Transcontinental Gas Pipe Line Company, LLC

Section 3-4 PCSM Plan for Compressor Station 515

Regional Energy Access Expansion Project – Compressor Station 515

April 2021
(Revised March 2022)

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SECTION 3.4.1
NARRATIVE

1. Project Description

Transcontinental Gas Pipe Line Company, LLC (Transco), indirectly owned by the Williams Companies, Inc. (Williams) is seeking authorization from the Federal Energy Regulatory Commission (FERC) under Section 7(c) of the Natural Gas Act and Part 157 of the Commissions regulations, to construct, own, operate, and maintain the proposed Project facilities associated with the Regional Energy Access Expansion Project (Project). The Project is an expansion of Transco's existing natural gas transmission system that will enable Transco to provide an incremental 829,400 dekatherms per day (Dth/d) of year-round firm transportation capacity from the Marcellus Shale production area in northeastern Pennsylvania to multiple delivery points along Transco's Leidy Line in PA and Mainline in PA, NJ, and MD.

The existing Compressor Station 515 component of the Project is located at the eastern terminus of the Regional Energy Lateral in Buck Township, Luzerne County. Proposed at this facility is the addition of one gas-fired turbine driven compressor with 31,871 nominal HP at ISO conditions and modification of three existing compressors. Also proposed is the abandonment and replacement of 17,000 HP from five existing gas fired reciprocating driven compressors with one additional gas-fired turbine driven compressor with 20,502 nominal HP at ISO conditions. One Mainline Valve will be installed at this facility.

This Post Construction Stormwater Management (PCSM) Plan has been developed for the Compressor Station 515 site. The PCSM Plan shall be designed and implemented to be consistent with the PCSM Plan under 25 Pa. Code § 102.8 (relating to PCSM requirements). The work and disturbed areas are located within Transco property, existing easements or legally obtained workspace. The limit of disturbance (LOD) for the Compressor Station 515 site will be approximately 24.83 acres, which includes the offline contractor yard. Subject to FERC's certification of the Project and receipt of the necessary permits and authorizations, Transco anticipates construction of the Project to start in second quarter 2023 to meet a proposed in-service date of fourth quarter 2024.

2. Topographic Features of the Area

A Project Location Map for Compressor Station 515 is included in Attachment 1. This map shows the topographical features of the general site vicinity and is based on the USGS 7.5 Minute topographical mapping of the Pleasant View Summit, Pennsylvania quadrangles.

3. Receiving Surface Waters

The following table (Table 1) lists each watershed located in the Compressor Station 515 Project Area, its Chapter 93 Water Quality Standards, and Pennsylvania Fish and Boat Commission classifications. A Wetland and Watercourse Delineation Report is included in Attachment A of the ESCP permit application.

Table 1 – Receiving Waters

Watershed Name	Designated Use	Existing Use	PFBC Classification
Trib 04285 to Shades Creek	HQ-CWF, MF	-	Class A Wild Trout
Stony Run	HQ-CWF, MF	-	Naturally Producing Wild Trout Stream

MF: Migratory Fishes, CWF: Cold Water Fishes, HQ: High Quality

An evaluation of potential hydrologic impacts to wetlands associated with proposed PCSM facilities was undertaken at Compressor Station 515. There are no changes in the pre and post construction drainage area associated with the gravel pad and PCSM facilities. There are no wetlands located with the drainage area or immediately downslope of the proposed PCSM facility that would result in a change to the hydrologic conditions of the area that could impact wetland hydrology.

4. Types, Depth, Slope, Locations & Limitation of the Soils and Geologic Formations

The soil associations on site were identified by soil map units as mapped in the Web Soil Survey website (https://websoilsurvey.sc.egov.usda.gov/) by the United States Dept. of Agriculture (USDA), Natural Resources Conservation Service (NRCS). There are 6 soil mapping units located within the LOD, see Table 2 below.

Table 2 – Soils Mapping Units with Limits of Disturbance

Soil Mapping Unit	Soil Series
MsB	Morris channery silt loam, 0 to 8 percent slopes, extremely stony
OpD	Oquaga and Lordstown extremely stony silt loams, 8 to 25 percent slopes
WIB	Wellsboro channery silt loam, 3 to 8 percent slopes
WIC	Wellsboro channery silt loam, 8 to 15 percent slopes
WID	Wellsboro channery silt loam, 15 to 25 percent slopes
WmB	Wellsboro channery silt loam, 3 to 8 percent slopes, extremely stony

Detailed descriptions and mapping of soil mapping units are provided in the Attachment 2. Soil use limitations (outlined in Table 3) were reviewed in relation to and resolutions were identified in Section 4.1.

Table 3 – Limitations of Pennsylvania Soils Pertaining to Earth Disturbance Projects (Erosion and Sediment Control Best Management Practice (BMP) Manual – Technical Guidance Number 363-3134-008/Page 401)

SOIL NAME	SOIL WITH SLOPE CLASS	CUTBANKS CAVE	CORROSIVE TO CONCRETE\STEEL	DROUGHTY	EASILY ERODIBLE	FLOODING	DEPTH TO SATURATED ZONE/ SEASONAL HIGH WATER TABLE	HYDRIC/ HYDRIC INCLUSIONS	LOW STRENGTH / LANDSLIDE PRONE	SLOW PERCOLATION	PIPING	POOR SOURCE OF TOPSOIL	FROST ACTION	SHRINK - SWELL	POTENTIAL SINKHOLE	PONDING	WETNESS
Morris	MsB	X	C/S	X	X		X	X	X	X		X	X				X
Oquaga	OpD	X	C	X	X			X		X			X				
Wellsboro	WIB, WIC, WID, WmB	X	C/S	X	X		X	X	X	X	X		X				X

4.1. Resolution of Soil Limitations

Transco proposes the following resolutions to compensate for soil limitations summarized in Table 3 above:

1. To offset the caving of cutbanks, trenching operations will be conducted in accordance with the OSHA Technical Manual for Trenching.
2. Preventative coatings shall be used to prevent corrosion of concrete and/ or steel.
3. When bedrock is encountered it will be removed by mechanical methods or blasting. Blasting operations will conform with local, state, and federal regulations.
4. Precautions will be taken to prevent slope failure when working within low strength soils by flattening cut / fill slopes, not overloading, maintaining lateral support, and preventing saturation of soils. Low strength soils will not be used for roadway construction.
5. Excavation in soils prone to flooding, slow percolation, ponding, wetness, located in a seasonal high water table, or which are hydric, will likely encounter water. Compensation will involve dewatering with appropriate means such as pump water filter bags, sediment traps, etc.

6. Soils that have the potential to swell, shrink, or heave due to frost action may cause damage to roadways or pads. Where foundations are critical, compensation may require removal and replacement of soils with suitable material.

7. In circumstances where soils appear to be a poor source of topsoil, droughty or prone to wetness, soil testing will be performed to determine the appropriate applications of soil amendments to promote growth. Soils onsite that are fair sources of topsoil, will be identified, stripped and stockpiled for use during restoration.

8. In order to minimize erosion of soils that are easily erodible, compensation may involve providing a protective lining, to apply seed, mulch, erosion control blankets (either in rolls or hydraulically applied), tracking slopes, upstream diversions, waterbars, etc. to minimize soil erosion.

4.2. Geologic Formations

Transco retained Civil & Environmental Consultants, Inc. (CEC) of Pittsburgh, PA to perform a geohazard assessment, the following is provided from their 2020 report. Transco utilized United States Geological Survey (USGS), Geologic Map of Pennsylvania - Map 1, dated 1980 (online), to evaluate geologic hazards on the Project. The desktop analysis completed for the Project by CEC revealed that Compressor Station 515 does not cross known, mapped, or inferred faults. No mines or Karst formations were identified in the site vicinity. However, the analysis outlined that Compressor Station 515 lies within a zone low landslide incidence and susceptibility.

A Geological Hazard Assessment and Mitigation Plan was completed by CEC and is submitted with this application (Attachment B). The Geological Hazard Assessment and Mitigation Plan identifies appropriate best management practices to avoid and mitigate for conditions encountered during construction.

5. Characterizations of Earth Disturbance Activities, Including Past, Present, and Proposed Land Uses

The Compressor Station 515 component of the Project is located at the eastern terminus of the Regional Energy Lateral in Buck Township, Luzerne County. The Project at Compressor Station 515 will involve the installation a gravel pad, several buildings, a new communications tower, proposed PCSM Best Management Practices (BMPs) and other compressor station modifications. Transco will use and implement the practices, measures, and details to control soil

erosion and off-site sedimentation during construction. Using data taken from Google Earth and Multi-Resolution Land Characteristics (MRLC) Consortium website (https://www.mrlc.gov/viewer/), it appears that land use for the past few decades has been utilized as a compressor station site. In the future, this site will continue to be used as a compressor station site.

6. Post Construction Stormwater Management Best Management Practices, Installation Sequence and PCSM Critical Stages

Increase in stormwater runoff during and after construction shall be controlled by sequencing the operations and using a selection of BMPs. Channels, culverts, vegetated filter strip and an infiltration berm will be installed across the developed area to convey the net increase in volume between the pre- and post-development 2-year storm events and mitigate the increase (pre-post development) in peak runoff for the 1-, 2-, 10-, 25-, 50-, and 100-year storm events. Channels will be constructed to direct the majority of runoff from the developed area to the vegetated filter strip and infiltration berm. PCSM BMP design calculations and drawings are provided in Attachment 4 and PCSM Plan set. For these calculations, Test Pit 501 and Test Pit 502 were selected and used for design criteria. See Attachment 3 for the specific infiltration data. A summary of the PCSM BMP design criteria is below.

Compressor Station 515: Design Criteria

Test Pits			**PCSM BMP**	
	TP 501	**TP 502**		**Infiltration Berm**
Existing Ground Elevation (ft)	1923.06	1924.41	**Minimum Final Grade (ft)**	1925.5
Elevation of Confining Layer (ft)	1920.73 (Bedrock)	1921.91 (SHWT)	**Interpreted Elevation of Confining Layer (ft)**	1921.91
Depth to Confining Layer (in)	28 (Bedrock)	30 (SHWT)	**Provided Separation (in)**	43.1
Lowest Observed Infiltration Rate (in/hr)	2.06	0.31	**Infiltration Rate Used (in/hr)**	0.31

BMP Installation Sequence

The PCSM BMPs should be installed in a manner designed to:

1. Protect BMP areas associated with infiltration from compaction prior to and during installation.
2. Maintain proper Erosion and Sediment Control Measures during construction.

3. Select plants that are well adapted to the specific site conditions. Meadow plants must be able to out compete weed species in the first few years as they become established.
4. Temporary E&S BMPs will be removed following site stabilization. Do not remove other Erosion and Sediment Control measures until site is fully stabilized.
5. Construct the infiltration berm and vegetated filter strip in accordance with the plans:*
    a. Complete site grading and stabilize within the limit of disturbance except where the infiltration berms will be constructed. Make every effort to minimize berm footprint and necessary zone of disturbance (including both removal of exiting vegetation and disturbance of empty soil) in order to maximize infiltration.
    b. Lightly scarify the soil in the area of the proposed berm before delivering soil to site.
    c. Utilize suitable fill material to make up the major portion of the berm. Soil should be added in 8-inch lifts and compacted after each addition according to design specifications. The slope and shape of the berm should be graded out as soil is added.
    d. Protect the surface ponding area at the base of the berm from compaction. If compaction of this area does occur, scarify the soil to a depth of at least 8 inches.
    e. Complete final grading of the berm after the top layer of soil is added. Tamp soil down lightly and smooth sides of the berm. The crest and base of the berm should be at level grade.
    f. Plant berm with turf, meadow plants, shrubs or trees, as desired.
    g. Mulch planted and disturbed areas with compost mulch to prevent erosion while plants become established.
6. Starting downstream at the infiltration berm, construct PCSM Channel C5, C4, Culvert 1, PCSM Channels C1 and level spreader, C2, and C3. Stabilize the PCSM channels with specified channel linings.*
7. Installed BMPs will be monitored until final site stabilization is achieved.*
8. Follow long term operation and maintenance guidelines discussed below.

**Portions of the BMP installation sequence denoted with an asterisk (*) above are critical stages as discussed on this sheet.*

PCSM Critical Stages

Critical points requiring visits by the licensed professional or delegate are as follows:

1. Following installation of the pad subgrade to ensure stormwater flow is directed to the infiltration BMPs.
2. Prior to construction to ensure the area of the infiltration berm and vegetated filter strip has not been impacted by construction activities.
3. During construction of the infiltration berm and vegetated filter strip to ensure compliance with construction requirements.
4. Following final grading and seeding of the PCSM channels, infiltration berm and vegetated filter strip in order to confirm they have been constructed according to the plan details for proper collection, infiltration, and conveyance of runoff. Periodic assessments will need to be made to ensure that accumulated sediment should be cleaned out so the channels and berm maintain necessary design volume.
5. For final inspection of constructed BMPs.
6. At the establishment of hard surface stabilization or 70% vegetation covers to allow removal of E&S controls.

7. Net Change in Volume and Rate of Runoff

An analysis of pre- and post-development stormwater runoff was performed for the proposed Compressor Station 515. The installation of compressor units, pad areas and access road will increase the volume of stormwater runoff between the pre and post development 2-year rain event due to the increase in the type and size of the impervious area. The increase in impervious area will increase the pre to post development peak runoff for the 1-, 2-, 10-, 25-, 50-, and 100-year storm events. Design calculations using HydroCAD software are included in Attachment 4. Refer to the Post-Construction Stormwater Management (PCSM) Plan drawings for additional information.

Pre- and Post-Construction Stormwater Volume for 2-yr Rainfall event

Pre-construction (cf)	Post-construction before BMPs (cf)	Post-construction after BMPs (cf)	Net (cf)
25,269	39,014	21,255	-4,014

Pre-Construction Peak Discharge Rates (cfs)

1-year	2-year	10-year	25-year	50-year	100-year
4.58	6.19	11.74	16.10	19.64	24.34

Post-Construction Peak Discharge Rates (cfs)

1-year	2-year	10-year	25-year	50-year	100-year
11.55	14.31	23.16	29.76	35.00	41.89

Post-Construction w/ BMPs Peak Discharge Rates (cfs)

1-year	2-year	10-year	25-year	50-year	100-year
1.04	2.55	10.18	15.89	19.57	24.23

Difference between Pre-Construction and Post-Construction w/ BMPs

	1-year	2-year	10-year	25-year	50-year	100-year
NET Difference	-3.54	-3.64	-1.56	-0.21	-0.07	-0.11

8. Temporary and Permanent Stabilization

Appropriate seed mixtures for temporary and permanent stabilization are outlined on the notes sheet of the plan drawings.

8.1. Permanent Stabilization

Upon final completion of an earth disturbance activity or stage or phase of an activity, the site shall immediately have topsoil restored, replaced, or amended, seeded, mulched or otherwise permanently stabilized and protected from accelerated erosion and sedimentation. E&S BMPs shall be implemented and maintained until the permanent stabilization is completed. Once permanent stabilization has been established, the temporary E&S BMPs shall be removed. Areas disturbed in the act of removing temporary E&S BMPs shall be permanently stabilized upon completion of the temporary E&S BMP removal activity. For an earth disturbance activity or stage or phase of an activity to be considered permanently stabilized, the disturbed areas shall be covered with one of the following:

- A minimum uniform 70% perennial vegetative cover, with a density capable of resisting accelerated erosion and sedimentation.
- An acceptable BMP which permanently minimizes accelerated erosion and sedimentation. When erosion and sedimentation controls are to be removed in agricultural non-sensitive areas (streams/wetlands), agricultural landowners shall maintain agricultural BMPs per PaDEP regulations.

8.2. Temporary Stabilization

Upon temporary cessation of an earth disturbance activity or stage or phase of an activity where a cessation of earth disturbance activities will exceed 4 days (including agricultural areas), the site shall be immediately seeded, mulched, or otherwise protected from accelerated erosion

and sedimentation pending future earth disturbance activities. For an earth disturbance activity or stage or phase of an activity to be considered temporarily stabilized, the disturbed areas shall be covered with one of the following:

- A minimum uniform coverage of mulch and seed, with a density capable of resisting accelerated erosion and sedimentation.
- An acceptable BMP which temporarily minimizes accelerated erosion and sedimentation.

8.3. Stabilization During Non-Growing Season

When utility construction must be done and is completed during a non-growing season, interim stabilization BMPs must be implemented and adequately maintained. The application of straw mulch at the rate of 3.0 tons per acre is required. The BMPs should be inspected weekly (unless snow covered) and after each runoff event to identify areas that become bare. Temporary erosion and sediment pollution controls must be maintained.

8.4. Riparian Buffer Stabilization

Temporary Cover for riparian areas to include seed from mixture 1 from Table 11.4 (provided in the PCSM Plan set), at the outlined seeding rate. Permanent cover for riparian areas will include 20 lbs/acre of Ernst 178 Riparian buffer mix. Where slopes exceed 10%, seed Mixture 2 from Table 11.4 shall be utilized.

9. Long Term Operation and Maintenance Schedule

PCSM BMPs should be properly maintained to ensure their effectiveness. Transcontinental Gas Pipe Line Company, LLC will be responsible for the long-term operation and maintenance of the PCSM BMPs proposed at Compressor Station 515. Sheet flow conditions and infiltration must be sustained throughout the life of the BMP. BMPs should be inspected for clogging from sediment of debris, damage by foot or vehicular traffic, and flow channelization. Inspections should be made on a quarterly basis for the first two years following installation, and then twice per year thereafter. Inspections should also be made after every storm event greater than 1 inch during the establishment period.

Channel linings should be inspected for signs of erosion or dislodging, as applicable. Channels should be inspected for debris, overgrown vegetation, and other blockages. Culverts and trench drains should be inspected at least two times per year and after runoff events and cleaned as needed. Vegetation along the surface of the infiltration berm and vegetated filter strip

should be maintained in good conditions. Vehicles should not park or drive on an infiltration berm or vegetated filter strip and care should be taken to avoid excessive compaction by mowers. Inspect the berm after runoff events and make sure that runoff drains within 72 hours.

Operation and maintenance guidelines should be provided to facility owner. Sediment and debris should be routinely removed upon observation. If erosion is observed, measures should be taken to improve the dispersion method to address the source of erosion. Sediment should be removed when the BMP is thoroughly dry. Trash and debris removed from the site should be deposited only at suitable disposal/recycling sites and must comply with applicable local, state, and federal waste regulations. Grass cover should be mowed with low ground pressure equipment annually to control noxious weeds. Mowing should be done only when the soil is dry in order to prevent tracking damage to vegetation, soil compaction, and flow concentrations. If vegetative cover is not fully established within the designated time, it should be replaced with an alternative species. Unwanted or invasive growth should be removed on an annual basis.

Vegetated areas will be inspected weekly and after runoff events until permanent vegetation is achieved. Once the vegetation is established, inspections of health, diversity, and density should be performed at least twice per year, during both the growing and non-growing season. Vegetative cover should be sustained at 85% and reestablished if damage greater than 50% is observed. Damaged BMPs will be repaired as soon as possible upon discovery. Repairs will be made to restore damaged BMPs to the original design condition.

The vegetated filter strip should be properly maintained to ensure their effectiveness. Sediment and debris should be routinely removed (biannually at minimum), or upon observation, when buildup exceeds 2 inches in depth over the filter strip. If erosion is observed, measures should be taken to maintain sheet flow over the filter strip. Re-grading may also be required when pools of standing water are observed along the slope. Grass cover should be mowed with low ground pressure equipment as needed to maintain a height of 4-6 inches. Mowing will be performed annually. Unwanted or invasive growth should be removed on an annual basis. All maintenance/mowing shall be performed when soil is dry to prevent tracking damage, soil compaction, and flow concentrations.

Transcontinental Gas Pipeline Company, LLC will be responsible for the long term operation and maintenance of the post-construction stormwater management facilities proposed at the site.

10. Recycling and Disposal of Materials

The restoration will require the removal of the temporary materials. The temporary materials include, but may not be limited to, stone surfaces and associated geotextiles. The contractors are required to dispose of the materials at suitable disposal or recycling sites and in compliance with local, state and federal regulations.

Contractors are required to inventory and manage their construction site materials. The goal is to be aware of the materials on-site, ensure they are properly maintained, used, and disposed of, and to make sure the materials are not exposed to stormwater. The following materials or substances are expected to be present on-site during construction (Note: this list is not an all-inclusive list and the materials management plan can be modified to address additional materials used on-site):

- Acids
- Detergents
- Fertilizers (nitrogen/phosphorus)
- Hydroseeding mixtures
- Petroleum based products
- Sanitary wastes
- Soil stabilization additives
- Solder
- Solvents

These materials must be stored as appropriate and shall not contact storm or non-stormwater discharges. Contractor shall provide a weatherproof container to store chemicals or erodible substances that must be kept on the site. Contractor is responsible for reading, maintaining, and making employees and subcontractors aware of Safety Data Sheets (SDSs).

11. Thermal Impacts

Thermal impacts to surface waters are not anticipated. Most of the stormwater will be routed through the stormwater BMP designed to retain and infiltrate the first surge of water from the site. The first surge of water will be the warmest water for the duration of the storm event and will quickly cool as the storm event progresses. The BMPs are designed to capture and infiltrate this warmest surge of stormwater. Based on routing calculations, stormwater is retained in the BMPs for a period of 11 hours before being discharged during a 100-year/24-hour storm event. This retention period is longer for less intense storms. Therefore, as a result of these measures, no significant thermal impact to the receiving waters is anticipated.

12. Antidegradation Requirements

The Compressor Station 515 site is located within an HQ watershed; therefore, an evaluation for antidegradation requirements was performed. Transco used various criteria to evaluate parcels suitable for a compressor station within the hydraulic range required to meet the purpose and need of the project. The criteria for parcel evaluation included but was not limited to existing conditions, resource impacts, workspace, and reasonable availability. Based on the location selected for Compressor Station 515, impacts to HQ watersheds are unavoidable. Transco determined that there are no cost-effective and environmental sound viable non-discharge alternatives for the project.

Construction activities within the HQ watershed will result in increased discharge of stormwater to surface waters which will be mitigated by the implementation of post construction stormwater management (PCSM) BMPs. Proposed PCSM BMPs are designed with stormwater volume reduction and water quality treatment maximized to the extent practicable within the site constraints to maintain and protect existing water quality and existing and designated uses.

13. Riparian Buffers

Temporary workspace associated with Compressor Station 515 is located within the non-forested riparian buffer of stream S77-T2. After completing the construction activities, the impacted riparian area will be restored back to pre-existing contours and reseeded with a riparian seed mix.

Because the project is temporary in nature and the site will be fully restored to its preexisting condition leaving riparian buffers undisturbed to the extent practical, it is eligible for the Riparian Buffer Waiver under 25 PA Code §102.14(d)(2)(iv). As such, a Riparian Buffer Waiver has been requested along with this ESCP application (Section 1-7).

14. Offsite Discharge Analysis

The stormwater BMPs being constructed at Compressor Station 515 are in areas that will discharge stormwater to offsite non-surface water. These areas have been analyzed to reduce the likelihood that these discharges will be erosive to adjacent property owners. The analysis has been performed in accordance with PADEP Document 3150-FS-DEP4124, “Off-Site Discharges of Stormwaters to Areas That Are Not Surface Waters”. The full analysis is presented in Attachment 6 – Offsite Discharge Report. A summary of the findings for Compressor Station 515 is presented below.

At Compressor Station 515, a series of channels will be installed to direct runoff water from the proposed expansion to a rip rap apron, which will release water into an infiltration berm. At the base of the spillway a level spreader will allow water to flow into the forested area northwest of the Limits of Disturbance. The area downgradient of the proposed infiltration berm is primarily forestland and vegetated. Calculations indicated that the discharge velocity at the riprap apron for the 25-yr 24-hr storm is 2.13 feet per second (fps). Since the outlet velocity is below 2.5 fps, downstream erosion will be minimal, if not negligible.

15. Non-Structural and Structural Water Quality BMP Description

Limit of disturbance will be minimized to the maximum extent possible by disturbing only those areas necessary to complete the proposed earthwork and BMP installations.

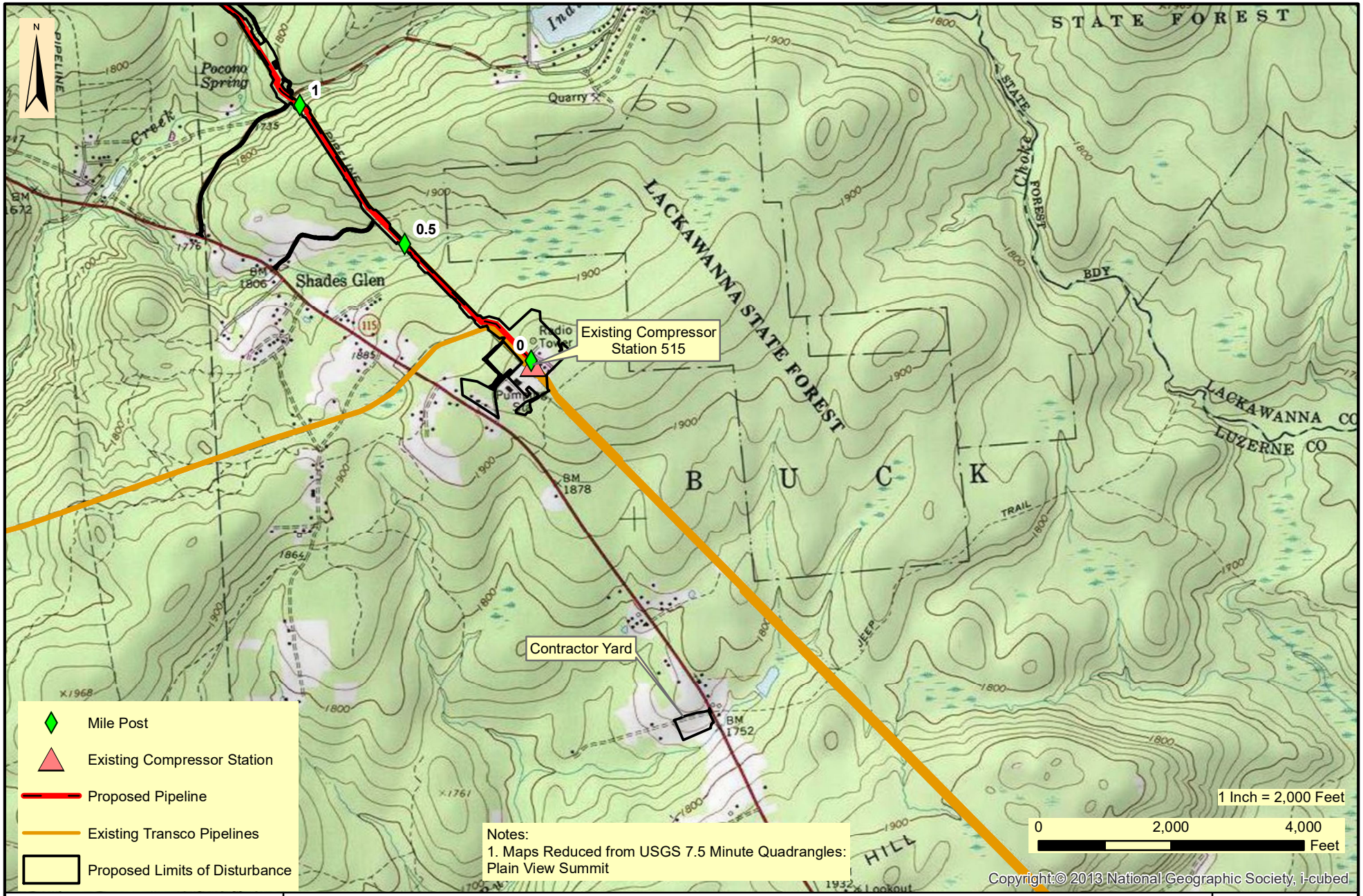
Sensitive features such as wetlands and riparian buffers will be protected to the maximum extent possible. These areas will be clearly delineated in the field and protected prior to construction activities taking place. Existing vegetation is not to be removed from the protected area and the areas shall not be subject to grading or movement of existing soils. Protected areas that have been disturbed/compacted during construction will be restored using soil amendment and restoration.

Temporarily impacted riparian buffer will be fully restored to its preexisting conditions. Disturbed areas that are not proposed to be impervious will be revegetated as per the seeding and mulching notes provided in PCSM plan notes.

16. The PCSM Plan Shall be Prepared by a Person Trained and Experienced in PCSM Methods and Techniques

These plans and narrative were prepared by Patrick Wozinski, PE (BAI Group, LLC) of State College, PA in accordance with the Pennsylvania Department of Environmental Protection Stormwater BMP Manual, December 2006. Plan preparer's resume is provided in Attachment C of the ESCP permit package).

ATTACHMENT 1
PROJECT LOCATION MAP



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Williams®

TRANSCONTINENTAL GAS PIPE LINE COMPANY, LLC

REGIONAL ENERGY ACCESS EXPANSION PROJECT

EXISTING COMPRESSOR STATION 515

PROJECT LOCATION MAP

BUCK TOWNSHIP | LUZERNE COUNTY | PENNSYLVANIA

Date: 2/10/2022

Drawn By: FTN

Figure Number: CS515-1

ATTACHMENT 2
SOILS MAP AND REPORT

United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Luzerne County, Pennsylvania

December 30, 2020

Preface

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

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

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

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

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

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

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Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map

Map Scale: 1:4,090 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 50 100 200 300

Feet: 0 150 300 600 900

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 18N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

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

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

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

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

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

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

Soil Survey Area: Luzerne County, Pennsylvania
Survey Area Data: Version 15, Jun 5, 2020

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

Date(s) aerial images were photographed: Sep 20, 2010—Jul 7, 2016

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

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
CnB	Chippewa silt loam, 0 to 8 percent slopes, extremely stony	0.6	0.9%
MsB	Morris channery silt loam, 0 to 8 percent slopes, extremely stony	10.3	16.8%
OpD	Oquaga and Lordstown extremely stony silt loams, 8 to 25 percent slopes	0.3	0.4%
WmB	Wellsboro channery silt loam, 3 to 8 percent slopes, extremely stony	50.1	81.8%
Totals for Area of Interest		**61.3**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it

was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Luzerne County, Pennsylvania

CnB—Chippewa silt loam, 0 to 8 percent slopes, extremely stony

Map Unit Setting

National map unit symbol: 2vcjf
Elevation: 330 to 2,460 feet
Mean annual precipitation: 31 to 70 inches
Mean annual air temperature: 39 to 52 degrees F
Frost-free period: 105 to 180 days
Farmland classification: Not prime farmland

Map Unit Composition

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

Description of Chippewa, Extremely Stony

Setting

Landform: Depressions
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Loamy till dominated by siltstone, sandstone, and shale fragments

Typical profile

Oe - 0 to 1 inches: moderately decomposed plant material
A - 1 to 5 inches: silt loam
Eg - 5 to 15 inches: channery silt loam
Bxg - 15 to 45 inches: channery silt loam
C - 45 to 72 inches: channery silt loam

Properties and qualities

Slope: 0 to 8 percent
Surface area covered with cobbles, stones or boulders: 7.0 percent
Depth to restrictive feature: 8 to 20 inches to fragipan
Drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.14 in/hr)
Depth to water table: About 0 to 6 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 15 percent
Available water capacity: Low (about 3.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: D
Ecological site: F140XY016NY - Mineral Wetlands
Hydric soil rating: Yes

Minor Components

Volusia, extremely stony

Percent of map unit: 8 percent
Landform: Hills, mountains
Landform position (two-dimensional): Footslope, summit
Landform position (three-dimensional): Base slope, interfluve, side slope
Down-slope shape: Concave
Across-slope shape: Linear
Hydric soil rating: No

Chippewa, extremely stony, very poorly drained

Percent of map unit: 7 percent
Landform: Depressions
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

MsB—Morris channery silt loam, 0 to 8 percent slopes, extremely stony

Map Unit Setting

National map unit symbol: 2vxct
Elevation: 330 to 2,460 feet
Mean annual precipitation: 31 to 70 inches
Mean annual air temperature: 39 to 52 degrees F
Frost-free period: 105 to 180 days
Farmland classification: Not prime farmland

Map Unit Composition

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

Description of Morris, Extremely Stony

Setting

Landform: Mountains, hills
Landform position (two-dimensional): Summit, footslope
Landform position (three-dimensional): Interfluve, base slope
Down-slope shape: Concave
Across-slope shape: Linear
Parent material: Loamy till from reddish sandstone, siltstone, and shale

Typical profile

Oe - 0 to 1 inches: moderately decomposed plant material
A - 1 to 5 inches: channery silt loam
Bw - 5 to 12 inches: channery silt loam
Eg - 12 to 16 inches: channery silt loam

Bx - 16 to 60 inches: channery silt loam
C - 60 to 72 inches: channery loam

Properties and qualities

Slope: 0 to 8 percent
Surface area covered with cobbles, stones or boulders: 7.0 percent
Depth to restrictive feature: 10 to 22 inches to fragipan
Drainage class: Somewhat poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.14 in/hr)
Depth to water table: About 6 to 18 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Very low (about 2.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: D
Hydric soil rating: No

Minor Components

Norwich, extremely stony

Percent of map unit: 5 percent
Landform: Depressions
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Wellsboro, extremely stony

Percent of map unit: 5 percent
Landform: Hills, mountains
Landform position (two-dimensional): Backslope, shoulder
Landform position (three-dimensional): Interfluve, side slope, head slope
Down-slope shape: Convex, concave
Across-slope shape: Convex, linear
Hydric soil rating: No

OpD—Oquaga and Lordstown extremely stony silt loams, 8 to 25 percent slopes

Map Unit Setting

National map unit symbol: 9yhm
Elevation: 700 to 1,800 feet
Mean annual precipitation: 32 to 50 inches
Mean annual air temperature: 45 to 52 degrees F
Frost-free period: 110 to 180 days
Farmland classification: Not prime farmland

Map Unit Composition

Oquaga and similar soils: 60 percent
Lordstown and similar soils: 40 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Oquaga

Setting

Landform: Hillslopes
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Reddish ablation till derived from sandstone and siltstone

Typical profile

A - 0 to 7 inches: channery silt loam
Bw - 7 to 30 inches: very channery silt loam
R - 30 to 42 inches: unweathered bedrock

Properties and qualities

Slope: 8 to 25 percent
Surface area covered with cobbles, stones or boulders: 15.0 percent
Depth to restrictive feature: 20 to 40 inches to lithic bedrock
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Very low (about 2.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: C
Ecological site: F140XY027NY - Well Drained Till Uplands
Hydric soil rating: No

Description of Lordstown

Setting

Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Convex, linear
Across-slope shape: Convex, linear

Typical profile

A - 0 to 7 inches: channery silt loam
Bw - 7 to 26 inches: channery silt loam
C - 26 to 30 inches: very channery loam
2R - 30 to 42 inches: unweathered bedrock

Properties and qualities

Slope: 8 to 25 percent

Surface area covered with cobbles, stones or boulders: 9.0 percent
Depth to restrictive feature: 20 to 40 inches to lithic bedrock
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Low (about 3.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: C
Hydric soil rating: No

WmB—Wellsboro channery silt loam, 3 to 8 percent slopes, extremely stony

Map Unit Setting

National map unit symbol: 2vckl
Elevation: 330 to 2,460 feet
Mean annual precipitation: 31 to 70 inches
Mean annual air temperature: 39 to 52 degrees F
Frost-free period: 105 to 180 days
Farmland classification: Not prime farmland

Map Unit Composition

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

Description of Wellsboro, Extremely Stony

Setting

Landform: Hills, mountains
Landform position (two-dimensional): Summit, shoulder
Landform position (three-dimensional): Interfluve, side slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loamy till from reddish sandstone, siltstone, and shale

Typical profile

Oe - 0 to 1 inches: moderately decomposed plant material
A - 1 to 3 inches: channery silt loam
Bw - 3 to 22 inches: channery silt loam
Bx - 22 to 55 inches: channery loam
C - 55 to 72 inches: very channery loam

Properties and qualities

Slope: 3 to 8 percent
Surface area covered with cobbles, stones or boulders: 7.0 percent
Depth to restrictive feature: 14 to 30 inches to fragipan
Drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.14 in/hr)
Depth to water table: About 13 to 24 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Low (about 3.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: D
Hydric soil rating: No

Minor Components

Morris, extremely stony

Percent of map unit: 5 percent
Landform: Hills, mountains
Landform position (two-dimensional): Summit, footslope
Landform position (three-dimensional): Interfluve, base slope
Down-slope shape: Concave
Across-slope shape: Linear
Hydric soil rating: No

Oquaga, extremely stony

Percent of map unit: 5 percent
Landform: Mountains, hills
Landform position (two-dimensional): Shoulder, summit, backslope
Landform position (three-dimensional): Mountaintop, upper third of mountainflank, side slope, crest, nose slope
Down-slope shape: Convex, linear
Across-slope shape: Linear
Hydric soil rating: No

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United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Luzerne County, Pennsylvania

February 12, 2021

Preface

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

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

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

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

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

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

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Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

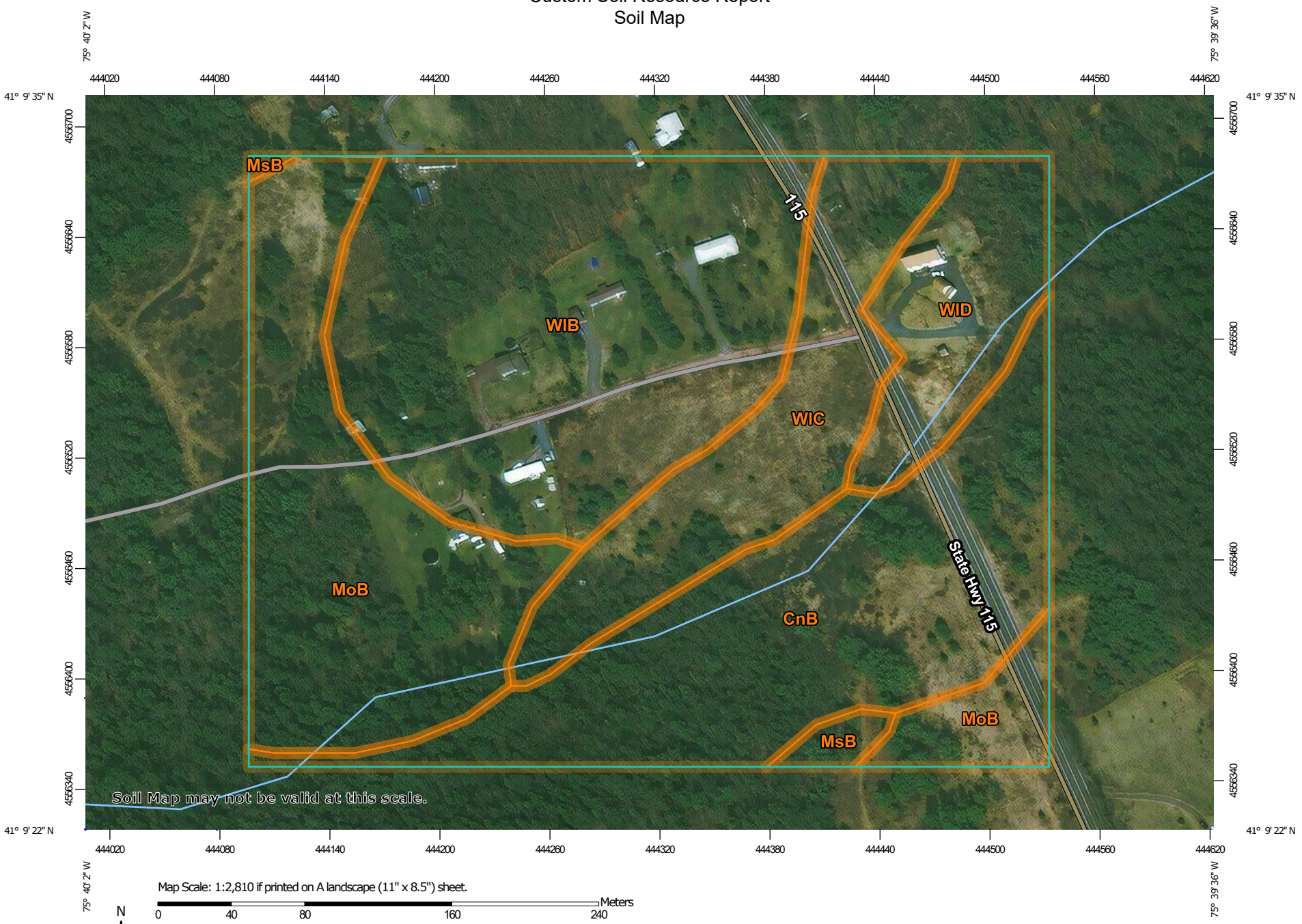
After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map



MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

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

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

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

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

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

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

Soil Survey Area: Luzerne County, Pennsylvania
Survey Area Data: Version 15, Jun 5, 2020

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

Date(s) aerial images were photographed: Sep 20, 2010—Jul 7, 2016

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

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
CnB	Chippewa silt loam, 0 to 8 percent slopes, extremely stony	8.6	23.8%
MoB	Morris channery silt loam, 0 to 8 percent slopes	8.4	23.2%
MsB	Morris channery silt loam, 0 to 8 percent slopes, extremely stony	0.4	1.0%
WlB	Wellsboro channery silt loam, 3 to 8 percent slopes	11.1	30.9%
WlC	Wellsboro channery silt loam, 8 to 15 percent slopes	4.7	13.0%
WlD	Wellsboro channery silt loam, 15 to 25 percent slopes	2.9	8.1%
Totals for Area of Interest		**36.0**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor

components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Luzerne County, Pennsylvania

CnB—Chippewa silt loam, 0 to 8 percent slopes, extremely stony

Map Unit Setting

National map unit symbol: 2vcjf
Elevation: 330 to 2,460 feet
Mean annual precipitation: 31 to 70 inches
Mean annual air temperature: 39 to 52 degrees F
Frost-free period: 105 to 180 days
Farmland classification: Not prime farmland

Map Unit Composition

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

Description of Chippewa, Extremely Stony

Setting

Landform: Depressions
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Loamy till dominated by siltstone, sandstone, and shale fragments

Typical profile

Oe - 0 to 1 inches: moderately decomposed plant material
A - 1 to 5 inches: silt loam
Eg - 5 to 15 inches: channery silt loam
Bxg - 15 to 45 inches: channery silt loam
C - 45 to 72 inches: channery silt loam

Properties and qualities

Slope: 0 to 8 percent
Surface area covered with cobbles, stones or boulders: 7.0 percent
Depth to restrictive feature: 8 to 20 inches to fragipan
Drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.14 in/hr)
Depth to water table: About 0 to 6 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 15 percent
Available water capacity: Low (about 3.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: D
Ecological site: F140XY016NY - Mineral Wetlands
Hydric soil rating: Yes

Minor Components

Volusia, extremely stony

Percent of map unit: 8 percent
Landform: Hills, mountains
Landform position (two-dimensional): Footslope, summit
Landform position (three-dimensional): Base slope, interfluve, side slope
Down-slope shape: Concave
Across-slope shape: Linear
Hydric soil rating: No

Chippewa, extremely stony, very poorly drained

Percent of map unit: 7 percent
Landform: Depressions
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

MoB—Morris channery silt loam, 0 to 8 percent slopes

Map Unit Setting

National map unit symbol: 2vclq
Elevation: 330 to 2,460 feet
Mean annual precipitation: 31 to 70 inches
Mean annual air temperature: 39 to 52 degrees F
Frost-free period: 105 to 180 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

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

Description of Morris

Setting

Landform: Hills, mountains
Landform position (two-dimensional): Summit, footslope
Landform position (three-dimensional): Interfluve, base slope
Down-slope shape: Concave
Across-slope shape: Linear
Parent material: Loamy till from reddish sandstone, siltstone, and shale

Typical profile

Ap - 0 to 8 inches: channery silt loam
Bw - 8 to 12 inches: channery silt loam
Eg - 12 to 16 inches: channery silt loam
Bx - 16 to 60 inches: channery silt loam

C - 60 to 72 inches: channery loam

Properties and qualities

Slope: 0 to 8 percent
Surface area covered with cobbles, stones or boulders: 0.0 percent
Depth to restrictive feature: 10 to 22 inches to fragipan
Drainage class: Somewhat poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.14 in/hr)
Depth to water table: About 6 to 18 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Very low (about 2.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: D
Hydric soil rating: No

Minor Components

Wellsboro

Percent of map unit: 5 percent
Landform: Hills, mountains
Landform position (two-dimensional): Backslope, shoulder
Landform position (three-dimensional): Interfluve, side slope
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Norwich

Percent of map unit: 5 percent
Landform: Depressions
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

MsB—Morris channery silt loam, 0 to 8 percent slopes, extremely stony

Map Unit Setting

National map unit symbol: 2vxct
Elevation: 330 to 2,460 feet
Mean annual precipitation: 31 to 70 inches
Mean annual air temperature: 39 to 52 degrees F
Frost-free period: 105 to 180 days
Farmland classification: Not prime farmland

Map Unit Composition

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

Description of Morris, Extremely Stony

Setting

Landform: Mountains, hills
Landform position (two-dimensional): Summit, footslope
Landform position (three-dimensional): Interfluve, base slope
Down-slope shape: Concave
Across-slope shape: Linear
Parent material: Loamy till from reddish sandstone, siltstone, and shale

Typical profile

Oe - 0 to 1 inches: moderately decomposed plant material
A - 1 to 5 inches: channery silt loam
Bw - 5 to 12 inches: channery silt loam
Eg - 12 to 16 inches: channery silt loam
Bx - 16 to 60 inches: channery silt loam
C - 60 to 72 inches: channery loam

Properties and qualities

Slope: 0 to 8 percent
Surface area covered with cobbles, stones or boulders: 7.0 percent
Depth to restrictive feature: 10 to 22 inches to fragipan
Drainage class: Somewhat poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.14 in/hr)
Depth to water table: About 6 to 18 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Very low (about 2.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: D
Hydric soil rating: No

Minor Components

Norwich, extremely stony

Percent of map unit: 5 percent
Landform: Depressions
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Wellsboro, extremely stony

Percent of map unit: 5 percent
Landform: Hills, mountains
Landform position (two-dimensional): Backslope, shoulder

Landform position (three-dimensional): Interfluve, side slope, head slope
Down-slope shape: Convex, concave
Across-slope shape: Convex, linear
Hydric soil rating: No

WlB—Wellsboro channery silt loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 2vck5
Elevation: 330 to 2,460 feet
Mean annual precipitation: 31 to 70 inches
Mean annual air temperature: 39 to 52 degrees F
Frost-free period: 105 to 180 days
Farmland classification: All areas are prime farmland

Map Unit Composition

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

Description of Wellsboro

Setting

Landform: Hills, mountains
Landform position (two-dimensional): Summit, shoulder
Landform position (three-dimensional): Interfluve, side slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loamy till from reddish sandstone, siltstone, and shale

Typical profile

Ap - 0 to 8 inches: channery silt loam
Bw - 8 to 22 inches: channery silt loam
Bx - 22 to 55 inches: channery loam
C - 55 to 72 inches: very channery loam

Properties and qualities

Slope: 3 to 8 percent
Surface area covered with cobbles, stones or boulders: 0.0 percent
Depth to restrictive feature: 14 to 30 inches to fragipan
Drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.14 in/hr)
Depth to water table: About 13 to 24 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Low (about 3.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2w

Hydrologic Soil Group: D
Hydric soil rating: No

Minor Components

Lackawanna
Percent of map unit: 5 percent
Landform: Mountains, hills
Landform position (two-dimensional): Shoulder, backslope
Landform position (three-dimensional): Interfluve, side slope
Down-slope shape: Convex
Across-slope shape: Linear
Hydric soil rating: No

Morris
Percent of map unit: 5 percent
Landform: Hills, mountains
Landform position (two-dimensional): Summit, footslope
Landform position (three-dimensional): Interfluve, base slope
Down-slope shape: Concave
Across-slope shape: Linear
Hydric soil rating: No

Oquaga
Percent of map unit: 5 percent
Landform: Mountains, hills
Landform position (two-dimensional): Shoulder, backslope
Landform position (three-dimensional): Upper third of mountainflank, crest, nose slope
Down-slope shape: Convex
Across-slope shape: Linear
Hydric soil rating: No

WlC—Wellsboro channery silt loam, 8 to 15 percent slopes

Map Unit Setting
National map unit symbol: 2vck6
Elevation: 330 to 2,460 feet
Mean annual precipitation: 31 to 70 inches
Mean annual air temperature: 39 to 52 degrees F
Frost-free period: 105 to 180 days
Farmland classification: Farmland of statewide importance

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

Description of Wellsboro

Setting

Landform: Hills, mountains
Landform position (two-dimensional): Backslope, shoulder
Landform position (three-dimensional): Interfluve, side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Loamy till from reddish sandstone, siltstone, and shale

Typical profile

Ap - 0 to 8 inches: channery silt loam
Bw - 8 to 22 inches: channery silt loam
Bx - 22 to 55 inches: channery loam
C - 55 to 72 inches: very channery loam

Properties and qualities

Slope: 8 to 15 percent
Surface area covered with cobbles, stones or boulders: 0.0 percent
Depth to restrictive feature: 14 to 30 inches to fragipan
Drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.14 in/hr)
Depth to water table: About 13 to 24 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Low (about 3.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: D
Hydric soil rating: No

Minor Components

Morris

Percent of map unit: 5 percent
Landform: Hills, mountains
Landform position (two-dimensional): Summit, footslope
Landform position (three-dimensional): Interfluve, base slope
Down-slope shape: Concave
Across-slope shape: Linear
Hydric soil rating: No

Lackawanna

Percent of map unit: 5 percent
Landform: Hills, mountains
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Nose slope, side slope
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

WlD—Wellsboro channery silt loam, 15 to 25 percent slopes

Map Unit Setting

National map unit symbol: 2vck7
Elevation: 330 to 2,460 feet
Mean annual precipitation: 31 to 70 inches
Mean annual air temperature: 39 to 52 degrees F
Frost-free period: 105 to 180 days
Farmland classification: Not prime farmland

Map Unit Composition

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

Description of Wellsboro

Setting

Landform: Hills, mountains
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope, head slope
Down-slope shape: Concave
Across-slope shape: Linear
Parent material: Loamy till from reddish sandstone, siltstone, and shale

Typical profile

Ap - 0 to 8 inches: channery silt loam
Bw - 8 to 22 inches: channery silt loam
Bx - 22 to 55 inches: channery loam
C - 55 to 72 inches: very channery loam

Properties and qualities

Slope: 15 to 25 percent
Surface area covered with cobbles, stones or boulders: 0.0 percent
Depth to restrictive feature: 14 to 30 inches to fragipan
Drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.14 in/hr)
Depth to water table: About 13 to 24 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Low (about 3.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: D
Hydric soil rating: No

Minor Components

Oquaga

Percent of map unit: 5 percent
Landform: Hills, mountains
Landform position (two-dimensional): Shoulder, backslope
Landform position (three-dimensional): Upper third of mountainflank, crest, nose slope, side slope
Down-slope shape: Convex, linear
Across-slope shape: Linear
Hydric soil rating: No

Morris

Percent of map unit: 5 percent
Landform: Hills, mountains
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Interfluve, side slope
Down-slope shape: Concave
Across-slope shape: Linear
Hydric soil rating: No

Lackawanna

Percent of map unit: 5 percent
Landform: Mountains, hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Nose slope, side slope
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

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ATTACHMENT 3

SITE EVALUATION AND SOIL INFILTRATION TEST REPORT

341 10th Avenue Suite 103, Royersford PA 19468 • 610.495.5585
Civil, Environmental, & Geological Consultants

March 3, 2022

TRANSCONTINENTAL GAS PIPE LINE COMPANY, LLC.
A SUBSIDIARY OF THE WILLIAMS COMPANIES, INC.
REGIONAL ENERGY ACCESS EXPANSION PROJECT
COMPRESSOR STATION 515 PROJECT

SITE EVALUATION AND SOIL INFILTRATION TEST REPORT

1.0 SITE SOILS

Based upon mapping provided by the United States Department of Agriculture's Natural Resources Conservation Service (USDA NRCS) Web Soil Survey[1], the project areas under consideration for infiltration BMPs are underlain by the following soil series: Wellsboro channery silt loam, 3 to 8 percent slopes (WlB), Oquaga and Lordstown channery silt loams, 3 to 8 precent loams (OlB), Morris channery silt loam , 0 to 8 precent slopes (MoB), Chippewa silt loam, 0 to 3 percent slopes (ClA) and Chippewa silt loam, 3 to 8 percent slopes (ClB).

WlB soils consist of moderately well drained soils found on hill and mountain shoulders and summits. The parent material is loamy till derived mainly from reddish sandstone, siltstone, and shale. A fragipan is typically located at a depth ranging from 14 to 30 inches below ground surface (bgs). Depth to the water table ranges from 13 to 24 inches. The available water capacity of WlB soils is low and permeability is slow.

OlB soils consist of moderately well drained soils found on hill slopes and shoulders. The parent material is reddish ablated till derived mainly from sandstone and siltstone. Bedrock begins at a depth ranging from 30 to 42 inches. Depth to the water table is more than 80 inches below grade surface. The available water capacity of OlB soils is very low and permeability is high.

MoB soils consist of somewhat poorly drained soils found on hill and mountain footslopes and summits. The parent material is loamy till derived mainly from reddish sandstone, siltstone, and shale. A fragipan is typically located at a depth ranging from 10 to 22 inches. Depth to the water table ranges from 6 to 18 inches. The available water capacity of MoB soils is very low and permeability is very slow.

The soil infiltration testing described in this report focused on WlB, MoB and OlB soils. These soils are anticipated as being the primary soils in the areas of possible best management practices (BMP).

2.0 FIELD INVESTIGATION AND TESTING METHODOLOGY

BAI completed a total of eight test pits and sixteen double-ring infiltrometer tests, two infiltration tests per test pit. Locations were selected to be representative of the main soil series in the areas of potential infiltration BMPs. Figure 1 presents locations of test pits and corresponding double-ring infiltrometer tests.

[1] http://websoilsurvey.nrcs.usda.gov/app/

Eight test pits (TP 501 through TP 508) were opened using an excavator for soil characterization up to 36 inches bgs on September 28 and 29, 2020. Infiltration tests were also performed in eight test pits at approximately 31 inches deep to evaluate infiltration rates of shallow soils in the study area. The infiltration tests used double-ring infiltrometer (DRI) tests.

The double-ring infiltrometer consisted of PVC construction with a nine-inch diameter outer ring (OR) and a six-inch diameter inner ring (IR) set two inches deep into the bottom of each borehole (approximately 31 inches below grade). DRI tests were used to determine infiltration rates of shallow soils at various locations across the Site. DRI testing was initiated by completing a one-hour pre-soak which involved adding two inches of head to both the OR and IR. By noting the drop in head in each infiltrometer at 30-minute increments during the pre-soak, BAI determined that 30-minute testing intervals for the infiltration tests would be used for DRI testing as per the Pennsylvania Stormwater Best Management Practices Manual (Document ID 363-0300-002) Appendix C.

Following the pre-soak, the test pits were refilled to a two-inch head level in both the IR and OR. As the water level decreased, the change in head was measured from a fixed reference point in the IR every 10 or 30 minutes for the infiltration tests depending on the infiltration rate during the presoak. The IR and OR were refilled following each reading. Results for DRI tests are discussed in Section 3.0.

3.0 FINDINGS AND CONCLUSIONS

Based upon examination of each test pit, soils beneath the Site consist of brown (10YR 4/3) silty sand to a depth of at least 5 inches bgs. From roughly 5 to 10 inches bgs a brown (10YR 5/6) silty sand or sandy silt was observed. The soil from 10 to 24 inches consisted of a friable brown (10YR 5/6) channery loam. At a depth of 24 inches bgs, a brown (10YR 4/4) silty sand or poorly graded sand layer until bedrock was encountered. The depth to bedrock was consistent throughout the Site, ranging from 23 to 36 inches below grade surface (bgs). Testing was completed within the same soil series at eight locations spread out in the areas of the potential BMP locations.

For the limiting zone investigation each of test pit excavated had a limiting zone at the SHWT or bedrock. TP 502 had a SHWT at 30 inches bgs, where a moderately mottled soil was observed. The other test pits have limiting zone at competent bedrock. TP 508 encountered bedrock at 23 inches bgs. The deepest bedrock limiting zone was in TP 503 at 35 inches bgs. The water table was not encountered in the test pits.

The following table summarizes the limiting zones identified in each test pit.

Limiting Zone Investigation Results					
Test Pit	Elevation (MSL ft)	Seasonal High Water Table (in)	Water Table (in)	Bedrock (in)	Total Depth (in)
TP 501	1923.06	Not encountered	Not encountered	28	28
TP 502	1924.409	30	Not encountered	36	36
TP 503	1931.729	Not encountered	Not encountered	35	35
TP 504	1933.762	Not encountered	Not encountered	33	33
TP 505	1934.233	Not encountered	Not encountered	34	34
TP 506	1933.416	Not encountered	Not encountered	33	33
TP 507	1936.626	Not encountered	Not encountered	26.5	26.5
TP 508	1936.604	Not encountered	Not encountered	23	23

Infiltration testing was completed within the same mapped soil series at eight locations spread out in the areas of the potential BMP locations. However, only the infiltration rates for TP 501 and TP 502 were used since they are representative of the area of the proposed BMPs. The following table summarizes the DRI readings for each test pit relevant to the proposed BMP.

Infiltration Testing Results								
Test pit	Hole	Testing Elevation	Reading Interval (min)	Reading 1 (in.)	Reading 2 (in.)	Reading 3 (in.)	Reading 4 (in.)	Infiltration Rate (in./hr)
TP 501	IT 501A	1920.80′	30	1.25	1.125	1.125	1.125	2.31
	IT 501B	1920.80′	30	1.125	1.00	1.00	1.00	2.06
TP 502	IT 502A	1921.50′	30	0.25	0.125	0.125	0.125	0.31
	IT 502B	1921.50′	30	0.25	0.25	0.25	0.25	0.50

Bottom Elevation of Proposed BMP = 1925.50′

Based on field observations, the infiltration testing was completed at an appropriate location in the soil profile and is representative to the BMP's infiltration elevation.

TP 501

The infiltration rate within IT 501A was 2.31 inches per hour (iph) based upon an average rate of drop of 1.155 inches over the last four 30-minute infiltration readings. The infiltration rate within IT 501B was 2.06 iph based upon an average rate of drop of 1.03 inches over the last four 30-minute infiltration readings.

TP 502

The infiltration rate within IT 502A was 0.31 iph based upon an average rate of drop of 0.156 inches over the four 30-minute infiltration readings. The infiltration rate within IT 502B was 0.50 iph based upon an average rate of drop of 0.25 inches over the four 30-minute infiltration readings.

4.0 REFERENCES

Pennsylvania Department of Environmental Protection. "Pennsylvania Stormwater Best Management Practices Manual" Document No. 363-0300-02, December 2006.

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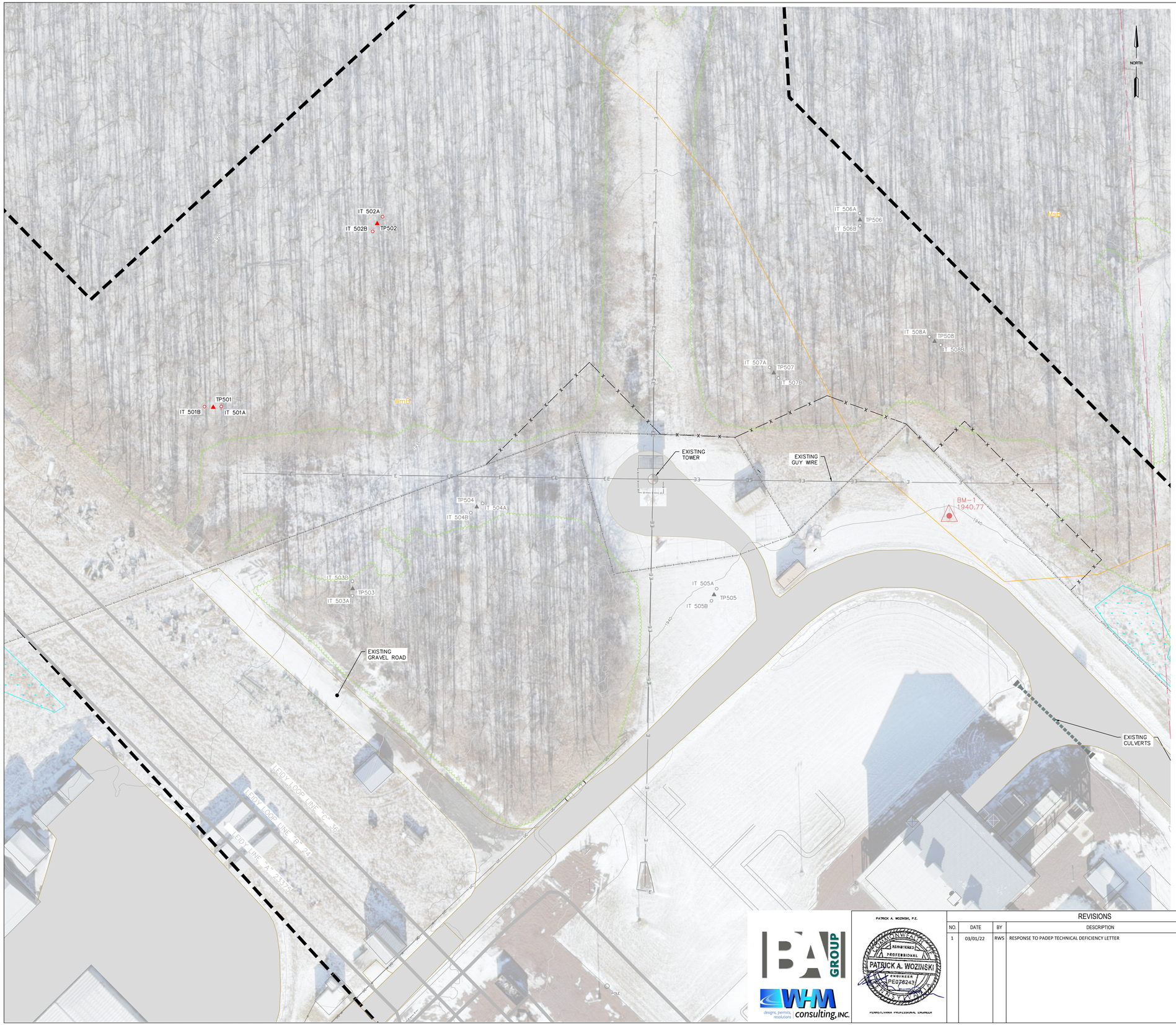


LEGEND

- PROPOSED PIPELINE
- LIMITS OF DISTURBANCE
- DELINEATED WETLAND
- DELINEATED WATERWAY / STREAM (TOP OF BANK)
- STREAM FLOW DIRECTION
- RIPARIAN BUFFER
- 50'/FEMA FLOODWAY
- FEMA 100-YEAR FLOODPLAIN
- MrB2 — SOIL BOUNDARY / TYPE
- EXISTING TREELINE / TREE/SHRUB
- PROPERTY LINE
- X — EXISTING FENCE
- X — PROPOSED FENCE
- EXISTING LEIDY / TGPL PIPELINES
- EXISTING FOREIGN PIPELINES
- EXISTING UTILITY POLE / TOWER
- EXISTING VALVE
- EXISTING CULVERT
- E — EXISTING ELECTRIC LINE
- UE — EXISTING UNDERGROUND ELECTRIC LINE
- G — EXISTING GAS LINE
- W — EXISTING WATER LINE
- SAN — EXISTING SANITARY LINE
- ST — EXISTING STORM SEWER
- T — EXISTING TELEPHONE LINE
- FO — EXISTING FIBER OPTIC LINE
- UC — EXISTING UNDERGROUND CABLE LINE
- EXISTING STORM INLET
- EXISTING SANITARY MANHOLE
- EXISTING COMMUNICATION/ELECTRIC MANHOLE
- EXISTING FIRE HYDRANT
- EXISTING POWER POLE
- EXISTING STRUCTURE
- EXISTING ROAD (GRAVEL)
- EXISTING ROAD (PAVED)
- EXISTING GRAVEL AREAS
- PROPOSED GRAVEL
- 1250 — EXISTING GRADE MAJOR CONTOURS (10' C.I.)
- EXISTING GRADE MINOR CONTOURS (2' C.I.)
- TP505 — TEST PIT USED FOR BMP DEISGN
- IT 505A — INFILTRATION TEST USED FOR BMP DESIGN
- TP505 — TEST PIT NOT USED FOR BMP DESIGN
- IT 505A — INFILTRATION TEST NOT USED FOR BMP DESIGN

SOIL LEGEND

MsB	MORRIS CHANNERY SILT LOAM, 0 TO 8 PERCENT SLOPES, EXTREMELY STONY
WmB	WELLSBORO CHANNERY SILT LOAM, 3 TO 8 PERCENT SLOPES
CnB	CHIPPEWA VERY STONY SILT LOAM, 0 TO 8 PERCENT SLOPES
OpD	OQUAGA AND LORDSTOWN EXTREMELY STONY SILT LOAMS, 8 TO 25 PERCENT SLOPES

EXISTING CONDITION NOTES/SOURCES

1. EXISTING ROADWAYS, CONTOURS, PROPERTY LINE, TREE LINE, ETC. ARE DERIVED FROM A FIELD SURVEY PERFORMED BY TRANSCO BETWEEN MARCH 2019 AND 2020.
2. PROPERTY BOUNDARIES BASED EITHER ON TAX PARCEL INFORMATION PROVIDED BY TRANSCO OR A COMBINATION OF DEED REFERENCE AND FIELD LOCATED EVIDENCE. PROPERTY BOUNDARY LOCATIONS BASED ON TAX PARCEL INFORMATION ARE APPROXIMATE.
3. PIPELINE ALIGNMENTS AND LIMITS OF DISTURBANCE PROVIDED BY TRANSCO.
4. STREAM AND WETLAND BOUNDARIES BASED ON SURVEYS CONDUCTED BY WHM CONSULTING FROM MARCH 2020 TO OCTOBER 2020.
5. DATUM BASED ON PENNSYLVANIA STATE PLANE COORDINATE SYSTEM, NAD 83 NORTH ZONE, NAVD88, ELEVATION MSL, DERIVED FROM GPS OBSERVATION.

SCALE
30 15 0 30
SCALE 1" =30'

BA GROUP

WHM consulting, INC.
designs, permits, resolutions

PATRICK A. WOZINSKI, P.E.
COMMONWEALTH OF PENNSYLVANIA
REGISTERED PROFESSIONAL
PATRICK A. WOZINSKI
ENGINEER
PE076243
PENNSYLVANIA PROFESSIONAL ENGINEER

REVISIONS						
NO.	DATE	BY	DESCRIPTION	W.O. NO.	CHK.	APP.
1	03/01/22	RWS	RESPONSE TO PADEP TECHNICAL DEFICIENCY LETTER			

TRANSCONTINENTAL GAS PIPE LINE COMPANY, LLC
REGIONAL ENERGY ACCESS EXPANSION PROJECT
CS515
SOIL TEST PIT LOCATIONS

EXISTING CONDITIONS

BUCK TOWNSHIP, LUZERNE COUNTY, PENNSYLVANIA

DRAWN BY: DRV	DATE: 03/31/21	ISSUED FOR BID:	SCALE: AS NOTED
CHECKED BY: PW	DATE: 03/31/21	ISSUED FOR CONSTRUCTION:	REVISION:
APPROVED BY: PW	DATE: 03/31/21		SHEET 1
WO: 1222639	RID: 305	DRAWING NUMBER: 26-1000-70-28-D	OF 1

ATTACHMENT 4

PCSM PLAN BMP DESIGN WORKSHEETS AND CALCULATIONS

TABLE OF CONTENTS

Attachment 4

ATTACHMENT 4.1
CN TABLE

Table 2-2a Runoff curve numbers for urban areas [1/]

Cover description		Curve numbers for hydrologic soil group			
Cover type and hydrologic condition	Average percent impervious area [2/]	A	B	C	D
Fully developed urban areas (vegetation established)					
Open space (lawns, parks, golf courses, cemeteries, etc.) [3/]:					
Poor condition (grass cover < 50%)		68	79	86	89
Fair condition (grass cover 50% to 75%)		49	69	79	84
Good condition (grass cover > 75%)		39	61	74	80
Impervious areas:					
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)		98	98	98	98
Streets and roads:					
Paved; curbs and storm sewers (excluding right-of-way)		98	98	98	98
Paved; open ditches (including right-of-way)		83	89	92	93
Gravel (including right-of-way)		76	85	89	91
Dirt (including right-of-way)		72	82	87	89
Western desert urban areas:					
Natural desert landscaping (pervious areas only) [4/]		63	77	85	88
Artificial desert landscaping (impervious weed barrier, desert shrub with 1- to 2-inch sand or gravel mulch and basin borders)		96	96	96	96
Urban districts:					
Commercial and business	85	89	92	94	95
Industrial	72	81	88	91	93
Residential districts by average lot size:					
1/8 acre or less (town houses)	65	77	85	90	92
1/4 acre	38	61	75	83	87
1/3 acre	30	57	72	81	86
1/2 acre	25	54	70	80	85
1 acre	20	51	68	79	84
2 acres	12	46	65	77	82
Developing urban areas					
Newly graded areas (pervious areas only, no vegetation) [5/]		77	86	91	94
Idle lands (CN's are determined using cover types similar to those in table 2-2c).					

[1] Average runoff condition, and $I_a = 0.2S$.

[2] The average percent impervious area shown was used to develop the composite CN's. Other assumptions are as follows: impervious areas are directly connected to the drainage system, impervious areas have a CN of 98, and pervious areas are considered equivalent to open space in good hydrologic condition. CN's for other combinations of conditions may be computed using figure 2-3 or 2-4.

[3] CN's shown are equivalent to those of pasture. Composite CN's may be computed for other combinations of open space cover type.

[4] Composite CN's for natural desert landscaping should be computed using figures 2-3 or 2-4 based on the impervious area percentage (CN = 98) and the pervious area CN. The pervious area CN's are assumed equivalent to desert shrub in poor hydrologic condition.

[5] Composite CN's to use for the design of temporary measures during grading and construction should be computed using figure 2-3 or 2-4 based on the degree of development (impervious area percentage) and the CN's for the newly graded pervious areas.

Table 2-2b Runoff curve numbers for cultivated agricultural lands [1/]

Cover description			Curve numbers for hydrologic soil group			
Cover type	Treatment [2/]	Hydrologic condition [3/]	A	B	C	D
Fallow	Bare soil	—	77	86	91	94
	Crop residue cover (CR)	Poor	76	85	90	93
		Good	74	83	88	90
Row crops	Straight row (SR)	Poor	72	81	88	91
		Good	67	78	85	89
	SR + CR	Poor	71	80	87	90
		Good	64	75	82	85
	Contoured (C)	Poor	70	79	84	88
		Good	65	75	82	86
	C + CR	Poor	69	78	83	87
		Good	64	74	81	85
	Contoured & terraced (C&T)	Poor	66	74	80	82
		Good	62	71	78	81
	C&T+ CR	Poor	65	73	79	81
		Good	61	70	77	80
Small grain	SR	Poor	65	76	84	88
		Good	63	75	83	87
	SR + CR	Poor	64	75	83	86
		Good	60	72	80	84
	C	Poor	63	74	82	85
		Good	61	73	81	84
	C + CR	Poor	62	73	81	84
		Good	60	72	80	83
	C&T	Poor	61	72	79	82
		Good	59	70	78	81
	C&T+ CR	Poor	60	71	78	81
		Good	58	69	77	80
Close-seeded or broadcast legumes or rotation meadow	SR	Poor	66	77	85	89
		Good	58	72	81	85
	C	Poor	64	75	83	85
		Good	55	69	78	83
	C&T	Poor	63	73	80	83
		Good	51	67	76	80

[1] Average runoff condition, and I_a=0.2S

[2] Crop residue cover applies only if residue is on at least 5% of the surface throughout the year.

[3] Hydraulic condition is based on combination factors that affect infiltration and runoff, including (a) density and canopy of vegetative areas, (b) amount of year-round cover, (c) amount of grass or close-seeded legumes, (d) percent of residue cover on the land surface (good ≥ 20%), and (e) degree of surface roughness.

Poor: Factors impair infiltration and tend to increase runoff.

Good: Factors encourage average and better than average infiltration and tend to decrease runoff.

Table 2-2c Runoff curve numbers for other agricultural lands [1/]

Cover description		Curve numbers for hydrologic soil group			
Cover type	Hydrologic condition	A	B	C	D
Pasture, grassland, or range—continuous forage for grazing. [2/]	Poor	68	79	86	89
	Fair	49	69	79	84
	Good	39	61	74	80
Meadow—continuous grass, protected from grazing and generally mowed for hay.	—	30	58	71	78
Brush—brush-weed-grass mixture with brush the major element. [3/]	Poor	48	67	77	83
	Fair	35	56	70	77
	Good	30 [4/]	48	65	73
Woods—grass combination (orchard or tree farm). [5/]	Poor	57	73	82	86
	Fair	43	65	76	82
	Good	32	58	72	79
Woods. [6/]	Poor	45	66	77	83
	Fair	36	60	73	79
	Good	30 [4/]	55	70	77
Farmsteads—buildings, lanes, driveways, and surrounding lots.	—	59	74	82	86

[1] Average runoff condition, and $I_a = 0.2S$.
[2] *Poor:* <50%) ground cover or heavily grazed with no mulch.
Fair: 50 to 75% ground cover and not heavily grazed.
Good: > 75% ground cover and lightly or only occasionally grazed.
[3] *Poor*: <50% ground cover.
Fair: 50 to 75% ground cover.
Good: >75% ground cover.
[4] Actual curve number is less than 30; use CN = 30 for runoff computations.
[5] CN's shown were computed for areas with 50% woods and 50% grass (pasture) cover. Other combinations of conditions may be computed from the CN's for woods and pasture.
[6] *Poor:* Forest litter, small trees, and brush are destroyed by heavy grazing or regular burning.
Fair: Woods are grazed but not burned, and some forest litter covers the soil.
Good: Woods are protected from grazing, and litter and brush adequately cover the soil.

Table 2-2d Runoff curve numbers for arid and semiarid rangelands [1/]

Cover description		Curve numbers for hydrologic soil group			
Cover type	Hydrologic condition [2/]	A [3/]	B	C	D
Herbaceous—mixture of grass, weeds, and low-growing brush, with brush the minor element.	Poor		80	87	93
	Fair		71	81	89
	Good		62	74	85
Oak-aspen—mountain brush mixture of oak brush, aspen, mountain mahogany, bitter brush, maple, and other brush.	Poor		66	74	79
	Fair		48	57	63
	Good		30	41	48
Pinyon-juniper—pinyon, juniper, or both; grass understory.	Poor		75	85	89
	Fair		58	73	80
	Good		41	61	71
Sagebrush with grass understory.	Poor		67	80	85
	Fair		51	63	70
	Good		35	47	55
Desert shrub—major plants include saltbush, greasewood, creosotebush, blackbrush, bursage, palo verde, mesquite, and cactus.	Poor	63	77	85	88
	Fair	55	72	81	86
	Good	49	68	79	84

1 Average runoff condition, and $I_a = 0.2S$. For range in humid regions, use table 2-2c.
2 Poor: <30% ground cover (litter, grass, and brush overstory).
Fair: 30 to 70% ground cover.
Good: > 70% ground cover.
3 Curve numbers for group A have been developed only for desert shrub.

ATTACHMENT 4.2

STORMWATER BMP MANUAL APPENDIX D WORKSHEET

General Information

Instructions | *General* | Volume | Rate | Quality

Project Name: **Compressor Station 515**

Application Type: **Individual NPDES Application**

County: **Luzerne**

Municipality: **Buck Township**

Project Type: **New Utilities**

◉ New Project ○ Minor / Major Amendment

Area: **4.54** acres
(In Watershed)

Total Earth Disturbance: **4.54** acres
(In Watershed)

No. of Post-Construction Discharge Points: **1**

Start DP Numbering at: **001**

Discharge Point (DP) No.	Drainage Area (DA) (acres)	Earth Disturbance in DA (acres)	Existing Impervious in DA (acres)	Proposed Impervious in DA (acres)	Receiving Waters	Ch. 93 Class	Structural BMP(s)
001	4.54	4.54	0.36	2.46	Discharge to Non-Surface Waters	HQ-CWF, MF	Yes
Undetained Areas							
Totals:	**4.54**	**4.54**	**0.36**	**2.46**			

Volume Management

Project: Compressor Station 515

Instructions | General | *Volume* | Rate | Quality

2-Year / 24-Hour Storm Event (NOAA Atlas 14): **3.4** inches

Alternative 2-Year / 24-Hour Storm Even _____ inches

Alternative Source: _____

Pre-Construction Conditions: *No. Rows:* **3** ☐ *Exempt from Meadow in Good Condition* ☑ *Automatically Calculate CN, Ia, Runoff and Volume*

Land Cover	Area (acres)	Soil Group	CN	Ia (in)	Q Runoff (in)	Runoff Volume (cf)
Pervious as Meadow	4.18	D	78	0.564	1.42	21,574
Impervious as Meadow	0.07	D	78	0.564	1.42	361
Impervious Areas: Paved Parking Lots, Roofs, Driveways, Etc. (Excluding ROW)	0.29	D	98	0.041	3.17	3,334
TOTAL (ACRES):	**4.54**				**TOTAL (CF):**	**25,269**

Post-Construction Conditions: *No. Rows:* **2**

Land Cover	Area (acres)	Soil Group	CN	Ia (in)	Q Runoff (in)	Runoff Volume (cf)
Impervious Areas: Streets and Roads - Paved; Curbs and Storm Sewers (Excluding ROW)	2.46	D	98	0.041	3.17	28,279
Meadow-Continuous Grass, Protected from Grazing and Generally Mowed for Hay	2.08	D	78	0.564	1.42	10,735
TOTAL (ACRES):	**4.54**				**TOTAL (CF):**	**39,014**

ET CHANGE IN VOLUME TO MANAGE (CF): **13,745**

Non-Structural BMP Volume Credits:

☐ Tree Planting Credit

☐ Other (attach calculations):

Structural BMP Volume Credits: *No. Structural BMPs:* **2** *Start BMP Numbering at:* **1**

DP No.	BMP No.	BMP Name	MRC?	Discharge	Incremental BMP DA (acres)	Volume Routed to BMP (CF)	Infiltration / Vegetated Area (SF)	Infiltration Rate (in/hr)	Infiltration Period (hrs)	Vegeta-ted?	Media Depth (ft)	Storage Volume (CF)	Infiltration Credit (CF)	ET Credit (CF)
001	1	Vegetated Filter Strip	-	to BMP No. 2	3.82	19,412	35,512	0.31	12	No				
001	2	Infiltration Berm & Retentive Grading	-	Off-Site	0.72	37,577	17,763	0.31	43	No		16,220	**17,759**	
												Totals:	**17,759**	

INFILTRATION & ET CREDITS (CF): **17,759**

NET CHANGE IN VOLUME TO MANAGE (CF): **13,745**

TOTAL CREDITS (CF): **17,759**

VOLUME REQUIREMENT SATISFIED

Rate Control

Project: Compressor Station 515

Instructions | General | Volume | *Rate* | Quality

Precipitation Amounts:

NOAA 2-Year 24-Hour Storm Event (in):	**3.4**	Alternative 2-Year 24-Hour Storm Event (in):	
NOAA 10-Year 24-Hour Storm Event (in):	**5**	Alternative 10-Year 24-Hour Storm Event (in):	
NOAA 50-Year 24-Hour Storm Event (in):	**7.16**	Alternative 50-Year 24-Hour Storm Event (in):	
NOAA 100-Year 24-Hour Storm Event (in):	**8.43**	Alternative 100-Year 24-Hour Storm Event (in):	

☑ **Report Summary of Peak Rates Only**

Attach model input and output data or other calculations to support the rates reported below.

	Peak Discharge Rates (cfs)			
	Pre-Construction	**Post-Construction**	**Net Change**	
2-Year Storm:	**6.19**	**2.55**	**-3.64**	***Rate Control Satisfied***
10-Year Storm:	**11.74**	**10.18**	**-1.56**	***Rate Control Satisfied***
50-Year Storm:	**19.64**	**19.57**	**-0.07**	***Rate Control Satisfied***
100-Year Storm:	**24.34**	**24.23**	**-0.11**	***Rate Control Satisfied***

Water Quality

Project: Compressor Station 515

PRINT

Instructions | General | Volume | Rate | *Quality*

Pre-Construction Pollutant Loads:

Land Cover (from Volume Worksheet)	Land Cover for Water Quality	Area (acres)	Soil Group	Runoff Volume (cf)	Pollutant Conc. (mg/L)			Pollutant Loads (lbs)		
					TSS	TP	TN	TSS	TP	TN
Pervious as Meadow	Grassland/Herbaceous	4.18	D	21,574	48.8	0.22	2.30	65.74	0.30	3.10
Impervious as Meadow	Grassland/Herbaceous	0.07	D	361	48.8	0.22	2.30	1.10	0.00	0.05
Impervious Areas: Paved Parking Lots, Roofs, Driveways, Etc. (Excluding ROW)	Residential	0.29	D	3,334	65.0	0.29	2.05	13.53	0.06	0.43
	TOTAL (ACRES):	**4.54**					**TOTALS:**	**80.37**	**0.36**	**3.58**

Post-Construction Pollutant Loads (without BMPs):

Land Cover (from Volume Worksheet)	Land Cover for Water Quality	Area (acres)	Soil Group	Runoff Volume (cf)	Pollutant Conc. (mg/L)			Pollutant Loads (lbs)		
					TSS	TP	TN	TSS	TP	TN
Impervious Areas: Streets and Roads - Paved; Curbs and Storm Sewers (Excluding ROW)	Urban Highway	2.46	D	28,279	142.0	0.32	3.00	250.74	0.57	5.30
Meadow-Continuous Grass, Protected from Grazing and Generally Mowed for Hay	Grassland/Herbaceous	2.08	D	10,735	48.8	0.22	2.30	32.71	0.15	1.54
	TOTAL (ACRES):	**4.54**					**TOTALS:**	**283.46**	**0.71**	**6.84**

POLLUTANT LOAD REDUCTION REQUIREMENTS (LBS):	**203.09**	**0.35**	**3.26**

☐ **Characterize Undetained Areas (for Untreated Stormwater)**

Land Cover	Area (acres)	Soil Group	CN	Ia (in)	Q Runoff (in)	Runoff Volume (cf)

Non-Structural BMP Water Quality Credits:

☐ Pervious Undetained Area Credit

☐ Other (attach calculations)

Structural BMP Water Quality Credits:

☑ *Use default BMP Outflows and Median BMP Outflow Concentrations*

DP No.	BMP No.	BMP Name	MRC?	BMP DA (acres)	Vol. Routed to BMP (CF)	Inf. & ET Credits (CF)	Capture & Buffer Credits (CF)	Outflow (CF)	Outflow Conc. (mg/L)			Pollutant Loads (lbs)		
									TSS	TP	TN	TSS	TP	TN
001	1	Vegetated Filter Strip	-	3.82	19,412			19,412	-	-	-	-	-	-
001	2	Infiltration Berm & Retentive Grading	-	0.72	37,577	17,759		19,818	10.00	0.24	0.96	12.38	0.30	1.19

	TSS	TP	TN
POLLUTANT LOADS FROM STRUCTURAL BMP (TREATED) OUTFLOWS (LBS):	**12.38**	**0.30**	**1.19**
POLLUTANT LOADS FROM UNTREATED STORMWATER (LBS):	**10.44**	**0.03**	**0.25**
NON-STRUCTURAL BMP WATER QUALITY CREDITS (LBS):			
NET POLLUTANT LOADS FROM SITE, POST-CONSTRUCTION (LBS):	**22.82**	**0.32**	**1.44**
POLLUTANT LOADS FROM SITE, PRE-CONSTRUCTION (LBS):	**80.37**	**0.36**	**3.58**

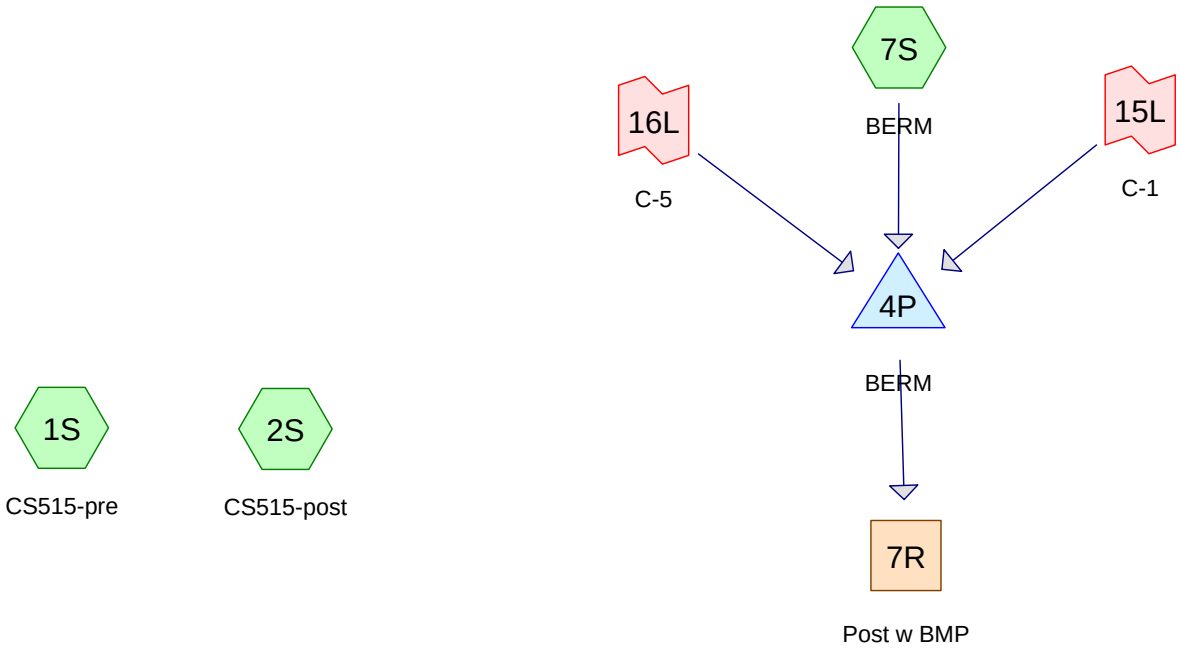
WATER QUALITY REQUIREMENT SATISFIED

CERTIFICATION

I certify under penalty of law and subject to the penalties of 18 Pa.C.S. § 4904 (relating to unsworn falsification to authorities) that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I further certify that the structure, function, and calculations contained in this spreadsheet have not been modified in comparison to the spreadsheet DEP has posted to its website or, if modifications were made, an explanation of the modifications made is attached to this spreadsheet.

Patrick Wozinski	2/14/2022
Spreadsheet User Name	Date

ATTACHMENT 4.3
BMP HYDROCAD REPORT



Subcat Reach Pond Link

Routing Diagram for CS515 - Pre, Post, Post w BMP
Prepared by Microsoft, Printed 2/24/2022

Project Notes

Rainfall events imported from "NRCS-Rain.txt" for 7639 PA Luzerne-C

Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
3,135	78	Meadow, (20% existing impervious) (1S)
334,430	78	Meadow, non-grazed, HSG D (1S, 2S, 7S)
122,950	98	Paved parking, HSG D (2S, 7S)
12,538	98	Paved roads w/curbs & sewers, HSG D (1S)
473,053	**84**	**TOTAL AREA**

Soil Listing (all nodes)

Area (sq-ft)	Soil Group	Subcatchment Numbers
0	HSG A	
0	HSG B	
0	HSG C	
469,918	HSG D	1S, 2S, 7S
3,135	Other	1S
473,053		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (sq-ft)	HSG-B (sq-ft)	HSG-C (sq-ft)	HSG-D (sq-ft)	Other (sq-ft)	Total (sq-ft)	Ground Cover
0	0	0	0	3,135	3,135	Meadow, (20% existing impervious)
0	0	0	334,430	0	334,430	Meadow, non-grazed
0	0	0	122,950	0	122,950	Paved parking
0	0	0	12,538	0	12,538	Paved roads w/curbs & sewers
0	**0**	**0**	**469,918**	**3,135**	**473,053**	**TOTAL AREA**

Time span=0.00-24.00 hrs, dt=0.04 hrs, 601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: CS515-pre Runoff Area=197,689 sf 6.34% Impervious Runoff Depth>1.11"
Flow Length=458' Tc=16.5 min CN=79 Runoff=4.58 cfs 18,291 cf

Subcatchment 2S: CS515-post Runoff Area=197,689 sf 54.17% Impervious Runoff Depth>1.81"
Flow Length=458' Tc=2.6 min CN=89 Runoff=11.55 cfs 29,801 cf

Subcatchment 7S: BERM Runoff Area=77,675 sf 20.42% Impervious Runoff Depth>1.30"
Tc=5.0 min CN=82 Runoff=3.15 cfs 8,409 cf

Reach 7R: Post w BMP Inflow=1.04 cfs 11,100 cf
Outflow=1.04 cfs 11,100 cf

Pond 4P: BERM Peak Elev=1,926.73' Storage=18,125 cf Inflow=8.69 cfs 30,277 cf
Discarded=0.06 cfs 2,708 cf Primary=1.04 cfs 11,100 cf Outflow=1.10 cfs 13,808 cf

Link 15L: C-1 1-Year Outflow Imported from CS515 - channels 1,4,5~Reach 4R.hce Inflow=2.87 cfs 9,048 cf
Area= 48,290 sf 81.96% Imperv. Primary=2.87 cfs 9,048 cf

Link 16L: C-5 1-Year Outflow Imported from CS515 - channels 1,4,5~Reach 13R.hce Inflow=3.44 cfs 12,820 cf
Area= 71,709 sf 72.02% Imperv. Primary=3.44 cfs 12,820 cf

Total Runoff Area = 473,053 sf Runoff Volume = 56,502 cf Average Runoff Depth = 1.43"
71.36% Pervious = 337,565 sf 28.64% Impervious = 135,488 sf

Summary for Subcatchment 1S: CS515-pre

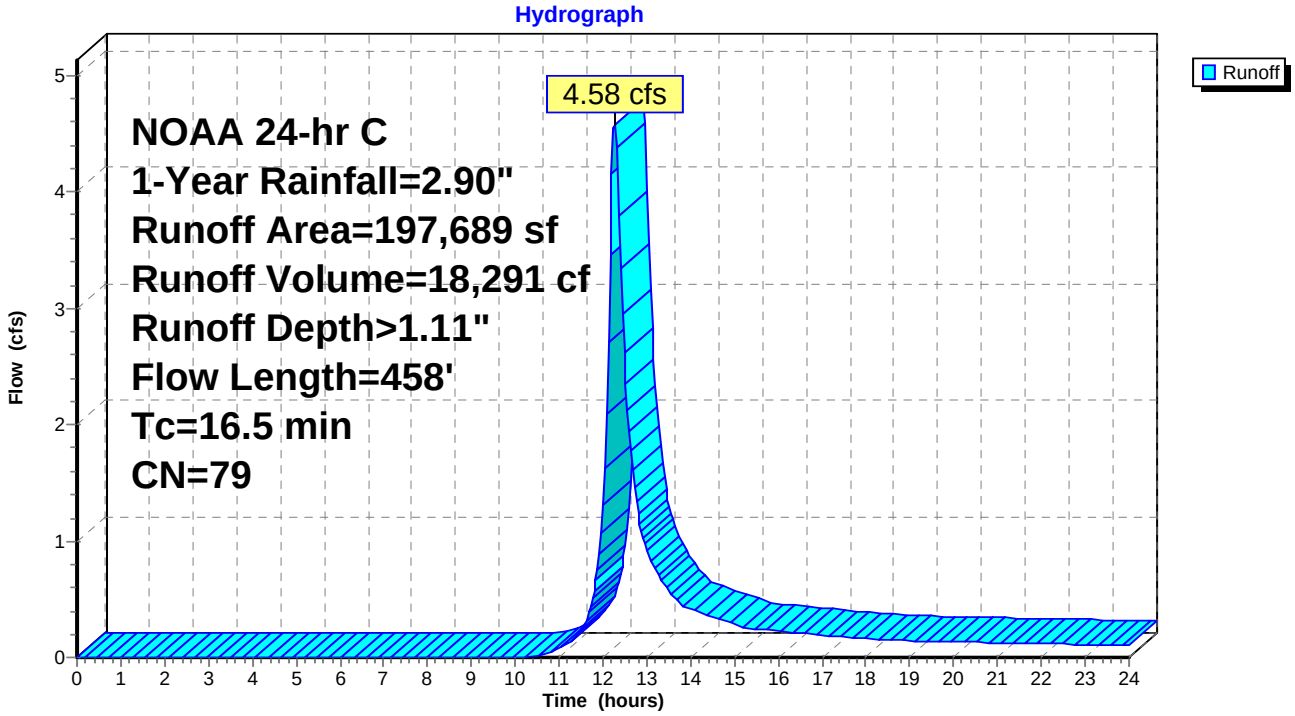
Runoff = 4.58 cfs @ 12.26 hrs, Volume= 18,291 cf, Depth> 1.11"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs
NOAA 24-hr C 1-Year Rainfall=2.90"

	Area (sf)	CN	Description
	182,016	78	Meadow, non-grazed, HSG D
*	3,135	78	Meadow, (20% existing impervious)
	12,538	98	Paved roads w/curbs & sewers, HSG D
	197,689	79	Weighted Average
	185,151		93.66% Pervious Area
	12,538		6.34% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.5	100	0.0100	0.13		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 3.40"
4.0	358	0.0446	1.48		**Shallow Concentrated Flow, shallow concentrated** Short Grass Pasture Kv= 7.0 fps
16.5	458	Total			

Subcatchment 1S: CS515-pre



Summary for Subcatchment 2S: CS515-post

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

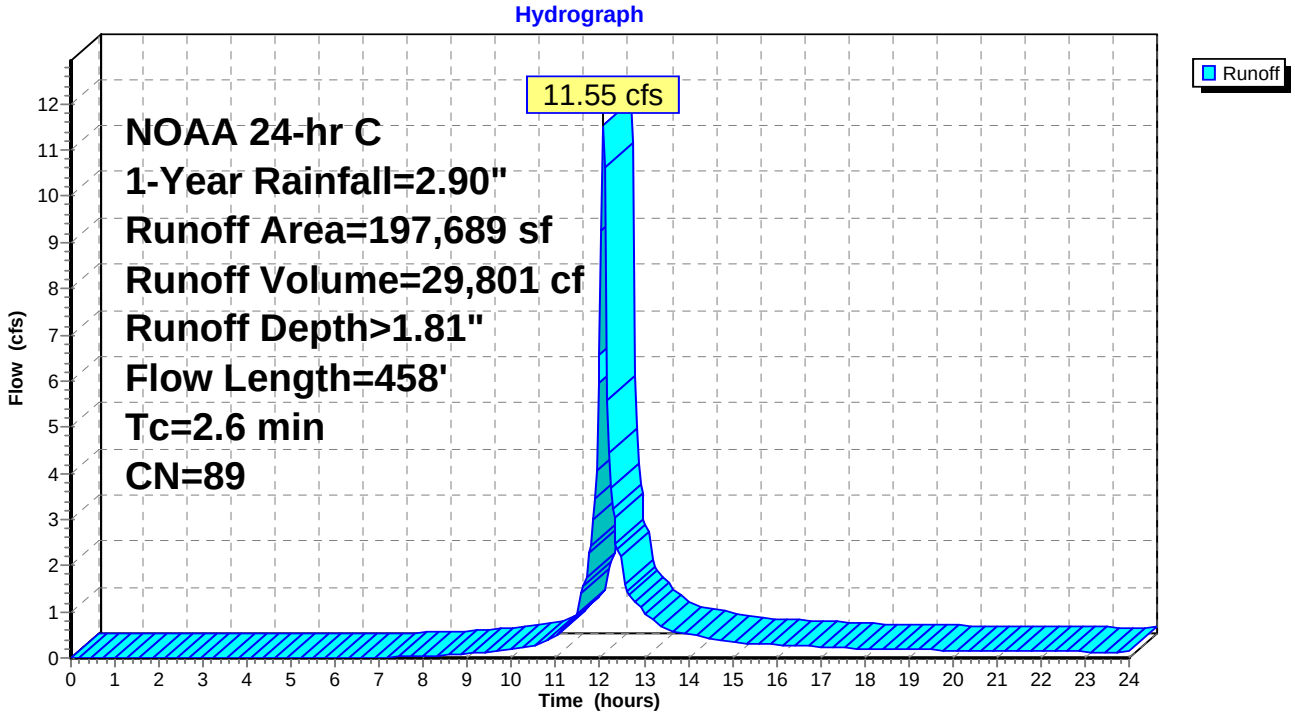
Runoff = 11.55 cfs @ 12.09 hrs, Volume= 29,801 cf, Depth> 1.81"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs
NOAA 24-hr C 1-Year Rainfall=2.90"

Area (sf)	CN	Description
107,087	98	Paved parking, HSG D
90,602	78	Meadow, non-grazed, HSG D
197,689	89	Weighted Average
90,602		45.83% Pervious Area
107,087		54.17% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	100	0.0200	1.42		**Sheet Flow, sheet flow** Smooth surfaces n= 0.011 P2= 3.40"
1.4	358	0.0446	4.29		**Shallow Concentrated Flow, shallow concentrated** Paved Kv= 20.3 fps
2.6	458	Total			

Subcatchment 2S: CS515-post



Summary for Subcatchment 7S: BERM

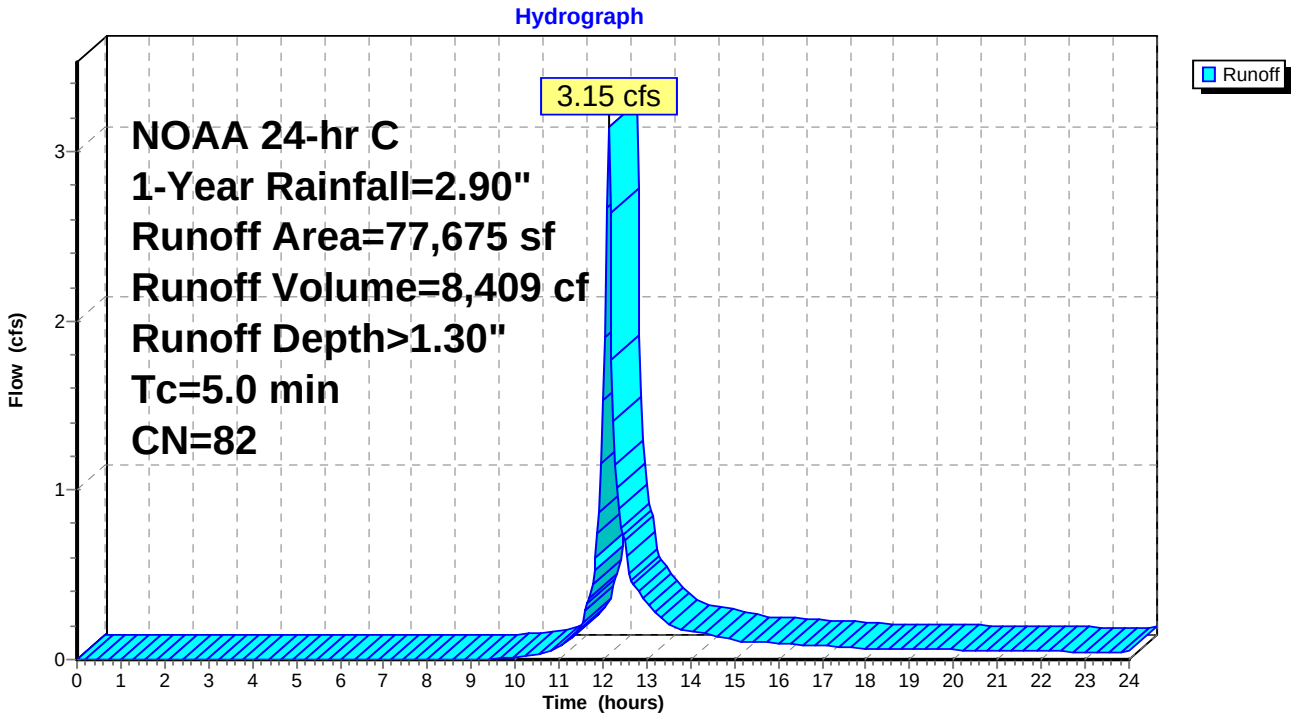
Runoff = 3.15 cfs @ 12.12 hrs, Volume= 8,409 cf, Depth> 1.30"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs
NOAA 24-hr C 1-Year Rainfall=2.90"

Area (sf)	CN	Description
15,863	98	Paved parking, HSG D
61,812	78	Meadow, non-grazed, HSG D
77,675	82	Weighted Average
61,812		79.58% Pervious Area
15,863		20.42% Impervious Area

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

Subcatchment 7S: BERM



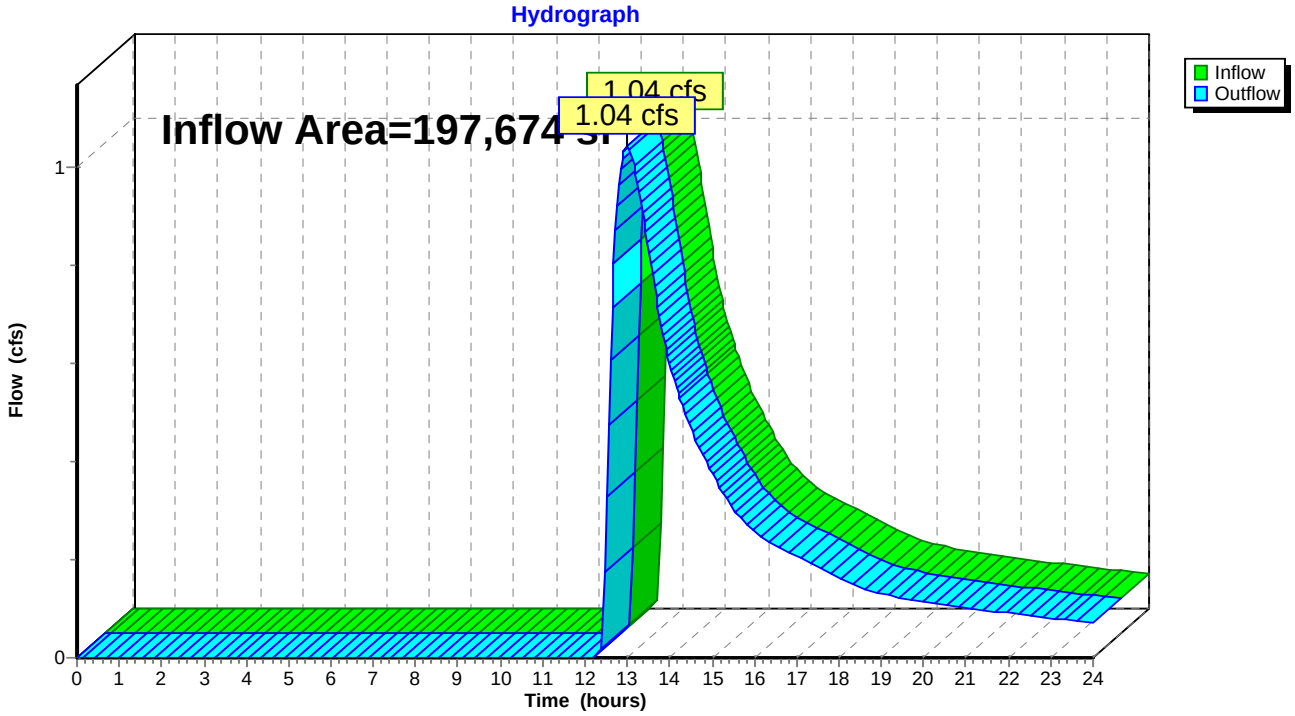
Summary for Reach 7R: Post w BMP

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 197,674 sf, 54.18% Impervious, Inflow Depth > 0.67" for 1-Year event
Inflow = 1.04 cfs @ 12.99 hrs, Volume= 11,100 cf
Outflow = 1.04 cfs @ 12.99 hrs, Volume= 11,100 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs

Reach 7R: Post w BMP



Summary for Pond 4P: BERM

[92] Warning: Device #3 is above defined storage

Inflow Area = 197,674 sf, 54.18% Impervious, Inflow Depth > 1.84" for 1-Year event
Inflow = 8.69 cfs @ 12.14 hrs, Volume= 30,277 cf
Outflow = 1.10 cfs @ 12.99 hrs, Volume= 13,808 cf, Atten= 87%, Lag= 51.4 min
Discarded = 0.06 cfs @ 12.99 hrs, Volume= 2,708 cf
Primary = 1.04 cfs @ 12.99 hrs, Volume= 11,100 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs
Peak Elev= 1,926.73' @ 12.99 hrs Surf.Area= 18,752 sf Storage= 18,125 cf

Plug-Flow detention time= 282.1 min calculated for 13,785 cf (46% of inflow)
Center-of-Mass det. time= 157.3 min (963.0 - 805.7)

Volume	Invert	Avail.Storage	Storage Description
#1	1,925.50'	34,602 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

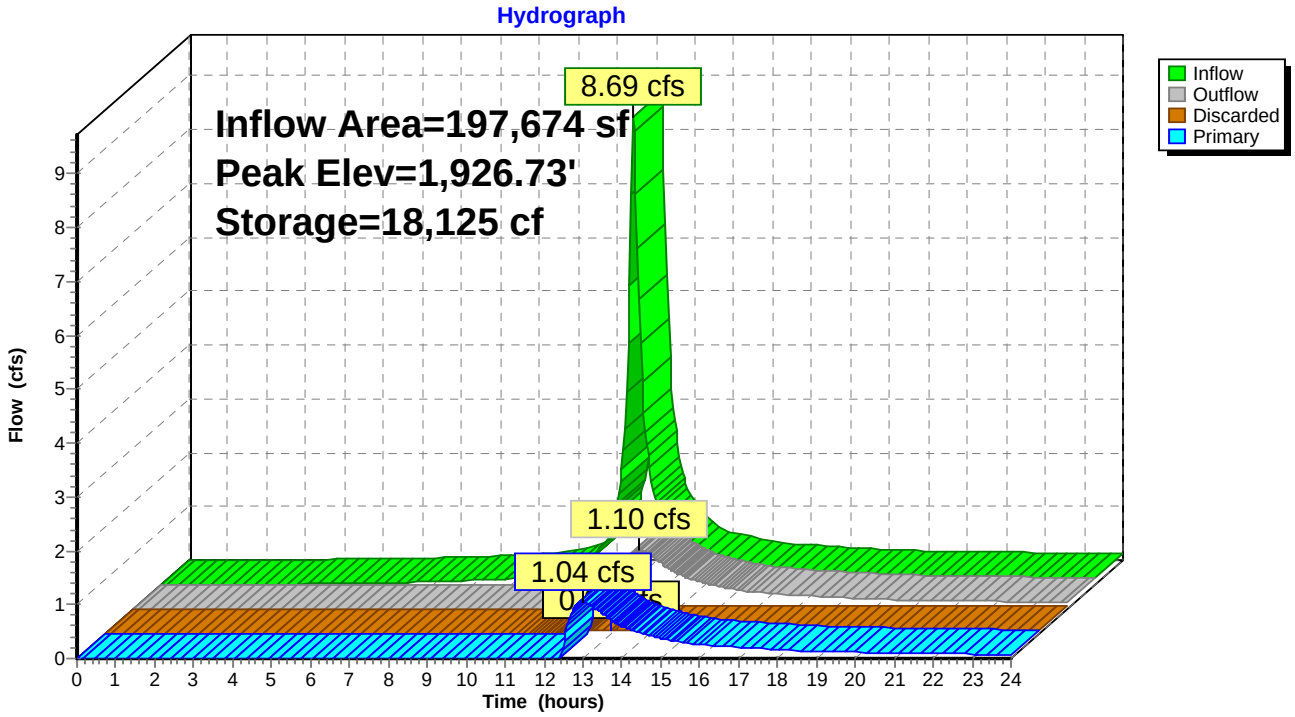
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,925.50	11,085	0	0
1,926.62	17,763	16,155	16,155
1,927.00	21,244	7,411	23,566
1,927.50	22,900	11,036	34,602

Device	Routing	Invert	Outlet Devices
#1	Discarded	1,925.50'	**0.310 in/hr Exfiltration over Surface area from 1,925.50' - 1,926.62'** Conductivity to Groundwater Elevation = 1,923.50' Excluded Surface area = 11,085 sf
#2	Primary	1,926.62'	**12.0' long x 8.3' breadth Spillway** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.44 2.54 2.70 2.69 2.68 2.68 2.66 2.64 2.64 2.64 2.65 2.65 2.65 2.66 2.67 2.69 2.72
#3	Primary	1,927.50'	**420.0' long x 3.0' breadth Top of Berm** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32

Discarded OutFlow Max=0.06 cfs @ 12.99 hrs HW=1,926.73' (Free Discharge)
└**1=Exfiltration** (Controls 0.06 cfs)

Primary OutFlow Max=1.04 cfs @ 12.99 hrs HW=1,926.73' (Free Discharge)
├**2=Spillway** (Weir Controls 1.04 cfs @ 0.80 fps)
└**3=Top of Berm** (Controls 0.00 cfs)

Pond 4P: BERM


Hydrograph
Inflow Area=197,674 sf
Peak Elev=1,926.73'
Storage=18,125 cf
8.69 cfs
1.10 cfs
1.04 cfs
Inflow
Outflow
Discarded
Primary
Flow (cfs)
Time (hours)
0 1 2 3 4 5 6 7 8 9
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24

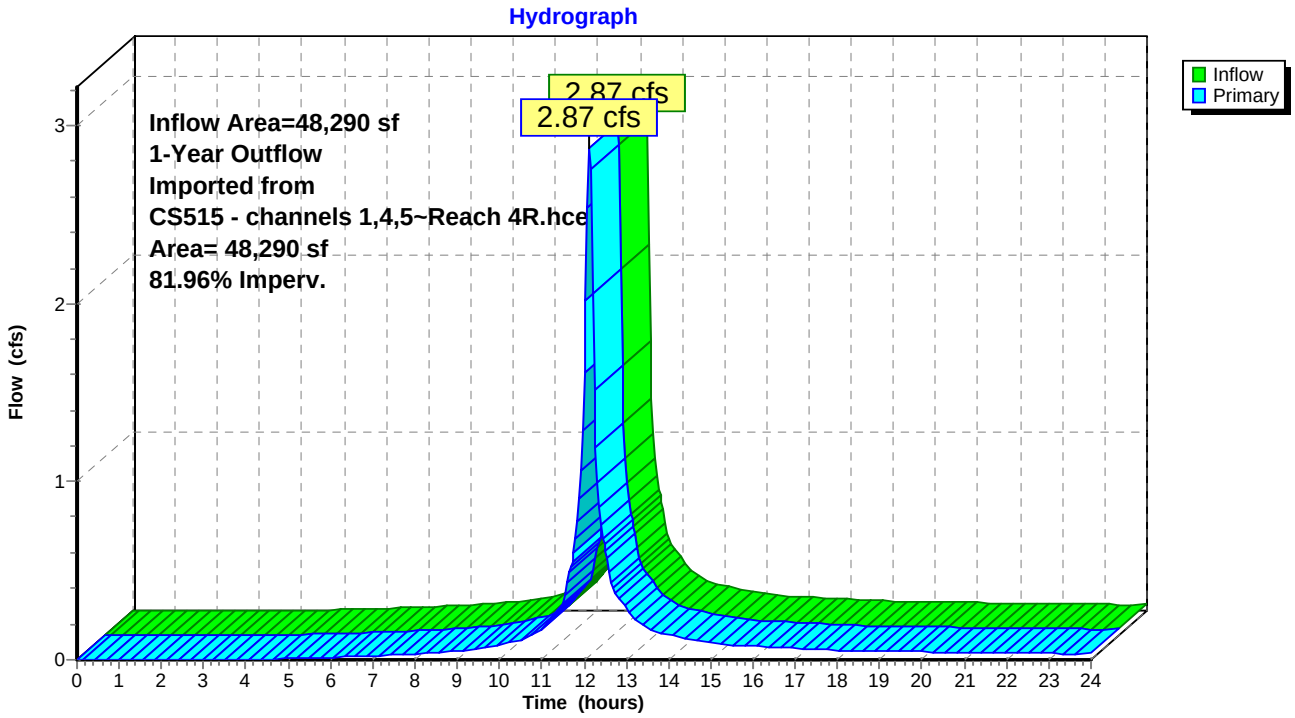
Summary for Link 15L: C-1

Inflow Area = 48,290 sf, 81.96% Impervious, Inflow Depth > 2.25" for 1-Year event
Inflow = 2.87 cfs @ 12.13 hrs, Volume= 9,048 cf
Primary = 2.87 cfs @ 12.13 hrs, Volume= 9,048 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs

1-Year Outflow Imported from CS515 - channels 1,4,5~Reach 4R.hce

Link 15L: C-1



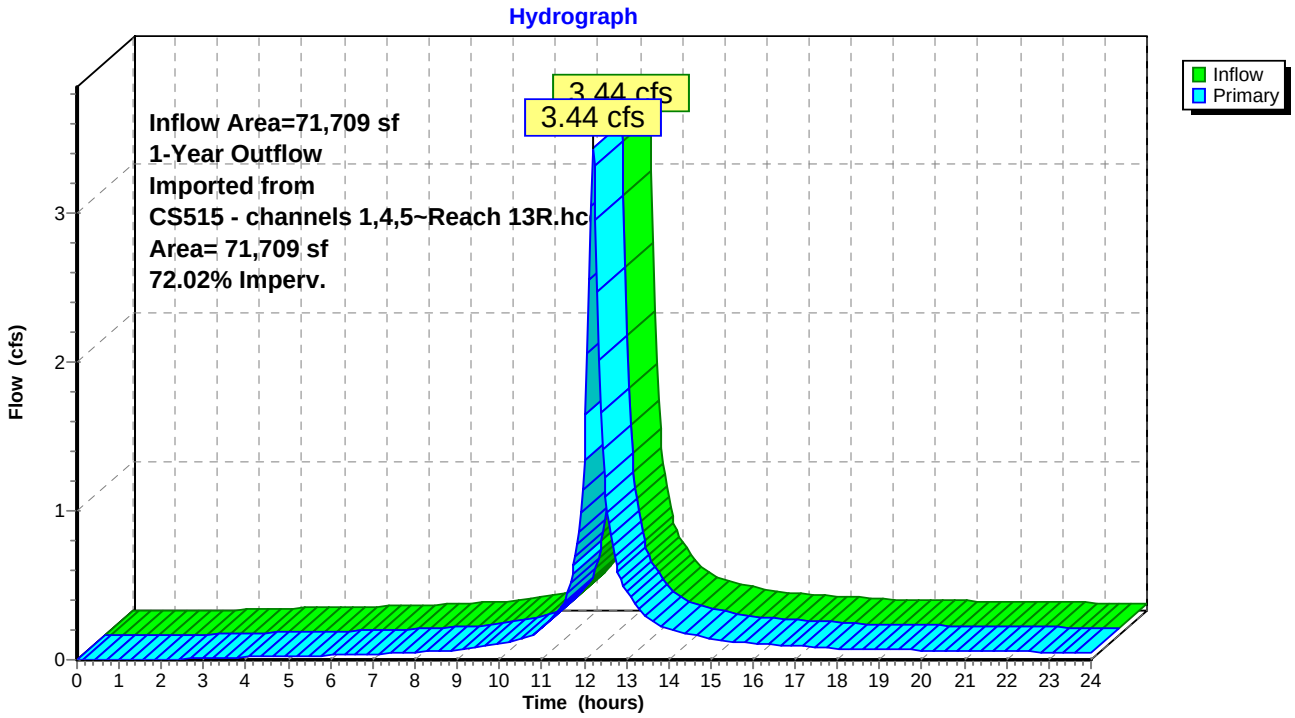
Summary for Link 16L: C-5

Inflow Area = 71,709 sf, 72.02% Impervious, Inflow Depth > 2.15" for 1-Year event
Inflow = 3.44 cfs @ 12.21 hrs, Volume= 12,820 cf
Primary = 3.44 cfs @ 12.21 hrs, Volume= 12,820 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs

1-Year Outflow Imported from CS515 - channels 1,4,5~Reach 13R.hce

Link 16L: C-5



Time span=0.00-24.00 hrs, dt=0.04 hrs, 601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: CS515-pre Runoff Area=197,689 sf 6.34% Impervious Runoff Depth>1.48"
Flow Length=458' Tc=16.5 min CN=79 Runoff=6.19 cfs 24,410 cf

Subcatchment 2S: CS515-post Runoff Area=197,689 sf 54.17% Impervious Runoff Depth>2.26"
Flow Length=458' Tc=2.6 min CN=89 Runoff=14.31 cfs 37,299 cf

Subcatchment 7S: BERM Runoff Area=77,675 sf 20.42% Impervious Runoff Depth>1.70"
Tc=5.0 min CN=82 Runoff=4.12 cfs 10,993 cf

Reach 7R: Post w BMP Inflow=2.55 cfs 18,257 cf
Outflow=2.55 cfs 18,257 cf

Pond 4P: BERM Peak Elev=1,926.82' Storage=19,820 cf Inflow=10.89 cfs 37,577 cf
Discarded=0.06 cfs 2,778 cf Primary=2.55 cfs 18,257 cf Outflow=2.61 cfs 21,035 cf

Link 15L: C-1 2-Year Outflow Imported from CS515 - channels 1,4,5~Reach 4R.hce Inflow=3.46 cfs 10,995 cf
Area= 48,290 sf 81.96% Imperv. Primary=3.46 cfs 10,995 cf

Link 16L: C-5 2-Year Outflow Imported from CS515 - channels 1,4,5~Reach 13R.hce Inflow=4.21 cfs 15,589 cf
Area= 71,709 sf 72.02% Imperv. Primary=4.21 cfs 15,589 cf

Total Runoff Area = 473,053 sf Runoff Volume = 72,702 cf Average Runoff Depth = 1.84"
71.36% Pervious = 337,565 sf 28.64% Impervious = 135,488 sf

Summary for Subcatchment 1S: CS515-pre

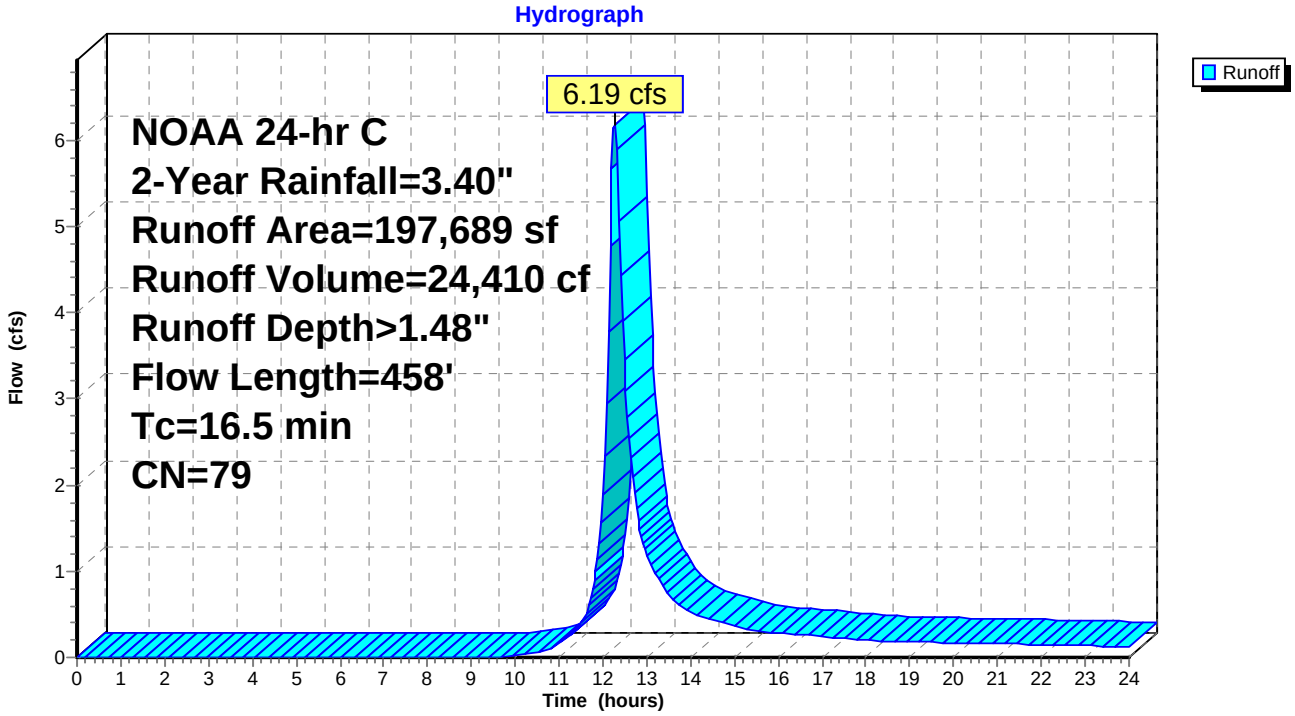
Runoff = 6.19 cfs @ 12.26 hrs, Volume= 24,410 cf, Depth> 1.48"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs
NOAA 24-hr C 2-Year Rainfall=3.40"

	Area (sf)	CN	Description
	182,016	78	Meadow, non-grazed, HSG D
*	3,135	78	Meadow, (20% existing impervious)
	12,538	98	Paved roads w/curbs & sewers, HSG D
	197,689	79	Weighted Average
	185,151		93.66% Pervious Area
	12,538		6.34% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.5	100	0.0100	0.13		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 3.40"
4.0	358	0.0446	1.48		**Shallow Concentrated Flow, shallow concentrated** Short Grass Pasture Kv= 7.0 fps
16.5	458	Total			

Subcatchment 1S: CS515-pre



Summary for Subcatchment 2S: CS515-post

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

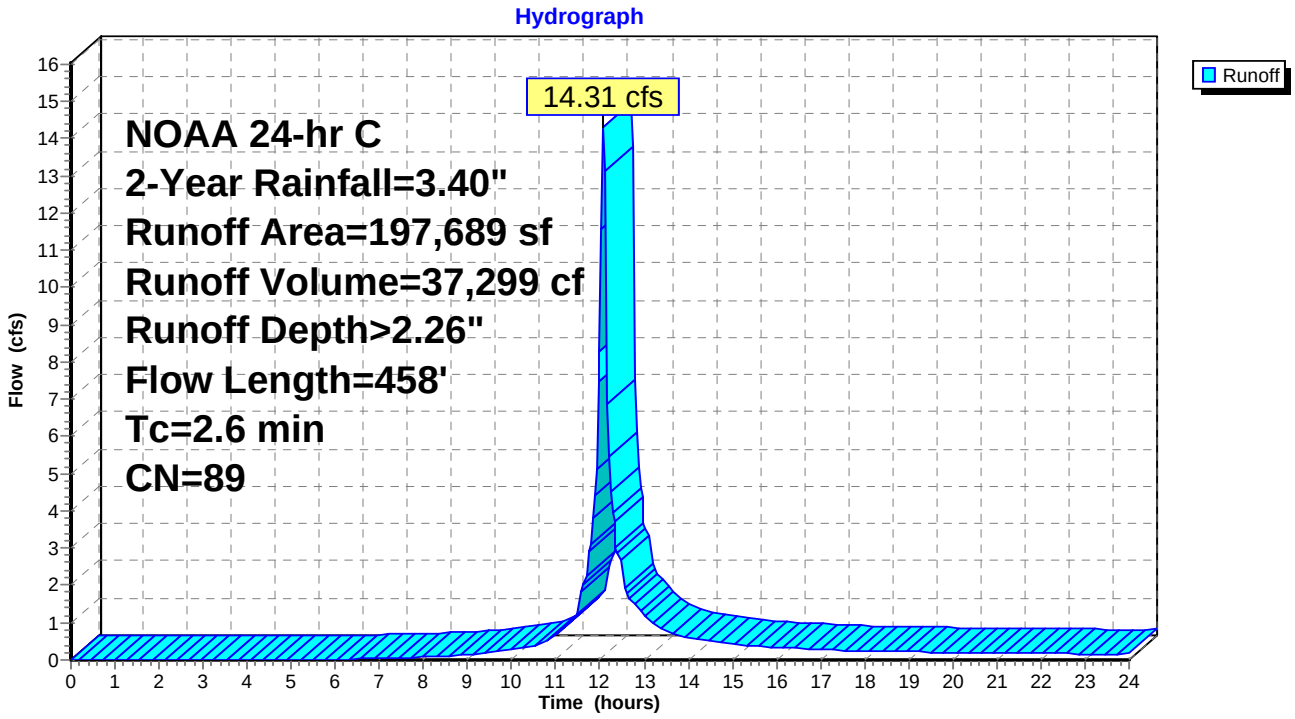
Runoff = 14.31 cfs @ 12.09 hrs, Volume= 37,299 cf, Depth> 2.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs
NOAA 24-hr C 2-Year Rainfall=3.40"

Area (sf)	CN	Description
107,087	98	Paved parking, HSG D
90,602	78	Meadow, non-grazed, HSG D
197,689	89	Weighted Average
90,602		45.83% Pervious Area
107,087		54.17% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	100	0.0200	1.42		**Sheet Flow, sheet flow** Smooth surfaces n= 0.011 P2= 3.40"
1.4	358	0.0446	4.29		**Shallow Concentrated Flow, shallow concentrated** Paved Kv= 20.3 fps
2.6	458	Total			

Subcatchment 2S: CS515-post



Summary for Subcatchment 7S: BERM

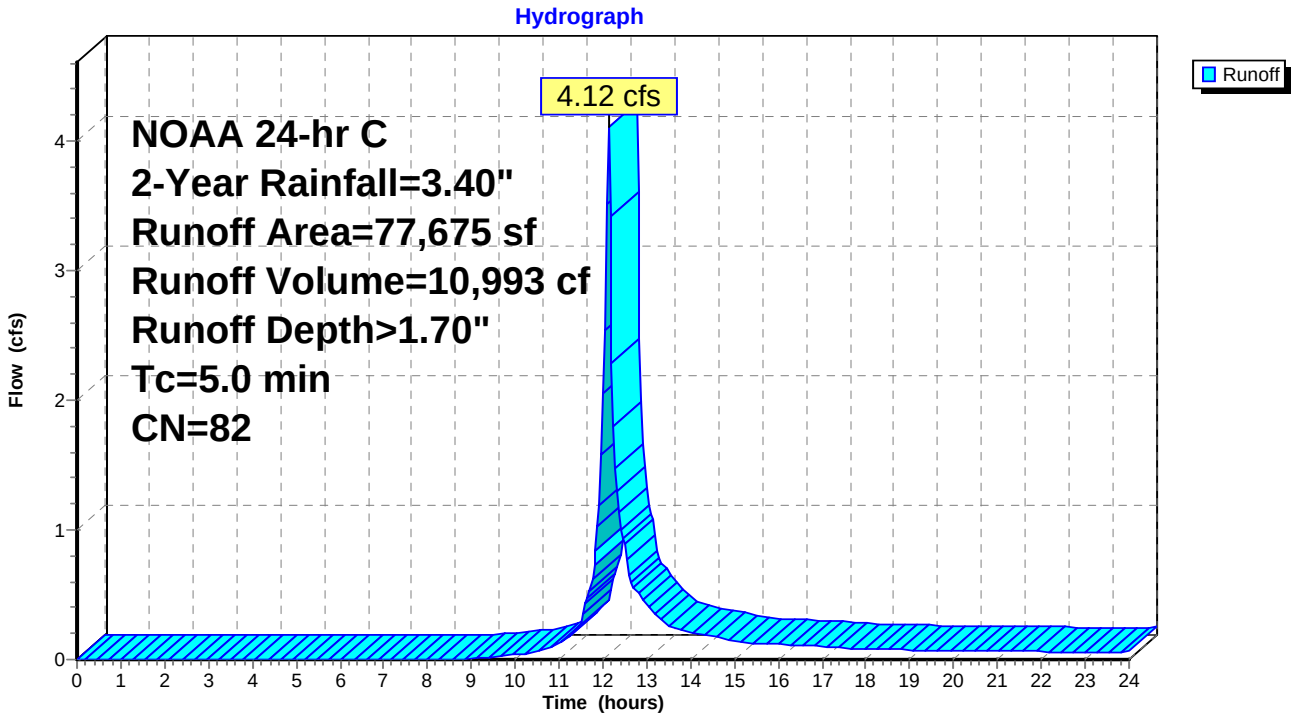
Runoff = 4.12 cfs @ 12.12 hrs, Volume= 10,993 cf, Depth> 1.70"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs
NOAA 24-hr C 2-Year Rainfall=3.40"

Area (sf)	CN	Description
15,863	98	Paved parking, HSG D
61,812	78	Meadow, non-grazed, HSG D
77,675	82	Weighted Average
61,812		79.58% Pervious Area
15,863		20.42% Impervious Area

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

Subcatchment 7S: BERM



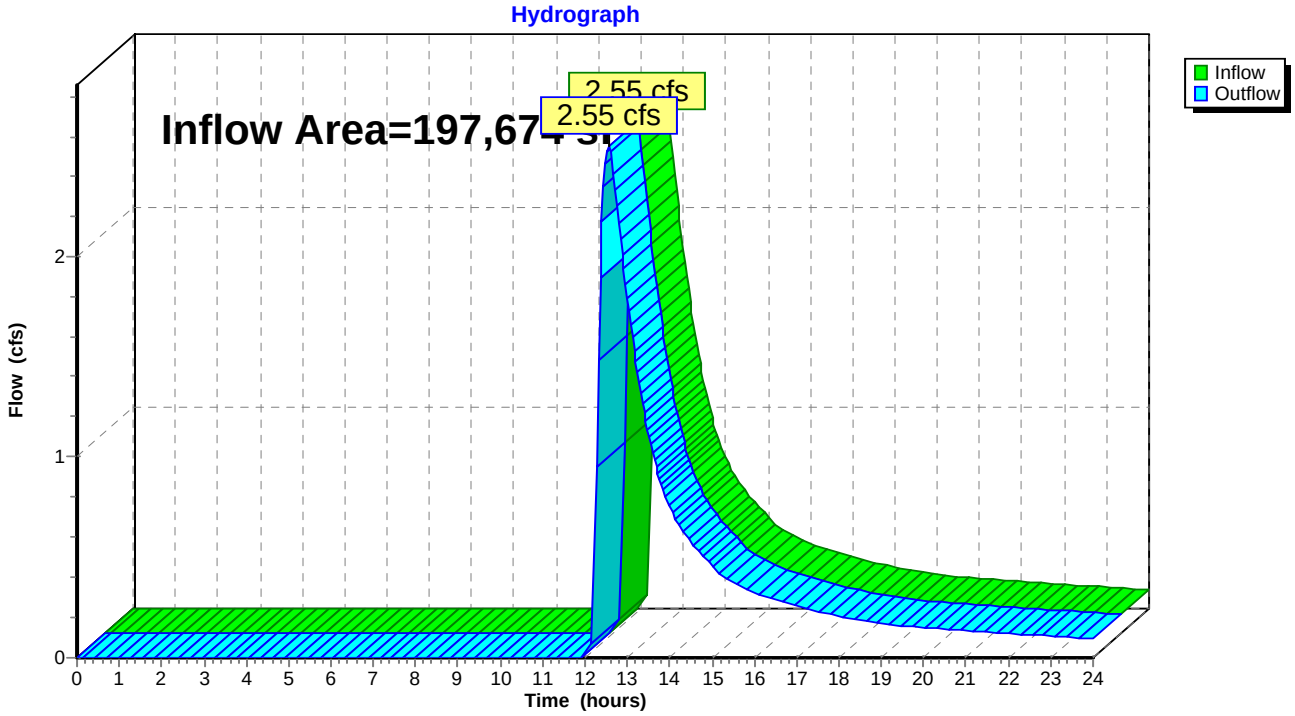
Summary for Reach 7R: Post w BMP

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 197,674 sf, 54.18% Impervious, Inflow Depth > 1.11" for 2-Year event
Inflow = 2.55 cfs @ 12.56 hrs, Volume= 18,257 cf
Outflow = 2.55 cfs @ 12.56 hrs, Volume= 18,257 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs

Reach 7R: Post w BMP



Summary for Pond 4P: BERM

[92] Warning: Device #3 is above defined storage

Inflow Area = 197,674 sf, 54.18% Impervious, Inflow Depth > 2.28" for 2-Year event
Inflow = 10.89 cfs @ 12.13 hrs, Volume= 37,577 cf
Outflow = 2.61 cfs @ 12.56 hrs, Volume= 21,035 cf, Atten= 76%, Lag= 25.6 min
Discarded = 0.06 cfs @ 12.56 hrs, Volume= 2,778 cf
Primary = 2.55 cfs @ 12.56 hrs, Volume= 18,257 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs
Peak Elev= 1,926.82' @ 12.56 hrs Surf.Area= 19,562 sf Storage= 19,820 cf

Plug-Flow detention time= 231.0 min calculated for 21,000 cf (56% of inflow)
Center-of-Mass det. time= 118.4 min (919.3 - 800.9)

Volume	Invert	Avail.Storage	Storage Description
#1	1,925.50'	34,602 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

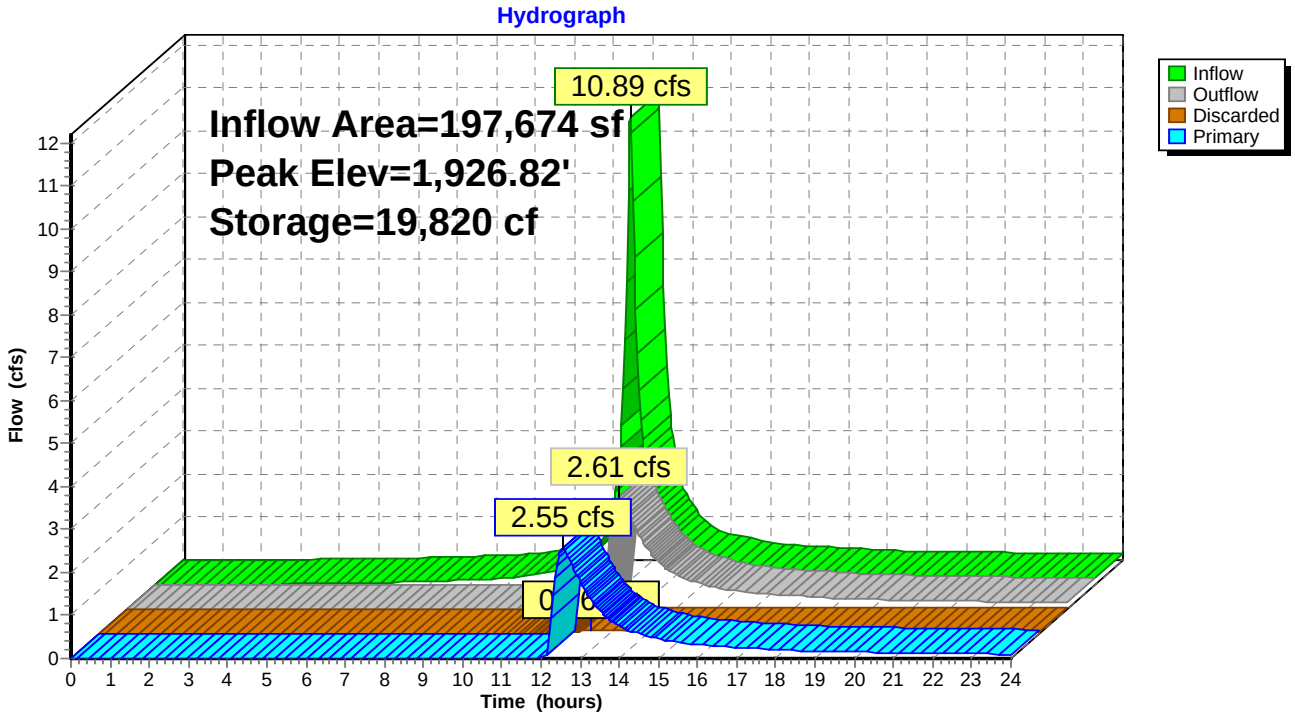
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,925.50	11,085	0	0
1,926.62	17,763	16,155	16,155
1,927.00	21,244	7,411	23,566
1,927.50	22,900	11,036	34,602

Device	Routing	Invert	Outlet Devices
#1	Discarded	1,925.50'	**0.310 in/hr Exfiltration over Surface area from 1,925.50' - 1,926.62'** Conductivity to Groundwater Elevation = 1,923.50' Excluded Surface area = 11,085 sf
#2	Primary	1,926.62'	**12.0' long x 8.3' breadth Spillway** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.44 2.54 2.70 2.69 2.68 2.68 2.66 2.64 2.64 2.64 2.65 2.65 2.65 2.66 2.67 2.69 2.72
#3	Primary	1,927.50'	**420.0' long x 3.0' breadth Top of Berm** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32

Discarded OutFlow Max=0.06 cfs @ 12.56 hrs HW=1,926.82' (Free Discharge)
└**1=Exfiltration** (Controls 0.06 cfs)

Primary OutFlow Max=2.55 cfs @ 12.56 hrs HW=1,926.82' (Free Discharge)
├**2=Spillway** (Weir Controls 2.55 cfs @ 1.08 fps)
└**3=Top of Berm** (Controls 0.00 cfs)

Pond 4P: BERM


Hydrograph
Inflow Area=197,674 sf
Peak Elev=1,926.82'
Storage=19,820 cf
10.89 cfs
2.61 cfs
2.55 cfs
Inflow
Outflow
Discarded
Primary
Flow (cfs)
Time (hours)
0 1 2 3 4 5 6 7 8 9 10 11 12
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24

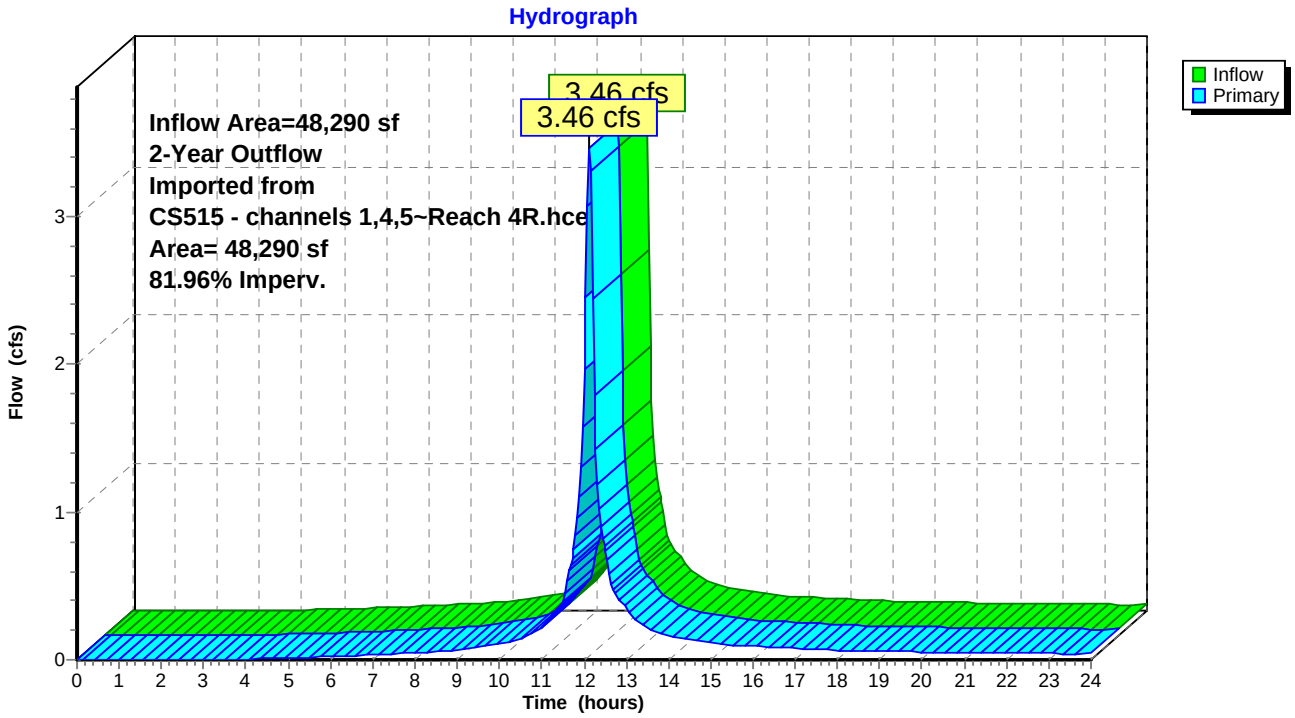
Summary for Link 15L: C-1

Inflow Area = 48,290 sf, 81.96% Impervious, Inflow Depth > 2.73" for 2-Year event
Inflow = 3.46 cfs @ 12.13 hrs, Volume= 10,995 cf
Primary = 3.46 cfs @ 12.13 hrs, Volume= 10,995 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs

2-Year Outflow Imported from CS515 - channels 1,4,5~Reach 4R.hce

Link 15L: C-1



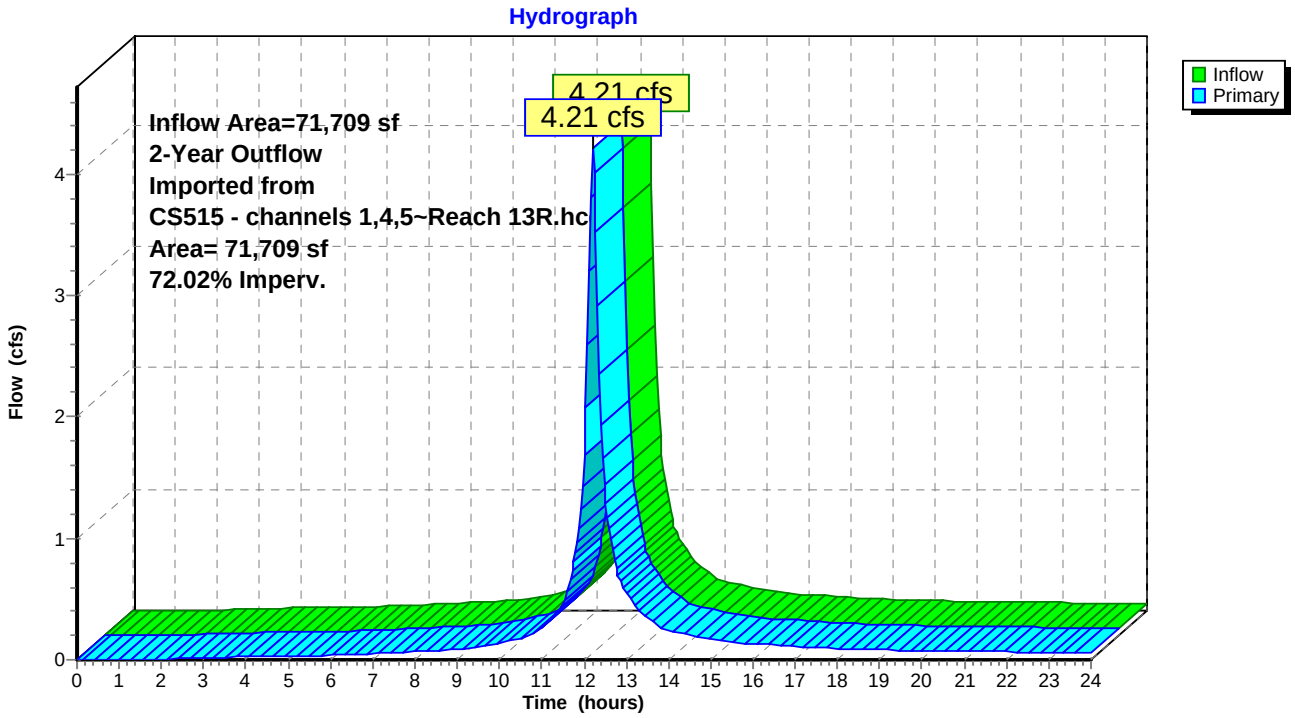
Summary for Link 16L: C-5

Inflow Area = 71,709 sf, 72.02% Impervious, Inflow Depth > 2.61" for 2-Year event
Inflow = 4.21 cfs @ 12.21 hrs, Volume= 15,589 cf
Primary = 4.21 cfs @ 12.21 hrs, Volume= 15,589 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs

2-Year Outflow Imported from CS515 - channels 1,4,5~Reach 13R.hce

Link 16L: C-5



Time span=0.00-24.00 hrs, dt=0.04 hrs, 601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: CS515-pre Runoff Area=197,689 sf 6.34% Impervious Runoff Depth>2.79"
Flow Length=458' Tc=16.5 min CN=79 Runoff=11.74 cfs 45,965 cf

Subcatchment 2S: CS515-post Runoff Area=197,689 sf 54.17% Impervious Runoff Depth>3.77"
Flow Length=458' Tc=2.6 min CN=89 Runoff=23.16 cfs 62,118 cf

Subcatchment 7S: BERM Runoff Area=77,675 sf 20.42% Impervious Runoff Depth>3.08"
Tc=5.0 min CN=82 Runoff=7.35 cfs 19,910 cf

Reach 7R: Post w BMP Inflow=10.18 cfs 42,141 cf
Outflow=10.18 cfs 42,141 cf

Pond 4P: BERM Peak Elev=1,927.09' Storage=25,580 cf Inflow=18.13 cfs 61,879 cf
Discarded=0.07 cfs 2,998 cf Primary=10.18 cfs 42,141 cf Outflow=10.25 cfs 45,139 cf

Link 15L: C-1 10-Year Outflow Imported from CS515 - channels 1,4,5~Reach 4R.hce Inflow=5.30 cfs 17,300 cf
Area= 48,290 sf 81.96% Imperv. Primary=5.30 cfs 17,300 cf

Link 16L: 10-Year Outflow Imported from CS515 - channels 1,4,5~Reach 13R.hce Inflow=6.72 cfs 24,669 cf
Area= 71,709 sf 72.02% Imperv. Primary=6.72 cfs 24,669 cf

Total Runoff Area = 473,053 sf Runoff Volume = 127,993 cf Average Runoff Depth = 3.25"
71.36% Pervious = 337,565 sf 28.64% Impervious = 135,488 sf

Summary for Subcatchment 1S: CS515-pre

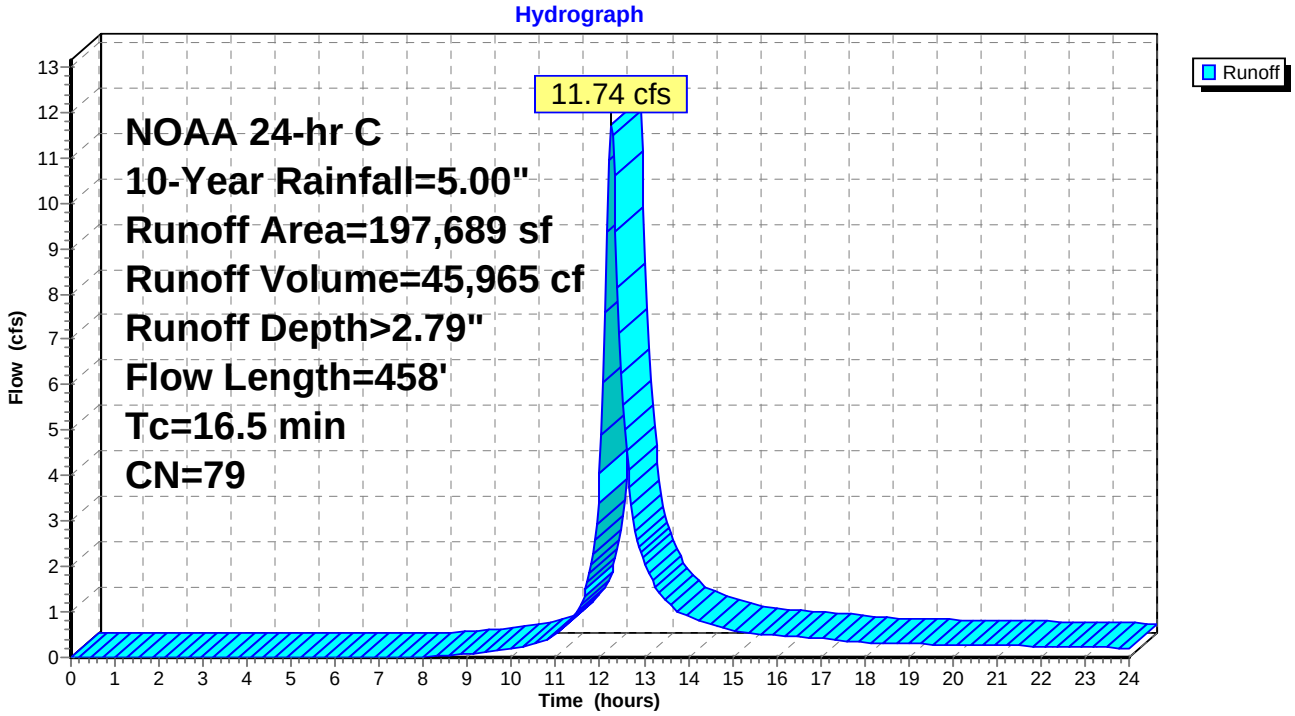
Runoff = 11.74 cfs @ 12.25 hrs, Volume= 45,965 cf, Depth> 2.79"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs
NOAA 24-hr C 10-Year Rainfall=5.00"

	Area (sf)	CN	Description
	182,016	78	Meadow, non-grazed, HSG D
*	3,135	78	Meadow, (20% existing impervious)
	12,538	98	Paved roads w/curbs & sewers, HSG D
	197,689	79	Weighted Average
	185,151		93.66% Pervious Area
	12,538		6.34% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.5	100	0.0100	0.13		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 3.40"
4.0	358	0.0446	1.48		**Shallow Concentrated Flow, shallow concentrated** Short Grass Pasture Kv= 7.0 fps
16.5	458	Total			

Subcatchment 1S: CS515-pre



Summary for Subcatchment 2S: CS515-post

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

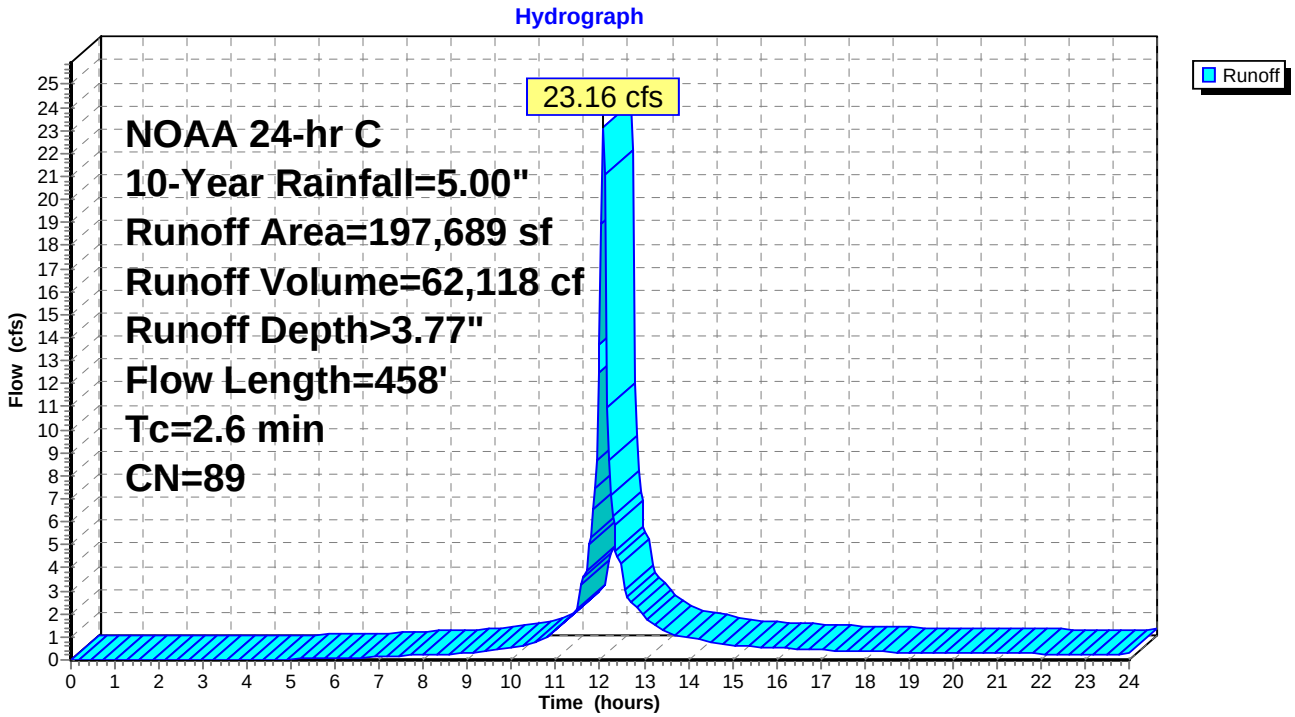
Runoff = 23.16 cfs @ 12.09 hrs, Volume= 62,118 cf, Depth> 3.77"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs
NOAA 24-hr C 10-Year Rainfall=5.00"

Area (sf)	CN	Description
107,087	98	Paved parking, HSG D
90,602	78	Meadow, non-grazed, HSG D
197,689	89	Weighted Average
90,602		45.83% Pervious Area
107,087		54.17% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	100	0.0200	1.42		**Sheet Flow, sheet flow** Smooth surfaces n= 0.011 P2= 3.40"
1.4	358	0.0446	4.29		**Shallow Concentrated Flow, shallow concentrated** Paved Kv= 20.3 fps
2.6	458	Total			

Subcatchment 2S: CS515-post



Summary for Subcatchment 7S: BERM

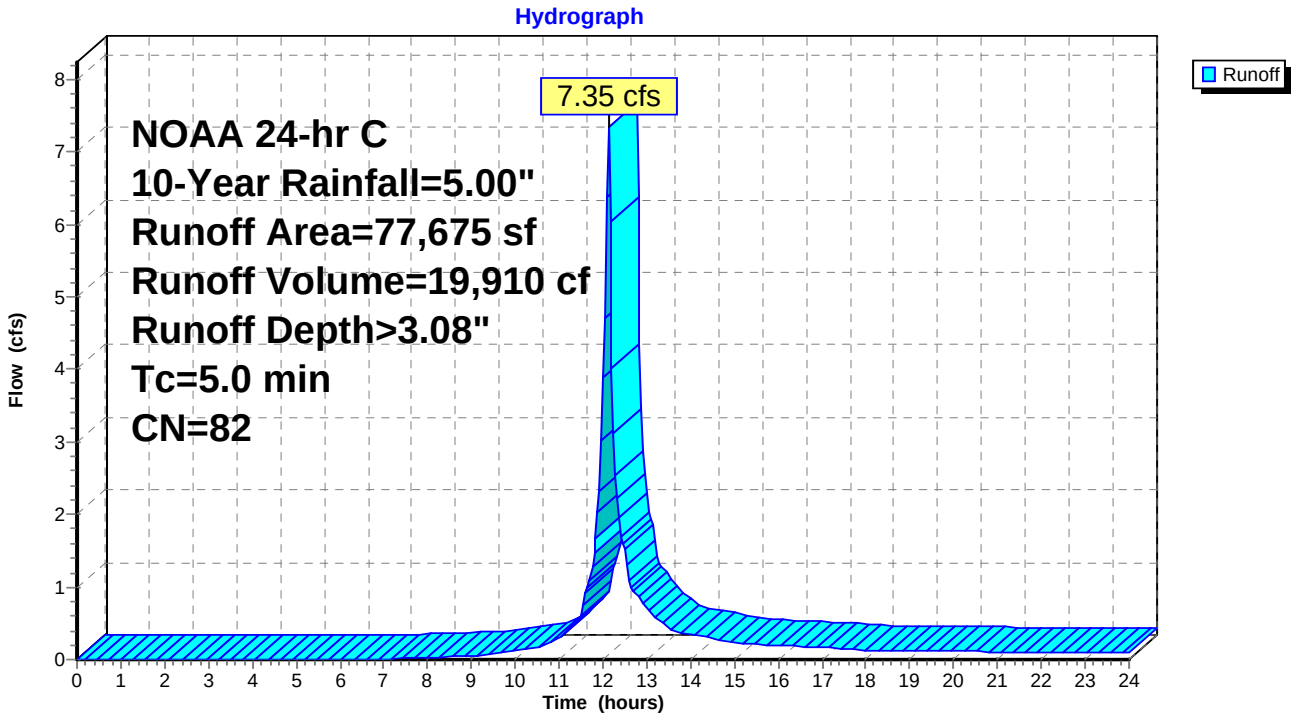
Runoff = 7.35 cfs @ 12.12 hrs, Volume= 19,910 cf, Depth> 3.08"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs
NOAA 24-hr C 10-Year Rainfall=5.00"

Area (sf)	CN	Description
15,863	98	Paved parking, HSG D
61,812	78	Meadow, non-grazed, HSG D
77,675	82	Weighted Average
61,812		79.58% Pervious Area
15,863		20.42% Impervious Area

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

Subcatchment 7S: BERM



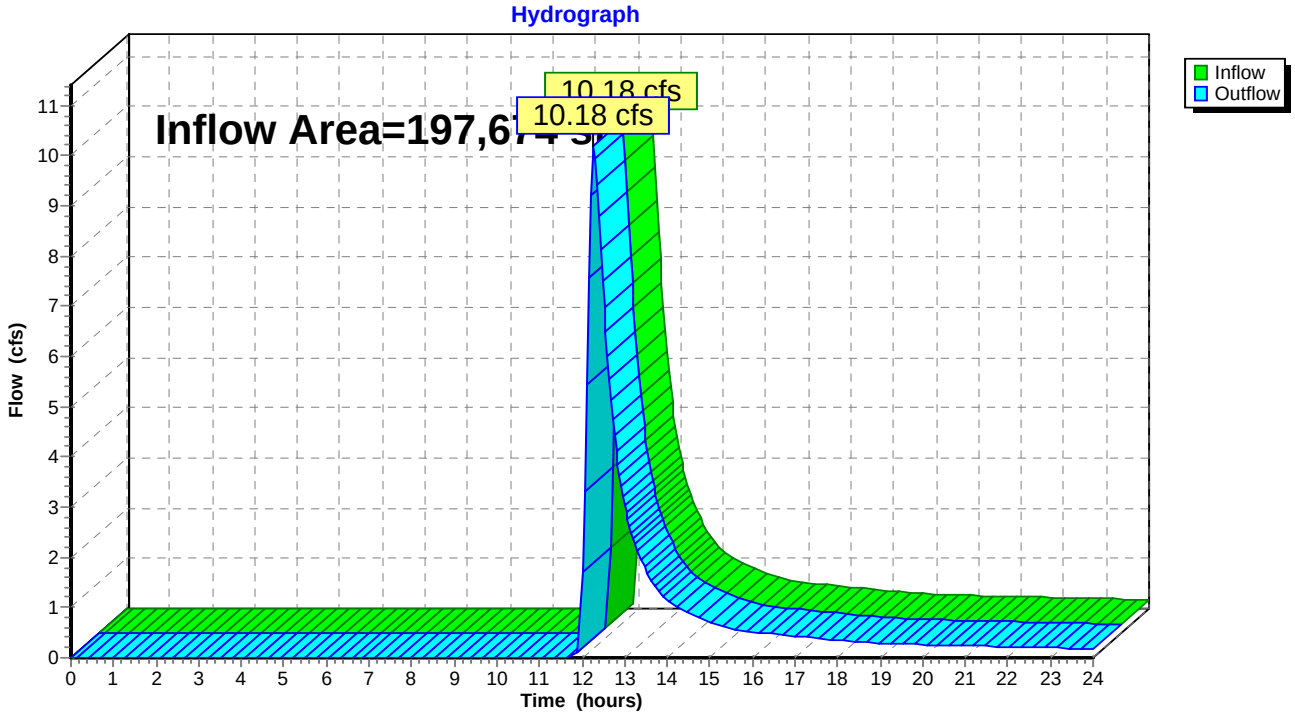
Summary for Reach 7R: Post w BMP

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 197,674 sf, 54.18% Impervious, Inflow Depth > 2.56" for 10-Year event
Inflow = 10.18 cfs @ 12.28 hrs, Volume= 42,141 cf
Outflow = 10.18 cfs @ 12.28 hrs, Volume= 42,141 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs

Reach 7R: Post w BMP



Summary for Pond 4P: BERM

[92] Warning: Device #3 is above defined storage

Inflow Area = 197,674 sf, 54.18% Impervious, Inflow Depth > 3.76" for 10-Year event
Inflow = 18.13 cfs @ 12.13 hrs, Volume= 61,879 cf
Outflow = 10.25 cfs @ 12.28 hrs, Volume= 45,139 cf, Atten= 43%, Lag= 8.7 min
Discarded = 0.07 cfs @ 12.28 hrs, Volume= 2,998 cf
Primary = 10.18 cfs @ 12.28 hrs, Volume= 42,141 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs
Peak Elev= 1,927.09' @ 12.28 hrs Surf.Area= 21,556 sf Storage= 25,580 cf

Plug-Flow detention time= 168.6 min calculated for 45,063 cf (73% of inflow)
Center-of-Mass det. time= 77.4 min (867.1 - 789.7)

Volume	Invert	Avail.Storage	Storage Description
#1	1,925.50'	34,602 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

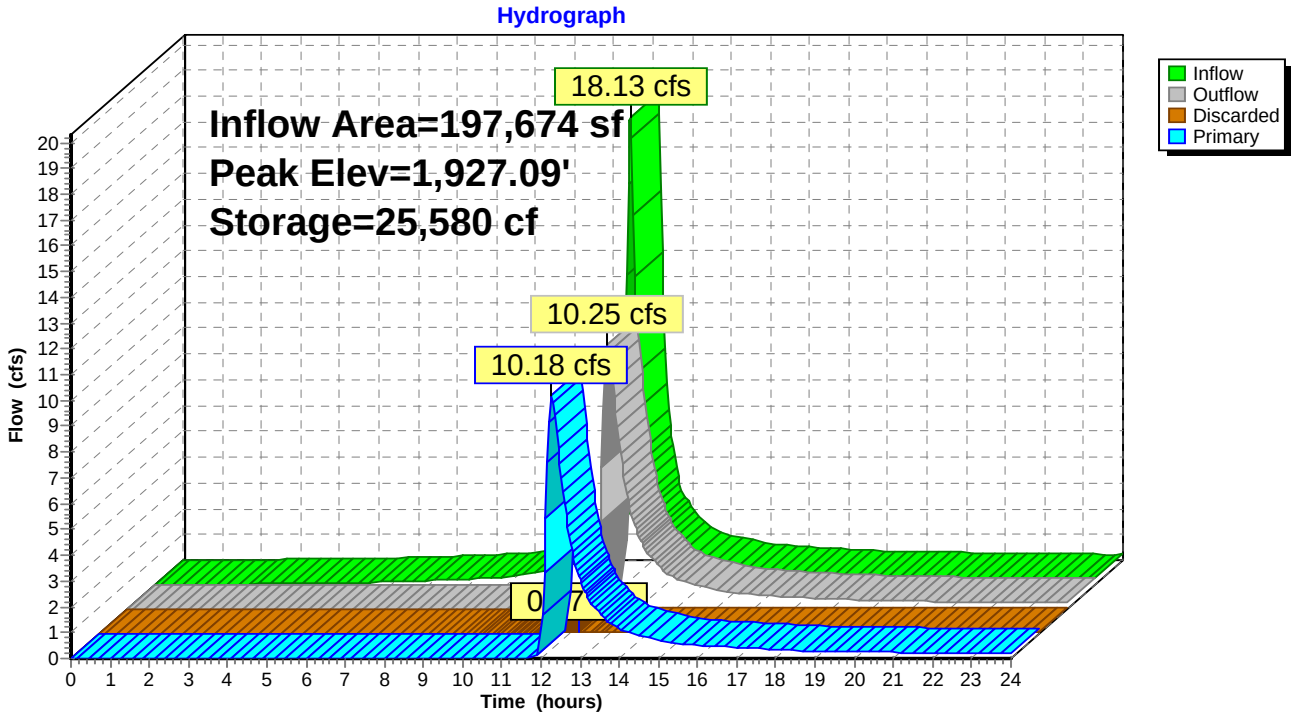
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,925.50	11,085	0	0
1,926.62	17,763	16,155	16,155
1,927.00	21,244	7,411	23,566
1,927.50	22,900	11,036	34,602

Device	Routing	Invert	Outlet Devices
#1	Discarded	1,925.50'	**0.310 in/hr Exfiltration over Surface area from 1,925.50' - 1,926.62'** Conductivity to Groundwater Elevation = 1,923.50' Excluded Surface area = 11,085 sf
#2	Primary	1,926.62'	**12.0' long x 8.3' breadth Spillway** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.44 2.54 2.70 2.69 2.68 2.68 2.66 2.64 2.64 2.64 2.65 2.65 2.65 2.66 2.67 2.69 2.72
#3	Primary	1,927.50'	**420.0' long x 3.0' breadth Top of Berm** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32

Discarded OutFlow Max=0.07 cfs @ 12.28 hrs HW=1,927.09' (Free Discharge)
└**1=Exfiltration** (Controls 0.07 cfs)

Primary OutFlow Max=10.17 cfs @ 12.28 hrs HW=1,927.09' (Free Discharge)
├**2=Spillway** (Weir Controls 10.17 cfs @ 1.79 fps)
└**3=Top of Berm** (Controls 0.00 cfs)

Pond 4P: BERM


Hydrograph
18.13 cfs
Inflow Area=197,674 sf
Peak Elev=1,927.09'
Storage=25,580 cf
10.25 cfs
10.18 cfs
Inflow
Outflow
Discarded
Primary
Flow (cfs)
Time (hours)

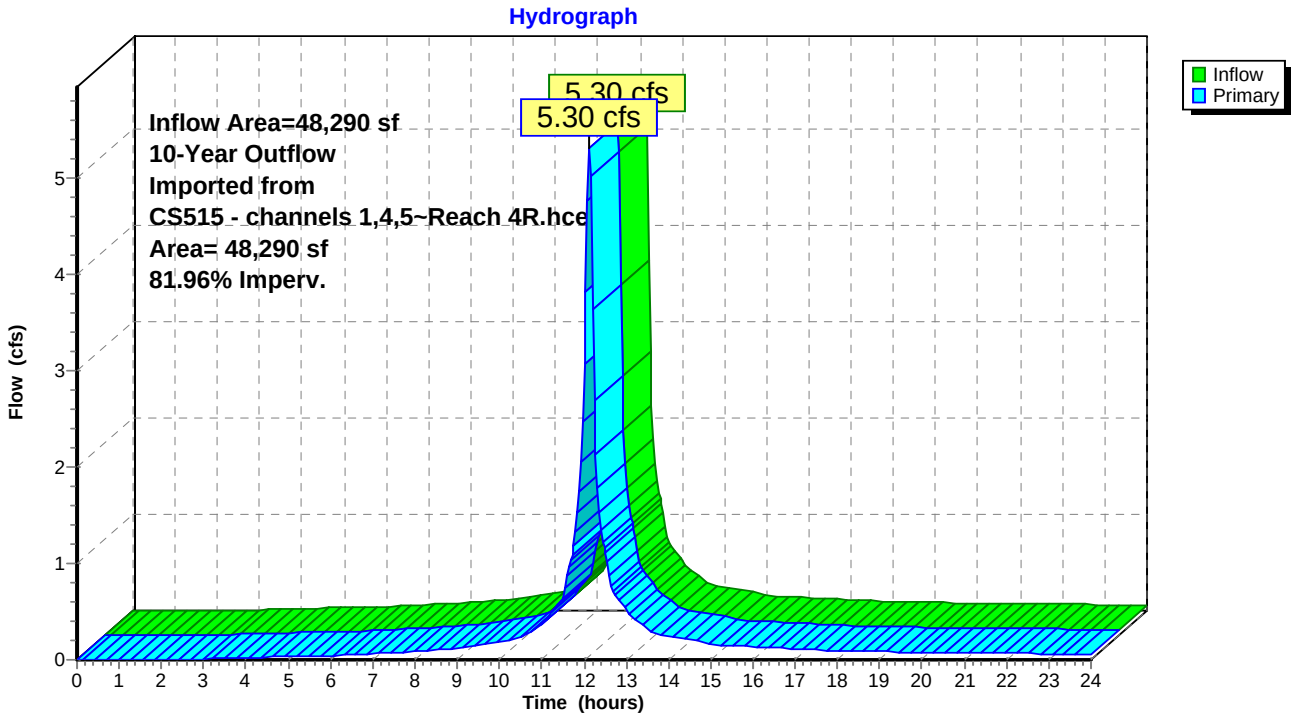
Summary for Link 15L: C-1

Inflow Area = 48,290 sf, 81.96% Impervious, Inflow Depth > 4.30" for 10-Year event
Inflow = 5.30 cfs @ 12.13 hrs, Volume= 17,300 cf
Primary = 5.30 cfs @ 12.13 hrs, Volume= 17,300 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs

10-Year Outflow Imported from CS515 - channels 1,4,5~Reach 4R.hce

Link 15L: C-1



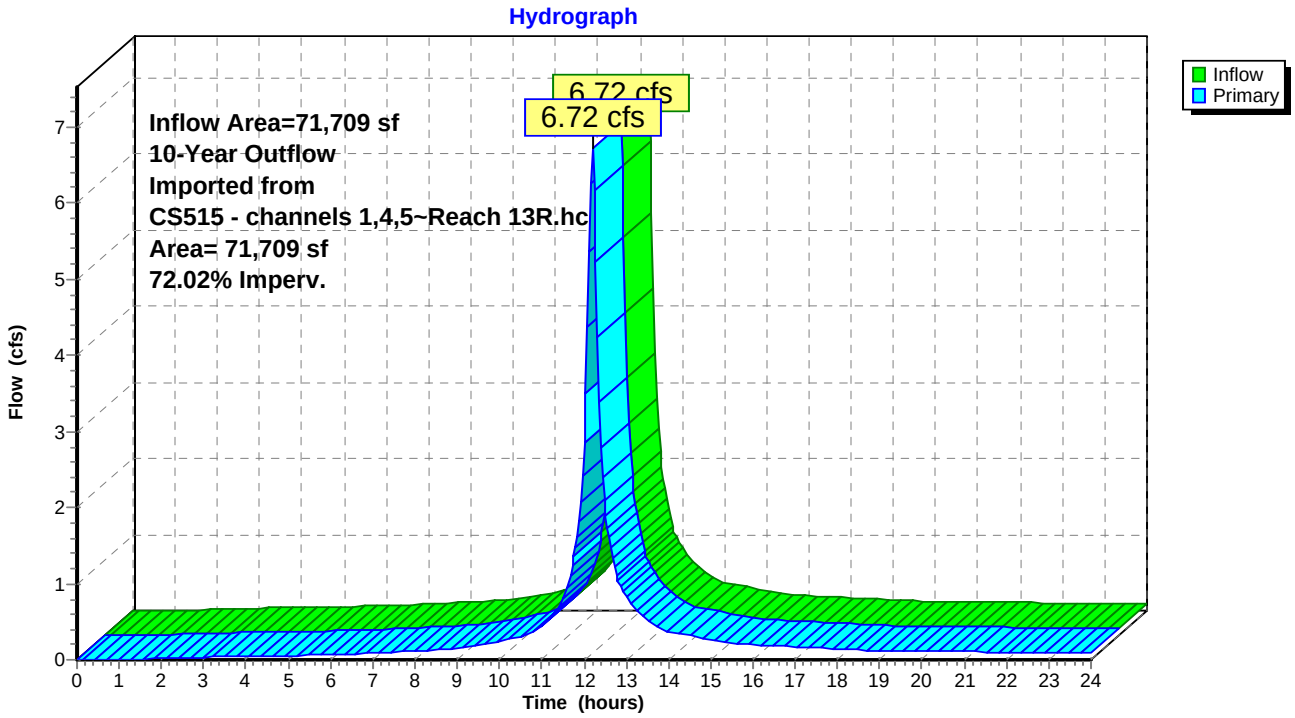
Summary for Link 16L: C-5

Inflow Area = 71,709 sf, 72.02% Impervious, Inflow Depth > 4.13" for 10-Year event
Inflow = 6.72 cfs @ 12.20 hrs, Volume= 24,669 cf
Primary = 6.72 cfs @ 12.20 hrs, Volume= 24,669 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs

10-Year Outflow Imported from CS515 - channels 1,4,5~Reach 13R.hce

Link 16L: C-5



Time span=0.00-24.00 hrs, dt=0.04 hrs, 601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: CS515-pre Runoff Area=197,689 sf 6.34% Impervious Runoff Depth>3.84"
Flow Length=458' Tc=16.5 min CN=79 Runoff=16.10 cfs 63,324 cf

Subcatchment 2S: CS515-post Runoff Area=197,689 sf 54.17% Impervious Runoff Depth>4.93"
Flow Length=458' Tc=2.6 min CN=89 Runoff=29.76 cfs 81,180 cf

Subcatchment 7S: BERM Runoff Area=77,675 sf 20.42% Impervious Runoff Depth>4.17"
Tc=5.0 min CN=82 Runoff=9.83 cfs 26,975 cf

Reach 7R: Post w BMP Inflow=15.89 cfs 60,603 cf
Outflow=15.89 cfs 60,603 cf

Pond 4P: BERM Peak Elev=1,927.24' Storage=28,804 cf Inflow=23.66 cfs 80,646 cf
Discarded=0.07 cfs 3,164 cf Primary=15.89 cfs 60,603 cf Outflow=15.96 cfs 63,767 cf

Link 15L: C-1 25-Year Outflow Imported from CS515 - channels 1,4,5~Reach 4R.hce Inflow=6.67 cfs 22,067 cf
Area= 48,290 sf 81.96% Imperv. Primary=6.67 cfs 22,067 cf

Link 16L: 25-Year Outflow Imported from CS515 - channels 1,4,5~Reach 13R.hce Inflow=8.62 cfs 31,604 cf
Area= 71,709 sf 72.02% Imperv. Primary=8.62 cfs 31,604 cf

Total Runoff Area = 473,053 sf Runoff Volume = 171,479 cf Average Runoff Depth = 4.35"
71.36% Pervious = 337,565 sf 28.64% Impervious = 135,488 sf

Summary for Subcatchment 1S: CS515-pre

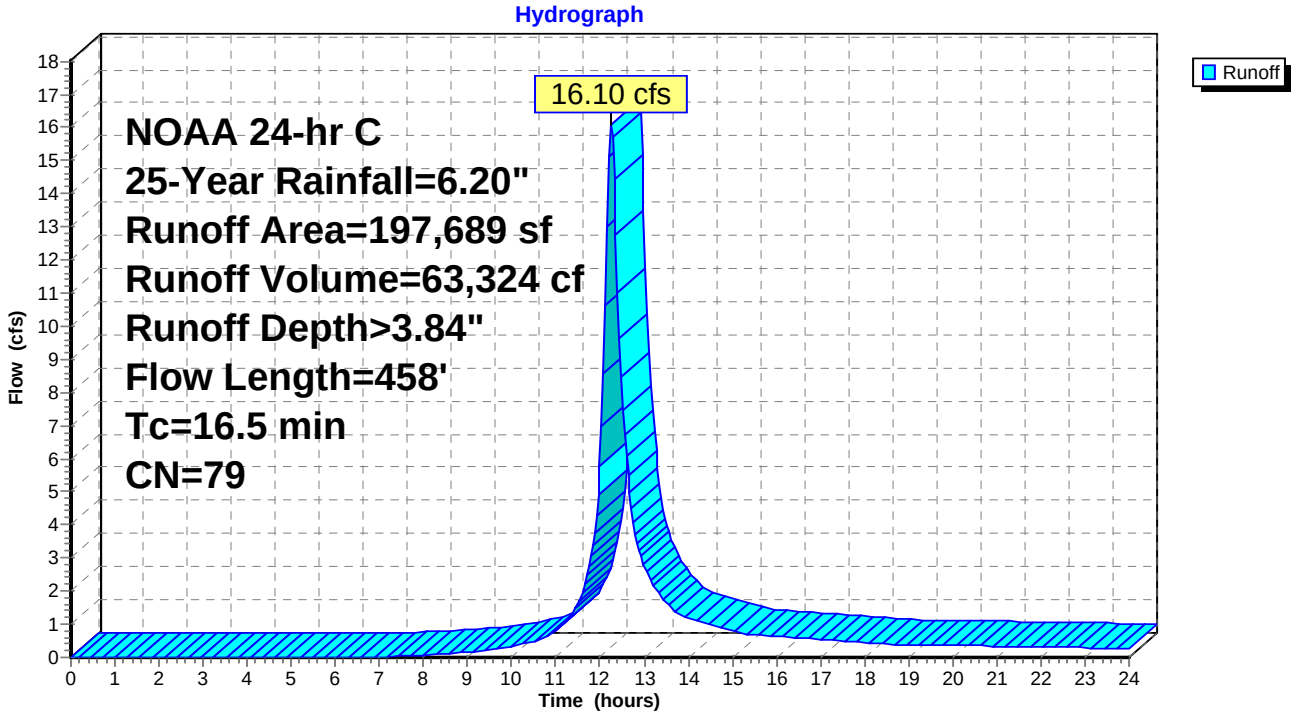
Runoff = 16.10 cfs @ 12.25 hrs, Volume= 63,324 cf, Depth> 3.84"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs
NOAA 24-hr C 25-Year Rainfall=6.20"

	Area (sf)	CN	Description
	182,016	78	Meadow, non-grazed, HSG D
*	3,135	78	Meadow, (20% existing impervious)
	12,538	98	Paved roads w/curbs & sewers, HSG D
	197,689	79	Weighted Average
	185,151		93.66% Pervious Area
	12,538		6.34% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.5	100	0.0100	0.13		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 3.40"
4.0	358	0.0446	1.48		**Shallow Concentrated Flow, shallow concentrated** Short Grass Pasture Kv= 7.0 fps
16.5	458	Total			

Subcatchment 1S: CS515-pre



Summary for Subcatchment 2S: CS515-post

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

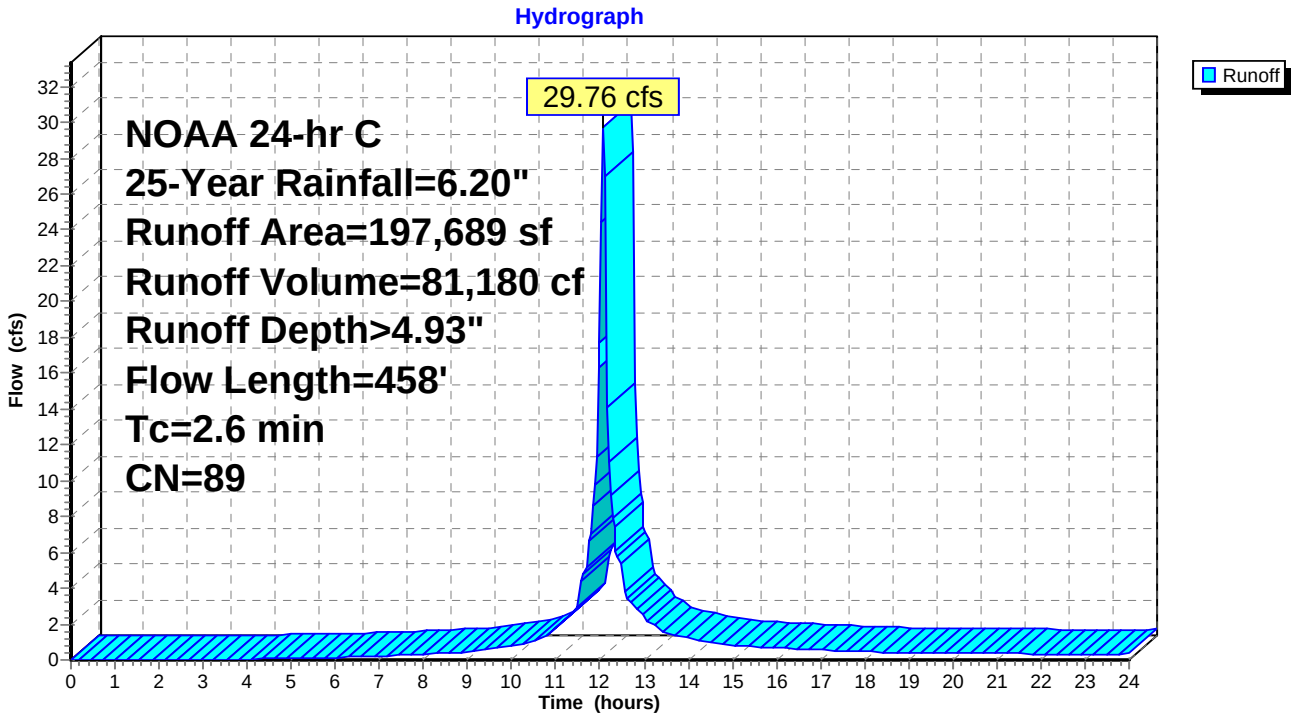
Runoff = 29.76 cfs @ 12.09 hrs, Volume= 81,180 cf, Depth> 4.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs
NOAA 24-hr C 25-Year Rainfall=6.20"

Area (sf)	CN	Description
107,087	98	Paved parking, HSG D
90,602	78	Meadow, non-grazed, HSG D
197,689	89	Weighted Average
90,602		45.83% Pervious Area
107,087		54.17% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	100	0.0200	1.42		**Sheet Flow, sheet flow** Smooth surfaces n= 0.011 P2= 3.40"
1.4	358	0.0446	4.29		**Shallow Concentrated Flow, shallow concentrated** Paved Kv= 20.3 fps
2.6	458	Total			

Subcatchment 2S: CS515-post



Summary for Subcatchment 7S: BERM

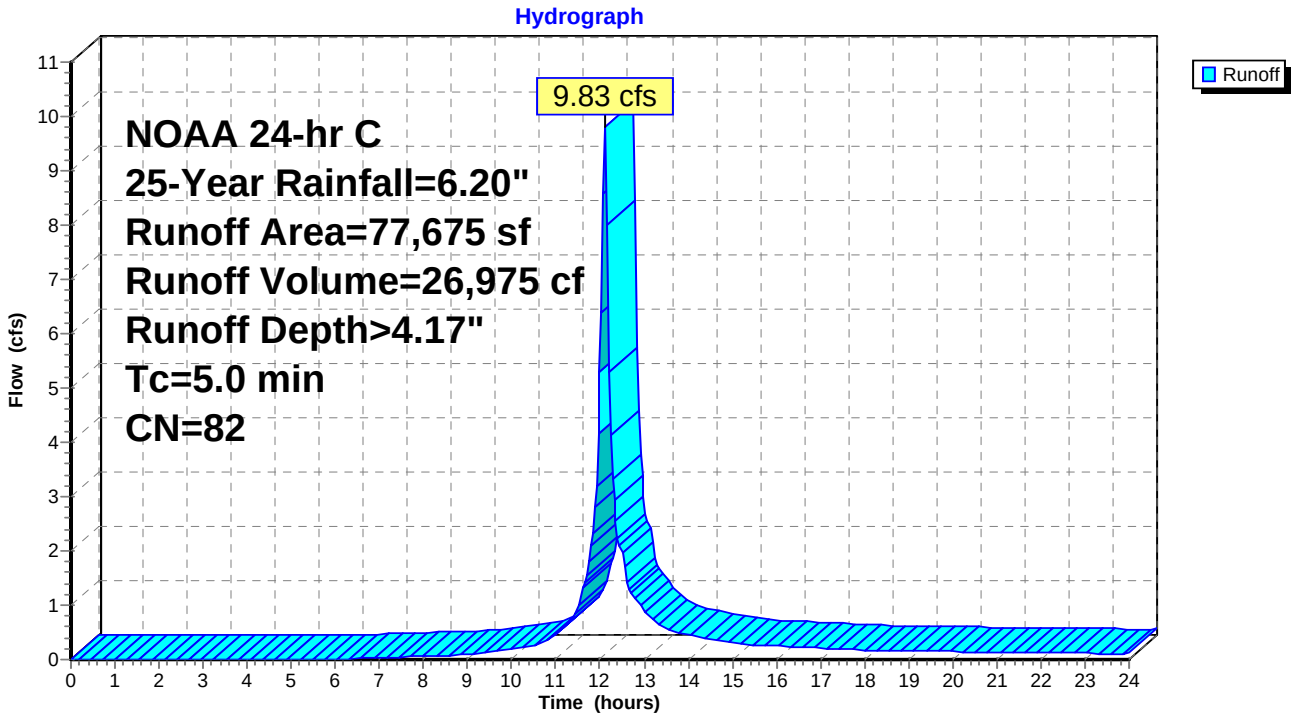
Runoff = 9.83 cfs @ 12.12 hrs, Volume= 26,975 cf, Depth> 4.17"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs
NOAA 24-hr C 25-Year Rainfall=6.20"

Area (sf)	CN	Description
15,863	98	Paved parking, HSG D
61,812	78	Meadow, non-grazed, HSG D
77,675	82	Weighted Average
61,812		79.58% Pervious Area
15,863		20.42% Impervious Area

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

Subcatchment 7S: BERM



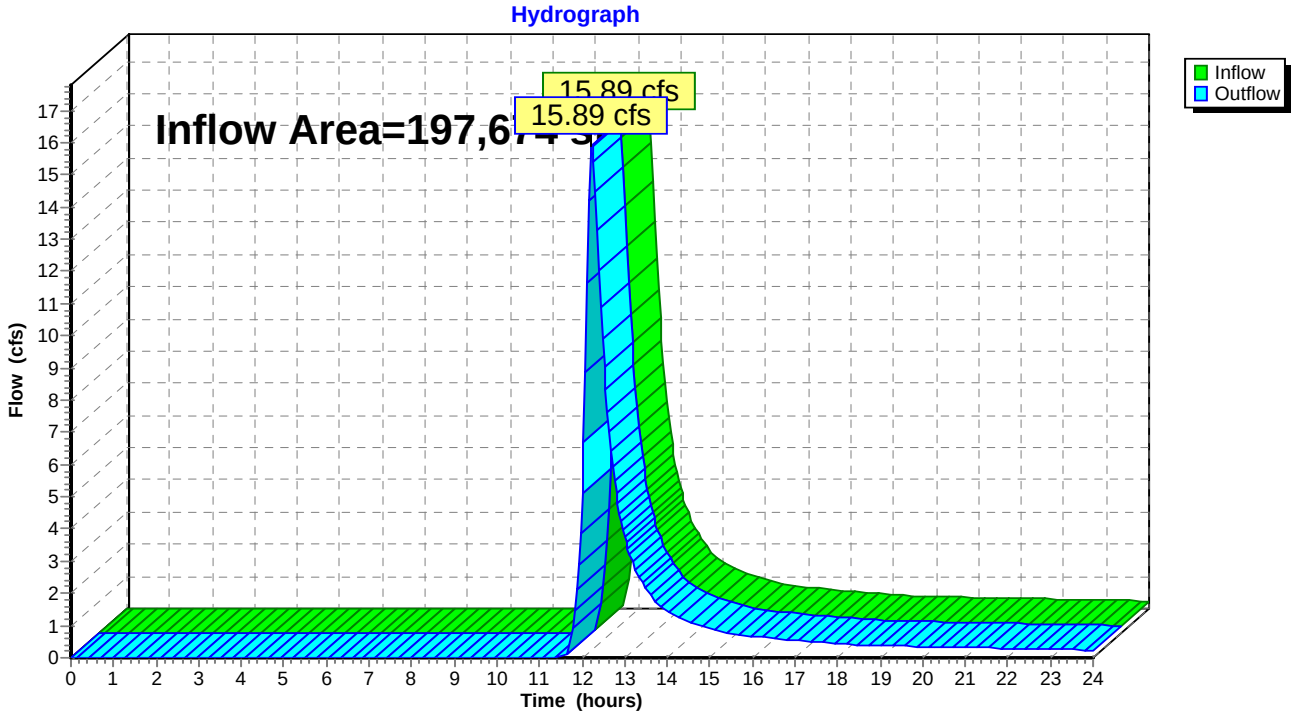
Summary for Reach 7R: Post w BMP

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 197,674 sf, 54.18% Impervious, Inflow Depth > 3.68" for 25-Year event
Inflow = 15.89 cfs @ 12.23 hrs, Volume= 60,603 cf
Outflow = 15.89 cfs @ 12.23 hrs, Volume= 60,603 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs

Reach 7R: Post w BMP



Summary for Pond 4P: BERM

[92] Warning: Device #3 is above defined storage

Inflow Area = 197,674 sf, 54.18% Impervious, Inflow Depth > 4.90" for 25-Year event
Inflow = 23.66 cfs @ 12.13 hrs, Volume= 80,646 cf
Outflow = 15.96 cfs @ 12.23 hrs, Volume= 63,767 cf, Atten= 33%, Lag= 6.3 min
Discarded = 0.07 cfs @ 12.23 hrs, Volume= 3,164 cf
Primary = 15.89 cfs @ 12.23 hrs, Volume= 60,603 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs
Peak Elev= 1,927.24' @ 12.23 hrs Surf.Area= 22,045 sf Storage= 28,804 cf

Plug-Flow detention time= 148.1 min calculated for 63,767 cf (79% of inflow)
Center-of-Mass det. time= 67.1 min (850.8 - 783.7)

Volume	Invert	Avail.Storage	Storage Description
#1	1,925.50'	34,602 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

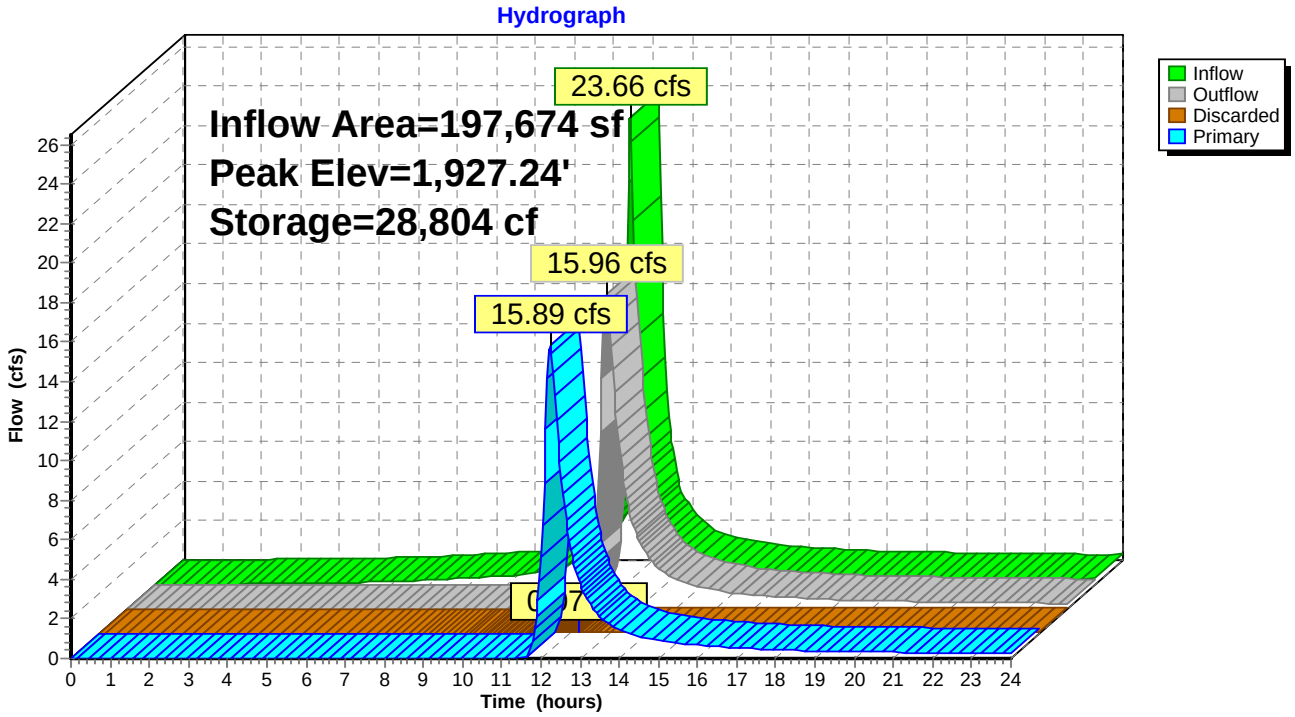
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,925.50	11,085	0	0
1,926.62	17,763	16,155	16,155
1,927.00	21,244	7,411	23,566
1,927.50	22,900	11,036	34,602

Device	Routing	Invert	Outlet Devices
#1	Discarded	1,925.50'	**0.310 in/hr Exfiltration over Surface area from 1,925.50' - 1,926.62'** Conductivity to Groundwater Elevation = 1,923.50' Excluded Surface area = 11,085 sf
#2	Primary	1,926.62'	**12.0' long x 8.3' breadth Spillway** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.44 2.54 2.70 2.69 2.68 2.68 2.66 2.64 2.64 2.64 2.65 2.65 2.65 2.66 2.67 2.69 2.72
#3	Primary	1,927.50'	**420.0' long x 3.0' breadth Top of Berm** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32

Discarded OutFlow Max=0.07 cfs @ 12.23 hrs HW=1,927.24' (Free Discharge)
└**1=Exfiltration** (Controls 0.07 cfs)

Primary OutFlow Max=15.84 cfs @ 12.23 hrs HW=1,927.24' (Free Discharge)
├**2=Spillway** (Weir Controls 15.84 cfs @ 2.13 fps)
└**3=Top of Berm** (Controls 0.00 cfs)

Pond 4P: BERM


Hydrograph
Inflow Area=197,674 sf
Peak Elev=1,927.24'
Storage=28,804 cf
23.66 cfs
15.96 cfs
15.89 cfs
Inflow
Outflow
Discarded
Primary
Flow (cfs)
Time (hours)

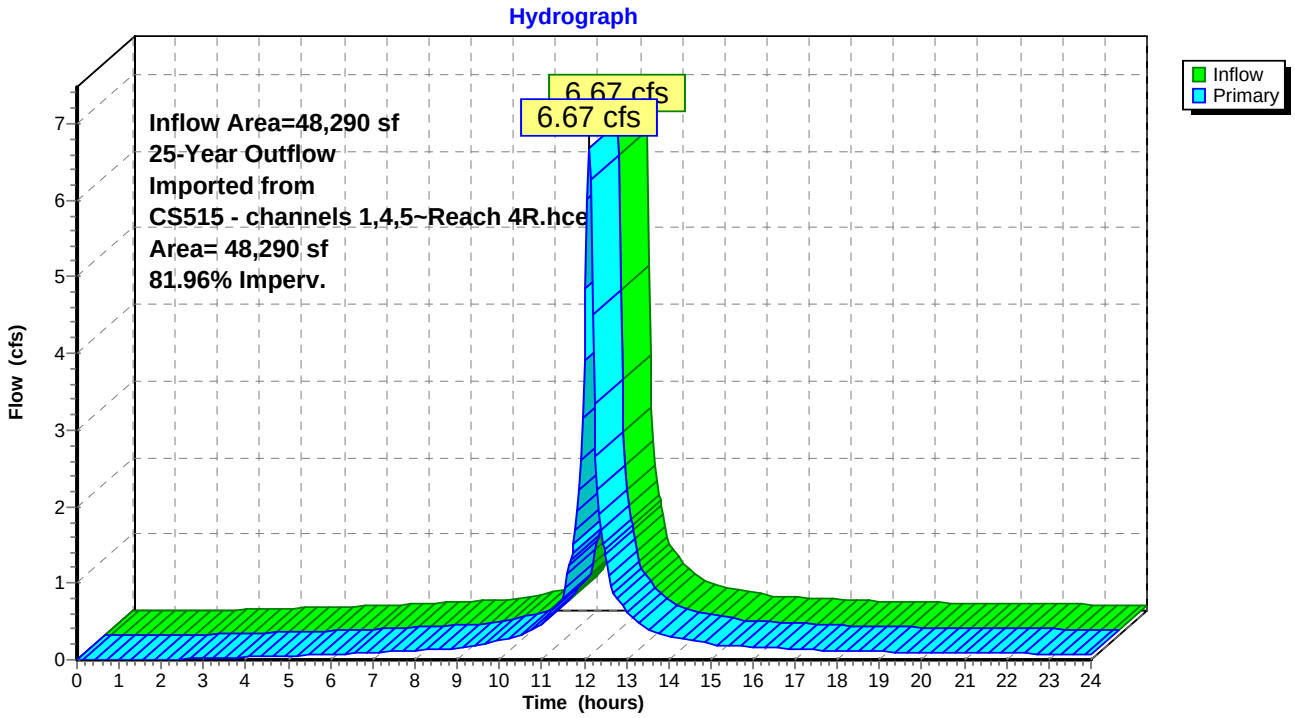
Summary for Link 15L: C-1

Inflow Area = 48,290 sf, 81.96% Impervious, Inflow Depth > 5.48" for 25-Year event
Inflow = 6.67 cfs @ 12.12 hrs, Volume= 22,067 cf
Primary = 6.67 cfs @ 12.12 hrs, Volume= 22,067 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs

25-Year Outflow Imported from CS515 - channels 1,4,5~Reach 4R.hce

Link 15L: C-1



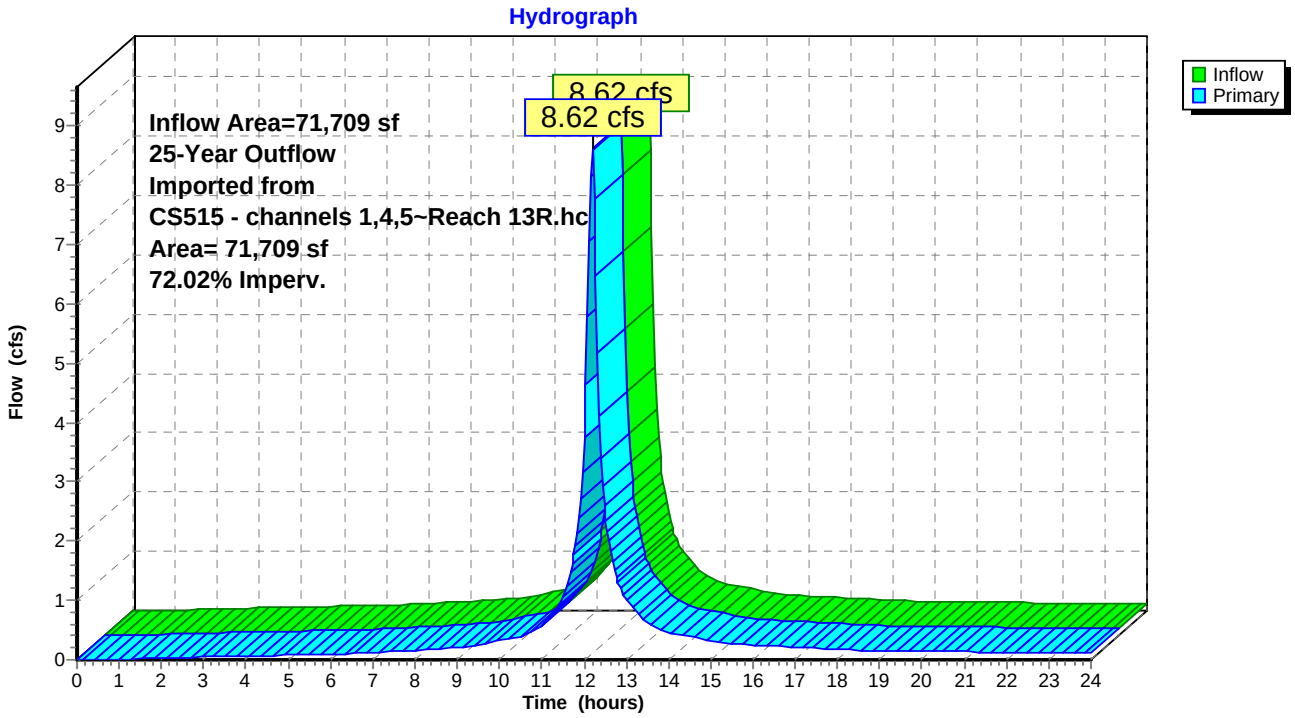
Summary for Link 16L: C-5

Inflow Area = 71,709 sf, 72.02% Impervious, Inflow Depth > 5.29" for 25-Year event
Inflow = 8.62 cfs @ 12.19 hrs, Volume= 31,604 cf
Primary = 8.62 cfs @ 12.19 hrs, Volume= 31,604 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs

25-Year Outflow Imported from CS515 - channels 1,4,5~Reach 13R.hce

Link 16L: C-5



Time span=0.00-24.00 hrs, dt=0.04 hrs, 601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: CS515-pre Runoff Area=197,689 sf 6.34% Impervious Runoff Depth>4.71"
Flow Length=458' Tc=16.5 min CN=79 Runoff=19.64 cfs 77,650 cf

Subcatchment 2S: CS515-post Runoff Area=197,689 sf 54.17% Impervious Runoff Depth>5.86"
Flow Length=458' Tc=2.6 min CN=89 Runoff=35.00 cfs 96,579 cf

Subcatchment 7S: BERM Runoff Area=77,675 sf 20.42% Impervious Runoff Depth>5.06"
Tc=5.0 min CN=82 Runoff=11.83 cfs 32,762 cf

Reach 7R: Post w BMP Inflow=19.57 cfs 75,588 cf
Outflow=19.57 cfs 75,588 cf

Pond 4P: BERM Peak Elev=1,927.34' Storage=30,882 cf Inflow=28.10 cfs 95,851 cf
Discarded=0.07 cfs 3,293 cf Primary=19.57 cfs 75,588 cf Outflow=19.64 cfs 78,881 cf

Link 15L: C-1 50-Year Outflow Imported from CS515 - channels 1,4,5~Reach 4R.hce Inflow=7.77 cfs 25,892 cf
Area= 48,290 sf 81.96% Imperv. Primary=7.77 cfs 25,892 cf

Link 16L: 50-Year Outflow Imported from CS515 - channels 1,4,5~Reach 13R.hce Inflow=10.15 cfs 37,197 cf
Area= 71,709 sf 72.02% Imperv. Primary=10.15 cfs 37,197 cf

Total Runoff Area = 473,053 sf Runoff Volume = 206,990 cf Average Runoff Depth = 5.25"
71.36% Pervious = 337,565 sf 28.64% Impervious = 135,488 sf

Summary for Subcatchment 1S: CS515-pre

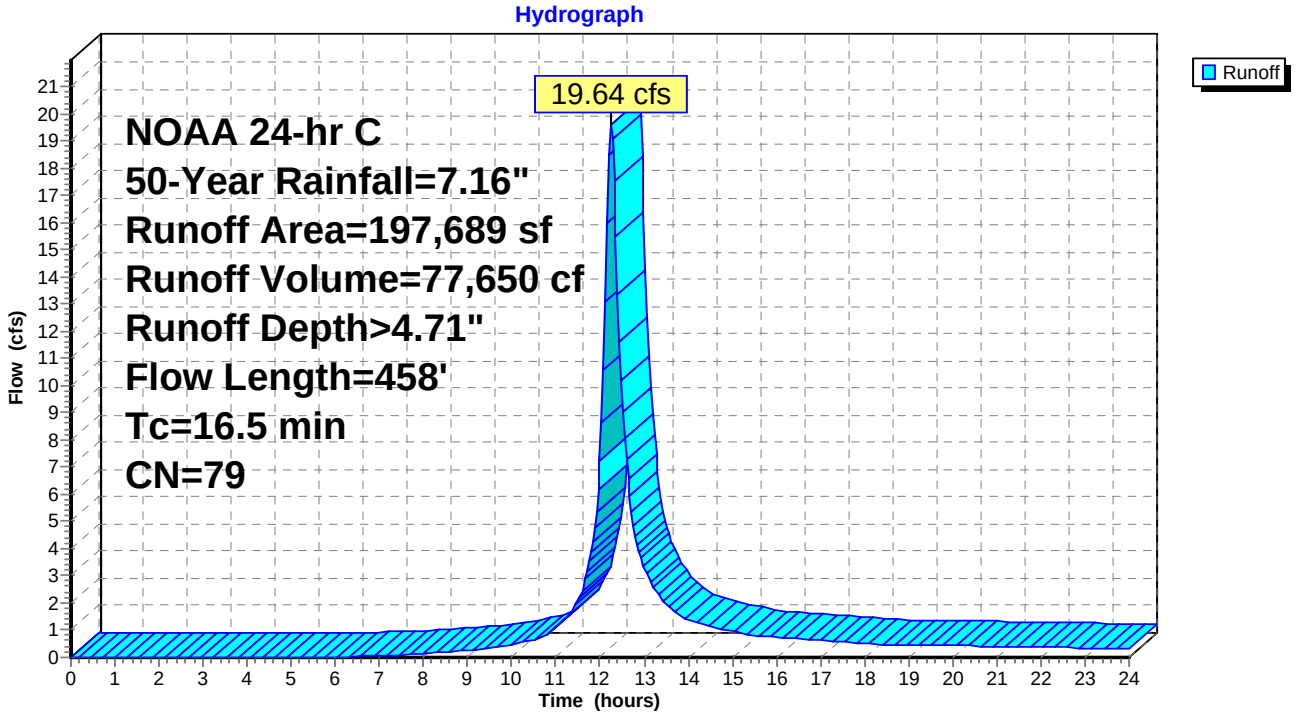
Runoff = 19.64 cfs @ 12.25 hrs, Volume= 77,650 cf, Depth> 4.71"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs
NOAA 24-hr C 50-Year Rainfall=7.16"

	Area (sf)	CN	Description
	182,016	78	Meadow, non-grazed, HSG D
*	3,135	78	Meadow, (20% existing impervious)
	12,538	98	Paved roads w/curbs & sewers, HSG D
	197,689	79	Weighted Average
	185,151		93.66% Pervious Area
	12,538		6.34% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.5	100	0.0100	0.13		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 3.40"
4.0	358	0.0446	1.48		**Shallow Concentrated Flow, shallow concentrated** Short Grass Pasture Kv= 7.0 fps
16.5	458	Total			

Subcatchment 1S: CS515-pre



Summary for Subcatchment 2S: CS515-post

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

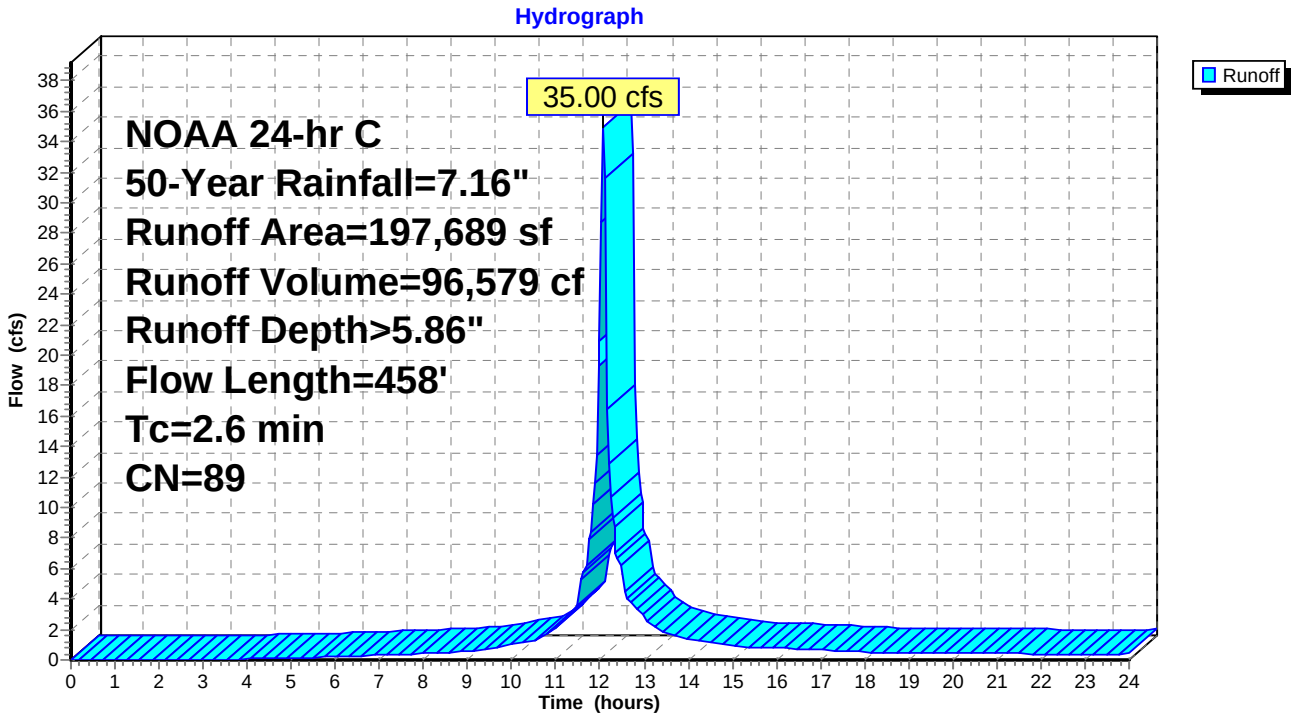
Runoff = 35.00 cfs @ 12.09 hrs, Volume= 96,579 cf, Depth> 5.86"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs
NOAA 24-hr C 50-Year Rainfall=7.16"

Area (sf)	CN	Description
107,087	98	Paved parking, HSG D
90,602	78	Meadow, non-grazed, HSG D
197,689	89	Weighted Average
90,602		45.83% Pervious Area
107,087		54.17% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	100	0.0200	1.42		**Sheet Flow, sheet flow** Smooth surfaces n= 0.011 P2= 3.40"
1.4	358	0.0446	4.29		**Shallow Concentrated Flow, shallow concentrated** Paved Kv= 20.3 fps
2.6	458	Total			

Subcatchment 2S: CS515-post



Summary for Subcatchment 7S: BERM

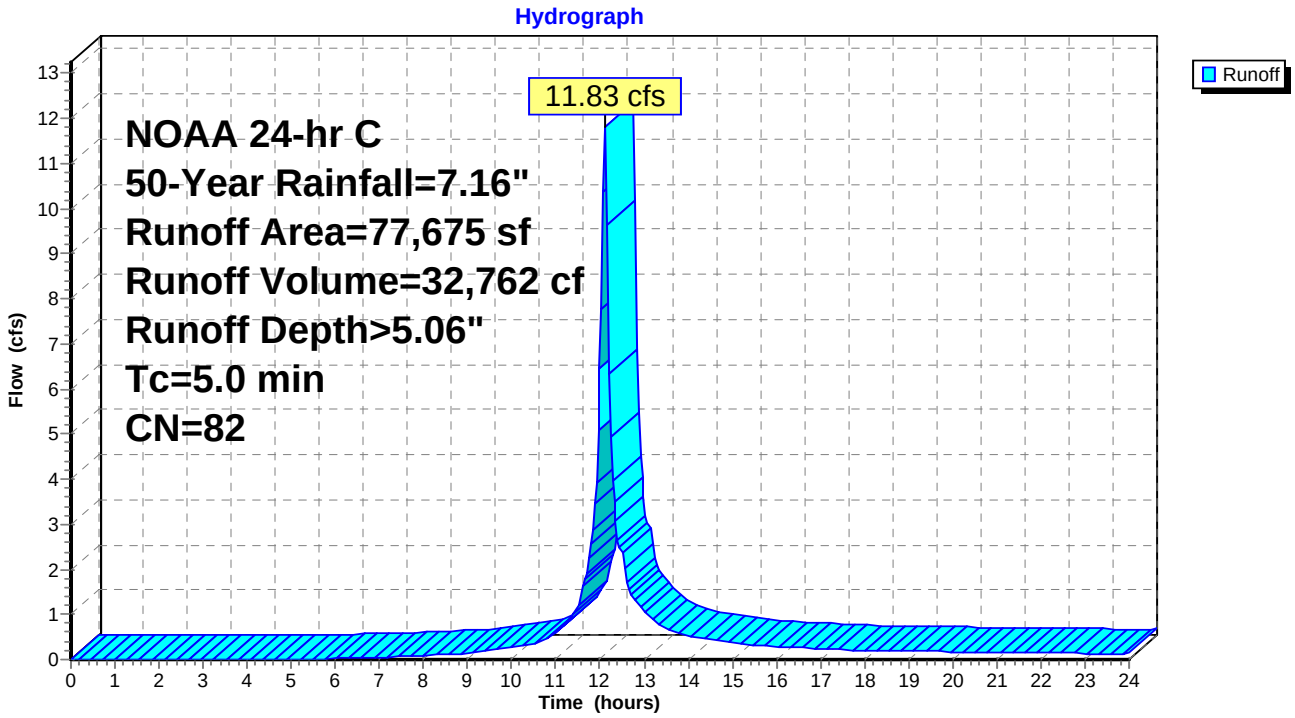
Runoff = 11.83 cfs @ 12.12 hrs, Volume= 32,762 cf, Depth> 5.06"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs
NOAA 24-hr C 50-Year Rainfall=7.16"

Area (sf)	CN	Description
15,863	98	Paved parking, HSG D
61,812	78	Meadow, non-grazed, HSG D
77,675	82	Weighted Average
61,812		79.58% Pervious Area
15,863		20.42% Impervious Area

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

Subcatchment 7S: BERM



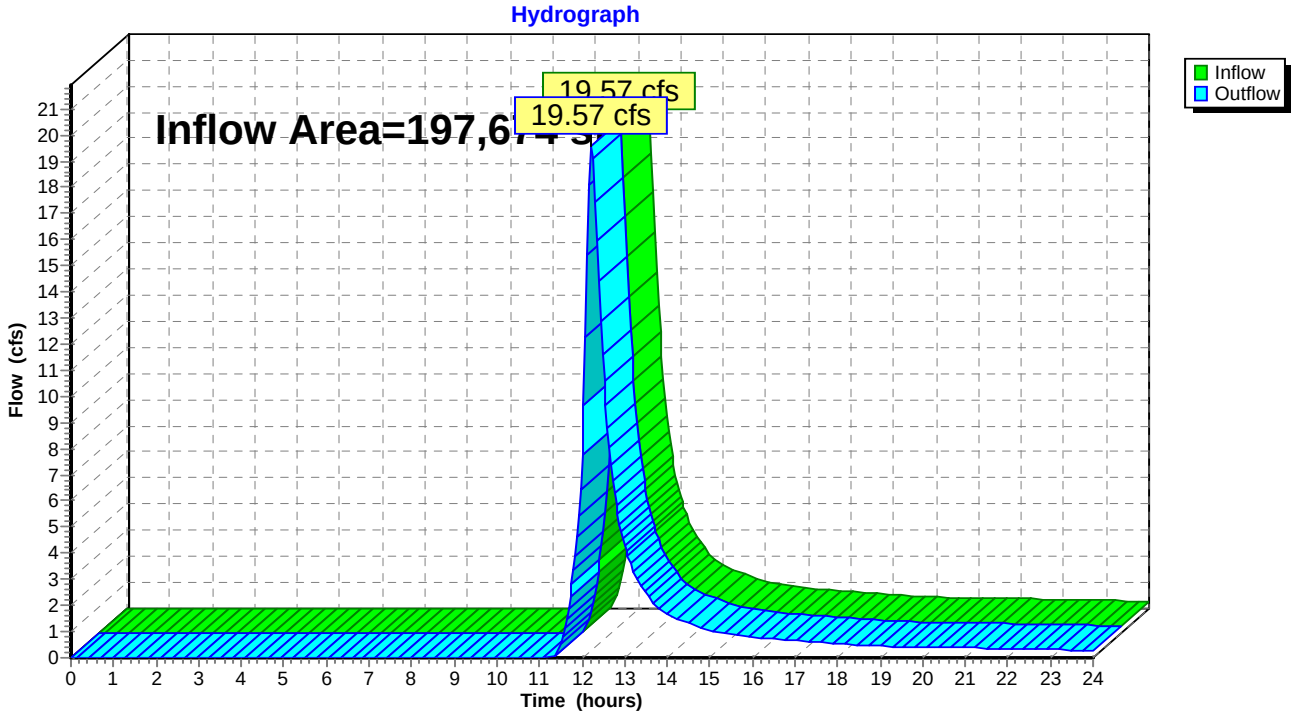
Summary for Reach 7R: Post w BMP

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 197,674 sf, 54.18% Impervious, Inflow Depth > 4.59" for 50-Year event
Inflow = 19.57 cfs @ 12.22 hrs, Volume= 75,588 cf
Outflow = 19.57 cfs @ 12.22 hrs, Volume= 75,588 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs

Reach 7R: Post w BMP



Summary for Pond 4P: BERM

[92] Warning: Device #3 is above defined storage

Inflow Area = 197,674 sf, 54.18% Impervious, Inflow Depth > 5.82" for 50-Year event
Inflow = 28.10 cfs @ 12.13 hrs, Volume= 95,851 cf
Outflow = 19.64 cfs @ 12.22 hrs, Volume= 78,881 cf, Atten= 30%, Lag= 5.6 min
Discarded = 0.07 cfs @ 12.22 hrs, Volume= 3,293 cf
Primary = 19.57 cfs @ 12.22 hrs, Volume= 75,588 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs
Peak Elev= 1,927.34' @ 12.22 hrs Surf.Area= 22,356 sf Storage= 30,882 cf

Plug-Flow detention time= 135.6 min calculated for 78,750 cf (82% of inflow)
Center-of-Mass det. time= 62.4 min (842.2 - 779.8)

Volume	Invert	Avail.Storage	Storage Description
#1	1,925.50'	34,602 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

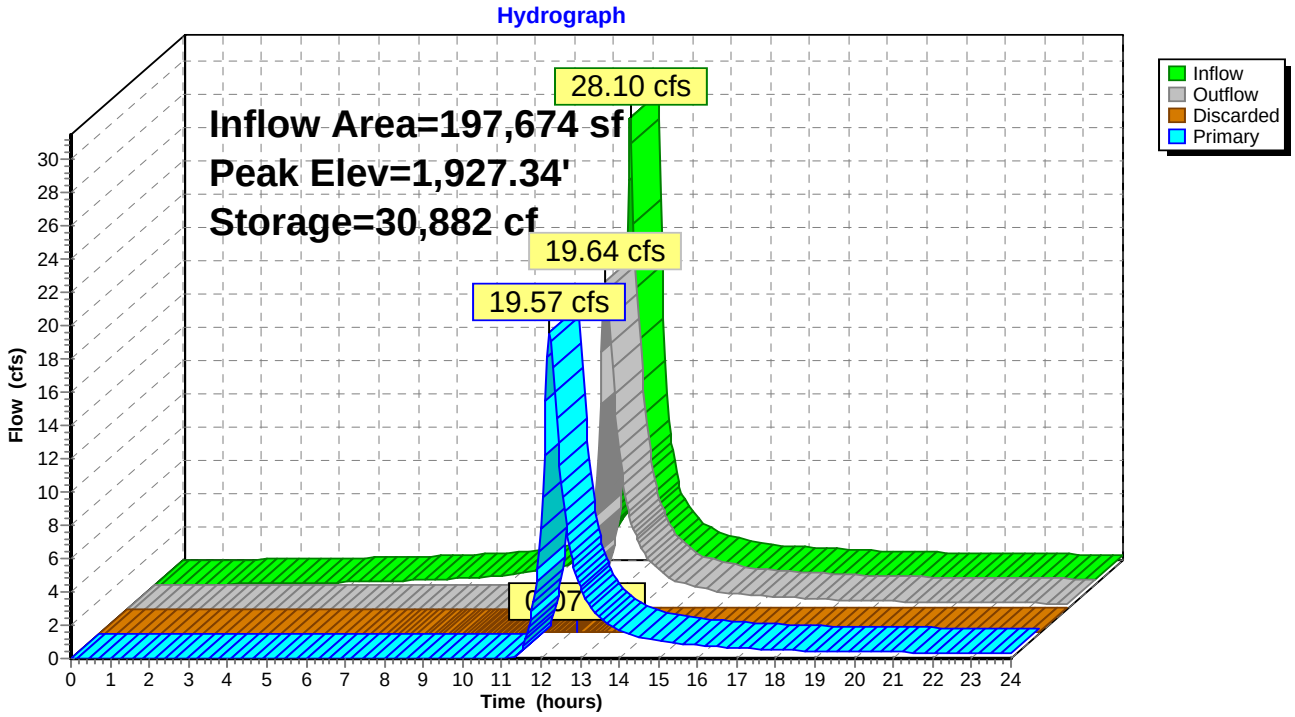
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,925.50	11,085	0	0
1,926.62	17,763	16,155	16,155
1,927.00	21,244	7,411	23,566
1,927.50	22,900	11,036	34,602

Device	Routing	Invert	Outlet Devices
#1	Discarded	1,925.50'	**0.310 in/hr Exfiltration over Surface area from 1,925.50' - 1,926.62'** Conductivity to Groundwater Elevation = 1,923.50' Excluded Surface area = 11,085 sf
#2	Primary	1,926.62'	**12.0' long x 8.3' breadth Spillway** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.44 2.54 2.70 2.69 2.68 2.68 2.66 2.64 2.64 2.64 2.65 2.65 2.65 2.66 2.67 2.69 2.72
#3	Primary	1,927.50'	**420.0' long x 3.0' breadth Top of Berm** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32

Discarded OutFlow Max=0.07 cfs @ 12.22 hrs HW=1,927.33' (Free Discharge)
└**1=Exfiltration** (Controls 0.07 cfs)

Primary OutFlow Max=19.47 cfs @ 12.22 hrs HW=1,927.33' (Free Discharge)
├**2=Spillway** (Weir Controls 19.47 cfs @ 2.28 fps)
└**3=Top of Berm** (Controls 0.00 cfs)

Pond 4P: BERM


Hydrograph
28.10 cfs
Inflow Area=197,674 sf
Peak Elev=1,927.34'
Storage=30,882 cf
19.64 cfs
19.57 cfs
Inflow
Outflow
Discarded
Primary
Flow (cfs)
Time (hours)

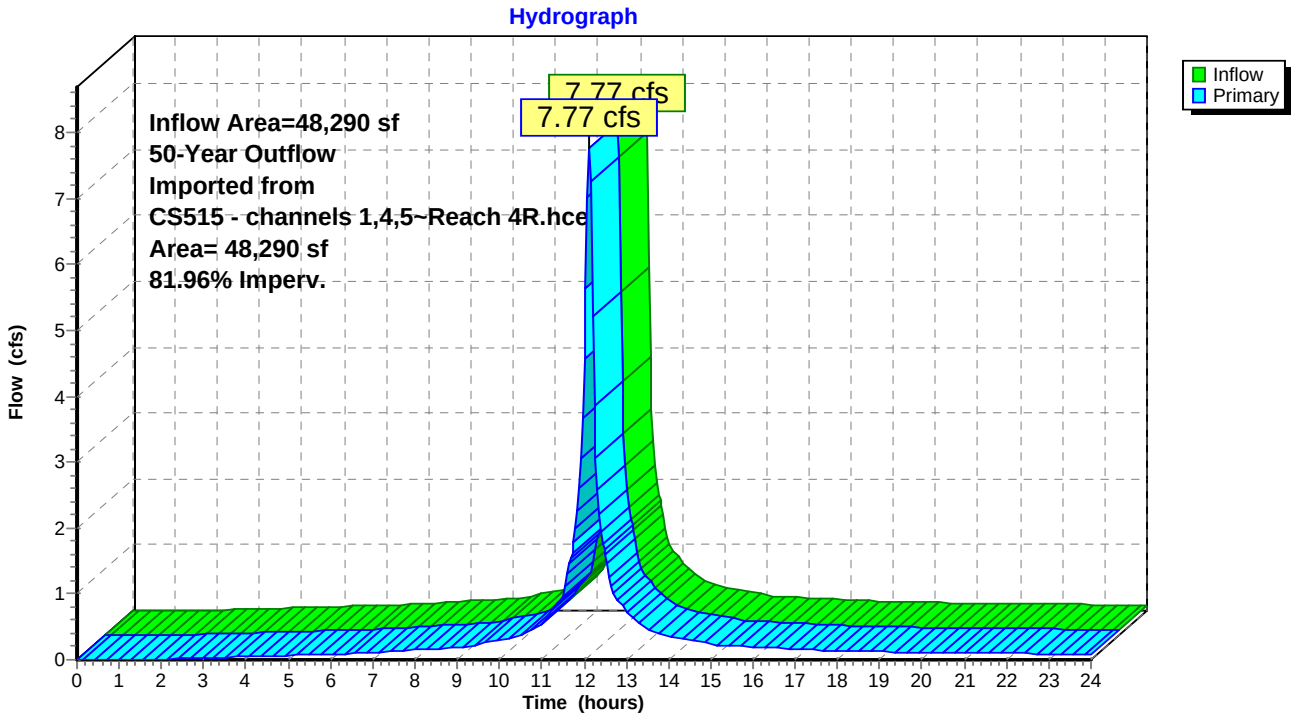
Summary for Link 15L: C-1

Inflow Area = 48,290 sf, 81.96% Impervious, Inflow Depth > 6.43" for 50-Year event
Inflow = 7.77 cfs @ 12.12 hrs, Volume= 25,892 cf
Primary = 7.77 cfs @ 12.12 hrs, Volume= 25,892 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs

50-Year Outflow Imported from CS515 - channels 1,4,5~Reach 4R.hce

Link 15L: C-1



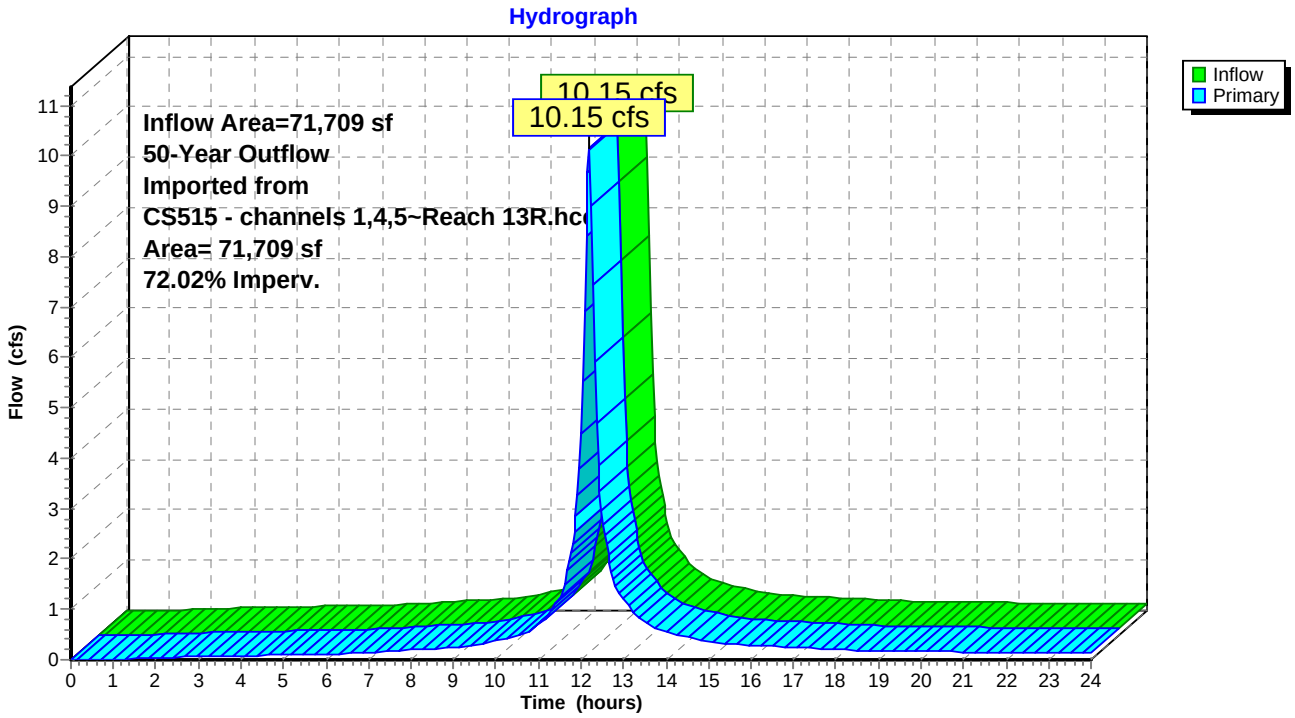
Summary for Link 16L: C-5

Inflow Area = 71,709 sf, 72.02% Impervious, Inflow Depth > 6.22" for 50-Year event
Inflow = 10.15 cfs @ 12.19 hrs, Volume= 37,197 cf
Primary = 10.15 cfs @ 12.19 hrs, Volume= 37,197 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs

50-Year Outflow Imported from CS515 - channels 1,4,5~Reach 13R.hce

Link 16L: C-5



Time span=0.00-24.00 hrs, dt=0.04 hrs, 601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: CS515-pre Runoff Area=197,689 sf 6.34% Impervious Runoff Depth>5.89"
Flow Length=458' Tc=16.5 min CN=79 Runoff=24.34 cfs 97,005 cf

Subcatchment 2S: CS515-post Runoff Area=197,689 sf 54.17% Impervious Runoff Depth>7.11"
Flow Length=458' Tc=2.6 min CN=89 Runoff=41.89 cfs 117,079 cf

Subcatchment 7S: BERM Runoff Area=77,675 sf 20.42% Impervious Runoff Depth>6.26"
Tc=5.0 min CN=82 Runoff=14.46 cfs 40,540 cf

Reach 7R: Post w BMP Inflow=24.23 cfs 95,592 cf
Outflow=24.23 cfs 95,592 cf

Pond 4P: BERM Peak Elev=1,927.45' Storage=33,378 cf Inflow=33.98 cfs 116,138 cf
Discarded=0.07 cfs 3,456 cf Primary=24.23 cfs 95,592 cf Outflow=24.31 cfs 99,048 cf

Link 15L: 100-Year Outflow Imported from CS515 - channels 1,4,5~Reach 4R.hce Inflow=9.21 cfs 30,964 cf
Area= 48,290 sf 81.96% Imperv. Primary=9.21 cfs 30,964 cf

Link 16L: 100-Year Outflow Imported from CS515 - channels 1,4,5~Reach 13R.hce Inflow=12.15 cfs 44,634 cf
Area= 71,709 sf 72.02% Imperv. Primary=12.15 cfs 44,634 cf

Total Runoff Area = 473,053 sf Runoff Volume = 254,625 cf Average Runoff Depth = 6.46"
71.36% Pervious = 337,565 sf 28.64% Impervious = 135,488 sf

Summary for Subcatchment 1S: CS515-pre

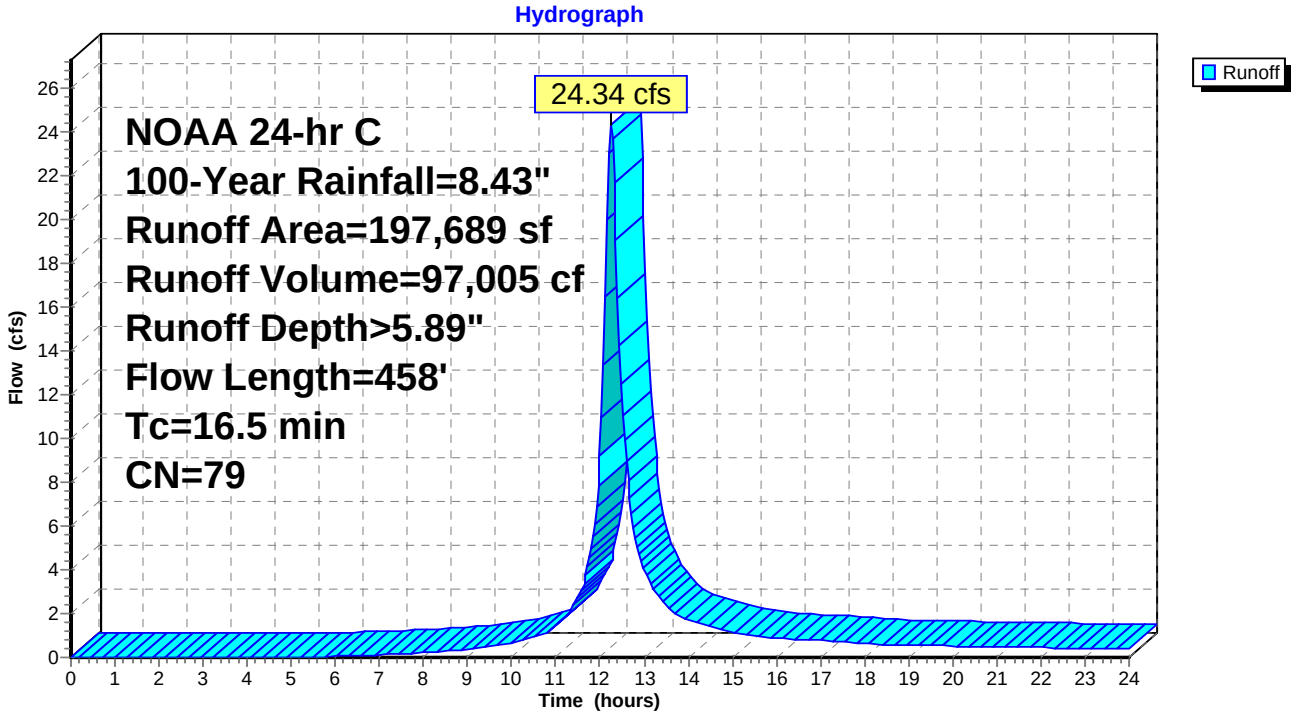
Runoff = 24.34 cfs @ 12.25 hrs, Volume= 97,005 cf, Depth> 5.89"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs
NOAA 24-hr C 100-Year Rainfall=8.43"

	Area (sf)	CN	Description
	182,016	78	Meadow, non-grazed, HSG D
*	3,135	78	Meadow, (20% existing impervious)
	12,538	98	Paved roads w/curbs & sewers, HSG D
	197,689	79	Weighted Average
	185,151		93.66% Pervious Area
	12,538		6.34% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.5	100	0.0100	0.13		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 3.40"
4.0	358	0.0446	1.48		**Shallow Concentrated Flow, shallow concentrated** Short Grass Pasture Kv= 7.0 fps
16.5	458	Total			

Subcatchment 1S: CS515-pre



Summary for Subcatchment 2S: CS515-post

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

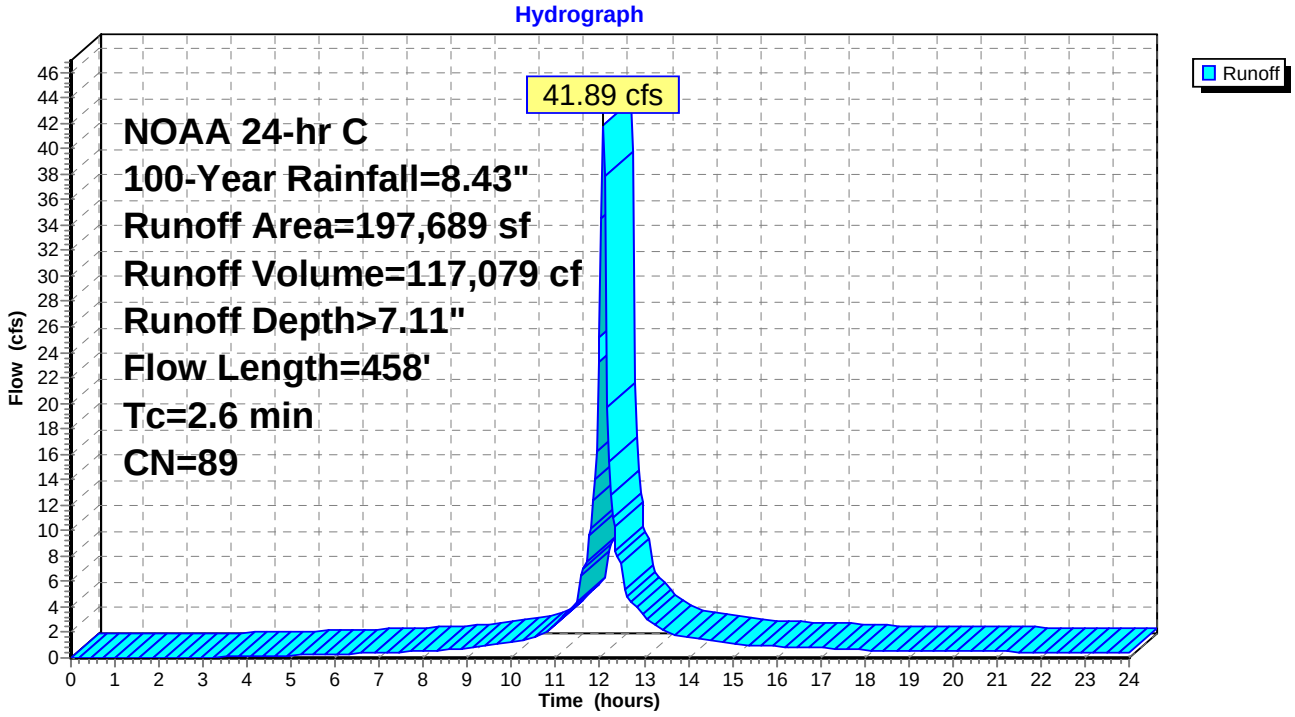
Runoff = 41.89 cfs @ 12.09 hrs, Volume= 117,079 cf, Depth> 7.11"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs
NOAA 24-hr C 100-Year Rainfall=8.43"

Area (sf)	CN	Description
107,087	98	Paved parking, HSG D
90,602	78	Meadow, non-grazed, HSG D
197,689	89	Weighted Average
90,602		45.83% Pervious Area
107,087		54.17% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	100	0.0200	1.42		**Sheet Flow, sheet flow** Smooth surfaces n= 0.011 P2= 3.40"
1.4	358	0.0446	4.29		**Shallow Concentrated Flow, shallow concentrated** Paved Kv= 20.3 fps
2.6	458	Total			

Subcatchment 2S: CS515-post



Summary for Subcatchment 7S: BERM

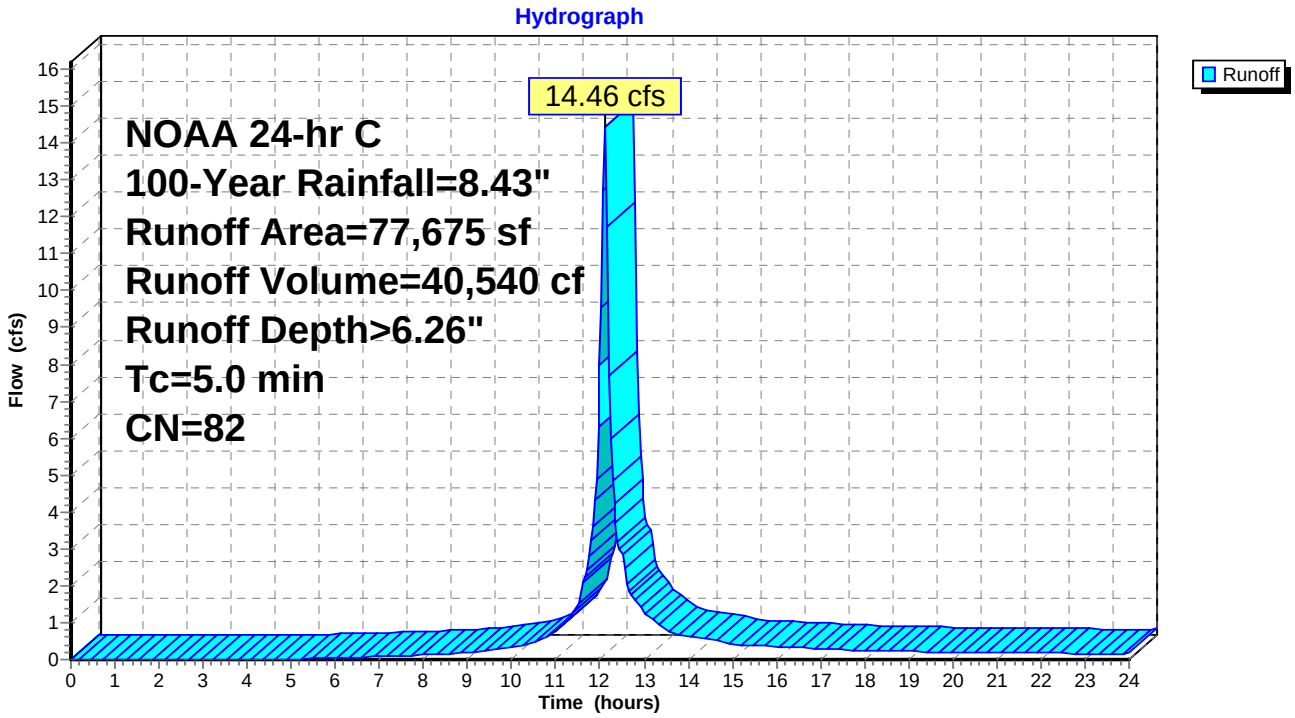
Runoff = 14.46 cfs @ 12.12 hrs, Volume= 40,540 cf, Depth> 6.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs
NOAA 24-hr C 100-Year Rainfall=8.43"

Area (sf)	CN	Description
15,863	98	Paved parking, HSG D
61,812	78	Meadow, non-grazed, HSG D
77,675	82	Weighted Average
61,812		79.58% Pervious Area
15,863		20.42% Impervious Area

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

Subcatchment 7S: BERM



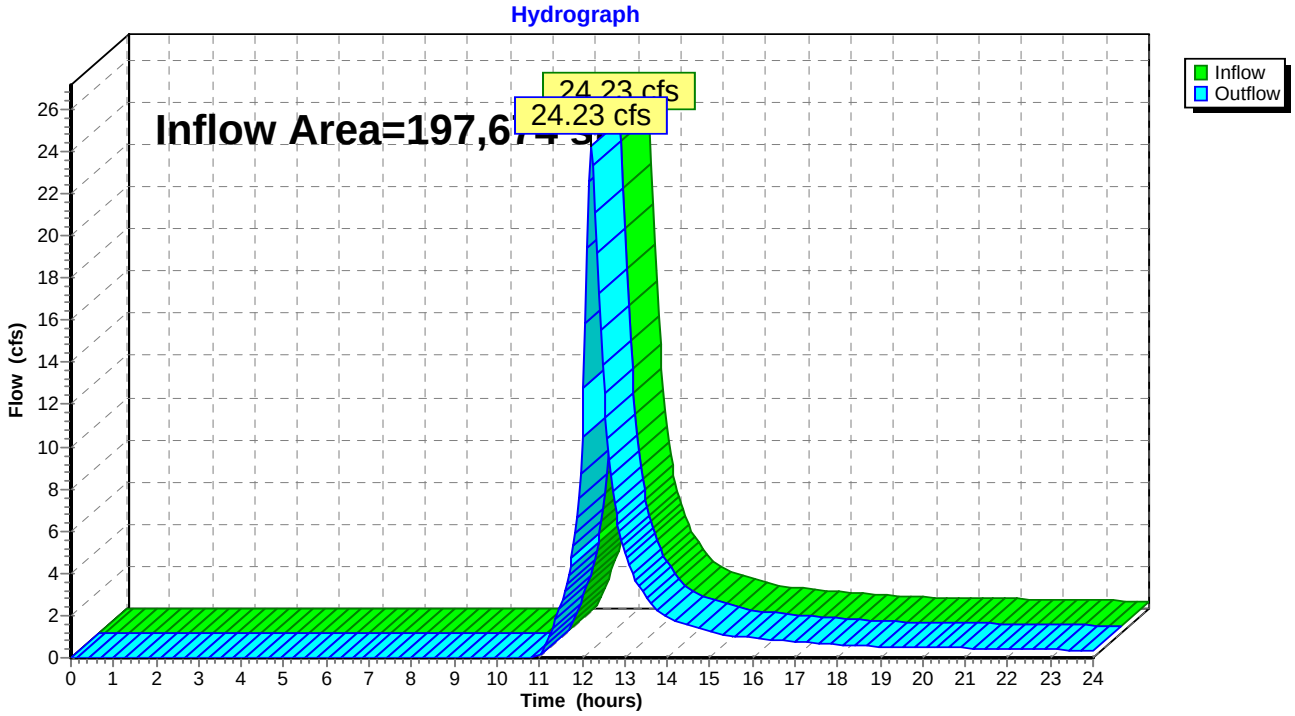
Summary for Reach 7R: Post w BMP

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 197,674 sf, 54.18% Impervious, Inflow Depth > 5.80" for 100-Year event
Inflow = 24.23 cfs @ 12.22 hrs, Volume= 95,592 cf
Outflow = 24.23 cfs @ 12.22 hrs, Volume= 95,592 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs

Reach 7R: Post w BMP



Summary for Pond 4P: BERM

[92] Warning: Device #3 is above defined storage

Inflow Area = 197,674 sf, 54.18% Impervious, Inflow Depth > 7.05" for 100-Year event
Inflow = 33.98 cfs @ 12.13 hrs, Volume= 116,138 cf
Outflow = 24.31 cfs @ 12.22 hrs, Volume= 99,048 cf, Atten= 28%, Lag= 5.3 min
Discarded = 0.07 cfs @ 12.22 hrs, Volume= 3,456 cf
Primary = 24.23 cfs @ 12.22 hrs, Volume= 95,592 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs
Peak Elev= 1,927.45' @ 12.22 hrs Surf.Area= 22,722 sf Storage= 33,378 cf

Plug-Flow detention time= 123.6 min calculated for 98,883 cf (85% of inflow)
Center-of-Mass det. time= 58.0 min (833.5 - 775.5)

Volume	Invert	Avail.Storage	Storage Description
#1	1,925.50'	34,602 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

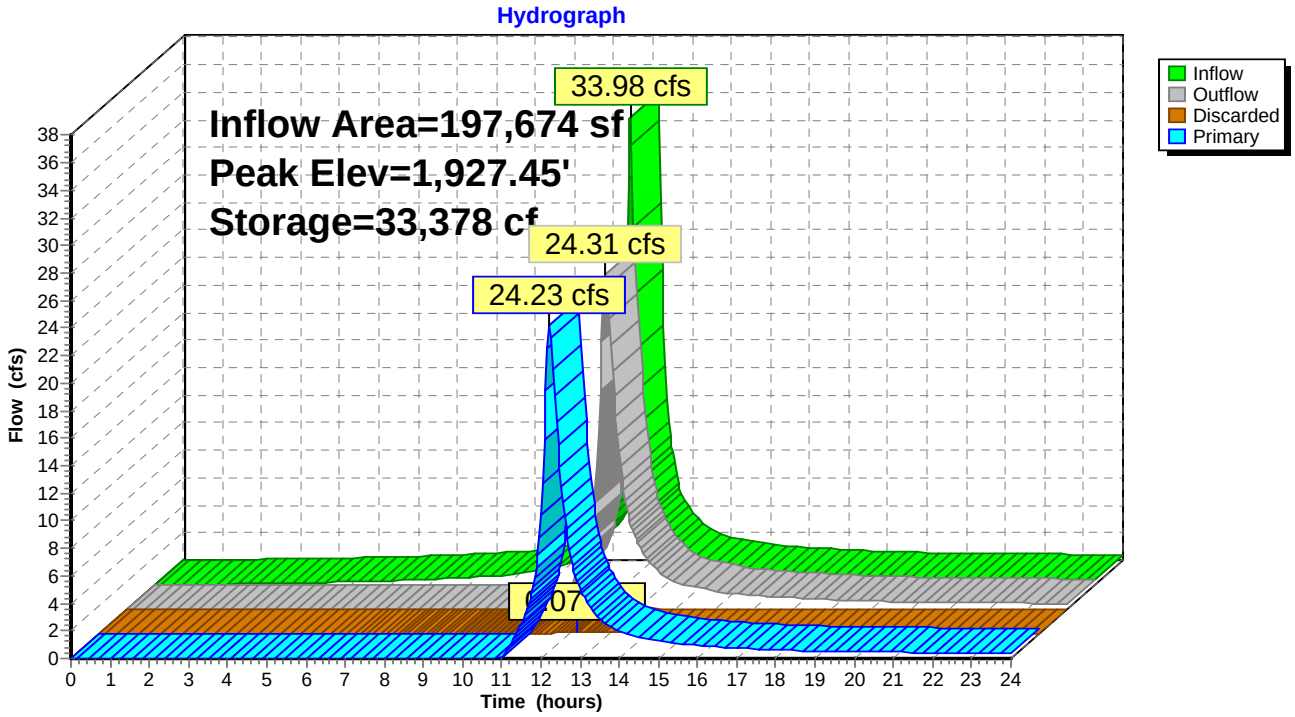
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,925.50	11,085	0	0
1,926.62	17,763	16,155	16,155
1,927.00	21,244	7,411	23,566
1,927.50	22,900	11,036	34,602

Device	Routing	Invert	Outlet Devices
#1	Discarded	1,925.50'	**0.310 in/hr Exfiltration over Surface area from 1,925.50' - 1,926.62'** Conductivity to Groundwater Elevation = 1,923.50' Excluded Surface area = 11,085 sf
#2	Primary	1,926.62'	**12.0' long x 8.3' breadth Spillway** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.44 2.54 2.70 2.69 2.68 2.68 2.66 2.64 2.64 2.64 2.65 2.65 2.65 2.66 2.67 2.69 2.72
#3	Primary	1,927.50'	**420.0' long x 3.0' breadth Top of Berm** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32

Discarded OutFlow Max=0.07 cfs @ 12.22 hrs HW=1,927.44' (Free Discharge)
└**1=Exfiltration** (Controls 0.07 cfs)

Primary OutFlow Max=24.03 cfs @ 12.22 hrs HW=1,927.44' (Free Discharge)
├**2=Spillway** (Weir Controls 24.03 cfs @ 2.44 fps)
└**3=Top of Berm** (Controls 0.00 cfs)

Pond 4P: BERM


Hydrograph
Inflow
Outflow
Discarded
Primary
33.98 cfs
Inflow Area=197,674 sf
Peak Elev=1,927.45'
Storage=33,378 cf
24.31 cfs
24.23 cfs
Flow (cfs)
Time (hours)

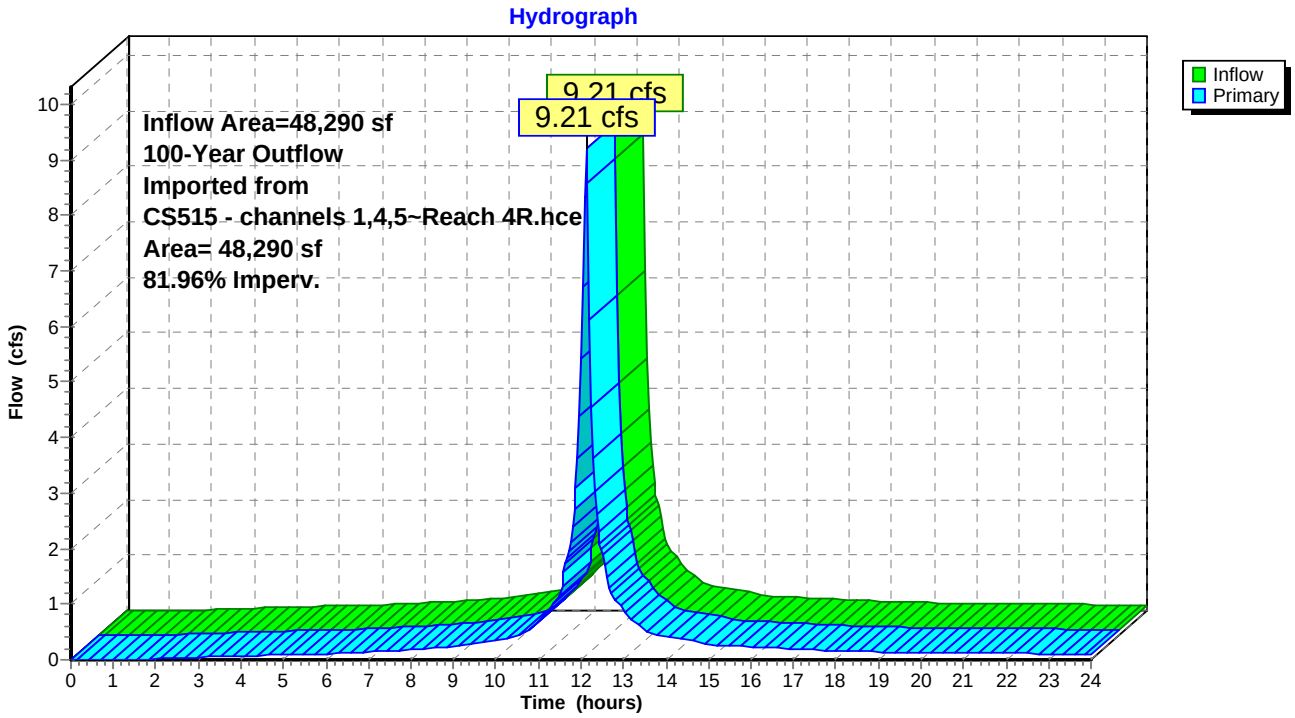
Summary for Link 15L: C-1

Inflow Area = 48,290 sf, 81.96% Impervious, Inflow Depth > 7.69" for 100-Year event
Inflow = 9.21 cfs @ 12.12 hrs, Volume= 30,964 cf
Primary = 9.21 cfs @ 12.12 hrs, Volume= 30,964 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs

100-Year Outflow Imported from CS515 - channels 1,4,5~Reach 4R.hce

Link 15L: C-1



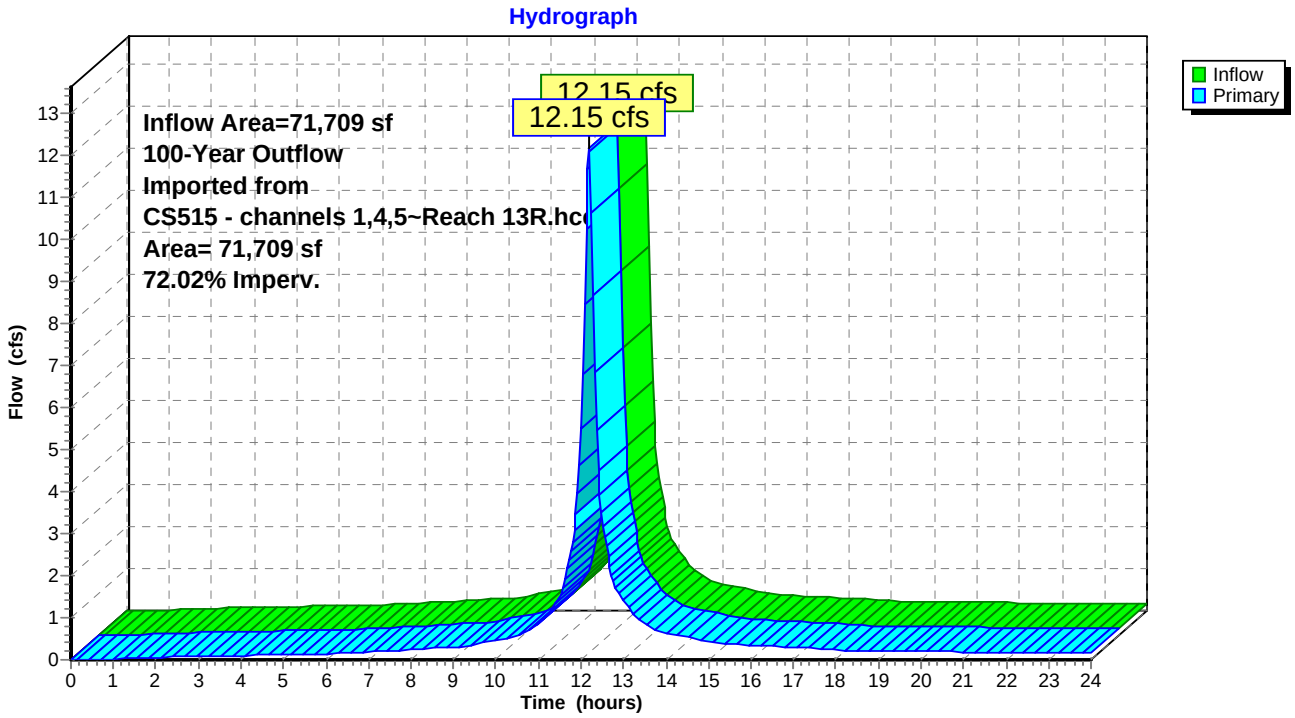
Summary for Link 16L: C-5

Inflow Area = 71,709 sf, 72.02% Impervious, Inflow Depth > 7.47" for 100-Year event
Inflow = 12.15 cfs @ 12.19 hrs, Volume= 44,634 cf
Primary = 12.15 cfs @ 12.19 hrs, Volume= 44,634 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs

100-Year Outflow Imported from CS515 - channels 1,4,5~Reach 13R.hce

Link 16L: C-5



ATTACHMENT 4.4
CHANNEL DESIGN WORKSHEETS

STANDARD E&S WORKSHEET # 9
Time of Concentration

PROJECT NAME: Williams REAE – Compressor Station 515
LOCATION: Luzerne County, PA
PREPARED BY: CD DATE: 03/02/2021 **[Rev 02/2022]**
CHECKED BY: PW DATE: 03/02/2021 **[Rev 02/2022]**

Direct Entry Method

Path Number	Time (min)
C-1	5.0
C-2	5.0
C-3	5.0
C-4	5.0
C-5	5.0

Channel Dimensions

Path Number	Bottom Width (ft)	Left Side Slope (H:V)	Right Side Slope (H:V)	Total Depth (ft)	Top Width (ft)
C-1	4	3	3	1.25	11.5
C-2	2	3	3	1.00	8.0
C-3	2	3	3	1.00	8.0
C-4	2	3	3	1.25	9.5
C-5	4	3	3	1.25	11.5
Spillway	12	2	2	1.00	16.0

STANDARD E&S WORKSHEET # 11
Channel Design Data

PROJECT NAME: Williams REAE – Compressor Station 515
LOCATION: Luzerne County, PA
PREPARED BY: CD DATE: 03/01/2021 **[Rev 02/2022]**
CHECKED BY: PW DATE: 03/01/2021 **[Rev 02/2022]**

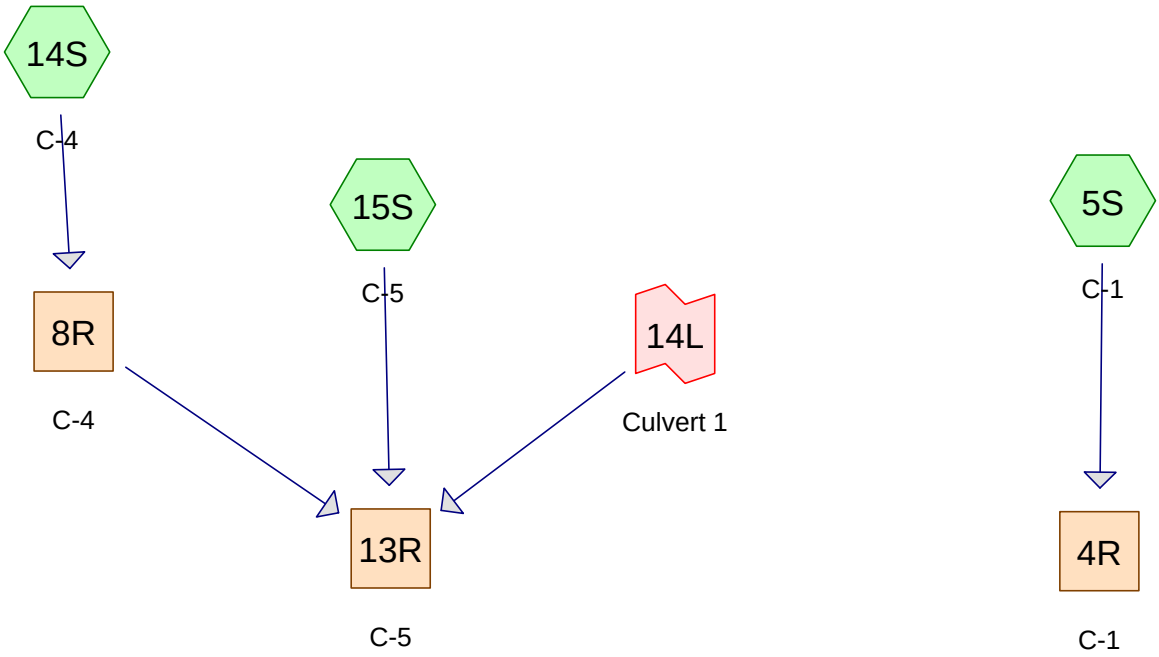
CHANNEL OR CHANNEL SECTION		C-1	C-1	C-2	C-3	C-4
TEMPORARY OR PERMANENT?	(T OR P)	P	P	P	P	P
DESIGN STORM	(2, 5, OR 10 YR)	10 YR	10 YR	10 YR	10 YR	10 YR
ACRES	(AC)	1.11	1.11	0.63	0.27	0.51
MULTIPLIER	(1.6, 2.25, or 2.75)[1]	N/A	N/A	N/A	N/A	N/A
Q_r (REQUIRED CAPACITY)	(CFS)	5.68	5.68	3.34	1.44	2.37
Q (CALCULATED AT FLOW DEPTH d)	(CFS)	5.68	5.68	3.34	1.44	2.37
PROTECTIVE LINING[2]		SC150BN	Grass	R-3 Riprap	R-3 Riprap	SC150BN
n (MANNING'S COEFFICIENT)[2]		0.050	0.050	0.0435	0.0566	0.050
V_a (ALLOWABLE VELOCITY)	(FPS)	8.0	4.5	6.5	6.5	8.0
V (CALCULATED AT FLOW DEPTH d)	(FPS)	2.8	2.8	1.9	2.1	1.7
τ_a (MAX ALLOWABLE SHEAR STRESS)	(LB/FT^2)	-	-	-	-	-
τ_d (CALC'D SHEAR STRESS AT FLOW DEPTH d)	(LB/FT^2)	-	-	-	-	-
CHANNEL BOTTOM WIDTH	(FT)	4	4	2	2	2
CHANNEL SIDE SLOPES	(H:V)	3	3	3	3	3
D (TOTAL DEPTH)	(FT)	1.25	1.25	1.00	1.00	1.25
CHANNEL TOP WIDTH @ D	(FT)	11.50	11.50	8.00	8.00	9.5
d (CALCULATED FLOW DEPTH)	(FT)	0.39	0.39	0.50	0.25	0.42
CHANNEL TOP WIDTH @ FLOW DEPTH d	(FT)	6.36	6.36	4.99	3.50	4.52
BOTTOM WIDTH: FLOW DEPTH RATIO	(12:1 MAX)	10.16	10.16	4.01	7.97	4.77
d_{50} STONE SIZE	(IN)	-	-	3	3	-
A (CROSS-SECTIONAL AREA)	(SQ. FT.)	2.039	2.039	1.741	0.690	1.368
R (HYDRAULIC RADIUS)	(FT)	0.314	0.314	0.338	0.193	0.294
S (BED SLOPE)[3]	(FT/FT)	0.041	0.041	0.013	0.057	0.017
S_c (CRITICAL SLOPE)	(FT/FT)	0.055	0.055	0.041	0.083	0.056
$.7S_c$	(FT/FT)	0.04	0.04	0.03	0.06	0.04
$1.3S_c$	(FT/FT)	0.07	0.07	0.05	0.11	0.07
STABLE FLOW?	(Y/N)	N	N	Y	Y	Y
FREEBOARD BASED ON UNSTABLE FLOW	(FT)	0.08	0.08	-	-	-
FREEBOARD BASED ON STABLE FLOW	(FT)	-	-	0.13	0.06	0.10
MINIMUM REQUIRED FREEBOARD[4]	(FT)	0.5	0.5	0.5	0.5	0.5
DESIGN METHOD FOR PROTECTIVE LINING [5] PERMISSIBLE VELOCITY (V) OR SHEAR STRESS (S)		V	V	V	V	V

1. Use 1.6 for Temporary Channels; 2.25 for Temporary Channels in Special Protection (HQ or EV) Watersheds; 2.75 for Permanent Channels. For Rational Method, enter "N/A" and attach E&S Worksheets 9 and 10. For TR-55 enter "N/A" and attach appropriate Worksheets.
2. Adjust "n" value for changes in channel liner and flow depth. For vegetated channels, provide data for manufactured linings without vegetation and with vegetation in separate columns.
3. Slopes may not be averaged.
4. Minimum Freeboard is 0.5 ft. or ¼ Total Channel Depth, whichever is greater
5. Permissible velocity lining design method is not acceptable for channels with a bed slope of 10% or greater. Shear stress lining design method is required for channels with a bed slope of 10% or greater. Shear stress lining design method may be used for any channel bed slope.

CHANNEL OR CHANNEL SECTION		C-4	C-5	C-5	Spillway	
TEMPORARY OR PERMANENT?	(T OR P)	P	P	P	P	
DESIGN STORM	(2, 5, OR 10 YR)	10 YR	10 YR	10 YR	100 YR	
ACRES	(AC)	0.51	1.64	1.64	4.54	
MULTIPLIER	(1.6, 2.25, or 2.75)[1]	N/A	N/A	N/A	N/A	
Q_r (REQUIRED CAPACITY)	(CFS)	2.37	7.04	7.04	24.23	
Q (CALCULATED AT FLOW DEPTH d)	(CFS)	2.37	7.04	7.04	24.8	
PROTECTIVE LINING[2]		Grass	SC150BN	Grass	R-4 Riprap	
n (MANNING'S COEFFICIENT)[2]		0.07	0.050	0.050	0.074	
V_a (ALLOWABLE VELOCITY)	(FPS)	4.5	8.0	4.5	9	
V (CALCULATED AT FLOW DEPTH d)	(FPS)	1.3	3.0	3.0	5.1	
τ_a (MAX ALLOWABLE SHEAR STRESS)	(LB/FT^2)	-	-	-	-	
τ_d (CALC'D SHEAR STRESS AT FLOW DEPTH d)	(LB/FT^2)	-	-	-	-	
CHANNEL BOTTOM WIDTH	(FT)	2	4	4	12	
CHANNEL SIDE SLOPES	(H:V)	3	3	3	2	
D (TOTAL DEPTH)	(FT)	1.25	1.25	1.25	1.00	
CHANNEL TOP WIDTH @ D	(FT)	9.50	11.50	11.50	16.00	
d (CALCULATED FLOW DEPTH)	(FT)	0.51	0.45	0.45	0.38	
CHANNEL TOP WIDTH @ FLOW DEPTH d	(FT)	5.06	6.67	6.67	13.54	
BOTTOM WIDTH: FLOW DEPTH RATIO	(12:1 MAX)	3.93	8.99	8.99	31.25	
d_{50} STONE SIZE	(IN)	-	-	-	6	
A (CROSS-SECTIONAL AREA)	(SQ. FT.)	1.797	2.374	2.374	4.903	
R (HYDRAULIC RADIUS)	(FT)	0.344	0.348	0.348	0.357	
S (BED SLOPE)[3]	(FT/FT)	0.017	0.041	0.041	0.250	
S_c (CRITICAL SLOPE)	(FT/FT)	0.114	0.053	0.053	0.114	
$.7S_c$	(FT/FT)	0.08	0.04	0.04	0.08	
$1.3S_c$	(FT/FT)	0.15	0.07	0.07	0.15	
STABLE FLOW?	(Y/N)	Y	N	N	Y	
FREEBOARD BASED ON UNSTABLE FLOW	(FT)	-	0.10	0.10	-	
FREEBOARD BASED ON STABLE FLOW	(FT)	0.13	-	-	0.1	
MINIMUM REQUIRED FREEBOARD[4]	(FT)	0.5	0.5	0.5	0.5	
DESIGN METHOD FOR PROTECTIVE LINING [5] PERMISSIBLE VELOCITY (V) OR SHEAR STRESS (S)		V	V	V	V	

1. Use 1.6 for Temporary Channels; 2.25 for Temporary Channels in Special Protection (HQ or EV) Watersheds; 2.75 for Permanent Channels. For Rational Method, enter "N/A" and attach E&S Worksheets 9 and 10. For TR-55 enter "N/A" and attach appropriate Worksheets.
2. Adjust "n" value for changes in channel liner and flow depth. For vegetated channels, provide data for manufactured linings without vegetation and with vegetation in separate columns.
3. Slopes may not be averaged.
4. Minimum Freeboard is 0.5 ft. or ¼ Total Channel Depth, whichever is greater
5. Permissible velocity lining design method is not acceptable for channels with a bed slope of 10% or greater. Shear stress lining design method is required for channels with a bed slope of 10% or greater. Shear stress lining design method may be used for any channel bed slope.

ATTACHMENT 4.5
CHANNEL HYDROCAD REPORTS



Subcat Reach Pond Link

Routing Diagram for CS515 - channels 1,4,5
Prepared by Microsoft, Printed 2/24/2022

Project Notes

Rainfall events imported from "NRCS-Rain.txt" for 7639 PA Luzerne-C

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.661	78	Meadow, non-grazed, HSG D (5S, 14S, 15S)
1.193	98	Paved parking, HSG D (5S, 14S, 15S)
1.854	**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	
1.854	HSG D	5S, 14S, 15S
0.000	Other	
1.854		**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	0.661	0.000	0.661	Meadow, non-grazed	5S, 14S, 15S
0.000	0.000	0.000	1.193	0.000	1.193	Paved parking	5S, 14S, 15S
0.000	**0.000**	**0.000**	**1.854**	**0.000**	**1.854**	**TOTAL AREA**	

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 5S: C-1 Runoff Area=48,290 sf 81.96% Impervious Runoff Depth>2.25"
Tc=5.0 min CN=94 Runoff=3.10 cfs 0.208 af

Subcatchment 14S: C-4 Runoff Area=22,384 sf 52.25% Impervious Runoff Depth>1.73"
Tc=5.0 min CN=88 Runoff=1.16 cfs 0.074 af

Subcatchment 15S: C-5 Runoff Area=10,073 sf 6.95% Impervious Runoff Depth>1.11"
Tc=5.0 min CN=79 Runoff=0.34 cfs 0.021 af

Reach 4R: C-1 Avg. Flow Depth=0.28' Max Vel=2.20 fps Inflow=3.10 cfs 0.208 af
n=0.050 L=72.0' S=0.0382 '/' Capacity=49.04 cfs Outflow=3.00 cfs 0.208 af

Reach 8R: C-4 Avg. Flow Depth=0.27' Max Vel=1.35 fps Inflow=1.16 cfs 0.074 af
n=0.050 L=345.8' S=0.0174 '/' Capacity=22.72 cfs Outflow=0.97 cfs 0.074 af

Reach 13R: C-5 Avg. Flow Depth=0.30' Max Vel=2.37 fps Inflow=3.61 cfs 0.295 af
n=0.050 L=258.5' S=0.0406 '/' Capacity=50.57 cfs Outflow=3.44 cfs 0.294 af

Link 14L: 1-Year Outflow Imported from CS515 - channels 2.3~Reach 7R.hce Inflow=2.53 cfs 0.200 af
Area= 0.901 ac 100.00% Imperv. Primary=2.53 cfs 0.200 af

Total Runoff Area = 1.854 ac Runoff Volume = 0.303 af Average Runoff Depth = 1.96"
35.63% Pervious = 0.661 ac 64.37% Impervious = 1.193 ac

Summary for Subcatchment 5S: C-1

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

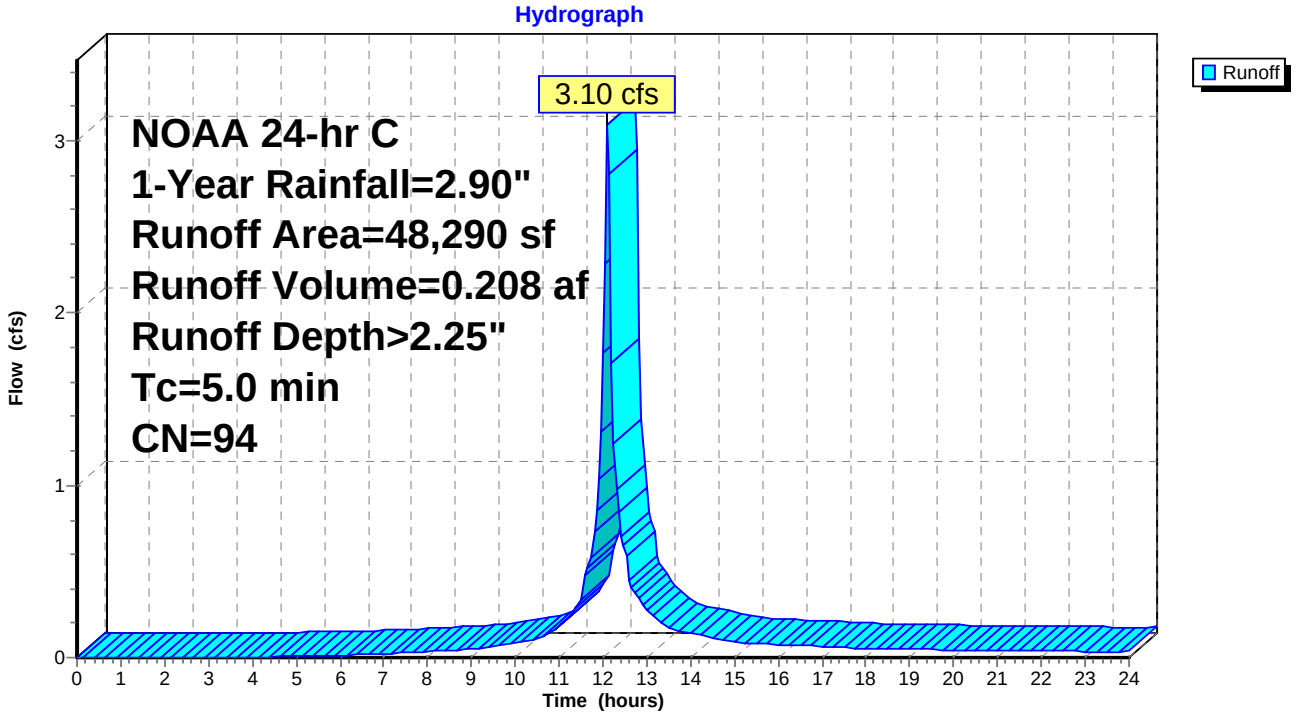
Runoff = 3.10 cfs @ 12.11 hrs, Volume= 0.208 af, Depth> 2.25"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 1-Year Rainfall=2.90"

	Area (sf)	CN	Description
*	39,580	98	Paved parking, HSG D
	8,710	78	Meadow, non-grazed, HSG D
	48,290	94	Weighted Average
	8,710		18.04% Pervious Area
	39,580		81.96% Impervious Area

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

Subcatchment 5S: C-1



Summary for Subcatchment 14S: C-4

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

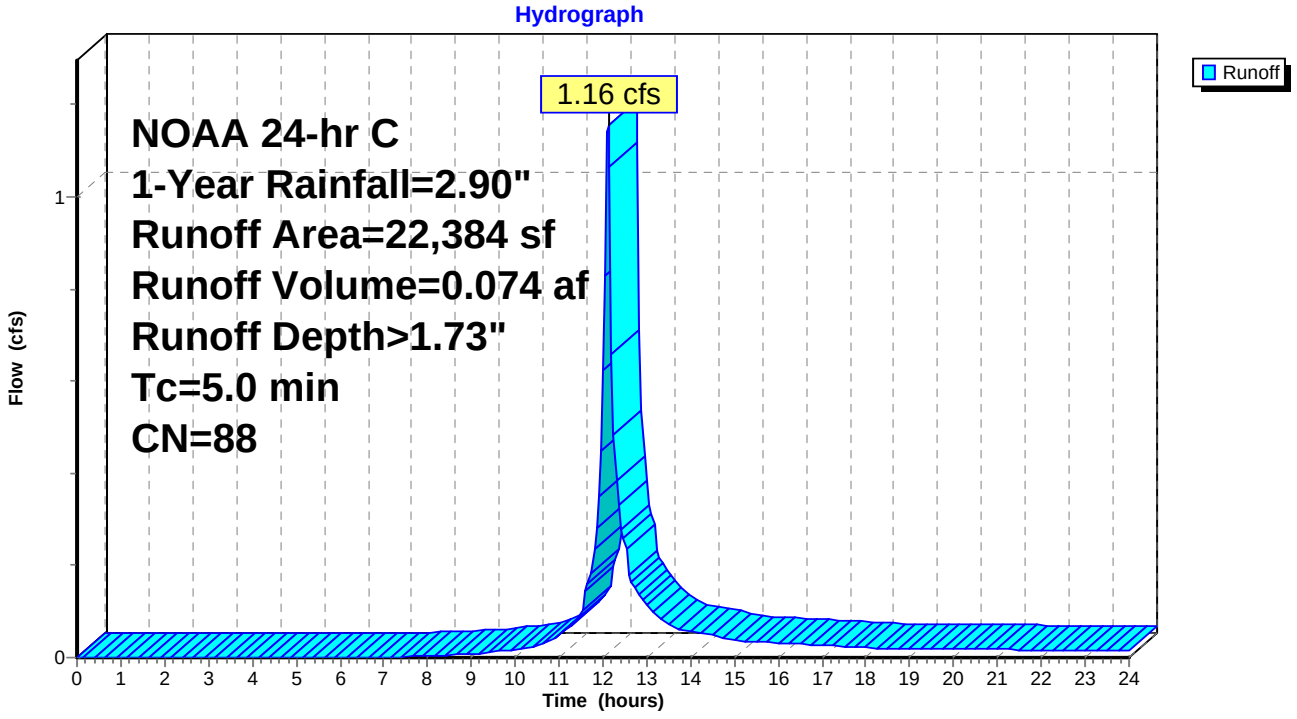
Runoff = 1.16 cfs @ 12.12 hrs, Volume= 0.074 af, Depth> 1.73"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 1-Year Rainfall=2.90"

Area (sf)	CN	Description
11,695	98	Paved parking, HSG D
10,689	78	Meadow, non-grazed, HSG D
22,384	88	Weighted Average
10,689		47.75% Pervious Area
11,695		52.25% Impervious Area

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

Subcatchment 14S: C-4



Summary for Subcatchment 15S: C-5

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

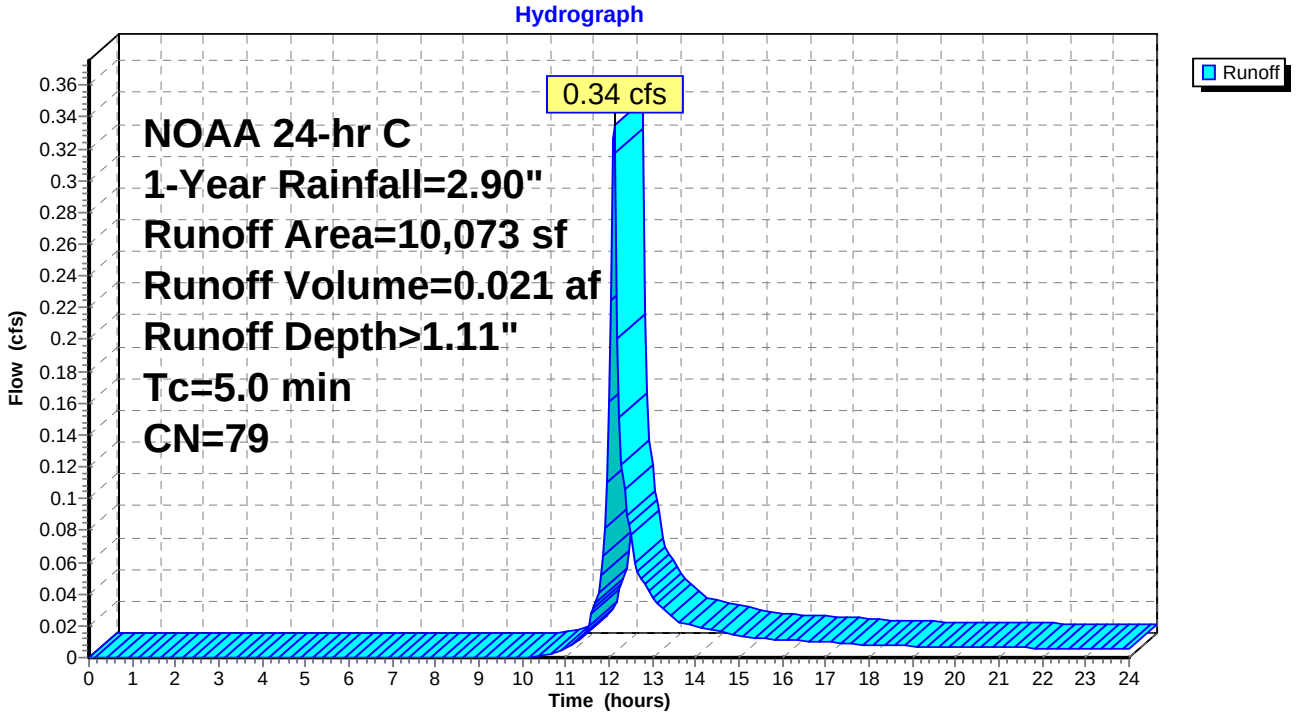
Runoff = 0.34 cfs @ 12.12 hrs, Volume= 0.021 af, Depth> 1.11"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 1-Year Rainfall=2.90"

Area (sf)	CN	Description
700	98	Paved parking, HSG D
9,373	78	Meadow, non-grazed, HSG D
10,073	79	Weighted Average
9,373		93.05% Pervious Area
700		6.95% Impervious Area

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

Subcatchment 15S: C-5



Summary for Reach 4R: C-1

Inflow Area = 1.109 ac, 81.96% Impervious, Inflow Depth > 2.25" for 1-Year event
Inflow = 3.10 cfs @ 12.11 hrs, Volume= 0.208 af
Outflow = 3.00 cfs @ 12.13 hrs, Volume= 0.208 af, Atten= 3%, Lag= 1.1 min

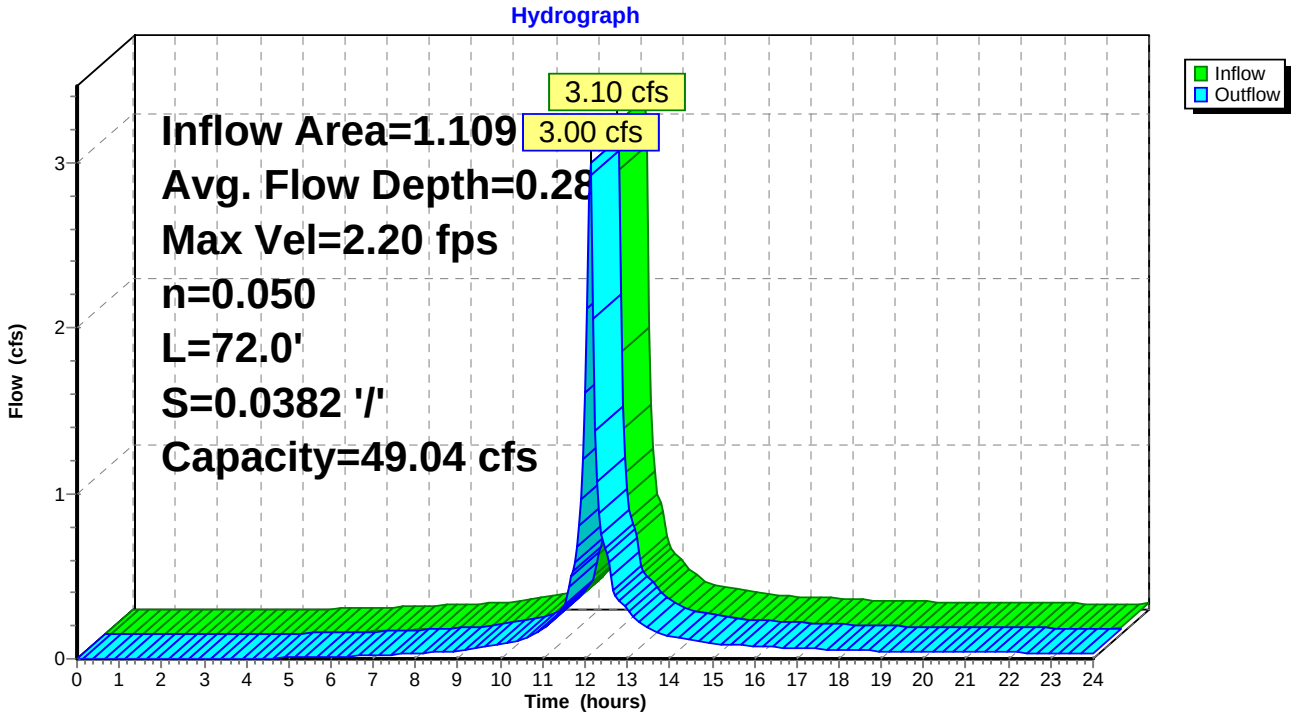
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.20 fps, Min. Travel Time= 0.5 min
Avg. Velocity = 0.57 fps, Avg. Travel Time= 2.1 min

Peak Storage= 98 cf @ 12.12 hrs
Average Depth at Peak Storage= 0.28'
Bank-Full Depth= 1.25' Flow Area= 9.7 sf, Capacity= 49.04 cfs

4.00' x 1.25' deep channel, n= 0.050
Side Slope Z-value= 3.0 '/' Top Width= 11.50'
Length= 72.0' Slope= 0.0382 '/'
Inlet Invert= 1,937.75', Outlet Invert= 1,935.00'

‡

Reach 4R: C-1



Summary for Reach 8R: C-4

Inflow Area = 0.514 ac, 52.25% Impervious, Inflow Depth > 1.73" for 1-Year event
Inflow = 1.16 cfs @ 12.12 hrs, Volume= 0.074 af
Outflow = 0.97 cfs @ 12.23 hrs, Volume= 0.074 af, Atten= 16%, Lag= 6.8 min

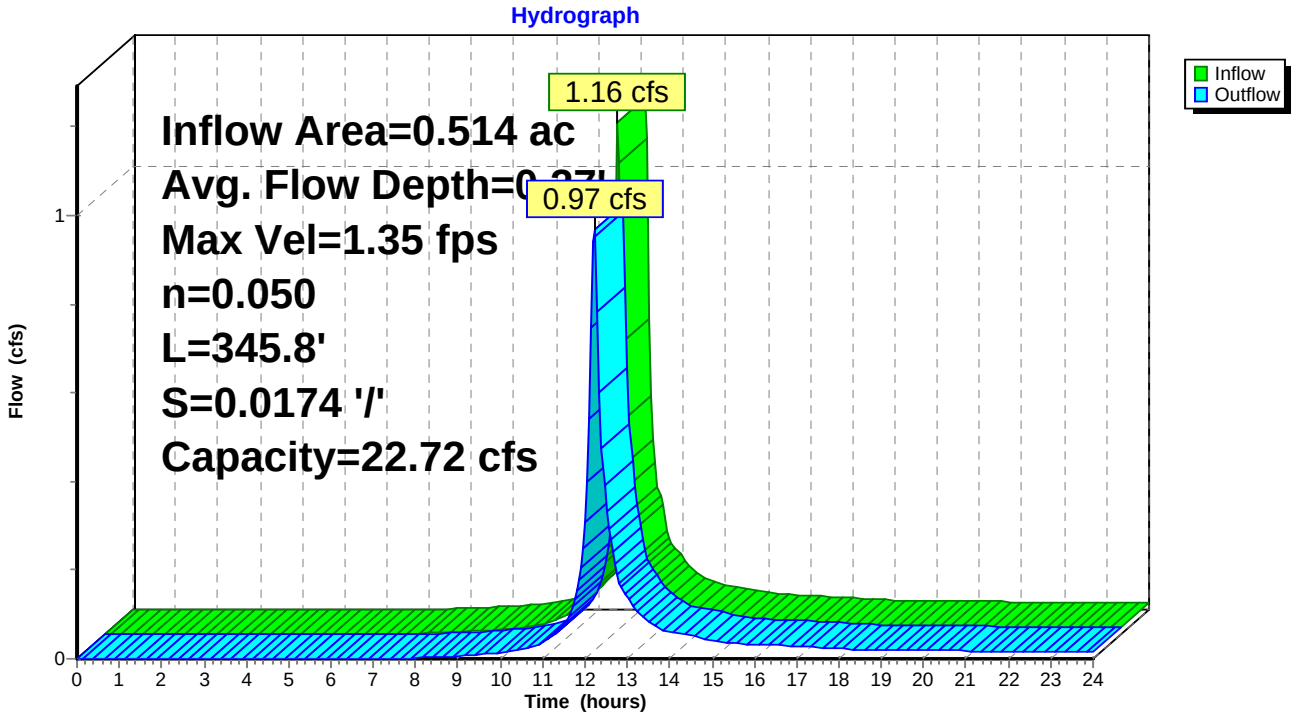
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.35 fps, Min. Travel Time= 4.3 min
Avg. Velocity = 0.41 fps, Avg. Travel Time= 14.1 min

Peak Storage= 260 cf @ 12.16 hrs
Average Depth at Peak Storage= 0.27'
Bank-Full Depth= 1.25' Flow Area= 7.2 sf, Capacity= 22.72 cfs

2.00' x 1.25' deep channel, n= 0.050
Side Slope Z-value= 3.0 '/' Top Width= 9.50'
Length= 345.8' Slope= 0.0174 '/'
Inlet Invert= 1,940.00', Outlet Invert= 1,934.00'

‡

Reach 8R: C-4



Summary for Reach 13R: C-5

[62] Hint: Exceeded Reach 8R OUTLET depth by 1.56' @ 12.25 hrs

Inflow Area = 1.646 ac, 72.02% Impervious, Inflow Depth > 2.15" for 1-Year event
Inflow = 3.61 cfs @ 12.16 hrs, Volume= 0.295 af
Outflow = 3.44 cfs @ 12.21 hrs, Volume= 0.294 af, Atten= 5%, Lag= 3.2 min

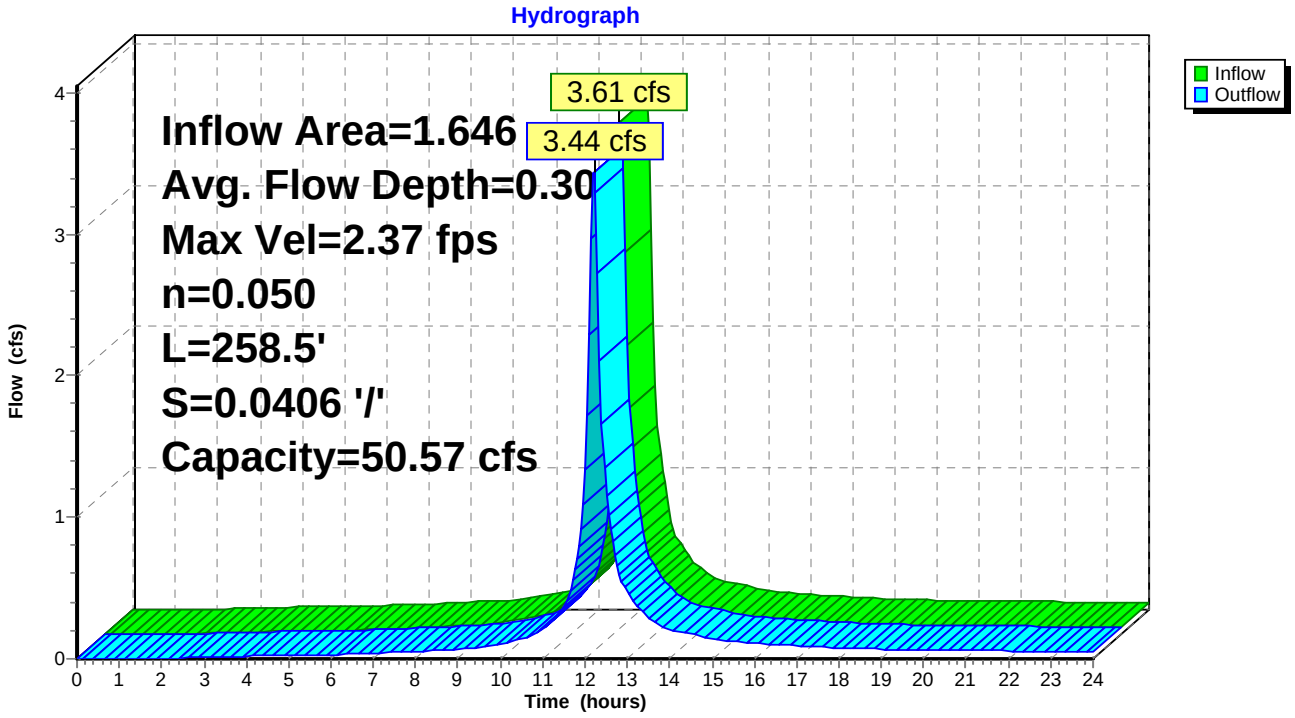
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.37 fps, Min. Travel Time= 1.8 min
Avg. Velocity = 0.63 fps, Avg. Travel Time= 6.8 min

Peak Storage= 383 cf @ 12.18 hrs
Average Depth at Peak Storage= 0.30'
Bank-Full Depth= 1.25' Flow Area= 9.7 sf, Capacity= 50.57 cfs

4.00' x 1.25' deep channel, n= 0.050
Side Slope Z-value= 3.0 '/' Top Width= 11.50'
Length= 258.5' Slope= 0.0406 '/'
Inlet Invert= 1,935.50', Outlet Invert= 1,925.00'

‡

Reach 13R: C-5



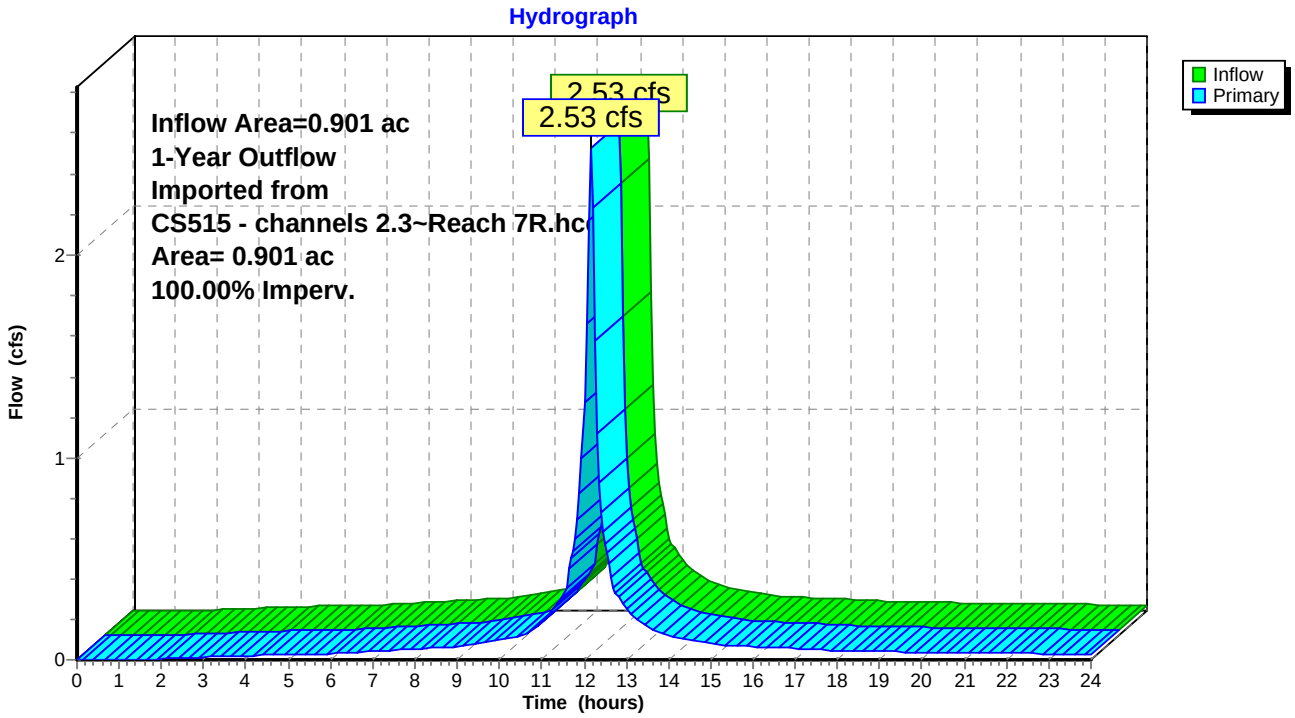
Summary for Link 14L: Culvert 1

Inflow Area = 0.901 ac,100.00% Impervious, Inflow Depth > 2.66" for 1-Year event
Inflow = 2.53 cfs @ 12.15 hrs, Volume= 0.200 af
Primary = 2.53 cfs @ 12.15 hrs, Volume= 0.200 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

1-Year Outflow Imported from CS515 - channels 2.3~Reach 7R.hce

Link 14L: Culvert 1



Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 5S: C-1 Runoff Area=48,290 sf 81.96% Impervious Runoff Depth>2.74"
Tc=5.0 min CN=94 Runoff=3.72 cfs 0.253 af

Subcatchment 14S: C-4 Runoff Area=22,384 sf 52.25% Impervious Runoff Depth>2.18"
Tc=5.0 min CN=88 Runoff=1.44 cfs 0.093 af

Subcatchment 15S: C-5 Runoff Area=10,073 sf 6.95% Impervious Runoff Depth>1.49"
Tc=5.0 min CN=79 Runoff=0.45 cfs 0.029 af

Reach 4R: C-1 Avg. Flow Depth=0.31' Max Vel=2.34 fps Inflow=3.72 cfs 0.253 af
n=0.050 L=72.0' S=0.0382 '/' Capacity=49.04 cfs Outflow=3.61 cfs 0.253 af

Reach 8R: C-4 Avg. Flow Depth=0.30' Max Vel=1.45 fps Inflow=1.44 cfs 0.093 af
n=0.050 L=345.8' S=0.0174 '/' Capacity=22.72 cfs Outflow=1.24 cfs 0.093 af

Reach 13R: C-5 Avg. Flow Depth=0.34' Max Vel=2.53 fps Inflow=4.41 cfs 0.359 af
n=0.050 L=258.5' S=0.0406 '/' Capacity=50.57 cfs Outflow=4.21 cfs 0.358 af

Link 14L: 2-Year Outflow Imported from CS515 - channels 2.3~Reach 7R.hce Inflow=2.99 cfs 0.237 af
Area= 0.901 ac 100.00% Imperv. Primary=2.99 cfs 0.237 af

Total Runoff Area = 1.854 ac Runoff Volume = 0.375 af Average Runoff Depth = 2.42"
35.63% Pervious = 0.661 ac 64.37% Impervious = 1.193 ac

Summary for Subcatchment 5S: C-1

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

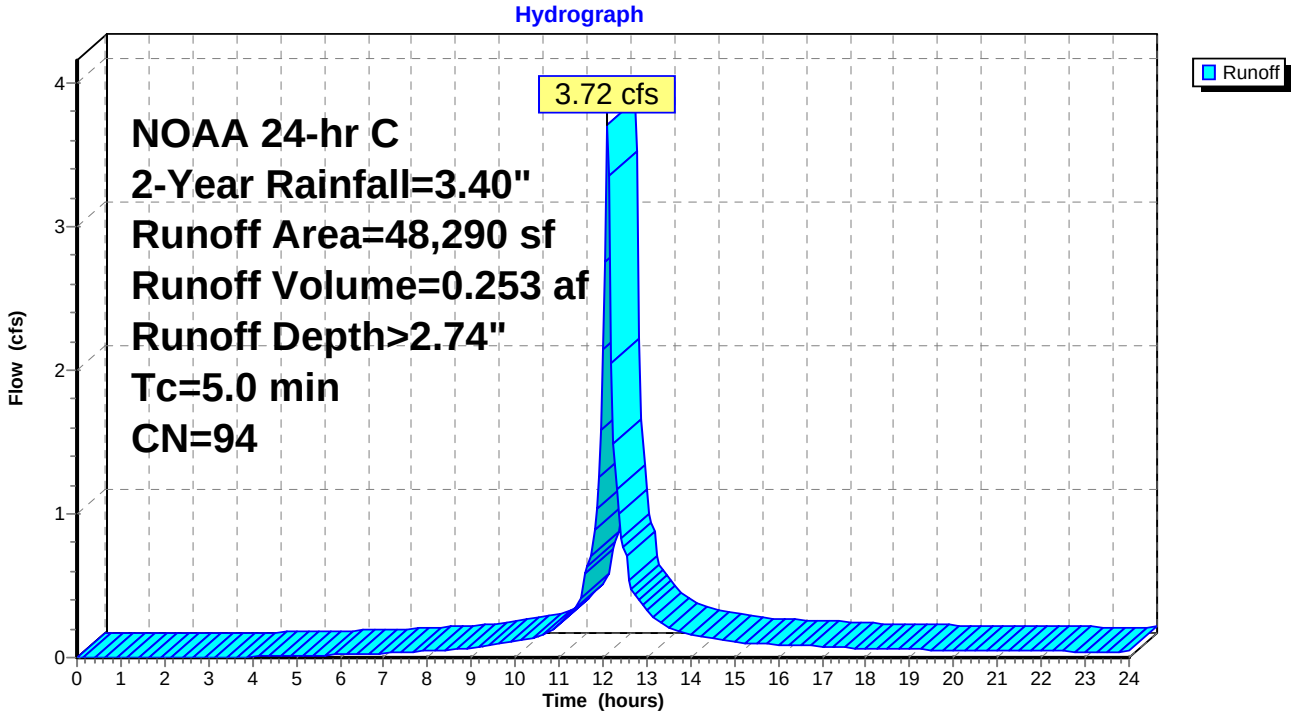
Runoff = 3.72 cfs @ 12.11 hrs, Volume= 0.253 af, Depth> 2.74"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 2-Year Rainfall=3.40"

	Area (sf)	CN	Description
*	39,580	98	Paved parking, HSG D
	8,710	78	Meadow, non-grazed, HSG D
	48,290	94	Weighted Average
	8,710		18.04% Pervious Area
	39,580		81.96% Impervious Area

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

Subcatchment 5S: C-1



Summary for Subcatchment 14S: C-4

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

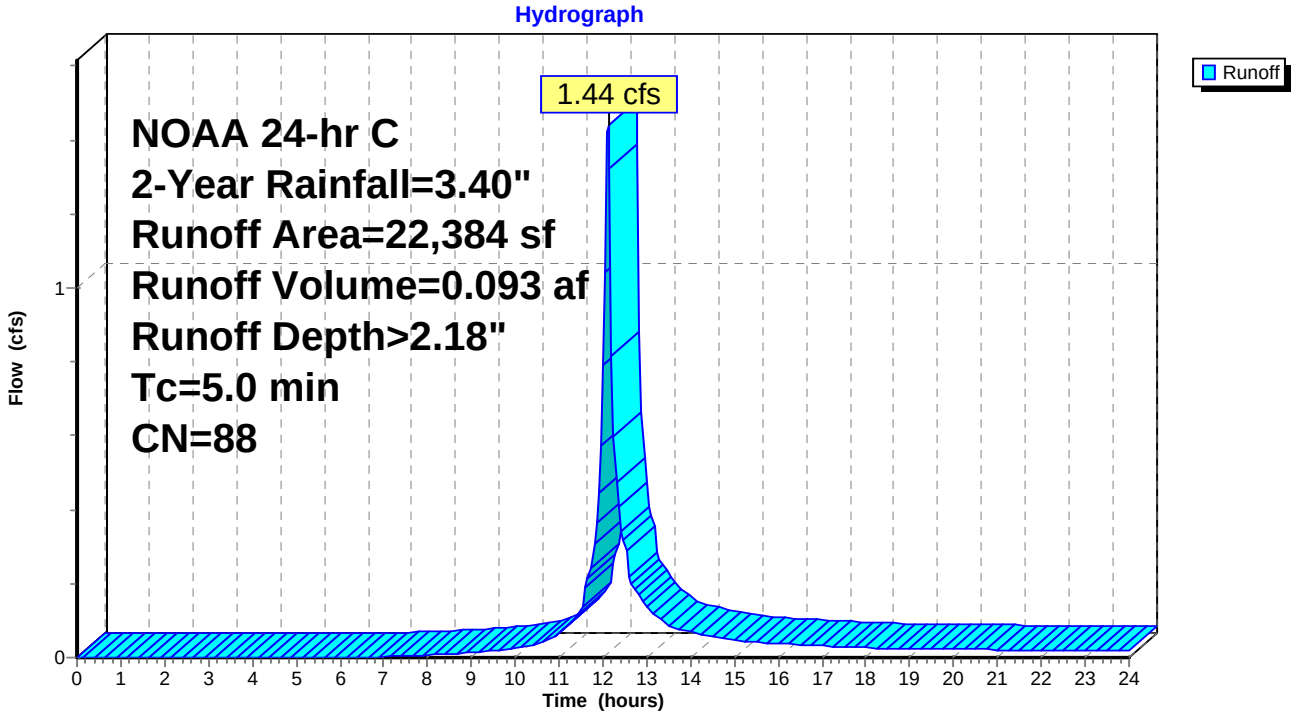
Runoff = 1.44 cfs @ 12.11 hrs, Volume= 0.093 af, Depth> 2.18"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 2-Year Rainfall=3.40"

Area (sf)	CN	Description
11,695	98	Paved parking, HSG D
10,689	78	Meadow, non-grazed, HSG D
22,384	88	Weighted Average
10,689		47.75% Pervious Area
11,695		52.25% Impervious Area

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

Subcatchment 14S: C-4



Summary for Subcatchment 15S: C-5

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

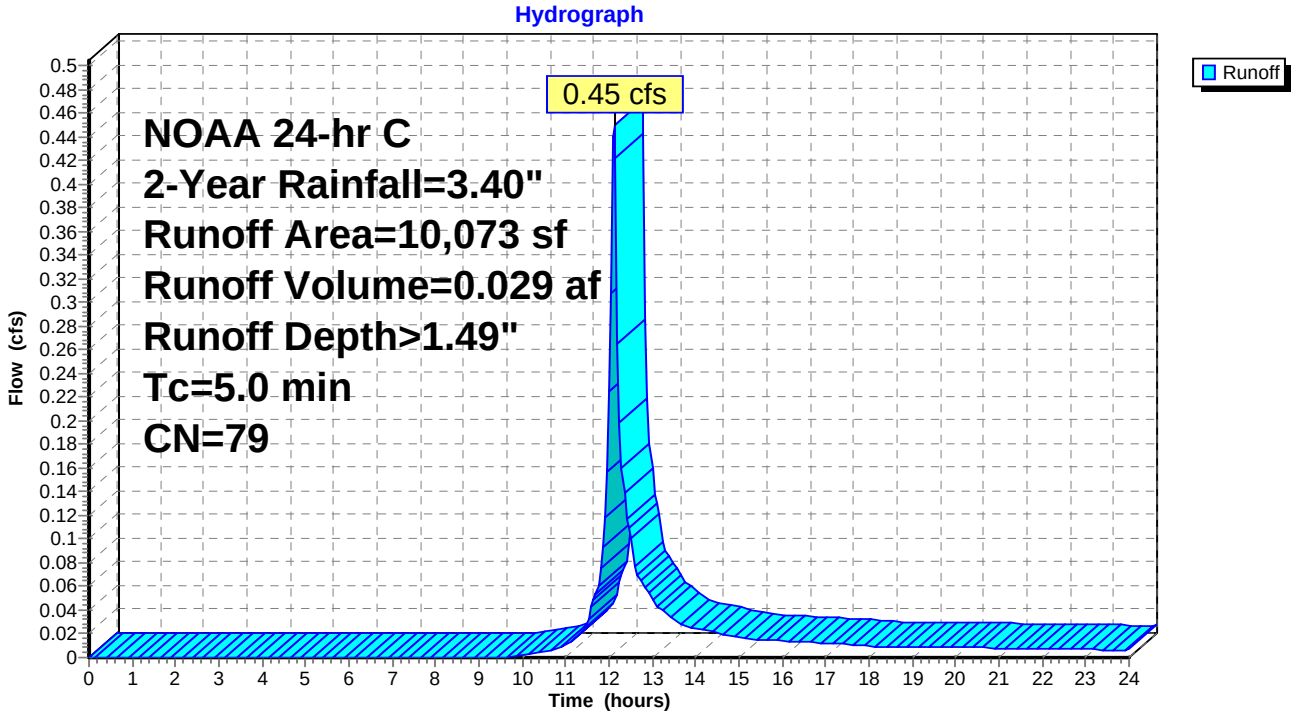
Runoff = 0.45 cfs @ 12.12 hrs, Volume= 0.029 af, Depth> 1.49"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 2-Year Rainfall=3.40"

Area (sf)	CN	Description
700	98	Paved parking, HSG D
9,373	78	Meadow, non-grazed, HSG D
10,073	79	Weighted Average
9,373		93.05% Pervious Area
700		6.95% Impervious Area

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

Subcatchment 15S: C-5



Summary for Reach 4R: C-1

Inflow Area = 1.109 ac, 81.96% Impervious, Inflow Depth > 2.74" for 2-Year event
Inflow = 3.72 cfs @ 12.11 hrs, Volume= 0.253 af
Outflow = 3.61 cfs @ 12.13 hrs, Volume= 0.253 af, Atten= 3%, Lag= 1.1 min

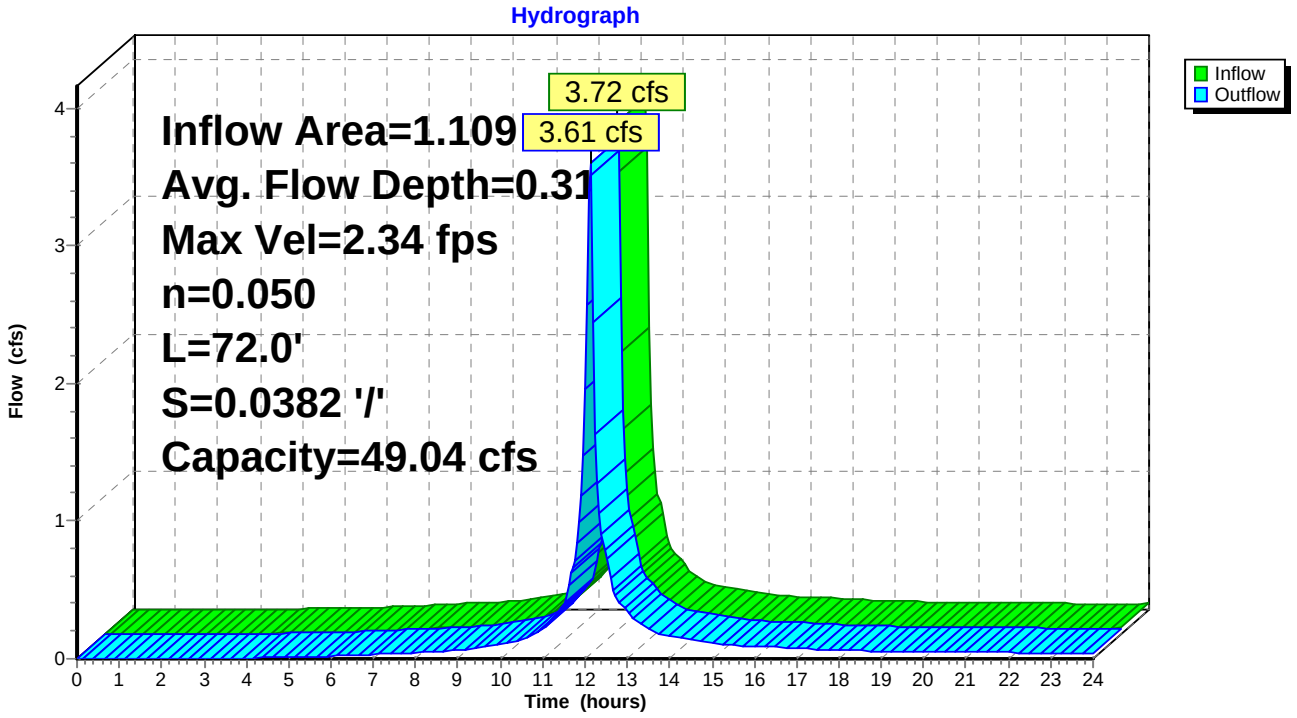
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.34 fps, Min. Travel Time= 0.5 min
Avg. Velocity = 0.61 fps, Avg. Travel Time= 2.0 min

Peak Storage= 111 cf @ 12.12 hrs
Average Depth at Peak Storage= 0.31'
Bank-Full Depth= 1.25' Flow Area= 9.7 sf, Capacity= 49.04 cfs

4.00' x 1.25' deep channel, n= 0.050
Side Slope Z-value= 3.0 '/' Top Width= 11.50'
Length= 72.0' Slope= 0.0382 '/'
Inlet Invert= 1,937.75', Outlet Invert= 1,935.00'

‡

Reach 4R: C-1



Summary for Reach 8R: C-4

Inflow Area = 0.514 ac, 52.25% Impervious, Inflow Depth > 2.18" for 2-Year event
Inflow = 1.44 cfs @ 12.11 hrs, Volume= 0.093 af
Outflow = 1.24 cfs @ 12.22 hrs, Volume= 0.093 af, Atten= 14%, Lag= 6.2 min

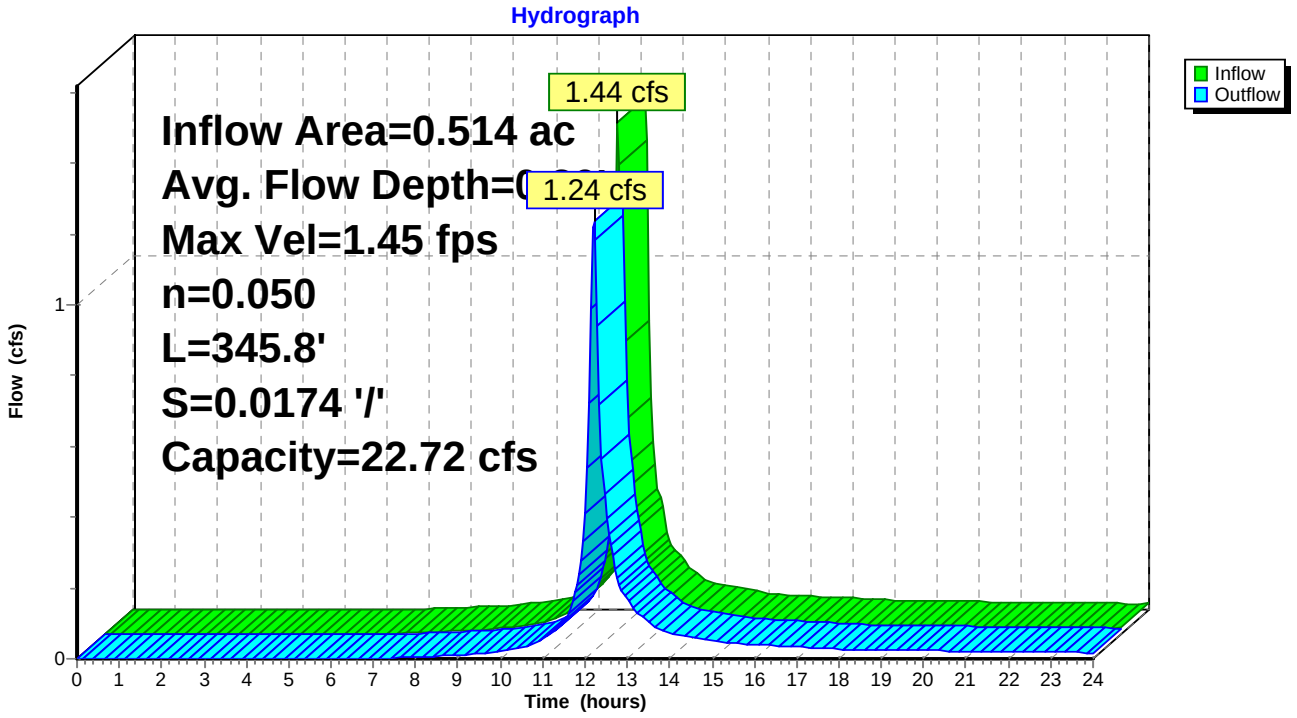
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.45 fps, Min. Travel Time= 4.0 min
Avg. Velocity = 0.44 fps, Avg. Travel Time= 13.2 min

Peak Storage= 306 cf @ 12.15 hrs
Average Depth at Peak Storage= 0.30'
Bank-Full Depth= 1.25' Flow Area= 7.2 sf, Capacity= 22.72 cfs

2.00' x 1.25' deep channel, n= 0.050
Side Slope Z-value= 3.0 '/' Top Width= 9.50'
Length= 345.8' Slope= 0.0174 '/'
Inlet Invert= 1,940.00', Outlet Invert= 1,934.00'

‡

Reach 8R: C-4



Summary for Reach 13R: C-5

[62] Hint: Exceeded Reach 8R OUTLET depth by 1.56' @ 12.25 hrs

Inflow Area = 1.646 ac, 72.02% Impervious, Inflow Depth > 2.61" for 2-Year event
Inflow = 4.41 cfs @ 12.16 hrs, Volume= 0.359 af
Outflow = 4.21 cfs @ 12.21 hrs, Volume= 0.358 af, Atten= 5%, Lag= 3.0 min

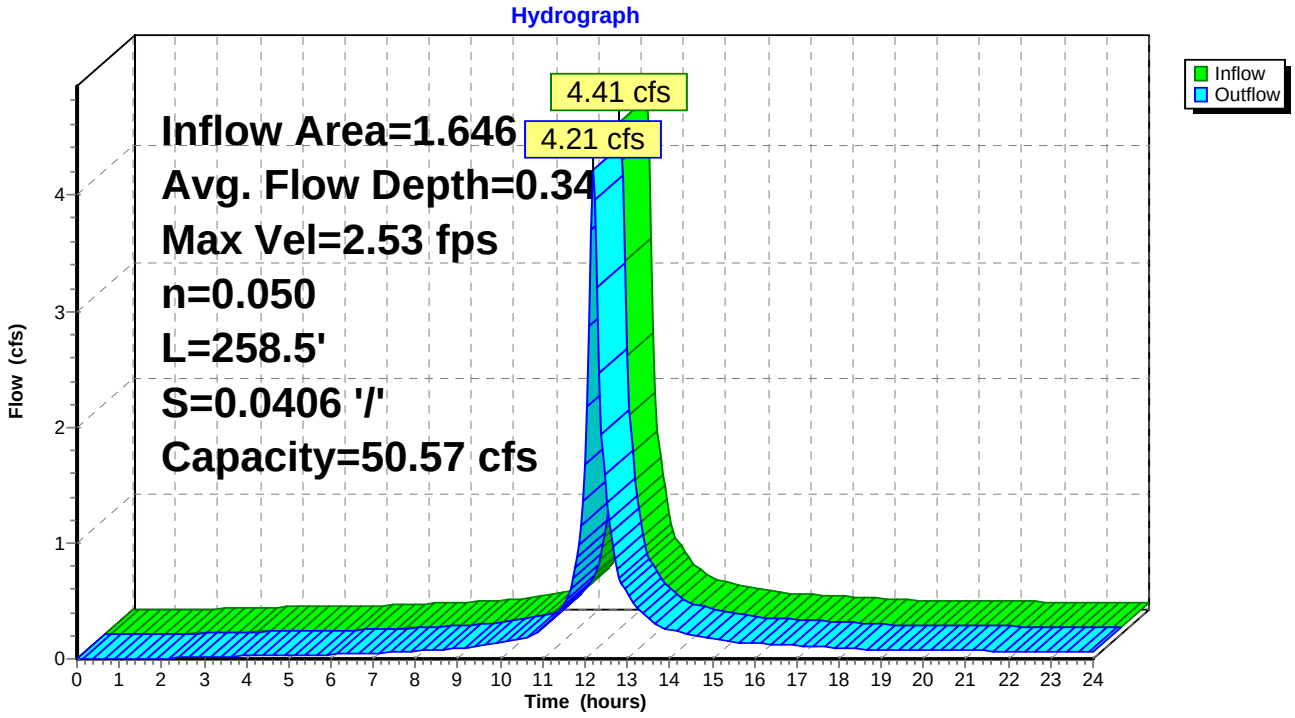
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.53 fps, Min. Travel Time= 1.7 min
Avg. Velocity = 0.68 fps, Avg. Travel Time= 6.3 min

Peak Storage= 439 cf @ 12.18 hrs
Average Depth at Peak Storage= 0.34'
Bank-Full Depth= 1.25' Flow Area= 9.7 sf, Capacity= 50.57 cfs

4.00' x 1.25' deep channel, n= 0.050
Side Slope Z-value= 3.0 '/' Top Width= 11.50'
Length= 258.5' Slope= 0.0406 '/'
Inlet Invert= 1,935.50', Outlet Invert= 1,925.00'

‡

Reach 13R: C-5



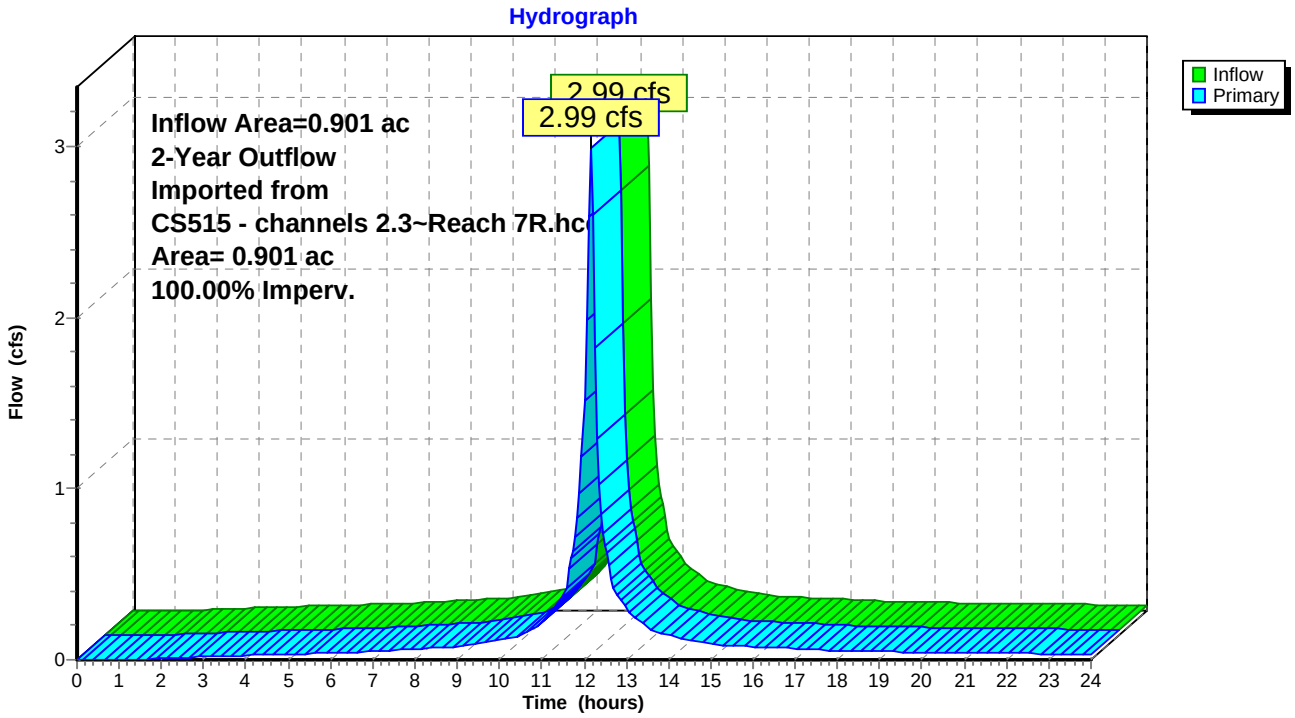
Summary for Link 14L: Culvert 1

Inflow Area = 0.901 ac,100.00% Impervious, Inflow Depth > 3.16" for 2-Year event
Inflow = 2.99 cfs @ 12.15 hrs, Volume= 0.237 af
Primary = 2.99 cfs @ 12.15 hrs, Volume= 0.237 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

2-Year Outflow Imported from CS515 - channels 2.3~Reach 7R.hce

Link 14L: Culvert 1



Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 5S: C-1 Runoff Area=48,290 sf 81.96% Impervious Runoff Depth>4.30"
Tc=5.0 min CN=94 Runoff=5.68 cfs 0.398 af

Subcatchment 14S: C-4 Runoff Area=22,384 sf 52.25% Impervious Runoff Depth>3.67"
Tc=5.0 min CN=88 Runoff=2.37 cfs 0.157 af

Subcatchment 15S: C-5 Runoff Area=10,073 sf 6.95% Impervious Runoff Depth>2.80"
Tc=5.0 min CN=79 Runoff=0.85 cfs 0.054 af

Reach 4R: C-1 Avg. Flow Depth=0.40' Max Vel=2.68 fps Inflow=5.68 cfs 0.398 af
n=0.050 L=72.0' S=0.0382 '/' Capacity=49.04 cfs Outflow=5.53 cfs 0.397 af

Reach 8R: C-4 Avg. Flow Depth=0.40' Max Vel=1.69 fps Inflow=2.37 cfs 0.157 af
n=0.050 L=345.8' S=0.0174 '/' Capacity=22.72 cfs Outflow=2.12 cfs 0.156 af

Reach 13R: C-5 Avg. Flow Depth=0.44' Max Vel=2.93 fps Inflow=7.04 cfs 0.567 af
n=0.050 L=258.5' S=0.0406 '/' Capacity=50.57 cfs Outflow=6.72 cfs 0.566 af

Link 14L: 10-Year Outflow Imported from CS515 - channels 2.3~Reach 7R.hce Inflow=4.46 cfs 0.357 af
Area= 0.901 ac 100.00% Imperv. Primary=4.46 cfs 0.357 af

Total Runoff Area = 1.854 ac Runoff Volume = 0.609 af Average Runoff Depth = 3.94"
35.63% Pervious = 0.661 ac 64.37% Impervious = 1.193 ac

Summary for Subcatchment 5S: C-1

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

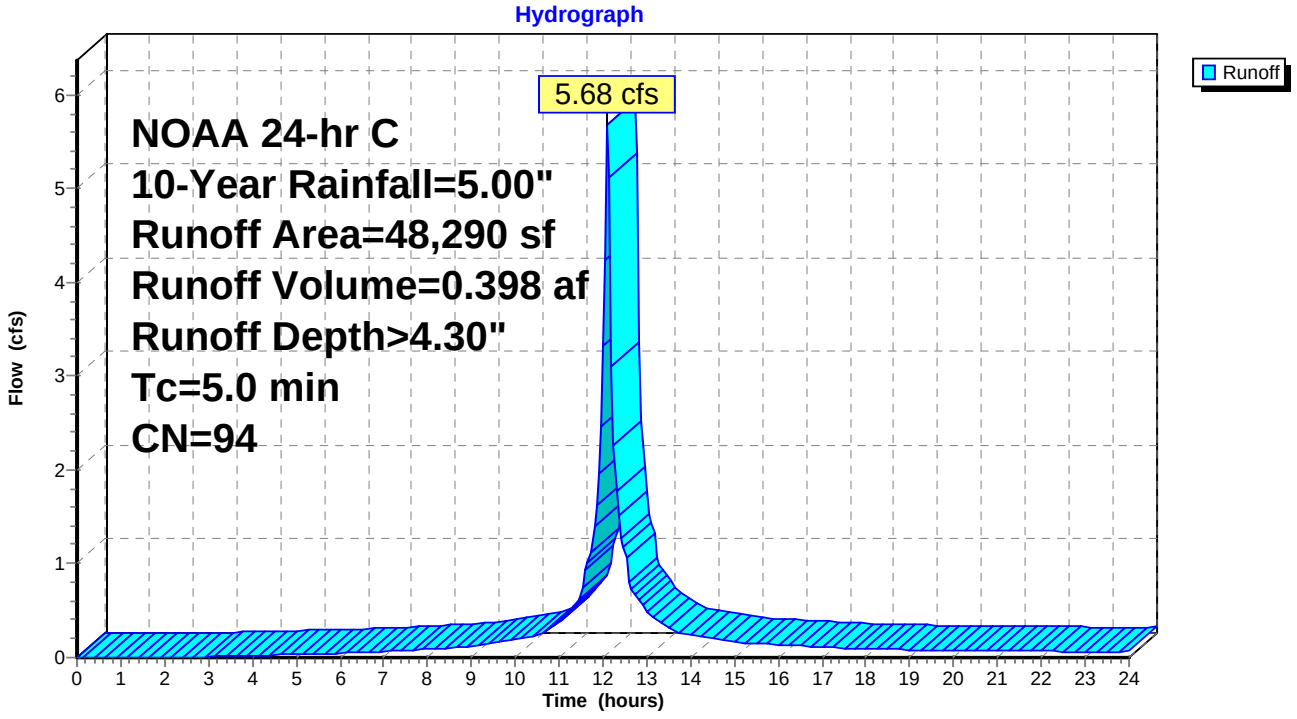
Runoff = 5.68 cfs @ 12.11 hrs, Volume= 0.398 af, Depth> 4.30"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 10-Year Rainfall=5.00"

	Area (sf)	CN	Description
*	39,580	98	Paved parking, HSG D
	8,710	78	Meadow, non-grazed, HSG D
	48,290	94	Weighted Average
	8,710		18.04% Pervious Area
	39,580		81.96% Impervious Area

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

Subcatchment 5S: C-1



Summary for Subcatchment 14S: C-4

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

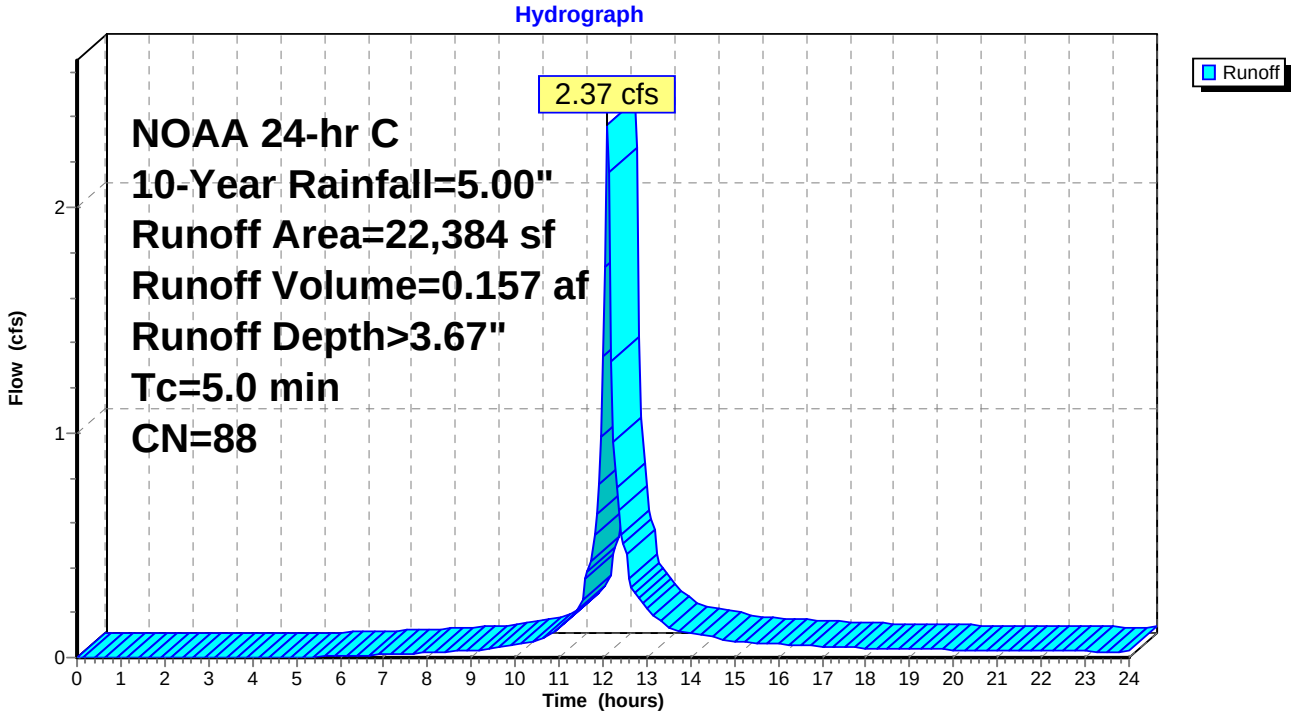
Runoff = 2.37 cfs @ 12.11 hrs, Volume= 0.157 af, Depth> 3.67"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 10-Year Rainfall=5.00"

Area (sf)	CN	Description
11,695	98	Paved parking, HSG D
10,689	78	Meadow, non-grazed, HSG D
22,384	88	Weighted Average
10,689		47.75% Pervious Area
11,695		52.25% Impervious Area

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

Subcatchment 14S: C-4



Summary for Subcatchment 15S: C-5

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

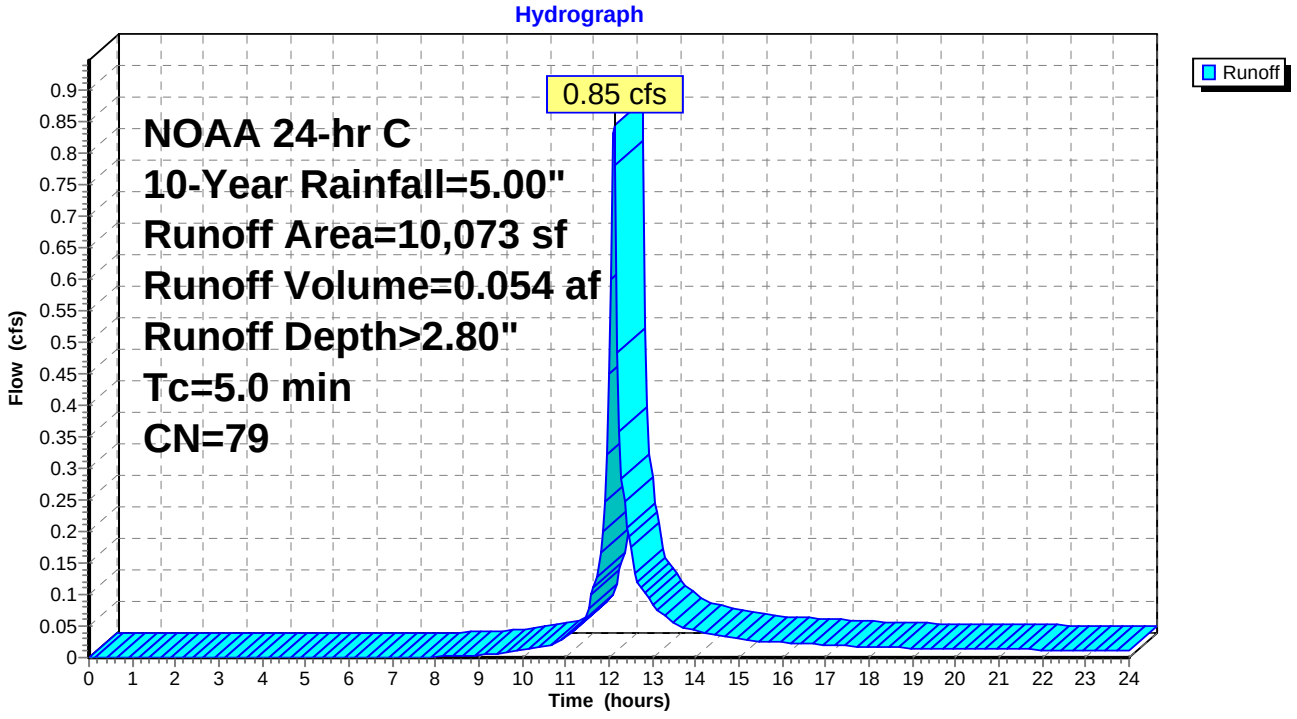
Runoff = 0.85 cfs @ 12.12 hrs, Volume= 0.054 af, Depth> 2.80"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 10-Year Rainfall=5.00"

Area (sf)	CN	Description
700	98	Paved parking, HSG D
9,373	78	Meadow, non-grazed, HSG D
10,073	79	Weighted Average
9,373		93.05% Pervious Area
700		6.95% Impervious Area

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

Subcatchment 15S: C-5



Summary for Reach 4R: C-1

Inflow Area = 1.109 ac, 81.96% Impervious, Inflow Depth > 4.30" for 10-Year event
Inflow = 5.68 cfs @ 12.11 hrs, Volume= 0.398 af
Outflow = 5.53 cfs @ 12.13 hrs, Volume= 0.397 af, Atten= 3%, Lag= 1.0 min

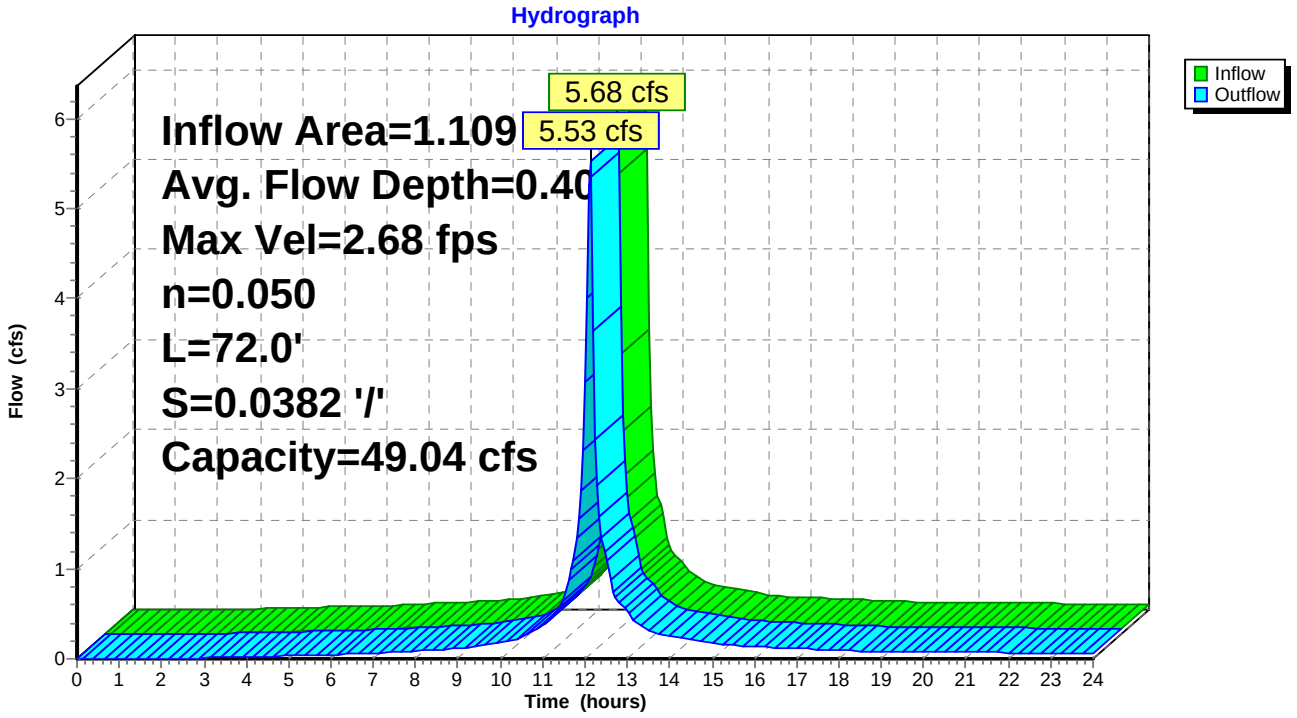
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.68 fps, Min. Travel Time= 0.4 min
Avg. Velocity = 0.71 fps, Avg. Travel Time= 1.7 min

Peak Storage= 149 cf @ 12.12 hrs
Average Depth at Peak Storage= 0.40'
Bank-Full Depth= 1.25' Flow Area= 9.7 sf, Capacity= 49.04 cfs

4.00' x 1.25' deep channel, n= 0.050
Side Slope Z-value= 3.0 '/' Top Width= 11.50'
Length= 72.0' Slope= 0.0382 '/'
Inlet Invert= 1,937.75', Outlet Invert= 1,935.00'

‡

Reach 4R: C-1



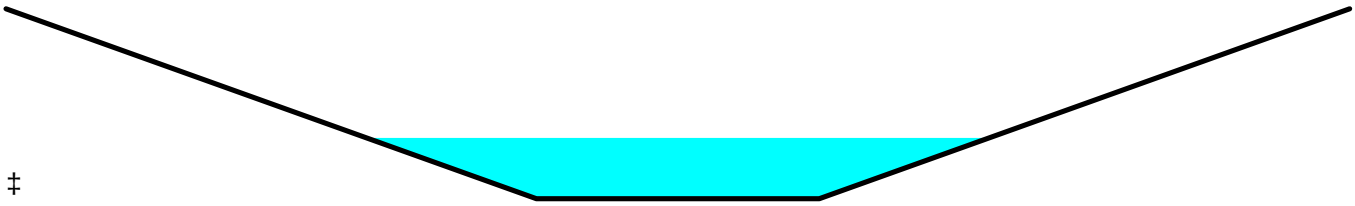
Summary for Reach 8R: C-4

Inflow Area = 0.514 ac, 52.25% Impervious, Inflow Depth > 3.67" for 10-Year event
Inflow = 2.37 cfs @ 12.11 hrs, Volume= 0.157 af
Outflow = 2.12 cfs @ 12.20 hrs, Volume= 0.156 af, Atten= 11%, Lag= 5.5 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.69 fps, Min. Travel Time= 3.4 min
Avg. Velocity = 0.50 fps, Avg. Travel Time= 11.5 min

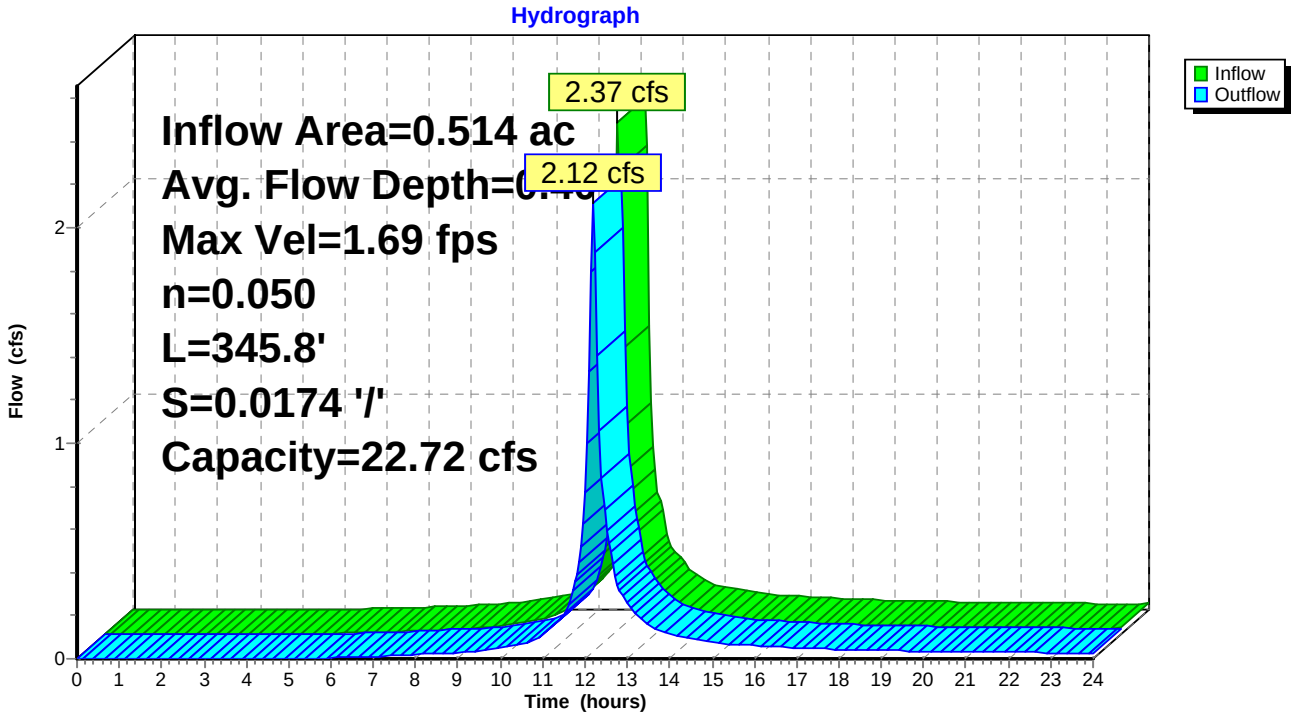
Peak Storage= 442 cf @ 12.15 hrs
Average Depth at Peak Storage= 0.40'
Bank-Full Depth= 1.25' Flow Area= 7.2 sf, Capacity= 22.72 cfs

2.00' x 1.25' deep channel, n= 0.050
Side Slope Z-value= 3.0 '/' Top Width= 9.50'
Length= 345.8' Slope= 0.0174 '/'
Inlet Invert= 1,940.00', Outlet Invert= 1,934.00'



‡

Reach 8R: C-4



Summary for Reach 13R: C-5

[62] Hint: Exceeded Reach 8R OUTLET depth by 1.57' @ 12.25 hrs

Inflow Area = 1.646 ac, 72.02% Impervious, Inflow Depth > 4.13" for 10-Year event
Inflow = 7.04 cfs @ 12.15 hrs, Volume= 0.567 af
Outflow = 6.72 cfs @ 12.20 hrs, Volume= 0.566 af, Atten= 5%, Lag= 2.6 min

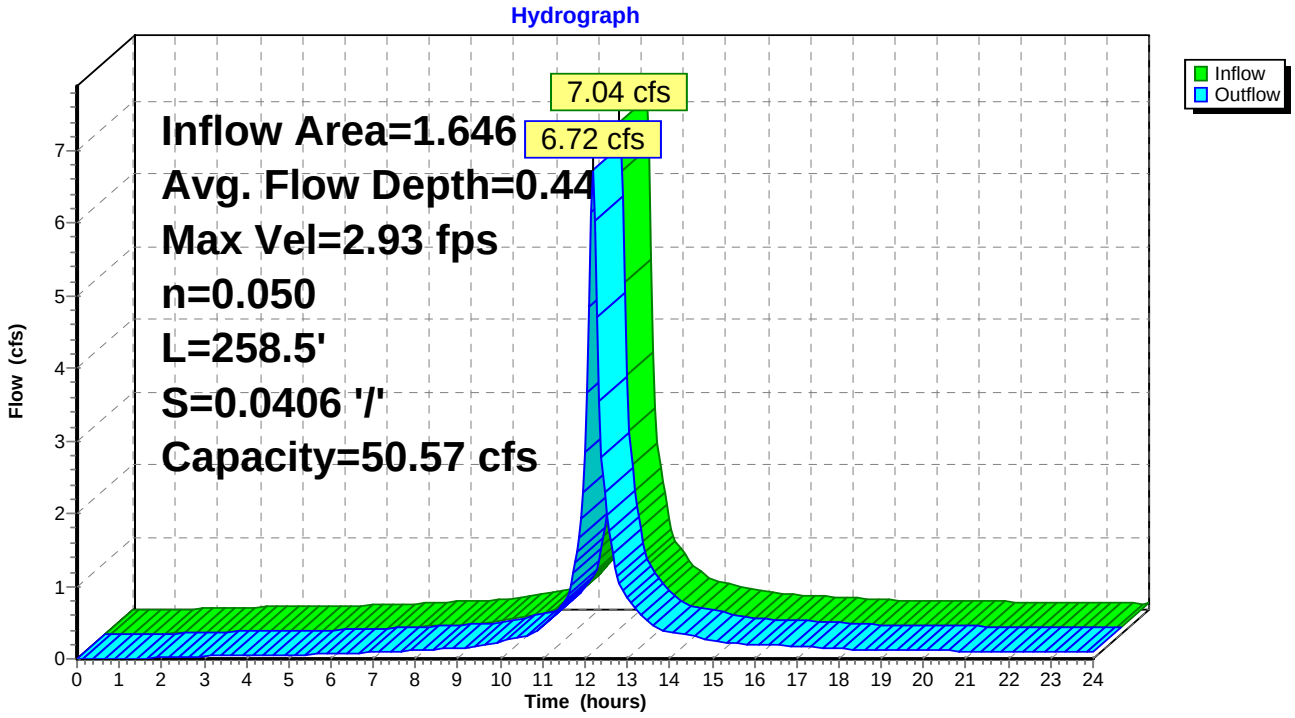
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.93 fps, Min. Travel Time= 1.5 min
Avg. Velocity = 0.80 fps, Avg. Travel Time= 5.4 min

Peak Storage= 604 cf @ 12.17 hrs
Average Depth at Peak Storage= 0.44'
Bank-Full Depth= 1.25' Flow Area= 9.7 sf, Capacity= 50.57 cfs

4.00' x 1.25' deep channel, n= 0.050
Side Slope Z-value= 3.0 '/' Top Width= 11.50'
Length= 258.5' Slope= 0.0406 '/'
Inlet Invert= 1,935.50', Outlet Invert= 1,925.00'

‡

Reach 13R: C-5



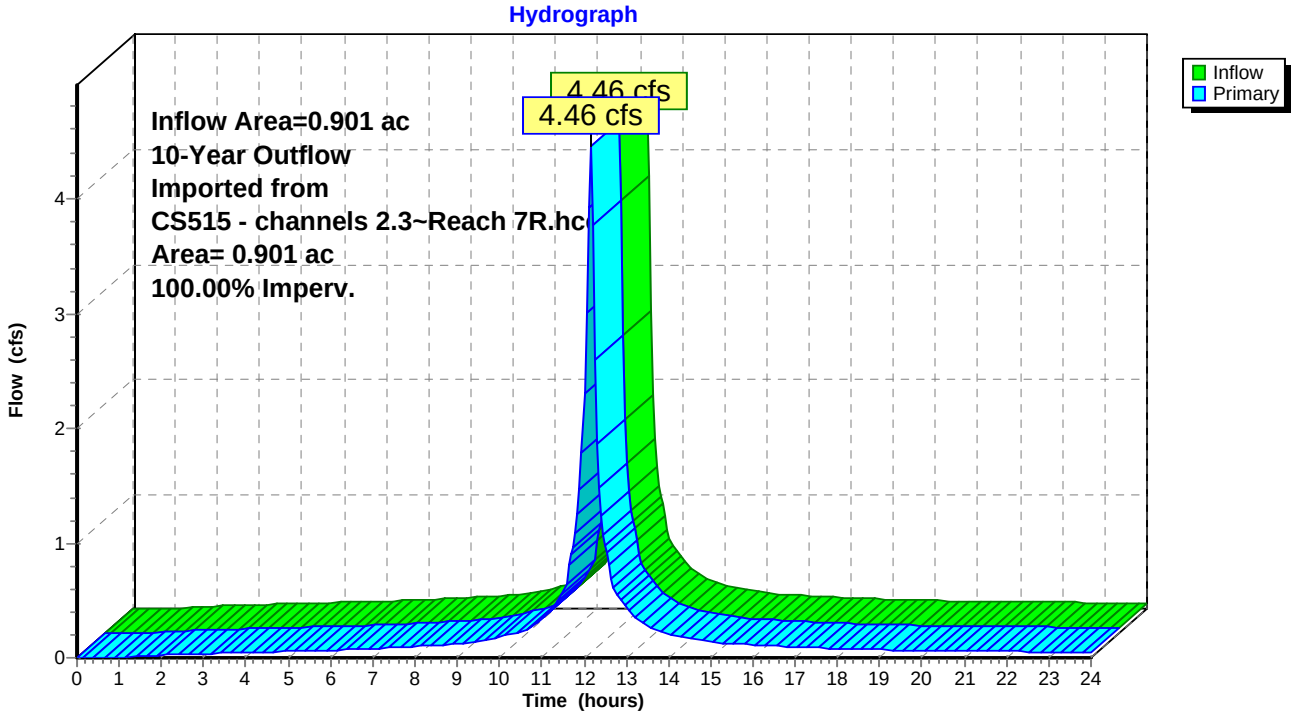
Summary for Link 14L: Culvert 1

Inflow Area = 0.901 ac,100.00% Impervious, Inflow Depth > 4.75" for 10-Year event
Inflow = 4.46 cfs @ 12.15 hrs, Volume= 0.357 af
Primary = 4.46 cfs @ 12.15 hrs, Volume= 0.357 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

10-Year Outflow Imported from CS515 - channels 2.3~Reach 7R.hce

Link 14L: Culvert 1



Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 5S: C-1 Runoff Area=48,290 sf 81.96% Impervious Runoff Depth>5.49"
Tc=5.0 min CN=94 Runoff=7.14 cfs 0.507 af

Subcatchment 14S: C-4 Runoff Area=22,384 sf 52.25% Impervious Runoff Depth>4.81"
Tc=5.0 min CN=88 Runoff=3.07 cfs 0.206 af

Subcatchment 15S: C-5 Runoff Area=10,073 sf 6.95% Impervious Runoff Depth>3.86"
Tc=5.0 min CN=79 Runoff=1.16 cfs 0.074 af

Reach 4R: C-1 Avg. Flow Depth=0.45' Max Vel=2.88 fps Inflow=7.14 cfs 0.507 af
n=0.050 L=72.0' S=0.0382 '/' Capacity=49.04 cfs Outflow=6.96 cfs 0.507 af

Reach 8R: C-4 Avg. Flow Depth=0.46' Max Vel=1.82 fps Inflow=3.07 cfs 0.206 af
n=0.050 L=345.8' S=0.0174 '/' Capacity=22.72 cfs Outflow=2.79 cfs 0.205 af

Reach 13R: C-5 Avg. Flow Depth=0.50' Max Vel=3.17 fps Inflow=9.04 cfs 0.726 af
n=0.050 L=258.5' S=0.0406 '/' Capacity=50.57 cfs Outflow=8.63 cfs 0.725 af

Link 14L: 25-Year Outflow Imported from CS515 - channels 2.3~Reach 7R.hce Inflow=5.56 cfs 0.447 af
Area= 0.901 ac 100.00% Imperv. Primary=5.56 cfs 0.447 af

Total Runoff Area = 1.854 ac Runoff Volume = 0.788 af Average Runoff Depth = 5.10"
35.63% Pervious = 0.661 ac 64.37% Impervious = 1.193 ac

Summary for Subcatchment 5S: C-1

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

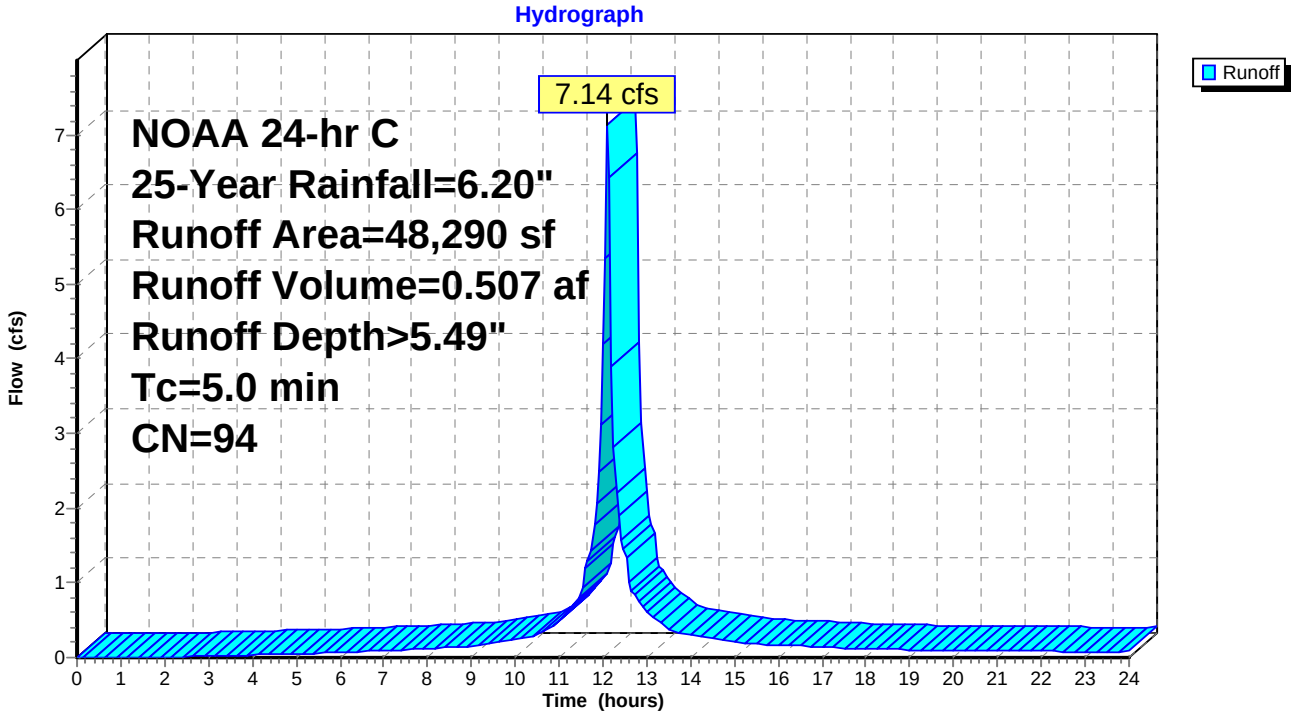
Runoff = 7.14 cfs @ 12.11 hrs, Volume= 0.507 af, Depth> 5.49"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 25-Year Rainfall=6.20"

	Area (sf)	CN	Description
*	39,580	98	Paved parking, HSG D
	8,710	78	Meadow, non-grazed, HSG D
	48,290	94	Weighted Average
	8,710		18.04% Pervious Area
	39,580		81.96% Impervious Area

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

Subcatchment 5S: C-1



Summary for Subcatchment 14S: C-4

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

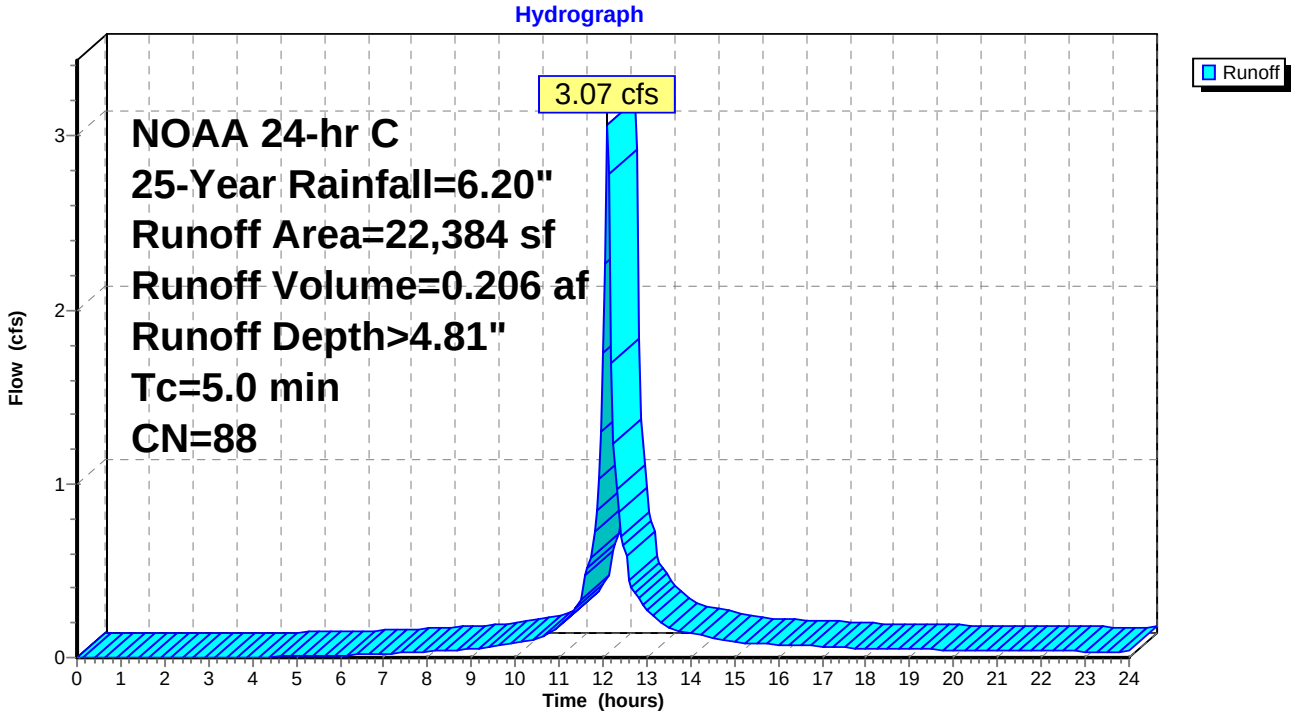
Runoff = 3.07 cfs @ 12.11 hrs, Volume= 0.206 af, Depth> 4.81"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 25-Year Rainfall=6.20"

Area (sf)	CN	Description
11,695	98	Paved parking, HSG D
10,689	78	Meadow, non-grazed, HSG D
22,384	88	Weighted Average
10,689		47.75% Pervious Area
11,695		52.25% Impervious Area

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

Subcatchment 14S: C-4



Summary for Subcatchment 15S: C-5

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

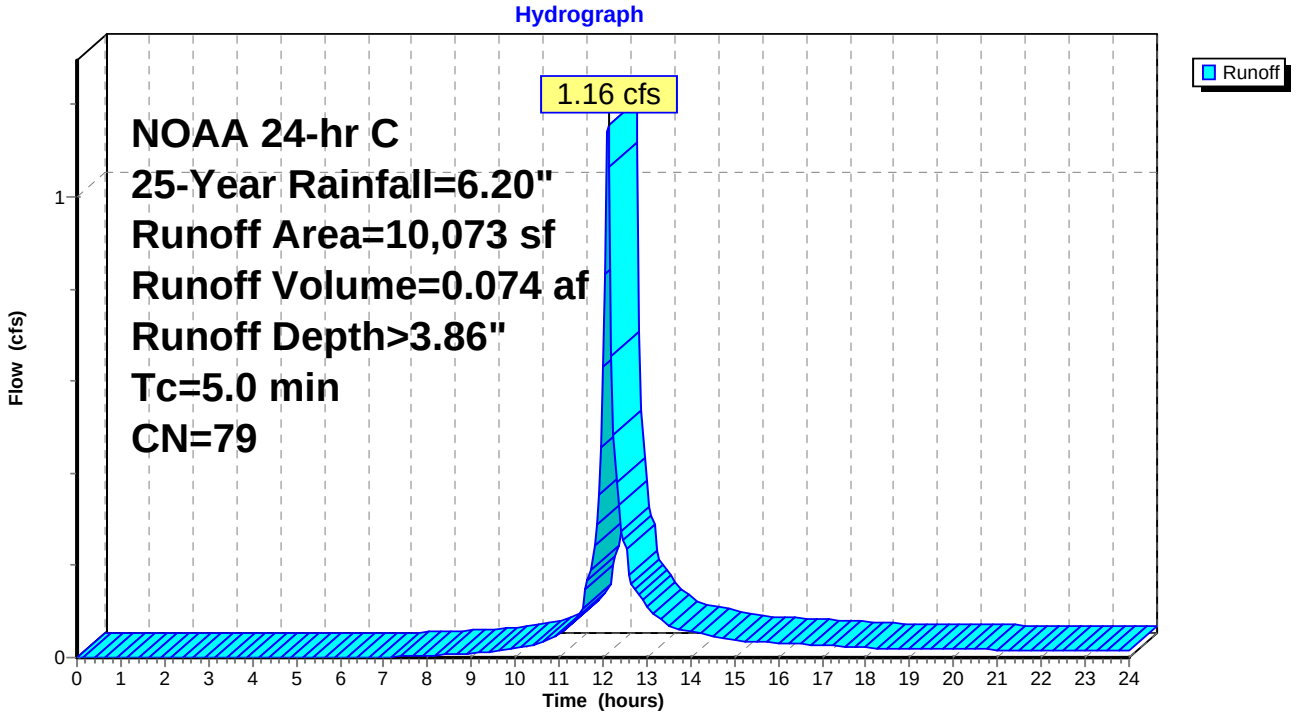
Runoff = 1.16 cfs @ 12.11 hrs, Volume= 0.074 af, Depth> 3.86"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 25-Year Rainfall=6.20"

Area (sf)	CN	Description
700	98	Paved parking, HSG D
9,373	78	Meadow, non-grazed, HSG D
10,073	79	Weighted Average
9,373		93.05% Pervious Area
700		6.95% Impervious Area

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

Subcatchment 15S: C-5



Summary for Reach 4R: C-1

Inflow Area = 1.109 ac, 81.96% Impervious, Inflow Depth > 5.49" for 25-Year event
Inflow = 7.14 cfs @ 12.11 hrs, Volume= 0.507 af
Outflow = 6.96 cfs @ 12.13 hrs, Volume= 0.507 af, Atten= 3%, Lag= 0.9 min

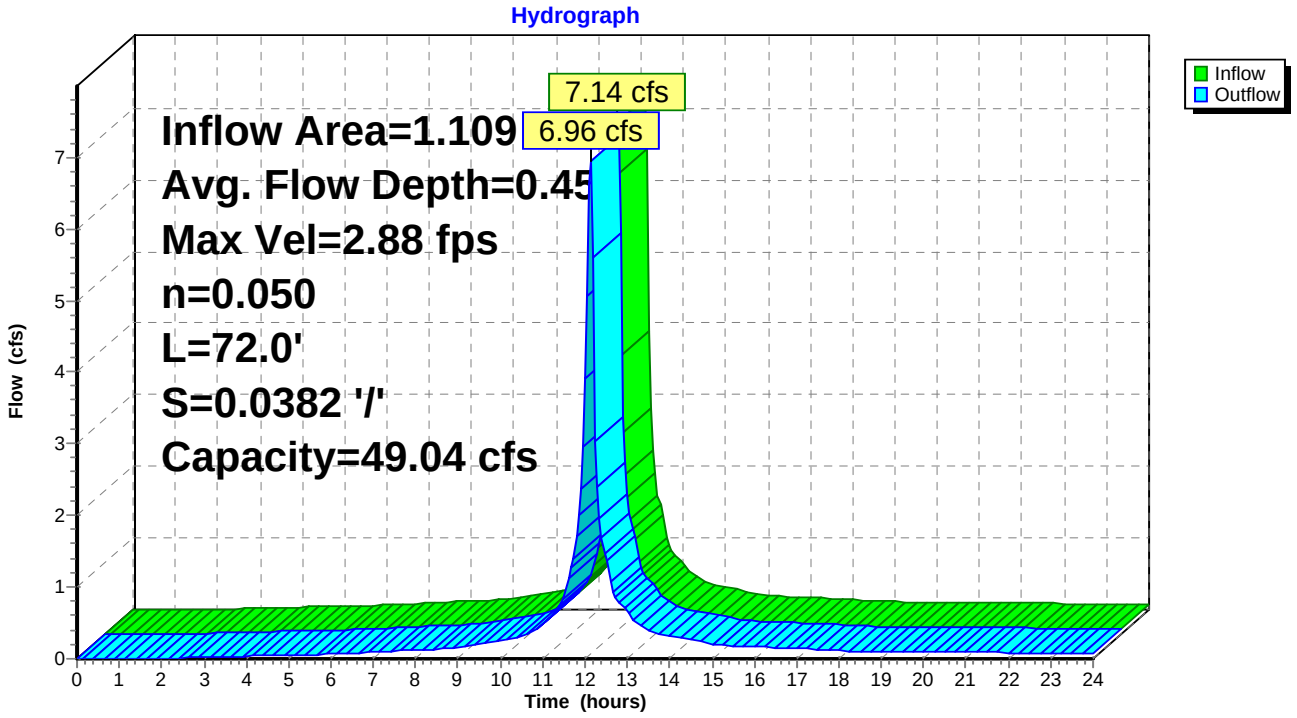
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.88 fps, Min. Travel Time= 0.4 min
Avg. Velocity = 0.77 fps, Avg. Travel Time= 1.6 min

Peak Storage= 174 cf @ 12.12 hrs
Average Depth at Peak Storage= 0.45'
Bank-Full Depth= 1.25' Flow Area= 9.7 sf, Capacity= 49.04 cfs

4.00' x 1.25' deep channel, n= 0.050
Side Slope Z-value= 3.0 '/' Top Width= 11.50'
Length= 72.0' Slope= 0.0382 '/'
Inlet Invert= 1,937.75', Outlet Invert= 1,935.00'

‡

Reach 4R: C-1



Summary for Reach 8R: C-4

Inflow Area = 0.514 ac, 52.25% Impervious, Inflow Depth > 4.81" for 25-Year event
Inflow = 3.07 cfs @ 12.11 hrs, Volume= 0.206 af
Outflow = 2.79 cfs @ 12.20 hrs, Volume= 0.205 af, Atten= 9%, Lag= 5.2 min

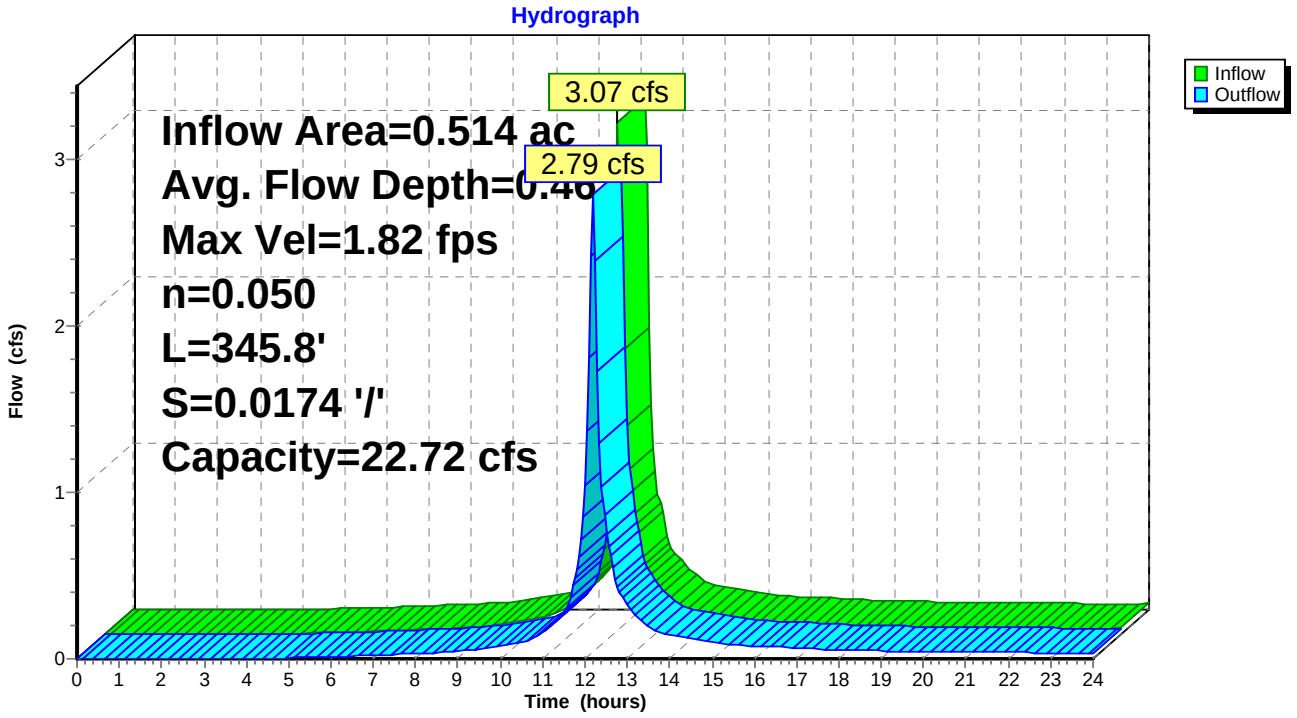
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.82 fps, Min. Travel Time= 3.2 min
Avg. Velocity = 0.54 fps, Avg. Travel Time= 10.6 min

Peak Storage= 535 cf @ 12.15 hrs
Average Depth at Peak Storage= 0.46'
Bank-Full Depth= 1.25' Flow Area= 7.2 sf, Capacity= 22.72 cfs

2.00' x 1.25' deep channel, n= 0.050
Side Slope Z-value= 3.0 '/' Top Width= 9.50'
Length= 345.8' Slope= 0.0174 '/'
Inlet Invert= 1,940.00', Outlet Invert= 1,934.00'

‡

Reach 8R: C-4



Summary for Reach 13R: C-5

[62] Hint: Exceeded Reach 8R OUTLET depth by 1.58' @ 12.25 hrs

Inflow Area = 1.646 ac, 72.02% Impervious, Inflow Depth > 5.30" for 25-Year event
Inflow = 9.04 cfs @ 12.15 hrs, Volume= 0.726 af
Outflow = 8.63 cfs @ 12.19 hrs, Volume= 0.725 af, Atten= 5%, Lag= 2.4 min

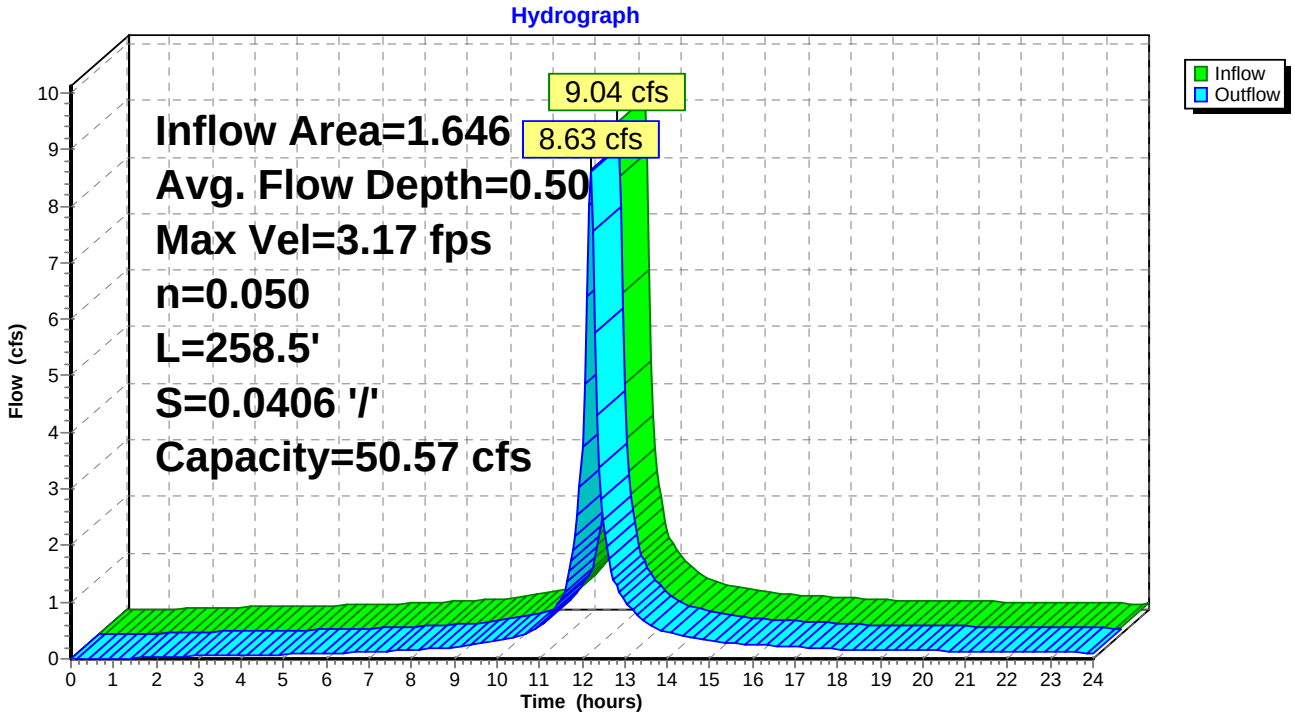
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.17 fps, Min. Travel Time= 1.4 min
Avg. Velocity = 0.87 fps, Avg. Travel Time= 4.9 min

Peak Storage= 719 cf @ 12.17 hrs
Average Depth at Peak Storage= 0.50'
Bank-Full Depth= 1.25' Flow Area= 9.7 sf, Capacity= 50.57 cfs

4.00' x 1.25' deep channel, n= 0.050
Side Slope Z-value= 3.0 '/' Top Width= 11.50'
Length= 258.5' Slope= 0.0406 '/'
Inlet Invert= 1,935.50', Outlet Invert= 1,925.00'

‡

Reach 13R: C-5



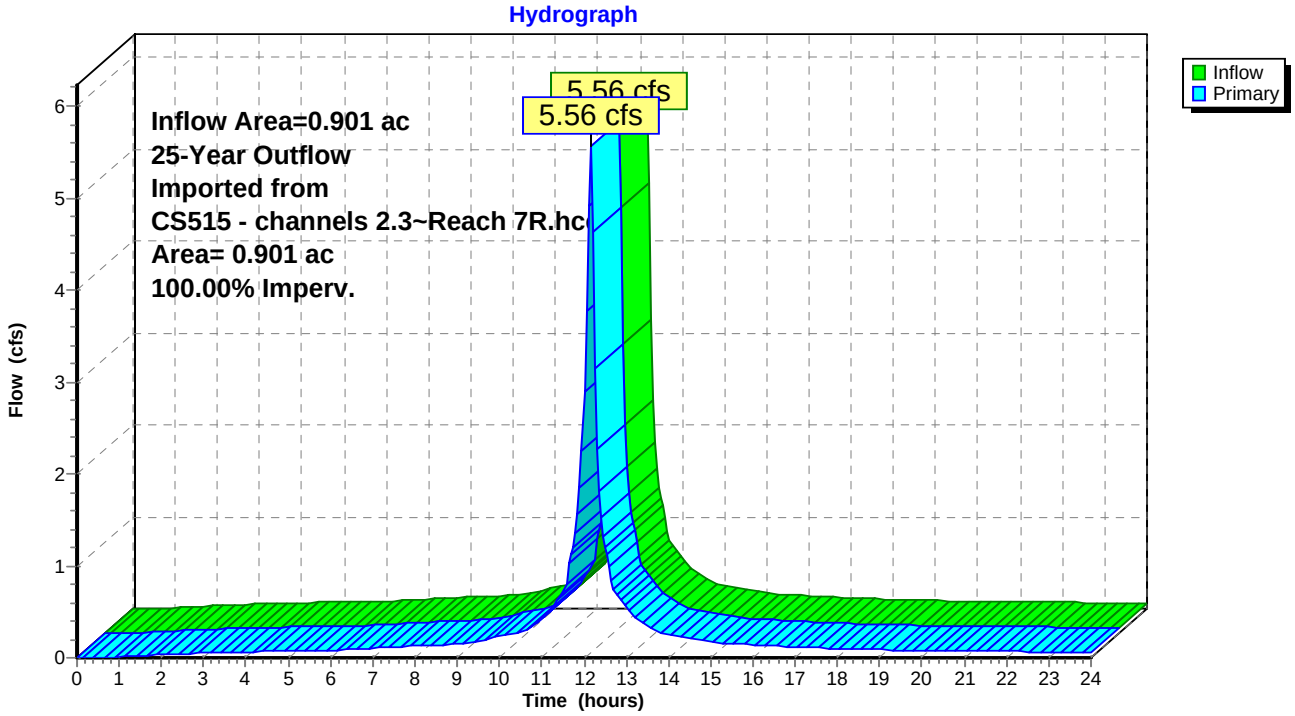
Summary for Link 14L: Culvert 1

Inflow Area = 0.901 ac,100.00% Impervious, Inflow Depth > 5.95" for 25-Year event
Inflow = 5.56 cfs @ 12.15 hrs, Volume= 0.447 af
Primary = 5.56 cfs @ 12.15 hrs, Volume= 0.447 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

25-Year Outflow Imported from CS515 - channels 2.3~Reach 7R.hce

Link 14L: Culvert 1



Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 5S: C-1 Runoff Area=48,290 sf 81.96% Impervious Runoff Depth>6.44"
Tc=5.0 min CN=94 Runoff=8.30 cfs 0.595 af

Subcatchment 14S: C-4 Runoff Area=22,384 sf 52.25% Impervious Runoff Depth>5.74"
Tc=5.0 min CN=88 Runoff=3.62 cfs 0.246 af

Subcatchment 15S: C-5 Runoff Area=10,073 sf 6.95% Impervious Runoff Depth>4.73"
Tc=5.0 min CN=79 Runoff=1.41 cfs 0.091 af

Reach 4R: C-1 Avg. Flow Depth=0.49' Max Vel=3.02 fps Inflow=8.30 cfs 0.595 af
n=0.050 L=72.0' S=0.0382 '/' Capacity=49.04 cfs Outflow=8.09 cfs 0.595 af

Reach 8R: C-4 Avg. Flow Depth=0.50' Max Vel=1.90 fps Inflow=3.62 cfs 0.246 af
n=0.050 L=345.8' S=0.0174 '/' Capacity=22.72 cfs Outflow=3.33 cfs 0.245 af

Reach 13R: C-5 Avg. Flow Depth=0.55' Max Vel=3.33 fps Inflow=10.64 cfs 0.855 af
n=0.050 L=258.5' S=0.0406 '/' Capacity=50.57 cfs Outflow=10.16 cfs 0.854 af

Link 14L: 50-Year Outflow Imported from CS515 - channels 2.3~Reach 7R.hce Inflow=6.45 cfs 0.519 af
Area= 0.901 ac 100.00% Imperv. Primary=6.45 cfs 0.519 af

Total Runoff Area = 1.854 ac Runoff Volume = 0.932 af Average Runoff Depth = 6.03"
35.63% Pervious = 0.661 ac 64.37% Impervious = 1.193 ac

Summary for Subcatchment 5S: C-1

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

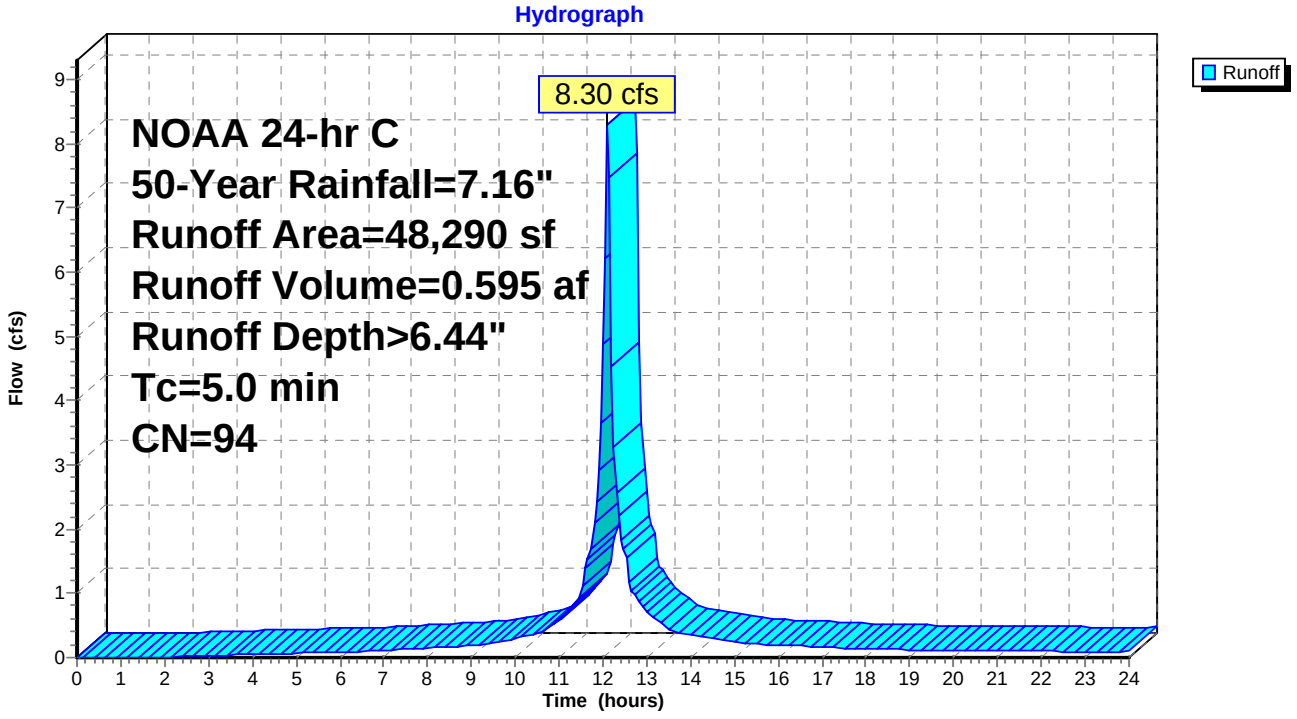
Runoff = 8.30 cfs @ 12.11 hrs, Volume= 0.595 af, Depth> 6.44"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 50-Year Rainfall=7.16"

	Area (sf)	CN	Description
*	39,580	98	Paved parking, HSG D
	8,710	78	Meadow, non-grazed, HSG D
	48,290	94	Weighted Average
	8,710		18.04% Pervious Area
	39,580		81.96% Impervious Area

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

Subcatchment 5S: C-1



Summary for Subcatchment 14S: C-4

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

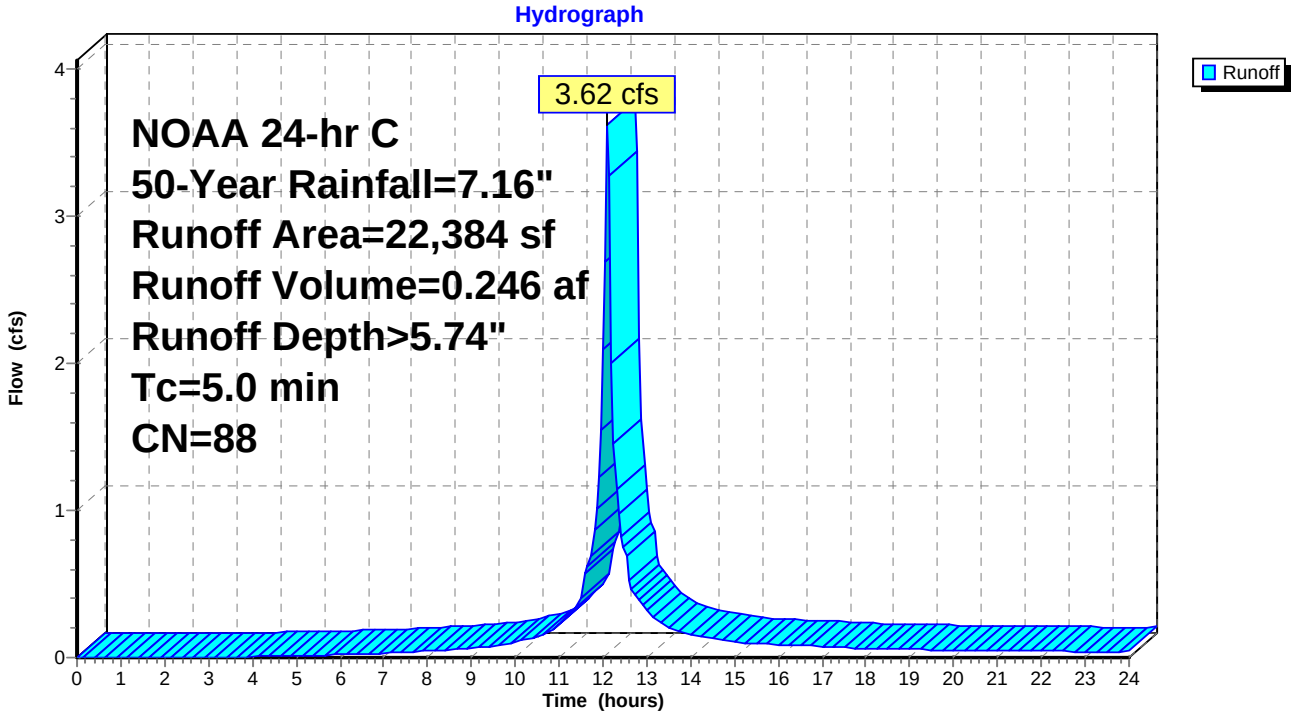
Runoff = 3.62 cfs @ 12.11 hrs, Volume= 0.246 af, Depth> 5.74"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 50-Year Rainfall=7.16"

Area (sf)	CN	Description
11,695	98	Paved parking, HSG D
10,689	78	Meadow, non-grazed, HSG D
22,384	88	Weighted Average
10,689		47.75% Pervious Area
11,695		52.25% Impervious Area

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

Subcatchment 14S: C-4



Summary for Subcatchment 15S: C-5

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

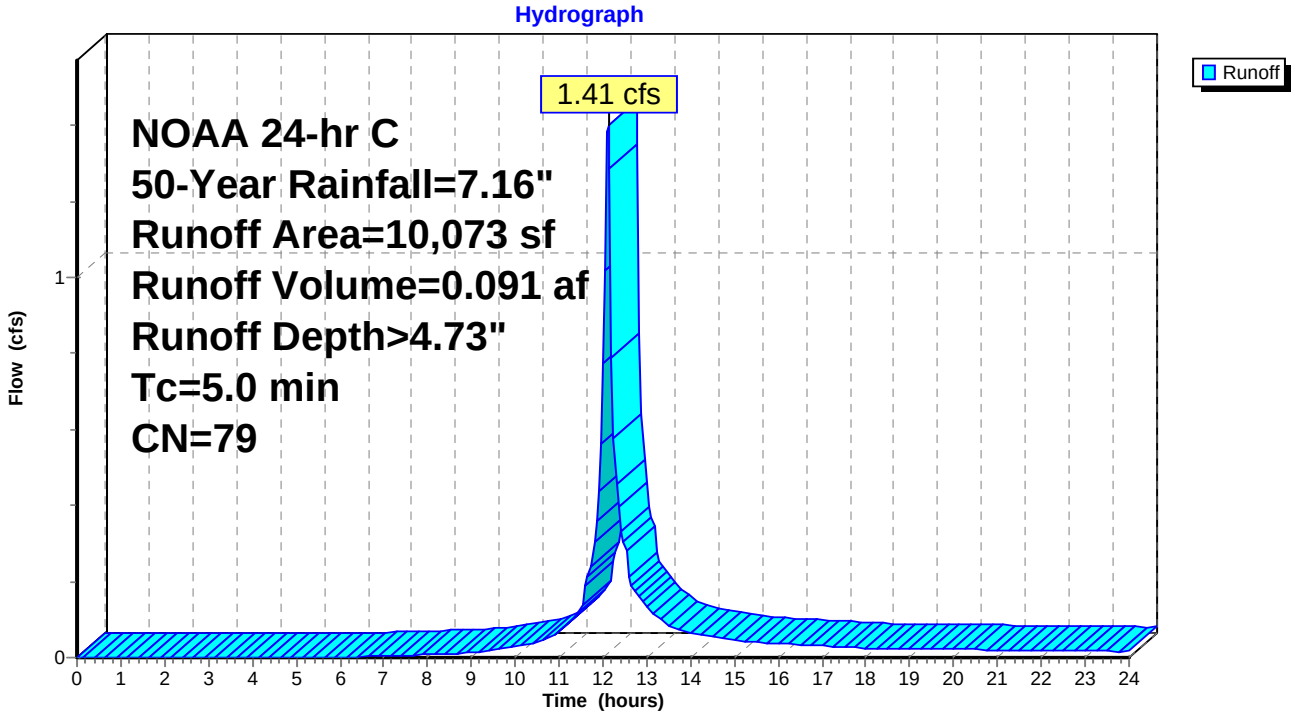
Runoff = 1.41 cfs @ 12.11 hrs, Volume= 0.091 af, Depth> 4.73"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 50-Year Rainfall=7.16"

Area (sf)	CN	Description
700	98	Paved parking, HSG D
9,373	78	Meadow, non-grazed, HSG D
10,073	79	Weighted Average
9,373		93.05% Pervious Area
700		6.95% Impervious Area

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

Subcatchment 15S: C-5



Summary for Reach 4R: C-1

Inflow Area = 1.109 ac, 81.96% Impervious, Inflow Depth > 6.44" for 50-Year event
Inflow = 8.30 cfs @ 12.11 hrs, Volume= 0.595 af
Outflow = 8.09 cfs @ 12.13 hrs, Volume= 0.595 af, Atten= 3%, Lag= 0.9 min

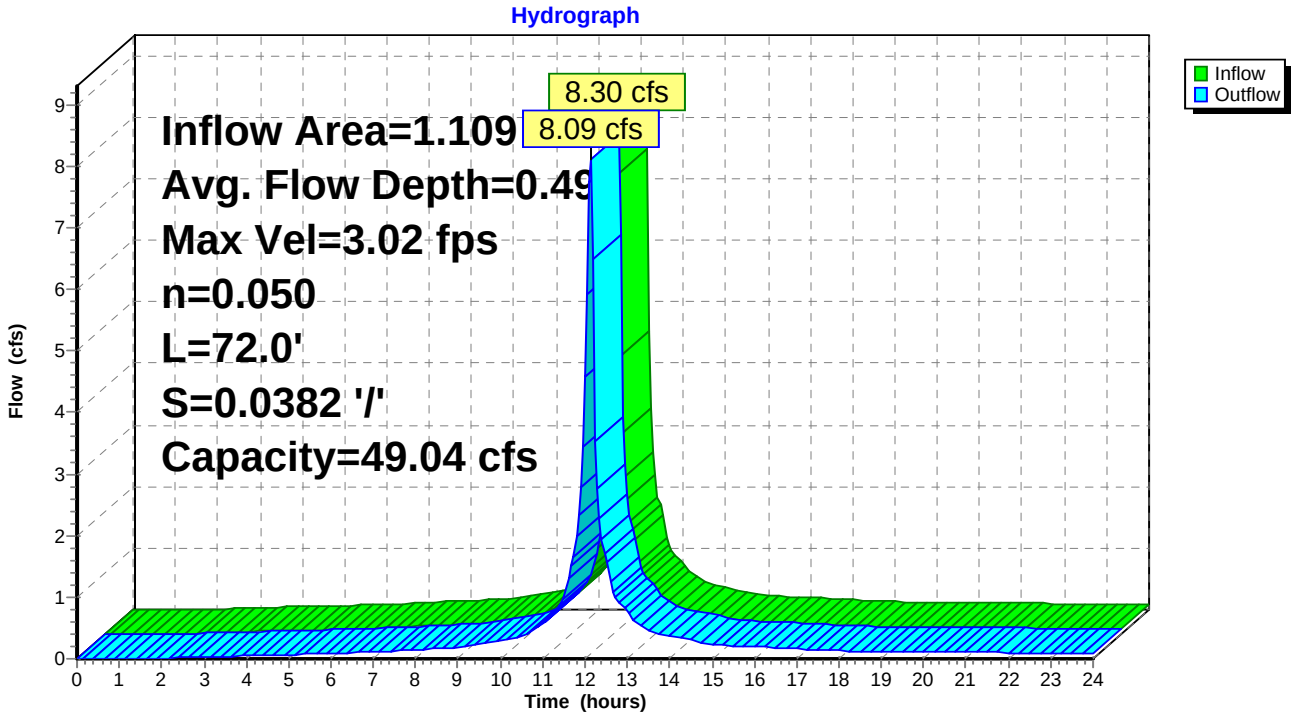
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.02 fps, Min. Travel Time= 0.4 min
Avg. Velocity = 0.81 fps, Avg. Travel Time= 1.5 min

Peak Storage= 193 cf @ 12.12 hrs
Average Depth at Peak Storage= 0.49'
Bank-Full Depth= 1.25' Flow Area= 9.7 sf, Capacity= 49.04 cfs

4.00' x 1.25' deep channel, n= 0.050
Side Slope Z-value= 3.0 '/' Top Width= 11.50'
Length= 72.0' Slope= 0.0382 '/'
Inlet Invert= 1,937.75', Outlet Invert= 1,935.00'

‡

Reach 4R: C-1



Summary for Reach 8R: C-4

Inflow Area = 0.514 ac, 52.25% Impervious, Inflow Depth > 5.74" for 50-Year event
Inflow = 3.62 cfs @ 12.11 hrs, Volume= 0.246 af
Outflow = 3.33 cfs @ 12.20 hrs, Volume= 0.245 af, Atten= 8%, Lag= 5.0 min

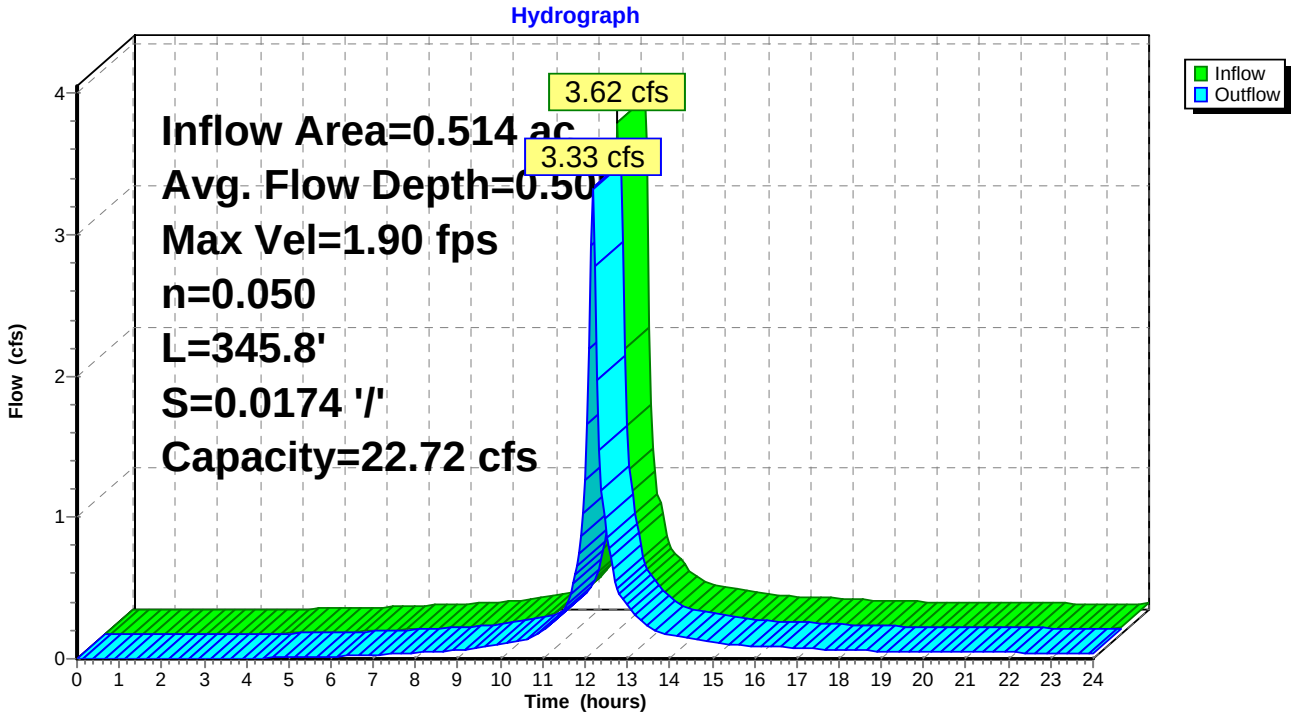
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.90 fps, Min. Travel Time= 3.0 min
Avg. Velocity = 0.57 fps, Avg. Travel Time= 10.1 min

Peak Storage= 606 cf @ 12.15 hrs
Average Depth at Peak Storage= 0.50'
Bank-Full Depth= 1.25' Flow Area= 7.2 sf, Capacity= 22.72 cfs

2.00' x 1.25' deep channel, n= 0.050
Side Slope Z-value= 3.0 '/' Top Width= 9.50'
Length= 345.8' Slope= 0.0174 '/'
Inlet Invert= 1,940.00', Outlet Invert= 1,934.00'

‡

Reach 8R: C-4



Summary for Reach 13R: C-5

[62] Hint: Exceeded Reach 8R OUTLET depth by 1.59' @ 12.25 hrs

Inflow Area = 1.646 ac, 72.02% Impervious, Inflow Depth > 6.23" for 50-Year event
Inflow = 10.64 cfs @ 12.15 hrs, Volume= 0.855 af
Outflow = 10.16 cfs @ 12.19 hrs, Volume= 0.854 af, Atten= 5%, Lag= 2.3 min

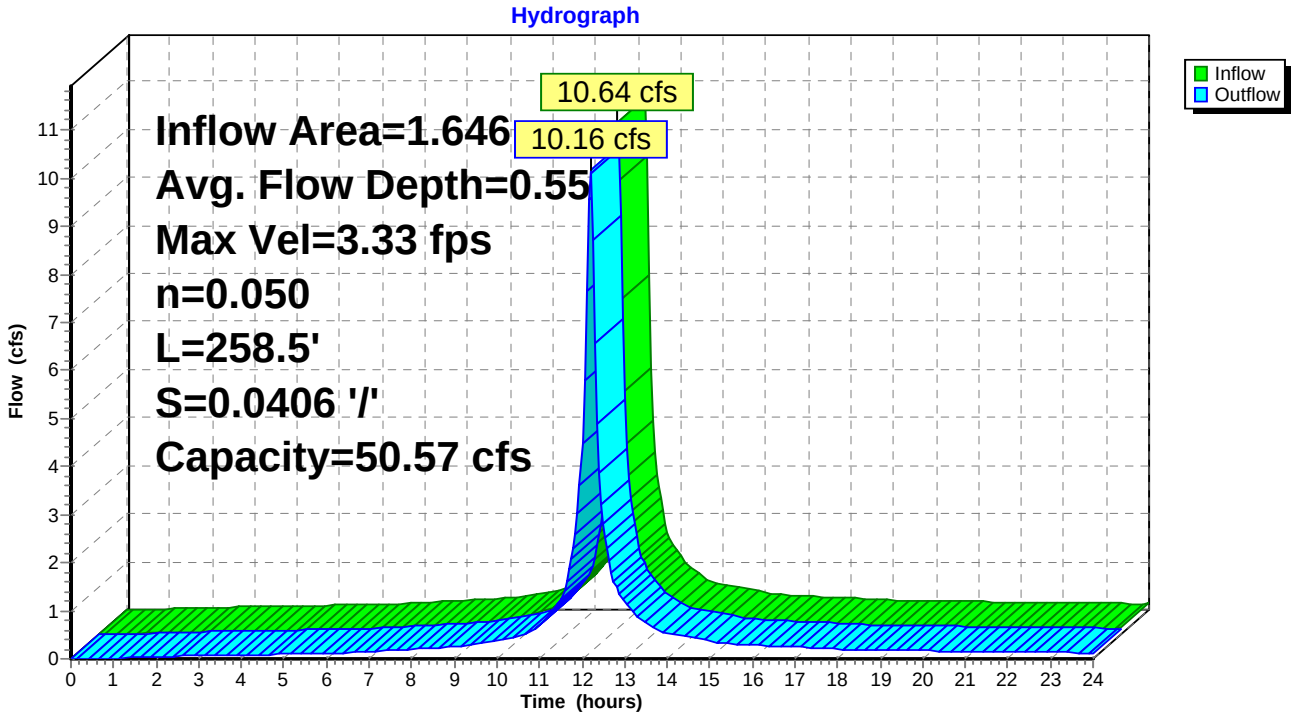
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.33 fps, Min. Travel Time= 1.3 min
Avg. Velocity = 0.93 fps, Avg. Travel Time= 4.6 min

Peak Storage= 807 cf @ 12.17 hrs
Average Depth at Peak Storage= 0.55'
Bank-Full Depth= 1.25' Flow Area= 9.7 sf, Capacity= 50.57 cfs

4.00' x 1.25' deep channel, n= 0.050
Side Slope Z-value= 3.0 '/' Top Width= 11.50'
Length= 258.5' Slope= 0.0406 '/'
Inlet Invert= 1,935.50', Outlet Invert= 1,925.00'

‡

Reach 13R: C-5



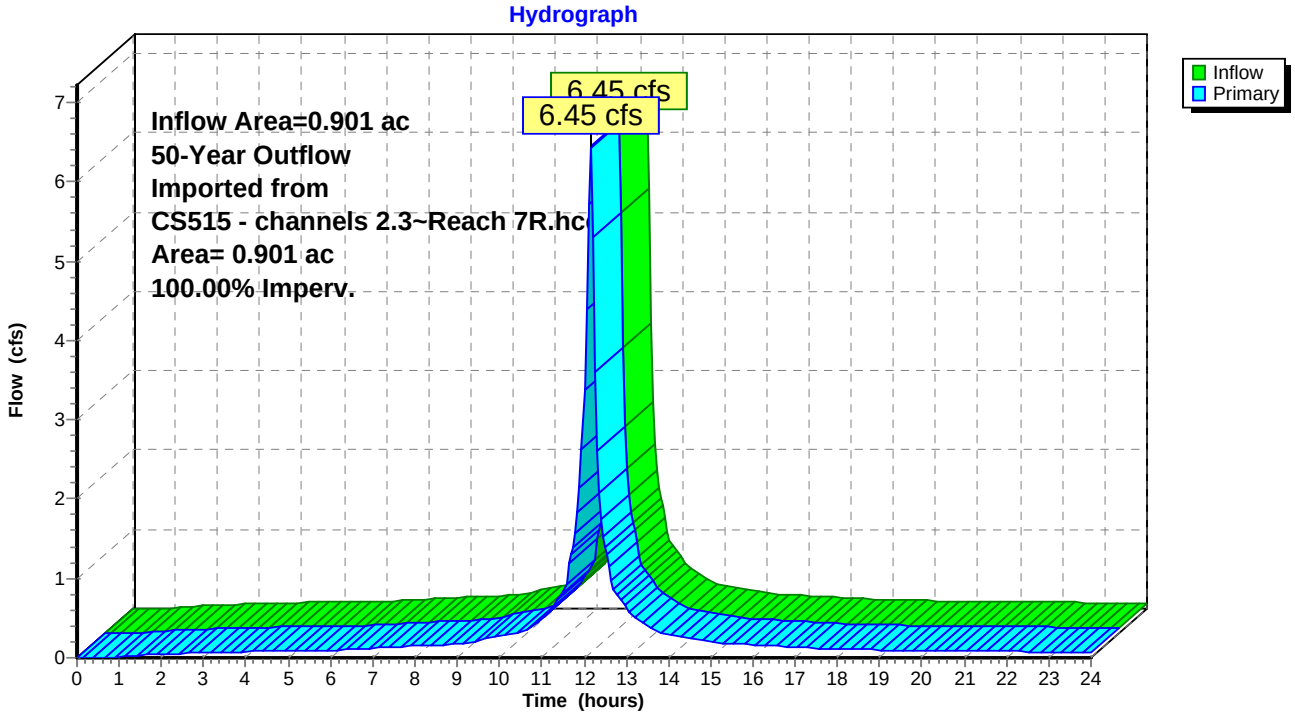
Summary for Link 14L: Culvert 1

Inflow Area = 0.901 ac,100.00% Impervious, Inflow Depth > 6.91" for 50-Year event
Inflow = 6.45 cfs @ 12.14 hrs, Volume= 0.519 af
Primary = 6.45 cfs @ 12.14 hrs, Volume= 0.519 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

50-Year Outflow Imported from CS515 - channels 2.3~Reach 7R.hce

Link 14L: Culvert 1



Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 5S: C-1 Runoff Area=48,290 sf 81.96% Impervious Runoff Depth>7.70"
Tc=5.0 min CN=94 Runoff=9.83 cfs 0.712 af

Subcatchment 14S: C-4 Runoff Area=22,384 sf 52.25% Impervious Runoff Depth>6.98"
Tc=5.0 min CN=88 Runoff=4.35 cfs 0.299 af

Subcatchment 15S: C-5 Runoff Area=10,073 sf 6.95% Impervious Runoff Depth>5.90"
Tc=5.0 min CN=79 Runoff=1.74 cfs 0.114 af

Reach 4R: C-1 Avg. Flow Depth=0.54' Max Vel=3.18 fps Inflow=9.83 cfs 0.712 af
n=0.050 L=72.0' S=0.0382 '/' Capacity=49.04 cfs Outflow=9.59 cfs 0.711 af

Reach 8R: C-4 Avg. Flow Depth=0.55' Max Vel=2.00 fps Inflow=4.35 cfs 0.299 af
n=0.050 L=345.8' S=0.0174 '/' Capacity=22.72 cfs Outflow=4.00 cfs 0.298 af

Reach 13R: C-5 Avg. Flow Depth=0.61' Max Vel=3.52 fps Inflow=12.75 cfs 1.026 af
n=0.050 L=258.5' S=0.0406 '/' Capacity=50.57 cfs Outflow=12.17 cfs 1.024 af

Link 14L: 100-Year Outflow Imported from CS515 - channels 2.3~Reach 7R.hce Inflow=7.61 cfs 0.614 af
Area= 0.901 ac 100.00% Imperv. Primary=7.61 cfs 0.614 af

Total Runoff Area = 1.854 ac Runoff Volume = 1.125 af Average Runoff Depth = 7.28"
35.63% Pervious = 0.661 ac 64.37% Impervious = 1.193 ac

Summary for Subcatchment 5S: C-1

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

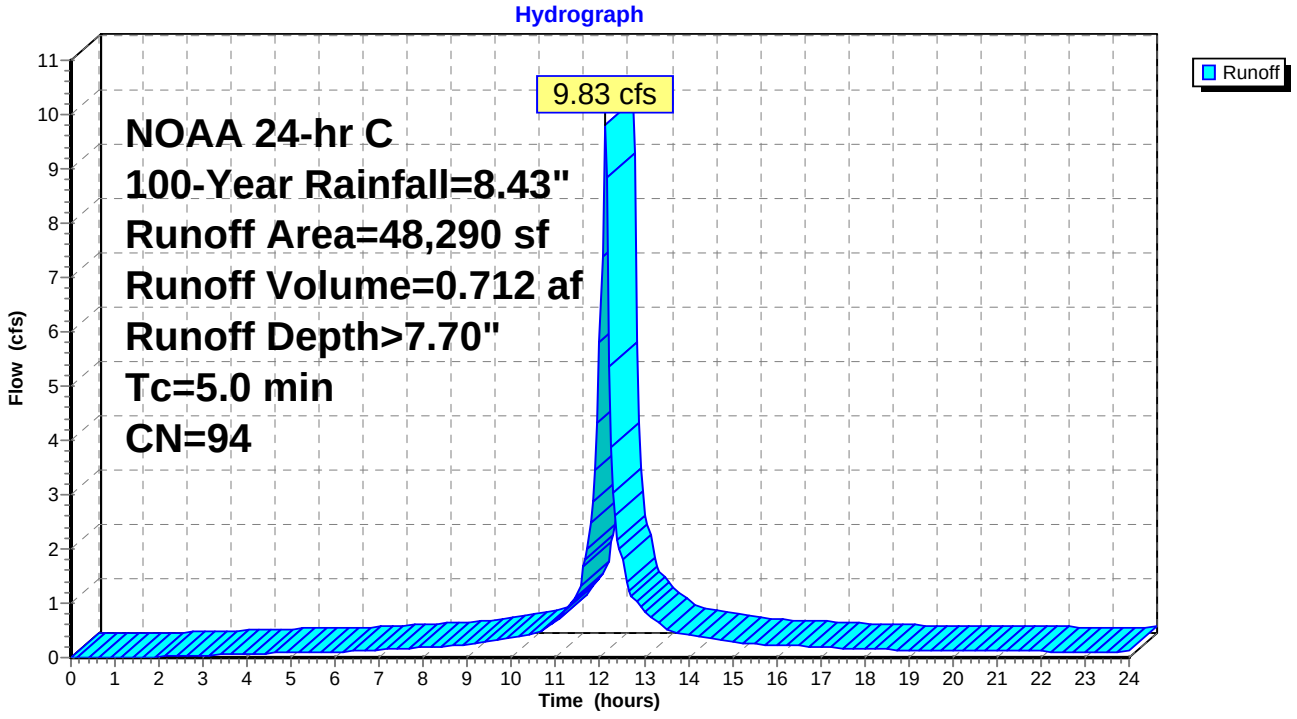
Runoff = 9.83 cfs @ 12.11 hrs, Volume= 0.712 af, Depth> 7.70"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 100-Year Rainfall=8.43"

	Area (sf)	CN	Description
*	39,580	98	Paved parking, HSG D
	8,710	78	Meadow, non-grazed, HSG D
	48,290	94	Weighted Average
	8,710		18.04% Pervious Area
	39,580		81.96% Impervious Area

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

Subcatchment 5S: C-1



Summary for Subcatchment 14S: C-4

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

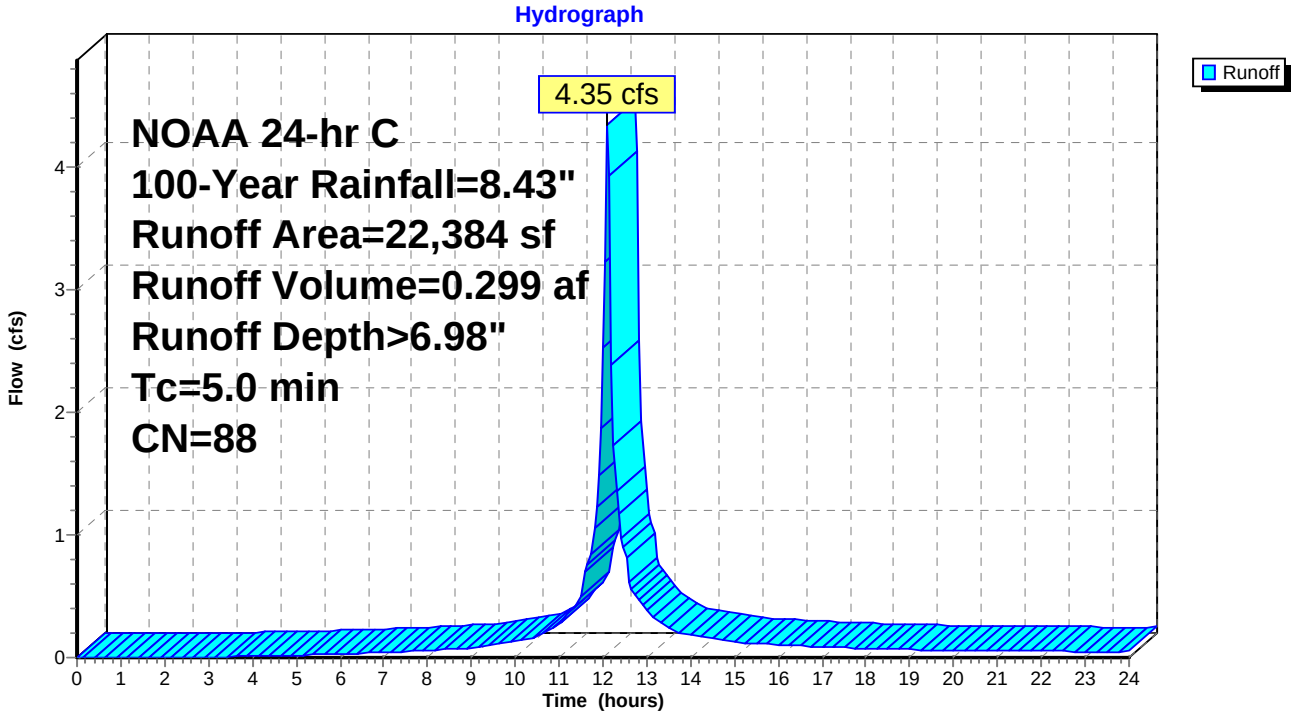
Runoff = 4.35 cfs @ 12.11 hrs, Volume= 0.299 af, Depth> 6.98"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 100-Year Rainfall=8.43"

Area (sf)	CN	Description
11,695	98	Paved parking, HSG D
10,689	78	Meadow, non-grazed, HSG D
22,384	88	Weighted Average
10,689		47.75% Pervious Area
11,695		52.25% Impervious Area

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

Subcatchment 14S: C-4



Summary for Subcatchment 15S: C-5

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

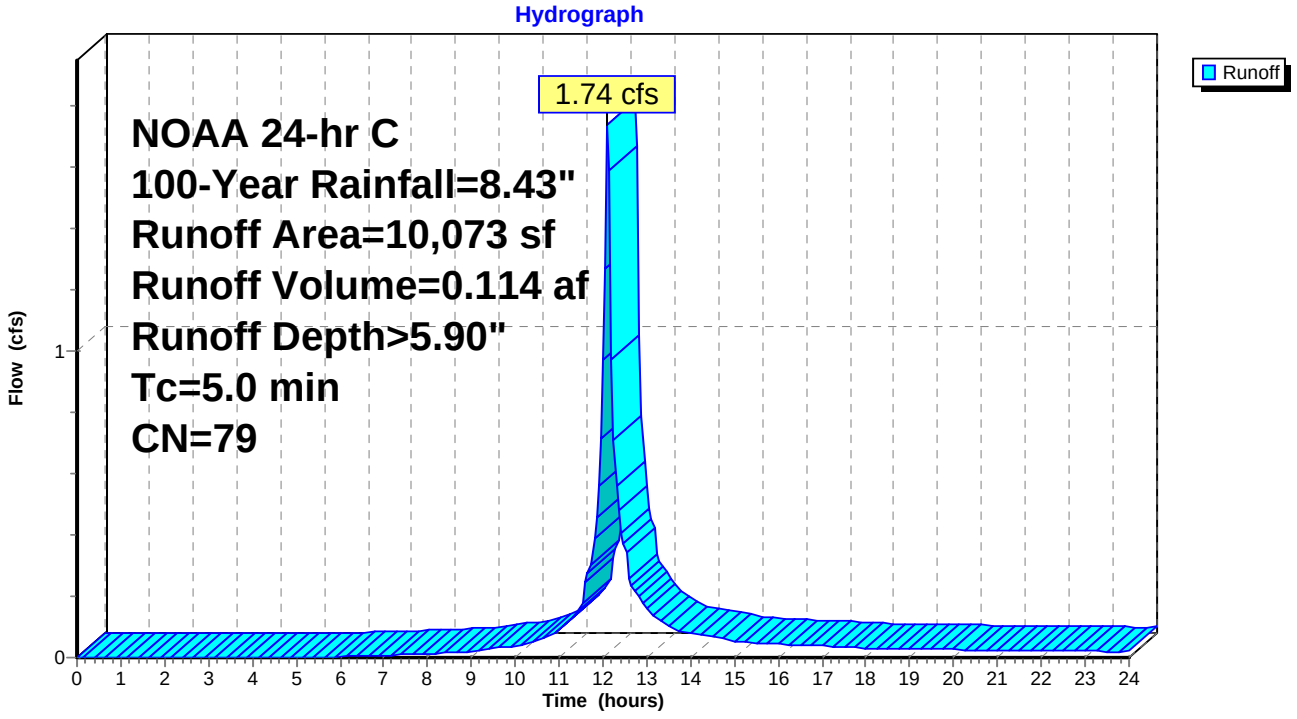
Runoff = 1.74 cfs @ 12.11 hrs, Volume= 0.114 af, Depth> 5.90"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 100-Year Rainfall=8.43"

Area (sf)	CN	Description
700	98	Paved parking, HSG D
9,373	78	Meadow, non-grazed, HSG D
10,073	79	Weighted Average
9,373		93.05% Pervious Area
700		6.95% Impervious Area

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

Subcatchment 15S: C-5



Summary for Reach 4R: C-1

Inflow Area = 1.109 ac, 81.96% Impervious, Inflow Depth > 7.70" for 100-Year event
Inflow = 9.83 cfs @ 12.11 hrs, Volume= 0.712 af
Outflow = 9.59 cfs @ 12.13 hrs, Volume= 0.711 af, Atten= 2%, Lag= 0.8 min

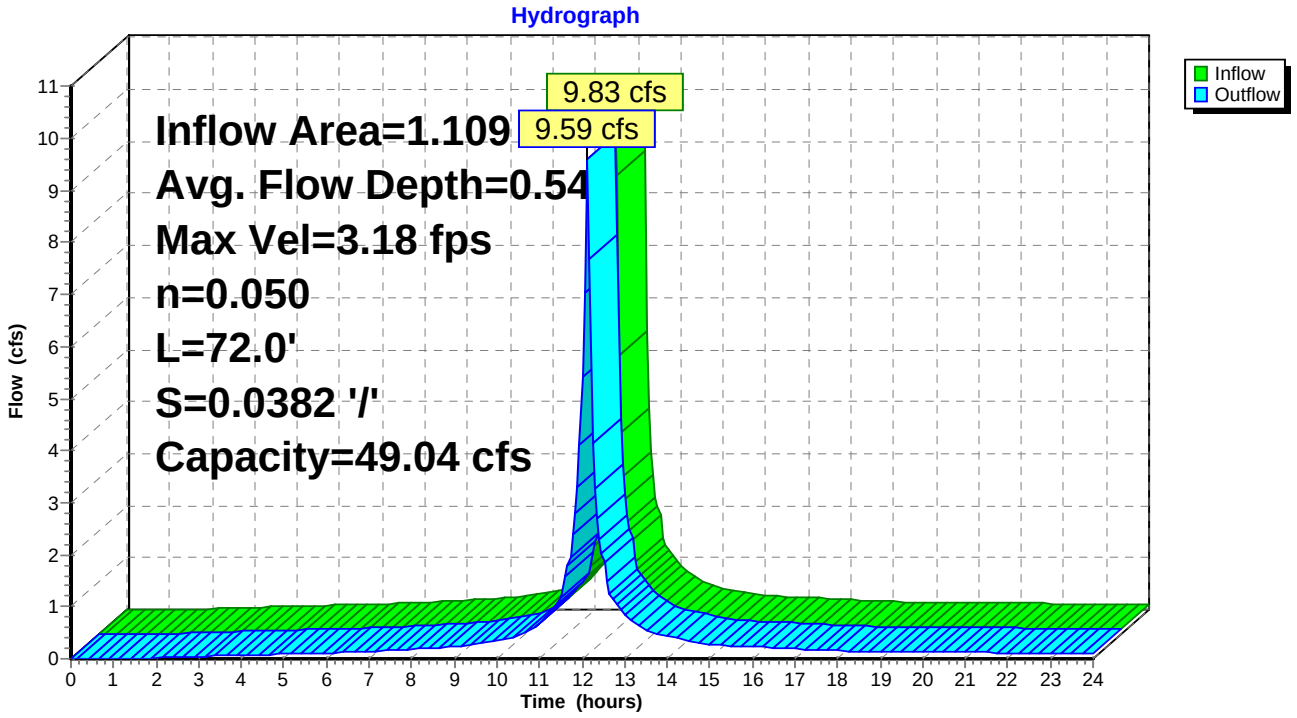
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.18 fps, Min. Travel Time= 0.4 min
Avg. Velocity = 0.87 fps, Avg. Travel Time= 1.4 min

Peak Storage= 218 cf @ 12.12 hrs
Average Depth at Peak Storage= 0.54'
Bank-Full Depth= 1.25' Flow Area= 9.7 sf, Capacity= 49.04 cfs

4.00' x 1.25' deep channel, n= 0.050
Side Slope Z-value= 3.0 '/' Top Width= 11.50'
Length= 72.0' Slope= 0.0382 '/'
Inlet Invert= 1,937.75', Outlet Invert= 1,935.00'

‡

Reach 4R: C-1



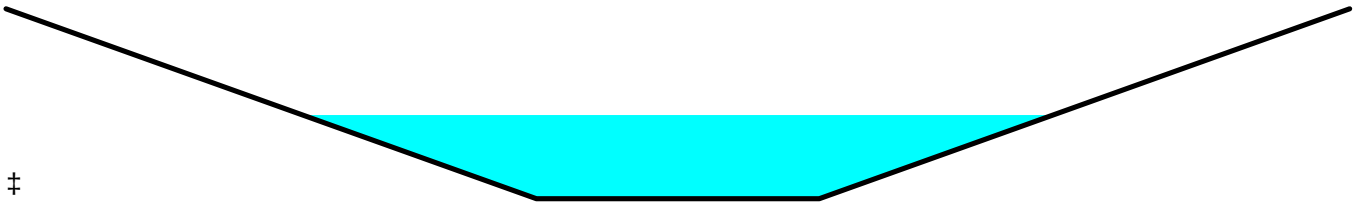
Summary for Reach 8R: C-4

Inflow Area = 0.514 ac, 52.25% Impervious, Inflow Depth > 6.98" for 100-Year event
Inflow = 4.35 cfs @ 12.11 hrs, Volume= 0.299 af
Outflow = 4.00 cfs @ 12.19 hrs, Volume= 0.298 af, Atten= 8%, Lag= 4.9 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.00 fps, Min. Travel Time= 2.9 min
Avg. Velocity = 0.61 fps, Avg. Travel Time= 9.5 min

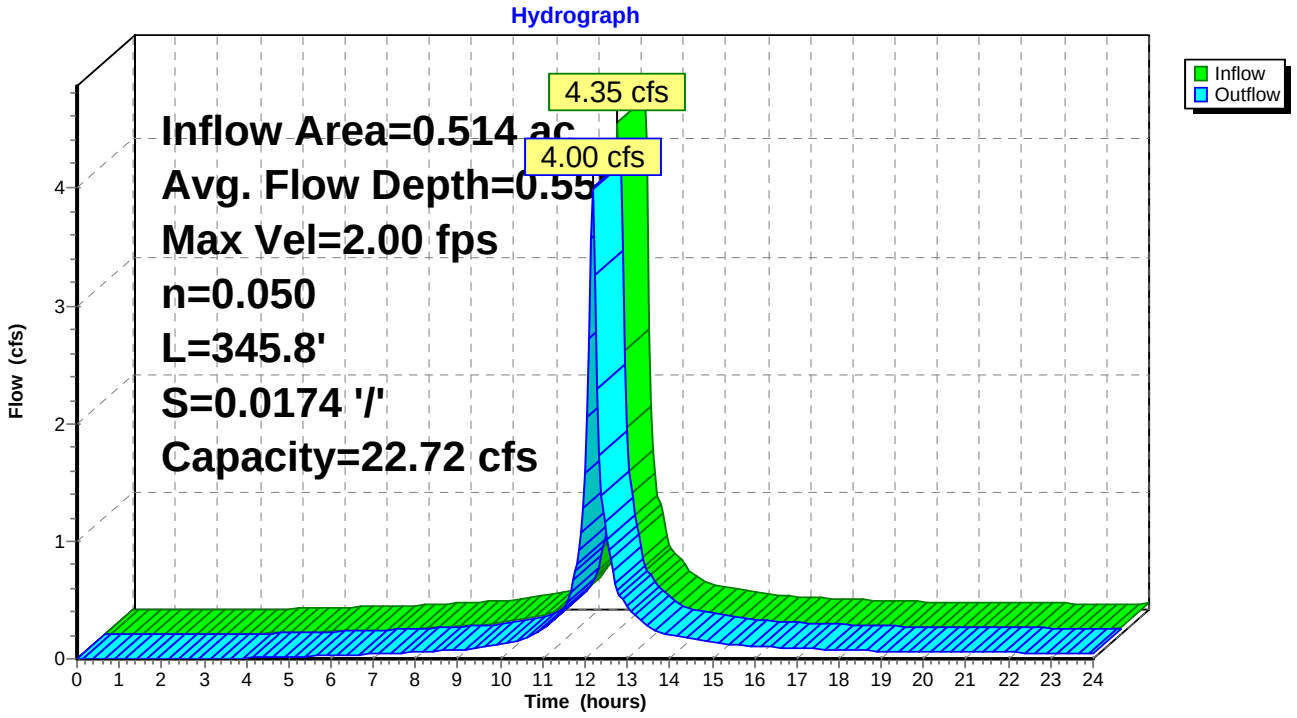
Peak Storage= 695 cf @ 12.14 hrs
Average Depth at Peak Storage= 0.55'
Bank-Full Depth= 1.25' Flow Area= 7.2 sf, Capacity= 22.72 cfs

2.00' x 1.25' deep channel, n= 0.050
Side Slope Z-value= 3.0 '/' Top Width= 9.50'
Length= 345.8' Slope= 0.0174 '/'
Inlet Invert= 1,940.00', Outlet Invert= 1,934.00'



‡

Reach 8R: C-4



Summary for Reach 13R: C-5

[62] Hint: Exceeded Reach 8R OUTLET depth by 1.60' @ 12.25 hrs

Inflow Area = 1.646 ac, 72.02% Impervious, Inflow Depth > 7.48" for 100-Year event
Inflow = 12.75 cfs @ 12.15 hrs, Volume= 1.026 af
Outflow = 12.17 cfs @ 12.19 hrs, Volume= 1.024 af, Atten= 5%, Lag= 2.2 min

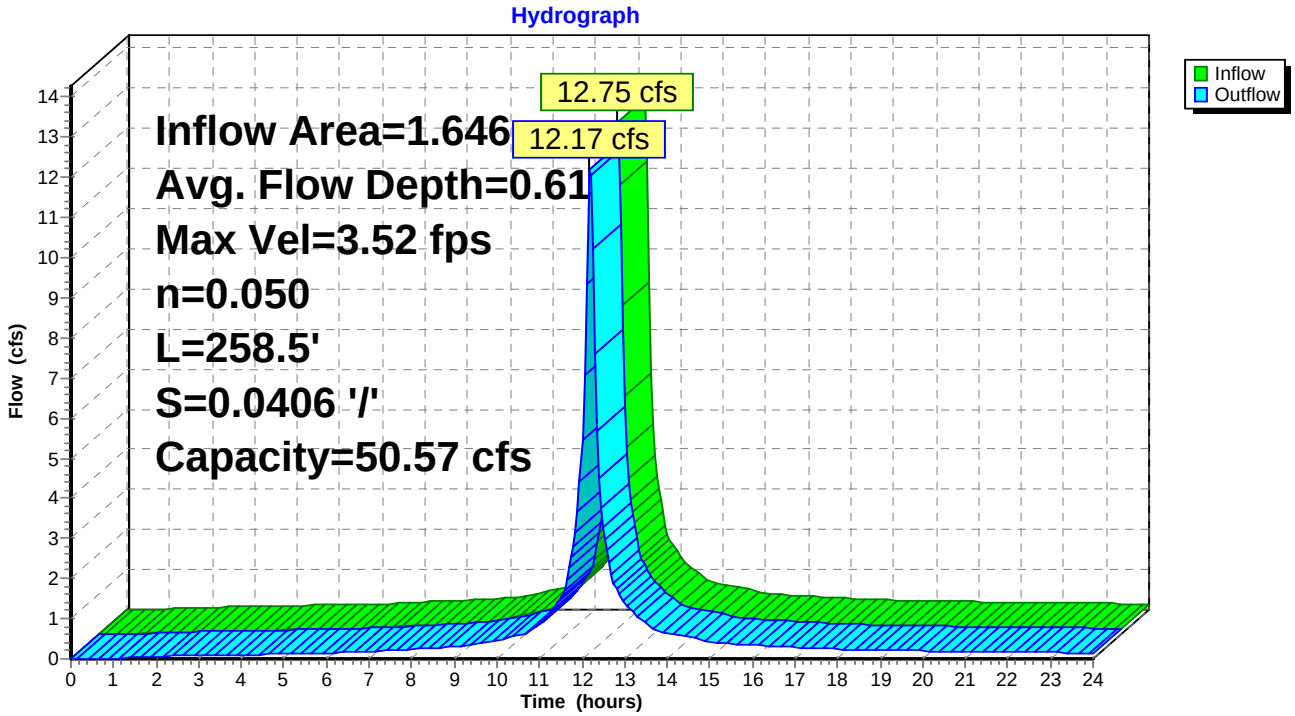
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.52 fps, Min. Travel Time= 1.2 min
Avg. Velocity = 0.99 fps, Avg. Travel Time= 4.3 min

Peak Storage= 917 cf @ 12.16 hrs
Average Depth at Peak Storage= 0.61'
Bank-Full Depth= 1.25' Flow Area= 9.7 sf, Capacity= 50.57 cfs

4.00' x 1.25' deep channel, n= 0.050
Side Slope Z-value= 3.0 '/' Top Width= 11.50'
Length= 258.5' Slope= 0.0406 '/'
Inlet Invert= 1,935.50', Outlet Invert= 1,925.00'

‡

Reach 13R: C-5



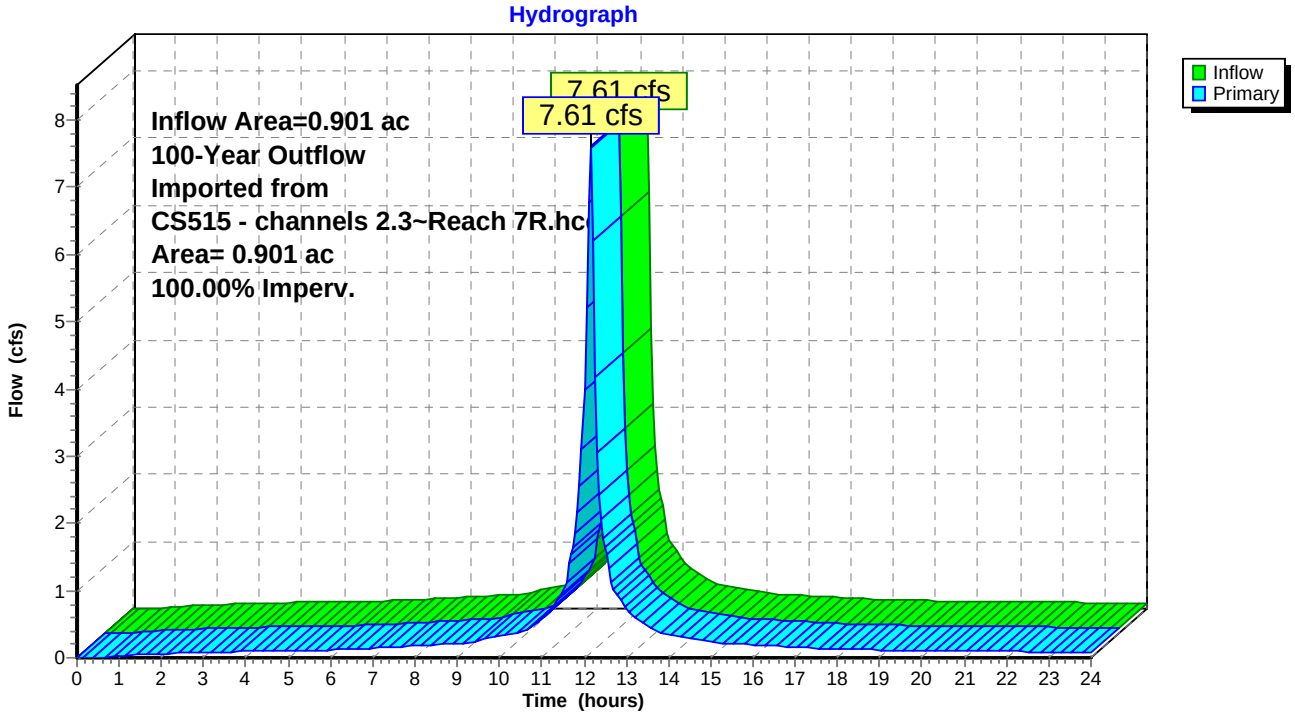
Summary for Link 14L: Culvert 1

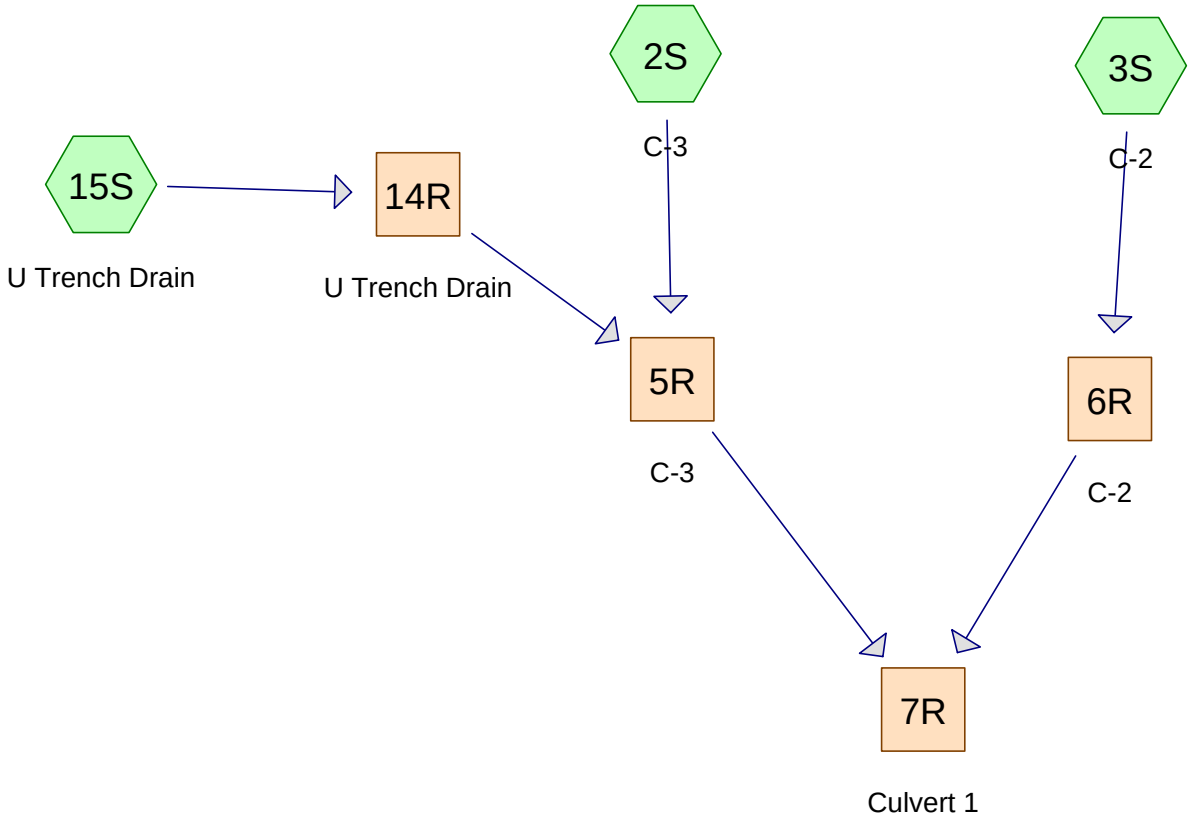
Inflow Area = 0.901 ac,100.00% Impervious, Inflow Depth > 8.17" for 100-Year event
Inflow = 7.61 cfs @ 12.14 hrs, Volume= 0.614 af
Primary = 7.61 cfs @ 12.14 hrs, Volume= 0.614 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

100-Year Outflow Imported from CS515 - channels 2.3~Reach 7R.hce

Link 14L: Culvert 1





Subcat Reach Pond Link

Routing Diagram for CS515 - channels 2.3
Prepared by Microsoft, Printed 2/24/2022

Project Notes

Rainfall events imported from "NRCS-Rain.txt" for 7639 PA Luzerne-C

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.901	98	Paved parking, HSG D (2S, 3S, 15S)
0.901	**98**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
0.000	HSG C	
0.901	HSG D	2S, 3S, 15S
0.000	Other	
0.901		**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	0.901	0.000	0.901	Paved parking	2S, 3S, 15S
0.000	**0.000**	**0.000**	**0.901**	**0.000**	**0.901**	**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	7R	1,935.75	1,935.44	63.0	0.0049	0.012	18.0	0.0	0.0
2	14R	1,941.00	1,939.40	70.0	0.0229	0.013	10.0	10.0	0.0

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 2S: C-3 Runoff Area=8,181 sf 100.00% Impervious Runoff Depth>2.67"
Tc=5.0 min CN=98 Runoff=0.57 cfs 0.042 af

Subcatchment 3S: C-2 Runoff Area=27,350 sf 100.00% Impervious Runoff Depth>2.67"
Tc=5.0 min CN=98 Runoff=1.92 cfs 0.140 af

Subcatchment 15S: U Trench Drain Runoff Area=3,721 sf 100.00% Impervious Runoff Depth>2.67"
Tc=5.0 min CN=98 Runoff=0.26 cfs 0.019 af

Reach 5R: C-3 Avg. Flow Depth=0.19' Max Vel=1.72 fps Inflow=0.82 cfs 0.061 af
n=0.057 L=60.0' S=0.0567 '/' Capacity=22.09 cfs Outflow=0.80 cfs 0.061 af

Reach 6R: C-2 Avg. Flow Depth=0.37' Max Vel=1.63 fps Inflow=1.92 cfs 0.140 af
n=0.043 L=149.5' S=0.0134 '/' Capacity=14.23 cfs Outflow=1.78 cfs 0.139 af

Reach 7R: Culvert 1 Avg. Flow Depth=0.58' Max Vel=4.02 fps Inflow=2.57 cfs 0.200 af
18.0" Round Pipe n=0.012 L=63.0' S=0.0049 '/' Capacity=7.98 cfs Outflow=2.53 cfs 0.200 af

Reach 14R: U Trench Drain Avg. Flow Depth=0.10' Max Vel=3.16 fps Inflow=0.26 cfs 0.019 af
10.0" x 10.0" Box Pipe n=0.013 L=70.0' S=0.0229 '/' Capacity=5.11 cfs Outflow=0.25 cfs 0.019 af

Total Runoff Area = 0.901 ac Runoff Volume = 0.200 af Average Runoff Depth = 2.67"
0.00% Pervious = 0.000 ac 100.00% Impervious = 0.901 ac

Summary for Subcatchment 2S: C-3

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

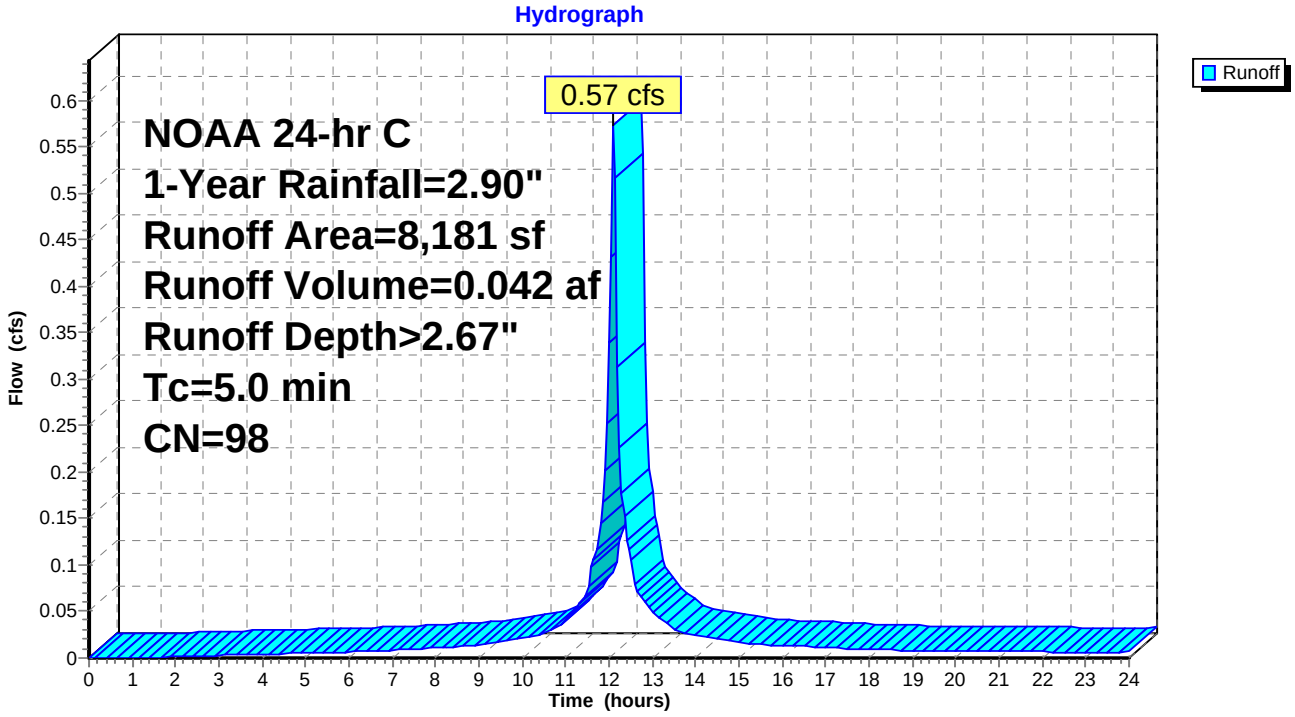
Runoff = 0.57 cfs @ 12.11 hrs, Volume= 0.042 af, Depth> 2.67"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 1-Year Rainfall=2.90"

	Area (sf)	CN	Description
*	8,181	98	Paved parking, HSG D
	8,181		100.00% Impervious Area

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

Subcatchment 2S: C-3



Summary for Subcatchment 3S: C-2

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

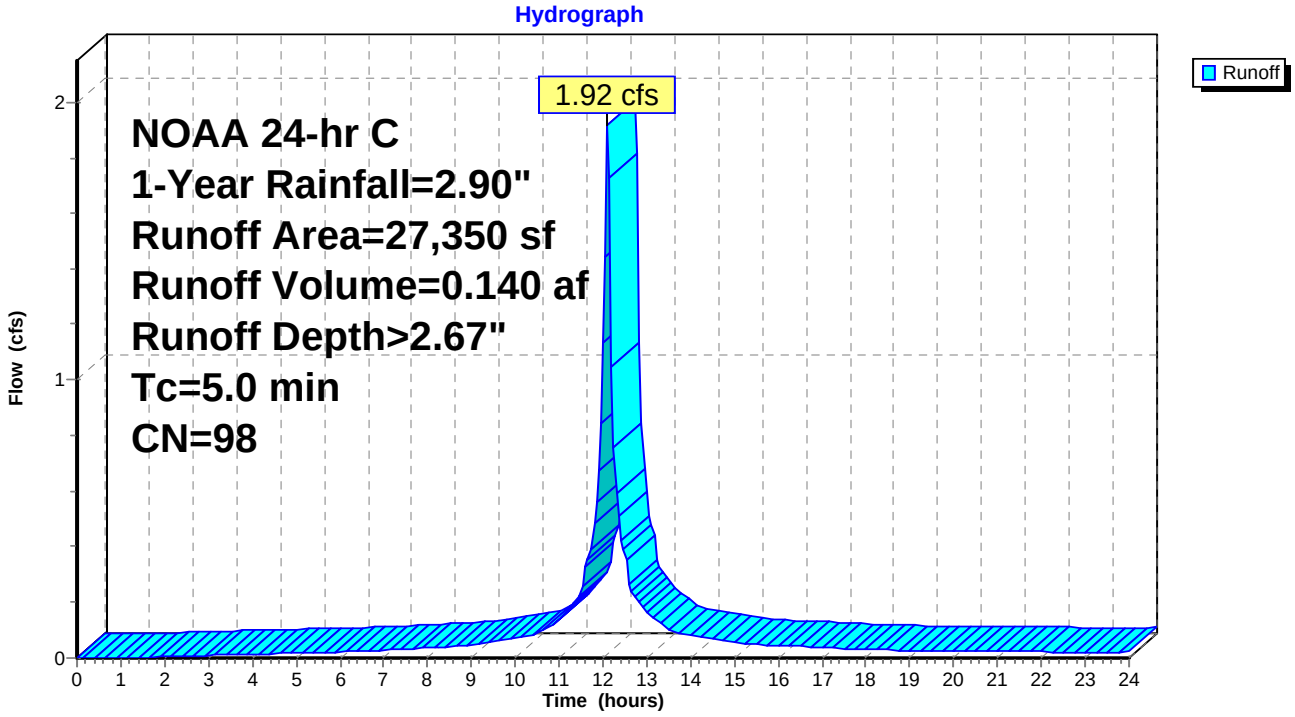
Runoff = 1.92 cfs @ 12.11 hrs, Volume= 0.140 af, Depth> 2.67"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 1-Year Rainfall=2.90"

	Area (sf)	CN	Description
*	27,350	98	Paved parking, HSG D
	27,350		100.00% Impervious Area

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

Subcatchment 3S: C-2



Summary for Subcatchment 15S: U Trench Drain

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

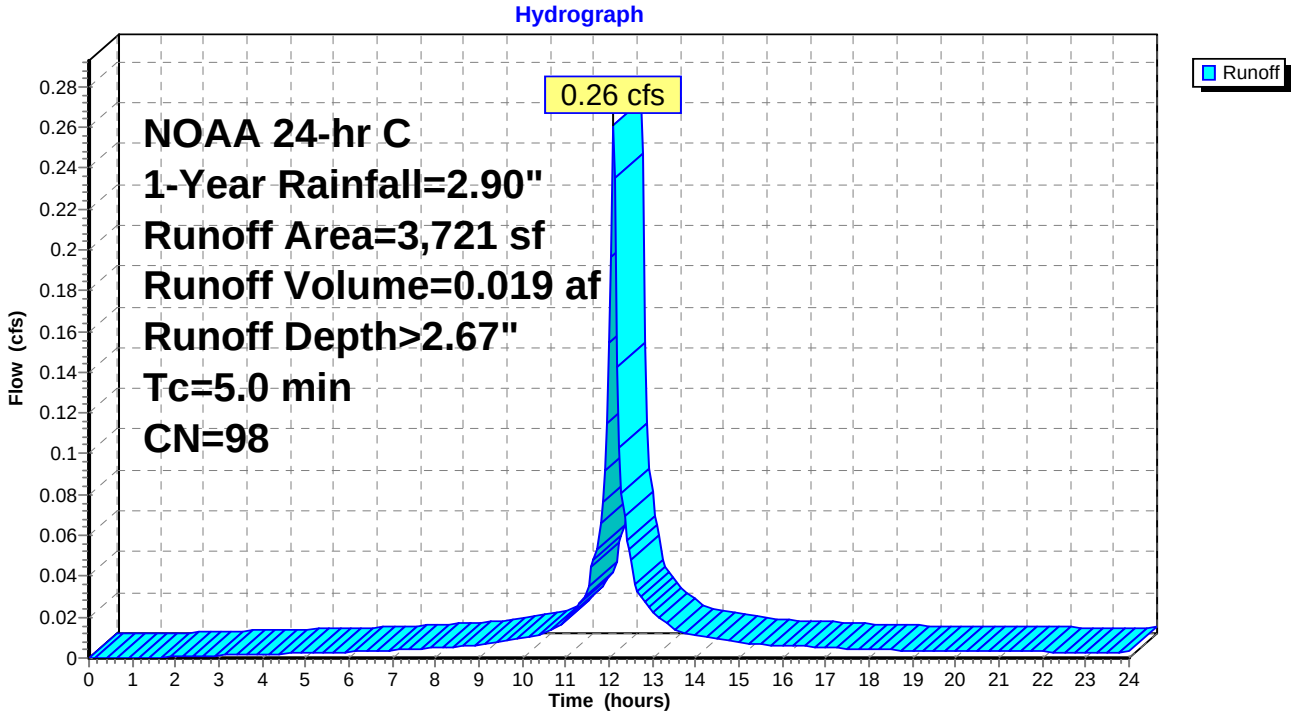
Runoff = 0.26 cfs @ 12.11 hrs, Volume= 0.019 af, Depth> 2.67"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 1-Year Rainfall=2.90"

	Area (sf)	CN	Description
*	3,721	98	Paved parking, HSG D
	3,721		100.00% Impervious Area

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

Subcatchment 15S: U Trench Drain



Summary for Reach 5R: C-3

[62] Hint: Exceeded Reach 14R OUTLET depth by 0.09' @ 12.15 hrs

Inflow Area = 0.273 ac,100.00% Impervious, Inflow Depth > 2.67" for 1-Year event
Inflow = 0.82 cfs @ 12.11 hrs, Volume= 0.061 af
Outflow = 0.80 cfs @ 12.13 hrs, Volume= 0.061 af, Atten= 3%, Lag= 1.1 min

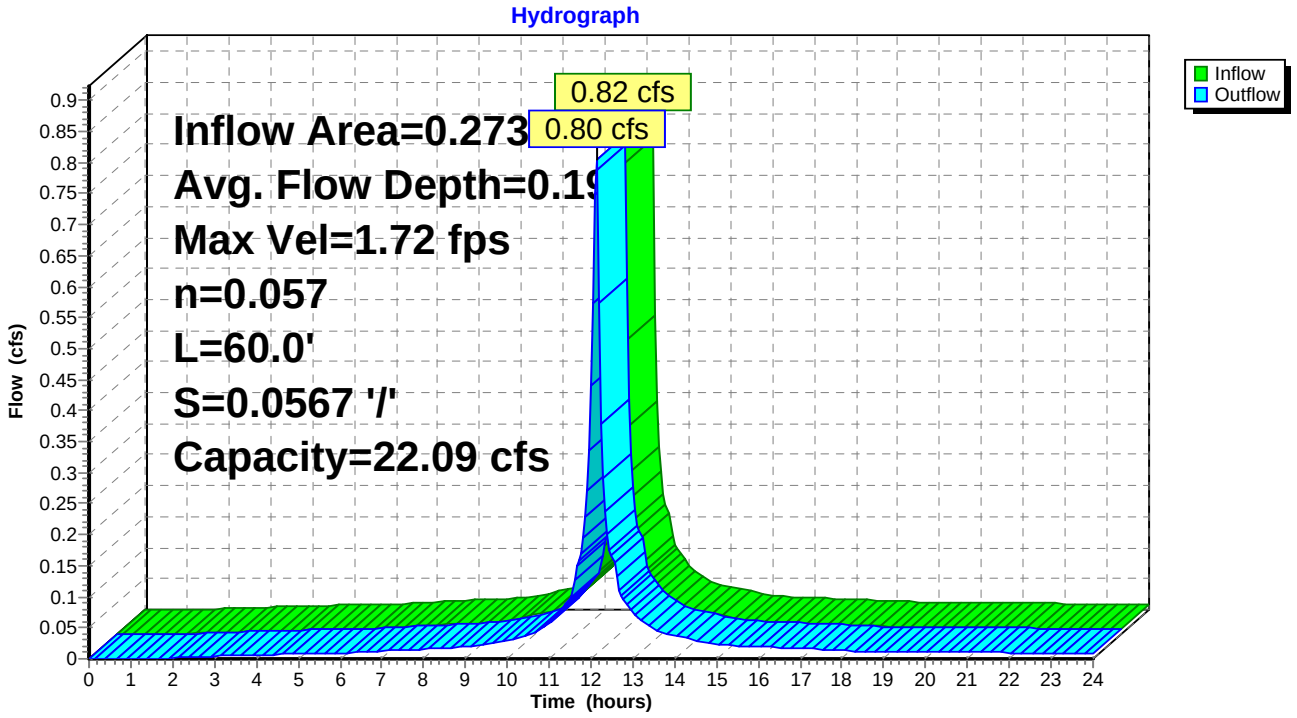
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.72 fps, Min. Travel Time= 0.6 min
Avg. Velocity = 0.47 fps, Avg. Travel Time= 2.1 min

Peak Storage= 28 cf @ 12.13 hrs
Average Depth at Peak Storage= 0.19'
Bank-Full Depth= 1.00' Flow Area= 5.0 sf, Capacity= 22.09 cfs

2.00' x 1.00' deep channel, n= 0.057
Side Slope Z-value= 3.0 '/' Top Width= 8.00'
Length= 60.0' Slope= 0.0567 '/'
Inlet Invert= 1,939.40', Outlet Invert= 1,936.00'

‡

Reach 5R: C-3



Summary for Reach 6R: C-2

Inflow Area = 0.628 ac,100.00% Impervious, Inflow Depth > 2.67" for 1-Year event
Inflow = 1.92 cfs @ 12.11 hrs, Volume= 0.140 af
Outflow = 1.78 cfs @ 12.15 hrs, Volume= 0.139 af, Atten= 8%, Lag= 2.6 min

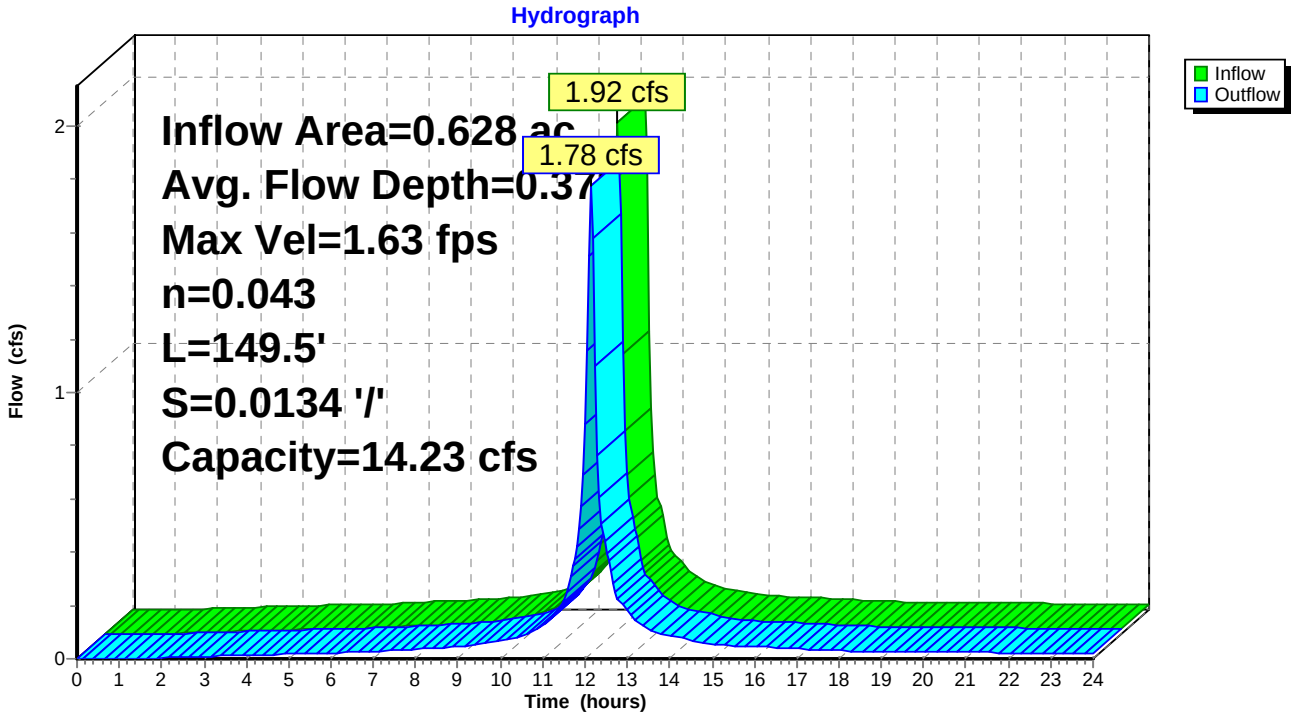
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.63 fps, Min. Travel Time= 1.5 min
Avg. Velocity = 0.47 fps, Avg. Travel Time= 5.3 min

Peak Storage= 170 cf @ 12.13 hrs
Average Depth at Peak Storage= 0.37'
Bank-Full Depth= 1.00' Flow Area= 5.0 sf, Capacity= 14.23 cfs

2.00' x 1.00' deep channel, n= 0.043
Side Slope Z-value= 3.0 '/' Top Width= 8.00'
Length= 149.5' Slope= 0.0134 '/'
Inlet Invert= 1,938.00', Outlet Invert= 1,936.00'

‡

Reach 6R: C-2



Summary for Reach 7R: Culvert 1

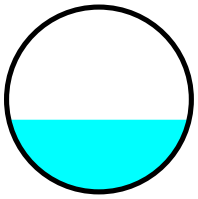
[52] Hint: Inlet/Outlet conditions not evaluated
[62] Hint: Exceeded Reach 5R OUTLET depth by 0.15' @ 12.15 hrs
[61] Hint: Exceeded Reach 6R outlet invert by 0.33' @ 12.15 hrs

Inflow Area = 0.901 ac,100.00% Impervious, Inflow Depth > 2.66" for 1-Year event
Inflow = 2.57 cfs @ 12.15 hrs, Volume= 0.200 af
Outflow = 2.53 cfs @ 12.15 hrs, Volume= 0.200 af, Atten= 1%, Lag= 0.4 min

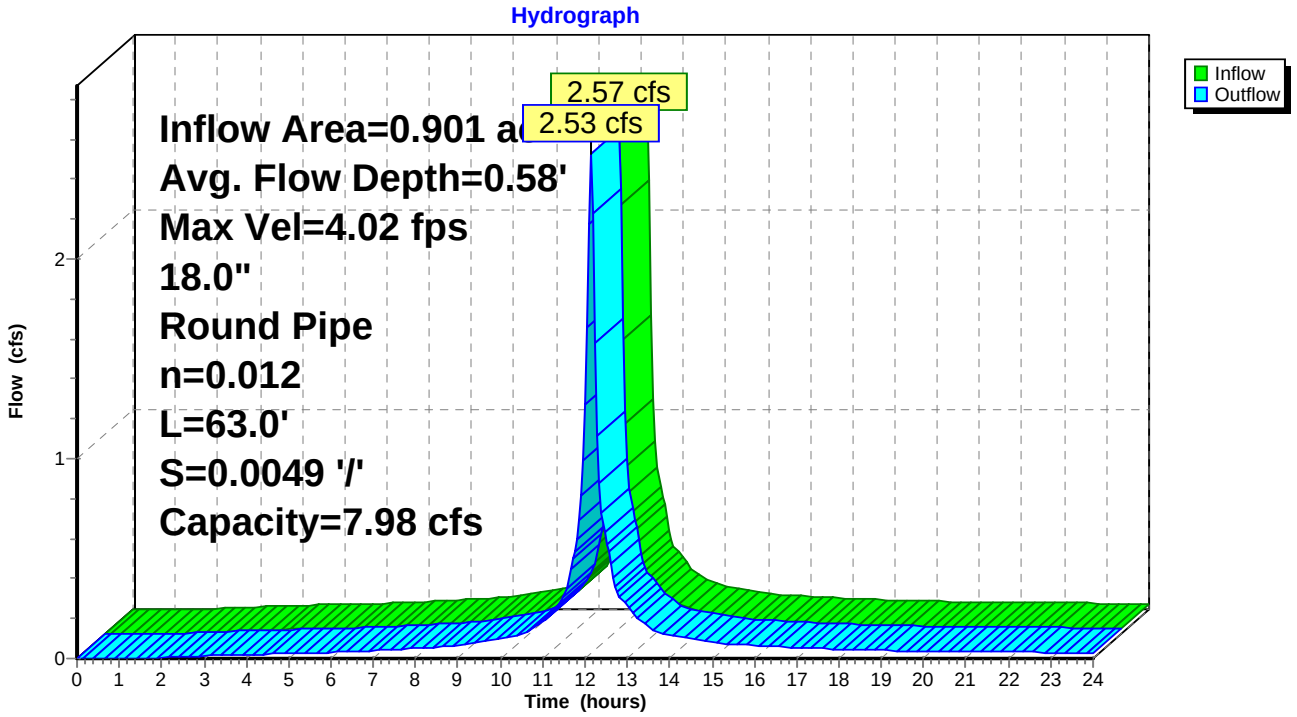
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.02 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 1.33 fps, Avg. Travel Time= 0.8 min

Peak Storage= 40 cf @ 12.15 hrs
Average Depth at Peak Storage= 0.58'
Bank-Full Depth= 1.50' Flow Area= 1.8 sf, Capacity= 7.98 cfs

18.0" Round Pipe
n= 0.012 Concrete pipe, finished
Length= 63.0' Slope= 0.0049 '/'
Inlet Invert= 1,935.75', Outlet Invert= 1,935.44'



Reach 7R: Culvert 1



Summary for Reach 14R: U Trench Drain

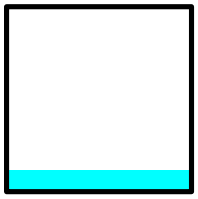
[52] Hint: Inlet/Outlet conditions not evaluated

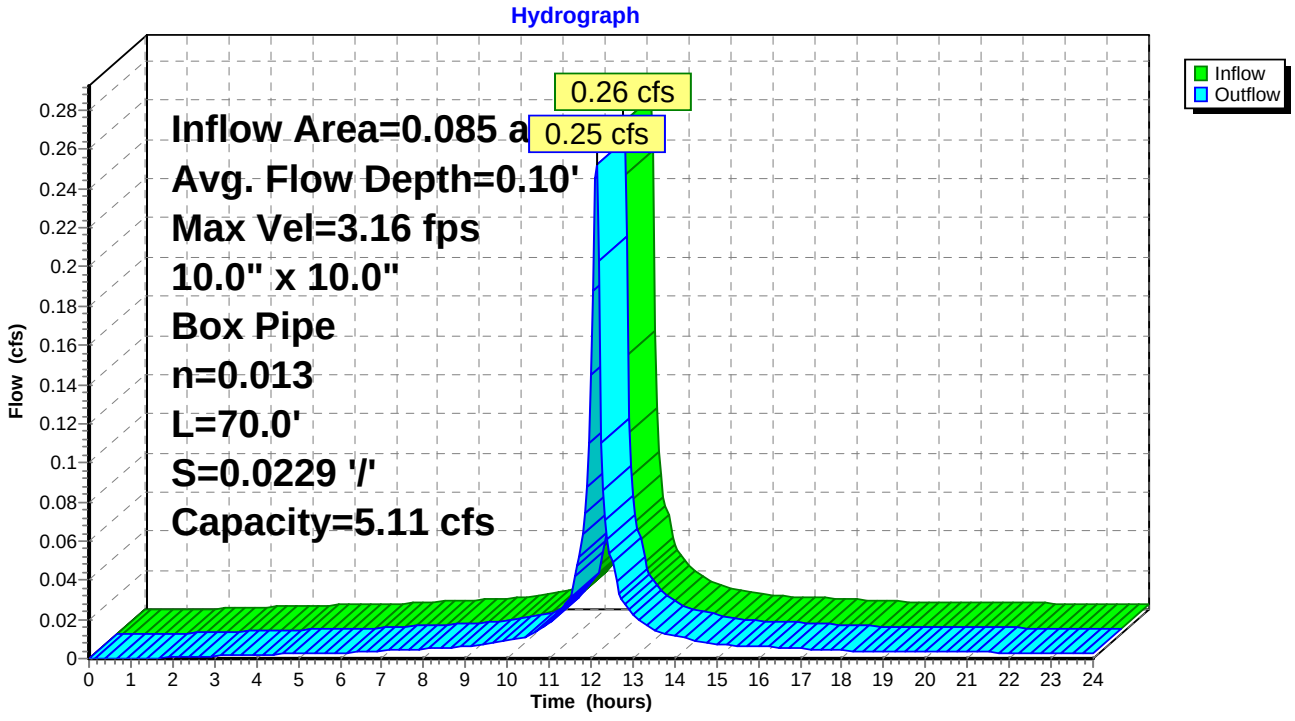
Inflow Area = 0.085 ac,100.00% Impervious, Inflow Depth > 2.67" for 1-Year event
Inflow = 0.26 cfs @ 12.11 hrs, Volume= 0.019 af
Outflow = 0.25 cfs @ 12.12 hrs, Volume= 0.019 af, Atten= 4%, Lag= 0.8 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.16 fps, Min. Travel Time= 0.4 min
Avg. Velocity = 0.86 fps, Avg. Travel Time= 1.4 min

Peak Storage= 6 cf @ 12.12 hrs
Average Depth at Peak Storage= 0.10'
Bank-Full Depth= 0.83' Flow Area= 0.7 sf, Capacity= 5.11 cfs

10.0" W x 10.0" H Box Pipe
n= 0.013 Corrugated PE, smooth interior
Length= 70.0' Slope= 0.0229 '/'
Inlet Invert= 1,941.00', Outlet Invert= 1,939.40'





Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 2S: C-3 Runoff Area=8,181 sf 100.00% Impervious Runoff Depth>3.16"
Tc=5.0 min CN=98 Runoff=0.68 cfs 0.050 af

Subcatchment 3S: C-2 Runoff Area=27,350 sf 100.00% Impervious Runoff Depth>3.16"
Tc=5.0 min CN=98 Runoff=2.26 cfs 0.166 af

Subcatchment 15S: U Trench Drain Runoff Area=3,721 sf 100.00% Impervious Runoff Depth>3.16"
Tc=5.0 min CN=98 Runoff=0.31 cfs 0.023 af

Reach 5R: C-3 Avg. Flow Depth=0.20' Max Vel=1.81 fps Inflow=0.97 cfs 0.072 af
n=0.057 L=60.0' S=0.0567 '/' Capacity=22.09 cfs Outflow=0.95 cfs 0.072 af

Reach 6R: C-2 Avg. Flow Depth=0.40' Max Vel=1.71 fps Inflow=2.26 cfs 0.166 af
n=0.043 L=149.5' S=0.0134 '/' Capacity=14.23 cfs Outflow=2.10 cfs 0.165 af

Reach 7R: Culvert 1 Avg. Flow Depth=0.64' Max Vel=4.20 fps Inflow=3.03 cfs 0.237 af
18.0" Round Pipe n=0.012 L=63.0' S=0.0049 '/' Capacity=7.98 cfs Outflow=2.99 cfs 0.237 af

Reach 14R: U Trench Drain Avg. Flow Depth=0.11' Max Vel=3.34 fps Inflow=0.31 cfs 0.023 af
10.0" x 10.0" Box Pipe n=0.013 L=70.0' S=0.0229 '/' Capacity=5.11 cfs Outflow=0.30 cfs 0.023 af

Total Runoff Area = 0.901 ac Runoff Volume = 0.238 af Average Runoff Depth = 3.16"
0.00% Pervious = 0.000 ac 100.00% Impervious = 0.901 ac

Summary for Subcatchment 2S: C-3

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

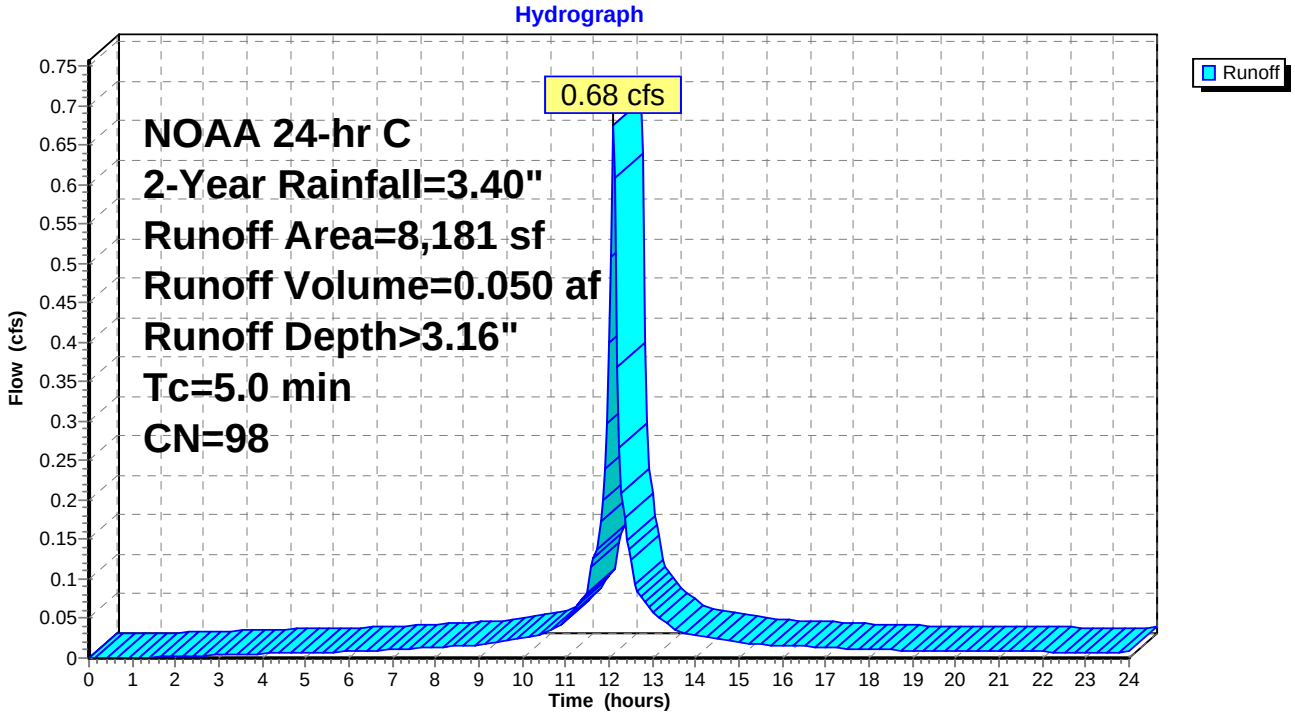
Runoff = 0.68 cfs @ 12.11 hrs, Volume= 0.050 af, Depth> 3.16"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 2-Year Rainfall=3.40"

	Area (sf)	CN	Description
*	8,181	98	Paved parking, HSG D
	8,181		100.00% Impervious Area

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

Subcatchment 2S: C-3



Summary for Subcatchment 3S: C-2

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

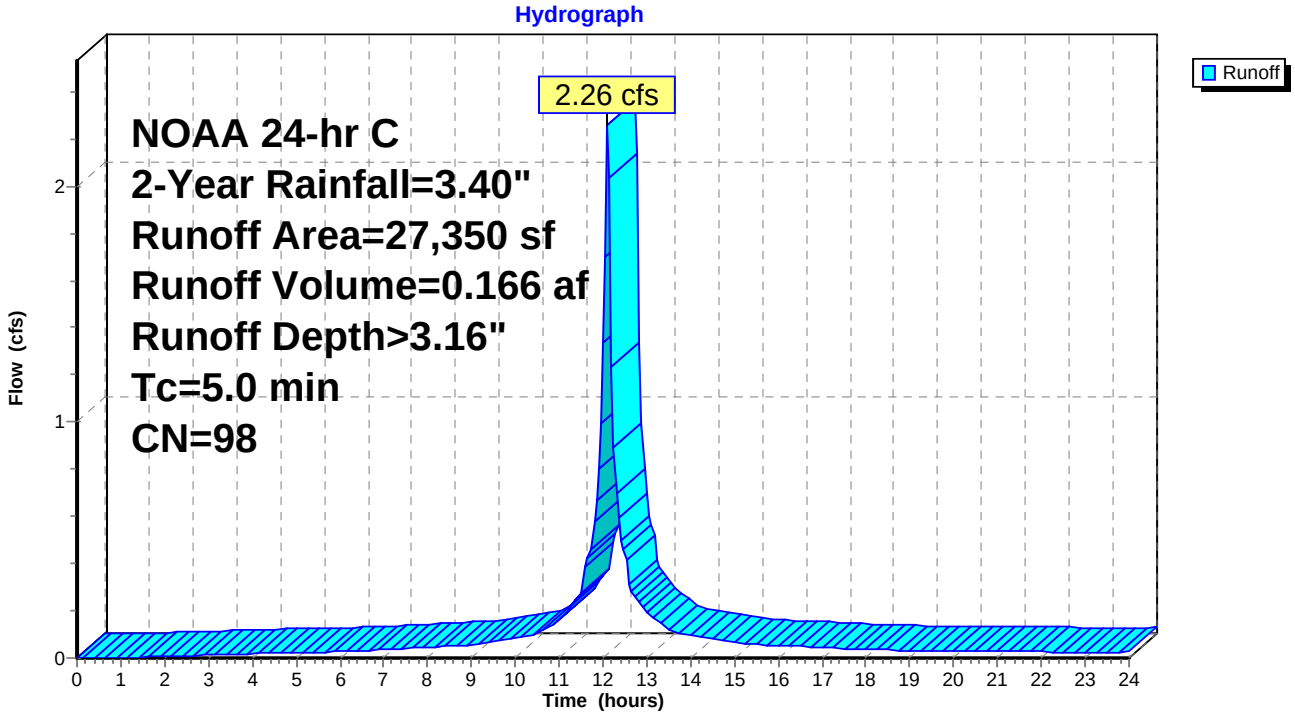
Runoff = 2.26 cfs @ 12.11 hrs, Volume= 0.166 af, Depth> 3.16"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 2-Year Rainfall=3.40"

	Area (sf)	CN	Description
*	27,350	98	Paved parking, HSG D
	27,350		100.00% Impervious Area

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

Subcatchment 3S: C-2



Summary for Subcatchment 15S: U Trench Drain

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

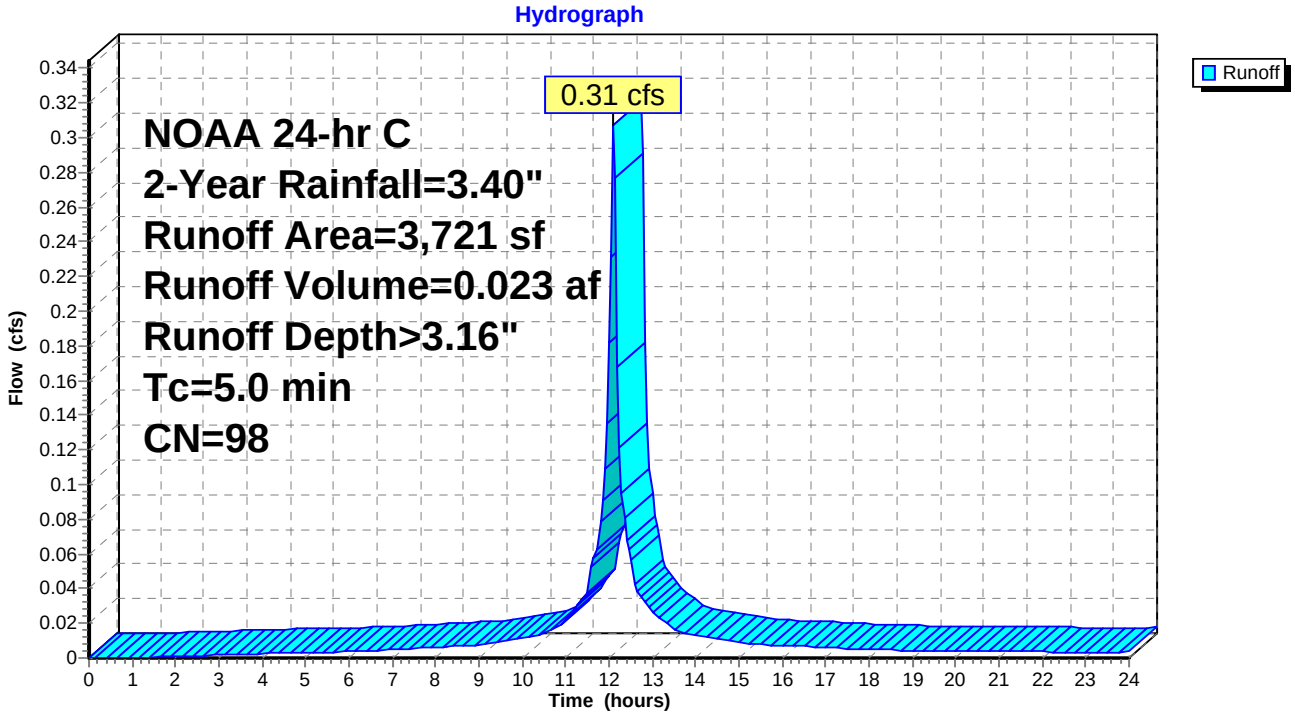
Runoff = 0.31 cfs @ 12.11 hrs, Volume= 0.023 af, Depth> 3.16"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 2-Year Rainfall=3.40"

	Area (sf)	CN	Description
*	3,721	98	Paved parking, HSG D
	3,721		100.00% Impervious Area

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

Subcatchment 15S: U Trench Drain



Summary for Reach 5R: C-3

[62] Hint: Exceeded Reach 14R OUTLET depth by 0.09' @ 12.15 hrs

Inflow Area = 0.273 ac,100.00% Impervious, Inflow Depth > 3.16" for 2-Year event
Inflow = 0.97 cfs @ 12.11 hrs, Volume= 0.072 af
Outflow = 0.95 cfs @ 12.13 hrs, Volume= 0.072 af, Atten= 2%, Lag= 1.1 min

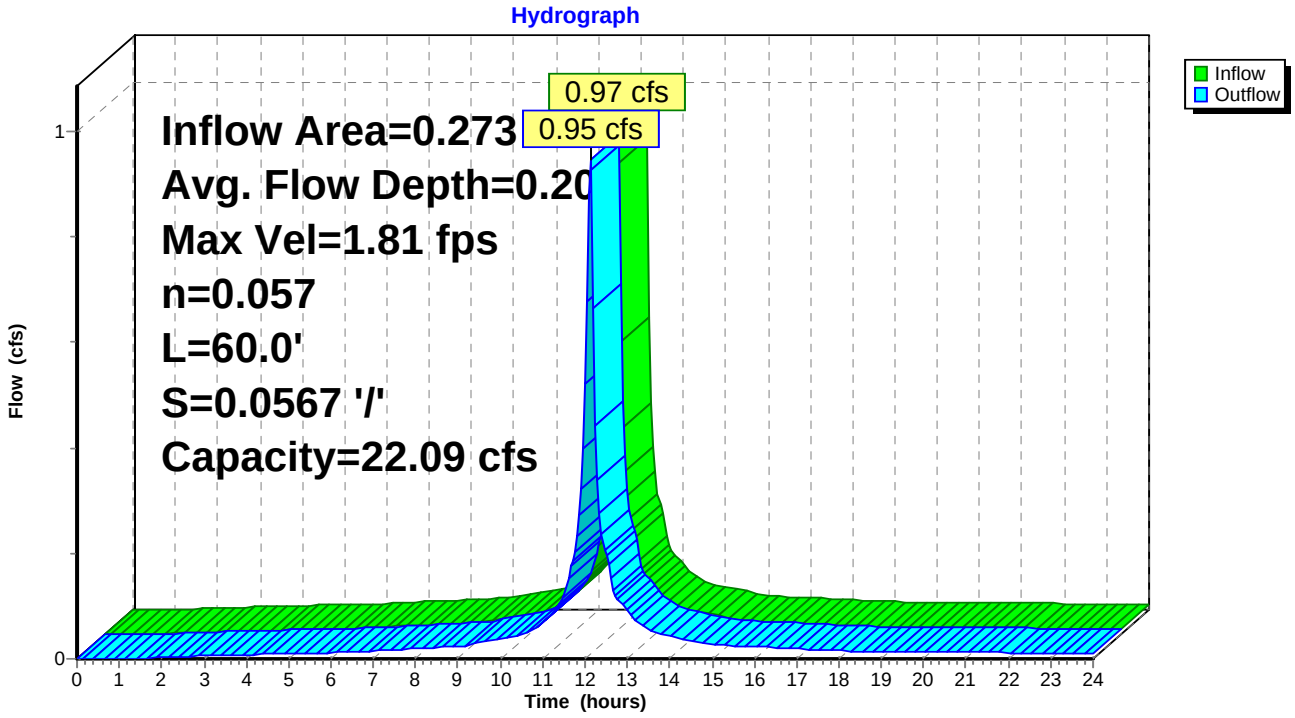
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.81 fps, Min. Travel Time= 0.6 min
Avg. Velocity = 0.49 fps, Avg. Travel Time= 2.0 min

Peak Storage= 32 cf @ 12.13 hrs
Average Depth at Peak Storage= 0.20'
Bank-Full Depth= 1.00' Flow Area= 5.0 sf, Capacity= 22.09 cfs

2.00' x 1.00' deep channel, n= 0.057
Side Slope Z-value= 3.0 '/' Top Width= 8.00'
Length= 60.0' Slope= 0.0567 '/'
Inlet Invert= 1,939.40', Outlet Invert= 1,936.00'

‡

Reach 5R: C-3



Summary for Reach 6R: C-2

Inflow Area = 0.628 ac,100.00% Impervious, Inflow Depth > 3.16" for 2-Year event
Inflow = 2.26 cfs @ 12.11 hrs, Volume= 0.166 af
Outflow = 2.10 cfs @ 12.15 hrs, Volume= 0.165 af, Atten= 7%, Lag= 2.4 min

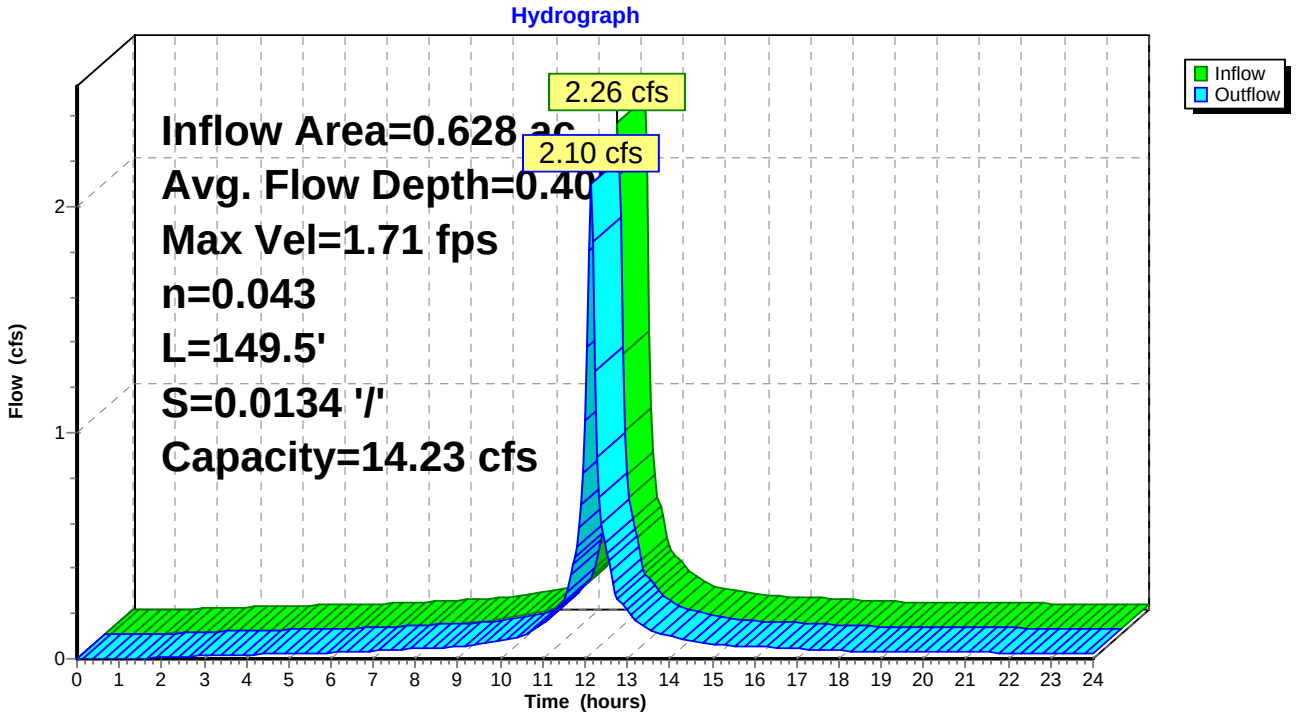
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.71 fps, Min. Travel Time= 1.5 min
Avg. Velocity = 0.50 fps, Avg. Travel Time= 5.0 min

Peak Storage= 191 cf @ 12.13 hrs
Average Depth at Peak Storage= 0.40'
Bank-Full Depth= 1.00' Flow Area= 5.0 sf, Capacity= 14.23 cfs

2.00' x 1.00' deep channel, n= 0.043
Side Slope Z-value= 3.0 '/' Top Width= 8.00'
Length= 149.5' Slope= 0.0134 '/'
Inlet Invert= 1,938.00', Outlet Invert= 1,936.00'

‡

Reach 6R: C-2



Summary for Reach 7R: Culvert 1

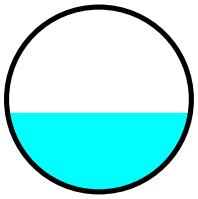
[52] Hint: Inlet/Outlet conditions not evaluated
[62] Hint: Exceeded Reach 5R OUTLET depth by 0.19' @ 12.15 hrs
[61] Hint: Exceeded Reach 6R outlet invert by 0.39' @ 12.15 hrs

Inflow Area = 0.901 ac,100.00% Impervious, Inflow Depth > 3.16" for 2-Year event
Inflow = 3.03 cfs @ 12.14 hrs, Volume= 0.237 af
Outflow = 2.99 cfs @ 12.15 hrs, Volume= 0.237 af, Atten= 1%, Lag= 0.3 min

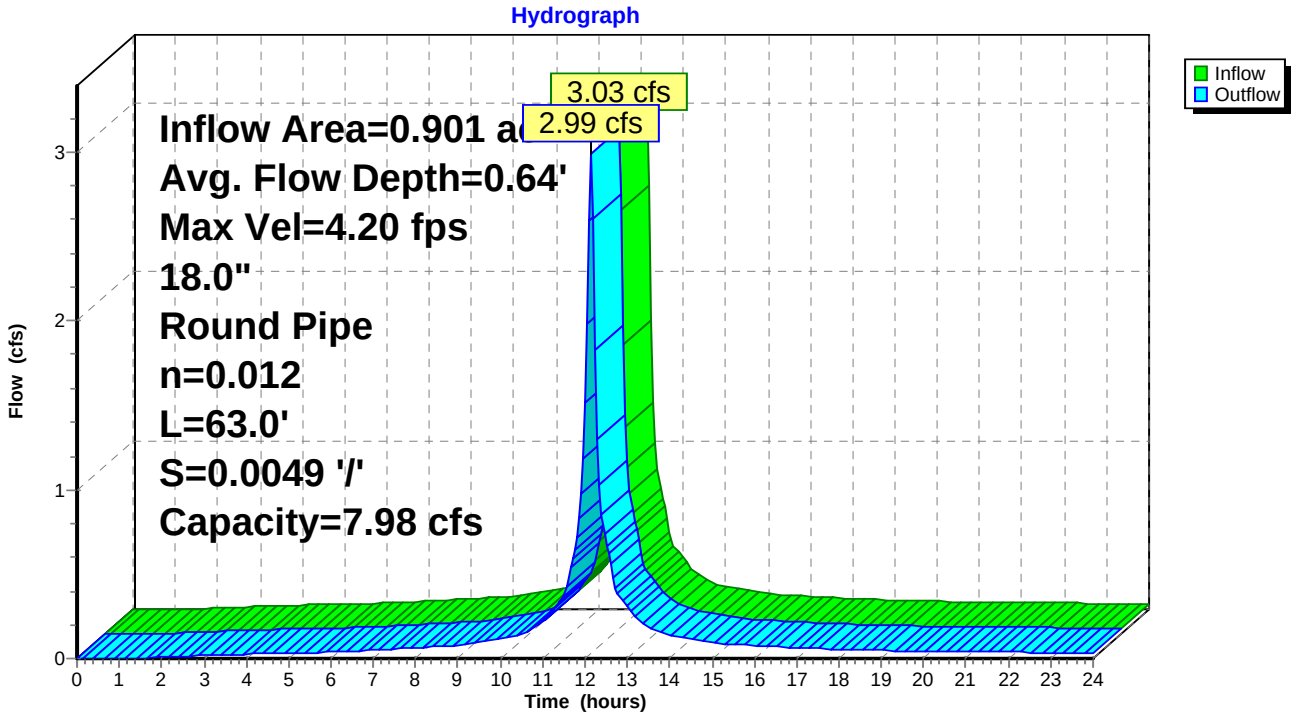
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.20 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 1.40 fps, Avg. Travel Time= 0.7 min

Peak Storage= 45 cf @ 12.15 hrs
Average Depth at Peak Storage= 0.64'
Bank-Full Depth= 1.50' Flow Area= 1.8 sf, Capacity= 7.98 cfs

18.0" Round Pipe
n= 0.012 Concrete pipe, finished
Length= 63.0' Slope= 0.0049 '/'
Inlet Invert= 1,935.75', Outlet Invert= 1,935.44'



Reach 7R: Culvert 1



Summary for Reach 14R: U Trench Drain

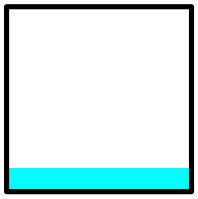
[52] Hint: Inlet/Outlet conditions not evaluated

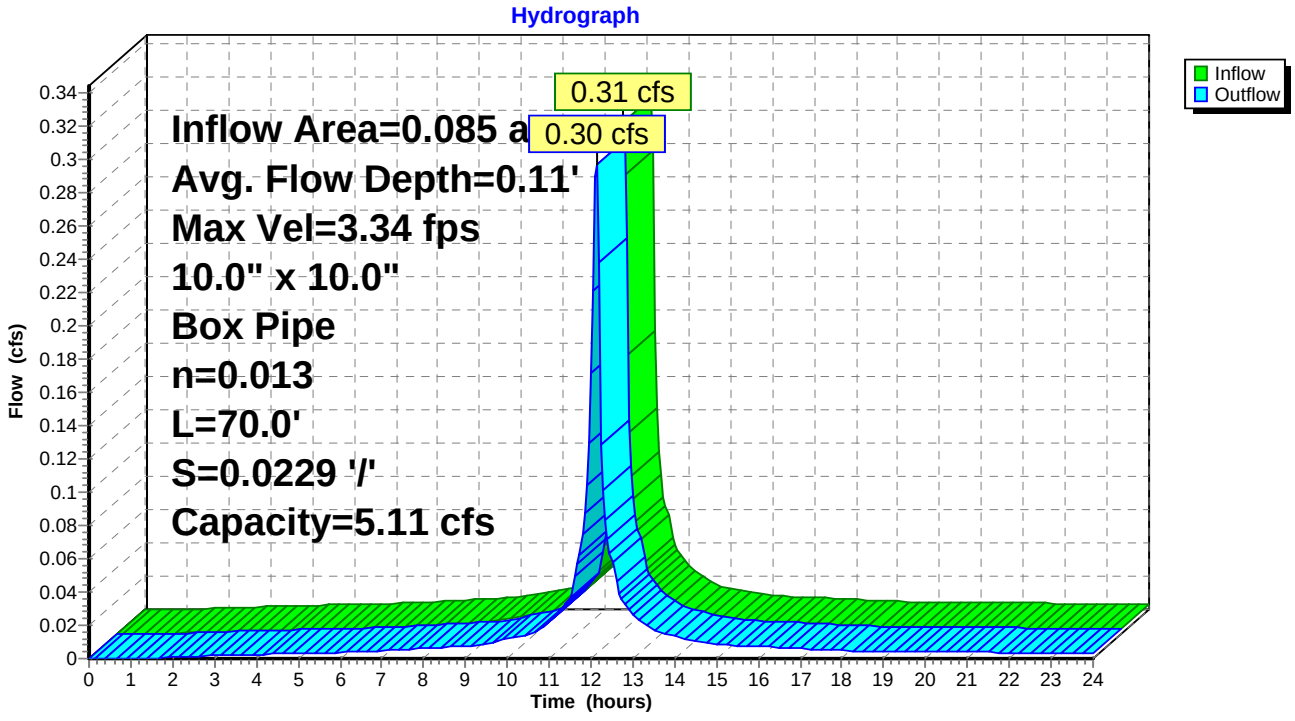
Inflow Area = 0.085 ac,100.00% Impervious, Inflow Depth > 3.16" for 2-Year event
Inflow = 0.31 cfs @ 12.11 hrs, Volume= 0.023 af
Outflow = 0.30 cfs @ 12.12 hrs, Volume= 0.023 af, Atten= 3%, Lag= 0.7 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.34 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 0.89 fps, Avg. Travel Time= 1.3 min

Peak Storage= 6 cf @ 12.12 hrs
Average Depth at Peak Storage= 0.11'
Bank-Full Depth= 0.83' Flow Area= 0.7 sf, Capacity= 5.11 cfs

10.0" W x 10.0" H Box Pipe
n= 0.013 Corrugated PE, smooth interior
Length= 70.0' Slope= 0.0229 '/'
Inlet Invert= 1,941.00', Outlet Invert= 1,939.40'





Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 2S: C-3 Runoff Area=8,181 sf 100.00% Impervious Runoff Depth>4.76"
Tc=5.0 min CN=98 Runoff=1.00 cfs 0.074 af

Subcatchment 3S: C-2 Runoff Area=27,350 sf 100.00% Impervious Runoff Depth>4.76"
Tc=5.0 min CN=98 Runoff=3.34 cfs 0.249 af

Subcatchment 15S: U Trench Drain Runoff Area=3,721 sf 100.00% Impervious Runoff Depth>4.76"
Tc=5.0 min CN=98 Runoff=0.45 cfs 0.034 af

Reach 5R: C-3 Avg. Flow Depth=0.25' Max Vel=2.05 fps Inflow=1.44 cfs 0.108 af
n=0.057 L=60.0' S=0.0567 '/' Capacity=22.09 cfs Outflow=1.41 cfs 0.108 af

Reach 6R: C-2 Avg. Flow Depth=0.49' Max Vel=1.91 fps Inflow=3.34 cfs 0.249 af
n=0.043 L=149.5' S=0.0134 '/' Capacity=14.23 cfs Outflow=3.12 cfs 0.249 af

Reach 7R: Culvert 1 Avg. Flow Depth=0.81' Max Vel=4.65 fps Inflow=4.51 cfs 0.357 af
18.0" Round Pipe n=0.012 L=63.0' S=0.0049 '/' Capacity=7.98 cfs Outflow=4.46 cfs 0.357 af

Reach 14R: U Trench Drain Avg. Flow Depth=0.14' Max Vel=3.82 fps Inflow=0.45 cfs 0.034 af
10.0" x 10.0" Box Pipe n=0.013 L=70.0' S=0.0229 '/' Capacity=5.11 cfs Outflow=0.44 cfs 0.034 af

Total Runoff Area = 0.901 ac Runoff Volume = 0.357 af Average Runoff Depth = 4.76"
0.00% Pervious = 0.000 ac 100.00% Impervious = 0.901 ac

Summary for Subcatchment 2S: C-3

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

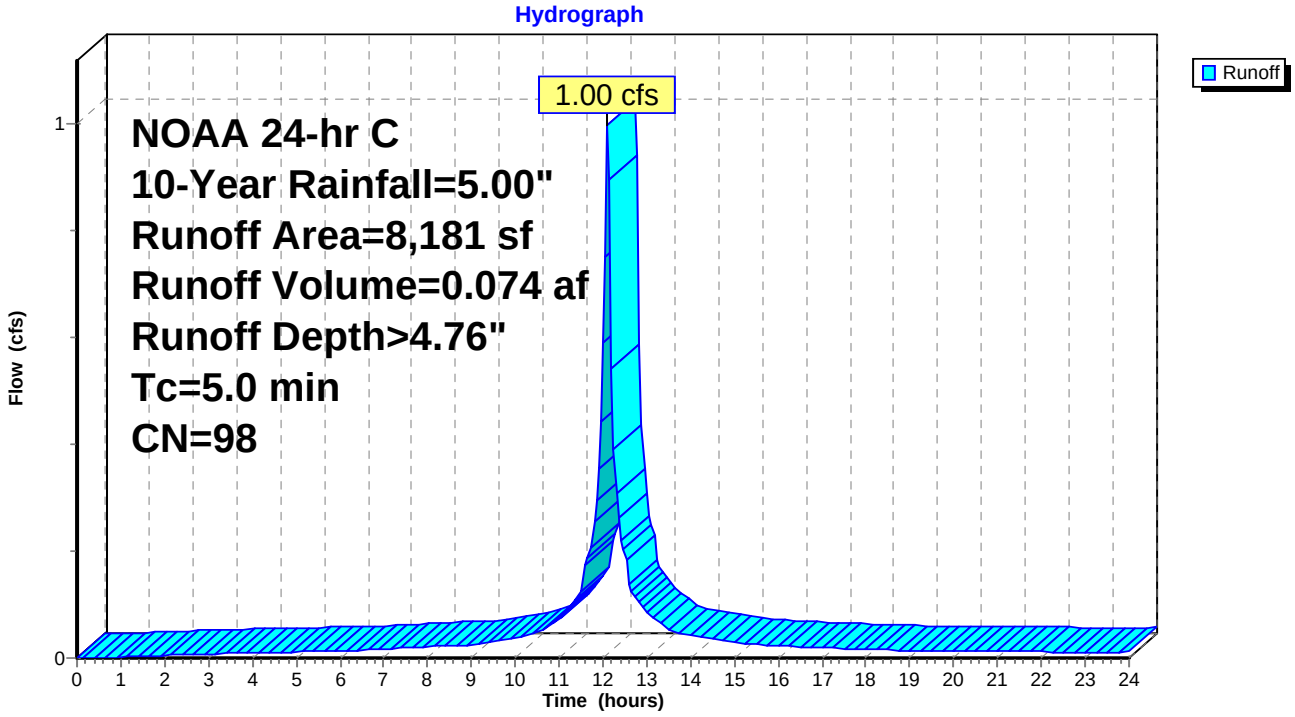
Runoff = 1.00 cfs @ 12.11 hrs, Volume= 0.074 af, Depth> 4.76"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 10-Year Rainfall=5.00"

	Area (sf)	CN	Description
*	8,181	98	Paved parking, HSG D
	8,181		100.00% Impervious Area

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

Subcatchment 2S: C-3



Summary for Subcatchment 3S: C-2

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

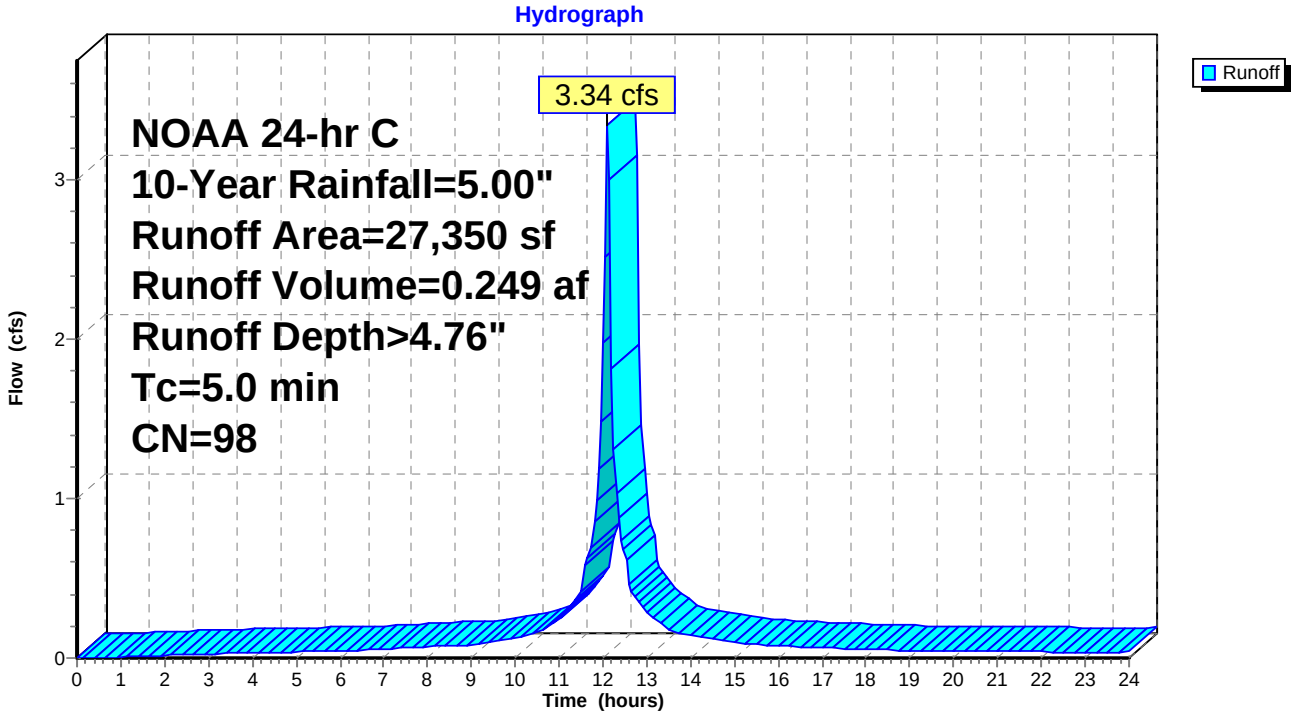
Runoff = 3.34 cfs @ 12.11 hrs, Volume= 0.249 af, Depth> 4.76"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 10-Year Rainfall=5.00"

	Area (sf)	CN	Description
*	27,350	98	Paved parking, HSG D
	27,350		100.00% Impervious Area

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

Subcatchment 3S: C-2



Summary for Subcatchment 15S: U Trench Drain

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

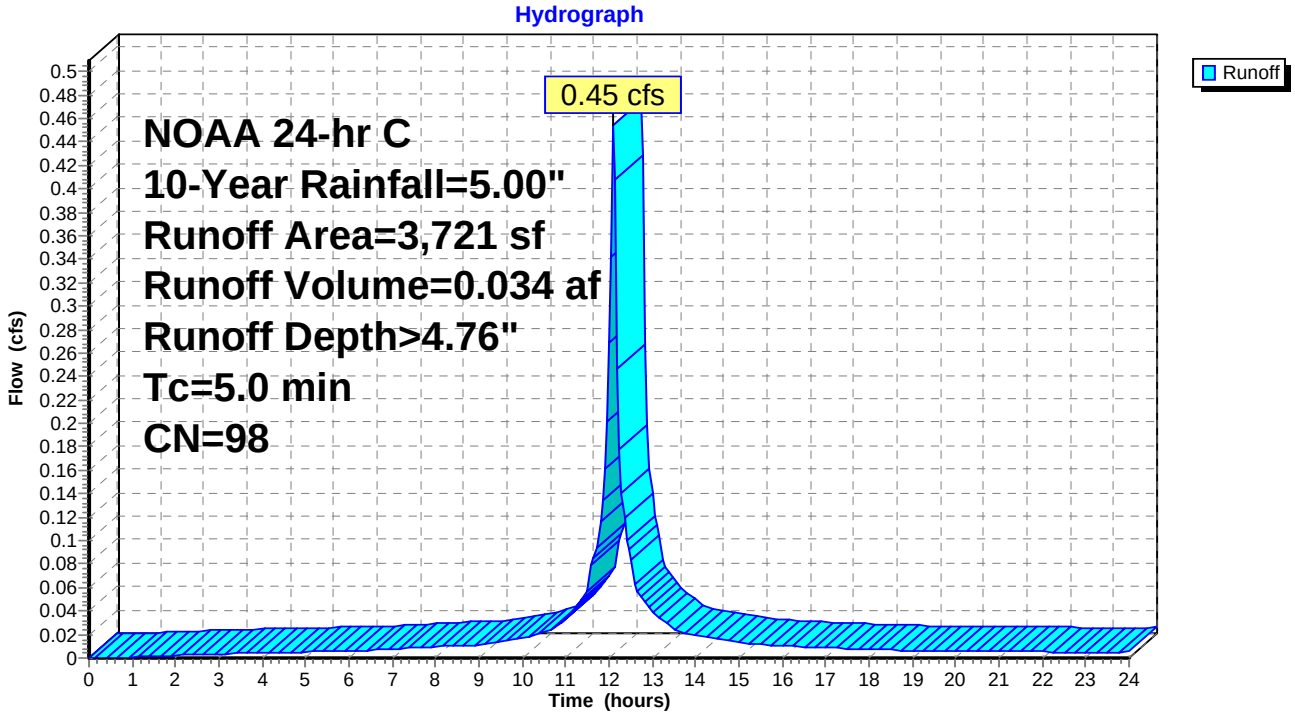
Runoff = 0.45 cfs @ 12.11 hrs, Volume= 0.034 af, Depth> 4.76"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 10-Year Rainfall=5.00"

	Area (sf)	CN	Description
*	3,721	98	Paved parking, HSG D
	3,721		100.00% Impervious Area

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

Subcatchment 15S: U Trench Drain



Summary for Reach 5R: C-3

[62] Hint: Exceeded Reach 14R OUTLET depth by 0.11' @ 12.15 hrs

Inflow Area = 0.273 ac,100.00% Impervious, Inflow Depth > 4.76" for 10-Year event
Inflow = 1.44 cfs @ 12.11 hrs, Volume= 0.108 af
Outflow = 1.41 cfs @ 12.13 hrs, Volume= 0.108 af, Atten= 2%, Lag= 1.0 min

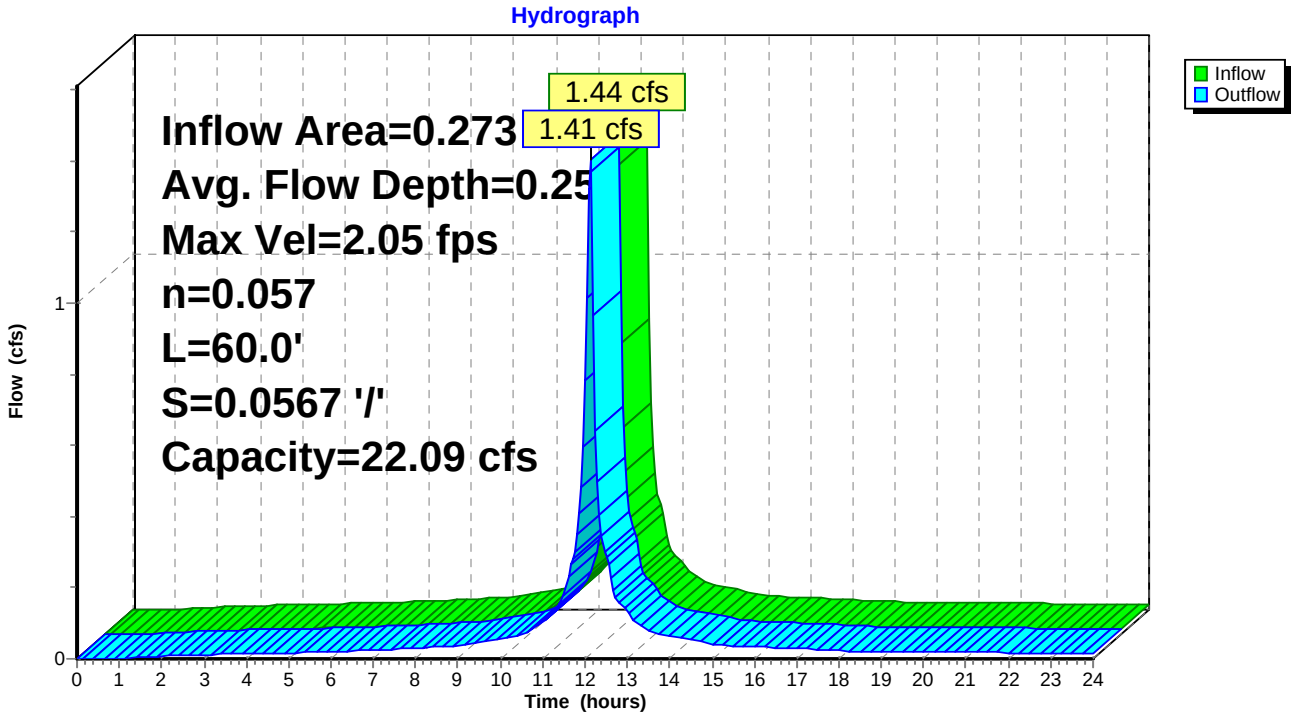
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.05 fps, Min. Travel Time= 0.5 min
Avg. Velocity = 0.57 fps, Avg. Travel Time= 1.8 min

Peak Storage= 41 cf @ 12.12 hrs
Average Depth at Peak Storage= 0.25'
Bank-Full Depth= 1.00' Flow Area= 5.0 sf, Capacity= 22.09 cfs

2.00' x 1.00' deep channel, n= 0.057
Side Slope Z-value= 3.0 '/' Top Width= 8.00'
Length= 60.0' Slope= 0.0567 '/'
Inlet Invert= 1,939.40', Outlet Invert= 1,936.00'

‡

Reach 5R: C-3



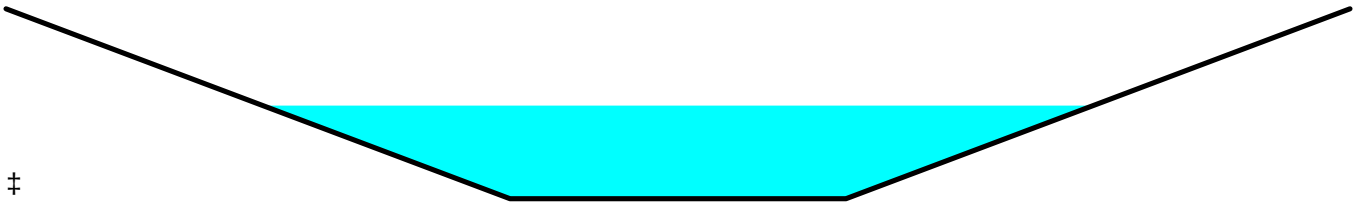
Summary for Reach 6R: C-2

Inflow Area = 0.628 ac,100.00% Impervious, Inflow Depth > 4.76" for 10-Year event
Inflow = 3.34 cfs @ 12.11 hrs, Volume= 0.249 af
Outflow = 3.12 cfs @ 12.15 hrs, Volume= 0.249 af, Atten= 7%, Lag= 2.2 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.91 fps, Min. Travel Time= 1.3 min
Avg. Velocity = 0.58 fps, Avg. Travel Time= 4.3 min

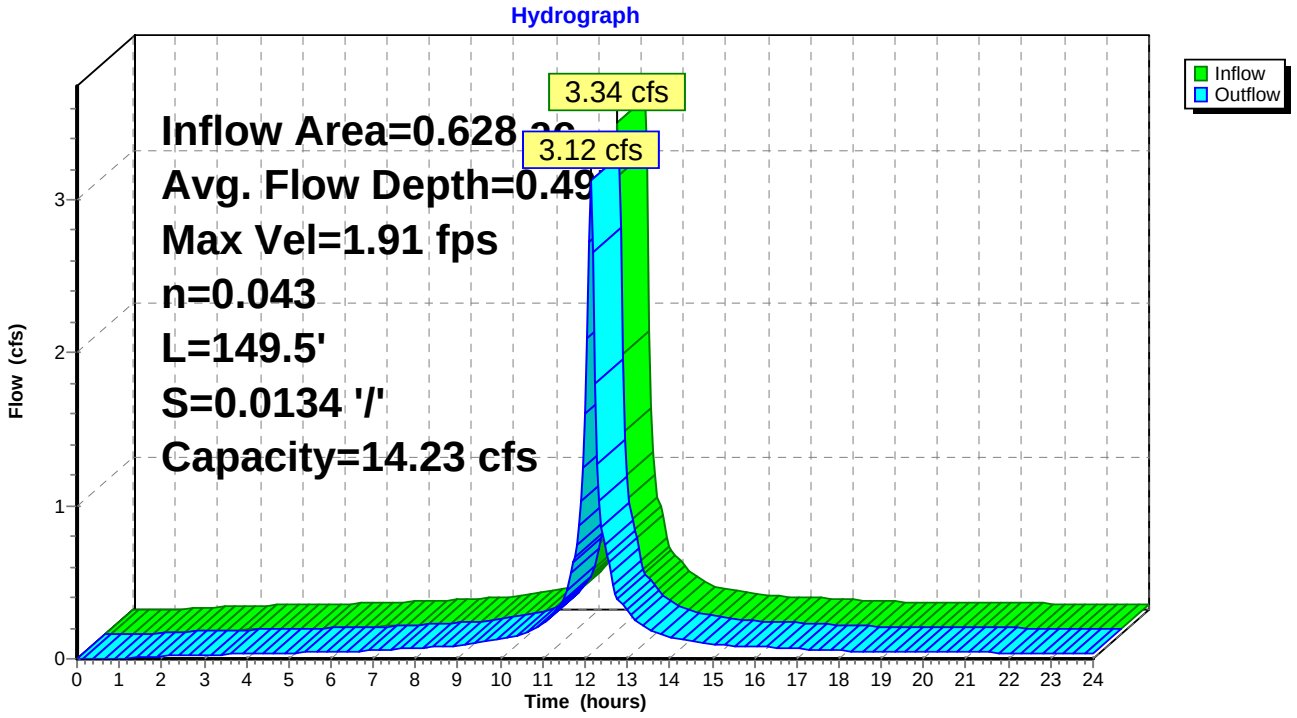
Peak Storage= 254 cf @ 12.13 hrs
Average Depth at Peak Storage= 0.49'
Bank-Full Depth= 1.00' Flow Area= 5.0 sf, Capacity= 14.23 cfs

2.00' x 1.00' deep channel, n= 0.043
Side Slope Z-value= 3.0 '/' Top Width= 8.00'
Length= 149.5' Slope= 0.0134 '/'
Inlet Invert= 1,938.00', Outlet Invert= 1,936.00'



‡

Reach 6R: C-2



Summary for Reach 7R: Culvert 1

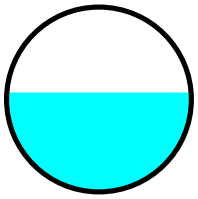
[52] Hint: Inlet/Outlet conditions not evaluated
[62] Hint: Exceeded Reach 5R OUTLET depth by 0.31' @ 12.15 hrs
[62] Hint: Exceeded Reach 6R OUTLET depth by 0.07' @ 12.15 hrs

Inflow Area = 0.901 ac,100.00% Impervious, Inflow Depth > 4.75" for 10-Year event
Inflow = 4.51 cfs @ 12.14 hrs, Volume= 0.357 af
Outflow = 4.46 cfs @ 12.15 hrs, Volume= 0.357 af, Atten= 1%, Lag= 0.3 min

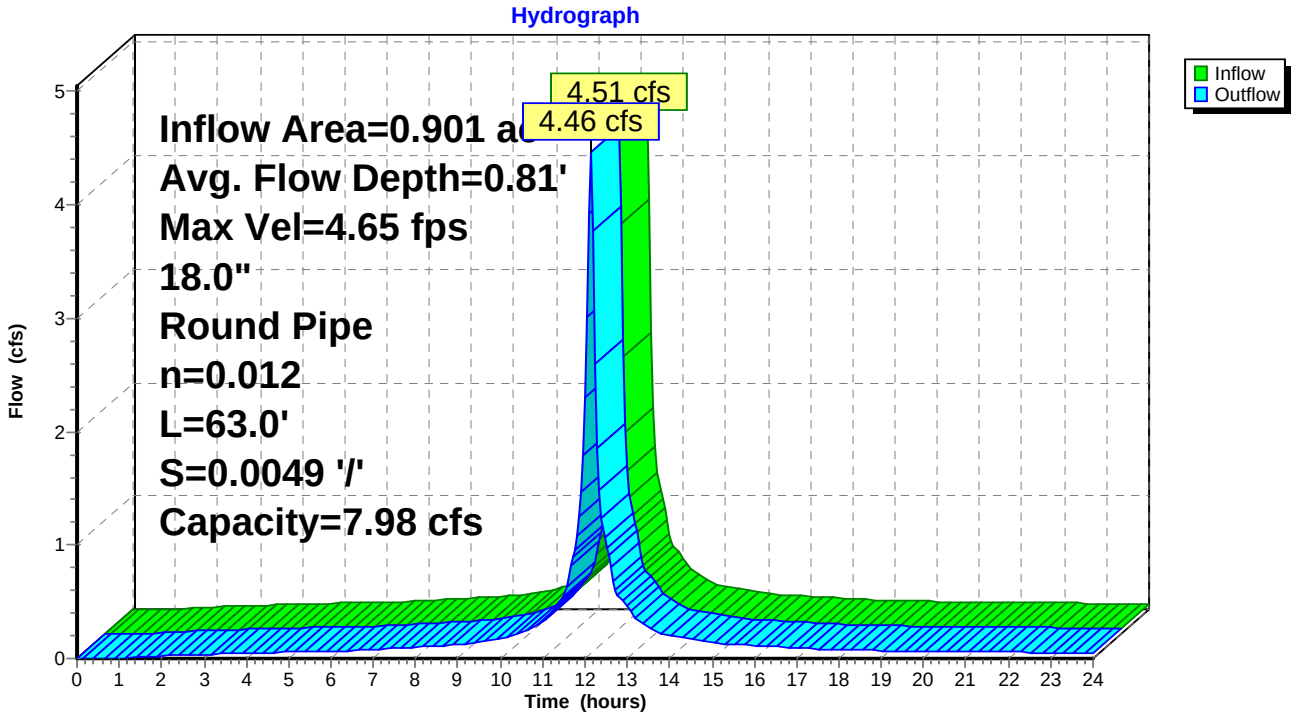
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.65 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 1.58 fps, Avg. Travel Time= 0.7 min

Peak Storage= 61 cf @ 12.14 hrs
Average Depth at Peak Storage= 0.81'
Bank-Full Depth= 1.50' Flow Area= 1.8 sf, Capacity= 7.98 cfs

18.0" Round Pipe
n= 0.012 Concrete pipe, finished
Length= 63.0' Slope= 0.0049 '/'
Inlet Invert= 1,935.75', Outlet Invert= 1,935.44'



Reach 7R: Culvert 1



Summary for Reach 14R: U Trench Drain

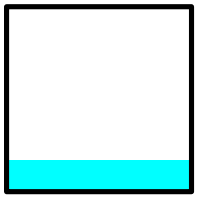
[52] Hint: Inlet/Outlet conditions not evaluated

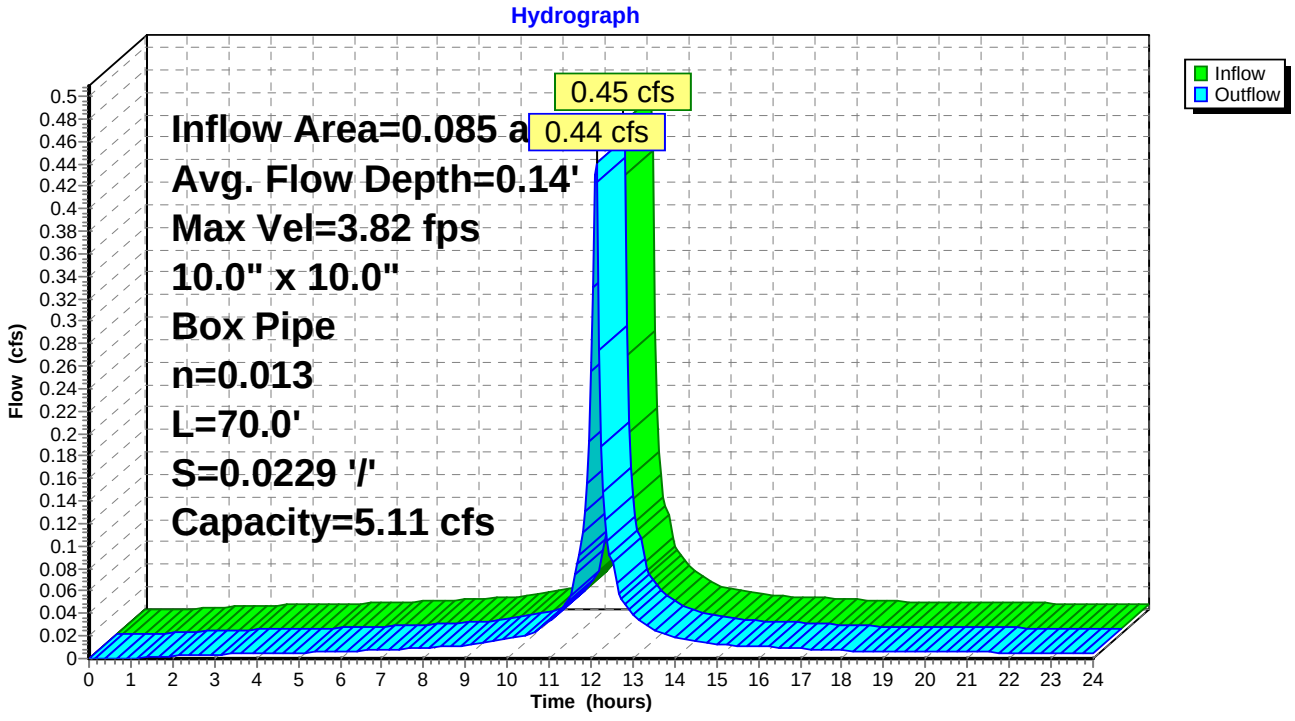
Inflow Area = 0.085 ac,100.00% Impervious, Inflow Depth > 4.76" for 10-Year event
Inflow = 0.45 cfs @ 12.11 hrs, Volume= 0.034 af
Outflow = 0.44 cfs @ 12.12 hrs, Volume= 0.034 af, Atten= 3%, Lag= 0.6 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.82 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 0.99 fps, Avg. Travel Time= 1.2 min

Peak Storage= 8 cf @ 12.12 hrs
Average Depth at Peak Storage= 0.14'
Bank-Full Depth= 0.83' Flow Area= 0.7 sf, Capacity= 5.11 cfs

10.0" W x 10.0" H Box Pipe
n= 0.013 Corrugated PE, smooth interior
Length= 70.0' Slope= 0.0229 '/'
Inlet Invert= 1,941.00', Outlet Invert= 1,939.40'





Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 2S: C-3 Runoff Area=8,181 sf 100.00% Impervious Runoff Depth>5.96"
Tc=5.0 min CN=98 Runoff=1.24 cfs 0.093 af

Subcatchment 3S: C-2 Runoff Area=27,350 sf 100.00% Impervious Runoff Depth>5.96"
Tc=5.0 min CN=98 Runoff=4.15 cfs 0.312 af

Subcatchment 15S: U Trench Drain Runoff Area=3,721 sf 100.00% Impervious Runoff Depth>5.96"
Tc=5.0 min CN=98 Runoff=0.56 cfs 0.042 af

Reach 5R: C-3 Avg. Flow Depth=0.28' Max Vel=2.19 fps Inflow=1.79 cfs 0.136 af
n=0.057 L=60.0' S=0.0567 '/' Capacity=22.09 cfs Outflow=1.75 cfs 0.136 af

Reach 6R: C-2 Avg. Flow Depth=0.55' Max Vel=2.03 fps Inflow=4.15 cfs 0.312 af
n=0.043 L=149.5' S=0.0134 '/' Capacity=14.23 cfs Outflow=3.89 cfs 0.311 af

Reach 7R: Culvert 1 Avg. Flow Depth=0.93' Max Vel=4.89 fps Inflow=5.62 cfs 0.447 af
18.0" Round Pipe n=0.012 L=63.0' S=0.0049 '/' Capacity=7.98 cfs Outflow=5.56 cfs 0.447 af

Reach 14R: U Trench Drain Avg. Flow Depth=0.16' Max Vel=4.11 fps Inflow=0.56 cfs 0.042 af
10.0" x 10.0" Box Pipe n=0.013 L=70.0' S=0.0229 '/' Capacity=5.11 cfs Outflow=0.55 cfs 0.042 af

Total Runoff Area = 0.901 ac Runoff Volume = 0.447 af Average Runoff Depth = 5.96"
0.00% Pervious = 0.000 ac 100.00% Impervious = 0.901 ac

Summary for Subcatchment 2S: C-3

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

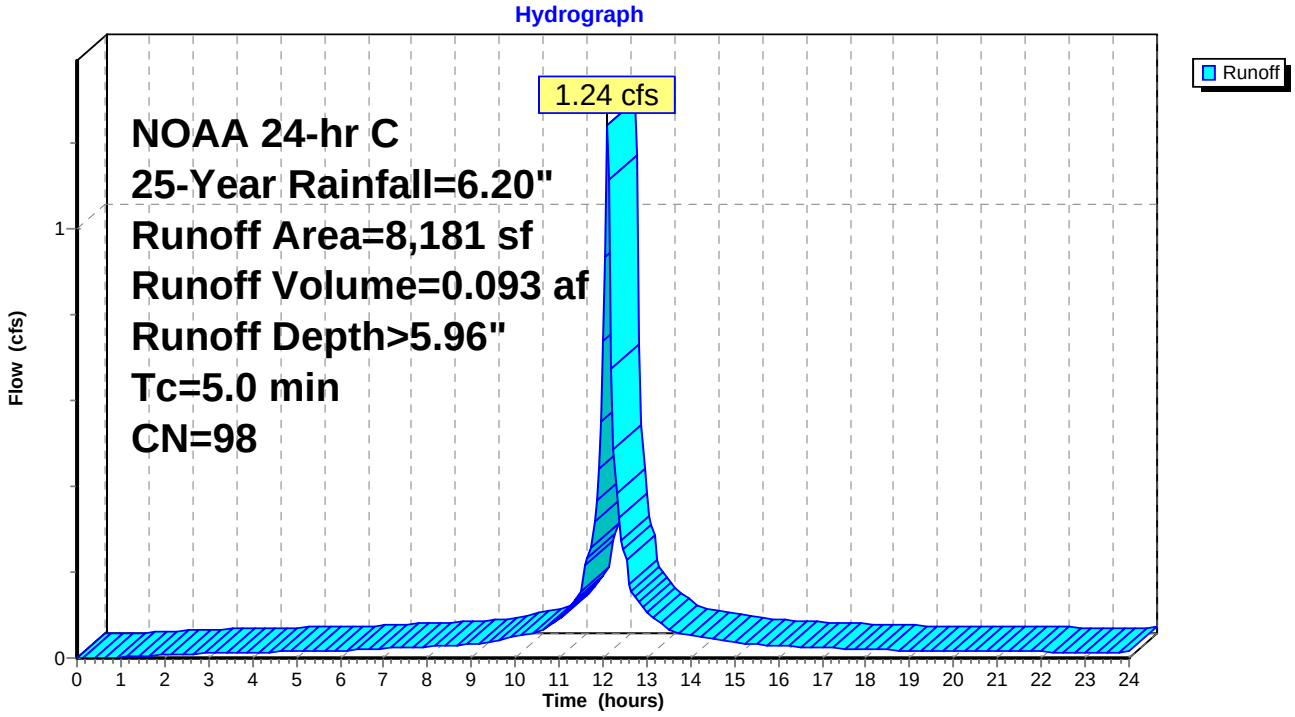
Runoff = 1.24 cfs @ 12.11 hrs, Volume= 0.093 af, Depth> 5.96"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 25-Year Rainfall=6.20"

	Area (sf)	CN	Description
*	8,181	98	Paved parking, HSG D
	8,181		100.00% Impervious Area

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

Subcatchment 2S: C-3



Summary for Subcatchment 3S: C-2

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

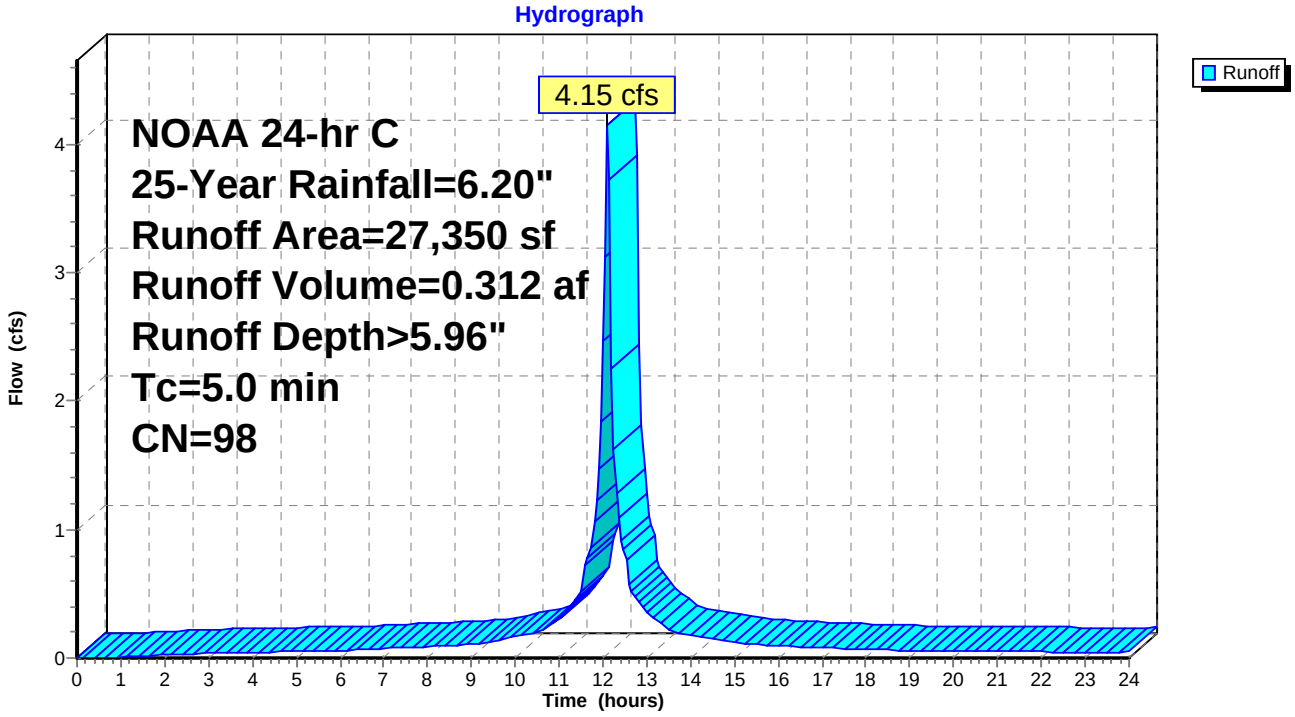
Runoff = 4.15 cfs @ 12.11 hrs, Volume= 0.312 af, Depth> 5.96"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 25-Year Rainfall=6.20"

	Area (sf)	CN	Description
*	27,350	98	Paved parking, HSG D
	27,350		100.00% Impervious Area

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

Subcatchment 3S: C-2



Summary for Subcatchment 15S: U Trench Drain

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

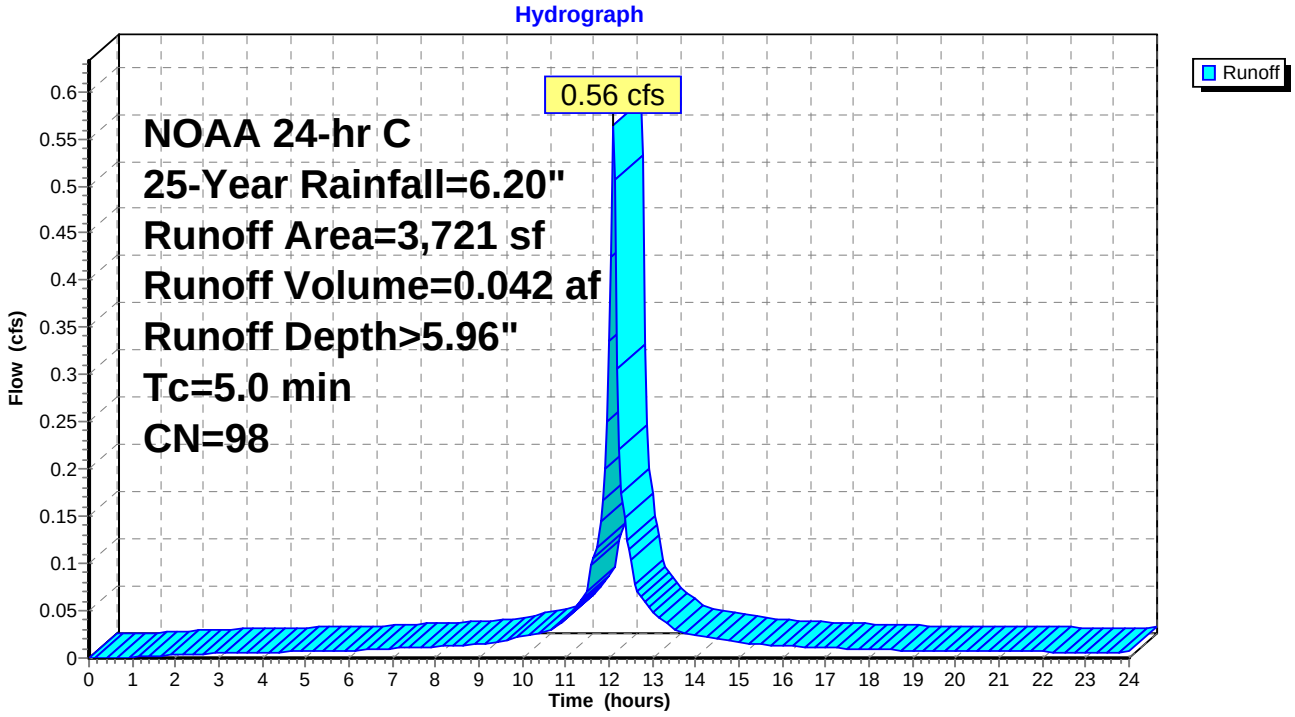
Runoff = 0.56 cfs @ 12.11 hrs, Volume= 0.042 af, Depth> 5.96"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 25-Year Rainfall=6.20"

	Area (sf)	CN	Description
*	3,721	98	Paved parking, HSG D
	3,721		100.00% Impervious Area

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

Subcatchment 15S: U Trench Drain



Summary for Reach 5R: C-3

[62] Hint: Exceeded Reach 14R OUTLET depth by 0.12' @ 12.15 hrs

Inflow Area = 0.273 ac,100.00% Impervious, Inflow Depth > 5.96" for 25-Year event
Inflow = 1.79 cfs @ 12.11 hrs, Volume= 0.136 af
Outflow = 1.75 cfs @ 12.13 hrs, Volume= 0.136 af, Atten= 2%, Lag= 1.0 min

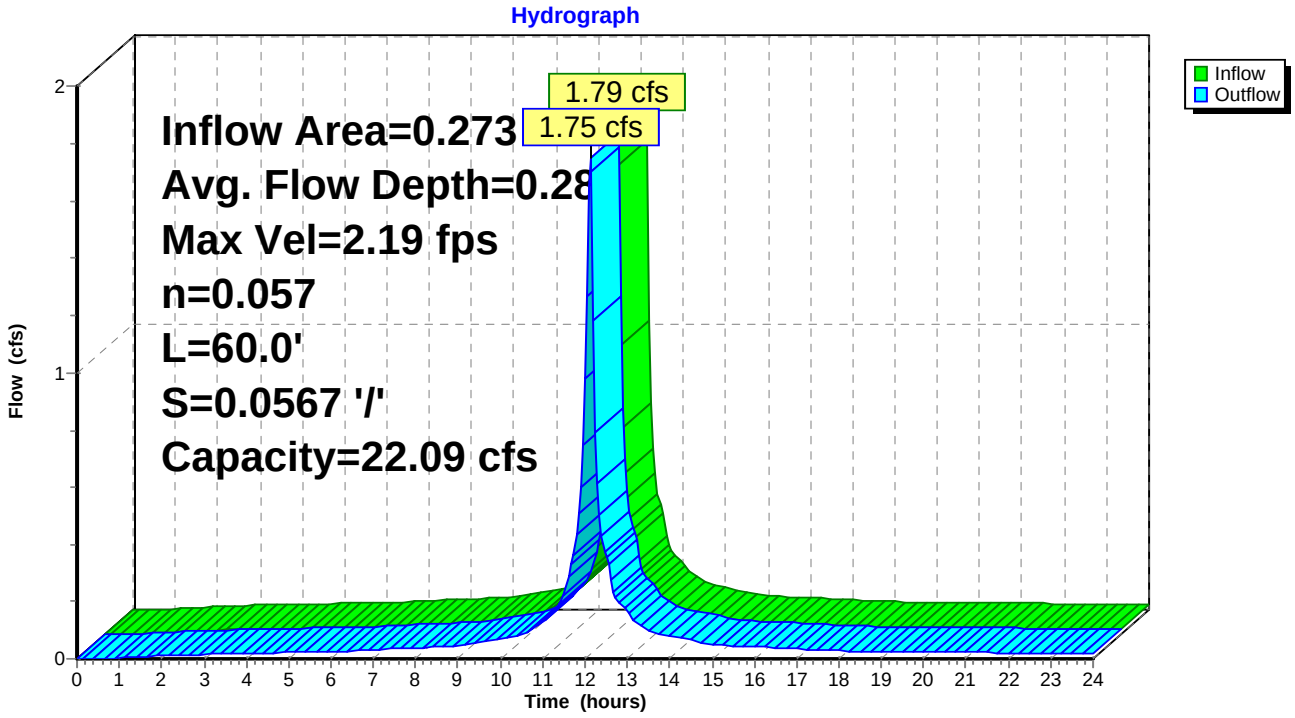
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.19 fps, Min. Travel Time= 0.5 min
Avg. Velocity = 0.62 fps, Avg. Travel Time= 1.6 min

Peak Storage= 48 cf @ 12.12 hrs
Average Depth at Peak Storage= 0.28'
Bank-Full Depth= 1.00' Flow Area= 5.0 sf, Capacity= 22.09 cfs

2.00' x 1.00' deep channel, n= 0.057
Side Slope Z-value= 3.0 '/' Top Width= 8.00'
Length= 60.0' Slope= 0.0567 '/'
Inlet Invert= 1,939.40', Outlet Invert= 1,936.00'

‡

Reach 5R: C-3



Summary for Reach 6R: C-2

Inflow Area = 0.628 ac,100.00% Impervious, Inflow Depth > 5.96" for 25-Year event
Inflow = 4.15 cfs @ 12.11 hrs, Volume= 0.312 af
Outflow = 3.89 cfs @ 12.15 hrs, Volume= 0.311 af, Atten= 6%, Lag= 2.1 min

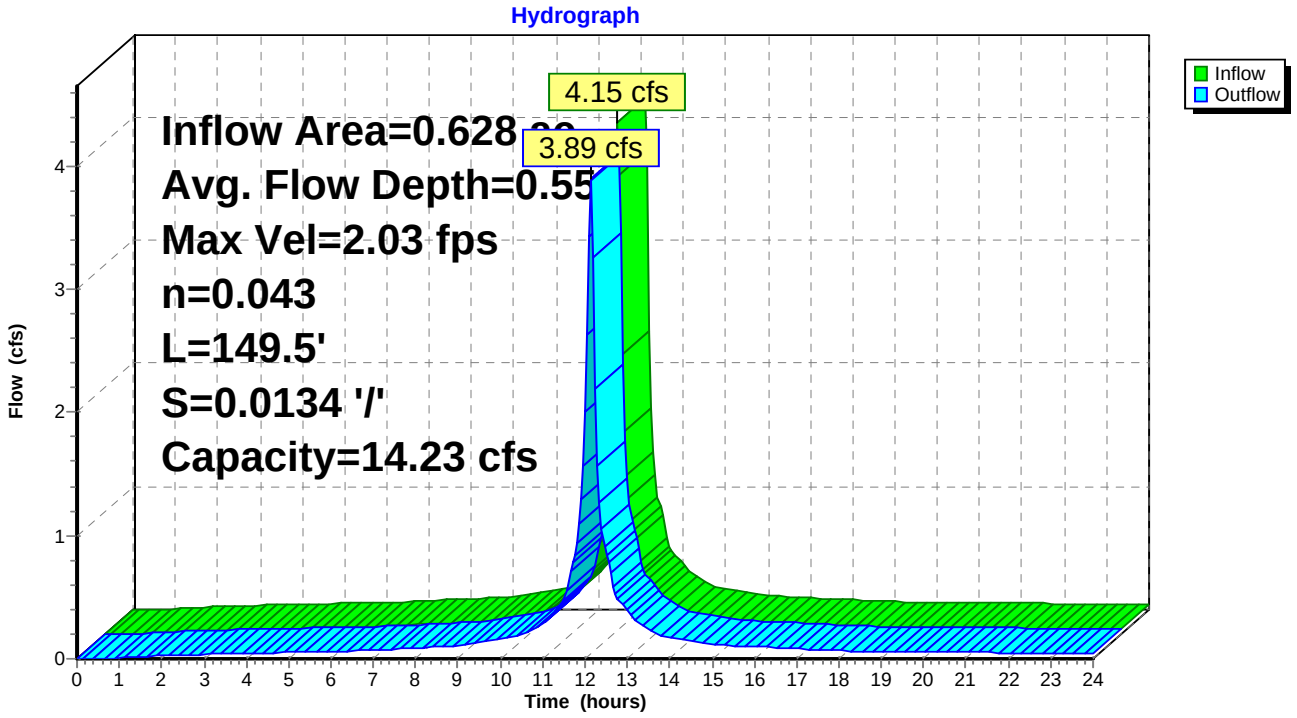
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.03 fps, Min. Travel Time= 1.2 min
Avg. Velocity = 0.62 fps, Avg. Travel Time= 4.0 min

Peak Storage= 298 cf @ 12.13 hrs
Average Depth at Peak Storage= 0.55'
Bank-Full Depth= 1.00' Flow Area= 5.0 sf, Capacity= 14.23 cfs

2.00' x 1.00' deep channel, n= 0.043
Side Slope Z-value= 3.0 '/' Top Width= 8.00'
Length= 149.5' Slope= 0.0134 '/'
Inlet Invert= 1,938.00', Outlet Invert= 1,936.00'

‡

Reach 6R: C-2



Summary for Reach 7R: Culvert 1

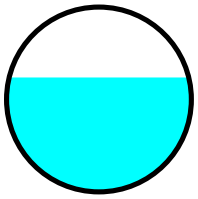
[52] Hint: Inlet/Outlet conditions not evaluated
[62] Hint: Exceeded Reach 5R OUTLET depth by 0.40' @ 12.15 hrs
[62] Hint: Exceeded Reach 6R OUTLET depth by 0.14' @ 12.15 hrs

Inflow Area = 0.901 ac,100.00% Impervious, Inflow Depth > 5.95" for 25-Year event
Inflow = 5.62 cfs @ 12.14 hrs, Volume= 0.447 af
Outflow = 5.56 cfs @ 12.15 hrs, Volume= 0.447 af, Atten= 1%, Lag= 0.3 min

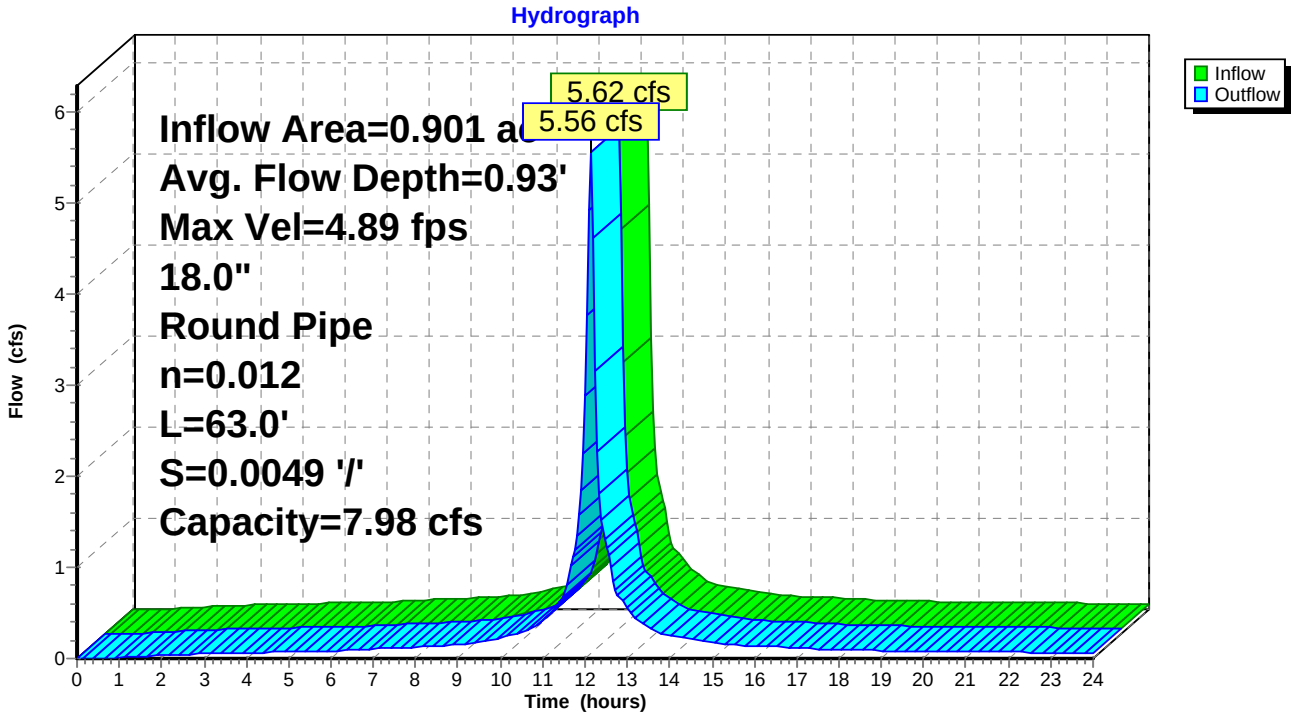
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.89 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 1.69 fps, Avg. Travel Time= 0.6 min

Peak Storage= 72 cf @ 12.14 hrs
Average Depth at Peak Storage= 0.93'
Bank-Full Depth= 1.50' Flow Area= 1.8 sf, Capacity= 7.98 cfs

18.0" Round Pipe
n= 0.012 Concrete pipe, finished
Length= 63.0' Slope= 0.0049 '/'
Inlet Invert= 1,935.75', Outlet Invert= 1,935.44'



Reach 7R: Culvert 1



Summary for Reach 14R: U Trench Drain

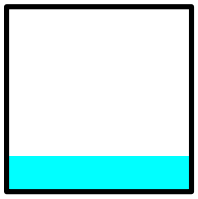
[52] Hint: Inlet/Outlet conditions not evaluated

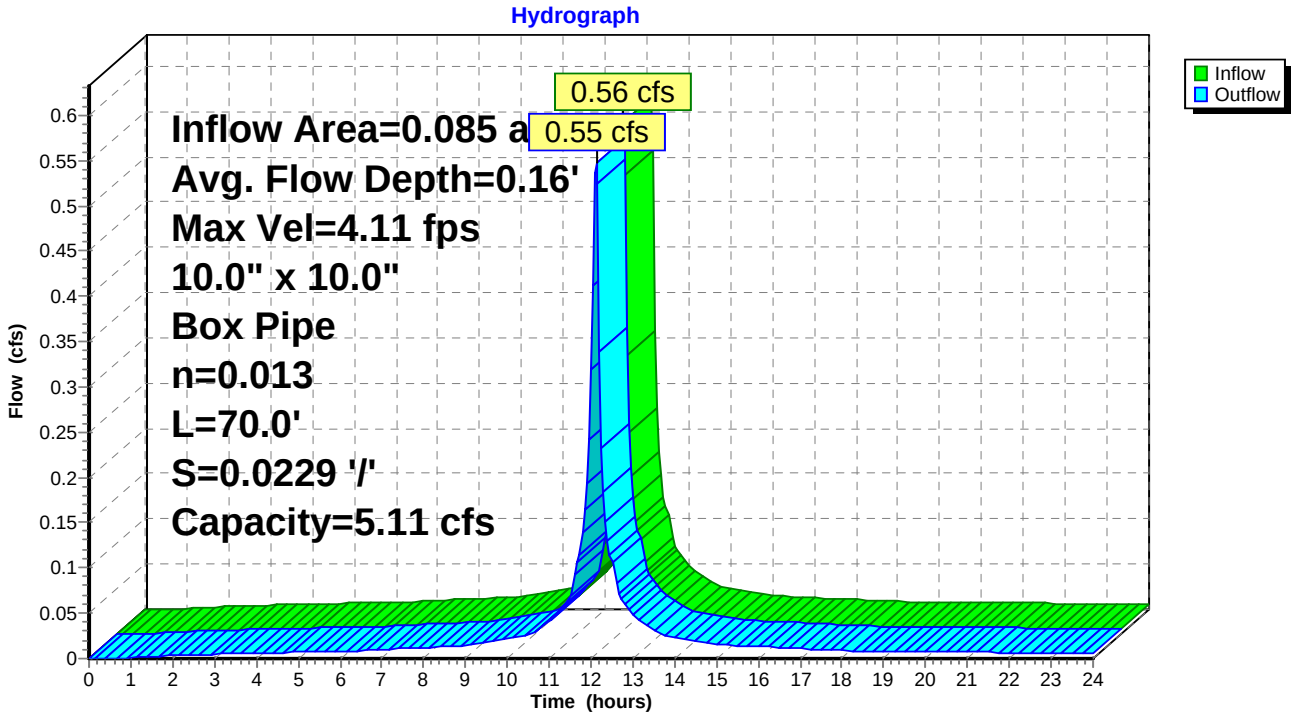
Inflow Area = 0.085 ac,100.00% Impervious, Inflow Depth > 5.96" for 25-Year event
Inflow = 0.56 cfs @ 12.11 hrs, Volume= 0.042 af
Outflow = 0.55 cfs @ 12.12 hrs, Volume= 0.042 af, Atten= 3%, Lag= 0.6 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.11 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 1.08 fps, Avg. Travel Time= 1.1 min

Peak Storage= 9 cf @ 12.12 hrs
Average Depth at Peak Storage= 0.16'
Bank-Full Depth= 0.83' Flow Area= 0.7 sf, Capacity= 5.11 cfs

10.0" W x 10.0" H Box Pipe
n= 0.013 Corrugated PE, smooth interior
Length= 70.0' Slope= 0.0229 '/'
Inlet Invert= 1,941.00', Outlet Invert= 1,939.40'





Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 2S: C-3 Runoff Area=8,181 sf 100.00% Impervious Runoff Depth>6.92"
Tc=5.0 min CN=98 Runoff=1.44 cfs 0.108 af

Subcatchment 3S: C-2 Runoff Area=27,350 sf 100.00% Impervious Runoff Depth>6.92"
Tc=5.0 min CN=98 Runoff=4.80 cfs 0.362 af

Subcatchment 15S: U Trench Drain Runoff Area=3,721 sf 100.00% Impervious Runoff Depth>6.92"
Tc=5.0 min CN=98 Runoff=0.65 cfs 0.049 af

Reach 5R: C-3 Avg. Flow Depth=0.30' Max Vel=2.28 fps Inflow=2.07 cfs 0.157 af
n=0.057 L=60.0' S=0.0567 '/' Capacity=22.09 cfs Outflow=2.02 cfs 0.157 af

Reach 6R: C-2 Avg. Flow Depth=0.59' Max Vel=2.11 fps Inflow=4.80 cfs 0.362 af
n=0.043 L=149.5' S=0.0134 '/' Capacity=14.23 cfs Outflow=4.51 cfs 0.361 af

Reach 7R: Culvert 1 Avg. Flow Depth=1.03' Max Vel=5.03 fps Inflow=6.51 cfs 0.519 af
18.0" Round Pipe n=0.012 L=63.0' S=0.0049 '/' Capacity=7.98 cfs Outflow=6.45 cfs 0.519 af

Reach 14R: U Trench Drain Avg. Flow Depth=0.18' Max Vel=4.30 fps Inflow=0.65 cfs 0.049 af
10.0" x 10.0" Box Pipe n=0.013 L=70.0' S=0.0229 '/' Capacity=5.11 cfs Outflow=0.63 cfs 0.049 af

Total Runoff Area = 0.901 ac Runoff Volume = 0.519 af Average Runoff Depth = 6.92"
0.00% Pervious = 0.000 ac 100.00% Impervious = 0.901 ac

Summary for Subcatchment 2S: C-3

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

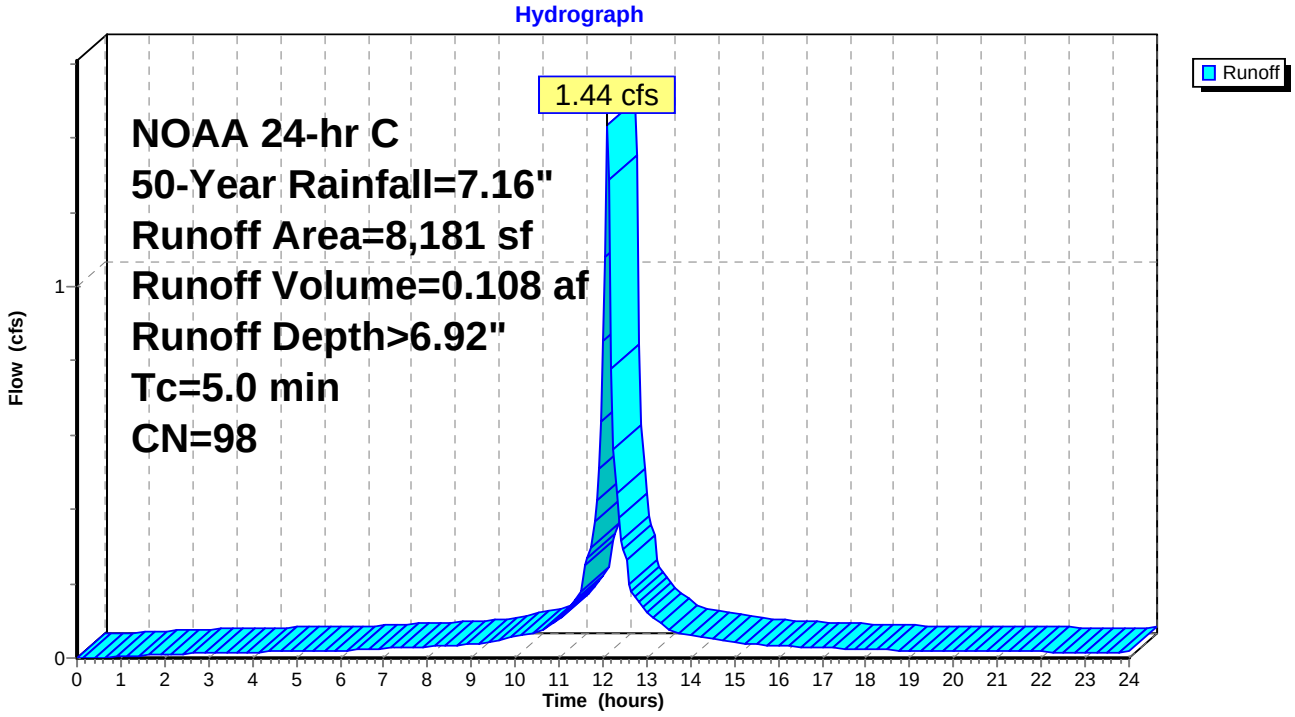
Runoff = 1.44 cfs @ 12.11 hrs, Volume= 0.108 af, Depth> 6.92"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 50-Year Rainfall=7.16"

	Area (sf)	CN	Description
*	8,181	98	Paved parking, HSG D
	8,181		100.00% Impervious Area

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

Subcatchment 2S: C-3



Summary for Subcatchment 3S: C-2

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

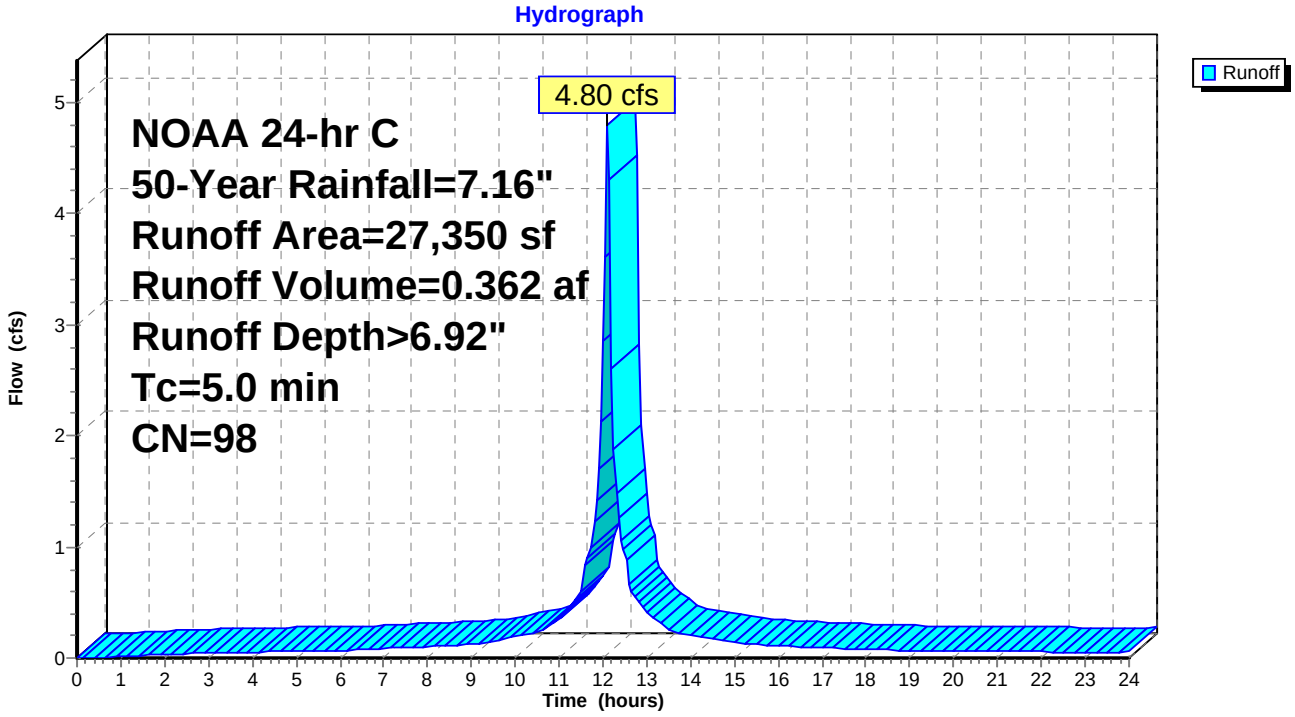
Runoff = 4.80 cfs @ 12.11 hrs, Volume= 0.362 af, Depth> 6.92"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 50-Year Rainfall=7.16"

	Area (sf)	CN	Description
*	27,350	98	Paved parking, HSG D
	27,350		100.00% Impervious Area

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

Subcatchment 3S: C-2



Summary for Subcatchment 15S: U Trench Drain

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

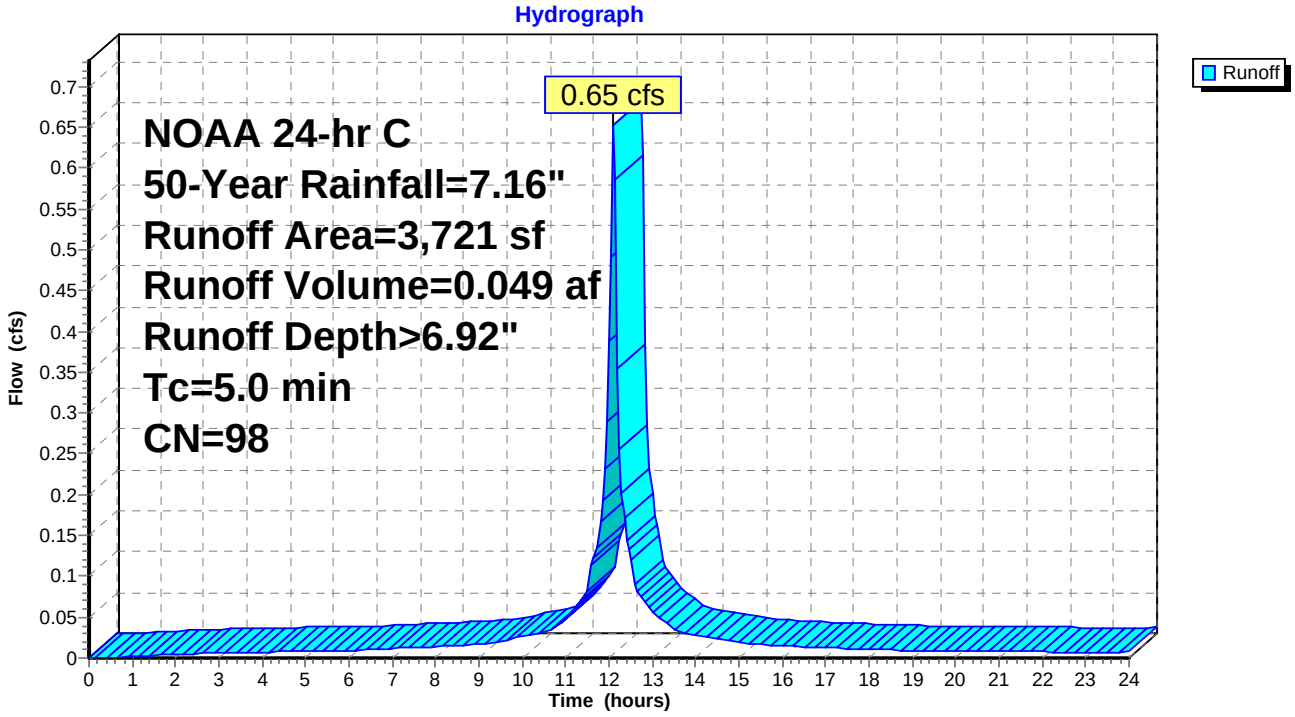
Runoff = 0.65 cfs @ 12.11 hrs, Volume= 0.049 af, Depth> 6.92"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 50-Year Rainfall=7.16"

	Area (sf)	CN	Description
*	3,721	98	Paved parking, HSG D
	3,721		100.00% Impervious Area

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

Subcatchment 15S: U Trench Drain



Summary for Reach 5R: C-3

[62] Hint: Exceeded Reach 14R OUTLET depth by 0.13' @ 12.15 hrs

Inflow Area = 0.273 ac,100.00% Impervious, Inflow Depth > 6.92" for 50-Year event
Inflow = 2.07 cfs @ 12.11 hrs, Volume= 0.157 af
Outflow = 2.02 cfs @ 12.13 hrs, Volume= 0.157 af, Atten= 2%, Lag= 0.9 min

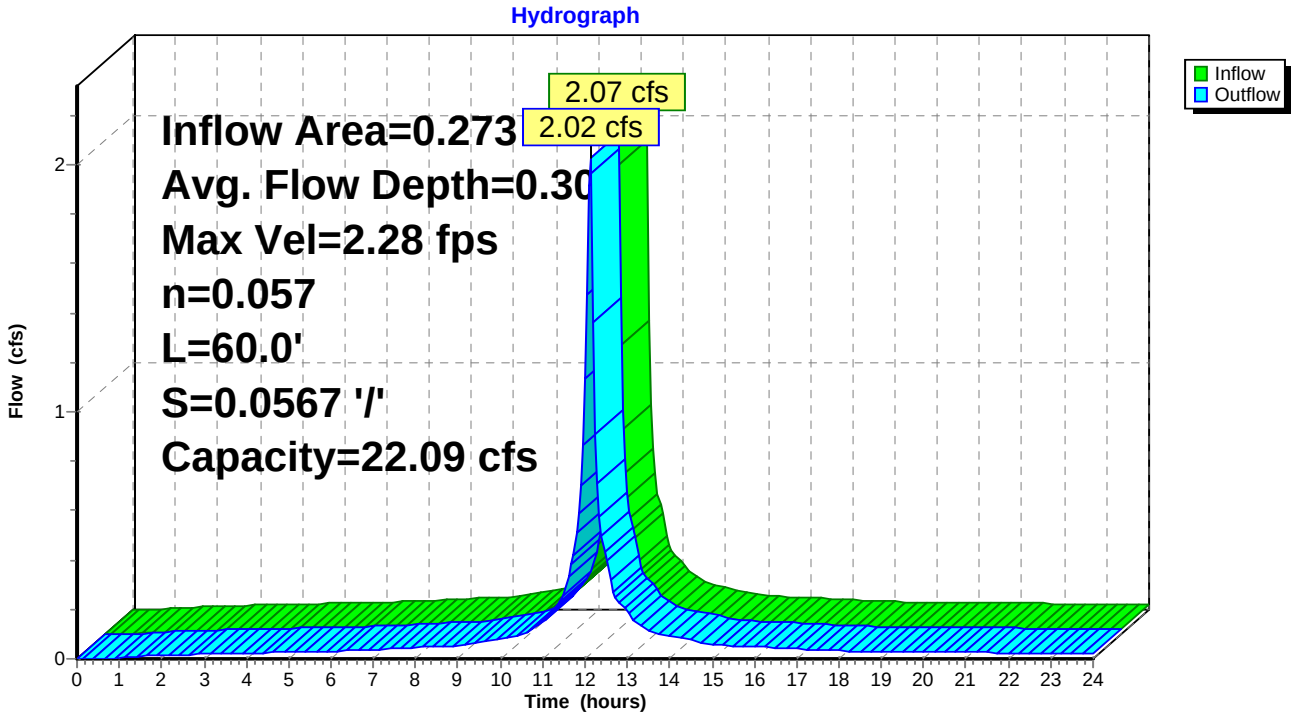
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.28 fps, Min. Travel Time= 0.4 min
Avg. Velocity = 0.65 fps, Avg. Travel Time= 1.5 min

Peak Storage= 53 cf @ 12.12 hrs
Average Depth at Peak Storage= 0.30'
Bank-Full Depth= 1.00' Flow Area= 5.0 sf, Capacity= 22.09 cfs

2.00' x 1.00' deep channel, n= 0.057
Side Slope Z-value= 3.0 '/' Top Width= 8.00'
Length= 60.0' Slope= 0.0567 '/'
Inlet Invert= 1,939.40', Outlet Invert= 1,936.00'

‡

Reach 5R: C-3



Summary for Reach 6R: C-2

Inflow Area = 0.628 ac,100.00% Impervious, Inflow Depth > 6.92" for 50-Year event
Inflow = 4.80 cfs @ 12.11 hrs, Volume= 0.362 af
Outflow = 4.51 cfs @ 12.14 hrs, Volume= 0.361 af, Atten= 6%, Lag= 2.0 min

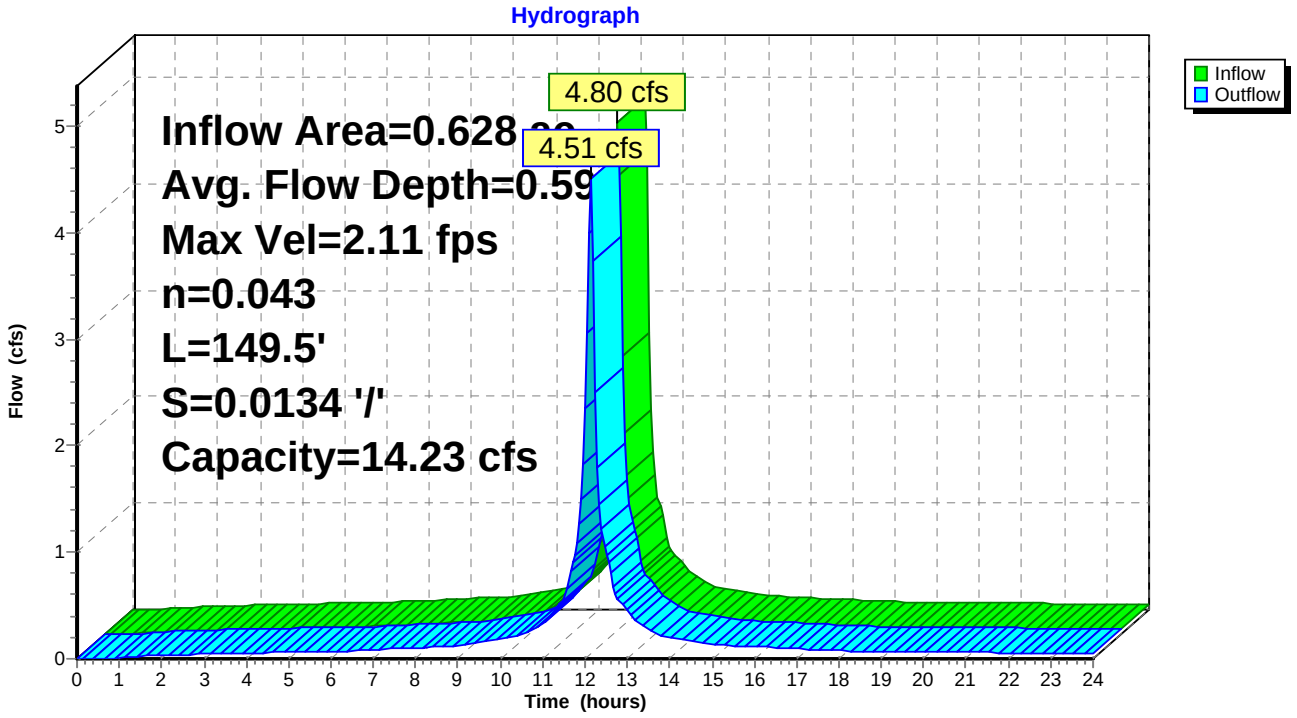
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.11 fps, Min. Travel Time= 1.2 min
Avg. Velocity = 0.66 fps, Avg. Travel Time= 3.8 min

Peak Storage= 331 cf @ 12.13 hrs
Average Depth at Peak Storage= 0.59'
Bank-Full Depth= 1.00' Flow Area= 5.0 sf, Capacity= 14.23 cfs

2.00' x 1.00' deep channel, n= 0.043
Side Slope Z-value= 3.0 '/' Top Width= 8.00'
Length= 149.5' Slope= 0.0134 '/'
Inlet Invert= 1,938.00', Outlet Invert= 1,936.00'

‡

Reach 6R: C-2



Summary for Reach 7R: Culvert 1

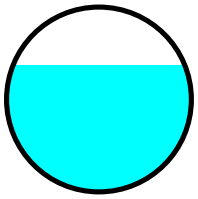
[52] Hint: Inlet/Outlet conditions not evaluated
[62] Hint: Exceeded Reach 5R OUTLET depth by 0.48' @ 12.15 hrs
[62] Hint: Exceeded Reach 6R OUTLET depth by 0.20' @ 12.15 hrs

Inflow Area = 0.901 ac,100.00% Impervious, Inflow Depth > 6.91" for 50-Year event
Inflow = 6.51 cfs @ 12.14 hrs, Volume= 0.519 af
Outflow = 6.45 cfs @ 12.14 hrs, Volume= 0.519 af, Atten= 1%, Lag= 0.3 min

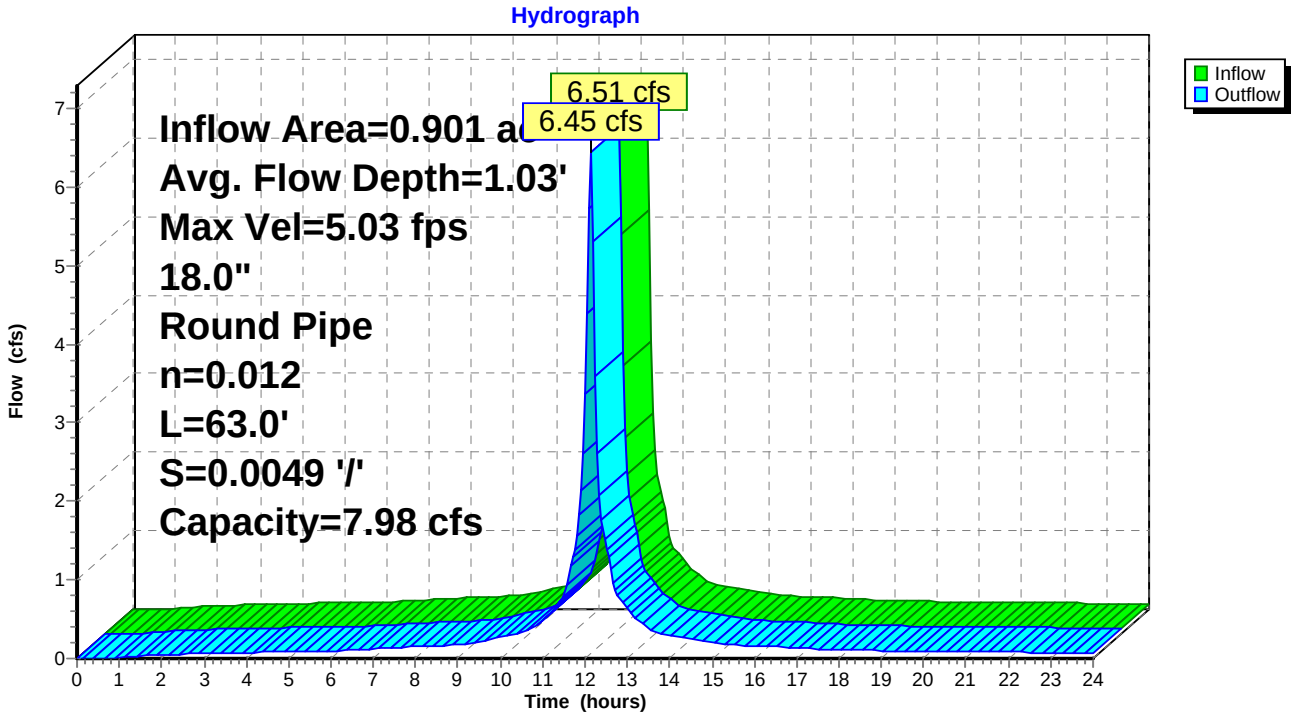
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 5.03 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 1.77 fps, Avg. Travel Time= 0.6 min

Peak Storage= 81 cf @ 12.14 hrs
Average Depth at Peak Storage= 1.03'
Bank-Full Depth= 1.50' Flow Area= 1.8 sf, Capacity= 7.98 cfs

18.0" Round Pipe
n= 0.012 Concrete pipe, finished
Length= 63.0' Slope= 0.0049 '/'
Inlet Invert= 1,935.75', Outlet Invert= 1,935.44'



Reach 7R: Culvert 1



Summary for Reach 14R: U Trench Drain

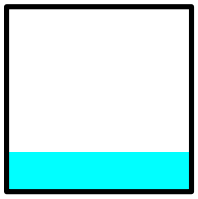
[52] Hint: Inlet/Outlet conditions not evaluated

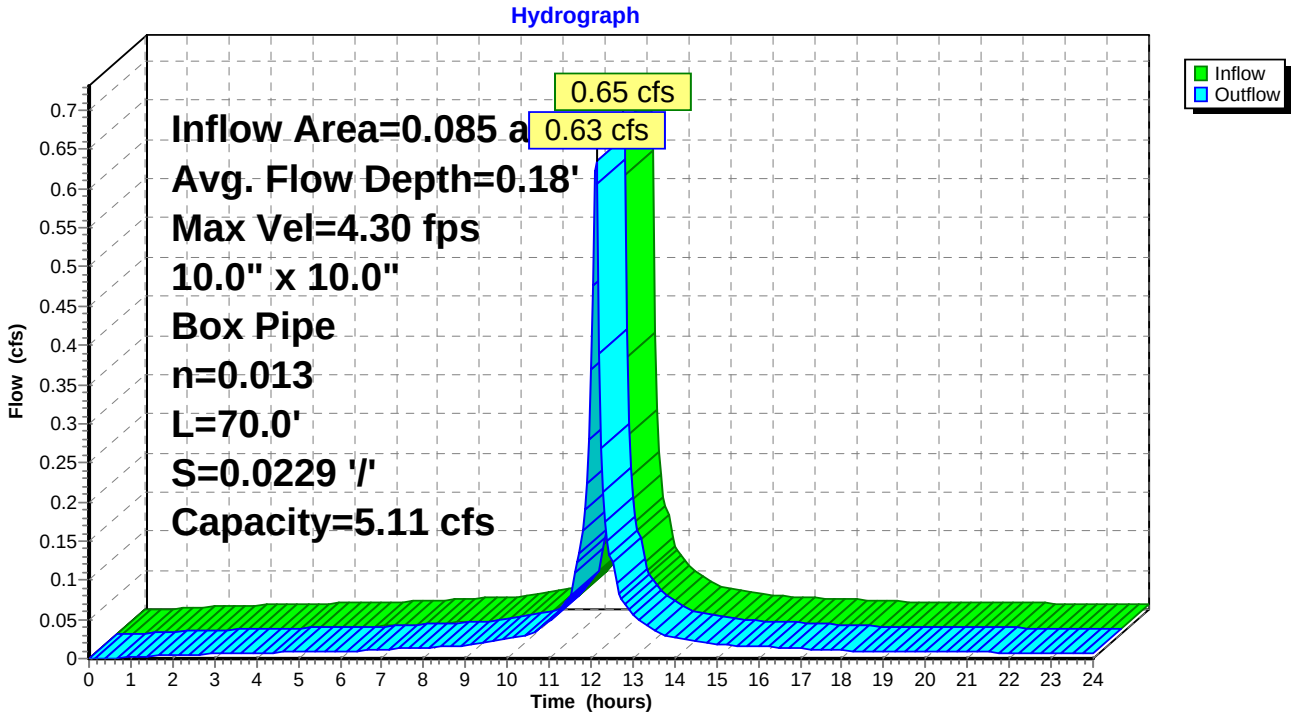
Inflow Area = 0.085 ac,100.00% Impervious, Inflow Depth > 6.92" for 50-Year event
Inflow = 0.65 cfs @ 12.11 hrs, Volume= 0.049 af
Outflow = 0.63 cfs @ 12.12 hrs, Volume= 0.049 af, Atten= 3%, Lag= 0.6 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.30 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 1.14 fps, Avg. Travel Time= 1.0 min

Peak Storage= 10 cf @ 12.12 hrs
Average Depth at Peak Storage= 0.18'
Bank-Full Depth= 0.83' Flow Area= 0.7 sf, Capacity= 5.11 cfs

10.0" W x 10.0" H Box Pipe
n= 0.013 Corrugated PE, smooth interior
Length= 70.0' Slope= 0.0229 '/'
Inlet Invert= 1,941.00', Outlet Invert= 1,939.40'





Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 2S: C-3 Runoff Area=8,181 sf 100.00% Impervious Runoff Depth>8.18"
Tc=5.0 min CN=98 Runoff=1.69 cfs 0.128 af

Subcatchment 3S: C-2 Runoff Area=27,350 sf 100.00% Impervious Runoff Depth>8.18"
Tc=5.0 min CN=98 Runoff=5.66 cfs 0.428 af

Subcatchment 15S: U Trench Drain Runoff Area=3,721 sf 100.00% Impervious Runoff Depth>8.18"
Tc=5.0 min CN=98 Runoff=0.77 cfs 0.058 af

Reach 5R: C-3 Avg. Flow Depth=0.33' Max Vel=2.40 fps Inflow=2.44 cfs 0.186 af
n=0.057 L=60.0' S=0.0567 '/' Capacity=22.09 cfs Outflow=2.39 cfs 0.186 af

Reach 6R: C-2 Avg. Flow Depth=0.64' Max Vel=2.20 fps Inflow=5.66 cfs 0.428 af
n=0.043 L=149.5' S=0.0134 '/' Capacity=14.23 cfs Outflow=5.33 cfs 0.428 af

Reach 7R: Culvert 1 Avg. Flow Depth=1.18' Max Vel=5.14 fps Inflow=7.69 cfs 0.614 af
18.0" Round Pipe n=0.012 L=63.0' S=0.0049 '/' Capacity=7.98 cfs Outflow=7.61 cfs 0.614 af

Reach 14R: U Trench Drain Avg. Flow Depth=0.20' Max Vel=4.53 fps Inflow=0.77 cfs 0.058 af
10.0" x 10.0" Box Pipe n=0.013 L=70.0' S=0.0229 '/' Capacity=5.11 cfs Outflow=0.75 cfs 0.058 af

Total Runoff Area = 0.901 ac Runoff Volume = 0.615 af Average Runoff Depth = 8.18"
0.00% Pervious = 0.000 ac 100.00% Impervious = 0.901 ac

Summary for Subcatchment 2S: C-3

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

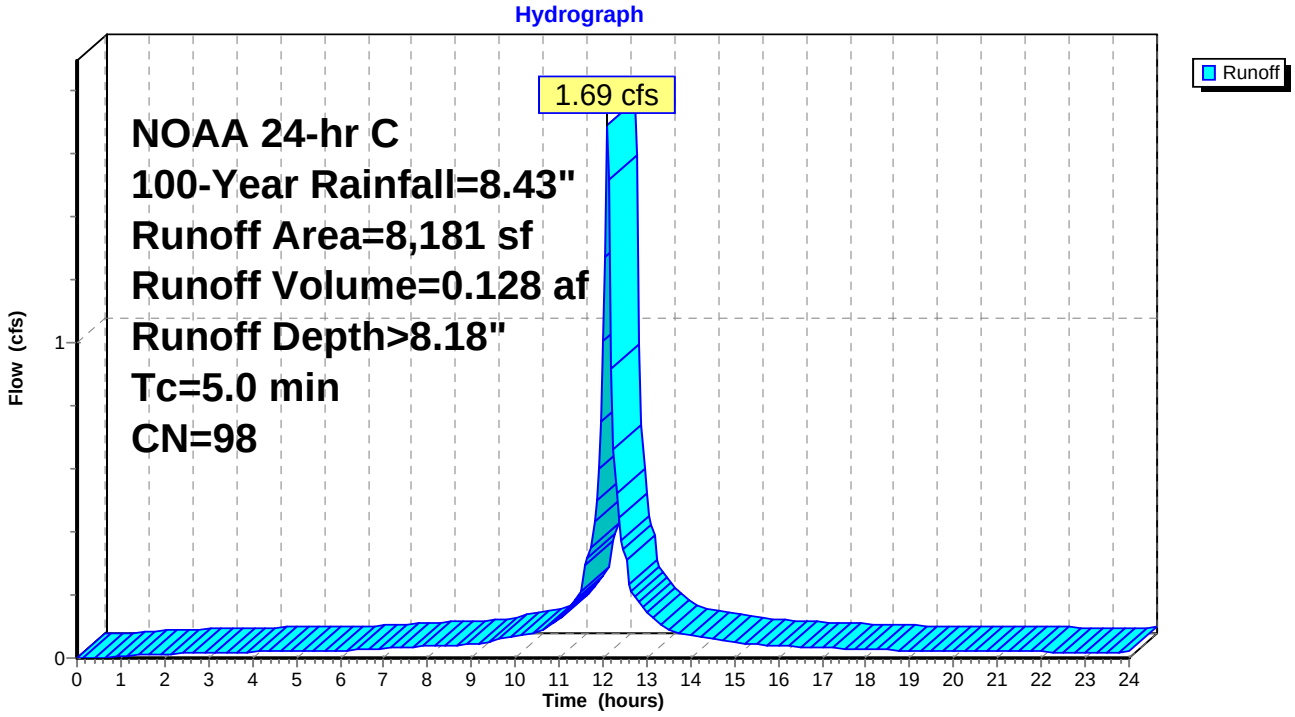
Runoff = 1.69 cfs @ 12.11 hrs, Volume= 0.128 af, Depth> 8.18"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 100-Year Rainfall=8.43"

	Area (sf)	CN	Description
*	8,181	98	Paved parking, HSG D
	8,181		100.00% Impervious Area

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

Subcatchment 2S: C-3



Summary for Subcatchment 3S: C-2

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

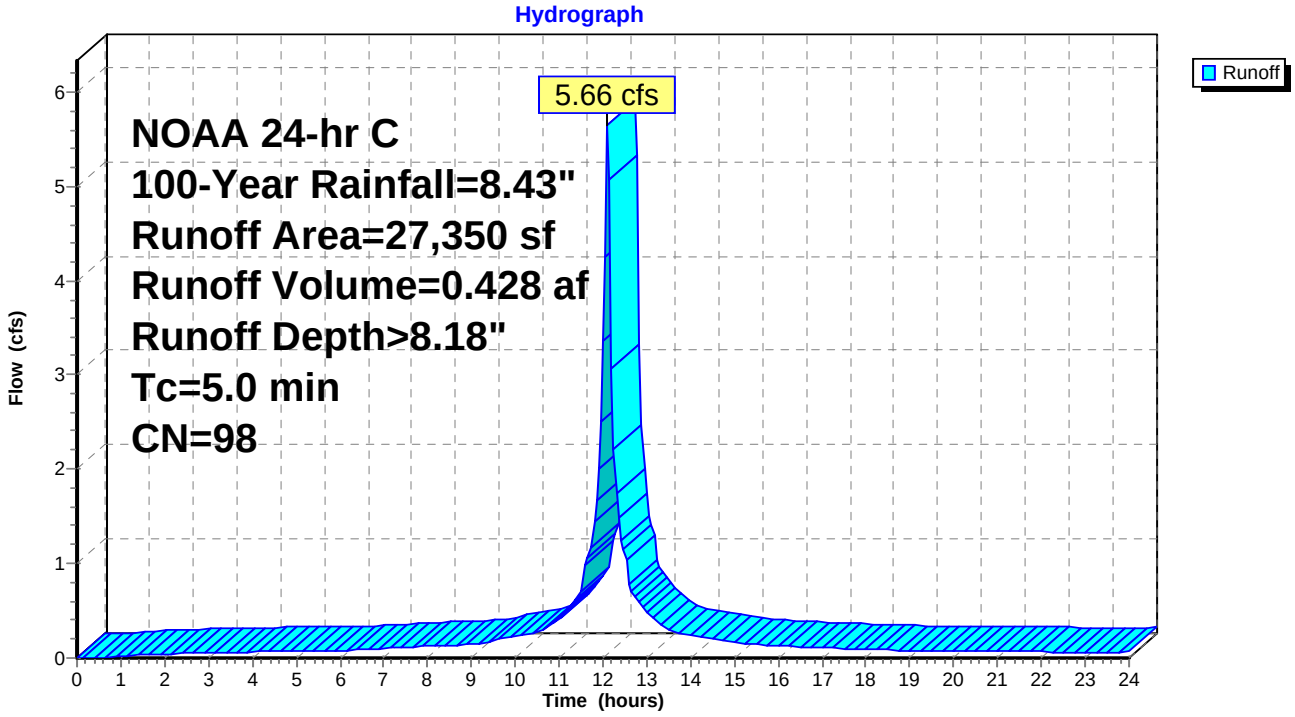
Runoff = 5.66 cfs @ 12.11 hrs, Volume= 0.428 af, Depth> 8.18"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 100-Year Rainfall=8.43"

	Area (sf)	CN	Description
*	27,350	98	Paved parking, HSG D
	27,350		100.00% Impervious Area

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

Subcatchment 3S: C-2



Summary for Subcatchment 15S: U Trench Drain

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

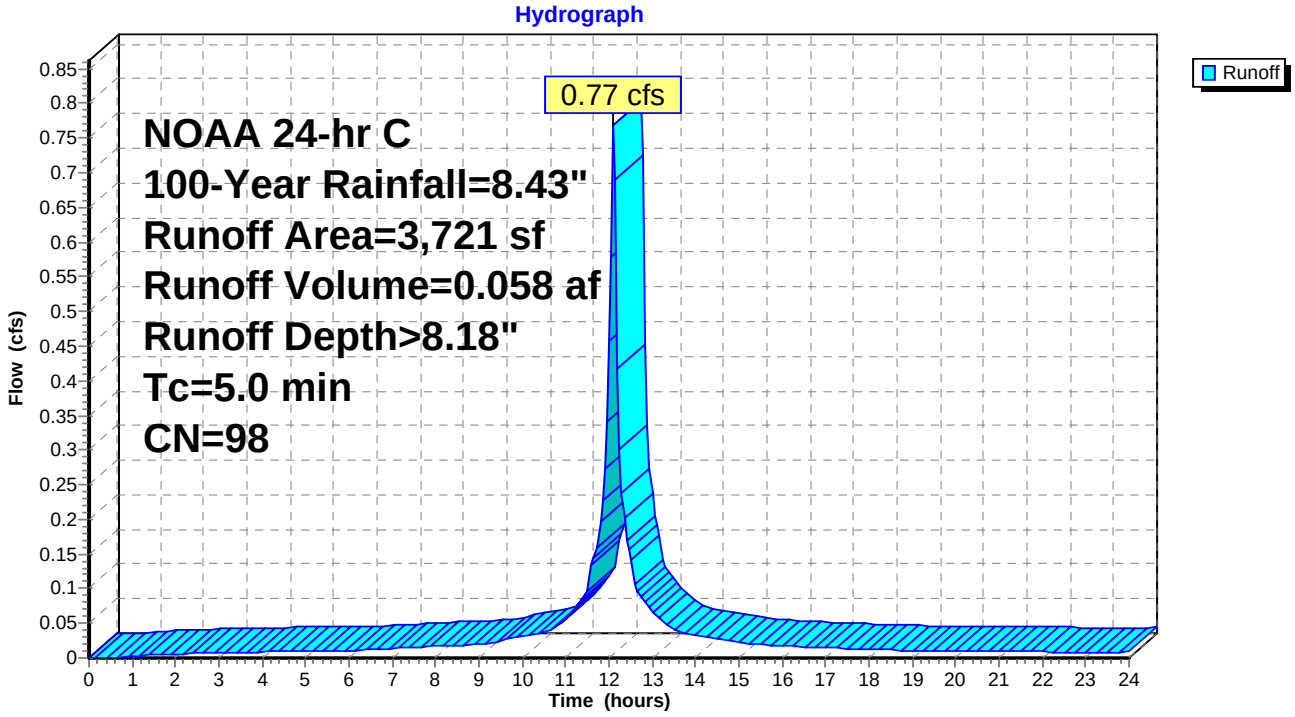
Runoff = 0.77 cfs @ 12.11 hrs, Volume= 0.058 af, Depth> 8.18"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 100-Year Rainfall=8.43"

	Area (sf)	CN	Description
*	3,721	98	Paved parking, HSG D
	3,721		100.00% Impervious Area

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

Subcatchment 15S: U Trench Drain



Summary for Reach 5R: C-3

[62] Hint: Exceeded Reach 14R OUTLET depth by 0.13' @ 12.15 hrs

Inflow Area = 0.273 ac,100.00% Impervious, Inflow Depth > 8.18" for 100-Year event
Inflow = 2.44 cfs @ 12.11 hrs, Volume= 0.186 af
Outflow = 2.39 cfs @ 12.13 hrs, Volume= 0.186 af, Atten= 2%, Lag= 0.9 min

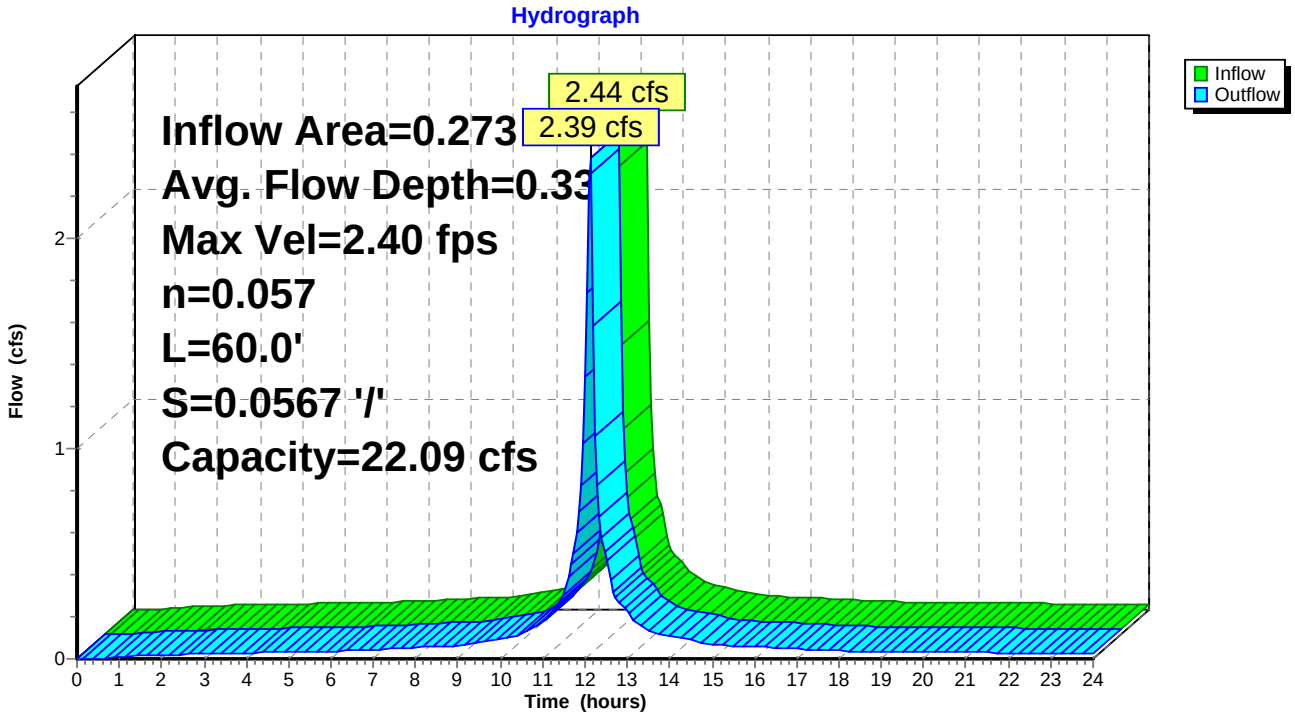
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.40 fps, Min. Travel Time= 0.4 min
Avg. Velocity = 0.69 fps, Avg. Travel Time= 1.4 min

Peak Storage= 60 cf @ 12.12 hrs
Average Depth at Peak Storage= 0.33'
Bank-Full Depth= 1.00' Flow Area= 5.0 sf, Capacity= 22.09 cfs

2.00' x 1.00' deep channel, n= 0.057
Side Slope Z-value= 3.0 '/' Top Width= 8.00'
Length= 60.0' Slope= 0.0567 '/'
Inlet Invert= 1,939.40', Outlet Invert= 1,936.00'

‡

Reach 5R: C-3



Summary for Reach 6R: C-2

Inflow Area = 0.628 ac,100.00% Impervious, Inflow Depth > 8.18" for 100-Year event
Inflow = 5.66 cfs @ 12.11 hrs, Volume= 0.428 af
Outflow = 5.33 cfs @ 12.14 hrs, Volume= 0.428 af, Atten= 6%, Lag= 2.0 min

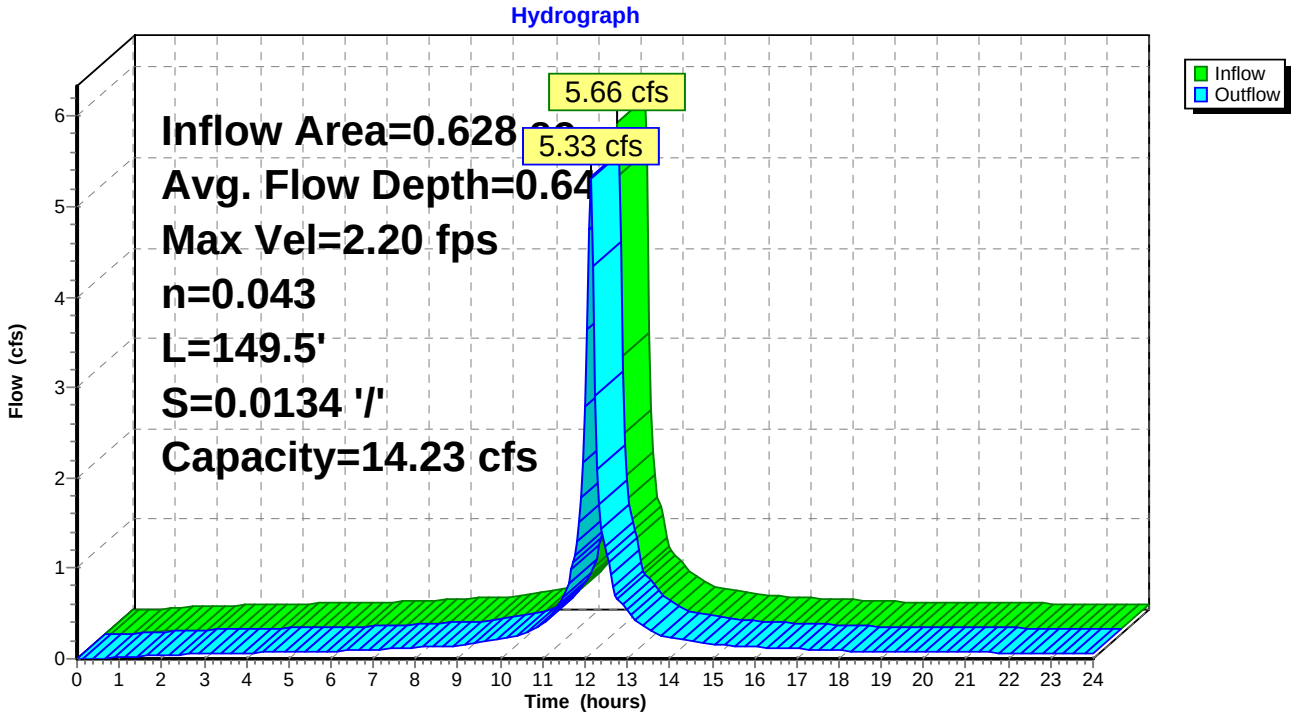
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.20 fps, Min. Travel Time= 1.1 min
Avg. Velocity = 0.70 fps, Avg. Travel Time= 3.6 min

Peak Storage= 373 cf @ 12.13 hrs
Average Depth at Peak Storage= 0.64'
Bank-Full Depth= 1.00' Flow Area= 5.0 sf, Capacity= 14.23 cfs

2.00' x 1.00' deep channel, n= 0.043
Side Slope Z-value= 3.0 '/' Top Width= 8.00'
Length= 149.5' Slope= 0.0134 '/'
Inlet Invert= 1,938.00', Outlet Invert= 1,936.00'

‡

Reach 6R: C-2



Summary for Reach 7R: Culvert 1

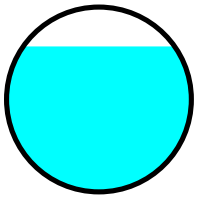
[52] Hint: Inlet/Outlet conditions not evaluated
[62] Hint: Exceeded Reach 5R OUTLET depth by 0.60' @ 12.15 hrs
[62] Hint: Exceeded Reach 6R OUTLET depth by 0.30' @ 12.15 hrs

Inflow Area = 0.901 ac,100.00% Impervious, Inflow Depth > 8.18" for 100-Year event
Inflow = 7.69 cfs @ 12.14 hrs, Volume= 0.614 af
Outflow = 7.61 cfs @ 12.14 hrs, Volume= 0.614 af, Atten= 1%, Lag= 0.3 min

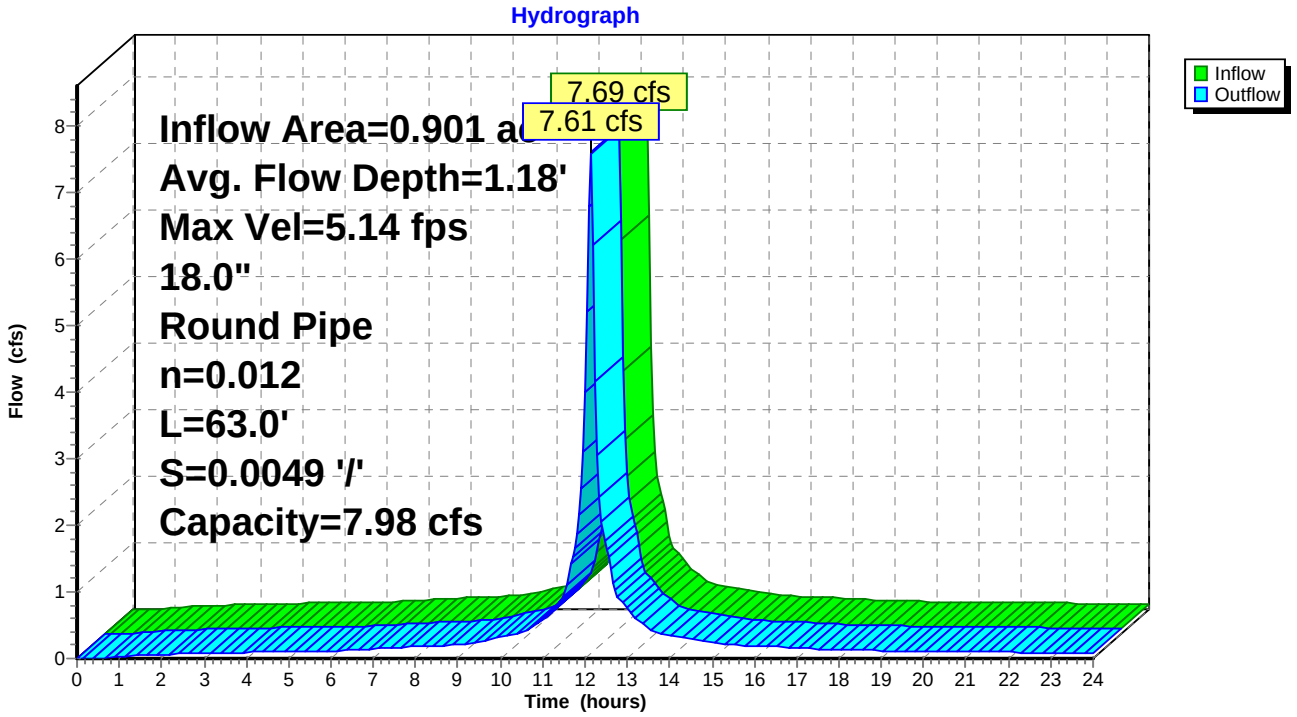
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 5.14 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 1.87 fps, Avg. Travel Time= 0.6 min

Peak Storage= 94 cf @ 12.14 hrs
Average Depth at Peak Storage= 1.18'
Bank-Full Depth= 1.50' Flow Area= 1.8 sf, Capacity= 7.98 cfs

18.0" Round Pipe
n= 0.012 Concrete pipe, finished
Length= 63.0' Slope= 0.0049 '/'
Inlet Invert= 1,935.75', Outlet Invert= 1,935.44'



Reach 7R: Culvert 1



Summary for Reach 14R: U Trench Drain

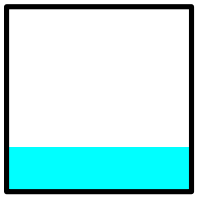
[52] Hint: Inlet/Outlet conditions not evaluated

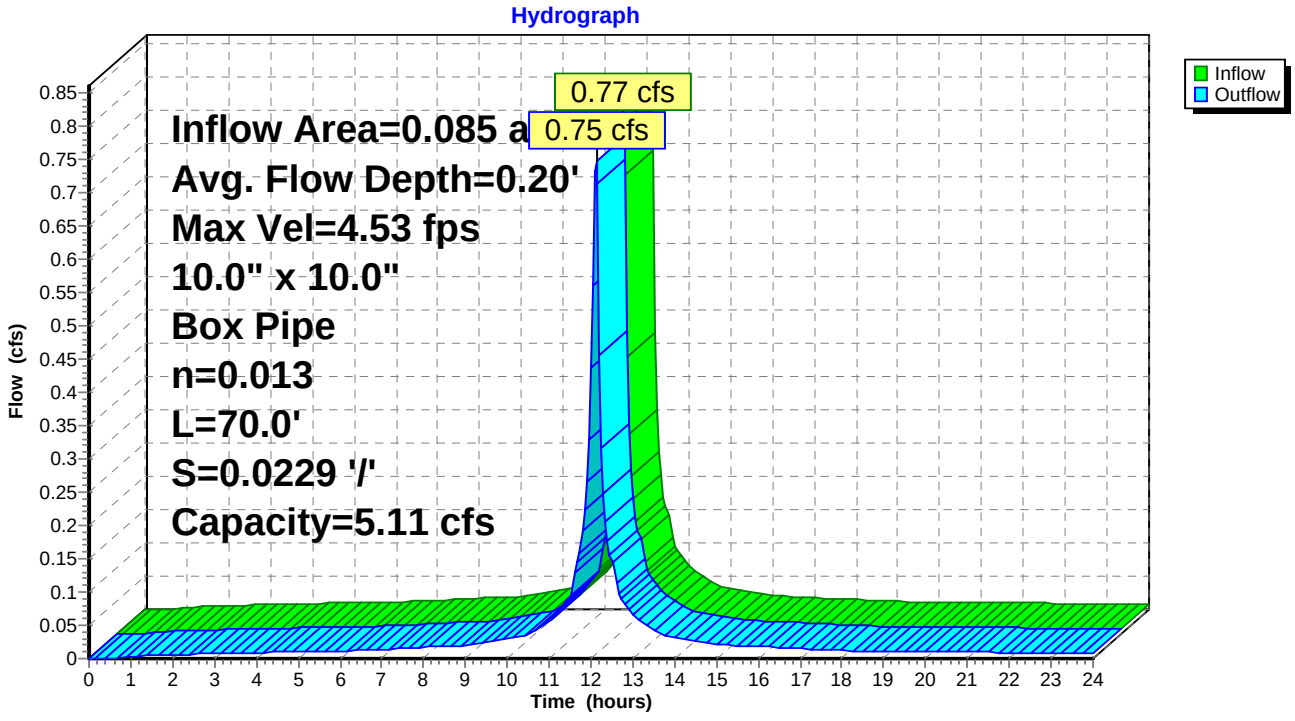
Inflow Area = 0.085 ac,100.00% Impervious, Inflow Depth > 8.18" for 100-Year event
Inflow = 0.77 cfs @ 12.11 hrs, Volume= 0.058 af
Outflow = 0.75 cfs @ 12.12 hrs, Volume= 0.058 af, Atten= 3%, Lag= 0.5 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.53 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 1.21 fps, Avg. Travel Time= 1.0 min

Peak Storage= 12 cf @ 12.12 hrs
Average Depth at Peak Storage= 0.20'
Bank-Full Depth= 0.83' Flow Area= 0.7 sf, Capacity= 5.11 cfs

10.0" W x 10.0" H Box Pipe
n= 0.013 Corrugated PE, smooth interior
Length= 70.0' Slope= 0.0229 '/'
Inlet Invert= 1,941.00', Outlet Invert= 1,939.40'

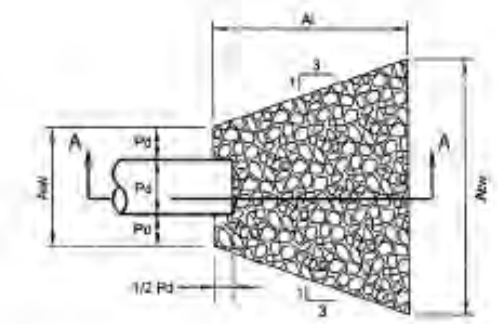




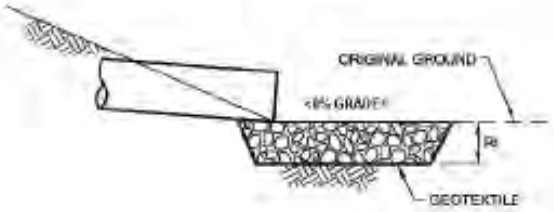
ATTACHMENT 4.6
RIPRAP APRON WORKSHEETS

STANDARD E&S WORKSHEET #20
Riprap Apron Outlet Protection

PROJECT NAME: Williams REAE - Compressor Station 515
LOCATION: Buck Township, Luzerne County, Pennsylvania
PREPARED BY: JCR DATE: Jan. 2021 **[Rev 02/2022]**
CHECKED BY: PW DATE: Jan. 2021 **[Rev 02/2022]**



PLAN VIEW

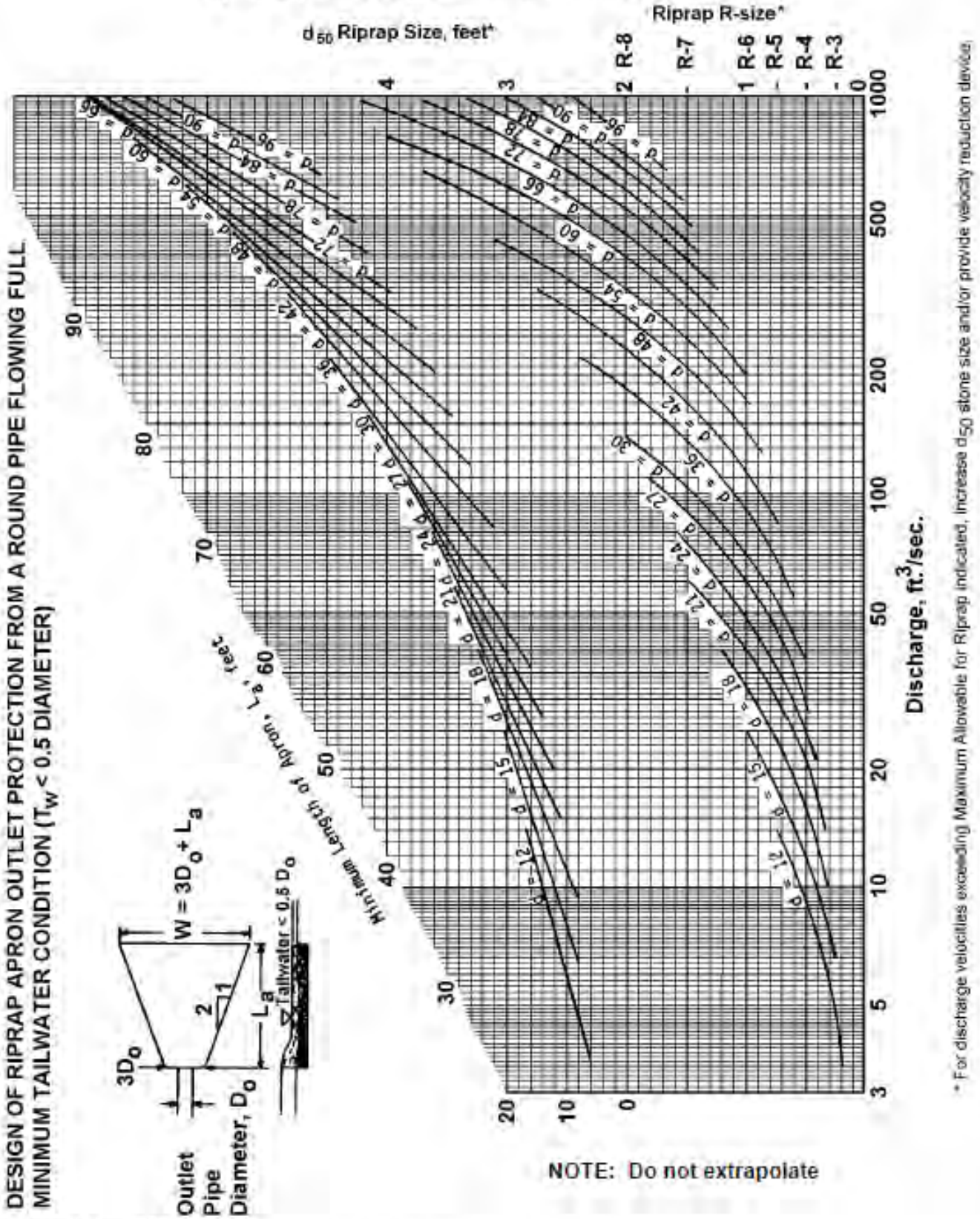


SECTION A - A

Location	Pipe Dia. Do (in)	Tail Water Cond. (Max or Min)	Man. "n" For Pipe	Pipe Slope (ft/ft)	Q (cfs)	V* (fps)	Riprap Size	Rt (in)	Al (ft)	Aiw (ft)	Atw (ft)
Channel C-5	48	Min	0.050	0.049	7.04	2.93	R-4	18	24	12	36
Culvert 1	18	Min	0.012	0.008	4.51	4.65	R-4	18	12	4.5	16.5
U Trench Drain	10	Min	0.013	0.023	0.45	3.82	R-3	9	8	2.5	10.5

*: The anticipated velocity (V) should not exceed the maximum permissible shown in Table 6.6 for the proposed riprap protection. Adjust for less than full pipe flow. Use Manning's equation to calculate velocity for pipe slopes $\geq$ 0.05 ft/ft.

FIGURE 9.3
Riprap Apron Design, Minimum Tailwater Condition



Adapted from USDA - NRCS

Not to be used for Box Culverts

ATTACHMENT 4.7
BMP EROSION CONTROL BLANKET REPORTS

North American Green
5401 St. Wendel-Cynthiana Rd.
Poseyville, Indiana 47633
Tel. 800.772.2040
>Fax 812.867.0247
www.nagreen.com
ECMDS v7.0

CHANNEL ANALYSIS

> > > CS515: C-1

Name	CS515: C-1
Discharge	5.68
Channel Slope	0.041
Channel Bottom Width	4
Left Side Slope	3
Right Side Slope	3
Low Flow Liner	
Retardence Class	C 6-12 in
Vegetation Type	Sod Former
Vegetation Density	Good 65-79%
Soil Type	Silt Loam (SM)

SC150BN

Phase	Reach	Discharge	Velocity	Normal Depth	Mannings N	Permissible Shear Stress	Calculated Shear Stress	Safety Factor	Remarks	Staple Pattern
SC150BN Unvegetated	Straight	5.68 cfs	2.78 ft/s	0.39 ft	0.05	2 lbs/ft2	1.01 lbs/ft2	1.99	STABLE	D
Underlying Substrate	Straight	5.68 cfs	2.78 ft/s	0.39 ft	0.05	1.47 lbs/ft2	0.8 lbs/ft2	1.82	STABLE	D

Unreinforced Vegetation

Phase	Reach	Discharge	Velocity	Normal Depth	Mannings N	Permissible Shear Stress	Calculated Shear Stress	Safety Factor	Remarks	Staple Pattern
Unreinforced Vegetation	Straight	5.68 cfs	2.78 ft/s	0.39 ft	0.05	4 lbs/ft2	1.01 lbs/ft2	3.97	STABLE	--
Underlying Substrate	Straight	5.68 cfs	2.78 ft/s	0.39 ft	0.05	4 lbs/ft2	0.8 lbs/ft2	4.97	STABLE	--

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ECMDS v7.0

CHANNEL ANALYSIS

> > > CS515:C-4

Name	CS515:C-4
Discharge	2.37
Channel Slope	0.017
Channel Bottom Width	2
Left Side Slope	3
Right Side Slope	3
Low Flow Liner	
Retardence Class	C 6-12 in
Vegetation Type	Sod Former
Vegetation Density	Good 65-79%
Soil Type	Silt Loam (SM)

SC150BN

Phase	Reach	Discharge	Velocity	Normal Depth	Mannings N	Permissible Shear Stress	Calculated Shear Stress	Safety Factor	Remarks	Staple Pattern
SC150BN Unvegetated	Straight	2.37 cfs	1.72 ft/s	0.42 ft	0.05	2 lbs/ft2	0.45 lbs/ft2	4.47	STABLE	D
Underlying Substrate	Straight	2.37 cfs	1.72 ft/s	0.42 ft	0.05	1.47 lbs/ft2	0.31 lbs/ft2	4.68	STABLE	D

Unreinforced Vegetation

Phase	Reach	Discharge	Velocity	Normal Depth	Mannings N	Permissible Shear Stress	Calculated Shear Stress	Safety Factor	Remarks	Staple Pattern
Underlying Substrate	Straight	2.37 cfs	1.72 ft/s	0.42 ft	0.05	4 lbs/ft2	0.31 lbs/ft2	12.77	STABLE	--
Unreinforced Vegetation	Straight	2.37 cfs	1.72 ft/s	0.42 ft	0.05	4 lbs/ft2	0.45 lbs/ft2	8.93	STABLE	--

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ECMDS v7.0

CHANNEL ANALYSIS

> > > CS515: C-5

Name	CS515: C-5
Discharge	7.04
Channel Slope	0.05
Channel Bottom Width	4
Left Side Slope	3
Right Side Slope	3
Low Flow Liner	
Retardence Class	C 6-12 in
Vegetation Type	Sod Former
Vegetation Density	Good 65-79%
Soil Type	Silt Loam (SM)

SC150BN

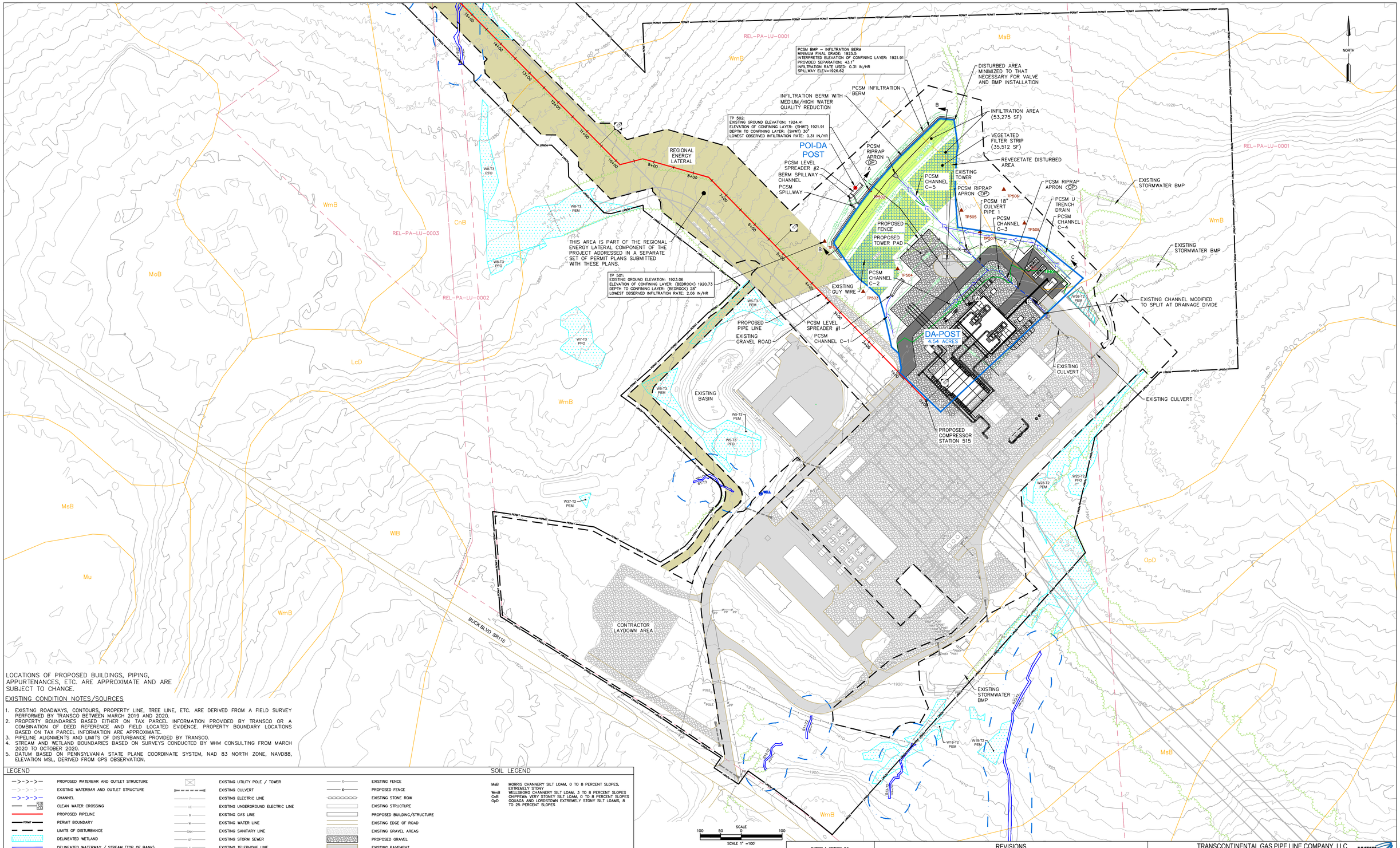
Phase	Reach	Discharge	Velocity	Normal Depth	Mannings N	Permissible Shear Stress	Calculated Shear Stress	Safety Factor	Remarks	Staple Pattern
SC150BN Unvegetated	Straight	7.04 cfs	3.18 ft/s	0.42 ft	0.05	2 lbs/ft2	1.31 lbs/ft2	1.53	STABLE	D
Underlying Substrate	Straight	7.04 cfs	3.18 ft/s	0.42 ft	0.05	1.47 lbs/ft2	1.03 lbs/ft2	1.42	STABLE	D

Unreinforced Vegetation

Phase	Reach	Discharge	Velocity	Normal Depth	Mannings N	Permissible Shear Stress	Calculated Shear Stress	Safety Factor	Remarks	Staple Pattern
Unreinforced Vegetation	Straight	7.04 cfs	3.18 ft/s	0.42 ft	0.05	4 lbs/ft2	1.31 lbs/ft2	3.06	STABLE	--
Underlying Substrate	Straight	7.04 cfs	3.18 ft/s	0.42 ft	0.05	4 lbs/ft2	1.03 lbs/ft2	3.87	STABLE	--

ATTACHMENT 5

NON-STRUCTURAL AND STRUCTURAL WATER QUALITY BMPS MAP



LOCATIONS OF PROPOSED BUILDINGS, PIPING, APPURTENANCES, ETC. ARE APPROXIMATE AND ARE SUBJECT TO CHANGE.

EXISTING CONDITION NOTES/SOURCES

1. EXISTING ROADWAYS, CONTOURS, PROPERTY LINE, TREE LINE, ETC. ARE DERIVED FROM A FIELD SURVEY PERFORMED BY TRANSCO BETWEEN MARCH 2019 AND 2020.
2. PROPERTY BOUNDARIES BASED EITHER ON TAX PARCEL INFORMATION PROVIDED BY TRANSCO OR A COMBINATION OF DEED REFERENCE AND FIELD LOCATED EVIDENCE. PROPERTY BOUNDARY LOCATIONS BASED ON TAX PARCEL INFORMATION ARE APPROXIMATE.
3. PIPELINE ALIGNMENTS AND LIMITS OF DISTURBANCE PROVIDED BY TRANSCO.
4. STREAM AND WETLAND BOUNDARIES BASED ON SURVEYS CONDUCTED BY WHM CONSULTING FROM MARCH 2020 TO OCTOBER 2020.
5. DATUM BASED ON PENNSYLVANIA STATE PLANE COORDINATE SYSTEM, NAD 83 NORTH ZONE, NAVD88, ELEVATION MSL, DERIVED FROM GPS OBSERVATION.

LEGEND

- PROPOSED WATERBAR AND OUTLET STRUCTURE
- EXISTING WATERBAR AND OUTLET STRUCTURE
- CHANNEL
- CLEAN WATER CROSSING
- PROPOSED PIPELINE
- PERMIT BOUNDARY
- LIMITS OF DISTURBANCE
- DELINEATED WETLAND
- DELINEATED WATERWAY / STREAM (TOP OF BANK)
- STREAM FLOW DIRECTION
- RIPARIAN BUFFER
- 50'/FEMA FLOODWAY
- FEMA 100–YEAR FLOODPLAIN
- SOIL BOUNDARY / TYPE
- EXISTING TREELINE / TREE/SHRUB
- PROPERTY LINE
- EXISTING LEIDY / TGPL PIPELINES
- EXISTING FOREIGN PIPELINES
- EXISTING UTILITY POLE / TOWER
- EXISTING CULVERT
- EXISTING ELECTRIC LINE
- EXISTING UNDERGROUND ELECTRIC LINE
- EXISTING GAS LINE
- EXISTING WATER LINE
- EXISTING SANITARY LINE
- EXISTING STORM SEWER
- EXISTING TELEPHONE LINE
- EXISTING FIBER OPTIC LINE
- EXISTING UNDERGROUND CABLE LINE
- EXISTING STORM INLET
- EXISTING SANITARY MANHOLE
- EXISTING COMMUNICATION/ELECTRIC MANHOLE
- EXISTING FIRE HYDRANT
- EXISTING POWER POLE
- EXISTING WELL
- EXISTING FENCE
- PROPOSED FENCE
- EXISTING STONE ROW
- EXISTING STRUCTURE
- PROPOSED BUILDING/STRUCTURE
- EXISTING EDGE OF ROAD
- EXISTING GRAVEL AREAS
- PROPOSED GRAVEL
- EXISTING PAVEMENT
- PROPOSED PERMANENT ROAD
- EXISTING GRADE MAJOR CONTOURS (10' C.I.)
- EXISTING GRADE MINOR CONTOURS (2' C.I.)
- PROPOSED GRADE MAJOR CONTOURS (10' C.I.)
- PROPOSED GRADE MINOR CONTOURS (2' C.I.)
- TEST PIT/INFILTRATION TEST LOCATION (2020)
- DELINEATED DRAINAGE AREA
- PROPOSED INFILTRATION AREA
- PROPOSED VEGETATED FILTER STRIP

SOIL LEGEND

MsB	MORRIS CHANNERY SILT LOAM, 0 TO 8 PERCENT SLOPES, EXTREMELY STONY
WmB	WELLSBORO CHANNERY SILT LOAM, 3 TO 8 PERCENT SLOPES
CnB	CHIPPEWA VERY STONEY SILT LOAM, 0 TO 8 PERCENT SLOPES
OpD	OQUAGA AND LORDSTOWN EXTREMELY STONY SILT LOAMS, 8 TO 25 PERCENT SLOPES

PATRICK A. WOZINSKI, P.E.
COMMONWEALTH OF PENNSYLVANIA
REGISTERED PROFESSIONAL
PATRICK A. WOZINSKI
ENGINEER
PE076243
PENNSYLVANIA PROFESSIONAL ENGINEER

BAI GROUP

WHM consulting, INC. designs, permits, resolutions

REVISIONS

NO.	DATE	BY	DESCRIPTION	W.O. NO.	CHK.	APP.
1	06/29/21	RHM	REVISED PER PADEP COMMENTS.			
2	03/01/22	RHM	RESPONSE TO PADEP TECHNICAL DEFICIENCY LETTER			

TRANSCONTINENTAL GAS PIPE LINE COMPANY, LLC
REGIONAL ENERGY ACCESS EXPANSION PROJECT
COMPRESSOR STATION 515
POST CONSTRUCTION STORMWATER MANAGEMENT PLAN

ATTACHMENT 5 WATER QUALITY BMP'S MAP

BUCK TOWNSHIP, LUZERNE COUNTY, PENNSYLVANIA

DRAWN BY: DRV	DATE: 03/31/21	ISSUED FOR BID:	SCALE: AS NOTED
CHECKED BY: RJN	DATE: 03/31/21	ISSUED FOR CONSTRUCTION:	REVISION:
APPROVED BY: PW	DATE: 03/31/21		SHEET 1
WO: 1222639	RID: 305	DRAWING NUMBER: 26-1000-70-28-D	OF 1

ATTACHMENT 6
OFFSITE DISCHARGE REPORT

Transcontinental Gas Pipe Line Company, LLC

Offsite Discharge Report

Regional Energy Access Expansion Project

Compressor Station 515

April 2021
(Revised March 2022)

1.0 Project Description

Transcontinental Gas Pipe Line Company, LLC (Transco), a subsidiary of The Williams Companies, Inc., is proposing the Regional Energy Access Expansion Project (Project). The existing Compressor Station 515 component of the Project is located at the eastern terminus of the Regional Energy Lateral in Buck Township, Luzerne County. Proposed at this facility is the addition of one gas-fired turbine driven compressor with 31,871 nominal HP at ISO conditions and modification of three existing compressors. Also proposed is the abandonment and replacement of 17,000 HP from five existing gas fired reciprocating driven compressors with one additional gas-fired turbine driven compressor with 20,502 nominal HP at ISO conditions. One Mainline Valve will be installed at this facility (MLV515RA10). Compressor Station 515 will require Erosion and Sediment (E&S) Control and Post Construction Stormwater Management (PCSM) Best Management Practices (BMPs) to manage stormwater runoff during and after construction.

Transco has developed an Offsite Discharge Report for the discharges associated with the proposed BMPs. An Offsite Discharge Report is performed to ensure that no offsite erosion will occur downstream of the proposed activities. The analysis conducted for this project followed the sequence outlined in PaDEP's factsheet for offsite discharges (Document #3930-FS-DEP4124).

2.0 Conveyance Best Management Practices

Erosion and Sediment Control and Post Construction Stormwater Management BMPs are proposed to manage stormwater runoff during and after construction. A series of channels will be installed to direct runoff water from the proposed expansion to a rip rap apron, which will release water into an infiltration berm. At the base of the spillway a level spreader will allow water to flow into the forested area northwest of the Limits of Disturbance. These BMPs will be installed to convey the net increase in volume between the pre- and post-development 2-year storm events and mitigate the increase (pre-post development) in peak runoff for the 2-, 10-, 50-, and 100-year storm events. A level spreader is proposed as the discharge structure at this location.

2.1 Infiltration Berm

The infiltration berm releases water through a spillway and it flows directly into a level spreader where it is discharged towards the forested area located northwest of the Limits of Disturbance. The stormwater is discharged as sheet flow and travels along a vegetative flow path until it reaches delineated wetland, W22-T1 PFO, northwest of the

Limits of Disturbance and ultimately to stream S18-T2. The flow path is depicted on Attachment 1.0. Soil types and the erodibility factors within the flow path are shown on Table 1.

Table 1 – Soils Mapped within Flow Path	
Soil Mapping Unit	**Soil Erodibility Factor, K_f**
WmB	**K_f = N/a**
CnB	**K_f = N/a**

The soil erodibility factors are shown in Table 1. Soil erodibility data is not provided for any of the soils in the flow path. Photos were taken along the flow path of the downstream area to show the vegetative cover.

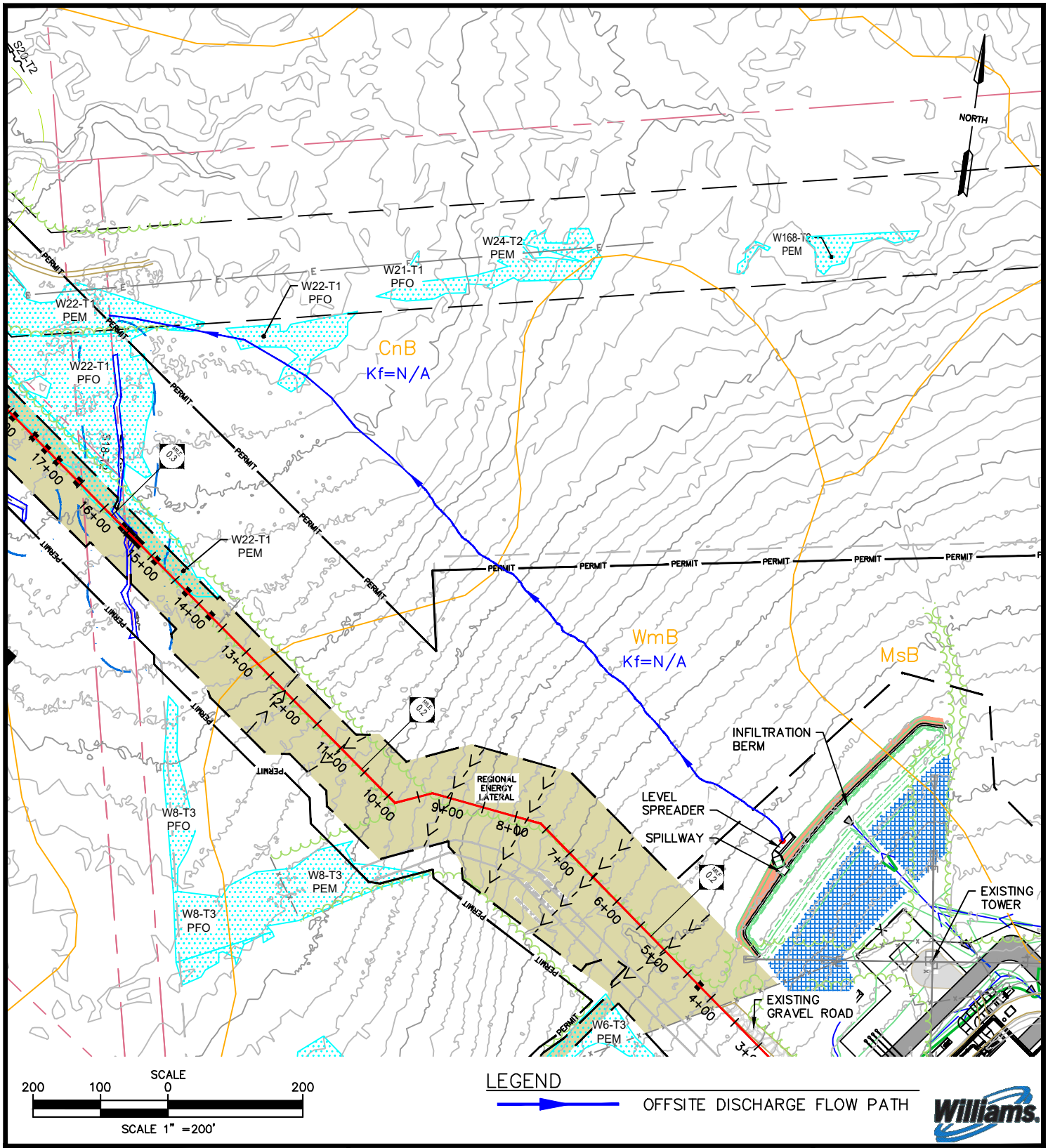
Photo 1: Existing Area at Proposed Level Spreader

Photo 2: Area Downgradient of the Proposed Level Spreader

Photo 1 shows the existing condition where the level spreader is proposed. The area will be graded to facilitate the installation of the level spreader and revegetated. Photo 2 shows the areas downgradient of the proposed level spreader, which is over 90% vegetated. In the E&S and PCSM Narrative, site calculations are provided and show the Pre- and Post-Construction runoff flow rates and volume. These calculations show a reduction in the post-construction discharge rates and volumes. Calculations indicated that the discharge velocity at the proposed level spreader is 2.13 feet per second for the for the 25 year, 24-hour storm event.

3.0 Conclusion

Based on the existing vegetative conditions, low discharge velocities from the BMPs and reduced peak flow rates and volumes from the site, downgradient soil erosion is not anticipate as a result of the proposed development of this site.



WHM consulting, INC.
designs, permits, resolutions

366 WALKER DRIVE, SUITE 300
STATE COLLEGE, PA 16801

TELEPHONE: (814)-689-1650 FAX: (814)-689-1557

TRANSCONTINENTAL GAS PIPE LINE COMPANY, LLC
REGIONAL ENERGY ACCESS EXPANSION PROJECT
COMPRESSOR STATION 515

EROSION AND SEDIMENTATION CONTROL PLAN

FLOW PATH

BUCK TOWNSHIP LUZERNE COUNTY PENNSYLVANIA

DATE:	02/22/22
DRAWN BY:	RHM
CHECKED:	PW
WHM DRAWING NO:	FLOW PATH

EXHIBIT 1.0

SECTION 3.4.2
DRAWINGS