elev=30.26' Inflow=6.35 cfs 0.349 af
Primary=2.78 cfs 0.292 af Secondary=3.57 cfs 0.057 af Outflow=6.35 cfs 0.349 af

Pond 39P: DT-4 Peak Elev=26.43' Storage=0.526 af Inflow=10.12 cfs 0.975 af
Outflow=0.40 cfs 0.975 af

Pond 40P: CB-E Peak Elev=35.77' Inflow=0.97 cfs 0.061 af
Primary=0.24 cfs 0.045 af Secondary=0.73 cfs 0.017 af Outflow=0.97 cfs 0.061 af

Pond 41P: DT-6 Peak Elev=28.61' Storage=0.081 af Inflow=0.88 cfs 0.171 af
Outflow=0.07 cfs 0.171 af

Pond 42P: CB-B Peak Elev=33.59' Inflow=0.89 cfs 0.044 af
Primary=0.33 cfs 0.035 af Secondary=0.56 cfs 0.009 af Outflow=0.89 cfs 0.044 af

Pond 43P: CB-A Peak Elev=32.70' Inflow=2.79 cfs 0.142 af
Primary=0.33 cfs 0.091 af Secondary=2.45 cfs 0.051 af Outflow=2.79 cfs 0.142 af

Pond 49P: CB-S Peak Elev=27.95' Inflow=3.50 cfs 0.175 af
Outflow=3.50 cfs 0.175 af

Pond 51P: CB-T Peak Elev=38.56' Inflow=0.88 cfs 0.044 af
12.0" Round Culvert n=0.120 L=100.0' S=0.0100 '/' Outflow=0.88 cfs 0.044 af

Pond 53P: CB-U Peak Elev=34.48' Inflow=1.09 cfs 0.054 af
12.0" Round Culvert n=0.012 L=100.0' S=0.0100 '/' Outflow=1.09 cfs 0.054 af

Pond 54P: DA-9 Peak Elev=30.60' Storage=0.132 af Inflow=3.35 cfs 0.246 af
Outflow=0.10 cfs 0.246 af

Pond 56P: (new Pond) Peak Elev=36.08' Inflow=1.06 cfs 0.056 af
12.0" Round Culvert n=0.012 L=40.0' S=0.0100 '/' Outflow=1.06 cfs 0.056 af

Total Runoff Area = 14.800 ac Runoff Volume = 2.802 af Average Runoff Depth = 2.27"
16.82% Pervious = 2.490 ac 83.18% Impervious = 12.310 ac

Summary for Subcatchment 1S: A

[49] Hint: Tc<2dt may require smaller dt

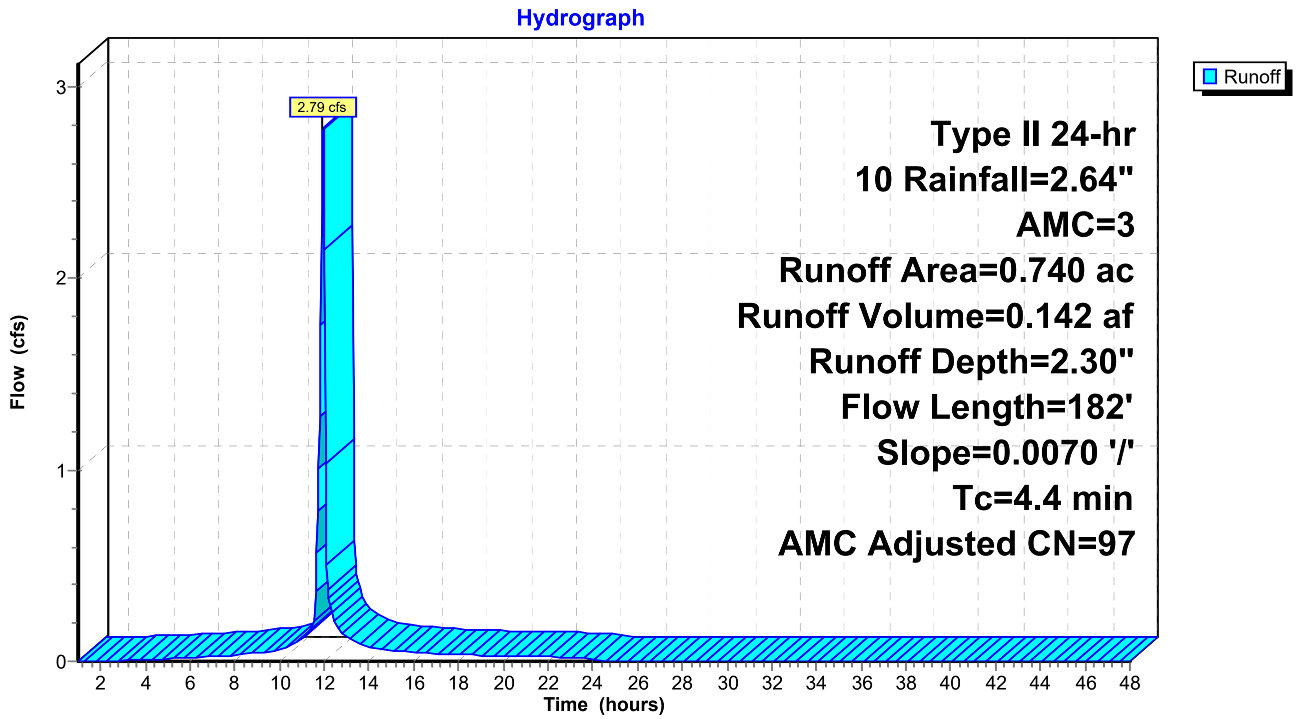
Runoff = 2.79 cfs @ 11.94 hrs, Volume= 0.142 af, Depth= 2.30"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 10 Rainfall=2.64", AMC=3

	Area (ac)	CN	Adj	Description
*	0.630	98		
*	0.110	56		
	0.740	92	97	Weighted Average, AMC Adjusted
	0.110			14.86% Pervious Area
	0.630			85.14% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.4	182	0.0070	0.70		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 1.49"

Subcatchment 1S: A



Summary for Subcatchment 2S: B

[49] Hint: Tc<2dt may require smaller dt

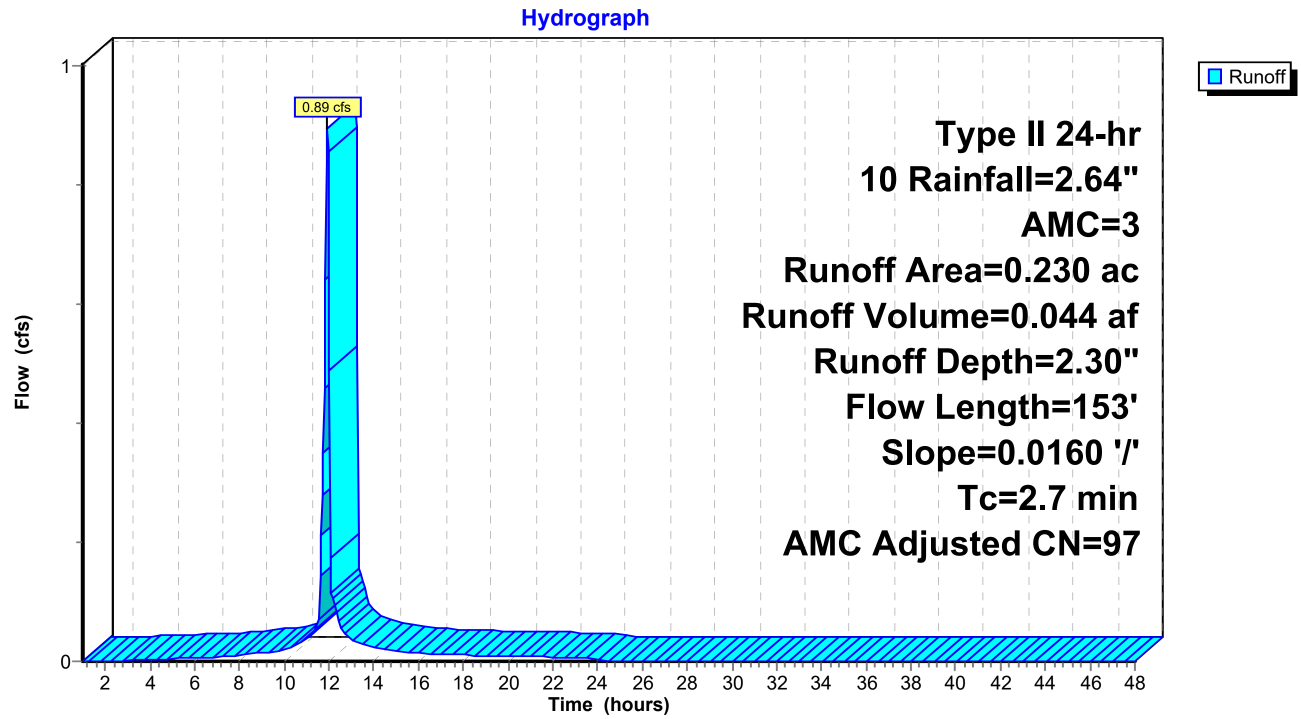
Runoff = 0.89 cfs @ 11.93 hrs, Volume= 0.044 af, Depth= 2.30"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 10 Rainfall=2.64", AMC=3

	Area (ac)	CN	Adj	Description
*	0.190	98		
*	0.040	56		
	0.230	91	97	Weighted Average, AMC Adjusted
	0.040			17.39% Pervious Area
	0.190			82.61% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.7	153	0.0160	0.93		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 1.49"

Subcatchment 2S: B



Summary for Subcatchment 3S: C

[49] Hint: Tc<2dt may require smaller dt

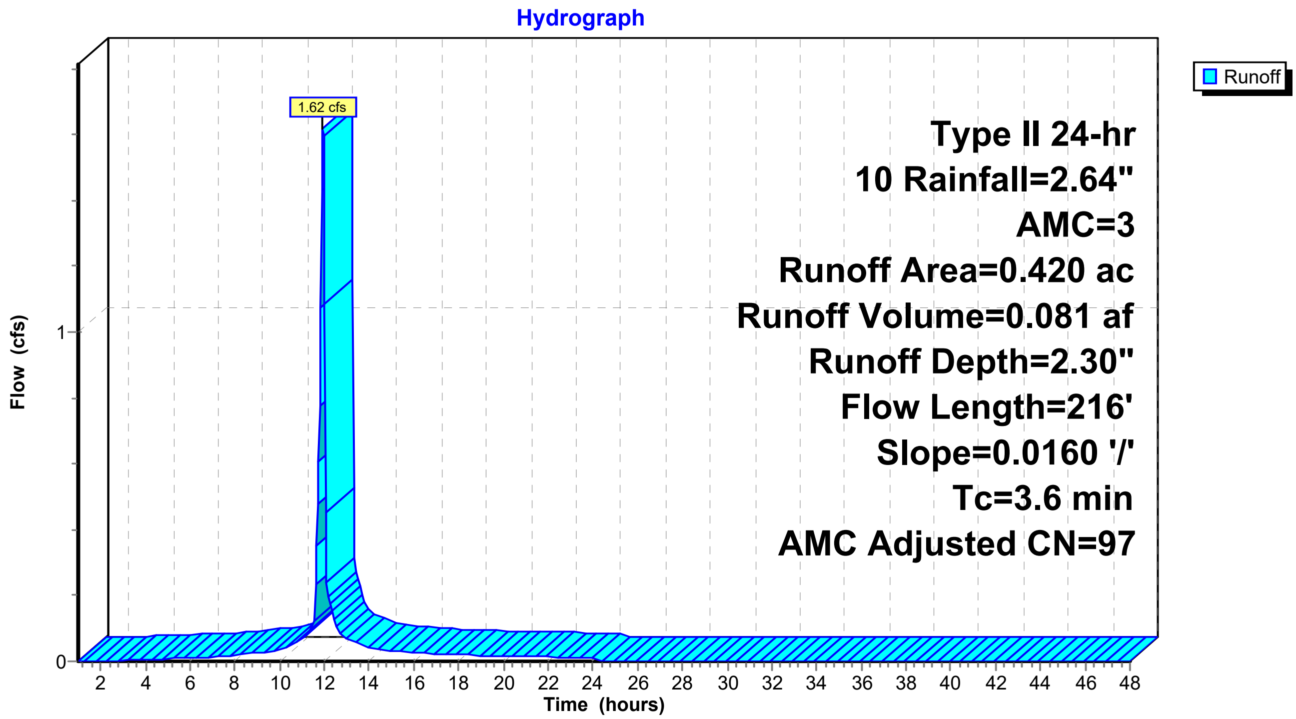
Runoff = 1.62 cfs @ 11.94 hrs, Volume= 0.081 af, Depth= 2.30"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 10 Rainfall=2.64", AMC=3

	Area (ac)	CN	Adj	Description
*	0.360	98		
*	0.060	56		
	0.420	92	97	Weighted Average, AMC Adjusted
	0.060			14.29% Pervious Area
	0.360			85.71% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.6	216	0.0160	1.00		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 1.49"

Subcatchment 3S: C



Summary for Subcatchment 4S: D

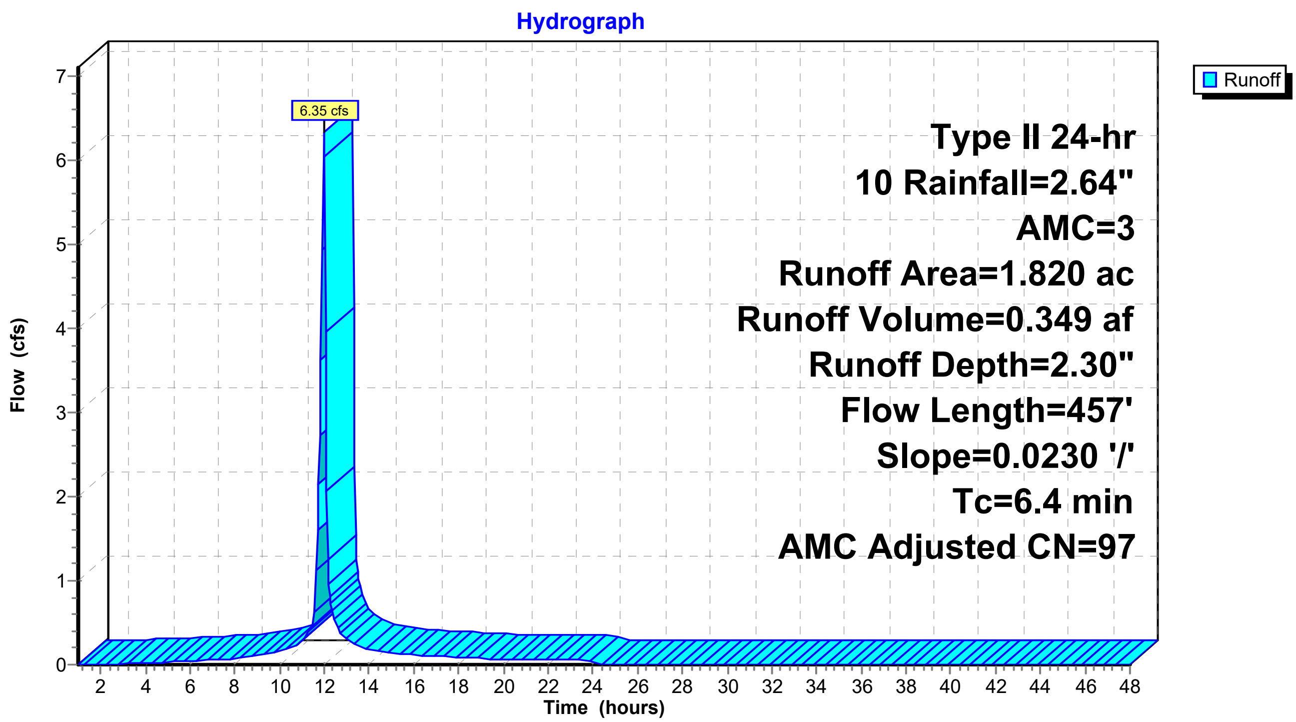
Runoff = 6.35 cfs @ 11.97 hrs, Volume= 0.349 af, Depth= 2.30"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 10 Rainfall=2.64", AMC=3

	Area (ac)	CN	Adj	Description
*	1.550	98		
*	0.270	56		
	1.820	92	97	Weighted Average, AMC Adjusted
	0.270			14.84% Pervious Area
	1.550			85.16% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.0	300	0.0230	1.24		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 1.49"
2.4	157	0.0230	1.09		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 1.49"
6.4	457	Total			

Subcatchment 4S: D



Summary for Subcatchment 5S: E

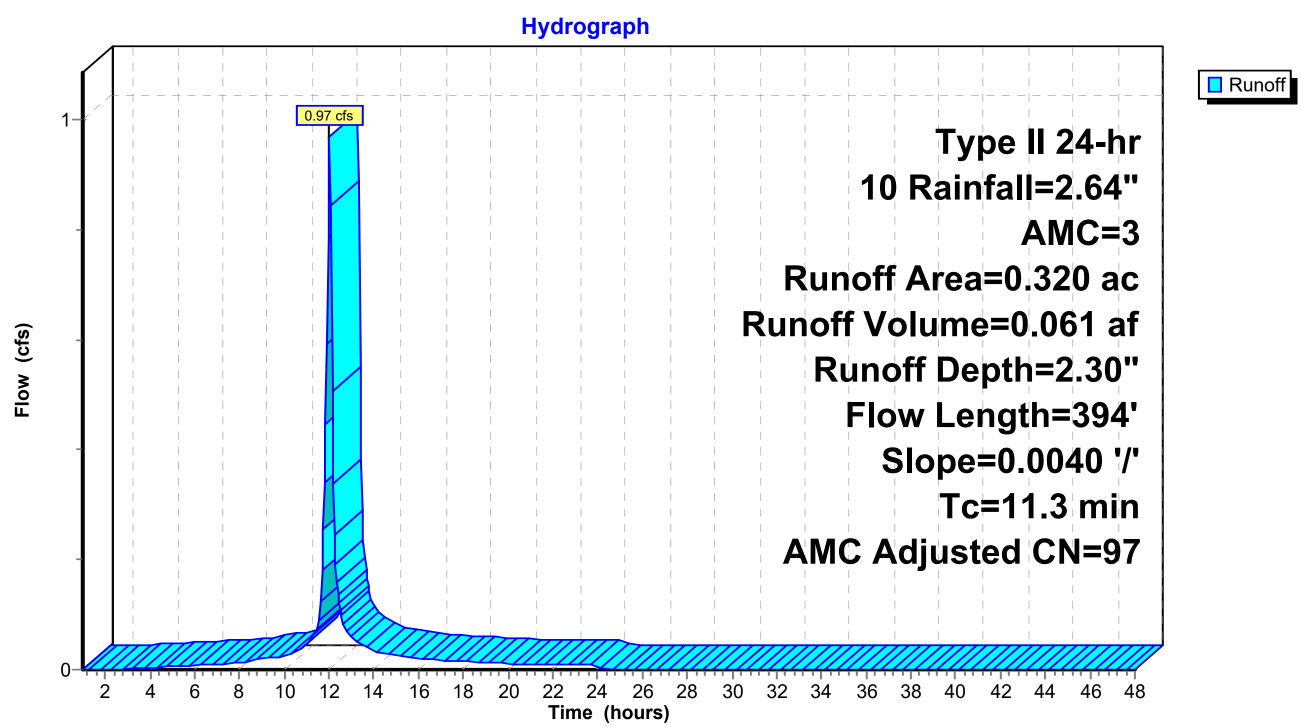
Runoff = 0.97 cfs @ 12.02 hrs, Volume= 0.061 af, Depth= 2.30"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 10 Rainfall=2.64", AMC=3

	Area (ac)	CN	Adj	Description
*	0.270	98		
*	0.050	56		
	0.320	91	97	Weighted Average, AMC Adjusted
	0.050			15.63% Pervious Area
	0.270			84.38% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.1	300	0.0040	0.61		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 1.49"
3.2	94	0.0040	0.49		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 1.49"
11.3	394	Total			

Subcatchment 5S: E



Summary for Subcatchment 6S: F

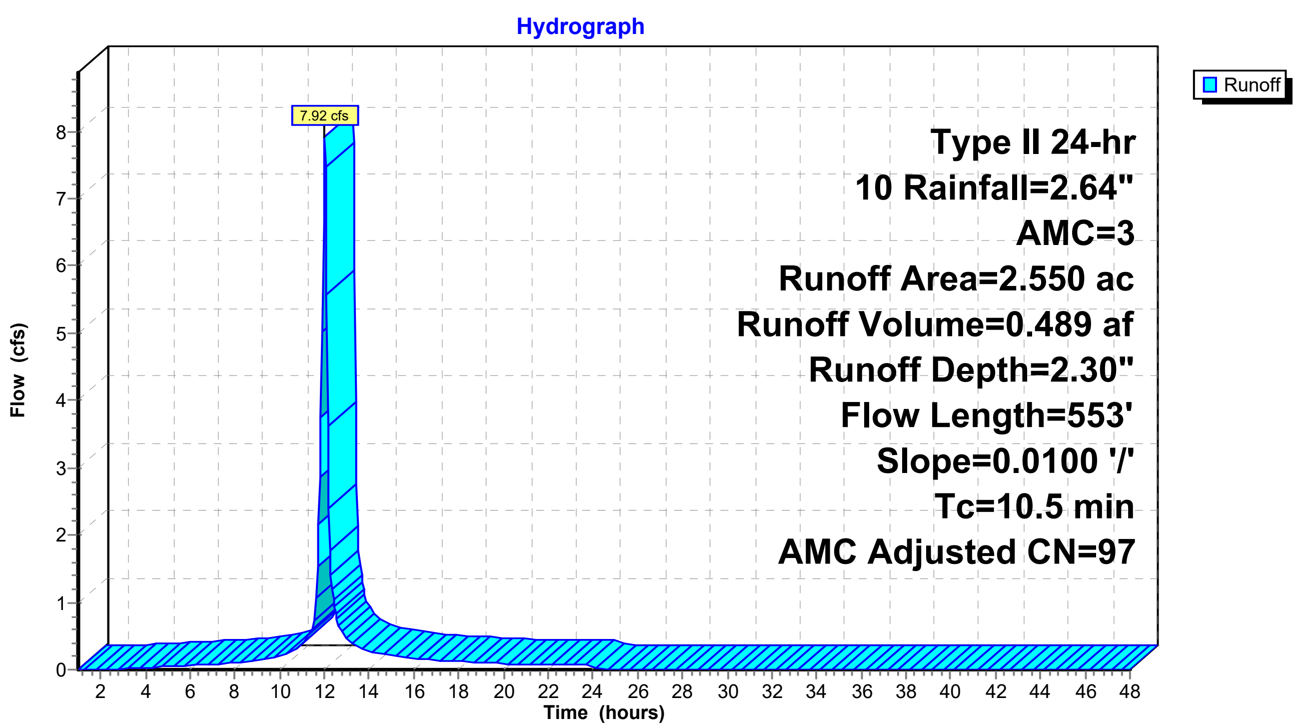
Runoff = 7.92 cfs @ 12.01 hrs, Volume= 0.489 af, Depth= 2.30"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 10 Rainfall=2.64", AMC=3

	Area (ac)	CN	Adj	Description
*	2.170	98		
*	0.380	56		
	2.550	92	97	Weighted Average, AMC Adjusted
	0.380			14.90% Pervious Area
	2.170			85.10% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.6	300	0.0100	0.89		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 1.49"
4.9	253	0.0100	0.86		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 1.49"
10.5	553	Total			

Subcatchment 6S: F



Summary for Subcatchment 7S: G

[49] Hint: Tc<2dt may require smaller dt

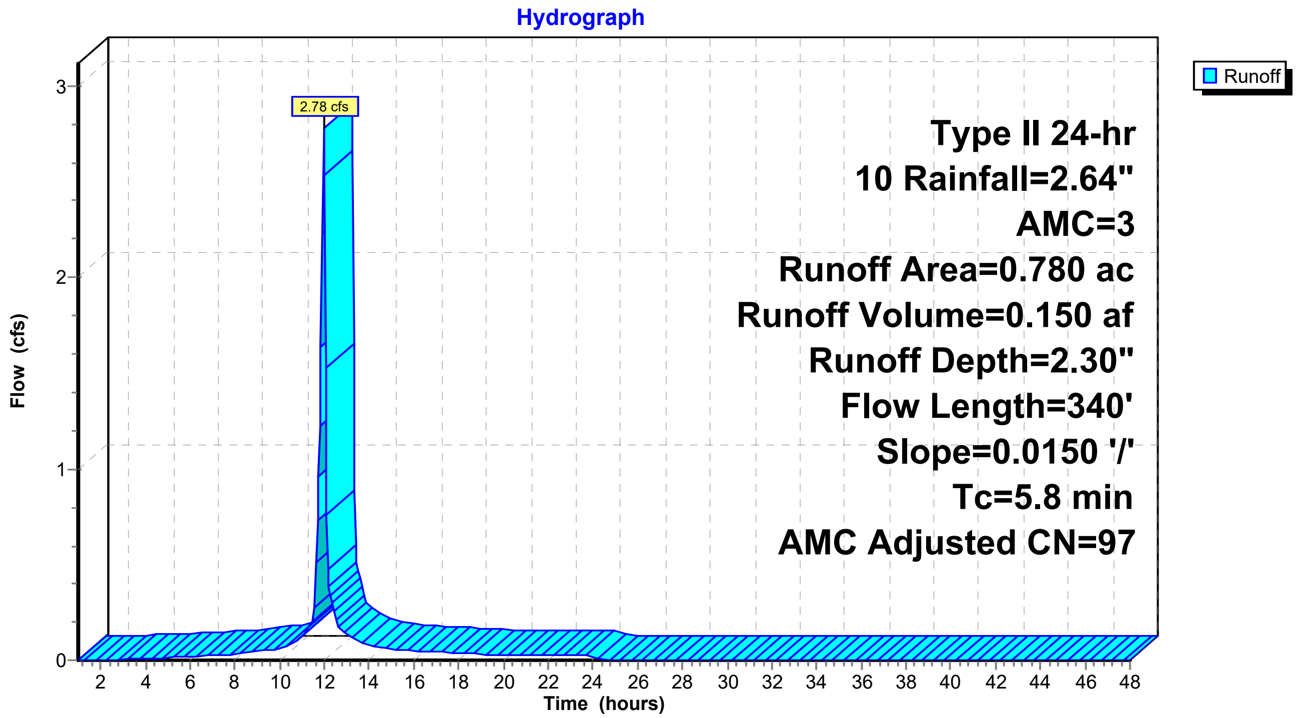
Runoff = 2.78 cfs @ 11.96 hrs, Volume= 0.150 af, Depth= 2.30"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 10 Rainfall=2.64", AMC=3

	Area (ac)	CN	Adj	Description
*	0.660	98		
*	0.120	56		
	0.780	92	97	Weighted Average, AMC Adjusted
	0.120			15.38% Pervious Area
	0.660			84.62% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.8	300	0.0150	1.04		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 1.49"
1.0	40	0.0150	0.70		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 1.49"
5.8	340	Total			

Subcatchment 7S: G



Summary for Subcatchment 8S: H

[49] Hint: Tc<2dt may require smaller dt

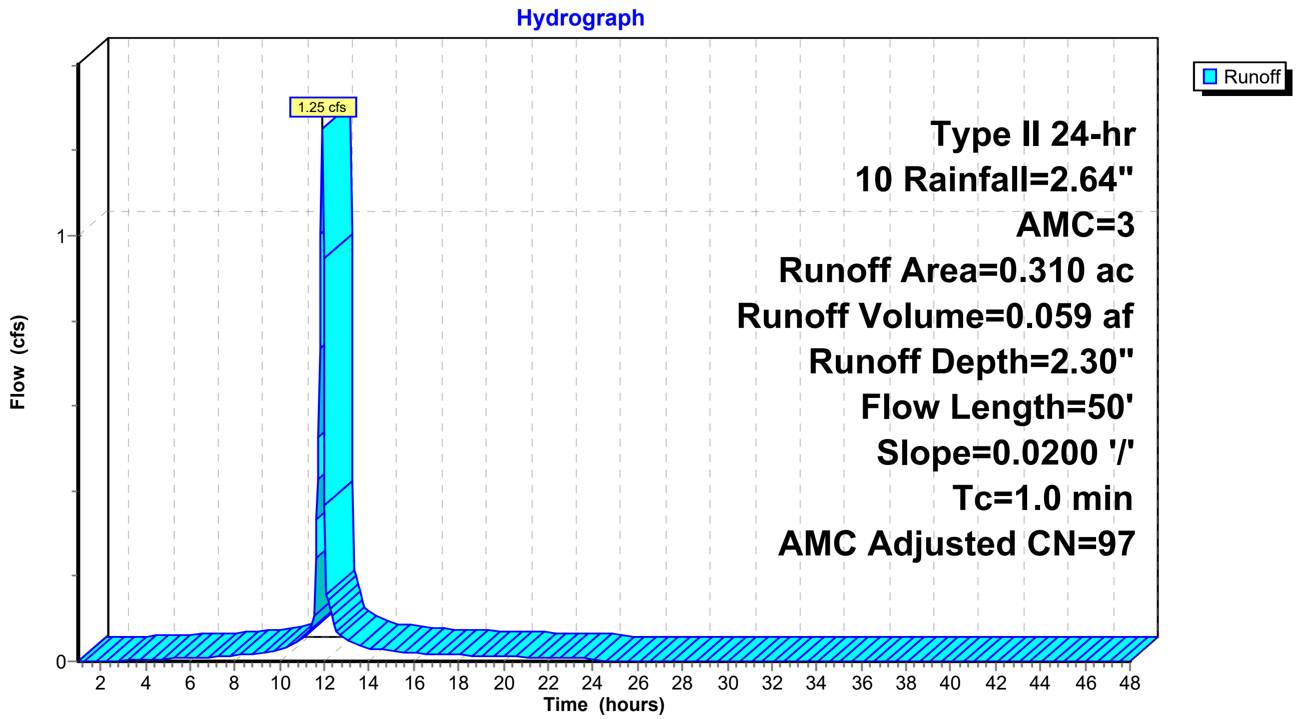
Runoff = 1.25 cfs @ 11.90 hrs, Volume= 0.059 af, Depth= 2.30"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 10 Rainfall=2.64", AMC=3

	Area (ac)	CN	Adj	Description
*	0.260	98		
*	0.050	56		
	0.310	91	97	Weighted Average, AMC Adjusted
	0.050			16.13% Pervious Area
	0.260			83.87% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.0	50	0.0200	0.82		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 1.49"

Subcatchment 8S: H



Summary for Subcatchment 9S: I

[49] Hint: Tc<2dt may require smaller dt

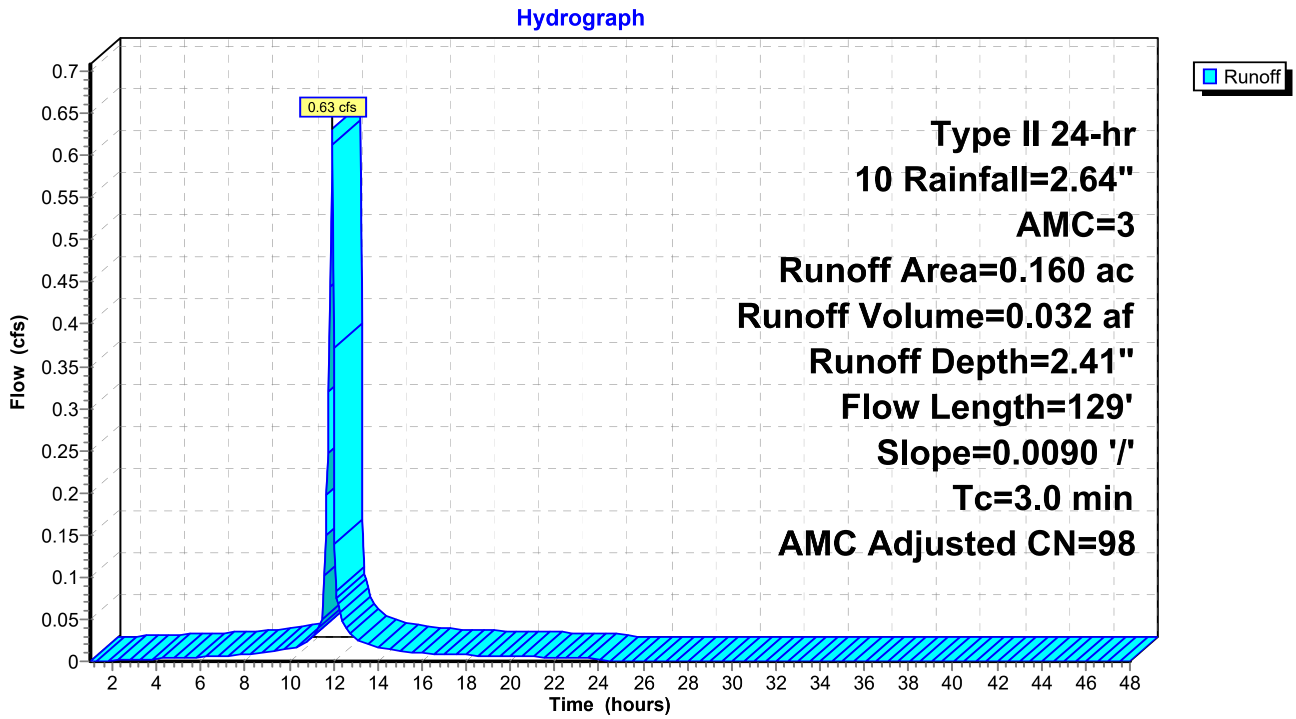
Runoff = 0.63 cfs @ 11.93 hrs, Volume= 0.032 af, Depth= 2.41"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 10 Rainfall=2.64", AMC=3

	Area (ac)	CN	Adj	Description
*	0.140	98		
*	0.020	56		
	0.160	93	98	Weighted Average, AMC Adjusted
	0.020			12.50% Pervious Area
	0.140			87.50% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.0	129	0.0090	0.72		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 1.49"

Subcatchment 9S: I



Summary for Subcatchment 10S: J

[49] Hint: Tc<2dt may require smaller dt

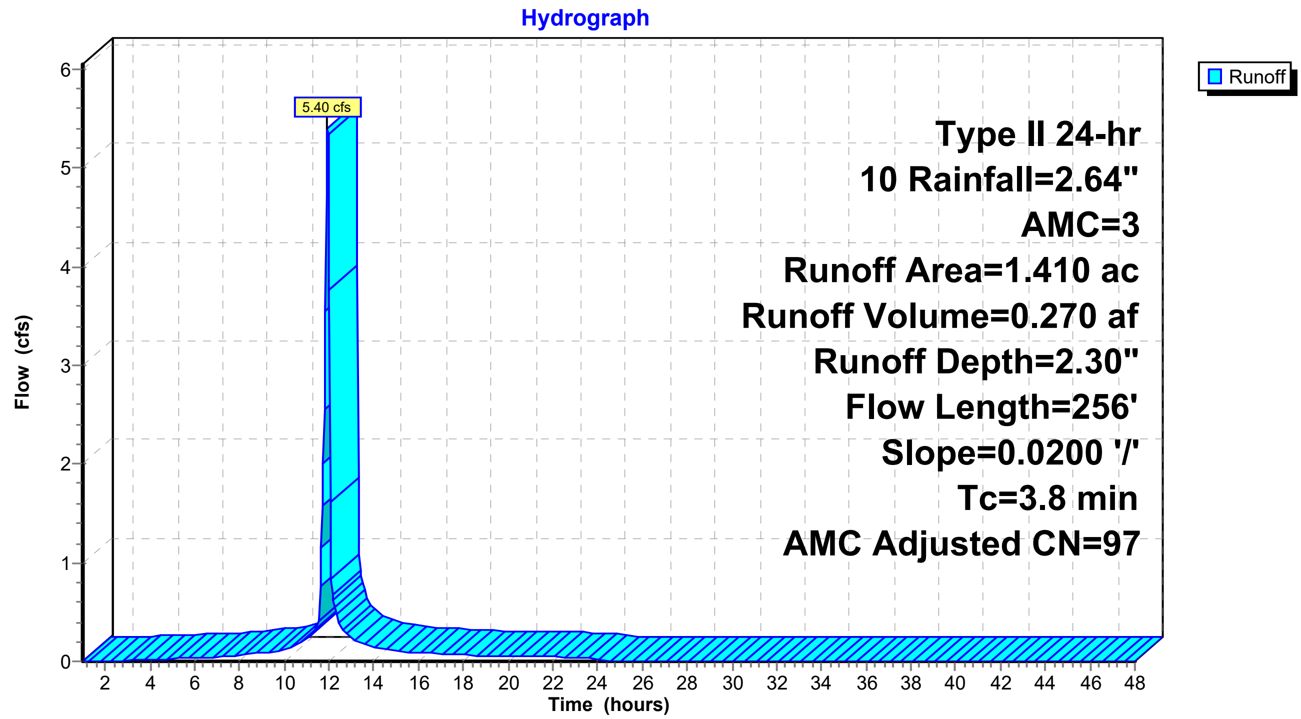
Runoff = 5.40 cfs @ 11.94 hrs, Volume= 0.270 af, Depth= 2.30"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 10 Rainfall=2.64", AMC=3

	Area (ac)	CN	Adj	Description
*	1.200	98		
*	0.210	56		
	1.410	92	97	Weighted Average, AMC Adjusted
	0.210			14.89% Pervious Area
	1.200			85.11% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.8	256	0.0200	1.13		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 1.49"

Subcatchment 10S: J



Summary for Subcatchment 11S: K

[49] Hint: Tc<2dt may require smaller dt

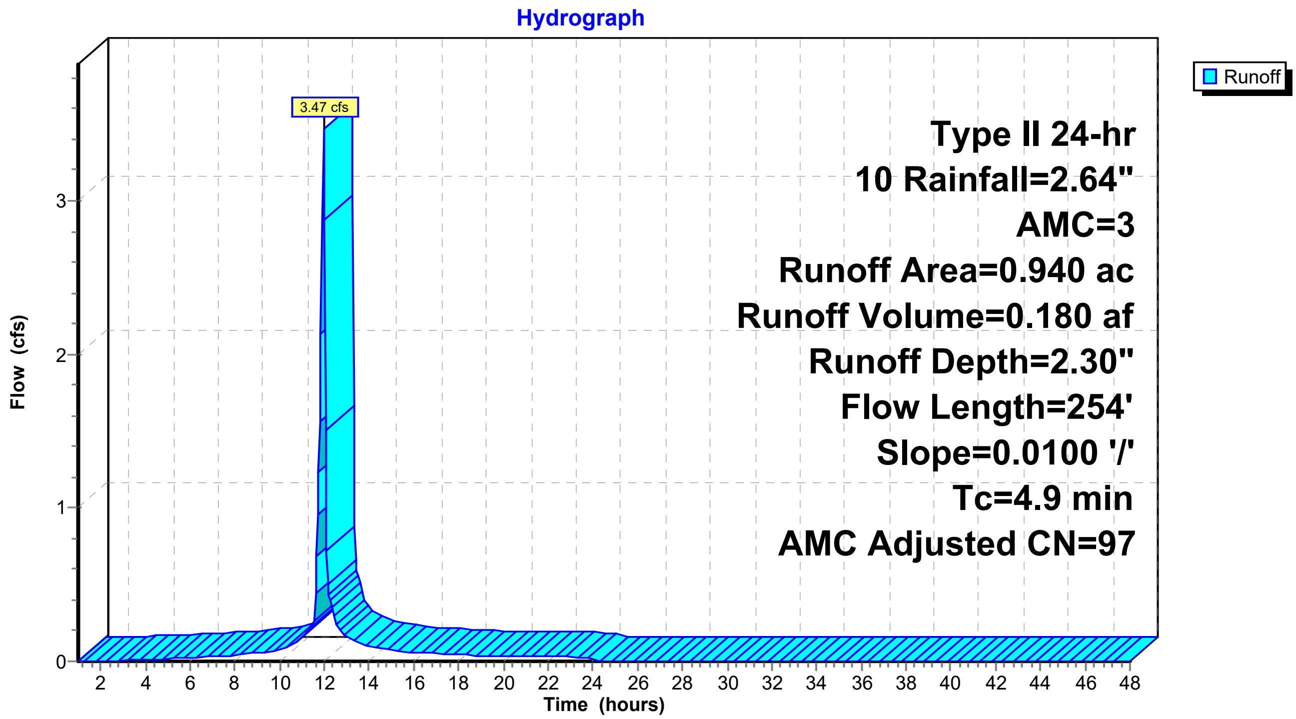
Runoff = 3.47 cfs @ 11.95 hrs, Volume= 0.180 af, Depth= 2.30"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 10 Rainfall=2.64", AMC=3

	Area (ac)	CN	Adj	Description
*	0.800	98		
*	0.140	56		
	0.940	92	97	Weighted Average, AMC Adjusted
	0.140			14.89% Pervious Area
	0.800			85.11% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.9	254	0.0100	0.86		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 1.49"

Subcatchment 11S: K



Summary for Subcatchment 12S: L

[49] Hint: Tc<2dt may require smaller dt

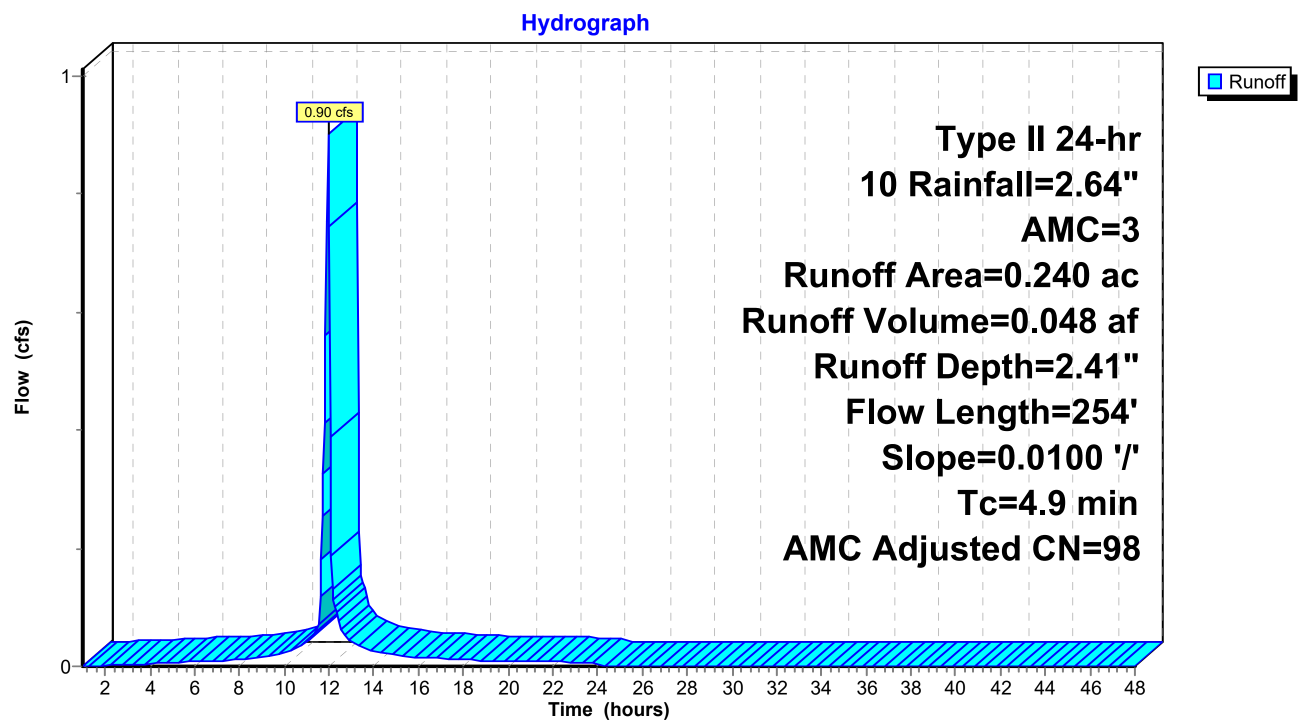
Runoff = 0.90 cfs @ 11.95 hrs, Volume= 0.048 af, Depth= 2.41"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 10 Rainfall=2.64", AMC=3

	Area (ac)	CN	Adj	Description
*	0.210	98		
*	0.030	56		
	0.240	93	98	Weighted Average, AMC Adjusted
	0.030			12.50% Pervious Area
	0.210			87.50% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.9	254	0.0100	0.86		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 1.49"

Subcatchment 12S: L



Summary for Subcatchment 13S: M

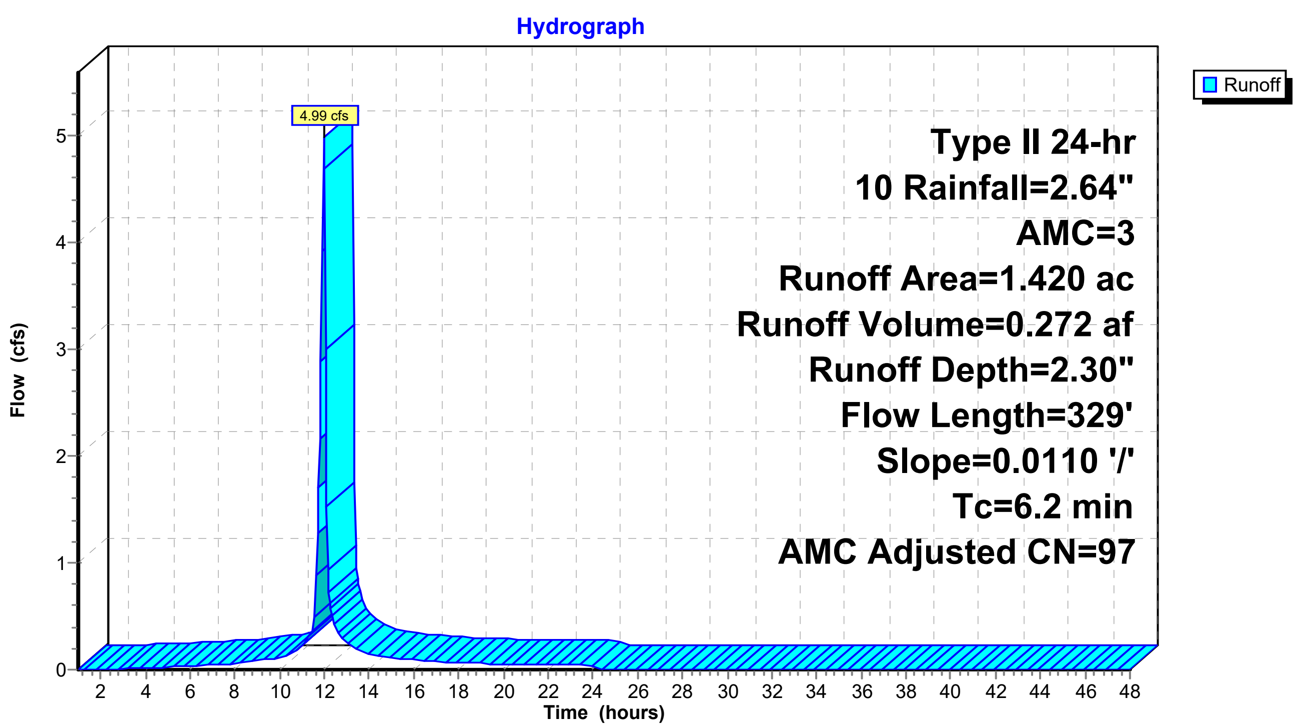
Runoff = 4.99 cfs @ 11.97 hrs, Volume= 0.272 af, Depth= 2.30"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 10 Rainfall=2.64", AMC=3

	Area (ac)	CN	Adj	Description
*	1.210	98		
*	0.210	56		
	1.420	92	97	Weighted Average, AMC Adjusted
	0.210			14.79% Pervious Area
	1.210			85.21% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.4	300	0.0110	0.92		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 1.49"
0.8	29	0.0110	0.58		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 1.49"
6.2	329	Total			

Subcatchment 13S: M



Summary for Subcatchment 14S: N

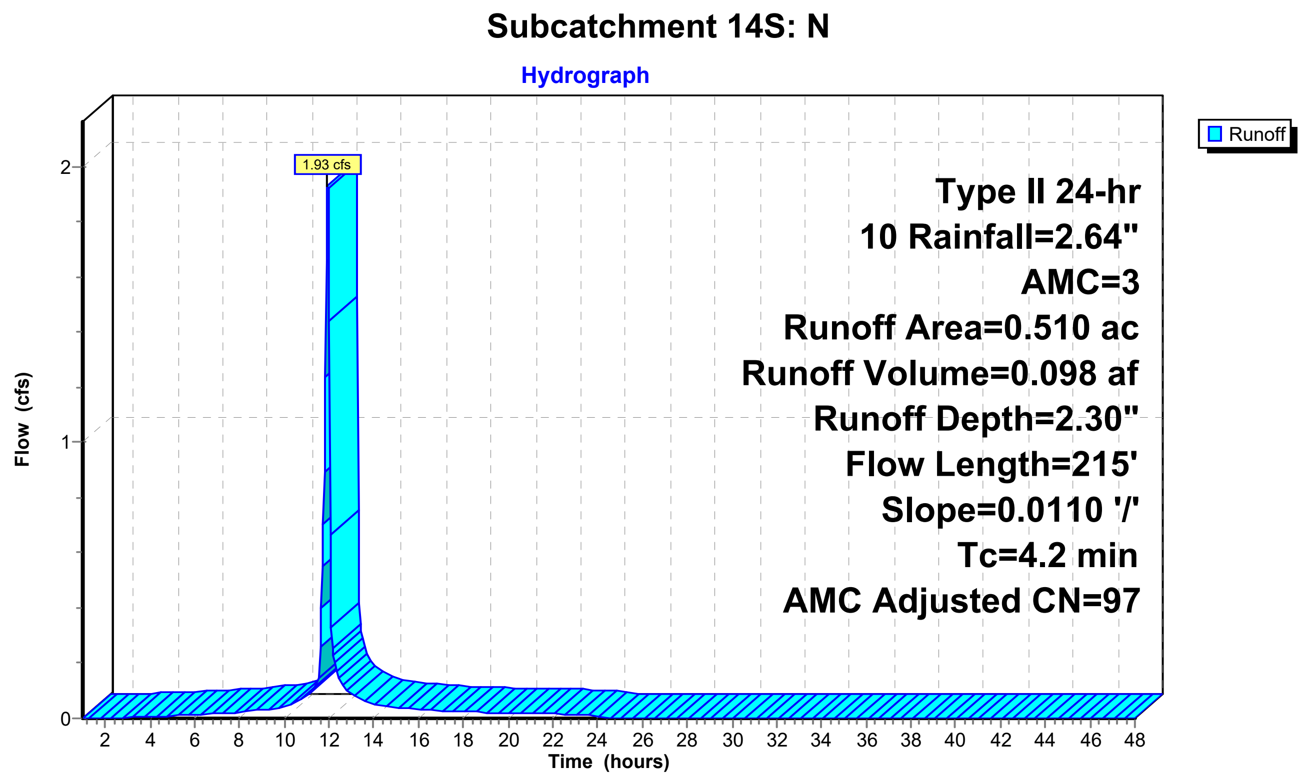
[49] Hint: Tc<2dt may require smaller dt

Runoff = 1.93 cfs @ 11.94 hrs, Volume= 0.098 af, Depth= 2.30"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 10 Rainfall=2.64", AMC=3

	Area (ac)	CN	Adj	Description
*	0.430	98		
*	0.080	56		
	0.510	91	97	Weighted Average, AMC Adjusted
	0.080			15.69% Pervious Area
	0.430			84.31% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.2	215	0.0110	0.86		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 1.49"



Summary for Subcatchment 15S: O

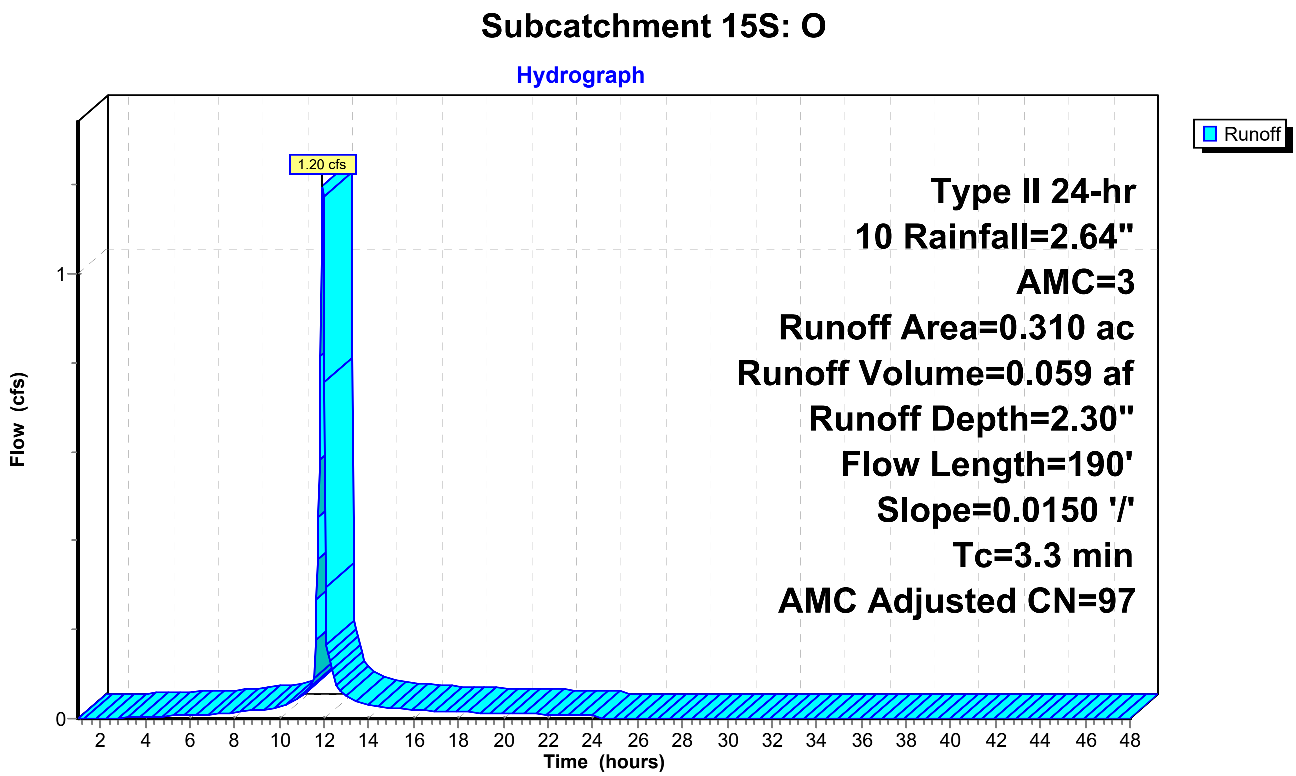
[49] Hint: Tc<2dt may require smaller dt

Runoff = 1.20 cfs @ 11.93 hrs, Volume= 0.059 af, Depth= 2.30"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 10 Rainfall=2.64", AMC=3

	Area (ac)	CN	Adj	Description
*	0.260	98		
*	0.050	56		
	0.310	91	97	Weighted Average, AMC Adjusted
	0.050			16.13% Pervious Area
	0.260			83.87% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.3	190	0.0150	0.95		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 1.49"



Summary for Subcatchment 16S: P

[49] Hint: Tc<2dt may require smaller dt

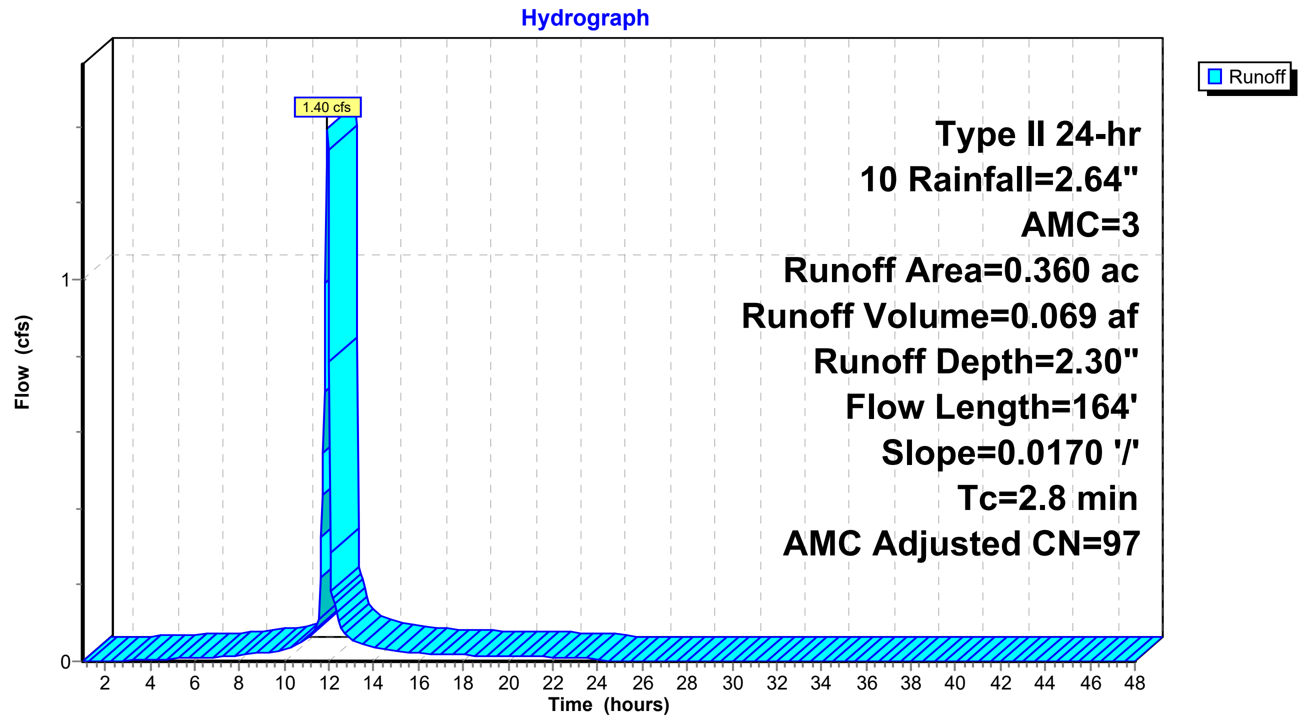
Runoff = 1.40 cfs @ 11.93 hrs, Volume= 0.069 af, Depth= 2.30"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 10 Rainfall=2.64", AMC=3

	Area (ac)	CN	Adj	Description
*	0.300	98		
*	0.060	56		
	0.360	91	97	Weighted Average, AMC Adjusted
	0.060			16.67% Pervious Area
	0.300			83.33% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.8	164	0.0170	0.97		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 1.49"

Subcatchment 16S: P



Summary for Subcatchment 17S: S

[49] Hint: Tc<2dt may require smaller dt

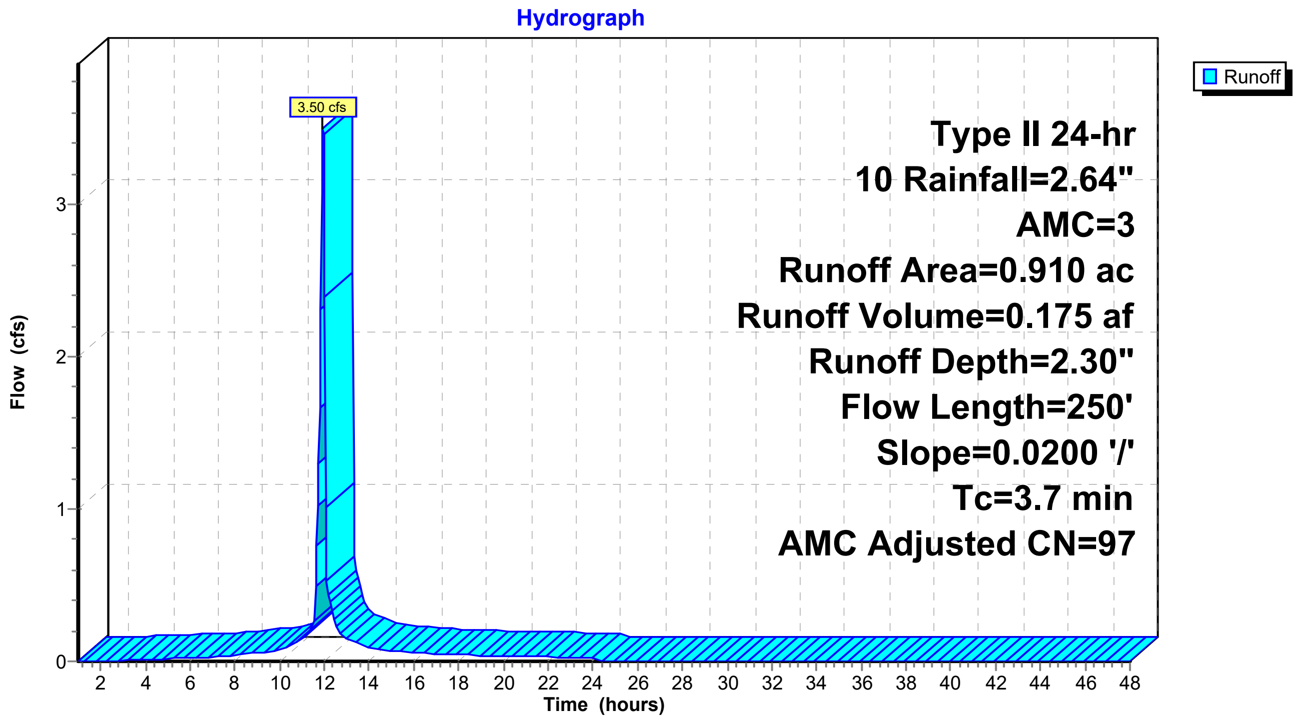
Runoff = 3.50 cfs @ 11.94 hrs, Volume= 0.175 af, Depth= 2.30"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 10 Rainfall=2.64", AMC=3

	Area (ac)	CN	Adj	Description
*	0.770	98		
*	0.140	56		
	0.910	92	97	Weighted Average, AMC Adjusted
	0.140			15.38% Pervious Area
	0.770			84.62% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.7	250	0.0200	1.13		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 1.49"

Subcatchment 17S: S



Summary for Subcatchment 18S: Q

[49] Hint: Tc<2dt may require smaller dt

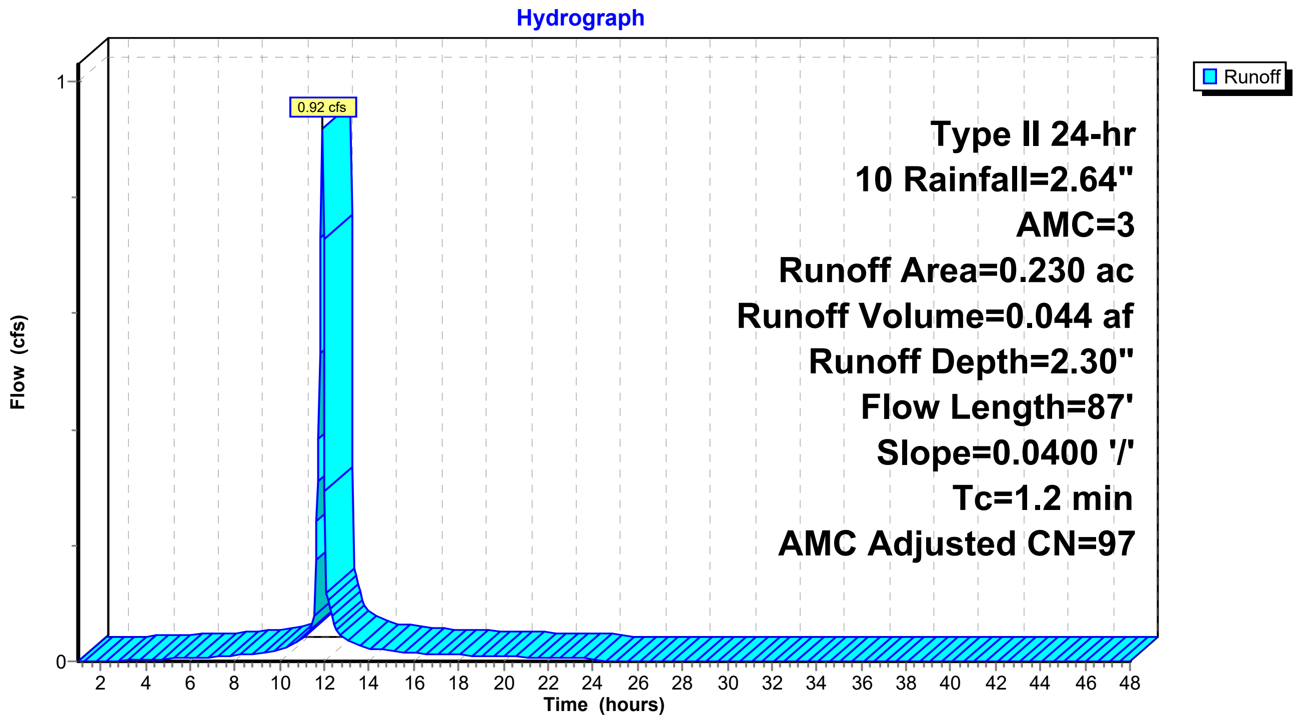
Runoff = 0.92 cfs @ 11.90 hrs, Volume= 0.044 af, Depth= 2.30"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 10 Rainfall=2.64", AMC=3

	Area (ac)	CN	Adj	Description
*	0.190	98		
*	0.040	56		
	0.230	91	97	Weighted Average, AMC Adjusted
	0.040			17.39% Pervious Area
	0.190			82.61% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	87	0.0400	1.20		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 1.49"

Subcatchment 18S: Q



Summary for Subcatchment 19S: R

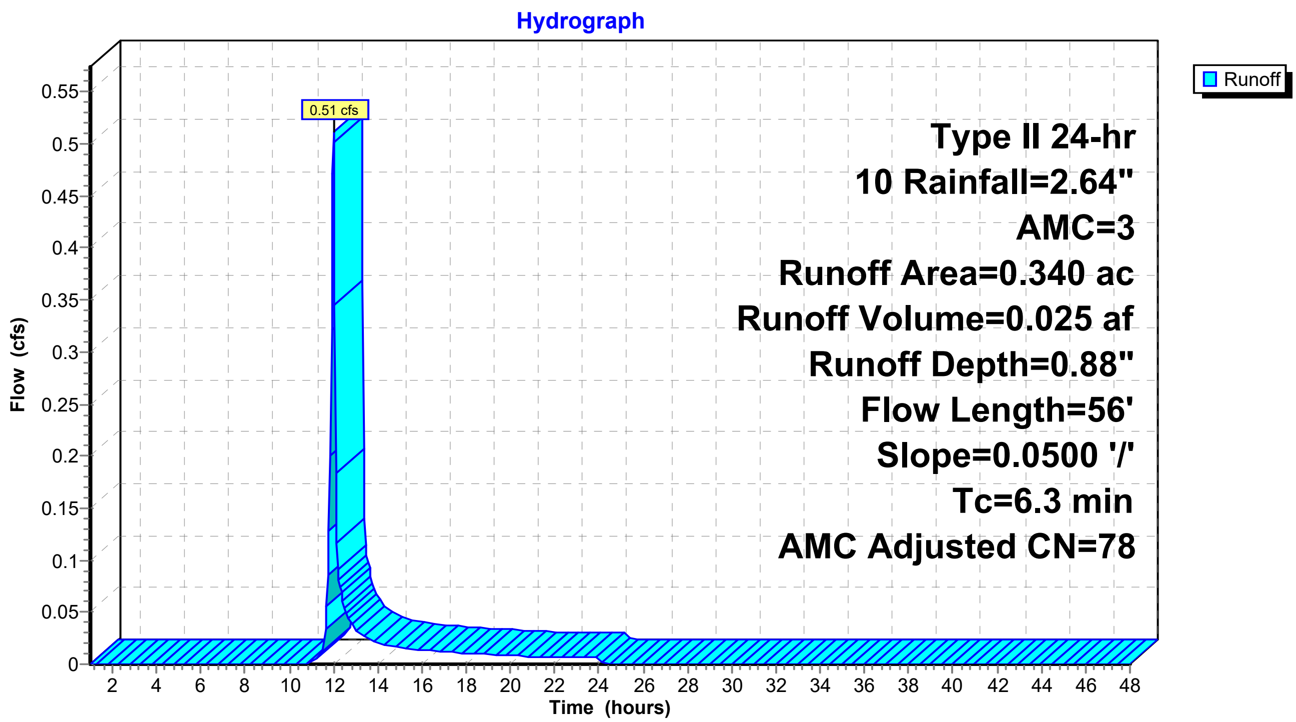
Runoff = 0.51 cfs @ 11.98 hrs, Volume= 0.025 af, Depth= 0.88"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 10 Rainfall=2.64", AMC=3

	Area (ac)	CN	Adj	Description
*	0.030	98		
*	0.310	56		
	0.340	60	78	Weighted Average, AMC Adjusted
	0.310			91.18% Pervious Area
	0.030			8.82% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.3	56	0.0500	0.15		**Sheet Flow,** Grass: Short n= 0.150 P2= 1.49"

Subcatchment 19S: R



Summary for Subcatchment 50S: T

[49] Hint: Tc<2dt may require smaller dt

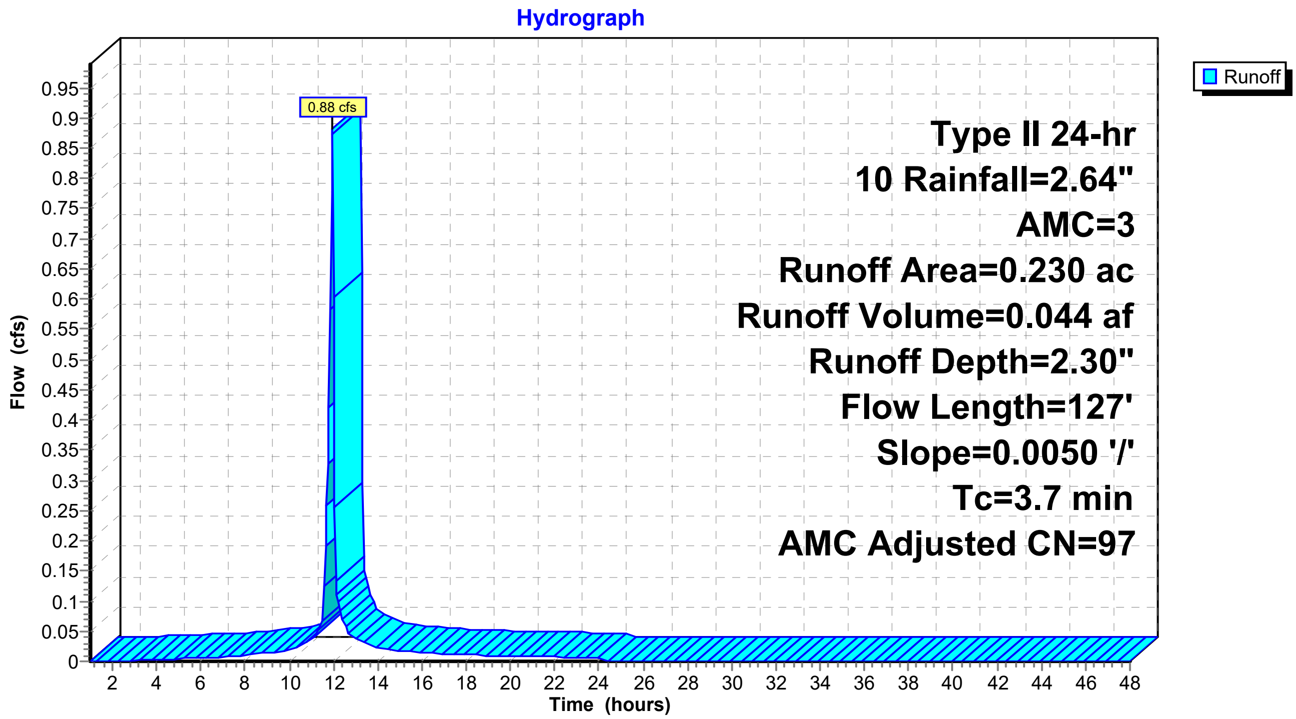
Runoff = 0.88 cfs @ 11.94 hrs, Volume= 0.044 af, Depth= 2.30"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 10 Rainfall=2.64", AMC=3

	Area (ac)	CN	Adj	Description
*	0.190	98		
*	0.040	56		
	0.230	91	97	Weighted Average, AMC Adjusted
	0.040			17.39% Pervious Area
	0.190			82.61% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.7	127	0.0050	0.57		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 1.49"

Subcatchment 50S: T



Summary for Subcatchment 52S: U

[49] Hint: Tc<2dt may require smaller dt

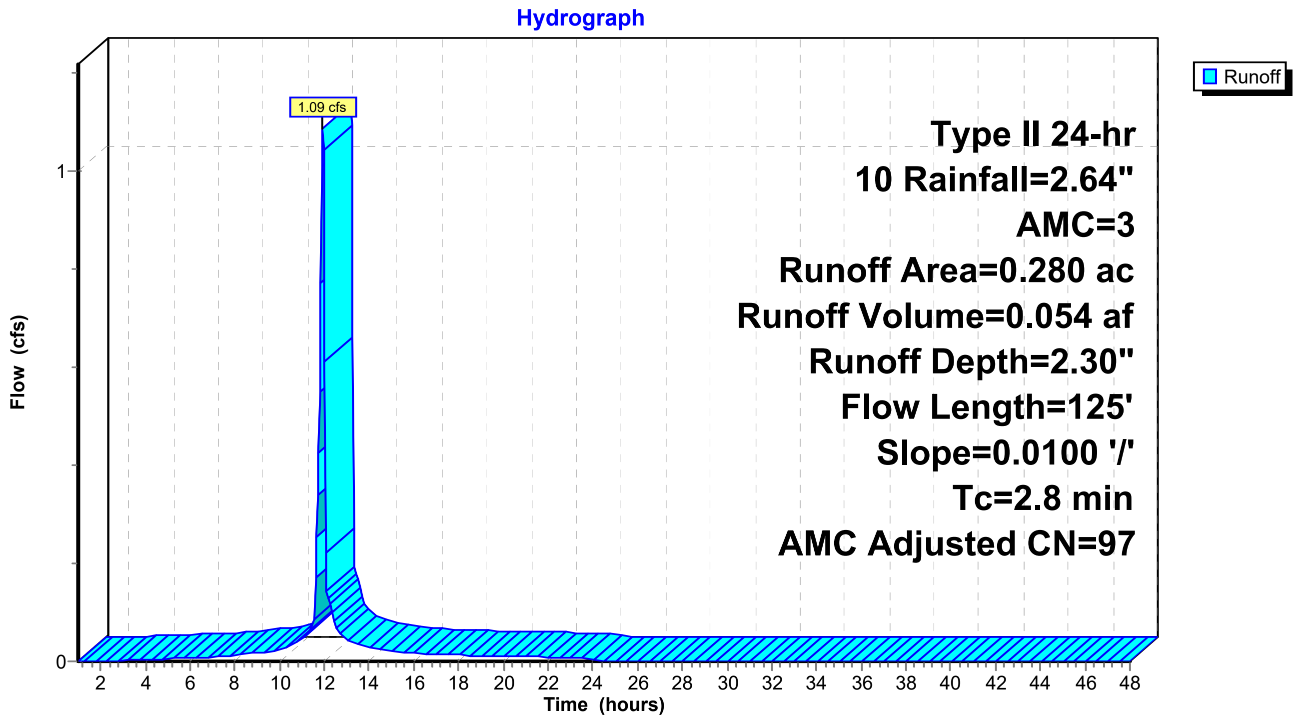
Runoff = 1.09 cfs @ 11.93 hrs, Volume= 0.054 af, Depth= 2.30"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 10 Rainfall=2.64", AMC=3

	Area (ac)	CN	Adj	Description
*	0.240	98		
*	0.040	56		
	0.280	92	97	Weighted Average, AMC Adjusted
	0.040			14.29% Pervious Area
	0.240			85.71% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.8	125	0.0100	0.74		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 1.49"

Subcatchment 52S: U



Summary for Subcatchment 55S: V

[49] Hint: Tc<2dt may require smaller dt

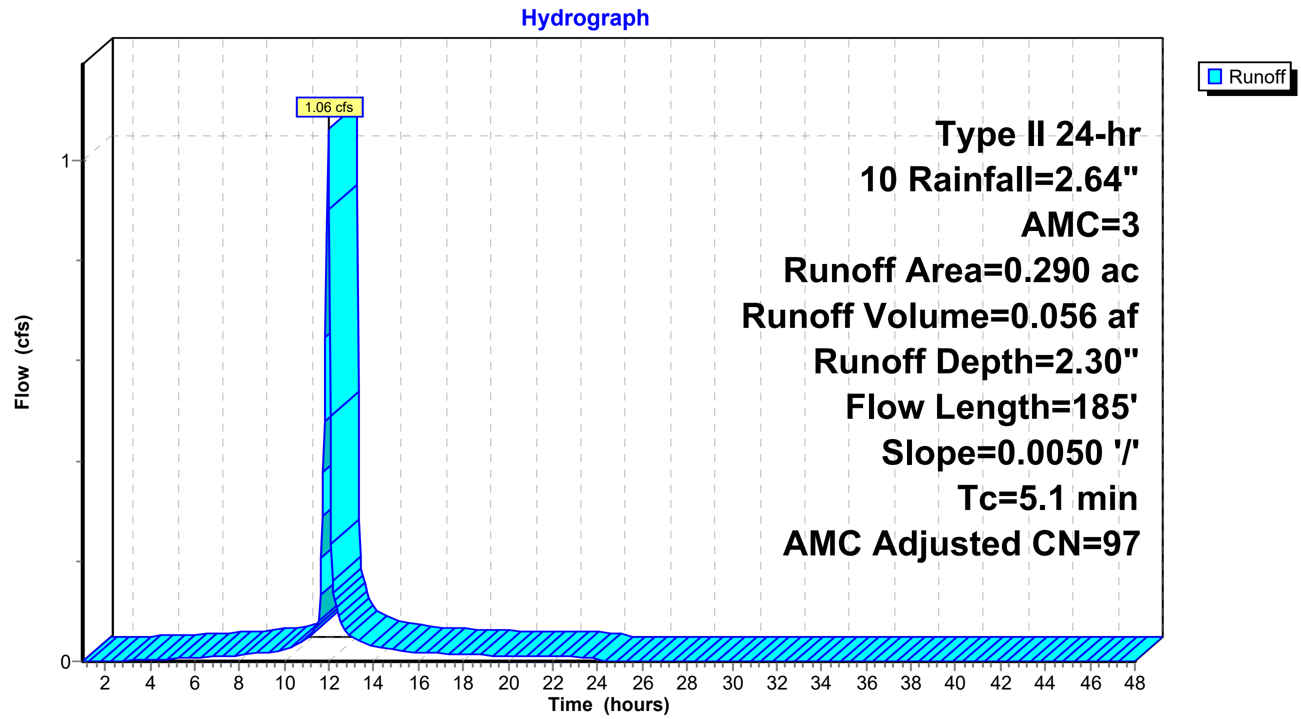
Runoff = 1.06 cfs @ 11.95 hrs, Volume= 0.056 af, Depth= 2.30"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 10 Rainfall=2.64", AMC=3

	Area (ac)	CN	Adj	Description
*	0.250	98		
*	0.040	56		
	0.290	92	97	Weighted Average, AMC Adjusted
	0.040			13.79% Pervious Area
	0.250			86.21% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.1	185	0.0050	0.61		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 1.49"

Subcatchment 55S: V



Summary for Reach 46R: REGIONAL SD

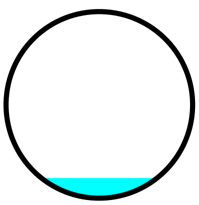
[52] Hint: Inlet/Outlet conditions not evaluated

Inflow Area = 1.790 ac, 69.83% Impervious, Inflow Depth = 3.76" for 10 event
Inflow = 19.52 cfs @ 11.95 hrs, Volume= 0.561 af
Outflow = 18.40 cfs @ 11.98 hrs, Volume= 0.561 af, Atten= 6%, Lag= 1.7 min

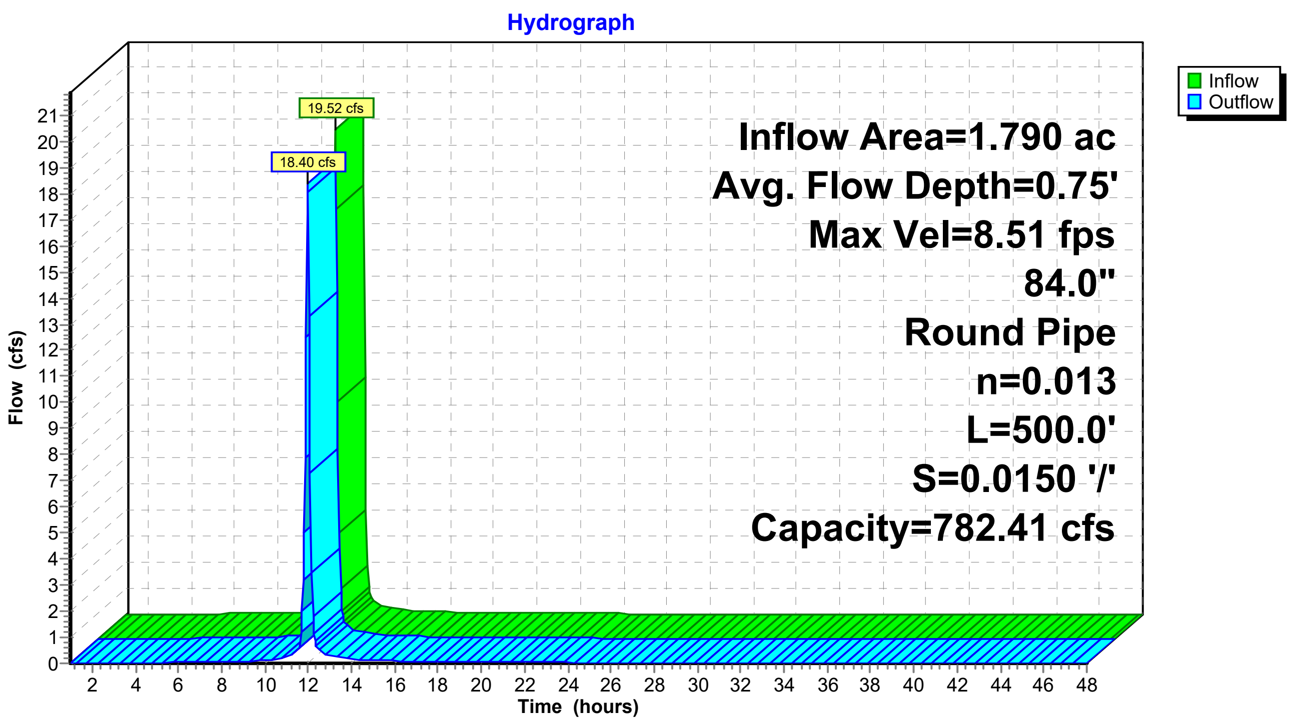
Routing by Stor-Ind+Trans method, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Max. Velocity= 8.51 fps, Min. Travel Time= 1.0 min
Avg. Velocity = 2.03 fps, Avg. Travel Time= 4.1 min

Peak Storage= 1,115 cf @ 11.97 hrs
Average Depth at Peak Storage= 0.75'
Bank-Full Depth= 7.00' Flow Area= 38.5 sf, Capacity= 782.41 cfs

84.0" Round Pipe
n= 0.013
Length= 500.0' Slope= 0.0150 '/'
Inlet Invert= 25.10', Outlet Invert= 17.60'



Reach 46R: REGIONAL SD



Summary for Pond 20P: DT-1

Inflow Area = 1.780 ac, 84.83% Impervious, Inflow Depth = 2.30" for 10 event
Inflow = 6.28 cfs @ 11.95 hrs, Volume= 0.341 af
Outflow = 0.19 cfs @ 13.93 hrs, Volume= 0.341 af, Atten= 97%, Lag= 118.5 min
Discarded = 0.19 cfs @ 13.93 hrs, Volume= 0.341 af

Routing by Stor-Ind method, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 34.39' @ 13.93 hrs Surf.Area= 0.210 ac Storage= 0.181 af

Plug-Flow detention time= 382.1 min calculated for 0.341 af (100% of inflow)
Center-of-Mass det. time= 381.8 min (1,148.9 - 767.1)

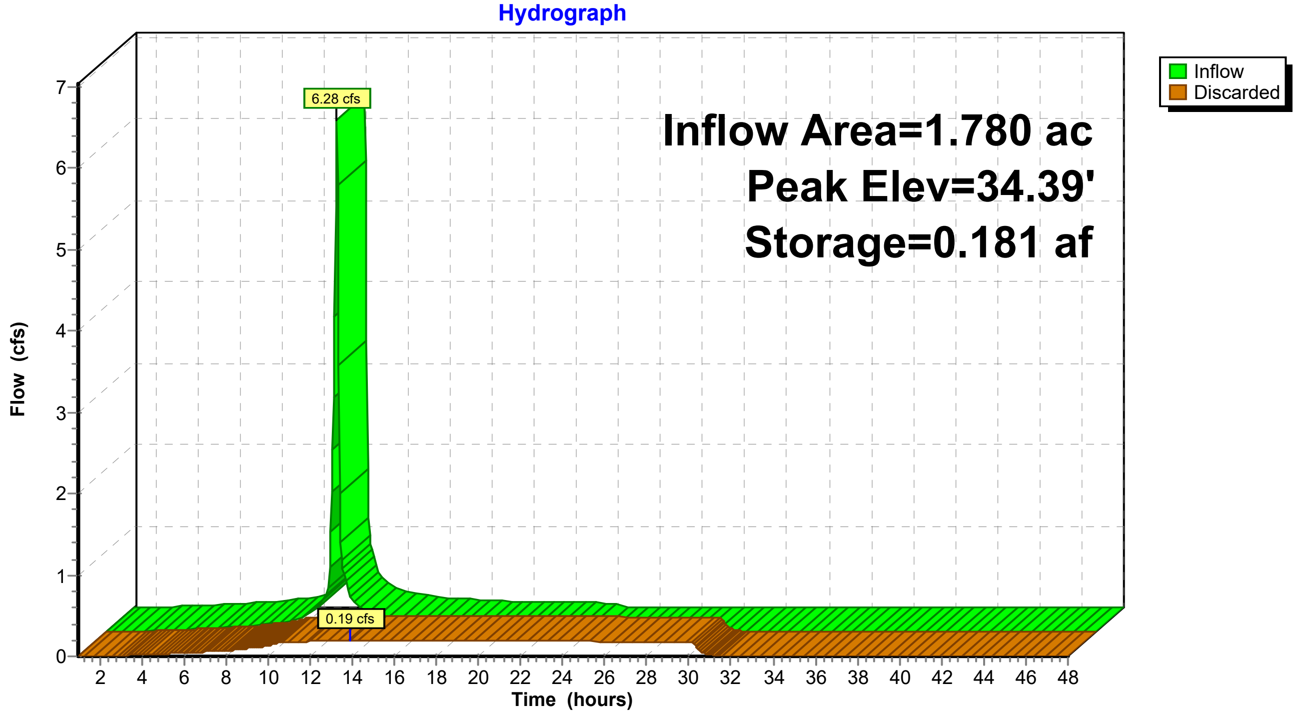
Volume	Invert	Avail.Storage	Storage Description
#1	33.50'	0.509 af	**Custom Stage Data (Irregular)** Listed below (Recalc) 0.525 af Overall x 97.0% Voids

Elevation (feet)	Surf.Area (acres)	Perim. (feet)	Inc.Store (acre-feet)	Cum.Store (acre-feet)	Wet.Area (acres)
33.50	0.210	402.0	0.000	0.000	0.210
36.00	0.210	402.0	0.525	0.525	0.233

Device	Routing	Invert	Outlet Devices
#1	Discarded	33.50'	**0.850 in/hr Exfiltration over Wetted area**

Discarded OutFlow Max=0.19 cfs @ 13.93 hrs HW=34.39' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.19 cfs)

Pond 20P: DT-1


Hydrograph
Inflow
Discarded
Inflow Area=1.780 ac
Peak Elev=34.39'
Storage=0.181 af
6.28 cfs
0.19 cfs
Flow (cfs)
Time (hours)
0
1
2
3
4
5
6
7
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
44
46
48

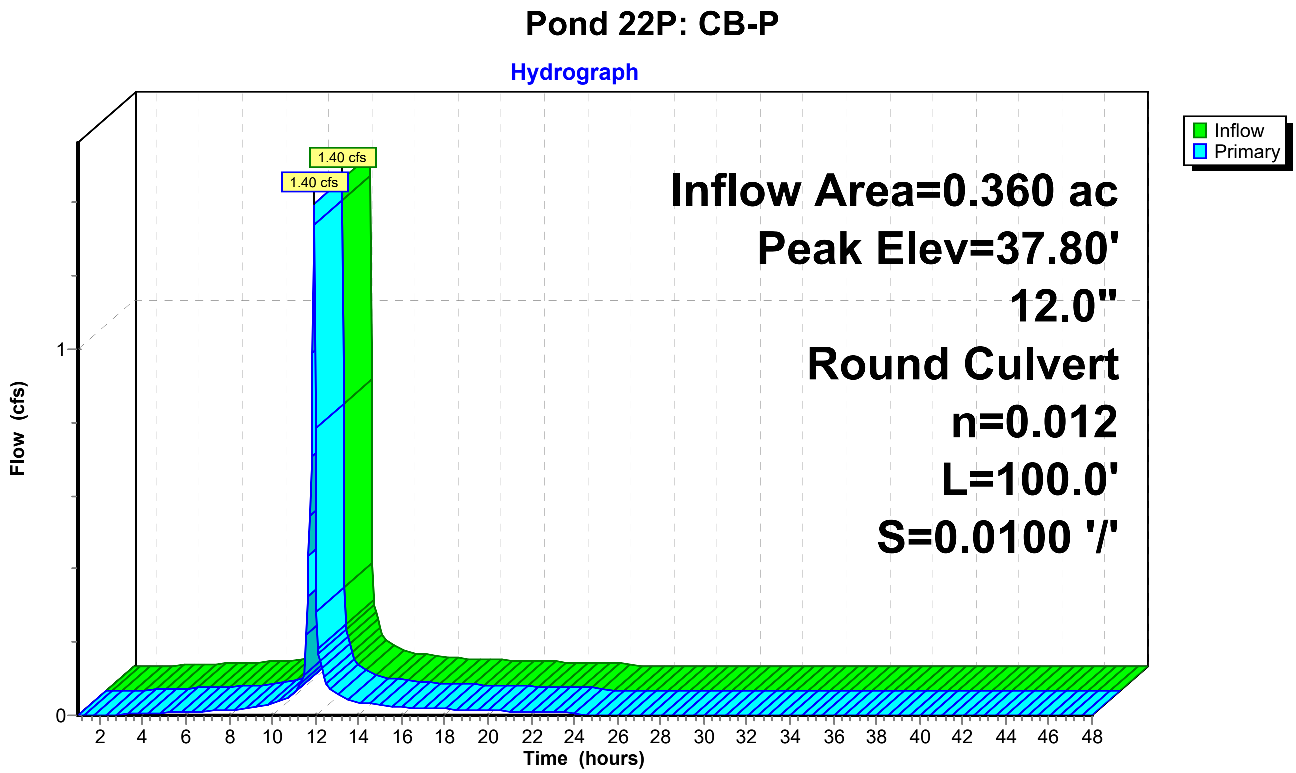
Summary for Pond 22P: CB-P

Inflow Area = 0.360 ac, 83.33% Impervious, Inflow Depth = 2.30" for 10 event
Inflow = 1.40 cfs @ 11.93 hrs, Volume= 0.069 af
Outflow = 1.40 cfs @ 11.93 hrs, Volume= 0.069 af, Atten= 0%, Lag= 0.0 min
Primary = 1.40 cfs @ 11.93 hrs, Volume= 0.069 af

Routing by Stor-Ind method, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 37.80' @ 11.93 hrs
Flood Elev= 40.50'

Device	Routing	Invert	Outlet Devices
#1	Primary	37.00'	**12.0" Round Culvert** L= 100.0' Ke= 1.200 Inlet / Outlet Invert= 37.00' / 36.00' S= 0.0100 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf

Primary OutFlow Max=1.33 cfs @ 11.93 hrs HW=37.77' (Free Discharge)
└**1=Culvert** (Inlet Controls 1.33 cfs @ 2.04 fps)



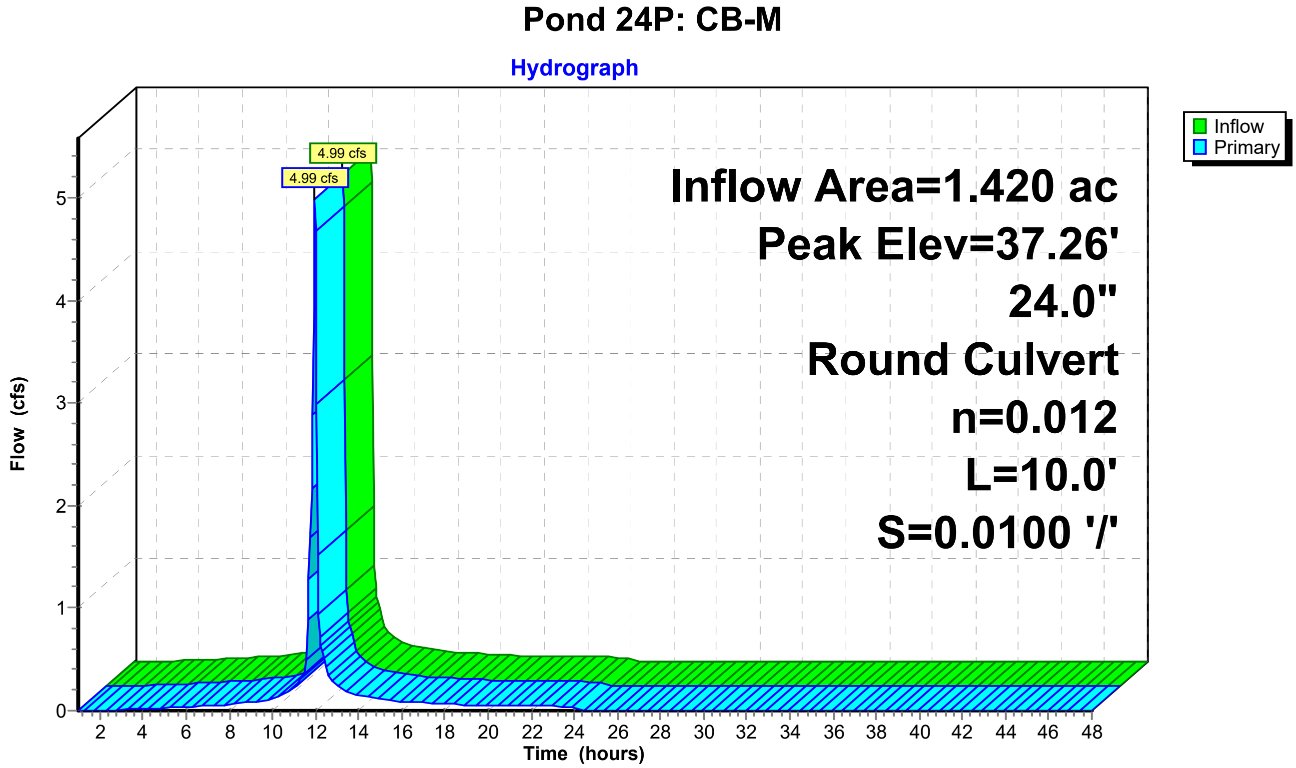
Summary for Pond 24P: CB-M

Inflow Area = 1.420 ac, 85.21% Impervious, Inflow Depth = 2.30" for 10 event
Inflow = 4.99 cfs @ 11.97 hrs, Volume= 0.272 af
Outflow = 4.99 cfs @ 11.97 hrs, Volume= 0.272 af, Atten= 0%, Lag= 0.0 min
Primary = 4.99 cfs @ 11.97 hrs, Volume= 0.272 af

Routing by Stor-Ind method, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 37.26' @ 11.97 hrs
Flood Elev= 40.89'

Device	Routing	Invert	Outlet Devices
#1	Primary	36.00'	**24.0" Round Culvert** L= 10.0' Ke= 1.200 Inlet / Outlet Invert= 36.00' / 35.90' S= 0.0100 '/' Cc= 0.900 n= 0.012, Flow Area= 3.14 sf

Primary OutFlow Max=4.86 cfs @ 11.97 hrs HW=37.24' (Free Discharge)
└─**1=Culvert** (Barrel Controls 4.86 cfs @ 3.38 fps)



Summary for Pond 26P: CB-N

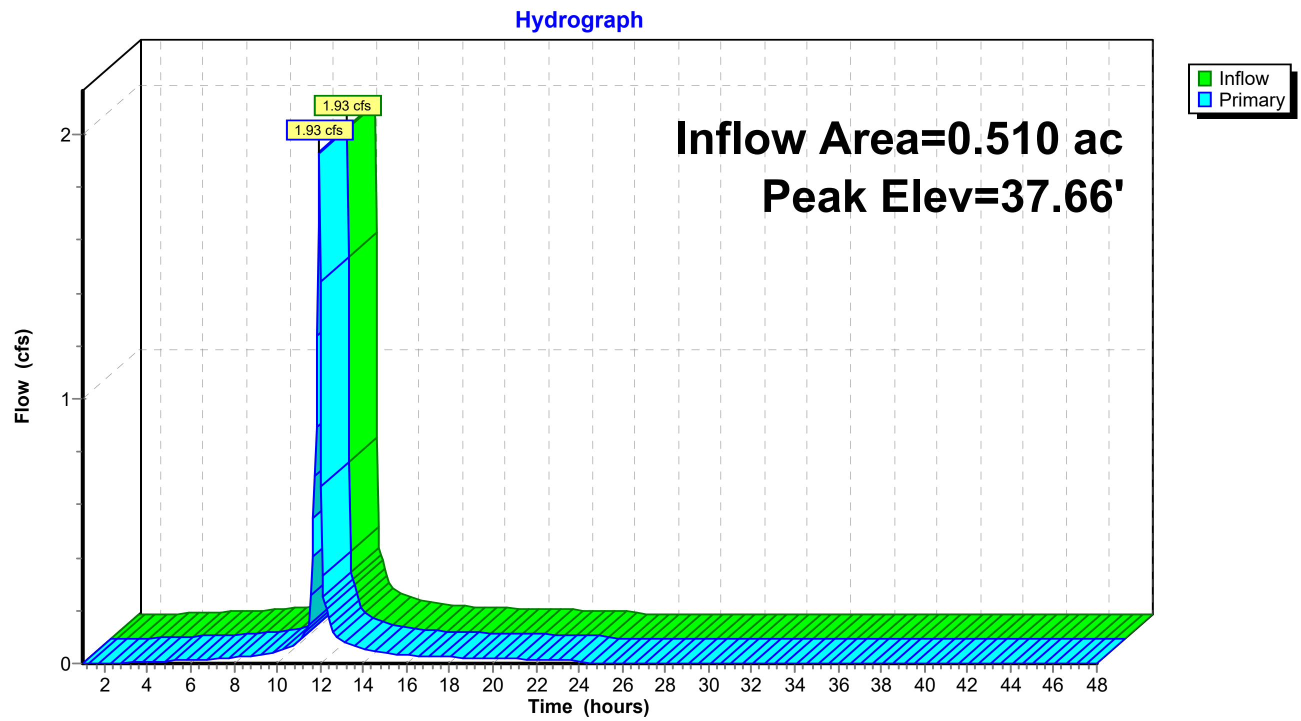
Inflow Area =	0.510 ac, 84.31% Impervious, Inflow Depth = 2.30" for 10 event			
Inflow =	1.93 cfs @	11.94 hrs, Volume=	0.098 af	
Outflow =	1.93 cfs @	11.94 hrs, Volume=	0.098 af,	Atten= 0%, Lag= 0.0 min
Primary =	1.93 cfs @	11.94 hrs, Volume=	0.098 af	

Routing by Stor-Ind method, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 37.66' @ 11.94 hrs
Flood Elev= 39.50'

Device	Routing	Invert	Outlet Devices
#1	Primary	39.57'	**12.0" x 12.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#2	Primary	36.60'	**12.0" Round Culvert** L= 10.0' Ke= 1.200 Inlet / Outlet Invert= 36.60' / 36.50' S= 0.0100 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf

Primary OutFlow Max=1.89 cfs @ 11.94 hrs HW=37.64' (Free Discharge)
1=Orifice/Grate (Controls 0.00 cfs)
2=Culvert (Inlet Controls 1.89 cfs @ 2.40 fps)

Pond 26P: CB-N



Summary for Pond 27P: CB-O

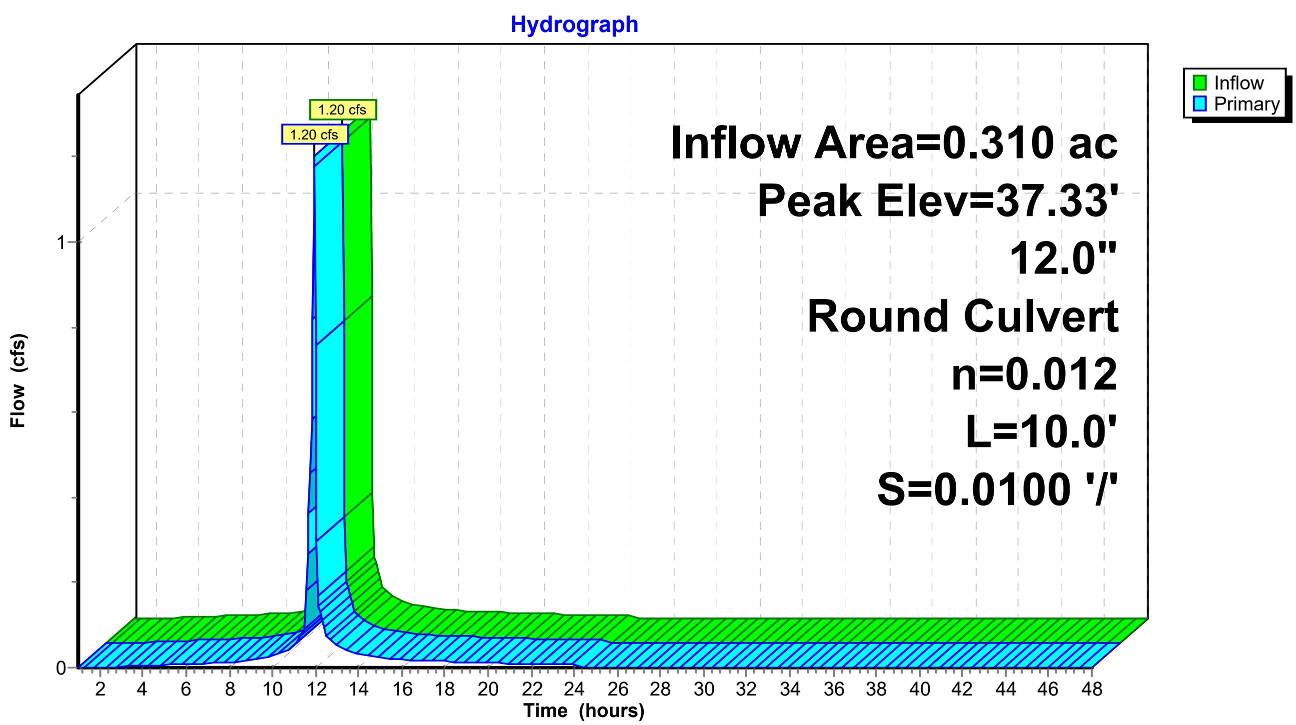
Inflow Area =	0.310 ac,	83.87% Impervious,	Inflow Depth = 2.30"	for 10 event	
Inflow =	1.20 cfs @	11.93 hrs,	Volume=	0.059 af	
Outflow =	1.20 cfs @	11.93 hrs,	Volume=	0.059 af,	Atten= 0%, Lag= 0.0 min
Primary =	1.20 cfs @	11.93 hrs,	Volume=	0.059 af	

Routing by Stor-Ind method, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 37.33' @ 11.93 hrs
Flood Elev= 39.50'

Device	Routing	Invert	Outlet Devices
#1	Primary	36.60'	**12.0" Round Culvert** L= 10.0' Ke= 1.200 Inlet / Outlet Invert= 36.60' / 36.50' S= 0.0100 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf

Primary OutFlow Max=1.14 cfs @ 11.93 hrs HW=37.31' (Free Discharge)
└**1=Culvert** (Barrel Controls 1.14 cfs @ 2.70 fps)

Pond 27P: CB-O



Summary for Pond 28P: DT-2

Inflow Area = 1.060 ac, 84.91% Impervious, Inflow Depth = 2.33" for 10 event
Inflow = 4.03 cfs @ 11.94 hrs, Volume= 0.206 af
Outflow = 0.10 cfs @ 14.05 hrs, Volume= 0.206 af, Atten= 97%, Lag= 126.6 min
Discarded = 0.10 cfs @ 14.05 hrs, Volume= 0.206 af

Routing by Stor-Ind method, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 32.54' @ 14.05 hrs Surf.Area= 0.110 ac Storage= 0.111 af

Plug-Flow detention time= 429.6 min calculated for 0.205 af (100% of inflow)
Center-of-Mass det. time= 429.8 min (1,193.0 - 763.3)

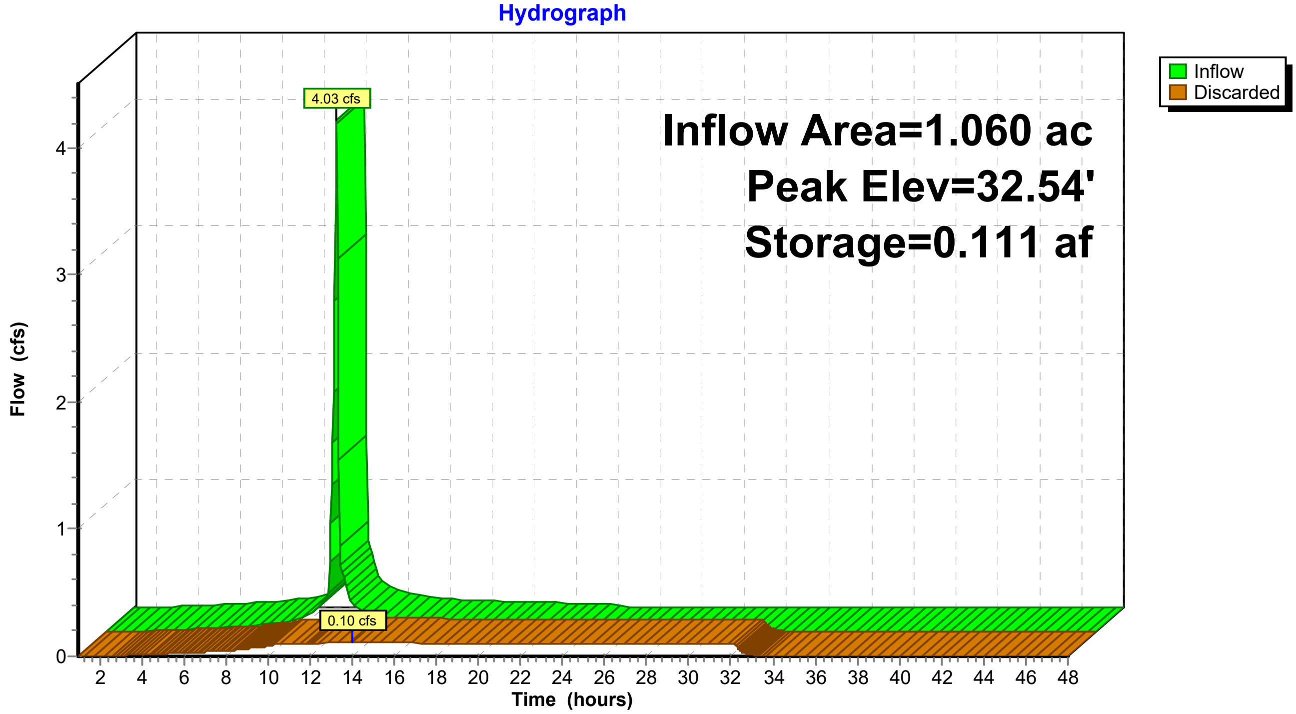
Volume	Invert	Avail.Storage	Storage Description
#1	31.50'	0.267 af	**Custom Stage Data (Irregular)** Listed below (Recalc) 0.275 af Overall x 97.0% Voids

Elevation (feet)	Surf.Area (acres)	Perim. (feet)	Inc.Store (acre-feet)	Cum.Store (acre-feet)	Wet.Area (acres)
31.50	0.110	477.0	0.000	0.000	0.110
34.00	0.110	477.0	0.275	0.275	0.137

Device	Routing	Invert	Outlet Devices
#1	Discarded	31.50'	**0.850 in/hr Exfiltration over Wetted area**

Discarded OutFlow Max=0.10 cfs @ 14.05 hrs HW=32.54' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.10 cfs)

Pond 28P: DT-2


Hydrograph
Inflow
Discarded
4.03 cfs
0.10 cfs
Inflow Area=1.060 ac
Peak Elev=32.54'
Storage=0.111 af
Flow (cfs)
0
1
2
3
4
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
44
46
48
Time (hours)

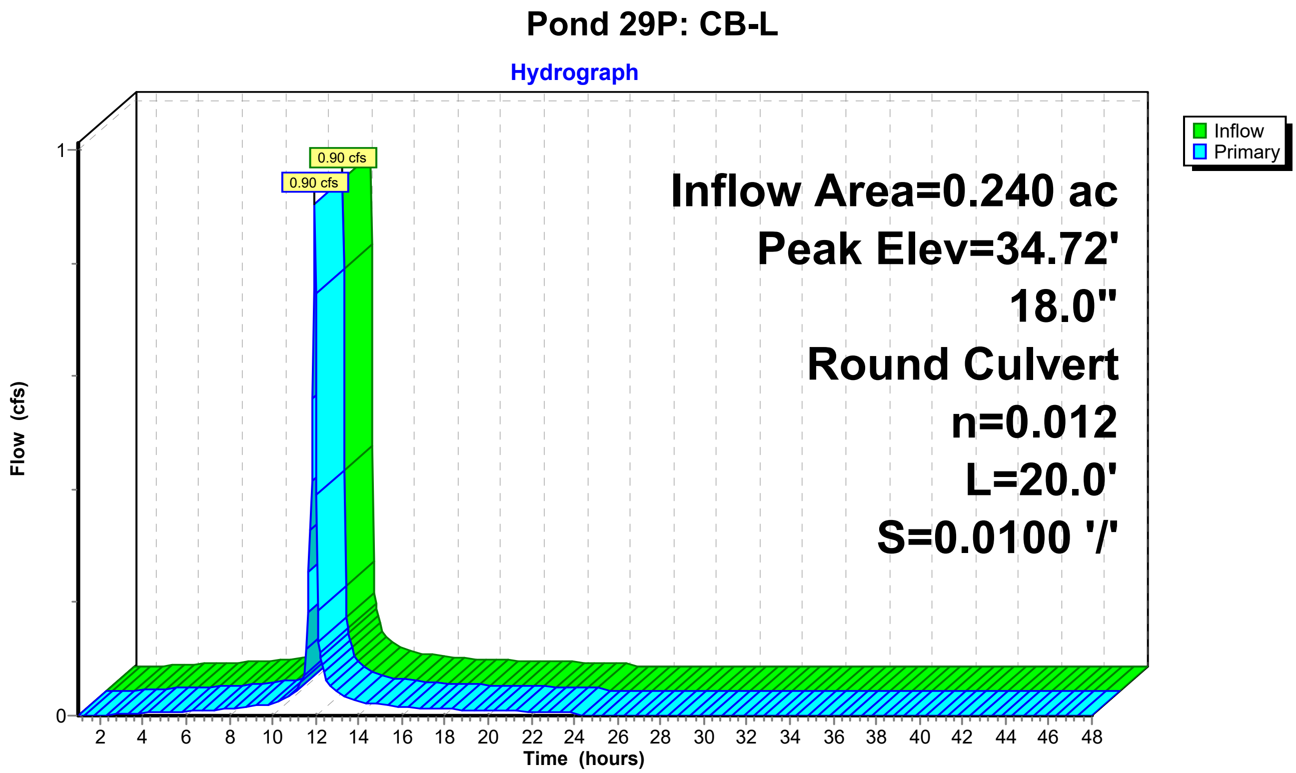
Summary for Pond 29P: CB-L

Inflow Area =	0.240 ac, 87.50% Impervious, Inflow Depth = 2.41" for 10 event			
Inflow =	0.90 cfs @	11.95 hrs, Volume=	0.048 af	
Outflow =	0.90 cfs @	11.95 hrs, Volume=	0.048 af,	Atten= 0%, Lag= 0.0 min
Primary =	0.90 cfs @	11.95 hrs, Volume=	0.048 af	

Routing by Stor-Ind method, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 34.72' @ 11.95 hrs
Flood Elev= 37.15'

Device	Routing	Invert	Outlet Devices
#1	Primary	34.20'	**18.0" Round Culvert** L= 20.0' Ke= 1.200 Inlet / Outlet Invert= 34.20' / 34.00' S= 0.0100 '/' Cc= 0.900 n= 0.012, Flow Area= 1.77 sf

Primary OutFlow Max=0.90 cfs @ 11.95 hrs HW=34.72' (Free Discharge)
└─**1=Culvert** (Inlet Controls 0.90 cfs @ 1.67 fps)



Summary for Pond 30P: CB-I

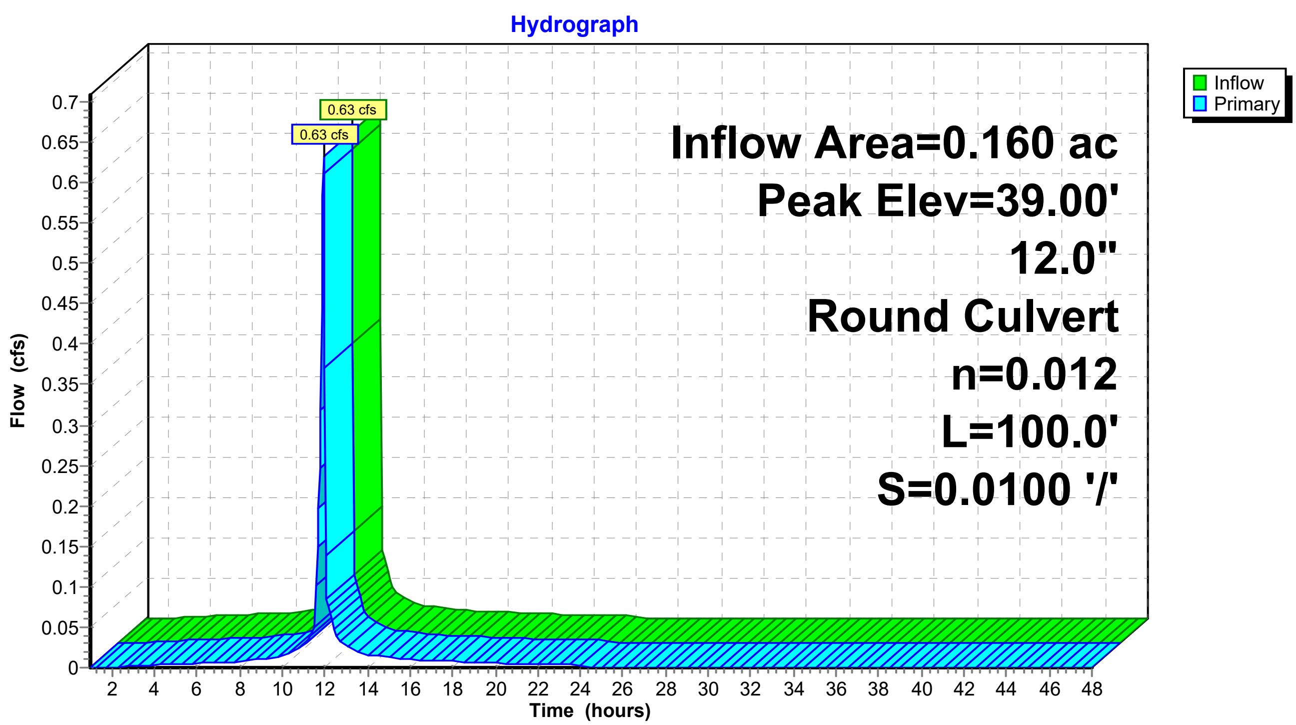
Inflow Area =	0.160 ac,	87.50% Impervious,	Inflow Depth = 2.41"	for 10 event	
Inflow =	0.63 cfs @	11.93 hrs,	Volume=	0.032 af	
Outflow =	0.63 cfs @	11.93 hrs,	Volume=	0.032 af,	Atten= 0%, Lag= 0.0 min
Primary =	0.63 cfs @	11.93 hrs,	Volume=	0.032 af	

Routing by Stor-Ind method, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 39.00' @ 11.93 hrs
Flood Elev= 41.99'

Device	Routing	Invert	Outlet Devices
#1	Primary	38.50'	**12.0" Round Culvert** L= 100.0' Ke= 1.200 Inlet / Outlet Invert= 38.50' / 37.50' S= 0.0100 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf

Primary OutFlow Max=0.60 cfs @ 11.93 hrs HW=38.98' (Free Discharge)
└─**1=Culvert** (Inlet Controls 0.60 cfs @ 1.61 fps)

Pond 30P: CB-I



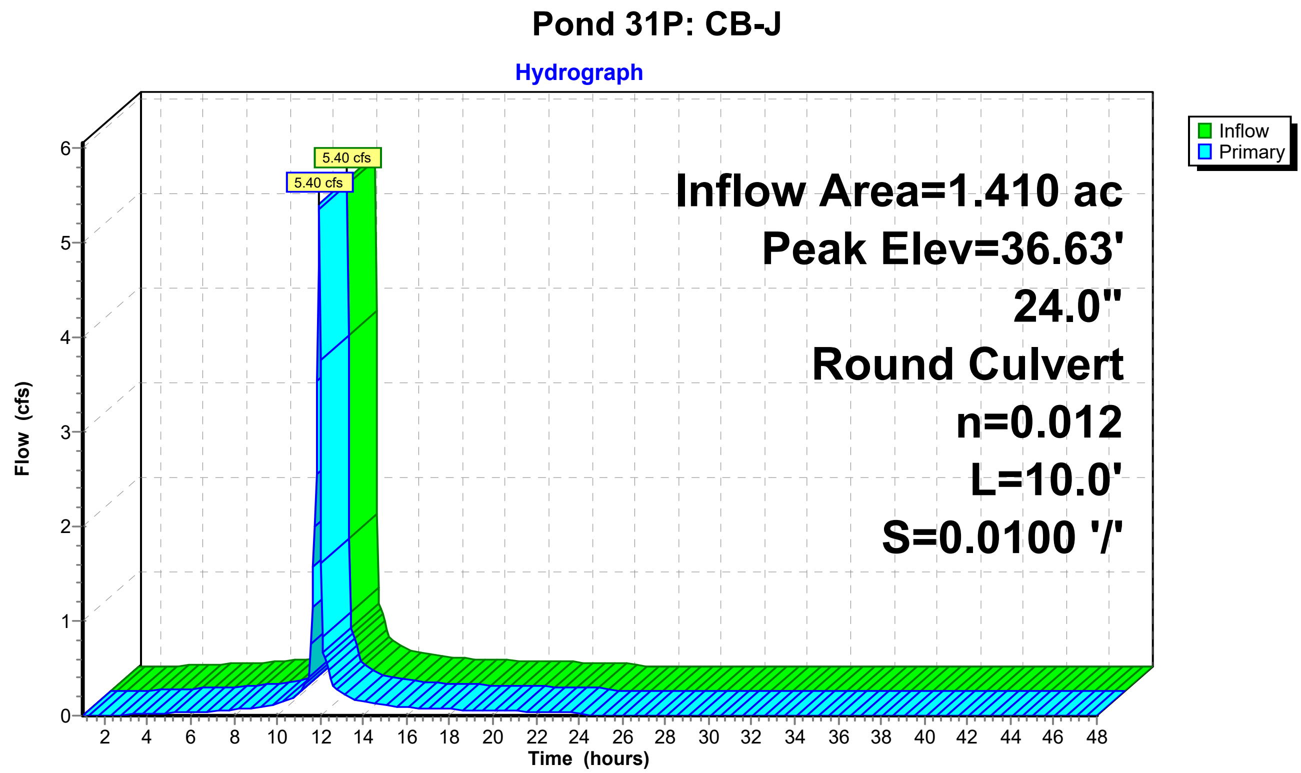
Summary for Pond 31P: CB-J

Inflow Area = 1.410 ac, 85.11% Impervious, Inflow Depth = 2.30" for 10 event
Inflow = 5.40 cfs @ 11.94 hrs, Volume= 0.270 af
Outflow = 5.40 cfs @ 11.94 hrs, Volume= 0.270 af, Atten= 0%, Lag= 0.0 min
Primary = 5.40 cfs @ 11.94 hrs, Volume= 0.270 af

Routing by Stor-Ind method, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 36.63' @ 11.94 hrs
Flood Elev= 38.26'

Device	Routing	Invert	Outlet Devices
#1	Primary	35.30'	**24.0" Round Culvert** L= 10.0' Ke= 1.200 Inlet / Outlet Invert= 35.30' / 35.20' S= 0.0100 '/' Cc= 0.900 n= 0.012, Flow Area= 3.14 sf

Primary OutFlow Max=5.21 cfs @ 11.94 hrs HW=36.60' (Free Discharge)
↑**1=Culvert** (Barrel Controls 5.21 cfs @ 3.44 fps)



Summary for Pond 32P: DT-3

Inflow Area = 1.570 ac, 85.35% Impervious, Inflow Depth = 2.31" for 10 event
Inflow = 6.03 cfs @ 11.94 hrs, Volume= 0.303 af
Outflow = 0.15 cfs @ 14.06 hrs, Volume= 0.303 af, Atten= 97%, Lag= 127.1 min
Discarded = 0.15 cfs @ 14.06 hrs, Volume= 0.303 af

Routing by Stor-Ind method, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 33.56' @ 14.06 hrs Surf.Area= 0.170 ac Storage= 0.164 af

Plug-Flow detention time= 424.8 min calculated for 0.302 af (100% of inflow)
Center-of-Mass det. time= 424.9 min (1,189.2 - 764.3)

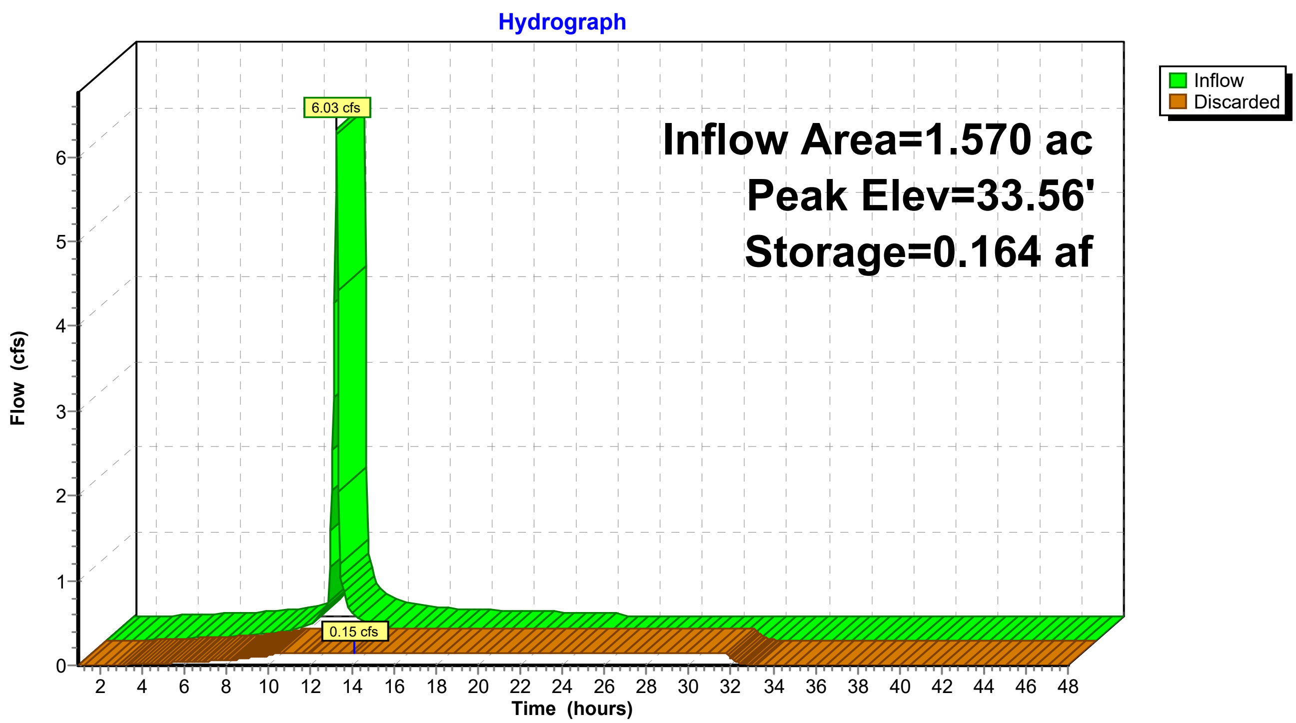
Volume	Invert	Avail.Storage	Storage Description
#1	32.60'	0.425 af	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Perim. (feet)	Inc.Store (acre-feet)	Cum.Store (acre-feet)	Wet.Area (acres)
32.60	0.170	403.0	0.000	0.000	0.170
35.10	0.170	403.0	0.425	0.425	0.193

Device	Routing	Invert	Outlet Devices
#1	Discarded	32.60'	**0.850 in/hr Exfiltration over Wetted area**

Discarded OutFlow Max=0.15 cfs @ 14.06 hrs HW=33.56' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.15 cfs)

Pond 32P: DT-3



Summary for Pond 33P: CB-G

Inflow Area = 0.780 ac, 84.62% Impervious, Inflow Depth = 2.30" for 10 event
Inflow = 2.78 cfs @ 11.96 hrs, Volume= 0.150 af
Outflow = 2.78 cfs @ 11.96 hrs, Volume= 0.150 af, Atten= 0%, Lag= 0.0 min
Primary = 1.05 cfs @ 11.96 hrs, Volume= 0.121 af
Secondary = 1.73 cfs @ 11.96 hrs, Volume= 0.029 af

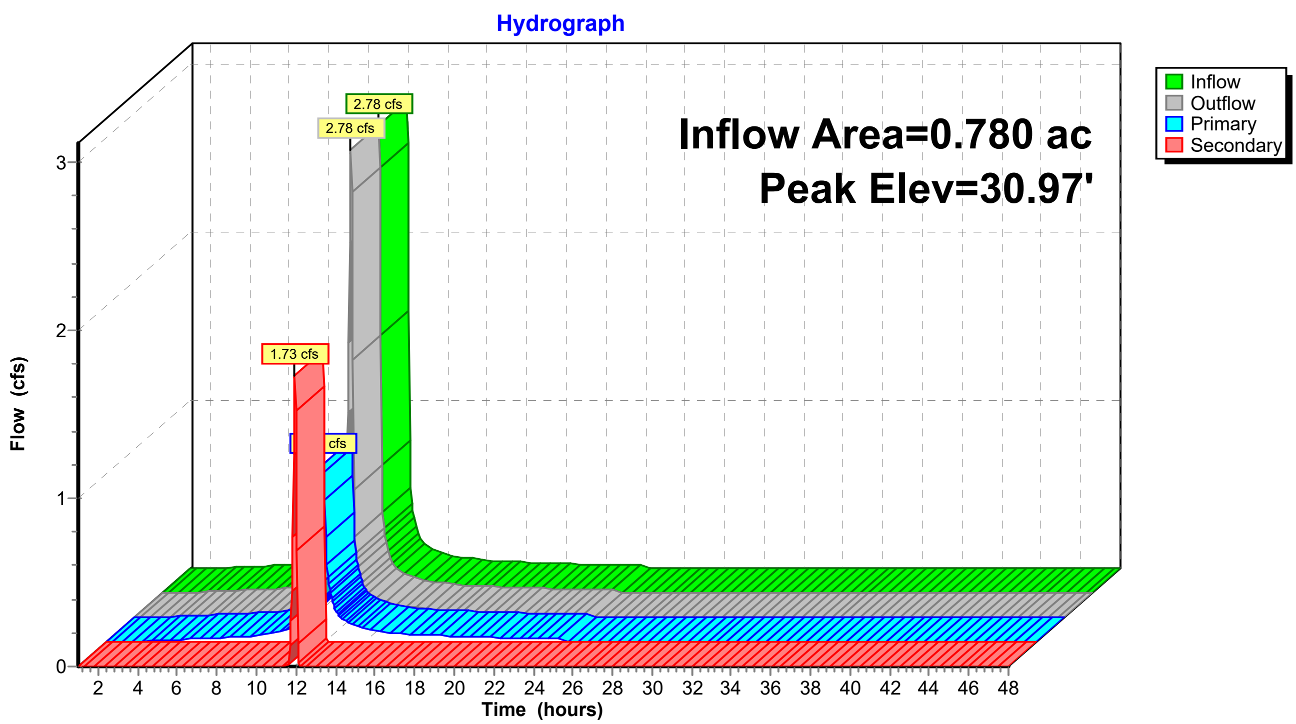
Routing by Stor-Ind method, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 30.97' @ 11.96 hrs
Flood Elev= 32.88'

Device	Routing	Invert	Outlet Devices
#1	Primary	29.80'	**8.0" Round Culvert** L= 100.0' Ke= 1.200 Inlet / Outlet Invert= 29.80' / 28.80' S= 0.0100 '/' Cc= 0.900 n= 0.012, Flow Area= 0.35 sf
#2	Secondary	30.23'	**18.0" Round Culvert** L= 15.0' Ke= 1.200 Inlet / Outlet Invert= 30.23' / 30.08' S= 0.0100 '/' Cc= 0.900 n= 0.012, Flow Area= 1.77 sf

Primary OutFlow Max=1.04 cfs @ 11.96 hrs HW=30.96' (Free Discharge)
└**1=Culvert** (Inlet Controls 1.04 cfs @ 2.98 fps)

Secondary OutFlow Max=1.68 cfs @ 11.96 hrs HW=30.96' (Free Discharge)
└**2=Culvert** (Inlet Controls 1.68 cfs @ 1.98 fps)

Pond 33P: CB-G



Summary for Pond 34P: CB-K

Inflow Area = 0.940 ac, 85.11% Impervious, Inflow Depth = 2.30" for 10 event
Inflow = 3.47 cfs @ 11.95 hrs, Volume= 0.180 af
Outflow = 3.47 cfs @ 11.95 hrs, Volume= 0.180 af, Atten= 0%, Lag= 0.0 min
Primary = 1.40 cfs @ 11.95 hrs, Volume= 0.148 af
Secondary = 2.08 cfs @ 11.95 hrs, Volume= 0.032 af

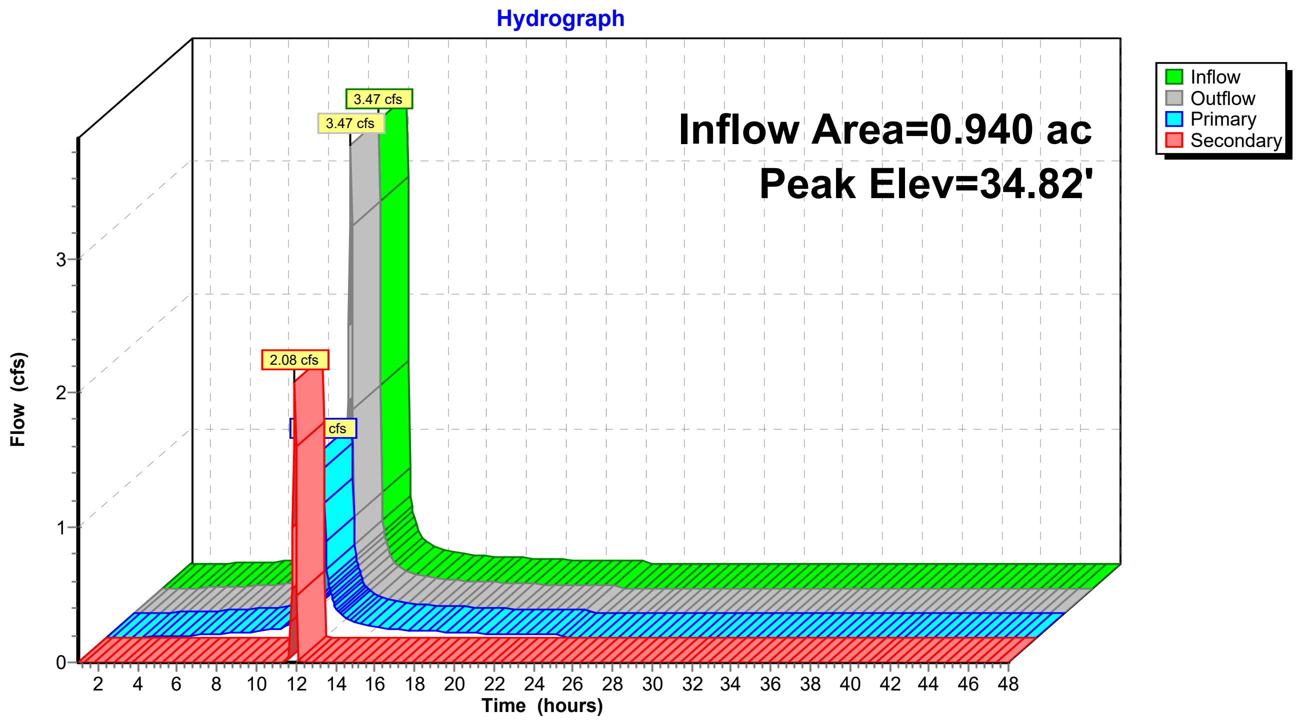
Routing by Stor-Ind method, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 34.82' @ 11.95 hrs
Flood Elev= 36.06'

Device	Routing	Invert	Outlet Devices
#1	Primary	33.00'	**8.0" Round Culvert** L= 100.0' Ke= 1.200 Inlet / Outlet Invert= 33.00' / 32.00' S= 0.0100 '/' Cc= 0.900 n= 0.012, Flow Area= 0.35 sf
#2	Secondary	33.67'	**12.0" Round Culvert** L= 20.0' Ke= 1.200 Inlet / Outlet Invert= 33.67' / 32.78' S= 0.0445 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf

Primary OutFlow Max=1.40 cfs @ 11.95 hrs HW=34.82' (Free Discharge)
↑**1=Culvert** (Inlet Controls 1.40 cfs @ 4.00 fps)

Secondary OutFlow Max=2.08 cfs @ 11.95 hrs HW=34.82' (Free Discharge)
↑**2=Culvert** (Inlet Controls 2.08 cfs @ 2.64 fps)

Pond 34P: CB-K



Summary for Pond 36P: CB-F

Inflow Area = 2.550 ac, 85.10% Impervious, Inflow Depth = 2.30" for 10 event
Inflow = 7.92 cfs @ 12.01 hrs, Volume= 0.489 af
Outflow = 7.92 cfs @ 12.01 hrs, Volume= 0.489 af, Atten= 0%, Lag= 0.0 min
Primary = 4.39 cfs @ 12.01 hrs, Volume= 0.432 af
Secondary = 3.53 cfs @ 12.01 hrs, Volume= 0.058 af

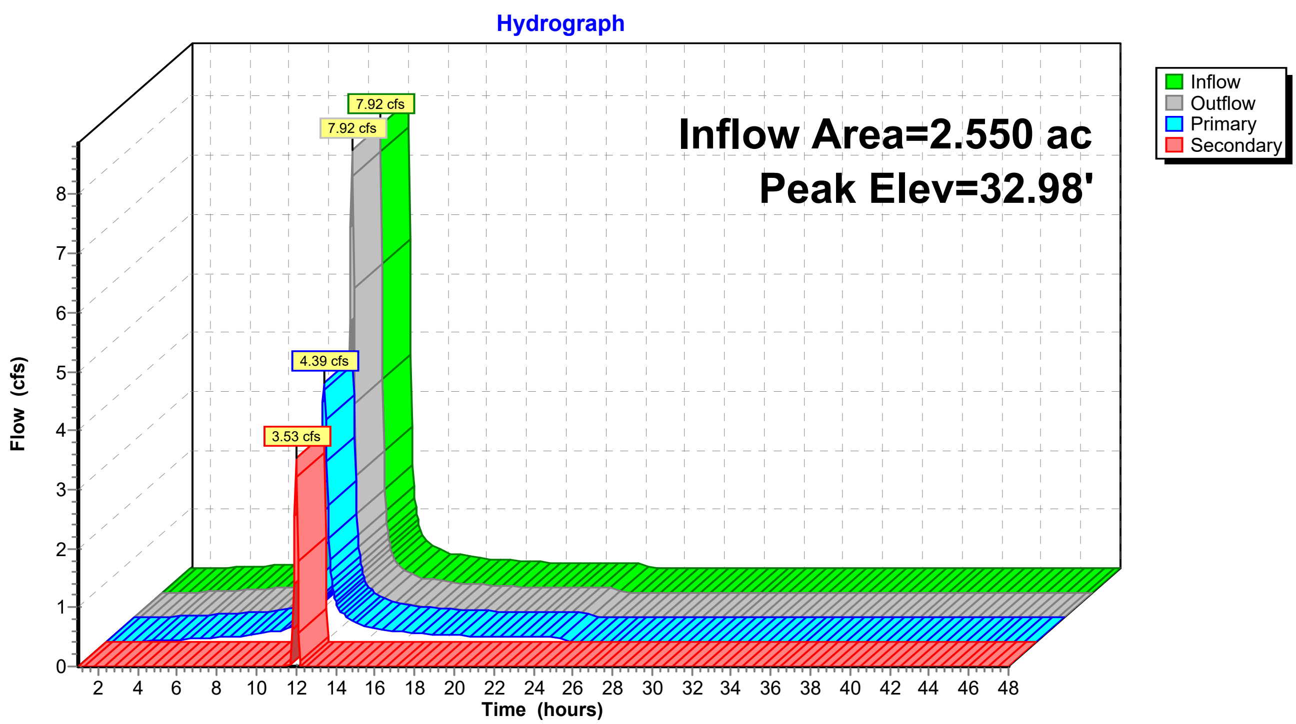
Routing by Stor-Ind method, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 32.98' @ 12.01 hrs
Flood Elev= 35.02'

Device	Routing	Invert	Outlet Devices
#1	Primary	31.17'	**15.0" Round Culvert** L= 100.0' Ke= 1.200 Inlet / Outlet Invert= 31.17' / 30.17' S= 0.0100 '/' Cc= 0.900 n= 0.012, Flow Area= 1.23 sf
#2	Secondary	32.00'	**24.0" Round Culvert** L= 200.0' Ke= 1.200 Inlet / Outlet Invert= 32.00' / 30.00' S= 0.0100 '/' Cc= 0.900 n= 0.012, Flow Area= 3.14 sf

Primary OutFlow Max=4.35 cfs @ 12.01 hrs HW=32.96' (Free Discharge)
└─**1=Culvert** (Inlet Controls 4.35 cfs @ 3.55 fps)

Secondary OutFlow Max=3.41 cfs @ 12.01 hrs HW=32.96' (Free Discharge)
└─**2=Culvert** (Inlet Controls 3.41 cfs @ 2.28 fps)

Pond 36P: CB-F



Summary for Pond 37P: CB-C

Inflow Area = 0.420 ac, 85.71% Impervious, Inflow Depth = 2.30" for 10 event
Inflow = 1.62 cfs @ 11.94 hrs, Volume= 0.081 af
Outflow = 1.62 cfs @ 11.94 hrs, Volume= 0.081 af, Atten= 0%, Lag= 0.0 min
Primary = 1.08 cfs @ 11.94 hrs, Volume= 0.075 af
Secondary = 0.53 cfs @ 11.94 hrs, Volume= 0.005 af

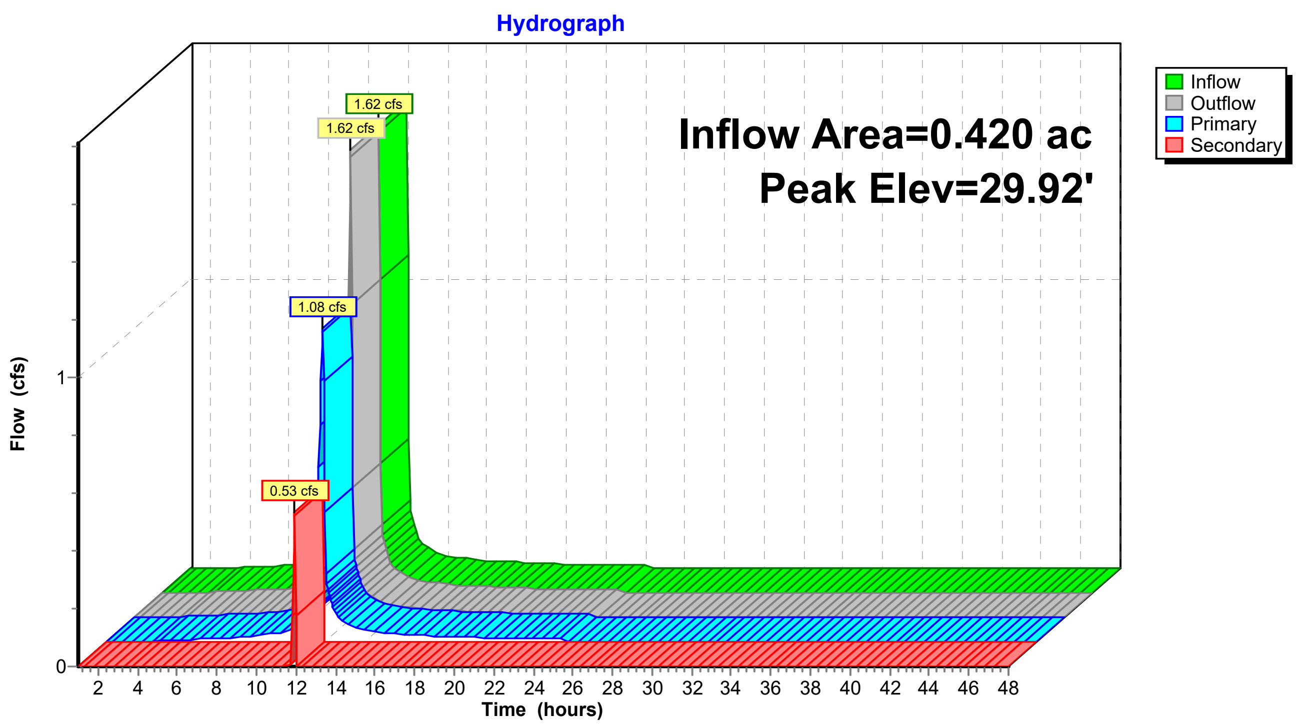
Routing by Stor-Ind method, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 29.92' @ 11.94 hrs
Flood Elev= 32.01'

Device	Routing	Invert	Outlet Devices
#1	Primary	28.70'	**8.0" Round Culvert** L= 100.0' Ke= 1.200 Inlet / Outlet Invert= 28.70' / 27.70' S= 0.0100 '/' Cc= 0.900 n= 0.012, Flow Area= 0.35 sf
#2	Secondary	29.37'	**8.0" Round Culvert** L= 200.0' Ke= 1.200 Inlet / Outlet Invert= 29.37' / 27.67' S= 0.0085 '/' Cc= 0.900 n= 0.012, Flow Area= 0.35 sf

Primary OutFlow Max=1.06 cfs @ 11.94 hrs HW=29.89' (Free Discharge)
└─**1=Culvert** (Inlet Controls 1.06 cfs @ 3.04 fps)

Secondary OutFlow Max=0.49 cfs @ 11.94 hrs HW=29.89' (Free Discharge)
└─**2=Culvert** (Inlet Controls 0.49 cfs @ 1.68 fps)

Pond 37P: CB-C



Summary for Pond 38P: CB-D

Inflow Area = 1.820 ac, 85.16% Impervious, Inflow Depth = 2.30" for 10 event
Inflow = 6.35 cfs @ 11.97 hrs, Volume= 0.349 af
Outflow = 6.35 cfs @ 11.97 hrs, Volume= 0.349 af, Atten= 0%, Lag= 0.0 min
Primary = 2.78 cfs @ 11.97 hrs, Volume= 0.292 af
Secondary = 3.57 cfs @ 11.97 hrs, Volume= 0.057 af

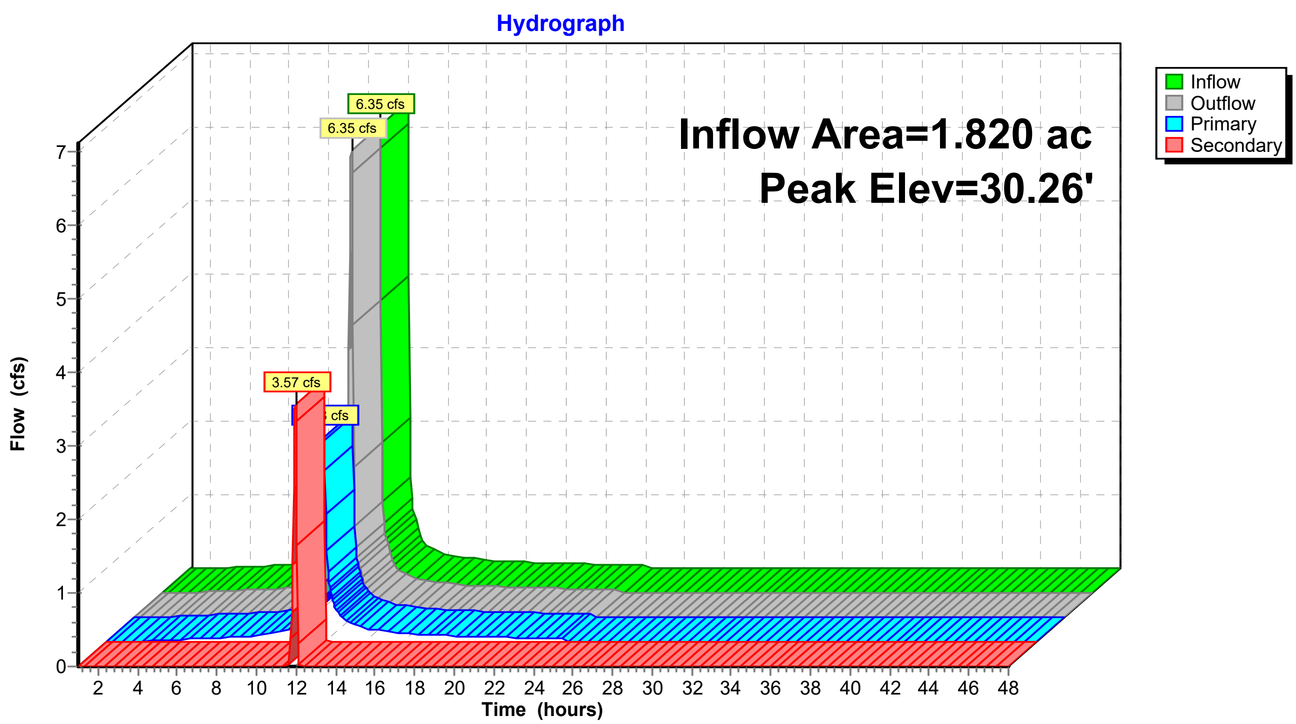
Routing by Stor-Ind method, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 30.26' @ 11.97 hrs
Flood Elev= 31.59'

Device	Routing	Invert	Outlet Devices
#1	Primary	28.60'	**12.0" Round Culvert** L= 40.0' Ke= 1.200 Inlet / Outlet Invert= 28.60' / 28.20' S= 0.0100 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf
#2	Secondary	29.27'	**24.0" Round Culvert** L= 100.0' Ke= 1.200 Inlet / Outlet Invert= 29.27' / 28.27' S= 0.0100 '/' Cc= 0.900 n= 0.012, Flow Area= 3.14 sf

Primary OutFlow Max=2.75 cfs @ 11.97 hrs HW=30.24' (Free Discharge)
↑—**1=Culvert** (Inlet Controls 2.75 cfs @ 3.50 fps)

Secondary OutFlow Max=3.43 cfs @ 11.97 hrs HW=30.24' (Free Discharge)
↑—**2=Culvert** (Inlet Controls 3.43 cfs @ 2.28 fps)

Pond 38P: CB-D



Summary for Pond 39P: DT-4

Inflow Area = 5.860 ac, 85.15% Impervious, Inflow Depth = 2.00" for 10 event
Inflow = 10.12 cfs @ 11.97 hrs, Volume= 0.975 af
Outflow = 0.40 cfs @ 15.70 hrs, Volume= 0.975 af, Atten= 96%, Lag= 224.1 min
Discarded = 0.40 cfs @ 15.70 hrs, Volume= 0.975 af

Routing by Stor-Ind method, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 26.43' @ 15.70 hrs Surf.Area= 0.440 ac Storage= 0.526 af

Plug-Flow detention time= 537.1 min calculated for 0.974 af (100% of inflow)
Center-of-Mass det. time= 537.5 min (1,314.6 - 777.1)

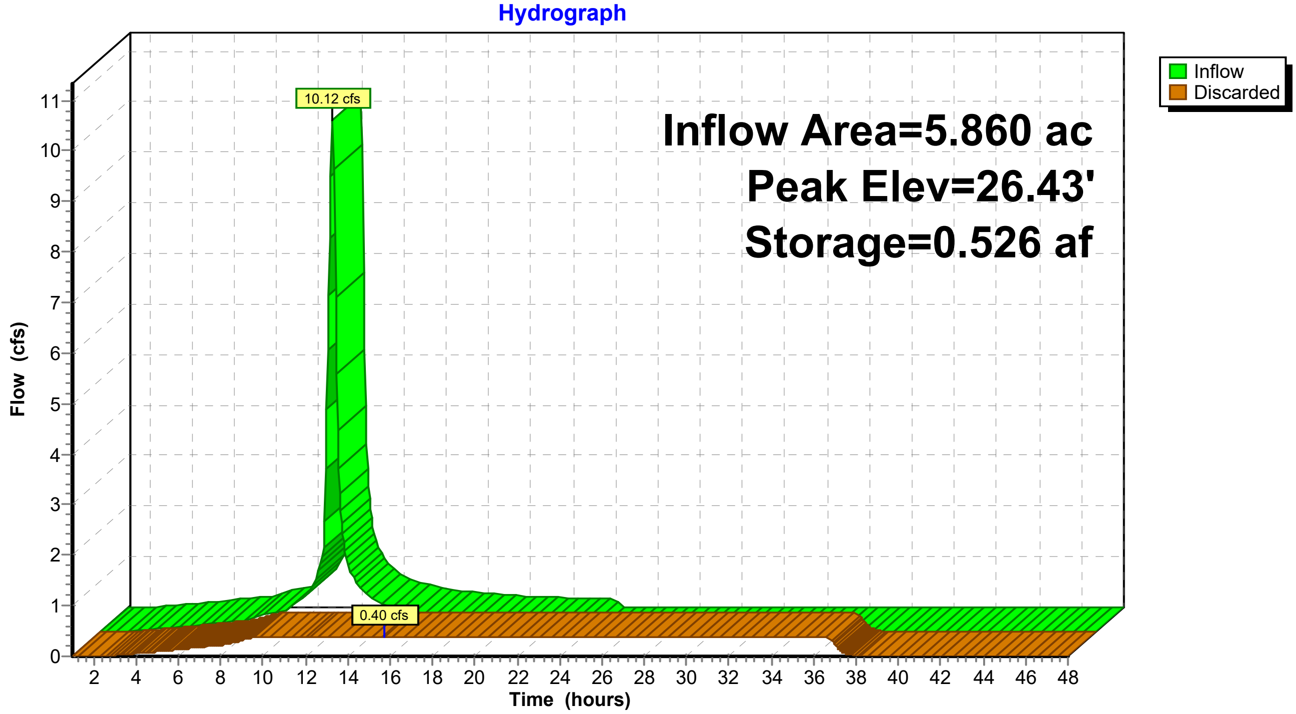
Volume	Invert	Avail.Storage	Storage Description
#1	25.20'	1.067 af	**Custom Stage Data (Irregular)** Listed below (Recalc) 1.100 af Overall x 97.0% Voids

Elevation (feet)	Surf.Area (acres)	Perim. (feet)	Inc.Store (acre-feet)	Cum.Store (acre-feet)	Wet.Area (acres)
25.20	0.440	871.0	0.000	0.000	0.440
27.70	0.440	871.0	1.100	1.100	0.490

Device	Routing	Invert	Outlet Devices
#1	Discarded	25.20'	**0.850 in/hr Exfiltration over Wetted area**

Discarded OutFlow Max=0.40 cfs @ 15.70 hrs HW=26.43' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.40 cfs)

Pond 39P: DT-4


Hydrograph
Inflow
Discarded
10.12 cfs
0.40 cfs
Inflow Area=5.860 ac
Peak Elev=26.43'
Storage=0.526 af
Flow (cfs)
Time (hours)
0
1
2
3
4
5
6
7
8
9
10
11
2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48

Summary for Pond 40P: CB-E

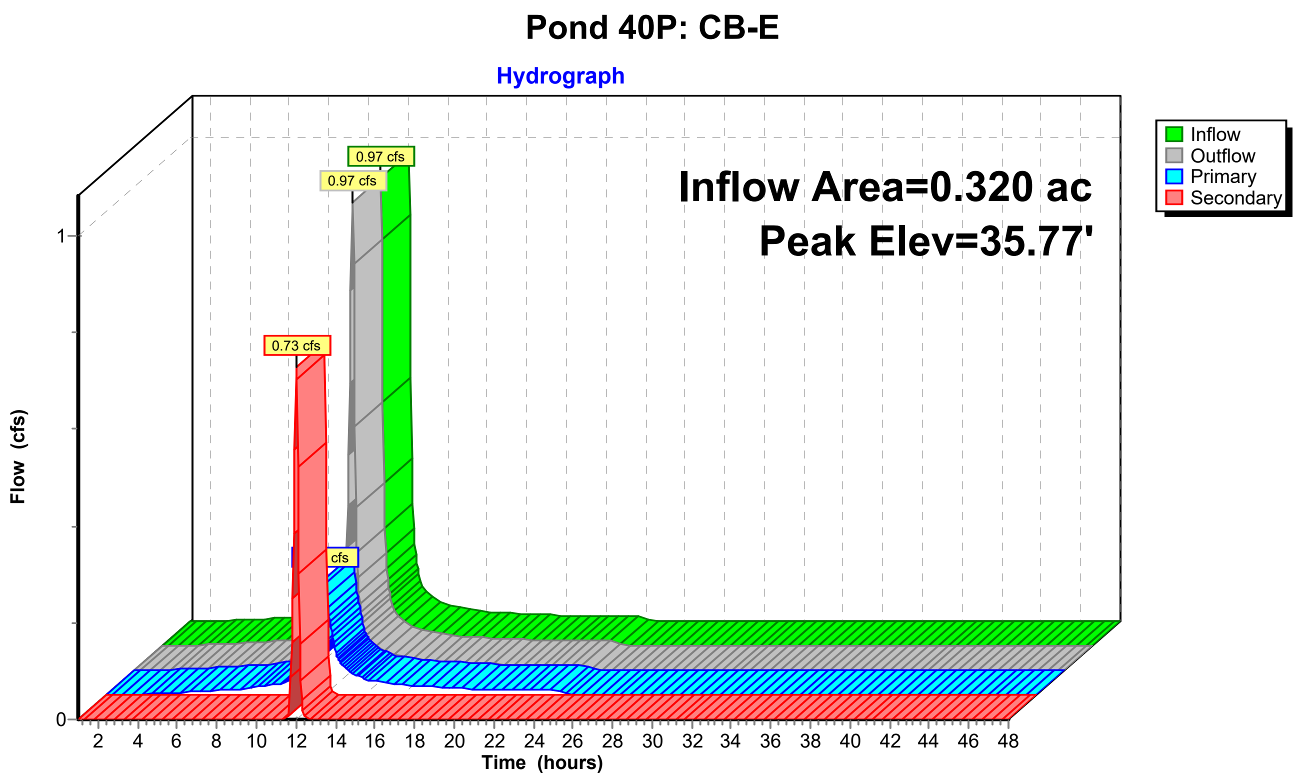
Inflow Area = 0.320 ac, 84.38% Impervious, Inflow Depth = 2.30" for 10 event
Inflow = 0.97 cfs @ 12.02 hrs, Volume= 0.061 af
Outflow = 0.97 cfs @ 12.02 hrs, Volume= 0.061 af, Atten= 0%, Lag= 0.0 min
Primary = 0.24 cfs @ 12.02 hrs, Volume= 0.045 af
Secondary = 0.73 cfs @ 12.02 hrs, Volume= 0.017 af

Routing by Stor-Ind method, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 35.77' @ 12.02 hrs
Flood Elev= 37.90'

Device	Routing	Invert	Outlet Devices
#1	Primary	34.90'	**4.0" Round Culvert** L= 75.0' Ke= 1.200 Inlet / Outlet Invert= 34.90' / 34.15' S= 0.0100 '/' Cc= 0.900 n= 0.012, Flow Area= 0.09 sf
#2	Secondary	35.23'	**12.0" Round Culvert** L= 200.0' Ke= 1.200 Inlet / Outlet Invert= 35.23' / 33.40' S= 0.0091 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf

Primary OutFlow Max=0.24 cfs @ 12.02 hrs HW=35.76' (Free Discharge)
└─**1=Culvert** (Inlet Controls 0.24 cfs @ 2.73 fps)

Secondary OutFlow Max=0.71 cfs @ 12.02 hrs HW=35.76' (Free Discharge)
└─**2=Culvert** (Inlet Controls 0.71 cfs @ 1.69 fps)



Summary for Pond 41P: DT-6

Inflow Area = 1.290 ac, 84.50% Impervious, Inflow Depth = 1.59" for 10 event
Inflow = 0.88 cfs @ 11.94 hrs, Volume= 0.171 af
Outflow = 0.07 cfs @ 16.45 hrs, Volume= 0.171 af, Atten= 92%, Lag= 270.4 min
Discarded = 0.07 cfs @ 16.45 hrs, Volume= 0.171 af

Routing by Stor-Ind method, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 28.61' @ 16.45 hrs Surf.Area= 0.075 ac Storage= 0.081 af

Plug-Flow detention time= 458.8 min calculated for 0.171 af (100% of inflow)
Center-of-Mass det. time= 459.1 min (1,249.5 - 790.3)

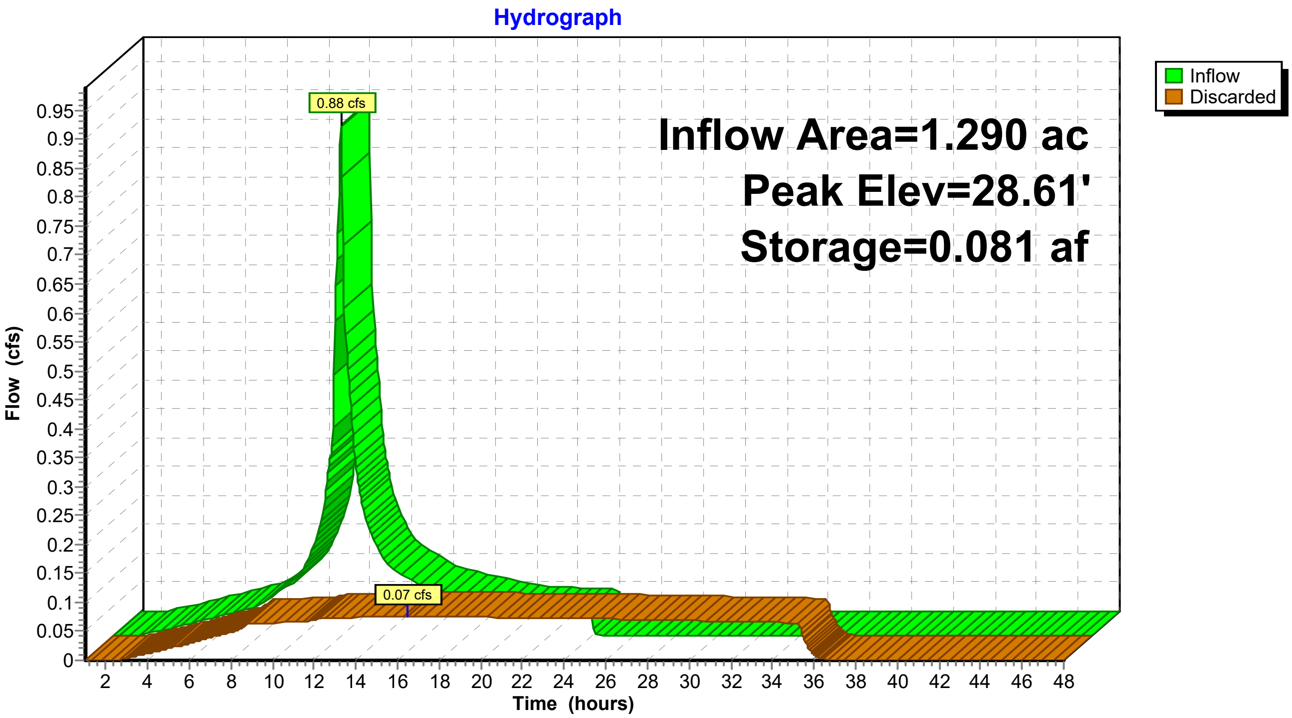
Volume	Invert	Avail.Storage	Storage Description
#1	27.50'	0.182 af	**Custom Stage Data (Irregular)** Listed below (Recalc) 0.187 af Overall x 97.0% Voids

Elevation (feet)	Surf.Area (acres)	Perim. (feet)	Inc.Store (acre-feet)	Cum.Store (acre-feet)	Wet.Area (acres)
27.50	0.075	482.0	0.000	0.000	0.075
30.00	0.075	482.0	0.187	0.187	0.103

Device	Routing	Invert	Outlet Devices
#1	Discarded	27.50'	**0.850 in/hr Exfiltration over Wetted area**

Discarded OutFlow Max=0.07 cfs @ 16.45 hrs HW=28.61' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.07 cfs)

Pond 41P: DT-6


Hydrograph
Inflow
Discarded
0.88 cfs
0.07 cfs
Inflow Area=1.290 ac
Peak Elev=28.61'
Storage=0.081 af
Flow (cfs)
0.95
0.9
0.85
0.8
0.75
0.7
0.65
0.6
0.55
0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48
Time (hours)

Summary for Pond 42P: CB-B

[57] Hint: Peaked at 33.59' (Flood elevation advised)

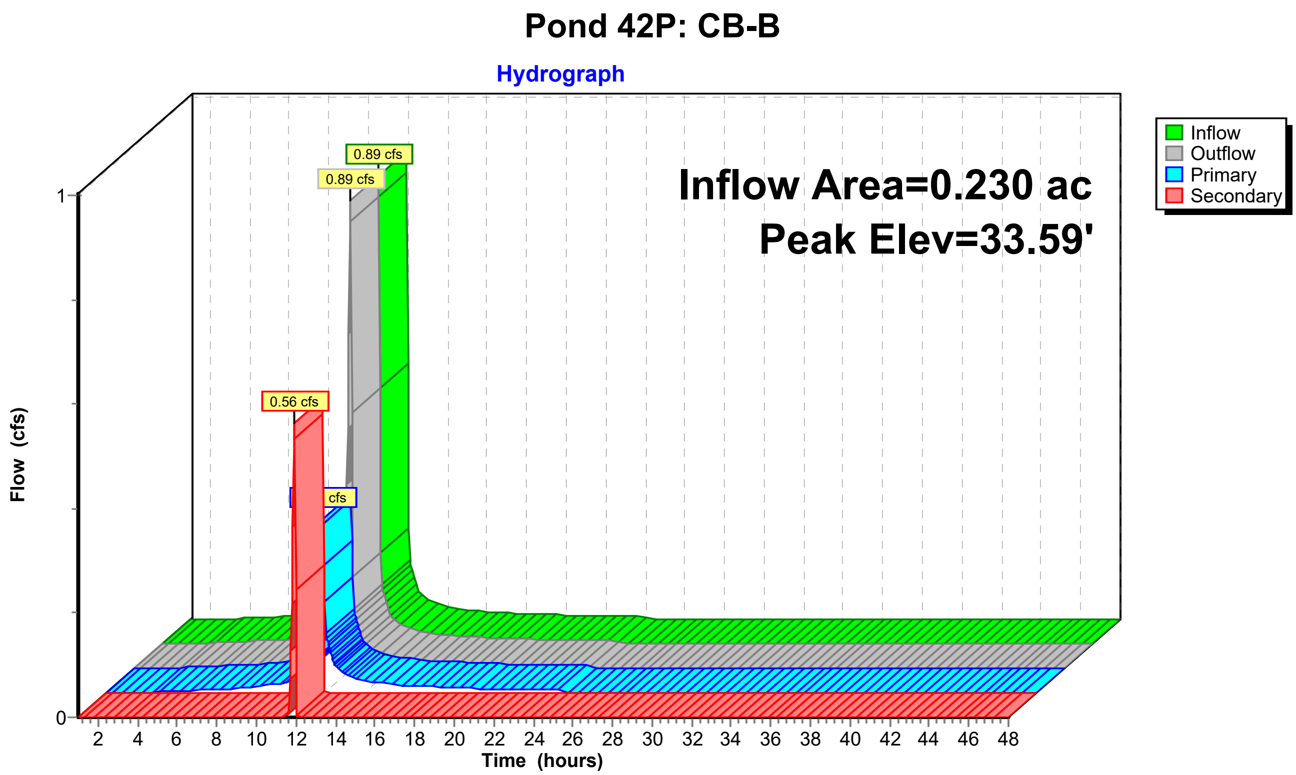
Inflow Area = 0.230 ac, 82.61% Impervious, Inflow Depth = 2.30" for 10 event
Inflow = 0.89 cfs @ 11.93 hrs, Volume= 0.044 af
Outflow = 0.89 cfs @ 11.93 hrs, Volume= 0.044 af, Atten= 0%, Lag= 0.0 min
Primary = 0.33 cfs @ 11.93 hrs, Volume= 0.035 af
Secondary = 0.56 cfs @ 11.93 hrs, Volume= 0.009 af

Routing by Stor-Ind method, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 33.59' @ 11.93 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	32.10'	**4.0" Round Culvert** L= 50.0' Ke= 1.200 Inlet / Outlet Invert= 32.10' / 31.20' S= 0.0180 '/' Cc= 0.900 n= 0.012, Flow Area= 0.09 sf
#2	Secondary	32.60'	**6.0" Round Culvert** L= 200.0' Ke= 1.200 Inlet / Outlet Invert= 32.60' / 30.60' S= 0.0100 '/' Cc= 0.900 n= 0.012, Flow Area= 0.20 sf

Primary OutFlow Max=0.32 cfs @ 11.93 hrs HW=33.52' (Free Discharge)
└─**1=Culvert** (Inlet Controls 0.32 cfs @ 3.67 fps)

Secondary OutFlow Max=0.53 cfs @ 11.93 hrs HW=33.52' (Free Discharge)
└─**2=Culvert** (Inlet Controls 0.53 cfs @ 2.68 fps)



Summary for Pond 43P: CB-A

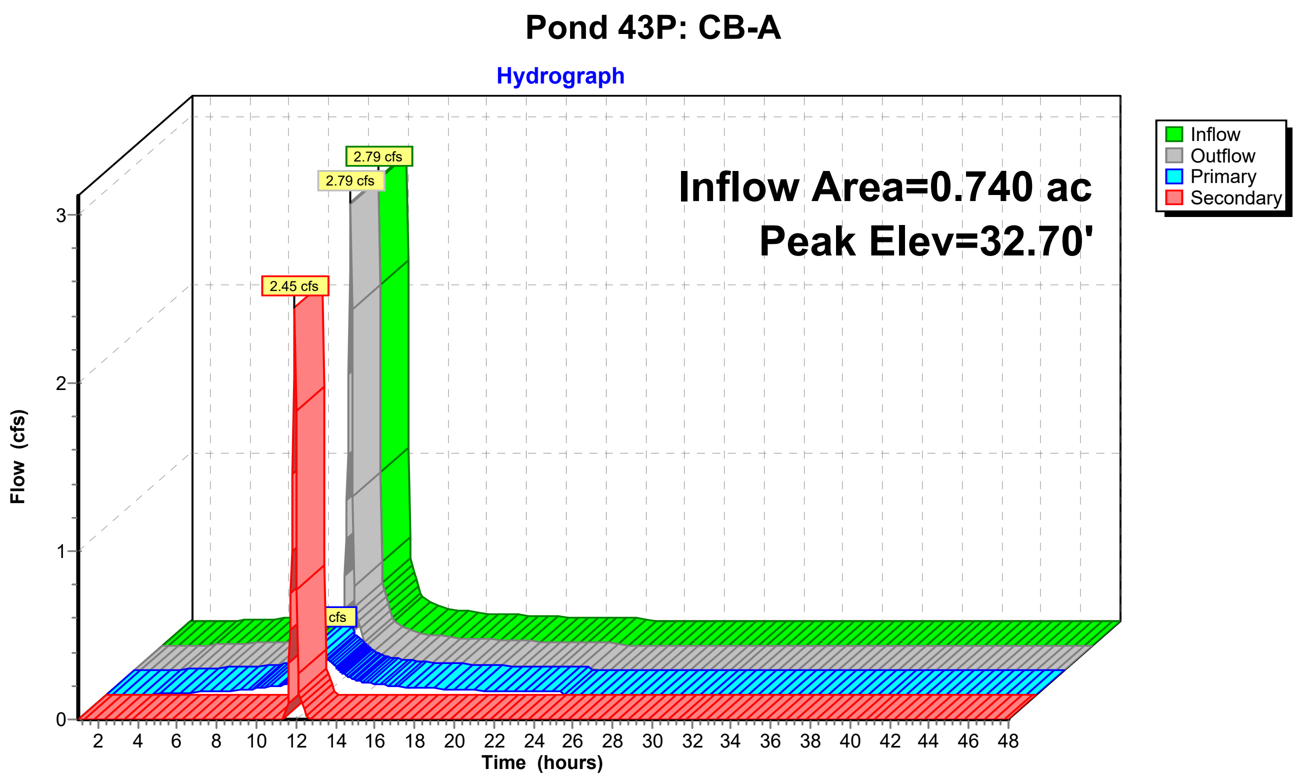
Inflow Area = 0.740 ac, 85.14% Impervious, Inflow Depth = 2.30" for 10 event
Inflow = 2.79 cfs @ 11.94 hrs, Volume= 0.142 af
Outflow = 2.79 cfs @ 11.94 hrs, Volume= 0.142 af, Atten= 0%, Lag= 0.0 min
Primary = 0.33 cfs @ 11.94 hrs, Volume= 0.091 af
Secondary = 2.45 cfs @ 11.94 hrs, Volume= 0.051 af

Routing by Stor-Ind method, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 32.70' @ 11.94 hrs
Flood Elev= 34.22'

Device	Routing	Invert	Outlet Devices
#1	Primary	31.20'	**4.0" Round Culvert** L= 30.0' Ke= 1.200 Inlet / Outlet Invert= 31.20' / 30.00' S= 0.0400 '/' Cc= 0.900 n= 0.012, Flow Area= 0.09 sf
#2	Secondary	31.70'	**15.0" Round Culvert** L= 200.0' Ke= 1.200 Inlet / Outlet Invert= 31.70' / 29.70' S= 0.0100 '/' Cc= 0.900 n= 0.012, Flow Area= 1.23 sf

Primary OutFlow Max=0.33 cfs @ 11.94 hrs HW=32.69' (Free Discharge)
└─**1=Culvert** (Inlet Controls 0.33 cfs @ 3.78 fps)

Secondary OutFlow Max=2.41 cfs @ 11.94 hrs HW=32.69' (Free Discharge)
└─**2=Culvert** (Inlet Controls 2.41 cfs @ 2.31 fps)



Summary for Pond 49P: CB-S

[57] Hint: Peaked at 27.95' (Flood elevation advised)

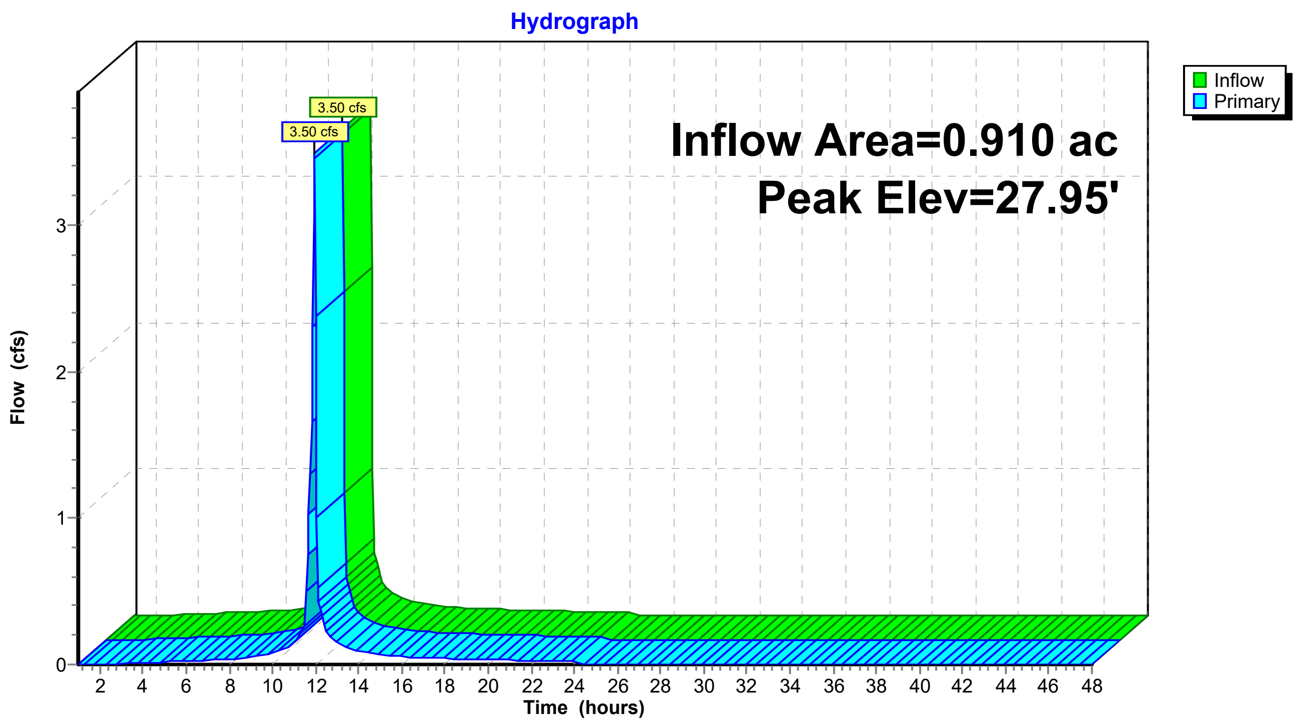
Inflow Area = 0.910 ac, 84.62% Impervious, Inflow Depth = 2.30" for 10 event
Inflow = 3.50 cfs @ 11.94 hrs, Volume= 0.175 af
Outflow = 3.50 cfs @ 11.94 hrs, Volume= 0.175 af, Atten= 0%, Lag= 0.0 min
Primary = 3.50 cfs @ 11.94 hrs, Volume= 0.175 af

Routing by Stor-Ind method, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 27.95' @ 11.94 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	26.60'	**12.0" Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=3.37 cfs @ 11.94 hrs HW=27.89' (Free Discharge)
↑—**1=Orifice/Grate** (Orifice Controls 3.37 cfs @ 4.29 fps)

Pond 49P: CB-S



Summary for Pond 51P: CB-T

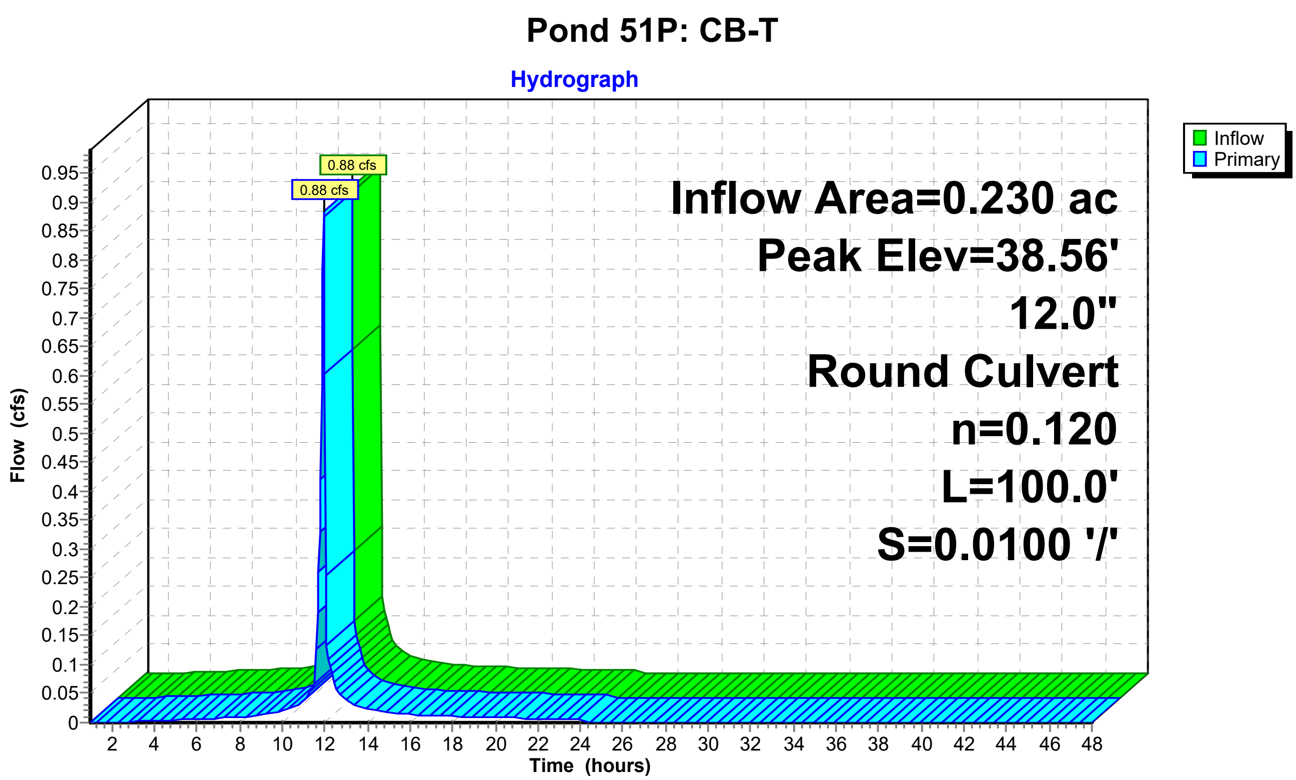
[58] Hint: Peaked 1.76' above defined flood level

Inflow Area =	0.230 ac, 82.61% Impervious, Inflow Depth = 2.30" for 10 event		
Inflow =	0.88 cfs @ 11.94 hrs, Volume=	0.044 af	
Outflow =	0.88 cfs @ 11.94 hrs, Volume=	0.044 af, Atten= 0%, Lag= 0.0 min	
Primary =	0.88 cfs @ 11.94 hrs, Volume=	0.044 af	

Routing by Stor-Ind method, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 38.56' @ 11.94 hrs
Flood Elev= 36.80'

Device	Routing	Invert	Outlet Devices
#1	Primary	33.30'	**12.0" Round Culvert** L= 100.0' Ke= 1.200 Inlet / Outlet Invert= 33.30' / 32.30' S= 0.0100 '/' Cc= 0.900 n= 0.120, Flow Area= 0.79 sf

Primary OutFlow Max=0.85 cfs @ 11.94 hrs HW=38.22' (Free Discharge)
1=Culvert (Barrel Controls 0.85 cfs @ 1.08 fps)



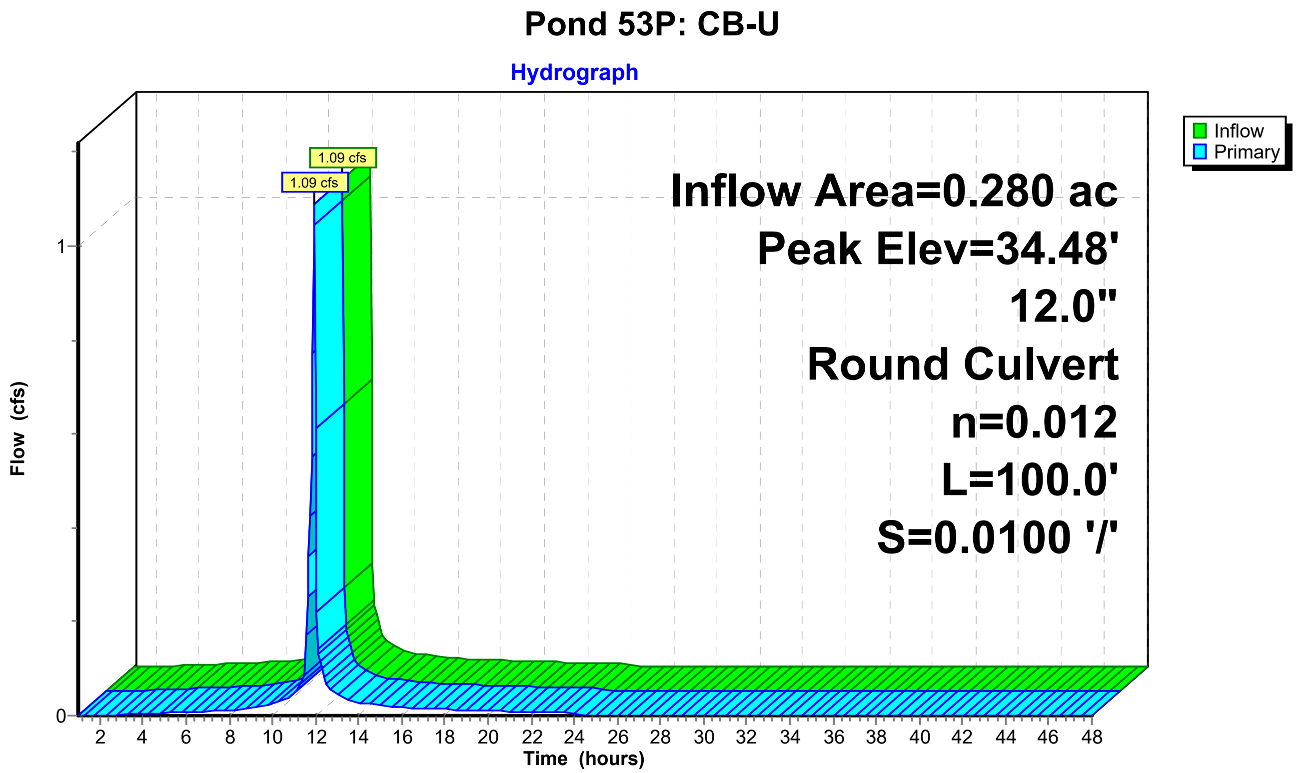
Summary for Pond 53P: CB-U

Inflow Area = 0.280 ac, 85.71% Impervious, Inflow Depth = 2.30" for 10 event
Inflow = 1.09 cfs @ 11.93 hrs, Volume= 0.054 af
Outflow = 1.09 cfs @ 11.93 hrs, Volume= 0.054 af, Atten= 0%, Lag= 0.0 min
Primary = 1.09 cfs @ 11.93 hrs, Volume= 0.054 af

Routing by Stor-Ind method, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 34.48' @ 11.93 hrs
Flood Elev= 36.80'

Device	Routing	Invert	Outlet Devices
#1	Primary	33.80'	**12.0" Round Culvert** L= 100.0' Ke= 1.200 Inlet / Outlet Invert= 33.80' / 32.80' S= 0.0100 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf

Primary OutFlow Max=1.03 cfs @ 11.93 hrs HW=34.46' (Free Discharge)
↑**1=Culvert** (Inlet Controls 1.03 cfs @ 1.88 fps)



Summary for Pond 54P: DA-9

Inflow Area = 1.450 ac, 84.83% Impervious, Inflow Depth = 2.04" for 10 event
Inflow = 3.35 cfs @ 11.94 hrs, Volume= 0.246 af
Outflow = 0.10 cfs @ 9.95 hrs, Volume= 0.246 af, Atten= 97%, Lag= 0.0 min
Discarded = 0.10 cfs @ 9.95 hrs, Volume= 0.246 af

Routing by Stor-Ind method, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 30.60' @ 15.49 hrs Surf.Area= 0.120 ac Storage= 0.132 af

Plug-Flow detention time= 514.5 min calculated for 0.246 af (100% of inflow)
Center-of-Mass det. time= 514.3 min (1,286.8 - 772.6)

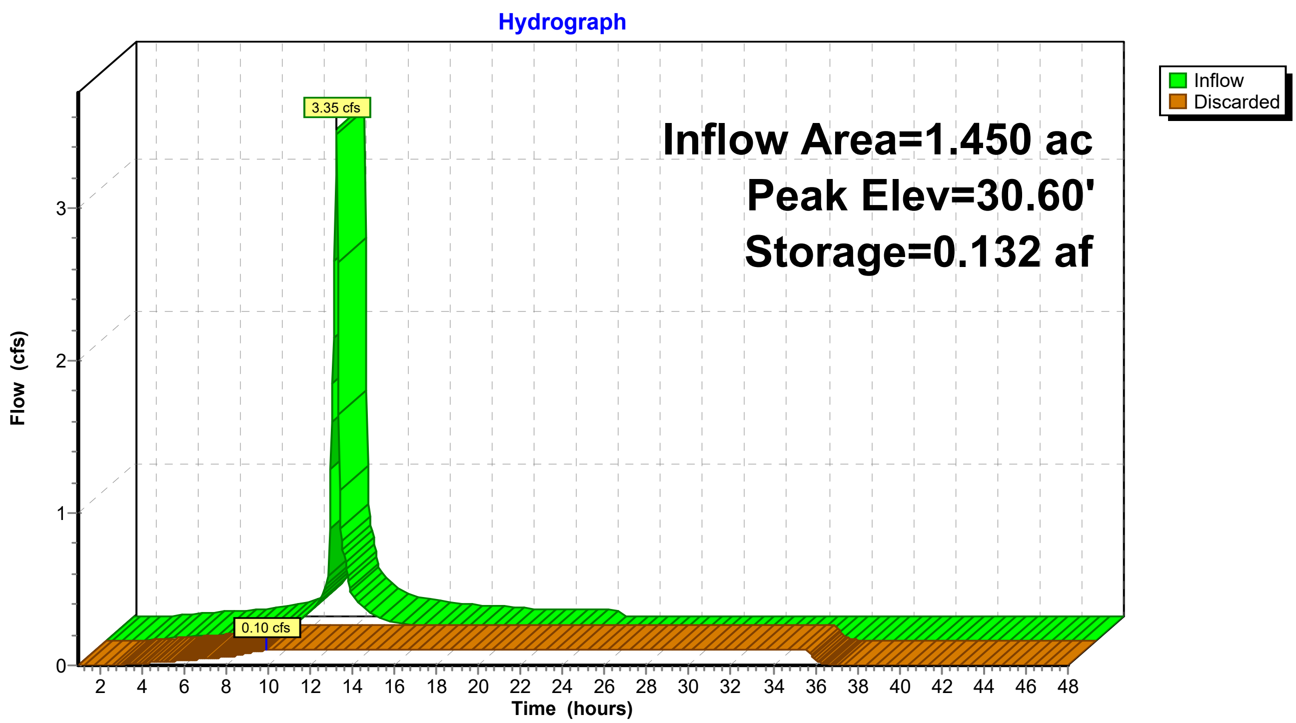
Volume	Invert	Avail.Storage	Storage Description
#1	29.50'	0.300 af	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
29.50	0.120	0.000	0.000
32.00	0.120	0.300	0.300

Device	Routing	Invert	Outlet Devices
#1	Discarded	29.50'	**0.850 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.10 cfs @ 9.95 hrs HW=29.53' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.10 cfs)

Pond 54P: DA-9



Summary for Pond 56P: (new Pond)

[57] Hint: Peaked at 36.08' (Flood elevation advised)

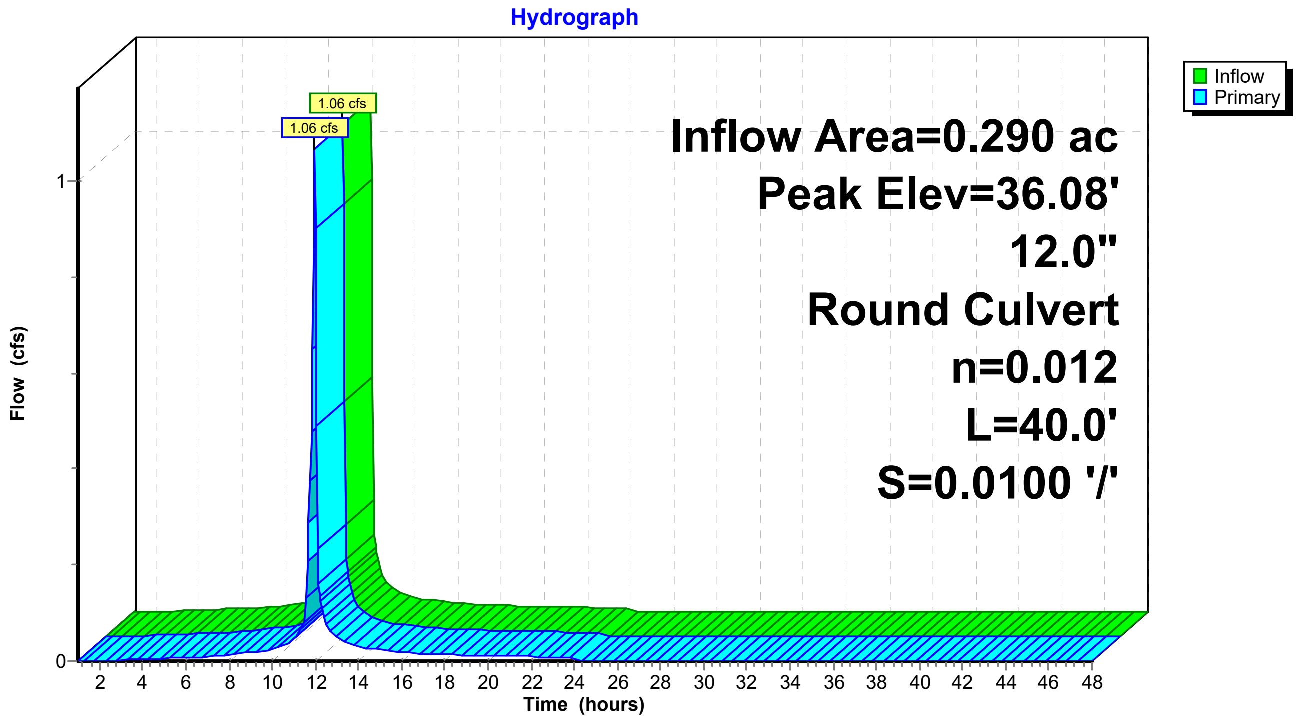
Inflow Area =	0.290 ac,	86.21% Impervious,	Inflow Depth = 2.30"	for 10 event
Inflow =	1.06 cfs @	11.95 hrs, Volume=	0.056 af	
Outflow =	1.06 cfs @	11.95 hrs, Volume=	0.056 af, Atten= 0%, Lag= 0.0 min	
Primary =	1.06 cfs @	11.95 hrs, Volume=	0.056 af	

Routing by Stor-Ind method, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 36.08' @ 11.95 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	35.41'	**12.0" Round Culvert** L= 40.0' Ke= 1.200 Inlet / Outlet Invert= 35.41' / 35.01' S= 0.0100 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf

Primary OutFlow Max=1.06 cfs @ 11.95 hrs HW=36.08' (Free Discharge)
└─**1=Culvert** (Inlet Controls 1.06 cfs @ 1.90 fps)

Pond 56P: (new Pond)



Time span=1.00-48.00 hrs, dt=0.05 hrs, 941 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1S: A Runoff Area=0.740 ac 85.14% Impervious Runoff Depth=4.35"
Flow Length=182' Slope=0.0070 '/' Tc=4.4 min AMC Adjusted CN=97 Runoff=5.07 cfs 0.268 af

Subcatchment2S: B Runoff Area=0.230 ac 82.61% Impervious Runoff Depth=4.35"
Flow Length=153' Slope=0.0160 '/' Tc=2.7 min AMC Adjusted CN=97 Runoff=1.63 cfs 0.083 af

Subcatchment3S: C Runoff Area=0.420 ac 85.71% Impervious Runoff Depth=4.35"
Flow Length=216' Slope=0.0160 '/' Tc=3.6 min AMC Adjusted CN=97 Runoff=2.94 cfs 0.152 af

Subcatchment4S: D Runoff Area=1.820 ac 85.16% Impervious Runoff Depth=4.35"
Flow Length=457' Slope=0.0230 '/' Tc=6.4 min AMC Adjusted CN=97 Runoff=11.58 cfs 0.659 af

Subcatchment5S: E Runoff Area=0.320 ac 84.38% Impervious Runoff Depth=4.35"
Flow Length=394' Slope=0.0040 '/' Tc=11.3 min AMC Adjusted CN=97 Runoff=1.77 cfs 0.116 af

Subcatchment6S: F Runoff Area=2.550 ac 85.10% Impervious Runoff Depth=4.35"
Flow Length=553' Slope=0.0100 '/' Tc=10.5 min AMC Adjusted CN=97 Runoff=14.46 cfs 0.924 af

Subcatchment7S: G Runoff Area=0.780 ac 84.62% Impervious Runoff Depth=4.35"
Flow Length=340' Slope=0.0150 '/' Tc=5.8 min AMC Adjusted CN=97 Runoff=5.07 cfs 0.283 af

Subcatchment8S: H Runoff Area=0.310 ac 83.87% Impervious Runoff Depth=4.35"
Flow Length=50' Slope=0.0200 '/' Tc=1.0 min AMC Adjusted CN=97 Runoff=2.28 cfs 0.112 af

Subcatchment9S: I Runoff Area=0.160 ac 87.50% Impervious Runoff Depth>4.46"
Flow Length=129' Slope=0.0090 '/' Tc=3.0 min AMC Adjusted CN=98 Runoff=1.14 cfs 0.060 af

Subcatchment10S: J Runoff Area=1.410 ac 85.11% Impervious Runoff Depth=4.35"
Flow Length=256' Slope=0.0200 '/' Tc=3.8 min AMC Adjusted CN=97 Runoff=9.84 cfs 0.511 af

Subcatchment11S: K Runoff Area=0.940 ac 85.11% Impervious Runoff Depth=4.35"
Flow Length=254' Slope=0.0100 '/' Tc=4.9 min AMC Adjusted CN=97 Runoff=6.33 cfs 0.341 af

Subcatchment12S: L Runoff Area=0.240 ac 87.50% Impervious Runoff Depth>4.46"
Flow Length=254' Slope=0.0100 '/' Tc=4.9 min AMC Adjusted CN=98 Runoff=1.63 cfs 0.089 af

Subcatchment13S: M Runoff Area=1.420 ac 85.21% Impervious Runoff Depth=4.35"
Flow Length=329' Slope=0.0110 '/' Tc=6.2 min AMC Adjusted CN=97 Runoff=9.10 cfs 0.515 af

Subcatchment14S: N Runoff Area=0.510 ac 84.31% Impervious Runoff Depth=4.35"
Flow Length=215' Slope=0.0110 '/' Tc=4.2 min AMC Adjusted CN=97 Runoff=3.52 cfs 0.185 af

Subcatchment15S: O Runoff Area=0.310 ac 83.87% Impervious Runoff Depth=4.35"
Flow Length=190' Slope=0.0150 '/' Tc=3.3 min AMC Adjusted CN=97 Runoff=2.18 cfs 0.112 af

Subcatchment16S: P Runoff Area=0.360 ac 83.33% Impervious Runoff Depth=4.35"
Flow Length=164' Slope=0.0170 '/' Tc=2.8 min AMC Adjusted CN=97 Runoff=2.55 cfs 0.130 af

Subcatchment 17S: S Runoff Area=0.910 ac 84.62% Impervious Runoff Depth=4.35"
Flow Length=250' Slope=0.0200 '/' Tc=3.7 min AMC Adjusted CN=97 Runoff=6.36 cfs 0.330 af

Subcatchment 18S: Q Runoff Area=0.230 ac 82.61% Impervious Runoff Depth=4.35"
Flow Length=87' Slope=0.0400 '/' Tc=1.2 min AMC Adjusted CN=97 Runoff=1.68 cfs 0.083 af

Subcatchment 19S: R Runoff Area=0.340 ac 8.82% Impervious Runoff Depth=2.46"
Flow Length=56' Slope=0.0500 '/' Tc=6.3 min AMC Adjusted CN=78 Runoff=1.44 cfs 0.070 af

Subcatchment 50S: T Runoff Area=0.230 ac 82.61% Impervious Runoff Depth=4.35"
Flow Length=127' Slope=0.0050 '/' Tc=3.7 min AMC Adjusted CN=97 Runoff=1.61 cfs 0.083 af

Subcatchment 52S: U Runoff Area=0.280 ac 85.71% Impervious Runoff Depth=4.35"
Flow Length=125' Slope=0.0100 '/' Tc=2.8 min AMC Adjusted CN=97 Runoff=1.98 cfs 0.101 af

Subcatchment 55S: V Runoff Area=0.290 ac 86.21% Impervious Runoff Depth=4.35"
Flow Length=185' Slope=0.0050 '/' Tc=5.1 min AMC Adjusted CN=97 Runoff=1.94 cfs 0.105 af

Reach 46R: REGIONAL SD Avg. Flow Depth=1.09' Max Vel=10.72 fps Inflow=41.70 cfs 1.275 af
84.0" Round Pipe n=0.013 L=500.0' S=0.0150 '/' Capacity=782.41 cfs Outflow=39.98 cfs 1.275 af

Pond 20P: DT-1 Peak Elev=35.45' Storage=0.396 af Inflow=11.45 cfs 0.645 af
Outflow=0.20 cfs 0.645 af

Pond 22P: CB-P Peak Elev=38.45' Inflow=2.55 cfs 0.130 af
12.0" Round Culvert n=0.012 L=100.0' S=0.0100 '/' Outflow=2.55 cfs 0.130 af

Pond 24P: CB-M Peak Elev=37.83' Inflow=9.10 cfs 0.515 af
24.0" Round Culvert n=0.012 L=10.0' S=0.0100 '/' Outflow=9.10 cfs 0.515 af

Pond 26P: CB-N Peak Elev=38.96' Inflow=3.52 cfs 0.185 af
Outflow=3.52 cfs 0.185 af

Pond 27P: CB-O Peak Elev=37.81' Inflow=2.18 cfs 0.112 af
12.0" Round Culvert n=0.012 L=10.0' S=0.0100 '/' Outflow=2.18 cfs 0.112 af

Pond 28P: DT-2 Peak Elev=33.76' Storage=0.241 af Inflow=7.31 cfs 0.386 af
Outflow=0.12 cfs 0.377 af

Pond 29P: CB-L Peak Elev=34.91' Inflow=1.63 cfs 0.089 af
18.0" Round Culvert n=0.012 L=20.0' S=0.0100 '/' Outflow=1.63 cfs 0.089 af

Pond 30P: CB-I Peak Elev=39.20' Inflow=1.14 cfs 0.060 af
12.0" Round Culvert n=0.012 L=100.0' S=0.0100 '/' Outflow=1.14 cfs 0.060 af

Pond 31P: CB-J Peak Elev=37.23' Inflow=9.84 cfs 0.511 af
24.0" Round Culvert n=0.012 L=10.0' S=0.0100 '/' Outflow=9.84 cfs 0.511 af

Pond 32P: DT-3 Peak Elev=34.70' Storage=0.358 af Inflow=10.97 cfs 0.570 af
Outflow=0.16 cfs 0.551 af

Pond 33P: CB-G Peak Elev=31.42' Inflow=5.07 cfs 0.283 af
Primary=1.30 cfs 0.209 af Secondary=3.78 cfs 0.074 af Outflow=5.07 cfs 0.283 af

Pond 34P: CB-K Peak Elev=36.81' Inflow=6.33 cfs 0.341 af
Primary=2.14 cfs 0.261 af Secondary=4.19 cfs 0.080 af Outflow=6.33 cfs 0.341 af

Pond 36P: CB-F Peak Elev=33.73' Inflow=14.46 cfs 0.924 af
Primary=5.61 cfs 0.745 af Secondary=8.85 cfs 0.179 af Outflow=14.46 cfs 0.924 af

Pond 37P: CB-C Peak Elev=31.02' Inflow=2.94 cfs 0.152 af
Primary=1.62 cfs 0.133 af Secondary=1.32 cfs 0.019 af Outflow=2.94 cfs 0.152 af

Pond 38P: CB-D Peak Elev=30.90' Inflow=11.58 cfs 0.659 af
Primary=3.46 cfs 0.505 af Secondary=8.12 cfs 0.155 af Outflow=11.58 cfs 0.659 af

Pond 39P: DT-4 Peak Elev=27.68' Storage=1.058 af Inflow=13.55 cfs 1.697 af
Outflow=0.42 cfs 1.465 af

Pond 40P: CB-E Peak Elev=36.07' Inflow=1.77 cfs 0.116 af
Primary=0.27 cfs 0.077 af Secondary=1.50 cfs 0.039 af Outflow=1.77 cfs 0.116 af

Pond 41P: DT-6 Peak Elev=29.79' Storage=0.166 af Inflow=1.29 cfs 0.294 af
Outflow=0.09 cfs 0.281 af

Pond 42P: CB-B Peak Elev=37.42' Inflow=1.63 cfs 0.083 af
Primary=0.61 cfs 0.064 af Secondary=1.02 cfs 0.020 af Outflow=1.63 cfs 0.083 af

Pond 43P: CB-A Peak Elev=33.65' Inflow=5.07 cfs 0.268 af
Primary=0.43 cfs 0.153 af Secondary=4.64 cfs 0.115 af Outflow=5.07 cfs 0.268 af

Pond 49P: CB-S Peak Elev=29.91' Inflow=6.36 cfs 0.330 af
Outflow=6.36 cfs 0.330 af

Pond 51P: CB-T Peak Elev=50.74' Inflow=1.61 cfs 0.083 af
12.0" Round Culvert n=0.120 L=100.0' S=0.0100 '/' Outflow=1.61 cfs 0.083 af

Pond 53P: CB-U Peak Elev=34.88' Inflow=1.98 cfs 0.101 af
12.0" Round Culvert n=0.012 L=100.0' S=0.0100 '/' Outflow=1.98 cfs 0.101 af

Pond 54P: DA-9 Peak Elev=31.87' Storage=0.284 af Inflow=5.70 cfs 0.446 af
Outflow=0.10 cfs 0.373 af

Pond 56P: (new Pond) Peak Elev=36.48' Inflow=1.94 cfs 0.105 af
12.0" Round Culvert n=0.012 L=40.0' S=0.0100 '/' Outflow=1.94 cfs 0.105 af

Total Runoff Area = 14.800 ac Runoff Volume = 5.313 af Average Runoff Depth = 4.31"
16.82% Pervious = 2.490 ac 83.18% Impervious = 12.310 ac

Summary for Subcatchment 1S: A

[49] Hint: Tc<2dt may require smaller dt

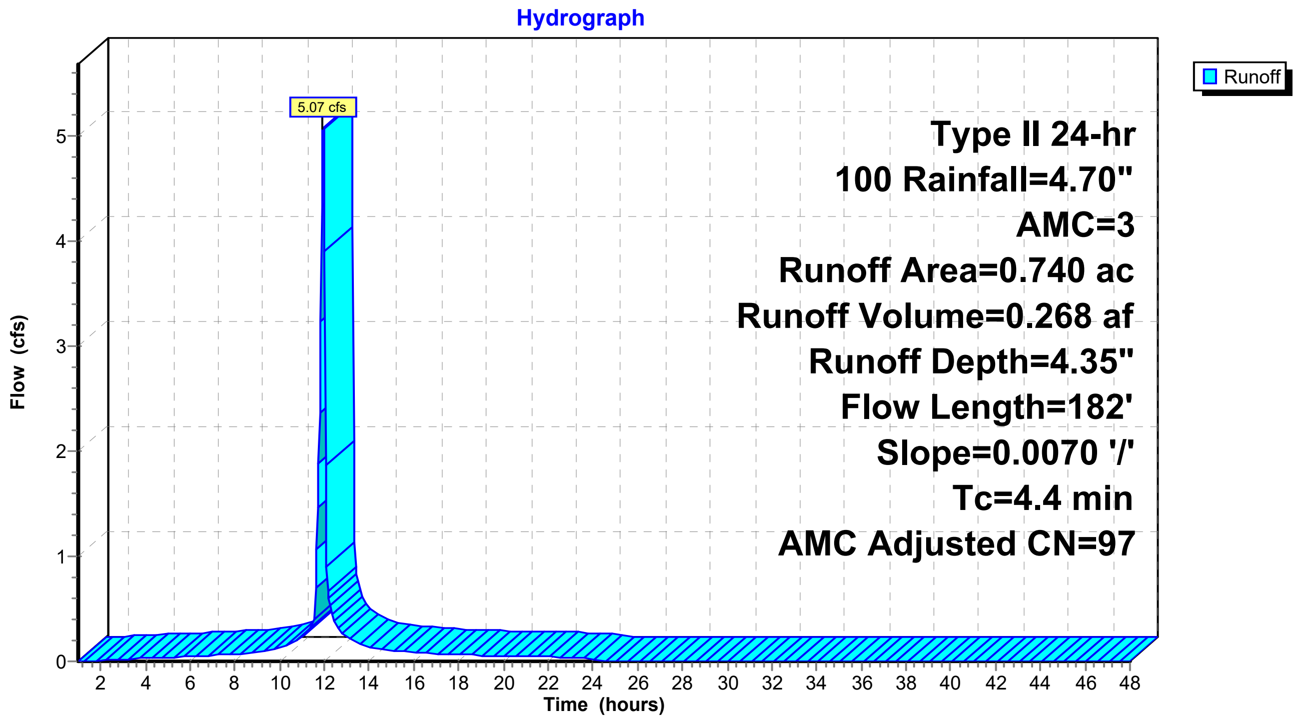
Runoff = 5.07 cfs @ 11.94 hrs, Volume= 0.268 af, Depth= 4.35"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 100 Rainfall=4.70", AMC=3

	Area (ac)	CN	Adj	Description
*	0.630	98		
*	0.110	56		
	0.740	92	97	Weighted Average, AMC Adjusted
	0.110			14.86% Pervious Area
	0.630			85.14% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.4	182	0.0070	0.70		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 1.49"

Subcatchment 1S: A



Summary for Subcatchment 2S: B

[49] Hint: Tc<2dt may require smaller dt

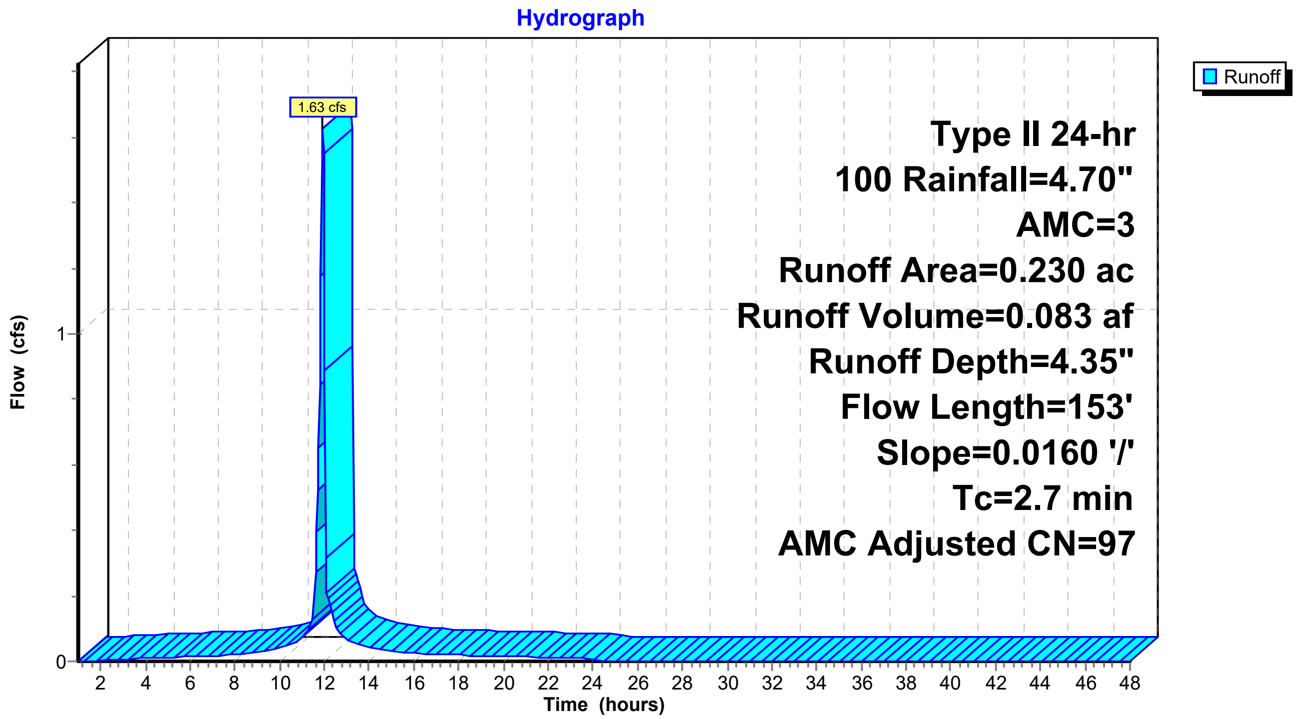
Runoff = 1.63 cfs @ 11.93 hrs, Volume= 0.083 af, Depth= 4.35"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 100 Rainfall=4.70", AMC=3

	Area (ac)	CN	Adj	Description
*	0.190	98		
*	0.040	56		
	0.230	91	97	Weighted Average, AMC Adjusted
	0.040			17.39% Pervious Area
	0.190			82.61% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.7	153	0.0160	0.93		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 1.49"

Subcatchment 2S: B



Summary for Subcatchment 3S: C

[49] Hint: Tc<2dt may require smaller dt

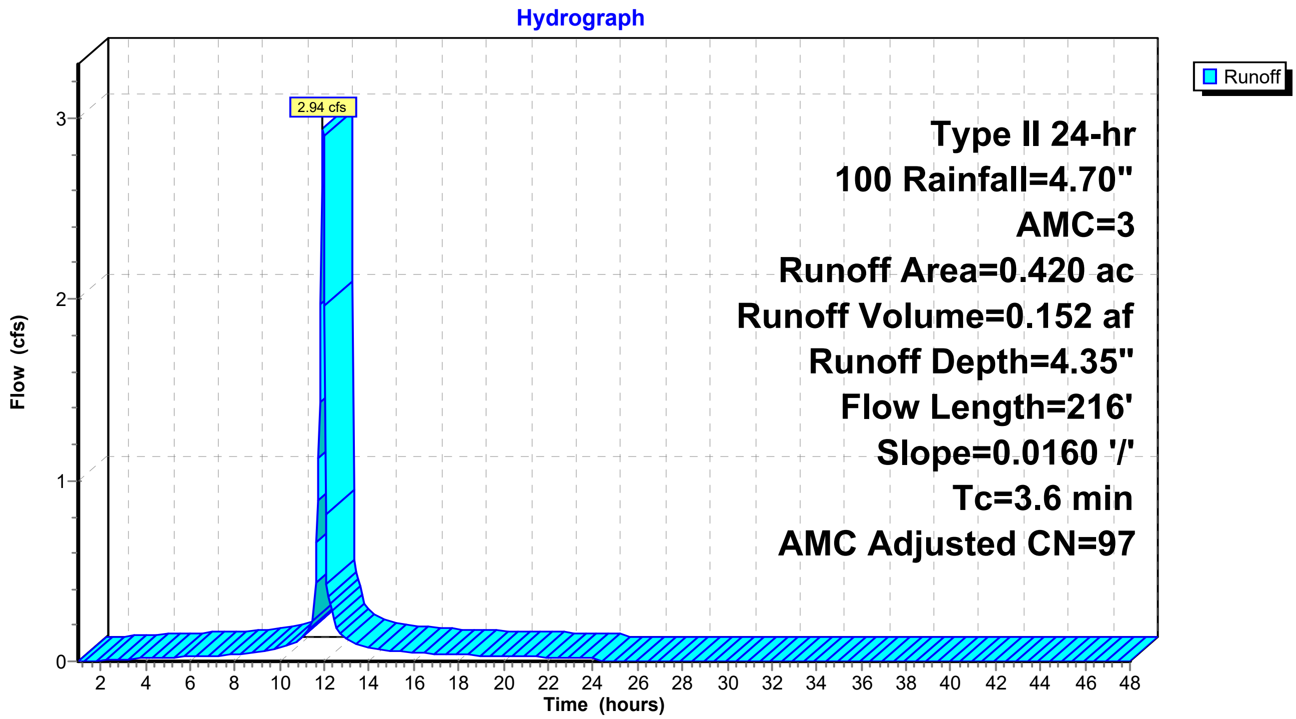
Runoff = 2.94 cfs @ 11.94 hrs, Volume= 0.152 af, Depth= 4.35"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 100 Rainfall=4.70", AMC=3

	Area (ac)	CN	Adj	Description
*	0.360	98		
*	0.060	56		
	0.420	92	97	Weighted Average, AMC Adjusted
	0.060			14.29% Pervious Area
	0.360			85.71% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.6	216	0.0160	1.00		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 1.49"

Subcatchment 3S: C



Summary for Subcatchment 4S: D

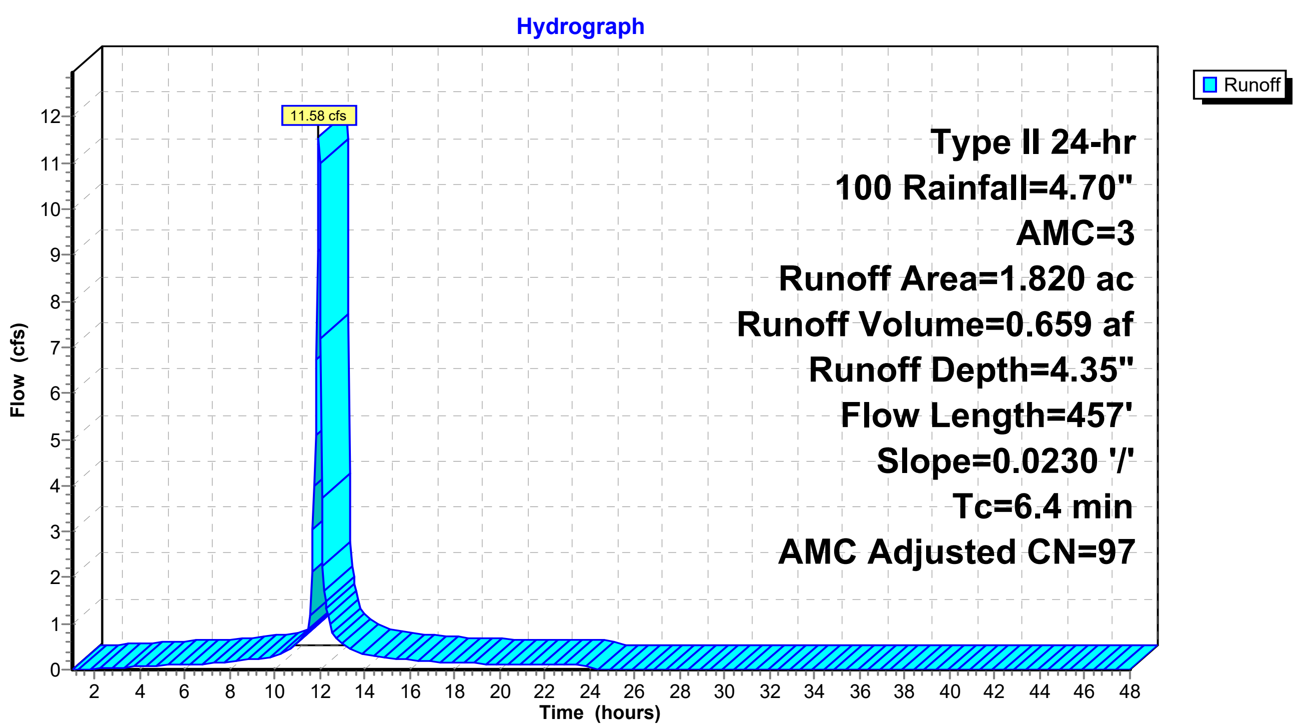
Runoff = 11.58 cfs @ 11.97 hrs, Volume= 0.659 af, Depth= 4.35"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 100 Rainfall=4.70", AMC=3

	Area (ac)	CN	Adj	Description
*	1.550	98		
*	0.270	56		
	1.820	92	97	Weighted Average, AMC Adjusted
	0.270			14.84% Pervious Area
	1.550			85.16% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.0	300	0.0230	1.24		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 1.49"
2.4	157	0.0230	1.09		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 1.49"
6.4	457	Total			

Subcatchment 4S: D



Summary for Subcatchment 5S: E

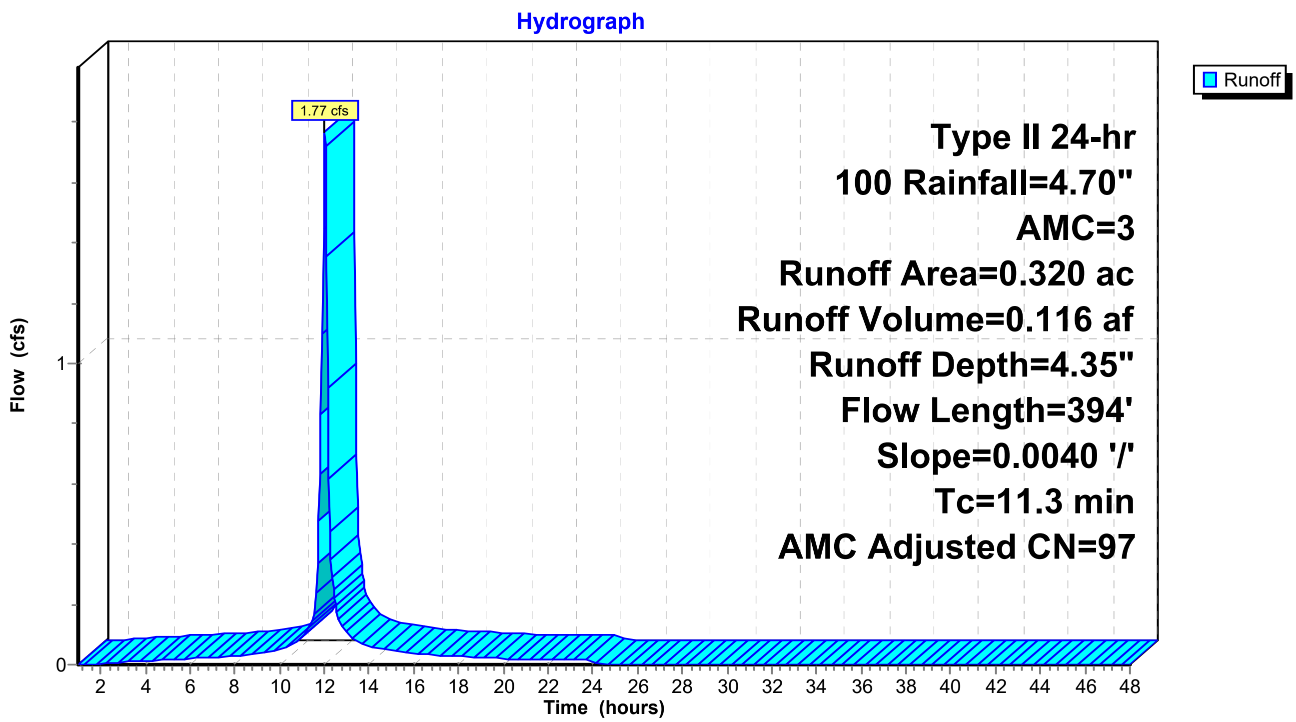
Runoff = 1.77 cfs @ 12.02 hrs, Volume= 0.116 af, Depth= 4.35"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 100 Rainfall=4.70", AMC=3

	Area (ac)	CN	Adj	Description
*	0.270	98		
*	0.050	56		
	0.320	91	97	Weighted Average, AMC Adjusted
	0.050			15.63% Pervious Area
	0.270			84.38% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.1	300	0.0040	0.61		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 1.49"
3.2	94	0.0040	0.49		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 1.49"
11.3	394	Total			

Subcatchment 5S: E



Summary for Subcatchment 6S: F

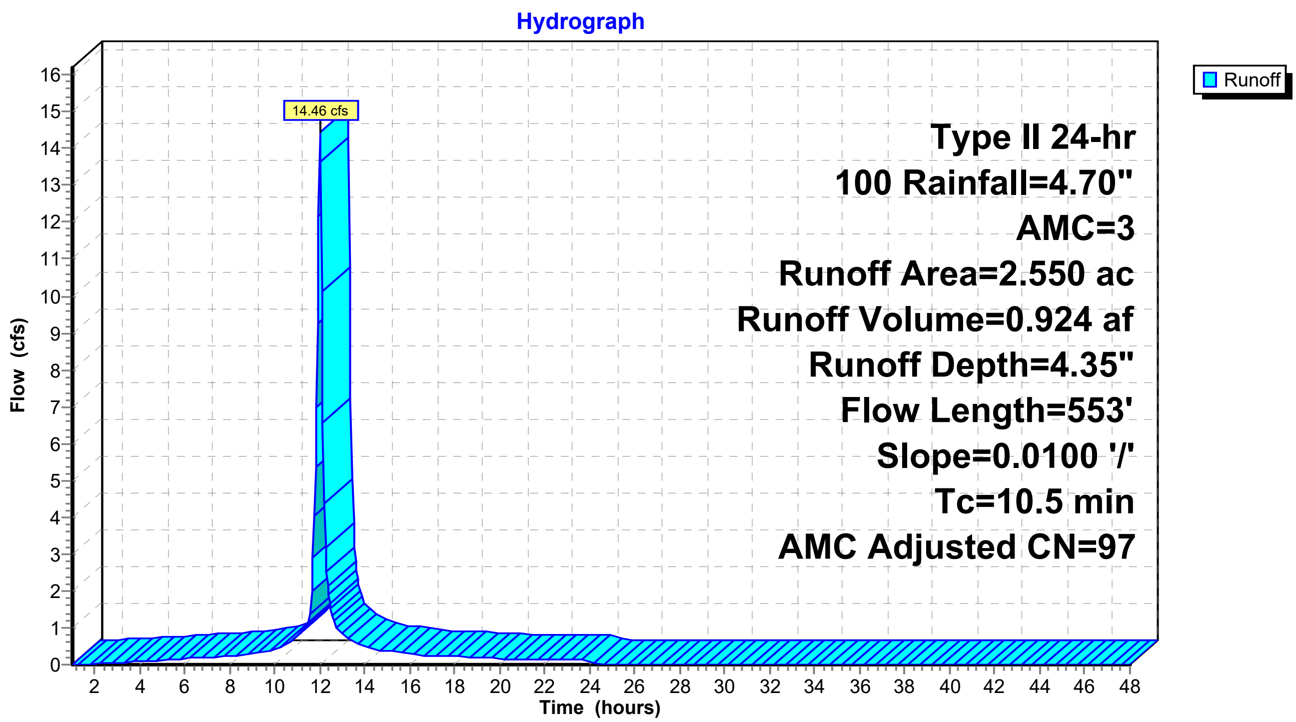
Runoff = 14.46 cfs @ 12.01 hrs, Volume= 0.924 af, Depth= 4.35"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 100 Rainfall=4.70", AMC=3

	Area (ac)	CN	Adj	Description
*	2.170	98		
*	0.380	56		
	2.550	92	97	Weighted Average, AMC Adjusted
	0.380			14.90% Pervious Area
	2.170			85.10% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.6	300	0.0100	0.89		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 1.49"
4.9	253	0.0100	0.86		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 1.49"
10.5	553	Total			

Subcatchment 6S: F



Summary for Subcatchment 7S: G

[49] Hint: Tc<2dt may require smaller dt

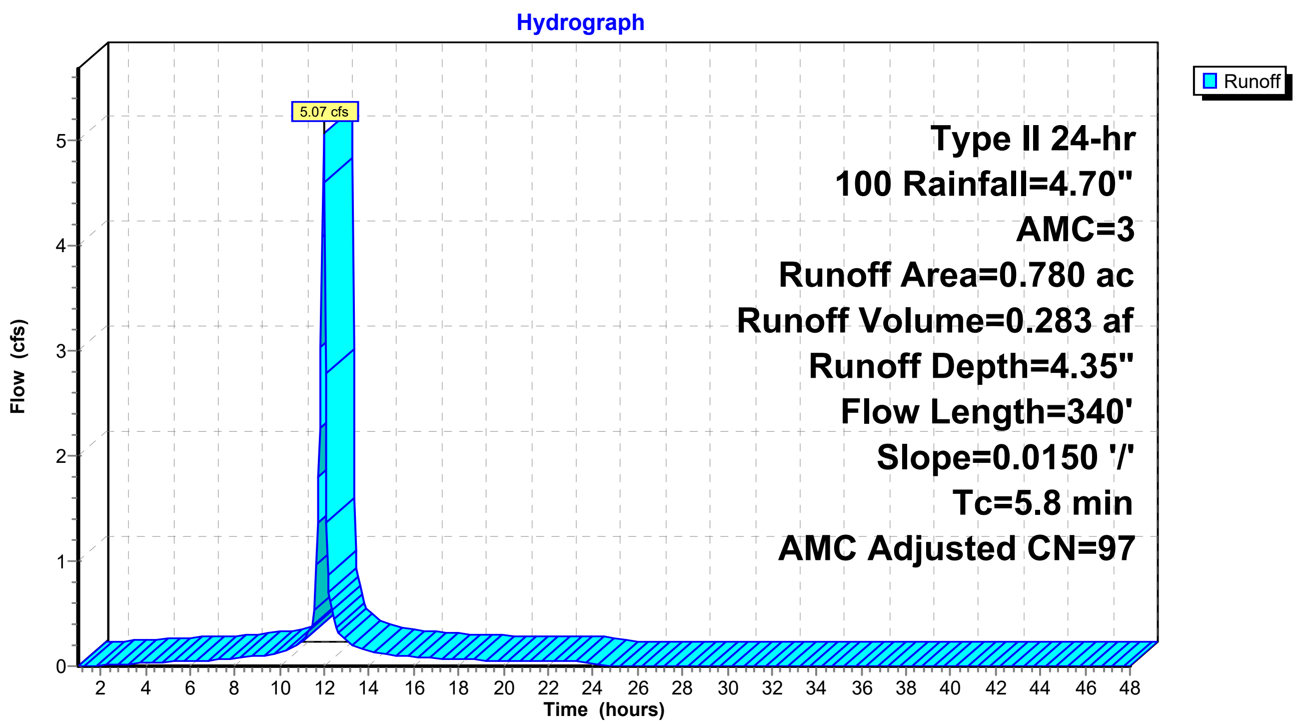
Runoff = 5.07 cfs @ 11.96 hrs, Volume= 0.283 af, Depth= 4.35"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 100 Rainfall=4.70", AMC=3

	Area (ac)	CN	Adj	Description
*	0.660	98		
*	0.120	56		
	0.780	92	97	Weighted Average, AMC Adjusted
	0.120			15.38% Pervious Area
	0.660			84.62% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.8	300	0.0150	1.04		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 1.49"
1.0	40	0.0150	0.70		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 1.49"
5.8	340	Total			

Subcatchment 7S: G



Summary for Subcatchment 8S: H

[49] Hint: Tc<2dt may require smaller dt

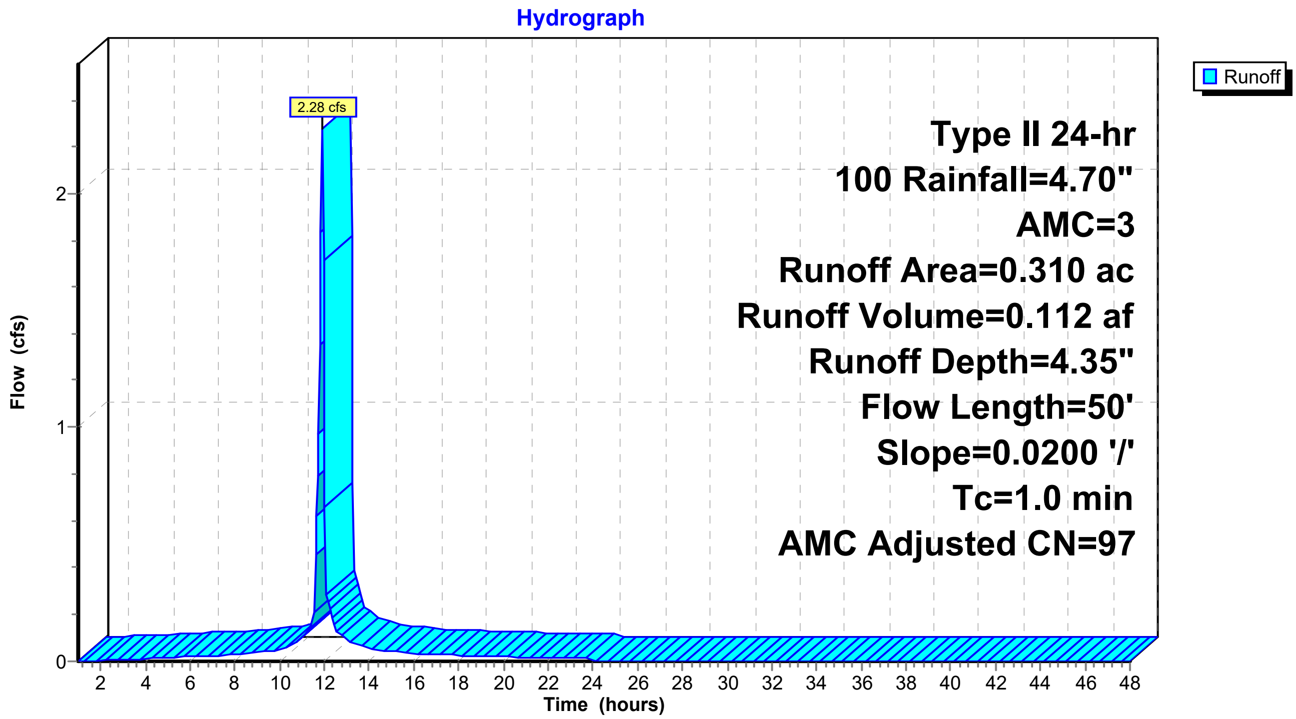
Runoff = 2.28 cfs @ 11.90 hrs, Volume= 0.112 af, Depth= 4.35"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 100 Rainfall=4.70", AMC=3

	Area (ac)	CN	Adj	Description
*	0.260	98		
*	0.050	56		
	0.310	91	97	Weighted Average, AMC Adjusted
	0.050			16.13% Pervious Area
	0.260			83.87% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.0	50	0.0200	0.82		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 1.49"

Subcatchment 8S: H



Summary for Subcatchment 9S: I

[49] Hint: Tc<2dt may require smaller dt

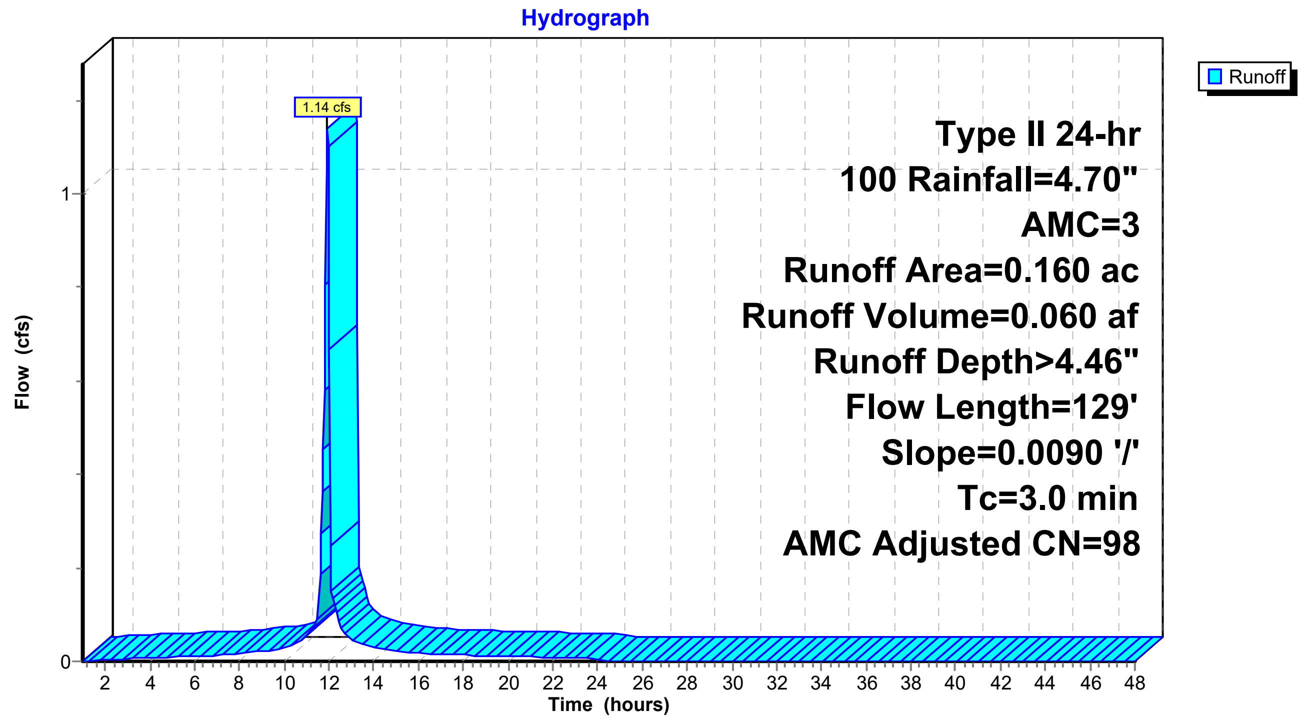
Runoff = 1.14 cfs @ 11.93 hrs, Volume= 0.060 af, Depth> 4.46"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 100 Rainfall=4.70", AMC=3

	Area (ac)	CN	Adj	Description
*	0.140	98		
*	0.020	56		
	0.160	93	98	Weighted Average, AMC Adjusted
	0.020			12.50% Pervious Area
	0.140			87.50% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.0	129	0.0090	0.72		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 1.49"

Subcatchment 9S: I



Summary for Subcatchment 10S: J

[49] Hint: Tc<2dt may require smaller dt

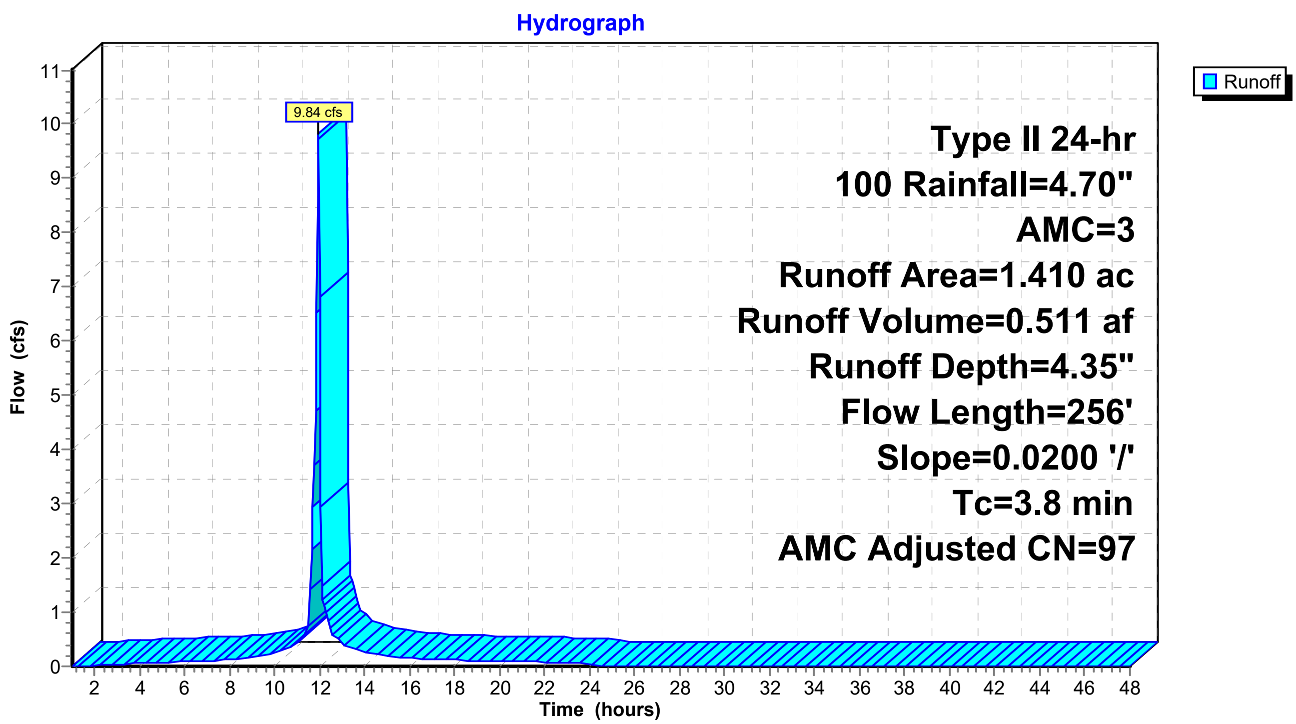
Runoff = 9.84 cfs @ 11.94 hrs, Volume= 0.511 af, Depth= 4.35"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 100 Rainfall=4.70", AMC=3

	Area (ac)	CN	Adj	Description
*	1.200	98		
*	0.210	56		
	1.410	92	97	Weighted Average, AMC Adjusted
	0.210			14.89% Pervious Area
	1.200			85.11% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.8	256	0.0200	1.13		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 1.49"

Subcatchment 10S: J



Summary for Subcatchment 11S: K

[49] Hint: Tc<2dt may require smaller dt

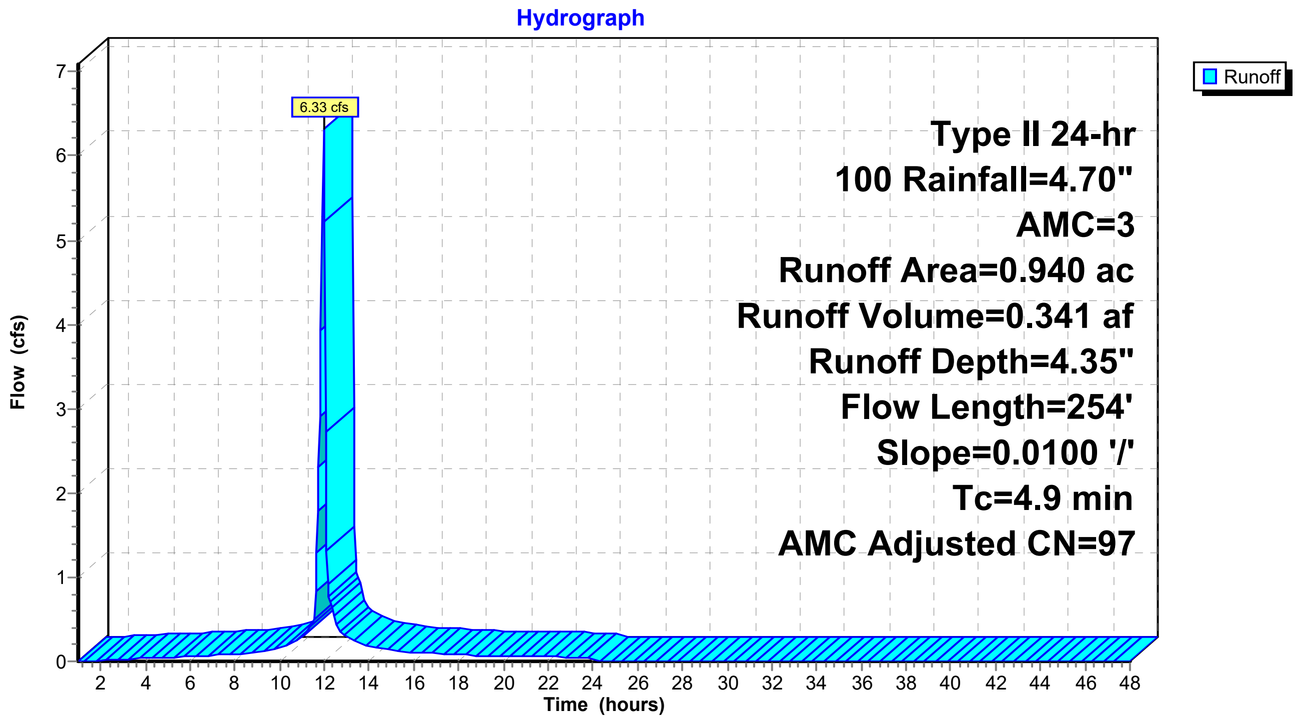
Runoff = 6.33 cfs @ 11.95 hrs, Volume= 0.341 af, Depth= 4.35"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 100 Rainfall=4.70", AMC=3

	Area (ac)	CN	Adj	Description
*	0.800	98		
*	0.140	56		
	0.940	92	97	Weighted Average, AMC Adjusted
	0.140			14.89% Pervious Area
	0.800			85.11% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.9	254	0.0100	0.86		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 1.49"

Subcatchment 11S: K



Summary for Subcatchment 12S: L

[49] Hint: Tc<2dt may require smaller dt

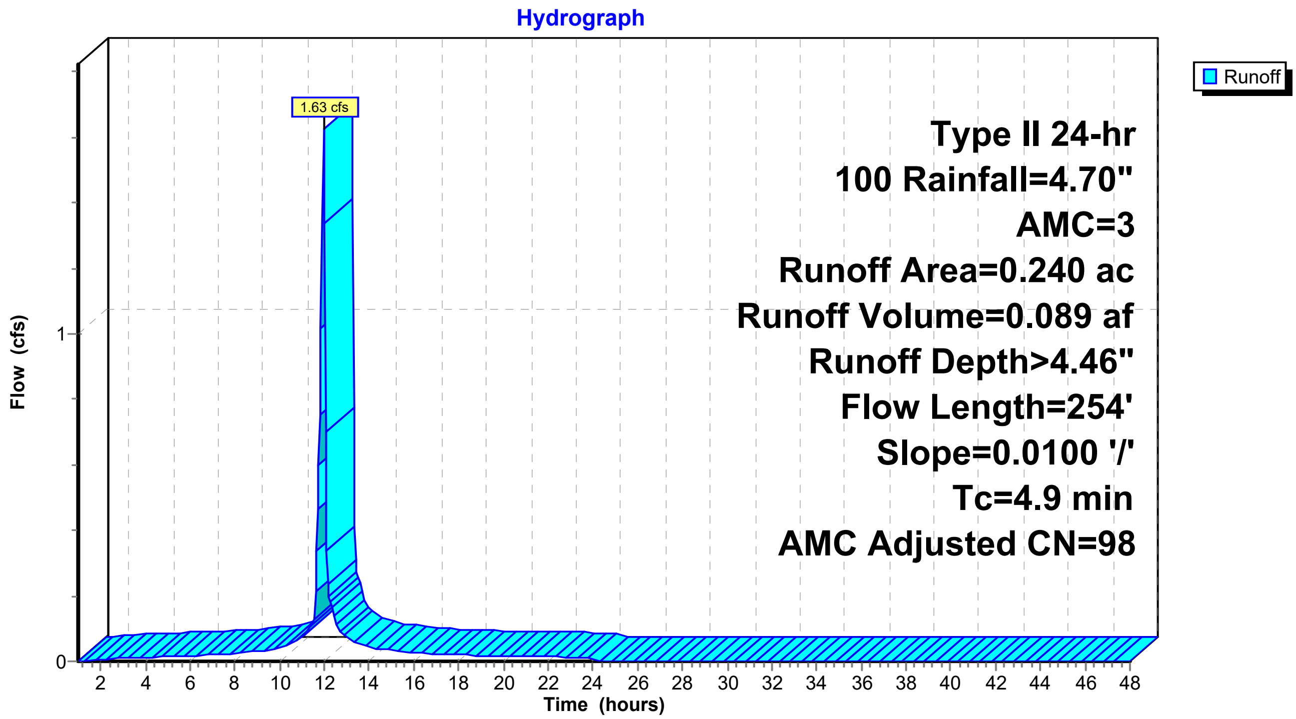
Runoff = 1.63 cfs @ 11.95 hrs, Volume= 0.089 af, Depth> 4.46"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 100 Rainfall=4.70", AMC=3

	Area (ac)	CN	Adj	Description
*	0.210	98		
*	0.030	56		
	0.240	93	98	Weighted Average, AMC Adjusted
	0.030			12.50% Pervious Area
	0.210			87.50% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.9	254	0.0100	0.86		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 1.49"

Subcatchment 12S: L



Summary for Subcatchment 13S: M

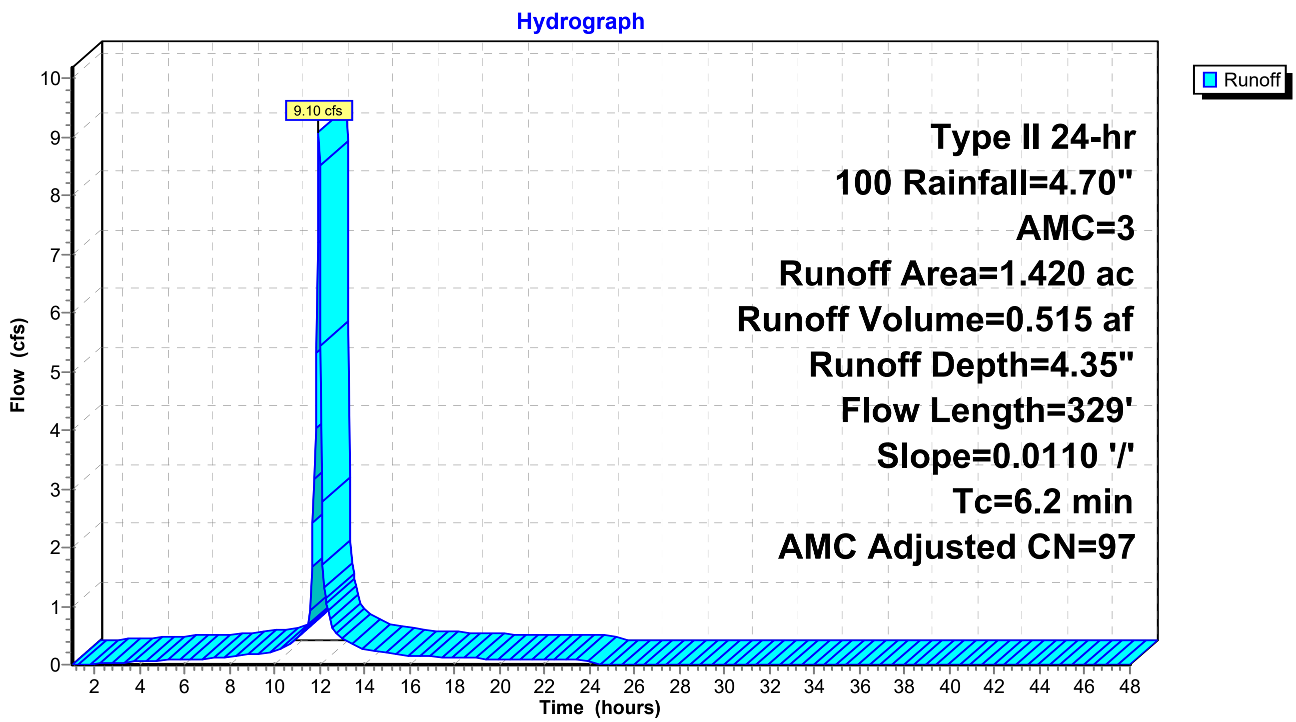
Runoff = 9.10 cfs @ 11.96 hrs, Volume= 0.515 af, Depth= 4.35"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 100 Rainfall=4.70", AMC=3

	Area (ac)	CN	Adj	Description
*	1.210	98		
*	0.210	56		
	1.420	92	97	Weighted Average, AMC Adjusted
	0.210			14.79% Pervious Area
	1.210			85.21% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.4	300	0.0110	0.92		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 1.49"
0.8	29	0.0110	0.58		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 1.49"
6.2	329	Total			

Subcatchment 13S: M



Summary for Subcatchment 14S: N

[49] Hint: Tc<2dt may require smaller dt

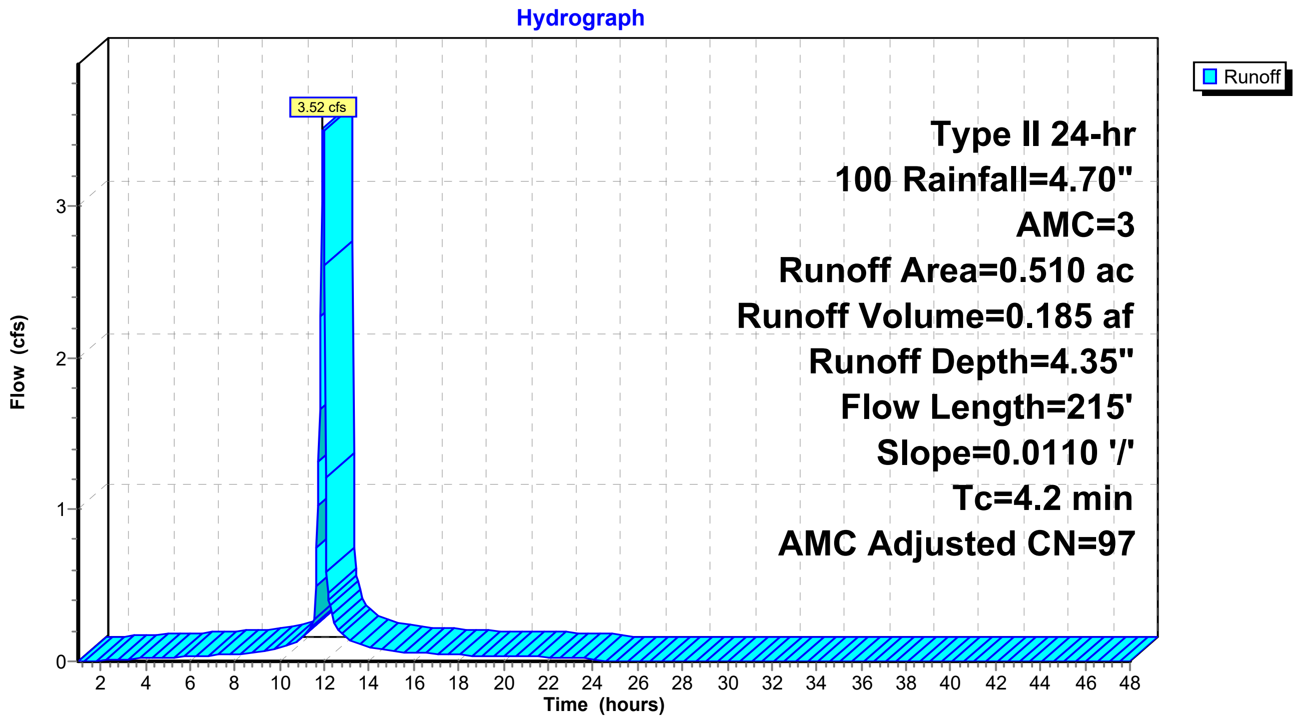
Runoff = 3.52 cfs @ 11.94 hrs, Volume= 0.185 af, Depth= 4.35"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 100 Rainfall=4.70", AMC=3

	Area (ac)	CN	Adj	Description
*	0.430	98		
*	0.080	56		
	0.510	91	97	Weighted Average, AMC Adjusted
	0.080			15.69% Pervious Area
	0.430			84.31% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.2	215	0.0110	0.86		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 1.49"

Subcatchment 14S: N



Summary for Subcatchment 15S: O

[49] Hint: Tc<2dt may require smaller dt

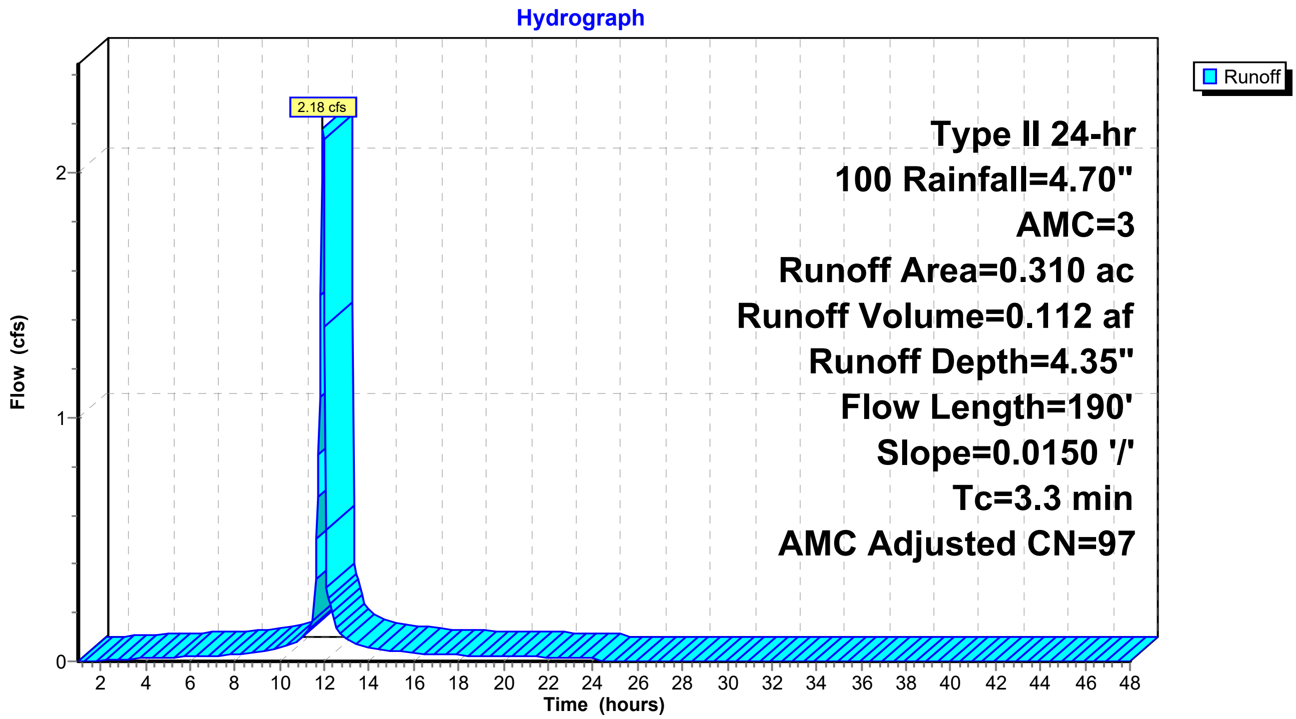
Runoff = 2.18 cfs @ 11.93 hrs, Volume= 0.112 af, Depth= 4.35"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 100 Rainfall=4.70", AMC=3

	Area (ac)	CN	Adj	Description
*	0.260	98		
*	0.050	56		
	0.310	91	97	Weighted Average, AMC Adjusted
	0.050			16.13% Pervious Area
	0.260			83.87% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.3	190	0.0150	0.95		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 1.49"

Subcatchment 15S: O



Summary for Subcatchment 16S: P

[49] Hint: Tc<2dt may require smaller dt

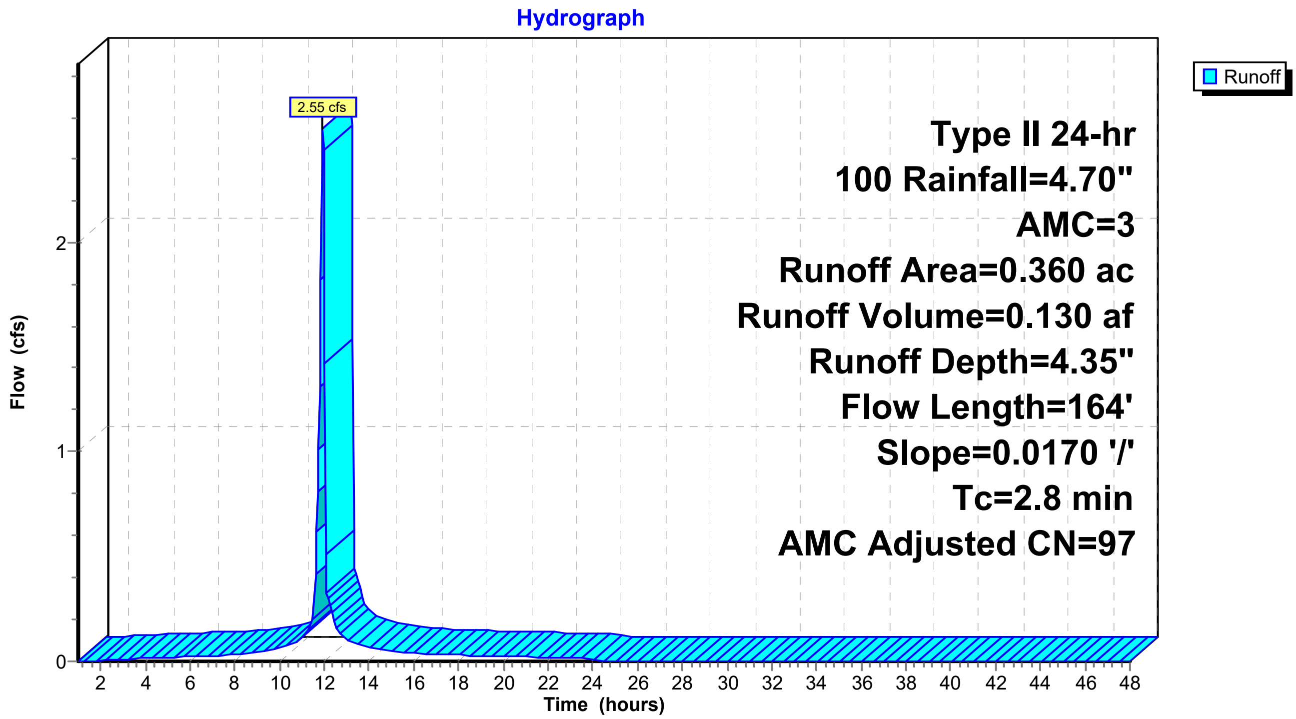
Runoff = 2.55 cfs @ 11.93 hrs, Volume= 0.130 af, Depth= 4.35"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 100 Rainfall=4.70", AMC=3

	Area (ac)	CN	Adj	Description
*	0.300	98		
*	0.060	56		
	0.360	91	97	Weighted Average, AMC Adjusted
	0.060			16.67% Pervious Area
	0.300			83.33% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.8	164	0.0170	0.97		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 1.49"

Subcatchment 16S: P



Summary for Subcatchment 17S: S

[49] Hint: Tc<2dt may require smaller dt

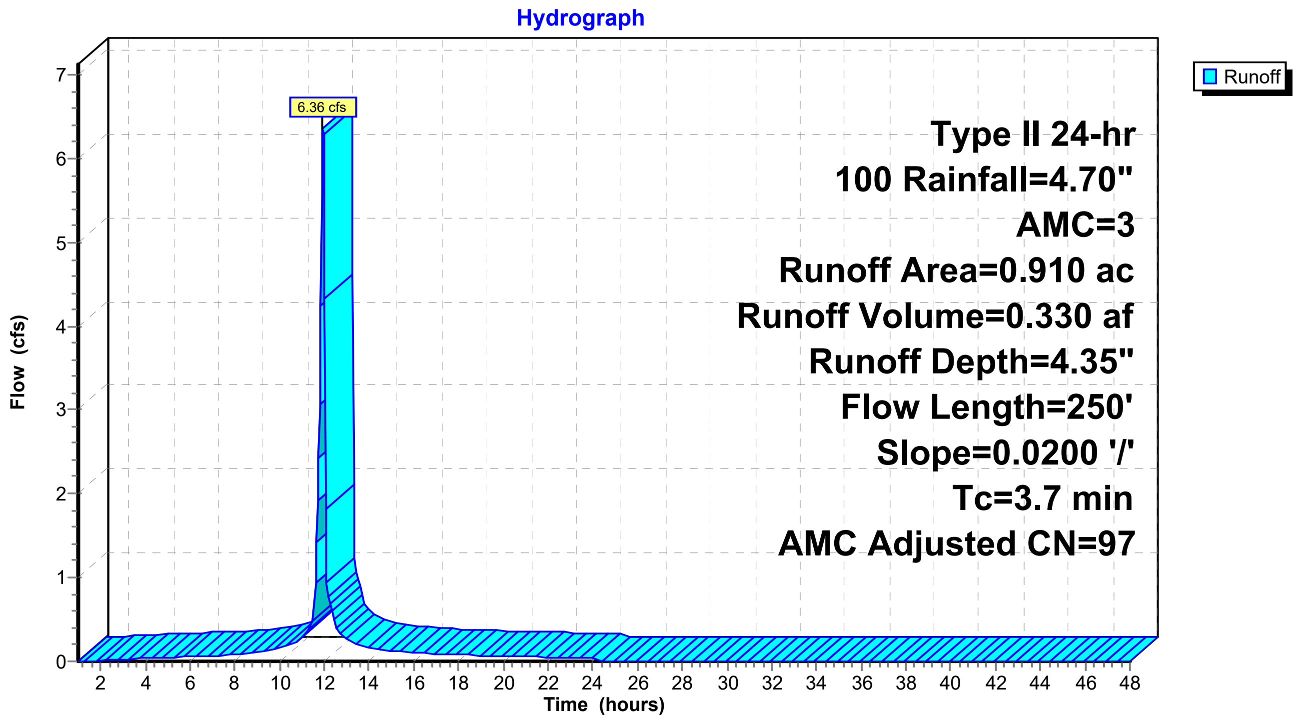
Runoff = 6.36 cfs @ 11.94 hrs, Volume= 0.330 af, Depth= 4.35"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 100 Rainfall=4.70", AMC=3

	Area (ac)	CN	Adj	Description
*	0.770	98		
*	0.140	56		
	0.910	92	97	Weighted Average, AMC Adjusted
	0.140			15.38% Pervious Area
	0.770			84.62% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.7	250	0.0200	1.13		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 1.49"

Subcatchment 17S: S



Summary for Subcatchment 18S: Q

[49] Hint: Tc<2dt may require smaller dt

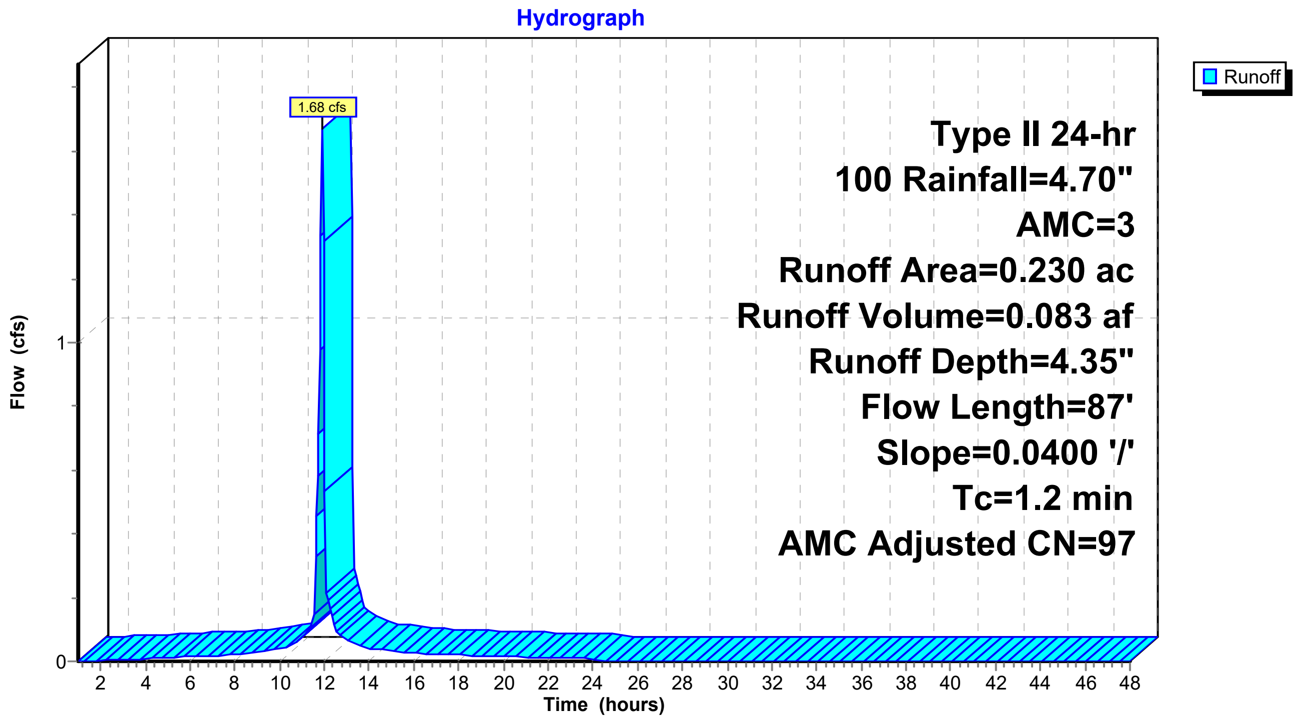
Runoff = 1.68 cfs @ 11.90 hrs, Volume= 0.083 af, Depth= 4.35"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 100 Rainfall=4.70", AMC=3

	Area (ac)	CN	Adj	Description
*	0.190	98		
*	0.040	56		
	0.230	91	97	Weighted Average, AMC Adjusted
	0.040			17.39% Pervious Area
	0.190			82.61% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	87	0.0400	1.20		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 1.49"

Subcatchment 18S: Q



Summary for Subcatchment 19S: R

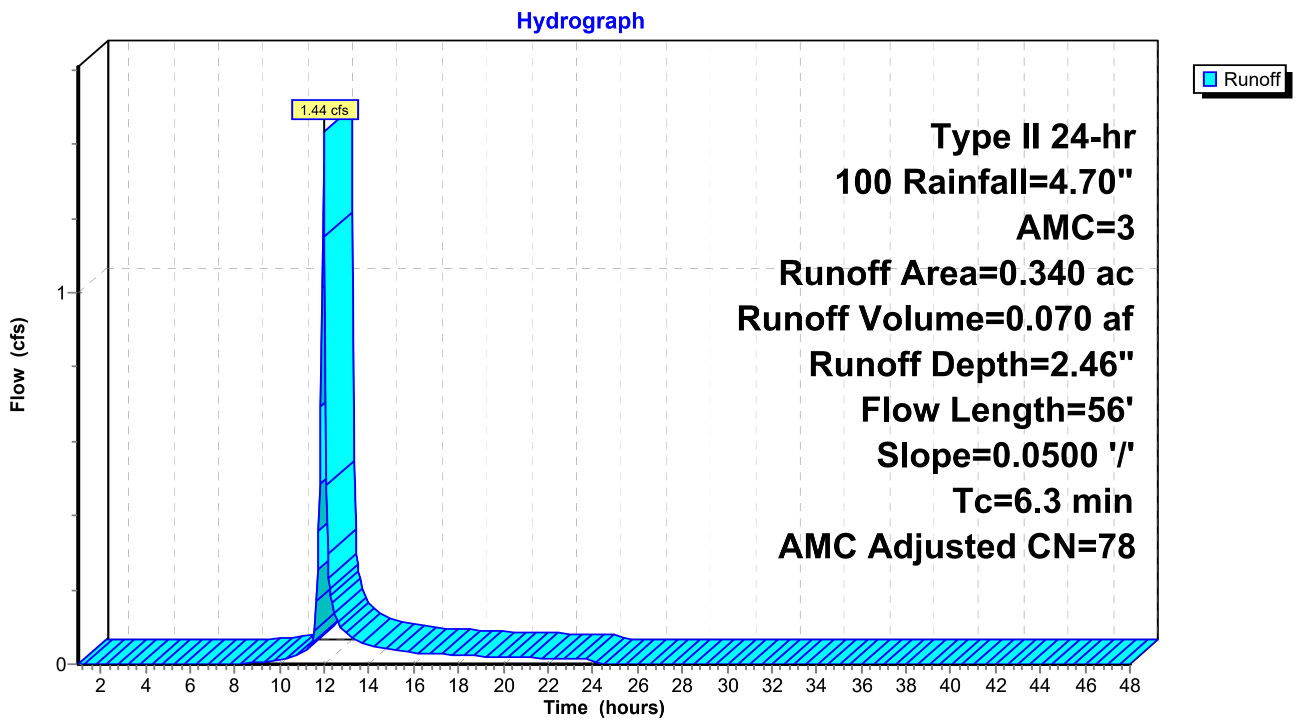
Runoff = 1.44 cfs @ 11.98 hrs, Volume= 0.070 af, Depth= 2.46"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 100 Rainfall=4.70", AMC=3

	Area (ac)	CN	Adj	Description
*	0.030	98		
*	0.310	56		
	0.340	60	78	Weighted Average, AMC Adjusted
	0.310			91.18% Pervious Area
	0.030			8.82% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.3	56	0.0500	0.15		**Sheet Flow,** Grass: Short n= 0.150 P2= 1.49"

Subcatchment 19S: R



Summary for Subcatchment 50S: T

[49] Hint: Tc<2dt may require smaller dt

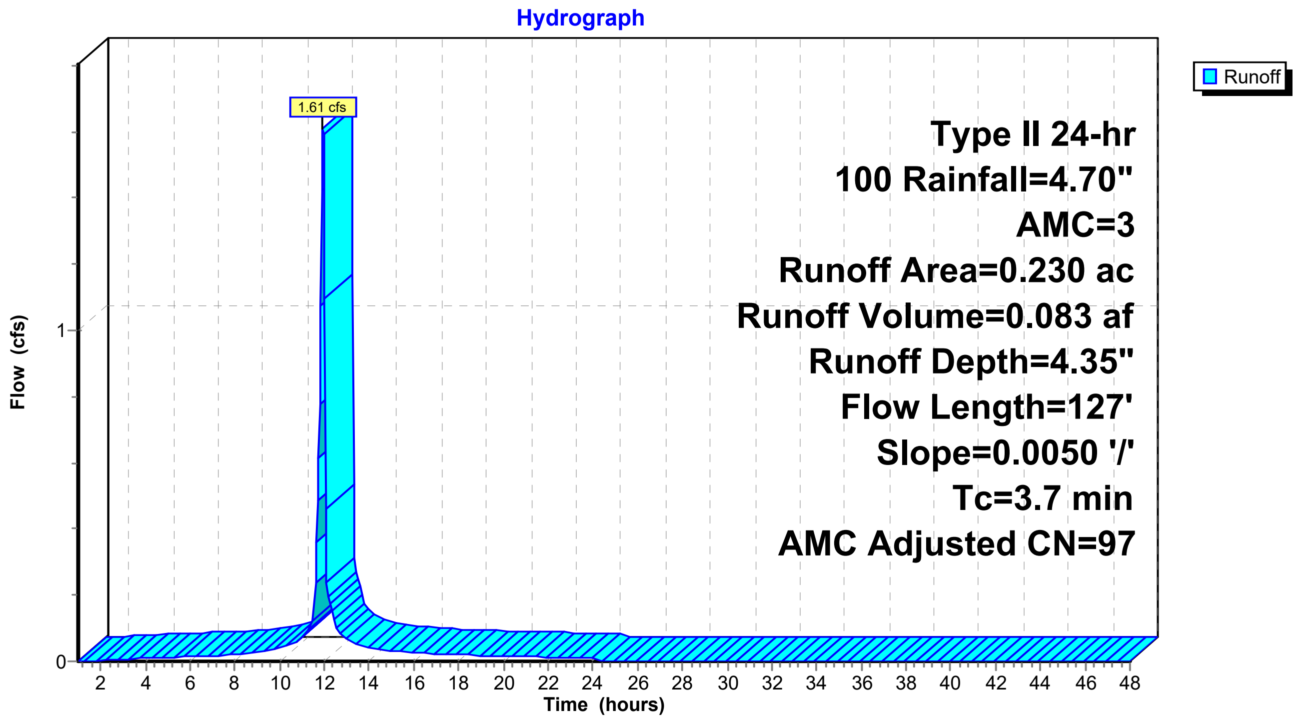
Runoff = 1.61 cfs @ 11.94 hrs, Volume= 0.083 af, Depth= 4.35"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 100 Rainfall=4.70", AMC=3

	Area (ac)	CN	Adj	Description
*	0.190	98		
*	0.040	56		
	0.230	91	97	Weighted Average, AMC Adjusted
	0.040			17.39% Pervious Area
	0.190			82.61% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.7	127	0.0050	0.57		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 1.49"

Subcatchment 50S: T



Summary for Subcatchment 52S: U

[49] Hint: Tc<2dt may require smaller dt

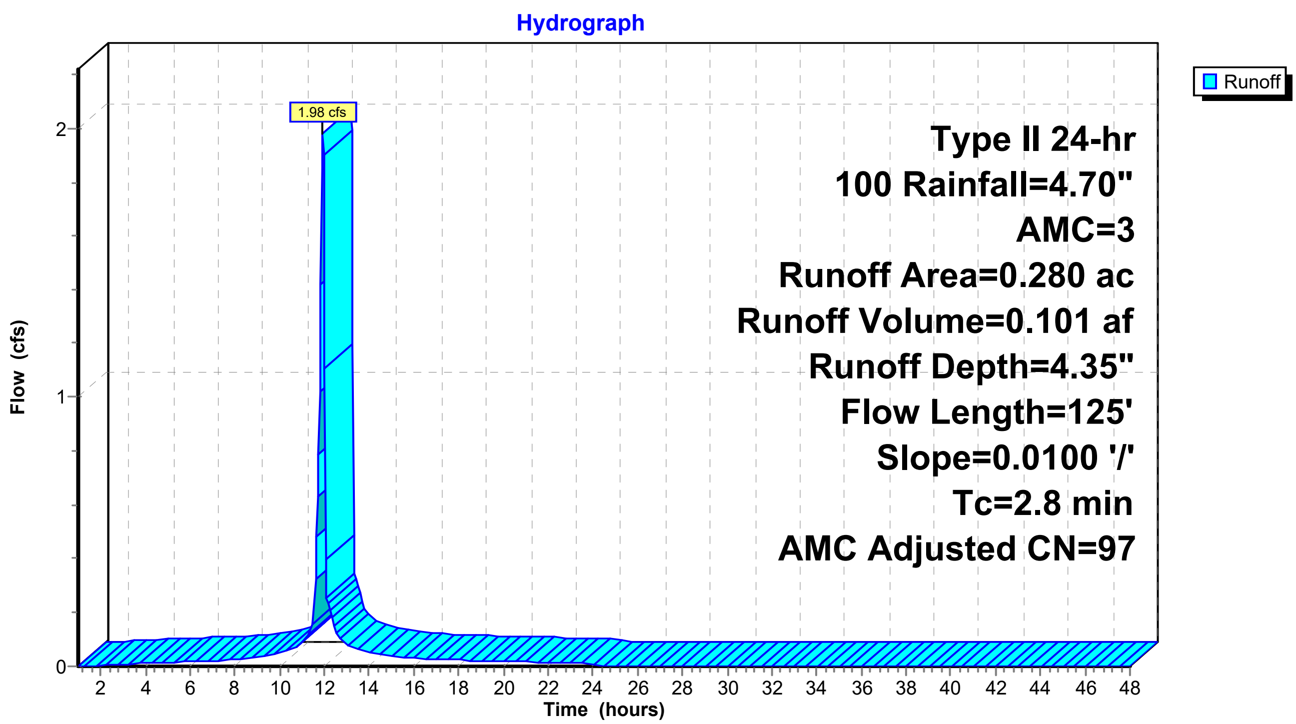
Runoff = 1.98 cfs @ 11.93 hrs, Volume= 0.101 af, Depth= 4.35"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 100 Rainfall=4.70", AMC=3

	Area (ac)	CN	Adj	Description
*	0.240	98		
*	0.040	56		
	0.280	92	97	Weighted Average, AMC Adjusted
	0.040			14.29% Pervious Area
	0.240			85.71% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.8	125	0.0100	0.74		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 1.49"

Subcatchment 52S: U



Summary for Subcatchment 55S: V

[49] Hint: Tc<2dt may require smaller dt

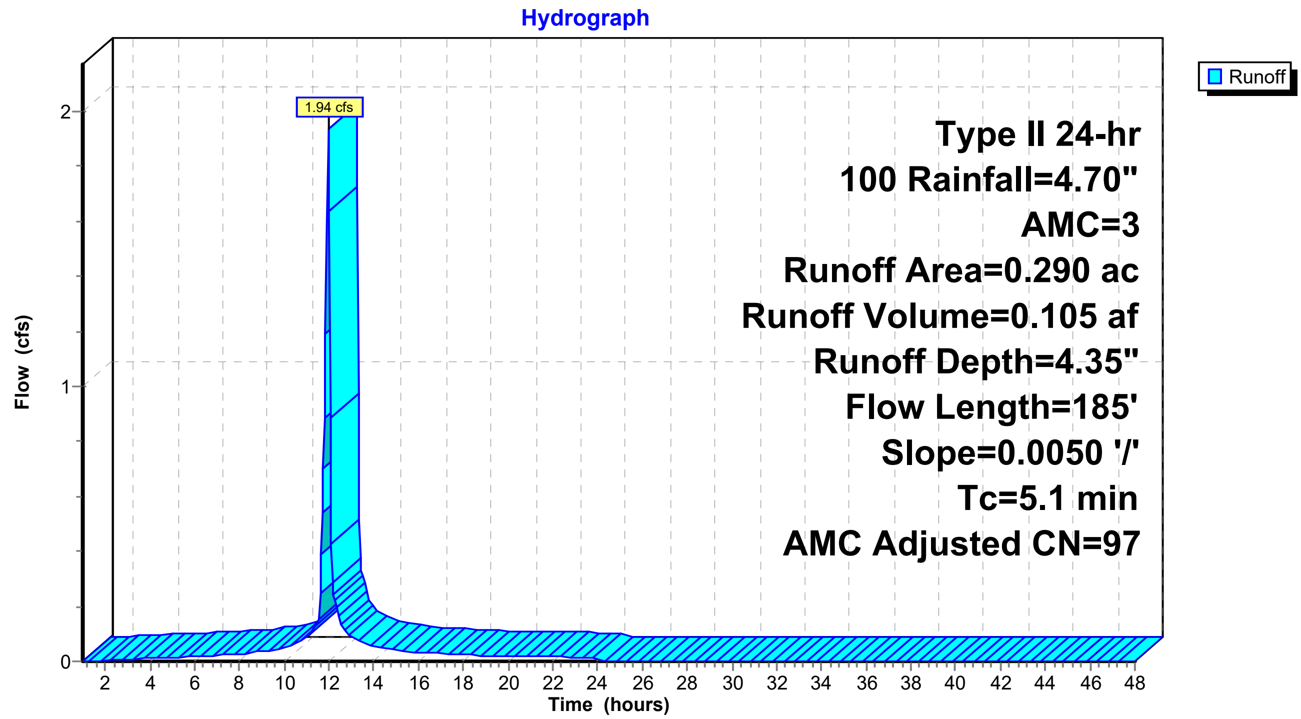
Runoff = 1.94 cfs @ 11.95 hrs, Volume= 0.105 af, Depth= 4.35"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 100 Rainfall=4.70", AMC=3

	Area (ac)	CN	Adj	Description
*	0.250	98		
*	0.040	56		
	0.290	92	97	Weighted Average, AMC Adjusted
	0.040			13.79% Pervious Area
	0.250			86.21% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.1	185	0.0050	0.61		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 1.49"

Subcatchment 55S: V



Summary for Reach 46R: REGIONAL SD

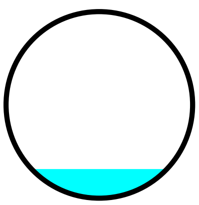
[52] Hint: Inlet/Outlet conditions not evaluated

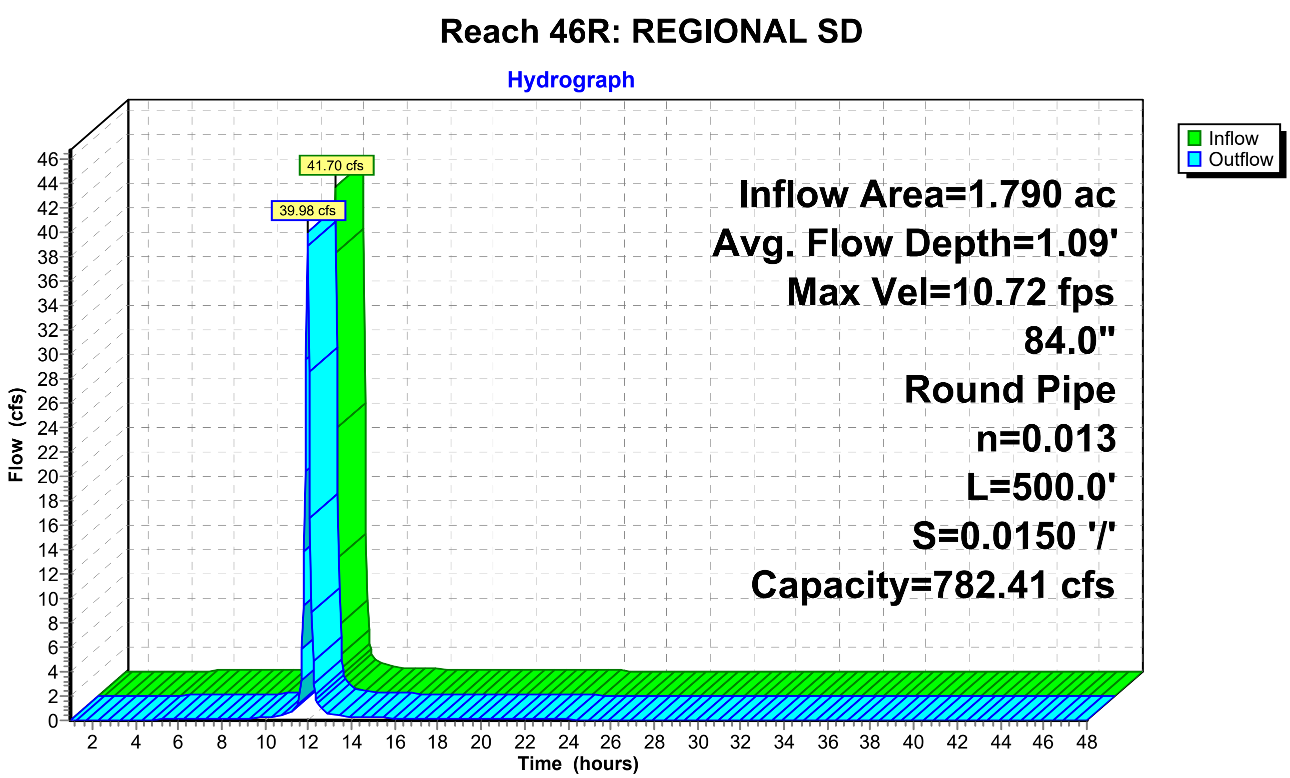
Inflow Area = 1.790 ac, 69.83% Impervious, Inflow Depth = 8.55" for 100 event
Inflow = 41.70 cfs @ 11.95 hrs, Volume= 1.275 af
Outflow = 39.98 cfs @ 11.98 hrs, Volume= 1.275 af, Atten= 4%, Lag= 1.4 min

Routing by Stor-Ind+Trans method, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Max. Velocity= 10.72 fps, Min. Travel Time= 0.8 min
Avg. Velocity = 2.26 fps, Avg. Travel Time= 3.7 min

Peak Storage= 1,910 cf @ 11.96 hrs
Average Depth at Peak Storage= 1.09'
Bank-Full Depth= 7.00' Flow Area= 38.5 sf, Capacity= 782.41 cfs

84.0" Round Pipe
n= 0.013
Length= 500.0' Slope= 0.0150 '/'
Inlet Invert= 25.10', Outlet Invert= 17.60'





Summary for Pond 20P: DT-1

Inflow Area = 1.780 ac, 84.83% Impervious, Inflow Depth = 4.35" for 100 event
Inflow = 11.45 cfs @ 11.95 hrs, Volume= 0.645 af
Outflow = 0.20 cfs @ 16.05 hrs, Volume= 0.645 af, Atten= 98%, Lag= 246.0 min
Discarded = 0.20 cfs @ 16.05 hrs, Volume= 0.645 af

Routing by Stor-Ind method, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 35.45' @ 16.05 hrs Surf.Area= 0.210 ac Storage= 0.396 af

Plug-Flow detention time= 802.8 min calculated for 0.644 af (100% of inflow)
Center-of-Mass det. time= 803.4 min (1,556.1 - 752.7)

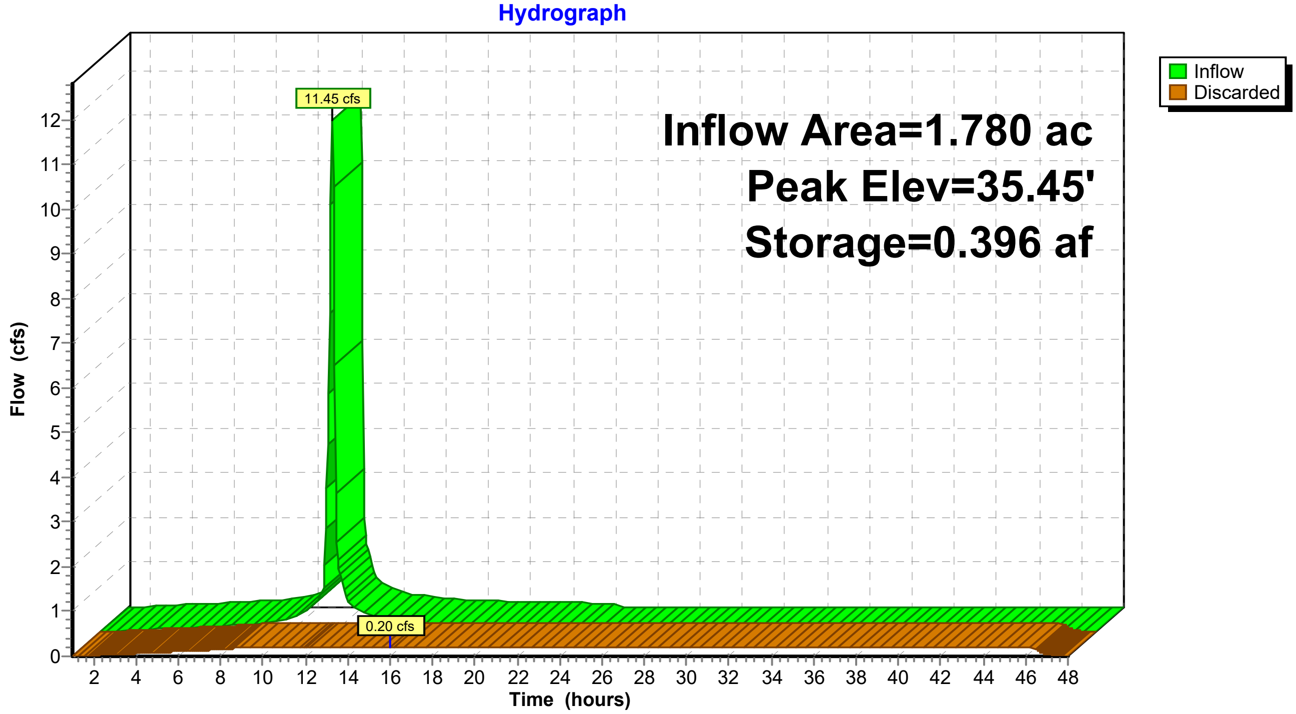
Volume	Invert	Avail.Storage	Storage Description
#1	33.50'	0.509 af	**Custom Stage Data (Irregular)** Listed below (Recalc) 0.525 af Overall x 97.0% Voids

Elevation (feet)	Surf.Area (acres)	Perim. (feet)	Inc.Store (acre-feet)	Cum.Store (acre-feet)	Wet.Area (acres)
33.50	0.210	402.0	0.000	0.000	0.210
36.00	0.210	402.0	0.525	0.525	0.233

Device	Routing	Invert	Outlet Devices
#1	Discarded	33.50'	**0.850 in/hr Exfiltration over Wetted area**

Discarded OutFlow Max=0.20 cfs @ 16.05 hrs HW=35.45' (Free Discharge)
└—**1=Exfiltration** (Exfiltration Controls 0.20 cfs)

Pond 20P: DT-1


Hydrograph
Inflow
Discarded
11.45 cfs
0.20 cfs
Inflow Area=1.780 ac
Peak Elev=35.45'
Storage=0.396 af
Flow (cfs)
0
1
2
3
4
5
6
7
8
9
10
11
12
2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48
Time (hours)

Summary for Pond 22P: CB-P

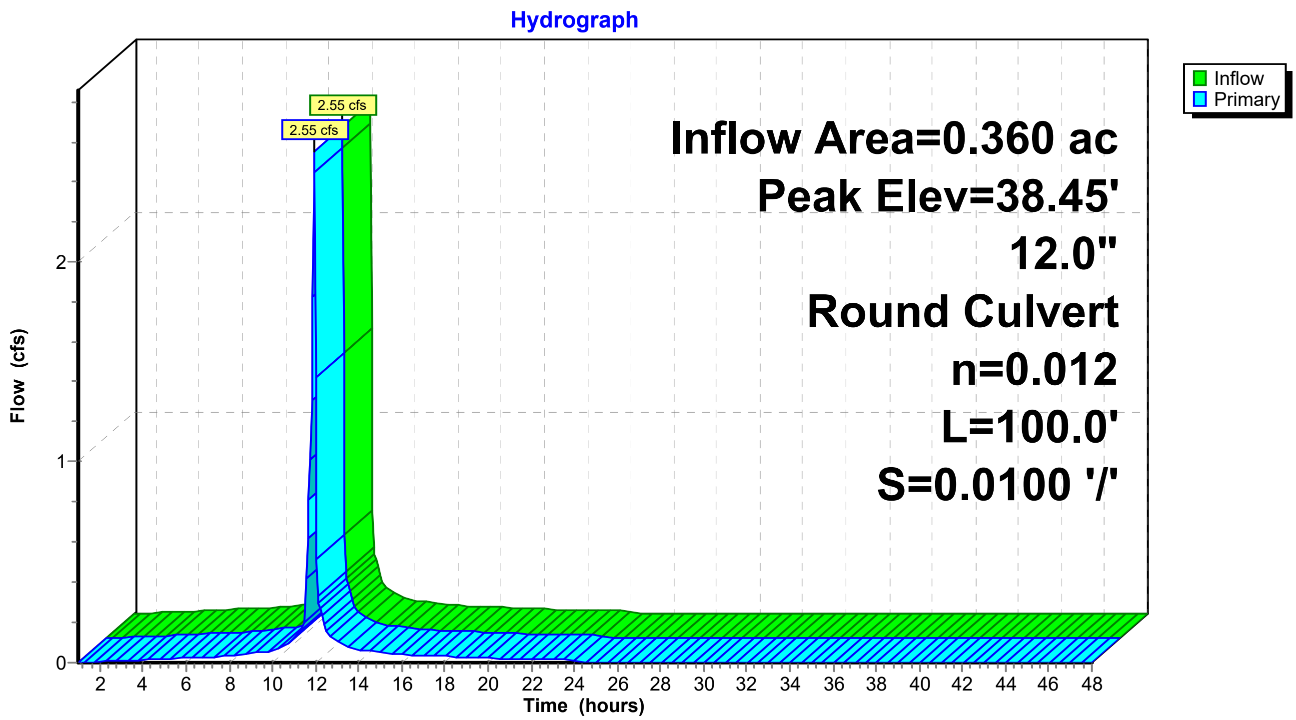
Inflow Area = 0.360 ac, 83.33% Impervious, Inflow Depth = 4.35" for 100 event
Inflow = 2.55 cfs @ 11.93 hrs, Volume= 0.130 af
Outflow = 2.55 cfs @ 11.93 hrs, Volume= 0.130 af, Atten= 0%, Lag= 0.0 min
Primary = 2.55 cfs @ 11.93 hrs, Volume= 0.130 af

Routing by Stor-Ind method, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 38.45' @ 11.93 hrs
Flood Elev= 40.50'

Device	Routing	Invert	Outlet Devices
#1	Primary	37.00'	**12.0" Round Culvert** L= 100.0' Ke= 1.200 Inlet / Outlet Invert= 37.00' / 36.00' S= 0.0100 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf

Primary OutFlow Max=2.41 cfs @ 11.93 hrs HW=38.38' (Free Discharge)
└─1=Culvert (Inlet Controls 2.41 cfs @ 3.07 fps)

Pond 22P: CB-P



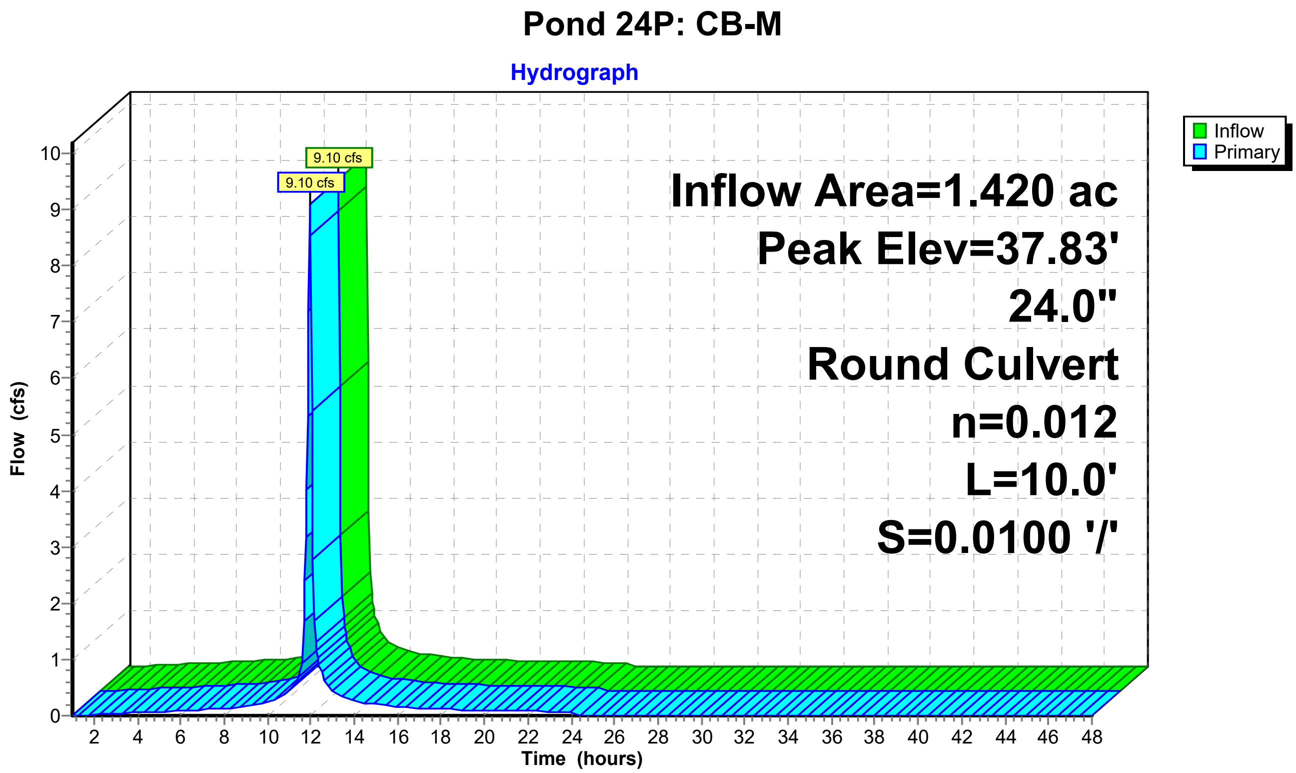
Summary for Pond 24P: CB-M

Inflow Area = 1.420 ac, 85.21% Impervious, Inflow Depth = 4.35" for 100 event
Inflow = 9.10 cfs @ 11.96 hrs, Volume= 0.515 af
Outflow = 9.10 cfs @ 11.96 hrs, Volume= 0.515 af, Atten= 0%, Lag= 0.0 min
Primary = 9.10 cfs @ 11.96 hrs, Volume= 0.515 af

Routing by Stor-Ind method, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 37.83' @ 11.96 hrs
Flood Elev= 40.89'

Device	Routing	Invert	Outlet Devices
#1	Primary	36.00'	**24.0" Round Culvert** L= 10.0' Ke= 1.200 Inlet / Outlet Invert= 36.00' / 35.90' S= 0.0100 '/' Cc= 0.900 n= 0.012, Flow Area= 3.14 sf

Primary OutFlow Max=8.86 cfs @ 11.96 hrs HW=37.80' (Free Discharge)
↑—**1=Culvert** (Barrel Controls 8.86 cfs @ 3.93 fps)



Summary for Pond 26P: CB-N

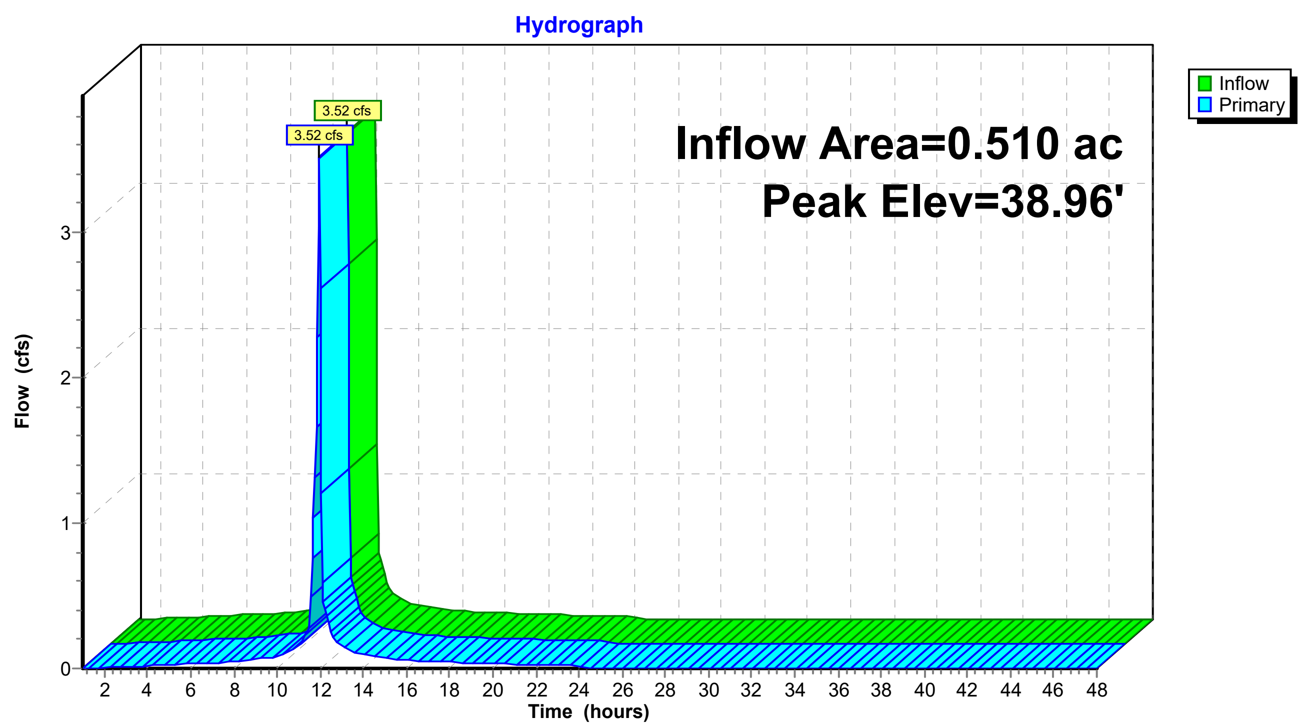
Inflow Area =	0.510 ac,	84.31% Impervious,	Inflow Depth = 4.35"	for 100 event
Inflow =	3.52 cfs @	11.94 hrs, Volume=	0.185 af	
Outflow =	3.52 cfs @	11.94 hrs, Volume=	0.185 af,	Atten= 0%, Lag= 0.0 min
Primary =	3.52 cfs @	11.94 hrs, Volume=	0.185 af	

Routing by Stor-Ind method, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 38.96' @ 11.94 hrs
Flood Elev= 39.50'

Device	Routing	Invert	Outlet Devices
#1	Primary	39.57'	**12.0" x 12.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#2	Primary	36.60'	**12.0" Round Culvert** L= 10.0' Ke= 1.200 Inlet / Outlet Invert= 36.60' / 36.50' S= 0.0100 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf

Primary OutFlow Max=3.43 cfs @ 11.94 hrs HW=38.87' (Free Discharge)
1=Orifice/Grate (Controls 0.00 cfs)
2=Culvert (Inlet Controls 3.43 cfs @ 4.37 fps)

Pond 26P: CB-N



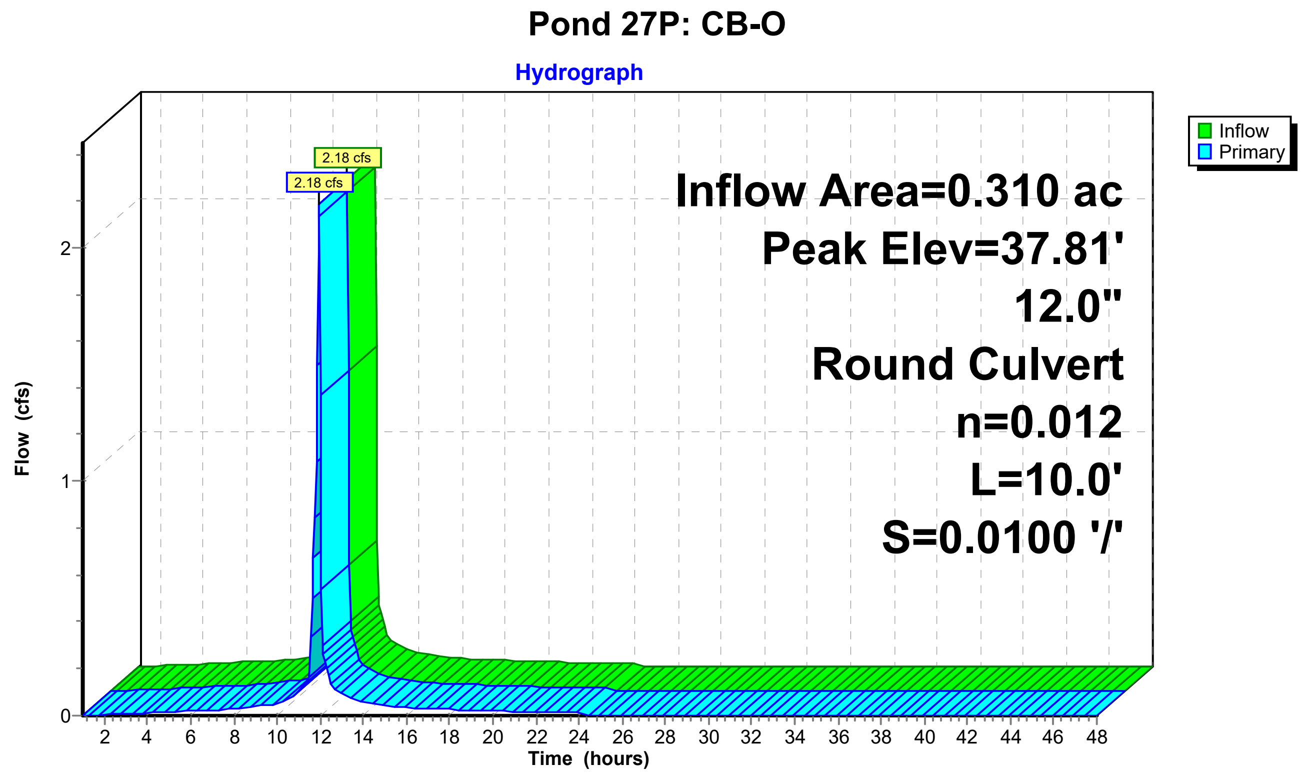
Summary for Pond 27P: CB-O

Inflow Area =	0.310 ac,	83.87% Impervious, Inflow Depth = 4.35" for 100 event		
Inflow =	2.18 cfs @	11.93 hrs, Volume=	0.112 af	
Outflow =	2.18 cfs @	11.93 hrs, Volume=	0.112 af,	Atten= 0%, Lag= 0.0 min
Primary =	2.18 cfs @	11.93 hrs, Volume=	0.112 af	

Routing by Stor-Ind method, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 37.81' @ 11.94 hrs
Flood Elev= 39.50'

Device	Routing	Invert	Outlet Devices
#1	Primary	36.60'	**12.0" Round Culvert** L= 10.0' Ke= 1.200 Inlet / Outlet Invert= 36.60' / 36.50' S= 0.0100 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf

Primary OutFlow Max=2.08 cfs @ 11.93 hrs HW=37.75' (Free Discharge)
↑—**1=Culvert** (Inlet Controls 2.08 cfs @ 2.65 fps)



Summary for Pond 28P: DT-2

Inflow Area = 1.060 ac, 84.91% Impervious, Inflow Depth > 4.37" for 100 event
Inflow = 7.31 cfs @ 11.94 hrs, Volume= 0.386 af
Outflow = 0.12 cfs @ 16.06 hrs, Volume= 0.377 af, Atten= 98%, Lag= 247.3 min
Discarded = 0.12 cfs @ 16.06 hrs, Volume= 0.377 af

Routing by Stor-Ind method, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 33.76' @ 16.06 hrs Surf.Area= 0.110 ac Storage= 0.241 af

Plug-Flow detention time= 834.2 min calculated for 0.377 af (98% of inflow)
Center-of-Mass det. time= 819.6 min (1,569.1 - 749.5)

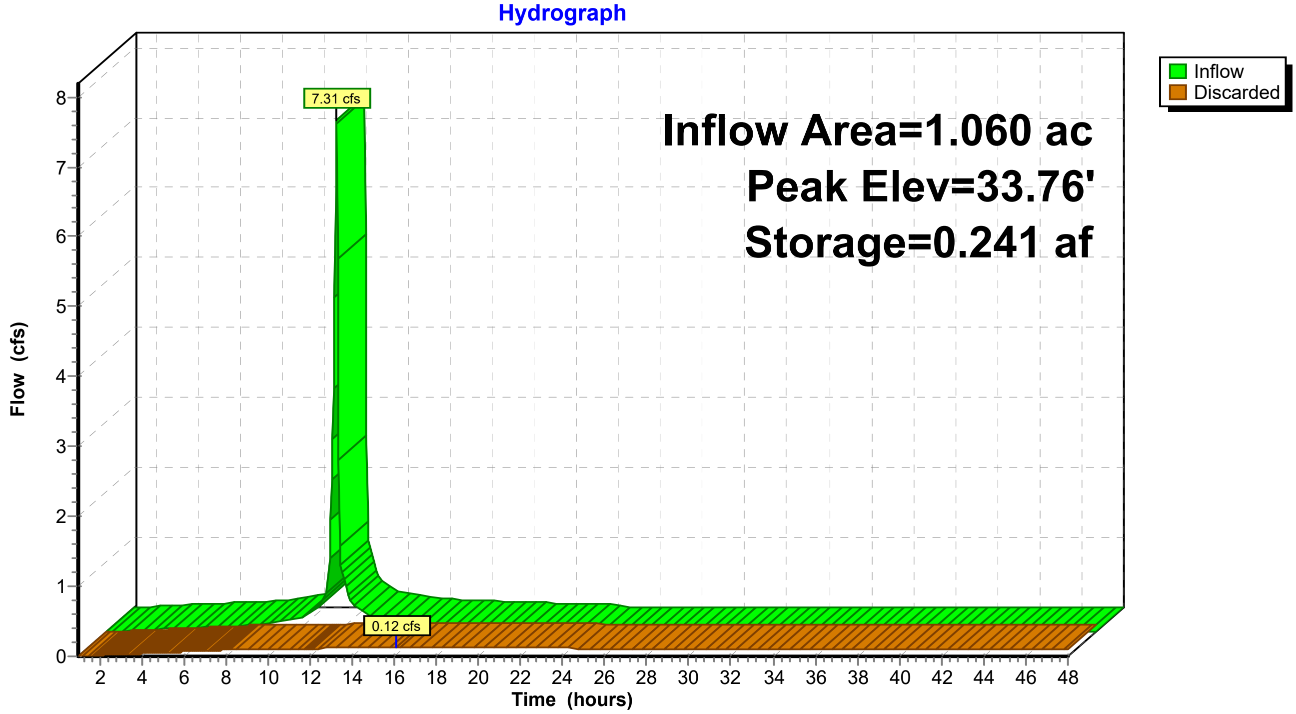
Volume	Invert	Avail.Storage	Storage Description
#1	31.50'	0.267 af	**Custom Stage Data (Irregular)** Listed below (Recalc) 0.275 af Overall x 97.0% Voids

Elevation (feet)	Surf.Area (acres)	Perim. (feet)	Inc.Store (acre-feet)	Cum.Store (acre-feet)	Wet.Area (acres)
31.50	0.110	477.0	0.000	0.000	0.110
34.00	0.110	477.0	0.275	0.275	0.137

Device	Routing	Invert	Outlet Devices
#1	Discarded	31.50'	**0.850 in/hr Exfiltration over Wetted area**

Discarded OutFlow Max=0.12 cfs @ 16.06 hrs HW=33.76' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.12 cfs)

Pond 28P: DT-2


Hydrograph
Inflow
Discarded
7.31 cfs
0.12 cfs
Inflow Area=1.060 ac
Peak Elev=33.76'
Storage=0.241 af
Flow (cfs)
Time (hours)
0
1
2
3
4
5
6
7
8
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
44
46
48

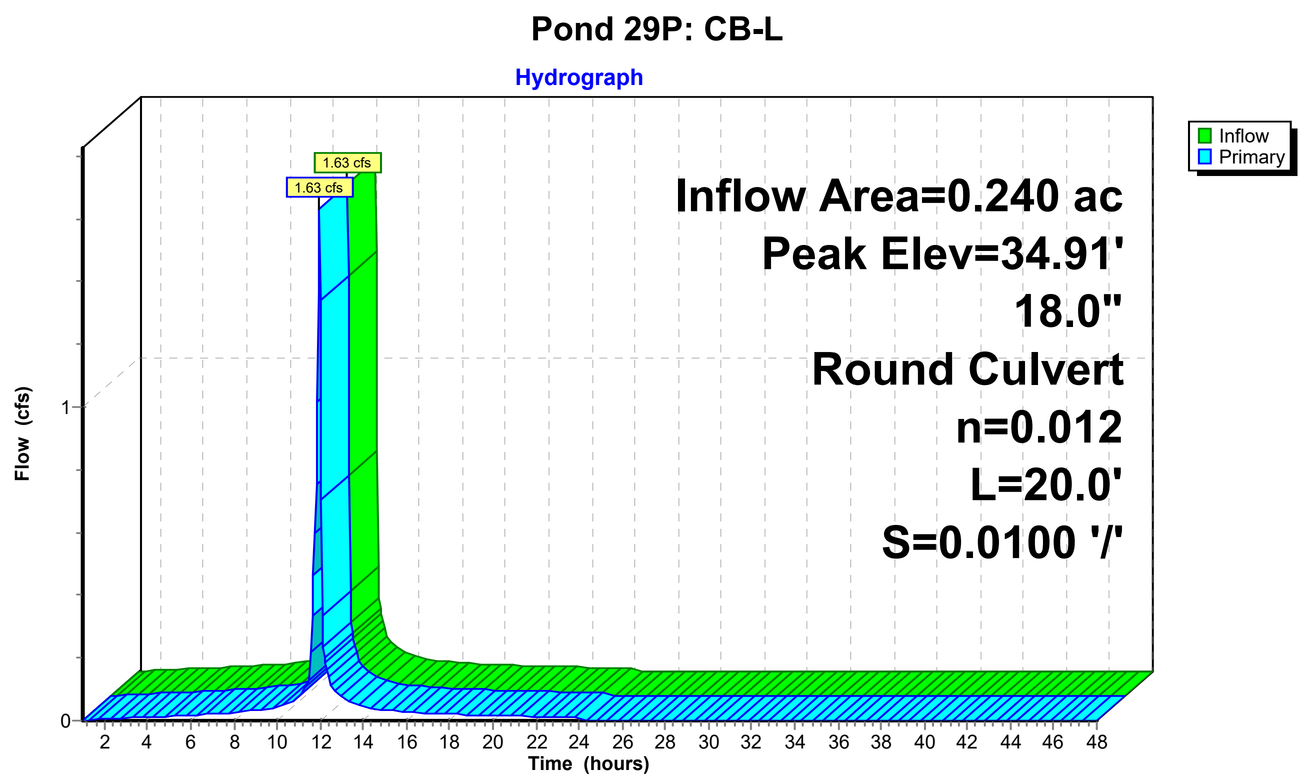
Summary for Pond 29P: CB-L

Inflow Area = 0.240 ac, 87.50% Impervious, Inflow Depth > 4.46" for 100 event
Inflow = 1.63 cfs @ 11.95 hrs, Volume= 0.089 af
Outflow = 1.63 cfs @ 11.95 hrs, Volume= 0.089 af, Atten= 0%, Lag= 0.0 min
Primary = 1.63 cfs @ 11.95 hrs, Volume= 0.089 af

Routing by Stor-Ind method, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 34.91' @ 11.95 hrs
Flood Elev= 37.15'

Device	Routing	Invert	Outlet Devices
#1	Primary	34.20'	**18.0" Round Culvert** L= 20.0' Ke= 1.200 Inlet / Outlet Invert= 34.20' / 34.00' S= 0.0100 '/' Cc= 0.900 n= 0.012, Flow Area= 1.77 sf

Primary OutFlow Max=1.62 cfs @ 11.95 hrs HW=34.91' (Free Discharge)
↑—**1=Culvert** (Inlet Controls 1.62 cfs @ 1.96 fps)



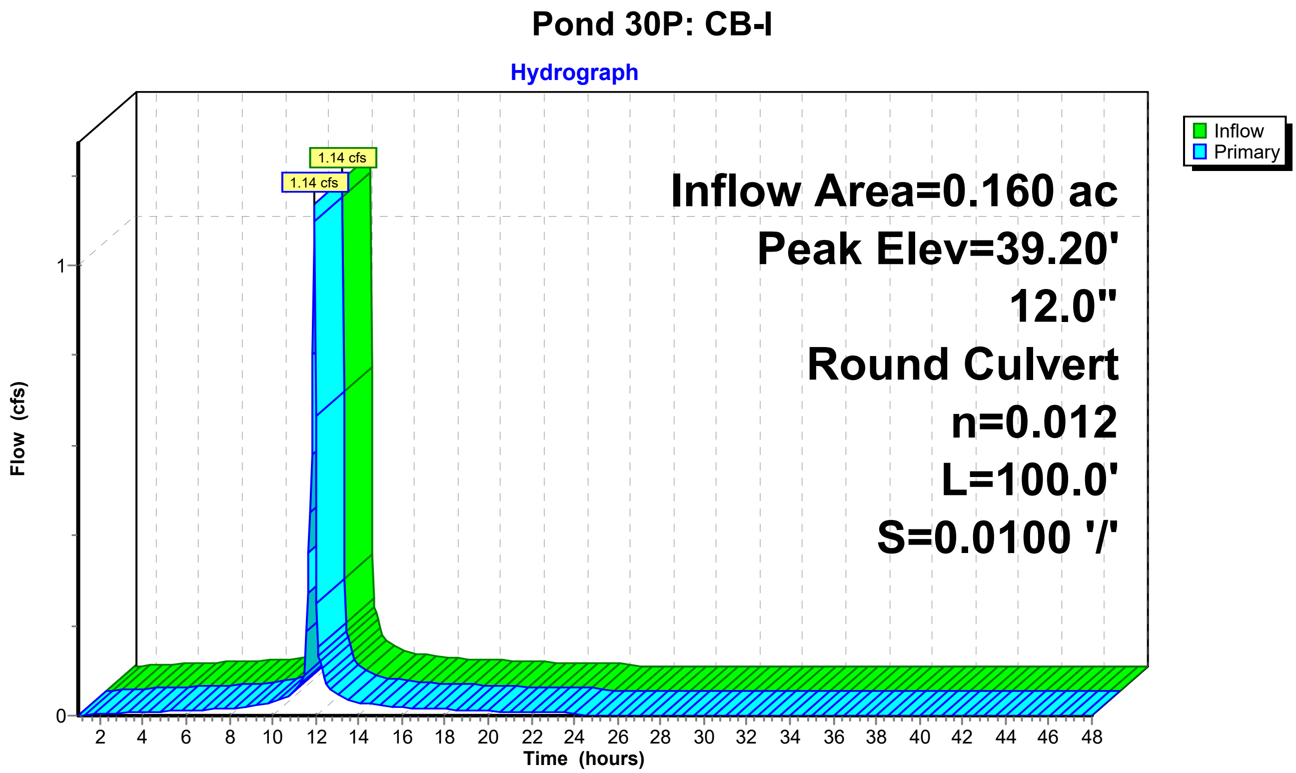
Summary for Pond 30P: CB-I

Inflow Area = 0.160 ac, 87.50% Impervious, Inflow Depth > 4.46" for 100 event
Inflow = 1.14 cfs @ 11.93 hrs, Volume= 0.060 af
Outflow = 1.14 cfs @ 11.93 hrs, Volume= 0.060 af, Atten= 0%, Lag= 0.0 min
Primary = 1.14 cfs @ 11.93 hrs, Volume= 0.060 af

Routing by Stor-Ind method, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 39.20' @ 11.93 hrs
Flood Elev= 41.99'

Device	Routing	Invert	Outlet Devices
#1	Primary	38.50'	**12.0" Round Culvert** L= 100.0' Ke= 1.200 Inlet / Outlet Invert= 38.50' / 37.50' S= 0.0100 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf

Primary OutFlow Max=1.08 cfs @ 11.93 hrs HW=39.18' (Free Discharge)
↑—**1=Culvert** (Inlet Controls 1.08 cfs @ 1.91 fps)



Summary for Pond 31P: CB-J

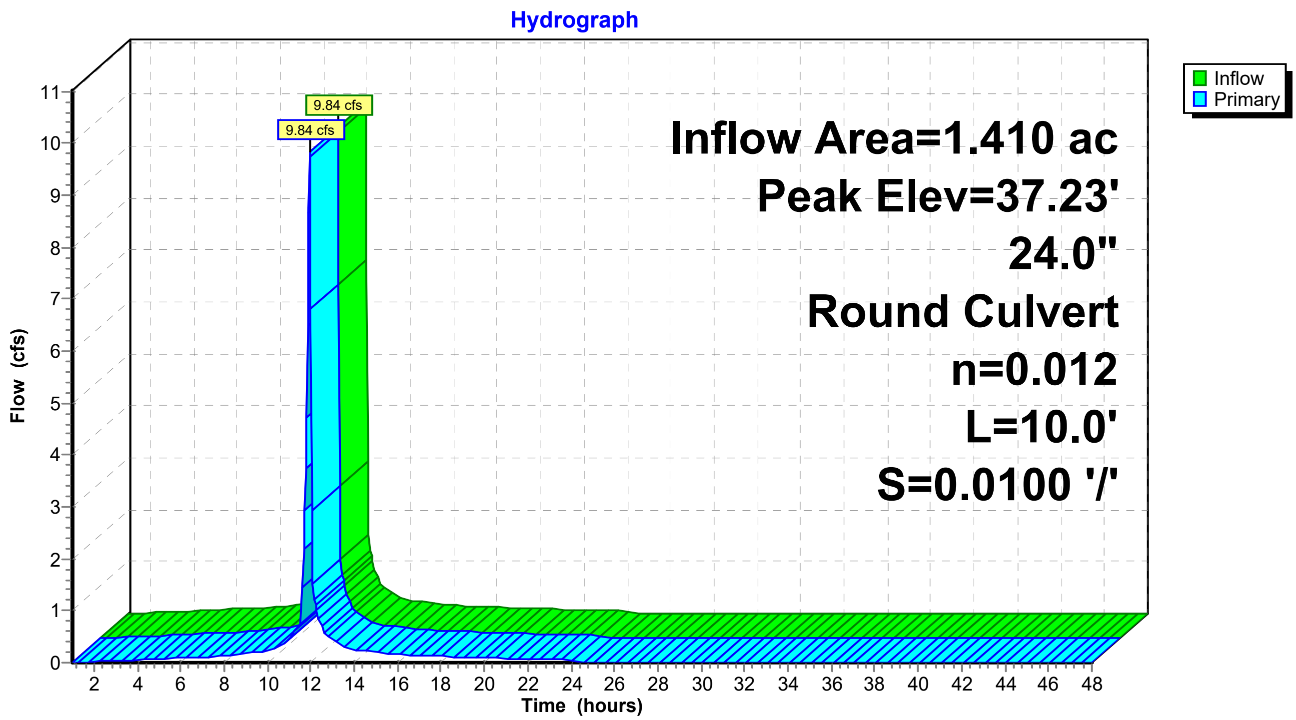
Inflow Area = 1.410 ac, 85.11% Impervious, Inflow Depth = 4.35" for 100 event
Inflow = 9.84 cfs @ 11.94 hrs, Volume= 0.511 af
Outflow = 9.84 cfs @ 11.94 hrs, Volume= 0.511 af, Atten= 0%, Lag= 0.0 min
Primary = 9.84 cfs @ 11.94 hrs, Volume= 0.511 af

Routing by Stor-Ind method, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 37.23' @ 11.94 hrs
Flood Elev= 38.26'

Device	Routing	Invert	Outlet Devices
#1	Primary	35.30'	**24.0" Round Culvert** L= 10.0' Ke= 1.200 Inlet / Outlet Invert= 35.30' / 35.20' S= 0.0100 '/' Cc= 0.900 n= 0.012, Flow Area= 3.14 sf

Primary OutFlow Max=9.48 cfs @ 11.94 hrs HW=37.18' (Free Discharge)
↑—**1=Culvert** (Barrel Controls 9.48 cfs @ 4.01 fps)

Pond 31P: CB-J



Summary for Pond 32P: DT-3

Inflow Area = 1.570 ac, 85.35% Impervious, Inflow Depth = 4.36" for 100 event
Inflow = 10.97 cfs @ 11.94 hrs, Volume= 0.570 af
Outflow = 0.16 cfs @ 16.49 hrs, Volume= 0.551 af, Atten= 99%, Lag= 273.0 min
Discarded = 0.16 cfs @ 16.49 hrs, Volume= 0.551 af

Routing by Stor-Ind method, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 34.70' @ 16.49 hrs Surf.Area= 0.170 ac Storage= 0.358 af

Plug-Flow detention time= 852.6 min calculated for 0.551 af (97% of inflow)
Center-of-Mass det. time= 830.9 min (1,581.1 - 750.2)

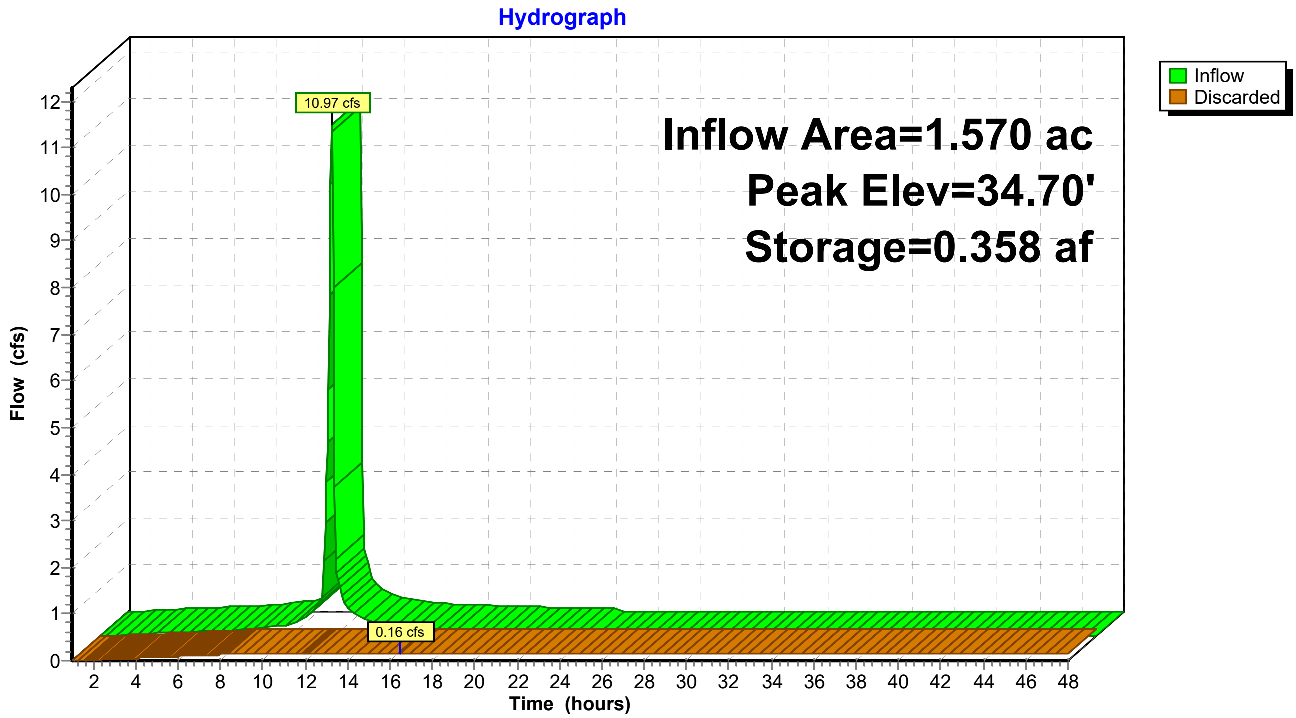
Volume	Invert	Avail.Storage	Storage Description
#1	32.60'	0.425 af	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Perim. (feet)	Inc.Store (acre-feet)	Cum.Store (acre-feet)	Wet.Area (acres)
32.60	0.170	403.0	0.000	0.000	0.170
35.10	0.170	403.0	0.425	0.425	0.193

Device	Routing	Invert	Outlet Devices
#1	Discarded	32.60'	**0.850 in/hr Exfiltration over Wetted area**

Discarded OutFlow Max=0.16 cfs @ 16.49 hrs HW=34.70' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.16 cfs)

Pond 32P: DT-3



Summary for Pond 33P: CB-G

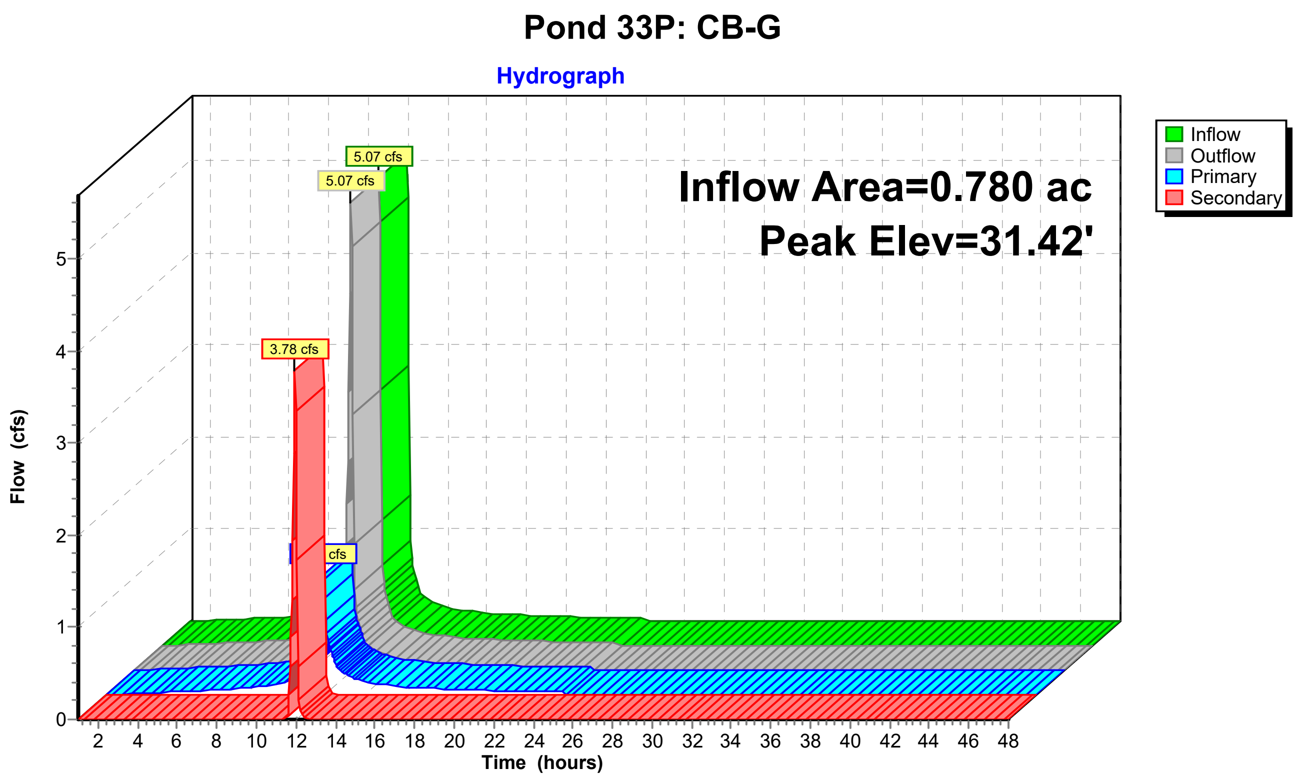
Inflow Area = 0.780 ac, 84.62% Impervious, Inflow Depth = 4.35" for 100 event
Inflow = 5.07 cfs @ 11.96 hrs, Volume= 0.283 af
Outflow = 5.07 cfs @ 11.96 hrs, Volume= 0.283 af, Atten= 0%, Lag= 0.0 min
Primary = 1.30 cfs @ 11.96 hrs, Volume= 0.209 af
Secondary = 3.78 cfs @ 11.96 hrs, Volume= 0.074 af

Routing by Stor-Ind method, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 31.42' @ 11.96 hrs
Flood Elev= 32.88'

Device	Routing	Invert	Outlet Devices
#1	Primary	29.80'	**8.0" Round Culvert** L= 100.0' Ke= 1.200 Inlet / Outlet Invert= 29.80' / 28.80' S= 0.0100 '/' Cc= 0.900 n= 0.012, Flow Area= 0.35 sf
#2	Secondary	30.23'	**18.0" Round Culvert** L= 15.0' Ke= 1.200 Inlet / Outlet Invert= 30.23' / 30.08' S= 0.0100 '/' Cc= 0.900 n= 0.012, Flow Area= 1.77 sf

Primary OutFlow Max=1.29 cfs @ 11.96 hrs HW=31.40' (Free Discharge)
└─**1=Culvert** (Inlet Controls 1.29 cfs @ 3.69 fps)

Secondary OutFlow Max=3.68 cfs @ 11.96 hrs HW=31.40' (Free Discharge)
└─**2=Culvert** (Barrel Controls 3.68 cfs @ 3.44 fps)



Summary for Pond 34P: CB-K

[58] Hint: Peaked 0.75' above defined flood level

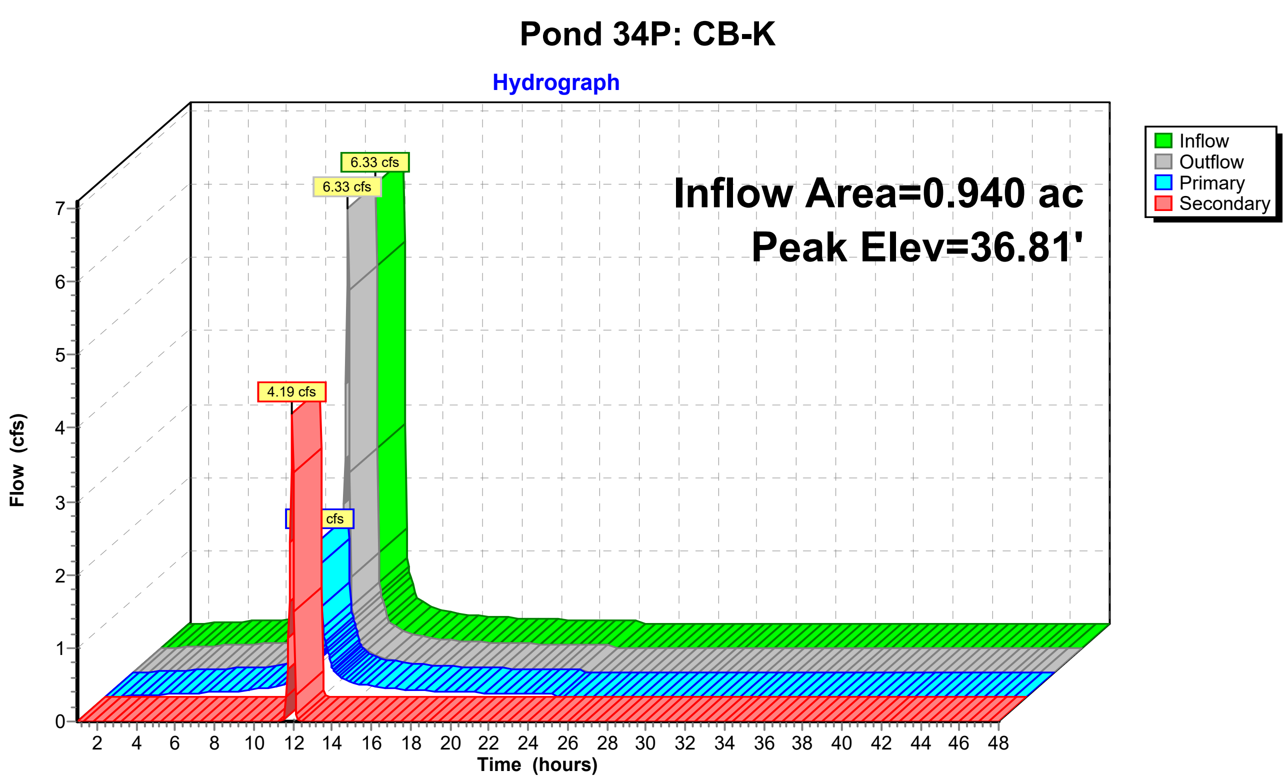
Inflow Area =	0.940 ac, 85.11% Impervious, Inflow Depth = 4.35" for 100 event		
Inflow =	6.33 cfs @ 11.95 hrs,	Volume=	0.341 af
Outflow =	6.33 cfs @ 11.95 hrs,	Volume=	0.341 af, Atten= 0%, Lag= 0.0 min
Primary =	2.14 cfs @ 11.95 hrs,	Volume=	0.261 af
Secondary =	4.19 cfs @ 11.95 hrs,	Volume=	0.080 af

Routing by Stor-Ind method, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 36.81' @ 11.95 hrs
Flood Elev= 36.06'

Device	Routing	Invert	Outlet Devices
#1	Primary	33.00'	**8.0" Round Culvert** L= 100.0' Ke= 1.200 Inlet / Outlet Invert= 33.00' / 32.00' S= 0.0100 '/' Cc= 0.900 n= 0.012, Flow Area= 0.35 sf
#2	Secondary	33.67'	**12.0" Round Culvert** L= 20.0' Ke= 1.200 Inlet / Outlet Invert= 33.67' / 32.78' S= 0.0445 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf

Primary OutFlow Max=2.13 cfs @ 11.95 hrs HW=36.80' (Free Discharge)
↑—**1=Culvert** (Inlet Controls 2.13 cfs @ 6.11 fps)

Secondary OutFlow Max=4.18 cfs @ 11.95 hrs HW=36.80' (Free Discharge)
↑—**2=Culvert** (Inlet Controls 4.18 cfs @ 5.32 fps)



Summary for Pond 36P: CB-F

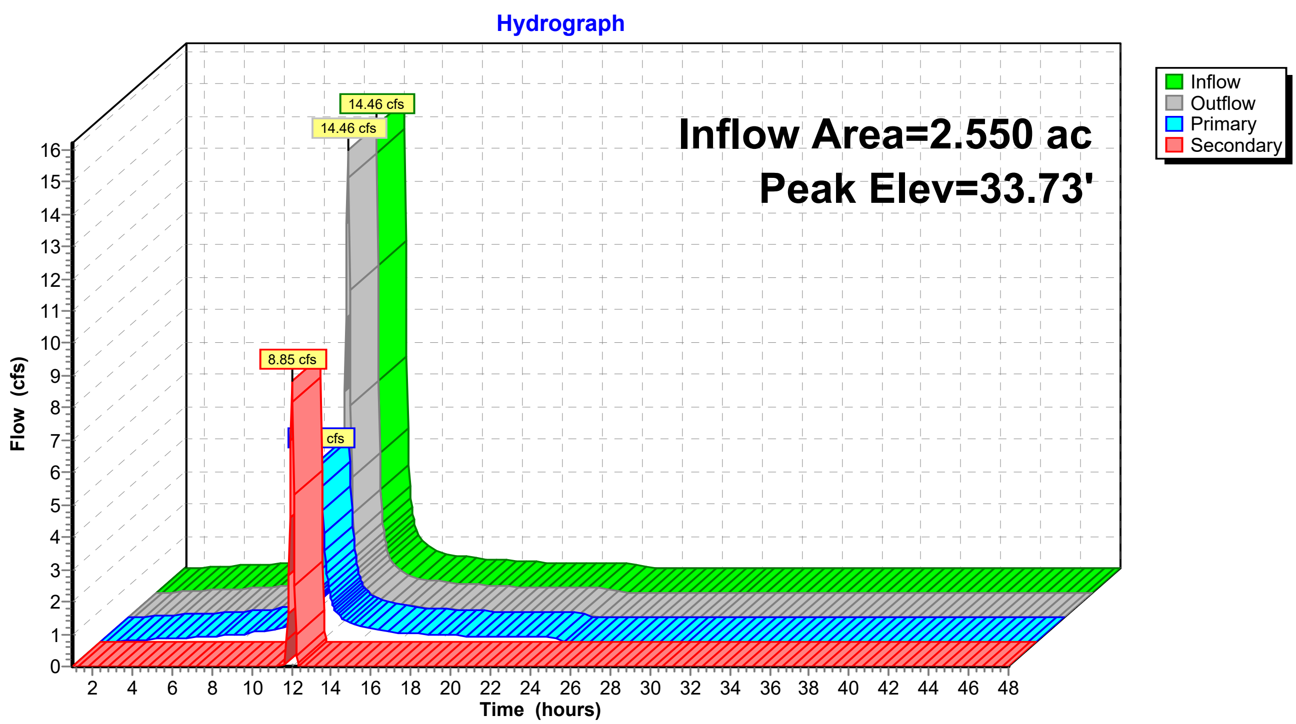
Inflow Area = 2.550 ac, 85.10% Impervious, Inflow Depth = 4.35" for 100 event
Inflow = 14.46 cfs @ 12.01 hrs, Volume= 0.924 af
Outflow = 14.46 cfs @ 12.01 hrs, Volume= 0.924 af, Atten= 0%, Lag= 0.0 min
Primary = 5.61 cfs @ 12.01 hrs, Volume= 0.745 af
Secondary = 8.85 cfs @ 12.01 hrs, Volume= 0.179 af

Routing by Stor-Ind method, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 33.73' @ 12.01 hrs
Flood Elev= 35.02'

Device	Routing	Invert	Outlet Devices
#1	Primary	31.17'	**15.0" Round Culvert** L= 100.0' Ke= 1.200 Inlet / Outlet Invert= 31.17' / 30.17' S= 0.0100 '/' Cc= 0.900 n= 0.012, Flow Area= 1.23 sf
#2	Secondary	32.00'	**24.0" Round Culvert** L= 200.0' Ke= 1.200 Inlet / Outlet Invert= 32.00' / 30.00' S= 0.0100 '/' Cc= 0.900 n= 0.012, Flow Area= 3.14 sf

Primary OutFlow Max=5.56 cfs @ 12.01 hrs HW=33.70' (Free Discharge)
↑—**1=Culvert** (Inlet Controls 5.56 cfs @ 4.53 fps)

Secondary OutFlow Max=8.63 cfs @ 12.01 hrs HW=33.70' (Free Discharge)
↑—**2=Culvert** (Inlet Controls 8.63 cfs @ 3.03 fps)



Summary for Pond 37P: CB-C

Inflow Area = 0.420 ac, 85.71% Impervious, Inflow Depth = 4.35" for 100 event
Inflow = 2.94 cfs @ 11.94 hrs, Volume= 0.152 af
Outflow = 2.94 cfs @ 11.94 hrs, Volume= 0.152 af, Atten= 0%, Lag= 0.0 min
Primary = 1.62 cfs @ 11.94 hrs, Volume= 0.133 af
Secondary = 1.32 cfs @ 11.94 hrs, Volume= 0.019 af

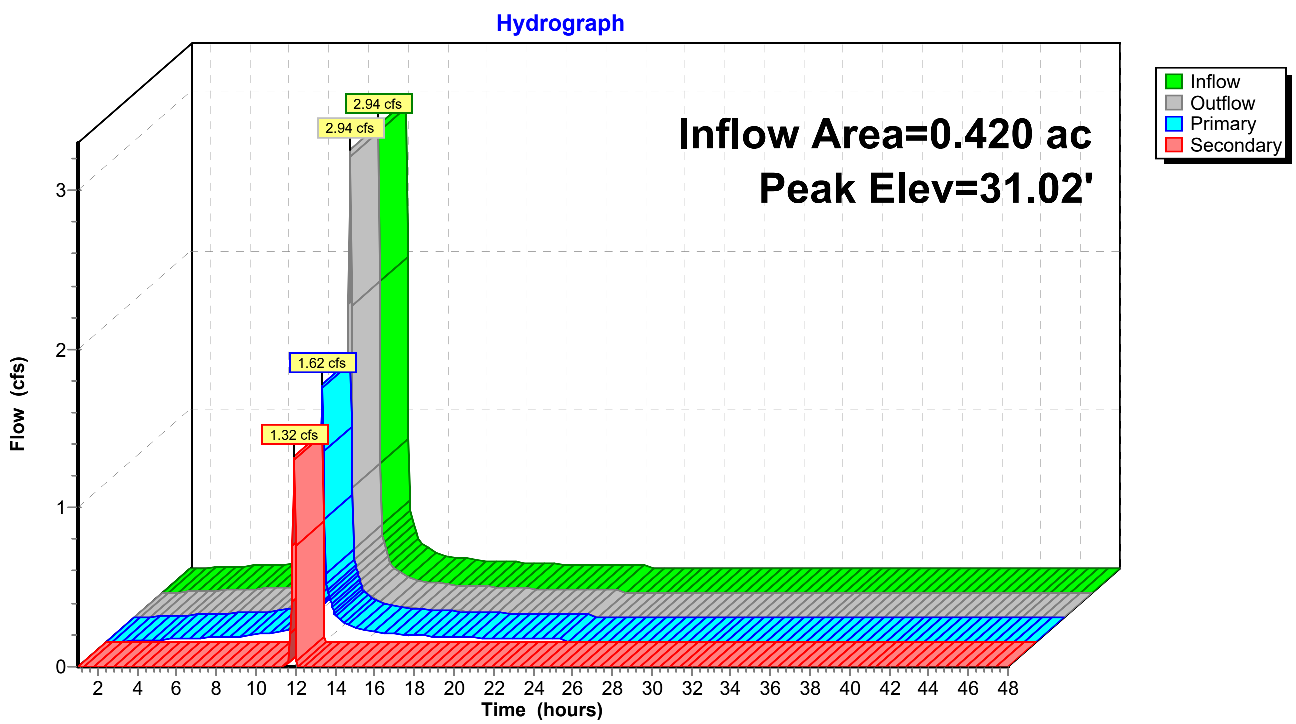
Routing by Stor-Ind method, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 31.02' @ 11.94 hrs
Flood Elev= 32.01'

Device	Routing	Invert	Outlet Devices
#1	Primary	28.70'	**8.0" Round Culvert** L= 100.0' Ke= 1.200 Inlet / Outlet Invert= 28.70' / 27.70' S= 0.0100 '/' Cc= 0.900 n= 0.012, Flow Area= 0.35 sf
#2	Secondary	29.37'	**8.0" Round Culvert** L= 200.0' Ke= 1.200 Inlet / Outlet Invert= 29.37' / 27.67' S= 0.0085 '/' Cc= 0.900 n= 0.012, Flow Area= 0.35 sf

Primary OutFlow Max=1.57 cfs @ 11.94 hrs HW=30.91' (Free Discharge)
└**1=Culvert** (Inlet Controls 1.57 cfs @ 4.50 fps)

Secondary OutFlow Max=1.26 cfs @ 11.94 hrs HW=30.91' (Free Discharge)
└**2=Culvert** (Inlet Controls 1.26 cfs @ 3.60 fps)

Pond 37P: CB-C



Summary for Pond 38P: CB-D

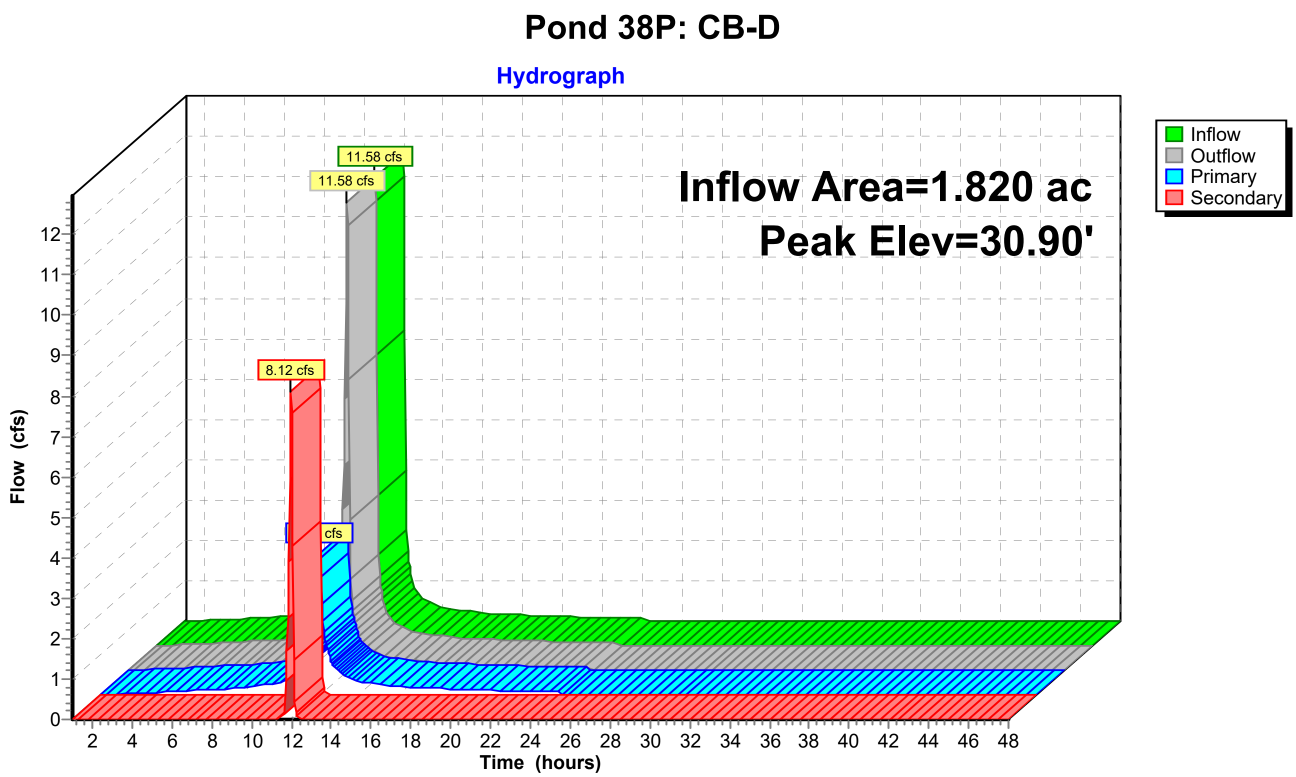
Inflow Area = 1.820 ac, 85.16% Impervious, Inflow Depth = 4.35" for 100 event
Inflow = 11.58 cfs @ 11.97 hrs, Volume= 0.659 af
Outflow = 11.58 cfs @ 11.97 hrs, Volume= 0.659 af, Atten= 0%, Lag= 0.0 min
Primary = 3.46 cfs @ 11.97 hrs, Volume= 0.505 af
Secondary = 8.12 cfs @ 11.97 hrs, Volume= 0.155 af

Routing by Stor-Ind method, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 30.90' @ 11.97 hrs
Flood Elev= 31.59'

Device	Routing	Invert	Outlet Devices
#1	Primary	28.60'	**12.0" Round Culvert** L= 40.0' Ke= 1.200 Inlet / Outlet Invert= 28.60' / 28.20' S= 0.0100 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf
#2	Secondary	29.27'	**24.0" Round Culvert** L= 100.0' Ke= 1.200 Inlet / Outlet Invert= 29.27' / 28.27' S= 0.0100 '/' Cc= 0.900 n= 0.012, Flow Area= 3.14 sf

Primary OutFlow Max=3.42 cfs @ 11.97 hrs HW=30.86' (Free Discharge)
└─**1=Culvert** (Inlet Controls 3.42 cfs @ 4.36 fps)

Secondary OutFlow Max=7.85 cfs @ 11.97 hrs HW=30.86' (Free Discharge)
└─**2=Culvert** (Inlet Controls 7.85 cfs @ 2.93 fps)



Summary for Pond 39P: DT-4

Inflow Area = 5.860 ac, 85.15% Impervious, Inflow Depth = 3.48" for 100 event
Inflow = 13.55 cfs @ 11.96 hrs, Volume= 1.697 af
Outflow = 0.42 cfs @ 19.25 hrs, Volume= 1.465 af, Atten= 97%, Lag= 437.2 min
Discarded = 0.42 cfs @ 19.25 hrs, Volume= 1.465 af

Routing by Stor-Ind method, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 27.68' @ 19.25 hrs Surf.Area= 0.440 ac Storage= 1.058 af

Plug-Flow detention time= 865.1 min calculated for 1.463 af (86% of inflow)
Center-of-Mass det. time= 795.7 min (1,560.0 - 764.3)

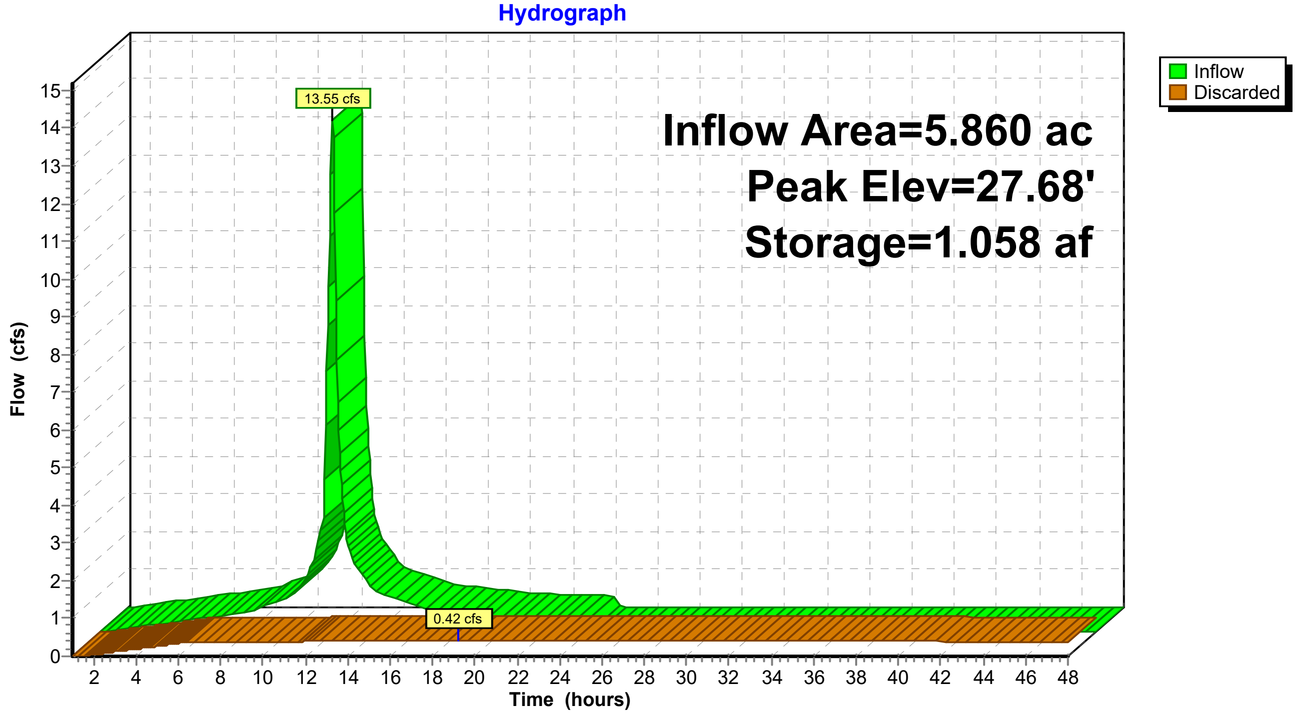
Volume	Invert	Avail.Storage	Storage Description
#1	25.20'	1.067 af	**Custom Stage Data (Irregular)** Listed below (Recalc) 1.100 af Overall x 97.0% Voids

Elevation (feet)	Surf.Area (acres)	Perim. (feet)	Inc.Store (acre-feet)	Cum.Store (acre-feet)	Wet.Area (acres)
25.20	0.440	871.0	0.000	0.000	0.440
27.70	0.440	871.0	1.100	1.100	0.490

Device	Routing	Invert	Outlet Devices
#1	Discarded	25.20'	**0.850 in/hr Exfiltration over Wetted area**

Discarded OutFlow Max=0.42 cfs @ 19.25 hrs HW=27.68' (Free Discharge)
└—**1=Exfiltration** (Exfiltration Controls 0.42 cfs)

Pond 39P: DT-4


Hydrograph
13.55 cfs
0.42 cfs
Inflow Area=5.860 ac
Peak Elev=27.68'
Storage=1.058 af
Inflow
Discarded
Flow (cfs)
Time (hours)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
44
46
48

Summary for Pond 40P: CB-E

Inflow Area = 0.320 ac, 84.38% Impervious, Inflow Depth = 4.35" for 100 event
Inflow = 1.77 cfs @ 12.02 hrs, Volume= 0.116 af
Outflow = 1.77 cfs @ 12.02 hrs, Volume= 0.116 af, Atten= 0%, Lag= 0.0 min
Primary = 0.27 cfs @ 12.02 hrs, Volume= 0.077 af
Secondary = 1.50 cfs @ 12.02 hrs, Volume= 0.039 af

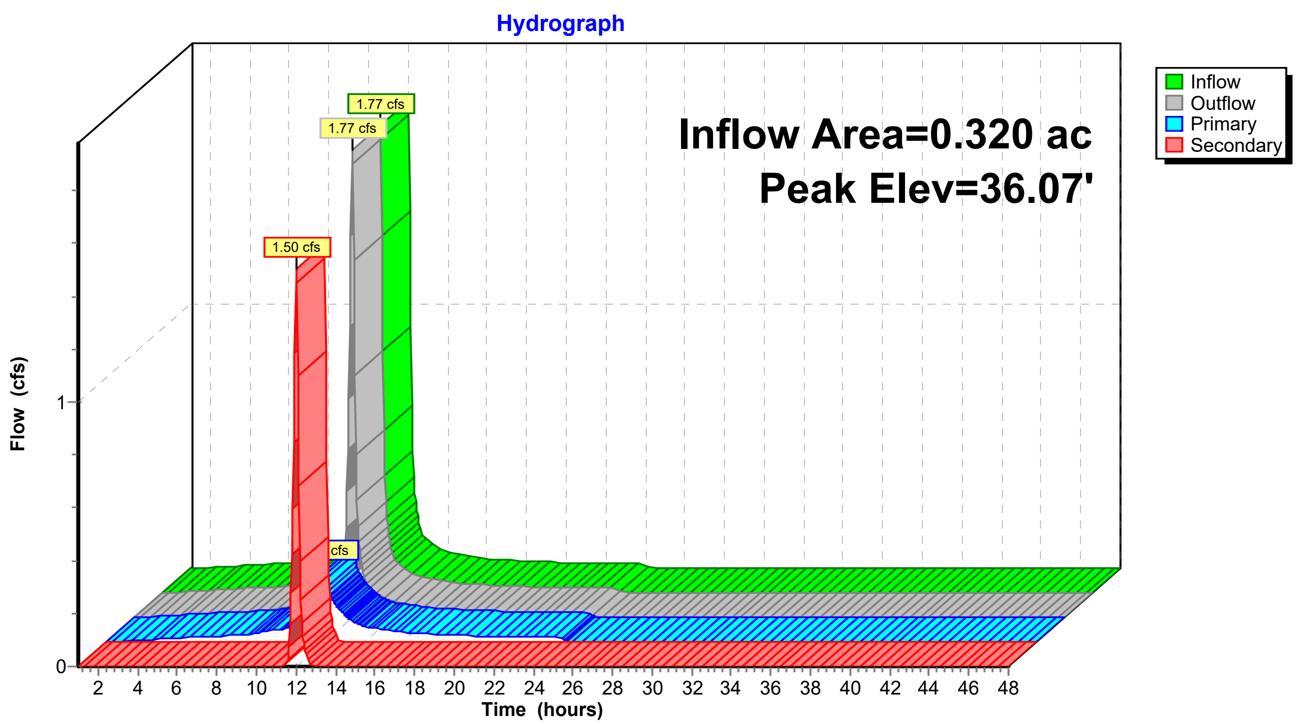
Routing by Stor-Ind method, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 36.07' @ 12.02 hrs
Flood Elev= 37.90'

Device	Routing	Invert	Outlet Devices
#1	Primary	34.90'	**4.0" Round Culvert** L= 75.0' Ke= 1.200 Inlet / Outlet Invert= 34.90' / 34.15' S= 0.0100 '/' Cc= 0.900 n= 0.012, Flow Area= 0.09 sf
#2	Secondary	35.23'	**12.0" Round Culvert** L= 200.0' Ke= 1.200 Inlet / Outlet Invert= 35.23' / 33.40' S= 0.0091 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf

Primary OutFlow Max=0.27 cfs @ 12.02 hrs HW=36.06' (Free Discharge)
└─**1=Culvert** (Barrel Controls 0.27 cfs @ 3.05 fps)

Secondary OutFlow Max=1.46 cfs @ 12.02 hrs HW=36.06' (Free Discharge)
└─**2=Culvert** (Inlet Controls 1.46 cfs @ 2.11 fps)

Pond 40P: CB-E



Summary for Pond 41P: DT-6

Inflow Area = 1.290 ac, 84.50% Impervious, Inflow Depth = 2.73" for 100 event
Inflow = 1.29 cfs @ 11.93 hrs, Volume= 0.294 af
Outflow = 0.09 cfs @ 19.64 hrs, Volume= 0.281 af, Atten= 93%, Lag= 462.5 min
Discarded = 0.09 cfs @ 19.64 hrs, Volume= 0.281 af

Routing by Stor-Ind method, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 29.79' @ 19.64 hrs Surf.Area= 0.075 ac Storage= 0.166 af

Plug-Flow detention time= 789.3 min calculated for 0.280 af (95% of inflow)
Center-of-Mass det. time= 762.0 min (1,536.8 - 774.8)

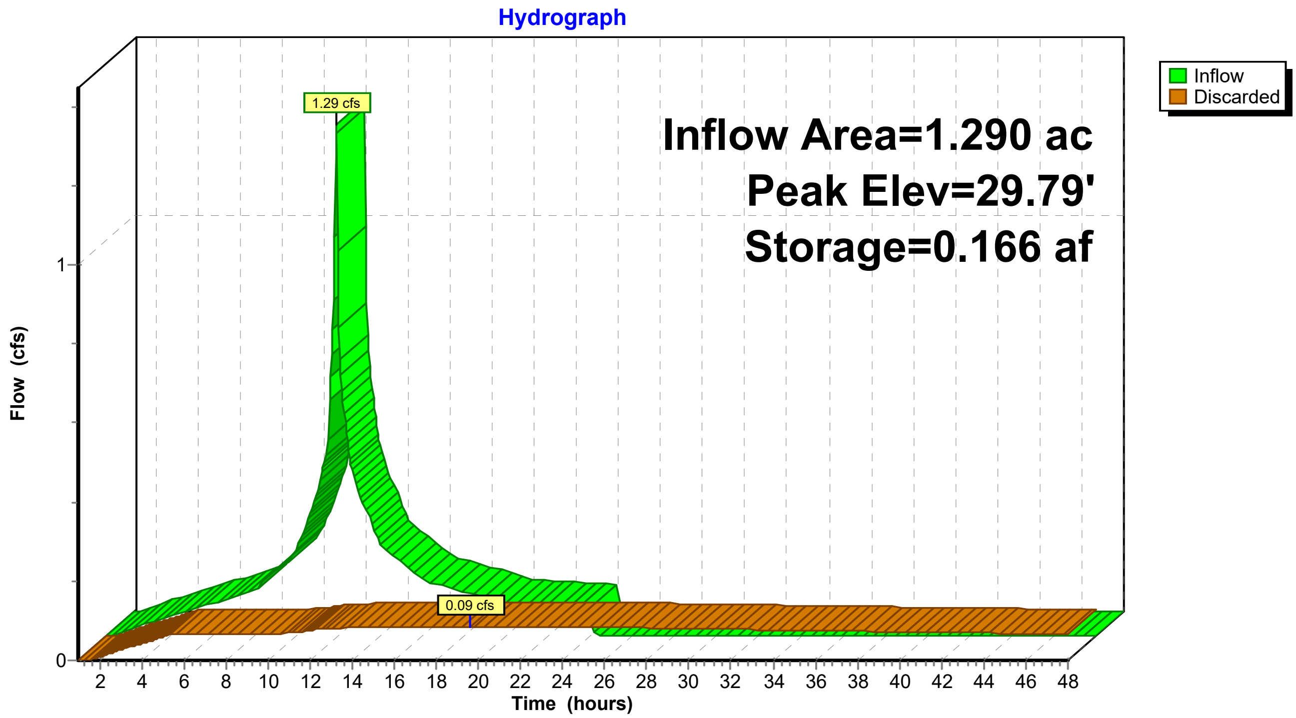
Volume	Invert	Avail.Storage	Storage Description
#1	27.50'	0.182 af	**Custom Stage Data (Irregular)** Listed below (Recalc) 0.187 af Overall x 97.0% Voids

Elevation (feet)	Surf.Area (acres)	Perim. (feet)	Inc.Store (acre-feet)	Cum.Store (acre-feet)	Wet.Area (acres)
27.50	0.075	482.0	0.000	0.000	0.075
30.00	0.075	482.0	0.187	0.187	0.103

Device	Routing	Invert	Outlet Devices
#1	Discarded	27.50'	**0.850 in/hr Exfiltration over Wetted area**

Discarded OutFlow Max=0.09 cfs @ 19.64 hrs HW=29.79' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.09 cfs)

Pond 41P: DT-6


Hydrograph
Inflow
Discarded
1.29 cfs
0.09 cfs
Inflow Area=1.290 ac
Peak Elev=29.79'
Storage=0.166 af
Flow (cfs)
0
1
2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48
Time (hours)

Summary for Pond 42P: CB-B

[57] Hint: Peaked at 37.42' (Flood elevation advised)

Inflow Area = 0.230 ac, 82.61% Impervious, Inflow Depth = 4.35" for 100 event
Inflow = 1.63 cfs @ 11.93 hrs, Volume= 0.083 af
Outflow = 1.63 cfs @ 11.93 hrs, Volume= 0.083 af, Atten= 0%, Lag= 0.0 min
Primary = 0.61 cfs @ 11.93 hrs, Volume= 0.064 af
Secondary = 1.02 cfs @ 11.93 hrs, Volume= 0.020 af

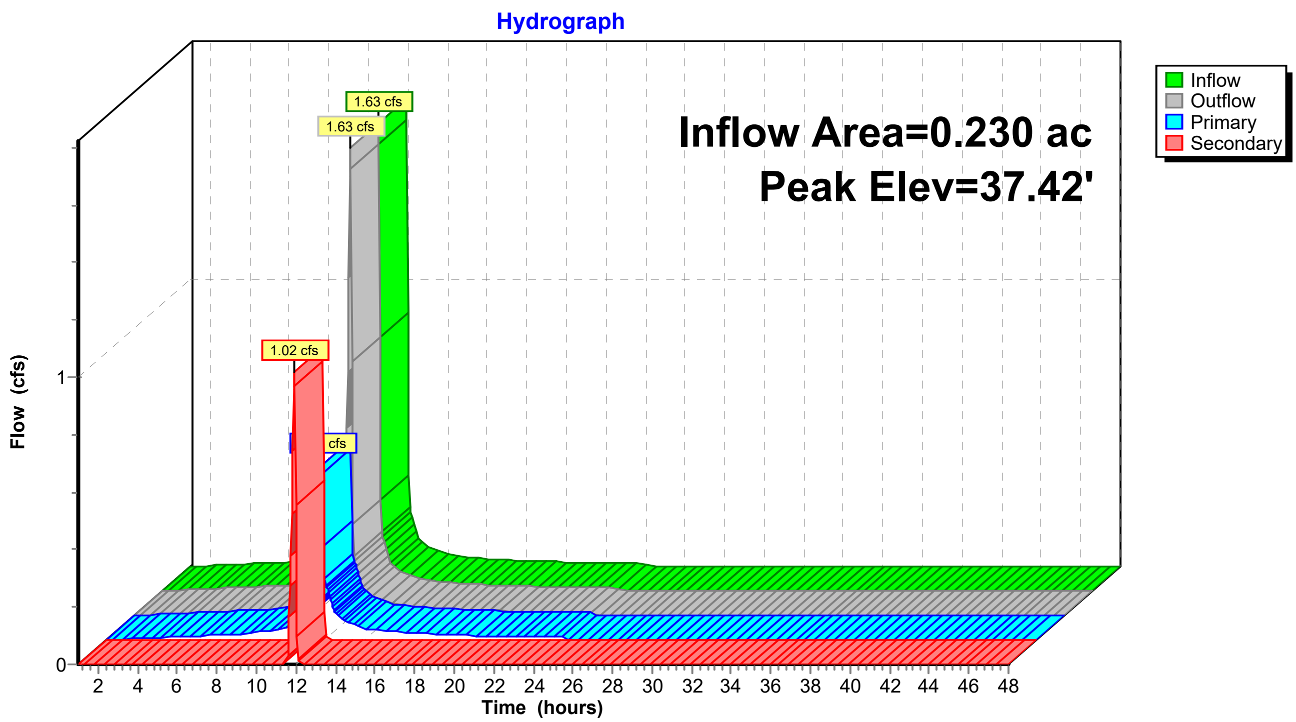
Routing by Stor-Ind method, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 37.42' @ 11.93 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	32.10'	**4.0" Round Culvert** L= 50.0' Ke= 1.200 Inlet / Outlet Invert= 32.10' / 31.20' S= 0.0180 '/' Cc= 0.900 n= 0.012, Flow Area= 0.09 sf
#2	Secondary	32.60'	**6.0" Round Culvert** L= 200.0' Ke= 1.200 Inlet / Outlet Invert= 32.60' / 30.60' S= 0.0100 '/' Cc= 0.900 n= 0.012, Flow Area= 0.20 sf

Primary OutFlow Max=0.58 cfs @ 11.93 hrs HW=36.97' (Free Discharge)
└─**1=Culvert** (Barrel Controls 0.58 cfs @ 6.62 fps)

Secondary OutFlow Max=0.96 cfs @ 11.93 hrs HW=36.97' (Free Discharge)
└─**2=Culvert** (Barrel Controls 0.96 cfs @ 4.91 fps)

Pond 42P: CB-B



Summary for Pond 43P: CB-A

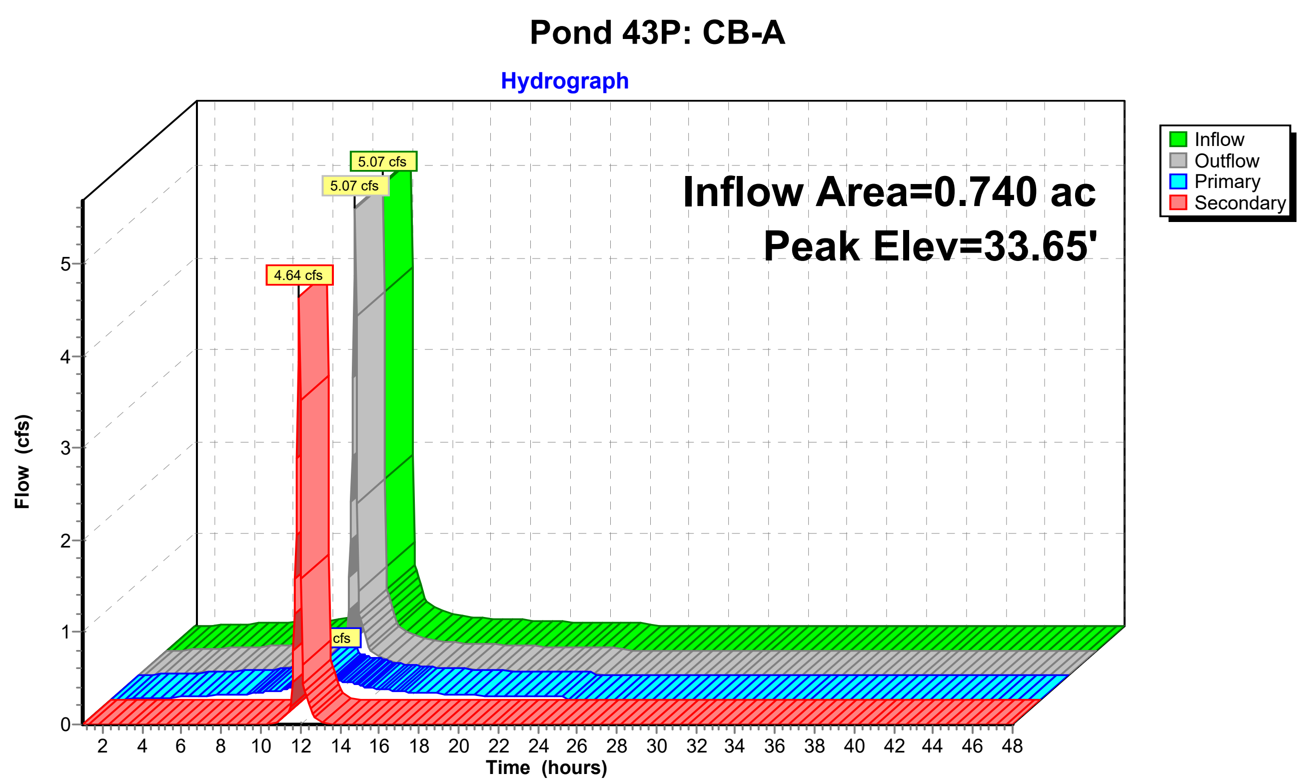
Inflow Area = 0.740 ac, 85.14% Impervious, Inflow Depth = 4.35" for 100 event
Inflow = 5.07 cfs @ 11.94 hrs, Volume= 0.268 af
Outflow = 5.07 cfs @ 11.94 hrs, Volume= 0.268 af, Atten= 0%, Lag= 0.0 min
Primary = 0.43 cfs @ 11.94 hrs, Volume= 0.153 af
Secondary = 4.64 cfs @ 11.94 hrs, Volume= 0.115 af

Routing by Stor-Ind method, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 33.65' @ 11.94 hrs
Flood Elev= 34.22'

Device	Routing	Invert	Outlet Devices
#1	Primary	31.20'	**4.0" Round Culvert** L= 30.0' Ke= 1.200 Inlet / Outlet Invert= 31.20' / 30.00' S= 0.0400 '/' Cc= 0.900 n= 0.012, Flow Area= 0.09 sf
#2	Secondary	31.70'	**15.0" Round Culvert** L= 200.0' Ke= 1.200 Inlet / Outlet Invert= 31.70' / 29.70' S= 0.0100 '/' Cc= 0.900 n= 0.012, Flow Area= 1.23 sf

Primary OutFlow Max=0.43 cfs @ 11.94 hrs HW=33.60' (Free Discharge)
└─**1=Culvert** (Inlet Controls 0.43 cfs @ 4.91 fps)

Secondary OutFlow Max=4.55 cfs @ 11.94 hrs HW=33.60' (Free Discharge)
└─**2=Culvert** (Inlet Controls 4.55 cfs @ 3.71 fps)



Summary for Pond 49P: CB-S

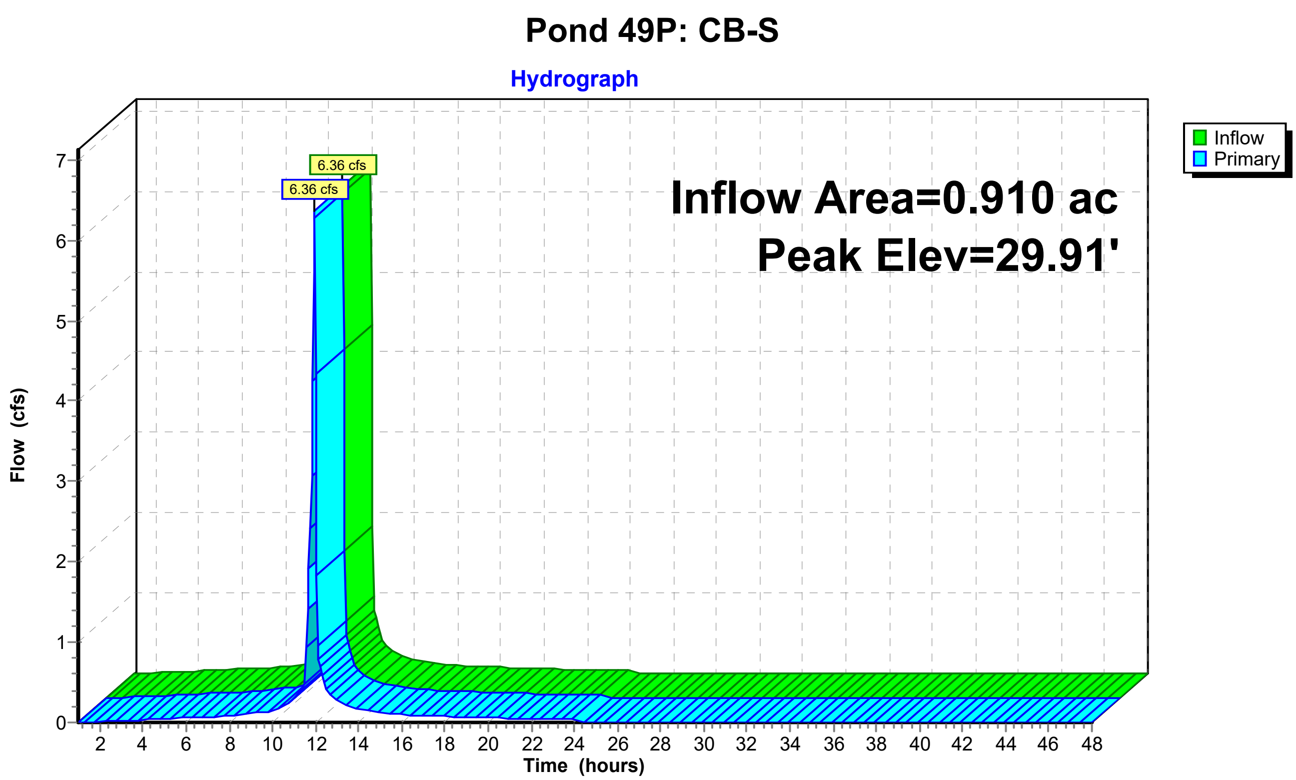
[57] Hint: Peaked at 29.91' (Flood elevation advised)

Inflow Area = 0.910 ac, 84.62% Impervious, Inflow Depth = 4.35" for 100 event
Inflow = 6.36 cfs @ 11.94 hrs, Volume= 0.330 af
Outflow = 6.36 cfs @ 11.94 hrs, Volume= 0.330 af, Atten= 0%, Lag= 0.0 min
Primary = 6.36 cfs @ 11.94 hrs, Volume= 0.330 af

Routing by Stor-Ind method, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 29.91' @ 11.94 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	26.60'	**12.0" Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=6.13 cfs @ 11.94 hrs HW=29.72' (Free Discharge)
└─**1=Orifice/Grate** (Orifice Controls 6.13 cfs @ 7.80 fps)



Summary for Pond 51P: CB-T

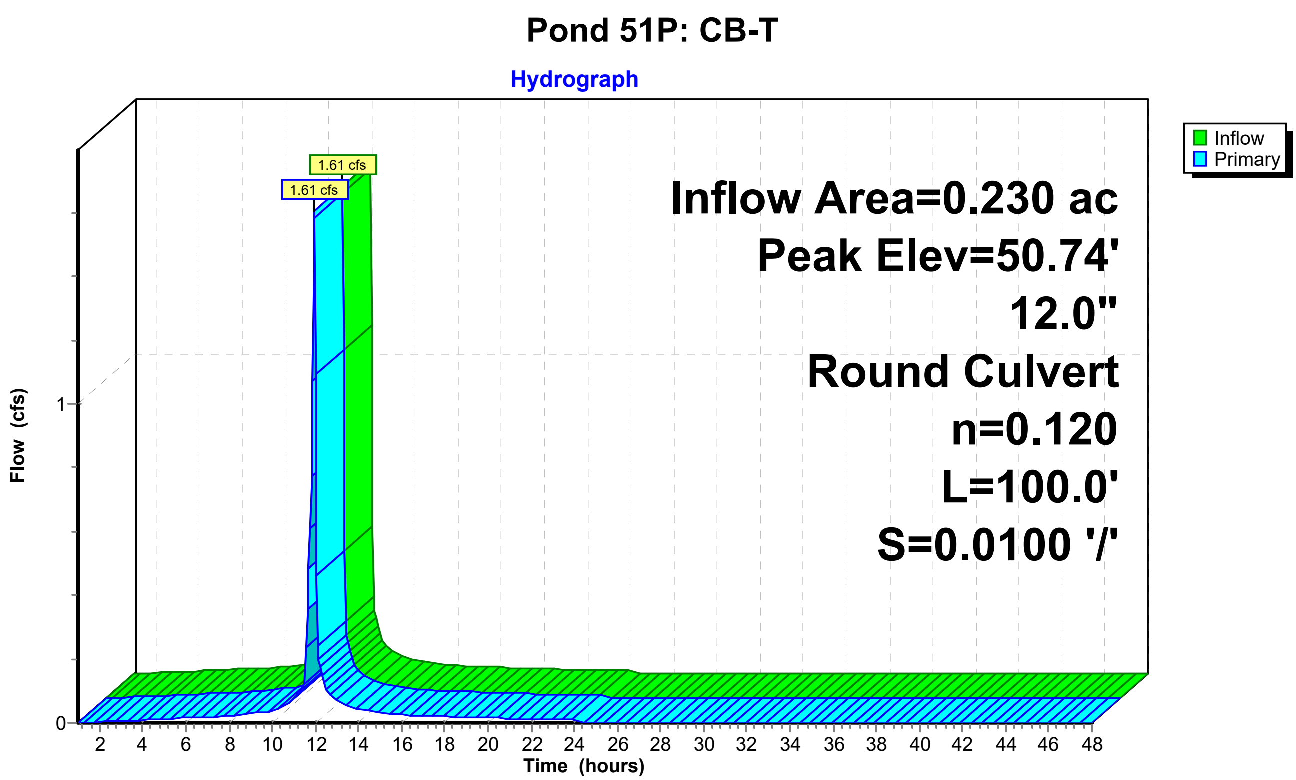
[58] Hint: Peaked 13.94' above defined flood level

Inflow Area = 0.230 ac, 82.61% Impervious, Inflow Depth = 4.35" for 100 event
Inflow = 1.61 cfs @ 11.94 hrs, Volume= 0.083 af
Outflow = 1.61 cfs @ 11.94 hrs, Volume= 0.083 af, Atten= 0%, Lag= 0.0 min
Primary = 1.61 cfs @ 11.94 hrs, Volume= 0.083 af

Routing by Stor-Ind method, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 50.74' @ 11.94 hrs
Flood Elev= 36.80'

Device	Routing	Invert	Outlet Devices
#1	Primary	33.30'	**12.0" Round Culvert** L= 100.0' Ke= 1.200 Inlet / Outlet Invert= 33.30' / 32.30' S= 0.0100 '/' Cc= 0.900 n= 0.120, Flow Area= 0.79 sf

Primary OutFlow Max=1.55 cfs @ 11.94 hrs HW=49.58' (Free Discharge)
└─**1=Culvert** (Barrel Controls 1.55 cfs @ 1.97 fps)



Summary for Pond 53P: CB-U

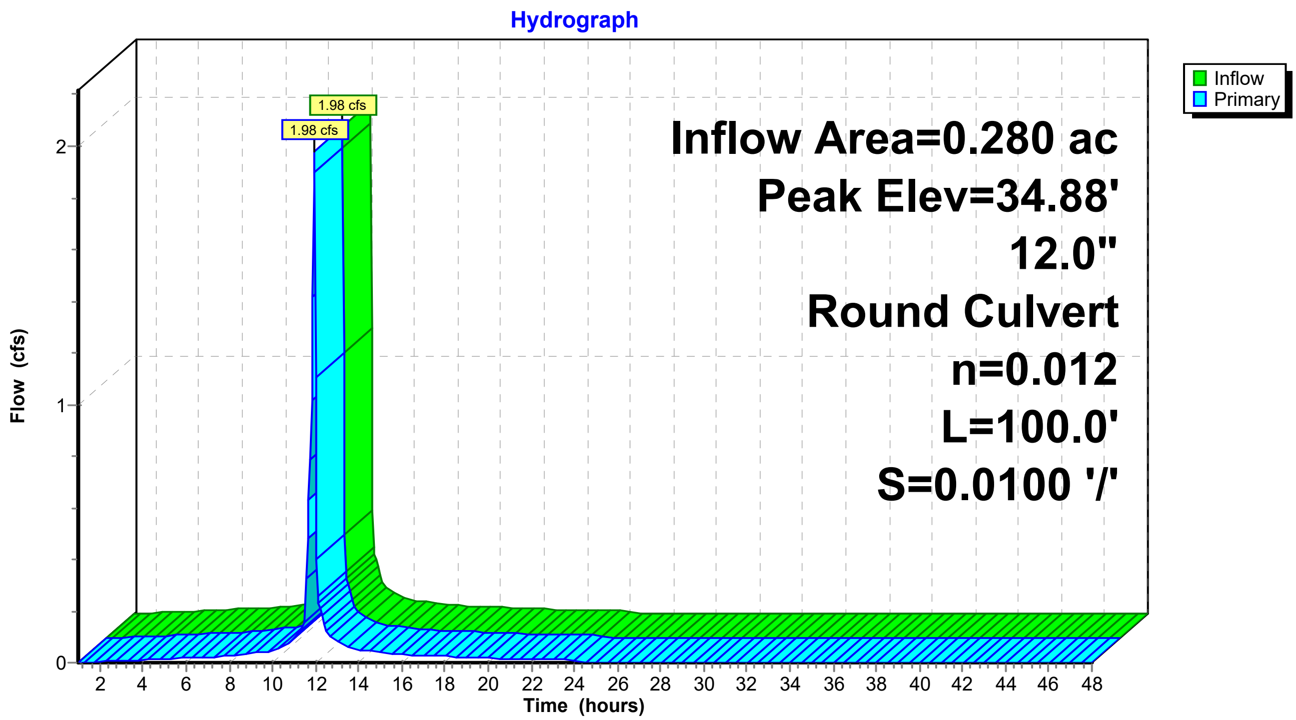
Inflow Area = 0.280 ac, 85.71% Impervious, Inflow Depth = 4.35" for 100 event
Inflow = 1.98 cfs @ 11.93 hrs, Volume= 0.101 af
Outflow = 1.98 cfs @ 11.93 hrs, Volume= 0.101 af, Atten= 0%, Lag= 0.0 min
Primary = 1.98 cfs @ 11.93 hrs, Volume= 0.101 af

Routing by Stor-Ind method, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 34.88' @ 11.93 hrs
Flood Elev= 36.80'

Device	Routing	Invert	Outlet Devices
#1	Primary	33.80'	**12.0" Round Culvert** L= 100.0' Ke= 1.200 Inlet / Outlet Invert= 33.80' / 32.80' S= 0.0100 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf

Primary OutFlow Max=1.88 cfs @ 11.93 hrs HW=34.83' (Free Discharge)
└**1=Culvert** (Inlet Controls 1.88 cfs @ 2.39 fps)

Pond 53P: CB-U



Summary for Pond 54P: DA-9

Inflow Area =	1.450 ac, 84.83% Impervious, Inflow Depth = 3.69"	for 100 event
Inflow =	5.70 cfs @ 11.94 hrs, Volume=	0.446 af
Outflow =	0.10 cfs @ 6.95 hrs, Volume=	0.373 af, Atten= 98%, Lag= 0.0 min
Discarded =	0.10 cfs @ 6.95 hrs, Volume=	0.373 af

Routing by Stor-Ind method, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 31.87' @ 19.25 hrs Surf.Area= 0.120 ac Storage= 0.284 af

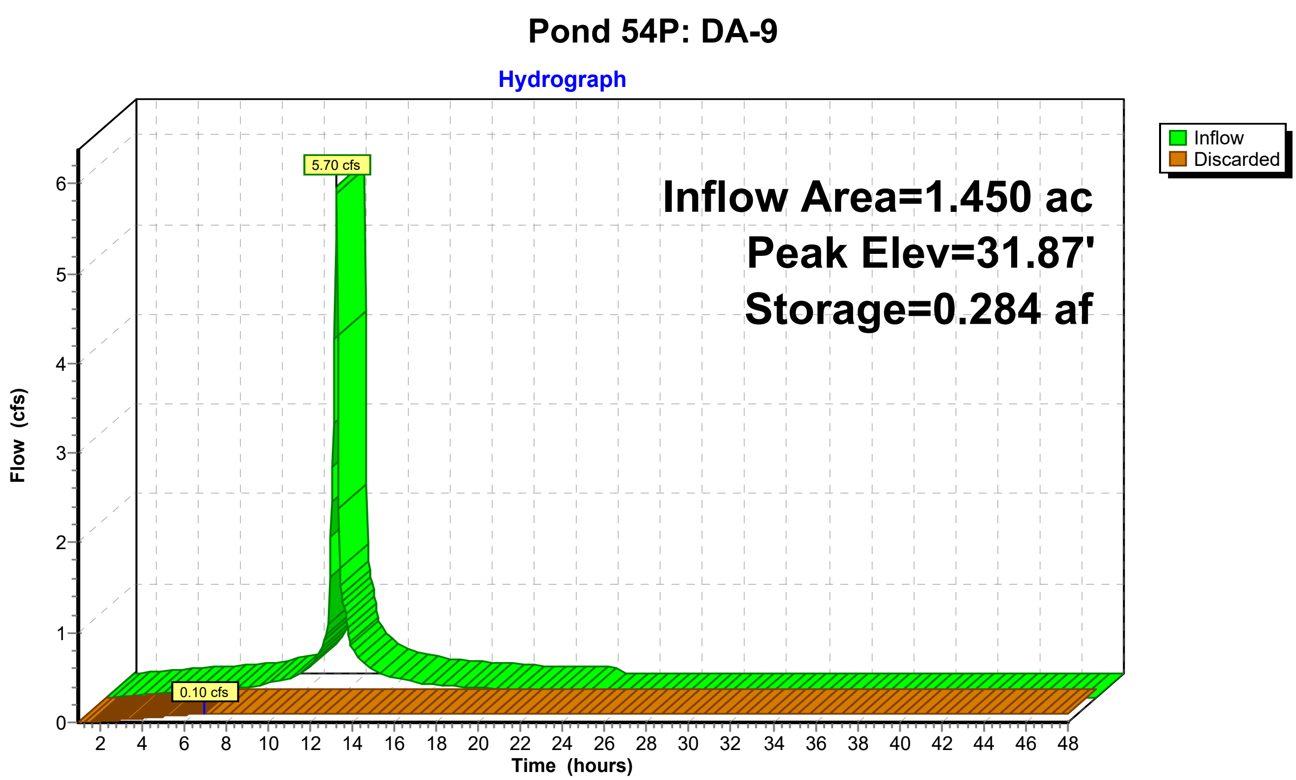
Plug-Flow detention time= 883.2 min calculated for 0.372 af (84% of inflow)
Center-of-Mass det. time= 806.3 min (1,564.5 - 758.2)

Volume	Invert	Avail.Storage	Storage Description
#1	29.50'	0.300 af	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
29.50	0.120	0.000	0.000
32.00	0.120	0.300	0.300

Device	Routing	Invert	Outlet Devices
#1	Discarded	29.50'	**0.850 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.10 cfs @ 6.95 hrs HW=29.53' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.10 cfs)



Summary for Pond 56P: (new Pond)

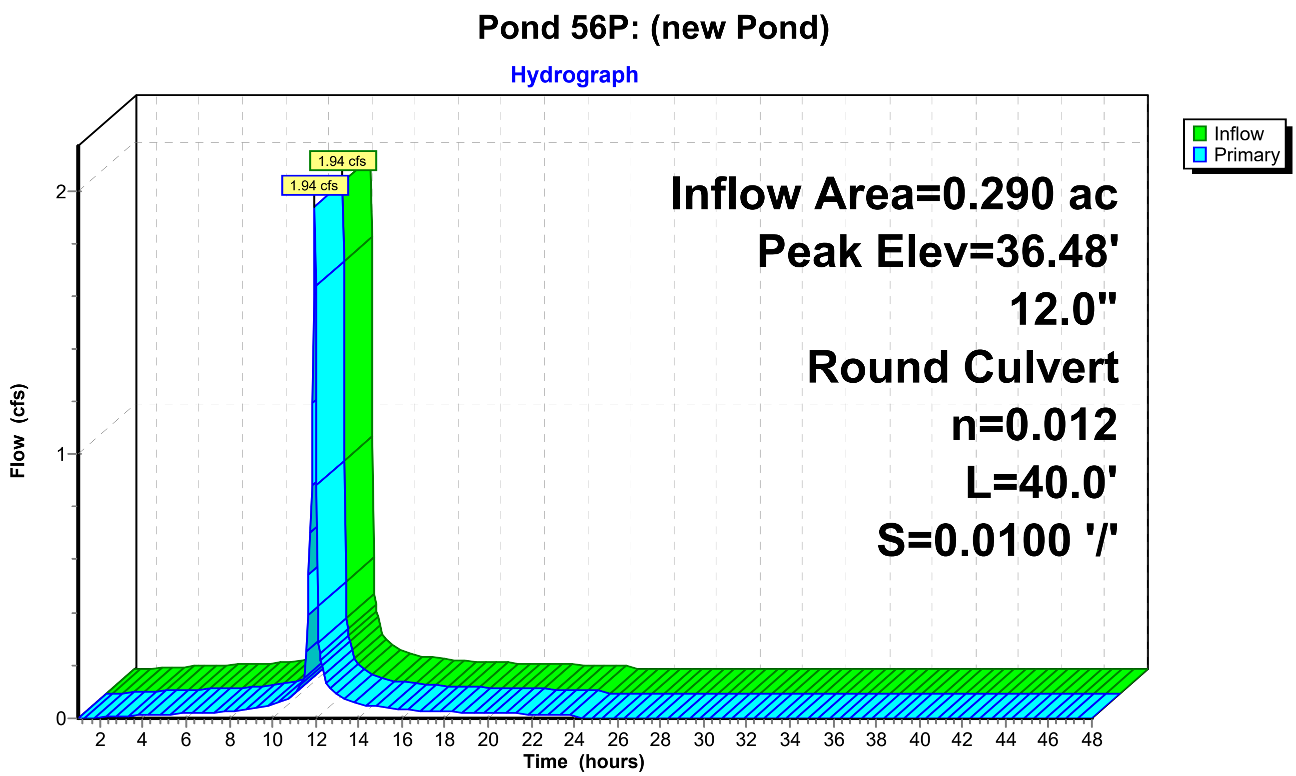
[57] Hint: Peaked at 36.48' (Flood elevation advised)

Inflow Area =	0.290 ac, 86.21% Impervious, Inflow Depth = 4.35" for 100 event		
Inflow =	1.94 cfs @ 11.95 hrs, Volume=	0.105 af	
Outflow =	1.94 cfs @ 11.95 hrs, Volume=	0.105 af, Atten= 0%, Lag= 0.0 min	
Primary =	1.94 cfs @ 11.95 hrs, Volume=	0.105 af	

Routing by Stor-Ind method, Time Span= 1.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 36.48' @ 11.95 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	35.41'	**12.0" Round Culvert** L= 40.0' Ke= 1.200 Inlet / Outlet Invert= 35.41' / 35.01' S= 0.0100 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf

Primary OutFlow Max=1.93 cfs @ 11.95 hrs HW=36.47' (Free Discharge)
└─**1=Culvert** (Inlet Controls 1.93 cfs @ 2.46 fps)



Curve (1) Numbers of Hydrologic Soil-Cover Complexes For Pervious Areas-AMC II					
Cover Type (3)	Quality of Cover (2)	Soil Group			
		A	B	C	D
NATURAL COVERS -					
Barren (Rockland, eroded and graded land)		78	86	91	93
Chaparral, Broadleaf (Manzonita, ceanothus and scrub oak)	Poor Fair Good	53 40 31	70 63 57	80 75 71	85 81 78
Chaparral, Narrowleaf (Chamise and redshank)	Poor Fair	71 55	82 72	88 81	91 86
Grass, Annual or Perennial	Poor Fair Good	67 50 38	78 69 61	86 79 74	89 84 80
Meadows or Cienegas (Areas with seasonally high water table, principal vegetation is sod forming grass)	Poor Fair Good	63 51 30	77 70 58	85 80 71	88 84 78
Open Brush (Soft wood shrubs - buckwheat, sage, etc.)	Poor Fair Good	62 46 41	76 66 63	84 77 75	88 83 81
Woodland (Coniferous or broadleaf trees predominate. Canopy density is at least 50 percent.)	Poor Fair Good	45 36 25	66 60 55	77 73 70	83 79 77
Woodland, Grass (Coniferous or broadleaf trees with canopy density from 20 to 50 percent)	Poor Fair Good	57 44 33	73 65 58	82 77 72	86 82 79
URBAN COVERS -					
Residential or Commercial Landscaping (Lawn, shrubs, etc.)	Good	32	56	69	75
Turf (Irrigated and mowed grass)	Poor Fair Good	58 44 33	74 65 58	83 77 72	87 82 79
AGRICULTURAL COVERS -					
Fallow (Land plowed but not tilled or seeded)		77	86	91	94

SAN BERNARDINO COUNTY

HYDROLOGY MANUAL

CURVE NUMBERS FOR PERVIOUS AREAS

Figure C-3 (1 of 2)

Curve (1) Numbers of Hydrologic Soil-Cover Complexes For Pervious Areas-AMC II

Cover Type (3)	Quality of Cover (2)	Soil Group A	Soil Group B	Soil Group C	Soil Group D
AGRICULTURAL COVERS (Continued)					
Legumes, Close Seeded (Alfalfa, sweetclover, timothy, etc.)	Poor	66	77	85	89
	Good	58	72	81	85
Orchards, Evergreen (Citrus, avocados, etc.)	Poor	57	73	82	86
	Fair	44	65	77	82
	Good	33	58	72	79
Pasture, Dryland (Annual grasses)	Poor	68	79	86	89
	Fair	49	69	79	84
	Good	39	61	74	80
Pasture, Irrigated (Legumes and perennial grass)	Poor	58	74	83	87
	Fair	44	65	77	82
	Good	33	58	72	79
Row Crops (Field crops - tomatoes, sugar beets, etc.)	Poor	72	81	88	91
	Good	67	78	85	89
Small grain (Wheat, oats, barley, etc.)	Poor	65	76	84	88
	Good	63	75	83	87

Notes:

1. All curve numbers are for Antecedent Moisture Condition (AMC) II.
2. Quality of cover definitions:

   Poor-Heavily grazed, regularly burned areas, or areas of high burn potential. Less than 50 percent of the ground surface is protected by plant cover or brush and tree canopy.

   Fair-Moderate cover with 50 percent to 75 percent of the ground surface protected.

   Good-Heavy or dense cover with more than 75 percent of the ground surface protected.
3. See Figure C-2 for definition of cover types.

Hydraulic Analysis Report

Project Data

Project Title: **84" RCP E-01 SD**

Designer:

Project Date: Wednesday, November 14, 2018

Project Units: U.S. Customary Units

Notes:

Channel Analysis: Channel Analysis

Notes:

Input Parameters

Channel Type: Circular

Pipe Diameter: 7.0000 ft

Longitudinal Slope: 0.0050 ft/ft

Manning's n: 0.0120

Flow: 424.0000 cfs

Result Parameters

Depth: 5.0328 ft

Area of Flow: 29.6185 ft^2

Wetted Perimeter: 14.1688 ft

Hydraulic Radius: 2.0904 ft

Average Velocity: 14.3154 ft/s

Top Width: 6.2930 ft

Froude Number: 1.1628

Critical Depth: 5.4209 ft

Critical Velocity: 13.2586 ft/s

Critical Slope: 0.0042 ft/ft

Critical Top Width: 5.85 ft

Calculated Max Shear Stress: 1.5702 lb/ft^2

Calculated Avg Shear Stress: 0.6522 lb/ft^2

Hydraulic Analysis Report

Project Data

Project Title: **DOUBLE 3'X7' RCB**

Designer:

Project Date: Wednesday, November 14, 2018

Project Units: U.S. Customary Units

Notes:

Channel Analysis: Channel Analysis

Notes:

Input Parameters

Channel Type: Rectangular

Channel Width: 7.0000 ft

Longitudinal Slope: 0.0050 ft/ft

Manning's n: 0.0120

Depth: 2.9000 ft

Result Parameters

Flow: 241.7367 cfs **X 2 FOR DOUBLE FLOW = 483 CFS**

Area of Flow: 20.3000 ft^2

Wetted Perimeter: 12.8000 ft

Hydraulic Radius: 1.5859 ft

Average Velocity: 11.9082 ft/s

Top Width: 7.0000 ft

Froude Number: 1.2323

Critical Depth: 3.3333 ft

Critical Velocity: 10.3602 ft/s

Critical Slope: 0.0034 ft/ft

Critical Top Width: 7.00 ft

Calculated Max Shear Stress: 0.9048 lb/ft^2

Calculated Avg Shear Stress: 0.4948 lb/ft^2

Hydraulic Analysis Report

Project Data

Project Title: STORM DRAIN LINE E-01A

Designer:

Project Date: Wednesday, November 14, 2018

Project Units: U.S. Customary Units

Notes:

Channel Analysis: Channel Analysis

Notes:

Input Parameters

Channel Type: Circular

Pipe Diameter: 4.0000 ft

Longitudinal Slope: 0.0100 ft/ft

Manning's n: 0.0120

Flow: 119.0000 cfs

Result Parameters

Depth: 2.6200 ft

Area of Flow: 8.7229 ft^2

Wetted Perimeter: 7.5440 ft

Hydraulic Radius: 1.1563 ft

Average Velocity: 13.6423 ft/s

Top Width: 3.8029 ft

Froude Number: 1.5874

Critical Depth: 3.2852 ft

Critical Velocity: 10.7750 ft/s

Critical Slope: 0.0058 ft/ft

Critical Top Width: 3.06 ft

Calculated Max Shear Stress: 1.6349 lb/ft^2

Calculated Avg Shear Stress: 0.7215 lb/ft^2

NOAA Atlas 14, Volume 6, Version 2
Location name: Adelanto, California, USA*
Latitude: 34.5067°, Longitude: -117.3995°
Elevation: 3129.85 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sarah Dietz, Sarah Heim, Lillian Hiner, Kazungu Maitaria, Deborah Martin, Sandra Pavlovic, Ishani Roy, Carl Trypaluk, Dale Unruh, Fenglin Yan, Michael Yekta, Tan Zhao, Geoffrey Bonnin, Daniel Brewer, Li-Chuan Chen, Tye Parzybok, John Yarchoan

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.080 (0.066-0.098)	0.114 (0.094-0.140)	0.160 (0.131-0.196)	0.197 (0.161-0.244)	0.249 (0.197-0.319)	0.290 (0.224-0.378)	0.331 (0.250-0.443)	0.375 (0.275-0.516)	0.434 (0.306-0.623)	0.481 (0.327-0.714)
10-min	0.114 (0.095-0.140)	0.163 (0.135-0.200)	0.229 (0.188-0.281)	0.283 (0.231-0.350)	0.357 (0.282-0.457)	0.415 (0.321-0.542)	0.475 (0.358-0.635)	0.537 (0.394-0.739)	0.622 (0.438-0.893)	0.689 (0.469-1.02)
15-min	0.138 (0.114-0.169)	0.198 (0.163-0.242)	0.277 (0.228-0.340)	0.342 (0.279-0.423)	0.432 (0.341-0.552)	0.502 (0.388-0.656)	0.574 (0.433-0.768)	0.649 (0.477-0.894)	0.753 (0.530-1.08)	0.833 (0.567-1.24)
30-min	0.203 (0.167-0.248)	0.289 (0.239-0.354)	0.405 (0.333-0.497)	0.500 (0.408-0.619)	0.632 (0.499-0.809)	0.735 (0.568-0.960)	0.841 (0.634-1.13)	0.951 (0.698-1.31)	1.10 (0.776-1.58)	1.22 (0.830-1.81)
60-min	0.264 (0.218-0.322)	0.377 (0.311-0.461)	0.527 (0.434-0.647)	0.651 (0.532-0.806)	0.823 (0.650-1.05)	0.956 (0.740-1.25)	1.09 (0.826-1.46)	1.24 (0.908-1.70)	1.43 (1.01-2.06)	1.59 (1.08-2.36)
2-hr	0.369 (0.305-0.451)	0.500 (0.413-0.612)	0.679 (0.559-0.834)	0.831 (0.678-1.03)	1.05 (0.826-1.34)	1.22 (0.942-1.59)	1.40 (1.06-1.87)	1.59 (1.17-2.19)	1.85 (1.31-2.66)	2.07 (1.41-3.07)
3-hr	0.458 (0.378-0.560)	0.611 (0.504-0.748)	0.823 (0.677-1.01)	1.00 (0.820-1.24)	1.26 (0.997-1.62)	1.47 (1.14-1.92)	1.70 (1.28-2.27)	1.93 (1.42-2.66)	2.27 (1.60-3.26)	2.54 (1.73-3.77)
6-hr	0.623 (0.514-0.761)	0.824 (0.680-1.01)	1.11 (0.911-1.36)	1.35 (1.10-1.67)	1.71 (1.35-2.18)	2.00 (1.54-2.61)	2.31 (1.74-3.09)	2.65 (1.94-3.64)	3.13 (2.21-4.49)	3.53 (2.40-5.24)
12-hr	0.776 (0.641-0.949)	1.06 (0.877-1.30)	1.47 (1.21-1.80)	1.81 (1.48-2.24)	2.31 (1.83-2.96)	2.73 (2.11-3.56)	3.17 (2.39-4.24)	3.64 (2.68-5.02)	4.33 (3.05-6.22)	4.90 (3.33-7.28)
24-hr	1.05 (0.929-1.21)	1.49 (1.32-1.72)	2.11 (1.87-2.44)	2.64 (2.32-3.08)	3.41 (2.89-4.11)	4.04 (3.35-4.96)	4.70 (3.81-5.93)	5.43 (4.28-7.03)	6.47 (4.89-8.74)	7.33 (5.35-10.2)
2-day	1.13 (1.00-1.30)	1.61 (1.43-1.86)	2.29 (2.02-2.64)	2.87 (2.51-3.34)	3.71 (3.15-4.47)	4.40 (3.65-5.41)	5.14 (4.17-6.48)	5.95 (4.69-7.71)	7.12 (5.38-9.61)	8.09 (5.91-11.3)
3-day	1.21 (1.07-1.39)	1.72 (1.52-1.98)	2.44 (2.15-2.81)	3.05 (2.68-3.56)	3.95 (3.35-4.76)	4.69 (3.89-5.76)	5.48 (4.44-6.90)	6.35 (5.00-8.22)	7.60 (5.75-10.3)	8.65 (6.32-12.1)
4-day	1.30 (1.15-1.49)	1.84 (1.63-2.12)	2.60 (2.30-3.01)	3.26 (2.86-3.80)	4.21 (3.57-5.07)	5.00 (4.15-6.14)	5.84 (4.73-7.36)	6.76 (5.32-8.75)	8.09 (6.12-10.9)	9.20 (6.72-12.9)
7-day	1.39 (1.24-1.60)	1.96 (1.74-2.26)	2.77 (2.44-3.20)	3.46 (3.03-4.03)	4.45 (3.77-5.36)	5.27 (4.37-6.47)	6.13 (4.97-7.72)	7.07 (5.57-9.15)	8.41 (6.36-11.4)	9.52 (6.95-13.3)
10-day	1.48 (1.31-1.71)	2.08 (1.84-2.40)	2.92 (2.58-3.38)	3.65 (3.20-4.25)	4.70 (3.98-5.66)	5.55 (4.60-6.82)	6.45 (5.22-8.12)	7.42 (5.84-9.61)	8.81 (6.66-11.9)	9.94 (7.26-13.9)
20-day	1.76 (1.56-2.02)	2.47 (2.19-2.85)	3.48 (3.07-4.02)	4.35 (3.81-5.07)	5.61 (4.75-6.75)	6.63 (5.51-8.15)	7.72 (6.25-9.73)	8.89 (7.00-11.5)	10.5 (7.96-14.2)	11.9 (8.66-16.6)
30-day	2.03 (1.80-2.34)	2.84 (2.52-3.27)	4.00 (3.53-4.62)	5.01 (4.39-5.84)	6.48 (5.49-7.80)	7.67 (6.37-9.44)	8.94 (7.24-11.3)	10.3 (8.11-13.3)	12.2 (9.23-16.5)	13.7 (10.0-19.2)
45-day	2.37 (2.10-2.73)	3.30 (2.92-3.80)	4.62 (4.08-5.34)	5.79 (5.07-6.75)	7.51 (6.36-9.04)	8.92 (7.40-11.0)	10.4 (8.43-13.1)	12.0 (9.46-15.6)	14.3 (10.8-19.3)	16.1 (11.7-22.5)
60-day	2.65 (2.35-3.05)	3.64 (3.23-4.20)	5.09 (4.50-5.88)	6.37 (5.58-7.42)	8.26 (7.00-9.95)	9.83 (8.16-12.1)	11.5 (9.32-14.5)	13.3 (10.5-17.2)	15.8 (12.0-21.3)	17.8 (13.0-24.9)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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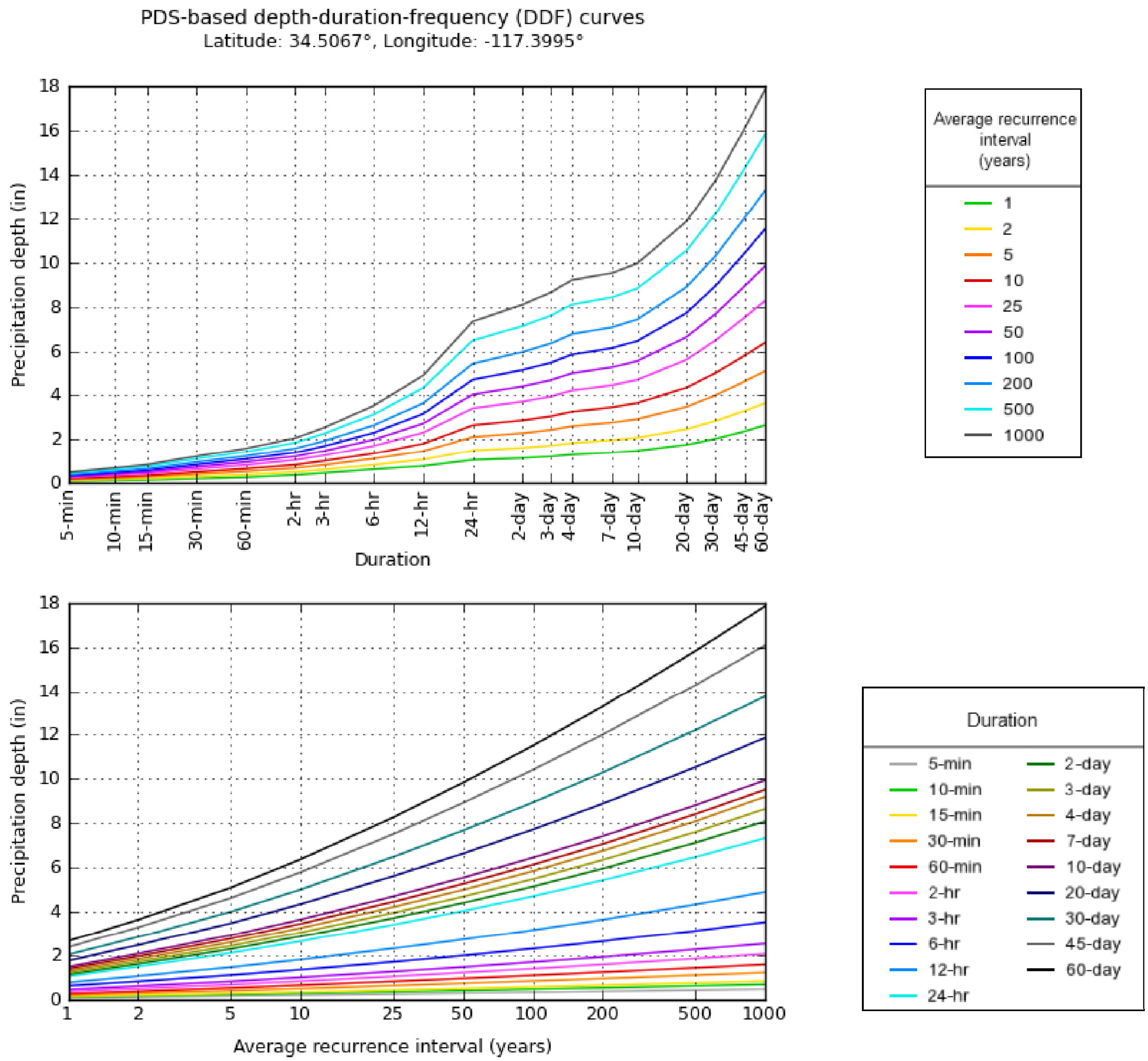
PF graphical



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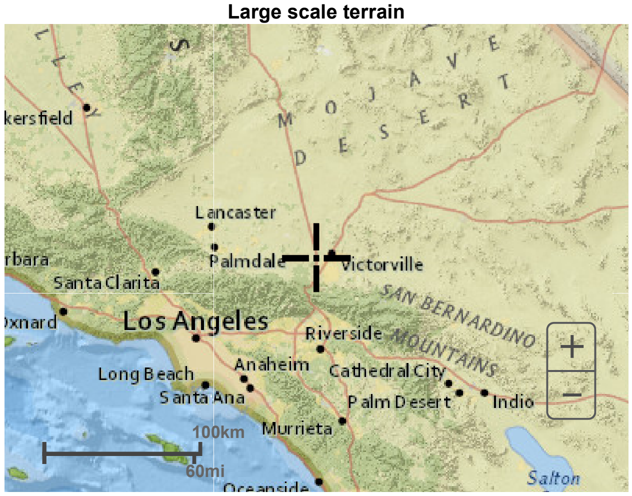
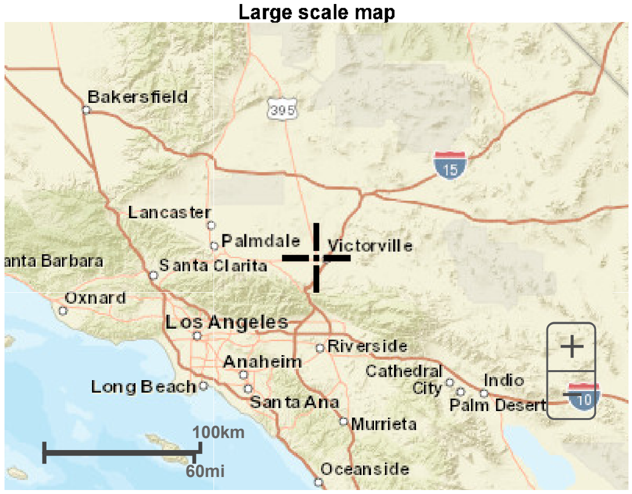
Maps & aerials

Small scale terrain

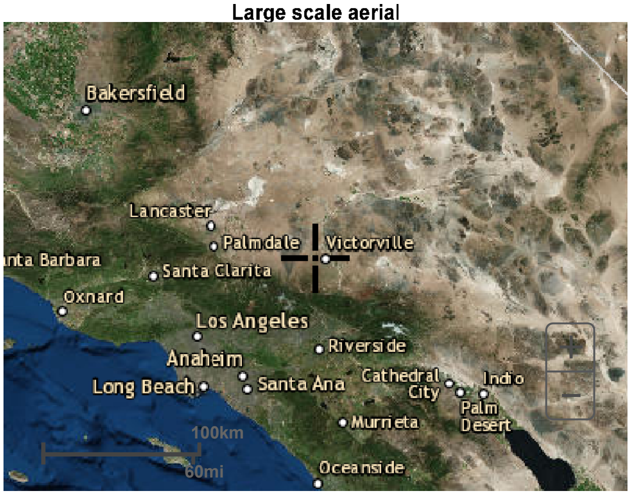
Large scale terrain



Large scale map



Large scale aerial



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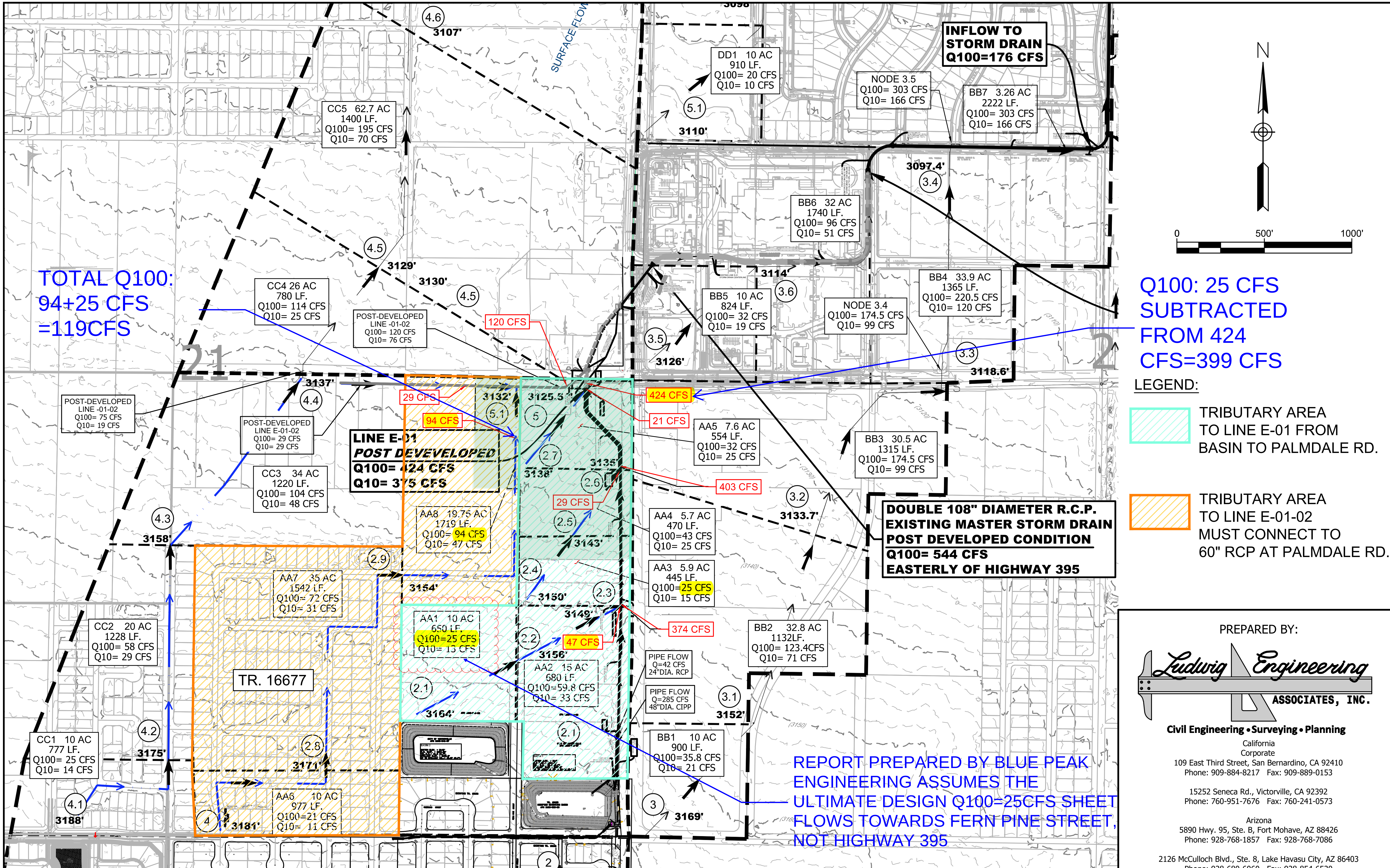
INFLOW TO STORM DRAIN Q100=176 CFS
DD1 10 AC 910 LF. Q100= 20 CFS Q10= 10 CFS
NODE 3.5 Q100= 303 CFS Q10= 166 CFS
BB7 3.26 AC 2222 LF. Q100= 303 CFS Q10= 166 CFS
CC5 62.7 AC 1400 LF. Q100= 195 CFS Q10= 70 CFS
SURFACE FLOW
3107'
3110'
3097.4'
BB6 32 AC 1740 LF. Q100= 96 CFS Q10= 51 CFS
TOTAL Q100: 94+25 CFS =119CFS
CC4 26 AC 780 LF. Q100= 114 CFS Q10= 25 CFS
POST-DEVELOPED LINE -01-02 Q100= 120 CFS Q10= 76 CFS
3129'
3130'
120 CFS
3114'
BB5 10 AC 824 LF. Q100= 32 CFS Q10= 19 CFS
NODE 3.4 Q100= 174.5 CFS Q10= 99 CFS
BB4 33.9 AC 1365 LF. Q100= 220.5 CFS Q10= 120 CFS
Q100: 25 CFS SUBTRACTED FROM 424 CFS=399 CFS
3126'
3118.6'
POST-DEVELOPED LINE -01-02 Q100= 75 CFS Q10= 19 CFS
3137'
29 CFS
3132'
3125.5
424 CFS
POST-DEVELOPED LINE E-01-02 Q100= 29 CFS Q10= 29 CFS
94 CFS
21 CFS
AA5 7.6 AC 554 LF. Q100=32 CFS Q10= 25 CFS
BB3 30.5 AC 1315 LF. Q100= 174.5 CFS Q10= 99 CFS
LINE E-01
POST DEVEVELOPED
Q100= 424 CFS
Q10= 375 CFS
3135'
3136'
CC3 34 AC 1220 LF. Q100= 104 CFS Q10= 48 CFS
403 CFS
29 CFS
3133.7'
AA8 19.75 AC 1719 LF. Q100= 94 CFS Q10= 47 CFS
AA4 5.7 AC 470 LF. Q100=43 CFS Q10= 25 CFS
DOUBLE 108" DIAMETER R.C.P.
EXISTING MASTER STORM DRAIN
POST DEVELOPED CONDITION
Q100= 544 CFS
EASTERLY OF HIGHWAY 395
3158'
3143'
AA7 35 AC 1542 LF. Q100= 72 CFS Q10= 31 CFS
3154'
AA3 5.9 AC 445 LF. Q100=25 CFS Q10= 15 CFS
3150'
3149'
CC2 20 AC 1228 LF. Q100= 58 CFS Q10= 29 CFS
AA1 10 AC 650 LF. Q100=25 CFS Q10= 13 CFS
374 CFS
47 CFS
BB2 32.8 AC 1132LF. Q100= 123.4CFS Q10= 71 CFS
TR. 16677
3156'
AA2 15 AC 680 LF. Q100=59.8 CFS Q10= 33 CFS
PIPE FLOW Q=42 CFS 24"DIA. RCP
PIPE FLOW Q=285 CFS 48"DIA. CIPP
3164'
3152'
CC1 10 AC 777 LF. Q100= 25 CFS Q10= 14 CFS
3175'
3171'
BB1 10 AC 900 LF. Q100=35.8 CFS Q10= 21 CFS
REPORT PREPARED BY BLUE PEAK ENGINEERING ASSUMES THE ULTIMATE DESIGN Q100=25CFS SHEET FLOWS TOWARDS FERN PINE STREET, NOT HIGHWAY 395
AA6 10 AC 977 LF. Q100=21 CFS Q10= 11 CFS
3188'
3181'
3169'
N
0 500' 1000'
LEGEND:
TRIBUTARY AREA TO LINE E-01 FROM BASIN TO PALMDALE RD.
TRIBUTARY AREA TO LINE E-01-02 MUST CONNECT TO 60" RCP AT PALMDALE RD.
PREPARED BY:
Ludwig Engineering ASSOCIATES, INC.
Civil Engineering • Surveying • Planning
California
Corporate
109 East Third Street, San Bernardino, CA 92410
Phone: 909-884-8217 Fax: 909-889-0153
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2126 McCulloch Blvd., Ste. 8, Lake Havasu City, AZ 86403
Phone: 928-680-6060 Fax: 928-854-6530

U60
6-30-05
4th CK

HYDROLOGY STUDY
FOR
TRACT 16677

bordered by Dos Palmas Road on the south, and
Mesa View Road on the west;
west of U.S. Highway 395,
south of Palmdale Road (Route 18)

Prepared for:
Frontier Homes
15345 Bonanza Road, Suite A
Victorville, California 92392
(760) 951-0442, fax:(760) 955-7153

Prepared by:
VTN West, Inc.
6949 Van Nuys Boulevard
Van Nuys, California 91405
VTN W.O. NO. 6314-001
(818) 779-8740, fax:(818) 779-8750

June 23, 2005

REGISTERED PROFESSIONAL ENGINEER
CHANG-HSIN HSIEH
No. 50211
Exp. 6/30/07
CIVIL
STATE OF CALIFORNIA

6-23-05

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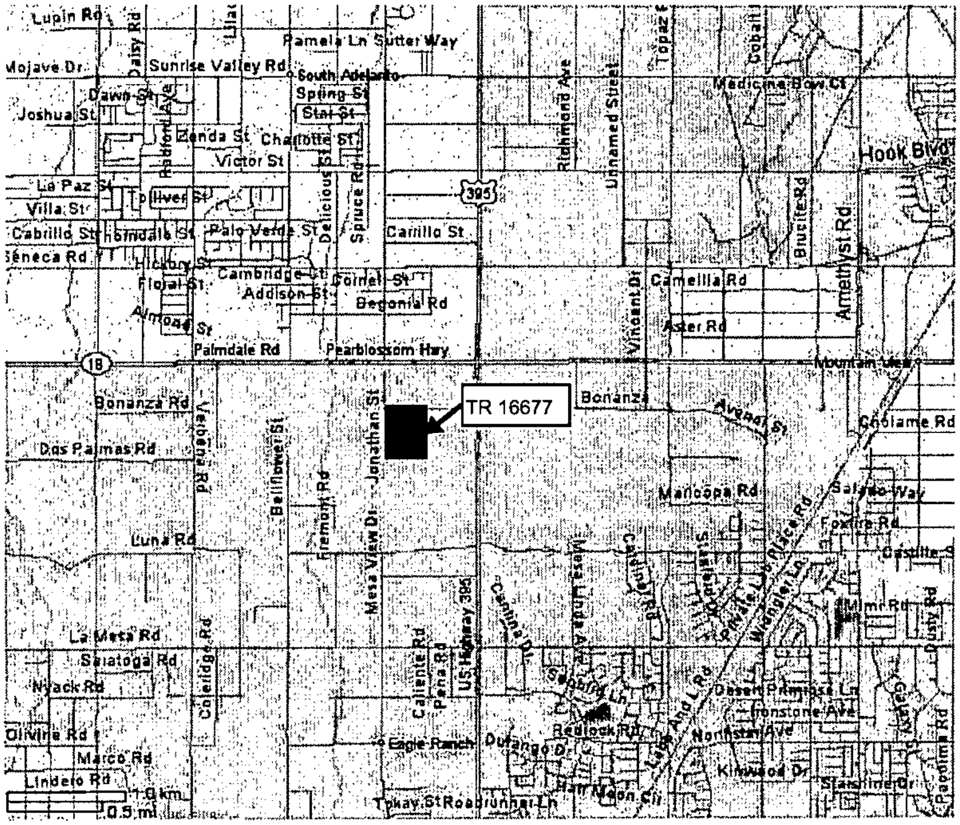


Figure 1: Vicinity Map

1 Introduction

Tract 16677 is located in Victorville, bordered by Dos Palmas Road on the south, and Mesa View Road on the west; west of U.S. Highway 395, south of Palmdale Road (Route 18). The existing drainage patter is generally from the south to the north. There is no well-defined drainage course through the site. The average slope is about 1.5%. The site is about 50.3 acres in size and will contain 215 single-family lots.

46.9 acres drain toward the north-east corner of the site. The rest, (3.4 acres) toward the north-west corner. Since the runoff from this 3.4-acre portion is small, a drywell is proposed at the north-west corner of the tract, in Mesa View Street, that will pick up the nuisance water, and low-intensity storm runoff.

The majority of the runoff concentrates and flows easterly on Far Hills Street. The owner of the property to the east has accepted this runoff, which in the future will be carried on the street further east and eventually discharged into the master-plan drainage facility E-01 (See Appendix F). This will be an earthen channel, running south to north, ~600 feet east of the tract boundary.

In the interim, the flow is captured by catch basins in Brynwood Street and Far Hills Street and conveyed into a detention basin in the north-east corner of the tract. The basin is discharged through a reinforced concrete box at the north-east corner of the basin, into an existing 20 foot wide storm drain & sewer easement. This easement, running south to north, approximately follows the historic drainage route.

When the property east of the project site is developed, the storm drain system and the detention basin will be abandoned.

The purpose of this study is to determine the pre- and post-development runoff from the site; and to verify that the proposed design satisfies the required storm protection criteria.

2 Methodology

The Rational Method is used for determining the peak runoff values for the pre-developed conditions, because only peak values are needed (no hydrographs).

The Rational Method is used also for calculating the time of concentration values for the post-developed conditions. These are necessary for determining the lag for the unit-hydrograph method. Within the site a stream line is selected that extends from the point of concentration at the downstream end of the watershed (at the detention basin) to the most hydraulically remote point. Only the areas contributing to this stream line are analyzed by the Rational Method, because this stream produces the time of concentration that is representative to the whole area.

The Unit-Hydrograph method is used for creating the runoff hydrographs for the post-developed conditions. These hydrographs then routed through the proposed basin.

2-, 10-, 25-, and 100-year storms are analyzed and routed through the proposed detention basin to ensure that the outflow from the basin will not be greater than 90% of the pre-development peak flow. Pre-development flows are calculated according to the County's criteria:

a) 10-year peak flow rate shall be calculated using 5-year rainfall,

Appendix E

Detention Basin Routing Calculations

E.1 100-year Runoff

Time [min]	Inflow [cfs]	OUTFLOW Low-Level [cfs]	Weir [cfs]	Total [cfs]	Depth [Ft]	W.S. Elev	Storage [Ac-Ft]
4.00	0.01	0.00	0.00	0.00	0.00	3147.50	0.00
8.00	0.04	0.00	0.00	0.00	0.00	3147.50	0.00
12.00	0.10	0.00	0.00	0.00	0.01	3147.51	0.00
16.00	0.24	0.00	0.00	0.00	0.03	3147.53	0.00
20.00	0.36	0.00	0.00	0.00	0.07	3147.57	0.00
24.00	0.44	0.00	0.00	0.00	0.11	3147.61	0.01
28.00	0.49	0.00	0.00	0.00	0.17	3147.67	0.01
32.00	0.53	0.00	0.00	0.00	0.23	3147.73	0.01
36.00	0.57	0.00	0.00	0.00	0.30	3147.80	0.01
40.00	0.59	0.00	0.00	0.00	0.37	3147.87	0.02
44.00	0.62	0.00	0.00	0.00	0.44	3147.94	0.02
48.00	0.63	0.00	0.00	0.00	0.50	3148.00	0.02
52.00	0.65	0.00	0.00	0.00	0.52	3148.02	0.03
56.00	0.66	0.00	0.00	0.00	0.54	3148.04	0.03
60.00	0.68	0.00	0.00	0.00	0.56	3148.06	0.03
64.00	0.69	0.00	0.00	0.00	0.57	3148.07	0.04
68.00	0.70	0.00	0.00	0.00	0.59	3148.09	0.04
72.00	0.71	0.00	0.00	0.00	0.61	3148.11	0.05
76.00	0.72	0.00	0.00	0.00	0.63	3148.13	0.05
80.00	0.73	0.00	0.00	0.00	0.65	3148.15	0.05
84.00	0.73	0.00	0.00	0.00	0.67	3148.17	0.06
88.00	0.74	0.00	0.00	0.00	0.69	3148.19	0.06
92.00	0.75	0.00	0.00	0.00	0.71	3148.21	0.07
96.00	0.75	0.00	0.00	0.00	0.73	3148.23	0.07
100.00	0.76	0.00	0.00	0.00	0.75	3148.25	0.07
104.00	0.76	0.00	0.00	0.00	0.77	3148.27	0.08
108.00	0.76	0.00	0.00	0.00	0.79	3148.29	0.08
112.00	0.77	0.00	0.00	0.00	0.81	3148.31	0.09
116.00	0.77	0.00	0.00	0.00	0.84	3148.34	0.09
120.00	0.78	0.00	0.00	0.00	0.86	3148.36	0.10
124.00	0.78	0.00	0.00	0.00	0.88	3148.38	0.10
128.00	0.78	0.00	0.00	0.00	0.90	3148.40	0.10
132.00	0.79	0.00	0.00	0.00	0.92	3148.42	0.11
136.00	0.79	0.00	0.00	0.00	0.94	3148.44	0.11
140.00	0.79	0.00	0.00	0.00	0.96	3148.46	0.12
144.00	0.80	0.00	0.00	0.00	0.98	3148.48	0.12
148.00	0.80	0.00	0.00	0.00	1.01	3148.51	0.13
152.00	0.80	0.00	0.00	0.00	1.03	3148.53	0.13

156.00	0.80	0.00	0.00	0.00	1.05	3148.55	0.13
160.00	0.81	0.00	0.00	0.00	1.07	3148.57	0.14
164.00	0.81	0.00	0.00	0.00	1.09	3148.59	0.14
168.00	0.81	0.00	0.00	0.00	1.11	3148.61	0.15
172.00	0.81	0.00	0.00	0.00	1.14	3148.64	0.15
176.00	0.82	0.00	0.00	0.00	1.16	3148.66	0.16
180.00	0.82	0.00	0.00	0.00	1.18	3148.68	0.16
184.00	0.82	0.00	0.00	0.00	1.20	3148.70	0.17
188.00	0.82	0.00	0.00	0.00	1.23	3148.73	0.17
192.00	0.83	0.00	0.00	0.00	1.25	3148.75	0.18
196.00	0.83	0.00	0.00	0.00	1.27	3148.77	0.18
200.00	0.83	0.00	0.00	0.00	1.29	3148.79	0.18
204.00	0.83	0.00	0.00	0.00	1.32	3148.82	0.19
208.00	0.84	0.00	0.00	0.00	1.34	3148.84	0.19
212.00	0.84	0.00	0.00	0.00	1.36	3148.86	0.20
216.00	0.84	0.00	0.00	0.00	1.38	3148.88	0.20
220.00	0.85	0.00	0.00	0.00	1.41	3148.91	0.21
224.00	0.85	0.00	0.00	0.00	1.43	3148.93	0.21
228.00	0.85	0.00	0.00	0.00	1.45	3148.95	0.22
232.00	0.85	0.00	0.00	0.00	1.48	3148.98	0.22
236.00	0.86	0.00	0.00	0.00	1.50	3149.00	0.23
240.00	0.86	0.00	0.00	0.00	1.52	3149.02	0.23
244.00	0.86	0.00	0.00	0.00	1.55	3149.05	0.24
248.00	0.87	0.00	0.00	0.00	1.57	3149.07	0.24
252.00	0.87	0.00	0.00	0.00	1.59	3149.09	0.25
256.00	0.87	0.00	0.00	0.00	1.62	3149.12	0.25
260.00	0.87	0.00	0.00	0.00	1.64	3149.14	0.25
264.00	0.88	0.00	0.00	0.00	1.66	3149.16	0.26
268.00	0.88	0.00	0.00	0.00	1.69	3149.19	0.26
272.00	0.88	0.00	0.00	0.00	1.71	3149.21	0.27
276.00	0.89	0.00	0.00	0.00	1.74	3149.24	0.27
280.00	0.89	0.00	0.00	0.00	1.76	3149.26	0.28
284.00	0.89	0.00	0.00	0.00	1.78	3149.28	0.28
288.00	0.90	0.00	0.00	0.00	1.81	3149.31	0.29
292.00	0.90	0.00	0.00	0.00	1.83	3149.33	0.29
296.00	0.90	0.00	0.00	0.00	1.86	3149.36	0.30
300.00	0.91	0.00	0.00	0.00	1.88	3149.38	0.30
304.00	0.91	0.00	0.00	0.00	1.91	3149.41	0.31
308.00	0.91	0.00	0.00	0.00	1.93	3149.43	0.31
312.00	0.92	0.00	0.00	0.00	1.96	3149.46	0.32
316.00	0.92	0.00	0.00	0.00	1.98	3149.48	0.32
320.00	0.92	0.00	0.00	0.00	2.01	3149.51	0.33
324.00	0.93	0.00	0.00	0.00	2.03	3149.53	0.33
328.00	0.93	0.00	0.00	0.00	2.06	3149.56	0.34
332.00	0.93	0.00	0.00	0.00	2.08	3149.58	0.34
336.00	0.94	0.00	0.00	0.00	2.11	3149.61	0.35
340.00	0.94	0.00	0.00	0.00	2.13	3149.63	0.35
344.00	0.94	0.00	0.00	0.00	2.16	3149.66	0.36
348.00	0.95	0.00	0.00	0.00	2.18	3149.68	0.36
352.00	0.95	0.00	0.00	0.00	2.21	3149.71	0.37
356.00	0.96	0.00	0.00	0.00	2.23	3149.73	0.38
360.00	0.96	0.00	0.00	0.00	2.26	3149.76	0.38
364.00	0.96	0.00	0.00	0.00	2.29	3149.79	0.39
368.00	0.97	0.00	0.00	0.00	2.31	3149.81	0.39
372.00	0.97	0.00	0.00	0.00	2.34	3149.84	0.40
376.00	0.98	0.00	0.00	0.00	2.37	3149.87	0.40
380.00	0.98	0.00	0.00	0.00	2.39	3149.89	0.41
384.00	0.98	0.00	0.00	0.00	2.42	3149.92	0.41
388.00	0.99	0.00	0.00	0.00	2.45	3149.95	0.42
392.00	0.99	0.00	0.00	0.00	2.47	3149.97	0.42
396.00	1.00	0.00	0.00	0.00	2.50	3150.00	0.43
400.00	1.00	0.00	0.00	0.00	2.51	3150.01	0.43
404.00	1.00	0.00	0.00	0.00	2.53	3150.03	0.44
408.00	1.01	0.00	0.00	0.00	2.54	3150.04	0.45
412.00	1.01	0.00	0.00	0.00	2.56	3150.06	0.45
416.00	1.02	0.00	0.00	0.00	2.57	3150.07	0.46
420.00	1.02	0.00	0.00	0.00	2.59	3150.09	0.46
424.00	1.03	0.00	0.00	0.00	2.60	3150.10	0.47
428.00	1.03	0.00	0.00	0.00	2.61	3150.11	0.47
432.00	1.04	0.00	0.00	0.00	2.63	3150.13	0.48
436.00	1.04	0.00	0.00	0.00	2.64	3150.14	0.49
440.00	1.05	0.00	0.00	0.00	2.66	3150.16	0.49
444.00	1.05	0.00	0.00	0.00	2.67	3150.17	0.50
448.00	1.06	0.00	0.00	0.00	2.69	3150.19	0.50

452.00	1.06	0.00	0.00	0.00	2.70	3150.20	0.51
456.00	1.07	0.00	0.00	0.00	2.72	3150.22	0.51
460.00	1.07	0.00	0.00	0.00	2.73	3150.23	0.52
464.00	1.08	0.00	0.00	0.00	2.75	3150.25	0.53
468.00	1.08	0.00	0.00	0.00	2.76	3150.26	0.53
472.00	1.09	0.00	0.00	0.00	2.78	3150.28	0.54
476.00	1.09	0.00	0.00	0.00	2.79	3150.29	0.54
480.00	1.10	0.00	0.00	0.00	2.81	3150.31	0.55
484.00	1.10	0.00	0.00	0.00	2.83	3150.33	0.56
488.00	1.11	0.00	0.00	0.00	2.84	3150.34	0.56
492.00	1.11	0.00	0.00	0.00	2.86	3150.36	0.57
496.00	1.12	0.00	0.00	0.00	2.87	3150.37	0.57
500.00	1.13	0.00	0.00	0.00	2.89	3150.39	0.58
504.00	1.13	0.00	0.00	0.00	2.90	3150.40	0.59
508.00	1.14	0.00	0.00	0.00	2.92	3150.42	0.59
512.00	1.14	0.00	0.00	0.00	2.94	3150.44	0.60
516.00	1.15	0.00	0.00	0.00	2.95	3150.45	0.61
520.00	1.16	0.00	0.00	0.00	2.97	3150.47	0.61
524.00	1.16	0.00	0.00	0.00	2.99	3150.49	0.62
528.00	1.17	0.00	0.00	0.00	3.00	3150.50	0.62
532.00	1.17	0.00	0.00	0.00	3.02	3150.52	0.63
536.00	1.18	0.00	0.00	0.00	3.04	3150.54	0.64
540.00	1.19	0.00	0.00	0.00	3.05	3150.55	0.64
544.00	1.19	0.00	0.00	0.00	3.07	3150.57	0.65
548.00	1.20	0.00	0.00	0.00	3.09	3150.59	0.66
552.00	1.21	0.00	0.00	0.00	3.10	3150.60	0.66
556.00	1.22	0.00	0.00	0.00	3.12	3150.62	0.67
560.00	1.22	0.00	0.00	0.00	3.14	3150.64	0.68
564.00	1.23	0.00	0.00	0.00	3.15	3150.65	0.68
568.00	1.24	0.00	0.00	0.00	3.17	3150.67	0.69
572.00	1.24	0.00	0.00	0.00	3.19	3150.69	0.70
576.00	1.25	0.00	0.00	0.00	3.21	3150.71	0.70
580.00	1.26	0.00	0.00	0.00	3.22	3150.72	0.71
584.00	1.27	0.00	0.00	0.00	3.24	3150.74	0.72
588.00	1.28	0.00	0.00	0.00	3.26	3150.76	0.73
592.00	1.28	0.00	0.00	0.00	3.28	3150.78	0.73
596.00	1.29	0.00	0.00	0.00	3.30	3150.80	0.74
600.00	1.30	0.00	0.00	0.00	3.32	3150.82	0.75
604.00	1.31	0.00	0.00	0.00	3.33	3150.83	0.75
608.00	1.32	0.00	0.00	0.00	3.35	3150.85	0.76
612.00	1.33	0.00	0.00	0.00	3.37	3150.87	0.77
616.00	1.34	0.00	0.00	0.00	3.39	3150.89	0.78
620.00	1.34	0.00	0.00	0.00	3.41	3150.91	0.78
624.00	1.35	0.00	0.00	0.00	3.43	3150.93	0.79
628.00	1.36	0.00	0.00	0.00	3.45	3150.95	0.80
632.00	1.37	0.00	0.00	0.00	3.47	3150.97	0.81
636.00	1.38	0.00	0.00	0.00	3.49	3150.99	0.81
640.00	1.39	0.00	0.00	0.00	3.51	3151.01	0.82
644.00	1.40	0.00	0.00	0.00	3.53	3151.03	0.83
648.00	1.41	0.00	0.00	0.00	3.55	3151.05	0.84
652.00	1.42	0.00	0.00	0.00	3.57	3151.07	0.84
656.00	1.43	0.00	0.00	0.00	3.59	3151.09	0.85
660.00	1.45	0.02	0.00	0.02	3.61	3151.11	0.86
664.00	1.46	0.11	0.00	0.11	3.63	3151.13	0.87
668.00	1.47	0.18	0.00	0.18	3.64	3151.14	0.87
672.00	1.48	0.26	0.00	0.26	3.66	3151.16	0.88
676.00	1.49	0.33	0.00	0.33	3.68	3151.18	0.89
680.00	1.50	0.40	0.00	0.40	3.69	3151.19	0.89
684.00	1.52	0.46	0.00	0.46	3.71	3151.21	0.90
688.00	1.53	0.54	0.00	0.54	3.72	3151.22	0.91
692.00	1.54	0.65	0.00	0.65	3.74	3151.24	0.91
696.00	1.56	0.75	0.00	0.75	3.75	3151.25	0.92
700.00	1.57	0.84	0.00	0.84	3.76	3151.26	0.92
704.00	1.58	0.92	0.00	0.92	3.77	3151.27	0.92
708.00	1.60	1.00	0.00	1.00	3.78	3151.28	0.93
712.00	1.61	1.08	0.00	1.08	3.79	3151.29	0.93
716.00	1.63	1.15	0.00	1.15	3.79	3151.29	0.93
720.00	1.64	1.21	0.00	1.21	3.80	3151.30	0.94
724.00	1.65	1.27	0.00	1.27	3.81	3151.31	0.94
728.00	1.65	1.32	0.00	1.32	3.81	3151.31	0.94
732.00	1.63	1.36	0.00	1.36	3.82	3151.32	0.94
736.00	1.56	1.39	0.00	1.39	3.82	3151.32	0.94
740.00	1.50	1.41	0.00	1.41	3.82	3151.32	0.94
744.00	1.47	1.42	0.00	1.42	3.82	3151.32	0.94

748.00	1.46	1.43	0.00	1.43	3.82	3151.32	0.94
752.00	1.45	1.43	0.00	1.43	3.82	3151.32	0.94
756.00	1.45	1.43	0.00	1.43	3.82	3151.32	0.94
760.00	1.45	1.44	0.00	1.44	3.82	3151.32	0.94
764.00	1.46	1.44	0.00	1.44	3.82	3151.32	0.94
768.00	1.46	1.44	0.00	1.44	3.82	3151.32	0.95
772.00	1.48	1.44	0.00	1.44	3.82	3151.32	0.95
776.00	1.49	1.45	0.00	1.45	3.82	3151.32	0.95
780.00	1.50	1.46	0.00	1.46	3.83	3151.33	0.95
784.00	1.52	1.46	0.00	1.46	3.83	3151.33	0.95
788.00	1.53	1.47	0.00	1.47	3.83	3151.33	0.95
792.00	1.55	1.48	0.00	1.48	3.83	3151.33	0.95
796.00	1.57	1.49	0.00	1.49	3.83	3151.33	0.95
800.00	1.59	1.50	0.00	1.50	3.83	3151.33	0.95
804.00	1.61	1.52	0.00	1.52	3.83	3151.33	0.95
808.00	1.64	1.53	0.00	1.53	3.83	3151.33	0.95
812.00	1.66	1.55	0.00	1.55	3.83	3151.33	0.95
816.00	1.69	1.56	0.00	1.56	3.84	3151.34	0.95
820.00	1.71	1.58	0.00	1.58	3.84	3151.34	0.95
824.00	1.74	1.60	0.00	1.60	3.84	3151.34	0.95
828.00	1.77	1.62	0.00	1.62	3.84	3151.34	0.95
832.00	1.81	1.64	0.00	1.64	3.84	3151.34	0.95
836.00	1.84	1.67	0.00	1.67	3.85	3151.35	0.95
840.00	1.87	1.69	0.00	1.69	3.85	3151.35	0.95
844.00	1.91	1.72	0.00	1.72	3.85	3151.35	0.96
848.00	1.95	1.75	0.00	1.75	3.85	3151.35	0.96
852.00	2.00	1.78	0.00	1.78	3.86	3151.36	0.96
856.00	2.04	1.81	0.00	1.81	3.86	3151.36	0.96
860.00	2.09	1.84	0.00	1.84	3.86	3151.36	0.96
864.00	2.15	1.88	0.00	1.88	3.87	3151.37	0.96
868.00	2.20	1.92	0.00	1.92	3.87	3151.37	0.96
872.00	2.26	1.96	0.00	1.96	3.88	3151.38	0.97
876.00	2.32	2.00	0.00	2.00	3.88	3151.38	0.97
880.00	2.38	2.05	0.00	2.05	3.88	3151.38	0.97
884.00	2.45	2.10	0.00	2.10	3.89	3151.39	0.97
888.00	2.53	2.15	0.00	2.15	3.89	3151.39	0.97
892.00	2.60	2.20	0.00	2.20	3.90	3151.40	0.97
896.00	2.69	2.26	0.00	2.26	3.91	3151.41	0.98
900.00	2.78	2.33	0.00	2.33	3.91	3151.41	0.98
904.00	2.88	2.39	0.00	2.39	3.92	3151.42	0.98
908.00	2.99	2.46	0.00	2.46	3.93	3151.43	0.98
912.00	3.12	2.56	0.00	2.56	3.93	3151.43	0.99
916.00	3.25	2.67	0.00	2.67	3.94	3151.44	0.99
920.00	3.40	2.78	0.00	2.78	3.95	3151.45	0.99
924.00	3.57	2.91	0.00	2.91	3.96	3151.46	1.00
928.00	3.78	3.04	0.00	3.04	3.97	3151.47	1.00
932.00	4.05	3.20	0.00	3.20	3.98	3151.48	1.01
936.00	4.46	3.38	0.00	3.38	3.99	3151.49	1.01
940.00	5.03	3.62	0.00	3.62	4.01	3151.51	1.02
944.00	5.88	3.95	0.00	3.95	4.04	3151.54	1.03
948.00	7.04	4.44	0.00	4.44	4.07	3151.57	1.04
952.00	8.64	5.11	0.00	5.11	4.11	3151.61	1.06
956.00	10.89	6.03	0.00	6.03	4.17	3151.67	1.08
960.00	14.40	7.33	0.00	7.33	4.26	3151.76	1.11
964.00	22.91	9.92	0.00	9.92	4.40	3151.90	1.17
968.00	36.58	14.33	0.00	14.33	4.62	3152.12	1.27
972.00	58.49	21.83	0.00	21.83	4.95	3152.45	1.43
976.00	85.63	34.64	0.00	34.64	5.44	3152.94	1.68
980.00	77.53	40.97	0.00	40.97	5.92	3153.42	1.91
984.00	54.90	43.11	0.00	43.11	6.19	3153.69	2.05
988.00	41.28	43.44	0.00	43.44	6.24	3153.74	2.07
992.00	31.82	42.97	0.00	42.97	6.16	3153.66	2.04
996.00	26.45	42.03	0.00	42.03	6.01	3153.51	1.96
1000.00	22.17	39.92	0.00	39.92	5.83	3153.33	1.87
1004.00	18.53	37.57	0.00	37.57	5.63	3153.13	1.77
1008.00	15.83	33.98	0.00	33.98	5.42	3152.92	1.66
1012.00	13.77	29.01	0.00	29.01	5.23	3152.73	1.57
1016.00	12.28	24.99	0.00	24.99	5.08	3152.58	1.50
1020.00	10.93	21.79	0.00	21.79	4.95	3152.45	1.43
1024.00	10.05	19.15	0.00	19.15	4.84	3152.34	1.38
1028.00	8.90	16.99	0.00	16.99	4.74	3152.24	1.33
1032.00	7.89	15.17	0.00	15.17	4.66	3152.16	1.29
1036.00	7.55	13.60	0.00	13.60	4.58	3152.08	1.25
1040.00	6.88	12.24	0.00	12.24	4.52	3152.02	1.22

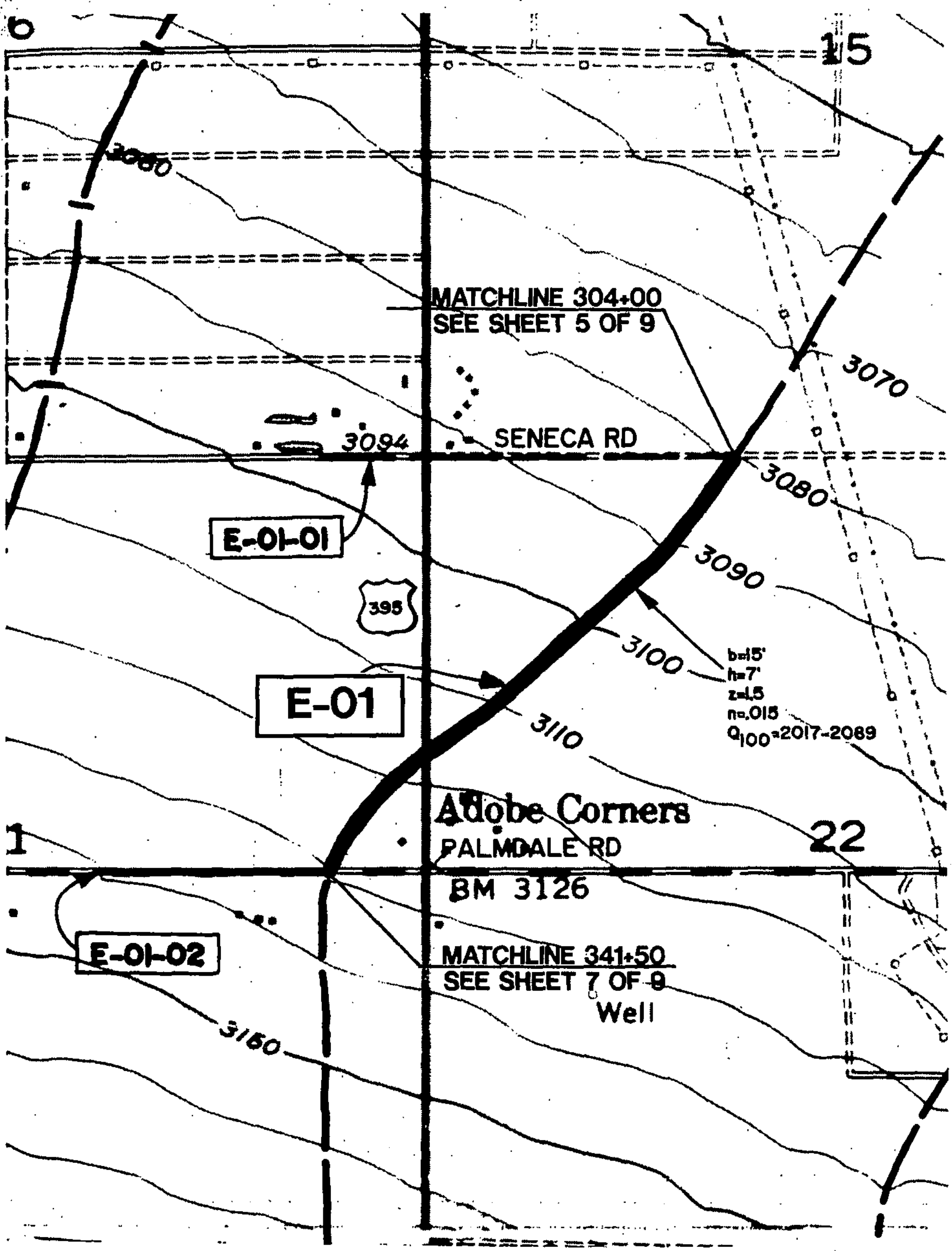
1044.00	6.10	10.95	0.00	10.95	4.45	3151.95	1.19
1048.00	5.54	9.74	0.00	9.74	4.39	3151.89	1.17
1052.00	5.04	8.68	0.00	8.68	4.34	3151.84	1.14
1056.00	4.52	7.80	0.00	7.80	4.29	3151.79	1.13
1060.00	4.03	7.11	0.00	7.11	4.24	3151.74	1.11
1064.00	3.63	6.47	0.00	6.47	4.20	3151.70	1.09
1068.00	3.30	5.88	0.00	5.88	4.16	3151.66	1.08
1072.00	3.04	5.35	0.00	5.35	4.13	3151.63	1.06
1076.00	2.83	4.88	0.00	4.88	4.10	3151.60	1.05
1080.00	2.67	4.46	0.00	4.46	4.07	3151.57	1.04
1084.00	2.57	4.10	0.00	4.10	4.05	3151.55	1.03
1088.00	2.50	3.82	0.00	3.82	4.03	3151.53	1.02
1092.00	2.47	3.58	0.00	3.58	4.01	3151.51	1.02
1096.00	2.48	3.39	0.00	3.39	4.00	3151.50	1.01
1100.00	2.44	3.23	0.00	3.23	3.98	3151.48	1.01
1104.00	2.34	3.08	0.00	3.08	3.97	3151.47	1.00
1108.00	1.77	2.90	0.00	2.90	3.96	3151.46	1.00
1112.00	1.71	2.69	0.00	2.69	3.94	3151.44	0.99
1116.00	1.67	2.52	0.00	2.52	3.93	3151.43	0.99
1120.00	1.64	2.40	0.00	2.40	3.92	3151.42	0.98
1124.00	1.61	2.30	0.00	2.30	3.91	3151.41	0.98
1128.00	1.58	2.20	0.00	2.20	3.90	3151.40	0.97
1132.00	1.56	2.12	0.00	2.12	3.89	3151.39	0.97
1136.00	1.54	2.05	0.00	2.05	3.88	3151.38	0.97
1140.00	1.51	1.98	0.00	1.98	3.88	3151.38	0.97
1144.00	1.49	1.91	0.00	1.91	3.87	3151.37	0.96
1148.00	1.47	1.86	0.00	1.86	3.87	3151.37	0.96
1152.00	1.45	1.81	0.00	1.81	3.86	3151.36	0.96
1156.00	1.43	1.76	0.00	1.76	3.86	3151.36	0.96
1160.00	1.41	1.71	0.00	1.71	3.85	3151.35	0.96
1164.00	1.39	1.67	0.00	1.67	3.85	3151.35	0.95
1168.00	1.38	1.63	0.00	1.63	3.84	3151.34	0.95
1172.00	1.36	1.60	0.00	1.60	3.84	3151.34	0.95
1176.00	1.34	1.57	0.00	1.57	3.84	3151.34	0.95
1180.00	1.32	1.54	0.00	1.54	3.83	3151.33	0.95
1184.00	1.31	1.51	0.00	1.51	3.83	3151.33	0.95
1188.00	1.29	1.48	0.00	1.48	3.83	3151.33	0.95
1192.00	1.28	1.45	0.00	1.45	3.83	3151.33	0.95
1196.00	1.26	1.43	0.00	1.43	3.82	3151.32	0.94
1200.00	1.25	1.41	0.00	1.41	3.82	3151.32	0.94
1204.00	1.23	1.38	0.00	1.38	3.82	3151.32	0.94
1208.00	1.22	1.36	0.00	1.36	3.82	3151.32	0.94
1212.00	1.20	1.34	0.00	1.34	3.81	3151.31	0.94
1216.00	1.19	1.32	0.00	1.32	3.81	3151.31	0.94
1220.00	1.18	1.30	0.00	1.30	3.81	3151.31	0.94
1224.00	1.17	1.29	0.00	1.29	3.81	3151.31	0.94
1228.00	1.15	1.27	0.00	1.27	3.81	3151.31	0.94
1232.00	1.14	1.25	0.00	1.25	3.81	3151.31	0.94
1236.00	1.13	1.24	0.00	1.24	3.80	3151.30	0.94
1240.00	1.12	1.22	0.00	1.22	3.80	3151.30	0.94
1244.00	1.11	1.21	0.00	1.21	3.80	3151.30	0.94
1248.00	1.09	1.19	0.00	1.19	3.80	3151.30	0.94
1252.00	1.08	1.18	0.00	1.18	3.80	3151.30	0.93
1256.00	1.07	1.17	0.00	1.17	3.80	3151.30	0.93
1260.00	1.06	1.15	0.00	1.15	3.80	3151.30	0.93
1264.00	1.05	1.14	0.00	1.14	3.79	3151.29	0.93
1268.00	1.04	1.13	0.00	1.13	3.79	3151.29	0.93
1272.00	1.03	1.12	0.00	1.12	3.79	3151.29	0.93
1276.00	1.02	1.11	0.00	1.11	3.79	3151.29	0.93
1280.00	1.02	1.09	0.00	1.09	3.79	3151.29	0.93
1284.00	1.01	1.08	0.00	1.08	3.79	3151.29	0.93
1288.00	1.00	1.07	0.00	1.07	3.79	3151.29	0.93
1292.00	0.99	1.06	0.00	1.06	3.79	3151.29	0.93
1296.00	0.98	1.05	0.00	1.05	3.79	3151.29	0.93
1300.00	0.97	1.04	0.00	1.04	3.78	3151.28	0.93
1304.00	0.96	1.03	0.00	1.03	3.78	3151.28	0.93
1308.00	0.96	1.02	0.00	1.02	3.78	3151.28	0.93
1312.00	0.95	1.01	0.00	1.01	3.78	3151.28	0.93
1316.00	0.94	1.00	0.00	1.00	3.78	3151.28	0.93
1320.00	0.93	1.00	0.00	1.00	3.78	3151.28	0.93
1324.00	0.93	0.99	0.00	0.99	3.78	3151.28	0.93
1328.00	0.92	0.98	0.00	0.98	3.78	3151.28	0.93
1332.00	0.91	0.97	0.00	0.97	3.78	3151.28	0.93
1336.00	0.91	0.97	0.00	0.97	3.78	3151.28	0.93

1340.00	0.90	0.96	0.00	0.96	3.78	3151.28	0.93
1344.00	0.89	0.95	0.00	0.95	3.77	3151.27	0.93
1348.00	0.89	0.95	0.00	0.95	3.77	3151.27	0.93
1352.00	0.88	0.94	0.00	0.94	3.77	3151.27	0.93
1356.00	0.87	0.93	0.00	0.93	3.77	3151.27	0.92
1360.00	0.87	0.93	0.00	0.93	3.77	3151.27	0.92
1364.00	0.86	0.92	0.00	0.92	3.77	3151.27	0.92
1368.00	0.86	0.91	0.00	0.91	3.77	3151.27	0.92
1372.00	0.85	0.91	0.00	0.91	3.77	3151.27	0.92
1376.00	0.85	0.90	0.00	0.90	3.77	3151.27	0.92
1380.00	0.84	0.89	0.00	0.89	3.77	3151.27	0.92
1384.00	0.83	0.89	0.00	0.89	3.77	3151.27	0.92
1388.00	0.83	0.88	0.00	0.88	3.77	3151.27	0.92
1392.00	0.82	0.87	0.00	0.87	3.76	3151.26	0.92
1396.00	0.82	0.87	0.00	0.87	3.76	3151.26	0.92
1400.00	0.81	0.86	0.00	0.86	3.76	3151.26	0.92
1404.00	0.81	0.86	0.00	0.86	3.76	3151.26	0.92
1408.00	0.80	0.85	0.00	0.85	3.76	3151.26	0.92
1412.00	0.80	0.85	0.00	0.85	3.76	3151.26	0.92
1416.00	0.79	0.84	0.00	0.84	3.76	3151.26	0.92
1420.00	0.79	0.84	0.00	0.84	3.76	3151.26	0.92
1424.00	0.79	0.83	0.00	0.83	3.76	3151.26	0.92
1428.00	0.78	0.82	0.00	0.82	3.76	3151.26	0.92
1432.00	0.78	0.82	0.00	0.82	3.76	3151.26	0.92
1436.00	0.77	0.81	0.00	0.81	3.76	3151.26	0.92
1440.00	0.77	0.81	0.00	0.81	3.76	3151.26	0.92
1444.00	0.75	0.80	0.00	0.80	3.76	3151.26	0.92
1448.00	0.72	0.80	0.00	0.80	3.76	3151.26	0.92
1452.00	0.65	0.78	0.00	0.78	3.75	3151.25	0.92
1456.00	0.51	0.76	0.00	0.76	3.75	3151.25	0.92
1460.00	0.39	0.73	0.00	0.73	3.75	3151.25	0.92
1464.00	0.31	0.68	0.00	0.68	3.74	3151.24	0.91
1468.00	0.26	0.64	0.00	0.64	3.74	3151.24	0.91
1472.00	0.22	0.59	0.00	0.59	3.73	3151.23	0.91
1476.00	0.18	0.55	0.00	0.55	3.73	3151.23	0.91
1480.00	0.16	0.51	0.00	0.51	3.72	3151.22	0.90
1484.00	0.13	0.48	0.00	0.48	3.72	3151.22	0.90
1488.00	0.12	0.46	0.00	0.46	3.71	3151.21	0.90
1492.00	0.10	0.44	0.00	0.44	3.71	3151.21	0.90
1496.00	0.09	0.42	0.00	0.42	3.70	3151.20	0.90
1500.00	0.08	0.40	0.00	0.40	3.70	3151.20	0.90
1504.00	0.07	0.38	0.00	0.38	3.69	3151.19	0.89
1508.00	0.06	0.37	0.00	0.37	3.69	3151.19	0.89
1512.00	0.05	0.35	0.00	0.35	3.68	3151.18	0.89
1516.00	0.04	0.33	0.00	0.33	3.68	3151.18	0.89
1520.00	0.04	0.31	0.00	0.31	3.68	3151.18	0.89
1524.00	0.03	0.30	0.00	0.30	3.67	3151.17	0.89
1528.00	0.03	0.28	0.00	0.28	3.67	3151.17	0.88
1532.00	0.02	0.27	0.00	0.27	3.66	3151.16	0.88
1536.00	0.02	0.25	0.00	0.25	3.66	3151.16	0.88
1540.00	0.02	0.24	0.00	0.24	3.66	3151.16	0.88
1544.00	0.01	0.23	0.00	0.23	3.65	3151.15	0.88
1548.00	0.01	0.22	0.00	0.22	3.65	3151.15	0.88
1552.00	0.01	0.20	0.00	0.20	3.65	3151.15	0.88
1556.00	0.01	0.19	0.00	0.19	3.65	3151.15	0.88
1560.00	0.01	0.18	0.00	0.18	3.64	3151.14	0.87
1564.00	0.01	0.17	0.00	0.17	3.64	3151.14	0.87
1568.00	0.01	0.16	0.00	0.16	3.64	3151.14	0.87
1572.00	0.00	0.15	0.00	0.15	3.64	3151.14	0.87
1576.00	0.00	0.14	0.00	0.14	3.63	3151.13	0.87
1580.00	0.00	0.14	0.00	0.14	3.63	3151.13	0.87
1584.00	0.00	0.13	0.00	0.13	3.63	3151.13	0.87
Total:	5.89	5.02	0.00	5.02	Acre-Feet		

Elevation	Storage Volume [Cubic-Feet]
3147.50	0.00
3148.00	1008.00
3150.00	18700.00
3152.00	52636.00
3154.00	95950.00

Appendix F

Victorville Master Plan of Drainage, Channel E-01



LEGEND

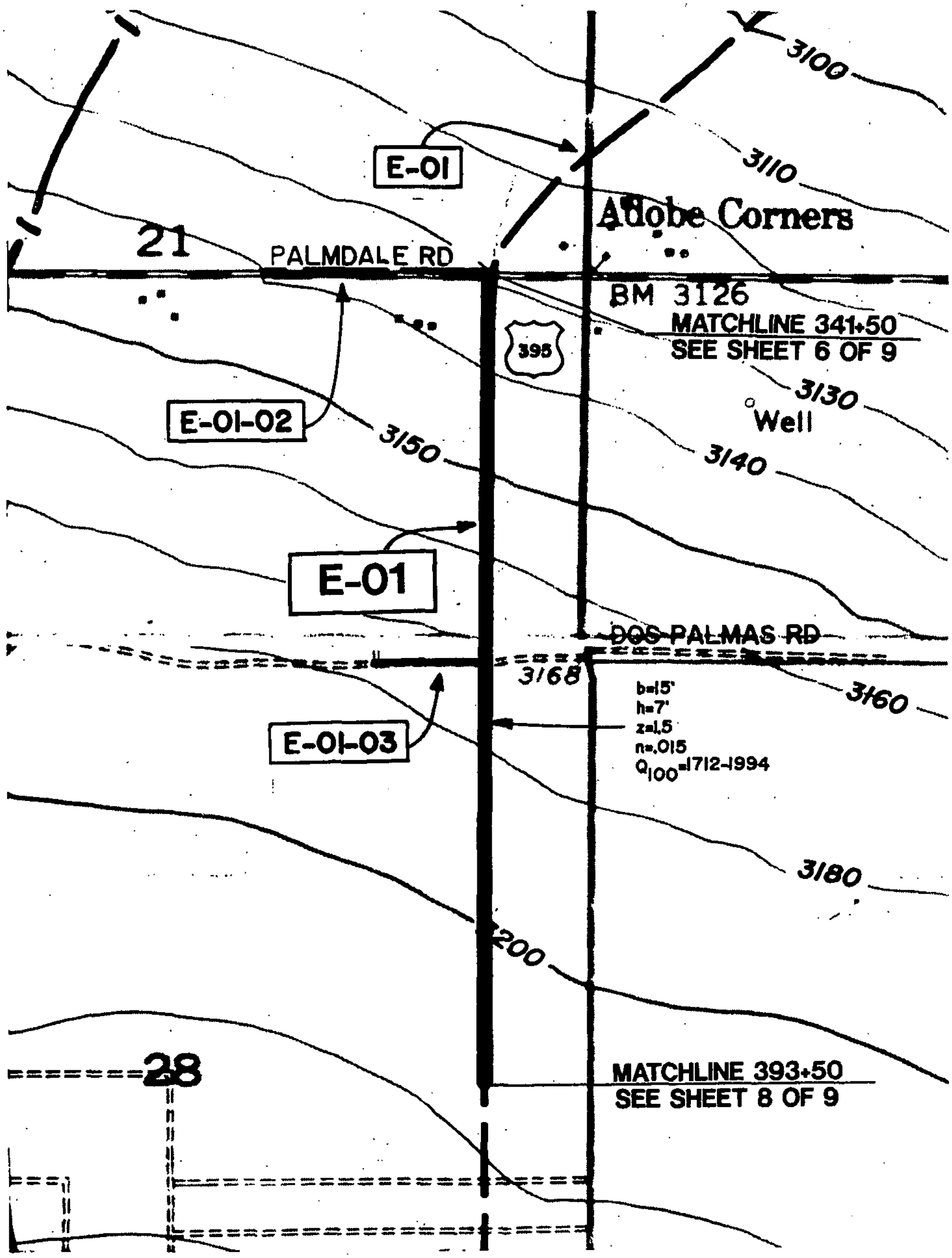
PROPOSED FACILITY	FLOODPLAIN
FACILITY SHOWN ELSEWHERE	FLOODWAY
WATERSHED BOUNDARY	DETENTION BASIN

VICTORVILLE
MASTER PLAN
OF DRAINAGE

COMPREHENSIVE STORM DRAIN PLAN
LINE E-01
SHEET 6 OF 9

SCALE 1"=1000'

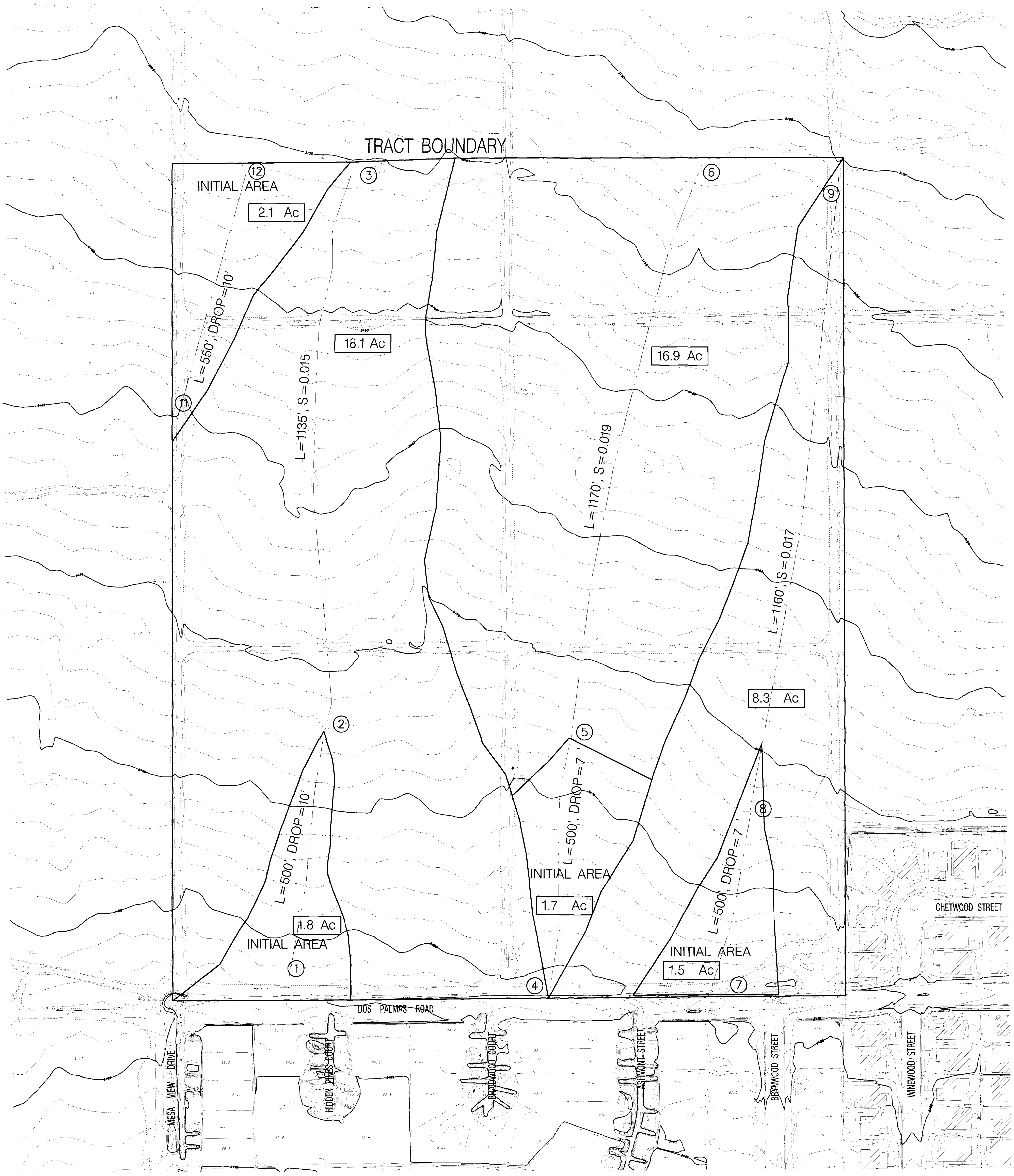
WILLIAMSON & SCHMID

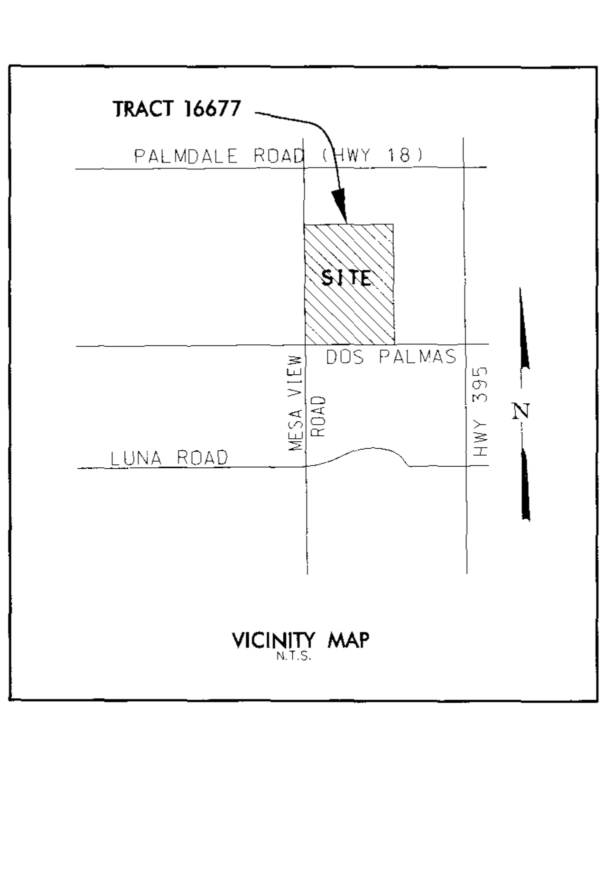


LEGEND

▬▬	PROPOSED FACILITY	⊓⊓⊓ ⊓⊓⊓	FLOODPLAIN
— —	FACILITY SHOWN ELSEWHERE	— —	FLOODWAY
—ǀ—	WATERSHED BOUNDARY	//////	DETENTION BASIN

VICTORVILLE MASTER PLAN OF DRAINAGE	COMPREHENSIVE STORM DRAIN PLAN LINE E-01 SHEET 7 OF 9	W S SCALE 1"=1000' WILLIAMSON & SCHMID



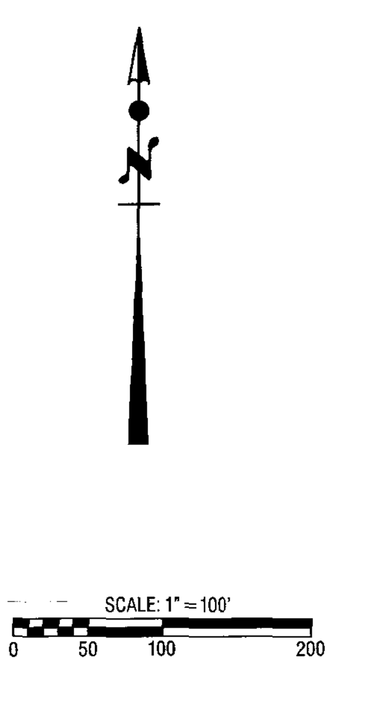


HYDROLOGIC PARAMETERS:

LAND USE	= UNDEVELOPED
IMPERVIOUSNESS	= 0%
TOTAL AREA	= 50.3 ACRES
SOIL ZONE	= B
SCS CURVE NUMBER, CN	= 74 (AMC II)
COVER DENSITY	= 40 %
COVER TYPE	= HERBACEOUS
INFILTRATION RATE, Fp	= 0.48 IN/HR (AMC II)

ISOHYETALS [INCHES]:

2-YR, 6-HR	= 0.70
2-YR, 14-HR	= 1.00
10-YR, 1-HR	= 0.75
100-YR, 1-HR	= 1.10
100-YR, 6-HR	= 1.80
100-YR, 24-HR	= 3.00



PLANS PREPARED UNDER THE SUPERVISION OF CHANG-HSIN HSIEH FOR FRONTIER HOMES

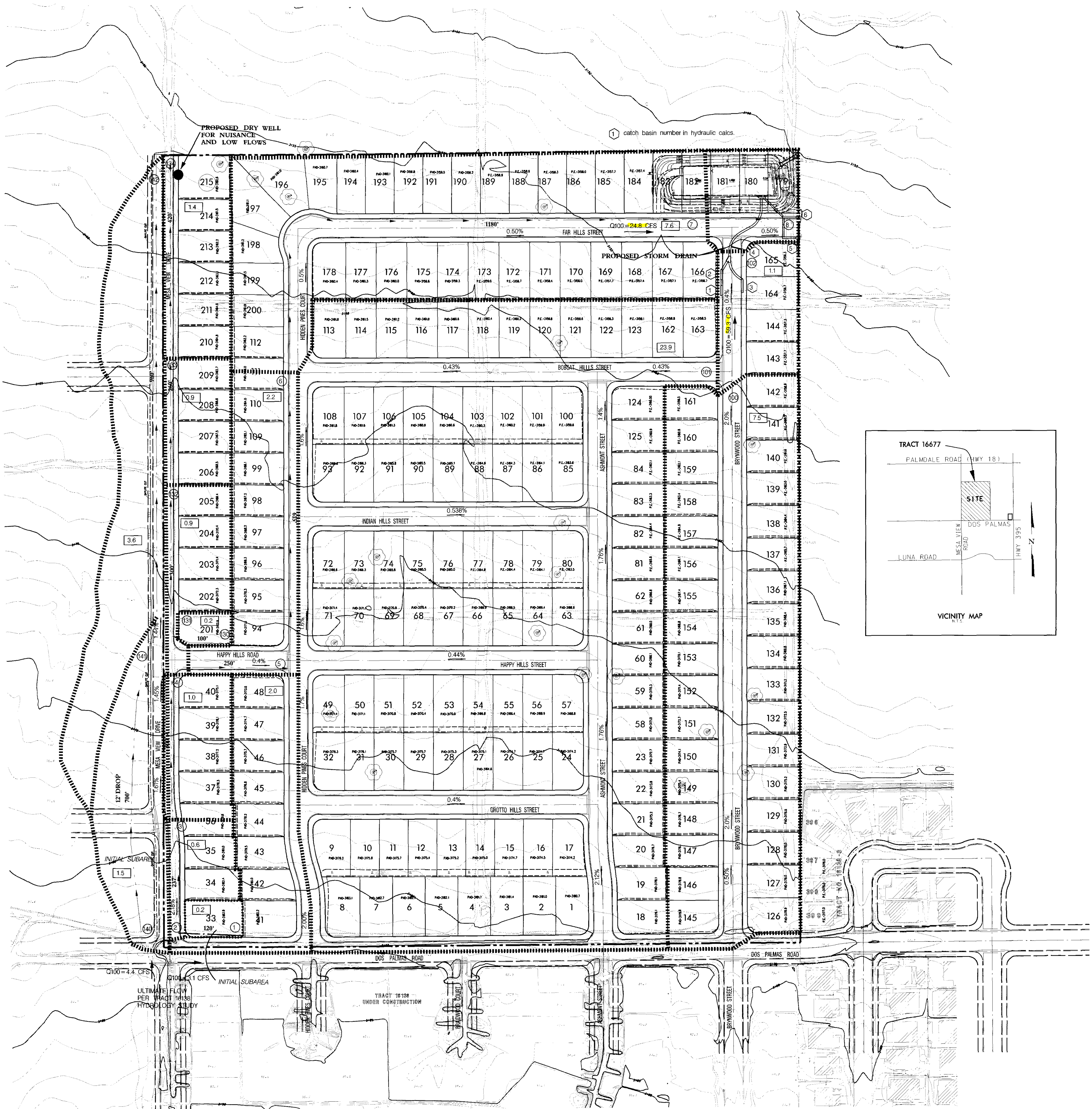
VTN WEST, INC.
6946 VAN NUYS BLVD., SUITE 100
VAN NUYS, CA. 91405-3963
818/779-8740/50-FAX

RCE# 50211 EXP. 6-30-05 DATE

CITY OF VICTORVILLE

HYDROLOGY MAP
TRACT 16677
EXISTING CONDITION

EXHIBIT 1



LEGEND

821'	WATERCOURSE AND LENGTH
....	SUBAREA BOUNDARY
(22)	NODE NUMBER
[33.3]	ACRES

HYDROLOGIC PARAMETERS:

LAND USE = SINGLE-FAMILY, 4.3 DU/AC
IMPERVIOUSNESS = 45%
TOTAL AREA = 50.3 ACRES
SOIL ZONE = B
SCS CURVE NUMBER, CN = 56 (AMC II)
INFILTRATION RATE, Fp = 0.75 IN/HR (AMC II)

ISOHYETALS [INCHES]:

2-YR, 6-HR = 0.70
2-YR, 14-HR = 1.00
10-YR, 1-HR = 0.75
100-YR, 1-HR = 1.10
100-YR, 6-HR = 1.80
100-YR, 24-HR = 3.00

SCALE: 1" = 100'
100 75 50 25 0 100

PLANS PREPARED UNDER THE SUPERVISION OF CHANG-HSIN HSIEH FOR FRONTIER HOMES

VTN WEST, INC.
6946 VAN NUYS BLVD., SUITE 100
VAN NUYS, CA 91405-3963
818/779-8740/50-FAX

RCE# 50211 EXP. 6-30-05 DATE

CITY OF VICTORVILLE

HYDROLOGY MAP
TRACT 16677
PROPOSED CONDITION

EXHIBIT
2

Metafile Date: Thu Jun 23 13:26:03 2005
Plt Name: $USER
VTN W.O. NO.

COORDINATE LISTING

#	NORTHERLY	EASTERLY
10	100002.34	49997.87
11	101359.48	50002.65
12	100045.68	49737.90
13	100061.63	49737.91
14	100290.40	49822.92
15	100400.38	49910.96
16	100283.84	49820.48
17	100427.27	49897.24
18	100399.27	49897.46
19	100430.05	49892.39
20	100463.72	49892.71
21	100394.41	49892.67
22	100394.70	49930.49

E.D.A. Award No. 074905428

S.A.E. PROJECT No. 106.0081

City Of Adelanto

APPROVED

CITY ENGINEER DATE
WILSON F. SO
RCE C21651 EXP. 9/30/05

DESIGNED BY W.L./W.S.

DRAWN BY R.E.S.

CHECKED BY

CITY OF ADELANTO

ADELANTO MARKETPLACE
ROAD IMPROVEMENT PROJECT
DRAINAGE FACILITY — PALMDALE ROAD TO STATE HWY 395

PREPARED BY:
So & Associates Engineers Inc.
15209 KAMANA ROAD • P.O. BOX 1712
APPLE VALLEY, CALIFORNIA 92307
(760) 242-2365 • FAX (760) 242-3085

SUBMITTED BY:

DATE

SCALE AS SHOWN

DRAWING No. C-5

SHEET 6 OF 21