PennEast Pipeline Company, LLC

PENNEAST PIPELINE PROJECT

Multi-Permit Application
for
Freshwater Wetlands Individual Permit
Transition Area Waiver Special Activity
Letter of Interpretation Verification
Water Quality Certificate
Flood Hazard Area Individual Permit
Flood Hazard Area Verification
Hardship Exception Request

ATTACHMENT M-1 - NJDEP Flood Hazard Area Engineering Report

Submitted to:
New Jersey Department of Environmental Protection
Division of Land Use Regulation

William Salmon, P.E.
Professional Engineer
N.J. License No. 41319

August 2019

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INTRODUCTION

This New Jersey Department of Environmental Protection Engineering Report for Flood Hazard Area Individual Permits and Flood Hazard Area Verifications pertains to the applicable engineering provisions of the NJDEP Flood Hazard Area Control Act Rules (NJAC 7:13), last revised April 16, 2018, and Technical Manual last revised 2018. The requirements of each applicable section of the regulations are cited along with an explanation of how the Permit Plans comply with the cited regulation.

Section 1 of this report provides statements with regard to engineering compliance for New Jersey Department of Environmental Protection (NJDEP) Individual Permits. Section 2 of this report pertains to NJDEP Flood Hazard Area Verifications, and Section 3 of this report analyzes temporary stream crossings associated with the proposed PennEast Pipeline Project (Project).

This report is to be utilized in conjunction with the following accompanying sections of the Multi-Permit Application:

1. Attachment E-2: PennEast Pipeline Flood Hazard Area Permit Plans, dated July 2019, prepared by Mott MacDonald;
2. Attachment E-5: PennEast Pipeline Supplemental Stream Crossing Detail Plans, dated July 2019, prepared by Mott MacDonald;
3. Attachment E-4: PennEast Pipeline Project - Soil Erosion and Sediment Control Plans, dated July 2019, prepared by Mott MacDonald:
    a. Hunterdon County – Pipeline (E-4);
    b. Hunterdon County - Above Ground Facilities and Wareyard (5 each: E-6, E-7, E-8, E-9, E-12);
    c. Mercer County – Pipeline (E-4);
    d. Mercer County – Above Ground Facilities and Wareyard (3 each: E-10, E-11, E-13).

4. Attachment G-1 and G-3: PennEast Pipeline Project Flood Hazard Area Control Act Environmental Report and Compliance Statement, dated August 2019, prepared by PS&S, LLC;
5. Attachment M-2 through M-5: Stormwater Management Reports:
    a. E'Town and Gilbert Interconnects Stormwater Management Report, dated July 2019, prepared by Mott MacDonald (M-2);
    b. Lambertville Launcher Stormwater Management Report, dated July 2019, prepared by Mott MacDonald (M-3);
    c. PennEast Pipeline Lambertville Interconnect Stormwater Management Report, dated June 28, 2019, prepared by TRC Engineers, Inc. (M-4);
    d. Transco Interconnect Stormwater Management Report, dated July 2019, prepared by Mott MacDonald (M-5);

1.0 FLOOD HAZARD AREA - INDIVIDUAL PERMITS

New Jersey Department of Environmental Protection Engineering Report – Individual Permits:

This NJDEP Report for Flood Hazard Area Individual Permits pertains to the applicable engineering provisions of Flood Hazard Area Control Act Rules (NJAC 7:13) and Technical Manual. The requirements of each applicable section of the regulations are cited along with an explanation of how the Permit Plans comply with the cited regulation. Additional NJDEP Flood Hazard Area Individual Permit compliance statements are found in a report entitled "NJDEP Flood Hazard Area Control Act Rules (NJAC 7:13) Environmental Report and Compliance Statement", dated August 2019, prepared by PS&S, LLC (Attachments G-1 and G-3).

NJAC 7:13–12.2: Requirements for Stormwater Management:

(b) ***Requirement****: The Department shall issue an individual permit for a regulated activity associated with a major development only if the requirements of the Stormwater Management rules at N.J.A.C. 7:8 are satisfied:*

Compliance: The proposed pipeline portion of the Project is exempt from Stormwater Management since the areas being disturbed will be revegetated upon completion of the work. Reference NJAC 7:8-5.2(d)1.

The proposed Project consists of eight (8) above-ground facilities. Four (4) above – ground facilities are not regulated since the project proposes less than one (1) acre of disturbance and less than ¼ acre of impervious surface improvements. Four (4) facilities are regulated under NJAC 7:8 – 5.2 since greater than one (1) acre of land is proposed to be disturbed. A review of the following Stormwater Management Reports (See Attachment M-2 through M-5) verifies compliance with the regulations for Recharge, Stormwater Quantity attenuation and Water Quality (if Applicable):

1. Gilbert and E'Town Interconnect Stormwater Management Report, dated July 2019, prepared by Mott MacDonald;
2. Lambertville Launcher Stormwater Management Report, dated July 2019, prepared by Mott MacDonald;
3. PennEast Pipeline Lambertville Interconnect Stormwater Management Report, dated June 28, 2019, prepared by TRC Engineers, Inc.;
4. Transco Interconnect Stormwater Management Report, dated July 2019, prepared by Mott MacDonald.

A copy of each report is included in this application (See Attachments M-2 through M-5).

(c) ***Requirement****: The Department shall issue an individual permit for a stormwater management basin located within or discharging within a flood hazard area only if the following requirements are satisfied:*

Compliance: The proposed stormwater management facilities do not discharge to regulated flood hazard areas.

NJAC 7:13–12.7: Requirements for a Bridge or Culvert:

(a) ***Requirement:*** *This section sets forth the design and construction standards under which the Department will issue an individual permit for the construction or reconstruction of a bridge or culvert in any regulated area.*

Compliance: The Applicant is proposing one (1) permanent culvert for the Project located at the driveway for the Lambertville Lateral Tap site. The proposed culvert is not located within a regulated floodplain, but is located within a riparian zone. The proposed culvert is designed in accordance with the applicable provisions of the regulations (See Attachments E-2 and E-4).

All bridges and other culverts associated with the Project are temporary for construction only and are not applicable to the requirements of this section of the regulations. However, Section 3 of this report provides an analysis of the streams at each crossing and established desired bottom chord elevations for temporary bridge crossings that will be utilized during construction. In accordance with NJDEP policy, hydrologic and hydraulic calculations associated with permanent structures can be avoided if it is demonstrated that the proposed temporary bridges are placed at or above the 2 year water surface elevation and the high chord is two (2) feet below an adjacent habitable building, railroad, or parking area. In addition, the approach ramp thickness leading up to the crossing must be 12" or less and no fill is to be placed in the channel. The Supplemental Stream Crossing Detail Plans (Attachment E-5) submitted with this application demonstrate compliance with NJDEP policy.

NJAC 7:13–12.9: Requirements for an Outfall Structure:

(b) Requirement: *The Department shall issue an individual permit to construct or reconstruct a stormwater outfall structure only if the following requirements are satisfied:*

1. The structure is built with concrete headwall or flared end section with footings that extend no less than three feet below grade;
2. The structure does not obstruct flow in a channel or floodway;
3. The structure includes adequate conduit outlet protection where required by the Standards for Soil Erosion and Sediment Control in New Jersey at NJAC 2:90, as determined by the local Soil Conservation District having jurisdiction over the site;
4. If the structure includes a riprap apron, a three feet deep by three feet wide riprap toe wall is constructed at the end of the apron; and
5. The structure does not interfere with the normal flow of the channel or threaten to change the dimensions or location of the channel. For example, a large discharge of stormwater into a small channel, or a discharge situated at a significant angle to the normal flow in the chanel, may cause the channel to move over time, interfere with the direction of flow and/or cause increased eroision or deposition of sediment within the channel.

Compliance: Permit Plan details demonstrate compliance to conditions 1-5 of NJAC 7:13-12.5(b); See Attachments E-2 and E-4.

2.0 FLOOD HAZARD AREA - VERIFICATIONS

2.1 Introduction

The proposed Project includes the installation of eight (8) "above – ground facilities" associated with the proposed transmission pipeline installation. Each above-ground facility was reviewed for potential impact to the NJDEP regulated flood hazard areas. Only the Gilbert Tap Site and the Transco Receiver Site were found to be adjacent to a regulated watercourse draining over 50 acres (NJAC 7:13 – 2.3 (b)).

2.2 The Gilbert Tap Site (Portion Block 20, Lot 10, Holland Township, NJ):

PennEast is requesting a Floodplain Verification of Tributary No. 1 to the Delaware River located on a Portion of Block 20, Lot 10, Holland Township. Tributary No. 1 is a State delineated stream; therefore, method 1 for determining the Flood Hazard Area is applicable.

The Gilbert Tap Site is located on Phillips Road, Holland Township, N.J. (Block 20, Lot 10). This is the location of a mainline valve (MLV) (#9) and associated aboveground piping where the Gilbert Lateral connects to the PennEast main line. MLVs consist of a small system of aboveground and underground piping and valves that control the flow of gas within the pipeline and can also be used to vacate, or blow-off, the gas within a pipeline segment, if necessary. MLVs are installed within the operational rights-of-way of the pipeline facilities. MLVs are also located at interconnections within a transmission system (i.e., between a mainline pipeline and a loop) and at locations based on the U.S. Department of Transportation (DOT) Class designation of the pipeline. In addition, there is a graveled area and connection point where a temporary pig launcher can be attached to inspect and maintain the Gilbert Lateral Pipeline.

The Gilbert Tap Site is located adjacent to a watercourse known as Tributary No. 1 to the Delaware River. The associated upstream drainage area of the watercourse at the easement area limit is approximately 1,184 acres and therefore regulated under NJAC 7:13. Tributary No. 1 downstream of Phillips Road is a NJDEP State Delineated Stream pursuant NJAC 7:13-3.3 (Appendix 2). The New Jersey Flood Hazard Area Design Flood Elevation (NJFHADFE) of Tributary No. 1 adjacent to the Gilbert Tap Site was established by review and plotting of the elevations established by the State on the Flood Profiles on the topographic mapping. The NJFHADFE was found to be outside the Gilbert Tap Site easement area. Reference Plans entitled PennEast Pipeline Flood Hazard Area Permit Plans (Attachment E-2). Since the project site is located outside the NJFHADFE, verification of the floodway is not requested. In addition, since the Gilbert Tap Site is located within an easement and not owned in fee by PennEast, Metes and Bounds of the floodplain are not provided.

Reference is made to plans entitled PennEast Pipeline Flood Hazard Area Permit Plans, prepared by Mott MacDonald (Attachment E-2) for proposed improvements and regulated areas.

2.3 The Transco Receiver Site (Portion Block 75, Lot 2, Hopewell Township, NJ):

The Applicant is not requesting a Floodplain Verification of an un-named tributary to Stony Brook, located on a Portion of Block 75, Lot 2, Hopewell Township, NJ since a prior (valid) verification has been obtained.

The Transco Receiver site is located on Blackwell Road in Hopewell Township, Mercer County (Block 75, Lot 2). The site is the termination point of the mainline of the Project and consists of launchers and receivers where internal pipeline cleaning and inspection tools can be inserted or retrieved from the pipeline. The pig launchers and receivers consist of aboveground components and piping within the pipeline right of way / easement over a gravel base.

The Applicant has previously secured a NJDEP Flood Hazard Area Verification Approval (File No. 0000-17-0007.1 FHA 170001). The flood hazard area of the un-named tributary to Stony Brook was established using Method 5 (Approximate Method) pursuant to NJAC 7:13-3.5.

Reference is made to plans entitled PennEast Pipeline Flood Hazard Area Permit Plans, prepared by Mott MacDonald (Attachment E-2) for proposed improvements and regulated areas. A review of the plans verifies that above-ground improvements associated with Transco Receiver Site lie outside the regulated (approximated) floodplain.

The May 24, 2017 Flood Hazard Area Verification Approval and supporting documents are found in Appendix B of this report.

3.0 FLOOD HAZARD AREA- SUPPLEMENTAL STREAM CROSSINGS

3.1 Introduction

The proposed Project consists of temporarily crossing features regulated by the NJDEP. NJDEP Regulated Flood Hazard Area features are proposed to be crossed by vehicular construction equipment as follows:

1. Horizontal directional drilling (no vehicular access);
2. Jack-Bore with adjacent vehicular access;
3. Open cut trenching with adjacent vehicular access.

The regulated features were established by field inspection performed by Amy S. Greene Associates and field surveyed by Mott MacDonald on various dates.

The purpose of this section of the Engineer's Report is to provide an analysis of the stream flow depth at each crossing to establish the desired bottom chord elevation for temporary bridge crossings that will be utilized during construction. In accordance with NJDEP policy, hydrologic and hydraulic calculations typically associated with permanent structures can be avoided if it is demonstrated that the proposed temporary bridges are placed at or above the 2 year water surface elevation and the high chord is two (2) feet below the an adjacent habitable building, railroad, or parking area. In addition, the approach ramp thickness leading up to the crossing must be 12" or less and no fill is to be placed in the channel.

3.2 Hydrologic Analysis

The contributing drainage areas to each stream crossed by the installation of the pipeline and work areas has been determined based on USGS StreamStats v4.1.3 when available. The drainage areas of streams crossed where StreamStats was unavailable were delineated from LIDAR topography. The runoff curve number (CN) was established by utilizing GIS shapefiles of Hunterdon and Mercer County soil information downloaded from the Web Soil Survey and approximating land coverage based on aerial imagery taken from New Jersey Graphical Information Network 2015 Orthophotography. The time of concentration was established by manual delineation based on LIDAR topography. CN and Tc calculation sheets are provided in this Appendix C.

3.3 Hydraulic Analysis

At each crossing, the 2-year storm event depth of flow was calculated to establish necessary bridge crossing low chord elevations since the storm event typically represents "bank-full flow" conditions. Flow depths were established using Bentley FlowMaster v8i utilizing cross-section characteristics of the channel and channel slope. Cross section data was provided by field survey and plotted by Mott MacDonald, LLC on various dates. Refer to the following pages of this report for 2-year storm normal depth calculations of each crossing, supporting hydrologic and hydraulic data. Refer to associated permit plans entitled "PennEast Pipeline – Supplemental Stream Crossing Detail Plans," dated July 2019, prepared by Mott MacDonald, LLC for individual stream crossing plans, profiles and cross-sections depicting the proposed temporary bridge elevations, 2-year storm depths and stream diversion methods for proposed temporary bridge installation.

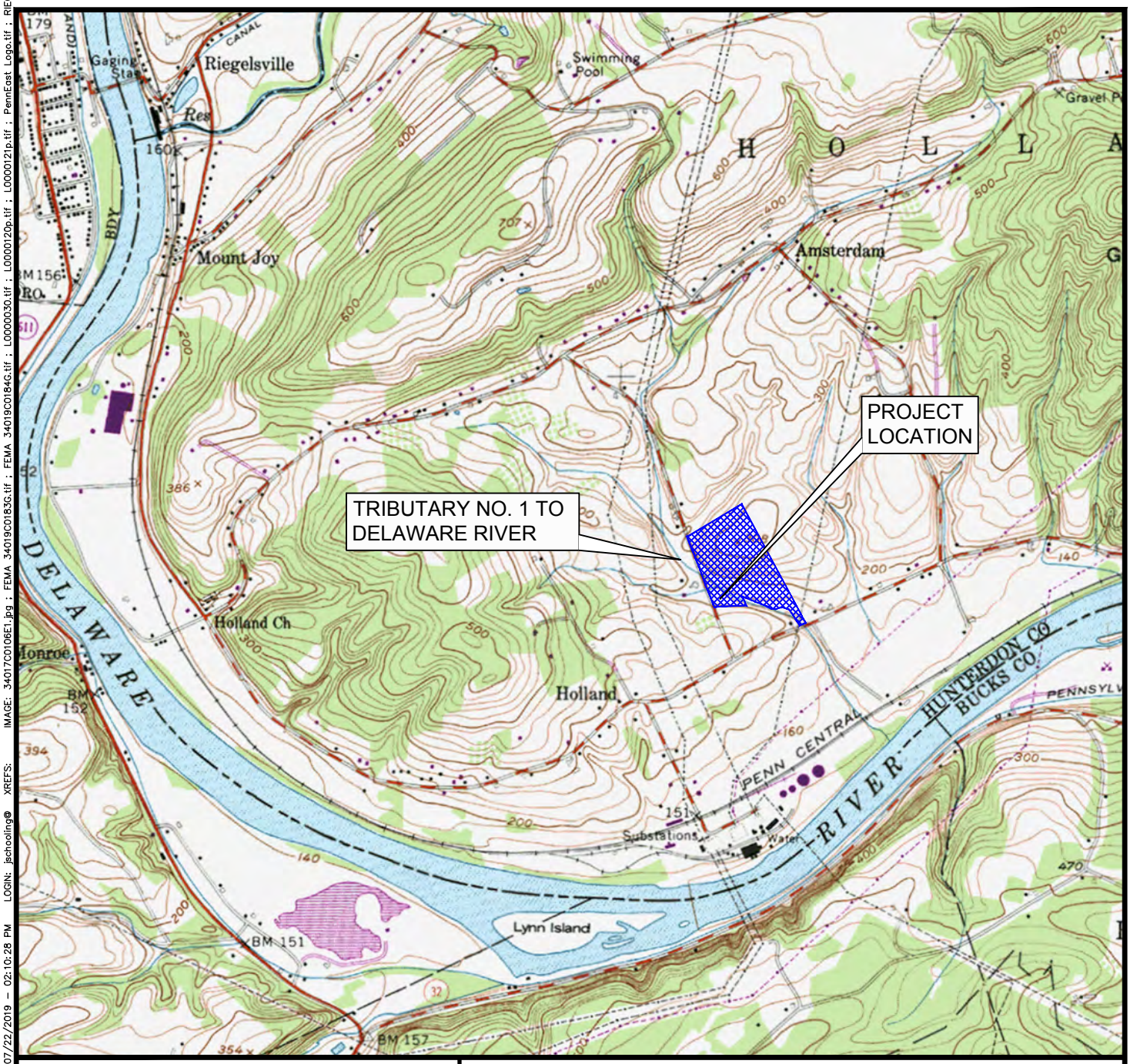
3.4 Summary

Proposed temporary bridge crossings allow for the passage of the 2-year storm event below the bottom bridge chord. With proper construction, no impacts are anticipated to stream channels and adjacent habitable buildings, railroads or parking areas.

APPENDIX A

GILBERT TAP/ MLV 9 SITE FIGURES

USGS MAP
TAX MAP
FEMA MAP
NJDEP FLOOD PROFILE
NJDEP DELINEATION OF FLOODWAY AND FLOOD HAZARD AREA



PennEast PIPELINE

PAULUS, SOKOLOWSKI AND SARTOR, LLC

PS&S

1433 ROUTE 34, SUITE A4
WALL, NEW JERSEY 7727
PHONE: (848) 206-2626

GRAPHIC SCALE

2000 0 1000 2000 4000

(IN FEET)
1 inch = 2000ft.

NORTH

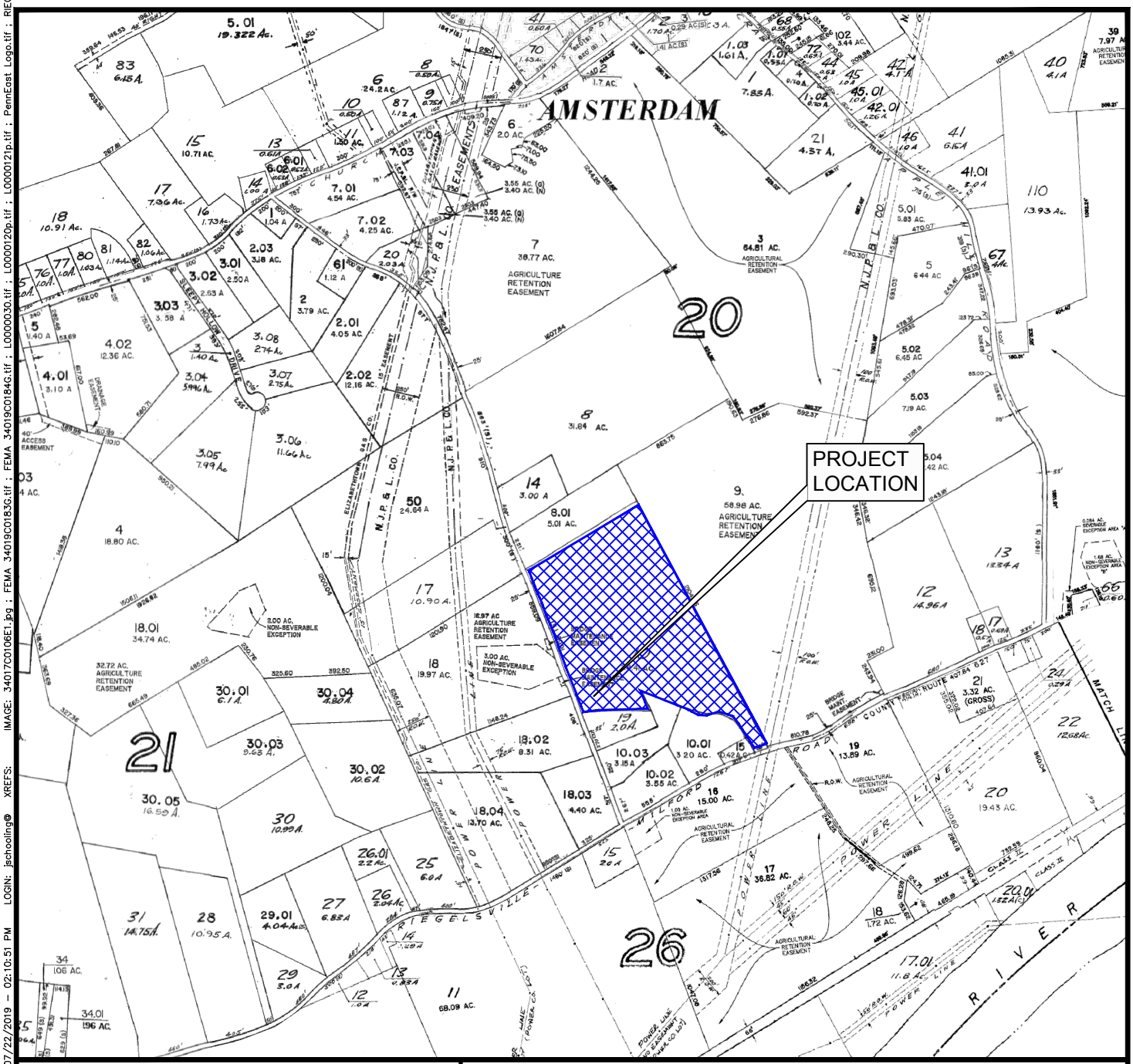
USGS MAP

PROJECT TITLE
PENNEAST PIPELINE PROJECT – GILBERT LATERAL
BLOCK 20, LOT 10
HOLLAND TOWNSHIP
HUNTERDON COUNTY, NJ

SOURCE:
USGS QUADRANGLE MAP
RIEGELSVILLE, NJ 2014

DATE: 2/15/17		PROJ. NO.: 05516–0001
SCALE: 1"=2000'		FIG. NO.: 1

FILE NAME: P:\05516\0001\DWGs\CAD\C-Civil\Usgs\USGS MAP.dwg LAST EDIT: 07/22/2019 – 02:10:28 PM LOGIN: jschooling@ XREFS: IMAGE: 34017C0106E1.jpg ; FEMA 34019C0183G.tif ; FEMA 34019C0184G.tif ; L0000030.tif ; L0000120p.tif ; L0000121p.tif ; PennEast Logo.tif ; RIEGELSVIL



GRAPHIC SCALE

1000 0 500 1000 2000

(IN FEET)

1 inch = 1000 ft.

NORTH

PennEast PIPELINE

PAULUS, SOKOLOWSKI AND SARTOR, LLC

PS&S

1433 ROUTE 34, SUITE A4
WALL, NEW JERSEY 7727
PHONE: (848) 206-2626

TAX MAP

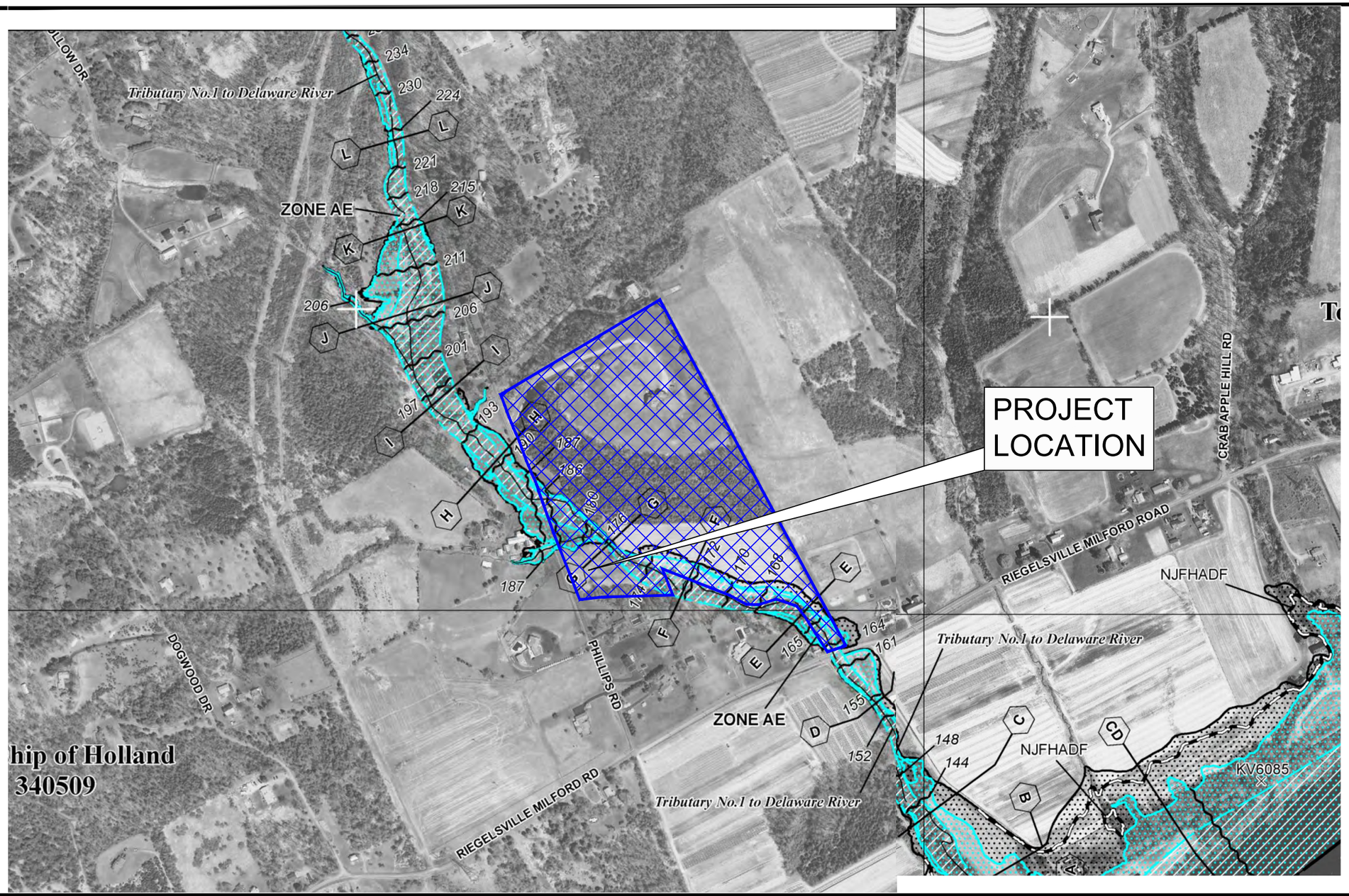
PROJECT TITLE

PENNEAST PIPELINE PROJECT – GILBERT LATERAL
BLOCK 20, LOT 10
HOLLAND TOWNSHIP
HUNTERDON COUNTY, NJ

SOURCE: **TAX MAP NO. 13, 14, 20, 21, 22 AND 26 – HOLLAND TOWNSHIP, HUNTERDON COUNTY, NJ, PREPARED BY BOHREN AND BOHREN EGINEERING ASSCOIATES, INC., LAST REVISED JANUARY 1988.**

DATE: 2/15/17		PROJ. NO.: 05516–0001
SCALE: 1"=2000'		FIG. NO.: 2

FILE NAME: P:\05516\0001\DWGs\CAD\C-Civil\Usgs\USGS MAP.dwg LAST EDIT: 07/22/2019 – 02:10:51 PM LOGIN: jschooling@ XREFS: IMAGE: 34017C0106E1.jpg ; FEMA 34019C0183G.tif ; FEMA 34019C0184G.tif ; L0000030.tif ; L0000120p.tif ; L0000121p.tif ; PennEast Logo.tif ; RIEGELSVILI



LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A	No Base Flood Elevations determined.
ZONE AE	Base Flood Elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR	Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99	Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V	Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE	Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X	Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X	Areas determined to be outside the 0.2% annual chance floodplain.
ZONE D	Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

1% annual chance floodplain boundary

New Jersey Flood Hazard Area Design Flood (NJFHADF)

0.2% annual chance floodplain boundary

Floodway boundary

Zone D boundary

CBRS and OPA boundary

Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.

Limit of Moderate Wave Action

513 — Base Flood Elevation line and value; elevation in feet*

(EL 987) — Base Flood Elevation value where uniform within zone; elevation in feet*

* Referenced to the North American Vertical Datum of 1988

A — A — Cross section line

3 — 3 — Limited detail cross section line

23 - - - - 23 — Transect line

87°07'45", 32°22'30" — Geographic coordinates referenced to the North American Datum of 1983 (NAD 83), Western Hemisphere

$^{39}76^{000m}$N — 1000-meter Universal Transverse Mercator grid values, zone 18

600000 FT — 5000-foot grid values: New Jersey State Plane coordinate system (FIPSZONE 2900), Transverse Mercator projection

DX5510 x — Bench mark (see explanation in Notes to Users section of this FIRM panel)

● M1.5 — River Mile

PAULUS, SOKOLOWSKI AND SARTOR, LLC
PS&S
1433 ROUTE 34, SUITE A4
WALL, NEW JERSEY 7727
PHONE: (848) 206-2626

NORTH

SCALE

1000 0 500 1000 2000

(IN FEET)
1 inch = 1000 ft.

PennEast PIPELINE

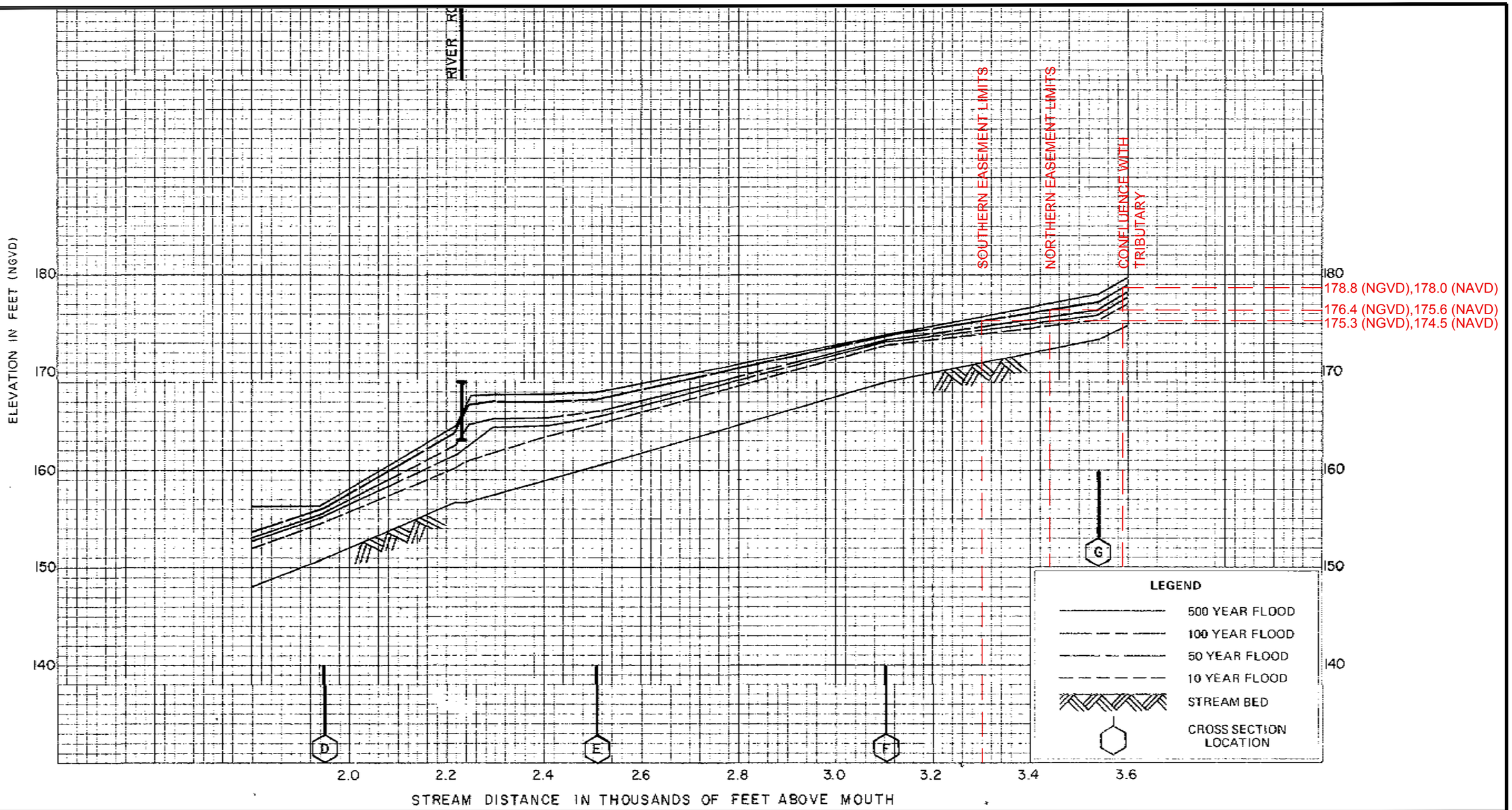
FEMA MAP

PROJECT TITLE
PENNEAST PIPELINE PROJECT – GILBERT LATERAL
BLOCK 20, LOT 10
HOLLAND TOWNSHIP
HUNTERDON COUNTY, NJ

SOURCE:
FEMA EFFECTIVE FLOOD INSURANCE RATE MAP NUMBER 34019C0183G AND 34019C0184G, HUNTERDON COUNTY, NJ – MAY 2, 2012

DATE: 2/15/17
SCALE: 1"=500'
PROJ. NO.: 05516-0001
FIG. NO.: 3

FILE NAME: P:\05516\0001\DWGs\CAD\C-Civil\Usgs\USGS MAP.dwg LAST EDIT: 07/22/2019 – 02:11:28 PM LOGIN: jschooling@ XREFS: IMAGE: 34017C0106E1.jpg ; FEMA 34019C0183G.tif ; FEMA 34019C0184G.tif ; L0000030.tif ; L0000120p.tif ; L0000121p.tif ; PennEast Logo.tif ; RIEGELSVILLE.tif



PAULUS, SOKOLOWSKI AND SARTOR, LLC
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WALL, NEW JERSEY 7727
PHONE: (848) 206-2626

NORTH

SCALE

200 0 100 200 400

(IN FEET)
1 inch = 200 ft.

PennEast PIPELINE

FEMA PROFILE

PROJECT TITLE
PENNEAST PIPELINE PROJECT – GILBERT LATERAL
BLOCK 20, LOT 10
HOLLAND TOWNSHIP
HUNTERDON COUNTY, NJ

SOURCE:
FEMA FLOOD PROFILE – TRIBUTARY NO.1 TO DELAWARE RIVER
TOWNSHIP PF HOLLAND, NJ (HUNTERDON COUNTY)
SHEET NO. 09P

DATE: 4/9/19		PROJ. NO.: 05516–0001
SCALE: 1"=200'		FIG. NO.: 4

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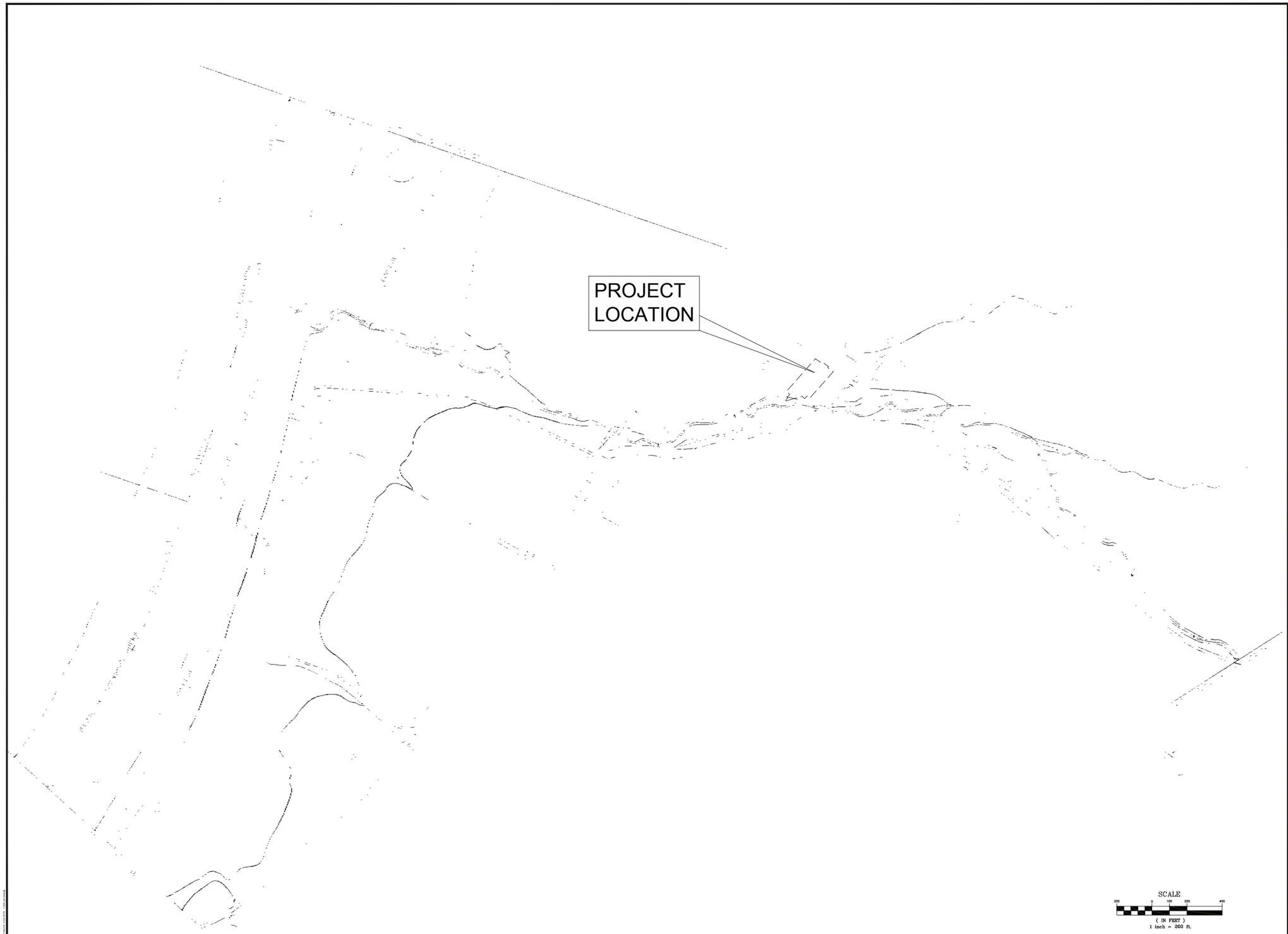

NOTES:

1. FLOODWAY AND FLOOD HAZARD AREA LIMITS TAKEN FROM PLAN ENTITLED "DEPARTMENT OF ENVIRONMENTAL PROTECTION DIVISION OF WATER RESOURCES – DELINEATION OF FLOODWAY AND FLOOD HAZARD AREA FOR THE DELAWARE RIVER TRIBUTARY NO. 1 (STA. 0+00 TO STA. 68+29)," PREPARED BY MICHAEL BAKER, JR. INC., DATED 1978.

REV. / ISSUE	DATE	DESCRIPTION

CONSULTANT

CONSULTANT

ORIENTATION / KEY PLAN

CLIENT

PAULUS, SOKOLOWSKI AND SARTOR, LLC.
1433 ROUTE 34
SUITE A4
WALL, NJ 07727
PHONE: (848) 206-2626
CERTIFICATE OF AUTHORIZATION NO. 24GA28032700

ALL DIMENSIONS MUST BE VERIFIED BY THE CONTRACTOR. NOTIFY PAULUS, SOKOLOWSKI AND SARTOR, LLC. OF ANY CONFLICTS, ERRORS, AMBIGUITIES OR DISCREPANCIES IN THE CONTRACT DRAWINGS OR SPECIFICATIONS BEFORE PROCEEDING WITH CONSTRUCTION.

ALL DIMENSIONS SHALL BE AS NOTED IN WORDS OR NUMBERS ON THE CONTRACT DRAWINGS. DO NOT SCALE THE DRAWINGS TO DETERMINE DIMENSIONS.

THESE CONTRACT DRAWINGS CONTAIN DATA INTENDED SPECIFICALLY FOR THE NOTED PROJECT AND CLIENT. THEY ARE NOT INTENDED FOR USE ON EXTENSIONS OF THIS PROJECT OR FOR REUSE ON ANY OTHER PROJECT.

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WILLIAM SALMON, P.E.
PROFESSIONAL ENGINEER
N.J. LIC. NO. 41319

SIGNATURE DATE

PROJECT

PENNEAST PIPELINE PROJECT
GILBERT LATERAL

BLOCK 20, LOT 10
HOLLAND TOWNSHIP, HUNTERDON COUNTY, NEW JERSEY

SHEET TITLE

DELINEATION OF FLOODWAY AND FLOOD HAZARD AREA

PROJECT NO.: 05516-0001	DRAWN BY: JPS
SCALE: 1"=200'	CHECKED BY: WS
DATE: 4/9/2019	SHEET 1 OF 1
SHEET NO.	FIG. 5

APPENDIX B

TRANSCO RECEIVER SITE VERIFICATION APPROVAL

NJDEP FHA VERIFICATION APPROVAL LETTER
NJDEP FHA & RIPARIAN ZONE VERIFICATION PLAN

State of New Jersey

DEPARTMENT OF ENVIRONMENTAL PROTECTION
Division of Land Use Regulation
Mail Code 501-02A
P.O. Box 420
Trenton, New Jersey 08625-0420
www.state.nj.us/dep/landuse

CHRIS CHRISTIE
Governor

KIM GUADAGNO
Lt. Governor

BOB MARTIN
Commissioner

Jeff England, Sr. Project Manager
PennEast Pipeline Company, LLC
One Meridian Blvd., Suite 2C01
Wyomissing, PA, 19610

May 24, 2017

Re: Flood Hazard Area Verification Approval
File No.: 0000-17-0007.1 FHA 170001
Applicant: PennEast Pipeline Company, LLC
Block: 75; Lot: 2
Township: Hopewell; County: Mercer

Dear Mr. England:

This letter is in response to your request for a verification of the flood hazard area and riparian zone limits associated with an unnamed tributary to Stony Brook, on a subject site located southerly at the intersection of Blackwell Road and Beechwood Drive, within Lot No. 2 of Block No. 75, in Hopewell Township, Mercer County, New Jersey.

The Department has reviewed your application and hereby verifies the flood hazard area elevation and/or limit and riparian zone limits on this site, as depicted on the approved plans described below;

The flood hazard area was established using Method 5 (Approximate Method) as described at N.J.A.C. 7:13-3.5.

The riparian zone extends 300 feet from the top of bank along both sides of each regulated water on this site. If a discernible bank is not present along regulated water, the riparian zone is measured in accordance with N.J.A.C. 7:13-4.1(b). This riparian zone width onsite is because the stream is a category-one watercourse.

Please note that altering land cover or topography in a flood hazard area, as well as clearing, cutting and/or removing vegetation within a riparian zone, is regulated by the Flood Hazard Area Control Act rules, and may be prohibited or restricted in some cases. A flood hazard area permit is required prior to undertaking any regulated activity within a flood hazard area or riparian zone described at N.J.A.C. 7:13-2.4. Some projects may qualify for a permit-by-rule at N.J.A.C. 7:13-7.2. All other projects must receive a general permit under N.J.A.C. 7:13-8 or an individual permit under N.J.A.C. 7:13-9. Projects situated entirely outside both the flood hazard area and riparian zone do not require a flood hazard area approval.

This verification is based on the best information presently available to the Department, and is subject to change if this information is no longer accurate or if additional information is made available to the Department including, but not limited to, information supplied by the applicant.

The drawing hereby approved was prepared by William A. Dibartolo Jr., Professional Land Surveyor, NJ LIC 24GS04331200, dated January, 2017, last revised May 11, 2017 and entitled:

"PENNEAST PIPELINE PROJECT, FLOOD HAZARD AREA & RIPARIAN ZONE VERIFICATION PLAN, PARCEL PE-ME-097.00, BLOCK 75 LOT 2, TOWNSHIP OF HOPEWELL, MERCER COUNTY, NEW JERSEY.

Within 90 calendar days of the date of this letter, the applicant shall submit the following information to the clerk of each county in which the site is located, and shall send proof to the Department that this information is recorded on the deed of each lot referenced in the verification:

1. The Department file number for the verification;
2. The approval and expiration dates of the verification;
3. A metes and bounds description of any flood hazard area limit and/or floodway limit approved under the verification;
4. The flood hazard area design flood elevation, or range of elevations if variable, approved under the verification; and
5. The following statement: "The State of New Jersey has determined that all or a portion of this lot lies in a flood hazard area. Certain activities in flood hazard areas are regulated by the New Jersey Department of Environmental Protection and some activities may be prohibited on this site or may first require a permit. Contact the Division of Land Use Regulation at (609) 777-0454 for more information prior to any construction onsite."

Failure to have this information recorded in the deed of each lot and/or to submit proof of recording to the Department constitutes a violation of the Flood Hazard Area Control Act rules and may result in suspension or termination of the verification and/or subject the applicant to enforcement action pursuant to N.J.A.C. 7:13-19.

A copy of this plan, together with the information upon which this boundary determination is based, has been made part of the Division's public records. Please note that this letter in no way legalizes any fill that may have been previously placed onsite, or any other regulated activities that may have previously occurred. Also, this determination does not affect the applicant's responsibility to obtain any local, State or Federal permits that may be required, such as local building permits or freshwater wetlands approvals.

This verification is valid for five years from its issuance date. A verification shall not be extended but it can be transferred at the time of sale of a property to which the verification applies to a new owner pursuant to N.J.A.C. 7:13-14.1. Pursuant to N.J.A.C. 7:13-6.1(f), if the Department issues a verification for a site, and within five years issues a general permit authorization or an individual permit for a regulated activity that references or relies upon the verification at that site, the Department shall automatically reissue the verification upon approval of the permit or authorization so that the verification and permit or authorization have the same expiration date. This automatic reissuance shall occur only once per verification and there is no fee for this reissuance. The reissued verification shall reflect any alterations to the flood hazard area design flood elevation, flood hazard area limit and/or floodway limit that will result from

the regulated activities authorized under the individual permit or general permit authorization. All pre-construction and post-construction elevations and limits shall be demarcated on drawings approved under the reissued verification.

In accordance with N.J.A.C. 7:13-18.1, any person who is aggrieved by this decision may request a hearing within 30 days after notice of the decision is published in the DEP Bulletin by writing to: New Jersey Department of Environmental Protection, Office of Legal Affairs, Attention: Adjudicatory Hearing Requests, 401 East State Street, P.O. Box 402, Trenton, NJ 08625-0402. This request must include a completed copy of the Administrative Hearing Request Checklist. The DEP Bulletin is available through the Department's website at www.state.nj.us/dep and the Checklist is available through the Division's website at www.state.nj.us/dep/landuse/forms/index.html.

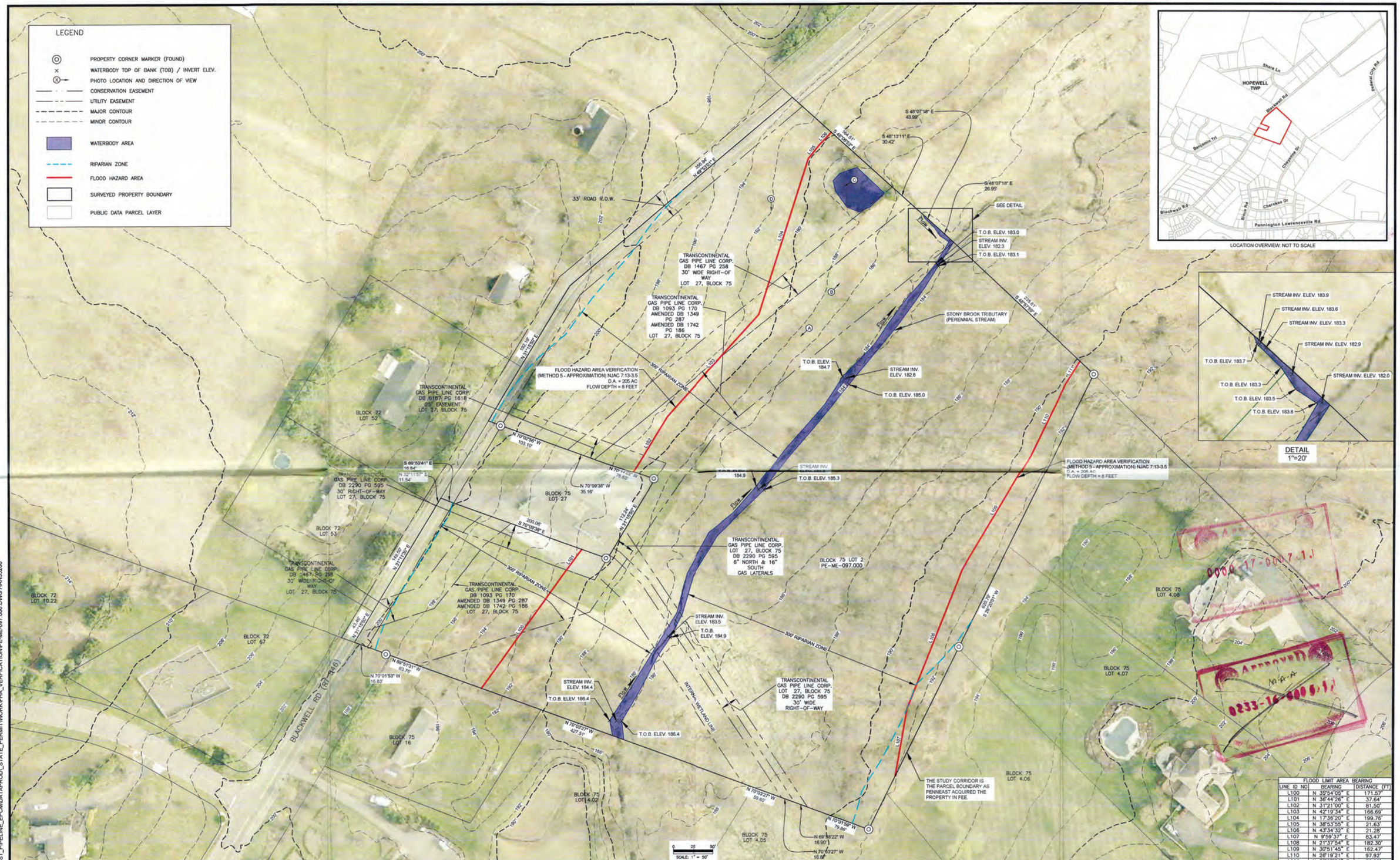
Please contact Marian Asante-Grable of my staff at marian.asante-grable@dep.nj.gov or by telephone at (609) 633-6563, should you have any questions regarding this letter. Be sure to indicate the Division's file number in all communication.

Sincerely,

Dennis Contois

Dennis Contois
North/Central Engineering Supervisor

c. Applicant
Municipal Clerk
Municipal Construction Official
Municipal Engineer



FLOOD LIMIT AREA BEARING		
LINE ID NO	BEARING	DISTANCE (FT)
L100	N 35°54'05" E	171.57'
L101	N 36°44'26" E	37.64'
L102	N 31°21'00" E	81.50'
L103	N 42°19'34" E	166.69'
L104	N 17°36'20" E	199.76'
L105	N 38°53'55" E	21.63'
L106	N 43°34'32" E	21.28'
L107	N 9°59'37" E	83.47'
L108	N 21°37'54" E	182.30'
L109	N 30°51'45" E	162.47'
L110	N 26°19'21" E	97.92'
L111	N 37°07'56" E	32.88'

WILLIAM A. DIBARTOLO JR.
PROFESSIONAL LAND SURVEYOR NJ LIC. 24GS04331200

5/12/17

GENERAL NOTES:
1. THE COORDINATE SYSTEM IS N.J.S.P.C.S. (NAD83) AND THE VERTICAL DATUM IS NAVD88.
2. THIS PLAN IS NOT A BOUNDARY SURVEY BASED UPON N.J.S.A. 46:23-9.9(E). N.J.A.C. 13:40-5.3-40.5.1. PROPERTY LINES FOR THE SUBJECT PARCEL OF THIS PLAN ARE BASED ON FIELD SURVEYS PERFORMED BY MOTT MACDONALD BETWEEN 2016 AND THE DATE ON THIS PLAN. OTHER EASEMENTS SHOWN ARE FOR REFERENCE ONLY.
3. AERIAL PHOTOGRAPHY SHOWN ON THIS PLAN IS FROM A MARCH 2016 AERIAL FLYOVER ACQUIRED BY PENNEAST FROM PICTOMETRY.
4. CONTOURS SHOWN ARE DERIVED FROM THE MARCH 2016 AERIAL FLYOVER ACQUIRED BY PENNEAST FROM PICTOMETRY AND CIVIL SURVEY CONDUCTED BY MOTT MACDONALD.
5. WATERBODIES SHOWN ARE DERIVED FROM NJDEP DATA.
6. FEATURES SHOWN OUTSIDE OF THE STUDY CORRIDOR ARE BASED ON PUBLICALLY AVAILABLE INFORMATION, UNLESS OTHERWISE NOTED ON THE PLAN.
6. WETLAND AND STREAM LIMITS WERE FIELD DELINEATED BY AMY S. GREENE ENVIRONMENTAL CONSULTANTS INC. UNLESS OTHERWISE NOTED ON THE PLAN.

FIELD REVISION NOTES:
1. THE PURPOSE OF THIS PLAN IS TO DEPICT STATE OPEN WATERS, RIPARIAN ZONES AND FLOOD HAZARD AREA WITHIN PENNEAST'S FEE PROPERTY. THIS PLAN SHALL NOT BE USED FOR CONVEYANCE OF LAND OR CONSTRUCTION PURPOSES.
2. THE SUBJECT PROPERTY IS DESCRIBED IN DEED BOOK 8258 AND PAGE 240.
3. THE FLOOD HAZARD AREA & RIPARIAN ZONE VERIFICATION REQUEST IS FOR THE AREA WITHIN PENNEAST'S FEE PROPERTY.
4. STONY BROOK TRIBUTARY IS A PERENNIAL STREAM AND WAS FIELD LOCATED ON 10/2/14.
5. ALL ON-SITE WATERS, WETLANDS, AND FLOOD HAZARD AREAS ARE SHOWN ON THIS PLAN. FLOOD HAZARD AREAS ARE REGULATED BY THE NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION AND SOME ACTIVITIES MAY BE PROHIBITED ON THIS SITE OR MAY FIRST REQUIRE A PERMIT. CONTACT THE DIVISION OF LAND USE REGULATION AT (609) 777-0454 FOR MORE INFORMATION PRIOR TO ANY CONSTRUCTION ONSITE.
6. THE CONVERSION TO NAVD88 AT THIS SITE IS NAVD88=0.00 PER US ARMY CORPS OF ENGINEERS CORPSCON SOFTWARE, VERSION 6.0.1
7. FLOOD HAZARD AREA VERIFICATION (METHOD 5) PREPARED BY WILLIAM DAUSON OF PSEG IN REPORT TITLED, "NJDEP FLOOD HAZARD AREA VERIFICATION ENGINEER'S REPORT" DATED JANUARY 2017.

REFERENCE DRAWINGS

DWG. NO.	TITLE

REVISIONS

NO.	REVISIONS	DATE	DRAWN	CK	APP'R
1	REVISED PLAN PER NJDEP COMMENTS	4/26/17	JJL	MDN	WAD
2	REVISED PLAN PER NJDEP COMMENTS	5/11/17	WAH	MDN	WAD

APPROVALS

DRAWN BY	DATE
MM	01/2017
CHECKED BY	DATE
MM	01/2017
ENG. APPROVAL	DATE
P.M. APPROVAL	DATE

CLIENT APPROVAL

DATE

PREPARED FOR

PennEast PIPELINE

PENNEAST PIPELINE PROJECT
FLOOD HAZARD AREA
& RIPARIAN ZONE VERIFICATION PLAN
PARCEL PE-ME-097.000
BLOCK 75 LOT 2
TOWNSHIP OF HOPEWELL
MERCER COUNTY, NEW JERSEY

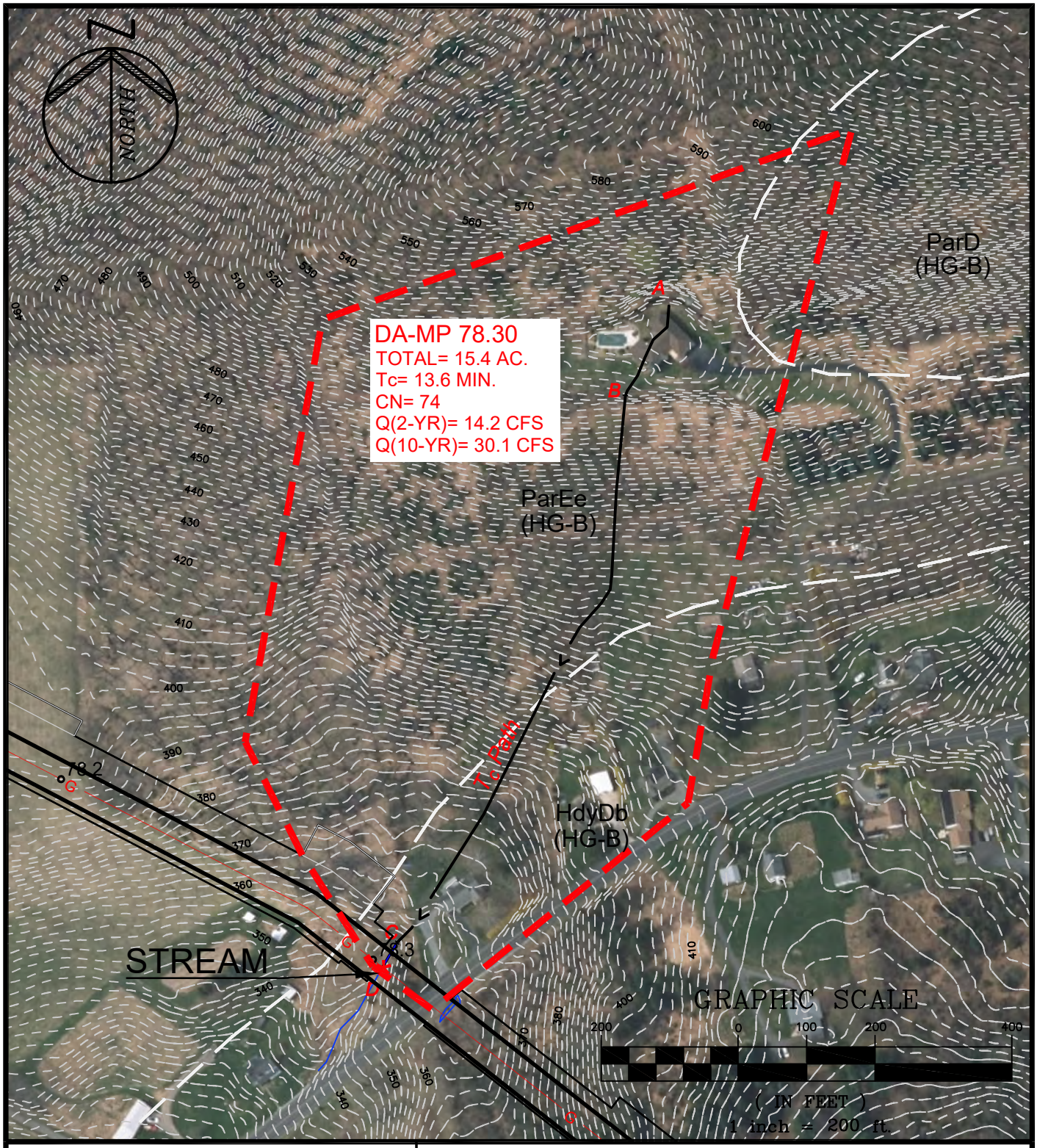
SCALE	DRAWING NO.	REVISION
1"=50'	PE-ME-097.000_FHA	2

G:\PENNEAST\353754_PENNEAST_PIPELINE_EPCM\DATA\PROD_STATE_PERMIT\WORK\FHA_VERIFICATION\PE-ME-097.000.DWG HAN35266

APPENDIX C

STREAM CROSSING CALCULATIONS

STREAMSTATS REPORTS
DRAINAGE AREA MAPS
CN NUMBER CALCULATION SHEETS
TC CALCULATION SHEETS
EXISTING HYDROGRAPHS
CHANNEL 2-YEAR STORM NORMAL DEPTH FLOW CALCULATIONS
SITE PHOTOGRAPHS



PAULUS, SOKOLOWSKI AND SARTOR, LLC.

1433 ROUTE 34
SUITE A4
WALL, NEW JERSEY 07727
PHONE: (848) 206-2626

CERTIFICATE OF AUTHORIZATION NO. 24GA28032700

PROJECT TITLE

PENNEAST PIPELINE

HUNTERDON AND MERCER COUNTY, NJ

SHEET TITLE

STREAM CROSSING DRAINAGE AREA MP 78.30

PROJ. NO.:	05516.0001	DRN. BY:	JPS	SCALE:	1"=200'
DATE:	05/23/19	CK'D BY:	WS		

FILE NAME: P:\05516\0001\DWGs\CADC-Civil\Plotdwgs\Drainage Area Maps\05516\0001-Stream_DA_MP78.3-84.4-WAL.dwg\MP 78.30 LAST EDIT: 06/13/2019 - 11:28:31 AM LOGIN: jmcgowan@

Worksheet 2: Runoff curve number and runoff (Approximated)

Project	By	Date
PennEast	JPS	26-Feb-18
Location	**Checked**	**Date**
Hunterdon County, NJ		

Check one: ☐ Present ☒ Developed — MP 78.30

1. Runoff curve number

Soil name and hydrologic group (appendix A)	Cover Description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN[1] Table 2-2	CN[1] Figure 2-3	CN[1] Figure 2-4	Area ☒ acres ☐ mi² ☐ %	Product of CN x Area
Type B	Farmstead, Good Condition	74			15.40	1,139.60
				Totals ➡	15.40	1,139.60

1. Use only one CN source per line

CN (weighted) $= \frac{\text{tot.prod.}}{\text{tot. area}} = \frac{1{,}139.60}{15.40} =$ 74.0 ; **Use CN** ➡ **74**

2. Runoff

		Storm #1	Storm #2	Storm #3
Frequency…….	yr			
Rainfall, P (24-hour)…….	in			
Runoff, Q……	in			

Use P and CN with table 2-1, figure 2-1, or equation 2-3 abd 2-4

PROJECT:	PennEast	JOB NO. 5516.0001	
		SHEET	DATE:2/12/2018
		BY:	JPS
SUBJECT:	Tc Calculations	CHK'D	

Time of Concentration calculations with the application of the SCS TR-55 methodology.

Watershed or Subarea Designation: DA 78.30

Area 15.4 AC

SHEET FLOW

Segment ID		A-B			
Surface Description (Table 3-1)		GRASS			
Manning's Coefficient, n (Table 3-1)		0.240			
Flow Length, L (total <= 150)	(ft)	150			
Two Year Rainfall, P	(in)	3.4			
Land Slope, s	(ft/ft)	0.087			
Computed Tt = 0.007 (nL)^0.8 / P^0.5*s^0.4	(hrs)	0.178			0.178

SHALLOW CONCENTRATED FLOW

Segment ID		B-C			
Surface Description (paved or unpaved)		UNPAVED			
Flow Length, L	(ft)	890			
Watercourse slope, s	(ft/ft)	0.171			
Average Velocity, V (Figure 3-1)	(ft/s)	5.4			
Computed Tt = L / 3600V	(hrs)	0.046			0.046

CHANNEL FLOW

Segment ID		C-D			
Cross sectional Area, a	(sf)	3.49			
Wetted Perimeter, Pw	(ft)	17.60			
Hydraulic Radius, r =a/Pw	(ft)	0.198			
Channel Slope (ft/ft)	(ft/ft)	0.095			
Manning's Roughness Coefficient, n		0.040			
Velocity, V = 1.49r^(2/3)s^0.5 / n	(ft/s)	3.90			
Flow Length, L	(ft)	42			
Computed Tt = L / 3600V	(hrs)	0.003			0.003

Watershed or subarea Tc	0.227	hrs.
	13.6	min.

Use minimum Tc of 10 minutes

Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 07 / 22 / 2019

Hyd. No. 2

DA 78.30

Hydrograph type	= SCS Runoff	Peak discharge	= 14.19 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.20 hrs
Time interval	= 6 min	Hyd. volume	= 56,456 cuft
Drainage area	= 15.400 ac	Curve number	= 74.000*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 13.6 min
Total precip.	= 3.26 in	Distribution	= Custom
Storm duration	= C:\Users\IKuzmina\AppData\Local\Autodesk\C3D 2019\enu\HHApps\Hydrograp	Storm frequency factor	= 484

* Composite (Area/CN) = [(15.400 x 74)] / 15.400

Hydrograph Discharge Table

(Printed values >= 5.00% of Qp. Print interval = 3)

Time -- (hrs	Outflow cfs)
11.60	0.811
11.90	2.819
12.20	14.19
<<	
12.50	6.058
12.80	3.369
13.10	2.459
13.40	1.875
13.70	1.459
14.00	1.290
14.30	1.179
14.60	1.063
14.90	0.943
15.20	0.827
15.50	0.780
15.80	0.750
16.10	0.719

...End

Worksheet for MP-78.30 STA 0+45_2YR_PIPE

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.09200	ft/ft
Discharge	14.20	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	348.00
0+35	348.00
0+49	345.65
0+50	344.25
0+51	345.00
0+65	348.00
0+79	352.00
0+90	354.00
1+00	354.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 348.00)	(1+00, 354.00)	0.045

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	1.27	ft
Elevation Range	344.25 to 354.00 ft	
Flow Area	2.46	ft²
Wetted Perimeter	5.60	ft

Worksheet for MP-78.30 STA 0+45_2YR_PIPE

Results

Hydraulic Radius		0.44	ft
Top Width		4.70	ft
Normal Depth		1.27	ft
Critical Depth		1.43	ft
Critical Slope		0.04380	ft/ft
Velocity		5.78	ft/s
Velocity Head		0.52	ft
Specific Energy		1.79	ft
Froude Number		1.41	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.27	ft
Critical Depth	1.43	ft
Channel Slope	0.09200	ft/ft
Critical Slope	0.04380	ft/ft

Worksheet for MP-78.30M_STA0+25_BRIDGE_2YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.09090	ft/ft
Discharge	14.20	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+12	350.00
0+25	350.00
0+48	346.80
0+50	345.67
0+51	346.60
0+70	352.20
0+77	354.00
1+00	356.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+12, 350.00)	(1+00, 356.00)	0.050

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	1.41	ft
Elevation Range	345.67 to 356.00 ft	
Flow Area	2.88	ft²
Wetted Perimeter	7.08	ft
Hydraulic Radius	0.41	ft

Worksheet for MP-78.30M_STA0+25_BRIDGE_2YR

Results

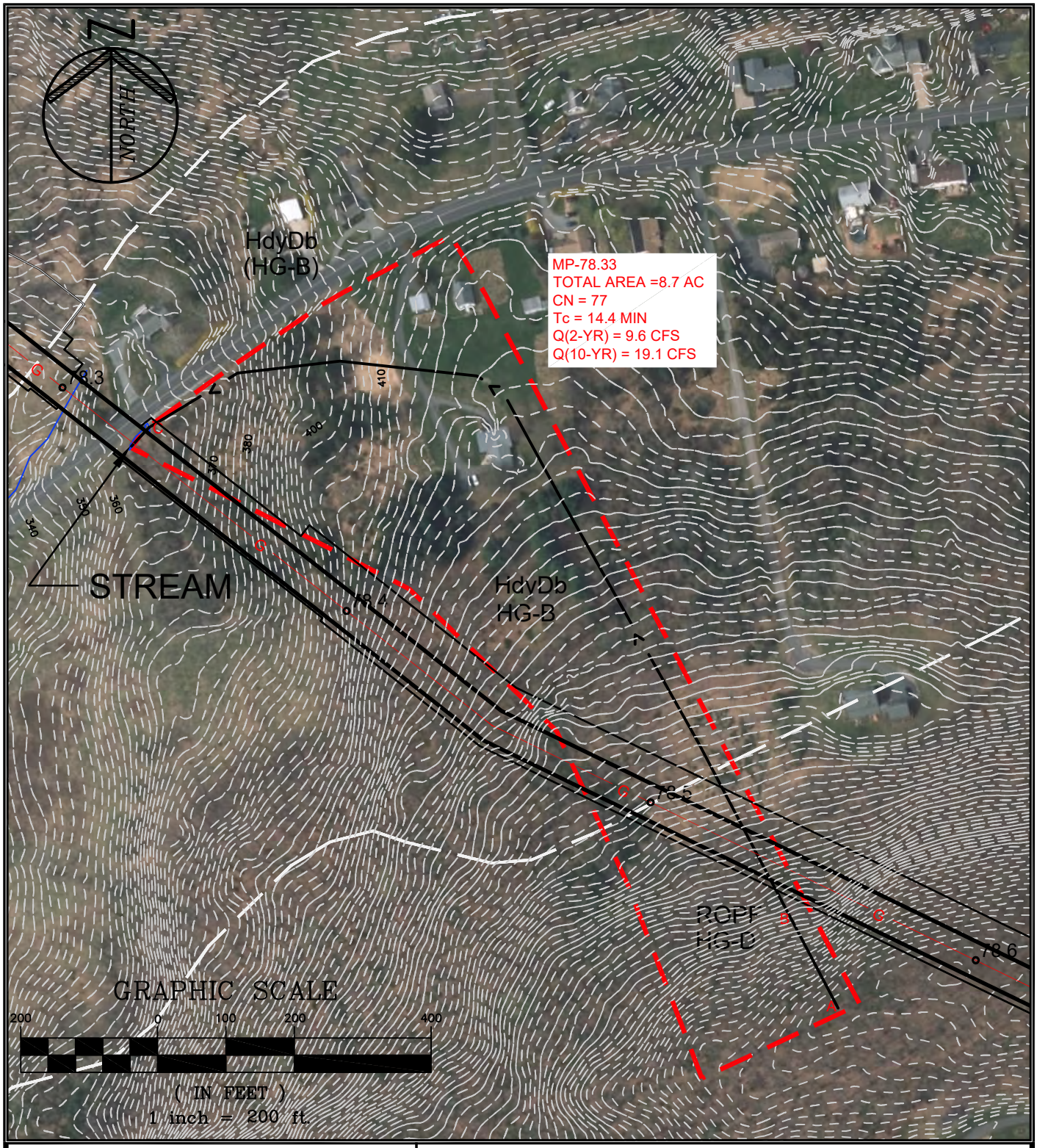
Top Width		6.23	ft
Normal Depth		1.41	ft
Critical Depth		1.51	ft
Critical Slope		0.05378	ft/ft
Velocity		4.92	ft/s
Velocity Head		0.38	ft
Specific Energy		1.79	ft
Froude Number		1.28	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.41	ft
Critical Depth	1.51	ft
Channel Slope	0.09090	ft/ft
Critical Slope	0.05378	ft/ft



PAULUS, SOKOLOWSKI AND SARTOR, LLC.

1433 ROUTE 34
SUITE A4
WALL, NEW JERSEY 07727
PHONE: (848) 206-2626

CERTIFICATE OF AUTHORIZATION NO. 24GA28032700

PROJECT TITLE

PENNEAST PIPELINE

HUNTERDON AND MERCER COUNTY, NJ

SHEET TITLE

STREAM CROSSING DRAINAGE AREA MP 78.33

PROJ. NO.:	05516.0001	DRN. BY:	JPS	SCALE:	1"=200'
DATE:	05/23/19	CK'D BY:	WS		

FILE NAME: P:\05516\0001\DWGs\CADC-Civil\Plotdwgs\Drainage Area Maps\05516\0001-Stream_DA_MP78.3-84.4-WAL.dwg\MP 78.33 LAST EDIT: 06/13/2019 - 12:15:03 PM LOGIN: jmcgowan@

Worksheet 2: Runoff curve number and runoff (Approximated)

Project	By	Date
PennEast	IK	9-Apr-19
Location	**Checked**	**Date**
Hunterdon County, NJ		

Check one: ☐ Present ☒ Developed | MP 78.33

1. Runoff curve number

Soil name and hydrologic group (appendix A)	Cover Description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN[1] Table 2-2	CN[1] Figure 2-3	CN[1] Figure 2-4	Area ☒ acres / ☐ mi² / ☐ %	Product of CN x Area
Type B	Farmstead, Good Condition	74			6.59	487.66
Type D	Farmstead, Good Condition	86			2.10	180.60
	Totals ➡				8.69	668.26

1. Use only one CN source per line

CN (weighted) = tot.prod. / tot. area = 668.26 / 8.69 = 76.9 ; **Use CN** ➡ **77**

2. Runoff

		Storm #1	Storm #2	Storm #3
Frequency…….	yr			
Rainfall, P (24-hour)…….	in			
Runoff, Q……	in			

Use P and CN with table 2-1, figure 2-1, or equation 2-3 abd 2-4

PROJECT:	PennEast	JOB NO. 5516.0001	
		SHEET	DATE:4/9/2019
		BY:	IK
SUBJECT:	Tc Calculations	CHK'D	

Time of Concentration calculations with the application of the SCS TR-55 methodology.

Watershed or Subarea Designation: DA 78.33

Area 8.7 AC

SHEET FLOW

Segment ID		A-B			
Surface Description (Table 3-1)		WOODS			
Manning's Coefficient, n (Table 3-1)		0.400			
Flow Length, L (total <= 150)	(ft)	150			
Two Year Rainfall, P	(in)	3.4			
Land Slope, s	(ft/ft)	0.293			
Computed Tt = 0.007 (nL)^0.8 / P^0.5*s^0.4	(hrs)	0.165			0.165

SHALLOW CONCENTRATED FLOW

Segment ID		B-C			
Surface Description (paved or unpaved)		UNPAVED			
Flow Length, L	(ft)	1423			
Watercourse slope, s	(ft/ft)	0.120			
Average Velocity, V (Figure 3-1)	(ft/s)	5.4			
Computed Tt = L / 3600V	(hrs)	0.073			0.073

CHANNEL FLOW

Segment ID		C-D			
Cross sectional Area, a	(sf)	3.00			
Wetted Perimeter, Pw	(ft)	4.83			
Hydraulic Radius, r =a/Pw	(ft)	0.621			
Channel Slope (ft/ft)	(ft/ft)	0.050			
Manning's Roughness Coefficient, n		0.040			
Velocity, V = 1.49r^(2/3)s^0.5 / n	(ft/s)	6.06			
Flow Length, L	(ft)	38			
Computed Tt = L / 3600V	(hrs)	0.002			0.002

Watershed or subarea Tc	0.240	hrs.
	14.4	min.

Use minimum Tc of 10 minutes

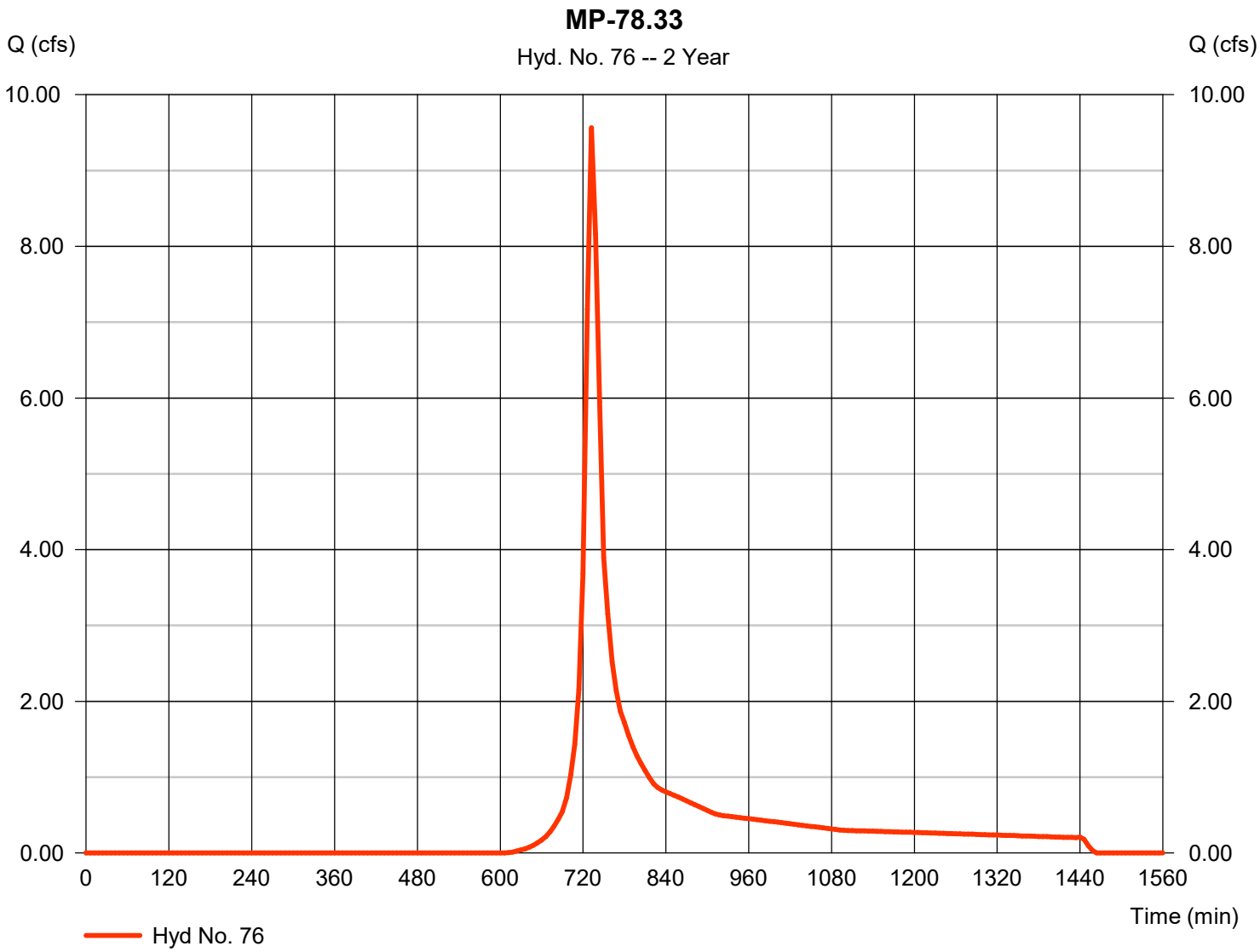
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 06 / 13 / 2019

Hyd. No. 76

MP-78.33

Hydrograph type	= SCS Runoff	Peak discharge	= 9.565 cfs
Storm frequency	= 2 yrs	Time to peak	= 732 min
Time interval	= 6 min	Hyd. volume	= 37,153 cuft
Drainage area	= 8.700 ac	Curve number	= 77
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 14.40 min
Total precip.	= 3.26 in	Distribution	= Custom
Storm duration	= C:\Users\IKuzmina\AppData\Local\Autodesk\C3D 2019\enu\AHHApps\Hydrograph	Shape factor	= 484



Worksheet for MP-78.33M_STA0+02_PIPE_2YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.02360	ft/ft
Discharge	9.60	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+47	357.40
0+50	356.91
0+54	357.40
1+00	358.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+47, 357.40)	(1+00, 358.00)	0.050

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.74	ft
Elevation Range	356.91 to 358.00 ft	
Flow Area	5.80	ft²
Wetted Perimeter	26.58	ft
Hydraulic Radius	0.22	ft
Top Width	26.25	ft
Normal Depth	0.74	ft
Critical Depth	0.66	ft
Critical Slope	0.06385	ft/ft

Worksheet for MP-78.33M_STA0+02_PIPE_2YR

Results

Velocity		1.65	ft/s
Velocity Head		0.04	ft
Specific Energy		0.79	ft
Froude Number		0.62	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.74	ft
Critical Depth	0.66	ft
Channel Slope	0.02360	ft/ft
Critical Slope	0.06385	ft/ft

Worksheet for MP-78.33M_STA0+22_BRIDGE_2YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.02360	ft/ft
Discharge	9.60	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+46	358.00
0+50	356.62
0+52	357.80
1+00	358.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+46, 358.00)	(1+00, 358.00)	0.050

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	1.17	ft
Elevation Range	356.62 to 358.00 ft	
Flow Area	3.18	ft²
Wetted Perimeter	5.93	ft
Hydraulic Radius	0.54	ft
Top Width	5.44	ft
Normal Depth	1.17	ft
Critical Depth	1.01	ft
Critical Slope	0.05130	ft/ft

Worksheet for MP-78.33M_STA0+22_BRIDGE_2YR

Results

Velocity		3.02	ft/s
Velocity Head		0.14	ft
Specific Energy		1.31	ft
Froude Number		0.69	
Flow Type	Subcritical		

GVF Input Data

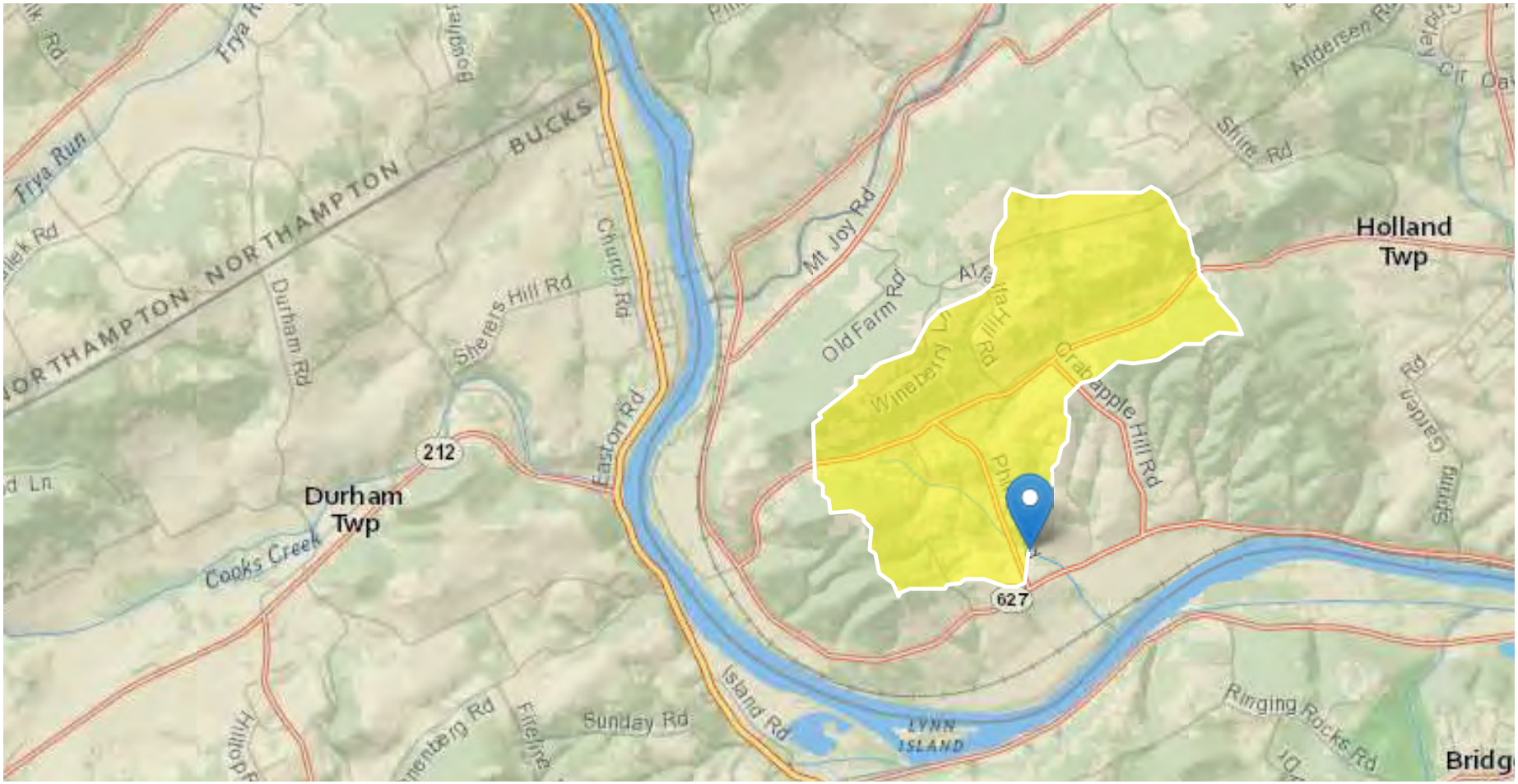
Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.17	ft
Critical Depth	1.01	ft
Channel Slope	0.02360	ft/ft
Critical Slope	0.05130	ft/ft

MP-79.77R3

Region ID: NJ
Workspace ID: NJ20170804141657886000
Clicked Point (Latitude, Longitude): 40.57550, -75.16080
Time: 2017-08-04 14:17:51 -0400



Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	1.85	square miles
STORAGE	Percentage of area of storage (lakes ponds reservoirs wetlands)	3.15	percent
CSL10_85	Change in elevation divided by length between points 10 and 85 percent of distance along main channel to basin divide - main channel method not known	211	feet per mi
POPDENS	Basin Population Density	212	persons per square mile

Peak-Flow Statistics Parameters [33 Percent (0.613 square miles) Peak Unglaciated Piedmont Region 2009 5167]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	1.85	square miles	0.25	779
STORAGE	Percent Storage	3.15	percent	0.23	32
CSL10_85	Stream Slope 10 and 85 Method	211	feet per mi	4.31	191
POPDENS	Basin Population Density	212	persons per square mile	83	11084

Peak-Flow Statistics Parameters [67 Percent (1.24 square miles) Peak Valley and Ridge Region 2009 5167]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	1.85	square miles	0.87	763
STORAGE	Percent Storage	3.15	percent	2.36	30.1
CSL10_85	Stream Slope 10 and 85 Method	211	feet per mi	2.56	268

Statistic	Value	Unit	SEe	SEp	Equiv. Yrs.
50 Year Peak Flood	645	ft^3/s	54.7	56.8	5
100 Year Peak Flood	788	ft^3/s	57.1	59.5	5
500 Year Peak Flood	1170	ft^3/s	63.9	66.3	6

Peak-Flow Statistics Flow Report [Area-Averaged]

Statistic	Value	Unit
2 Year Peak Flood	242	ft^3/s
5 Year Peak Flood	419	ft^3/s
10 Year Peak Flood	564	ft^3/s
25 Year Peak Flood	778	ft^3/s
50 Year Peak Flood	955	ft^3/s
100 Year Peak Flood	1160	ft^3/s
500 Year Peak Flood	1680	ft^3/s

Peak-Flow Statistics Citations

Watson, K.M.,and Schopp, R.D.,2009, Methodology for estimation of flood magnitude and frequency for New Jersey streams, U.S. Geological Survey Scientific Investigations Report 2009-5167, 51 p. (http://pubs.usgs.gov/sir/2009/5167/)

Worksheet for MP-79.77MR2_STA0+44_PIPE_2YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.01588	ft/ft
Discharge	242.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	178.00
0+32	174.00
0+40	172.00
0+42	171.70
0+50	169.58
0+53	170.40
0+57	172.50
0+64	174.00
1+00	178.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 178.00)	(1+00, 178.00)	0.030

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	3.01	ft
Elevation Range	169.58 to 178.00 ft	
Flow Area	30.28	ft²
Wetted Perimeter	20.91	ft

Worksheet for MP-79.77MR2_STA0+44_PIPE_2YR

Results

Hydraulic Radius		1.45	ft
Top Width		19.89	ft
Normal Depth		3.01	ft
Critical Depth		3.18	ft
Critical Slope		0.01199	ft/ft
Velocity		7.99	ft/s
Velocity Head		0.99	ft
Specific Energy		4.00	ft
Froude Number		1.14	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	3.01	ft
Critical Depth	3.18	ft
Channel Slope	0.01588	ft/ft
Critical Slope	0.01199	ft/ft

Worksheet for MP-79.77MR2_STA0+25_BRIDGE_2YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.01588	ft/ft
Discharge	242.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	176.00
0+32	174.00
0+50	169.83
0+56	173.00
0+62	174.00
0+68	176.00
1+00	176.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 176.00)	(1+00, 176.00)	0.030

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	3.11	ft
Elevation Range	169.83 to 176.00 ft	
Flow Area	29.96	ft²
Wetted Perimeter	20.36	ft
Hydraulic Radius	1.47	ft
Top Width	19.25	ft

Worksheet for MP-79.77MR2_STA0+25_BRIDGE_2YR

Results

Normal Depth		3.11	ft
Critical Depth		3.29	ft
Critical Slope		0.01201	ft/ft
Velocity		8.08	ft/s
Velocity Head		1.01	ft
Specific Energy		4.13	ft
Froude Number		1.14	
Flow Type	Supercritical		

GVF Input Data

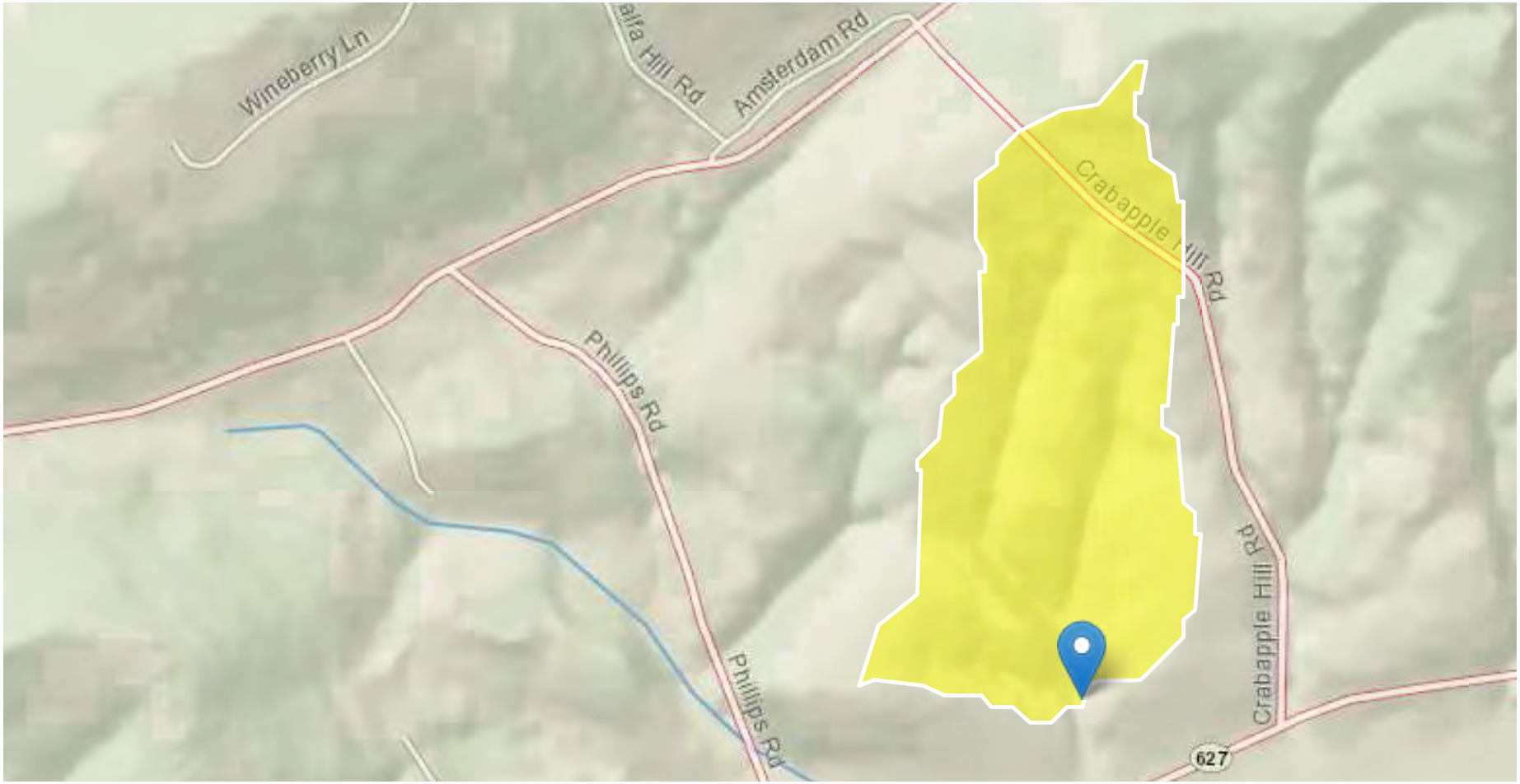
Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	3.11	ft
Critical Depth	3.29	ft
Channel Slope	0.01588	ft/ft
Critical Slope	0.01201	ft/ft

MP80.09R2

Region ID: NJ
Workspace ID: NJ20170804142210152000
Clicked Point (Latitude, Longitude): 40.57708, -75.15502
Time: 2017-08-04 14:23:13 -0400



Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	0.18	square miles
STORAGE	Percentage of area of storage (lakes ponds reservoirs wetlands)	0	percent
CSL10_85	Change in elevation divided by length between points 10 and 85 percent of distance along main channel to basin divide - main channel method not known	352	feet per mi
POPDENS	Basin Population Density	209	persons per square mile

Peak-Flow Statistics Parameters [100 Percent (0.183 square miles) Peak Unglaciated Piedmont Region 2009 5167]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.18	square miles	0.25	779
STORAGE	Percent Storage	0	percent	0.23	32
CSL10_85	Stream Slope 10 and 85 Method	352	feet per mi	4.31	191
POPDENS	Basin Population Density	209	persons per square mile	83	11084

Peak-Flow Statistics Disclaimers [100 Percent (0.183 square miles) Peak Unglaciated Piedmont Region 2009 5167]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors

Peak-Flow Statistics Flow Report [100 Percent (0.183 square miles) Peak Unglaciated Piedmont Region 2009 5167]

Statistic	Value	Unit
2 Year Peak Flood	89.3	ft^3/s
5 Year Peak Flood	163	ft^3/s
10 Year Peak Flood	227	ft^3/s
25 Year Peak Flood	323	ft^3/s
50 Year Peak Flood	407	ft^3/s
100 Year Peak Flood	501	ft^3/s
500 Year Peak Flood	756	ft^3/s

Peak-Flow Statistics Citations

Watson, K.M.,and Schopp, R.D.,2009, Methodology for estimation of flood magnitude and frequency for New Jersey streams, U.S. Geological Survey Scientific Investigations Report 2009-5167, 51 p. (http://pubs.usgs.gov/sir/2009/5167/)

Worksheet for MP-80.09R2 STA 0+44_2YR_PIPE

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.04800	ft/ft
Discharge	89.30	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	186.00
0+48	184.10
0+50	182.37
0+52	184.00
0+61	186.00
0+67	188.00
1+00	196.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 186.00)	(1+00, 196.00)	0.045

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	2.57	ft
Elevation Range	182.37 to 196.00 ft	
Flow Area	17.77	ft²
Wetted Perimeter	30.69	ft
Hydraulic Radius	0.58	ft
Top Width	29.34	ft

Worksheet for MP-80.09R2 STA 0+44_2YR_PIPE

Results

Normal Depth		2.57	ft
Critical Depth		2.64	ft
Critical Slope		0.03639	ft/ft
Velocity		5.03	ft/s
Velocity Head		0.39	ft
Specific Energy		2.96	ft
Froude Number		1.14	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	2.57	ft
Critical Depth	2.64	ft
Channel Slope	0.04800	ft/ft
Critical Slope	0.03639	ft/ft

Worksheet for MP-80.09R2 STA 0+18_2YR_BRIDGE

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.04800	ft/ft
Discharge	89.30	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	186.00
0+55	184.95
0+57	183.74
0+58	184.80
0+68	186.00
0+87	190.00
1+00	192.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 186.00)	(1+00, 192.00)	0.045

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	1.95	ft
Elevation Range	183.74 to 192.00 ft	
Flow Area	21.63	ft²
Wetted Perimeter	50.18	ft
Hydraulic Radius	0.43	ft
Top Width	49.30	ft

Worksheet for MP-80.09R2 STA 0+18_2YR_BRIDGE

Results

Normal Depth		1.95	ft
Critical Depth		1.98	ft
Critical Slope		0.03926	ft/ft
Velocity		4.13	ft/s
Velocity Head		0.26	ft
Specific Energy		2.21	ft
Froude Number		1.10	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.95	ft
Critical Depth	1.98	ft
Channel Slope	0.04800	ft/ft
Critical Slope	0.03926	ft/ft

MP-80.37R2

Region ID: NJ
Workspace ID: NJ20170804143311494000
Clicked Point (Latitude, Longitude): 40.57941, -75.15048
Time: 2017-08-04 14:33:59 -0400

Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	0.22	square miles
STORAGE	Percentage of area of storage (lakes ponds reservoirs wetlands)	1.1	percent
CSL10_85	Change in elevation divided by length between points 10 and 85 percent of distance along main channel to basin divide - main channel method not known	521	feet per mi
POPDENS	Basin Population Density	209	persons per square mile

Peak-Flow Statistics Parameters [100 Percent (0.216 square miles) Peak Unglaciated Piedmont Region 2009 5167]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.22	square miles	0.25	779
STORAGE	Percent Storage	1.1	percent	0.23	32
CSL10_85	Stream Slope 10 and 85 Method	521	feet per mi	4.31	191
POPDENS	Basin Population Density	209	persons per square mile	83	11084

Peak-Flow Statistics Disclaimers [100 Percent (0.216 square miles) Peak Unglaciated Piedmont Region 2009 5167]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors

Peak-Flow Statistics Flow Report [100 Percent (0.216 square miles) Peak Unglaciated Piedmont Region 2009 5167]

Statistic	Value	Unit
2 Year Peak Flood	110	ft^3/s
5 Year Peak Flood	197	ft^3/s
10 Year Peak Flood	269	ft^3/s
25 Year Peak Flood	378	ft^3/s
50 Year Peak Flood	470	ft^3/s
100 Year Peak Flood	574	ft^3/s
500 Year Peak Flood	848	ft^3/s

Peak-Flow Statistics Citations

Watson, K.M.,and Schopp, R.D.,2009, Methodology for estimation of flood magnitude and frequency for New Jersey streams, U.S. Geological Survey Scientific Investigations Report 2009-5167, 51 p. (http://pubs.usgs.gov/sir/2009/5167/)

Worksheet for MP-80.37R2 STA 1+25_2YR_PIPE

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.03300	ft/ft
Discharge	110.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	200.00
0+16	200.00
0+36	192.00
0+43	190.30
0+49	188.45
0+55	189.50
0+59	190.00
0+70	194.00
1+00	198.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 200.00)	(1+00, 198.00)	0.050

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	2.11	ft
Elevation Range	188.45 to 200.00 ft	
Flow Area	19.76	ft²
Wetted Perimeter	18.87	ft

Worksheet for MP-80.37R2 STA 1+25_2YR_PIPE

Results

Hydraulic Radius		1.05	ft
Top Width		18.34	ft
Normal Depth		2.11	ft
Critical Depth		2.06	ft
Critical Slope		0.03722	ft/ft
Velocity		5.57	ft/s
Velocity Head		0.48	ft
Specific Energy		2.59	ft
Froude Number		0.95	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	2.11	ft
Critical Depth	2.06	ft
Channel Slope	0.03300	ft/ft
Critical Slope	0.03722	ft/ft

Worksheet for MP-80.37R2_STA 0+99_2YR_BRIDGE

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.03300	ft/ft
Discharge	110.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	206.00
0+12	204.00
0+20	202.00
0+29	198.00
0+36	196.00
0+44	192.00
0+52	189.29
0+55	189.90
0+67	194.00
1+00	194.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 206.00)	(1+00, 194.00)	0.050

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	2.35	ft
Elevation Range	189.29 to 206.00 ft	
Flow Area	18.42	ft²

Worksheet for MP-80.37R2_STA 0+99_2YR_BRIDGE

Results

Wetted Perimeter	15.84	ft
Hydraulic Radius	1.16	ft
Top Width	15.12	ft
Normal Depth	2.35	ft
Critical Depth	2.30	ft
Critical Slope	0.03652	ft/ft
Velocity	5.97	ft/s
Velocity Head	0.55	ft
Specific Energy	2.90	ft
Froude Number	0.95	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	2.35	ft
Critical Depth	2.30	ft
Channel Slope	0.03300	ft/ft
Critical Slope	0.03652	ft/ft

MP 80.63R2

Region ID: NJ
Workspace ID: NJ20170804143622739000
Clicked Point (Latitude, Longitude): 40.57970, -75.14539
Time: 2017-08-04 14:37:17 -0400

Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	0.16	square miles
STORAGE	Percentage of area of storage (lakes ponds reservoirs wetlands)	0	percent
CSL10_85	Change in elevation divided by length between points 10 and 85 percent of distance along main channel to basin divide - main channel method not known	693	feet per mi
POPDENS	Basin Population Density	209	persons per square mile

Peak-Flow Statistics Parameters [Peak Unglaciated Piedmont Region 2009 5167]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.16	square miles	0.25	779
STORAGE	Percent Storage	0	percent	0.23	32
CSL10_85	Stream Slope 10 and 85 Method	693	feet per mi	4.31	191
POPDENS	Basin Population Density	209	persons per square mile	83	11084

Peak-Flow Statistics Disclaimers [Peak Unglaciated Piedmont Region 2009 5167]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors

Peak-Flow Statistics Flow Report [Peak Unglaciated Piedmont Region 2009 5167]

Statistic	Value	Unit
2 Year Peak Flood	96.9	ft^3/s
5 Year Peak Flood	178	ft^3/s
10 Year Peak Flood	248	ft^3/s
25 Year Peak Flood	354	ft^3/s
50 Year Peak Flood	447	ft^3/s
100 Year Peak Flood	553	ft^3/s
500 Year Peak Flood	838	ft^3/s

Peak-Flow Statistics Citations

Watson, K.M.,and Schopp, R.D.,2009, Methodology for estimation of flood magnitude and frequency for New Jersey streams, U.S. Geological Survey Scientific Investigations Report 2009-5167, 51 p. (http://pubs.usgs.gov/sir/2009/5167/)

Worksheet for M-80.63R2 STA 2+84_2YR_PIPE

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.06400	ft/ft
Discharge	96.90	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	228.00
0+08	222.00
0+14	218.00
0+15	217.30
0+19	214.70
0+23	213.25
0+28	214.40
0+29	214.70
0+55	216.00
0+74	218.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 228.00)	(0+74, 218.00)	0.030

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	1.63	ft
Elevation Range	213.25 to 228.00 ft	
Flow Area	9.96	ft²

Worksheet for M-80.63R2 STA 2+84_2YR_PIPE

Results

Wetted Perimeter		14.56	ft
Hydraulic Radius		0.68	ft
Top Width		14.05	ft
Normal Depth		1.63	ft
Critical Depth		2.11	ft
Critical Slope		0.01470	ft/ft
Velocity		9.73	ft/s
Velocity Head		1.47	ft
Specific Energy		3.10	ft
Froude Number		2.04	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.63	ft
Critical Depth	2.11	ft
Channel Slope	0.06400	ft/ft
Critical Slope	0.01470	ft/ft

Worksheet for M-80.63R2 STA 2+58_2YR_BRIDGE

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.04600	ft/ft
Discharge	96.90	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	236.00
0+16	223.00
0+17	222.00
0+20	220.00
0+25	218.00
0+30	216.00
0+32	215.40
0+36	214.53
0+43	216.60
0+45	217.80
0+75	218.00
0+87	220.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 236.00)	(0+87, 220.00)	0.030

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	1.63	ft

Worksheet for M-80.63R2 STA 2+58_2YR_BRIDGE

Results

Elevation Range	214.53 to 236.00 ft		
Flow Area		10.19	ft²
Wetted Perimeter		12.02	ft
Hydraulic Radius		0.85	ft
Top Width		11.54	ft
Normal Depth		1.63	ft
Critical Depth		2.09	ft
Critical Slope		0.01335	ft/ft
Velocity		9.51	ft/s
Velocity Head		1.41	ft
Specific Energy		3.04	ft
Froude Number		1.79	
Flow Type	Supercritical		

GVF Input Data

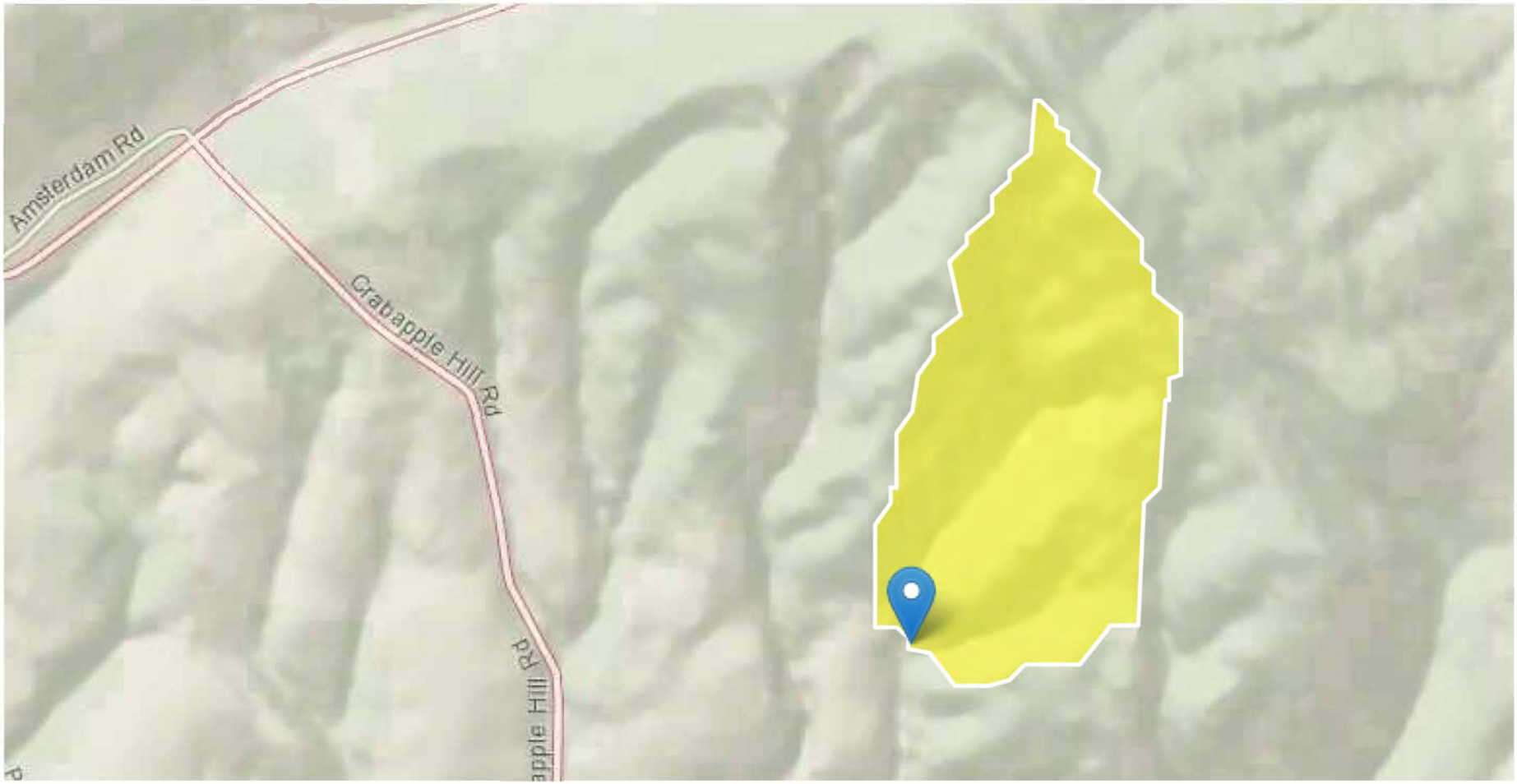
Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.63	ft
Critical Depth	2.09	ft
Channel Slope	0.04600	ft/ft
Critical Slope	0.01335	ft/ft

MP 80.78 R2

Region ID: NJ
Workspace ID: NJ20170804143959729000
Clicked Point (Latitude, Longitude): 40.57993, -75.14277
Time: 2017-08-04 14:40:45 -0400



Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	0.15	square miles
STORAGE	Percentage of area of storage (lakes ponds reservoirs wetlands)	0	percent
CSL10_85	Change in elevation divided by length between points 10 and 85 percent of distance along main channel to basin divide - main channel method not known	830	feet per mi
POPDENS	Basin Population Density	209	persons per square mile

Peak-Flow Statistics Parameters [Peak Unglaciated Piedmont Region 2009 5167]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.15	square miles	0.25	779
STORAGE	Percent Storage	0	percent	0.23	32
CSL10_85	Stream Slope 10 and 85 Method	830	feet per mi	4.31	191
POPDENS	Basin Population Density	209	persons per square mile	83	11084

Peak-Flow Statistics Disclaimers [Peak Unglaciated Piedmont Region 2009 5167]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors

Peak-Flow Statistics Flow Report [Peak Unglaciated Piedmont Region 2009 5167]

Statistic	Value	Unit
2 Year Peak Flood	96.5	ft^3/s
5 Year Peak Flood	178	ft^3/s
10 Year Peak Flood	248	ft^3/s
25 Year Peak Flood	354	ft^3/s
50 Year Peak Flood	448	ft^3/s
100 Year Peak Flood	554	ft^3/s
500 Year Peak Flood	841	ft^3/s

Peak-Flow Statistics Citations

Watson, K.M.,and Schopp, R.D.,2009, Methodology for estimation of flood magnitude and frequency for New Jersey streams, U.S. Geological Survey Scientific Investigations Report 2009-5167, 51 p. (http://pubs.usgs.gov/sir/2009/5167/)

Worksheet for MP-80.78R2_STA0+30_2YR_PIPE

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.09300	ft/ft
Discharge	96.50	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	246.00
0+18	236.00
0+24	234.00
0+31	232.00
0+48	231.20
0+49	230.64
0+55	232.00
0+81	240.00
1+00	246.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 246.00)	(1+00, 246.00)	0.050

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	1.50	ft
Elevation Range	230.64 to 246.00 ft	
Flow Area	15.01	ft²
Wetted Perimeter	25.14	ft

Worksheet for MP-80.78R2_STA0+30_2YR_PIPE

Results

Hydraulic Radius		0.60	ft
Top Width		24.74	ft
Normal Depth		1.50	ft
Critical Depth		1.68	ft
Critical Slope		0.04096	ft/ft
Velocity		6.43	ft/s
Velocity Head		0.64	ft
Specific Energy		2.14	ft
Froude Number		1.45	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.50	ft
Critical Depth	1.68	ft
Channel Slope	0.09300	ft/ft
Critical Slope	0.04096	ft/ft

Worksheet for MP-80.78R2_STA 0+04_2YR_BRIDGE

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.09300	ft/ft
Discharge	96.50	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	248.00
0+04	246.00
0+21	238.00
0+26	236.00
0+43	233.15
0+48	233.07
0+60	236.00
1+00	254.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 248.00)	(1+00, 254.00)	0.050

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	1.19	ft
Elevation Range	233.07 to 254.00 ft	
Flow Area	12.81	ft²
Wetted Perimeter	16.90	ft
Hydraulic Radius	0.76	ft

Worksheet for MP-80.78R2_STA 0+04_2YR_BRIDGE

Results

Top Width		16.66	ft
Normal Depth		1.19	ft
Critical Depth		1.47	ft
Critical Slope		0.03826	ft/ft
Velocity		7.53	ft/s
Velocity Head		0.88	ft
Specific Energy		2.08	ft
Froude Number		1.51	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.19	ft
Critical Depth	1.47	ft
Channel Slope	0.09300	ft/ft
Critical Slope	0.03826	ft/ft

MP-80.82R2

Region ID: NJ
Workspace ID: NJ20190520214957031000
Clicked Point (Latitude, Longitude): 40.57985, -75.14245
Time: 2019-05-20 17:50:11 -0400

Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	0.0356	square miles
STORAGE	Percentage of area of storage (lakes ponds reservoirs wetlands)	0	percent
CSL10_85	Change in elevation divided by length between points 10 and 85 percent of distance along main channel to basin divide - main channel method not known	877	feet per mi

Parameter Code	Parameter Description	Value	Unit
POPDENS	Basin Population Density	209	persons per square mile

Peak-Flow Statistics Parameters [Peak Unglaciated Piedmont Region 2009 5167]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.0356	square miles	0.25	779
STORAGE	Percent Storage	0	percent	0.23	32
CSL10_85	Stream Slope 10 and 85 Method	877	feet per mi	4.31	191
POPDENS	Basin Population Density	209	persons per square mile	83	11084

Peak-Flow Statistics Disclaimers [Peak Unglaciated Piedmont Region 2009 5167]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors

Peak-Flow Statistics Flow Report [Peak Unglaciated Piedmont Region 2009 5167]

Statistic	Value	Unit
2 Year Peak Flood	33.1	ft^3/s
5 Year Peak Flood	62	ft^3/s
10 Year Peak Flood	87.1	ft^3/s
25 Year Peak Flood	125	ft^3/s
50 Year Peak Flood	159	ft^3/s
100 Year Peak Flood	197	ft^3/s
500 Year Peak Flood	301	ft^3/s

Peak-Flow Statistics Citations

Worksheet for MP-80.82R2 STA 1+58_2YR_PIPE

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.17000	ft/ft
Discharge	33.10	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	296.00
0+02	294.00
0+29	284.00
0+37	280.00
0+44	278.00
0+48	276.20
0+50	275.63
0+51	275.55
0+70	280.00
0+79	284.00
0+95	290.00
1+00	296.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 296.00)	(1+00, 296.00)	0.050

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.91	ft

Worksheet for MP-80.82R2 STA 1+58_2YR_PIPE

Results

Elevation Range	275.55 to 296.00 ft		
Flow Area		4.19	ft²
Wetted Perimeter		8.08	ft
Hydraulic Radius		0.52	ft
Top Width		7.83	ft
Normal Depth		0.91	ft
Critical Depth		1.23	ft
Critical Slope		0.04289	ft/ft
Velocity		7.91	ft/s
Velocity Head		0.97	ft
Specific Energy		1.89	ft
Froude Number		1.91	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.91	ft
Critical Depth	1.23	ft
Channel Slope	0.17000	ft/ft
Critical Slope	0.04289	ft/ft

Worksheet for MP-80.82R2 STA 1+16_2YR_BRIDGE

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.17000	ft/ft
Discharge	33.10	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	306.00
0+02	304.00
0+16	296.00
0+36	286.00
0+43	284.00
0+50	282.46
0+53	283.25
0+64	286.00
0+96	298.00
1+00	300.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 306.00)	(1+00, 300.00)	0.050

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	1.01	ft
Elevation Range	282.46 to 306.00 ft	
Flow Area	4.35	ft²

Worksheet for MP-80.82R2 STA 1+16_2YR_BRIDGE

Results

Wetted Perimeter		8.90	ft
Hydraulic Radius		0.49	ft
Top Width		8.67	ft
Normal Depth		1.01	ft
Critical Depth		1.30	ft
Critical Slope		0.04365	ft/ft
Velocity		7.60	ft/s
Velocity Head		0.90	ft
Specific Energy		1.91	ft
Froude Number		1.89	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.01	ft
Critical Depth	1.30	ft
Channel Slope	0.17000	ft/ft
Critical Slope	0.04365	ft/ft

MP 81.16R2

Region ID: NJ
Workspace ID: NJ20170804145125258000
Clicked Point (Latitude, Longitude): 40.57972, -75.13689
Time: 2017-08-04 14:52:52 -0400

Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	0.0382	square miles
STORAGE	Percentage of area of storage (lakes ponds reservoirs wetlands)	0	percent
CSL10_85	Change in elevation divided by length between points 10 and 85 percent of distance along main channel to basin divide - main channel method not known	814	feet per mi
POPDENS	Basin Population Density	209	persons per square mile

Peak-Flow Statistics Parameters [Peak Unglaciated Piedmont Region 2009 5167]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.0382	square miles	0.25	779
STORAGE	Percent Storage	0	percent	0.23	32
CSL10_85	Stream Slope 10 and 85 Method	814	feet per mi	4.31	191
POPDENS	Basin Population Density	209	persons per square mile	83	11084

Peak-Flow Statistics Disclaimers [Peak Unglaciated Piedmont Region 2009 5167]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors

Peak-Flow Statistics Flow Report [Peak Unglaciated Piedmont Region 2009 5167]

Statistic	Value	Unit
2 Year Peak Flood	34.3	ft^3/s
5 Year Peak Flood	64.1	ft^3/s
10 Year Peak Flood	90	ft^3/s
25 Year Peak Flood	130	ft^3/s
50 Year Peak Flood	164	ft^3/s
100 Year Peak Flood	204	ft^3/s
500 Year Peak Flood	310	ft^3/s

Peak-Flow Statistics Citations

Watson, K.M.,and Schopp, R.D.,2009, Methodology for estimation of flood magnitude and frequency for New Jersey streams, U.S. Geological Survey Scientific Investigations Report 2009-5167, 51 p. (http://pubs.usgs.gov/sir/2009/5167/)

Worksheet for MP-81.16R2 STA 1+53_2YR_PIPE

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.19000	ft/ft
Discharge	34.30	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	400.00
0+03	400.00
0+12	398.00
0+18	396.00
0+50	388.70
0+58	390.00
0+76	396.00
0+94	400.00
1+00	402.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 400.00)	(1+00, 402.00)	0.050

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.91	ft
Elevation Range	388.70 to 402.00 ft	
Flow Area	4.52	ft²
Wetted Perimeter	10.07	ft

Worksheet for MP-81.16R2 STA 1+53_2YR_PIPE

Results

Hydraulic Radius		0.45	ft
Top Width		9.90	ft
Normal Depth		0.91	ft
Critical Depth		1.20	ft
Critical Slope		0.04420	ft/ft
Velocity		7.59	ft/s
Velocity Head		0.90	ft
Specific Energy		1.81	ft
Froude Number		1.98	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth		0.00	ft
Length		0.00	ft
Number Of Steps		0	

GVF Output Data

Upstream Depth		0.00	ft
Profile Description			
Profile Headloss		0.00	ft
Downstream Velocity		Infinity	ft/s
Upstream Velocity		Infinity	ft/s
Normal Depth		0.91	ft
Critical Depth		1.20	ft
Channel Slope		0.19000	ft/ft
Critical Slope		0.04420	ft/ft

Worksheet for MP-81.16R2 STA 1+97_2YR_BRIDGE

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.19000	ft/ft
Discharge	34.30	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	400.00
0+04	398.00
0+14	394.00
0+43	384.00
0+50	382.82
0+56	384.20
0+78	392.00
0+93	396.00
1+00	400.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 400.00)	(1+00, 400.00)	0.050

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.94	ft
Elevation Range	382.82 to 400.00 ft	
Flow Area	4.45	ft²
Wetted Perimeter	9.71	ft

Worksheet for MP-81.16R2 STA 1+97_2YR_BRIDGE

Results

Hydraulic Radius		0.46	ft
Top Width		9.52	ft
Normal Depth		0.94	ft
Critical Depth		1.23	ft
Critical Slope		0.04385	ft/ft
Velocity		7.70	ft/s
Velocity Head		0.92	ft
Specific Energy		1.86	ft
Froude Number		1.99	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.94	ft
Critical Depth	1.23	ft
Channel Slope	0.19000	ft/ft
Critical Slope	0.04385	ft/ft

MP-81.49R2

Region ID: NJ
Workspace ID: NJ20180209150754589000
Clicked Point (Latitude, Longitude): 40.58200, -75.13149
Time: 2018-02-09 10:08:08 -0500

Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	0.0695	square miles
STORAGE	Percentage of area of storage (lakes ponds reservoirs wetlands)	0	percent
CSL10_85	Change in elevation divided by length between points 10 and 85 percent of distance along main channel to basin divide - main channel method not known	593	feet per mi
POPDENS	Basin Population Density	209	persons per square mile

Peak-Flow Statistics Parameters [Peak Unglaciated Piedmont Region 2009 5167]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.0695	square miles	0.25	779
STORAGE	Percent Storage	0	percent	0.23	32
CSL10_85	Stream Slope 10 and 85 Method	593	feet per mi	4.31	191
POPDENS	Basin Population Density	209	persons per square mile	83	11084

Peak-Flow Statistics Disclaimers [Peak Unglaciated Piedmont Region 2009 5167]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors

Peak-Flow Statistics Flow Report [Peak Unglaciated Piedmont Region 2009 5167]

Statistic	Value	Unit
2 Year Peak Flood	49.7	ft^3/s
5 Year Peak Flood	92.2	ft^3/s
10 Year Peak Flood	129	ft^3/s
25 Year Peak Flood	185	ft^3/s
50 Year Peak Flood	234	ft^3/s
100 Year Peak Flood	289	ft^3/s
500 Year Peak Flood	438	ft^3/s

Peak-Flow Statistics Citations

Watson, K.M.,and Schopp, R.D.,2009, Methodology for estimation of flood magnitude and frequency for New Jersey streams, U.S. Geological Survey Scientific Investigations Report 2009-5167, 51 p. (http://pubs.usgs.gov/sir/2009/5167/)

Worksheet for MP-81.49R2_STA1+99_PIPE-2YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.12600	ft/ft
Discharge	49.70	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	382.00
0+15	380.00
0+24	380.08
0+25	379.30
0+27	380.00
0+45	380.00
0+60	382.00

Roughness Segment Definitions

Start Station & Elevation	End Station & Elevation	Roughness Coefficient
(0+00, 382.00)	(0+60, 382.00)	0.050

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	1.01	ft
Elevation Range	379.30 to 382.00 ft	
Flow Area	10.48	ft²
Wetted Perimeter	34.73	ft
Hydraulic Radius	0.30	ft
Top Width	34.28	ft

Worksheet for MP-81.49R2_STA1+99_PIPE-2YR

Results

Normal Depth	1.01	ft
Critical Depth	1.11	ft
Critical Slope	0.05068	ft/ft
Velocity	4.74	ft/s
Velocity Head	0.35	ft
Specific Energy	1.36	ft
Froude Number	1.51	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.01	ft
Critical Depth	1.11	ft
Channel Slope	0.12600	ft/ft
Critical Slope	0.05068	ft/ft

Worksheet for MP-81.49R2_STA2+40_BRIDGE-2YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.12600	ft/ft
Discharge	49.70	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+19	374.48
0+29	374.72
0+34	374.48
0+37	374.72
0+45	374.48

Roughness Segment Definitions

Start Station & Elevation	End Station & Elevation	Roughness Coefficient
(0+19, 374.48)	(0+45, 374.48)	0.050

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.49	ft
Elevation Range	374.48 to 374.72 ft	
Flow Area	9.42	ft²
Wetted Perimeter	26.64	ft
Hydraulic Radius	0.35	ft
Top Width	25.64	ft
Normal Depth	0.49	ft
Critical Depth	0.61	ft

Worksheet for MP-81.49R2_STA2+40_BRIDGE-2YR

Results

Critical Slope		0.04925	ft/ft
Velocity		5.28	ft/s
Velocity Head		0.43	ft
Specific Energy		0.92	ft
Froude Number		1.53	
Flow Type	Supercritical		

GVF Input Data

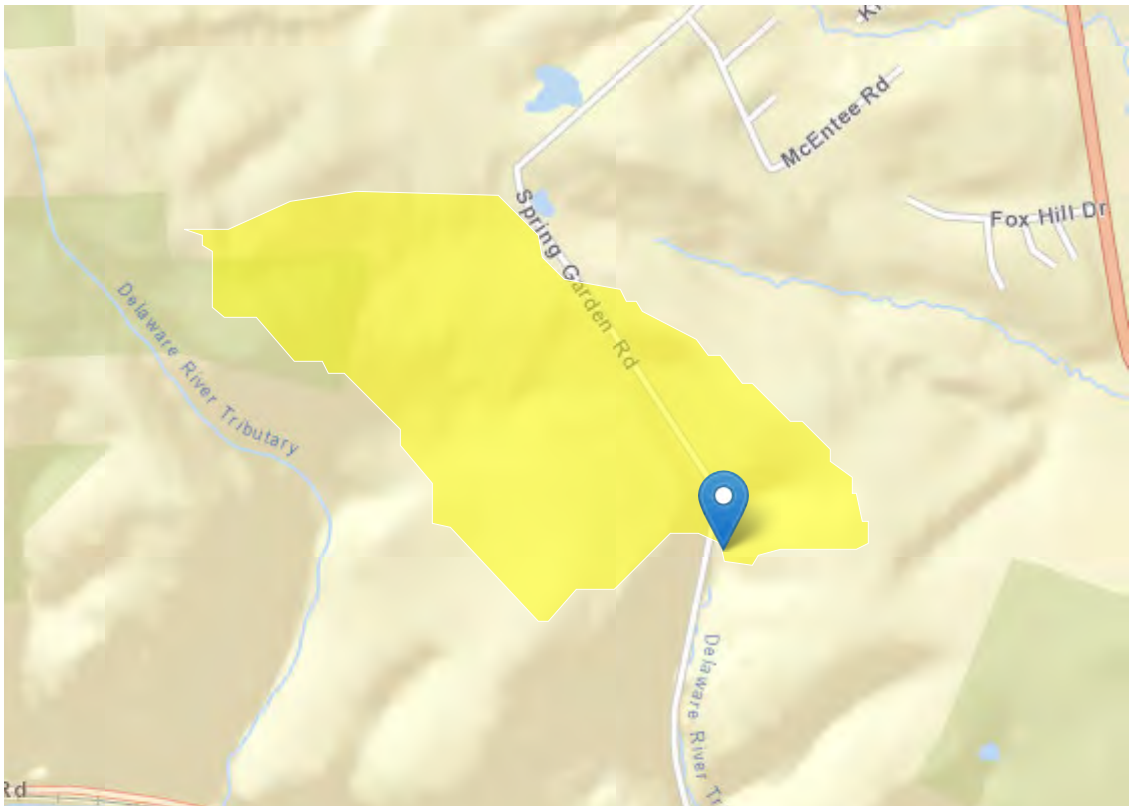
Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.49	ft
Critical Depth	0.61	ft
Channel Slope	0.12600	ft/ft
Critical Slope	0.04925	ft/ft

MP 81.66

Region ID: NJ
Workspace ID: NJ20170814170351599000
Clicked Point (Latitude, Longitude): 40.58065, -75.12228
Time: 2017-08-14 17:04:33 -0400



Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	0.18	square miles
STORAGE	Percentage of area of storage (lakes ponds reservoirs wetlands)	2.54	percent
CSL10_85	Change in elevation divided by length between points 10 and 85 percent of distance along main channel to basin divide - main channel method not known	468	feet per mi
POPDENS	Basin Population Density	209	persons per square mile

Peak-Flow Statistics Parameters [Peak Unglaciated Piedmont Region 2009 5167]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.18	square miles	0.25	779
STORAGE	Percent Storage	2.54	percent	0.23	32
CSL10_85	Stream Slope 10 and 85 Method	468	feet per mi	4.31	191
POPDENS	Basin Population Density	209	persons per square mile	83	11084

Peak-Flow Statistics Disclaimers [Peak Unglaciated Piedmont Region 2009 5167]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors

Peak-Flow Statistics Flow Report [Peak Unglaciated Piedmont Region 2009 5167]

Statistic	Value	Unit
2 Year Peak Flood	89.6	ft^3/s
5 Year Peak Flood	158	ft^3/s
10 Year Peak Flood	214	ft^3/s
25 Year Peak Flood	297	ft^3/s
50 Year Peak Flood	366	ft^3/s
100 Year Peak Flood	444	ft^3/s
500 Year Peak Flood	644	ft^3/s

Peak-Flow Statistics Citations

Watson, K.M.,and Schopp, R.D.,2009, Methodology for estimation of flood magnitude and frequency for New Jersey streams, U.S. Geological Survey Scientific Investigations Report 2009-5167, 51 p. (http://pubs.usgs.gov/sir/2009/5167/)

Worksheet for MP-81.66_STA 1+86_PIPE_2YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.02700	ft/ft
Discharge	89.60	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	278.00
0+27	276.00
0+35	274.00
0+41	274.10
0+50	270.31
0+53	270.70
0+64	273.45
1+00	274.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 278.00)	(1+00, 274.00)	0.050

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	2.13	ft
Elevation Range	270.31 to 278.00 ft	
Flow Area	17.18	ft²
Wetted Perimeter	15.57	ft
Hydraulic Radius	1.10	ft

Worksheet for MP-81.66_STA 1+86_PIPE_2YR

Results

Top Width		14.89	ft
Normal Depth		2.13	ft
Critical Depth		1.99	ft
Critical Slope		0.03765	ft/ft
Velocity		5.21	ft/s
Velocity Head		0.42	ft
Specific Energy		2.55	ft
Froude Number		0.86	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	2.13	ft
Critical Depth	1.99	ft
Channel Slope	0.02700	ft/ft
Critical Slope	0.03765	ft/ft

Worksheet for MP-81.66_STA1+61_BRIDGE_2YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.02700	ft/ft
Discharge	89.60	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	278.00
0+27	276.00
0+50	271.03
0+61	274.00
0+93	276.00
1+00	276.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 278.00)	(1+00, 276.00)	0.050

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	2.08	ft
Elevation Range	271.03 to 278.00 ft	
Flow Area	18.21	ft²
Wetted Perimeter	18.01	ft
Hydraulic Radius	1.01	ft
Top Width	17.52	ft
Normal Depth	2.08	ft

Worksheet for MP-81.66_STA1+61_BRIDGE_2YR

Results

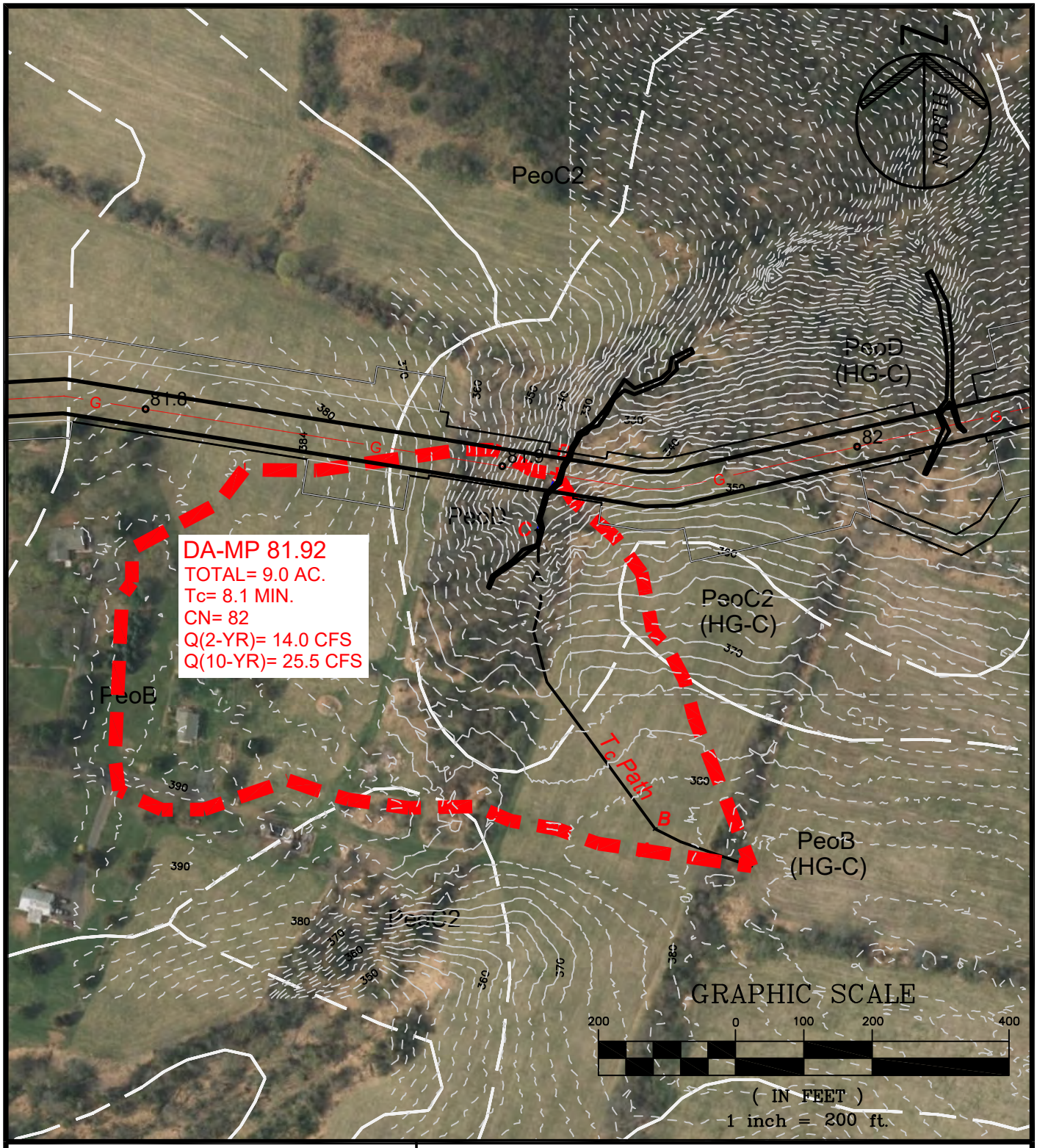
Critical Depth	1.95	ft
Critical Slope	0.03813	ft/ft
Velocity	4.92	ft/s
Velocity Head	0.38	ft
Specific Energy	2.46	ft
Froude Number	0.85	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	2.08	ft
Critical Depth	1.95	ft
Channel Slope	0.02700	ft/ft
Critical Slope	0.03813	ft/ft



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CERTIFICATE OF AUTHORIZATION NO. 24GA28032700

PROJECT TITLE

PENNEAST PIPELINE

HUNTERDON AND MERCER COUNTY, NJ

SHEET TITLE

STREAM CROSSING DRAINAGE AREA MP 81.92

PROJ. NO.: 05516.0001	DRN. BY: JPS	SCALE: 1"=200'
DATE: 05/23/19	CK'D BY: WS	

FILE NAME: P:\05516\0001\DWGs\CADC-Civil\Plotdwgs\Drainage Area Maps\05516\0001-Stream_DA_MP78.3-84.4-WAL.dwg\MP-81.92 LAST EDIT: 06/07/2019 - 02:00:02 PM LOGIN: jmcgowan@

Worksheet 2: Runoff curve number and runoff (Approximated)

Project	By	Date
PennEast	JPS	26-Feb-18
Location	**Checked**	**Date**
Hunterdon County, NJ		

Check one: ☐ Present ☒ Developed — MP 81.9

1. Runoff curve number

Soil name and hydrologic group (appendix A)	Cover Description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN[1] Table 2-2	CN[1] Figure 2-3	CN[1] Figure 2-4	Area (X / acres / mi² / %)	Product of CN x Area
Type C	Farmstead, Good Condition	82			9.00	738.00
				Totals ➡	9.00	738.00

1. Use only one CN source per line

CN (weighted) = tot.prod. / tot. area = 738.00 / 9.00 = 82.0 ; Use CN ➡ **82**

2. Runoff

		Storm #1	Storm #2	Storm #3
Frequency……	yr			
Rainfall, P (24-hour)…….	in			
Runoff, Q……	in			

Use P and CN with table 2-1, figure 2-1, or equation 2-3 abd 2-4

PSS&	PROJECT: PennEast	JOB NO. 5516.0001	
		SHEET	DATE:2/12/2018
		BY:	JPS
	SUBJECT: Tc Calculations	CHK'D	

Time of Concentration calculations with the application of the SCS TR-55 methodology.

Watershed or Subarea Designation: DA 81.9

Area 9.0 AC

SHEET FLOW

Segment ID		A-B				
Surface Description (Table 3-1)		CULTIVATED				
Manning's Coefficient, n (Table 3-1)		0.060				
Flow Length, L (total <= 150)	(ft)	150				
Two Year Rainfall, P	(in)	3.4				
Land Slope, s	(ft/ft)	0.020				
Computed Tt = 0.007 (nL)^0.8 / P^0.5*s^0.4	(hrs)	0.106				0.106

SHALLOW CONCENTRATED FLOW

Segment ID		B-C				
Surface Description (paved or unpaved)		UNPAVED				
Flow Length, L	(ft)	379				
Watercourse slope, s	(ft/ft)	0.087				
Average Velocity, V (Figure 3-1)	(ft/s)	4.0				
Computed Tt = L / 3600V	(hrs)	0.026				0.026

CHANNEL FLOW

Segment ID		C-D				
Cross sectional Area, a	(sf)	1.47				
Wetted Perimeter, Pw	(ft)	8.13				
Hydraulic Radius, r =a/Pw	(ft)	0.181				
Channel Slope (ft/ft)	(ft/ft)	0.494				
Manning's Roughness Coefficient, n		0.040				
Velocity, V = 1.49r^(2/3)s^0.5 / n	(ft/s)	8.37				
Flow Length, L	(ft)	85				
Computed Tt = L / 3600V	(hrs)	0.003				0.003

Watershed or subarea Tc	0.135	hrs.
	8.1	min.

Use minimum Tc of 10 minutes

Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 05 / 23 / 2019

Hyd. No. 6

DA 81.9

Hydrograph type	= SCS Runoff	Peak discharge	= 12.75 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.20 hrs
Time interval	= 6 min	Hyd. volume	= 48,591 cuft
Drainage area	= 9.000 ac	Curve number	= 82.000*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 10.0 min
Total precip.	= 3.26 in	Distribution	= Custom
Storm duration	= C:\Users\IKuzmina\AppData\Local\Autodesk\C3D 2019\enu\HHApps\Hydrograp	Shape factor	= 484

* Composite (Area/CN) = [(9.000 x 82)] / 9.000

Hydrograph Discharge Table

(Printed values >= 1.00% of Qp.)

Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)
10.10	0.141	11.90	3.333	13.70	1.101	15.50	0.575
10.20	0.159	12.00	5.392	13.80	1.038	15.60	0.568
10.30	0.178	12.10	9.882	13.90	0.997	15.70	0.560
10.40	0.198	12.20	12.75	14.00	0.969	15.80	0.551
10.50	0.219	12.30	10.65	14.10	0.939	15.90	0.544
10.60	0.246	12.40	7.598	14.20	0.910	16.00	0.536
10.70	0.283	12.50	4.870	14.30	0.881	16.10	0.528
10.80	0.331	12.60	3.908	14.40	0.851	16.20	0.520
10.90	0.387	12.70	3.107	14.50	0.821	16.30	0.512
11.00	0.449	12.80	2.626	14.60	0.791	16.40	0.504
11.10	0.524	12.90	2.287	14.70	0.760	16.50	0.495
11.20	0.622	13.00	2.093	14.80	0.730	16.60	0.487
11.30	0.741	13.10	1.888	14.90	0.699	16.70	0.480
11.40	0.878	13.20	1.701	15.00	0.668	16.80	0.471
11.50	1.024	13.30	1.550	15.10	0.638	16.90	0.463
11.60	1.307	13.40	1.426	15.20	0.611	17.00	0.455
11.70	1.751	13.50	1.313	15.30	0.594	17.10	0.447
11.80	2.330	13.60	1.199	15.40	0.583	17.20	0.439

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Worksheet for M-81.92 STA 2+10_2YR_PIPE

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.08100	ft/ft
Discharge	14.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	342.00
0+17	338.00
0+28	336.00
0+48	333.10
0+50	332.61
0+52	333.20
0+94	338.00
1+00	342.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 342.00)	(1+00, 342.00)	0.030

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.73	ft
Elevation Range	332.61 to 342.00 ft	
Flow Area	2.20	ft²
Wetted Perimeter	7.21	ft
Hydraulic Radius	0.30	ft

Worksheet for M-81.92 STA 2+10_2YR_PIPE

Results

Top Width		7.05	ft
Normal Depth		0.73	ft
Critical Depth		0.94	ft
Critical Slope		0.01843	ft/ft
Velocity		6.38	ft/s
Velocity Head		0.63	ft
Specific Energy		1.36	ft
Froude Number		2.01	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.73	ft
Critical Depth	0.94	ft
Channel Slope	0.08100	ft/ft
Critical Slope	0.01843	ft/ft

Worksheet for MP-81.92_STA2+37_BRIDGE_2YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.07700	ft/ft
Discharge	14.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	342.00
0+15	338.00
0+24	336.00
0+46	332.00
0+48	330.65
0+50	330.42
0+52	331.25
0+56	332.00
0+78	334.00
0+93	336.00
1+00	340.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 342.00)	(1+00, 340.00)	0.030

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.66	ft
Elevation Range	330.42 to 342.00 ft	

Worksheet for MP-81.92_STA2+37_BRIDGE_2YR

Results

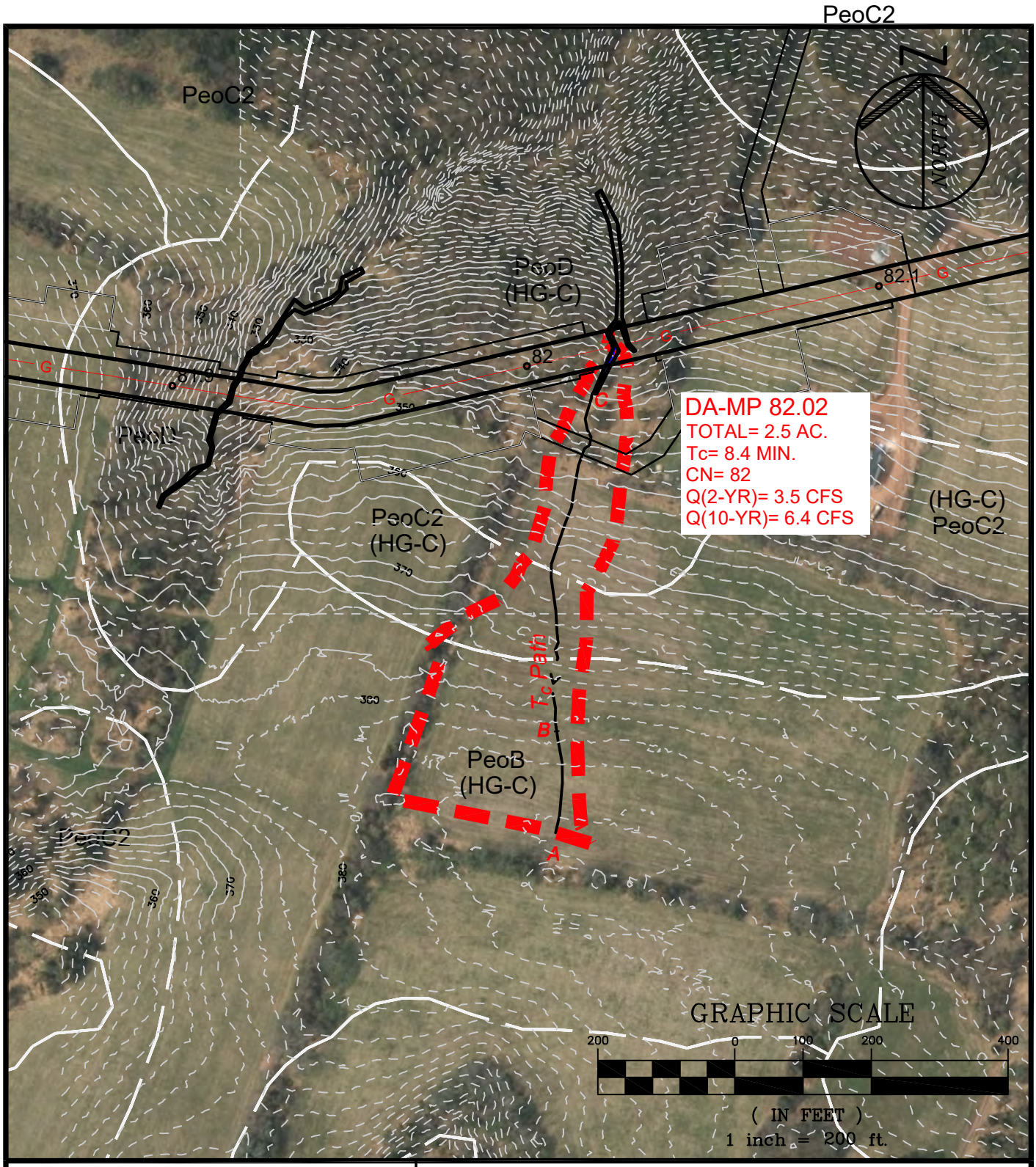
Flow Area	1.91	ft²
Wetted Perimeter	4.91	ft
Hydraulic Radius	0.39	ft
Top Width	4.66	ft
Normal Depth	0.66	ft
Critical Depth	0.92	ft
Critical Slope	0.01727	ft/ft
Velocity	7.33	ft/s
Velocity Head	0.83	ft
Specific Energy	1.49	ft
Froude Number	2.02	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.66	ft
Critical Depth	0.92	ft
Channel Slope	0.07700	ft/ft
Critical Slope	0.01727	ft/ft



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CERTIFICATE OF AUTHORIZATION NO. 24GA28032700

PROJECT TITLE

PENNEAST PIPELINE

HUNTERDON AND MERCER COUNTY, NJ

SHEET TITLE

STREAM CROSSING DRAINAGE AREA MP 82.02

PROJ. NO.: 05516.0001	DRN. BY: JPS	SCALE: 1"=200'
DATE: 05/23/19	CK'D BY: WS	

FILE NAME: P:\05516\0001\DWGs\CADC-Civil\Plotdwgs\Drainage Area Maps\055160001-Stream_DA_MP78.3-84.4-WAL.dwg\MP 82.02 LAST EDIT: 06/07/2019 - 02:01:48 PM LOGIN: jmcgowan@

Worksheet 2: Runoff curve number and runoff (Approximated)

Project	By	Date
PennEast	JM	22-May-19
Location	**Checked**	**Date**
Hunterdon County, NJ		

Check one: ☐ Present ☒ Developed | MP 87.89

1. Runoff curve number

Soil name and hydrologic group (appendix A)	Cover Description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN[1] Table 2-2	CN[1] Figure 2-3	CN[1] Figure 2-4	Area ☒ acres / ☐ mi² / ☐ %	Product of CN x Area
Type C	Farmstead	82			2.50	205.00
				Totals ➡	2.50	205.00

1. Use only one CN source per line

CN (weighted) $= \frac{\text{tot.prod.}}{\text{tot. area}} = \frac{205.00}{2.50} = 82.0$; Use CN ➡ **82**

2. Runoff

		Storm #1	Storm #2	Storm #3
Frequency……	yr			
Rainfall, P (24-hour)…….	in			
Runoff, Q……	in			

Use P and CN with table 2-1, figure 2-1, or equation 2-3 abd 2-4

PSS &	PROJECT: PennEast	JOB NO. 5516.0001	
		SHEET	DATE:2/12/2018
		BY:	JPS
	SUBJECT: Tc Calculations	CHK'D	

Time of Concentration calculations with the application of the SCS TR-55 methodology.

Watershed or Subarea Designation: DA 82.02

Area 2.5 AC

SHEET FLOW

Segment ID		A-B				
Surface Description (Table 3-1)		CULTIVATED				
Manning's Coefficient, n (Table 3-1)		0.060				
Flow Length, L (total <= 150)	(ft)	150				
Two Year Rainfall, P	(in)	3.4				
Land Slope, s	(ft/ft)	0.022				
Computed Tt = 0.007 (nL)^0.8 / P^0.5*s^0.4	(hrs)	0.102				0.102

SHALLOW CONCENTRATED FLOW

Segment ID		B-C				
Surface Description (paved or unpaved)		UNPAVED				
Flow Length, L	(ft)	512				
Watercourse slope, s	(ft/ft)	0.080				
Average Velocity, V (Figure 3-1)	(ft/s)	4.0				
Computed Tt = L / 3600V	(hrs)	0.036				0.036

CHANNEL FLOW

Segment ID		C-D				
Cross sectional Area, a	(sf)	3.00				
Wetted Perimeter, Pw	(ft)	4.80				
Hydraulic Radius, r =a/Pw	(ft)	0.625				
Channel Slope (ft/ft)	(ft/ft)	0.130				
Manning's Roughness Coefficient, n		0.040				
Velocity, V = 1.49r^(2/3)s^0.5 / n	(ft/s)	9.82				
Flow Length, L	(ft)	79				
Computed Tt = L / 3600V	(hrs)	0.002				0.002

Watershed or subarea Tc	0.139	hrs.
	8.4	min.

Use minimum Tc of 10 minutes

Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Wednesday, 02 / 20 / 2019

Hyd. No. 42

DA 82.0-1

Hydrograph type	= SCS Runoff	Peak discharge	= 3.542 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.20 hrs
Time interval	= 6 min	Hyd. volume	= 13,497 cuft
Drainage area	= 2.500 ac	Curve number	= 82.000
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 10.0 min
Total precip.	= 3.26 in	Distribution	= Custom
Storm duration	= C:\Users\IKuzmina\AppData\Local\Autodesk\C3D2019\enu\HHApps\Hydrograp		

Hydrograph Discharge Table

(Printed values >= 1.00% of Qp.)

Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)
10.10	0.039	11.90	0.926	13.70	0.306	15.50	0.160
10.20	0.044	12.00	1.498	13.80	0.288	15.60	0.158
10.30	0.049	12.10	2.745	13.90	0.277	15.70	0.156
10.40	0.055	12.20	3.542	14.00	0.269	15.80	0.153
10.50	0.061	12.30	2.958	14.10	0.261	15.90	0.151
10.60	0.068	12.40	2.110	14.20	0.253	16.00	0.149
10.70	0.079	12.50	1.353	14.30	0.245	16.10	0.147
10.80	0.092	12.60	1.086	14.40	0.236	16.20	0.145
10.90	0.107	12.70	0.863	14.50	0.228	16.30	0.142
11.00	0.125	12.80	0.730	14.60	0.220	16.40	0.140
11.10	0.146	12.90	0.635	14.70	0.211	16.50	0.138
11.20	0.173	13.00	0.581	14.80	0.203	16.60	0.135
11.30	0.206	13.10	0.525	14.90	0.194	16.70	0.133
11.40	0.244	13.20	0.472	15.00	0.186	16.80	0.131
11.50	0.285	13.30	0.431	15.10	0.177	16.90	0.129
11.60	0.363	13.40	0.396	15.20	0.170	17.00	0.126
11.70	0.486	13.50	0.365	15.30	0.165	17.10	0.124
11.80	0.647	13.60	0.333	15.40	0.162	17.20	0.122

Continues on next page...

Worksheet for M-82.02 STA 0+77_2YR_PIPE

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.09800	ft/ft
Discharge	3.50	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	336.00
0+45	330.00
0+47	329.40
0+50	328.51
0+59	328.81

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 336.00)	(0+59, 328.81)	0.045

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.27	ft
Elevation Range	328.51 to 336.00 ft	
Flow Area	1.28	ft²
Wetted Perimeter	9.42	ft
Hydraulic Radius	0.14	ft
Top Width	9.38	ft
Normal Depth	0.27	ft
Critical Depth	0.30	ft

Worksheet for M-82.02 STA 0+77_2YR_PIPE

Results

Critical Slope		0.05554	ft/ft
Velocity		2.73	ft/s
Velocity Head		0.12	ft
Specific Energy		0.39	ft
Froude Number		1.30	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.27	ft
Critical Depth	0.30	ft
Channel Slope	0.09800	ft/ft
Critical Slope	0.05554	ft/ft

Worksheet for MP-82.02_STA0+97_BRIDGE_2YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.13000	ft/ft
Discharge	3.50	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	334.00
0+20	331.90
0+48	327.90
0+50	326.72
0+54	327.10

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 334.00)	(0+54, 327.10)	0.045

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.38	ft
Elevation Range	326.72 to 334.00 ft	
Flow Area	0.90	ft²
Wetted Perimeter	4.83	ft
Hydraulic Radius	0.19	ft
Top Width	4.71	ft
Normal Depth	0.38	ft
Critical Depth	0.45	ft

Worksheet for MP-82.02_STA0+97_BRIDGE_2YR

Results

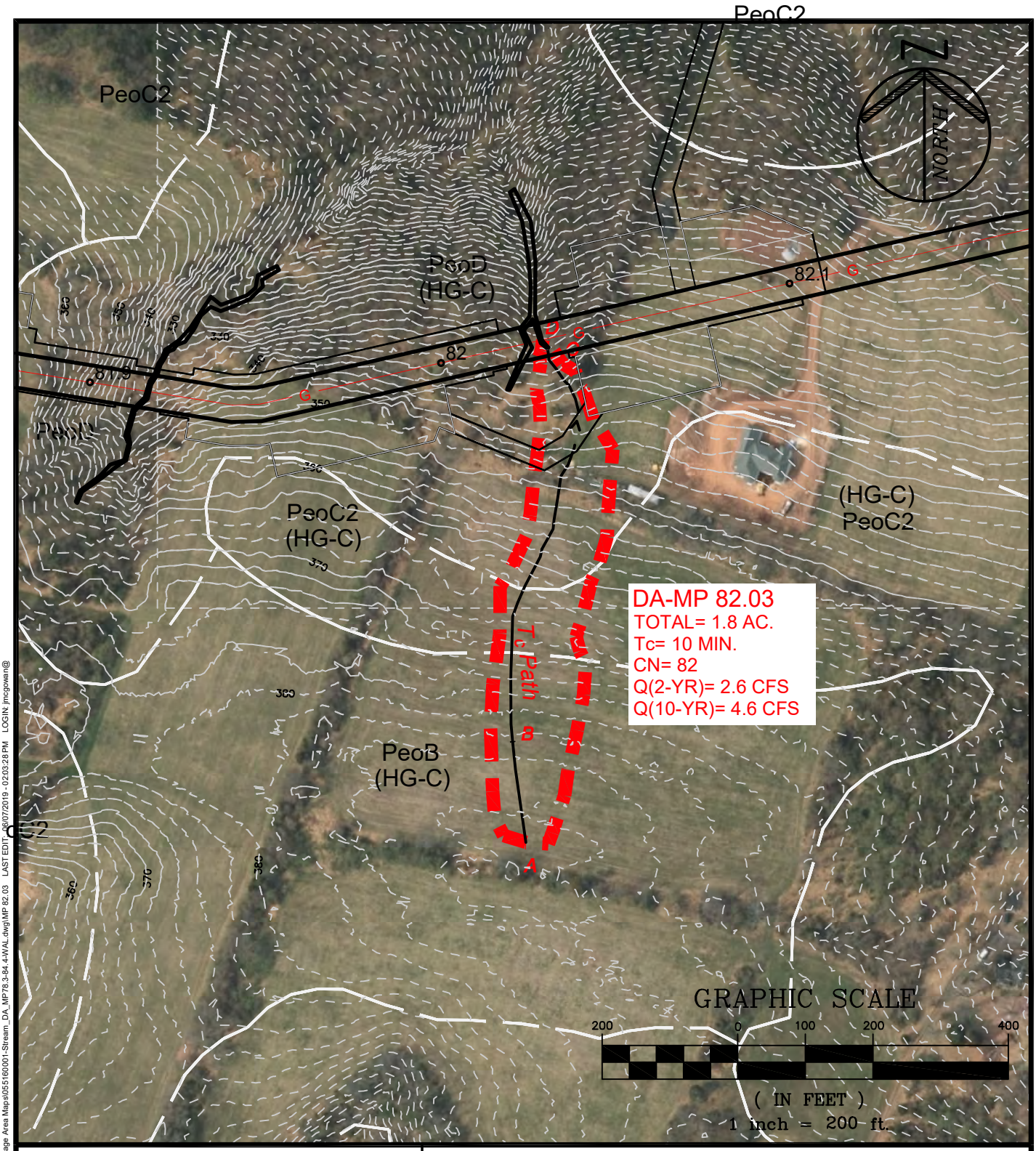
Critical Slope		0.04922	ft/ft
Velocity		3.88	ft/s
Velocity Head		0.23	ft
Specific Energy		0.62	ft
Froude Number		1.56	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.38	ft
Critical Depth	0.45	ft
Channel Slope	0.13000	ft/ft
Critical Slope	0.04922	ft/ft



PAULUS, SOKOLOWSKI AND SARTOR, LLC.

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CERTIFICATE OF AUTHORIZATION NO. 24GA28032700

PROJECT TITLE

PENNEAST PIPELINE

HUNTERDON AND MERCER COUNTY, NJ

SHEET TITLE

STREAM CROSSING DRAINAGE AREA MP 82.03

PROJ. NO.:	05516.0001	DRN. BY:	JPS	SCALE:	1"=200'
DATE:	05/23/19	CK'D BY:	WS		

FILE NAME: P:\05516\0001\DWGs\CADC-Civil\Plotdwgs\Drainage Area Maps\055160001-Stream_DA_MP78.3-84.4-WAL.dwg\MP 82.03 LAST EDIT: 06/07/2019 - 02:03:28 PM LOGIN: jmcgowan@

PSS &	PROJECT: PennEast	JOB NO. 5516.0001	
		SHEET	DATE:2/12/2018
		BY:	JPS
	SUBJECT: Tc Calculations	CHK'D	

Time of Concentration calculations with the application of the SCS TR-55 methodology.

Watershed or Subarea Designation: DA 82.03

Area 1.8 AC

SHEET FLOW

Segment ID		A-B			
Surface Description (Table 3-1)		CULTIVATED			
Manning's Coefficient, n (Table 3-1)		0.060			
Flow Length, L (total <= 150)	(ft)	150			
Two Year Rainfall, P	(in)	3.4			
Land Slope, s	(ft/ft)	0.022			
Computed Tt = 0.007 (nL)^0.8 / P^0.5*s^0.4	(hrs)	0.102			0.102

SHALLOW CONCENTRATED FLOW

Segment ID		B-C			
Surface Description (paved or unpaved)		UNPAVED			
Flow Length, L	(ft)	616			
Watercourse slope, s	(ft/ft)	0.082			
Average Velocity, V (Figure 3-1)	(ft/s)	4.0			
Computed Tt = L / 3600V	(hrs)	0.043			0.043

CHANNEL FLOW

Segment ID		C-D			
Cross sectional Area, a	(sf)	3.00			
Wetted Perimeter, Pw	(ft)	4.80			
Hydraulic Radius, r =a/Pw	(ft)	0.625			
Channel Slope (ft/ft)	(ft/ft)	0.130			
Manning's Roughness Coefficient, n		0.040			
Velocity, V = 1.49r^(2/3)s^0.5 / n	(ft/s)	9.82			
Flow Length, L	(ft)	16			
Computed Tt = L / 3600V	(hrs)	0.000			0.000

Watershed or subarea Tc	0.145	hrs.
	8.7	min.

Use minimum Tc of 10 minutes

Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Wednesday, 02 / 20 / 2019

Hyd. No. 43

DA 82.0-2

Hydrograph type	= SCS Runoff	Peak discharge	= 2.550 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.20 hrs
Time interval	= 6 min	Hyd. volume	= 9,718 cuft
Drainage area	= 1.800 ac	Curve number	= 82.000
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 10.0 min
Total precip.	= 3.26 in	Distribution	= Custom
Storm duration	= C:\Users\IKuzmina\AppData\Local\Autodesk\C3D2019\enu\HHApps\Hydrograp		

Hydrograph Discharge Table

(Printed values >= 1.00% of Qp.)

Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)
10.10	0.028	11.90	0.667	13.70	0.220	15.50	0.115
10.20	0.032	12.00	1.078	13.80	0.208	15.60	0.114
10.30	0.036	12.10	1.976	13.90	0.199	15.70	0.112
10.40	0.040	12.20	2.550	14.00	0.194	15.80	0.110
10.50	0.044	12.30	2.129	14.10	0.188	15.90	0.109
10.60	0.049	12.40	1.520	14.20	0.182	16.00	0.107
10.70	0.057	12.50	0.974	14.30	0.176	16.10	0.106
10.80	0.066	12.60	0.782	14.40	0.170	16.20	0.104
10.90	0.077	12.70	0.621	14.50	0.164	16.30	0.102
11.00	0.090	12.80	0.525	14.60	0.158	16.40	0.101
11.10	0.105	12.90	0.457	14.70	0.152	16.50	0.099
11.20	0.124	13.00	0.419	14.80	0.146	16.60	0.097
11.30	0.148	13.10	0.378	14.90	0.140	16.70	0.096
11.40	0.176	13.20	0.340	15.00	0.134	16.80	0.094
11.50	0.205	13.30	0.310	15.10	0.128	16.90	0.093
11.60	0.261	13.40	0.285	15.20	0.122	17.00	0.091
11.70	0.350	13.50	0.263	15.30	0.119	17.10	0.089
11.80	0.466	13.60	0.240	15.40	0.117	17.20	0.088

Continues on next page...

Worksheet for MP-82.03_STA0+15_PIPE_2YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.14000	ft/ft
Discharge	2.60	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	334.00
0+10	332.00
0+26	330.00
0+42	330.00
0+49	328.60
0+52	328.90
0+96	330.00
1+00	330.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 334.00)	(1+00, 330.00)	0.045

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.35	ft
Elevation Range	328.60 to 334.00 ft	
Flow Area	0.81	ft²
Wetted Perimeter	6.05	ft
Hydraulic Radius	0.13	ft

Worksheet for MP-82.03_STA0+15_PIPE_2YR

Results

Top Width		5.99	ft
Normal Depth		0.35	ft
Critical Depth		0.41	ft
Critical Slope		0.05706	ft/ft
Velocity		3.23	ft/s
Velocity Head		0.16	ft
Specific Energy		0.51	ft
Froude Number		1.55	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.35	ft
Critical Depth	0.41	ft
Channel Slope	0.14000	ft/ft
Critical Slope	0.05706	ft/ft

Worksheet for MP-82.03_STA0+35_BRIDGE_2YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.14000	ft/ft
Discharge	2.60	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	332.00
0+25	328.00
0+49	326.30
0+50	325.90
0+54	325.86
1+00	328.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 332.00)	(1+00, 328.00)	0.045

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.17	ft
Elevation Range	325.86 to 332.00 ft	
Flow Area	0.89	ft²
Wetted Perimeter	7.85	ft
Hydraulic Radius	0.11	ft
Top Width	7.82	ft
Normal Depth	0.17	ft

Worksheet for MP-82.03_STA0+35_BRIDGE_2YR

Results

Critical Depth		0.21	ft
Critical Slope		0.05718	ft/ft
Velocity		2.91	ft/s
Velocity Head		0.13	ft
Specific Energy		0.30	ft
Froude Number		1.51	
Flow Type	Supercritical		

GVF Input Data

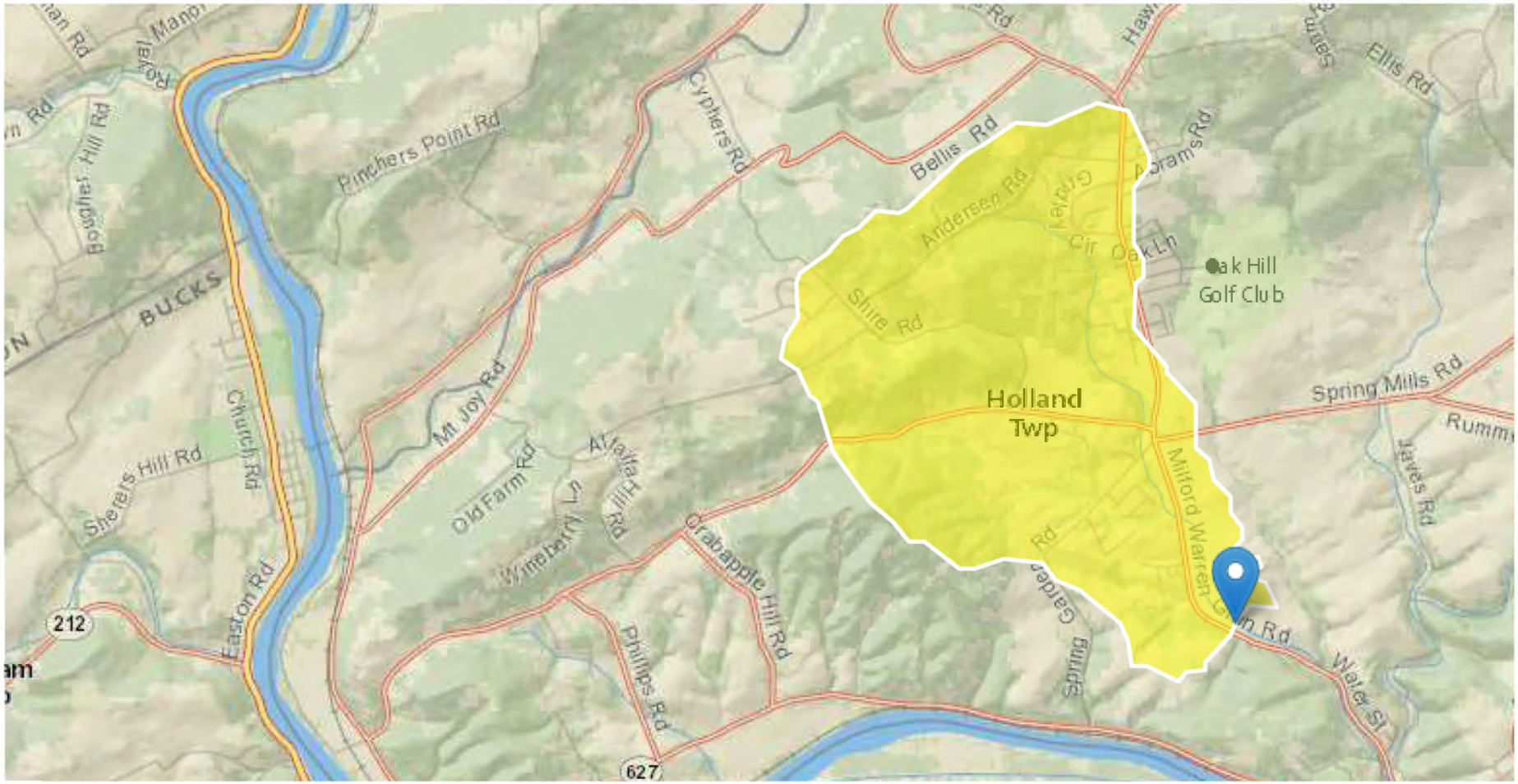
Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.17	ft
Critical Depth	0.21	ft
Channel Slope	0.14000	ft/ft
Critical Slope	0.05718	ft/ft

MP 82.34

Region ID: NJ
Workspace ID: NJ20170804160533622000
Clicked Point (Latitude, Longitude): 40.58220, -75.10966
Time: 2017-08-04 16:06:36 -0400



Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	3.31	square miles
STORAGE	Percentage of area of storage (lakes ponds reservoirs wetlands)	7.94	percent
CSL10_85	Change in elevation divided by length between points 10 and 85 percent of distance along main channel to basin divide - main channel method not known	163	feet per mi
POPDENS	Basin Population Density	216	persons per square mile

Peak-Flow Statistics Parameters [44 Percent (1.45 square miles) Peak Unglaciated Piedmont Region 2009 5167]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	3.31	square miles	0.25	779
STORAGE	Percent Storage	7.94	percent	0.23	32
CSL10_85	Stream Slope 10 and 85 Method	163	feet per mi	4.31	191
POPDENS	Basin Population Density	216	persons per square mile	83	11084

Peak-Flow Statistics Parameters [56 Percent (1.87 square miles) Peak Valley and Ridge Region 2009 5167]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	3.31	square miles	0.87	763
STORAGE	Percent Storage	7.94	percent	2.36	30.1
CSL10_85	Stream Slope 10 and 85 Method	163	feet per mi	2.56	268

Peak-Flow Statistics Flow Report [Area-Averaged]

Statistic	Value	Unit	Equiv. Yrs.
2 Year Peak Flood	378	ft^3/s	2
5 Year Peak Flood	631	ft^3/s	4
10 Year Peak Flood	832	ft^3/s	6
25 Year Peak Flood	1120	ft^3/s	8
50 Year Peak Flood	1350	ft^3/s	10
100 Year Peak Flood	1610	ft^3/s	10
500 Year Peak Flood	2270	ft^3/s	12

Peak-Flow Statistics Citations

Watson, K.M.,and Schopp, R.D.,2009, Methodology for estimation of flood magnitude and frequency for New Jersey streams, U.S. Geological Survey Scientific Investigations Report 2009-5167, 51 p. (http://pubs.usgs.gov/sir/2009/5167/)

Worksheet for M-82.34 STA 0+34 _2YR_PIPE

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00900	ft/ft
Discharge	378.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	204.00
0+26	202.00
0+41	202.20
0+44	199.10
0+50	198.29
0+59	199.20
0+63	200.90
1+00	200.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 204.00)	(1+00, 200.00)	0.030

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	2.91	ft
Elevation Range	198.29 to 204.00 ft	
Flow Area	71.97	ft²
Wetted Perimeter	60.90	ft
Hydraulic Radius	1.18	ft

Worksheet for M-82.34 STA 0+34 _2YR_PIPE

Results

Top Width		58.35	ft
Normal Depth		2.91	ft
Critical Depth		2.76	ft
Critical Slope		0.01342	ft/ft
Velocity		5.25	ft/s
Velocity Head		0.43	ft
Specific Energy		3.34	ft
Froude Number		0.83	
Flow Type	Subcritical		

GVF Input Data

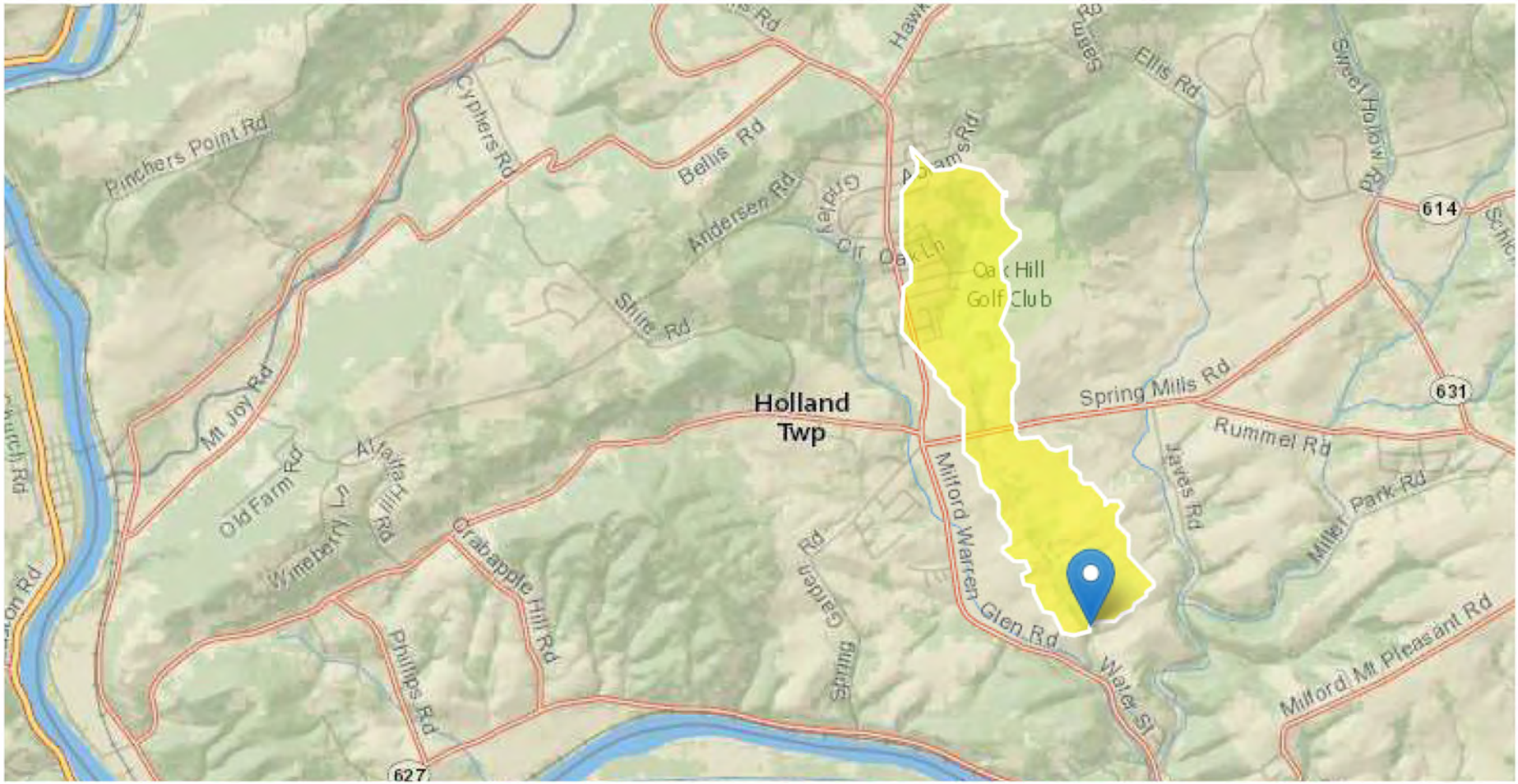
Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	2.91	ft
Critical Depth	2.76	ft
Channel Slope	0.00900	ft/ft
Critical Slope	0.01342	ft/ft

MP 82.74

Region ID: NJ
Workspace ID: NJ20170804163934371000
Clicked Point (Latitude, Longitude): 40.58221, -75.10202
Time: 2017-08-04 16:40:35 -0400



Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	0.95	square miles
STORAGE	Percentage of area of storage (lakes ponds reservoirs wetlands)	7.9	percent
CSL10_85	Change in elevation divided by length between points 10 and 85 percent of distance along main channel to basin divide - main channel method not known	184	feet per mi
POPDENS	Basin Population Density	219	persons per square mile

Peak-Flow Statistics Parameters [64 Percent (0.605 square miles) Peak Unglaciated Piedmont Region 2009 5167]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.95	square miles	0.25	779
STORAGE	Percent Storage	7.9	percent	0.23	32
CSL10_85	Stream Slope 10 and 85 Method	184	feet per mi	4.31	191
POPDENS	Basin Population Density	219	persons per square mile	83	11084

Peak-Flow Statistics Parameters [36 Percent (0.345 square miles) Peak Valley and Ridge Region 2009 5167]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.95	square miles	0.87	763
STORAGE	Percent Storage	7.9	percent	2.36	30.1
CSL10_85	Stream Slope 10 and 85 Method	184	feet per mi	2.56	268

Peak-Flow Statistics Flow Report [Area-Averaged]

Statistic	Value	Unit	Equiv. Yrs.
2 Year Peak Flood	183	ft^3/s	2
5 Year Peak Flood	308	ft^3/s	4
10 Year Peak Flood	407	ft^3/s	6
25 Year Peak Flood	548	ft^3/s	8
50 Year Peak Flood	661	ft^3/s	10
100 Year Peak Flood	789	ft^3/s	10
500 Year Peak Flood	1110	ft^3/s	12

Peak-Flow Statistics Citations

Watson, K.M.,and Schopp, R.D.,2009, Methodology for estimation of flood magnitude and frequency for New Jersey streams, U.S. Geological Survey Scientific Investigations Report 2009-5167, 51 p. (http://pubs.usgs.gov/sir/2009/5167/)

Worksheet for M-82.74 STA 0+69_2YR_PIPE

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.01100	ft/ft
Discharge	183.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	202.00
0+21	200.00
0+30	198.00
0+38	197.90
0+51	194.09
0+68	196.00
1+00	198.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 202.00)	(1+00, 198.00)	0.030

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	2.31	ft
Elevation Range	194.09 to 202.00 ft	
Flow Area	33.94	ft²
Wetted Perimeter	32.10	ft
Hydraulic Radius	1.06	ft
Top Width	31.67	ft

Worksheet for M-82.74 STA 0+69_2YR_PIPE

Results

Normal Depth	2.31	ft
Critical Depth	2.23	ft
Critical Slope	0.01316	ft/ft
Velocity	5.39	ft/s
Velocity Head	0.45	ft
Specific Energy	2.76	ft
Froude Number	0.92	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	2.31	ft
Critical Depth	2.23	ft
Channel Slope	0.01100	ft/ft
Critical Slope	0.01316	ft/ft

Worksheet for M-82.74 STA 0+38_2YR_BRIDGE

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.01200	ft/ft
Discharge	183.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	201.80
0+21	199.80
0+30	197.70
0+38	197.70
0+51	194.30
0+62	195.00
0+68	195.80
1+00	197.70

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 201.80)	(1+00, 197.70)	0.030

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	2.01	ft
Elevation Range	194.30 to 201.80 ft	
Flow Area	33.84	ft²
Wetted Perimeter	34.00	ft
Hydraulic Radius	1.00	ft

Worksheet for M-82.74 STA 0+38_2YR_BRIDGE

Results

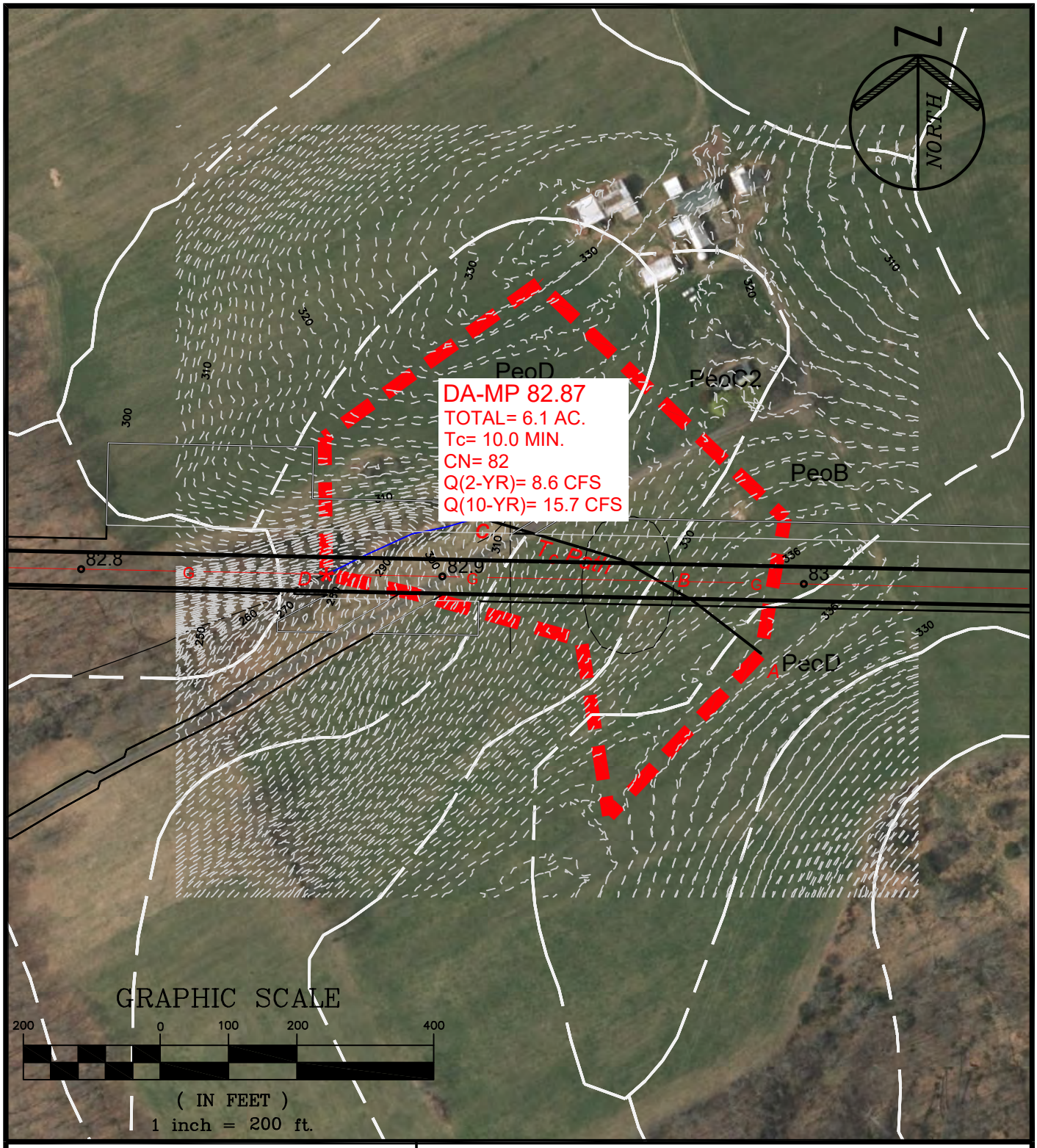
Top Width		33.67	ft
Normal Depth		2.01	ft
Critical Depth		1.97	ft
Critical Slope		0.01334	ft/ft
Velocity		5.41	ft/s
Velocity Head		0.45	ft
Specific Energy		2.46	ft
Froude Number		0.95	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	2.01	ft
Critical Depth	1.97	ft
Channel Slope	0.01200	ft/ft
Critical Slope	0.01334	ft/ft



PAULUS, SOKOLOWSKI AND SARTOR, LLC.

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WALL, NEW JERSEY 07727
PHONE: (848) 206-2626

CERTIFICATE OF AUTHORIZATION NO. 24GA28032700

PROJECT TITLE

PENNEAST PIPELINE

HUNTERDON AND MERCER COUNTY, NJ

SHEET TITLE

STREAM CROSSING DRAINAGE AREA MP 82.87

PROJ. NO.: 05516.0001	DRN. BY: JPS	SCALE: 1"=200'
DATE: 05/23/19	CK'D BY: WS	

FILE NAME: P:\05516\0001\DWGs\CADC-Civil\Plotdwgs\Drainage Area Maps\05516\0001-Stream_DA_MP78.3-84.4-WAL.dwg\MP 82.87 LAST EDIT: 06/07/2019 - 02:14:52 PM LOGIN: jmcgowan@

Worksheet 2: Runoff curve number and runoff (Approximated)

Project	By	Date
PennEast	JPS	26-Feb-18
Location	**Checked**	**Date**
Hunterdon County, NJ		

Check one: ☐ Present ☒ Developed — MP 82.9

1. Runoff curve number

Soil name and hydrologic group (appendix A)	Cover Description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN[1] Table 2-2	CN[1] Figure 2-3	CN[1] Figure 2-4	Area ☒ acres / ☐ mi² / ☐ %	Product of CN x Area
Type C	Farmstead, Good Condition	82			6.10	500.20
				Totals ➡	6.10	500.20

1. Use only one CN source per line

CN (weighted) $= \frac{\text{tot.prod.}}{\text{tot. area}} = \frac{500.20}{6.10} = 82.0$; Use CN ➡ **82**

2. Runoff

		Storm #1	Storm #2	Storm #3
Frequency……	yr			
Rainfall, P (24-hour)…….	in			
Runoff, Q……	in			

Use P and CN with table 2-1, figure 2-1, or equation 2-3 abd 2-4

PSS&	PROJECT: PennEast	JOB NO. 5516.0001	
		SHEET	DATE:2/12/2018
		BY:	JPS
	SUBJECT: Tc Calculations	CHK'D	

Time of Concentration calculations with the application of the SCS TR-55 methodology.

Watershed or Subarea Designation: DA 82.9

Area 6.1 AC

SHEET FLOW

Segment ID		A-B				
Surface Description (Table 3-1)		CULTIVATED				
Manning's Coefficient, n (Table 3-1)		0.060				
Flow Length, L (total <= 150)	(ft)	150				
Two Year Rainfall, P	(in)	3.4				
Land Slope, s	(ft/ft)	0.040				
Computed Tt = 0.007 (nL)^0.8 / P^0.5*s^0.4	(hrs)	0.080				0.080

SHALLOW CONCENTRATED FLOW

Segment ID		B-C				
Surface Description (paved or unpaved)		UNPAVED				
Flow Length, L	(ft)	313				
Watercourse slope, s	(ft/ft)	0.083				
Average Velocity, V (Figure 3-1)	(ft/s)	4.0				
Computed Tt = L / 3600V	(hrs)	0.022				0.022

CHANNEL FLOW

Segment ID		C-D				
Cross sectional Area, a	(sf)	2.12				
Wetted Perimeter, Pw	(ft)	10.82				
Hydraulic Radius, r =a/Pw	(ft)	0.196				
Channel Slope (ft/ft)	(ft/ft)	0.125				
Manning's Roughness Coefficient, n		0.040				
Velocity, V = 1.49r^(2/3)s^0.5 / n	(ft/s)	4.44				
Flow Length, L	(ft)	240				
Computed Tt = L / 3600V	(hrs)	0.015				0.015

Watershed or subarea Tc	0.117	hrs.
	7.0	min.

Use minimum Tc of 10 minutes

Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Wednesday, 02 / 20 / 2019

Hyd. No. 8

DA 82.9

Hydrograph type	= SCS Runoff	Peak discharge	= 8.643 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.20 hrs
Time interval	= 6 min	Hyd. volume	= 32,934 cuft
Drainage area	= 6.100 ac	Curve number	= 82.000*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 10.0 min
Total precip.	= 3.26 in	Distribution	= Custom
Storm duration	= C:\Users\IKuzmina\AppData\Local\Autodesk\C3D 2019\enu\HHApps\Hydrograp		

* Composite (Area/CN) = [(6.100 x 82)] / 6.100

Hydrograph Discharge Table

(Printed values >= 1.00% of Qp.)

Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)
10.10	0.096	11.90	2.259	13.70	0.746	15.50	0.390
10.20	0.108	12.00	3.654	13.80	0.703	15.60	0.385
10.30	0.120	12.10	6.698	13.90	0.676	15.70	0.379
10.40	0.134	12.20	8.643	14.00	0.657	15.80	0.374
10.50	0.148	12.30	7.217	14.10	0.637	15.90	0.368
10.60	0.166	12.40	5.150	14.20	0.617	16.00	0.363
10.70	0.192	12.50	3.301	14.30	0.597	16.10	0.358
10.80	0.224	12.60	2.649	14.40	0.577	16.20	0.353
10.90	0.262	12.70	2.106	14.50	0.556	16.30	0.347
11.00	0.304	12.80	1.780	14.60	0.536	16.40	0.341
11.10	0.355	12.90	1.550	14.70	0.515	16.50	0.336
11.20	0.421	13.00	1.419	14.80	0.495	16.60	0.330
11.30	0.502	13.10	1.280	14.90	0.474	16.70	0.325
11.40	0.595	13.20	1.153	15.00	0.453	16.80	0.319
11.50	0.694	13.30	1.051	15.10	0.432	16.90	0.314
11.60	0.886	13.40	0.966	15.20	0.414	17.00	0.308
11.70	1.187	13.50	0.890	15.30	0.403	17.10	0.303
11.80	1.579	13.60	0.813	15.40	0.395	17.20	0.297

Continues on next page...

Worksheet for M-82.87 STA 0+53_2YR_PIPE

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.14400	ft/ft
Discharge	8.60	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	290.00
0+05	288.00
0+16	284.00
0+30	278.00
0+34	275.30
0+39	274.81
0+41	275.50
0+45	276.00
0+54	278.00
0+81	282.00
0+88	284.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 290.00)	(0+88, 284.00)	0.050

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.54	ft
Elevation Range	274.81 to 290.00 ft	

Worksheet for M-82.87 STA 0+53_2YR_PIPE

Results

Flow Area		1.77	ft²
Wetted Perimeter		6.29	ft
Hydraulic Radius		0.28	ft
Top Width		6.12	ft
Normal Depth		0.54	ft
Critical Depth		0.65	ft
Critical Slope		0.05272	ft/ft
Velocity		4.85	ft/s
Velocity Head		0.37	ft
Specific Energy		0.91	ft
Froude Number		1.59	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

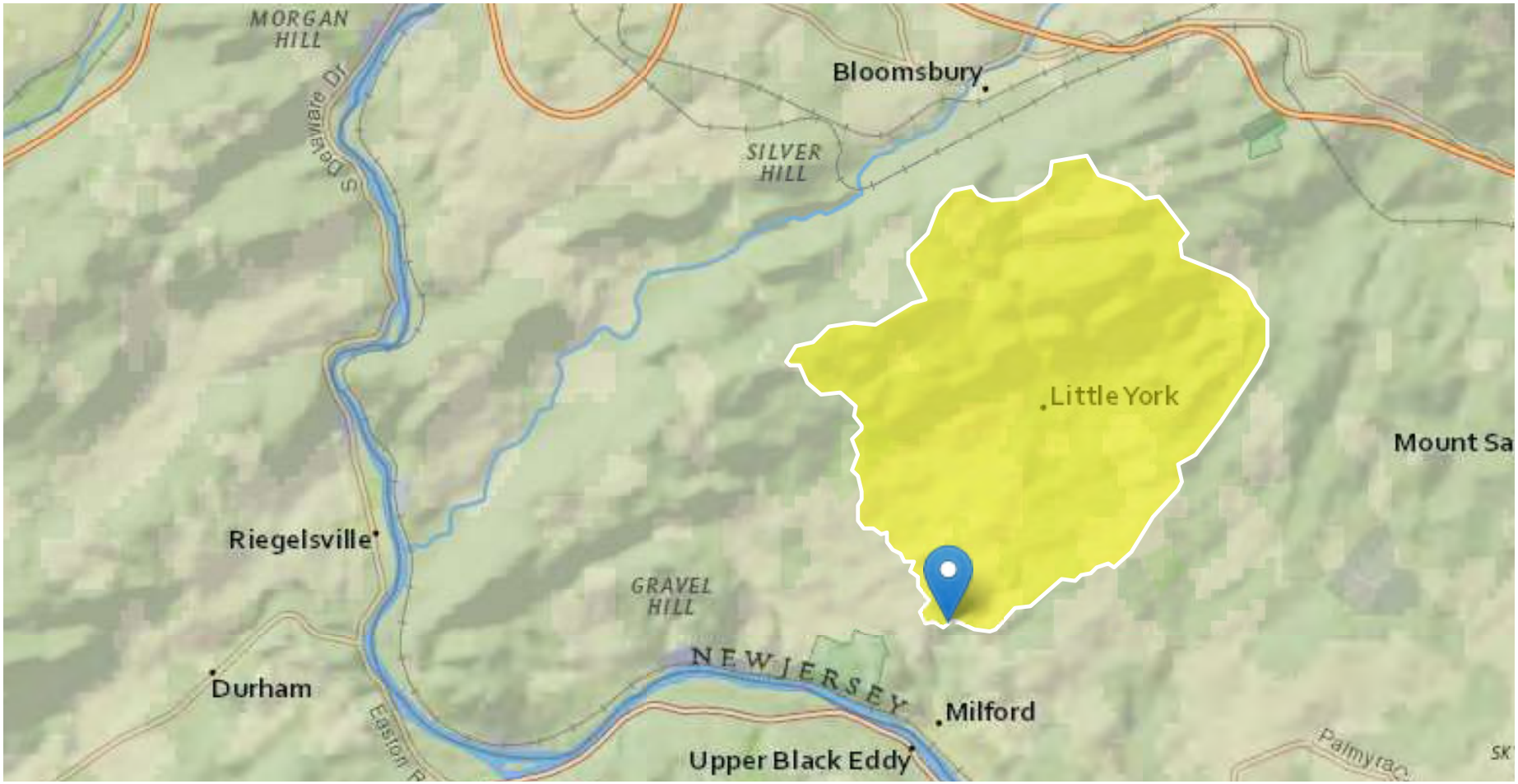
GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.54	ft
Critical Depth	0.65	ft
Channel Slope	0.14400	ft/ft
Critical Slope	0.05272	ft/ft

MP 83.18

MP 83.18

Region ID: NJ
Workspace ID: NJ20170804165256399000
Clicked Point (Latitude, Longitude): 40.58212, -75.09340
Time: 2017-08-04 16:53:45 -0400



Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	11.4	square miles
STORAGE	Percentage of area of storage (lakes ponds reservoirs wetlands)	11.2	percent
CSL10_85	Change in elevation divided by length between points 10 and 85 percent of distance along main channel to basin divide - main channel method not known	102	feet per mi
POPDENS	Basin Population Density	200	persons per square mile

Peak-Flow Statistics Parameters [52 Percent (5.9 square miles) Peak Unglaciated Piedmont Region 2009 5167]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	11.4	square miles	0.25	779
STORAGE	Percent Storage	11.2	percent	0.23	32
CSL10_85	Stream Slope 10 and 85 Method	102	feet per mi	4.31	191
POPDENS	Basin Population Density	200	persons per square mile	83	11084

Peak-Flow Statistics Parameters [48 Percent (5.5 square miles) Peak Valley and Ridge Region 2009 5167]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	11.4	square miles	0.87	763
STORAGE	Percent Storage	11.2	percent	2.36	30.1
CSL10_85	Stream Slope 10 and 85 Method	102	feet per mi	2.56	268

Peak-Flow Statistics Flow Report [Area-Averaged]

Statistic	Value	Unit	Equiv. Yrs.
2 Year Peak Flood	896	ft^3/s	2
5 Year Peak Flood	1460	ft^3/s	4
10 Year Peak Flood	1890	ft^3/s	6
25 Year Peak Flood	2500	ft^3/s	8
50 Year Peak Flood	2990	ft^3/s	10
100 Year Peak Flood	3540	ft^3/s	10
500 Year Peak Flood	4890	ft^3/s	12

Peak-Flow Statistics Citations

Watson, K.M.,and Schopp, R.D.,2009, Methodology for estimation of flood magnitude and frequency for New Jersey streams, U.S. Geological Survey Scientific Investigations Report 2009-5167, 51 p. (http://pubs.usgs.gov/sir/2009/5167/)

Worksheet for M-83.18 STA 2+04_2YR_PIPE

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00400	ft/ft
Discharge	896.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	190.00
0+12	182.00
0+15	180.60
0+16	180.00
0+19	176.20
0+38	175.50
0+62	175.95
0+66	178.50
0+68	179.00
0+80	180.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 190.00)	(0+80, 180.00)	0.030

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	3.42	ft
Elevation Range	175.50 to 190.00 ft	
Flow Area	145.78	ft²

Worksheet for M-83.18 STA 2+04_2YR_PIPE

Results

Wetted Perimeter		53.05	ft
Hydraulic Radius		2.75	ft
Top Width		50.93	ft
Normal Depth		3.42	ft
Critical Depth		2.62	ft
Critical Slope		0.01051	ft/ft
Velocity		6.15	ft/s
Velocity Head		0.59	ft
Specific Energy		4.01	ft
Froude Number		0.64	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	3.42	ft
Critical Depth	2.62	ft
Channel Slope	0.00400	ft/ft
Critical Slope	0.01051	ft/ft

Worksheet for M-83.18 STA 1+75_2YR_BRIDGE

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00600	ft/ft
Discharge	896.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	196.00
0+08	190.00
0+19	182.00
0+23	181.00
0+24	180.50
0+27	176.10
0+47	175.67
0+70	176.20
0+73	180.00
0+92	180.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 196.00)	(0+92, 180.00)	0.030

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	3.04	ft
Elevation Range	175.67 to 196.00 ft	
Flow Area	125.63	ft²

Worksheet for M-83.18 STA 1+75_2YR_BRIDGE

Results

Wetted Perimeter		49.57	ft
Hydraulic Radius		2.53	ft
Top Width		47.14	ft
Normal Depth		3.04	ft
Critical Depth		2.60	ft
Critical Slope		0.01057	ft/ft
Velocity		7.13	ft/s
Velocity Head		0.79	ft
Specific Energy		3.83	ft
Froude Number		0.77	
Flow Type	Subcritical		

GVF Input Data

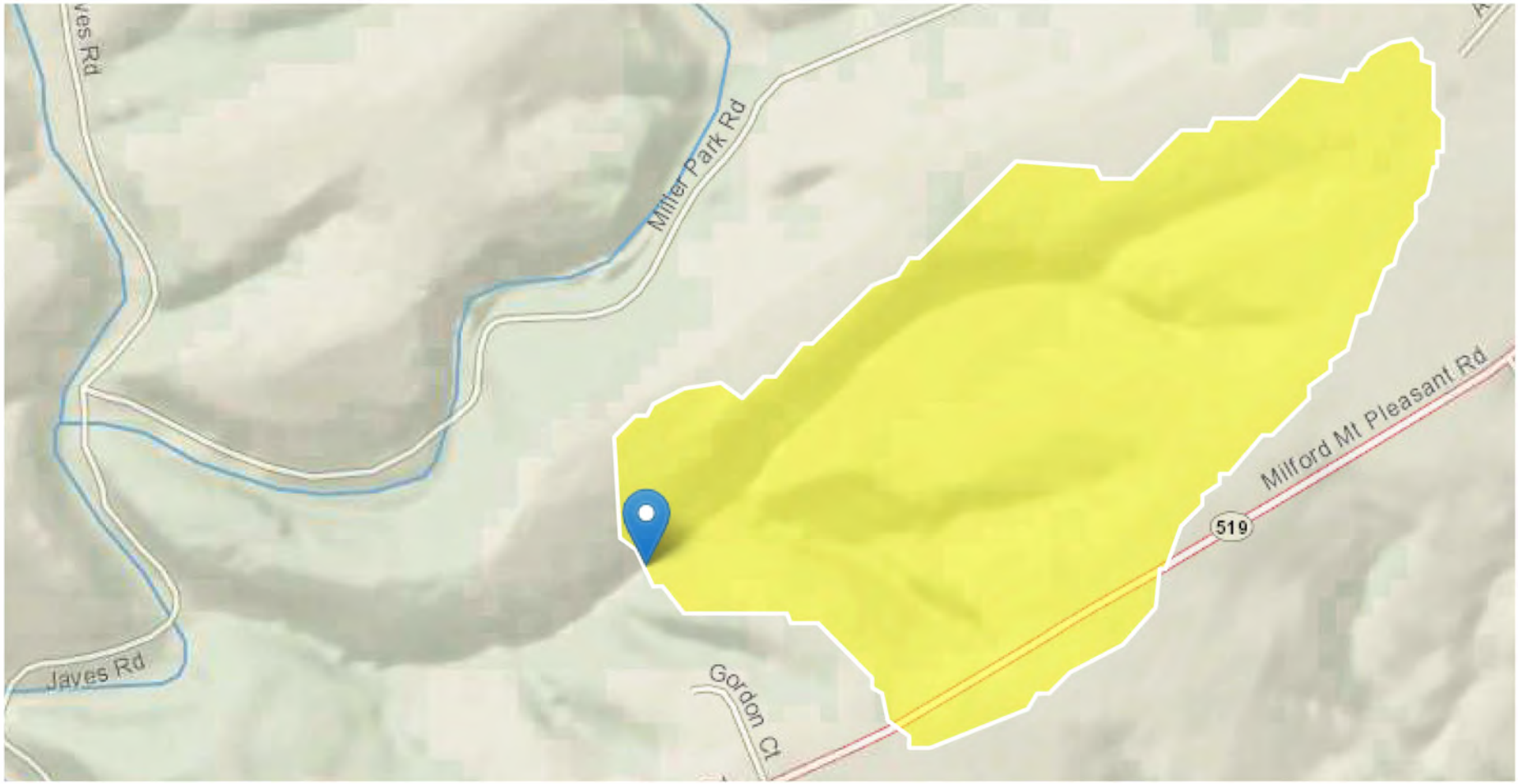
Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	3.04	ft
Critical Depth	2.60	ft
Channel Slope	0.00600	ft/ft
Critical Slope	0.01057	ft/ft

MP 83.85

Region ID: NJ
Workspace ID: NJ20170807092826427000
Clicked Point (Latitude, Longitude): 40.58140, -75.08142
Time: 2017-08-07 09:29:25 -0400



Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	0.39	square miles
STORAGE	Percentage of area of storage (lakes ponds reservoirs wetlands)	6.69	percent
CSL10_85	Change in elevation divided by length between points 10 and 85 percent of distance along main channel to basin divide - main channel method not known	168	feet per mi
POPDENS	Basin Population Density	215	persons per square mile

Peak-Flow Statistics Parameters [Peak Unglaciated Piedmont Region 2009 5167]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.39	square miles	0.25	779
STORAGE	Percent Storage	6.69	percent	0.23	32
CSL10_85	Stream Slope 10 and 85 Method	168	feet per mi	4.31	191
POPDENS	Basin Population Density	215	persons per square mile	83	11084

Peak-Flow Statistics Flow Report [Peak Unglaciated Piedmont Region 2009 5167]

PIl: Prediction Interval-Lower, Plu: Prediction Interval-Upper, SEp: Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	SEe	SEp	Equiv. Yrs.
2 Year Peak Flood	119	ft^3/s	49	50.3	1
5 Year Peak Flood	203	ft^3/s	49.4	50.9	2
10 Year Peak Flood	269	ft^3/s	50.5	52.2	3

Statistic	Value	Unit	SEe	SEp	Equiv. Yrs.
25 Year Peak Flood	362	ft^3/s	52.6	54.5	4
50 Year Peak Flood	438	ft^3/s	54.7	56.8	5
100 Year Peak Flood	523	ft^3/s	57.1	59.5	5
500 Year Peak Flood	734	ft^3/s	63.9	66.3	6

Peak-Flow Statistics Citations

Watson, K.M.,and Schopp, R.D.,2009, Methodology for estimation of flood magnitude and frequency for New Jersey streams, U.S. Geological Survey Scientific Investigations Report 2009-5167, 51 p. (http://pubs.usgs.gov/sir/2009/5167/)

Worksheet for M-83.85 STA 0+35_2YR_PIPE

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.01400	ft/ft
Discharge	119.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	268.00
0+10	262.00
0+18	258.00
0+22	256.30
0+27	253.30
0+34	252.73
0+45	254.20
0+48	255.70
0+82	260.00
0+86	268.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 268.00)	(0+86, 268.00)	0.030

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	1.64	ft
Elevation Range	252.73 to 268.00 ft	
Flow Area	20.40	ft²

Worksheet for M-83.85 STA 0+35_2YR_PIPE

Results

Wetted Perimeter		20.55	ft
Hydraulic Radius		0.99	ft
Top Width		20.09	ft
Normal Depth		1.64	ft
Critical Depth		1.66	ft
Critical Slope		0.01340	ft/ft
Velocity		5.83	ft/s
Velocity Head		0.53	ft
Specific Energy		2.17	ft
Froude Number		1.02	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.64	ft
Critical Depth	1.66	ft
Channel Slope	0.01400	ft/ft
Critical Slope	0.01340	ft/ft

Worksheet for M-83.85 STA 0+10_2YR_BRIDGE

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00200	ft/ft
Discharge	119.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	274.00
0+13	266.00
0+22	260.00
0+24	258.80
0+29	253.70
0+34	252.68
0+44	254.00
0+47	256.00
0+52	256.00
0+80	258.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 274.00)	(0+80, 258.00)	0.030

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	2.83	ft
Elevation Range	252.68 to 274.00 ft	
Flow Area	36.41	ft²

Worksheet for M-83.85 STA 0+10_2YR_BRIDGE

Results

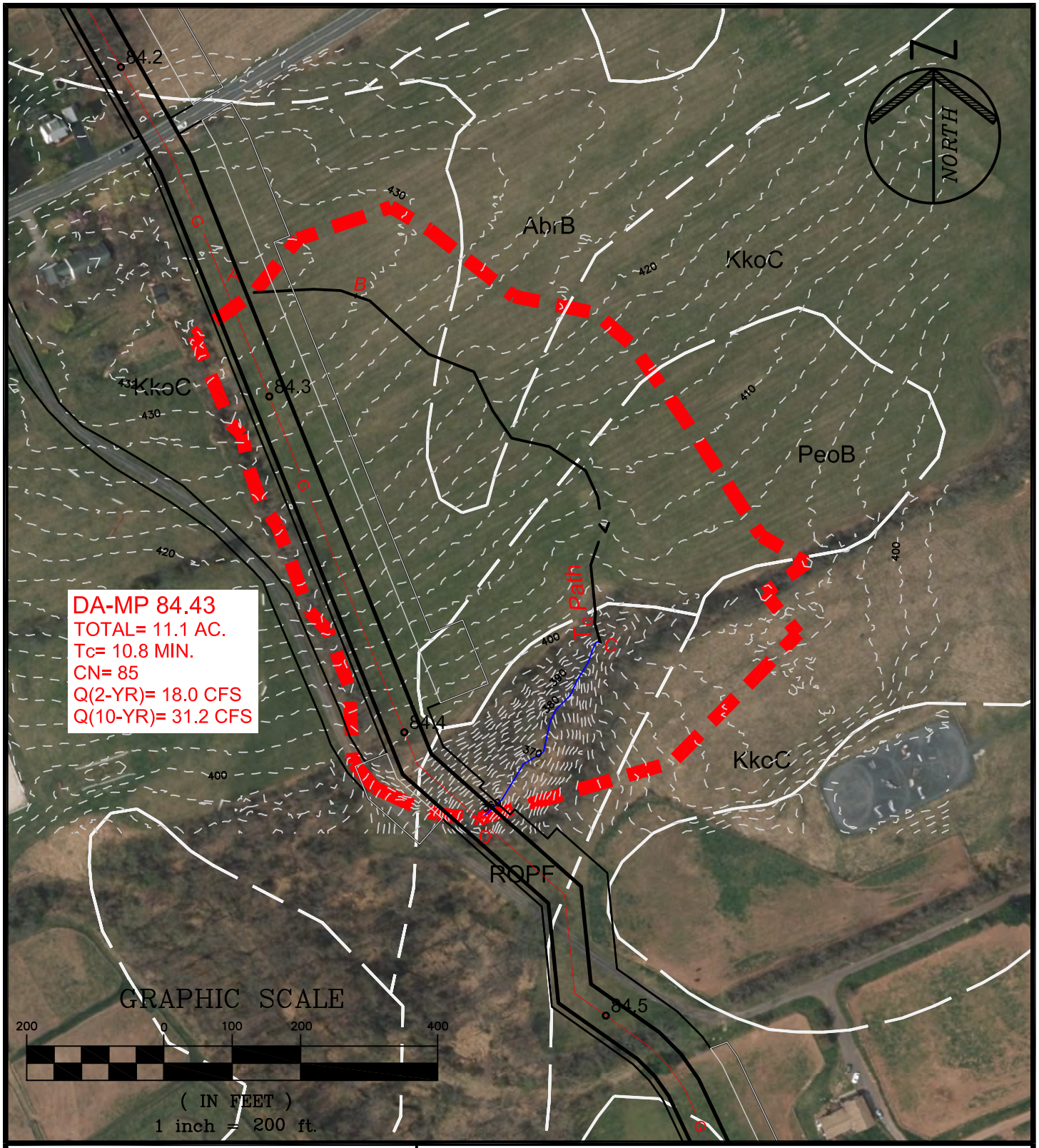
Wetted Perimeter		20.31	ft
Hydraulic Radius		1.79	ft
Top Width		18.89	ft
Normal Depth		2.83	ft
Critical Depth		1.87	ft
Critical Slope		0.01316	ft/ft
Velocity		3.27	ft/s
Velocity Head		0.17	ft
Specific Energy		2.99	ft
Froude Number		0.42	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	2.83	ft
Critical Depth	1.87	ft
Channel Slope	0.00200	ft/ft
Critical Slope	0.01316	ft/ft



PAULUS, SOKOLOWSKI AND SARTOR, LLC.

1433 ROUTE 34
SUITE A4
WALL, NEW JERSEY 07727
PHONE: (848) 206-2626

CERTIFICATE OF AUTHORIZATION NO. 24GA28032700

PROJECT TITLE

PENNEAST PIPELINE

HUNTERDON AND MERCER COUNTY, NJ

SHEET TITLE

STREAM CROSSING DRAINAGE AREA MP 84.43

PROJ. NO.:	05516.0001	DRN. BY:	JPS	SCALE:	1"=200'
DATE:	05/23/19	CK'D BY:	WS		

FILE NAME: P:\05516\0001\DWGs\CAD\C-Civil\Plotdwgs\Drainage Area Maps\05516001-Stream_DA_MP78.3-84.4-WAL.dwg\MP 84.4 LAST EDIT: 06/13/2019 - 08:40:34 AM LOGIN: lkuzmha@

Worksheet 2: Runoff curve number and runoff (Approximated)

Project	By	Date
PennEast	JPS	26-Feb-18
Location	**Checked**	**Date**
Hunterdon County, NJ		

Check one: ☐ Present ☒ Developed | MP 84.43

1. Runoff curve number

Soil name and hydrologic group (appendix A)	Cover Description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN[1] Table 2-2	CN[1] Figure 2-3	CN[1] Figure 2-4	Area ☒ acres ☐ mi² ☐ %	Product of CN x Area
Type C	Farmstead, Good Condition	82			3.30	270.60
Type D	Farmstead, Good Condition	86			7.80	670.80
1. Use only one CN source per line				Totals ➡	11.10	941.40

CN (weighted) = tot.prod. / tot. area = 941.40 / 11.10 = 84.8 ; Use CN ➡ **85**

2. Runoff

		Storm #1	Storm #2	Storm #3
Frequency……	yr			
Rainfall, P (24-hour)…….	in			
Runoff, Q……	in			

Use P and CN with table 2-1, figure 2-1, or equation 2-3 abd 2-4

PSS&	PROJECT: PennEast	JOB NO. 5516.0001	
		SHEET	DATE:2/12/2018
		BY:	JPS
	SUBJECT: Tc Calculations	CHK'D	

Time of Concentration calculations with the application of the SCS TR-55 methodology.

Watershed or Subarea Designation: DA 84.43

Area 11.13 AC

SHEET FLOW

Segment ID		A-B				
Surface Description (Table 3-1)		CULTIVATED				
Manning's Coefficient, n (Table 3-1)		0.060				
Flow Length, L (total <= 150)	(ft)	150				
Two Year Rainfall, P	(in)	3.4				
Land Slope, s	(ft/ft)	0.017				
Computed Tt = 0.007 (nL)^0.8 / P^0.5*s^0.4	(hrs)	0.113				0.113

SHALLOW CONCENTRATED FLOW

Segment ID		B-C				
Surface Description (paved or unpaved)		UNPAVED				
Flow Length, L	(ft)	699				
Watercourse slope, s	(ft/ft)	0.054				
Average Velocity, V (Figure 3-1)	(ft/s)	3.6				
Computed Tt = L / 3600V	(hrs)	0.054				0.054

CHANNEL FLOW

Segment ID		C-D				
Cross sectional Area, a	(sf)	2.64				
Wetted Perimeter, Pw	(ft)	6.60				
Hydraulic Radius, r =a/Pw	(ft)	0.400				
Channel Slope (ft/ft)	(ft/ft)	0.105				
Manning's Roughness Coefficient, n		0.040				
Velocity, V = 1.49r^(2/3)s^0.5 / n	(ft/s)	6.55				
Flow Length, L	(ft)	323				
Computed Tt = L / 3600V	(hrs)	0.014				0.014

Watershed or subarea Tc	0.180	hrs.
	10.8	min.

Use minimum Tc of 10 minutes

Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Wednesday, 02 / 20 / 2019

Hyd. No. 9

DA 84.43

Hydrograph type	= SCS Runoff	Peak discharge	= 17.96 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.20 hrs
Time interval	= 6 min	Hyd. volume	= 68,333 cuft
Drainage area	= 11.100 ac	Curve number	= 85.000*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 10.8 min
Total precip.	= 3.26 in	Distribution	= Custom
Storm duration	= C:\Users\IKuzmina\AppData\Local\Autodesk\C3D2019\enu\HHApps\Hydrograp		

* Composite (Area/CN) = [(3.300 x 82) + (7.800 x 86)] / 11.100

Hydrograph Discharge Table

(Printed values >= 1.00% of Qp.)

Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)
9.60	0.198	11.40	1.454	13.20	2.278	15.00	0.886
9.70	0.219	11.50	1.669	13.30	2.075	15.10	0.845
9.80	0.242	11.60	2.091	13.40	1.906	15.20	0.810
9.90	0.265	11.70	2.751	13.50	1.753	15.30	0.787
10.00	0.290	11.80	3.592	13.60	1.600	15.40	0.772
10.10	0.316	11.90	5.035	13.70	1.469	15.50	0.762
10.20	0.344	12.00	7.943	13.80	1.383	15.60	0.751
10.30	0.373	12.10	14.15	13.90	1.329	15.70	0.741
10.40	0.403	12.20	17.96	14.00	1.290	15.80	0.729
10.50	0.435	12.30	14.83	14.10	1.250	15.90	0.719
10.60	0.477	12.40	10.46	14.20	1.210	16.00	0.708
10.70	0.538	12.50	6.627	14.30	1.171	16.10	0.697
10.80	0.615	12.60	5.296	14.40	1.130	16.20	0.687
10.90	0.704	12.70	4.197	14.50	1.090	16.30	0.676
11.00	0.800	12.80	3.540	14.60	1.050	16.40	0.665
11.10	0.916	12.90	3.076	14.70	1.009	16.50	0.654
11.20	1.067	13.00	2.811	14.80	0.968	16.60	0.643
11.30	1.249	13.10	2.533	14.90	0.927	16.70	0.633

Continues on next page...

Worksheet for MP-84.43_STA0+60_2YR_PIPE

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.05200	ft/ft
Discharge	18.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	370.00
0+01	370.00
0+18	364.00
0+39	358.00
0+43	355.89
0+50	355.92
0+52	356.30
0+58	360.00
0+78	370.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 370.00)	(0+78, 370.00)	0.045

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.51	ft
Elevation Range	355.89 to 370.00 ft	
Flow Area	4.26	ft²
Wetted Perimeter	10.14	ft

Worksheet for MP-84.43_STA0+60_2YR_PIPE

Results

Hydraulic Radius		0.42	ft
Top Width		9.94	ft
Normal Depth		0.51	ft
Critical Depth		0.55	ft
Critical Slope		0.03930	ft/ft
Velocity		4.22	ft/s
Velocity Head		0.28	ft
Specific Energy		0.78	ft
Froude Number		1.14	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.51	ft
Critical Depth	0.55	ft
Channel Slope	0.05200	ft/ft
Critical Slope	0.03930	ft/ft

Worksheet for MP-84.43_STA0+34_2YR_BRIDGE

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.05200	ft/ft
Discharge	18.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	370.00
0+19	364.00
0+27	362.00
0+35	357.50
0+40	357.23
0+41	358.00
0+50	360.00
0+59	366.00
0+63	368.00
0+77	370.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 370.00)	(0+77, 370.00)	0.045

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.77	ft
Elevation Range	357.23 to 370.00 ft	
Flow Area	3.77	ft²

Worksheet for MP-84.43_STA0+34_2YR_BRIDGE

Results

Wetted Perimeter		7.47	ft
Hydraulic Radius		0.50	ft
Top Width		7.17	ft
Normal Depth		0.77	ft
Critical Depth		0.83	ft
Critical Slope		0.03785	ft/ft
Velocity		4.77	ft/s
Velocity Head		0.35	ft
Specific Energy		1.12	ft
Froude Number		1.16	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.77	ft
Critical Depth	0.83	ft
Channel Slope	0.05200	ft/ft
Critical Slope	0.03785	ft/ft

MP 84.80

84.80-MottMac

Region ID: NJ
Workspace ID: NJ20170807100756802000
Clicked Point (Latitude, Longitude): 40.57454, -75.06887
Time: 2017-08-07 10:08:52 -0400

Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	0.0653	square miles
STORAGE	Percentage of area of storage (lakes ponds reservoirs wetlands)	17.3	percent
CSL10_85	Change in elevation divided by length between points 10 and 85 percent of distance along main channel to basin divide - main channel method not known	288	feet per mi
POPDENS	Basin Population Density	215	persons per square mile

Peak-Flow Statistics Parameters [Peak Unglaciated Piedmont Region 2009 5167]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.0653	square miles	0.25	779
STORAGE	Percent Storage	17.3	percent	0.23	32
CSL10_85	Stream Slope 10 and 85 Method	288	feet per mi	4.31	191
POPDENS	Basin Population Density	215	persons per square mile	83	11084

Peak-Flow Statistics Disclaimers [Peak Unglaciated Piedmont Region 2009 5167]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors

Peak-Flow Statistics Flow Report [Peak Unglaciated Piedmont Region 2009 5167]

Statistic	Value	Unit
2 Year Peak Flood	33.9	ft^3/s
5 Year Peak Flood	57.6	ft^3/s
10 Year Peak Flood	75.7	ft^3/s
25 Year Peak Flood	101	ft^3/s
50 Year Peak Flood	121	ft^3/s
100 Year Peak Flood	144	ft^3/s
500 Year Peak Flood	198	ft^3/s

Peak-Flow Statistics Citations

Watson, K.M.,and Schopp, R.D.,2009, Methodology for estimation of flood magnitude and frequency for New Jersey streams, U.S. Geological Survey Scientific Investigations Report 2009-5167, 51 p. (http://pubs.usgs.gov/sir/2009/5167/)

Worksheet for MP-84.80_STA1+40_PIPE_2YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.03700	ft/ft
Discharge	33.90	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	318.00
0+47	316.15
0+48	316.00
0+49	315.71
0+50	316.10
0+53	316.70
0+82	318.00
1+00	322.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 318.00)	(1+00, 322.00)	0.050

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	1.16	ft
Elevation Range	315.71 to 322.00 ft	
Flow Area	11.00	ft²
Wetted Perimeter	27.83	ft
Hydraulic Radius	0.40	ft

Worksheet for MP-84.80_STA1+40_PIPE_2YR

Results

Top Width		27.60	ft
Normal Depth		1.16	ft
Critical Depth		1.11	ft
Critical Slope		0.05073	ft/ft
Velocity		3.08	ft/s
Velocity Head		0.15	ft
Specific Energy		1.31	ft
Froude Number		0.86	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.16	ft
Critical Depth	1.11	ft
Channel Slope	0.03700	ft/ft
Critical Slope	0.05073	ft/ft

Worksheet for MP-84.80_STA1+03_BRIDGE_2YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.03700	ft/ft
Discharge	33.90	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	318.00
0+45	318.00
0+47	317.10
0+50	316.73
0+53	317.60
0+57	318.00
1+00	320.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 318.00)	(1+00, 320.00)	0.050

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	1.40	ft
Elevation Range	316.73 to 320.00 ft	
Flow Area	14.96	ft²
Wetted Perimeter	59.91	ft
Hydraulic Radius	0.25	ft
Top Width	59.47	ft

Worksheet for MP-84.80_STA1+03_BRIDGE_2YR

Results

Normal Depth		1.40	ft
Critical Depth		1.36	ft
Critical Slope		0.06107	ft/ft
Velocity		2.27	ft/s
Velocity Head		0.08	ft
Specific Energy		1.48	ft
Froude Number		0.80	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

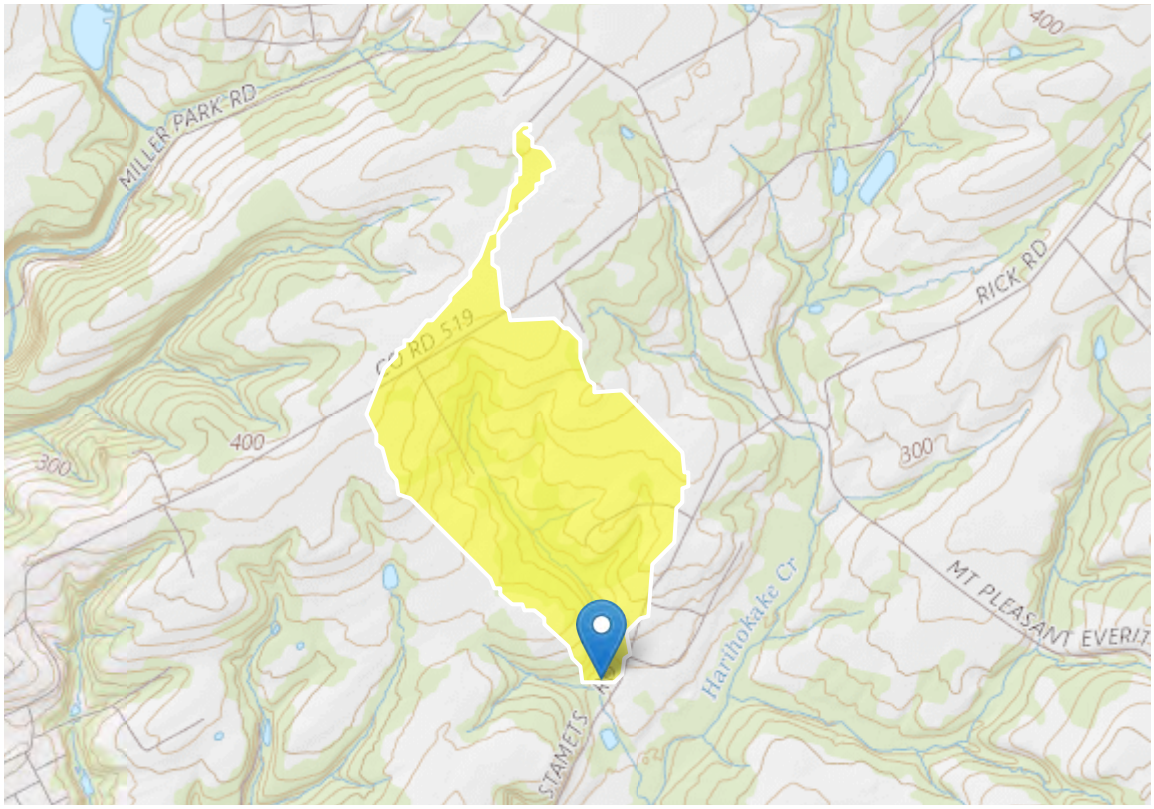
GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.40	ft
Critical Depth	1.36	ft
Channel Slope	0.03700	ft/ft
Critical Slope	0.06107	ft/ft

StreamStats Report MP-85.36

MP 85.36 &
MP-85.39

Region ID: NJ
Workspace ID: NJ20180221165109901000
Clicked Point (Latitude, Longitude): 40.57191, -75.06025
Time: 2018-02-21 11:51:24 -0500



Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	0.38	square miles
STORAGE	Percentage of area of storage (lakes ponds reservoirs wetlands)	12.2	percent
CSL10_85	Change in elevation divided by length between points 10 and 85 percent of distance along main channel to basin divide - main channel method not known	161	feet per mi

Parameter Code	Parameter Description	Value	Unit
POPDENS	Basin Population Density	214	persons per square mile

Peak-Flow Statistics Parameters [Peak Unglaciated Piedmont Region 2009 5167]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.38	square miles	0.25	779
STORAGE	Percent Storage	12.2	percent	0.23	32
CSL10_85	Stream Slope 10 and 85 Method	161	feet per mi	4.31	191
POPDENS	Basin Population Density	214	persons per square mile	83	11084

Peak-Flow Statistics Flow Report [Peak Unglaciated Piedmont Region 2009 5167]

PII: Prediction Interval-Lower, PIu: Prediction Interval-Upper, SEp: Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	SEp	Equiv. Yrs.
2 Year Peak Flood	112	ft^3/s	50.3	1
5 Year Peak Flood	188	ft^3/s	50.9	2
10 Year Peak Flood	246	ft^3/s	52.2	3
25 Year Peak Flood	328	ft^3/s	54.5	4
50 Year Peak Flood	393	ft^3/s	56.8	5
100 Year Peak Flood	466	ft^3/s	59.5	5
500 Year Peak Flood	643	ft^3/s	66.3	6

FLOW DIVIDED BY 2 BETWEEN MP85.36 & MP85.39

Peak-Flow Statistics Citations

Watson, K.M.,and Schopp, R.D.,2009, Methodology for estimation of flood magnitude and frequency for New Jersey streams, U.S. Geological Survey Scientific Investigations Report 2009-5167, 51 p. (http://pubs.usgs.gov/sir/2009/5167/)

Worksheet for M-85.36R1 STA 0+32_2YR_PIPE

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.01600	ft/ft
Discharge	56.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	238.00
0+47	236.30
0+50	235.96
0+57	236.50
0+78	236.00
1+00	236.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 238.00)	(1+00, 236.00)	0.045

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.62	ft
Elevation Range	235.96 to 238.00 ft	
Flow Area	24.66	ft²
Wetted Perimeter	61.51	ft
Hydraulic Radius	0.40	ft
Top Width	60.88	ft
Normal Depth	0.62	ft

Worksheet for M-85.36R1 STA 0+32_2YR_PIPE

Results

Critical Depth		0.50	ft
Critical Slope		0.04380	ft/ft
Velocity		2.27	ft/s
Velocity Head		0.08	ft
Specific Energy		0.70	ft
Froude Number		0.63	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.62	ft
Critical Depth	0.50	ft
Channel Slope	0.01600	ft/ft
Critical Slope	0.04380	ft/ft

Worksheet for MP-85.36_STA0+22_BRIDGE_2YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.01600	ft/ft
Discharge	56.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	238.00
0+46	236.50
0+50	236.13
0+53	236.80
1+00	236.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 238.00)	(1+00, 236.00)	0.045

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.83	ft
Elevation Range	236.00 to 238.00 ft	
Flow Area	25.23	ft²
Wetted Perimeter	65.15	ft
Hydraulic Radius	0.39	ft
Top Width	64.21	ft
Normal Depth	0.83	ft
Critical Depth	0.70	ft

Worksheet for MP-85.36_STA0+22_BRIDGE_2YR

Results

Critical Slope		0.04389	ft/ft
Velocity		2.22	ft/s
Velocity Head		0.08	ft
Specific Energy		0.91	ft
Froude Number		0.62	
Flow Type	Subcritical		

GVF Input Data

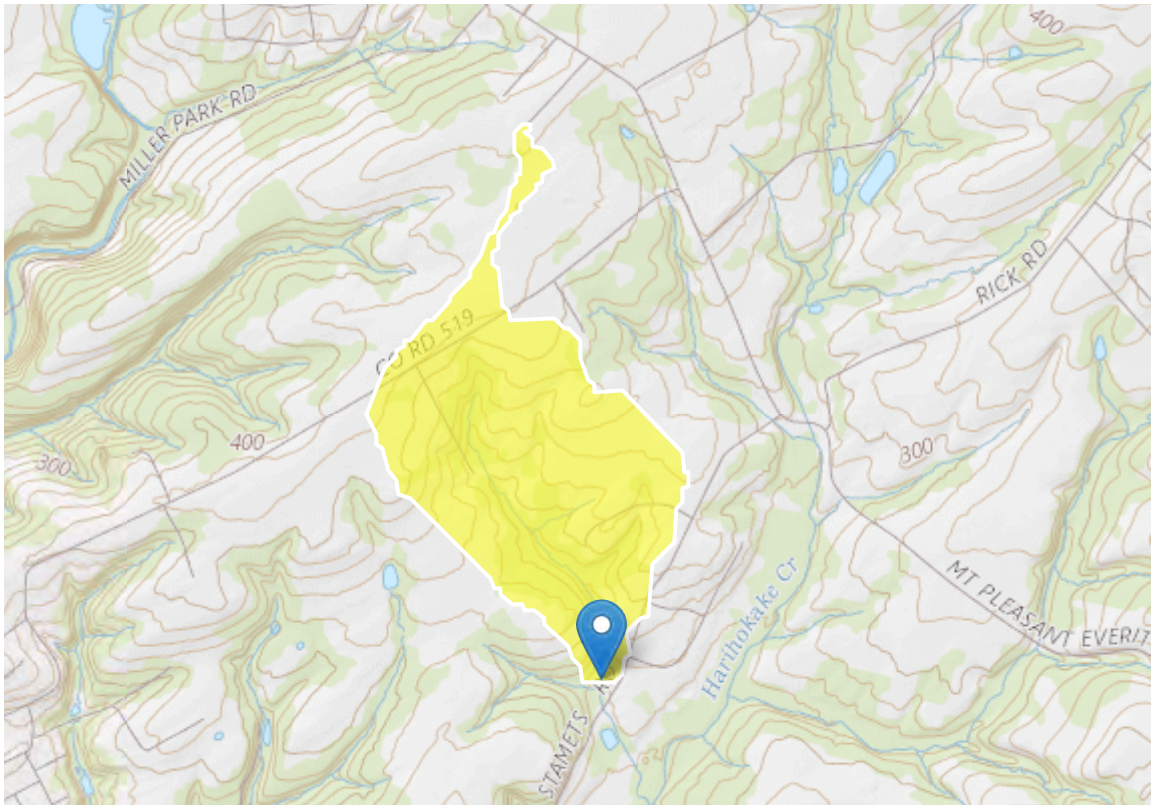
Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.83	ft
Critical Depth	0.70	ft
Channel Slope	0.01600	ft/ft
Critical Slope	0.04389	ft/ft

StreamStats Report MP-85.39R1

Region ID: NJ
Workspace ID: NJ20180221165109901000
Clicked Point (Latitude, Longitude): 40.57191, -75.06025
Time: 2018-02-21 11:51:24 -0500



Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	0.38	square miles
STORAGE	Percentage of area of storage (lakes ponds reservoirs wetlands)	12.2	percent
CSL10_85	Change in elevation divided by length between points 10 and 85 percent of distance along main channel to basin divide - main channel method not known	161	feet per mi

Parameter Code	Parameter Description	Value	Unit
POPDENS	Basin Population Density	214	persons per square mile

Peak-Flow Statistics Parameters [Peak Unglaciated Piedmont Region 2009 5167]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.38	square miles	0.25	779
STORAGE	Percent Storage	12.2	percent	0.23	32
CSL10_85	Stream Slope 10 and 85 Method	161	feet per mi	4.31	191
POPDENS	Basin Population Density	214	persons per square mile	83	11084

Peak-Flow Statistics Flow Report [Peak Unglaciated Piedmont Region 2009 5167]

PIl: Prediction Interval-Lower, PIu: Prediction Interval-Upper, SEp: Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	SEp	Equiv. Yrs.
2 Year Peak Flood	112	ft^3/s	50.3	1
5 Year Peak Flood	188	ft^3/s	50.9	2
10 Year Peak Flood	246	ft^3/s	52.2	3
25 Year Peak Flood	328	ft^3/s	54.5	4
50 Year Peak Flood	393	ft^3/s	56.8	5
100 Year Peak Flood	466	ft^3/s	59.5	5
500 Year Peak Flood	643	ft^3/s	66.3	6

Peak-Flow Statistics Citations

Watson, K.M.,and Schopp, R.D.,2009, Methodology for estimation of flood magnitude and frequency for New Jersey streams, U.S. Geological Survey Scientific Investigations Report 2009-5167, 51 p. (http://pubs.usgs.gov/sir/2009/5167/)

Worksheet for M-85.39R1 STA 0+44_2YR_PIPE

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.02200	ft/ft
Discharge	56.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	236.00
0+48	235.20
0+51	233.80
0+52	233.76
0+52	233.90
0+53	236.00
0+61	238.00
0+67	240.00
1+00	242.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 236.00)	(1+00, 242.00)	0.045

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	2.05	ft
Elevation Range	233.76 to 242.00 ft	
Flow Area	19.57	ft²
Wetted Perimeter	43.84	ft

Worksheet for M-85.39R1 STA 0+44_2YR_PIPE

Results

Hydraulic Radius		0.45	ft
Top Width		42.18	ft
Normal Depth		2.05	ft
Critical Depth		1.94	ft
Critical Slope		0.04152	ft/ft
Velocity		2.86	ft/s
Velocity Head		0.13	ft
Specific Energy		2.18	ft
Froude Number		0.74	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	2.05	ft
Critical Depth	1.94	ft
Channel Slope	0.02200	ft/ft
Critical Slope	0.04152	ft/ft

Worksheet for MP-85.39_STA0+28_BRIDGE_2YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.02500	ft/ft
Discharge	56.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	236.00
0+48	235.55
0+50	234.30
0+53	234.30
0+81	242.00
1+00	242.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 236.00)	(1+00, 242.00)	0.045

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	1.67	ft
Elevation Range	234.30 to 242.00 ft	
Flow Area	20.84	ft²
Wetted Perimeter	56.44	ft
Hydraulic Radius	0.37	ft
Top Width	55.78	ft
Normal Depth	1.67	ft

Worksheet for MP-85.39_STA0+28_BRIDGE_2YR

Results

Critical Depth	1.59	ft
Critical Slope	0.04240	ft/ft
Velocity	2.69	ft/s
Velocity Head	0.11	ft
Specific Energy	1.78	ft
Froude Number	0.78	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.67	ft
Critical Depth	1.59	ft
Channel Slope	0.02500	ft/ft
Critical Slope	0.04240	ft/ft

MP 85.59R1

Region ID: NJ
Workspace ID: NJ20170807103054438000
Clicked Point (Latitude, Longitude): 40.56984, -75.05671
Time: 2017-08-07 10:31:59 -0400

Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	7.05	square miles
STORAGE	Percentage of area of storage (lakes ponds reservoirs wetlands)	7.16	percent
CSL10_85	Change in elevation divided by length between points 10 and 85 percent of distance along main channel to basin divide - main channel method not known	106	feet per mi
POPDENS	Basin Population Density	175	persons per square mile

Peak-Flow Statistics Parameters [Peak Unglaciated Piedmont Region 2009 5167]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	7.05	square miles	0.25	779
STORAGE	Percent Storage	7.16	percent	0.23	32
CSL10_85	Stream Slope 10 and 85 Method	106	feet per mi	4.31	191
POPDENS	Basin Population Density	175	persons per square mile	83	11084

Peak-Flow Statistics Flow Report [Peak Unglaciated Piedmont Region 2009 5167]

PIl: Prediction Interval-Lower, Plu: Prediction Interval-Upper, SEp: Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	SEe	SEp	Equiv. Yrs.
2 Year Peak Flood	913	ft^3/s	49	50.3	1
5 Year Peak Flood	1500	ft^3/s	49.4	50.9	2
10 Year Peak Flood	1960	ft^3/s	50.5	52.2	3

Worksheet for MP-85.59_STA0+25_PIPE_2YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.01300	ft/ft
Discharge	457.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	224.00
0+34	222.00
0+40	216.95
0+50	215.72
0+59	217.00
0+64	218.00
0+71	218.00
1+00	219.80

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 224.00)	(1+00, 219.80)	0.035

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	3.23	ft
Elevation Range	215.72 to 224.00 ft	
Flow Area	72.98	ft²
Wetted Perimeter	49.61	ft
Hydraulic Radius	1.47	ft

Worksheet for MP-85.59_STA0+25_PIPE_2YR

Results

Top Width		48.62	ft
Normal Depth		3.23	ft
Critical Depth		3.10	ft
Critical Slope		0.01622	ft/ft
Velocity		6.26	ft/s
Velocity Head		0.61	ft
Specific Energy		3.84	ft
Froude Number		0.90	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	3.23	ft
Critical Depth	3.10	ft
Channel Slope	0.01300	ft/ft
Critical Slope	0.01622	ft/ft

Worksheet for MP-85.59_STA0+35_BRIDGE_2YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.01300	ft/ft
Discharge	457.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	224.00
0+36	222.30
0+50	215.58
0+63	218.10
0+69	218.00
1+00	220.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 224.00)	(1+00, 220.00)	0.035

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	3.87	ft
Elevation Range	215.58 to 224.00 ft	
Flow Area	73.51	ft²
Wetted Perimeter	50.51	ft
Hydraulic Radius	1.46	ft
Top Width	49.32	ft
Normal Depth	3.87	ft

Worksheet for MP-85.59_STA0+35_BRIDGE_2YR

Results

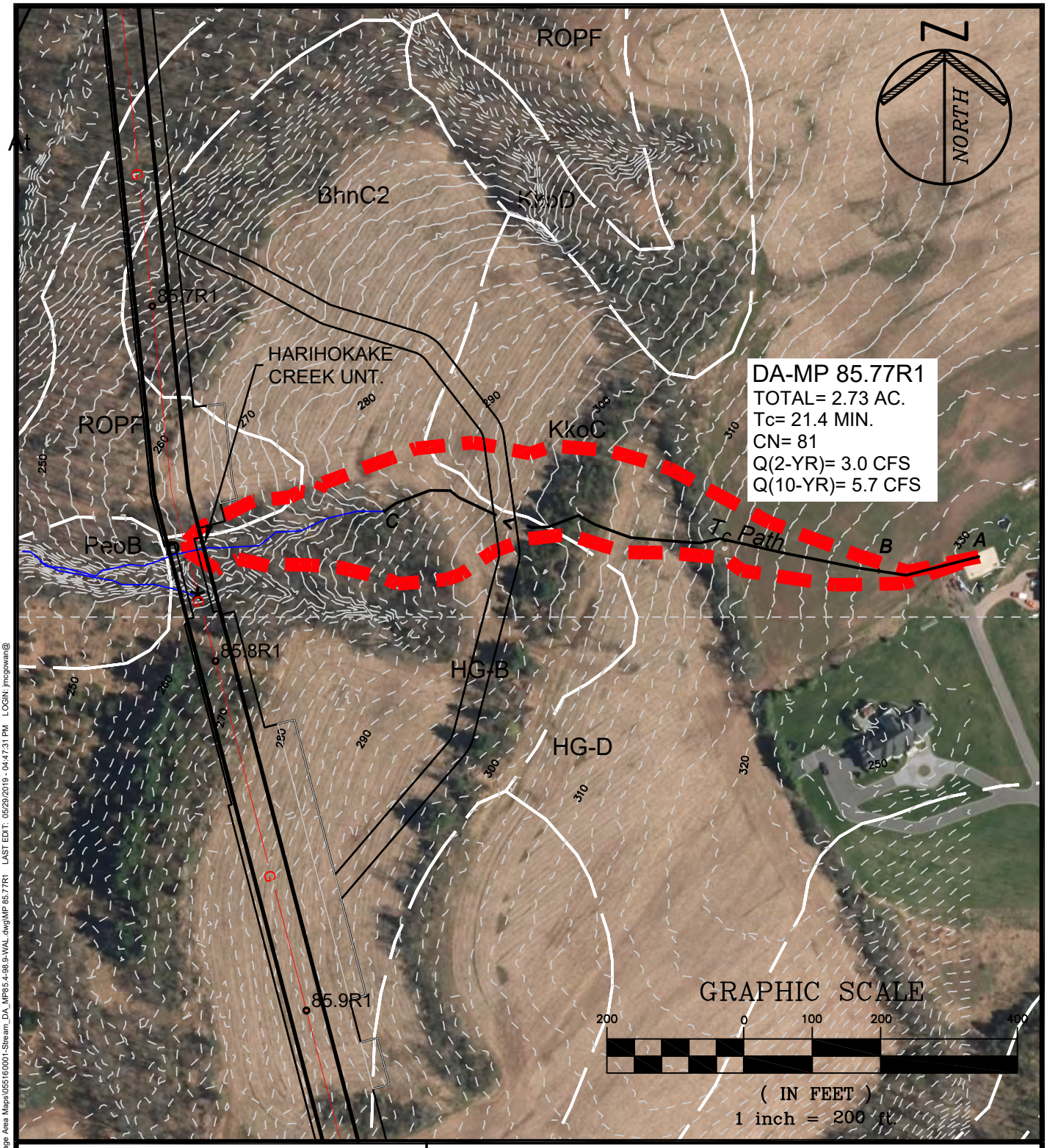
Critical Depth		3.74	ft
Critical Slope		0.01636	ft/ft
Velocity		6.22	ft/s
Velocity Head		0.60	ft
Specific Energy		4.47	ft
Froude Number		0.90	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	3.87	ft
Critical Depth	3.74	ft
Channel Slope	0.01300	ft/ft
Critical Slope	0.01636	ft/ft



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CERTIFICATE OF AUTHORIZATION NO. 24GA28032700

PROJECT TITLE

PENNEAST PIPELINE

HUNTERDON AND MERCER COUNTY, NJ

SHEET TITLE

STREAM CROSSING DRAINAGE AREA MP-85.77R1

PROJ. NO.:	05516.0001	DRN. BY:	JPS	SCALE:	1"=200'
DATE:	05/23/19	CK'D BY:	WS		

FILE NAME: P:\05516\0001\DWGs\CAD\C-Civil\Plotdwgs\Drainage Area Maps\05516\0001-Stream_DA_MP85.4-98.9-WAL.dwg\MP 85.77R1 LAST EDIT: 05/29/2019 - 04:47:31 PM LOGIN: jmcgowan@

Worksheet 2: Runoff curve number and runoff (Approximated)

Project	By	Date
PennEast	JPS	26-Feb-18
Location	**Checked**	**Date**
Hunterdon County, NJ		

Check one: ☐ Present ☒ Developed | MP 85.8-1

1. Runoff curve number

Soil name and hydrologic group (appendix A)	Cover Description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN[1] Table 2-2	CN[1] Figure 2-3	CN[1] Figure 2-4	Area ☒ acres ☐ mi² ☐ %	Product of CN x Area
Type B	Farmstead, Good Condition	74			1.25	92.50
Type D	Farmstead, Good Condition	86			1.48	127.28
1. Use only one CN source per line				Totals ➡	2.73	219.78

CN (weighted) = tot.prod. / tot. area = 219.78 / 2.73 = 80.5 ; Use CN ➡ **81**

2. Runoff

		Storm #1	Storm #2	Storm #3
Frequency……	yr			
Rainfall, P (24-hour)…….	in			
Runoff, Q……	in			

Use P and CN with table 2-1, figure 2-1, or equation 2-3 abd 2-4

PSS&	PROJECT: PennEast	JOB NO. 5516.0001	
		SHEET	DATE:2/12/2018
		BY:	JPS
	SUBJECT: Tc Calculations	CHK'D	

Time of Concentration calculations with the application of the SCS TR-55 methodology.

Watershed or Subarea Designation: DA 85.8-1

Area 2.73 AC

SHEET FLOW

Segment ID		A-B				
Surface Description (Table 3-1)		GRASS				
Manning's Coefficient, n (Table 3-1)		0.240				
Flow Length, L (total <= 150)	(ft)	150				
Two Year Rainfall, P	(in)	3.4				
Land Slope, s	(ft/ft)	0.027				
Computed Tt = 0.007 (nL)^0.8 / P^0.5*s^0.4	(hrs)	0.284				0.284

SHALLOW CONCENTRATED FLOW

Segment ID		B-C				
Surface Description (paved or unpaved)		UNPAVED				
Flow Length, L	(ft)	759				
Watercourse slope, s	(ft/ft)	0.064				
Average Velocity, V (Figure 3-1)	(ft/s)	4.0				
Computed Tt = L / 3600V	(hrs)	0.053				0.053

CHANNEL FLOW

Segment ID		C-D				
Cross sectional Area, a	(sf)	2.46				
Wetted Perimeter, Pw	(ft)	9.75				
Hydraulic Radius, r =a/Pw	(ft)	0.252				
Channel Slope (ft/ft)	(ft/ft)	0.080				
Manning's Roughness Coefficient, n		0.040				
Velocity, V = 1.49r^(2/3)s^0.5 / n	(ft/s)	4.21				
Flow Length, L	(ft)	300				
Computed Tt = L / 3600V	(hrs)	0.020				0.020

Watershed or subarea Tc	0.356	hrs.
	21.4	min.

Use minimum Tc of 10 minutes

Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Wednesday, 02 / 20 / 2019

Hyd. No. 38

DA 85.8-1

Hydrograph type	= SCS Runoff	Peak discharge	= 3.048 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.30 hrs
Time interval	= 6 min	Hyd. volume	= 15,027 cuft
Drainage area	= 2.730 ac	Curve number	= 81.000*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 21.4 min
Total precip.	= 3.26 in	Distribution	= Custom
Storm duration	= C:\Users\IKuzmina\AppData\Local\Autodesk\C3D 2019\enu\HHApps\Hydrograp		

* Composite (Area/CN) = [(1.250 x 74) + (1.480 x 86)] / 2.730

Hydrograph Discharge Table

(Printed values >= 1.00% of Qp.)

Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)
10.20	0.033	12.00	1.069	13.80	0.362	15.60	0.183
10.30	0.038	12.10	1.818	13.90	0.339	15.70	0.180
10.40	0.044	12.20	2.562	14.00	0.322	15.80	0.177
10.50	0.050	12.30	3.048	14.10	0.309	15.90	0.175
10.60	0.057	12.40	2.863	14.20	0.299	16.00	0.172
10.70	0.065	12.50	2.507	14.30	0.290	16.10	0.170
10.80	0.075	12.60	2.043	14.40	0.280	16.20	0.167
10.90	0.088	12.70	1.551	14.50	0.271	16.30	0.165
11.00	0.103	12.80	1.111	14.60	0.262	16.40	0.162
11.10	0.122	12.90	0.919	14.70	0.252	16.50	0.160
11.20	0.144	13.00	0.788	14.80	0.243	16.60	0.157
11.30	0.172	13.10	0.693	14.90	0.233	16.70	0.155
11.40	0.206	13.20	0.615	15.00	0.224	16.80	0.152
11.50	0.244	13.30	0.559	15.10	0.214	16.90	0.150
11.60	0.302	13.40	0.510	15.20	0.205	17.00	0.147
11.70	0.383	13.50	0.466	15.30	0.197	17.10	0.144
11.80	0.511	13.60	0.426	15.40	0.191	17.20	0.142
11.90	0.700	13.70	0.391	15.50	0.186	17.30	0.139

Continues on next page...

Worksheet for M-85.77R1 STA 2+15_2YR_PIPE

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.01400	ft/ft
Discharge	3.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	260.00
0+19	260.00
0+37	258.00
0+44	254.00
0+48	252.60
0+50	252.38
0+52	252.60
0+55	256.00
0+93	256.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 260.00)	(0+93, 256.00)	0.050

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.55	ft
Elevation Range	252.38 to 260.00 ft	
Flow Area	1.74	ft²
Wetted Perimeter	5.07	ft

Worksheet for M-85.77R1 STA 2+15_2YR_PIPE

Results

Hydraulic Radius		0.34	ft
Top Width		4.86	ft
Normal Depth		0.55	ft
Critical Depth		0.40	ft
Critical Slope		0.06004	ft/ft
Velocity		1.72	ft/s
Velocity Head		0.05	ft
Specific Energy		0.60	ft
Froude Number		0.51	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.55	ft
Critical Depth	0.40	ft
Channel Slope	0.01400	ft/ft
Critical Slope	0.06004	ft/ft

Worksheet for MP-85.77_STA2+05_BRIDGE_2YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.09800	ft/ft
Discharge	3.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	260.00
0+25	260.00
0+37	258.00
0+41	256.00
0+44	254.00
0+48	254.10
0+50	252.51
0+55	258.00
0+87	258.00
0+99	256.00
1+00	256.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 260.00)	(1+00, 256.00)	0.050

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.82	ft
Elevation Range	252.51 to 260.00 ft	

Worksheet for MP-85.77_STA2+05_BRIDGE_2YR

Results

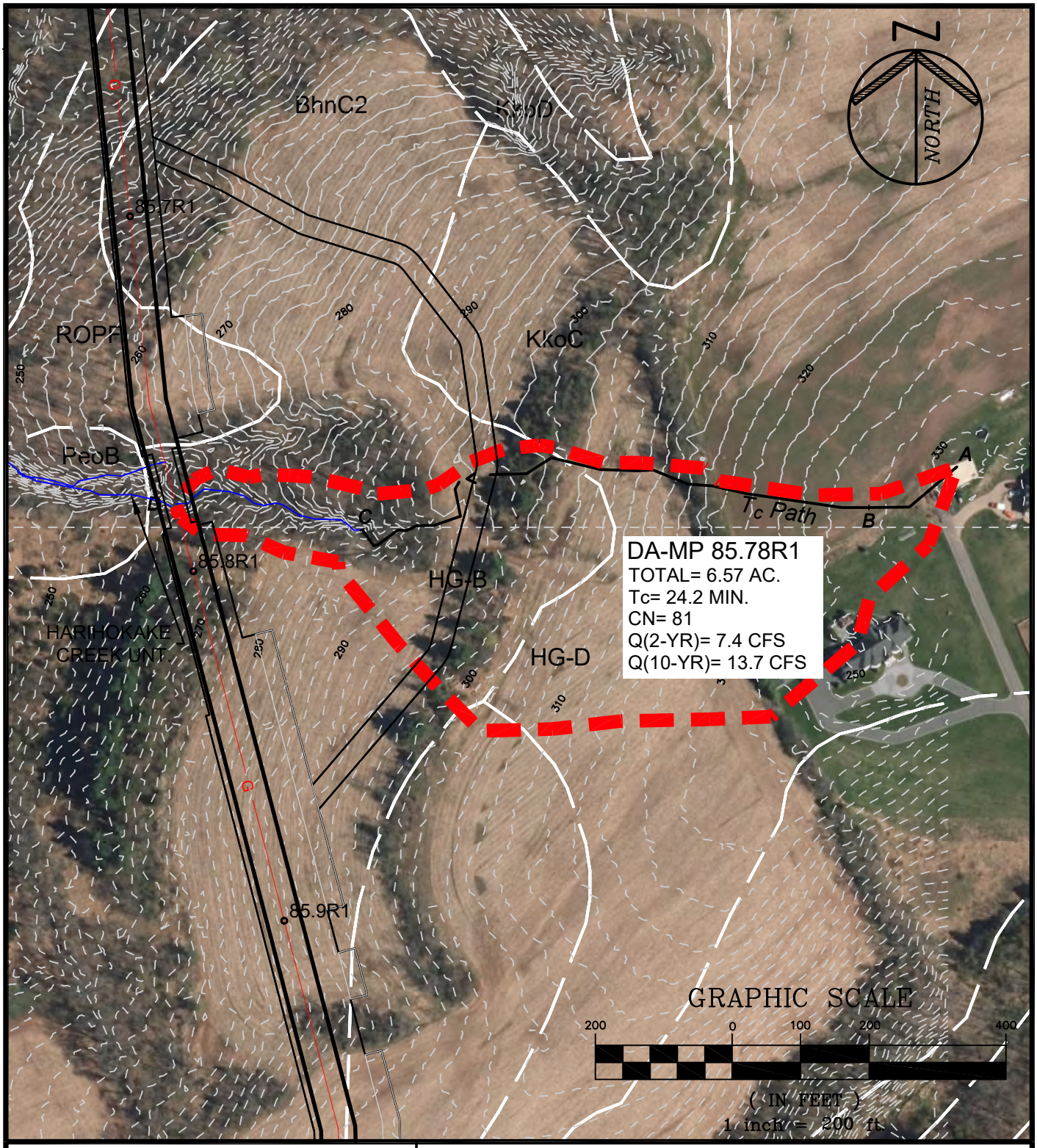
Flow Area		0.72	ft²
Wetted Perimeter		2.41	ft
Hydraulic Radius		0.30	ft
Top Width		1.77	ft
Normal Depth		0.82	ft
Critical Depth		0.86	ft
Critical Slope		0.07300	ft/ft
Velocity		4.16	ft/s
Velocity Head		0.27	ft
Specific Energy		1.08	ft
Froude Number		1.15	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.82	ft
Critical Depth	0.86	ft
Channel Slope	0.09800	ft/ft
Critical Slope	0.07300	ft/ft



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CERTIFICATE OF AUTHORIZATION NO. 24GA28032700

PROJECT TITLE

PENNEAST PIPELINE

HUNTERDON AND MERCER COUNTY, NJ

SHEET TITLE

STREAM CROSSING DRAINAGE AREA MP-85.78R1

PROJ. NO.: 05516.0001	DRN. BY: JPS	SCALE: 1"=200'
DATE: 05/23/19	CK'D BY: WS	

FILE NAME: P:\05516\0001\DWGs\CAD\C-Civil\Plotdwgs\Drainage Area Maps\05516\0001-Stream_DA_MP85.4-98.9-WAL.dwg\MP 85.78R1 LAST EDIT: 05/29/2019 - 04:50:48 PM LOGIN: jmcgowan@

Worksheet 2: Runoff curve number and runoff (Approximated)

Project	By	Date
PennEast	JPS	26-Feb-18
Location	**Checked**	**Date**
Hunterdon County, NJ		

Check one: ☐ Present ☒ Developed | MP 85.8-2

1. Runoff curve number

Soil name and hydrologic group (appendix A)	Cover Description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN[1] Table 2-2	CN[1] Figure 2-3	CN[1] Figure 2-4	Area ☒ acres / ☐ mi² / ☐ %	Product of CN x Area
Type B	Farmstead, Good Condition	74			2.80	207.20
Type D	Farmstead, Good Condition	86			3.80	326.80
				Totals ➡	6.60	534.00

1. Use only one CN source per line

CN (weighted) = tot.prod. / tot. area = 534.00 / 6.60 = 80.9 ; Use CN ➡ **81**

2. Runoff

		Storm #1	Storm #2	Storm #3
Frequency……	yr			
Rainfall, P (24-hour)…….	in			
Runoff, Q……	in			

Use P and CN with table 2-1, figure 2-1, or equation 2-3 abd 2-4

PSS&	PROJECT: PennEast	JOB NO. 5516.0001	
		SHEET	DATE:2/12/2018
		BY:	JPS
	SUBJECT: Tc Calculations	CHK'D	

Time of Concentration calculations with the application of the SCS TR-55 methodology.

Watershed or Subarea Designation: DA 85.8-2

Area 6.57 AC

SHEET FLOW

Segment ID		A-B				
Surface Description (Table 3-1)		GRASS				
Manning's Coefficient, n (Table 3-1)		0.240				
Flow Length, L (total <= 150)	(ft)	150				
Two Year Rainfall, P	(in)	3.4				
Land Slope, s	(ft/ft)	0.020				
Computed Tt = 0.007 (nL)^0.8 / P^0.5*s^0.4	(hrs)	0.320				0.320

SHALLOW CONCENTRATED FLOW

Segment ID		B-C				
Surface Description (paved or unpaved)		UNPAVED				
Flow Length, L	(ft)	838				
Watercourse slope, s	(ft/ft)	0.059				
Average Velocity, V (Figure 3-1)	(ft/s)	3.6				
Computed Tt = L / 3600V	(hrs)	0.065				0.065

CHANNEL FLOW

Segment ID		C-D				
Cross sectional Area, a	(sf)	2.46				
Wetted Perimeter, Pw	(ft)	9.75				
Hydraulic Radius, r =a/Pw	(ft)	0.252				
Channel Slope (ft/ft)	(ft/ft)	0.084				
Manning's Roughness Coefficient, n		0.040				
Velocity, V = 1.49r^(2/3)s^0.5 / n	(ft/s)	4.31				
Flow Length, L	(ft)	297				
Computed Tt = L / 3600V	(hrs)	0.019				0.019

Watershed or subarea Tc	0.404	hrs.
	24.2	min.

Use minimum Tc of 10 minutes

Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Wednesday, 02 / 20 / 2019

Hyd. No. 12

DA 85.8-2

Hydrograph type	= SCS Runoff	Peak discharge	= 7.370 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.30 hrs
Time interval	= 6 min	Hyd. volume	= 36,329 cuft
Drainage area	= 6.600 ac	Curve number	= 81.000*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 24.2 min
Total precip.	= 3.26 in	Distribution	= Custom
Storm duration	= C:\Users\IKuzmina\AppData\Local\Autodesk\C3D2019\enu\HHApps\Hydrograp		

* Composite (Area/CN) = [(2.800 x 74) + (3.800 x 86)] / 6.600

Hydrograph Discharge Table

(Printed values >= 1.00% of Qp.)

Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)
10.20	0.080	12.00	2.585	13.80	0.875	15.60	0.442
10.30	0.093	12.10	4.396	13.90	0.821	15.70	0.435
10.40	0.106	12.20	6.193	14.00	0.779	15.80	0.429
10.50	0.120	12.30	7.370	14.10	0.748	15.90	0.423
10.60	0.137	12.40	6.921	14.20	0.722	16.00	0.417
10.70	0.157	12.50	6.062	14.30	0.700	16.10	0.411
10.80	0.182	12.60	4.939	14.40	0.678	16.20	0.405
10.90	0.213	12.70	3.751	14.50	0.655	16.30	0.399
11.00	0.250	12.80	2.685	14.60	0.633	16.40	0.393
11.10	0.295	12.90	2.221	14.70	0.610	16.50	0.386
11.20	0.349	13.00	1.906	14.80	0.587	16.60	0.380
11.30	0.416	13.10	1.675	14.90	0.564	16.70	0.374
11.40	0.497	13.20	1.487	15.00	0.541	16.80	0.368
11.50	0.589	13.30	1.352	15.10	0.517	16.90	0.362
11.60	0.731	13.40	1.232	15.20	0.495	17.00	0.355
11.70	0.927	13.50	1.126	15.30	0.476	17.10	0.349
11.80	1.235	13.60	1.029	15.40	0.461	17.20	0.343
11.90	1.693	13.70	0.945	15.50	0.450	17.30	0.337

Continues on next page...

Worksheet for M-85.78R1 STA 4+10_2YR_PIPE

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.09900	ft/ft
Discharge	7.40	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	258.00
0+32	258.00
0+50	251.31
0+56	252.10
0+64	256.00
0+69	258.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 258.00)	(0+69, 258.00)	0.050

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.59	ft
Elevation Range	251.31 to 258.00 ft	
Flow Area	1.80	ft²
Wetted Perimeter	6.21	ft
Hydraulic Radius	0.29	ft
Top Width	6.07	ft
Normal Depth	0.59	ft

Worksheet for M-85.78R1 STA 4+10_2YR_PIPE

Results

Critical Depth		0.67	ft
Critical Slope		0.05424	ft/ft
Velocity		4.10	ft/s
Velocity Head		0.26	ft
Specific Energy		0.86	ft
Froude Number		1.33	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.59	ft
Critical Depth	0.67	ft
Channel Slope	0.09900	ft/ft
Critical Slope	0.05424	ft/ft

Worksheet for MP-85.78MR1_STA3+98_BRIDGE_2YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.09130	ft/ft
Discharge	7.40	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	260.00
0+27	260.00
0+32	258.00
0+40	256.00
0+41	256.00
0+50	252.46
0+56	253.30
0+62	258.00
0+80	260.00
1+00	260.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 260.00)	(1+00, 260.00)	0.050

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.61	ft
Elevation Range	252.46 to 260.00 ft	
Flow Area	1.85	ft²

Worksheet for MP-85.78MR1_STA3+98_BRIDGE_2YR

Results

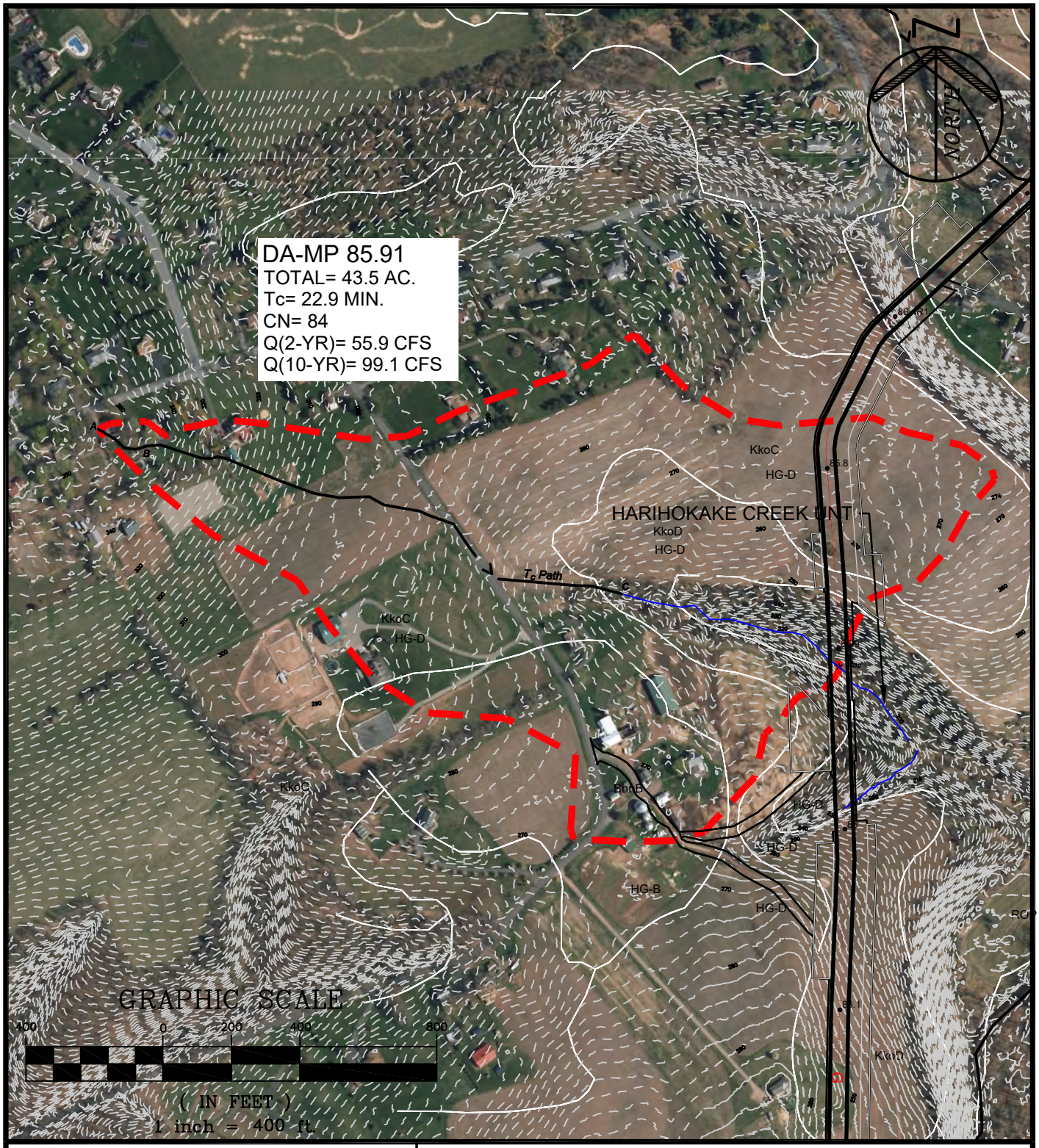
Wetted Perimeter		6.25	ft
Hydraulic Radius		0.30	ft
Top Width		6.10	ft
Normal Depth		0.61	ft
Critical Depth		0.67	ft
Critical Slope		0.05421	ft/ft
Velocity		3.99	ft/s
Velocity Head		0.25	ft
Specific Energy		0.86	ft
Froude Number		1.28	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.61	ft
Critical Depth	0.67	ft
Channel Slope	0.09130	ft/ft
Critical Slope	0.05421	ft/ft



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CERTIFICATE OF AUTHORIZATION NO. 24GA28032700

PROJECT TITLE

PENNEAST PIPELINE

HUNTERDON AND MERCER COUNTY, NJ

SHEET TITLE

STREAM CROSSING DRAINAGE AREA MP-85.91

PROJ. NO.: 05516.0001	DRN. BY: JPS	SCALE: 1"=400'
DATE: 05/23/19	CK'D BY: WS	

FILE NAME: P:\05516\0001\DWGs\CADC-Civil\Plotdwgs\Drainage Area Maps\055160001-Stream_DA_MP85.4-98.9-WAL.dwg\MP 85.91 LAST EDIT: 05/29/2019 - 04:57:56 PM LOGIN: jmcgowan@

Worksheet 2: Runoff curve number and runoff (Approximated)

Project	By	Date
PennEast	JPS	26-Feb-18
Location	**Checked**	**Date**
Hunterdon County, NJ		

Check one: ☐ Present ☒ Developed | MP 85.91

1. Runoff curve number

Soil name and hydrologic group (appendix A)	Cover Description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN[1] Table 2-2	CN[1] Figure 2-3	CN[1] Figure 2-4	Area X acres mi² %	Product of CN x Area
Type B	Farmstead, Good Condition	74			6.60	488.40
Type D	Farmstead, Good Condition	86			36.90	3,173.40
1. Use only one CN source per line				Totals ➡	43.50	3,661.80

CN (weighted) = tot.prod. / tot. area = 3,661.80 / 43.50 = 84.2 ; Use CN ➡ **84**

2. Runoff

		Storm #1	Storm #2	Storm #3
Frequency……	yr			
Rainfall, P (24-hour)…….	in			
Runoff, Q……	in			

Use P and CN with table 2-1, figure 2-1, or equation 2-3 abd 2-4

PSS &	PROJECT: PennEast	JOB NO. 5516.0001	
		SHEET	DATE:2/12/2018
		BY:	JPS
	SUBJECT: Tc Calculations	CHK'D	

Time of Concentration calculations with the application of the SCS TR-55 methodology.

Watershed or Subarea Designation: DA 85.91

Area 43.5 AC

SHEET FLOW

Segment ID		A-B				
Surface Description (Table 3-1)		GRASS				
Manning's Coefficient, n (Table 3-1)		0.240				
Flow Length, L (total <= 150)	(ft)	150				
Two Year Rainfall, P	(in)	3.4				
Land Slope, s	(ft/ft)	0.040				
Computed Tt = 0.007 (nL)^0.8 / P^0.5*s^0.4	(hrs)	0.243				0.243

SHALLOW CONCENTRATED FLOW

Segment ID		B-C				
Surface Description (paved or unpaved)		UNPAVED				
Flow Length, L	(ft)	1529				
Watercourse slope, s	(ft/ft)	0.060				
Average Velocity, V (Figure 3-1)	(ft/s)	4.0				
Computed Tt = L / 3600V	(hrs)	0.106				0.106

CHANNEL FLOW

Segment ID		C-D				
Cross sectional Area, a	(sf)	9.75				
Wetted Perimeter, Pw	(ft)	17.97				
Hydraulic Radius, r =a/Pw	(ft)	0.543				
Channel Slope (ft/ft)	(ft/ft)	0.056				
Manning's Roughness Coefficient, n		0.040				
Velocity, V = 1.49r^(2/3)s^0.5 / n	(ft/s)	5.86				
Flow Length, L	(ft)	696				
Computed Tt = L / 3600V	(hrs)	0.033				0.033

Watershed or subarea Tc	0.382	hrs.
	22.9	min.

Use minimum Tc of 10 minutes

Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Wednesday, 02 / 20 / 2019

Hyd. No. 39

DA 85.9

Hydrograph type	= SCS Runoff	Peak discharge	= 55.94 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.30 hrs
Time interval	= 6 min	Hyd. volume	= 273,602 cuft
Drainage area	= 43.500 ac	Curve number	= 84.000*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 22.9 min
Total precip.	= 3.26 in	Distribution	= Custom
Storm duration	= C:\Users\IKuzmina\AppData\Local\Autodesk\C3D 2019\enu\HHApps\Hydrograp		

* Composite (Area/CN) = [(6.600 x 74) + (36.900 x 86)] / 43.500

Hydrograph Discharge Table

(Printed values >= 1.00% of Qp.)

Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)
9.60	0.566	11.40	4.576	13.20	10.70	15.00	3.843
9.70	0.638	11.50	5.318	13.30	9.718	15.10	3.675
9.80	0.716	11.60	6.458	13.40	8.845	15.20	3.517
9.90	0.799	11.70	8.021	13.50	8.072	15.30	3.381
10.00	0.888	11.80	10.46	13.60	7.375	15.40	3.275
10.10	0.982	11.90	14.03	13.70	6.765	15.50	3.194
10.20	1.082	12.00	20.87	13.80	6.258	15.60	3.134
10.30	1.187	12.10	34.43	13.90	5.865	15.70	3.084
10.40	1.299	12.20	47.64	14.00	5.566	15.80	3.040
10.50	1.415	12.30	55.94	14.10	5.336	15.90	2.997
10.60	1.551	12.40	52.06	14.20	5.153	16.00	2.953
10.70	1.720	12.50	45.21	14.30	4.992	16.10	2.910
10.80	1.940	12.60	36.52	14.40	4.831	16.20	2.867
10.90	2.209	12.70	27.48	14.50	4.668	16.30	2.824
11.00	2.524	12.80	19.51	14.60	4.504	16.40	2.780
11.10	2.901	12.90	16.09	14.70	4.340	16.50	2.735
11.20	3.358	13.00	13.77	14.80	4.175	16.60	2.691
11.30	3.917	13.10	12.07	14.90	4.009	16.70	2.647

Continues on next page...

Worksheet for M-85.91 STA 1+13_2YR_PIPE

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.02000	ft/ft
Discharge	55.90	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	216.00
0+03	216.00
0+46	209.60
0+50	206.60
0+53	206.03
0+63	206.10
0+70	209.50
0+95	212.00
1+00	212.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 216.00)	(1+00, 212.00)	0.050

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	1.13	ft
Elevation Range	206.03 to 216.00 ft	
Flow Area	14.36	ft²
Wetted Perimeter	16.12	ft

Worksheet for M-85.91 STA 1+13_2YR_PIPE

Results

Hydraulic Radius		0.89	ft
Top Width		15.63	ft
Normal Depth		1.13	ft
Critical Depth		0.93	ft
Critical Slope		0.04128	ft/ft
Velocity		3.89	ft/s
Velocity Head		0.24	ft
Specific Energy		1.36	ft
Froude Number		0.72	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.13	ft
Critical Depth	0.93	ft
Channel Slope	0.02000	ft/ft
Critical Slope	0.04128	ft/ft

Worksheet for M-85.91 STA 1+42_10YR_BRIDGE

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.03150	ft/ft
Discharge	99.10	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	218.00
0+02	218.00
0+28	210.00
0+45	208.80
0+51	205.92
0+80	212.00
0+94	216.00
1+00	222.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 218.00)	(1+00, 222.00)	0.050

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	2.28	ft
Elevation Range	205.92 to 222.00 ft	
Flow Area	17.75	ft²
Wetted Perimeter	16.31	ft
Hydraulic Radius	1.09	ft

Worksheet for M-85.91 STA 1+42_10YR_BRIDGE

Results

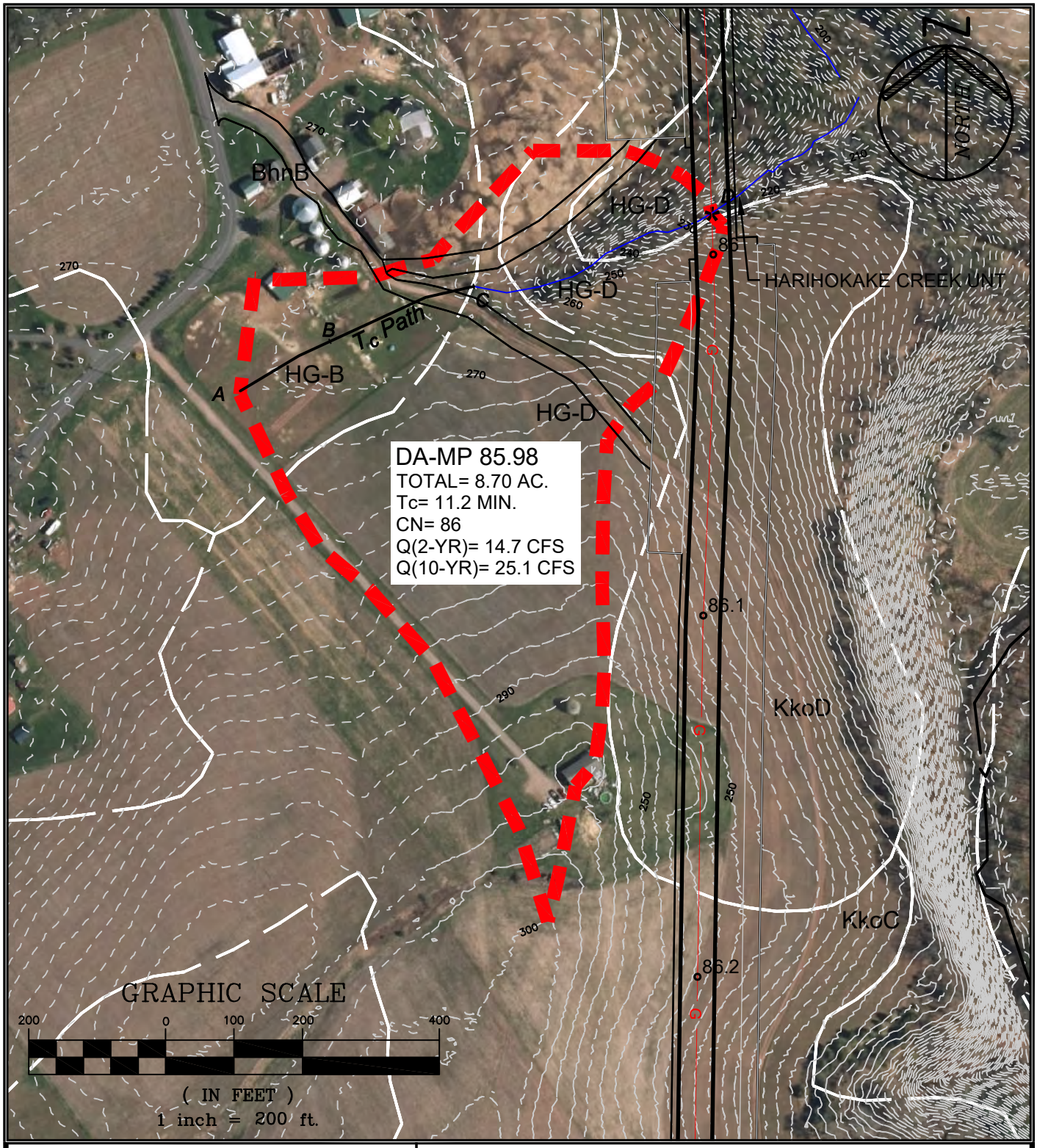
Top Width		15.55	ft
Normal Depth		2.28	ft
Critical Depth		2.21	ft
Critical Slope		0.03756	ft/ft
Velocity		5.58	ft/s
Velocity Head		0.48	ft
Specific Energy		2.77	ft
Froude Number		0.92	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	2.28	ft
Critical Depth	2.21	ft
Channel Slope	0.03150	ft/ft
Critical Slope	0.03756	ft/ft



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WALL, NEW JERSEY 07727
PHONE: (848) 206-2626

CERTIFICATE OF AUTHORIZATION NO. 24GA28032700

PROJECT TITLE

PENNEAST PIPELINE

HUNTERDON AND MERCER COUNTY, NJ

SHEET TITLE

STREAM CROSSING DRAINAGE AREA MP-85.98

PROJ. NO.: 05516.0001	DRN. BY: JPS	SCALE: 1"=200'
DATE: 05/23/19	CK'D BY: WS	

FILE NAME: P:\05516\0001\DWGs\CADC-Civil\Plotdwgs\Drainage Area Maps\055160001-Stream_DA_MP85.4-98.9-WAL.dwg\MP 85.98 LAST EDIT: 06/13/2019 - 01:59:35 PM LOGIN: jmcgowan@

Worksheet 2: Runoff curve number and runoff (Approximated)

Project	By	Date
PennEast	JPS	26-Feb-18
Location	**Checked**	**Date**
Hunterdon County, NJ		

Check one: ☐ Present ☒ Developed | MP 85.98

1. Runoff curve number

Soil name and hydrologic group (appendix A)	Cover Description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN[1] Table 2-2	CN[1] Figure 2-3	CN[1] Figure 2-4	Area X acres / mi² / %	Product of CN x Area
Type D	Farmstead, Good Condition	86			8.70	748.20
1. Use only one CN source per line				**Totals** ➡	8.70	748.20

CN (weighted) = tot.prod. / tot. area = 748.20 / 8.70 = 86.0 ; **Use CN** ➡ **86**

2. Runoff

		Storm #1	Storm #2	Storm #3
Frequency…….	yr			
Rainfall, P (24-hour)…….	in			
Runoff, Q……	in			

Use P and CN with table 2-1, figure 2-1, or equation 2-3 abd 2-4

PROJECT:	PennEast	JOB NO. 5516.0001	
		SHEET	DATE:2/12/2018
		BY:	JPS
SUBJECT:	Tc Calculations	CHK'D	

Time of Concentration calculations with the application of the SCS TR-55 methodology.

Watershed or Subarea Designation: DA 85.98

Area 8.70 AC

SHEET FLOW

Segment ID		A-B			
Surface Description (Table 3-1)		CULTIVATED			
Manning's Coefficient, n (Table 3-1)		0.060			
Flow Length, L (total <= 150)	(ft)	150			
Two Year Rainfall, P	(in)	3.4			
Land Slope, s	(ft/ft)	0.010			
Computed Tt = 0.007 (nL)^0.8 / P^0.5*s^0.4	(hrs)	0.139			0.139

SHALLOW CONCENTRATED FLOW

Segment ID		B-C			
Surface Description (paved or unpaved)		UNPAVED			
Flow Length, L	(ft)	226			
Watercourse slope, s	(ft/ft)	0.024			
Average Velocity, V (Figure 3-1)	(ft/s)	2.2			
Computed Tt = L / 3600V	(hrs)	0.029			0.029

CHANNEL FLOW

Segment ID		C-D			
Cross sectional Area, a	(sf)	2.46			
Wetted Perimeter, Pw	(ft)	7.28			
Hydraulic Radius, r =a/Pw	(ft)	0.338			
Channel Slope (ft/ft)	(ft/ft)	0.101			
Manning's Roughness Coefficient, n		0.040			
Velocity, V = 1.49r^(2/3)s^0.5 / n	(ft/s)	5.74			
Flow Length, L	(ft)	376			
Computed Tt = L / 3600V	(hrs)	0.018			0.018

Watershed or subarea Tc	0.186	hrs.
	11.2	min.

Use minimum Tc of 10 minutes

Hydrograph Report

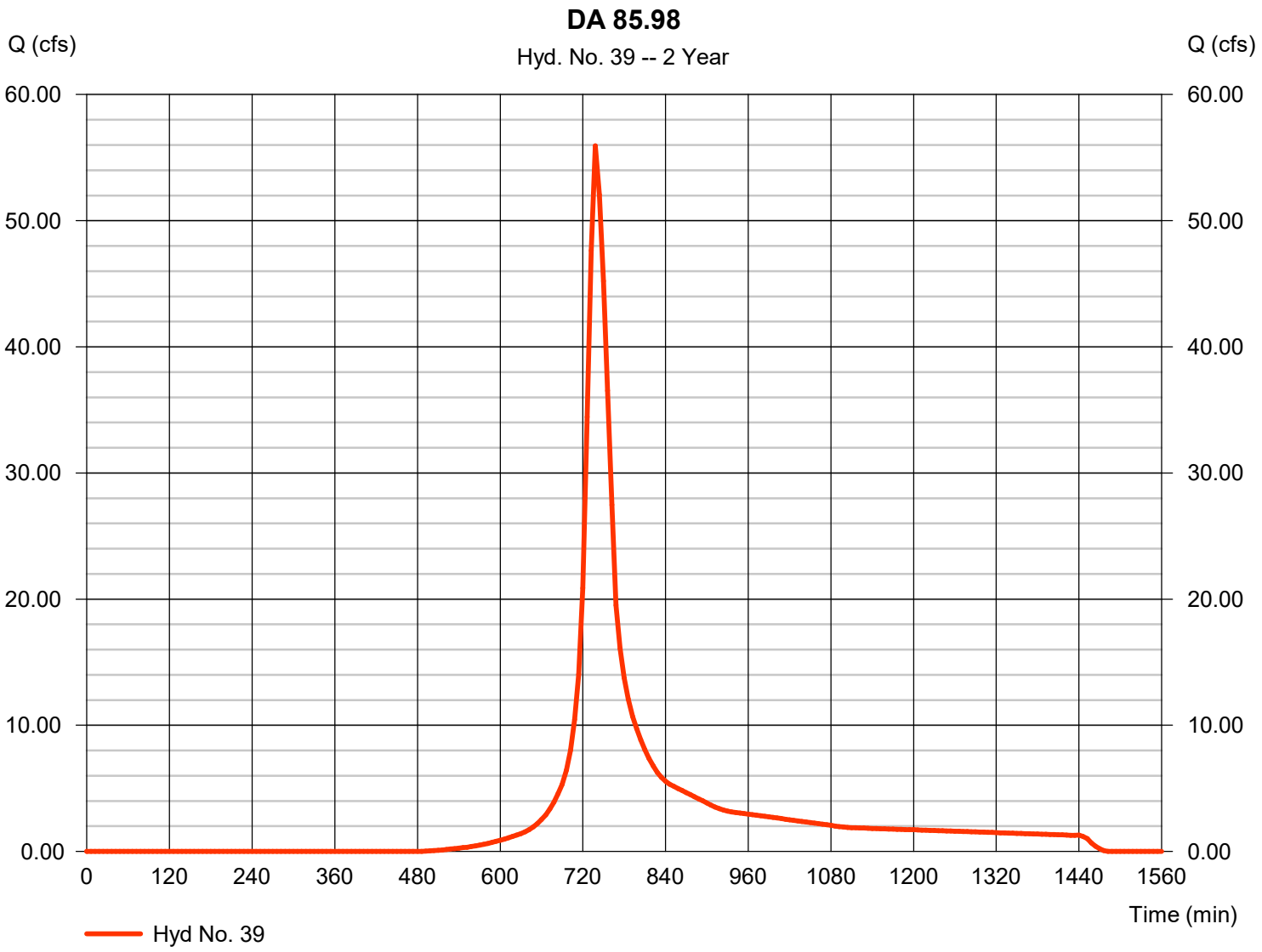
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 06 / 13 / 2019

Hyd. No. 39

DA 85.98

Hydrograph type	= SCS Runoff	Peak discharge	= 55.94 cfs
Storm frequency	= 2 yrs	Time to peak	= 738 min
Time interval	= 6 min	Hyd. volume	= 273,602 cuft
Drainage area	= 43.500 ac	Curve number	= 84*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 22.90 min
Total precip.	= 3.26 in	Distribution	= Custom
Storm duration	= C:\Users\IKuzmina\AppData\Local\Autodesk\C3D 2019\enu\AHHApps\Hydrograph	Shape factor	= 484

* Composite (Area/CN) = [(6.600 x 74) + (36.900 x 86)] / 43.500



Worksheet for M-85.98 STA 0+41_2YR_PIPE

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.05000	ft/ft
Discharge	14.70	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	238.00
0+25	236.00
0+41	228.00
0+52	221.98
0+56	226.60
0+74	228.00
0+88	232.00
1+00	234.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 238.00)	(1+00, 234.00)	0.050

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	1.47	ft
Elevation Range	221.98 to 238.00 ft	
Flow Area	3.11	ft²
Wetted Perimeter	5.20	ft
Hydraulic Radius	0.60	ft

Worksheet for M-85.98 STA 0+41_2YR_PIPE

Results

Top Width		4.22	ft
Normal Depth		1.47	ft
Critical Depth		1.46	ft
Critical Slope		0.05340	ft/ft
Velocity		4.72	ft/s
Velocity Head		0.35	ft
Specific Energy		1.82	ft
Froude Number		0.97	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.47	ft
Critical Depth	1.46	ft
Channel Slope	0.05000	ft/ft
Critical Slope	0.05340	ft/ft

Worksheet for M-85.98 STA 0+67_2YR_BRIDGE

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.06500	ft/ft
Discharge	14.70	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	240.00
0+06	238.00
0+14	236.00
0+21	234.00
0+25	232.00
0+41	224.00
0+50	220.54
0+56	223.40
0+61	224.00
0+67	226.00
0+75	230.00
0+81	232.00
0+88	234.00
1+00	236.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 240.00)	(1+00, 236.00)	0.050

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Worksheet for M-85.98 STA 0+67_2YR_BRIDGE

Results

Normal Depth		1.11	ft
Elevation Range	220.54 to 240.00 ft		
Flow Area		3.02	ft²
Wetted Perimeter		5.87	ft
Hydraulic Radius		0.51	ft
Top Width		5.43	ft
Normal Depth		1.11	ft
Critical Depth		1.18	ft
Critical Slope		0.04825	ft/ft
Velocity		4.87	ft/s
Velocity Head		0.37	ft
Specific Energy		1.48	ft
Froude Number		1.15	
Flow Type	Supercritical		

GVF Input Data

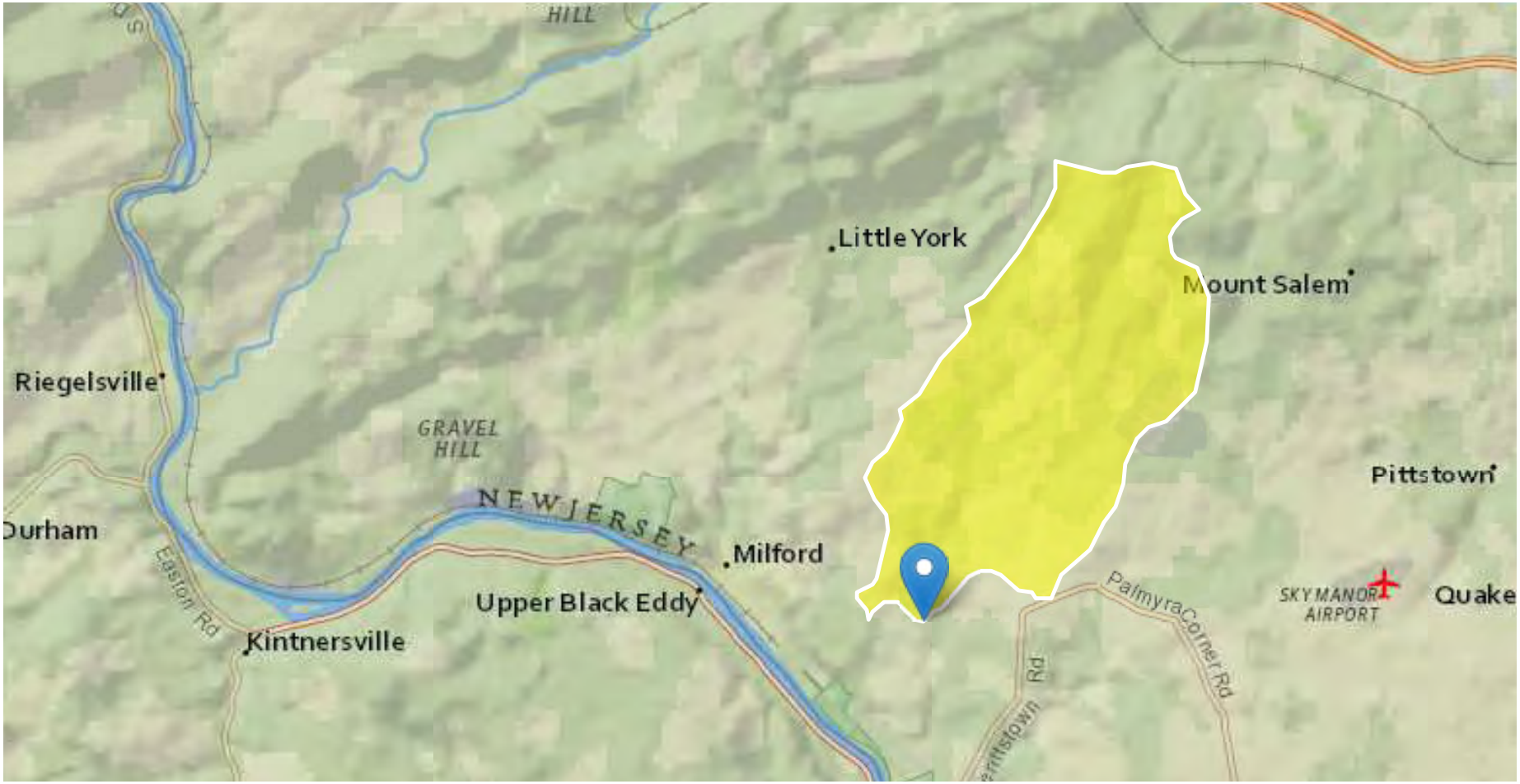
Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.11	ft
Critical Depth	1.18	ft
Channel Slope	0.06500	ft/ft
Critical Slope	0.04825	ft/ft

MP 86.29R1

Region ID: NJ
Workspace ID: NJ20170807105635586000
Clicked Point (Latitude, Longitude): 40.56147, -75.05986
Time: 2017-08-07 10:57:52 -0400



Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	7.94	square miles
STORAGE	Percentage of area of storage (lakes ponds reservoirs wetlands)	7.45	percent
CSL10_85	Change in elevation divided by length between points 10 and 85 percent of distance along main channel to basin divide - main channel method not known	91	feet per mi
POPDENS	Basin Population Density	178	persons per square mile

Peak-Flow Statistics Parameters [Peak Unglaciated Piedmont Region 2009 5167]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	7.94	square miles	0.25	779
STORAGE	Percent Storage	7.45	percent	0.23	32
CSL10_85	Stream Slope 10 and 85 Method	91	feet per mi	4.31	191
POPDENS	Basin Population Density	178	persons per square mile	83	11084

Peak-Flow Statistics Flow Report [Peak Unglaciated Piedmont Region 2009 5167]

PIl: Prediction Interval-Lower, Plu: Prediction Interval-Upper, SEp: Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	SEe	SEp	Equiv. Yrs.
2 Year Peak Flood	961	ft^3/s	49	50.3	1
5 Year Peak Flood	1580	ft^3/s	49.4	50.9	2
10 Year Peak Flood	2050	ft^3/s	50.5	52.2	3

Statistic	Value	Unit	SEe	SEp	Equiv. Yrs.
25 Year Peak Flood	2730	ft^3/s	52.6	54.5	4
50 Year Peak Flood	3260	ft^3/s	54.7	56.8	5
100 Year Peak Flood	3870	ft^3/s	57.1	59.5	5
500 Year Peak Flood	5360	ft^3/s	63.9	66.3	6

Peak-Flow Statistics Citations

Watson, K.M.,and Schopp, R.D.,2009, Methodology for estimation of flood magnitude and frequency for New Jersey streams, U.S. Geological Survey Scientific Investigations Report 2009-5167, 51 p. (http://pubs.usgs.gov/sir/2009/5167/)

Worksheet for MP-86.29R1_STA0+36_2YR_PIPE

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.02000	ft/ft
Discharge	961.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	200.00
0+01	200.00
0+08	196.00
0+12	194.00
0+29	190.60
0+48	187.81
0+72	190.50
1+00	192.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 200.00)	(1+00, 192.00)	0.030

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	3.54	ft
Elevation Range	187.81 to 200.00 ft	
Flow Area	100.36	ft²
Wetted Perimeter	62.81	ft
Hydraulic Radius	1.60	ft

Worksheet for MP-86.29R1_STA0+36_2YR_PIPE

Results

Top Width		62.35	ft
Normal Depth		3.54	ft
Critical Depth		3.94	ft
Critical Slope		0.01095	ft/ft
Velocity		9.58	ft/s
Velocity Head		1.42	ft
Specific Energy		4.96	ft
Froude Number		1.33	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	3.54	ft
Critical Depth	3.94	ft
Channel Slope	0.02000	ft/ft
Critical Slope	0.01095	ft/ft

Worksheet for MP-86.29R1_STA0+61_2YR_BRIDGE

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.02000	ft/ft
Discharge	961.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	212.00
0+07	208.00
0+14	203.00
0+23	196.00
0+30	192.00
0+48	186.85
0+69	189.70
0+84	190.00
1+00	192.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 212.00)	(1+00, 192.00)	0.030

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	3.94	ft
Elevation Range	186.85 to 212.00 ft	
Flow Area	96.71	ft²
Wetted Perimeter	57.24	ft

Worksheet for MP-86.29R1_STA0+61_2YR_BRIDGE

Results

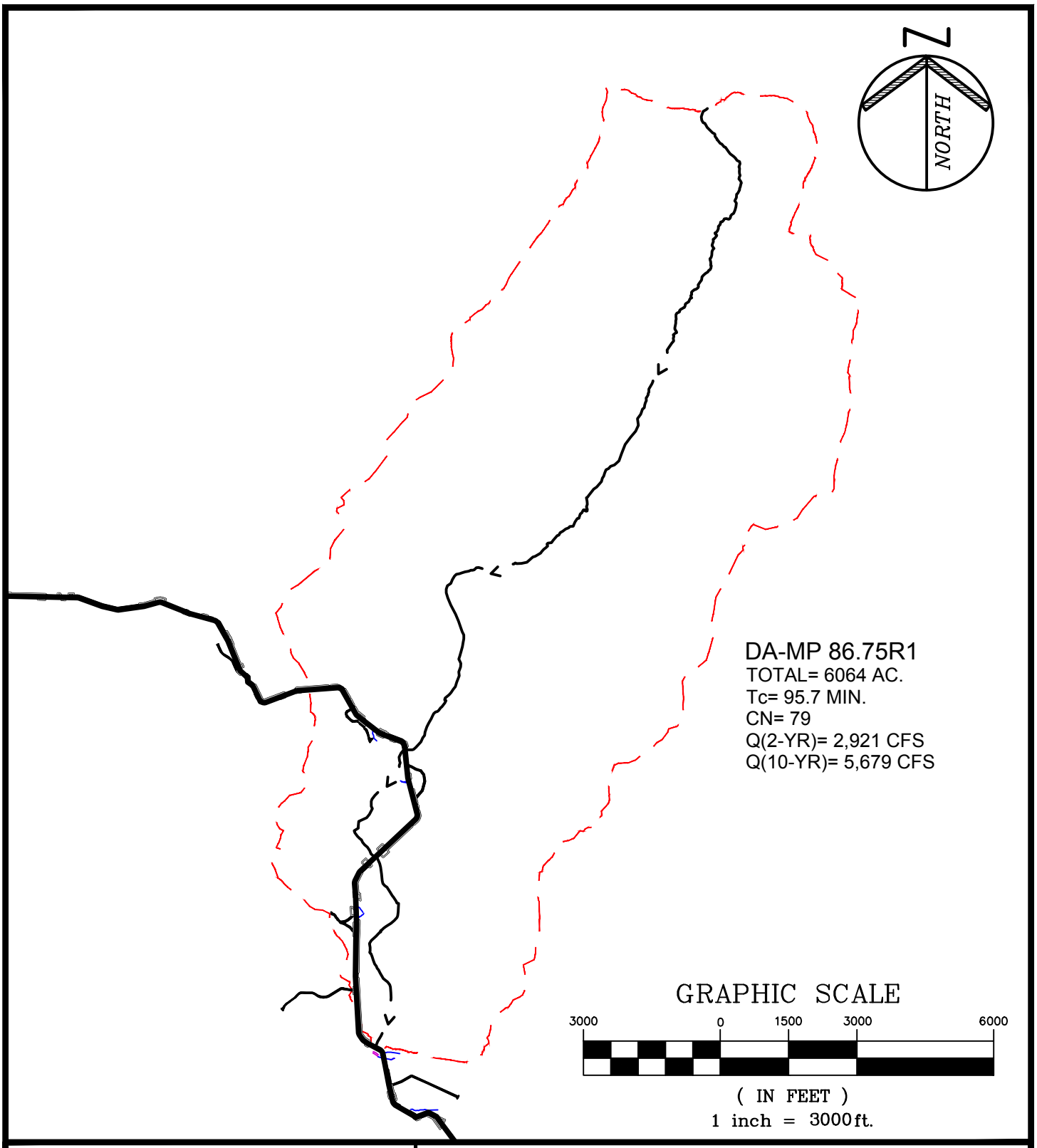
Hydraulic Radius		1.69	ft
Top Width		56.44	ft
Normal Depth		3.94	ft
Critical Depth		4.35	ft
Critical Slope		0.01066	ft/ft
Velocity		9.94	ft/s
Velocity Head		1.53	ft
Specific Energy		5.48	ft
Froude Number		1.34	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	3.94	ft
Critical Depth	4.35	ft
Channel Slope	0.02000	ft/ft
Critical Slope	0.01066	ft/ft



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CERTIFICATE OF AUTHORIZATION NO. 24GA28032700

PROJECT TITLE

PENNEAST PIPELINE

HUNTERDON AND MERCER COUNTY, NJ

SHEET TITLE

STREAM CROSSING DRAINAGE AREA MP-86.75R1

PROJ. NO.: 05516.0001	DRN. BY: JPS	SCALE: 1"=3000'
DATE: 05/23/19	CK'D BY: WS	

FILE NAME: P:\05516\0001\DWGs\CAD\C-Civil\Plotdwgs\Drainage Area Maps\055160001-Stream_DA_MP85.4-98.9-1-WAL.dwg\MP 86.7R1 LAST EDIT: 07/25/2019 - 03:52:03 PM LOGIN: jschooling@

Worksheet for M-86.75 STA 2+05_2YR_PIPE

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00500	ft/ft
Discharge	1050.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	146.00
0+22	145.00
0+23	145.50
0+50	142.37
0+78	146.50
0+83	147.50
0+88	148.00
1+00	148.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 146.00)	(1+00, 148.00)	0.030

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	4.48	ft
Elevation Range	142.37 to 148.00 ft	
Flow Area	177.76	ft²
Wetted Perimeter	81.16	ft
Hydraulic Radius	2.19	ft

Worksheet for M-86.75 STA 2+05_2YR_PIPE

Results

Top Width		79.67	ft
Normal Depth		4.48	ft
Critical Depth		3.97	ft
Critical Slope		0.01096	ft/ft
Velocity		5.91	ft/s
Velocity Head		0.54	ft
Specific Energy		5.02	ft
Froude Number		0.70	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	4.48	ft
Critical Depth	3.97	ft
Channel Slope	0.00500	ft/ft
Critical Slope	0.01096	ft/ft

Worksheet for M-86.75 STA 1+80_2YR_BRIDGE

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00500	ft/ft
Discharge	1050.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	146.00
0+20	145.90
0+21	144.90
0+50	142.39
0+80	145.50
0+82	148.00
0+85	148.00
1+00	150.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 146.00)	(1+00, 150.00)	0.030

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	4.21	ft
Elevation Range	142.39 to 150.00 ft	
Flow Area	179.04	ft²
Wetted Perimeter	82.63	ft
Hydraulic Radius	2.17	ft

Worksheet for M-86.75 STA 1+80_2YR_BRIDGE

Results

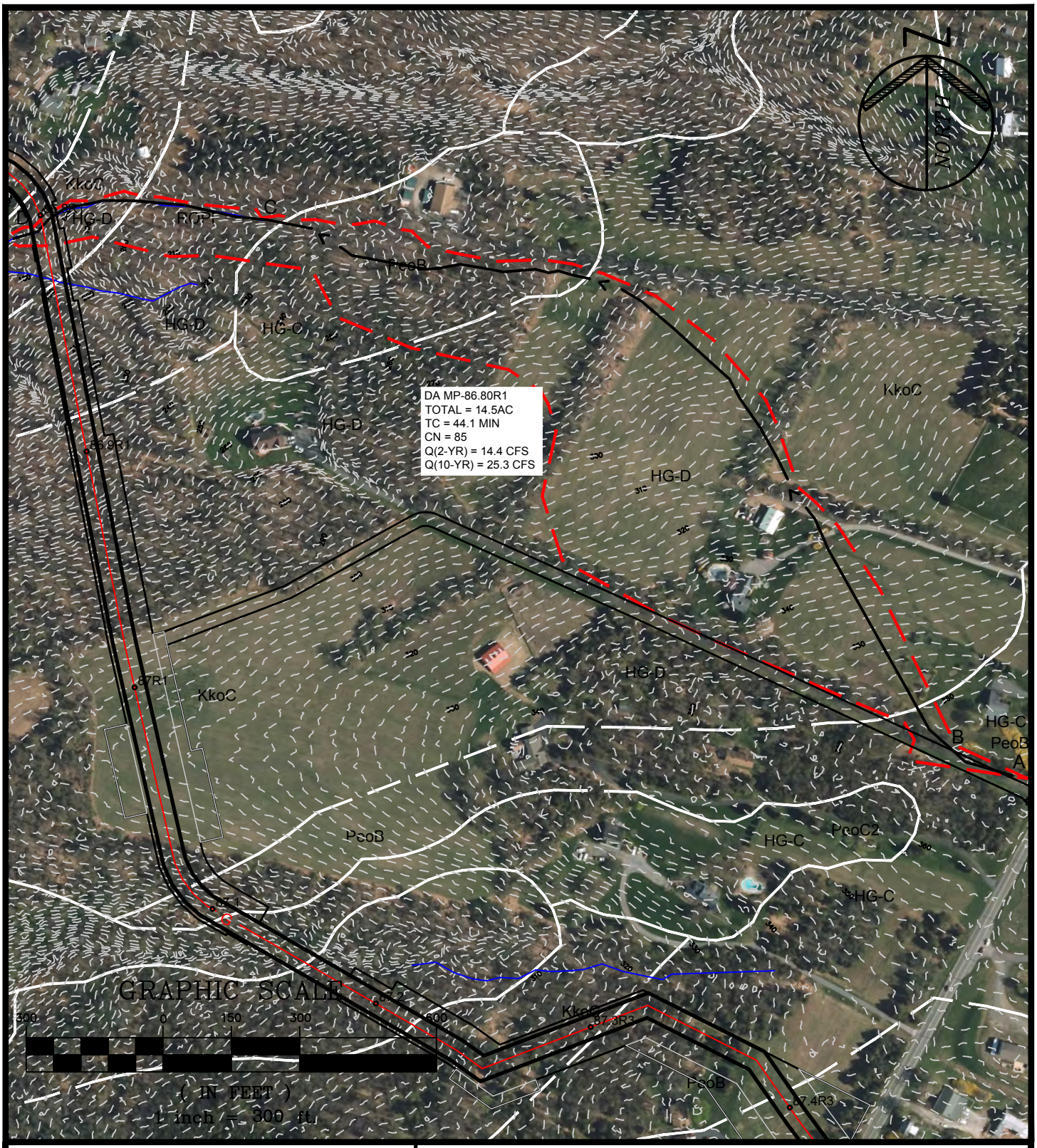
Top Width		80.72	ft
Normal Depth		4.21	ft
Critical Depth		3.72	ft
Critical Slope		0.01111	ft/ft
Velocity		5.86	ft/s
Velocity Head		0.53	ft
Specific Energy		4.74	ft
Froude Number		0.69	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	4.21	ft
Critical Depth	3.72	ft
Channel Slope	0.00500	ft/ft
Critical Slope	0.01111	ft/ft



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CERTIFICATE OF AUTHORIZATION NO. 24GA28032700

PROJECT TITLE

PENNEAST PIPELINE

HUNTERDON AND MERCER COUNTY, NJ

SHEET TITLE

STREAM CROSSING DRAINAGE AREA MP-86.80R1

PROJ. NO.:	05516.0001	DRN. BY:	JPS	SCALE:	1" = 300'
DATE:	05/23/19	CK'D BY:	WS		

FILE NAME: P:\05516\0001\DWGs\CAD\C-Civil\Plotdwgs\Drainage Area Maps\05516\0001-Stream_DA_MP85.4-98.9-1-WAL.dwg\MP 86.80R1 LAST EDIT: 06/13/2019 - 10:09:00 AM LOGIN: IKuzmina@

Worksheet 2: Runoff curve number and runoff (Approximated)

Project	By	Date
PennEast	IK	3-May-19
Location	**Checked**	**Date**
Hunterdon County, NJ		

Check one: ☐ Present ☒ Developed | MP 86.80R1

1. Runoff curve number

Soil name and hydrologic group (appendix A)	Cover Description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN[1] Table 2-2	CN[1] Figure 2-3	CN[1] Figure 2-4	Area ☒ acres / ☐ mi² / ☐ %	Product of CN x Area
Type C	Farmstead, Good Condition	82			2.77	227.14
Type D	Farmstead, Good Condition	86			11.73	1,008.78
1. Use only one CN source per line				Totals ➡	14.50	1,235.92

CN (weighted) = tot.prod. / tot. area = 1,235.92 / 14.50 = 85.2 ; Use CN ➡ **85**

2. Runoff

		Storm #1	Storm #2	Storm #3
Frequency……	yr			
Rainfall, P (24-hour)…….	in			
Runoff, Q……	in			

Use P and CN with table 2-1, figure 2-1, or equation 2-3 abd 2-4

PSS &	PROJECT: PennEast	JOB NO. 5516.0001	
		SHEET	DATE:05-03-2019
		BY:	IK
	SUBJECT: Tc Calculations	CHK'D	

Time of Concentration calculations with the application of the SCS TR-55 methodology.

Watershed or Subarea Designation: DA 86.80R1

Area 14.5 AC

SHEET FLOW

Segment ID		A-B				
Surface Description (Table 3-1)		WOODS				
Manning's Coefficient, n (Table 3-1)		0.400				
Flow Length, L (total <= 150)	(ft)	150				
Two Year Rainfall, P	(in)	3.4				
Land Slope, s	(ft/ft)	0.013				
Computed Tt = 0.007 (nL)^0.8 / P^0.5*s^0.4	(hrs)	0.572				0.572

SHALLOW CONCENTRATED FLOW

Segment ID		B-C				
Surface Description (paved or unpaved)		UNPAVED				
Flow Length, L	(ft)	2068				
Watercourse slope, s	(ft/ft)	0.070				
Average Velocity, V (Figure 3-1)	(ft/s)	4.0				
Computed Tt = L / 3600V	(hrs)	0.144				0.144

CHANNEL FLOW

Segment ID		C-D				
Cross sectional Area, a	(sf)	7.50				
Wetted Perimeter, Pw	(ft)	10.40				
Hydraulic Radius, r =a/Pw	(ft)	0.721				
Channel Slope (ft/ft)	(ft/ft)	0.102				
Manning's Roughness Coefficient, n		0.045				
Velocity, V = 1.49r^(2/3)s^0.5 / n	(ft/s)	8.50				
Flow Length, L	(ft)	586				
Computed Tt = L / 3600V	(hrs)	0.019				0.019

Watershed or subarea Tc	0.735	hrs.
	44.1	min.

Use minimum Tc of 10 minutes

Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 05 / 23 / 2019

Hyd. No. 86

MP-86.80R1

Hydrograph type	= SCS Runoff	Peak discharge	= 14.42 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.50 hrs
Time interval	= 6 min	Hyd. volume	= 92,834 cuft
Drainage area	= 14.500 ac	Curve number	= 85.000
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 44.1 min
Total precip.	= 3.26 in	Distribution	= Custom
Storm duration	= C:\Users\IKuzmina\AppData\Local\Autodesk\C3D 2019\enu\HHApps\Hydrograp	Shape factor	= 484

Hydrograph Discharge Table

(Printed values >= 1.00% of Qp.)

Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)
9.40	0.152	11.20	0.932	13.00	8.976	14.80	1.517
9.50	0.169	11.30	1.066	13.10	7.404	14.90	1.462
9.60	0.188	11.40	1.226	13.20	5.898	15.00	1.407
9.70	0.209	11.50	1.414	13.30	4.652	15.10	1.352
9.80	0.232	11.60	1.671	13.40	4.007	15.20	1.298
9.90	0.257	11.70	2.000	13.50	3.526	15.30	1.246
10.00	0.284	11.80	2.457	13.60	3.153	15.40	1.198
10.10	0.313	11.90	3.137	13.70	2.845	15.50	1.155
10.20	0.344	12.00	4.317	13.80	2.604	15.60	1.118
10.30	0.377	12.10	6.443	13.90	2.392	15.70	1.087
10.40	0.412	12.20	8.772	14.00	2.212	15.80	1.060
10.50	0.448	12.30	11.08	14.10	2.065	15.90	1.038
10.60	0.488	12.40	13.12	14.20	1.945	16.00	1.018
10.70	0.533	12.50	14.42	14.30	1.847	16.10	1.002
10.80	0.587	12.60	14.04	14.40	1.763	16.20	0.986
10.90	0.651	12.70	13.16	14.50	1.692	16.30	0.972
11.00	0.728	12.80	11.94	14.60	1.629	16.40	0.957
11.10	0.820	12.90	10.54	14.70	1.571	16.50	0.943

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Worksheet for MP-86.80R1_STA0+73_PIPE_2yr

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.12000	ft/ft
Discharge	14.40	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+08	169.35
0+20	168.57
0+22	172.10
0+45	174.00
0+60	176.00
0+70	178.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+08, 169.35)	(0+70, 178.00)	0.030

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.53	ft
Elevation Range	168.57 to 178.00 ft	
Flow Area	2.09	ft²
Wetted Perimeter	8.19	ft
Hydraulic Radius	0.25	ft
Top Width	7.88	ft
Normal Depth	0.53	ft

Worksheet for MP-86.81R1_STA0+73_PIPE_2yr

Results

Critical Depth		0.75	ft
Critical Slope		0.01916	ft/ft
Velocity		6.90	ft/s
Velocity Head		0.74	ft
Specific Energy		1.27	ft
Froude Number		2.36	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.53	ft
Critical Depth	0.75	ft
Channel Slope	0.12000	ft/ft
Critical Slope	0.01916	ft/ft

Worksheet for MP-86.80R1_STA0+46_BRIDGE_2YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.12000	ft/ft
Discharge	14.40	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+11	172.25
0+14	171.47
0+17	172.80
0+22	174.00
0+27	176.00
0+54	180.00
0+64	182.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+11, 172.25)	(0+64, 182.00)	0.030

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.73	ft
Elevation Range	171.47 to 182.00 ft	
Flow Area	1.69	ft²
Wetted Perimeter	4.84	ft
Hydraulic Radius	0.35	ft
Top Width	4.60	ft

Worksheet for MP-86.81R1_STA0+46_BRIDGE_2YR

Results

Normal Depth	0.73	ft
Critical Depth	1.05	ft
Critical Slope	0.01777	ft/ft
Velocity	8.51	ft/s
Velocity Head	1.13	ft
Specific Energy	1.86	ft
Froude Number	2.48	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.73	ft
Critical Depth	1.05	ft
Channel Slope	0.12000	ft/ft
Critical Slope	0.01777	ft/ft

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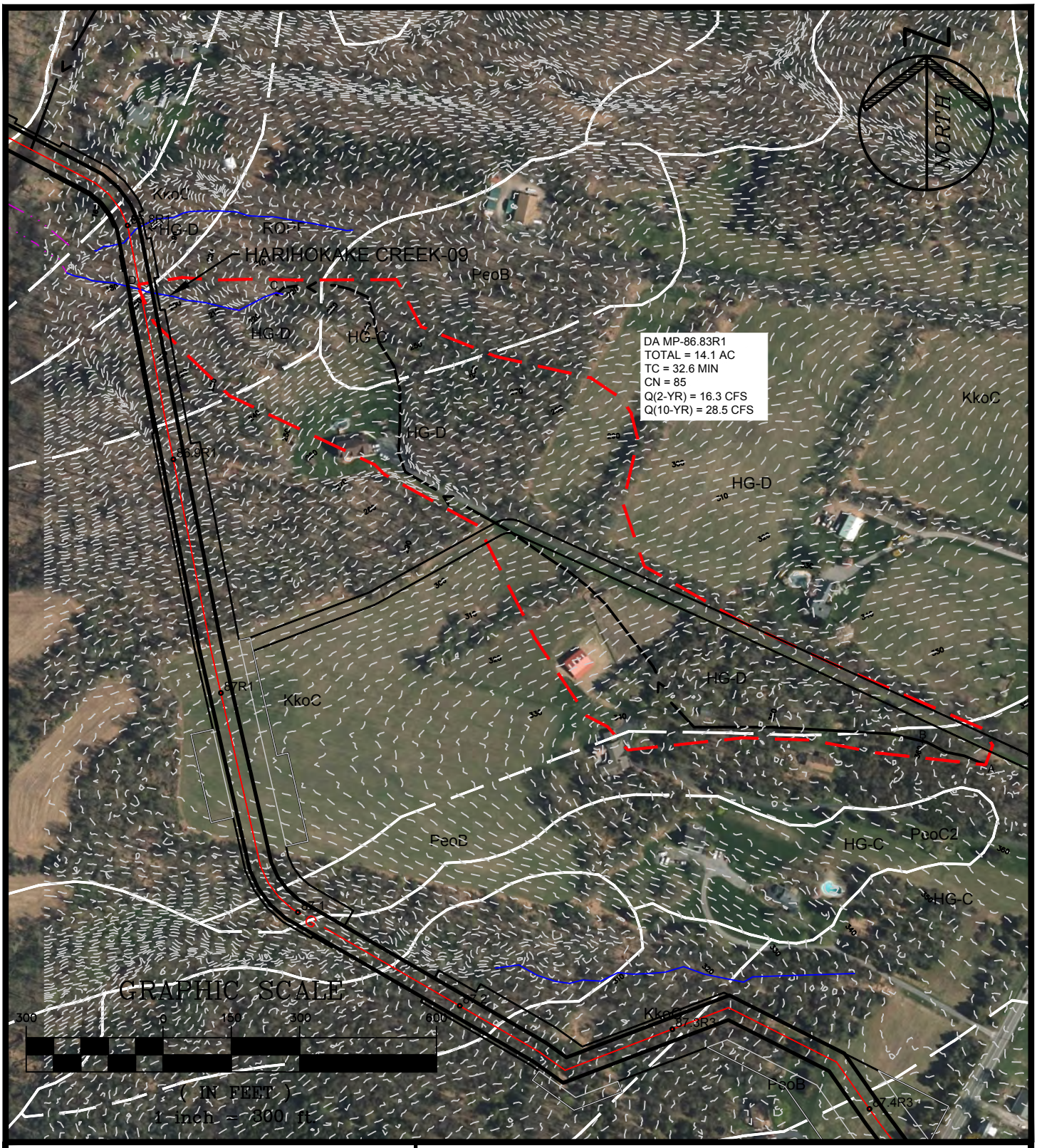

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CERTIFICATE OF AUTHORIZATION NO. 24GA28032700

PROJECT TITLE

PENNEAST PIPELINE

HUNTERDON AND MERCER COUNTY, NJ

SHEET TITLE

STREAM CROSSING DRAINAGE AREA MP-86.83R1

PROJ. NO.:	05516.0001	DRN. BY:	JPS	SCALE:	1" = 300'
DATE:	05/23/19	CK'D BY:	WS		

FILE NAME: P:\05516\0001\DWGs\CAD\C-Civil\Plotdwgs\Drainage Area Maps\05516\0001-Stream_DA_MP85.4-98.9-WAL.dwg\MP 86.83R1 LAST EDIT: 05/29/2019 - 03:53:31 PM LOGIN: IKuzmina@

Worksheet 2: Runoff curve number and runoff (Approximated)

Project	By	Date
PennEast	JPS	26-Feb-18
Location	**Checked**	**Date**
Hunterdon County, NJ		

Check one: ☐ Present ☒ Developed — MP 86.83R1

1. Runoff curve number

Soil name and hydrologic group (appendix A)	Cover Description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN[1] Table 2-2	CN[1] Figure 2-3	CN[1] Figure 2-4	Area ☒ acres / ☐ mi² / ☐ %	Product of CN x Area
Type C	Farmstead, Good Condition	82			2.20	180.40
Type D	Farmstead, Good Condition	86			11.90	1,023.40
1. Use only one CN source per line				Totals ➡	14.10	1,203.80

CN (weighted) = tot.prod. / tot. area = 1,203.80 / 14.10 = 85.4 ; Use CN ➡ **85**

2. Runoff

		Storm #1	Storm #2	Storm #3
Frequency……	yr			
Rainfall, P (24-hour)…….	in			
Runoff, Q……	in			

Use P and CN with table 2-1, figure 2-1, or equation 2-3 abd 2-4

PSS &	PROJECT: PennEast	JOB NO. 5516.0001	
		SHEET	DATE:2/12/2018
		BY:	JPS
	SUBJECT: Tc Calculations	CHK'D	

Time of Concentration calculations with the application of the SCS TR-55 methodology.

Watershed or Subarea Designation: DA 86.83

Area 14.1 AC

SHEET FLOW

Segment ID		A-B			
Surface Description (Table 3-1)		WOODS			
Manning's Coefficient, n (Table 3-1)		0.400			
Flow Length, L (total <= 150)	(ft)	150			
Two Year Rainfall, P	(in)	3.4			
Land Slope, s	(ft/ft)	0.033			
Computed Tt = 0.007 (nL)^0.8 / P^0.5*s^0.4	(hrs)	0.394			0.394

SHALLOW CONCENTRATED FLOW

Segment ID		B-C			
Surface Description (paved or unpaved)		UNPAVED			
Flow Length, L	(ft)	1998			
Watercourse slope, s	(ft/ft)	0.072			
Average Velocity, V (Figure 3-1)	(ft/s)	4.0			
Computed Tt = L / 3600V	(hrs)	0.139			0.139

CHANNEL FLOW

Segment ID		C-D			
Cross sectional Area, a	(sf)	7.44			
Wetted Perimeter, Pw	(ft)	13.15			
Hydraulic Radius, r =a/Pw	(ft)	0.566			
Channel Slope (ft/ft)	(ft/ft)	0.130			
Manning's Roughness Coefficient, n		0.040			
Velocity, V = 1.49r^(2/3)s^0.5 / n	(ft/s)	9.19			
Flow Length, L	(ft)	322			
Computed Tt = L / 3600V	(hrs)	0.010			0.010

Watershed or subarea Tc	0.543	hrs.
	32.6	min.

Use minimum Tc of 10 minutes

Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 05 / 23 / 2019

Hyd. No. 13

DA 86.8

Hydrograph type	= SCS Runoff	Peak discharge	= 16.27 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.40 hrs
Time interval	= 6 min	Hyd. volume	= 95,481 cuft
Drainage area	= 14.100 ac	Curve number	= 85.000*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 32.6 min
Total precip.	= 3.26 in	Distribution	= Custom
Storm duration	= C:\Users\IKuzmina\AppData\Local\Autodesk\C3D 2019\enu\HHApps\Hydrograp	Shape factor	= 484

* Composite (Area/CN) = [(2.200 x 82) + (11.900 x 86)] / 14.100

Hydrograph Discharge Table

(Printed values >= 1.00% of Qp.)

Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)
9.40	0.172	11.20	1.070	13.00	6.971	14.80	1.504
9.50	0.191	11.30	1.231	13.10	5.354	14.90	1.447
9.60	0.213	11.40	1.424	13.20	4.559	15.00	1.390
9.70	0.237	11.50	1.647	13.30	3.979	15.10	1.333
9.80	0.263	11.60	1.960	13.40	3.535	15.20	1.278
9.90	0.291	11.70	2.369	13.50	3.175	15.30	1.226
10.00	0.320	11.80	2.959	13.60	2.896	15.40	1.181
10.10	0.352	11.90	3.876	13.70	2.644	15.50	1.142
10.20	0.386	12.00	5.440	13.80	2.425	15.60	1.111
10.30	0.421	12.10	8.421	13.90	2.240	15.70	1.085
10.40	0.459	12.20	11.56	14.00	2.094	15.80	1.064
10.50	0.498	12.30	14.45	14.10	1.976	15.90	1.045
10.60	0.542	12.40	16.27	14.20	1.880	16.00	1.029
10.70	0.593	12.50	15.76	14.30	1.800	16.10	1.014
10.80	0.656	12.60	14.53	14.40	1.732	16.20	1.000
10.90	0.733	12.70	12.88	14.50	1.672	16.30	0.985
11.00	0.826	12.80	10.99	14.60	1.616	16.40	0.970
11.10	0.936	12.90	8.934	14.70	1.560	16.50	0.955

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Worksheet for MP-86.83R1_ STA 1+24_2YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.11400	ft/ft
Discharge	16.30	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	180.00
0+34	178.00
0+44	176.00
0+50	173.45
0+57	175.80
0+89	180.00
1+00	180.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 180.00)	(1+00, 180.00)	0.045

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.96	ft
Elevation Range	173.45 to 180.00 ft	
Flow Area	2.49	ft²
Wetted Perimeter	5.53	ft
Hydraulic Radius	0.45	ft
Top Width	5.19	ft

Worksheet for MP-86.83R1_ STA 1+24_2YR

Results

Normal Depth	0.96	ft
Critical Depth	1.18	ft
Critical Slope	0.03836	ft/ft
Velocity	6.55	ft/s
Velocity Head	0.67	ft
Specific Energy	1.63	ft
Froude Number	1.67	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.96	ft
Critical Depth	1.18	ft
Channel Slope	0.11400	ft/ft
Critical Slope	0.03836	ft/ft

Worksheet for MP-86.83R1_STA 0+85_2YR_BRIDGE

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.11400	ft/ft
Discharge	16.30	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	188.00
0+32	184.00
0+41	182.00
0+45	180.30
0+49	177.94
0+58	180.60
0+69	182.00
0+91	186.00
1+00	186.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 188.00)	(1+00, 186.00)	0.043

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.97	ft
Elevation Range	177.94 to 188.00 ft	
Flow Area	2.38	ft²
Wetted Perimeter	5.32	ft

Worksheet for MP-86.83R1_STA 0+85_2YR_BRIDGE

Results

Hydraulic Radius		0.45	ft
Top Width		4.94	ft
Normal Depth		0.97	ft
Critical Depth		1.20	ft
Critical Slope		0.03525	ft/ft
Velocity		6.84	ft/s
Velocity Head		0.73	ft
Specific Energy		1.69	ft
Froude Number		1.73	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.97	ft
Critical Depth	1.20	ft
Channel Slope	0.11400	ft/ft
Critical Slope	0.03525	ft/ft

MP-87.15

Region ID: NJ
Workspace ID: NJ20190520193123735000
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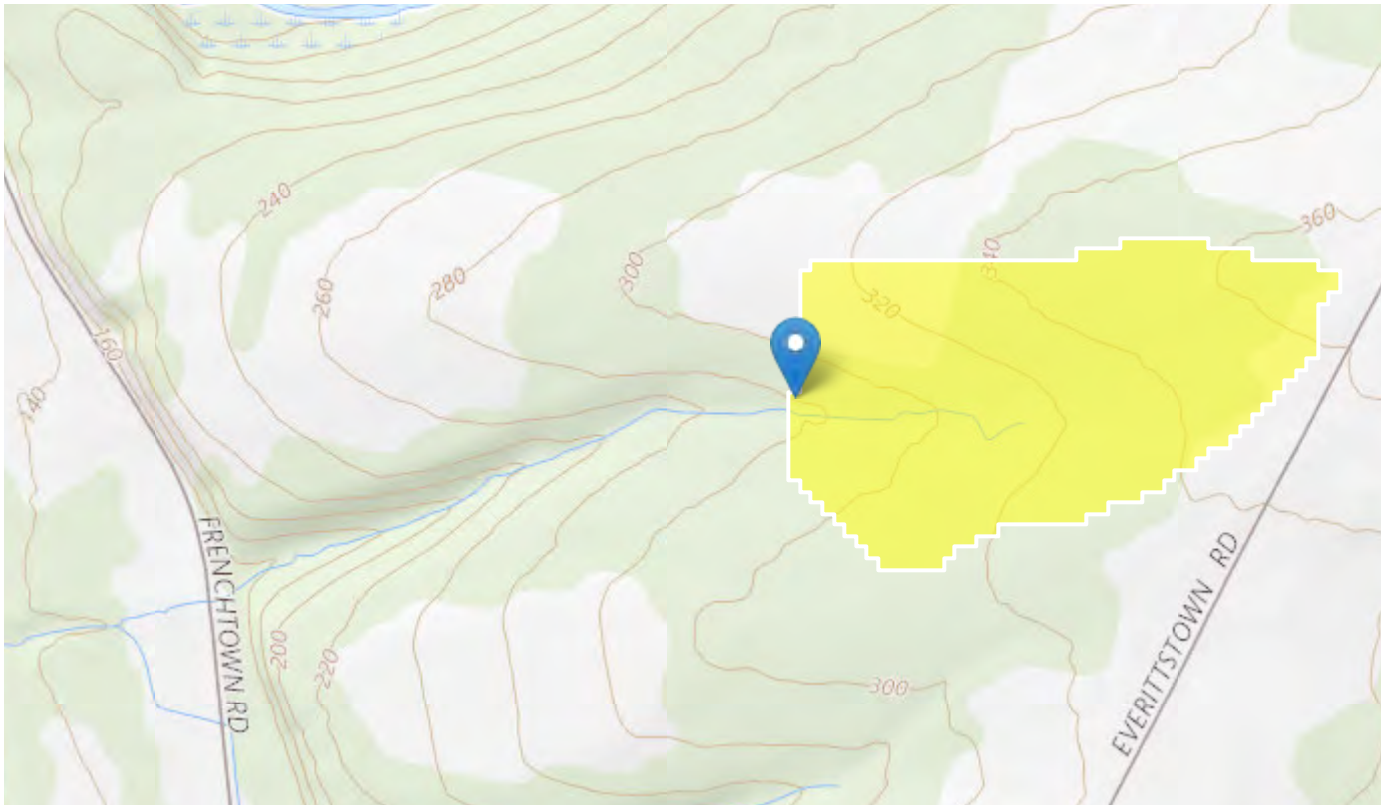
Time: 2019-05-20 15:31:39 -0400



Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	0.0408	square miles
STORAGE	Percentage of area of storage (lakes ponds reservoirs wetlands)	5.87	percent
CSL10_85	Change in elevation divided by length between points 10 and 85 percent of distance along main channel to basin divide - main channel method not known	270	feet per mi

Parameter Code	Parameter Description	Value	Unit
POPDENS	Basin Population Density	165	persons per square mile

Peak-Flow Statistics Parameters [Peak Unglaciated Piedmont Region 2009 5167]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.0408	square miles	0.25	779
STORAGE	Percent Storage	5.87	percent	0.23	32
CSL10_85	Stream Slope 10 and 85 Method	270	feet per mi	4.31	191
POPDENS	Basin Population Density	165	persons per square mile	83	11084

Peak-Flow Statistics Disclaimers [Peak Unglaciated Piedmont Region 2009 5167]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors

Peak-Flow Statistics Flow Report [Peak Unglaciated Piedmont Region 2009 5167]

Statistic	Value	Unit
2 Year Peak Flood	23.9	ft^3/s
5 Year Peak Flood	42.2	ft^3/s
10 Year Peak Flood	56.9	ft^3/s
25 Year Peak Flood	78.2	ft^3/s
50 Year Peak Flood	95.7	ft^3/s
100 Year Peak Flood	115	ft^3/s
500 Year Peak Flood	165	ft^3/s

Peak-Flow Statistics Citations

Worksheet for MP-87.15_STA0+38_2YR_PIPE

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.06500	ft/ft
Discharge	23.90	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	284.00
0+04	284.00
0+13	282.00
0+25	280.00
0+48	278.40
0+50	277.20
0+53	277.20
0+56	280.00
0+61	282.00
0+68	284.00
1+00	286.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 284.00)	(1+00, 286.00)	0.045

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.89	ft
Elevation Range	277.20 to 286.00 ft	

Worksheet for MP-87.15_STA0+38_2YR_PIPE

Results

Flow Area	3.88	ft²
Wetted Perimeter	6.19	ft
Hydraulic Radius	0.63	ft
Top Width	5.60	ft
Normal Depth	0.89	ft
Critical Depth	1.04	ft
Critical Slope	0.03694	ft/ft
Velocity	6.16	ft/s
Velocity Head	0.59	ft
Specific Energy	1.48	ft
Froude Number	1.31	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.89	ft
Critical Depth	1.04	ft
Channel Slope	0.06500	ft/ft
Critical Slope	0.03694	ft/ft

Worksheet for MP-87.15_STA0+18_2YR_BRIDGE

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.06500	ft/ft
Discharge	23.90	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	284.00
0+07	284.00
0+29	282.00
0+48	279.30
0+50	278.77
0+53	279.00
0+66	284.00
0+77	286.00
0+94	288.00
1+00	288.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 284.00)	(1+00, 288.00)	0.045

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.88	ft
Elevation Range	278.77 to 288.00 ft	
Flow Area	4.59	ft²

Worksheet for MP-87.15_STA0+18_2YR_BRIDGE

Results

Wetted Perimeter	9.47	ft
Hydraulic Radius	0.49	ft
Top Width	9.24	ft
Normal Depth	0.88	ft
Critical Depth	1.00	ft
Critical Slope	0.03720	ft/ft
Velocity	5.20	ft/s
Velocity Head	0.42	ft
Specific Energy	1.31	ft
Froude Number	1.30	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.88	ft
Critical Depth	1.00	ft
Channel Slope	0.06500	ft/ft
Critical Slope	0.03720	ft/ft

01/16/2018 - 1:10 PM

MP 87.68

87.68-MottMac

Region ID: NJ
Workspace ID: NJ20170807113756790000
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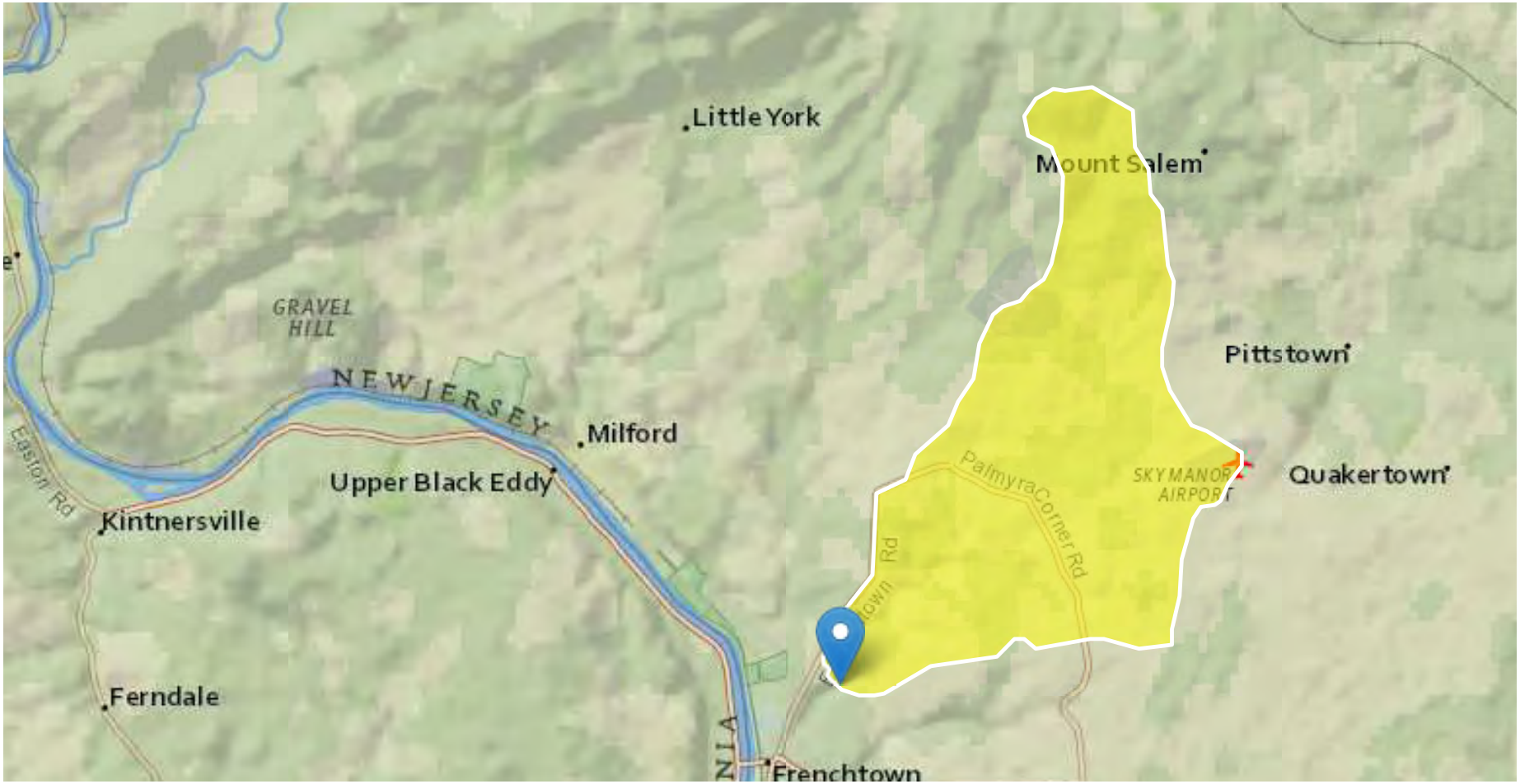
Time: 2017-08-07 11:38:58 -0400



Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	10.5	square miles
STORAGE	Percentage of area of storage (lakes ponds reservoirs wetlands)	9.41	percent
CSL10_85	Change in elevation divided by length between points 10 and 85 percent of distance along main channel to basin divide - main channel method not known	61.1	feet per mi
POPDENS	Basin Population Density	157	persons per square mile

Peak-Flow Statistics Parameters [Peak Unglaciated Piedmont Region 2009 5167]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	10.5	square miles	0.25	779
STORAGE	Percent Storage	9.41	percent	0.23	32
CSL10_85	Stream Slope 10 and 85 Method	61.1	feet per mi	4.31	191
POPDENS	Basin Population Density	157	persons per square mile	83	11084

Peak-Flow Statistics Flow Report [Peak Unglaciated Piedmont Region 2009 5167]

PIl: Prediction Interval-Lower, PIu: Prediction Interval-Upper, SEp: Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	SEe	SEp	Equiv. Yrs.
2 Year Peak Flood	1040	ft^3/s	49	50.3	1
5 Year Peak Flood	1700	ft^3/s	49.4	50.9	2
10 Year Peak Flood	2200	ft^3/s	50.5	52.2	3

Statistic	Value	Unit	SEe	SEp	Equiv. Yrs.
25 Year Peak Flood	2900	ft^3/s	52.6	54.5	4
50 Year Peak Flood	3450	ft^3/s	54.7	56.8	5
100 Year Peak Flood	4090	ft^3/s	57.1	59.5	5
500 Year Peak Flood	5620	ft^3/s	63.9	66.3	6

Peak-Flow Statistics Citations

Watson, K.M.,and Schopp, R.D.,2009, Methodology for estimation of flood magnitude and frequency for New Jersey streams, U.S. Geological Survey Scientific Investigations Report 2009-5167, 51 p. (http://pubs.usgs.gov/sir/2009/5167/)

Worksheet for M-87.68 STA 2+59_2YR_PIPE

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.01600	ft/ft
Discharge	1040.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	164.10
0+13	164.10
0+26	159.70
0+36	158.20
0+50	157.87
0+75	158.60
0+77	159.80
0+78	166.00
0+83	172.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 164.10)	(0+83, 172.00)	0.050

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	3.31	ft
Elevation Range	157.87 to 172.00 ft	
Flow Area	148.00	ft²
Wetted Perimeter	57.91	ft

Worksheet for M-87.68 STA 2+59_2YR_PIPE

Results

Hydraulic Radius		2.56	ft
Top Width		56.11	ft
Normal Depth		3.31	ft
Critical Depth		2.85	ft
Critical Slope		0.02875	ft/ft
Velocity		7.03	ft/s
Velocity Head		0.77	ft
Specific Energy		4.07	ft
Froude Number		0.76	
Flow Type	Subcritical		

GVF Input Data

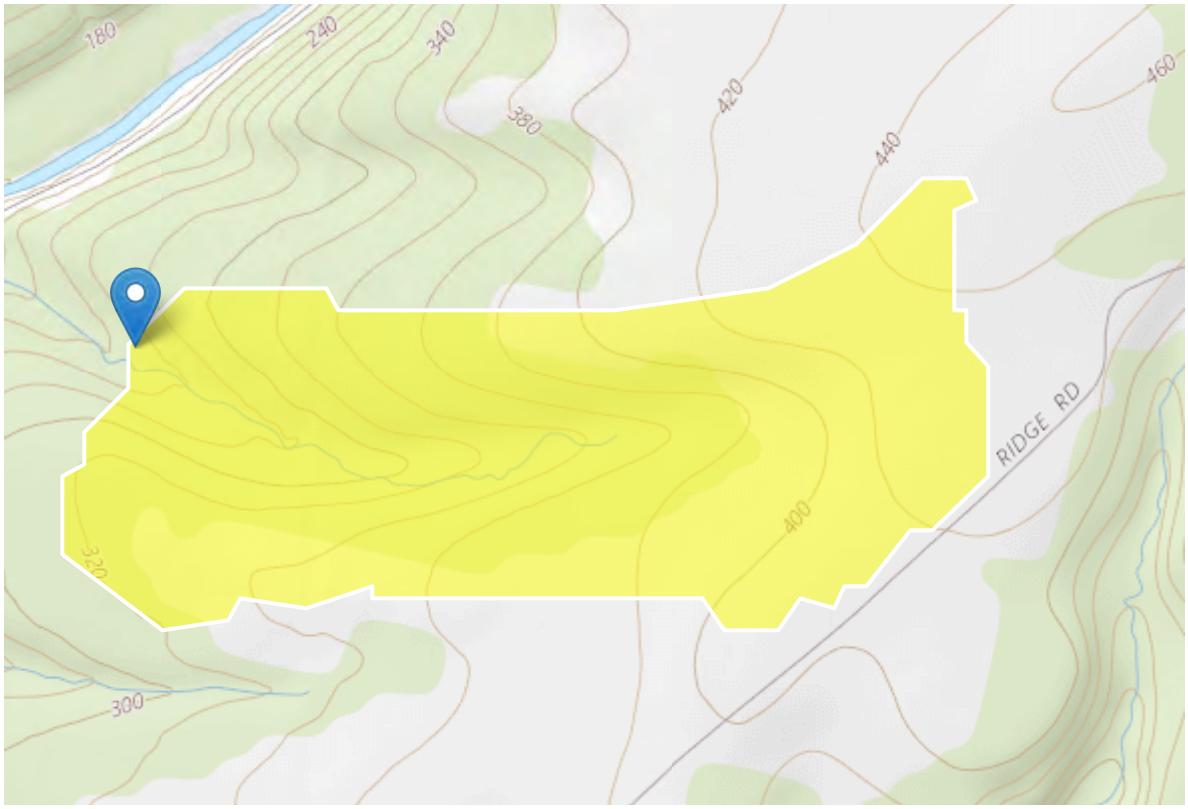
Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	3.31	ft
Critical Depth	2.85	ft
Channel Slope	0.01600	ft/ft
Critical Slope	0.02875	ft/ft

MP-87.85R3-2

Region ID: NJ
Workspace ID: NJ20180228164304725000
Clicked Point (Latitude, Longitude): 40.53482, -75.04786
Time: 2018-02-28 11:43:19 -0500



The South Carolina StreamStats application is testing LiDAR-derived data and streams for delineation. This is a beta version and QA/QC is incomplete. It may calculate basin characteristics and flow statistics incorrectly. Please verify the drainage areas and flow stats carefully. Use at your own risk

Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	0.0866	square miles
STORAGE	Percentage of area of storage (lakes ponds reservoirs wetlands)	14.8	percent

Parameter Code	Parameter Description	Value	Unit
CSL10_85	Change in elevation divided by length between points 10 and 85 percent of distance along main channel to basin divide - main channel method not known	421	feet per mi
POPDENS	Basin Population Density	269	persons per square mile

Peak-Flow Statistics Parameters [Peak Unglaciated Piedmont Region 2009 5167]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.0866	square miles	0.25	779
STORAGE	Percent Storage	14.8	percent	0.23	32
CSL10_85	Stream Slope 10 and 85 Method	421	feet per mi	4.31	191
POPDENS	Basin Population Density	269	persons per square mile	83	11084

Peak-Flow Statistics Disclaimers [Peak Unglaciated Piedmont Region 2009 5167]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors

Peak-Flow Statistics Flow Report [Peak Unglaciated Piedmont Region 2009 5167]

Statistic	Value	Unit
2 Year Peak Flood	47.9	ft^3/s
5 Year Peak Flood	81	ft^3/s
10 Year Peak Flood	107	ft^3/s
25 Year Peak Flood	142	ft^3/s
50 Year Peak Flood	171	ft^3/s
100 Year Peak Flood	203	ft^3/s
500 Year Peak Flood	280	ft^3/s

Worksheet for MP-87.85_STA1+30_2YR_PIPE

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.07500	ft/ft
Discharge	47.90	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	268.00
0+19	264.00
0+26	262.00
0+32	260.00
0+35	258.00
0+42	256.20
0+45	253.78
0+55	255.20
0+56	256.00
0+64	258.00
0+75	260.00
1+00	260.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 268.00)	(1+00, 260.00)	0.045

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	1.35	ft

Worksheet for MP-87.85_STA1+30_2YR_PIPE

Results

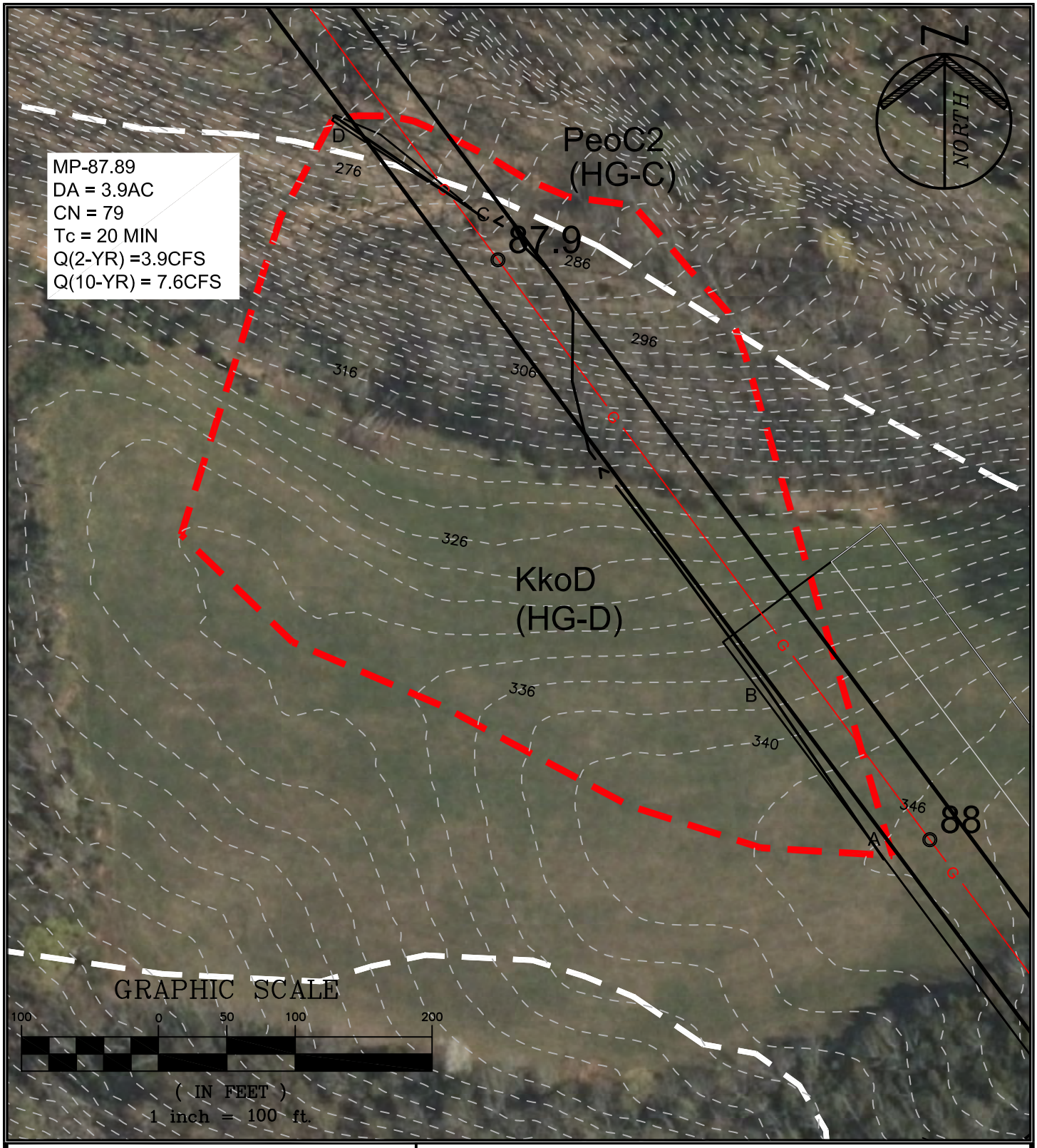
Elevation Range	253.78 to 268.00 ft		
Flow Area		7.13	ft²
Wetted Perimeter		11.16	ft
Hydraulic Radius		0.64	ft
Top Width		10.54	ft
Normal Depth		1.35	ft
Critical Depth		1.55	ft
Critical Slope		0.03428	ft/ft
Velocity		6.71	ft/s
Velocity Head		0.70	ft
Specific Energy		2.05	ft
Froude Number		1.44	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.35	ft
Critical Depth	1.55	ft
Channel Slope	0.07500	ft/ft
Critical Slope	0.03428	ft/ft



PAULUS, SOKOLOWSKI AND SARTOR, LLC.

1433 ROUTE 34
SUITE A4
WALL, NEW JERSEY 07727
PHONE: (848) 206-2626

CERTIFICATE OF AUTHORIZATION NO. 24GA28032700

PROJECT TITLE

PENNEAST PIPELINE

HUNTERDON AND MERCER COUNTY, NJ

SHEET TITLE

STREAM CROSSING DRAINAGE AREA MP-87.89

PROJ. NO.:	05516.0001	DRN. BY:	JPS	SCALE:	1"=100'
DATE:	05/23/19	CK'D BY:	WS		

FILE NAME: P:\05516\0001\DWGs\CAD\C-Civil\Plotdwgs\Drainage Area Maps\05516\0001-Stream_DA_MP85.4-98.9-1-WAL.dwg\MP 87.88 LAST EDIT: 06/13/2019 - 10:43:53 AM LOGIN: IKuzmina@

Worksheet 2: Runoff curve number and runoff (Approximated)

Project	By	Date
PennEast	JM	22-May-19
Location	**Checked**	**Date**
Hunterdon County, NJ		

Check one: ☐ Present ☒ Developed | MP 87.89

1. Runoff curve number

Soil name and hydrologic group (appendix A)	Cover Description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN[1] Table 2-2	CN[1] Figure 2-3	CN[1] Figure 2-4	Area ☒ acres / ☐ mi² / ☐ %	Product of CN x Area
Type C	Woods	70			0.20	14.00
Type D	Woods-grass combination	79			3.57	282.03
1. Use only one CN source per line				Totals ➡	3.77	296.03

CN (weighted) = tot.prod. / tot. area = 296.03 / 3.77 = 78.5 ; Use CN ➡ **79**

2. Runoff

		Storm #1	Storm #2	Storm #3
Frequency……	yr			
Rainfall, P (24-hour)…….	in			
Runoff, Q……	in			

Use P and CN with table 2-1, figure 2-1, or equation 2-3 abd 2-4

PROJECT:	PennEast	JOB NO. 5516.0001	
		SHEET	DATE:05-22-19
		BY:	JM
SUBJECT:	Tc Calculations	CHK'D	

Time of Concentration calculations with the application of the SCS TR-55 methodology.

Watershed or Subarea Designation: 87.89

Area 3.9 AC

SHEET FLOW

Segment ID		A-B				
Surface Description (Table 3-1)		LIGHT WOODS				
Manning's Coefficient, n (Table 3-1)		0.400				
Flow Length, L (total <= 150)	(ft)	150				
Two Year Rainfall, P	(in)	3.4				
Land Slope, s	(ft/ft)	0.060				
Computed Tt = 0.007 (nL)^0.8 / P^0.5*s^0.4	(hrs)	0.310				0.310

SHALLOW CONCENTRATED FLOW

Segment ID		B-C				
Surface Description (paved or unpaved)		UNPAVED				
Flow Length, L	(ft)	435				
Watercourse slope, s	(ft/ft)	0.124				
Average Velocity, V (Figure 3-1)	(ft/s)	5.4				
Computed Tt = L / 3600V	(hrs)	0.022				0.022

CHANNEL FLOW

Segment ID		CD				
Cross sectional Area, a	(sf)	7.50				
Wetted Perimeter, Pw	(ft)	10.39				
Hydraulic Radius, r =a/Pw	(ft)	0.722				
Channel Slope (ft/ft)	(ft/ft)	0.060				
Manning's Roughness Coefficient, n		0.045				
Velocity, V = 1.49r^(2/3)s^0.5 / n	(ft/s)	6.53				
Flow Length, L	(ft)	120				
Computed Tt = L / 3600V	(hrs)	0.005				

Watershed or subarea Tc	0.333	hrs.
	20.0	min.

Use minimum Tc of 10 minutes

Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 05 / 23 / 2019

Hyd. No. 94

MP-87.89

Hydrograph type	= SCS Runoff	Peak discharge	= 3.931 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.30 hrs
Time interval	= 6 min	Hyd. volume	= 19,564 cuft
Drainage area	= 3.900 ac	Curve number	= 79.000
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 20.0 min
Total precip.	= 3.26 in	Distribution	= Custom
Storm duration	= C:\Users\IKuzmina\AppData\Local\Autodesk\C3D2019\enu\HHApps\Hydrograp	Shape factor	= 484

Hydrograph Discharge Table

(Printed values >= 1.00% of Qp.)

Time -- Outflow (hrs cfs)		Time -- Outflow (hrs cfs)		Time -- Outflow (hrs cfs)		Time -- Outflow (hrs cfs)	
10.60	0.047	12.40	3.716	14.20	0.403	16.00	0.233
10.70	0.057	12.50	3.275	14.30	0.390	16.10	0.230
10.80	0.069	12.60	2.685	14.40	0.378	16.20	0.227
10.90	0.084	12.70	2.052	14.50	0.366	16.30	0.223
11.00	0.102	12.80	1.478	14.60	0.353	16.40	0.220
11.10	0.124	12.90	1.226	14.70	0.341	16.50	0.217
11.20	0.151	13.00	1.054	14.80	0.328	16.60	0.213
11.30	0.184	13.10	0.927	14.90	0.315	16.70	0.210
11.40	0.224	13.20	0.824	15.00	0.302	16.80	0.206
11.50	0.271	13.30	0.750	15.10	0.289	16.90	0.203
11.60	0.344	13.40	0.684	15.20	0.277	17.00	0.199
11.70	0.444	13.50	0.625	15.30	0.266	17.10	0.196
11.80	0.603	13.60	0.572	15.40	0.258	17.20	0.193
11.90	0.843	13.70	0.526	15.50	0.252	17.30	0.189
12.00	1.315	13.80	0.487	15.60	0.247	17.40	0.186
12.10	2.290	13.90	0.457	15.70	0.243	17.50	0.182
12.20	3.271	14.00	0.434	15.80	0.240	17.60	0.178
12.30	3.931	14.10	0.417	15.90	0.237	17.70	0.175

<<

Continues on next page...

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Worksheet for MP-87.89_STA0+15_2YR_PIPE

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.07600	ft/ft
Discharge	3.90	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	280.00
0+49	279.10
0+50	278.87
0+52	279.40
0+62	280.00
0+81	282.00
1+00	286.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 280.00)	(1+00, 286.00)	0.045

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.42	ft
Elevation Range	278.87 to 286.00 ft	
Flow Area	1.68	ft²
Wetted Perimeter	13.07	ft
Hydraulic Radius	0.13	ft
Top Width	12.99	ft

Worksheet for MP-87.89_STA0+15_2YR_PIPE

Results

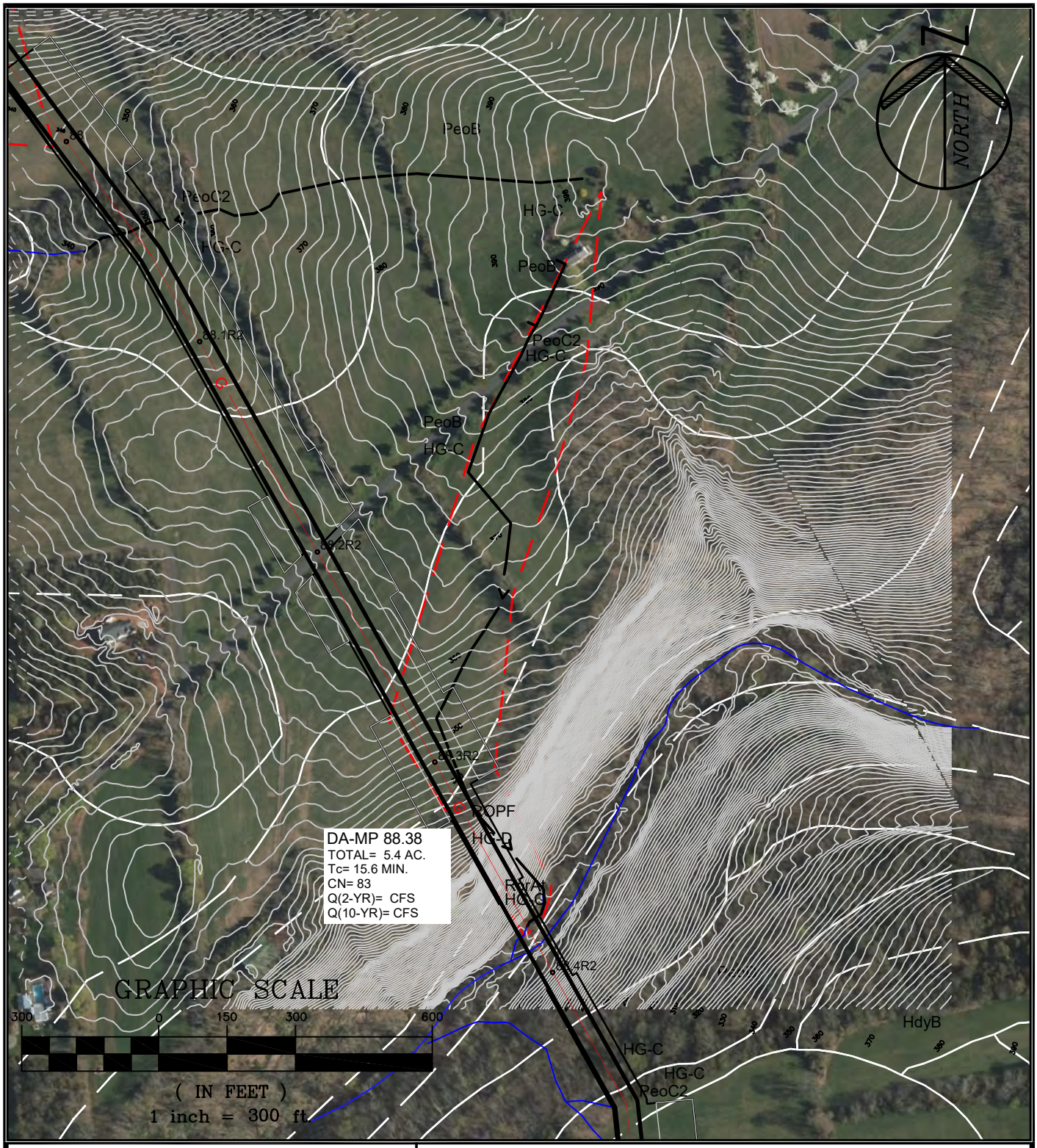
Normal Depth	0.42	ft
Critical Depth	0.43	ft
Critical Slope	0.05793	ft/ft
Velocity	2.32	ft/s
Velocity Head	0.08	ft
Specific Energy	0.50	ft
Froude Number	1.14	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.42	ft
Critical Depth	0.43	ft
Channel Slope	0.07600	ft/ft
Critical Slope	0.05793	ft/ft



PAULUS, SOKOLOWSKI AND SARTOR, LLC.

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PHONE: (848) 206-2626

CERTIFICATE OF AUTHORIZATION NO. 24GA28032700

PROJECT TITLE

PENNEAST PIPELINE

HUNTERDON AND MERCER COUNTY, NJ

SHEET TITLE

STREAM CROSSING DRAINAGE AREA MP-88.38

PROJ. NO.:	05516.0001	DRN. BY:	JPS	SCALE:	1"=300'
DATE:	05/23/19	CK'D BY:	WS		

FILE NAME: P:\05516\0001\DWGs\CADC-Civil\Plotdwgs\Drainage Area Maps\05516\001-Stream_DA_MP85.4-98.9-WAL.dwg\MP 88.38 LAST EDIT: 05/30/2019 - 08:58:49 AM LOGIN: jmcgowan@

Worksheet 2: Runoff curve number and runoff (Approximated)

Project	By	Date
PennEast	IK	28-Mar-19
Location	**Checked**	**Date**
Hunterdon County, NJ		

Check one: ☐ Present ☒ Developed MP 88.38

1. Runoff curve number

Soil name and hydrologic group (appendix A)	Cover Description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN[1] Table 2-2	CN[1] Figure 2-3	CN[1] Figure 2-4	Area X acres mi² %	Product of CN x Area
Type C	FARMSTEADS	82			4.47	366.54
Type D	FARMSTEADS	86			0.93	79.98
1. Use only one CN source per line				Totals ➡	5.40	446.52

CN (weighted) = tot.prod. / tot. area = 446.52 / 5.40 = 82.7 ; Use CN ➡ **83**

2. Runoff

		Storm #1	Storm #2	Storm #3
Frequency……	yr			
Rainfall, P (24-hour)…….	in			
Runoff, Q……	in			

Use P and CN with table 2-1, figure 2-1, or equation 2-3 abd 2-4

PSS &	PROJECT: PennEast	JOB NO. 5516.0001	
		SHEET	DATE: 03/28/2019
		BY:	IK
	SUBJECT: Tc Calculations	CHK'D	

Time of Concentration calculations with the application of the SCS TR-55 methodology.

Watershed or Subarea Designation: DA 88.38

Area 5.4 AC

SHEET FLOW

Segment ID		A-B				
Surface Description (Table 3-1)		GRASS				
Manning's Coefficient, n (Table 3-1)		0.150				
Flow Length, L (total <= 150)	(ft)	150				
Two Year Rainfall, P	(in)	3.4				
Land Slope, s	(ft/ft)	0.040				
Computed Tt = 0.007 (nL)^0.8 / P^0.5*s^0.4	(hrs)	0.167				0.167

SHALLOW CONCENTRATED FLOW

Segment ID		B-C				
Surface Description (paved or unpaved)		UNPAVED				
Flow Length, L	(ft)	1414				
Watercourse slope, s	(ft/ft)	0.120				
Average Velocity, V (Figure 3-1)	(ft/s)	5.4				
Computed Tt = L / 3600V	(hrs)	0.073				0.073

CHANNEL FLOW

Segment ID		C-D				
Cross sectional Area, a	(sf)	5.25				
Wetted Perimeter, Pw	(ft)	2.01				
Hydraulic Radius, r =a/Pw	(ft)	2.612				
Channel Slope (ft/ft)	(ft/ft)	0.020				
Manning's Roughness Coefficient, n		0.045				
Velocity, V = 1.49r^(2/3)s^0.5 / n	(ft/s)	8.88				
Flow Length, L	(ft)	655				
Computed Tt = L / 3600V	(hrs)	0.020				0.020

Watershed or subarea Tc	0.260	hrs.
	15.6	min.

Use minimum Tc of 10 minutes

Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 05 / 23 / 2019

Hyd. No. 70

MP-88.38

Hydrograph type	= SCS Runoff	Peak discharge	= 8.009 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.20 hrs
Time interval	= 6 min	Hyd. volume	= 30,479 cuft
Drainage area	= 5.400 ac	Curve number	= 83.000
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 15.6 min
Total precip.	= 3.26 in	Distribution	= Custom
Storm duration	= C:\Users\IKuzmina\AppData\Local\Autodesk\C3D 2019\enu\HHApps\Hydrograp	Storm frequency	= 24 yrs

Hydrograph Discharge Table

(Printed values >= 1.00% of Qp.)

Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)
9.90	0.085	11.70	1.143	13.50	0.810	15.30	0.365
10.00	0.095	11.80	1.511	13.60	0.739	15.40	0.359
10.10	0.106	11.90	2.145	13.70	0.679	15.50	0.354
10.20	0.118	12.00	3.440	13.80	0.640	15.60	0.349
10.30	0.130	12.10	6.243	13.90	0.615	15.70	0.344
10.40	0.143	12.20	8.009	14.00	0.597	15.80	0.339
10.50	0.157	12.30	6.661	14.10	0.579	15.90	0.334
10.60	0.174	12.40	4.735	14.20	0.561	16.00	0.329
10.70	0.199	12.50	3.023	14.30	0.542	16.10	0.324
10.80	0.230	12.60	2.422	14.40	0.524	16.20	0.320
10.90	0.267	12.70	1.924	14.50	0.505	16.30	0.315
11.00	0.307	12.80	1.625	14.60	0.487	16.40	0.310
11.10	0.356	12.90	1.414	14.70	0.468	16.50	0.304
11.20	0.419	13.00	1.293	14.80	0.449	16.60	0.299
11.30	0.496	13.10	1.166	14.90	0.430	16.70	0.295
11.40	0.584	13.20	1.050	15.00	0.411	16.80	0.289
11.50	0.678	13.30	0.957	15.10	0.392	16.90	0.284
11.60	0.859	13.40	0.880	15.20	0.376	17.00	0.279

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Worksheet for MP-88.38R2 STA0+42_2YR_PIPE

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.02300	ft/ft
Discharge	8.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	238.00
0+01	236.00
0+18	230.00
0+31	224.00
0+46	221.77
0+50	221.70
1+00	222.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 238.00)	(1+00, 222.00)	0.045

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.25	ft
Elevation Range	221.70 to 238.00 ft	
Flow Area	6.18	ft²
Wetted Perimeter	47.01	ft
Hydraulic Radius	0.13	ft
Top Width	47.00	ft

Worksheet for MP-88.38R2 STA0+42_2YR_PIPE

Results

Normal Depth	0.25	ft
Critical Depth	0.21	ft
Critical Slope	0.06183	ft/ft
Velocity	1.29	ft/s
Velocity Head	0.03	ft
Specific Energy	0.28	ft
Froude Number	0.63	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.25	ft
Critical Depth	0.21	ft
Channel Slope	0.02300	ft/ft
Critical Slope	0.06183	ft/ft

Worksheet for MP-88.38R2 STA0+15_2YR-BRIDGE

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.02300	ft/ft
Discharge	8.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	238.00
0+01	236.00
0+12	232.00
0+28	224.00
0+46	221.99
0+54	222.20
0+70	222.20
1+00	222.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 238.00)	(1+00, 222.00)	0.045

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.26	ft
Elevation Range	221.99 to 238.00 ft	
Flow Area	6.67	ft²
Wetted Perimeter	56.92	ft
Hydraulic Radius	0.12	ft

Worksheet for MP-88.38R2 STA0+15_2YR-BRIDGE

Results

Top Width		56.66	ft
Normal Depth		0.26	ft
Critical Depth		0.22	ft
Critical Slope		0.06731	ft/ft
Velocity		1.20	ft/s
Velocity Head		0.02	ft
Specific Energy		0.28	ft
Froude Number		0.62	
Flow Type	Subcritical		

GVF Input Data

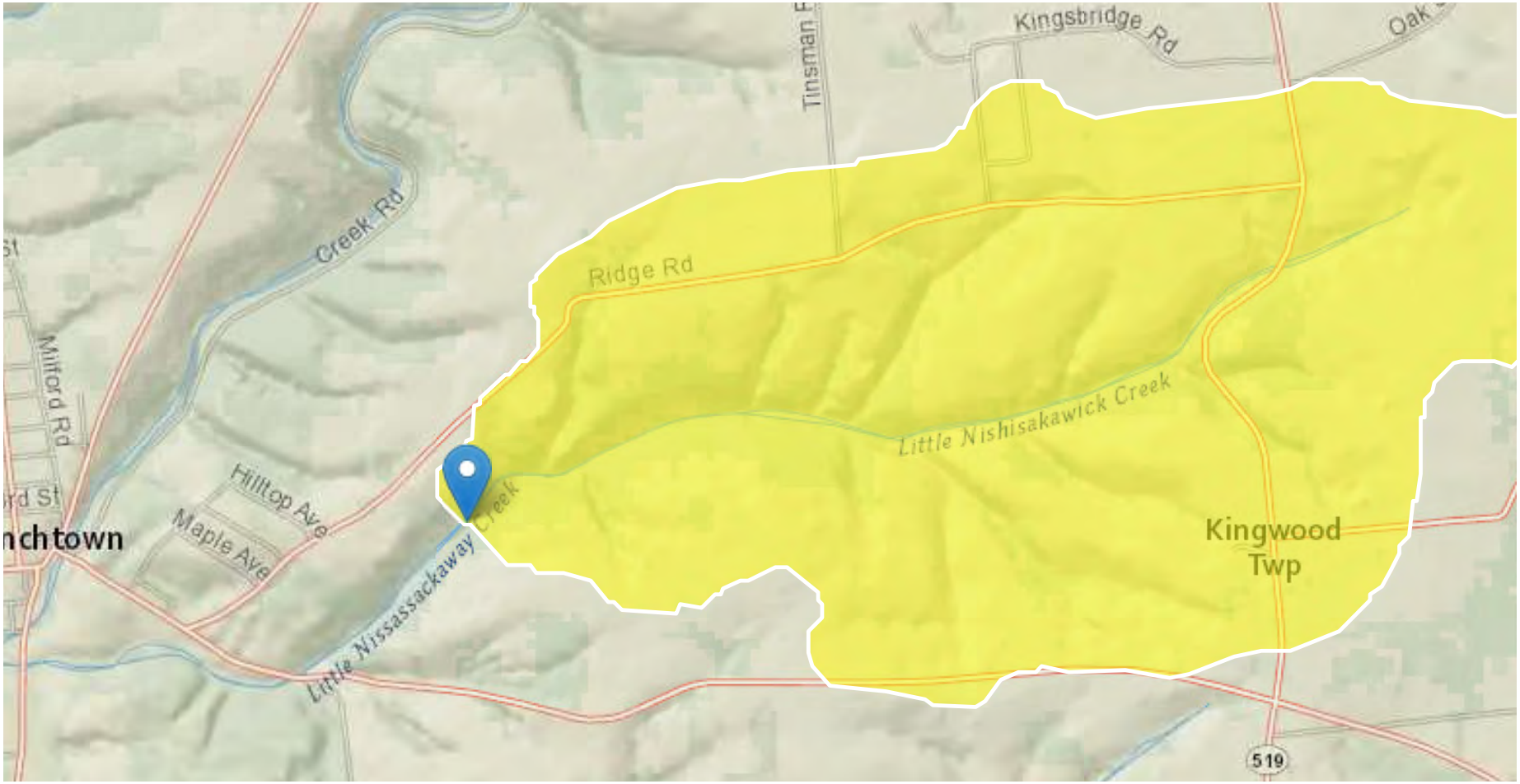
Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.26	ft
Critical Depth	0.22	ft
Channel Slope	0.02300	ft/ft
Critical Slope	0.06731	ft/ft

MP 88.39R2

Region ID: NJ
Workspace ID: NJ20170807121808572000
Clicked Point (Latitude, Longitude): 40.52794, -75.04201
Time: 2017-08-07 12:19:17 -0400



Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	2.69	square miles
STORAGE	Percentage of area of storage (lakes ponds reservoirs wetlands)	10.4	percent
CSL10_85	Change in elevation divided by length between points 10 and 85 percent of distance along main channel to basin divide - main channel method not known	109	feet per mi
POPDENS	Basin Population Density	105	persons per square mile

Peak-Flow Statistics Parameters [Peak Unglaciated Piedmont Region 2009 5167]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	2.69	square miles	0.25	779
STORAGE	Percent Storage	10.4	percent	0.23	32
CSL10_85	Stream Slope 10 and 85 Method	109	feet per mi	4.31	191
POPDENS	Basin Population Density	105	persons per square mile	83	11084

Peak-Flow Statistics Flow Report [Peak Unglaciated Piedmont Region 2009 5167]

PIl: Prediction Interval-Lower, Plu: Prediction Interval-Upper, SEp: Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	SEe	SEp	Equiv. Yrs.
2 Year Peak Flood	410	ft^3/s	49	50.3	1
5 Year Peak Flood	683	ft^3/s	49.4	50.9	2
10 Year Peak Flood	895	ft^3/s	50.5	52.2	3

Worksheet for MP-88.39R2_STA 0+43_2YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.01260	ft/ft
Discharge	410.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	222.00
0+29	221.20
0+50	219.35
0+60	222.00
0+63	225.80
0+70	226.00
0+91	228.00
1+00	230.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 222.00)	(1+00, 230.00)	0.050

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	3.18	ft
Elevation Range	219.35 to 230.00 ft	
Flow Area	93.33	ft²
Wetted Perimeter	61.74	ft
Hydraulic Radius	1.51	ft

Worksheet for MP-88.39R2_STA 0+43_2YR

Results

Top Width		60.53	ft
Normal Depth		3.18	ft
Critical Depth		2.76	ft
Critical Slope		0.03544	ft/ft
Velocity		4.39	ft/s
Velocity Head		0.30	ft
Specific Energy		3.48	ft
Froude Number		0.62	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	3.18	ft
Critical Depth	2.76	ft
Channel Slope	0.01260	ft/ft
Critical Slope	0.03544	ft/ft

Worksheet for MP-88.39R2_STA 0+18_2YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.01260	ft/ft
Discharge	410.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	222.00
0+27	221.80
0+58	219.70
0+65	222.00
0+69	226.20
0+82	228.10
0+93	230.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 222.00)	(0+93, 230.00)	0.050

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	3.03	ft
Elevation Range	219.70 to 230.00 ft	
Flow Area	96.37	ft²
Wetted Perimeter	66.94	ft
Hydraulic Radius	1.44	ft
Top Width	65.45	ft

Worksheet for MP-88.39R2_STA 0+18_2YR

Results

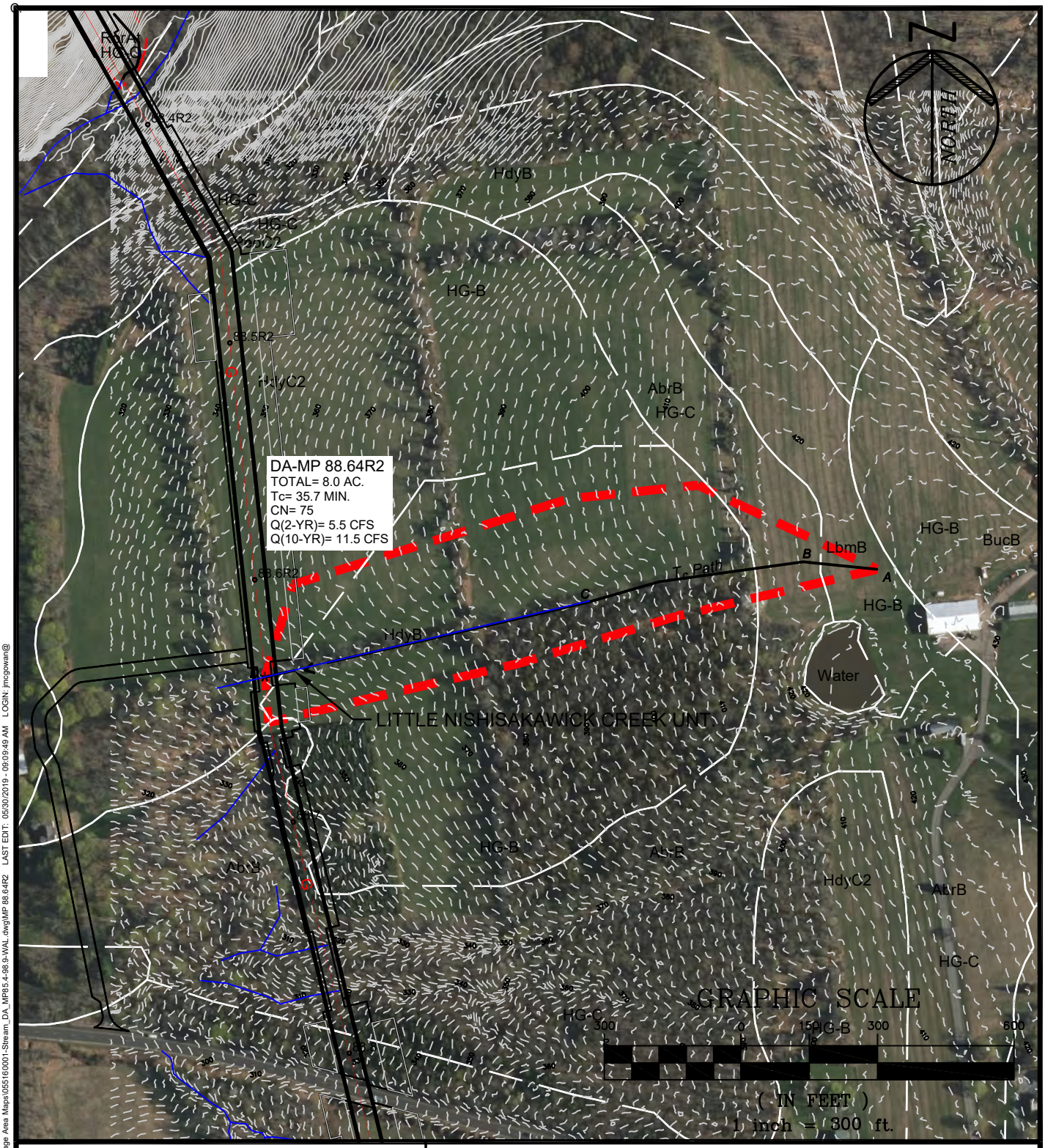
Normal Depth	3.03	ft
Critical Depth	2.62	ft
Critical Slope	0.03626	ft/ft
Velocity	4.25	ft/s
Velocity Head	0.28	ft
Specific Energy	3.31	ft
Froude Number	0.62	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	3.03	ft
Critical Depth	2.62	ft
Channel Slope	0.01260	ft/ft
Critical Slope	0.03626	ft/ft



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CERTIFICATE OF AUTHORIZATION NO. 24GA28032700

PROJECT TITLE

PENNEAST PIPELINE

HUNTERDON AND MERCER COUNTY, NJ

SHEET TITLE

STREAM CROSSING DRAINAGE AREA MP-88.64R2

PROJ. NO.:	05516.0001	DRN. BY:	JPS	SCALE:	1"=300'
DATE:	05/23/19	CK'D BY:	WS		

FILE NAME: P:\05516\0001\DWGs\CAD\C-Civil\Plotdwgs\Drainage Area Maps\05516\0001-Stream_DA_MP85.4-98.9-WAL.dwg\MP 88.64R2 LAST EDIT: 05/30/2019 - 09:09:49 AM LOGIN: jmcgowan@

Worksheet 2: Runoff curve number and runoff (Approximated)

Project	By	Date
PennEast	JPS	26-Feb-18
Location	**Checked**	**Date**
Hunterdon County, NJ		

Check one: ☐ Present ☒ Developed | MP 88.64R2

1. Runoff curve number

Soil name and hydrologic group (appendix A)	Cover Description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN[1] Table 2-2	CN[1] Figure 2-3	CN[1] Figure 2-4	Area ☒ acres ☐ mi² ☐ %	Product of CN x Area
Type B	Farmstead, Good Condition	74			7.50	555.00
Type C	Farmstead, Good Condition	82			0.50	41.00
1. Use only one CN source per line				Totals ➡	8.00	596.00

CN (weighted) = tot.prod. / tot. area = 596.00 / 8.00 = 74.5 ; Use CN ➡ **75**

2. Runoff

		Storm #1	Storm #2	Storm #3
Frequency……	yr			
Rainfall, P (24-hour)…….	in			
Runoff, Q……	in			

Use P and CN with table 2-1, figure 2-1, or equation 2-3 abd 2-4

PSS &	PROJECT: PennEast	JOB NO. 5516.0001	
		SHEET	DATE:2/12/2018
		BY:	JPS
	SUBJECT: Tc Calculations	CHK'D	

Time of Concentration calculations with the application of the SCS TR-55 methodology.

Watershed or Subarea Designation: DA 88.64R2

Area 8.0 AC

SHEET FLOW

Segment ID		A-B				
Surface Description (Table 3-1)		CULTIVATED				
Manning's Coefficient, n (Table 3-1)		0.240				
Flow Length, L (total <= 150)	(ft)	150				
Two Year Rainfall, P	(in)	3.4				
Land Slope, s	(ft/ft)	0.007				
Computed Tt = 0.007 (nL)^0.8 / P^0.5*s^0.4	(hrs)	0.487				0.487

SHALLOW CONCENTRATED FLOW

Segment ID		B-C				
Surface Description (paved or unpaved)		UNPAVED				
Flow Length, L	(ft)	497				
Watercourse slope, s	(ft/ft)	0.058				
Average Velocity, V (Figure 3-1)	(ft/s)	3.6				
Computed Tt = L / 3600V	(hrs)	0.038				0.038

CHANNEL FLOW

Segment ID		C-D				
Cross sectional Area, a	(sf)	2.41				
Wetted Perimeter, Pw	(ft)	18.48				
Hydraulic Radius, r =a/Pw	(ft)	0.130				
Channel Slope (ft/ft)	(ft/ft)	0.095				
Manning's Roughness Coefficient, n		0.040				
Velocity, V = 1.49r^(2/3)s^0.5 / n	(ft/s)	2.95				
Flow Length, L	(ft)	740				
Computed Tt = L / 3600V	(hrs)	0.070				0.070

Watershed or subarea Tc	0.595	hrs.
	35.7	min.

Use minimum Tc of 10 minutes

Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Wednesday, 02 / 20 / 2019

Hyd. No. 16

DA 88.6-1

Hydrograph type	= SCS Runoff	Peak discharge	= 5.455 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.40 hrs
Time interval	= 6 min	Hyd. volume	= 33,983 cuft
Drainage area	= 8.000 ac	Curve number	= 75.000*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 35.7 min
Total precip.	= 3.26 in	Distribution	= Custom
Storm duration	= C:\Users\IKuzmina\AppData\Local\Autodesk\C3D 2019\enu\HHApps\Hydrograp		

* Composite (Area/CN) = [(7.500 x 74) + (0.500 x 82)] / 8.000

Hydrograph Discharge Table

(Printed values >= 1.00% of Qp.)

Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)
11.20	0.076	13.00	2.735	14.80	0.643	16.60	0.410
11.30	0.111	13.10	2.152	14.90	0.620	16.70	0.404
11.40	0.156	13.20	1.852	15.00	0.596	16.80	0.397
11.50	0.212	13.30	1.629	15.10	0.573	16.90	0.391
11.60	0.293	13.40	1.456	15.20	0.550	17.00	0.385
11.70	0.404	13.50	1.314	15.30	0.528	17.10	0.378
11.80	0.570	13.60	1.204	15.40	0.509	17.20	0.372
11.90	0.840	13.70	1.103	15.50	0.493	17.30	0.365
12.00	1.339	13.80	1.015	15.60	0.480	17.40	0.359
12.10	2.373	13.90	0.940	15.70	0.469	17.50	0.352
12.20	3.524	14.00	0.881	15.80	0.461	17.60	0.346
12.30	4.646	14.10	0.834	15.90	0.453	17.70	0.339
12.40	5.455	14.20	0.795	16.00	0.447	17.80	0.333
12.50	5.443	14.30	0.763	16.10	0.441	17.90	0.326
12.60	5.150	14.40	0.736	16.20	0.435	18.00	0.319
12.70	4.674	14.50	0.712	16.30	0.428	18.10	0.313
12.80	4.089	14.60	0.689	16.40	0.422	18.20	0.306
12.90	3.410	14.70	0.666	16.50	0.416	18.30	0.300

<<

Continues on next page...

Worksheet for MP-88.64MR2_STA0+77_PIPE_2YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.05419	ft/ft
Discharge	5.50	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	354.00
0+50	350.38
0+53	351.30

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 354.00)	(0+53, 351.30)	0.050

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.49	ft
Elevation Range	350.38 to 354.00 ft	
Flow Area	2.04	ft²
Wetted Perimeter	8.38	ft
Hydraulic Radius	0.24	ft
Top Width	8.28	ft
Normal Depth	0.49	ft
Critical Depth	0.48	ft
Critical Slope	0.05937	ft/ft
Velocity	2.70	ft/s

Worksheet for MP-88.64MR2_STA0+77_PIPE_2YR

Results

Velocity Head	0.11	ft
Specific Energy	0.61	ft
Froude Number	0.96	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.49	ft
Critical Depth	0.48	ft
Channel Slope	0.05419	ft/ft
Critical Slope	0.05937	ft/ft

Worksheet for MP-88.64MR2_STA0+68_BRIDGE_2YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.05419	ft/ft
Discharge	5.50	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	354.00
0+48	352.00
0+50	350.91
0+52	351.30

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 354.00)	(0+52, 351.30)	0.050

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.66	ft
Elevation Range	350.91 to 354.00 ft	
Flow Area	1.55	ft²
Wetted Perimeter	4.23	ft
Hydraulic Radius	0.37	ft
Top Width	3.79	ft
Normal Depth	0.66	ft
Critical Depth	0.65	ft
Critical Slope	0.05690	ft/ft

Worksheet for MP-88.64MR2_STA0+68_BRIDGE_2YR

Results

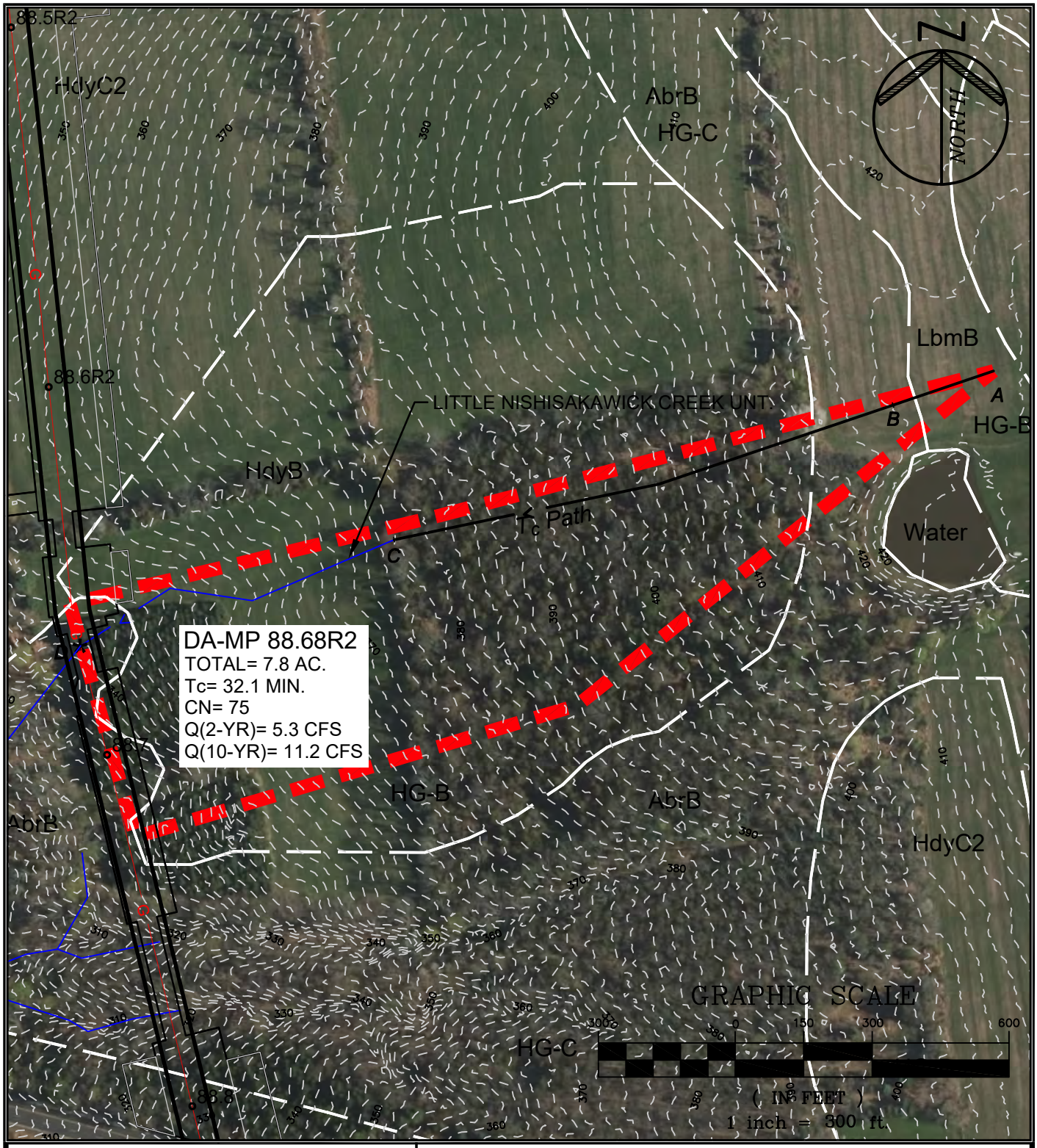
Velocity		3.55	ft/s
Velocity Head		0.20	ft
Specific Energy		0.85	ft
Froude Number		0.98	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.66	ft
Critical Depth	0.65	ft
Channel Slope	0.05419	ft/ft
Critical Slope	0.05690	ft/ft



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CERTIFICATE OF AUTHORIZATION NO. 24GA28032700

PROJECT TITLE

PENNEAST PIPELINE

HUNTERDON AND MERCER COUNTY, NJ

SHEET TITLE

STREAM CROSSING DRAINAGE AREA MP-88.68R2

PROJ. NO.:	05516.0001	DRN. BY:	JPS	SCALE:	1"=200'
DATE:	05/23/19	CK'D BY:	WS		

FILE NAME: P:\05516\0001\DWGs\CAD\C-Civil\Plotdwgs\Drainage Area Maps\05516\0001-Stream_DA_MP85.4-98.9-WAL.dwg\MP 88.68R2 LAST EDIT: 05/30/2019 - 09:13:33 AM LOGIN: jmcgowan@

Worksheet 2: Runoff curve number and runoff (Approximated)

Project	By	Date
PennEast	JPS	26-Feb-18
Location	**Checked**	**Date**
Hunterdon County, NJ		

Check one: ☐ Present ☒ Developed | MP 88.68R2

1. Runoff curve number

Soil name and hydrologic group (appendix A)	Cover Description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN[1] Table 2-2	CN[1] Figure 2-3	CN[1] Figure 2-4	Area ☒ acres / ☐ mi² / ☐ %	Product of CN x Area
Type B	Farmstead, Good Condition	74			7.10	525.40
Type C	Farmstead, Good Condition	82			0.70	57.40
1. Use only one CN source per line				Totals ➡	7.80	582.80

CN (weighted) = tot.prod. / tot. area = 582.80 / 7.80 = 74.7 ; Use CN ➡ **75**

2. Runoff

		Storm #1	Storm #2	Storm #3
Frequency……	yr			
Rainfall, P (24-hour)…….	in			
Runoff, Q……	in			

Use P and CN with table 2-1, figure 2-1, or equation 2-3 abd 2-4

PSS &	PROJECT: PennEast	JOB NO. 5516.0001	
		SHEET	DATE:2/12/2018
		BY:	JPS
	SUBJECT: Tc Calculations	CHK'D	

Time of Concentration calculations with the application of the SCS TR-55 methodology.

Watershed or Subarea Designation: DA 88.68R2

Area 7.8 AC

SHEET FLOW

Segment ID		A-B				
Surface Description (Table 3-1)		CULTIVATED				
Manning's Coefficient, n (Table 3-1)		0.240				
Flow Length, L (total <= 150)	(ft)	150				
Two Year Rainfall, P	(in)	3.4				
Land Slope, s	(ft/ft)	0.010				
Computed Tt = 0.007 (nL)^0.8 / P^0.5*s^0.4	(hrs)	0.422				0.422

SHALLOW CONCENTRATED FLOW

Segment ID		B-C				
Surface Description (paved or unpaved)		UNPAVED				
Flow Length, L	(ft)	757				
Watercourse slope, s	(ft/ft)	0.058				
Average Velocity, V (Figure 3-1)	(ft/s)	3.6				
Computed Tt = L / 3600V	(hrs)	0.058				0.058

CHANNEL FLOW

Segment ID		C-D				
Cross sectional Area, a	(sf)	2.22				
Wetted Perimeter, Pw	(ft)	17.86				
Hydraulic Radius, r =a/Pw	(ft)	0.124				
Channel Slope (ft/ft)	(ft/ft)	0.076				
Manning's Roughness Coefficient, n		0.040				
Velocity, V = 1.49r^(2/3)s^0.5 / n	(ft/s)	2.56				
Flow Length, L	(ft)	502				
Computed Tt = L / 3600V	(hrs)	0.055				0.055

Watershed or subarea Tc	0.535	hrs.
	32.1	min.

Use minimum Tc of 10 minutes

Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Wednesday, 02 / 20 / 2019

Hyd. No. 17

DA 88.6-2

Hydrograph type	= SCS Runoff	Peak discharge	= 5.319 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.40 hrs
Time interval	= 6 min	Hyd. volume	= 33,134 cuft
Drainage area	= 7.800 ac	Curve number	= 75.000*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 32.1 min
Total precip.	= 3.26 in	Distribution	= Custom
Storm duration	= C:\Users\IKuzmina\AppData\Local\Autodesk\C3D 2019\enu\HHApps\Hydrograp		

* Composite (Area/CN) = [(7.100 x 74) + (0.700 x 82)] / 7.800

Hydrograph Discharge Table

(Printed values >= 1.00% of Qp.)

Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)
11.20	0.074	13.00	2.667	14.80	0.627	16.60	0.400
11.30	0.108	13.10	2.098	14.90	0.604	16.70	0.394
11.40	0.152	13.20	1.806	15.00	0.581	16.80	0.387
11.50	0.207	13.30	1.588	15.10	0.558	16.90	0.381
11.60	0.285	13.40	1.419	15.20	0.536	17.00	0.375
11.70	0.394	13.50	1.281	15.30	0.515	17.10	0.369
11.80	0.556	13.60	1.174	15.40	0.496	17.20	0.363
11.90	0.819	13.70	1.076	15.50	0.481	17.30	0.356
12.00	1.305	13.80	0.989	15.60	0.468	17.40	0.350
12.10	2.314	13.90	0.917	15.70	0.458	17.50	0.344
12.20	3.436	14.00	0.859	15.80	0.449	17.60	0.337
12.30	4.530	14.10	0.813	15.90	0.442	17.70	0.331
12.40	5.319	14.20	0.775	16.00	0.435	17.80	0.324
12.50	5.307	14.30	0.744	16.10	0.430	17.90	0.318
12.60	5.021	14.40	0.717	16.20	0.424	18.00	0.311
12.70	4.557	14.50	0.694	16.30	0.418	18.10	0.305
12.80	3.986	14.60	0.672	16.40	0.412	18.20	0.299
12.90	3.325	14.70	0.649	16.50	0.406	18.30	0.293

<<

Continues on next page...

Worksheet for MP-88.68M_STA0+41_PIPE_2YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.07420	ft/ft
Discharge	5.30	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	338.00
0+50	337.15
0+52	337.50
0+59	338.00
1+00	344.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 338.00)	(1+00, 344.00)	0.045

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.26	ft
Elevation Range	337.15 to 344.00 ft	
Flow Area	2.28	ft²
Wetted Perimeter	17.29	ft
Hydraulic Radius	0.13	ft
Top Width	17.27	ft
Normal Depth	0.26	ft
Critical Depth	0.28	ft

Worksheet for MP-88.68M_STA0+41_PIPE_2YR

Results

Critical Slope		0.05714	ft/ft
Velocity		2.33	ft/s
Velocity Head		0.08	ft
Specific Energy		0.35	ft
Froude Number		1.13	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.26	ft
Critical Depth	0.28	ft
Channel Slope	0.07420	ft/ft
Critical Slope	0.05714	ft/ft

Worksheet for MP-88.68M_STA0+24_BRIDGE_2YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.07420	ft/ft
Discharge	5.30	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	342.00
0+13	342.00
0+48	338.90
0+50	338.44
0+52	338.90
0+71	340.00
0+87	342.00
1+00	342.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 342.00)	(1+00, 342.00)	0.045

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.62	ft
Elevation Range	338.44 to 342.00 ft	
Flow Area	1.69	ft²
Wetted Perimeter	8.15	ft
Hydraulic Radius	0.21	ft

Worksheet for MP-88.68M_STA0+24_BRIDGE_2YR

Results

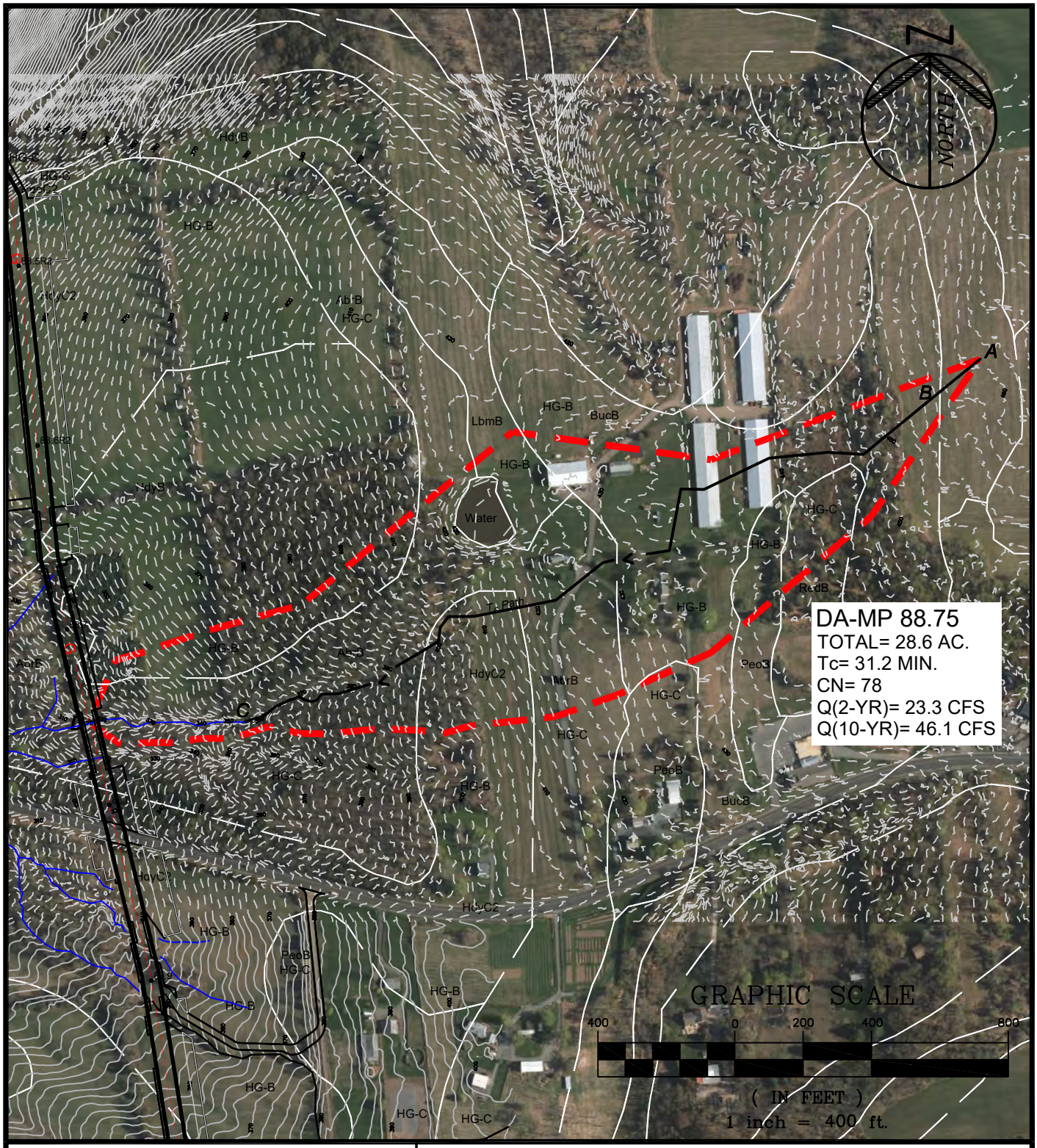
Top Width		8.02	ft
Normal Depth		0.62	ft
Critical Depth		0.66	ft
Critical Slope		0.04988	ft/ft
Velocity		3.14	ft/s
Velocity Head		0.15	ft
Specific Energy		0.78	ft
Froude Number		1.21	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.62	ft
Critical Depth	0.66	ft
Channel Slope	0.07420	ft/ft
Critical Slope	0.04988	ft/ft



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CERTIFICATE OF AUTHORIZATION NO. 24GA28032700

PROJECT TITLE

PENNEAST PIPELINE

HUNTERDON AND MERCER COUNTY, NJ

SHEET TITLE

STREAM CROSSING DRAINAGE AREA MP-88.75

PROJ. NO.: 05516.0001	DRN. BY: JPS	SCALE: 1"=400'
DATE: 05/23/19	CK'D BY: WS	

FILE NAME: P:\05516\0001\DWGs\CAD\C-Civil\Plotdwgs\Drainage Area Maps\05516\0001-Stream_DA_MP88.4-98.9-1-WAL.dwg\MP 88.75 LAST EDIT: 06/13/2019 - 02:39:20 PM LOGIN: jmcgowan@

Worksheet 2: Runoff curve number and runoff (Approximated)

Project	By	Date
PennEast	JPS	26-Feb-18
Location	**Checked**	**Date**
Hunterdon County, NJ		

Check one: ☐ Present ☒ Developed | MP 88.75

1. Runoff curve number

Soil name and hydrologic group (appendix A)	Cover Description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN[1] Table 2-2	CN[1] Figure 2-3	CN[1] Figure 2-4	Area ☒ acres ☐ mi² ☐ %	Product of CN x Area
Type B	Farmstead, Good Condition	74			15.50	1,147.00
Type C	Farmstead, Good Condition	82			13.07	1,071.74
1. Use only one CN source per line				**Totals** ➡	28.57	2,218.74

CN (weighted) = tot.prod. / tot. area = 2,218.74 / 28.57 = 77.7 ; **Use CN** ➡ **78**

2. Runoff

		Storm #1	Storm #2	Storm #3
Frequency…….	yr			
Rainfall, P (24-hour)…….	in			
Runoff, Q……	in			

Use P and CN with table 2-1, figure 2-1, or equation 2-3 abd 2-4

PROJECT:	PennEast	JOB NO. 5516.0001	
		SHEET	DATE:2/12/2018
		BY:	JPS
SUBJECT:	Tc Calculations	CHK'D	

Time of Concentration calculations with the application of the SCS TR-55 methodology.

Watershed or Subarea Designation: DA 88.75

Area 30.8 AC

SHEET FLOW

Segment ID		A-B			
Surface Description (Table 3-1)		CULTIVATED			
Manning's Coefficient, n (Table 3-1)		0.240			
Flow Length, L (total <= 150)	(ft)	150			
Two Year Rainfall, P	(in)	3.4			
Land Slope, s	(ft/ft)	0.027			
Computed Tt = 0.007 (nL)^0.8 / P^0.5*s^0.4	(hrs)	0.284			0.284

SHALLOW CONCENTRATED FLOW

Segment ID		B-C			
Surface Description (paved or unpaved)		UNPAVED			
Flow Length, L	(ft)	2440			
Watercourse slope, s	(ft/ft)	0.041			
Average Velocity, V (Figure 3-1)	(ft/s)	3.2			
Computed Tt = L / 3600V	(hrs)	0.212			0.212

CHANNEL FLOW

Segment ID		C-D			
Cross sectional Area, a	(sf)	4.81			
Wetted Perimeter, Pw	(ft)	13.24			
Hydraulic Radius, r =a/Pw	(ft)	0.363			
Channel Slope (ft/ft)	(ft/ft)	0.085			
Manning's Roughness Coefficient, n		0.040			
Velocity, V = 1.49r^(2/3)s^0.5 / n	(ft/s)	5.53			
Flow Length, L	(ft)	471			
Computed Tt = L / 3600V	(hrs)	0.024			0.024

Watershed or subarea Tc	0.519	hrs.
	31.2	min.

Use minimum Tc of 10 minutes

Hydrograph Report

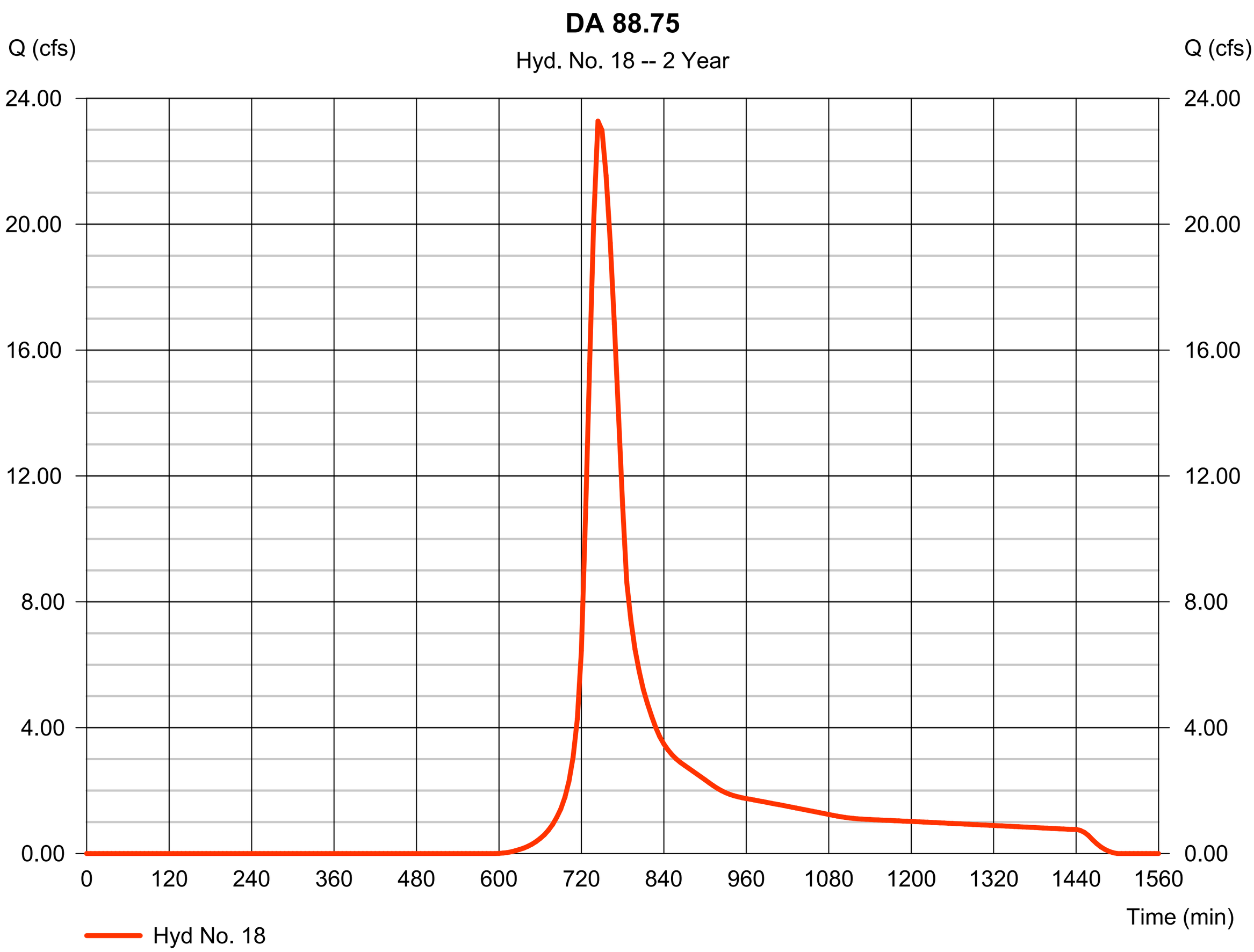
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 06 / 13 / 2019

Hyd. No. 18

DA 88.75

Hydrograph type	=	SCS Runoff	Peak discharge	=	23.28 cfs
Storm frequency	=	2 yrs	Time to peak	=	744 min
Time interval	=	6 min	Hyd. volume	=	140,906 cuft
Drainage area	=	28.570 ac	Curve number	=	78*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	31.20 min
Total precip.	=	3.26 in	Distribution	=	Custom
Storm duration	=	C:\Users\IKuzmina\AppData\Local\Autodesk\C3D 2019\enu\HHApps\Hydrograph	Shape factor	=	484

* Composite (Area/CN) = [(15.500 x 74) + (13.070 x 82)] / 28.570



Worksheet for MP-88.75_STA0+16_PIPE_2YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.07990	ft/ft
Discharge	23.30	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	322.00
0+19	318.00
0+31	316.50
0+37	314.53
0+40	314.80
0+44	315.70
0+47	316.00
0+53	318.00
0+81	322.00
1+00	322.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 322.00)	(1+00, 322.00)	0.050

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.95	ft
Elevation Range	314.53 to 322.00 ft	
Flow Area	4.34	ft²

Worksheet for MP-88.75_STA0+16_PIPE_2YR

Results

Wetted Perimeter		8.48	ft
Hydraulic Radius		0.51	ft
Top Width		8.23	ft
Normal Depth		0.95	ft
Critical Depth		1.07	ft
Critical Slope		0.04529	ft/ft
Velocity		5.37	ft/s
Velocity Head		0.45	ft
Specific Energy		1.40	ft
Froude Number		1.30	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.95	ft
Critical Depth	1.07	ft
Channel Slope	0.07990	ft/ft
Critical Slope	0.04529	ft/ft

Worksheet for MP-88.75_STA0+06_BRIDGE_2YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.07990	ft/ft
Discharge	23.30	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	324.00
0+01	324.00
0+25	322.00
0+33	320.00
0+38	318.00
0+50	315.14
0+63	318.00
0+91	322.00
1+00	322.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 324.00)	(1+00, 322.00)	0.050

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	1.01	ft
Elevation Range	315.14 to 324.00 ft	
Flow Area	4.45	ft²
Wetted Perimeter	9.03	ft

Worksheet for MP-88.75_STA0+06_BRIDGE_2YR

Results

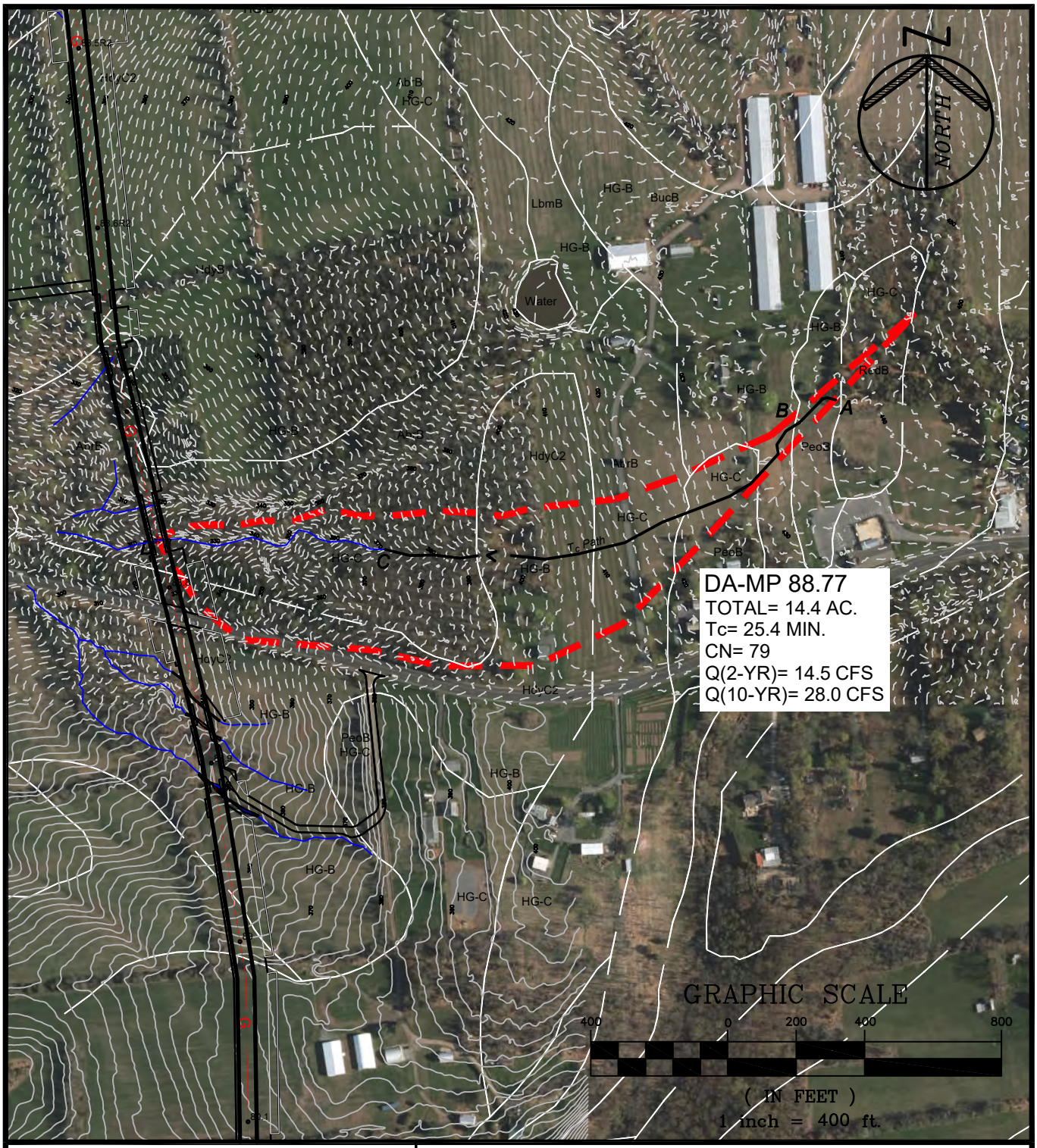
Hydraulic Radius		0.49	ft
Top Width		8.80	ft
Normal Depth		1.01	ft
Critical Depth		1.12	ft
Critical Slope		0.04571	ft/ft
Velocity		5.24	ft/s
Velocity Head		0.43	ft
Specific Energy		1.44	ft
Froude Number		1.30	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.01	ft
Critical Depth	1.12	ft
Channel Slope	0.07990	ft/ft
Critical Slope	0.04571	ft/ft



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CERTIFICATE OF AUTHORIZATION NO. 24GA28032700

PROJECT TITLE

PENNEAST PIPELINE

HUNTERDON AND MERCER COUNTY, NJ

SHEET TITLE

STREAM CROSSING DRAINAGE AREA MP-88.77

PROJ. NO.: 05516.0001	DRN. BY: JPS	SCALE: 1"=400'
DATE: 05/23/19	CK'D BY: WS	

FILE NAME: P:\05516\0001\DWGs\CADC-Civil\Plotdwgs\Drainage Area Maps\055160001-Stream_DA_MP85.4-98.9-1-WALL.dwg\MP 88.77 LAST EDIT: 06/07/2019 - 11:48:30 AM LOGIN: jmcgowan@

Worksheet 2: Runoff curve number and runoff (Approximated)

Project	By	Date
PennEast	JPS	26-Feb-18
Location	**Checked**	**Date**
Hunterdon County, NJ		

Check one: ☐ Present ☒ Developed | MP 88.77

1. Runoff curve number

Soil name and hydrologic group (appendix A)	Cover Description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN[1] Table 2-2	CN[1] Figure 2-3	CN[1] Figure 2-4	Area X acres mi² %	Product of CN x Area
Type B	Farmstead, Good Condition	74			4.90	362.60
Type C	Farmstead, Good Condition	82			9.50	779.00
1. Use only one CN source per line				Totals ➡	14.40	1,141.60

CN (weighted) = tot.prod. / tot. area = 1,141.60 / 14.40 = 79.3 ; Use CN ➡ **79**

2. Runoff

		Storm #1	Storm #2	Storm #3
Frequency……	yr			
Rainfall, P (24-hour)…….	in			
Runoff, Q……	in			

Use P and CN with table 2-1, figure 2-1, or equation 2-3 abd 2-4

PROJECT:	PennEast	JOB NO. 5516.0001	
		SHEET	DATE:2/12/2018
		BY:	JPS
SUBJECT:	Tc Calculations	CHK'D	

Time of Concentration calculations with the application of the SCS TR-55 methodology.

Watershed or Subarea Designation: DA 88.77

Area 14.42 AC

SHEET FLOW

Segment ID		A-B				
Surface Description (Table 3-1)		CULTIVATED				
Manning's Coefficient, n (Table 3-1)		0.240				
Flow Length, L (total <= 150)	(ft)	150				
Two Year Rainfall, P	(in)	3.4				
Land Slope, s	(ft/ft)	0.030				
Computed Tt = 0.007 (nL)^0.8 / P^0.5*s^0.4	(hrs)	0.272				0.272

SHALLOW CONCENTRATED FLOW

Segment ID		B-C				
Surface Description (paved or unpaved)		UNPAVED				
Flow Length, L	(ft)	1343				
Watercourse slope, s	(ft/ft)	0.049				
Average Velocity, V (Figure 3-1)	(ft/s)	3.4				
Computed Tt = L / 3600V	(hrs)	0.110				0.110

CHANNEL FLOW

Segment ID		C-D				
Cross sectional Area, a	(sf)	3.17				
Wetted Perimeter, Pw	(ft)	10.21				
Hydraulic Radius, r =a/Pw	(ft)	0.310				
Channel Slope (ft/ft)	(ft/ft)	0.075				
Manning's Roughness Coefficient, n		0.040				
Velocity, V = 1.49r^(2/3)s^0.5 / n	(ft/s)	4.68				
Flow Length, L	(ft)	709				
Computed Tt = L / 3600V	(hrs)	0.042				0.042

Watershed or subarea Tc	0.424	hrs.
	25.4	min.

Use minimum Tc of 10 minutes

Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Wednesday, 02 / 20 / 2019

Hyd. No. 19

DA 88.7-2

Hydrograph type	= SCS Runoff	Peak discharge	= 14.51 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.30 hrs
Time interval	= 6 min	Hyd. volume	= 72,237 cuft
Drainage area	= 14.400 ac	Curve number	= 79.000*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 25.4 min
Total precip.	= 3.26 in	Distribution	= Custom
Storm duration	= C:\Users\IKuzmina\AppData\Local\Autodesk\C3D 2019\enu\HHApps\Hydrograp		

* Composite (Area/CN) = [(4.900 x 74) + (9.500 x 82)] / 14.400

Hydrograph Discharge Table

(Printed values >= 1.00% of Qp.)

Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)
10.60	0.174	12.40	13.72	14.20	1.487	16.00	0.862
10.70	0.210	12.50	12.09	14.30	1.442	16.10	0.850
10.80	0.255	12.60	9.913	14.40	1.396	16.20	0.837
10.90	0.311	12.70	7.578	14.50	1.350	16.30	0.825
11.00	0.376	12.80	5.457	14.60	1.304	16.40	0.813
11.10	0.457	12.90	4.526	14.70	1.258	16.50	0.800
11.20	0.556	13.00	3.890	14.80	1.211	16.60	0.787
11.30	0.679	13.10	3.423	14.90	1.163	16.70	0.775
11.40	0.829	13.20	3.043	15.00	1.116	16.80	0.762
11.50	1.002	13.30	2.770	15.10	1.068	16.90	0.749
11.60	1.269	13.40	2.526	15.20	1.022	17.00	0.736
11.70	1.640	13.50	2.309	15.30	0.983	17.10	0.724
11.80	2.227	13.60	2.113	15.40	0.953	17.20	0.711
11.90	3.112	13.70	1.941	15.50	0.930	17.30	0.698
12.00	4.856	13.80	1.798	15.60	0.913	17.40	0.685
12.10	8.456	13.90	1.687	15.70	0.899	17.50	0.672
12.20	12.08	14.00	1.603	15.80	0.887	17.60	0.659
12.30	14.51	14.10	1.538	15.90	0.874	17.70	0.646

<<

Continues on next page...

Worksheet for MP-88.77M_STA0+20_PIPE_2YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.11630	ft/ft
Discharge	14.50	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	322.00
0+15	322.00
0+42	318.00
0+51	317.50
0+53	316.00
0+56	315.72
0+61	316.00
0+93	320.00
1+00	322.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 322.00)	(1+00, 322.00)	0.050

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.51	ft
Elevation Range	315.72 to 322.00 ft	
Flow Area	3.11	ft²
Wetted Perimeter	10.01	ft

Worksheet for MP-88.77M_STA0+20_PIPE_2YR

Results

Hydraulic Radius		0.31	ft
Top Width		9.88	ft
Normal Depth		0.51	ft
Critical Depth		0.61	ft
Critical Slope		0.05122	ft/ft
Velocity		4.66	ft/s
Velocity Head		0.34	ft
Specific Energy		0.85	ft
Froude Number		1.46	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.51	ft
Critical Depth	0.61	ft
Channel Slope	0.11630	ft/ft
Critical Slope	0.05122	ft/ft

Worksheet for MP-88.77M_STA0+10_BRIDGE_2YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.11630	ft/ft
Discharge	14.50	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	324.00
0+14	324.00
0+43	318.00
0+45	317.00
0+50	317.00
0+53	316.50
0+86	320.00
1+00	322.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 324.00)	(1+00, 322.00)	0.050

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.62	ft
Elevation Range	316.50 to 324.00 ft	
Flow Area	3.62	ft²
Wetted Perimeter	14.56	ft
Hydraulic Radius	0.25	ft

Worksheet for MP-88.77M_STA0+10_BRIDGE_2YR

Results

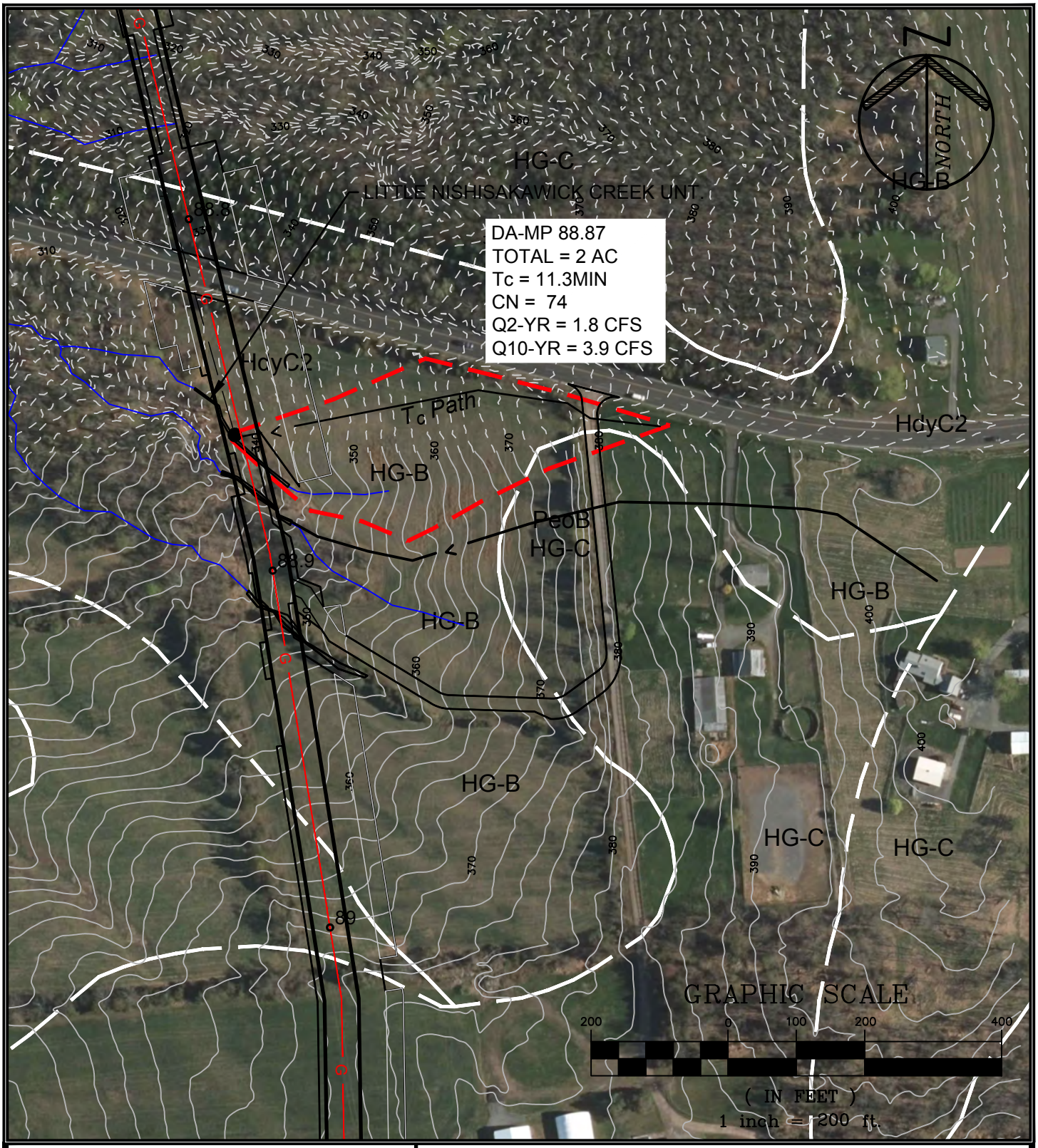
Top Width		14.46	ft
Normal Depth		0.62	ft
Critical Depth		0.69	ft
Critical Slope		0.05473	ft/ft
Velocity		4.01	ft/s
Velocity Head		0.25	ft
Specific Energy		0.87	ft
Froude Number		1.41	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.62	ft
Critical Depth	0.69	ft
Channel Slope	0.11630	ft/ft
Critical Slope	0.05473	ft/ft



FILE NAME: P:\05516\0001\DWGs\CAD\C-Civil\Plotdwgs\Drainage Area Maps\0551600001-Stream_DA_MP85.4-98.9-WAL.dwg\MP 88.87 LAST EDIT: 05/30/2019 - 10:03:34 AM LOGIN: jmcgowan@

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CERTIFICATE OF AUTHORIZATION NO. 24GA28032700

PROJECT TITLE

PENNEAST PIPELINE

HUNTERDON AND MERCER COUNTY, NJ

SHEET TITLE

STREAM CROSSING DRAINAGE AREA MP-88.87

PROJ. NO.: 05516.0001	DRN. BY: JPS	SCALE: 1"=200'
DATE: 05/23/19	CK'D BY: WS	

Worksheet 2: Runoff curve number and runoff (Approximated)

Project	By	Date
PennEast	IK	8-Mar-19
Location	**Checked**	**Date**
Hunterdon County, NJ		

Check one: ☐ Present ☒ Developed | MP 88.87

1. Runoff curve number

Soil name and hydrologic group (appendix A)	Cover Description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN[1] Table 2-2	CN[1] Figure 2-3	CN[1] Figure 2-4	Area X acres / mi² / %	Product of CN x Area
Type B	Farmstead, Good Condition	74			1.91	141.34
Type C	Farmstead, Good Condition	82			0.098	8.04
1. Use only one CN source per line				Totals ➡	2.01	149.38

CN (weighted) = tot.prod. / tot. area = 149.38 / 2.01 = 74.4 ; Use CN ➡ **74**

2. Runoff

		Storm #1	Storm #2	Storm #3
Frequency……	yr			
Rainfall, P (24-hour)…….	in			
Runoff, Q……	in			

Use P and CN with table 2-1, figure 2-1, or equation 2-3 abd 2-4

PSS &	PROJECT: PennEast	JOB NO. 5516.0001	
		SHEET	DATE:3/08/2019
		BY:	IK
	SUBJECT: Tc Calculations	CHK'D	

Time of Concentration calculations with the application of the SCS TR-55 methodology.

Watershed or Subarea Designation: DA 88.87

Area 2 AC

SHEET FLOW

Segment ID		A-B	B-C	C-D	
Surface Description (Table 3-1)		GRASS	ASPHALT	GRASS	
Manning's Coefficient, n (Table 3-1)		0.150	0.011	0.150	
Flow Length, L (total <= 150)	(ft)	92	23	35	
Two Year Rainfall, P	(in)	3.4	3.4	3.4	
Land Slope, s	(ft/ft)	0.065	0.130	0.029	
Computed Tt = 0.007 (nL)^0.8 / P^0.5*s^0.4	(hrs)	0.093	0.003	0.059	0.155

SHALLOW CONCENTRATED FLOW

Segment ID		D-E			
Surface Description (paved or unpaved)		UNPAVED			
Flow Length, L	(ft)	488			
Watercourse slope, s	(ft/ft)	0.078			
Average Velocity, V (Figure 3-1)	(ft/s)	4.0			
Computed Tt = L / 3600V	(hrs)	0.034			0.034

CHANNEL FLOW

Segment ID					
Cross sectional Area, a	(sf)				
Wetted Perimeter, Pw	(ft)				
Hydraulic Radius, r =a/Pw	(ft)				
Channel Slope (ft/ft)	(ft/ft)				
Manning's Roughness Coefficient, n					
Velocity, V = 1.49r^(2/3)s^0.5 / n	(ft/s)				
Flow Length, L	(ft)				
Computed Tt = L / 3600V	(hrs)				0.000

Watershed or subarea Tc	0.188	hrs.
	11.3	min.

Use minimum Tc of 10 minutes

Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 05 / 23 / 2019

Hyd. No. 59

MP-88.87

Hydrograph type	= SCS Runoff	Peak discharge	= 1.843 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.20 hrs
Time interval	= 6 min	Hyd. volume	= 7,332 cuft
Drainage area	= 2.000 ac	Curve number	= 74.000
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 11.3 min
Total precip.	= 3.26 in	Distribution	= Custom
Storm duration	= C:\Users\IKuzmina\AppData\Local\Autodesk\C3D 2019\enu\HHApps\Hydrograp	Storm frequency	= 24 hrs

Hydrograph Discharge Table

(Printed values >= 1.00% of Qp.)

Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)
11.20	0.026	13.00	0.353	14.80	0.128	16.60	0.087
11.30	0.039	13.10	0.319	14.90	0.122	16.70	0.085
11.40	0.054	13.20	0.289	15.00	0.117	16.80	0.084
11.50	0.072	13.30	0.264	15.10	0.112	16.90	0.082
11.60	0.105	13.40	0.244	15.20	0.107	17.00	0.081
11.70	0.157	13.50	0.225	15.30	0.104	17.10	0.080
11.80	0.232	13.60	0.206	15.40	0.103	17.20	0.078
11.90	0.366	13.70	0.189	15.50	0.101	17.30	0.077
12.00	0.659	13.80	0.179	15.60	0.100	17.40	0.075
12.10	1.347	13.90	0.172	15.70	0.099	17.50	0.074
12.20	1.843	14.00	0.168	15.80	0.097	17.60	0.072
12.30	1.599	14.10	0.163	15.90	0.096	17.70	0.071
12.40	1.184	14.20	0.158	16.00	0.095	17.80	0.069
12.50	0.787	14.30	0.153	16.10	0.093	17.90	0.068
12.60	0.640	14.40	0.148	16.20	0.092	18.00	0.066
12.70	0.514	14.50	0.143	16.30	0.091	18.10	0.065
12.80	0.437	14.60	0.138	16.40	0.089	18.20	0.064
12.90	0.383	14.70	0.133	16.50	0.088	18.30	0.063

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Worksheet for MP-88.87M_STA0+85_PIPE_2YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.04850	ft/ft
Discharge	1.80	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+48	337.50
0+50	336.85
0+51	337.50
1+00	340.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+48, 337.50)	(1+00, 340.00)	0.045

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.51	ft
Elevation Range	336.85 to 340.00 ft	
Flow Area	0.65	ft²
Wetted Perimeter	2.75	ft
Hydraulic Radius	0.24	ft
Top Width	2.55	ft
Normal Depth	0.51	ft
Critical Depth	0.50	ft
Critical Slope	0.05182	ft/ft

Worksheet for MP-88.87M_STA0+85_PIPE_2YR

Results

Velocity		2.78	ft/s
Velocity Head		0.12	ft
Specific Energy		0.63	ft
Froude Number		0.97	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.51	ft
Critical Depth	0.50	ft
Channel Slope	0.04850	ft/ft
Critical Slope	0.05182	ft/ft

Worksheet for MP-88.87M_STA0+67_BRIDGE_2YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.04850	ft/ft
Discharge	1.80	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+48	338.50
0+50	337.84
0+51	338.70
0+68	340.00
1+00	340.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+48, 338.50)	(1+00, 340.00)	0.045

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.55	ft
Elevation Range	337.84 to 340.00 ft	
Flow Area	0.63	ft²
Wetted Perimeter	2.55	ft
Hydraulic Radius	0.25	ft
Top Width	2.29	ft
Normal Depth	0.55	ft
Critical Depth	0.54	ft

Worksheet for MP-88.87M_STA0+67_BRIDGE_2YR

Results

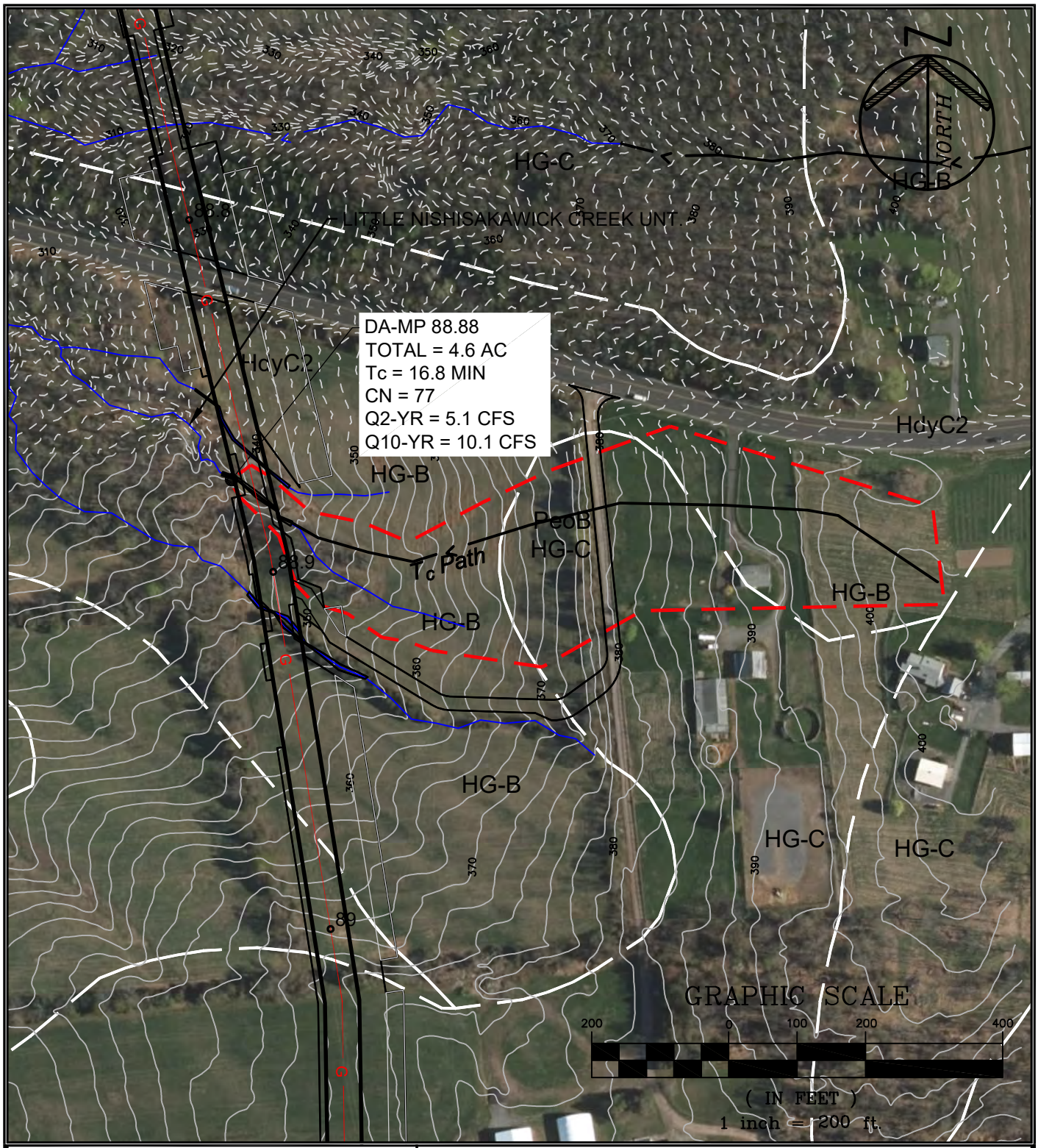
Critical Slope		0.05257	ft/ft
Velocity		2.86	ft/s
Velocity Head		0.13	ft
Specific Energy		0.68	ft
Froude Number		0.96	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.55	ft
Critical Depth	0.54	ft
Channel Slope	0.04850	ft/ft
Critical Slope	0.05257	ft/ft



FILE NAME: P:\05516\0001\DWGs\CAD\C-Civil\Plotdwgs\Drainage Area Maps\05516\0001-Stream_DA_MP85.4-98.9-WAL.dwg\MP 88.88 LAST EDIT: 05/30/2019 - 10:10:15 AM LOGIN: jmcgowan@

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CERTIFICATE OF AUTHORIZATION NO. 24GA28032700

PROJECT TITLE

PENNEAST PIPELINE

HUNTERDON AND MERCER COUNTY, NJ

SHEET TITLE

STREAM CROSSING DRAINAGE AREA MP-88.88

PROJ. NO.: 05516.0001	DRN. BY: JPS	SCALE: 1"=200'
DATE: 05/23/19	CK'D BY: WS	

Worksheet 2: Runoff curve number and runoff (Approximated)

Project	By	Date
PennEast	IK	28-Mar-19
Location	**Checked**	**Date**
Hunterdon County, NJ		

Check one: ☐ Present ☒ Developed | MP 88.88

1. Runoff curve number

Soil name and hydrologic group (appendix A)	Cover Description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN[1] Table 2-2	CN[1] Figure 2-3	CN[1] Figure 2-4	Area X acres / mi² / %	Product of CN x Area
Type B	Farmstead, Good Condition	74			2.87	212.38
Type C	Farmstead, Good Condition	82			1.73	141.86
1. Use only one CN source per line				Totals ➡	4.60	354.24

CN (weighted) = tot.prod. / tot. area = 354.24 / 4.60 = 77.0 ; Use CN ➡ **77**

2. Runoff

		Storm #1	Storm #2	Storm #3
Frequency……	yr			
Rainfall, P (24-hour)…….	in			
Runoff, Q……	in			

Use P and CN with table 2-1, figure 2-1, or equation 2-3 abd 2-4

PROJECT:	PennEast	JOB NO. 5516.0001	
		SHEET	DATE:3/28/2019
		BY:	IK
SUBJECT:	Tc Calculations	CHK'D	

Time of Concentration calculations with the application of the SCS TR-55 methodology.

Watershed or Subarea Designation: DA 88.88

Area 4.6 AC

SHEET FLOW

Segment ID		A-B				
Surface Description (Table 3-1)		GRASS				
Manning's Coefficient, n (Table 3-1)		0.150				
Flow Length, L (total <= 150)	(ft)	150				
Two Year Rainfall, P	(in)	3.4				
Land Slope, s	(ft/ft)	0.020				
Computed Tt = 0.007 (nL)^0.8 / P^0.5*s^0.4	(hrs)	0.220				0.220

SHALLOW CONCENTRATED FLOW

Segment ID		B-C				
Surface Description (paved or unpaved)		UNPAVED				
Flow Length, L	(ft)	845				
Watercourse slope, s	(ft/ft)	0.070				
Average Velocity, V (Figure 3-1)	(ft/s)	4.0				
Computed Tt = L / 3600V	(hrs)	0.059				0.059

CHANNEL FLOW

Segment ID		C-D				
Cross sectional Area, a	(sf)	5.25				
Wetted Perimeter, Pw	(ft)	2.02				
Hydraulic Radius, r =a/Pw	(ft)	2.60				
Channel Slope (ft/ft)	(ft/ft)	0.060				
Manning's Roughness Coefficient, n		0.045				
Velocity, V = 1.49r^(2/3)s^0.5 / n	(ft/s)	15.33				
Flow Length, L	(ft)	127				
Computed Tt = L / 3600V	(hrs)	0.002				0.002

Watershed or subarea Tc	0.281	hrs.
	16.8	min.

Use minimum Tc of 10 minutes

Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 05 / 23 / 2019

Hyd. No. 67

MP-88.88

Hydrograph type	= SCS Runoff	Peak discharge	= 5.057 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.20 hrs
Time interval	= 6 min	Hyd. volume	= 19,644 cuft
Drainage area	= 4.600 ac	Curve number	= 77.000
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 16.8 min
Total precip.	= 3.26 in	Distribution	= Custom
Storm duration	= C:\Users\IKuzmina\AppData\Local\Autodesk\C3D 2019\enu\HHApps\Hydrograp	Shape factor	= 484

Hydrograph Discharge Table

(Printed values >= 1.00% of Qp.)

Time -- Outflow (hrs cfs)		Time -- Outflow (hrs cfs)		Time -- Outflow (hrs cfs)		Time -- Outflow (hrs cfs)	
10.80	0.054	12.60	1.667	14.40	0.376	16.20	0.232
10.90	0.070	12.70	1.333	14.50	0.363	16.30	0.229
11.00	0.090	12.80	1.132	14.60	0.350	16.40	0.225
11.10	0.114	12.90	0.989	14.70	0.337	16.50	0.222
11.20	0.146	13.00	0.908	14.80	0.324	16.60	0.218
11.30	0.186	13.10	0.821	14.90	0.310	16.70	0.215
11.40	0.233	13.20	0.741	15.00	0.297	16.80	0.211
11.50	0.287	13.30	0.677	15.10	0.283	16.90	0.207
11.60	0.387	13.40	0.624	15.20	0.272	17.00	0.204
11.70	0.544	13.50	0.575	15.30	0.264	17.10	0.200
11.80	0.758	13.60	0.526	15.40	0.260	17.20	0.197
11.90	1.140	13.70	0.484	15.50	0.256	17.30	0.193
12.00	1.950	13.80	0.456	15.60	0.253	17.40	0.189
12.10	3.790	13.90	0.439	15.70	0.250	17.50	0.186
12.20	5.057	14.00	0.427	15.80	0.246	17.60	0.182
12.30	4.316	14.10	0.414	15.90	0.243	17.70	0.178
12.40	3.148	14.20	0.402	16.00	0.239	17.80	0.175
12.50	2.061	14.30	0.389	16.10	0.236	17.90	0.171

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Worksheet for MP-88.88M_STA0+73_PIPE_2YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.07135	ft/ft
Discharge	5.10	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	340.00
0+35	340.00
0+45	337.50
0+50	337.06
0+52	337.70
1+00	342.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 340.00)	(1+00, 342.00)	0.045

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.45	ft
Elevation Range	337.06 to 342.00 ft	
Flow Area	1.55	ft²
Wetted Perimeter	6.82	ft
Hydraulic Radius	0.23	ft
Top Width	6.73	ft
Normal Depth	0.45	ft

Worksheet for MP-88.88M_STA0+73_PIPE_2YR

Results

Critical Depth	0.49	ft
Critical Slope	0.04742	ft/ft
Velocity	3.29	ft/s
Velocity Head	0.17	ft
Specific Energy	0.62	ft
Froude Number	1.21	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.45	ft
Critical Depth	0.49	ft
Channel Slope	0.07135	ft/ft
Critical Slope	0.04742	ft/ft

Worksheet for MP-88.88M_STA0+57_BRIDGE_2YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.07100	ft/ft
Discharge	5.10	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	340.00
0+38	340.00
0+45	338.70
0+50	338.09
0+58	340.00
0+97	341.00
1+00	342.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 340.00)	(1+00, 342.00)	0.045

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.49	ft
Elevation Range	338.09 to 342.00 ft	
Flow Area	1.50	ft²
Wetted Perimeter	6.21	ft
Hydraulic Radius	0.24	ft
Top Width	6.12	ft

Worksheet for MP-88.88M_STA0+57_BRIDGE_2YR

Results

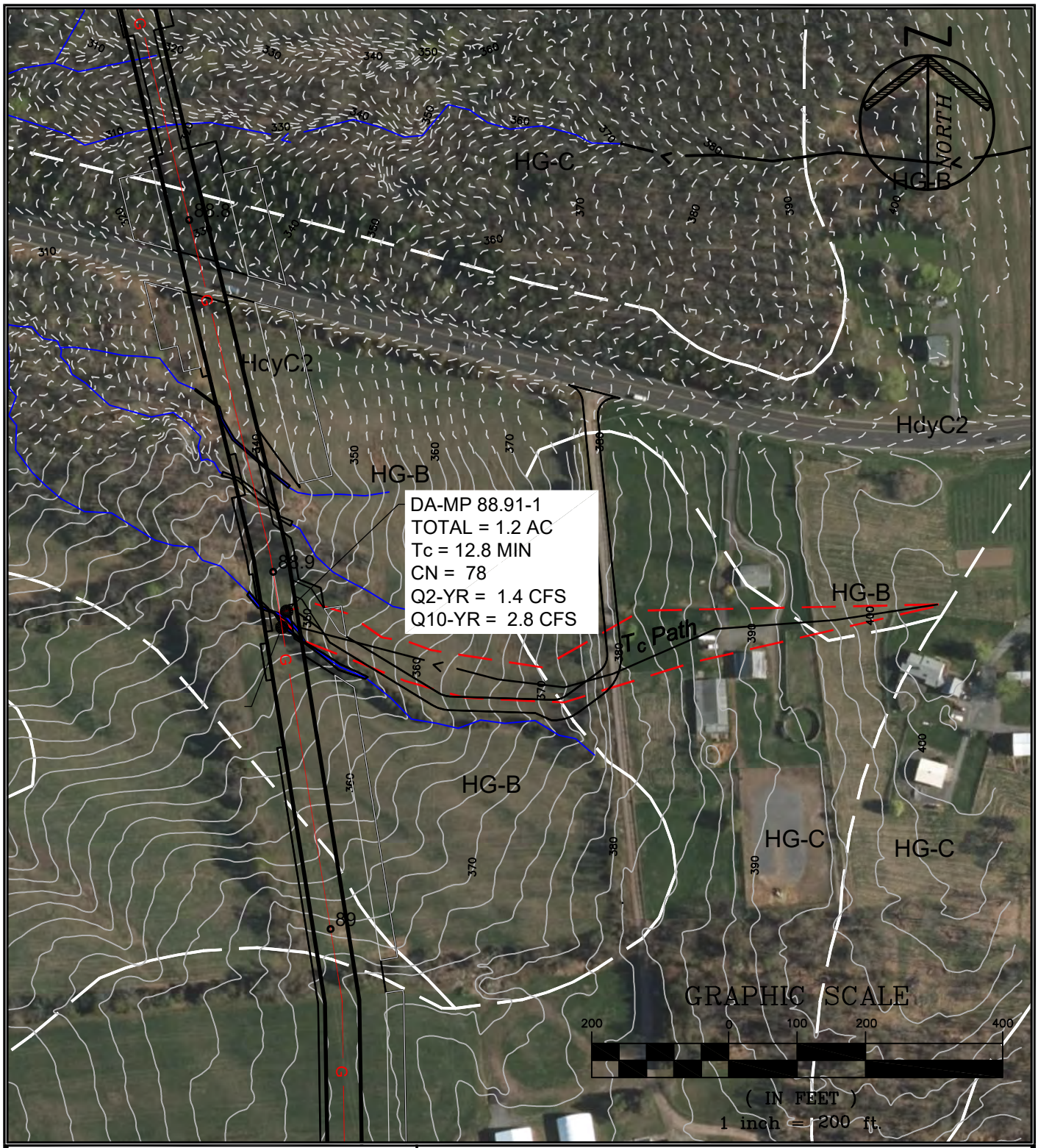
Normal Depth		0.49	ft
Critical Depth		0.53	ft
Critical Slope		0.04683	ft/ft
Velocity		3.41	ft/s
Velocity Head		0.18	ft
Specific Energy		0.67	ft
Froude Number		1.21	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.49	ft
Critical Depth	0.53	ft
Channel Slope	0.07100	ft/ft
Critical Slope	0.04683	ft/ft



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CERTIFICATE OF AUTHORIZATION NO. 24GA28032700

PROJECT TITLE

PENNEAST PIPELINE

HUNTERDON AND MERCER COUNTY, NJ

SHEET TITLE

STREAM CROSSING DRAINAGE AREA MP-88.91-1

PROJ. NO.: 05516.0001	DRN. BY: JPS	SCALE: 1"=200'
DATE: 05/23/19	CK'D BY: WS	

FILE NAME: P:\05516\0001\DWGs\CAD\C-Civil\Plotdwgs\Drainage Area Maps\05516\0001-Stream_DA_MP85.4-98.9-1-WAL.dwg\MP 88.91-1 LAST EDIT: 06/07/2019 - 02:33:44 PM LOGIN: jmcgowan@

Worksheet 2: Runoff curve number and runoff (Approximated)

Project	By	Date
PennEast	IK	8-Mar-19
Location	**Checked**	**Date**
Hunterdon County, NJ		

Check one: ☐ Present ☒ Developed | MP 88.91-1

1. Runoff curve number

Soil name and hydrologic group (appendix A)	Cover Description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN[1] Table 2-2	CN[1] Figure 2-3	CN[1] Figure 2-4	Area ☒ acres / ☐ mi² / ☐ %	Product of CN x Area
Type B	Farmstead, Good Condition	74			0.56	41.29
Type C	Farmstead, Good Condition	82			0.662	54.28
1. Use only one CN source per line				Totals ➡	1.22	95.58

CN (weighted) = tot.prod. / tot. area = 95.58 / 1.22 = 78.3 ; Use CN ➡ **78**

2. Runoff

		Storm #1	Storm #2	Storm #3
Frequency……	yr			
Rainfall, P (24-hour)…….	in			
Runoff, Q……	in			

Use P and CN with table 2-1, figure 2-1, or equation 2-3 abd 2-4

PSS &	PROJECT: PennEast	JOB NO. 5516.0001	
		SHEET	DATE: 03/08/2019
		BY:	IK
	SUBJECT: Tc Calculations	CHK'D	

Time of Concentration calculations with the application of the SCS TR-55 methodology.

Watershed or Subarea Designation: DA 89.91-1

Area 1.22 AC

SHEET FLOW

Segment ID		A-B			
Surface Description (Table 3-1)		GRASS			
Manning's Coefficient, n (Table 3-1)		0.150			
Flow Length, L (total <= 150)	(ft)	150			
Two Year Rainfall, P	(in)	3.4			
Land Slope, s	(ft/ft)	0.047			
Computed Tt = 0.007 (nL)^0.8 / P^0.5*s^0.4	(hrs)	0.156			0.156

SHALLOW CONCENTRATED FLOW

Segment ID		B-C	C-D		
Surface Description (paved or unpaved)		PAVED	UNPAVED		
Flow Length, L	(ft)	140	704		
Watercourse slope, s	(ft/ft)	0.050	0.060		
Average Velocity, V (Figure 3-1)	(ft/s)	4.6	4.0		
Computed Tt = L / 3600V	(hrs)	0.008	0.049		0.057

CHANNEL FLOW

Segment ID		C-D			
Cross sectional Area, a	(sf)	6.15			
Wetted Perimeter, Pw	(ft)	5.90			
Hydraulic Radius, r =a/Pw	(ft)	1.042			
Channel Slope (ft/ft)	(ft/ft)	0.070			
Manning's Roughness Coefficient, n		0.030			
Velocity, V = 1.49r^(2/3)s^0.5 / n	(ft/s)	13.51			
Flow Length, L	(ft)	26			
Computed Tt = L / 3600V	(hrs)	0.001			0.001

Watershed or subarea Tc	0.214	hrs.
	12.8	min.

Use minimum Tc of 10 minutes

Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 05 / 23 / 2019

Hyd. No. 60

MP-88.91-1

Hydrograph type	= SCS Runoff	Peak discharge	= 1.416 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.20 hrs
Time interval	= 6 min	Hyd. volume	= 5,470 cuft
Drainage area	= 1.220 ac	Curve number	= 78.000
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 12.8 min
Total precip.	= 3.26 in	Distribution	= Custom
Storm duration	= C:\Users\IKuzmina\AppData\Local\Autodesk\C3D 2019\enu\HHApps\Hydrograp	Shape factor	= 484

Hydrograph Discharge Table

(Printed values >= 1.00% of Qp.)

Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)
10.70	0.016	12.50	0.569	14.30	0.106	16.10	0.064
10.80	0.020	12.60	0.460	14.40	0.103	16.20	0.063
10.90	0.025	12.70	0.367	14.50	0.099	16.30	0.062
11.00	0.031	12.80	0.311	14.60	0.096	16.40	0.061
11.10	0.038	12.90	0.272	14.70	0.092	16.50	0.061
11.20	0.047	13.00	0.249	14.80	0.089	16.60	0.060
11.30	0.059	13.10	0.225	14.90	0.085	16.70	0.059
11.40	0.072	13.20	0.203	15.00	0.081	16.80	0.058
11.50	0.088	13.30	0.186	15.10	0.077	16.90	0.057
11.60	0.116	13.40	0.171	15.20	0.074	17.00	0.056
11.70	0.161	13.50	0.158	15.30	0.072	17.10	0.055
11.80	0.223	13.60	0.144	15.40	0.071	17.20	0.054
11.90	0.330	13.70	0.133	15.50	0.070	17.30	0.053
12.00	0.558	13.80	0.125	15.60	0.069	17.40	0.052
12.10	1.069	13.90	0.120	15.70	0.068	17.50	0.051
12.20	1.416	14.00	0.117	15.80	0.067	17.60	0.050
12.30	1.203	14.10	0.113	15.90	0.066	17.70	0.049
12.40	0.873	14.20	0.110	16.00	0.065	17.80	0.048

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Worksheet for MP-88.91M_STA0+55_PIPE_2YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.04870	ft/ft
Discharge	1.40	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	348.00
0+48	346.00
0+50	345.79
0+52	346.00
1+00	348.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 348.00)	(1+00, 348.00)	0.045

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.29	ft
Elevation Range	345.79 to 348.00 ft	
Flow Area	0.84	ft²
Wetted Perimeter	7.57	ft
Hydraulic Radius	0.11	ft
Top Width	7.55	ft
Normal Depth	0.29	ft
Critical Depth	0.28	ft

Worksheet for MP-88.91M_STA0+55_PIPE_2YR

Results

Critical Slope		0.06238	ft/ft
Velocity		1.68	ft/s
Velocity Head		0.04	ft
Specific Energy		0.34	ft
Froude Number		0.89	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.29	ft
Critical Depth	0.28	ft
Channel Slope	0.04870	ft/ft
Critical Slope	0.06238	ft/ft

Worksheet for MP-88.91M_STA0+42_BRIDGE_2YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.04870	ft/ft
Discharge	1.40	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	348.00
0+47	346.60
0+50	346.03
0+66	348.00
1+00	350.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 348.00)	(1+00, 350.00)	0.045

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.31	ft
Elevation Range	346.03 to 350.00 ft	
Flow Area	0.67	ft²
Wetted Perimeter	4.42	ft
Hydraulic Radius	0.15	ft
Top Width	4.37	ft
Normal Depth	0.31	ft
Critical Depth	0.30	ft

Worksheet for MP-88.91M_STA0+42_BRIDGE_2YR

Results

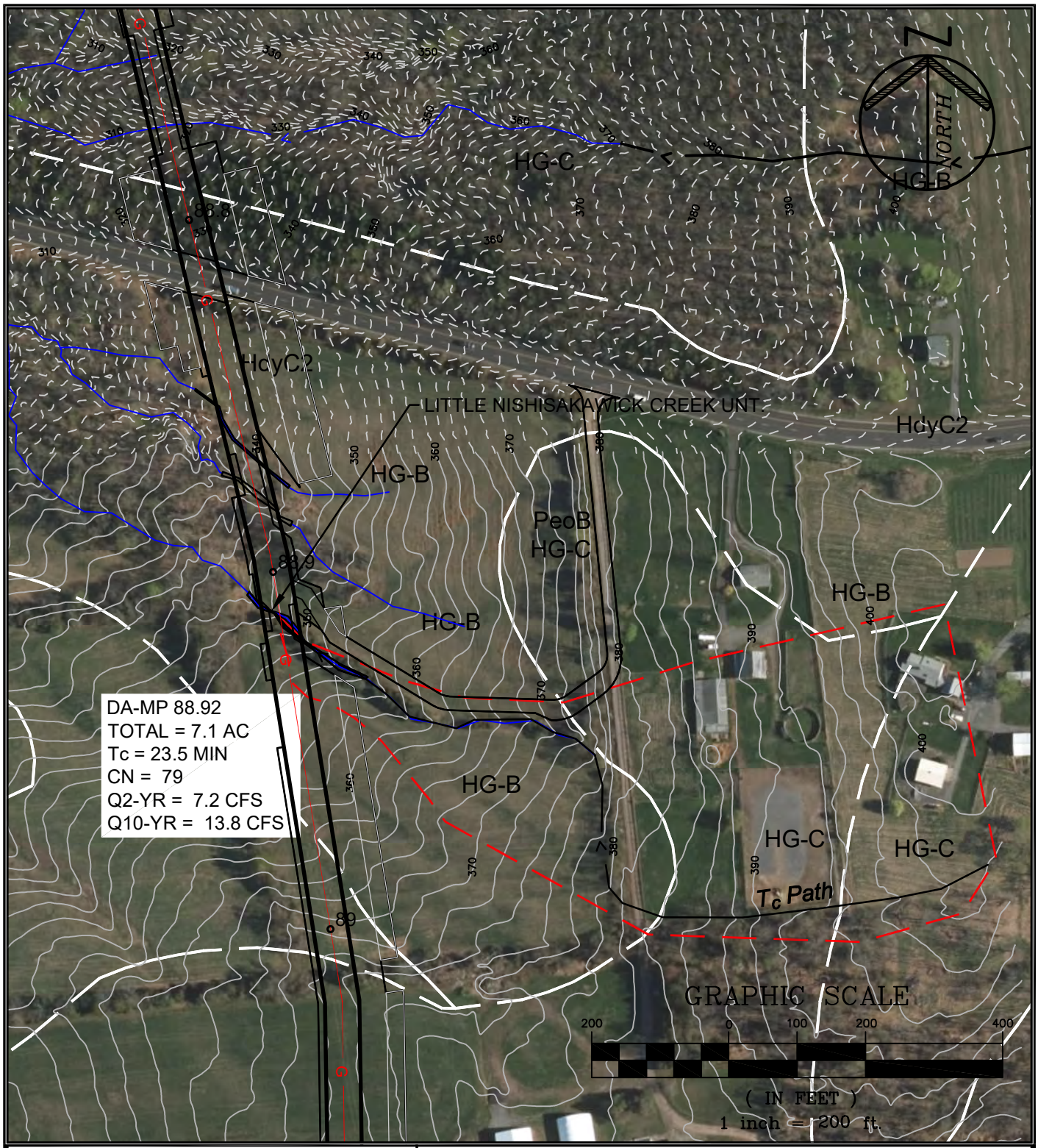
Critical Slope		0.05630	ft/ft
Velocity		2.08	ft/s
Velocity Head		0.07	ft
Specific Energy		0.38	ft
Froude Number		0.93	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.31	ft
Critical Depth	0.30	ft
Channel Slope	0.04870	ft/ft
Critical Slope	0.05630	ft/ft



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CERTIFICATE OF AUTHORIZATION NO. 24GA28032700

PROJECT TITLE

PENNEAST PIPELINE

HUNTERDON AND MERCER COUNTY, NJ

SHEET TITLE

STREAM CROSSING DRAINAGE AREA MP-88.92

PROJ. NO.: 05516.0001	DRN. BY: JPS	SCALE: 1"=200'
DATE: 05/23/19	CK'D BY: WS	

FILE NAME: P:\05516\0001\DWGs\CAD\C-Civil\Plotdwgs\Drainage Area Maps\05516\0001-Stream_DA_MP85.4-98.9-WAL.dwg\MP 88.92 LAST EDIT: 06/13/2019 - 03:05:46 PM LOGIN: jmcgowan@

Worksheet 2: Runoff curve number and runoff (Approximated)

Project	By	Date
PennEast	IK	8-Mar-19
Location	**Checked**	**Date**
Hunterdon County, NJ		

Check one: ☐ Present ☒ Developed | MP 88.92

1. Runoff curve number

Soil name and hydrologic group (appendix A)	Cover Description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN[1] Table 2-2	CN[1] Figure 2-3	CN[1] Figure 2-4	Area ☒ acres ☐ mi² ☐ %	Product of CN x Area
Type B	Farmstead, Good Condition	74			2.30	170.20
Type C	Farmstead, Good Condition	82			4.800	393.60
1. Use only one CN source per line				**Totals** ➡	7.10	563.80

CN (weighted) = tot.prod. / tot. area = 563.80 / 7.10 = 79.4 ; **Use CN** ➡ **79**

2. Runoff

		Storm #1	Storm #2	Storm #3
Frequency…….	yr			
Rainfall, P (24-hour)…….	in			
Runoff, Q……	in			

Use P and CN with table 2-1, figure 2-1, or equation 2-3 abd 2-4

PROJECT:	PennEast	JOB NO. 5516.0001	
		SHEET	DATE: 03/08/2019
		BY:	IK
SUBJECT:	Tc Calculations	CHK'D	

Time of Concentration calculations with the application of the SCS TR-55 methodology.

Watershed or Subarea Designation: DA 88.92

Area 7.1 AC

SHEET FLOW

Segment ID		A-B			
Surface Description (Table 3-1)		GRASS			
Manning's Coefficient, n (Table 3-1)		0.240			
Flow Length, L (total <= 150)	(ft)	150			
Two Year Rainfall, P	(in)	3.4			
Land Slope, s	(ft/ft)	0.020			
Computed Tt = 0.007 (nL)^0.8 / P^0.5*s^0.4	(hrs)	0.320			0.320

SHALLOW CONCENTRATED FLOW

Segment ID		B-C	C-D		
Surface Description (paved or unpaved)		UNPAVED	PAVED		
Flow Length, L	(ft)	593	30		
Watercourse slope, s	(ft/ft)	0.035	0.030		
Average Velocity, V (Figure 3-1)	(ft/s)	3.0	2.6		
Computed Tt = L / 3600V	(hrs)	0.055	0.003		0.058

CHANNEL FLOW

Segment ID		C-D			
Cross sectional Area, a	(sf)	6.15			
Wetted Perimeter, Pw	(ft)	5.90			
Hydraulic Radius, r =a/Pw	(ft)	1.042			
Channel Slope (ft/ft)	(ft/ft)	0.052			
Manning's Roughness Coefficient, n		0.030			
Velocity, V = 1.49r^(2/3)s^0.5 / n	(ft/s)	11.64			
Flow Length, L	(ft)	541			
Computed Tt = L / 3600V	(hrs)	0.013			0.013

Watershed or subarea Tc	0.391	hrs.
	23.5	min.

Use minimum Tc of 10 minutes

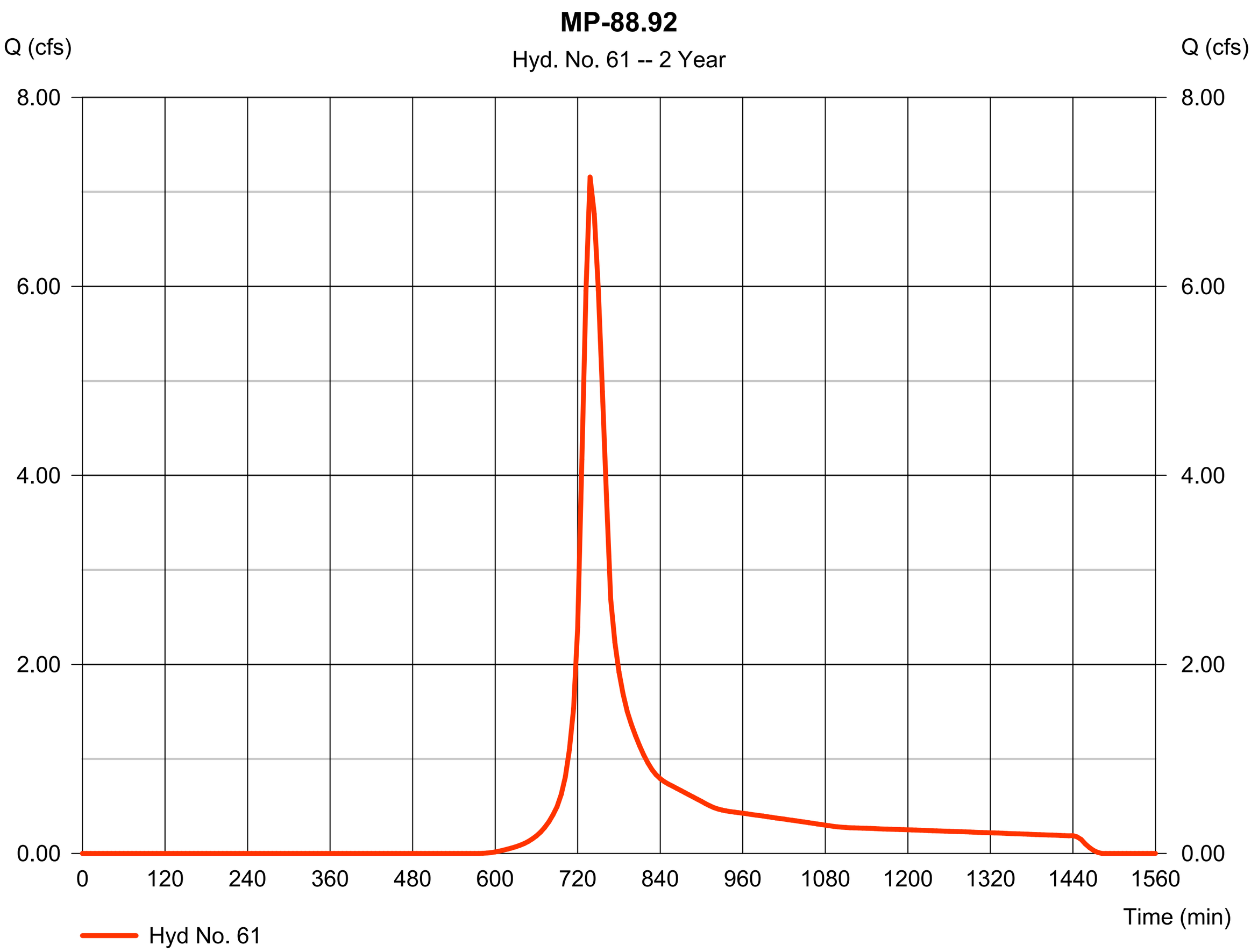
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 06 / 13 / 2019

Hyd. No. 61

MP-88.92

Hydrograph type	=	SCS Runoff	Peak discharge	=	7.156 cfs
Storm frequency	=	2 yrs	Time to peak	=	738 min
Time interval	=	6 min	Hyd. volume	=	35,617 cuft
Drainage area	=	7.100 ac	Curve number	=	79
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	23.50 min
Total precip.	=	3.26 in	Distribution	=	Custom
Storm duration	=	C:\Users\IKuzmina\AppData\Local\Autodesk\C3D 2019\enu\HHApps\Hydrograph Shape factor	=	484	



Worksheet for MP-88.92M_STA1+49_PIPE_2YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.05000	ft/ft
Discharge	7.20	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	348.00
0+48	346.30
0+49	346.14
0+52	346.80
0+76	348.00
1+00	350.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 348.00)	(1+00, 350.00)	0.045

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.52	ft
Elevation Range	346.14 to 350.00 ft	
Flow Area	2.77	ft²
Wetted Perimeter	13.32	ft
Hydraulic Radius	0.21	ft
Top Width	13.24	ft
Normal Depth	0.52	ft

Worksheet for MP-88.92M_STA1+49_PIPE_2YR

Results

Critical Depth	0.52	ft
Critical Slope	0.05010	ft/ft
Velocity	2.60	ft/s
Velocity Head	0.10	ft
Specific Energy	0.63	ft
Froude Number	1.00	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.52	ft
Critical Depth	0.52	ft
Channel Slope	0.05000	ft/ft
Critical Slope	0.05010	ft/ft

Worksheet for MP-88.92M_STA1+33_BRIDGE_2YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.05000	ft/ft
Discharge	7.20	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	348.00
0+43	348.00
0+50	347.15
0+52	347.60
0+70	348.00
1+00	350.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 348.00)	(1+00, 350.00)	0.045

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.60	ft
Elevation Range	347.15 to 350.00 ft	
Flow Area	2.85	ft²
Wetted Perimeter	14.28	ft
Hydraulic Radius	0.20	ft
Top Width	14.19	ft
Normal Depth	0.60	ft

Worksheet for MP-88.92M_STA1+33_BRIDGE_2YR

Results

Critical Depth		0.60	ft
Critical Slope		0.05084	ft/ft
Velocity		2.52	ft/s
Velocity Head		0.10	ft
Specific Energy		0.70	ft
Froude Number		0.99	
Flow Type	Subcritical		

GVF Input Data

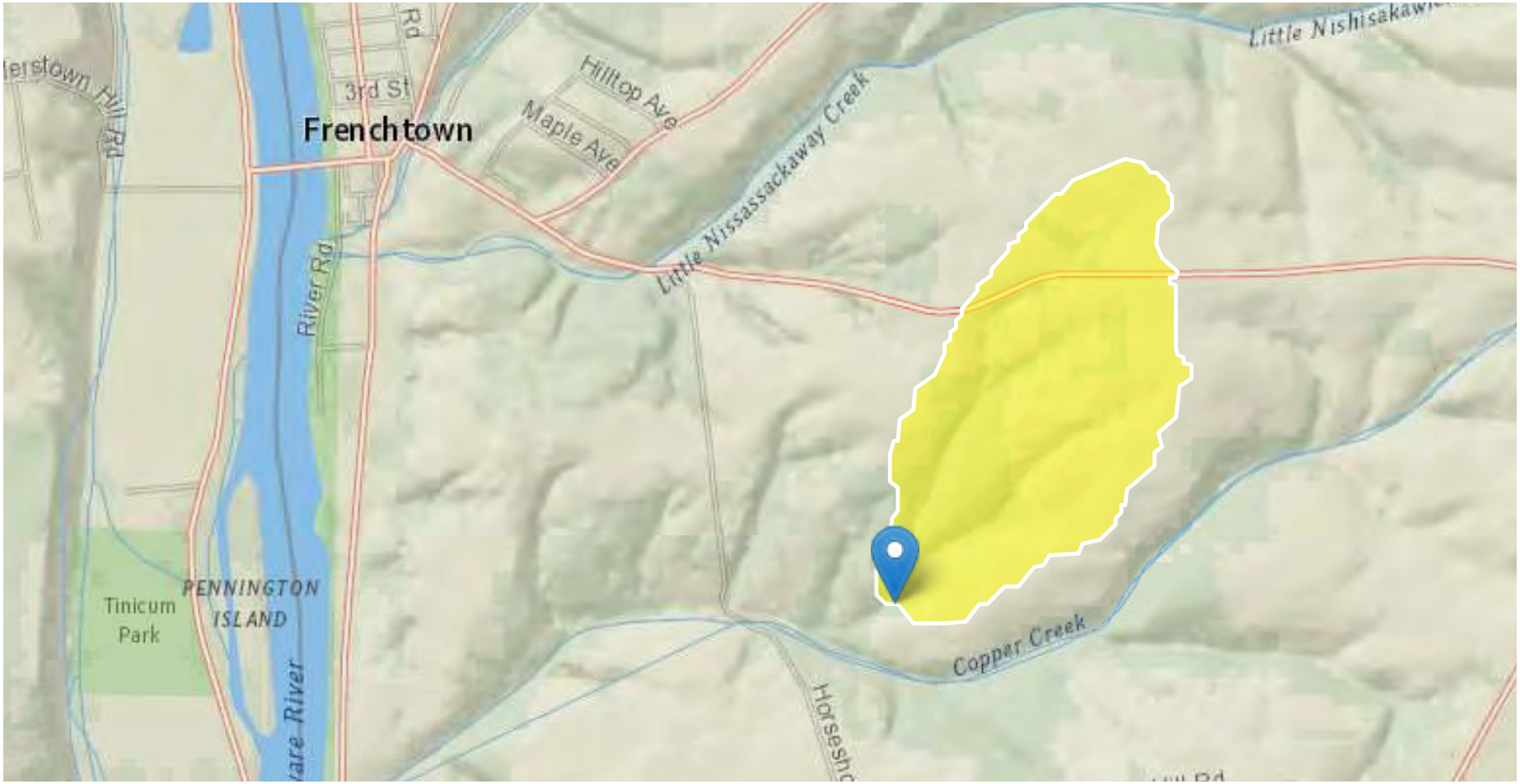
Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.60	ft
Critical Depth	0.60	ft
Channel Slope	0.05000	ft/ft
Critical Slope	0.05084	ft/ft

MP 89.5

Region ID: NJ
Workspace ID: NJ20170807144504465000
Clicked Point (Latitude, Longitude): 40.51155, -75.03855
Time: 2017-08-07 14:48:16 -0400



Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	0.48	square miles
STORAGE	Percentage of area of storage (lakes ponds reservoirs wetlands)	9.87	percent
CSL10_85	Change in elevation divided by length between points 10 and 85 percent of distance along main channel to basin divide - main channel method not known	203	feet per mi
POPDENS	Basin Population Density	101	persons per square mile

Peak-Flow Statistics Parameters [Peak Unglaciated Piedmont Region 2009 5167]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.48	square miles	0.25	779
STORAGE	Percent Storage	9.87	percent	0.23	32
CSL10_85	Stream Slope 10 and 85 Method	203	feet per mi	4.31	191
POPDENS	Basin Population Density	101	persons per square mile	83	11084

Peak-Flow Statistics Disclaimers [Peak Unglaciated Piedmont Region 2009 5167]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors

Peak-Flow Statistics Flow Report [Peak Unglaciated Piedmont Region 2009 5167]

Statistic	Value	Unit
2 Year Peak Flood	131	ft^3/s
5 Year Peak Flood	223	ft^3/s
10 Year Peak Flood	296	ft^3/s
25 Year Peak Flood	400	ft^3/s
50 Year Peak Flood	484	ft^3/s
100 Year Peak Flood	579	ft^3/s
500 Year Peak Flood	816	ft^3/s

Peak-Flow Statistics Citations

Watson, K.M.,and Schopp, R.D.,2009, Methodology for estimation of flood magnitude and frequency for New Jersey streams, U.S. Geological Survey Scientific Investigations Report 2009-5167, 51 p. (http://pubs.usgs.gov/sir/2009/5167/)

Worksheet for MP-89.54R2_STA0+29_PIPE-2YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.04900	ft/ft
Discharge	131.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	228.00
0+04	225.67
0+11	225.38
0+18	226.00
0+24	228.00

Roughness Segment Definitions

Start Station & Elevation	End Station & Elevation	Roughness Coefficient
(0+00, 228.00)	(0+24, 228.00)	0.045

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	1.38	ft
Elevation Range	225.38 to 228.00 ft	
Flow Area	18.25	ft²
Wetted Perimeter	18.76	ft
Hydraulic Radius	0.97	ft
Top Width	18.29	ft
Normal Depth	1.38	ft
Critical Depth	1.56	ft

Worksheet for MP-89.54R2_STA0+29_PIPE-2YR

Results

Critical Slope		0.02942	ft/ft
Velocity		7.18	ft/s
Velocity Head		0.80	ft
Specific Energy		2.18	ft
Froude Number		1.27	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.38	ft
Critical Depth	1.56	ft
Channel Slope	0.04900	ft/ft
Critical Slope	0.02942	ft/ft

Worksheet for MP-89.54R2_STA0+19_BRIDGE-2YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.04900	ft/ft
Discharge	131.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	230.00
0+06	228.00
0+10	225.67
0+17	225.59
0+25	226.61
0+29	228.00
0+33	230.00

Roughness Segment Definitions

Start Station & Elevation	End Station & Elevation	Roughness Coefficient
(0+00, 230.00)	(0+33, 230.00)	0.045

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	1.40	ft
Elevation Range	225.59 to 230.00 ft	
Flow Area	18.10	ft²
Wetted Perimeter	18.37	ft
Hydraulic Radius	0.99	ft
Top Width	17.85	ft

Worksheet for MP-89.54R2_STA0+19_BRIDGE-2YR

Results

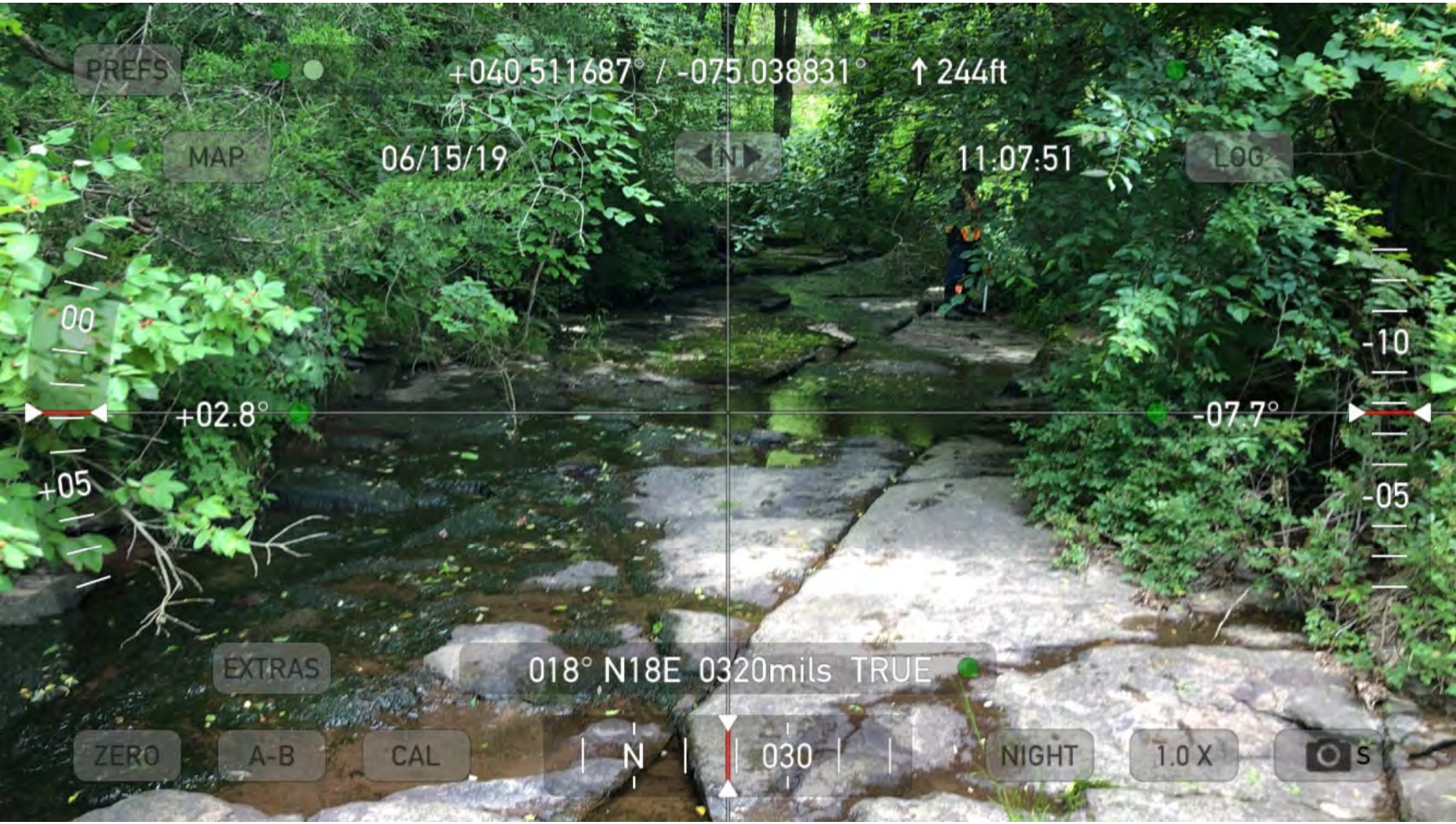
Normal Depth	1.40	ft
Critical Depth	1.59	ft
Critical Slope	0.02939	ft/ft
Velocity	7.24	ft/s
Velocity Head	0.81	ft
Specific Energy	2.22	ft
Froude Number	1.27	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.40	ft
Critical Depth	1.59	ft
Channel Slope	0.04900	ft/ft
Critical Slope	0.02939	ft/ft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MP89.96R2

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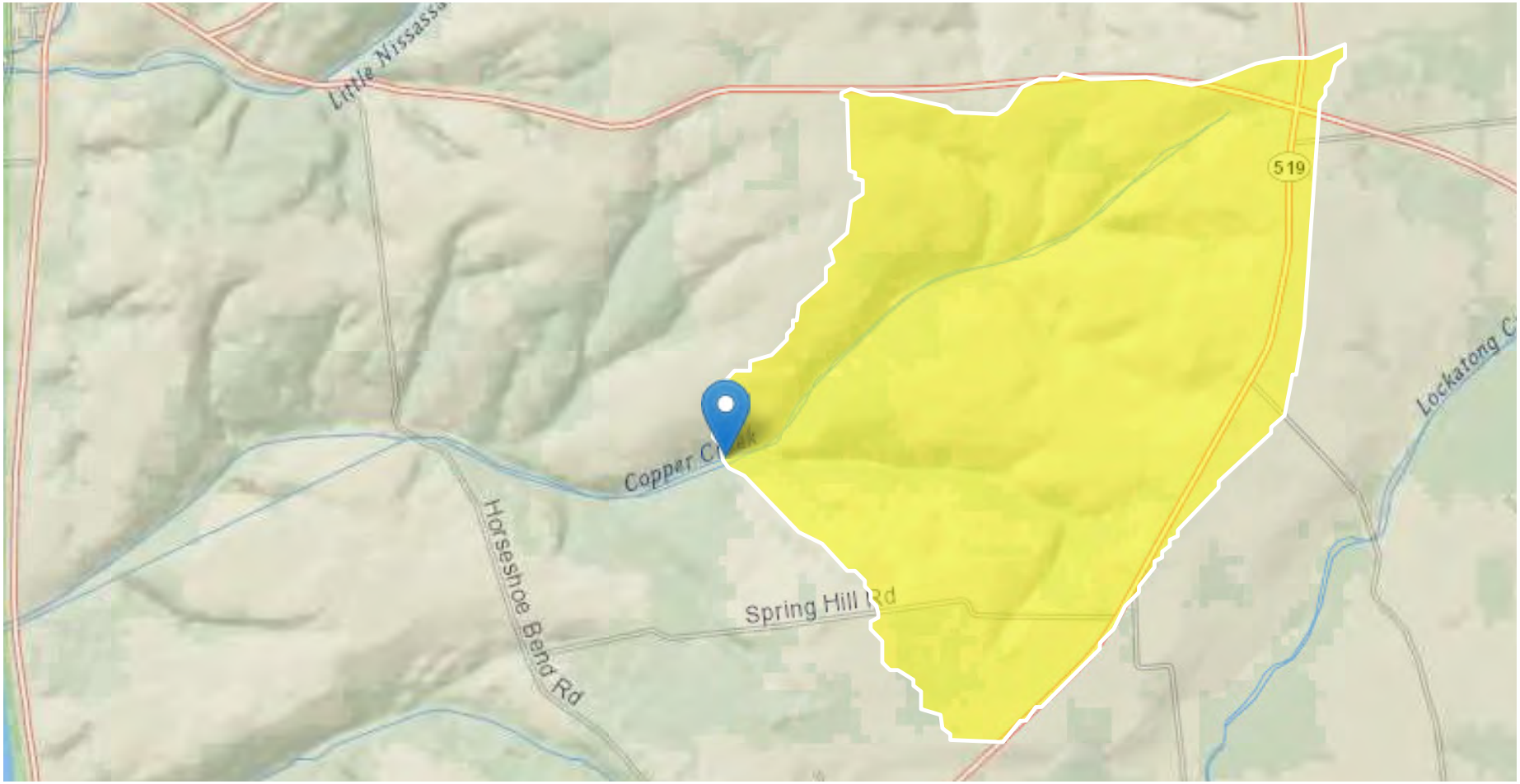
Workspace ID: NJ20170807151413247000
Clicked Point (Latitude, Longitude): 40.51019, -75.03143
Time: 2017-08-07 15:17:08 -0400



Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	1.43	square miles
STORAGE	Percentage of area of storage (lakes ponds reservoirs wetlands)	18.1	percent
CSL10_85	Change in elevation divided by length between points 10 and 85 percent of distance along main channel to basin divide - main channel method not known	130	feet per mi
POPDENS	Basin Population Density	102	persons per square mile

Peak-Flow Statistics Parameters [Peak Unglaciated Piedmont Region 2009 5167]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	1.43	square miles	0.25	779
STORAGE	Percent Storage	18.1	percent	0.23	32
CSL10_85	Stream Slope 10 and 85 Method	130	feet per mi	4.31	191
POPDENS	Basin Population Density	102	persons per square mile	83	11084

Peak-Flow Statistics Flow Report [Peak Unglaciated Piedmont Region 2009 5167]

PIl: Prediction Interval-Lower, Plu: Prediction Interval-Upper, SEp: Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	SEe	SEp	Equiv. Yrs.
2 Year Peak Flood	258	ft^3/s	49	50.3	1
5 Year Peak Flood	427	ft^3/s	49.4	50.9	2
10 Year Peak Flood	556	ft^3/s	50.5	52.2	3

Worksheet for MP-89.96R2 STA0+37_2YR_PIPE

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.04100	ft/ft
Discharge	258.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	268.00
0+02	266.00
0+18	262.00
0+20	260.50
0+50	258.74
1+00	262.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 268.00)	(1+00, 262.00)	0.050

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	1.72	ft
Elevation Range	258.74 to 268.00 ft	
Flow Area	47.47	ft²
Wetted Perimeter	55.29	ft
Hydraulic Radius	0.86	ft
Top Width	55.19	ft
Normal Depth	1.72	ft

Worksheet for MP-89.96R2 STA0+37_2YR_PIPE

Results

Critical Depth		1.74	ft
Critical Slope		0.03824	ft/ft
Velocity		5.44	ft/s
Velocity Head		0.46	ft
Specific Energy		2.18	ft
Froude Number		1.03	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.72	ft
Critical Depth	1.74	ft
Channel Slope	0.04100	ft/ft
Critical Slope	0.03824	ft/ft

Cross Section for MP-89.96R2 STA0+11_2YR_BRIDGE

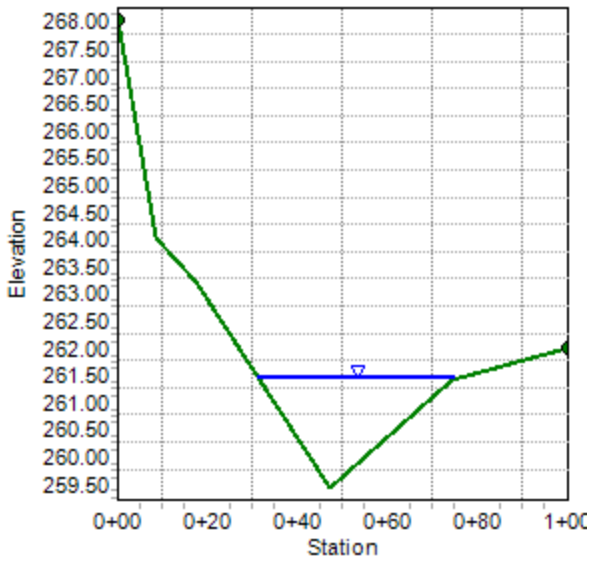
Project Description

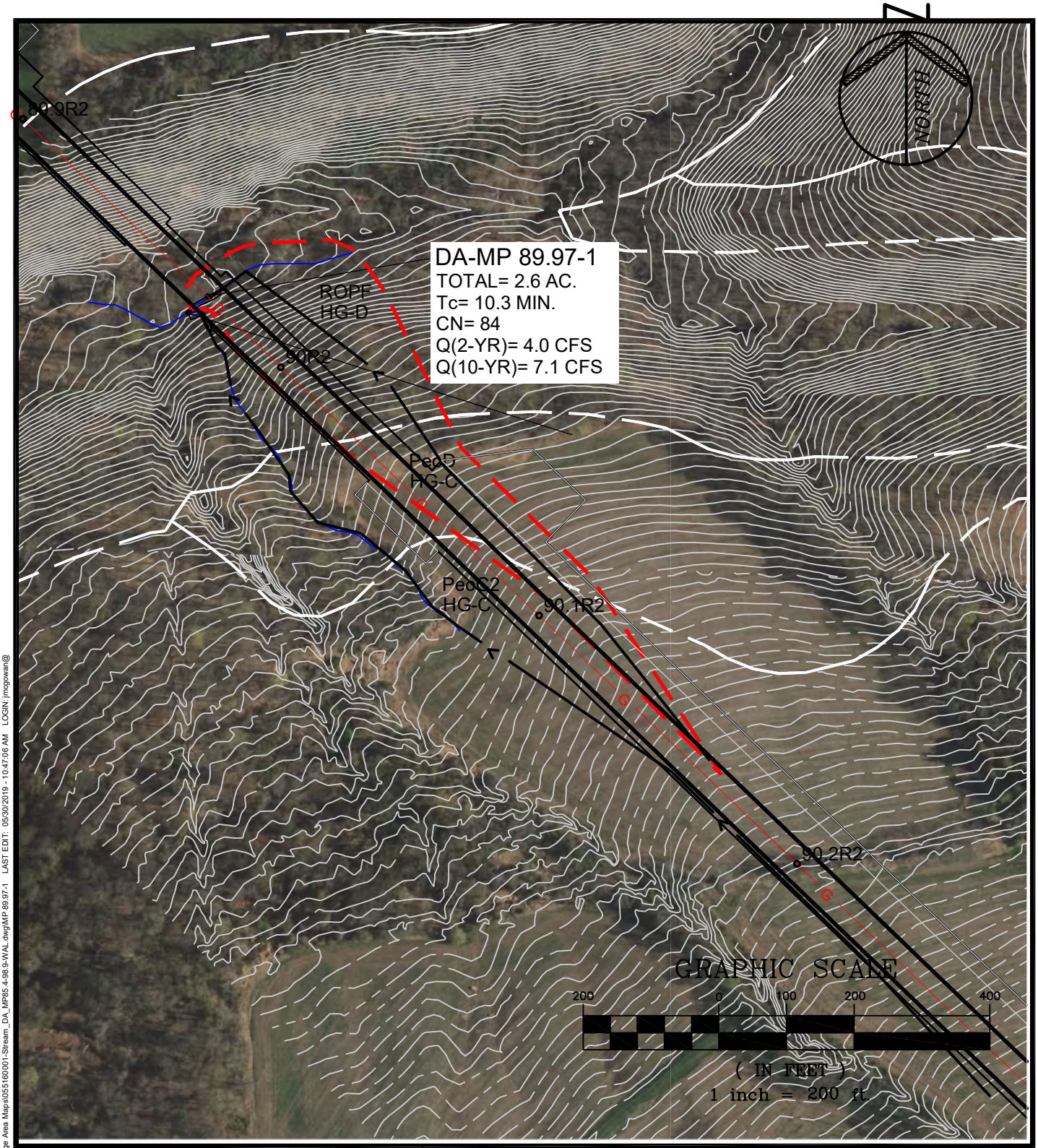
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.04100	ft/ft
Normal Depth	2.01	ft
Discharge	258.00	ft³/s

Cross Section Image





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CERTIFICATE OF AUTHORIZATION NO. 24GA28032700

PROJECT TITLE

PENNEAST PIPELINE

HUNTERDON AND MERCER COUNTY, NJ

SHEET TITLE

STREAM CROSSING DRAINAGE AREA MP-89.97-1

PROJ. NO.:	05516.0001	DRN. BY:	JPS	SCALE:	1"=200'
DATE:	05/23/19	CK'D BY:	WS		

FILE NAME: P:\05516\0001\DWGs\CADC-Civil\Plotdwgs\Drainage Area Maps\05516\0001-Stream_DA_MP85.4-98.9-WAL.dwg\MP 89.97-1 LAST EDIT: 05/30/2019 - 10:47:06 AM LOGIN: jmcgowan@

Worksheet 2: Runoff curve number and runoff (Approximated)

Project	By	Date
PennEast	IK	28-Mar-19
Location	**Checked**	**Date**
Hunterdon County, NJ		

Check one: ☐ Present ☒ Developed | MP 89.97-1

1. Runoff curve number

Soil name and hydrologic group (appendix A)	Cover Description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN[1] Table 2-2	CN[1] Figure 2-3	CN[1] Figure 2-4	Area X acres mi² %	Product of CN x Area
Type C	FARMSTEADS	82			1.07	87.74
Type D	FARMSTEADS	86			1.53	131.58
1. Use only one CN source per line				Totals ➡	2.60	219.32

CN (weighted) = tot.prod. / tot. area = 219.32 / 2.60 = 84.4 ; Use CN ➡ **84**

2. Runoff

		Storm #1	Storm #2	Storm #3
Frequency……	yr			
Rainfall, P (24-hour)…….	in			
Runoff, Q……	in			

Use P and CN with table 2-1, figure 2-1, or equation 2-3 abd 2-4

PSS &	PROJECT: PennEast	JOB NO. 5516.0001	
		SHEET	DATE: 03/28/2019
		BY:	IK
	SUBJECT: Tc Calculations	CHK'D	

Time of Concentration calculations with the application of the SCS TR-55 methodology.

Watershed or Subarea Designation: DA 89.97-1

Area 2.6 AC

SHEET FLOW

Segment ID		A-B				
Surface Description (Table 3-1)		GRASS				
Manning's Coefficient, n (Table 3-1)		0.150				
Flow Length, L (total <= 150)	(ft)	150				
Two Year Rainfall, P	(in)	3.4				
Land Slope, s	(ft/ft)	0.080				
Computed Tt = 0.007 (nL)^0.8 / P^0.5*s^0.4	(hrs)	0.126				0.126

SHALLOW CONCENTRATED FLOW

Segment ID		B-C				
Surface Description (paved or unpaved)		UNPAVED				
Flow Length, L	(ft)	849				
Watercourse slope, s	(ft/ft)	0.120				
Average Velocity, V (Figure 3-1)	(ft/s)	5.4				
Computed Tt = L / 3600V	(hrs)	0.044				0.044

CHANNEL FLOW

Segment ID		C-D				
Cross sectional Area, a	(sf)	5.25				
Wetted Perimeter, Pw	(ft)	2.01				
Hydraulic Radius, r =a/Pw	(ft)	2.612				
Channel Slope (ft/ft)	(ft/ft)	0.028				
Manning's Roughness Coefficient, n		0.045				
Velocity, V = 1.49r^(2/3)s^0.5 / n	(ft/s)	10.51				
Flow Length, L	(ft)	65				
Computed Tt = L / 3600V	(hrs)	0.002				0.002

Watershed or subarea Tc	0.172	hrs.
	10.3	min.

Use minimum Tc of 10 minutes

Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 05 / 23 / 2019

Hyd. No. 68

MP-89.97-1

Hydrograph type	= SCS Runoff	Peak discharge	= 4.031 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.20 hrs
Time interval	= 6 min	Hyd. volume	= 15,331 cuft
Drainage area	= 2.600 ac	Curve number	= 84.000
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 10.3 min
Total precip.	= 3.26 in	Distribution	= Custom
Storm duration	= C:\Users\IKuzmina\AppData\Local\Autodesk\C3D2019\enu\HHApps\Hydrograp	Shape factor	= 484

Hydrograph Discharge Table

(Printed values >= 1.00% of Qp.)

Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)
9.70	0.041	11.50	0.358	13.30	0.473	15.10	0.193
9.80	0.046	11.60	0.451	13.40	0.435	15.20	0.185
9.90	0.051	11.70	0.596	13.50	0.400	15.30	0.180
10.00	0.057	11.80	0.783	13.60	0.365	15.40	0.177
10.10	0.062	11.90	1.105	13.70	0.336	15.50	0.174
10.20	0.068	12.00	1.757	13.80	0.316	15.60	0.172
10.30	0.075	12.10	3.159	13.90	0.304	15.70	0.170
10.40	0.081	12.20	4.031	14.00	0.295	15.80	0.167
10.50	0.088	12.30	3.340	14.10	0.286	15.90	0.165
10.60	0.097	12.40	2.365	14.20	0.277	16.00	0.162
10.70	0.110	12.50	1.504	14.30	0.268	16.10	0.160
10.80	0.127	12.60	1.204	14.40	0.259	16.20	0.158
10.90	0.146	12.70	0.955	14.50	0.249	16.30	0.155
11.00	0.167	12.80	0.806	14.60	0.240	16.40	0.152
11.10	0.192	12.90	0.701	14.70	0.231	16.50	0.150
11.20	0.225	13.00	0.641	14.80	0.222	16.60	0.147
11.30	0.265	13.10	0.578	14.90	0.212	16.70	0.145
11.40	0.310	13.20	0.520	15.00	0.203	16.80	0.143

<<

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Worksheet for MP-89.97_STA 0+16-2YEAR_PIPE

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.01400	ft/ft
Discharge	4.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	260.00
0+44	259.20
0+50	258.90
0+52	259.60
0+61	264.00
0+69	266.00
0+87	270.00
1+00	272.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 260.00)	(1+00, 272.00)	0.045

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.48	ft
Elevation Range	258.90 to 272.00 ft	
Flow Area	3.18	ft²
Wetted Perimeter	17.44	ft
Hydraulic Radius	0.18	ft

Worksheet for MP-89.97_STA 0+16-2YEAR_PIPE

Results

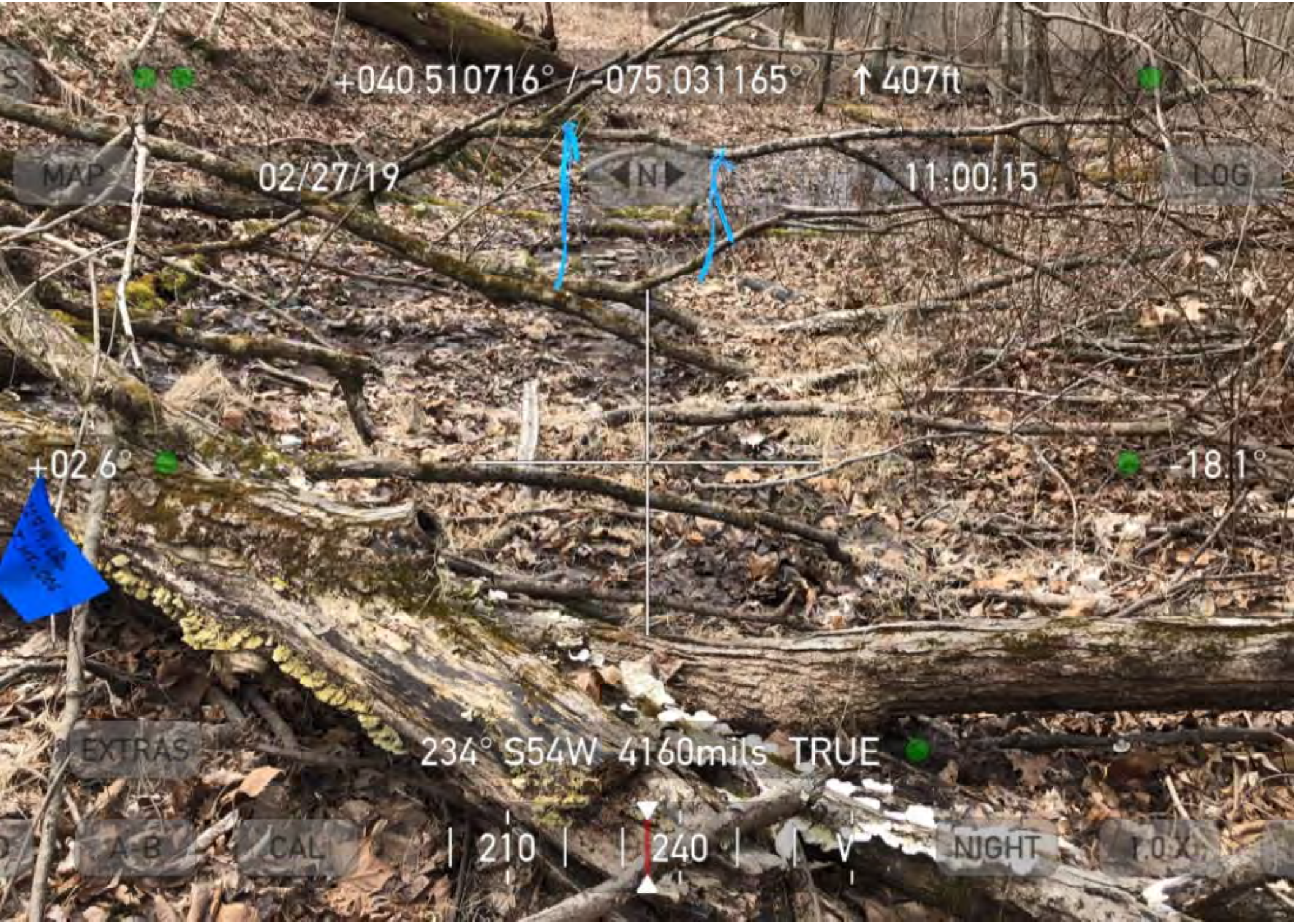
Top Width		17.36	ft
Normal Depth		0.48	ft
Critical Depth		0.39	ft
Critical Slope		0.05560	ft/ft
Velocity		1.26	ft/s
Velocity Head		0.02	ft
Specific Energy		0.51	ft
Froude Number		0.52	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.48	ft
Critical Depth	0.39	ft
Channel Slope	0.01400	ft/ft
Critical Slope	0.05560	ft/ft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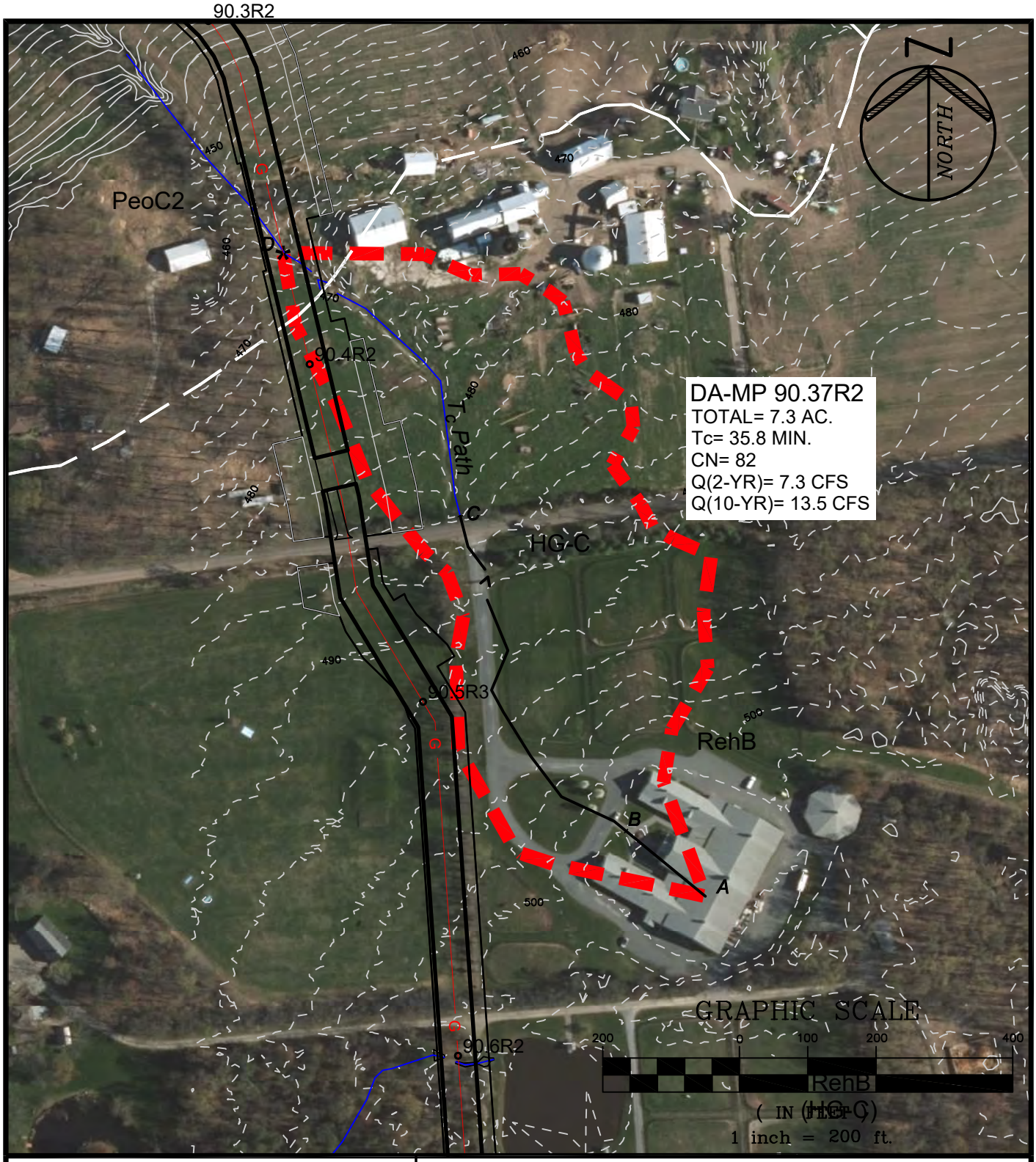

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CERTIFICATE OF AUTHORIZATION NO. 24GA28032700

PROJECT TITLE

PENNEAST PIPELINE

HUNTERDON AND MERCER COUNTY, NJ

SHEET TITLE

STREAM CROSSING DRAINAGE AREA MP-90.37R2

PROJ. NO.:	05516.0001	DRN. BY:	JPS	SCALE:	1"=200'
DATE:	05/23/19	CK'D BY:	WS		

FILE NAME: P:\05516\0001\DWGs\CADC-Civil\Plotdwgs\Drainage Area Maps\055160001-Stream_DA_MP85.4-98.9-1-WAL.dwg\MP 90.37R2 LAST EDIT: 06/13/2019 - 03:18:43 PM LOGIN: jmcgowan@

Worksheet 2: Runoff curve number and runoff (Approximated)

Project	By	Date
PennEast	JPS	26-Feb-18
Location	**Checked**	**Date**
Hunterdon County, NJ		

Check one: ☐ Present ☒ Developed | MP 90.37

1. Runoff curve number

Soil name and hydrologic group (appendix A)	Cover Description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN[1] Table 2-2	CN[1] Figure 2-3	CN[1] Figure 2-4	Area ☒ acres ☐ mi² ☐ %	Product of CN x Area
Type C	Farmstead, Good Condition	82			7.30	598.60
				Totals ➡	7.30	598.60

1. Use only one CN source per line

CN (weighted) = tot.prod. / tot. area = 598.60 / 7.30 = 82.0 ; **Use CN** ➡ **82**

2. Runoff

		Storm #1	Storm #2	Storm #3
Frequency…….	yr			
Rainfall, P (24-hour)…….	in			
Runoff, Q……	in			

Use P and CN with table 2-1, figure 2-1, or equation 2-3 abd 2-4

PROJECT:	PennEast	JOB NO. 5516.0001	
		SHEET	DATE:2/12/2018
		BY:	JPS
SUBJECT:	Tc Calculations	CHK'D	

Time of Concentration calculations with the application of the SCS TR-55 methodology.

Watershed or Subarea Designation: DA 90.37R2

Area 7.3 AC

SHEET FLOW

Segment ID		A-B			
Surface Description (Table 3-1)		GRASS			
Manning's Coefficient, n (Table 3-1)		0.240			
Flow Length, L (total <= 150)	(ft)	150			
Two Year Rainfall, P	(in)	3.4			
Land Slope, s	(ft/ft)	0.007			
Computed Tt = 0.007 (nL)^0.8 / P^0.5*s^0.4	(hrs)	0.487			0.487

SHALLOW CONCENTRATED FLOW

Segment ID		B-C			
Surface Description (paved or unpaved)		UNPAVED			
Flow Length, L	(ft)	575			
Watercourse slope, s	(ft/ft)	0.030			
Average Velocity, V (Figure 3-1)	(ft/s)	2.8			
Computed Tt = L / 3600V	(hrs)	0.057			0.057

CHANNEL FLOW

Segment ID		C-D			
Cross sectional Area, a	(sf)	2.95			
Wetted Perimeter, Pw	(ft)	15.07			
Hydraulic Radius, r =a/Pw	(ft)	0.196			
Channel Slope (ft/ft)	(ft/ft)	0.044			
Manning's Roughness Coefficient, n		0.040			
Velocity, V = 1.49r^(2/3)s^0.5 / n	(ft/s)	2.63			
Flow Length, L	(ft)	500			
Computed Tt = L / 3600V	(hrs)	0.053			0.053

Watershed or subarea Tc	0.597	hrs.
	35.8	min.

Use minimum Tc of 10 minutes

Hydrograph Report

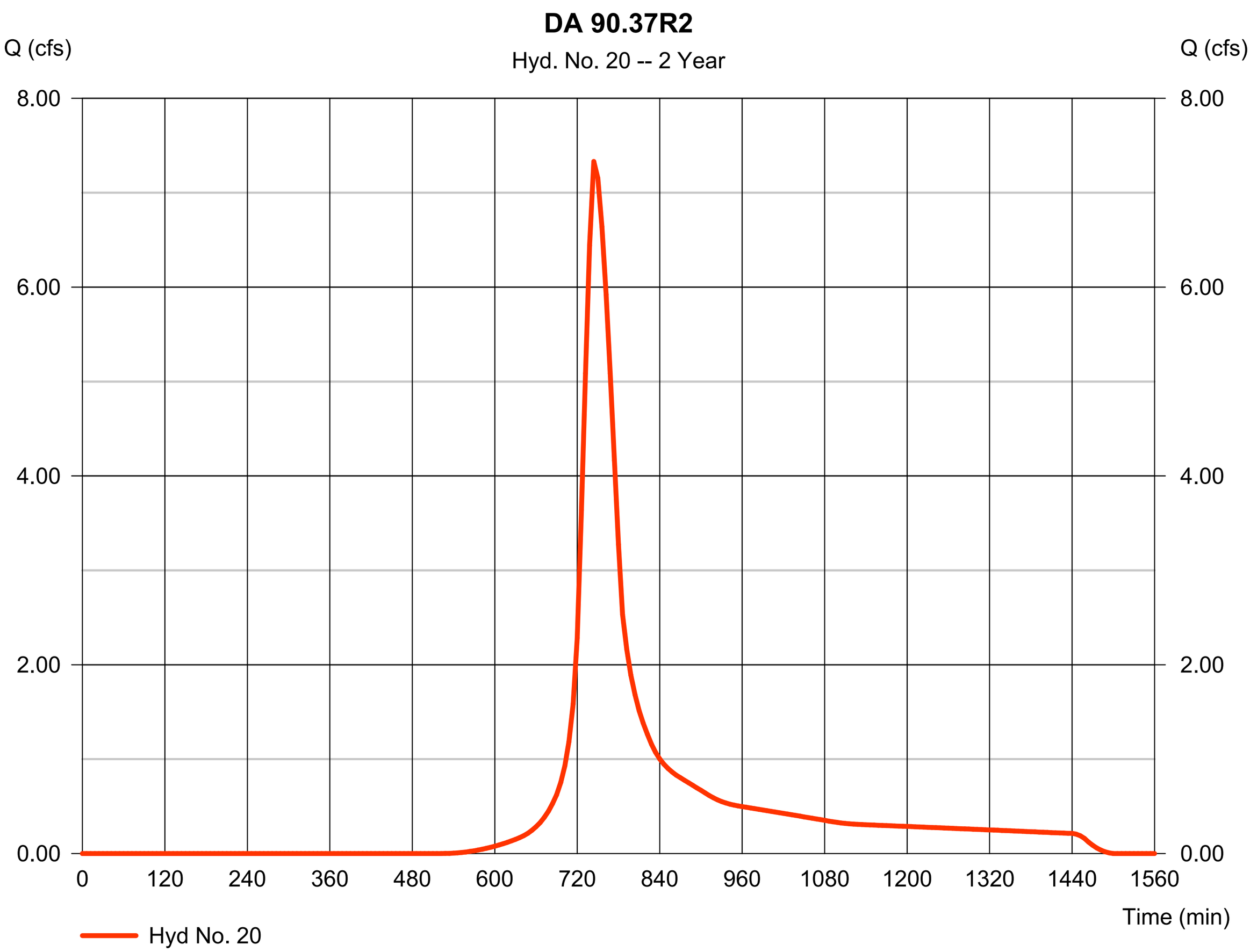
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 06 / 13 / 2019

Hyd. No. 20

DA 90.37R2

Hydrograph type	=	SCS Runoff	Peak discharge	=	7.330 cfs
Storm frequency	=	2 yrs	Time to peak	=	744 min
Time interval	=	6 min	Hyd. volume	=	43,354 cuft
Drainage area	=	7.300 ac	Curve number	=	82*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	35.80 min
Total precip.	=	3.26 in	Distribution	=	Custom
Storm duration	=	C:\Users\IKuzmina\AppData\Local\Autodesk\C3D 2019\enu\HHApps\Hydrograph Shape factor	=	484	

* Composite (Area/CN) = [(7.300 x 82)] / 7.300



Worksheet for MP-90.37R2 STA0+80_2YR_PIPE

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.07000	ft/ft
Discharge	7.30	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	464.00
0+50	461.72
0+53	463.00
1+00	468.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 464.00)	(1+00, 468.00)	0.045

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.44	ft
Elevation Range	461.72 to 468.00 ft	
Flow Area	2.31	ft²
Wetted Perimeter	10.67	ft
Hydraulic Radius	0.22	ft
Top Width	10.57	ft
Normal Depth	0.44	ft
Critical Depth	0.47	ft
Critical Slope	0.04848	ft/ft

Worksheet for MP-90.37R2 STA0+80_2YR_PIPE

Results

Velocity		3.15	ft/s
Velocity Head		0.15	ft
Specific Energy		0.59	ft
Froude Number		1.19	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.44	ft
Critical Depth	0.47	ft
Channel Slope	0.07000	ft/ft
Critical Slope	0.04848	ft/ft

Worksheet for MP-90.37R2 STA0+35_2YR_BRIDGE

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.07000	ft/ft
Discharge	7.30	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	470.00
0+08	470.00
0+28	468.00
0+49	465.20
0+50	464.99
0+53	464.99
0+69	468.00
1+00	470.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 470.00)	(1+00, 470.00)	0.045

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.40	ft
Elevation Range	464.99 to 470.00 ft	
Flow Area	2.01	ft²
Wetted Perimeter	7.53	ft
Hydraulic Radius	0.27	ft

Worksheet for MP-90.37R2 STA0+35_2YR_BRIDGE

Results

Top Width		7.46	ft
Normal Depth		0.40	ft
Critical Depth		0.45	ft
Critical Slope		0.04491	ft/ft
Velocity		3.62	ft/s
Velocity Head		0.20	ft
Specific Energy		0.61	ft
Froude Number		1.23	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.40	ft
Critical Depth	0.45	ft
Channel Slope	0.07000	ft/ft
Critical Slope	0.04491	ft/ft

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↑408ft
MAP
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LOG
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-18.5°
EXTRAS
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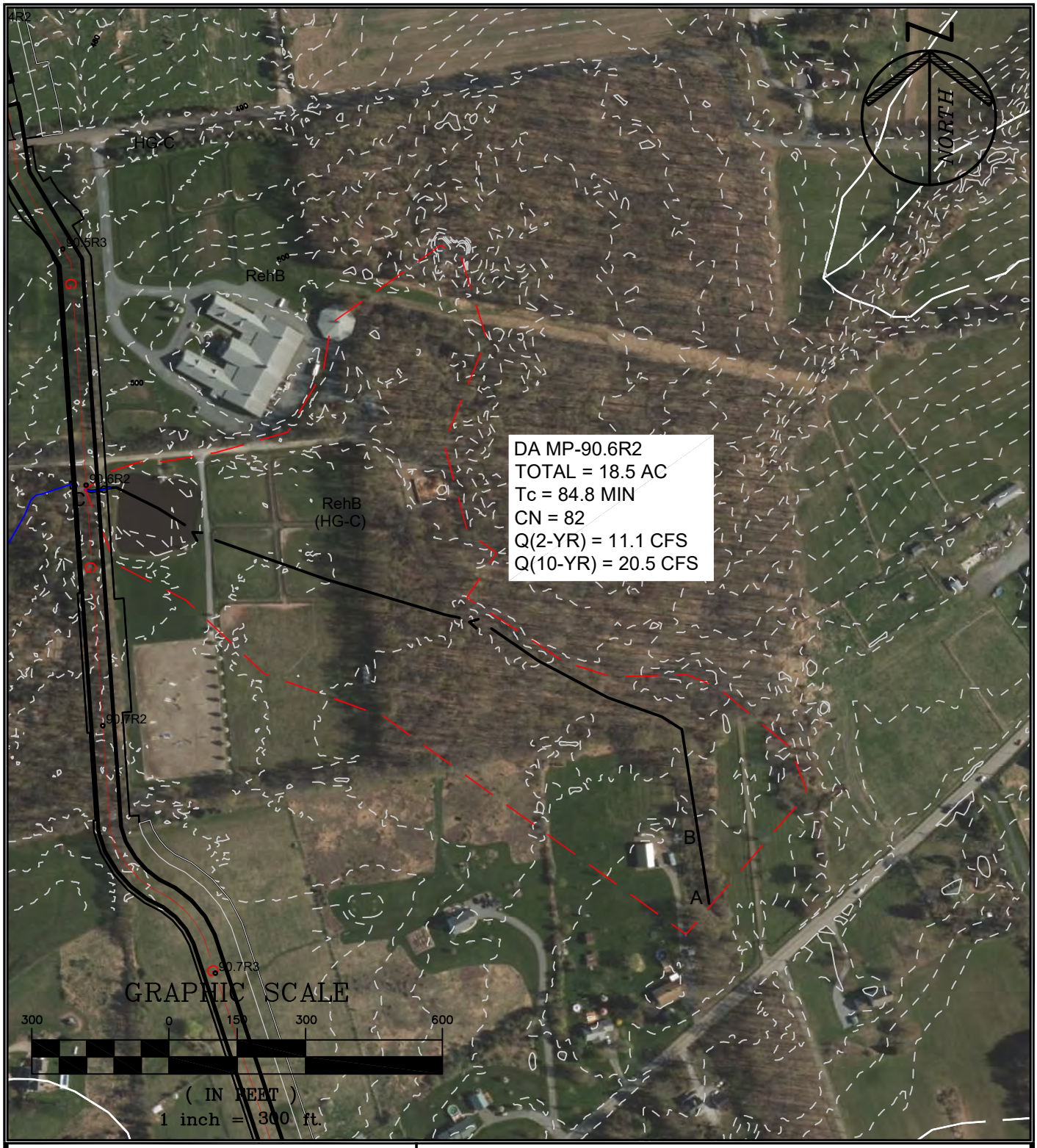

PAULUS, SOKOLOWSKI AND SARTOR, LLC.

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PHONE: (848) 206-2626

CERTIFICATE OF AUTHORIZATION NO. 24GA28032700

PROJECT TITLE

PENNEAST PIPELINE

HUNTERDON AND MERCER COUNTY, NJ

SHEET TITLE

STREAM CROSSING DRAINAGE AREA MP-90.6R2

PROJ. NO.:	05516.0001	DRN. BY:	JPS	SCALE:	1"=300'
DATE:	05/23/19	CK'D BY:	WS		

FILE NAME: P:\05516\0001\DWGs\CADC-Civil\Plotdwgs\Drainage Area Maps\05516\0001-Stream_DA_MP85.4-98.9-WAL.dwg\MP 90.6R2 LAST EDIT: 05/30/2019 - 10:52:00 AM LOGIN: jmcgowan@

PSS &	PROJECT: PennEast	JOB NO. 5516.0001	
		SHEET	DATE:4/24/2019
		BY:	IK
	SUBJECT: Tc Calculations	CHK'D	

Time of Concentration calculations with the application of the SCS TR-55 methodology.

Watershed or Subarea Designation: DA 90.6R2

Area 20.8 AC

SHEET FLOW

Segment ID		A-B				
Surface Description (Table 3-1)		WOODS				
Manning's Coefficient, n (Table 3-1)		0.400				
Flow Length, L (total <= 150)	(ft)	150				
Two Year Rainfall, P	(in)	3.4				
Land Slope, s	(ft/ft)	0.003				
Computed Tt = 0.007 (nL)^0.8 / P^0.5*s^0.4	(hrs)	1.029				1.029

SHALLOW CONCENTRATED FLOW

Segment ID		B-C				
Surface Description (paved or unpaved)		UNPAVED				
Flow Length, L	(ft)	1608				
Watercourse slope, s	(ft/ft)	0.005				
Average Velocity, V (Figure 3-1)	(ft/s)	1.2				
Computed Tt = L / 3600V	(hrs)	0.382				0.382

CHANNEL FLOW

Segment ID		C-D				
Cross sectional Area, a	(sf)	6.90				
Wetted Perimeter, Pw	(ft)	9.70				
Hydraulic Radius, r =a/Pw	(ft)	0.711				
Channel Slope (ft/ft)	(ft/ft)	0.030				
Manning's Roughness Coefficient, n		0.045				
Velocity, V = 1.49r^(2/3)s^0.5 / n	(ft/s)	4.57				
Flow Length, L	(ft)	55				
Computed Tt = L / 3600V	(hrs)	0.003				0.003

Watershed or subarea Tc	1.414	hrs.
	84.8	min.

Use minimum Tc of 10 minutes

Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 05 / 23 / 2019

Hyd. No. 85

MP-90.6R2

Hydrograph type	= SCS Runoff	Peak discharge	= 11.11 cfs
Storm frequency	= 2 yrs	Time to peak	= 13.00 hrs
Time interval	= 6 min	Hyd. volume	= 106,540 cuft
Drainage area	= 18.500 ac	Curve number	= 82.000
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 84.8 min
Total precip.	= 3.26 in	Distribution	= Custom
Storm duration	= C:\Users\IKuzmina\AppData\Local\Autodesk\C3D2019\enu\HHApps\Hydrograp	Storm frequency	= 2 yrs

Hydrograph Discharge Table

(Printed values >= 1.00% of Qp.)

Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)
10.20	0.113	12.00	2.103	13.80	7.337	15.60	1.662
10.30	0.135	12.10	2.981	13.90	6.646	15.70	1.602
10.40	0.158	12.20	3.980	14.00	5.947	15.80	1.547
10.50	0.184	12.30	5.057	14.10	5.246	15.90	1.497
10.60	0.213	12.40	6.179	14.20	4.560	16.00	1.451
10.70	0.245	12.50	7.317	14.30	3.914	16.10	1.408
10.80	0.282	12.60	8.433	14.40	3.371	16.20	1.370
10.90	0.322	12.70	9.489	14.50	3.048	16.30	1.334
11.00	0.369	12.80	10.42	14.60	2.798	16.40	1.302
11.10	0.423	12.90	11.07	14.70	2.597	16.50	1.272
11.20	0.486	13.00	11.11	14.80	2.429	16.60	1.244
11.30	0.560	13.10	10.96	14.90	2.292	16.70	1.219
11.40	0.649	13.20	10.66	15.00	2.170	16.80	1.196
11.50	0.753	13.30	10.26	15.10	2.061	16.90	1.174
11.60	0.888	13.40	9.771	15.20	1.964	17.00	1.154
11.70	1.058	13.50	9.227	15.30	1.877	17.10	1.134
11.80	1.284	13.60	8.635	15.40	1.799	17.20	1.116
11.90	1.600	13.70	8.002	15.50	1.727	17.30	1.098

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Worksheet for MP-90.6R2_STA0+47_2YR_PIPE

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.03000	ft/ft
Discharge	11.10	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	498.00
0+47	497.90
0+50	497.25
0+50	497.50
1+00	498.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 498.00)	(1+00, 498.00)	0.045

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.58	ft
Elevation Range	497.25 to 498.00 ft	
Flow Area	6.20	ft²
Wetted Perimeter	35.48	ft
Hydraulic Radius	0.17	ft
Top Width	35.34	ft
Normal Depth	0.58	ft
Critical Depth	0.54	ft

Worksheet for MP-90.6R2_STA0+47_2YR_PIPE

Results

Critical Slope		0.05499	ft/ft
Velocity		1.79	ft/s
Velocity Head		0.05	ft
Specific Energy		0.63	ft
Froude Number		0.75	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.58	ft
Critical Depth	0.54	ft
Channel Slope	0.03000	ft/ft
Critical Slope	0.05499	ft/ft

Worksheet for MP-90.6R2_STA0+11_2YR_BRIDGE

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.03000	ft/ft
Discharge	11.10	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	500.00
0+50	498.32
0+55	498.45
1+00	500.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 500.00)	(1+00, 500.00)	0.045

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.41	ft
Elevation Range	498.32 to 500.00 ft	
Flow Area	5.43	ft²
Wetted Perimeter	25.49	ft
Hydraulic Radius	0.21	ft
Top Width	25.48	ft
Normal Depth	0.41	ft
Critical Depth	0.37	ft
Critical Slope	0.05112	ft/ft

Worksheet for MP-90.6R2_STA0+11_2YR_BRIDGE

Results

Velocity		2.04	ft/s
Velocity Head		0.06	ft
Specific Energy		0.48	ft
Froude Number		0.78	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.41	ft
Critical Depth	0.37	ft
Channel Slope	0.03000	ft/ft
Critical Slope	0.05112	ft/ft

+040.502792° / -075.025476°
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+01.9°
-23.0°
EXTRAS
284° N76W 5049mils TRUE
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1.0 X

MP 91.54

MP-91.54 & 91.58 (1,2)

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Workspace ID: NJ20170807160012808000
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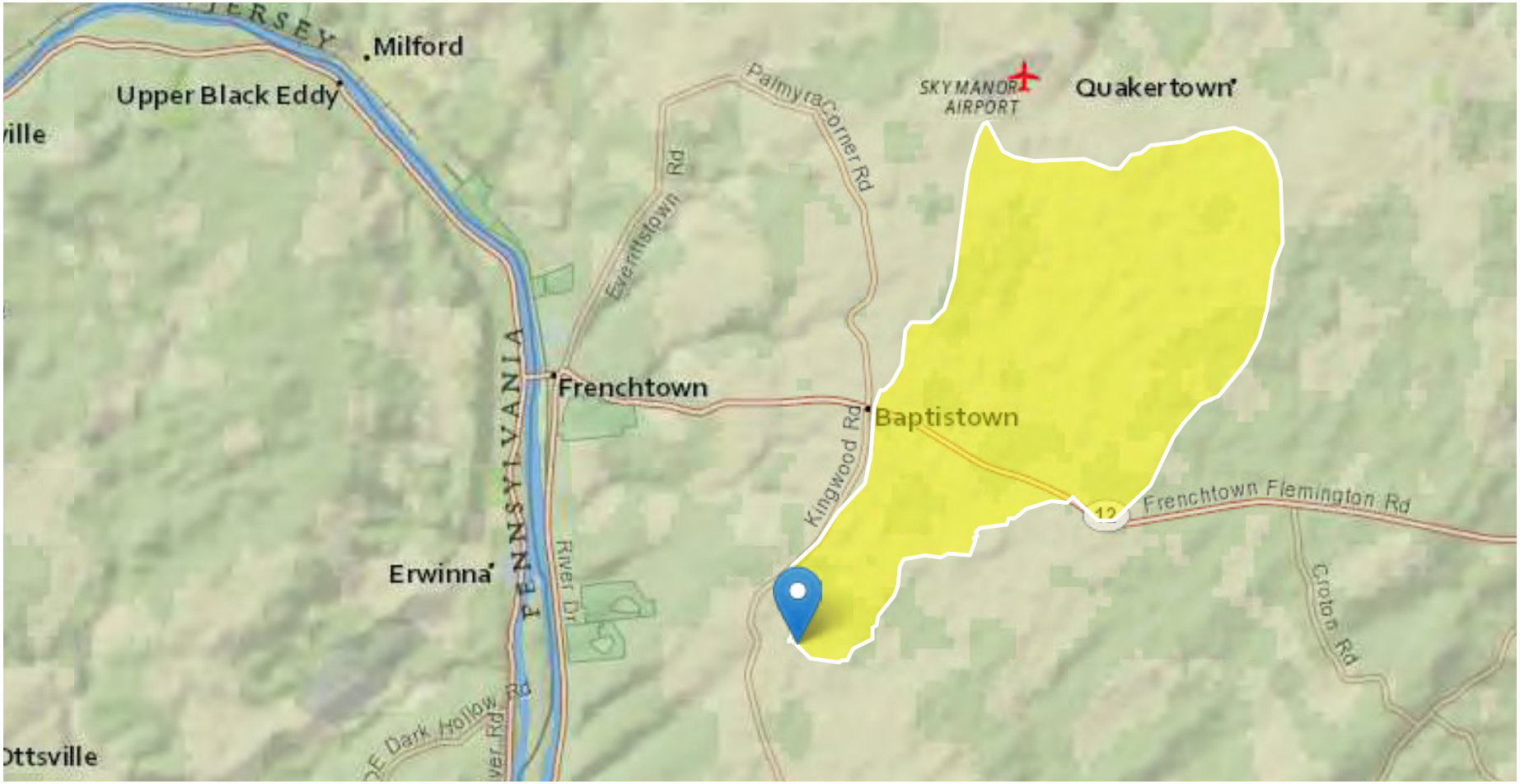

Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	11.3	square miles
STORAGE	Percentage of area of storage (lakes ponds reservoirs wetlands)	19.2	percent
CSL10_85	Change in elevation divided by length between points 10 and 85 percent of distance along main channel to basin divide - main channel method not known	16.3	feet per mi
POPDENS	Basin Population Density	113	persons per square mile

Peak-Flow Statistics Parameters [Peak Unglaciated Piedmont Region 2009 5167]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	11.3	square miles	0.25	779
STORAGE	Percent Storage	19.2	percent	0.23	32
CSL10_85	Stream Slope 10 and 85 Method	16.3	feet per mi	4.31	191
POPDENS	Basin Population Density	113	persons per square mile	83	11084

Peak-Flow Statistics Flow Report [Peak Unglaciated Piedmont Region 2009 5167]

PIl: Prediction Interval-Lower, PIu: Prediction Interval-Upper, SEp: Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	SEe	SEp	Equiv. Yrs.
2 Year Peak Flood	734	ft^3/s	49	50.3	1
5 Year Peak Flood	1170	ft^3/s	49.4	50.9	2
10 Year Peak Flood	1500	ft^3/s	50.5	52.2	3

Statistic	Value	Unit	SEe	SEp	Equiv. Yrs.
25 Year Peak Flood	1940	ft^3/s	52.6	54.5	4
50 Year Peak Flood	2280	ft^3/s	54.7	56.8	5
100 Year Peak Flood	2660	ft^3/s	57.1	59.5	5
500 Year Peak Flood	3570	ft^3/s	63.9	66.3	6

Peak-Flow Statistics Citations

Watson, K.M.,and Schopp, R.D.,2009, Methodology for estimation of flood magnitude and frequency for New Jersey streams, U.S. Geological Survey Scientific Investigations Report 2009-5167, 51 p. (http://pubs.usgs.gov/sir/2009/5167/)

Worksheet for MP-91.54R2 STA 2+08_2YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00360	ft/ft
Discharge	734.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	464.00
0+24	465.10
0+50	459.71
0+84	464.60
1+00	464.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 464.00)	(1+00, 464.00)	0.030

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	5.08	ft
Elevation Range	459.71 to 465.10 ft	
Flow Area	168.01	ft²
Wetted Perimeter	94.25	ft
Hydraulic Radius	1.78	ft
Top Width	91.78	ft
Normal Depth	5.08	ft
Critical Depth	3.93	ft

Worksheet for MP-91.54R2 STA 2+08_2YR

Results

Critical Slope		0.01067	ft/ft
Velocity		4.37	ft/s
Velocity Head		0.30	ft
Specific Energy		5.38	ft
Froude Number		0.57	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	5.08	ft
Critical Depth	3.93	ft
Channel Slope	0.00360	ft/ft
Critical Slope	0.01067	ft/ft

MP 91.58-1

MP-91.54 & 91.58 (1,2)

Region ID: NJ
Workspace ID: NJ20170807160012808000
Clicked Point (Latitude, Longitude): 40.49014, -75.01877
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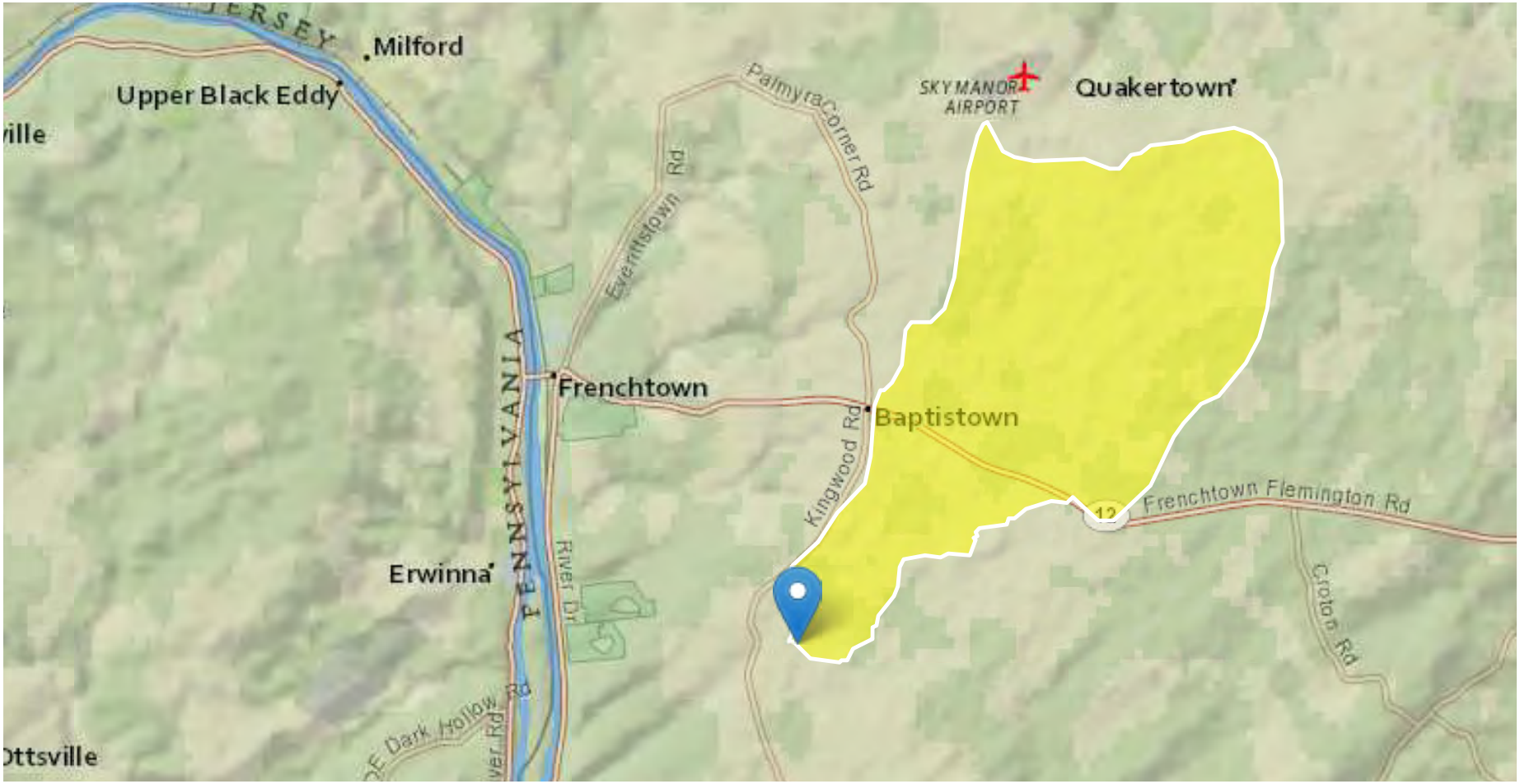

Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	11.3	square miles
STORAGE	Percentage of area of storage (lakes ponds reservoirs wetlands)	19.2	percent
CSL10_85	Change in elevation divided by length between points 10 and 85 percent of distance along main channel to basin divide - main channel method not known	16.3	feet per mi
POPDENS	Basin Population Density	113	persons per square mile

Peak-Flow Statistics Parameters [Peak Unglaciated Piedmont Region 2009 5167]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	11.3	square miles	0.25	779
STORAGE	Percent Storage	19.2	percent	0.23	32
CSL10_85	Stream Slope 10 and 85 Method	16.3	feet per mi	4.31	191
POPDENS	Basin Population Density	113	persons per square mile	83	11084

Peak-Flow Statistics Flow Report [Peak Unglaciated Piedmont Region 2009 5167]

PIl: Prediction Interval-Lower, PIu: Prediction Interval-Upper, SEp: Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	SEe	SEp	Equiv. Yrs.
2 Year Peak Flood	734	ft^3/s	49	50.3	1
5 Year Peak Flood	1170	ft^3/s	49.4	50.9	2
10 Year Peak Flood	1500	ft^3/s	50.5	52.2	3

Statistic	Value	Unit	SEe	SEp	Equiv. Yrs.
25 Year Peak Flood	1940	ft^3/s	52.6	54.5	4
50 Year Peak Flood	2280	ft^3/s	54.7	56.8	5
100 Year Peak Flood	2660	ft^3/s	57.1	59.5	5
500 Year Peak Flood	3570	ft^3/s	63.9	66.3	6

Peak-Flow Statistics Citations

Watson, K.M.,and Schopp, R.D.,2009, Methodology for estimation of flood magnitude and frequency for New Jersey streams, U.S. Geological Survey Scientific Investigations Report 2009-5167, 51 p. (http://pubs.usgs.gov/sir/2009/5167/)

Worksheet for MP-91.58R2 STA 4+00_2YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.02800	ft/ft
Discharge	734.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	463.80
0+26	463.40
0+38	459.54
0+80	463.80
0+90	464.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 463.80)	(0+90, 464.00)	0.033

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	3.28	ft
Elevation Range	459.54 to 464.00 ft	
Flow Area	70.75	ft²
Wetted Perimeter	43.80	ft
Hydraulic Radius	1.62	ft
Top Width	43.13	ft
Normal Depth	3.28	ft
Critical Depth	3.78	ft

Worksheet for MP-91.58R2 STA 4+00_2YR

Results

Critical Slope		0.01309	ft/ft
Velocity		10.37	ft/s
Velocity Head		1.67	ft
Specific Energy		4.95	ft
Froude Number		1.43	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	3.28	ft
Critical Depth	3.78	ft
Channel Slope	0.02800	ft/ft
Critical Slope	0.01309	ft/ft

MP 91.58-2

MP-91.54 & 91.58 (1,2)

Region ID: NJ
Workspace ID: NJ20170807160012808000
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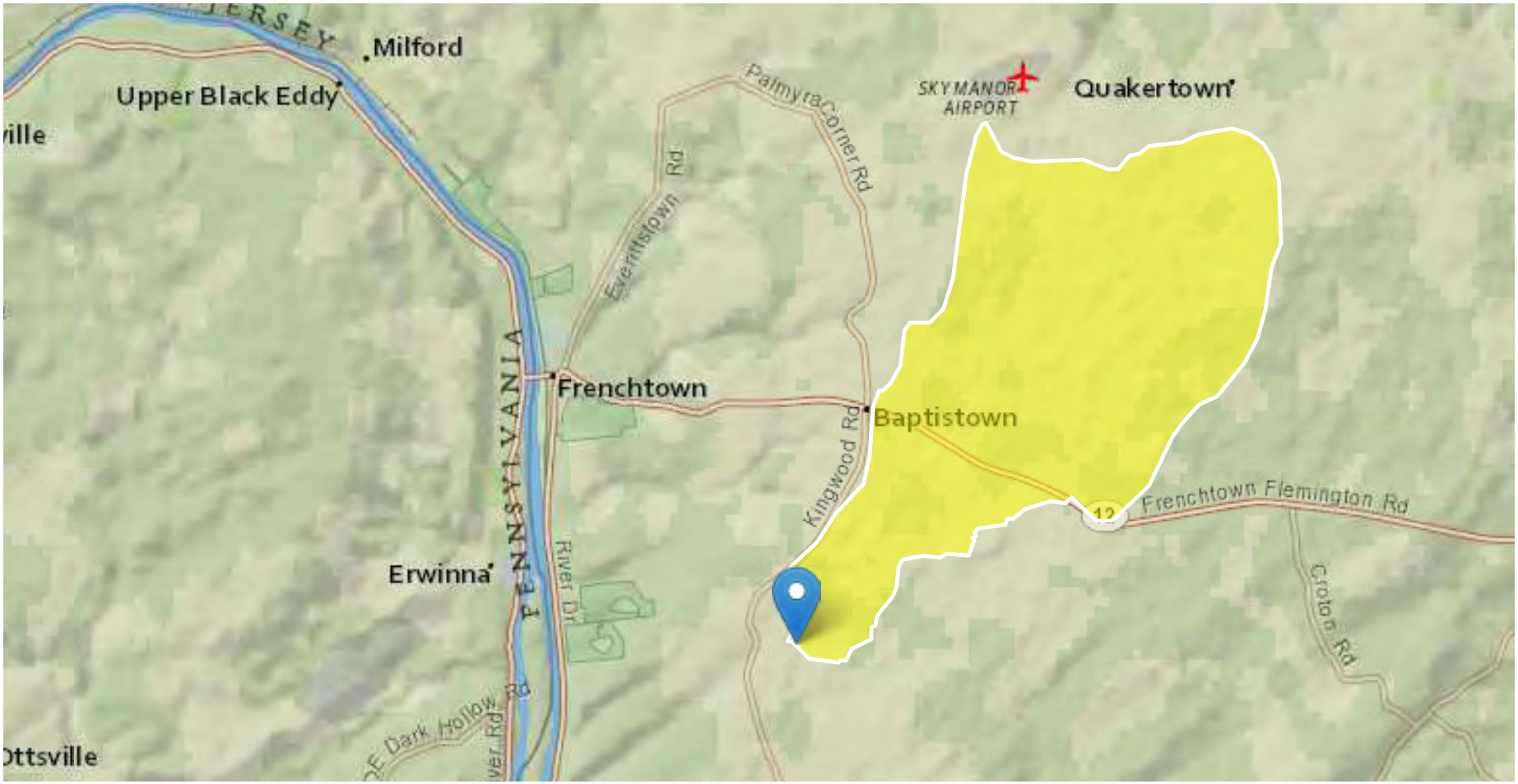


Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	11.3	square miles
STORAGE	Percentage of area of storage (lakes ponds reservoirs wetlands)	19.2	percent
CSL10_85	Change in elevation divided by length between points 10 and 85 percent of distance along main channel to basin divide - main channel method not known	16.3	feet per mi
POPDENS	Basin Population Density	113	persons per square mile

Peak-Flow Statistics Parameters [Peak Unglaciated Piedmont Region 2009 5167]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	11.3	square miles	0.25	779
STORAGE	Percent Storage	19.2	percent	0.23	32
CSL10_85	Stream Slope 10 and 85 Method	16.3	feet per mi	4.31	191
POPDENS	Basin Population Density	113	persons per square mile	83	11084

Peak-Flow Statistics Flow Report [Peak Unglaciated Piedmont Region 2009 5167]

PIl: Prediction Interval-Lower, PIu: Prediction Interval-Upper, SEp: Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	SEe	SEp	Equiv. Yrs.
2 Year Peak Flood	734	ft^3/s	49	50.3	1
5 Year Peak Flood	1170	ft^3/s	49.4	50.9	2
10 Year Peak Flood	1500	ft^3/s	50.5	52.2	3

Statistic	Value	Unit	SEe	SEp	Equiv. Yrs.
25 Year Peak Flood	1940	ft^3/s	52.6	54.5	4
50 Year Peak Flood	2280	ft^3/s	54.7	56.8	5
100 Year Peak Flood	2660	ft^3/s	57.1	59.5	5
500 Year Peak Flood	3570	ft^3/s	63.9	66.3	6

Peak-Flow Statistics Citations

Watson, K.M.,and Schopp, R.D.,2009, Methodology for estimation of flood magnitude and frequency for New Jersey streams, U.S. Geological Survey Scientific Investigations Report 2009-5167, 51 p. (http://pubs.usgs.gov/sir/2009/5167/)

Worksheet for MP-91.58R2 STA 4+51_2YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.01400	ft/ft
Discharge	734.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	463.50
0+30	462.65
0+50	459.08
0+75	465.70
1+00	466.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 463.50)	(1+00, 466.00)	0.033

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	4.44	ft
Elevation Range	459.08 to 466.00 ft	
Flow Area	103.43	ft²
Wetted Perimeter	67.28	ft
Hydraulic Radius	1.54	ft
Top Width	66.36	ft
Normal Depth	4.44	ft
Critical Depth	4.44	ft

Worksheet for MP-91.58R2 STA 4+51_2YR

Results

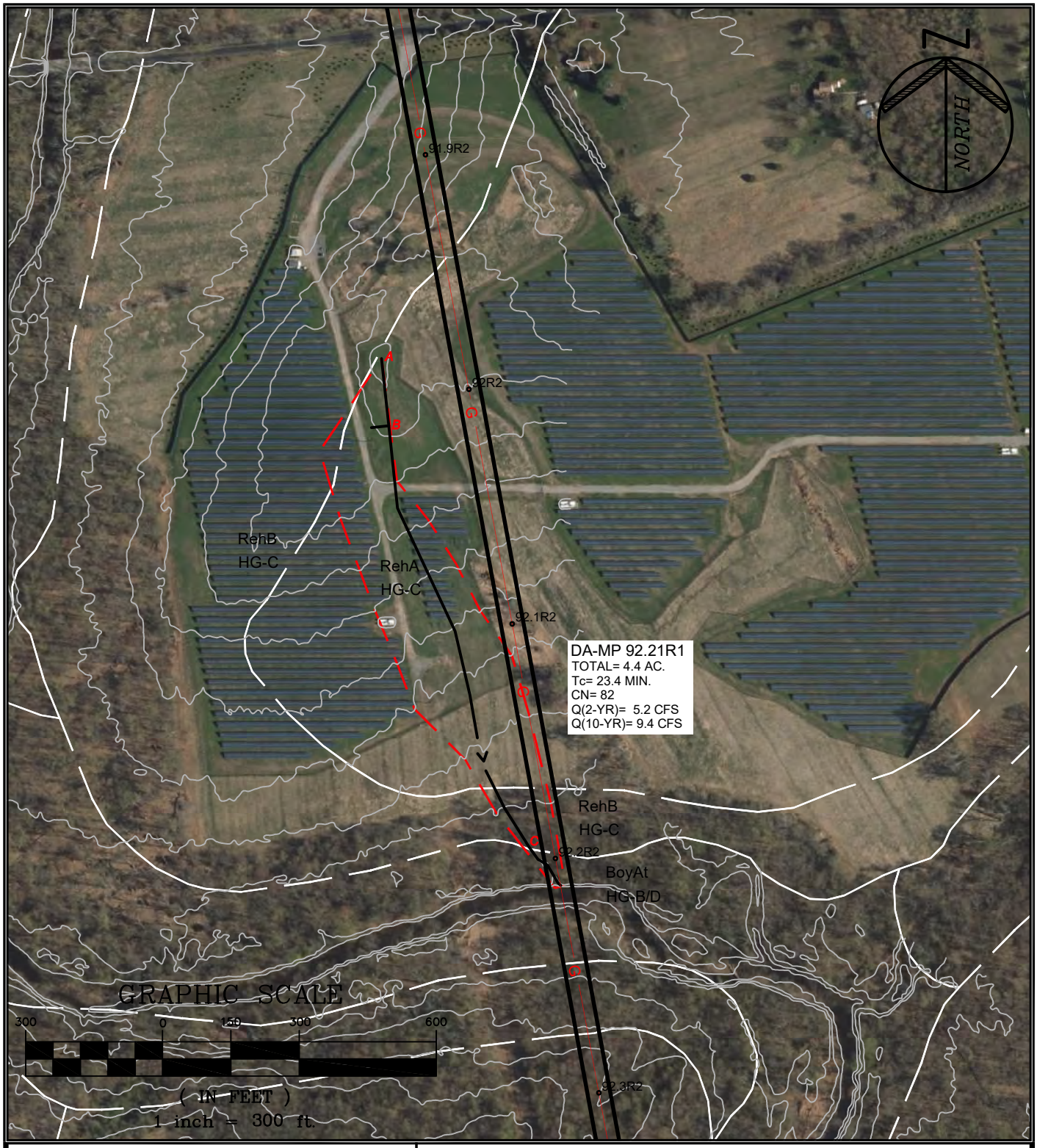
Critical Slope		0.01394	ft/ft
Velocity		7.10	ft/s
Velocity Head		0.78	ft
Specific Energy		5.22	ft
Froude Number		1.00	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	4.44	ft
Critical Depth	4.44	ft
Channel Slope	0.01400	ft/ft
Critical Slope	0.01394	ft/ft



PAULUS, SOKOLOWSKI AND SARTOR, LLC.

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WALL, NEW JERSEY 07727
PHONE: (848) 206-2626

CERTIFICATE OF AUTHORIZATION NO. 24GA28032700

PROJECT TITLE

PENNEAST PIPELINE

HUNTERDON AND MERCER COUNTY, NJ

SHEET TITLE

STREAM CROSSING DRAINAGE AREA MP-92.21R1

PROJ. NO.:	05516.0001	DRN. BY:	JPS	SCALE:	1"=300'
DATE:	05/23/19	CK'D BY:	WS		

FILE NAME: P:\05516\0001\DWGs\CAD\C-Civil\Plotdwgs\Drainage Area Maps\05516\0001-Stream_DA_MP85.4-98.9-WAL.dwg\MP 92.21R1 LAST EDIT: 05/30/2019 - 11:02:38 AM LOGIN: jmcgowan@

PROJECT:	PennEast	JOB NO. 5516.0001	
		SHEET	DATE: 04/01/2019
		BY:	IK
SUBJECT:	Tc Calculations	CHK'D	

Time of Concentration calculations with the application of the SCS TR-55 methodology.

Watershed or Subarea Designation: DA 92.21R1

Area 4.4 AC

SHEET FLOW

Segment ID		A-B				
Surface Description (Table 3-1)		GRASS				
Manning's Coefficient, n (Table 3-1)		0.150				
Flow Length, L (total <= 150)	(ft)	150				
Two Year Rainfall, P	(in)	3.4				
Land Slope, s	(ft/ft)	0.017				
Computed Tt = 0.007 (nL)^0.8 / P^0.5*s^0.4	(hrs)	0.235				0.235

SHALLOW CONCENTRATED FLOW

Segment ID		B-C				
Surface Description (paved or unpaved)		UNPAVED				
Flow Length, L	(ft)	997				
Watercourse slope, s	(ft/ft)	0.015				
Average Velocity, V (Figure 3-1)	(ft/s)	1.9				
Computed Tt = L / 3600V	(hrs)	0.146				0.146

CHANNEL FLOW

Segment ID		C-D				
Cross sectional Area, a	(sf)	6.90				
Wetted Perimeter, Pw	(ft)	11.77				
Hydraulic Radius, r =a/Pw	(ft)	0.586				
Channel Slope (ft/ft)	(ft/ft)	0.020				
Manning's Roughness Coefficient, n		0.045				
Velocity, V = 1.49r^(2/3)s^0.5 / n	(ft/s)	3.28				
Flow Length, L	(ft)	111				
Computed Tt = L / 3600V	(hrs)	0.009				0.009

Watershed or subarea Tc	0.390	hrs.
	23.4	min.

Use minimum Tc of 10 minutes

Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 05 / 23 / 2019

Hyd. No. 71

MP-92.21R1

Hydrograph type	= SCS Runoff	Peak discharge	= 5.158 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.30 hrs
Time interval	= 6 min	Hyd. volume	= 25,339 cuft
Drainage area	= 4.400 ac	Curve number	= 82.000
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 23.4 min
Total precip.	= 3.26 in	Distribution	= Custom
Storm duration	= C:\Users\IKuzmina\AppData\Local\Autodesk\C3D2019\enu\HHApps\Hydrograp	Storm frequency	= 24 hrs

Hydrograph Discharge Table

(Printed values >= 1.00% of Qp.)

Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)
10.00	0.054	11.80	0.899	13.60	0.706	15.40	0.316
10.10	0.062	11.90	1.222	13.70	0.648	15.50	0.308
10.20	0.071	12.00	1.849	13.80	0.600	15.60	0.302
10.30	0.080	12.10	3.111	13.90	0.563	15.70	0.297
10.40	0.090	12.20	4.355	14.00	0.534	15.80	0.293
10.50	0.100	12.30	5.158	14.10	0.512	15.90	0.289
10.60	0.112	12.40	4.829	14.20	0.495	16.00	0.285
10.70	0.126	12.50	4.217	14.30	0.480	16.10	0.281
10.80	0.145	12.60	3.426	14.40	0.464	16.20	0.277
10.90	0.168	12.70	2.594	14.50	0.449	16.30	0.273
11.00	0.195	12.80	1.851	14.60	0.433	16.40	0.268
11.10	0.227	12.90	1.530	14.70	0.417	16.50	0.264
11.20	0.267	13.00	1.312	14.80	0.402	16.60	0.260
11.30	0.315	13.10	1.151	14.90	0.386	16.70	0.256
11.40	0.373	13.20	1.022	15.00	0.370	16.80	0.251
11.50	0.439	13.30	0.929	15.10	0.354	16.90	0.247
11.60	0.540	13.40	0.846	15.20	0.339	17.00	0.243
11.70	0.680	13.50	0.773	15.30	0.326	17.10	0.239

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Worksheet for MP-92.21_STA1+02_2YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.01800	ft/ft
Discharge	5.20	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	458.20
0+16	459.30
0+20	456.23
0+27	459.30
0+40	459.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 458.20)	(0+40, 459.00)	0.050

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	1.10	ft
Elevation Range	456.23 to 459.30 ft	
Flow Area	2.14	ft²
Wetted Perimeter	4.50	ft
Hydraulic Radius	0.48	ft
Top Width	3.88	ft
Normal Depth	1.10	ft
Critical Depth	0.89	ft

Worksheet for MP-92.21_STA1+02_2YR

Results

Critical Slope		0.05824	ft/ft
Velocity		2.43	ft/s
Velocity Head		0.09	ft
Specific Energy		1.20	ft
Froude Number		0.58	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.10	ft
Critical Depth	0.89	ft
Channel Slope	0.01800	ft/ft
Critical Slope	0.05824	ft/ft

MP-92.22R2

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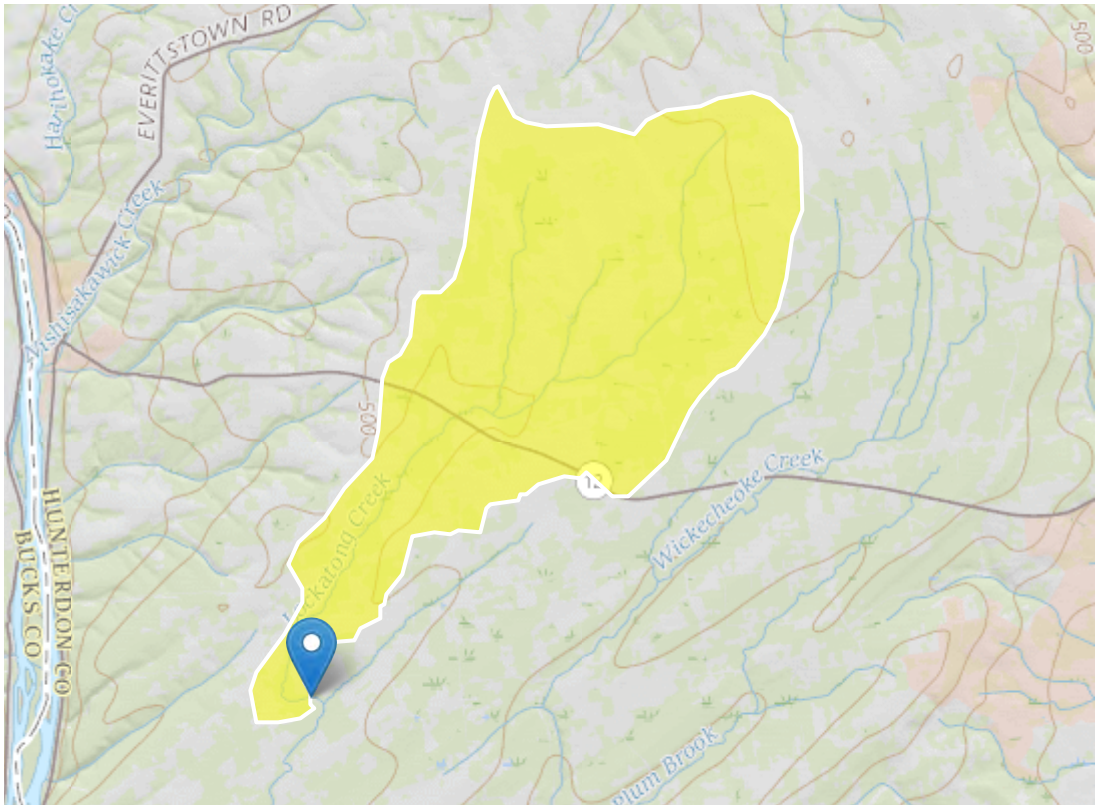

Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	11.7	square miles
STORAGE	Percentage of area of storage (lakes ponds reservoirs wetlands)	19.5	percent
CSL10_85	Change in elevation divided by length between points 10 and 85 percent of distance along main channel to basin divide - main channel method not known	14.4	feet per mi

Parameter Code	Parameter Description	Value	Unit
POPDENS	Basin Population Density	113	persons per square mile

Peak-Flow Statistics Parameters [Peak Unglaciated Piedmont Region 2009 5167]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	11.7	square miles	0.25	779
STORAGE	Percent Storage	19.5	percent	0.23	32
CSL10_85	Stream Slope 10 and 85 Method	14.4	feet per mi	4.31	191
POPDENS	Basin Population Density	113	persons per square mile	83	11084

Peak-Flow Statistics Flow Report [Peak Unglaciated Piedmont Region 2009 5167]

PIl: Prediction Interval-Lower, PIu: Prediction Interval-Upper, SEp: Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	SEp	Equiv. Yrs.
2 Year Peak Flood	729	ft^3/s	50.3	1
5 Year Peak Flood	1160	ft^3/s	50.9	2
10 Year Peak Flood	1480	ft^3/s	52.2	3
25 Year Peak Flood	1920	ft^3/s	54.5	4
50 Year Peak Flood	2250	ft^3/s	56.8	5
100 Year Peak Flood	2630	ft^3/s	59.5	5
500 Year Peak Flood	3530	ft^3/s	66.3	6

Peak-Flow Statistics Citations

Watson, K.M.,and Schopp, R.D.,2009, Methodology for estimation of flood magnitude and frequency for New Jersey streams, U.S. Geological Survey Scientific Investigations Report 2009-5167, 51 p. (http://pubs.usgs.gov/sir/2009/5167/)

Worksheet for M-92.21 STA 1+99_2YR_PIPE

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00300	ft/ft
Discharge	729.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	459.40
0+23	454.18
0+40	454.90
0+56	459.00
0+58	458.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 459.40)	(0+58, 458.00)	0.030

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	4.52	ft
Elevation Range	454.18 to 459.40 ft	
Flow Area	142.61	ft²
Wetted Perimeter	55.13	ft
Hydraulic Radius	2.59	ft
Top Width	53.31	ft
Normal Depth	4.52	ft
Critical Depth	3.37	ft

Worksheet for M-92.21 STA 1+99_2YR_PIPE

Results

Critical Slope		0.01045	ft/ft
Velocity		5.11	ft/s
Velocity Head		0.41	ft
Specific Energy		4.93	ft
Froude Number		0.55	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	4.52	ft
Critical Depth	3.37	ft
Channel Slope	0.00300	ft/ft
Critical Slope	0.01045	ft/ft

MP 92.42R2

Region ID: NJ
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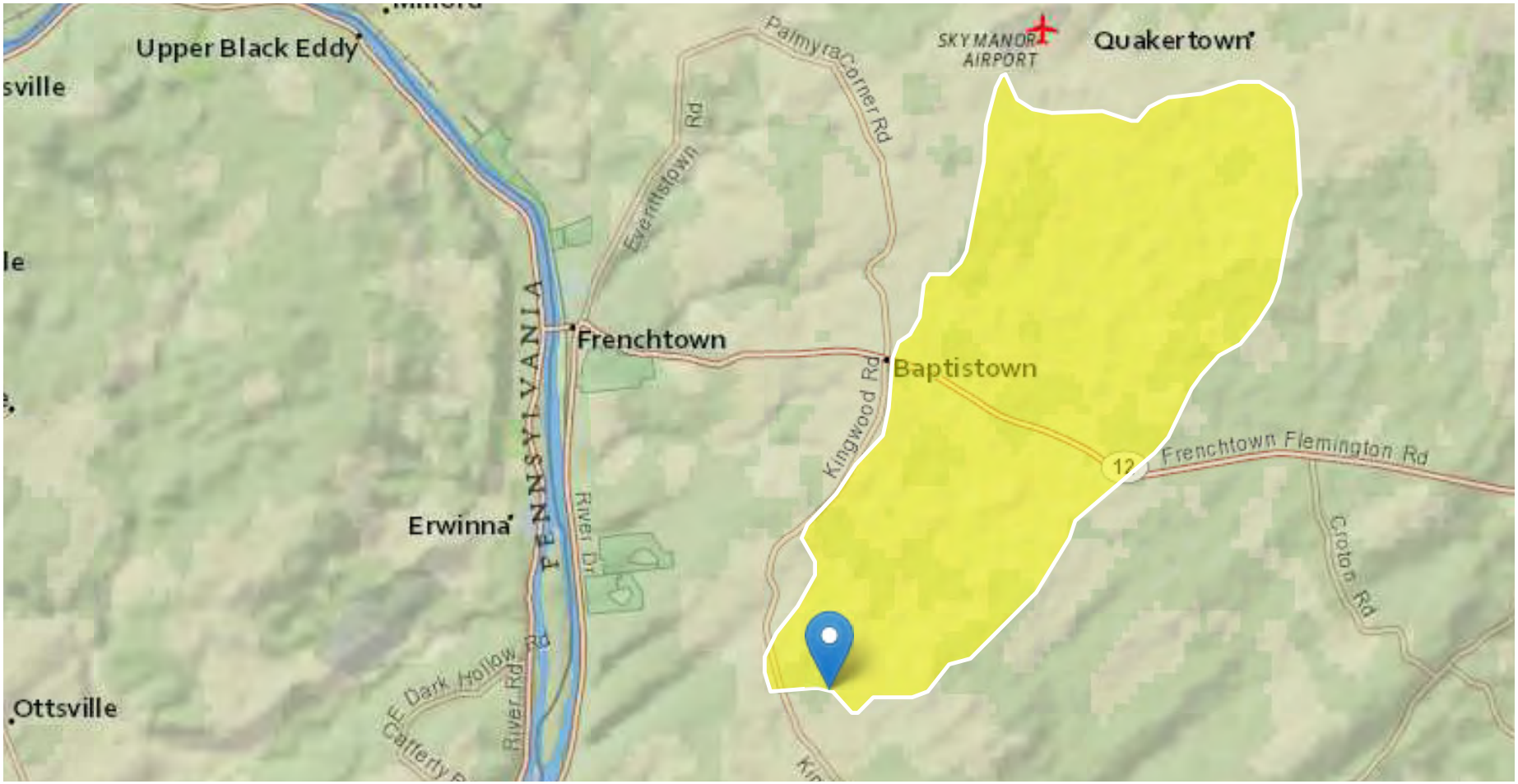

Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	14.6	square miles
STORAGE	Percentage of area of storage (lakes ponds reservoirs wetlands)	22.2	percent
CSL10_85	Change in elevation divided by length between points 10 and 85 percent of distance along main channel to basin divide - main channel method not known	13.8	feet per mi
POPDENS	Basin Population Density	114	persons per square mile

Peak-Flow Statistics Parameters [Peak Unglaciated Piedmont Region 2009 5167]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	14.6	square miles	0.25	779
STORAGE	Percent Storage	22.2	percent	0.23	32
CSL10_85	Stream Slope 10 and 85 Method	13.8	feet per mi	4.31	191
POPDENS	Basin Population Density	114	persons per square mile	83	11084

Peak-Flow Statistics Flow Report [Peak Unglaciated Piedmont Region 2009 5167]

PIl: Prediction Interval-Lower, PIu: Prediction Interval-Upper, SEp: Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	SEe	SEp	Equiv. Yrs.
2 Year Peak Flood	848	ft^3/s	49	50.3	1
5 Year Peak Flood	1340	ft^3/s	49.4	50.9	2
10 Year Peak Flood	1710	ft^3/s	50.5	52.2	3

Statistic	Value	Unit	SEe	SEp	Equiv. Yrs.
25 Year Peak Flood	2200	ft^3/s	52.6	54.5	4
50 Year Peak Flood	2570	ft^3/s	54.7	56.8	5
100 Year Peak Flood	3000	ft^3/s	57.1	59.5	5
500 Year Peak Flood	4000	ft^3/s	63.9	66.3	6

Peak-Flow Statistics Citations

Watson, K.M.,and Schopp, R.D.,2009, Methodology for estimation of flood magnitude and frequency for New Jersey streams, U.S. Geological Survey Scientific Investigations Report 2009-5167, 51 p. (http://pubs.usgs.gov/sir/2009/5167/)

Worksheet for MP-92.42R2 STA 2+26_2YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00300	ft/ft
Discharge	848.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	458.00
0+16	457.00
0+23	454.00
0+50	452.64
0+72	455.90
1+00	456.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 458.00)	(1+00, 456.00)	0.033

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	4.33	ft
Elevation Range	452.64 to 458.00 ft	
Flow Area	197.53	ft²
Wetted Perimeter	86.02	ft
Hydraulic Radius	2.30	ft
Top Width	84.15	ft
Normal Depth	4.33	ft

Worksheet for MP-92.42R2 STA 2+26_2YR

Results

Critical Depth		3.43	ft
Critical Slope		0.01406	ft/ft
Velocity		4.29	ft/s
Velocity Head		0.29	ft
Specific Energy		4.62	ft
Froude Number		0.49	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	4.33	ft
Critical Depth	3.43	ft
Channel Slope	0.00300	ft/ft
Critical Slope	0.01406	ft/ft

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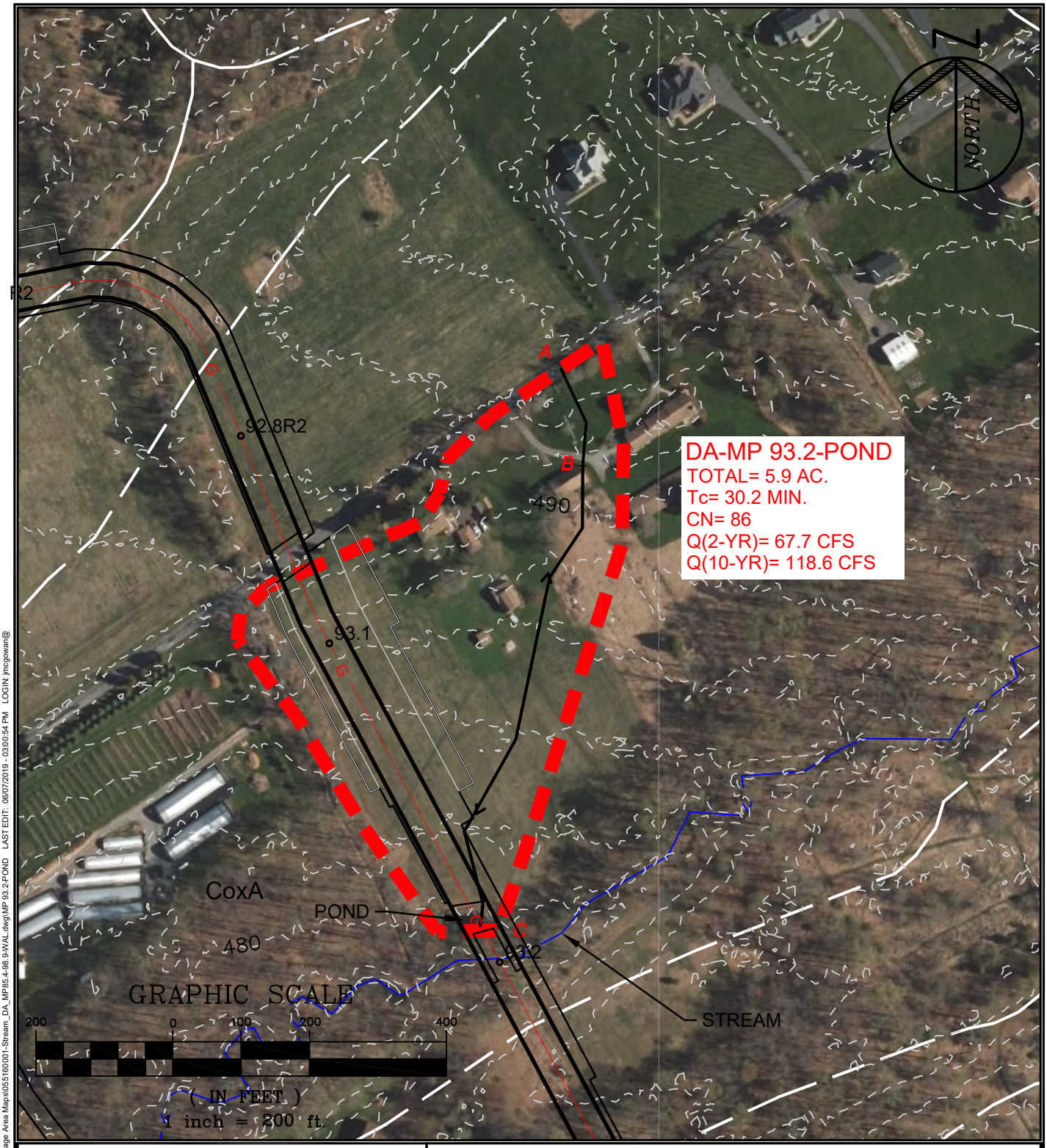

PAULUS, SOKOLOWSKI AND SARTOR, LLC.

1433 ROUTE 34
SUITE A4
WALL, NEW JERSEY 07727
PHONE: (848) 206-2626

CERTIFICATE OF AUTHORIZATION NO. 24GA28032700

PROJECT TITLE

PENNEAST PIPELINE

HUNTERDON AND MERCER COUNTY, NJ

SHEET TITLE

STREAM CROSSING DRAINAGE AREA MP-93.2-POND

PROJ. NO.: 05516.0001	DRN. BY: JPS	SCALE: 1"=200'
DATE: 05/23/19	CK'D BY: WS	

FILE NAME: P:\05516\0001\DWGs\CADC-Civil\Plotdwgs\Drainage Area Maps\05516\0001-Stream_DA_MP85.4-98.9-WAL.dwg\MP 93.2-POND LAST EDIT: 06/07/2019 - 03:00:54 PM LOGIN: jmcgowan@

Worksheet 2: Runoff curve number and runoff (Approximated)

Project	By	Date
PennEast	JPS	26-Feb-18
Location	**Checked**	**Date**
Hunterdon County, NJ		

Check one: ☐ Present ☒ Developed — MP 93.2-POND

1. Runoff curve number

Soil name and hydrologic group (appendix A)	Cover Description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN[1] Table 2-2	CN[1] Figure 2-3	CN[1] Figure 2-4	Area X acres mi² %	Product of CN x Area
Type D	Farmstead, Good Condition	86			5.90	507.40
				Totals ➡	5.90	507.40

1. Use only one CN source per line

CN (weighted) = tot.prod. / tot. area = 507.40 / 5.90 = 86.0 ; Use CN ➡ **86**

2. Runoff

		Storm #1	Storm #2	Storm #3
Frequency……	yr			
Rainfall, P (24-hour)…….	in			
Runoff, Q……	in			

Use P and CN with table 2-1, figure 2-1, or equation 2-3 abd 2-4

PROJECT:	PennEast	JOB NO. 5516.0001	
		SHEET	DATE:2/12/2018
		BY:	JPS
SUBJECT:	Tc Calculations	CHK'D	

Time of Concentration calculations with the application of the SCS TR-55 methodology.

Watershed or Subarea Designation: DA 93.2-POND

Area 5.9 AC

SHEET FLOW

Segment ID		A-B				
Surface Description (Table 3-1)		WOODS				
Manning's Coefficient, n (Table 3-1)		0.400				
Flow Length, L (total <= 150)	(ft)	150				
Two Year Rainfall, P	(in)	3.4				
Land Slope, s	(ft/ft)	0.030				
Computed Tt = 0.007 (nL)^0.8 / P^0.5*s^0.4	(hrs)	0.410				0.410

SHALLOW CONCENTRATED FLOW

Segment ID		B-C				
Surface Description (paved or unpaved)		UNPAVED				
Flow Length, L	(ft)	715				
Watercourse slope, s	(ft/ft)	0.017				
Average Velocity, V (Figure 3-1)	(ft/s)	2.1				
Computed Tt = L / 3600V	(hrs)	0.095				0.095

CHANNEL FLOW

Segment ID						
Cross sectional Area, a	(sf)					
Wetted Perimeter, Pw	(ft)					
Hydraulic Radius, r =a/Pw	(ft)					
Channel Slope (ft/ft)	(ft/ft)					
Manning's Roughness Coefficient, n						
Velocity, V = 1.49r^(2/3)s^0.5 / n	(ft/s)					
Flow Length, L	(ft)					
Computed Tt = L / 3600V	(hrs)					0.000

Watershed or subarea Tc	0.504	hrs.
	30.2	min.

Use minimum Tc of 10 minutes

Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Wednesday, 02 / 20 / 2019

Hyd. No. 58

DA 93.2-POND

Hydrograph type	= SCS Runoff	Peak discharge	= 7.112 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.40 hrs
Time interval	= 6 min	Hyd. volume	= 41,685 cuft
Drainage area	= 5.900 ac	Curve number	= 86.000
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 30.2 min
Total precip.	= 3.26 in	Distribution	= Custom
Storm duration	= C:\Users\IKuzmina\AppData\Local\Autodesk\C3D2019\enu\HHApps\Hydrograp		

Hydrograph Discharge Table

(Printed values >= 1.00% of Qp.)

Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)
9.10	0.071	10.90	0.347	12.70	5.591	14.50	0.716
9.20	0.078	11.00	0.389	12.80	4.762	14.60	0.692
9.30	0.085	11.10	0.439	12.90	3.862	14.70	0.668
9.40	0.093	11.20	0.499	13.00	3.006	14.80	0.644
9.50	0.102	11.30	0.571	13.10	2.304	14.90	0.619
9.60	0.112	11.40	0.658	13.20	1.960	15.00	0.595
9.70	0.123	11.50	0.757	13.30	1.710	15.10	0.571
9.80	0.135	11.60	0.897	13.40	1.518	15.20	0.547
9.90	0.148	11.70	1.078	13.50	1.363	15.30	0.525
10.00	0.161	11.80	1.339	13.60	1.243	15.40	0.505
10.10	0.176	11.90	1.744	13.70	1.134	15.50	0.489
10.20	0.191	12.00	2.429	13.80	1.040	15.60	0.475
10.30	0.207	12.10	3.728	13.90	0.960	15.70	0.464
10.40	0.224	12.20	5.091	14.00	0.897	15.80	0.455
10.50	0.242	12.30	6.336	14.10	0.847	15.90	0.447
10.60	0.261	12.40	7.112	14.20	0.805	16.00	0.440
10.70	0.284	12.50	6.873	14.30	0.771	16.10	0.434
10.80	0.313	12.60	6.322	14.40	0.742	16.20	0.427

<<

Continues on next page...

Worksheet for MP-93.19_POND_STA0+58-2YR_PIPE

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00300	ft/ft
Discharge	7.10	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	480.00
0+06	480.00
0+30	479.15
0+48	475.54
0+71	480.00
0+93	478.00
1+00	478.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 480.00)	(1+00, 478.00)	0.045

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	1.08	ft
Elevation Range	475.54 to 480.00 ft	
Flow Area	6.00	ft²
Wetted Perimeter	11.34	ft
Hydraulic Radius	0.53	ft
Top Width	11.13	ft

Worksheet for MP-93.19_POND_STA0+58-2YR_PIPE

Results

Normal Depth		1.08	ft
Critical Depth		0.65	ft
Critical Slope		0.04395	ft/ft
Velocity		1.18	ft/s
Velocity Head		0.02	ft
Specific Energy		1.10	ft
Froude Number		0.28	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.08	ft
Critical Depth	0.65	ft
Channel Slope	0.00300	ft/ft
Critical Slope	0.04395	ft/ft

MP 93.20

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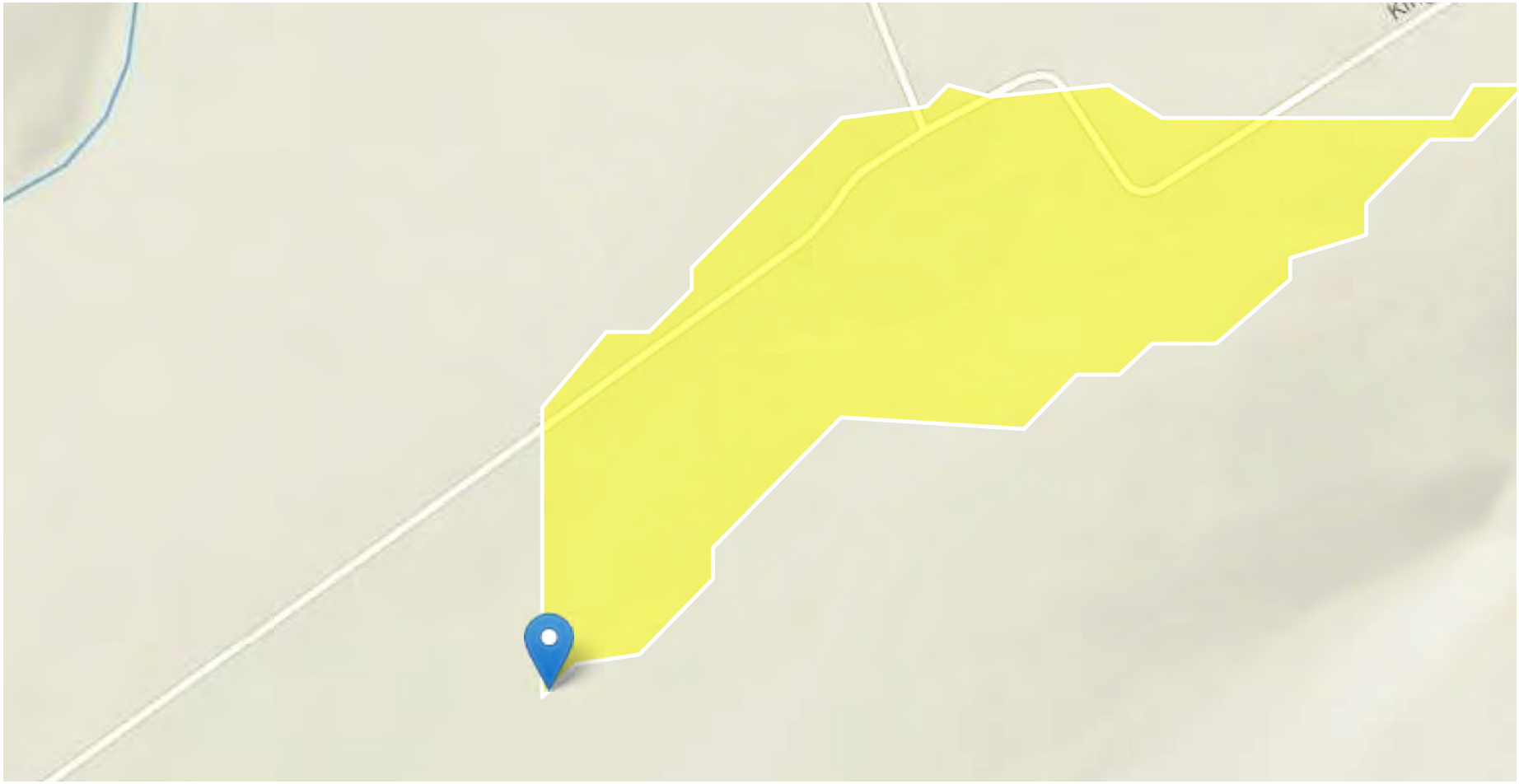


Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	0.0783	square miles
STORAGE	Percentage of area of storage (lakes ponds reservoirs wetlands)	24.5	percent
CSL10_85	Change in elevation divided by length between points 10 and 85 percent of distance along main channel to basin divide - main channel method not known	79.3	feet per mi
POPDENS	Basin Population Density	116	persons per square mile

Peak-Flow Statistics Parameters [Peak Unglaciated Piedmont Region 2009 5167]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.0783	square miles	0.25	779
STORAGE	Percent Storage	24.5	percent	0.23	32
CSL10_85	Stream Slope 10 and 85 Method	79.3	feet per mi	4.31	191
POPDENS	Basin Population Density	116	persons per square mile	83	11084

Peak-Flow Statistics Disclaimers [Peak Unglaciated Piedmont Region 2009 5167]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors

Peak-Flow Statistics Flow Report [Peak Unglaciated Piedmont Region 2009 5167]

Statistic	Value	Unit
2 Year Peak Flood	25.6	ft^3/s
5 Year Peak Flood	43.3	ft^3/s
10 Year Peak Flood	56.7	ft^3/s
25 Year Peak Flood	75.1	ft^3/s
50 Year Peak Flood	89.6	ft^3/s
100 Year Peak Flood	106	ft^3/s
500 Year Peak Flood	144	ft^3/s

Peak-Flow Statistics Citations

Watson, K.M.,and Schopp, R.D.,2009, Methodology for estimation of flood magnitude and frequency for New Jersey streams, U.S. Geological Survey Scientific Investigations Report 2009-5167, 51 p. (http://pubs.usgs.gov/sir/2009/5167/)

Worksheet for MP-93.2 STA 1+08_2YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.02100	ft/ft
Discharge	25.60	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	480.00
0+42	477.80
0+50	475.78
0+54	480.10
1+00	480.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 480.00)	(1+00, 480.00)	0.045

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	1.59	ft
Elevation Range	475.78 to 480.10 ft	
Flow Area	6.63	ft²
Wetted Perimeter	9.16	ft
Hydraulic Radius	0.72	ft
Top Width	8.32	ft
Normal Depth	1.59	ft
Critical Depth	1.43	ft

Worksheet for MP-93.2 STA 1+08_2YR

Results

Critical Slope		0.03749	ft/ft
Velocity		3.86	ft/s
Velocity Head		0.23	ft
Specific Energy		1.83	ft
Froude Number		0.76	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.59	ft
Critical Depth	1.43	ft
Channel Slope	0.02100	ft/ft
Critical Slope	0.03749	ft/ft

Worksheet for MP-93.20_STA0+73_BRIDGE_2YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00700	ft/ft
Discharge	25.60	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	480.00
0+12	480.00
0+47	478.50
0+50	476.63
0+55	477.40
0+73	478.00
1+00	480.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 480.00)	(1+00, 480.00)	0.045

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	1.47	ft
Elevation Range	476.63 to 480.00 ft	
Flow Area	14.25	ft²
Wetted Perimeter	27.18	ft
Hydraulic Radius	0.52	ft
Top Width	26.66	ft

Worksheet for MP-93.20_STA0+73_BRIDGE_2YR

Results

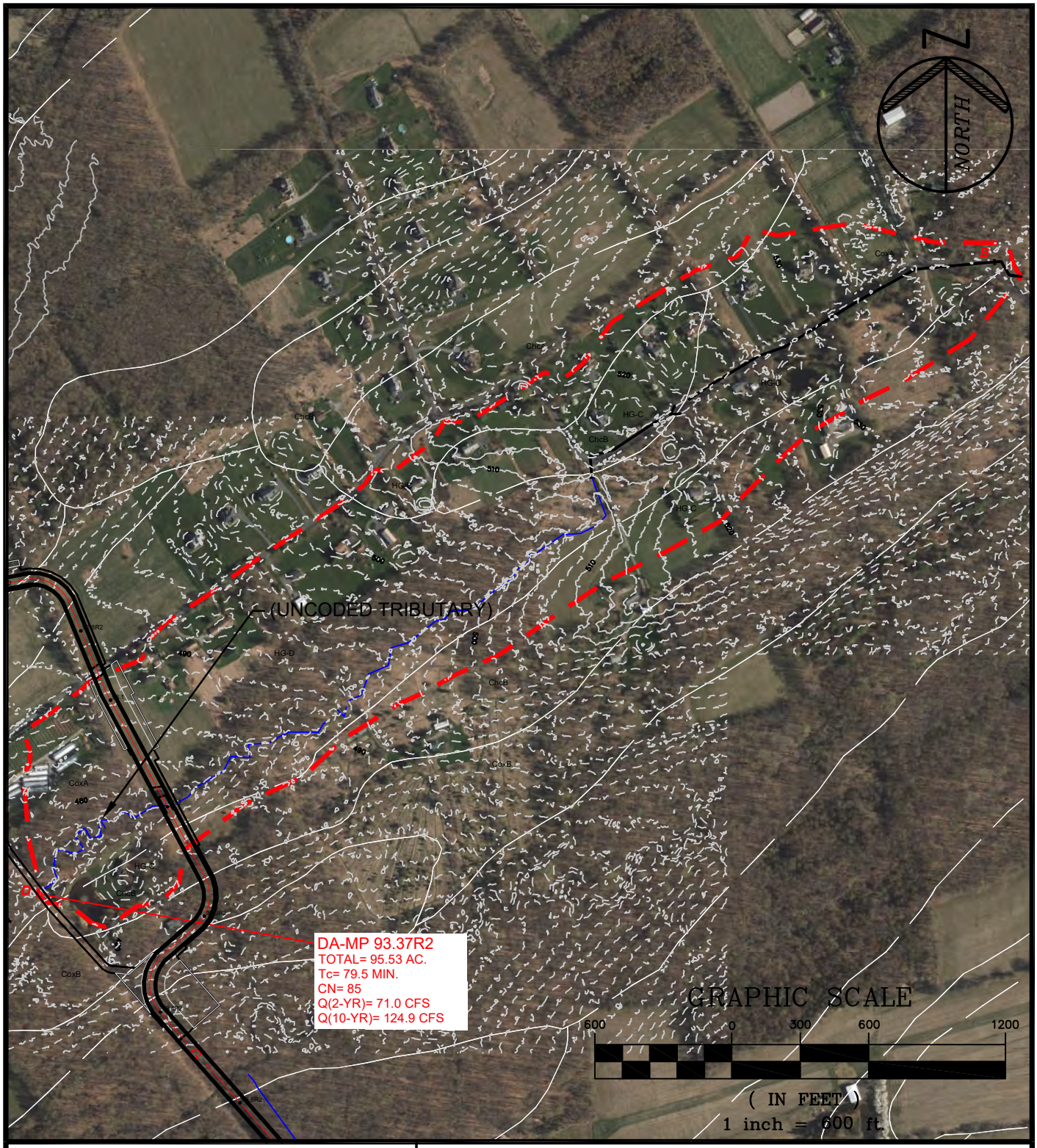
Normal Depth		1.47	ft
Critical Depth		1.17	ft
Critical Slope		0.04173	ft/ft
Velocity		1.80	ft/s
Velocity Head		0.05	ft
Specific Energy		1.52	ft
Froude Number		0.43	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.47	ft
Critical Depth	1.17	ft
Channel Slope	0.00700	ft/ft
Critical Slope	0.04173	ft/ft



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CERTIFICATE OF AUTHORIZATION NO. 24GA28032700

PROJECT TITLE

PENNEAST PIPELINE

HUNTERDON AND MERCER COUNTY, NJ

SHEET TITLE

STREAM CROSSING DRAINAGE AREA MP-93.37R2

PROJ. NO.:	05516.0001	DRN. BY:	JPS	SCALE:	1"=600'
DATE:	05/23/19	CK'D BY:	WS		

FILE NAME: P:\05516\0001\DWGs\CAD\C-Civil\Plotdwgs\Drainage Area Maps\05516\0001-Stream_DA_MP85.4-98.9-WAL.dwg\MP 93.37R2 LAST EDIT: 06/13/2019 - 03:35:21 PM LOGIN: jmcgowan@

Worksheet 2: Runoff curve number and runoff (Approximated)

Project	By	Date
PennEast	JPS	26-Feb-18
Location	**Checked**	**Date**
Hunterdon County, NJ		

Check one: ☐ Present ☒ Developed | MP 93.37R2

1. Runoff curve number

Soil name and hydrologic group (appendix A)	Cover Description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN[1] Table 2-2	CN[1] Figure 2-3	CN[1] Figure 2-4	Area ☒ acres ☐ mi² ☐ %	Product of CN x Area
Type C	Farmstead, Good Condition	82			30.57	2,506.74
Type D	Farmstead, Good Condition	86			64.96	5,586.56
1. Use only one CN source per line				**Totals** ➡	95.53	8,093.30

CN (weighted) = tot.prod. / tot. area = 8,093.30 / 95.53 = 84.7 ; **Use CN** ➡ **85**

2. Runoff

		Storm #1	Storm #2	Storm #3
Frequency…….	yr			
Rainfall, P (24-hour)…….	in			
Runoff, Q……	in			

Use P and CN with table 2-1, figure 2-1, or equation 2-3 abd 2-4

PROJECT:	PennEast	JOB NO. 5516.0001	
		SHEET	DATE:2/12/2018
		BY:	JPS
SUBJECT:	Tc Calculations	CHK'D	

Time of Concentration calculations with the application of the SCS TR-55 methodology.

Watershed or Subarea Designation: DA 93.37R2

Area 95.53 AC

SHEET FLOW

Segment ID		A-B			
Surface Description (Table 3-1)		WOODS			
Manning's Coefficient, n (Table 3-1)		0.400			
Flow Length, L (total <= 150)	(ft)	150			
Two Year Rainfall, P	(in)	3.4			
Land Slope, s	(ft/ft)	0.017			
Computed Tt = 0.007 (nL)^0.8 / P^0.5*s^0.4	(hrs)	0.518			0.518

SHALLOW CONCENTRATED FLOW

Segment ID		B-C			
Surface Description (paved or unpaved)		UNPAVED			
Flow Length, L	(ft)	2089			
Watercourse slope, s	(ft/ft)	0.011			
Average Velocity, V (Figure 3-1)	(ft/s)	1.6			
Computed Tt = L / 3600V	(hrs)	0.363			0.363

CHANNEL FLOW

Segment ID		C-D			
Cross sectional Area, a	(sf)	29.16			
Wetted Perimeter, Pw	(ft)	58.92			
Hydraulic Radius, r =a/Pw	(ft)	0.495			
Channel Slope (ft/ft)	(ft/ft)	0.010			
Manning's Roughness Coefficient, n		0.040			
Velocity, V = 1.49r^(2/3)s^0.5 / n	(ft/s)	2.33			
Flow Length, L	(ft)	3730			
Computed Tt = L / 3600V	(hrs)	0.445			0.445

Watershed or subarea Tc	1.325	hrs.
	79.5	min.

Use minimum Tc of 10 minutes

Hydrograph Report

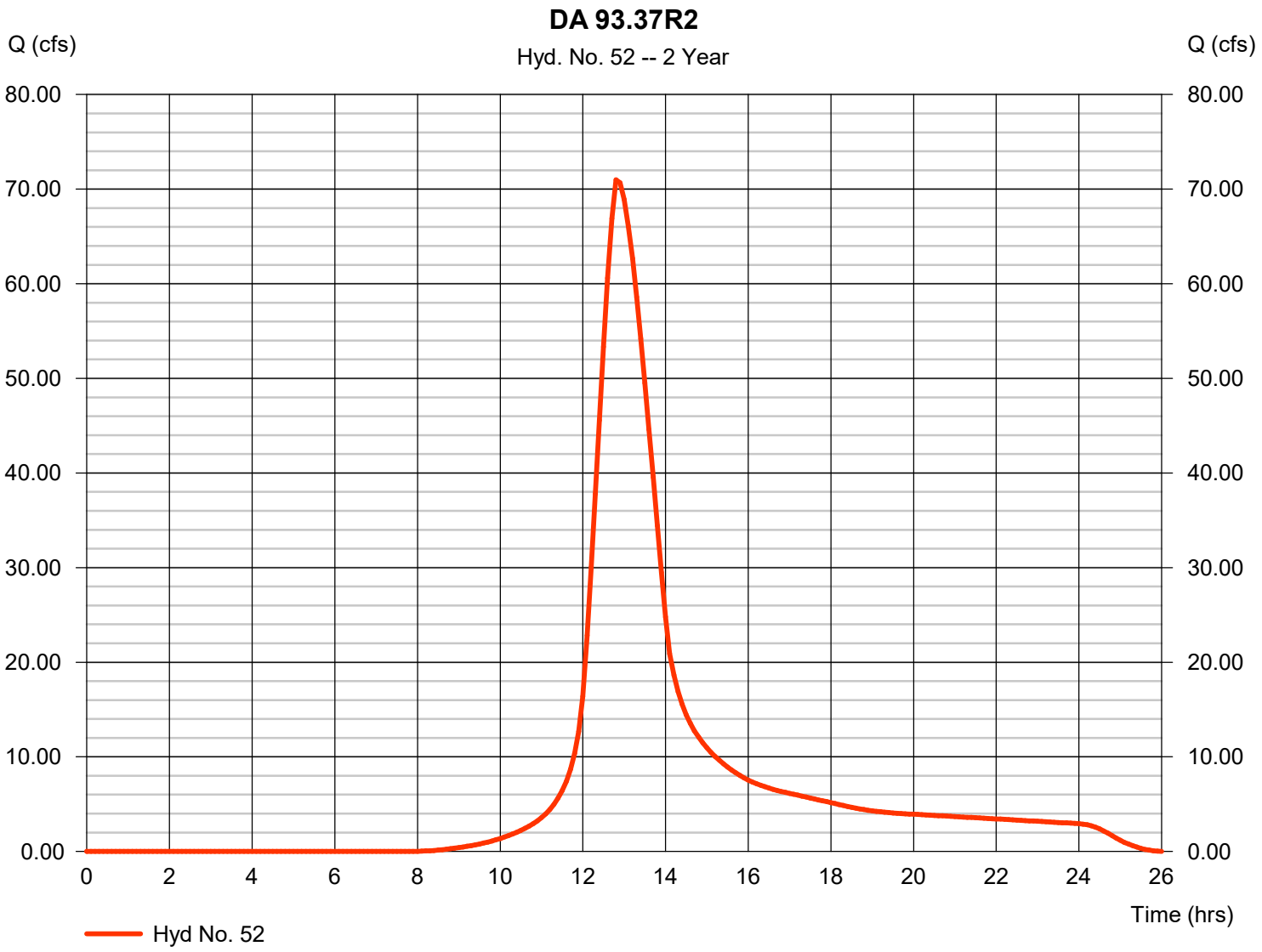
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 07 / 18 / 2019

Hyd. No. 52

DA 93.37R2

Hydrograph type	= SCS Runoff	Peak discharge	= 70.99 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.80 hrs
Time interval	= 6 min	Hyd. volume	= 617,495 cuft
Drainage area	= 95.530 ac	Curve number	= 85*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 79.50 min
Total precip.	= 3.26 in	Distribution	= Custom
Storm duration	= C:\Users\IKuzmina\AppData\Local\Autodesk\C3D 2019\enu\AHHApps\Hydrograph	Shape factor	= 484

* Composite (Area/CN) = [(64.960 x 86) + (30.570 x 82)] / 95.530



Worksheet for MP-93.37R2_STA0+18_2YR_AR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.01300	ft/ft
Discharge	71.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	474.00
0+45	474.25
0+52	470.64
0+55	472.00
0+67	474.00
1+00	474.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 474.00)	(1+00, 474.00)	0.045

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	2.72	ft
Elevation Range	470.64 to 474.25 ft	
Flow Area	18.19	ft²
Wetted Perimeter	17.24	ft
Hydraulic Radius	1.06	ft
Top Width	16.13	ft
Normal Depth	2.72	ft

Worksheet for MP-93.37R2_STA0+18_2YR_AR

Results

Critical Depth		2.34	ft
Critical Slope		0.03286	ft/ft
Velocity		3.90	ft/s
Velocity Head		0.24	ft
Specific Energy		2.95	ft
Froude Number		0.65	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

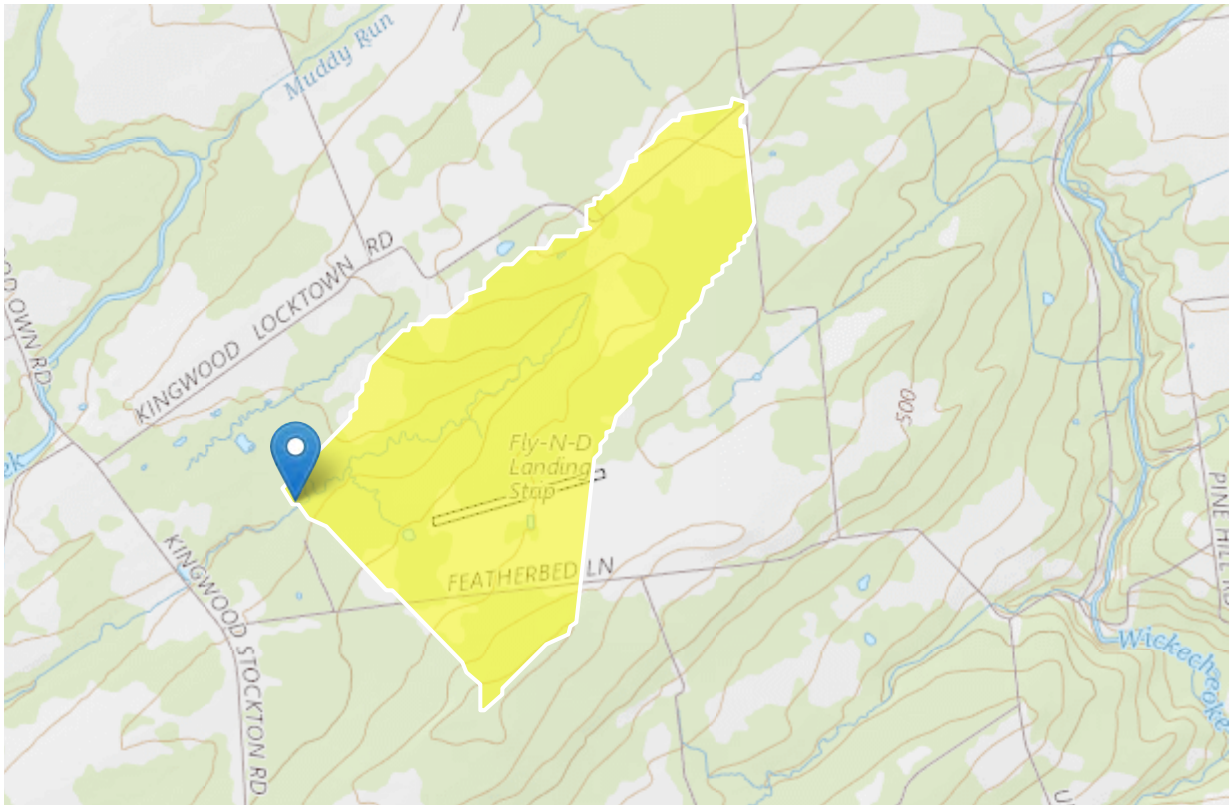
GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	2.72	ft
Critical Depth	2.34	ft
Channel Slope	0.01300	ft/ft
Critical Slope	0.03286	ft/ft

MP 93.48R2

StreamStats Report

Region ID: NJ
Workspace ID: NJ20180308153047324000
Clicked Point (Latitude, Longitude): 40.46847, -75.01083
Time: 2018-03-08 10:31:02 -0500



The South Carolina StreamStats application is testing LiDAR-derived data and streams for delineation. This is a beta version and QA/QC is incomplete. It may calculate basin characteristics and flow statistics incorrectly. Please verify the drainage areas and flow stats carefully. Use at your own risk

Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	0.6	square miles
STORAGE	Percentage of area of storage (lakes ponds reservoirs wetlands)	36.3	percent

Parameter Code	Parameter Description	Value	Unit
CSL10_85	Change in elevation divided by length between points 10 and 85 percent of distance along main channel to basin divide - main channel method not known	53.2	feet per mi
POPDENS	Basin Population Density	116	persons per square mile

Peak-Flow Statistics Parameters [Peak Unglaciated Piedmont Region 2009 5167]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.6	square miles	0.25	779
STORAGE	Percent Storage	36.3	percent	0.23	32
CSL10_85	Stream Slope 10 and 85 Method	53.2	feet per mi	4.31	191
POPDENS	Basin Population Density	116	persons per square mile	83	11084

Peak-Flow Statistics Disclaimers [Peak Unglaciated Piedmont Region 2009 5167]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors

Peak-Flow Statistics Flow Report [Peak Unglaciated Piedmont Region 2009 5167]

Statistic	Value	Unit
2 Year Peak Flood	105	ft^3/s
5 Year Peak Flood	171	ft^3/s
10 Year Peak Flood	220	ft^3/s
25 Year Peak Flood	286	ft^3/s
50 Year Peak Flood	337	ft^3/s
100 Year Peak Flood	393	ft^3/s
500 Year Peak Flood	527	ft^3/s

Worksheet for MP-93.48R2_STA0+27_2YR_PIPE

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.01300	ft/ft
Discharge	105.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	466.00
0+24	466.00
0+50	462.65
0+60	464.40
1+00	466.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 466.00)	(1+00, 466.00)	0.050

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	2.17	ft
Elevation Range	462.65 to 466.00 ft	
Flow Area	33.55	ft²
Wetted Perimeter	37.80	ft
Hydraulic Radius	0.89	ft
Top Width	37.50	ft
Normal Depth	2.17	ft
Critical Depth	1.72	ft

Worksheet for MP-93.48R2_STA0+27_2YR_PIPE

Results

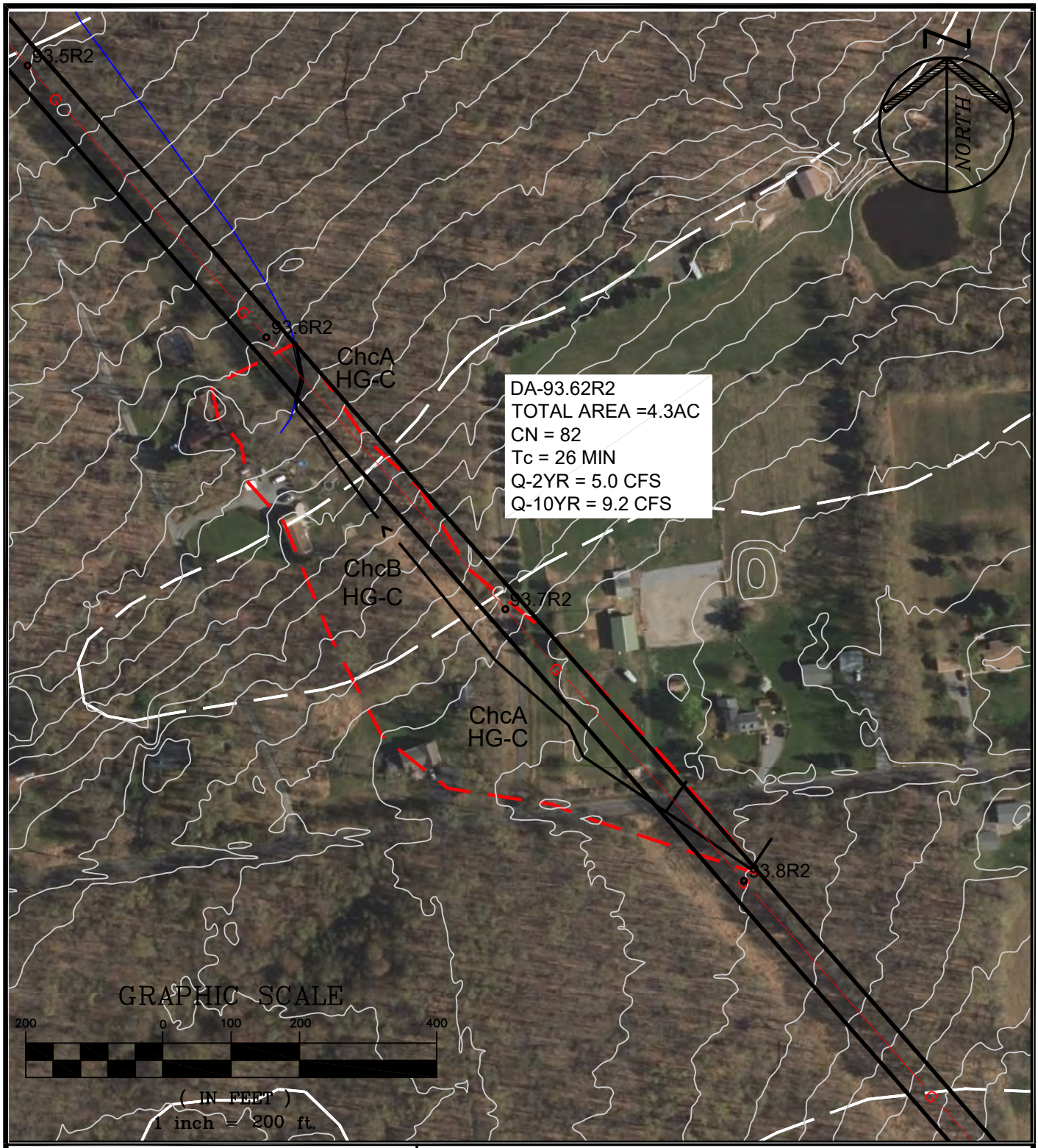
Critical Slope		0.03888	ft/ft
Velocity		3.13	ft/s
Velocity Head		0.15	ft
Specific Energy		2.33	ft
Froude Number		0.58	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	2.17	ft
Critical Depth	1.72	ft
Channel Slope	0.01300	ft/ft
Critical Slope	0.03888	ft/ft



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CERTIFICATE OF AUTHORIZATION NO. 24GA28032700

PROJECT TITLE

PENNEAST PIPELINE

HUNTERDON AND MERCER COUNTY, NJ

SHEET TITLE

STREAM CROSSING DRAINAGE AREA MP-93.62R2

PROJ. NO.: 05516.0001	DRN. BY: JPS	SCALE: 1"=200'
DATE: 05/23/19	CK'D BY: WS	

FILE NAME: P:\05516\0001\DWGs\CAD\C-Civil\Plotdwgs\Drainage Area Maps\05516\0001-Stream_DA_MP85.4-98.9-WAL.dwg\MP 93.62R2 LAST EDIT: 05/30/2019 - 11:22:15 AM LOGIN: jmcgowan@

Worksheet 2: Runoff curve number and runoff (Approximated)

Project	By	Date
PennEast	IK	1-Apr-19
Location	**Checked**	**Date**
Hunterdon County, NJ		

Check one: ☐ Present ☒ Developed | MP 93.62R2

1. Runoff curve number

Soil name and hydrologic group (appendix A)	Cover Description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN[1] Table 2-2	CN[1] Figure 2-3	CN[1] Figure 2-4	Area X acres mi² %	Product of CN x Area
Type C	Farmstead, Good Condition	82			4.30	352.60
				Totals ➡	4.30	352.60

1. Use only one CN source per line

CN (weighted) $= \frac{\text{tot.prod.}}{\text{tot. area}} = \frac{352.60}{4.30} = 82.0$; Use CN ➡ **82**

2. Runoff

		Storm #1	Storm #2	Storm #3
Frequency……	yr			
Rainfall, P (24-hour)…….	in			
Runoff, Q……	in			

Use P and CN with table 2-1, figure 2-1, or equation 2-3 abd 2-4

PROJECT:	PennEast	JOB NO. 5516.0001	
		SHEET	DATE: 04/01/2019
		BY:	IK
SUBJECT:	Tc Calculations	CHK'D	

Time of Concentration calculations with the application of the SCS TR-55 methodology.

Watershed or Subarea Designation: DA 93.62R2

Area 4.3 AC

SHEET FLOW

Segment ID		A-B			
Surface Description (Table 3-1)		GRASS			
Manning's Coefficient, n (Table 3-1)		0.150			
Flow Length, L (total <= 150)	(ft)	150			
Two Year Rainfall, P	(in)	3.4			
Land Slope, s	(ft/ft)	0.007			
Computed Tt = 0.007 (nL)^0.8 / P^0.5*s^0.4	(hrs)	0.334			0.334

SHALLOW CONCENTRATED FLOW

Segment ID		B-C	C-D		
Surface Description (paved or unpaved)		PAVED	UNPAVED		
Flow Length, L	(ft)	48	769		
Watercourse slope, s	(ft/ft)	0.020	0.026		
Average Velocity, V (Figure 3-1)	(ft/s)	2.9	2.5		
Computed Tt = L / 3600V	(hrs)	0.005	0.085		0.090

CHANNEL FLOW

Segment ID		C-D			
Cross sectional Area, a	(sf)	3.30			
Wetted Perimeter, Pw	(ft)	5.28			
Hydraulic Radius, r =a/Pw	(ft)	0.625			
Channel Slope (ft/ft)	(ft/ft)	0.014			
Manning's Roughness Coefficient, n		0.045			
Velocity, V = 1.49r^(2/3)s^0.5 / n	(ft/s)	2.86			
Flow Length, L	(ft)	88			
Computed Tt = L / 3600V	(hrs)	0.009			0.009

Watershed or subarea Tc	0.433	hrs.
	26.0	min.

Use minimum Tc of 10 minutes

Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 05 / 23 / 2019

Hyd. No. 72

MP-93.62R2

Hydrograph type	= SCS Runoff	Peak discharge	= 5.041 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.30 hrs
Time interval	= 6 min	Hyd. volume	= 24,763 cuft
Drainage area	= 4.300 ac	Curve number	= 82.000
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 26.0 min
Total precip.	= 3.26 in	Distribution	= Custom
Storm duration	= C:\Users\IKuzmina\AppData\Local\Autodesk\C3D 2019\enu\HHApps\Hydrograp	Storm frequency	= 24 hrs

Hydrograph Discharge Table

(Printed values >= 1.00% of Qp.)

Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)
10.00	0.053	11.80	0.878	13.60	0.690	15.40	0.308
10.10	0.061	11.90	1.194	13.70	0.634	15.50	0.301
10.20	0.069	12.00	1.807	13.80	0.586	15.60	0.295
10.30	0.078	12.10	3.040	13.90	0.550	15.70	0.291
10.40	0.088	12.20	4.256	14.00	0.522	15.80	0.287
10.50	0.098	12.30	5.041	14.10	0.501	15.90	0.282
10.60	0.109	12.40	4.719	14.20	0.484	16.00	0.278
10.70	0.124	12.50	4.121	14.30	0.469	16.10	0.274
10.80	0.142	12.60	3.348	14.40	0.454	16.20	0.270
10.90	0.164	12.70	2.535	14.50	0.439	16.30	0.266
11.00	0.190	12.80	1.809	14.60	0.423	16.40	0.262
11.10	0.222	12.90	1.495	14.70	0.408	16.50	0.258
11.20	0.261	13.00	1.282	14.80	0.393	16.60	0.254
11.30	0.308	13.10	1.125	14.90	0.377	16.70	0.250
11.40	0.365	13.20	0.999	15.00	0.362	16.80	0.246
11.50	0.429	13.30	0.908	15.10	0.346	16.90	0.241
11.60	0.528	13.40	0.827	15.20	0.331	17.00	0.237
11.70	0.664	13.50	0.755	15.30	0.318	17.10	0.233

Continues on next page...

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Worksheet for MP-93.62R2_STA0+37_2YR_PIPE

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.01400	ft/ft
Discharge	5.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+18	482.95
0+20	482.29
0+22	483.20
0+46	484.00
0+70	484.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+18, 482.95)	(0+70, 484.00)	0.045

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.86	ft
Elevation Range	482.29 to 484.00 ft	
Flow Area	2.21	ft²
Wetted Perimeter	4.99	ft
Hydraulic Radius	0.44	ft
Top Width	4.52	ft
Normal Depth	0.86	ft
Critical Depth	0.69	ft

Worksheet for MP-93.62R2_STA0+37_2YR_PIPE

Results

Critical Slope		0.04524	ft/ft
Velocity		2.27	ft/s
Velocity Head		0.08	ft
Specific Energy		0.94	ft
Froude Number		0.57	
Flow Type	Subcritical		

GVF Input Data

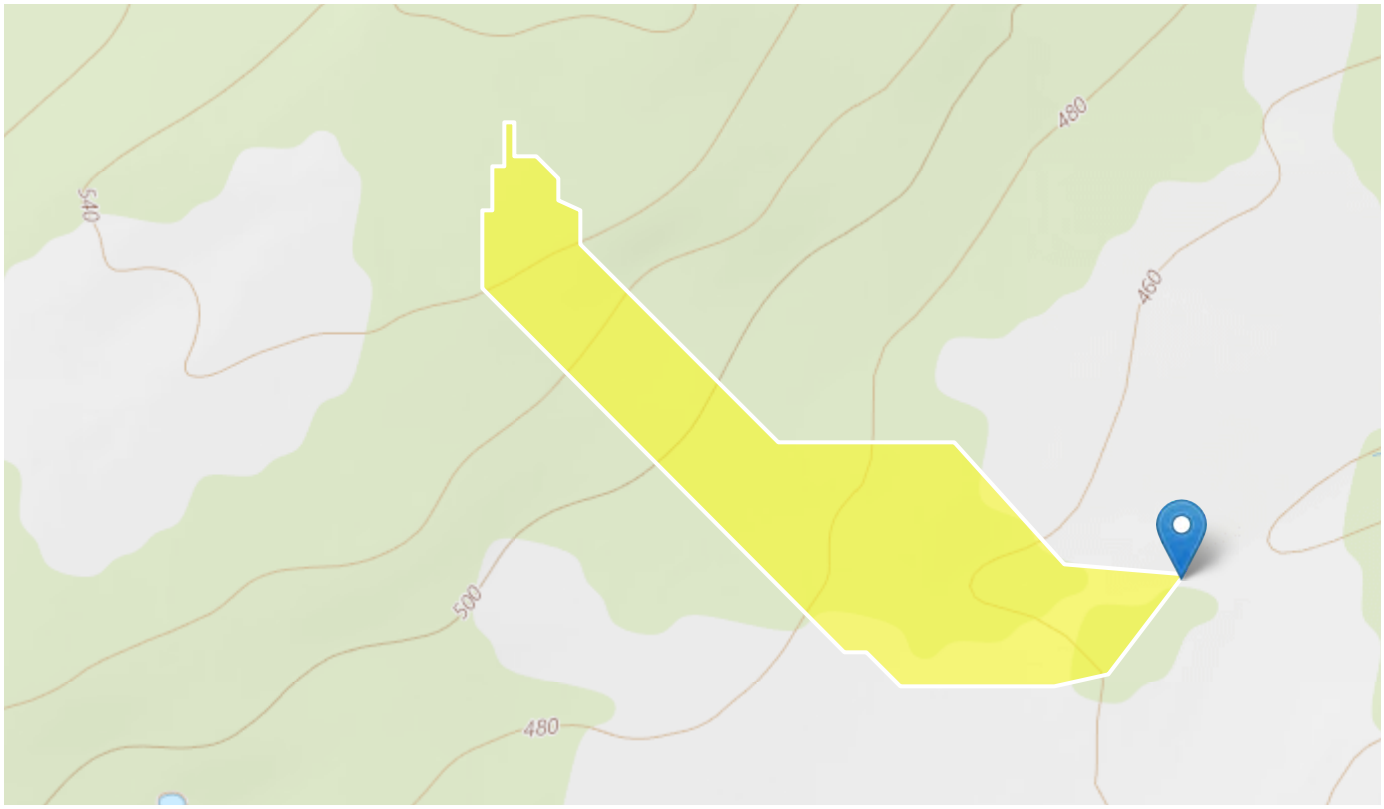
Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.86	ft
Critical Depth	0.69	ft
Channel Slope	0.01400	ft/ft
Critical Slope	0.04524	ft/ft

MP 94.57R2

Region ID: NJ
Workspace ID: NJ20180308154224467000
Clicked Point (Latitude, Longitude): 40.45616, -74.99650
Time: 2018-03-08 10:42:39 -0500



The South Carolina StreamStats application is testing LiDAR-derived data and streams for delineation. This is a beta version and QA/QC is incomplete. It may calculate basin characteristics and flow statistics incorrectly. Please verify the drainage areas and flow stats carefully. Use at your own risk

Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	0.0349	square miles
STORAGE	Percentage of area of storage (lakes ponds reservoirs wetlands)	14.3	percent

Parameter Code	Parameter Description	Value	Unit
CSL10_85	Change in elevation divided by length between points 10 and 85 percent of distance along main channel to basin divide - main channel method not known	218	feet per mi
POPDENS	Basin Population Density	111	persons per square mile

Peak-Flow Statistics Parameters [Peak Unglaciated Piedmont Region 2009 5167]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.0349	square miles	0.25	779
STORAGE	Percent Storage	14.3	percent	0.23	32
CSL10_85	Stream Slope 10 and 85 Method	218	feet per mi	4.31	191
POPDENS	Basin Population Density	111	persons per square mile	83	11084

Peak-Flow Statistics Disclaimers [Peak Unglaciated Piedmont Region 2009 5167]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors

Peak-Flow Statistics Flow Report [Peak Unglaciated Piedmont Region 2009 5167]

Statistic	Value	Unit
2 Year Peak Flood	18.3	ft^3/s
5 Year Peak Flood	32	ft^3/s
10 Year Peak Flood	42.6	ft^3/s
25 Year Peak Flood	57.7	ft^3/s
50 Year Peak Flood	69.9	ft^3/s
100 Year Peak Flood	83.4	ft^3/s
500 Year Peak Flood	117	ft^3/s

Worksheet for MP-94.57R2 STA 0+31_2YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00400	ft/ft
Discharge	18.30	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	460.00
0+08	458.00
0+40	456.00
0+47	456.00
0+52	455.13
0+54	456.35
0+94	458.00
1+00	458.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 460.00)	(1+00, 458.00)	0.045

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	1.44	ft
Elevation Range	455.13 to 460.00 ft	
Flow Area	14.15	ft²
Wetted Perimeter	29.02	ft
Hydraulic Radius	0.49	ft

Worksheet for MP-94.57R2 STA 0+31_2YR

Results

Top Width		28.63	ft
Normal Depth		1.44	ft
Critical Depth		1.04	ft
Critical Slope		0.04358	ft/ft
Velocity		1.29	ft/s
Velocity Head		0.03	ft
Specific Energy		1.47	ft
Froude Number		0.32	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.44	ft
Critical Depth	1.04	ft
Channel Slope	0.00400	ft/ft
Critical Slope	0.04358	ft/ft

Worksheet for MP-94.57_STA0+67_BRIDGE_2YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00500	ft/ft
Discharge	18.30	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	456.00
0+46	455.60
0+50	454.93
0+52	456.55
0+78	458.00
1+00	458.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 456.00)	(1+00, 458.00)	0.045

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	1.15	ft
Elevation Range	454.93 to 458.00 ft	
Flow Area	16.67	ft²
Wetted Perimeter	51.71	ft
Hydraulic Radius	0.32	ft
Top Width	51.07	ft
Normal Depth	1.15	ft

Worksheet for MP-94.57_STA0+67_BRIDGE_2YR

Results

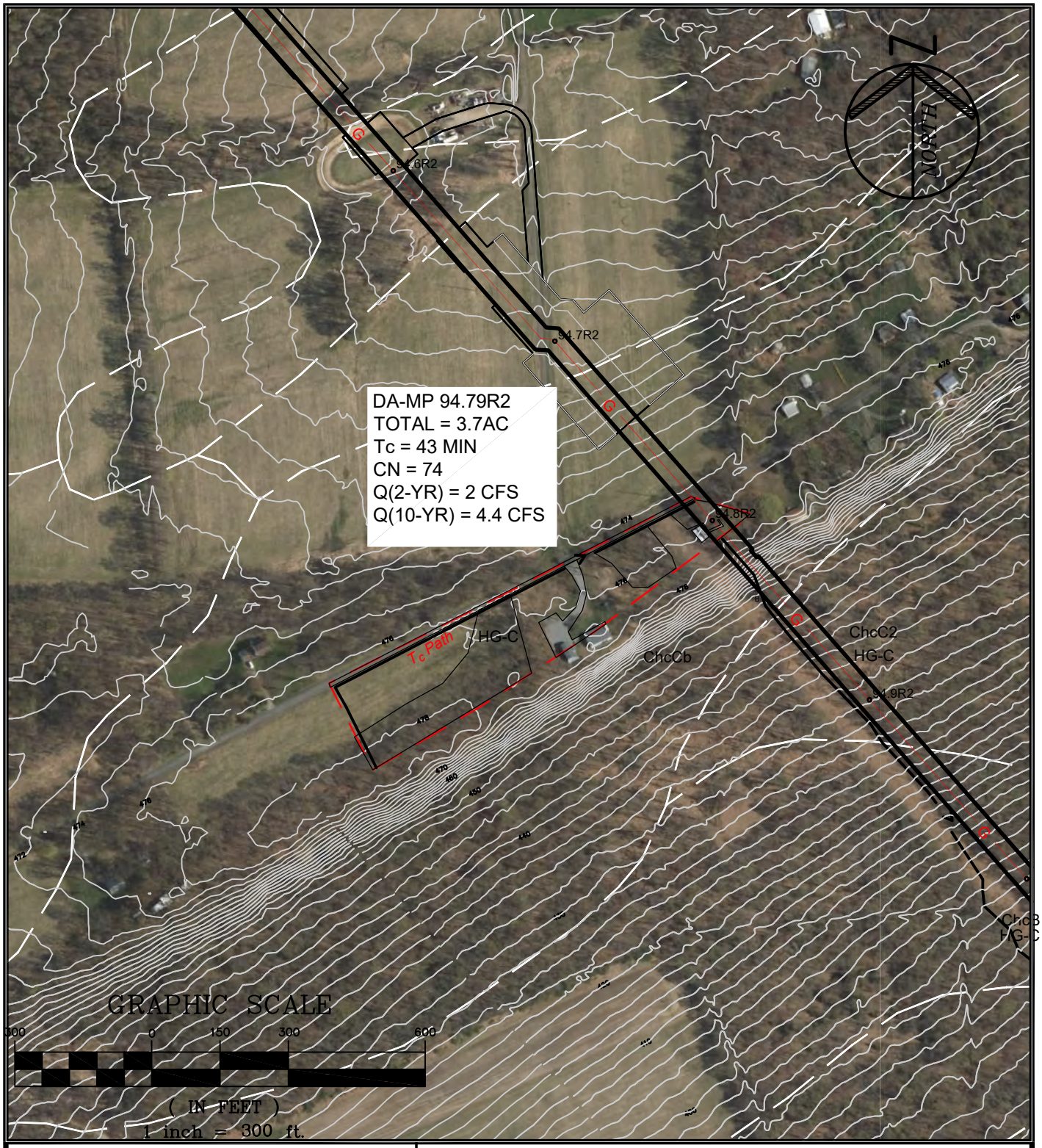
Critical Depth		0.95	ft
Critical Slope		0.05161	ft/ft
Velocity		1.10	ft/s
Velocity Head		0.02	ft
Specific Energy		1.17	ft
Froude Number		0.34	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.15	ft
Critical Depth	0.95	ft
Channel Slope	0.00500	ft/ft
Critical Slope	0.05161	ft/ft



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CERTIFICATE OF AUTHORIZATION NO. 24GA28032700

PROJECT TITLE

PENNEAST PIPELINE

HUNTERDON AND MERCER COUNTY, NJ

SHEET TITLE

STREAM CROSSING DRAINAGE AREA MP-94.79

PROJ. NO.: 05516.0001	DRN. BY: JPS	SCALE: 1"=300'
DATE: 05/23/19	CK'D BY: WS	

Worksheet 2: Runoff curve number and runoff (Approximated)

Project	By	Date
PennEast	IK	19-Mar-19
Location	**Checked**	**Date**
Hunterdon County, NJ		

Check one: ☐ Present ☒ Developed — MP 94.79R2

1. Runoff curve number

Soil name and hydrologic group (appendix A)	Cover Description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN[1] Table 2-2	CN[1] Figure 2-3	CN[1] Figure 2-4	Area ☒ acres / ☐ mi² / ☐ %	Product of CN x Area
Type C	WOODS	70			1.58	110.60
Type C	GRASS	74			1.91	141.34
Type C	IMPERVIOUS	98			0.21	20.58
				Totals ➡	3.70	272.52

1. Use only one CN source per line

CN (weighted) = tot.prod. / tot. area = 272.52 / 3.70 = 73.7 ; Use CN ➡ **74**

2. Runoff

		Storm #1	Storm #2	Storm #3
Frequency……	yr			
Rainfall, P (24-hour)…….	in			
Runoff, Q……	in			

Use P and CN with table 2-1, figure 2-1, or equation 2-3 abd 2-4

PROJECT:	PennEast	JOB NO. 5516.0001	
		SHEET	DATE: 03/19/2019
		BY:	IK
SUBJECT:	Tc Calculations	CHK'D	

Time of Concentration calculations with the application of the SCS TR-55 methodology.

Watershed or Subarea Designation: DA 94.79R2

Area 3.7 AC

SHEET FLOW

Segment ID		A-B	B-C		
Surface Description (Table 3-1)		WOODS	GRASS		
Manning's Coefficient, n (Table 3-1)		0.400	0.240		
Flow Length, L (total <= 150)	(ft)	65	85		
Two Year Rainfall, P	(in)	3.4	3.4		
Land Slope, s	(ft/ft)	0.010	0.010		
Computed Tt = 0.007 (nL)^0.8 / P^0.5*s^0.4	(hrs)	0.326	0.27		0.593

SHALLOW CONCENTRATED FLOW

Segment ID		C-D	D-E		
Surface Description (paved or unpaved)		UNPAVED	PAVED		
Flow Length, L	(ft)	50	691		
Watercourse slope, s	(ft/ft)	0.010	0.010		
Average Velocity, V (Figure 3-1)	(ft/s)	1.6	2.0		
Computed Tt = L / 3600V	(hrs)	0.009	0.096		0.105

CHANNEL FLOW

Segment ID		E-F			
Cross sectional Area, a	(sf)	2.50			
Wetted Perimeter, Pw	(ft)	3.00			
Hydraulic Radius, r =a/Pw	(ft)	0.833			
Channel Slope (ft/ft)	(ft/ft)	0.010			
Manning's Roughness Coefficient, n		0.045			
Velocity, V = 1.49r^(2/3)s^0.5 / n	(ft/s)	2.93			
Flow Length, L	(ft)	205			
Computed Tt = L / 3600V	(hrs)	0.019			0.019

Watershed or subarea Tc	0.717	hrs.
	43.0	min.

Use minimum Tc of 10 minutes

Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 05 / 23 / 2019

Hyd. No. 64

MP-94.79R2

Hydrograph type	= SCS Runoff	Peak discharge	= 2.046 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.60 hrs
Time interval	= 6 min	Hyd. volume	= 14,107 cuft
Drainage area	= 3.700 ac	Curve number	= 74.000
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 43.0 min
Total precip.	= 3.26 in	Distribution	= Custom
Storm duration	= C:\Users\IKuzmina\AppData\Local\Autodesk\C3D 2019\enu\HHApps\Hydrograp	Storm frequency	= 24 yrs

Hydrograph Discharge Table

(Printed values >= 1.00% of Qp.)

Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)
11.30	0.022	13.10	1.225	14.90	0.272	16.70	0.174
11.40	0.035	13.20	1.004	15.00	0.262	16.80	0.171
11.50	0.052	13.30	0.812	15.10	0.252	16.90	0.168
11.60	0.077	13.40	0.707	15.20	0.242	17.00	0.166
11.70	0.112	13.50	0.627	15.30	0.233	17.10	0.163
11.80	0.164	13.60	0.564	15.40	0.224	17.20	0.160
11.90	0.245	13.70	0.511	15.50	0.217	17.30	0.158
12.00	0.398	13.80	0.470	15.60	0.210	17.40	0.155
12.10	0.706	13.90	0.434	15.70	0.204	17.50	0.152
12.20	1.060	14.00	0.402	15.80	0.200	17.60	0.149
12.30	1.431	14.10	0.377	15.90	0.196	17.70	0.147
12.40	1.781	14.20	0.356	16.00	0.192	17.80	0.144
12.50	2.040	14.30	0.339	16.10	0.189	17.90	0.141
12.60	2.046	14.40	0.324	16.20	0.187	18.00	0.138
12.70	1.968	14.50	0.312	16.30	0.184	18.10	0.135
12.80	1.831	14.60	0.301	16.40	0.181	18.20	0.133
12.90	1.656	14.70	0.291	16.50	0.179	18.30	0.130
13.00	1.446	14.80	0.281	16.60	0.176	18.40	0.128

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Worksheet for MP-94.79R2 STA 1+98_2YR_PIPE

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.01500	ft/ft
Discharge	2.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+08	474.80
0+10	474.54
0+14	475.40
0+60	476.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+08, 474.80)	(0+60, 476.00)	0.045

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.51	ft
Elevation Range	474.54 to 476.00 ft	
Flow Area	1.18	ft²
Wetted Perimeter	4.34	ft
Hydraulic Radius	0.27	ft
Top Width	4.02	ft
Normal Depth	0.51	ft
Critical Depth	0.39	ft
Critical Slope	0.05255	ft/ft

Worksheet for MP-94.79R2 STA 1+98_2YR_PIPE

Results

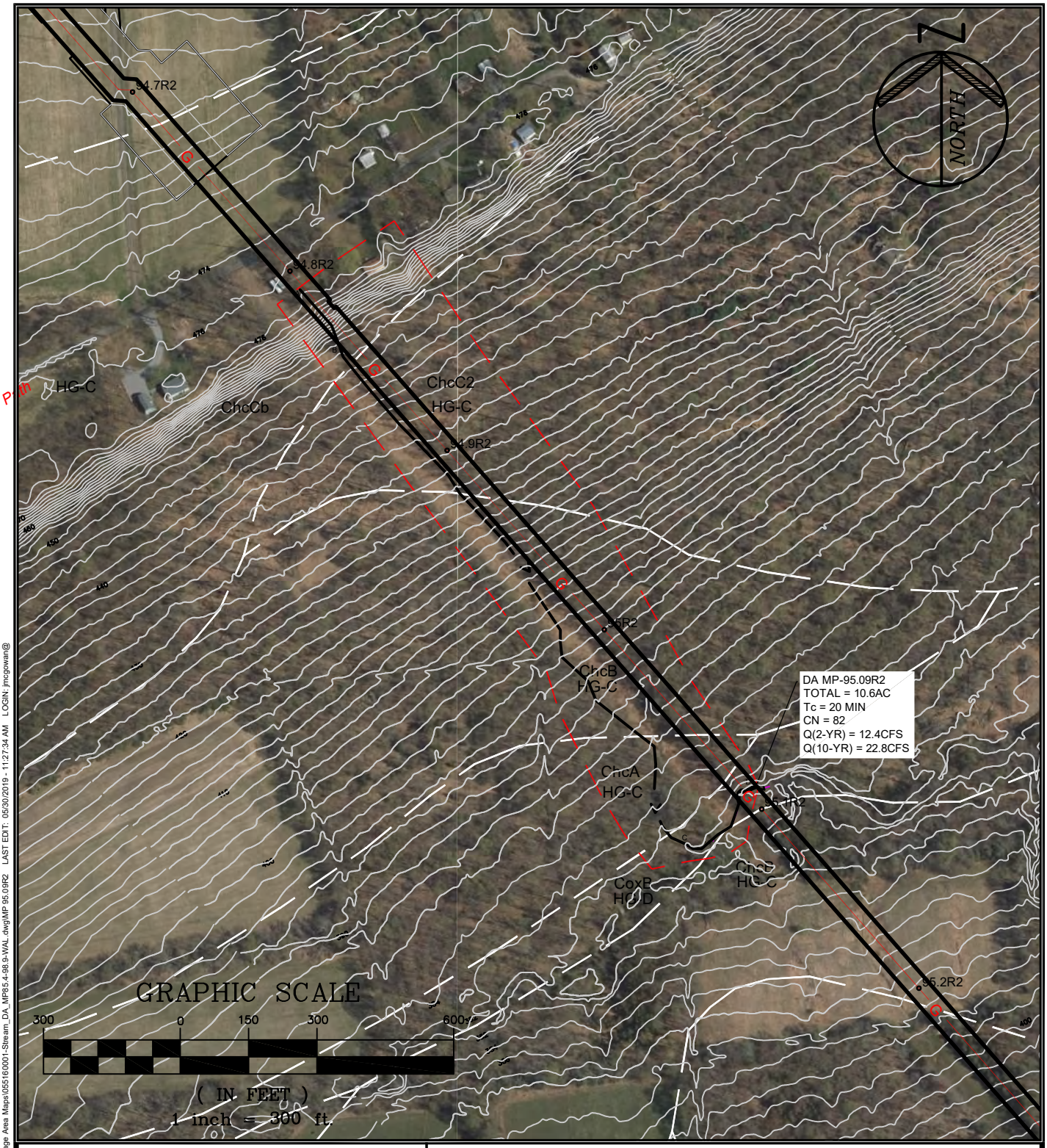
Velocity		1.70	ft/s
Velocity Head		0.04	ft
Specific Energy		0.55	ft
Froude Number		0.55	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.51	ft
Critical Depth	0.39	ft
Channel Slope	0.01500	ft/ft
Critical Slope	0.05255	ft/ft



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CERTIFICATE OF AUTHORIZATION NO. 24GA28032700

PROJECT TITLE

PENNEAST PIPELINE

HUNTERDON AND MERCER COUNTY, NJ

SHEET TITLE

STREAM CROSSING DRAINAGE AREA MP-95.09R2

PROJ. NO.: 05516.0001	DRN. BY: JPS	SCALE: 1"=300'
DATE: 05/23/19	CK'D BY: WS	

FILE NAME: P:\05516\0001\DWGs\CAD\C-Civil\Plotdwgs\Drainage Area Maps\05516\0001-Stream_DA_MP95.4-98.9-WAL.dwg\MP 95.09R2 LAST EDIT: 05/30/2019 - 11:27:34 AM LOGIN: jmcgowan@

Worksheet 2: Runoff curve number and runoff (Approximated)

Project	By	Date
PennEast	IK	22-Apr-19
Location	**Checked**	**Date**
Hunterdon County, NJ		

Check one: ☐ Present ☒ Developed — MP 95.09R2

1. Runoff curve number

Soil name and hydrologic group (appendix A)	Cover Description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN[1] Table 2-2	CN[1] Figure 2-3	CN[1] Figure 2-4	Area ☒ acres / ☐ mi² / ☐ %	Product of CN x Area
Type C	Farmstead, Good Condition	82			10.06	824.92
Type D	Farmstead, Good Condition	86			0.540	46.44
1. Use only one CN source per line				Totals ➡	10.60	871.36

CN (weighted) = tot.prod. / tot. area = 871.36 / 10.60 = 82.2 ; Use CN ➡ **82**

2. Runoff

		Storm #1	Storm #2	Storm #3
Frequency……	yr			
Rainfall, P (24-hour)…….	in			
Runoff, Q……	in			

Use P and CN with table 2-1, figure 2-1, or equation 2-3 abd 2-4

PROJECT:	PennEast	JOB NO. 5516.0001	
		SHEET	DATE:4/22/2019
		BY:	IK
SUBJECT:	Tc Calculations	CHK'D	

Time of Concentration calculations with the application of the SCS TR-55 methodology.

Watershed or Subarea Designation: DA 95.09R2

Area 10.6 AC

SHEET FLOW

Segment ID		A-B				
Surface Description (Table 3-1)		WOODS				
Manning's Coefficient, n (Table 3-1)		0.400				
Flow Length, L (total <= 150)	(ft)	150				
Two Year Rainfall, P	(in)	3.4				
Land Slope, s	(ft/ft)	0.173				
Computed Tt = 0.007 (nL)^0.8 / P^0.5*s^0.4	(hrs)	0.203				0.203

SHALLOW CONCENTRATED FLOW

Segment ID		B-C				
Surface Description (paved or unpaved)		UNPAVED				
Flow Length, L	(ft)	1403				
Watercourse slope, s	(ft/ft)	0.051				
Average Velocity, V (Figure 3-1)	(ft/s)	3.6				
Computed Tt = L / 3600V	(hrs)	0.108				0.108

CHANNEL FLOW

Segment ID		C-D				
Cross sectional Area, a	(sf)	5.60				
Wetted Perimeter, Pw	(ft)	7.77				
Hydraulic Radius, r =a/Pw	(ft)	0.721				
Channel Slope (ft/ft)	(ft/ft)	0.011				
Manning's Roughness Coefficient, n		0.040				
Velocity, V = 1.49r^(2/3)s^0.5 / n	(ft/s)	3.14				
Flow Length, L	(ft)	246				
Computed Tt = L / 3600V	(hrs)	0.022				0.022

Watershed or subarea Tc	0.333	hrs.
	20.0	min.

Use minimum Tc of 10 minutes

Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 05 / 23 / 2019

Hyd. No. 77

MP-95.09R2

Hydrograph type	= SCS Runoff	Peak discharge	= 12.43 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.30 hrs
Time interval	= 6 min	Hyd. volume	= 61,044 cuft
Drainage area	= 10.600 ac	Curve number	= 82.000
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 20.0 min
Total precip.	= 3.26 in	Distribution	= Custom
Storm duration	= C:\Users\IKuzmina\AppData\Local\Autodesk\C3D2019\enu\HHApps\Hydrograp	Shape factor	= 484

Hydrograph Discharge Table

(Printed values >= 1.00% of Qp.)

Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)
10.00	0.131	11.80	2.165	13.60	1.702	15.40	0.760
10.10	0.151	11.90	2.944	13.70	1.562	15.50	0.742
10.20	0.171	12.00	4.454	13.80	1.445	15.60	0.728
10.30	0.193	12.10	7.494	13.90	1.355	15.70	0.716
10.40	0.216	12.20	10.49	14.00	1.287	15.80	0.706
10.50	0.241	12.30	12.43	14.10	1.234	15.90	0.696
10.60	0.269	12.40	11.63	14.20	1.192	16.00	0.686
10.70	0.305	12.50	10.16	14.30	1.155	16.10	0.676
10.80	0.350	12.60	8.253	14.40	1.118	16.20	0.666
10.90	0.404	12.70	6.248	14.50	1.081	16.30	0.656
11.00	0.469	12.80	4.460	14.60	1.043	16.40	0.647
11.10	0.547	12.90	3.686	14.70	1.006	16.50	0.636
11.20	0.642	13.00	3.160	14.80	0.968	16.60	0.626
11.30	0.760	13.10	2.774	14.90	0.929	16.70	0.616
11.40	0.899	13.20	2.462	15.00	0.891	16.80	0.605
11.50	1.058	13.30	2.238	15.10	0.853	16.90	0.595
11.60	1.301	13.40	2.038	15.20	0.816	17.00	0.585
11.70	1.638	13.50	1.862	15.30	0.785	17.10	0.575

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Worksheet for MP-95.09R2_STA0+34_PIPE_2YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.03100	ft/ft
Discharge	12.40	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	380.00
0+15	380.00
0+45	376.00
0+50	375.57
0+55	376.25
1+00	378.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 380.00)	(1+00, 378.00)	0.045

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.70	ft
Elevation Range	375.57 to 380.00 ft	
Flow Area	4.27	ft²
Wetted Perimeter	12.07	ft
Hydraulic Radius	0.35	ft
Top Width	11.98	ft
Normal Depth	0.70	ft

Worksheet for MP-95.09R2_STA0+34_PIPE_2YR

Results

Critical Depth		0.66	ft
Critical Slope		0.04256	ft/ft
Velocity		2.91	ft/s
Velocity Head		0.13	ft
Specific Energy		0.83	ft
Froude Number		0.86	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

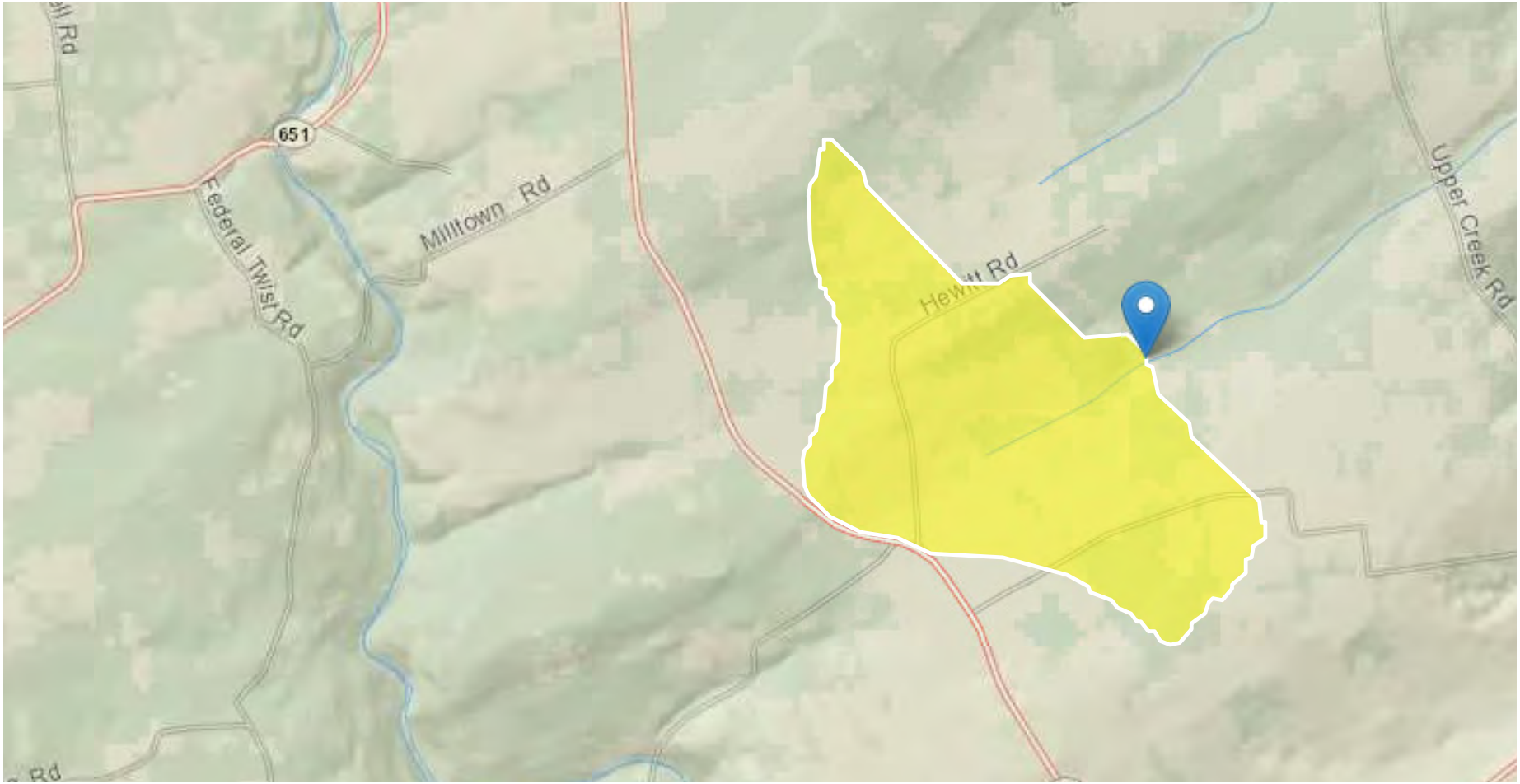
GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.70	ft
Critical Depth	0.66	ft
Channel Slope	0.03100	ft/ft
Critical Slope	0.04256	ft/ft

+040.450834° / -074.990579°
↑363ft
MAP
02/28/19
N
11:50:25
LOG
+01.0°
-18.3°
EXTRAS
061° N61E 1084mils TRUE
A-B
CAL
030
060
E
NIGHT
1.0X

MP 95.11R2

Region ID: NJ
Workspace ID: NJ20170808090211070000
Clicked Point (Latitude, Longitude): 40.45067, -74.99021
Time: 2017-08-08 09:03:05 -0400



Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	0.63	square miles
STORAGE	Percentage of area of storage (lakes ponds reservoirs wetlands)	14.3	percent
CSL10_85	Change in elevation divided by length between points 10 and 85 percent of distance along main channel to basin divide - main channel method not known	71.8	feet per mi
POPDENS	Basin Population Density	106	persons per square mile

Peak-Flow Statistics Parameters [Peak Unglaciated Piedmont Region 2009 5167]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.63	square miles	0.25	779
STORAGE	Percent Storage	14.3	percent	0.23	32
CSL10_85	Stream Slope 10 and 85 Method	71.8	feet per mi	4.31	191
POPDENS	Basin Population Density	106	persons per square mile	83	11084

Peak-Flow Statistics Flow Report [Peak Unglaciated Piedmont Region 2009 5167]

PIl: Prediction Interval-Lower, PIu: Prediction Interval-Upper, SEp: Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	SEe	SEp	Equiv. Yrs.
2 Year Peak Flood	122	ft^3/s	49	50.3	1
5 Year Peak Flood	205	ft^3/s	49.4	50.9	2
10 Year Peak Flood	268	ft^3/s	50.5	52.2	3

Statistic	Value	Unit	SEe	SEp	Equiv. Yrs.
25 Year Peak Flood	357	ft^3/s	52.6	54.5	4
50 Year Peak Flood	427	ft^3/s	54.7	56.8	5
100 Year Peak Flood	506	ft^3/s	57.1	59.5	5
500 Year Peak Flood	699	ft^3/s	63.9	66.3	6

Peak-Flow Statistics Citations

Watson, K.M.,and Schopp, R.D.,2009, Methodology for estimation of flood magnitude and frequency for New Jersey streams, U.S. Geological Survey Scientific Investigations Report 2009-5167, 51 p. (http://pubs.usgs.gov/sir/2009/5167/)

Worksheet for MP-95.11R2_STA 0+29-2YR_PIPE

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.01300	ft/ft
Discharge	122.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	376.00
0+31	376.25
0+41	374.59
0+48	375.40
1+00	378.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 376.00)	(1+00, 378.00)	0.050

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	1.94	ft
Elevation Range	374.59 to 378.00 ft	
Flow Area	47.31	ft²
Wetted Perimeter	71.22	ft
Hydraulic Radius	0.66	ft
Top Width	70.48	ft
Normal Depth	1.94	ft
Critical Depth	1.71	ft

Worksheet for MP-95.11R2_STA 0+29-2YR_PIPE

Results

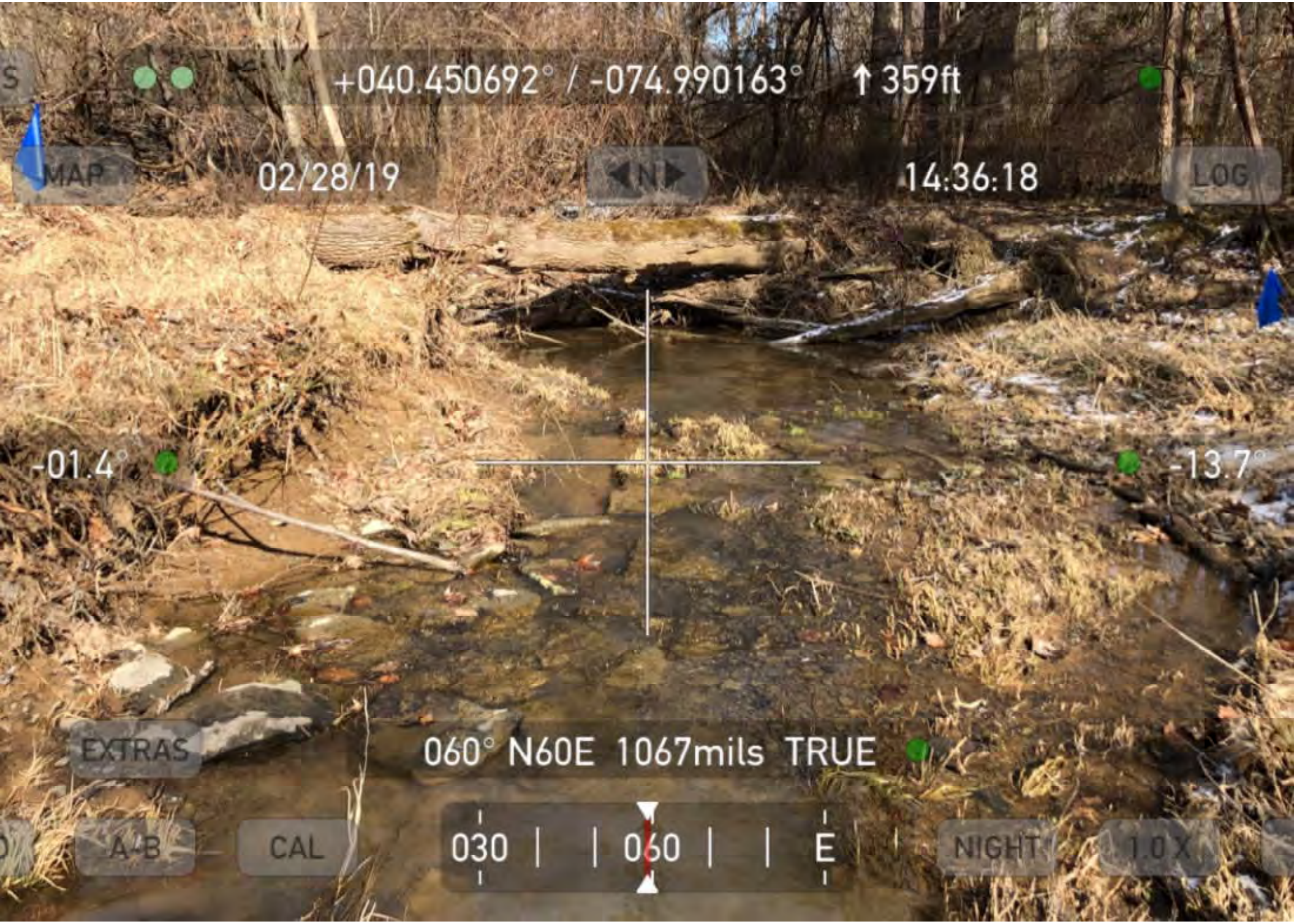
Critical Slope	0.04716	ft/ft
Velocity	2.58	ft/s
Velocity Head	0.10	ft
Specific Energy	2.05	ft
Froude Number	0.55	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.94	ft
Critical Depth	1.71	ft
Channel Slope	0.01300	ft/ft
Critical Slope	0.04716	ft/ft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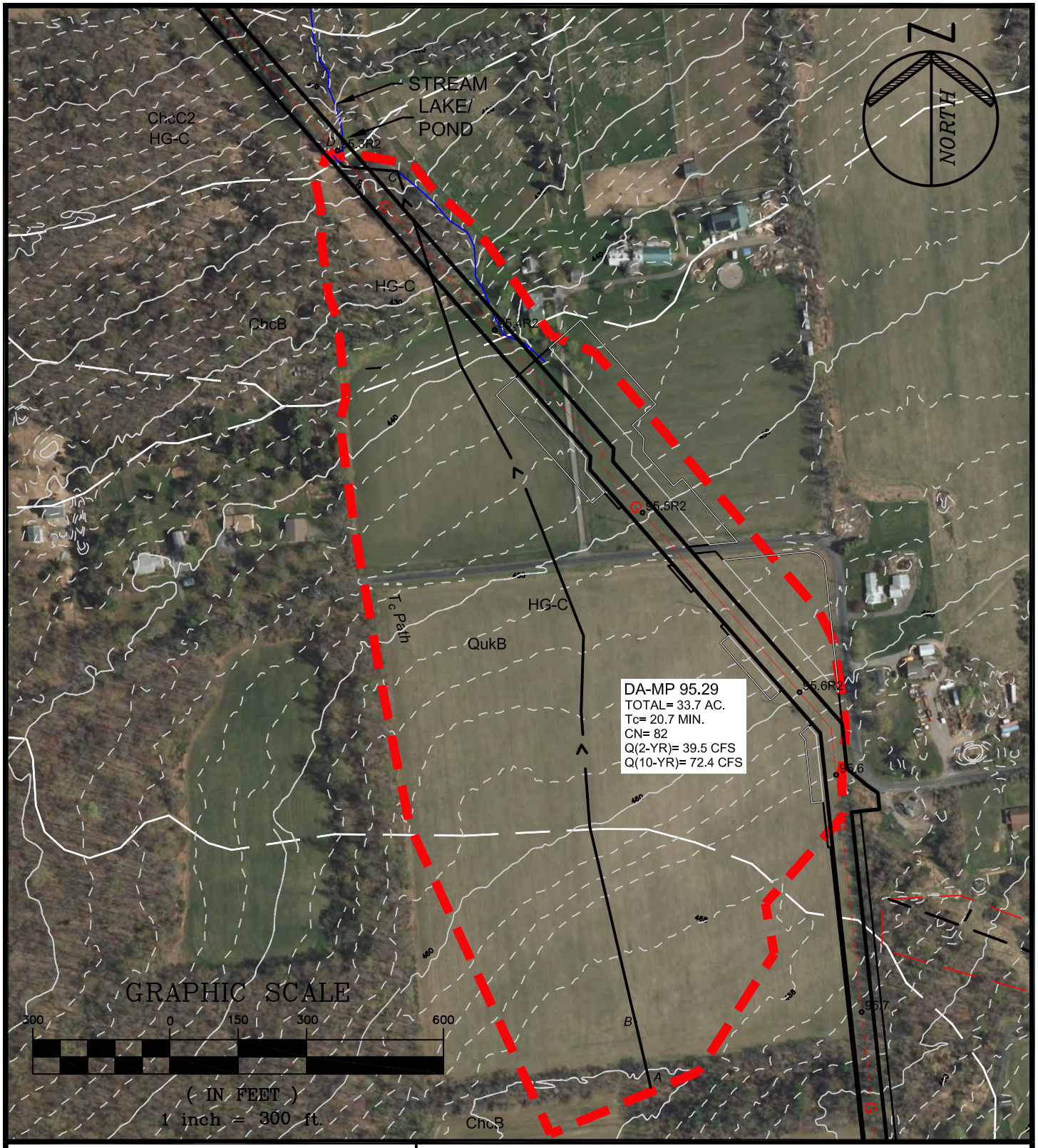

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CERTIFICATE OF AUTHORIZATION NO. 24GA28032700

PROJECT TITLE

PENNEAST PIPELINE

HUNTERDON AND MERCER COUNTY, NJ

SHEET TITLE

STREAM CROSSING DRAINAGE AREA MP-95.29R2

PROJ. NO.:	05516.0001	DRN. BY:	JPS	SCALE:	1"=300'
DATE:	05/23/19	CK'D BY:	WS		

FILE NAME: P:\05516\0001\DWGs\CAD\C-Civil\Plotdwgs\Drainage Area Maps\05516\0001-Stream_DA_MP85.4-98.9-WAL.dwg\MP 95.3 LAST EDIT: 06/13/2019 - 11:02:27 AM LOGIN: lkuzmha@

Worksheet 2: Runoff curve number and runoff (Approximated)

Project	By	Date
PennEast	JPS	26-Feb-18
Location	**Checked**	**Date**
Hunterdon County, NJ		

Check one: ☐ Present ☒ Developed — MP 95.29

1. Runoff curve number

Soil name and hydrologic group (appendix A)	Cover Description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN[1] Table 2-2	CN[1] Figure 2-3	CN[1] Figure 2-4	Area X acres mi² %	Product of CN x Area
Type C	Farmstead, Good Condition	82			33.70	2,763.40
				Totals ➡	33.70	2,763.40

1. Use only one CN source per line

CN (weighted) = tot.prod. / tot. area = 2,763.40 / 33.70 = 82.0 ; Use CN ➡ **82**

2. Runoff

		Storm #1	Storm #2	Storm #3
Frequency……	yr			
Rainfall, P (24-hour)…….	in			
Runoff, Q……	in			

Use P and CN with table 2-1, figure 2-1, or equation 2-3 abd 2-4

PSS &	PROJECT: PennEast	JOB NO. 5516.0001	
		SHEET	DATE:2/12/2018
		BY:	JPS
	SUBJECT: Tc Calculations	CHK'D	

Time of Concentration calculations with the application of the SCS TR-55 methodology.

Watershed or Subarea Designation: DA 95.29

Area 33.7 AC

SHEET FLOW

Segment ID		A-B				
Surface Description (Table 3-1)		CULTIVATED				
Manning's Coefficient, n (Table 3-1)		0.060				
Flow Length, L (total <= 150)	(ft)	150				
Two Year Rainfall, P	(in)	3.4				
Land Slope, s	(ft/ft)	0.013				
Computed Tt = 0.007 (nL)^0.8 / P^0.5*s^0.4	(hrs)	0.125				0.125

SHALLOW CONCENTRATED FLOW

Segment ID		B-C				
Surface Description (paved or unpaved)		UNPAVED				
Flow Length, L	(ft)	1977				
Watercourse slope, s	(ft/ft)	0.026				
Average Velocity, V (Figure 3-1)	(ft/s)	2.5				
Computed Tt = L / 3600V	(hrs)	0.220				0.220

CHANNEL FLOW

Segment ID		CD				
Cross sectional Area, a	(sf)	4.50				
Wetted Perimeter, Pw	(ft)	6.60				
Hydraulic Radius, r =a/Pw	(ft)	0.682				
Channel Slope (ft/ft)	(ft/ft)	0.015				
Manning's Roughness Coefficient, n		0.045				
Velocity, V = 1.49r^(2/3)s^0.5 / n	(ft/s)	3.14				
Flow Length, L	(ft)	130				
Computed Tt = L / 3600V	(hrs)	0.011				

Watershed or subarea Tc	0.345	hrs.
	20.7	min.

Use minimum Tc of 10 minutes

Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 05 / 30 / 2019

Hyd. No. 22

DA 95.29

Hydrograph type	= SCS Runoff	Peak discharge	= 39.51 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.30 hrs
Time interval	= 6 min	Hyd. volume	= 194,075 cuft
Drainage area	= 33.700 ac	Curve number	= 82.000*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 20.7 min
Total precip.	= 3.26 in	Distribution	= Custom
Storm duration	= C:\Users\IKuzmina\AppData\Local\Autodesk\C3D 2019\enu\HHApps\Hydrograp		

* Composite (Area/CN) = [(16.200 x 82)] / 33.700

Hydrograph Discharge Table

(Printed values >= 1.00% of Qp.)

Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)
10.00	0.417	11.80	6.883	13.60	5.410	15.40	2.417
10.10	0.479	11.90	9.361	13.70	4.966	15.50	2.358
10.20	0.544	12.00	14.16	13.80	4.595	15.60	2.313
10.30	0.614	12.10	23.82	13.90	4.309	15.70	2.277
10.40	0.688	12.20	33.35	14.00	4.091	15.80	2.245
10.50	0.766	12.30	39.51	14.10	3.924	15.90	2.214
10.60	0.857	12.40	36.99	14.20	3.790	16.00	2.182
10.70	0.968	12.50	32.30	14.30	3.673	16.10	2.150
10.80	1.111	12.60	26.24	14.40	3.556	16.20	2.119
10.90	1.286	12.70	19.86	14.50	3.437	16.30	2.087
11.00	1.492	12.80	14.18	14.60	3.317	16.40	2.055
11.10	1.739	12.90	11.72	14.70	3.198	16.50	2.022
11.20	2.042	13.00	10.05	14.80	3.077	16.60	1.990
11.30	2.415	13.10	8.819	14.90	2.955	16.70	1.958
11.40	2.858	13.20	7.827	15.00	2.833	16.80	1.925
11.50	3.362	13.30	7.114	15.10	2.710	16.90	1.892
11.60	4.137	13.40	6.480	15.20	2.595	17.00	1.860
11.70	5.206	13.50	5.918	15.30	2.495	17.10	1.827

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Worksheet for MP-95.29R2_STA0+91_PIPE_2YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.04400	ft/ft
Discharge	39.50	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	412.00
0+45	412.10
0+50	411.37
0+51	413.00
0+58	414.00
0+68	416.00
1+00	416.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 412.00)	(1+00, 416.00)	0.045

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.92	ft
Elevation Range	411.37 to 416.00 ft	
Flow Area	13.72	ft²
Wetted Perimeter	51.22	ft
Hydraulic Radius	0.27	ft
Top Width	50.24	ft

Worksheet for MP-95.29R2_STA0+91_PIPE_2YR

Results

Normal Depth	0.92	ft
Critical Depth	0.91	ft
Critical Slope	0.04696	ft/ft
Velocity	2.88	ft/s
Velocity Head	0.13	ft
Specific Energy	1.05	ft
Froude Number	0.97	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.92	ft
Critical Depth	0.91	ft
Channel Slope	0.04400	ft/ft
Critical Slope	0.04696	ft/ft

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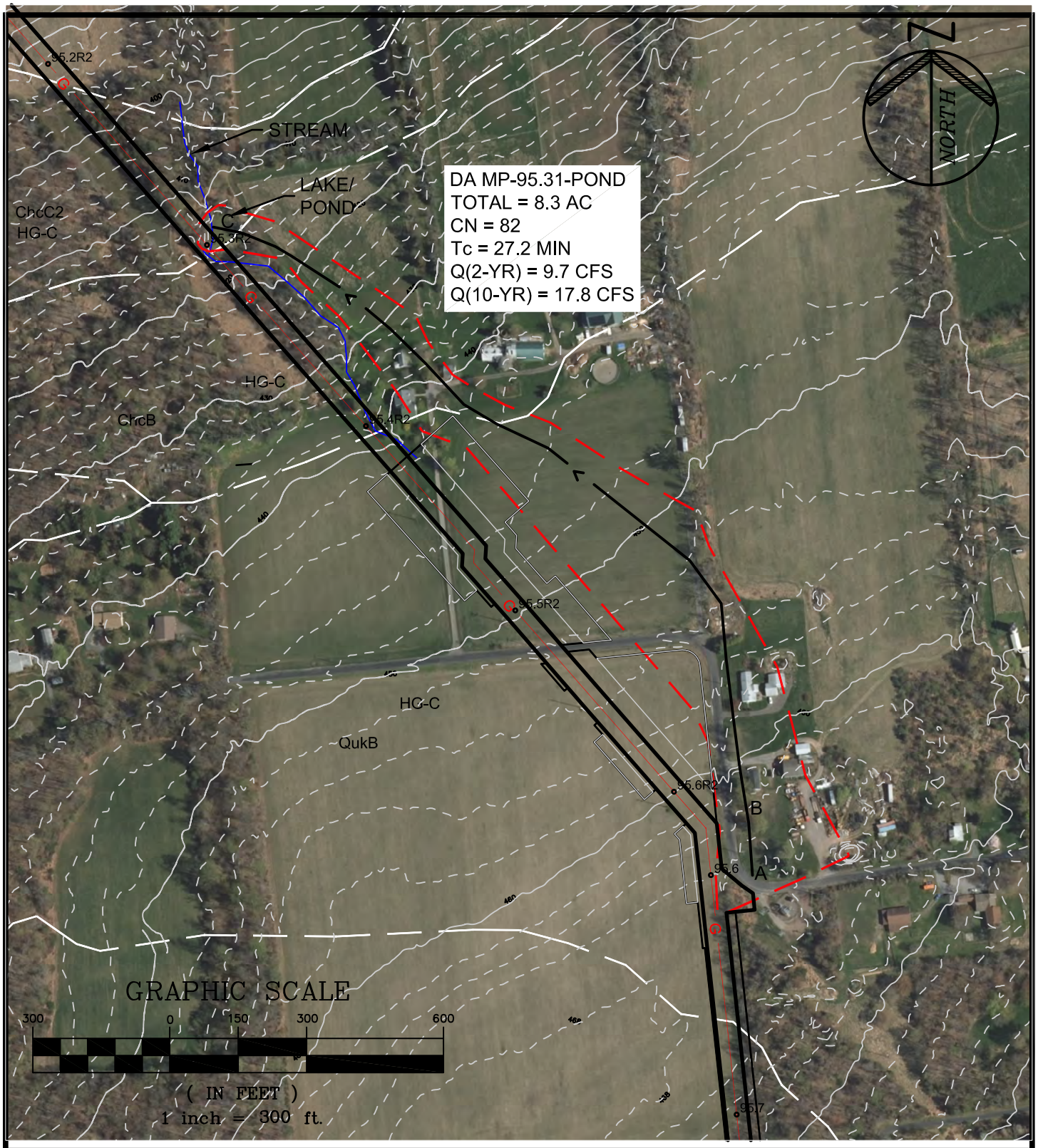

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CERTIFICATE OF AUTHORIZATION NO. 24GA28032700

PROJECT TITLE

PENNEAST PIPELINE

HUNTERDON AND MERCER COUNTY, NJ

SHEET TITLE

STREAM CROSSING DRAINAGE AREA MP-95.31-POND

PROJ. NO.: 05516.0001	DRN. BY: JPS	SCALE: 1"=300'
DATE: 05/23/19	CK'D BY: WS	

PROJECT:	PennEast	JOB NO. 5516.0001	
		SHEET	DATE:05-21-19
		BY:	IK
SUBJECT:	Tc Calculations	CHK'D	

Time of Concentration calculations with the application of the SCS TR-55 methodology.

Watershed or Subarea Designation: DA 95.31-POND

Area 8.3 AC

SHEET FLOW

Segment ID		A-B			
Surface Description (Table 3-1)		GRASS			
Manning's Coefficient, n (Table 3-1)		0.150			
Flow Length, L (total <= 150)	(ft)	150			
Two Year Rainfall, P	(in)	3.4			
Land Slope, s	(ft/ft)	0.015			
Computed Tt = 0.007 (nL)^0.8 / P^0.5*s^0.4	(hrs)	0.247			0.247

SHALLOW CONCENTRATED FLOW

Segment ID		B-C			
Surface Description (paved or unpaved)		UNPAVED			
Flow Length, L	(ft)	1857			
Watercourse slope, s	(ft/ft)	0.026			
Average Velocity, V (Figure 3-1)	(ft/s)	2.5			
Computed Tt = L / 3600V	(hrs)	0.206			0.206

CHANNEL FLOW

Segment ID		CD			
Cross sectional Area, a	(sf)				
Wetted Perimeter, Pw	(ft)				
Hydraulic Radius, r =a/Pw	(ft)				
Channel Slope (ft/ft)	(ft/ft)				
Manning's Roughness Coefficient, n					
Velocity, V = 1.49r^(2/3)s^0.5 / n	(ft/s)				
Flow Length, L	(ft)				
Computed Tt = L / 3600V	(hrs)				

Watershed or subarea Tc	0.453	hrs.
	27.2	min.

Use minimum Tc of 10 minutes

Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 05 / 23 / 2019

Hyd. No. 93

MP-95.31-POND

Hydrograph type	= SCS Runoff	Peak discharge	= 9.730 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.30 hrs
Time interval	= 6 min	Hyd. volume	= 47,799 cuft
Drainage area	= 8.300 ac	Curve number	= 82.000
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 27.2 min
Total precip.	= 3.26 in	Distribution	= Custom
Storm duration	= C:\Users\IKuzmina\AppData\Local\Autodesk\C3D 2019\enu\HHApps\Hydrograp	Storm frequency	= 24 yrs

Hydrograph Discharge Table

(Printed values >= 1.00% of Qp.)

Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)
10.00	0.103	11.80	1.695	13.60	1.332	15.40	0.595
10.10	0.118	11.90	2.306	13.70	1.223	15.50	0.581
10.20	0.134	12.00	3.488	13.80	1.132	15.60	0.570
10.30	0.151	12.10	5.868	13.90	1.061	15.70	0.561
10.40	0.169	12.20	8.215	14.00	1.008	15.80	0.553
10.50	0.189	12.30	9.730	14.10	0.966	15.90	0.545
10.60	0.211	12.40	9.109	14.20	0.933	16.00	0.537
10.70	0.238	12.50	7.955	14.30	0.905	16.10	0.530
10.80	0.274	12.60	6.462	14.40	0.876	16.20	0.522
10.90	0.317	12.70	4.893	14.50	0.846	16.30	0.514
11.00	0.367	12.80	3.493	14.60	0.817	16.40	0.506
11.10	0.428	12.90	2.886	14.70	0.788	16.50	0.498
11.20	0.503	13.00	2.474	14.80	0.758	16.60	0.490
11.30	0.595	13.10	2.172	14.90	0.728	16.70	0.482
11.40	0.704	13.20	1.928	15.00	0.698	16.80	0.474
11.50	0.828	13.30	1.752	15.10	0.668	16.90	0.466
11.60	1.019	13.40	1.596	15.20	0.639	17.00	0.458
11.70	1.282	13.50	1.458	15.30	0.614	17.10	0.450

Continues on next page...

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Worksheet for MP-95.31R2_STA0+05_2YR_PIPE

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00500	ft/ft
Discharge	9.70	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+10	416.00
0+21	416.00
0+26	416.30
0+50	412.78
0+62	415.90
0+71	416.00
0+89	418.00
1+00	420.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+10, 416.00)	(1+00, 420.00)	0.030

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.94	ft
Elevation Range	412.78 to 420.00 ft	
Flow Area	4.65	ft²
Wetted Perimeter	10.11	ft
Hydraulic Radius	0.46	ft

Worksheet for MP-95.31R2_STA0+05_2YR_PIPE

Results

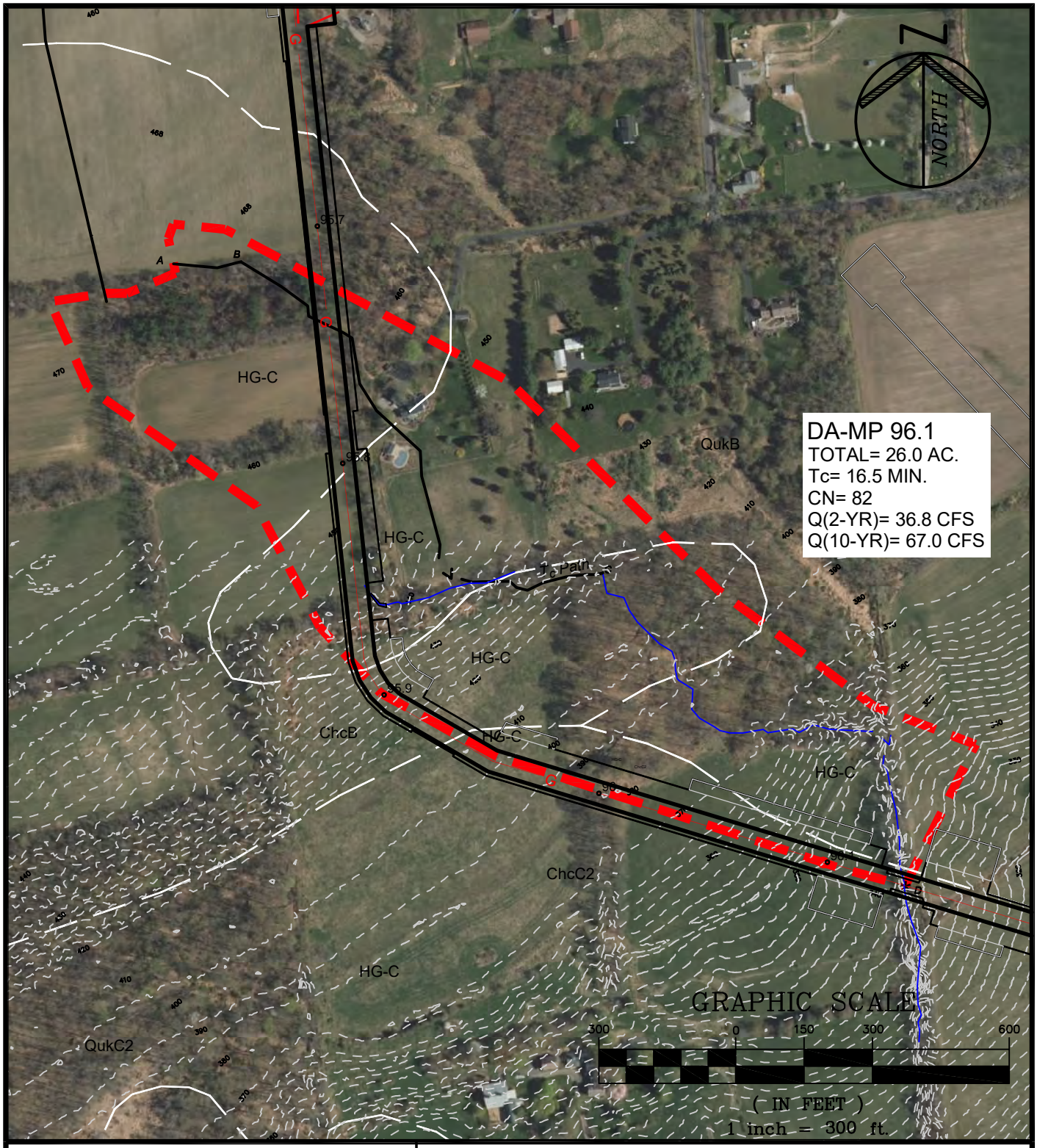
Top Width		9.92	ft
Normal Depth		0.94	ft
Critical Depth		0.73	ft
Critical Slope		0.01881	ft/ft
Velocity		2.09	ft/s
Velocity Head		0.07	ft
Specific Energy		1.01	ft
Froude Number		0.54	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.94	ft
Critical Depth	0.73	ft
Channel Slope	0.00500	ft/ft
Critical Slope	0.01881	ft/ft



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CERTIFICATE OF AUTHORIZATION NO. 24GA28032700

PROJECT TITLE

PENNEAST PIPELINE

HUNTERDON AND MERCER COUNTY, NJ

SHEET TITLE

STREAM CROSSING DRAINAGE AREA MP-96.1

PROJ. NO.: 05516.0001	DRN. BY: JPS	SCALE: 1"=300'
DATE: 05/23/19	CK'D BY: WS	

FILE NAME: P:\05516\0001\DWGs\CADC-Civil\Plotdwgs\Drainage Area Maps\05516\0001-Stream_DA_MP85.4-98.9-1-WAL.dwg\MP 96.1 LAST EDIT: 06/07/2019 - 12:17:24 PM LOGIN: jmcgowan@

Worksheet 2: Runoff curve number and runoff (Approximated)

Project	By	Date
PennEast	JPS	26-Feb-18
Location	**Checked**	**Date**
Hunterdon County, NJ		

Check one: ☐ Present ☒ Developed — MP 96.1

1. Runoff curve number

Soil name and hydrologic group (appendix A)	Cover Description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN[1] Table 2-2	CN[1] Figure 2-3	CN[1] Figure 2-4	Area (X / acres / mi² / %)	Product of CN x Area
Type C	Farmstead, Good Condition	82			26.00	2,132.00
				Totals ➡	26.00	2,132.00

1. Use only one CN source per line

CN (weighted) = tot.prod. / tot. area = 2,132.00 / 26.00 = 82.0 ; Use CN ➡ **82**

2. Runoff

		Storm #1	Storm #2	Storm #3
Frequency……	yr			
Rainfall, P (24-hour)…….	in			
Runoff, Q……	in			

Use P and CN with table 2-1, figure 2-1, or equation 2-3 abd 2-4

PSS&	PROJECT: PennEast	JOB NO. 5516.0001	
		SHEET	DATE:2/12/2018
		BY:	JPS
	SUBJECT: Tc Calculations	CHK'D	

Time of Concentration calculations with the application of the SCS TR-55 methodology.

Watershed or Subarea Designation: DA 96.1

Area 26.0 AC

SHEET FLOW

Segment ID		A-B			
Surface Description (Table 3-1)		CULTIVATED			
Manning's Coefficient, n (Table 3-1)		0.060			
Flow Length, L (total <= 150)	(ft)	150			
Two Year Rainfall, P	(in)	3.4			
Land Slope, s	(ft/ft)	0.023			
Computed Tt = 0.007 (nL)^0.8 / P^0.5*s^0.4	(hrs)	0.100			0.100

SHALLOW CONCENTRATED FLOW

Segment ID		B-C			
Surface Description (paved or unpaved)		UNPAVED			
Flow Length, L	(ft)	1257			
Watercourse slope, s	(ft/ft)	0.037			
Average Velocity, V (Figure 3-1)	(ft/s)	3.0			
Computed Tt = L / 3600V	(hrs)	0.116			0.116

CHANNEL FLOW

Segment ID		C-D			
Cross sectional Area, a	(sf)	6.21			
Wetted Perimeter, Pw	(ft)	14.27			
Hydraulic Radius, r =a/Pw	(ft)	0.435			
Channel Slope (ft/ft)	(ft/ft)	0.071			
Manning's Roughness Coefficient, n		0.040			
Velocity, V = 1.49r^(2/3)s^0.5 / n	(ft/s)	5.70			
Flow Length, L	(ft)	1195			
Computed Tt = L / 3600V	(hrs)	0.058			0.058

Watershed or subarea Tc	0.274	hrs.
	16.5	min.

Use minimum Tc of 10 minutes

Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Wednesday, 02 / 20 / 2019

Hyd. No. 23

DA 96.1

Hydrograph type	= SCS Runoff	Peak discharge	= 36.84 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.20 hrs
Time interval	= 6 min	Hyd. volume	= 140,373 cuft
Drainage area	= 26.000 ac	Curve number	= 82.000*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 16.5 min
Total precip.	= 3.26 in	Distribution	= Custom
Storm duration	= C:\Users\IKuzmina\AppData\Local\Autodesk\C3D 2019\enu\HHApps\Hydrograp		

* Composite (Area/CN) = [(26.000 x 82)] / 26.000

Hydrograph Discharge Table

(Printed values >= 1.00% of Qp.)

Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)
10.10	0.407	11.90	9.629	13.70	3.182	15.50	1.662
10.20	0.459	12.00	15.58	13.80	2.998	15.60	1.640
10.30	0.513	12.10	28.55	13.90	2.881	15.70	1.617
10.40	0.571	12.20	36.84	14.00	2.798	15.80	1.593
10.50	0.632	12.30	30.76	14.10	2.713	15.90	1.570
10.60	0.710	12.40	21.95	14.20	2.629	16.00	1.547
10.70	0.819	12.50	14.07	14.30	2.544	16.10	1.525
10.80	0.957	12.60	11.29	14.40	2.457	16.20	1.503
10.90	1.118	12.70	8.974	14.50	2.371	16.30	1.479
11.00	1.296	12.80	7.587	14.60	2.285	16.40	1.455
11.10	1.514	12.90	6.606	14.70	2.196	16.50	1.431
11.20	1.796	13.00	6.047	14.80	2.108	16.60	1.407
11.30	2.140	13.10	5.455	14.90	2.020	16.70	1.385
11.40	2.535	13.20	4.913	15.00	1.931	16.80	1.361
11.50	2.959	13.30	4.479	15.10	1.842	16.90	1.337
11.60	3.777	13.40	4.118	15.20	1.766	17.00	1.314
11.70	5.059	13.50	3.792	15.30	1.716	17.10	1.291
11.80	6.731	13.60	3.463	15.40	1.684	17.20	1.267

Continues on next page...

Worksheet for MP-96.13_STA0+32_PIPE_2YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.07400	ft/ft
Discharge	36.80	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	340.00
0+28	340.00
0+38	338.00
0+43	336.00
0+46	335.20
0+47	334.00
0+50	333.65
0+51	334.00
0+61	336.00
0+72	336.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 340.00)	(0+72, 336.00)	0.045

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	1.15	ft
Elevation Range	333.65 to 340.00 ft	
Flow Area	5.67	ft²

Worksheet for MP-96.13_STA0+32_PIPE_2YR

Results

Wetted Perimeter		9.25	ft
Hydraulic Radius		0.61	ft
Top Width		8.82	ft
Normal Depth		1.15	ft
Critical Depth		1.35	ft
Critical Slope		0.03474	ft/ft
Velocity		6.49	ft/s
Velocity Head		0.65	ft
Specific Energy		1.81	ft
Froude Number		1.43	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.15	ft
Critical Depth	1.35	ft
Channel Slope	0.07400	ft/ft
Critical Slope	0.03474	ft/ft

Worksheet for MP-96.13_STA0+21_BRIDGE_2YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.07400	ft/ft
Discharge	36.80	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	340.00
0+29	340.00
0+46	336.10
0+50	333.65
0+56	333.65
0+58	335.00
0+74	335.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 340.00)	(0+74, 335.00)	0.045

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.78	ft
Elevation Range	333.65 to 340.00 ft	
Flow Area	5.59	ft²
Wetted Perimeter	8.91	ft
Hydraulic Radius	0.63	ft
Top Width	8.47	ft

Worksheet for MP-96.13_STA0+21_BRIDGE_2YR

Results

Normal Depth	0.78	ft
Critical Depth	0.97	ft
Critical Slope	0.03436	ft/ft
Velocity	6.58	ft/s
Velocity Head	0.67	ft
Specific Energy	1.45	ft
Froude Number	1.43	
Flow Type	Supercritical	

GVF Input Data

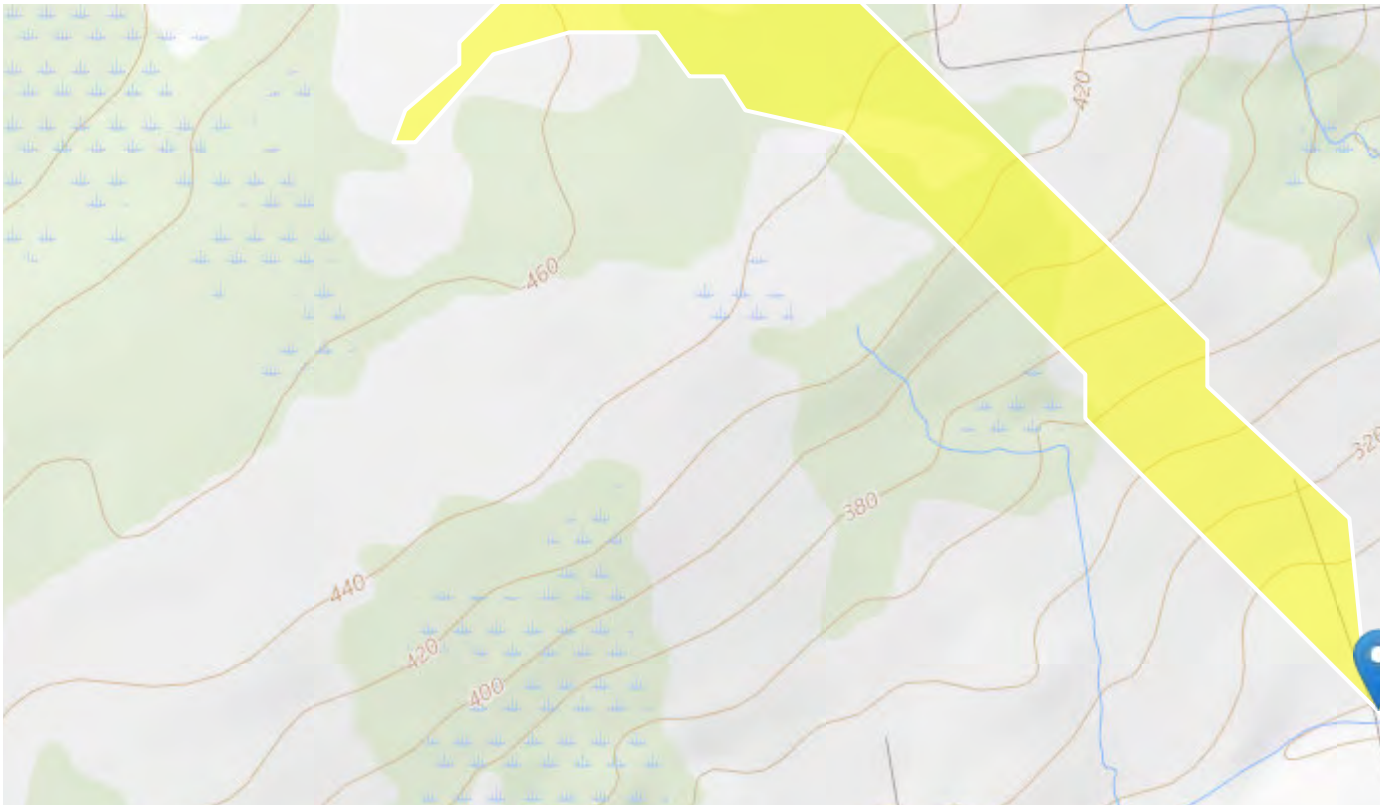
Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.78	ft
Critical Depth	0.97	ft
Channel Slope	0.07400	ft/ft
Critical Slope	0.03436	ft/ft

MP-96.30R2

Region ID: NJ
Workspace ID: NJ20190204190202140000
Clicked Point (Latitude, Longitude): 40.43823, -74.97581
Time: 2019-02-04 14:02:16 -0500



Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	0.041	square miles
STORAGE	Percentage of area of storage (lakes ponds reservoirs wetlands)	6.77	percent
CSL10_85	Change in elevation divided by length between points 10 and 85 percent of distance along main channel to basin divide - main channel method not known	288	feet per mi

Parameter Code	Parameter Description	Value	Unit
POPDENS	Basin Population Density	105	persons per square mile

Peak-Flow Statistics Parameters [Peak Unglaciated Piedmont Region 2009 5167]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.041	square miles	0.25	779
STORAGE	Percent Storage	6.77	percent	0.23	32
CSL10_85	Stream Slope 10 and 85 Method	288	feet per mi	4.31	191
POPDENS	Basin Population Density	105	persons per square mile	83	11084

Peak-Flow Statistics Disclaimers [Peak Unglaciated Piedmont Region 2009 5167]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors

Peak-Flow Statistics Flow Report [Peak Unglaciated Piedmont Region 2009 5167]

Statistic	Value	Unit
2 Year Peak Flood	22.9	ft^3/s
5 Year Peak Flood	40.7	ft^3/s
10 Year Peak Flood	55	ft^3/s
25 Year Peak Flood	75.8	ft^3/s
50 Year Peak Flood	93	ft^3/s
100 Year Peak Flood	112	ft^3/s
500 Year Peak Flood	161	ft^3/s

Peak-Flow Statistics Citations

Worksheet for M-96.30 STA 4+70_2YR_PIPE

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.09500	ft/ft
Discharge	22.90	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	286.00
0+07	286.00
0+37	283.10
0+38	282.80
0+39	282.53
0+42	283.10
0+43	283.40
0+55	286.00
0+70	286.00
0+80	285.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 286.00)	(0+80, 285.00)	0.045

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.92	ft
Elevation Range	282.53 to 286.00 ft	
Flow Area	4.01	ft²

Worksheet for M-96.30 STA 4+70_2YR_PIPE

Results

Wetted Perimeter		9.57	ft
Hydraulic Radius		0.42	ft
Top Width		9.29	ft
Normal Depth		0.92	ft
Critical Depth		1.09	ft
Critical Slope		0.03874	ft/ft
Velocity		5.70	ft/s
Velocity Head		0.51	ft
Specific Energy		1.43	ft
Froude Number		1.53	
Flow Type	Supercritical		

GVF Input Data

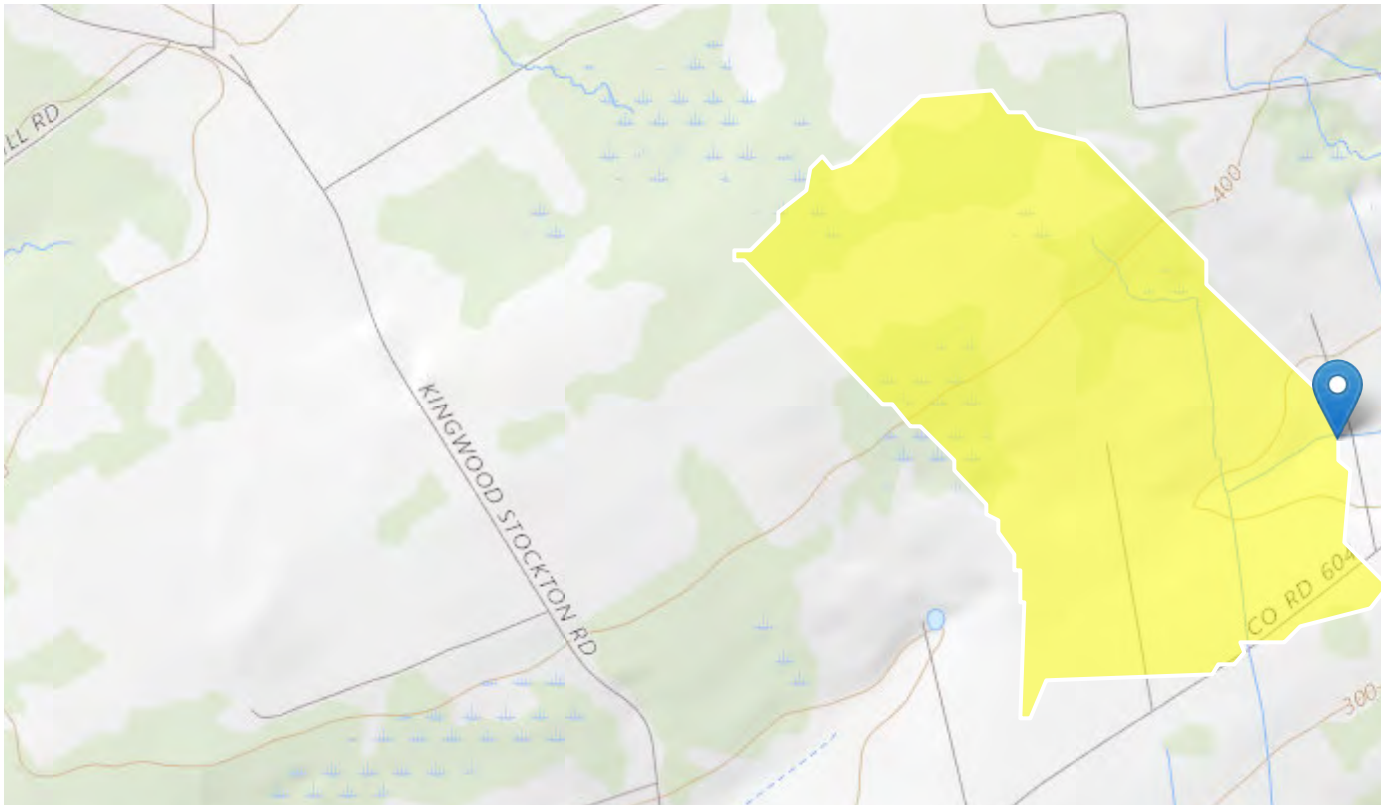
Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.92	ft
Critical Depth	1.09	ft
Channel Slope	0.09500	ft/ft
Critical Slope	0.03874	ft/ft

MP-96.31R2

Region ID: NJ
Workspace ID: NJ20190222171803426000
Clicked Point (Latitude, Longitude): 40.43806, -74.97615
Time: 2019-02-22 12:18:17 -0500



Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	0.26	square miles
STORAGE	Percentage of area of storage (lakes ponds reservoirs wetlands)	7.8	percent
CSL10_85	Change in elevation divided by length between points 10 and 85 percent of distance along main channel to basin divide - main channel method not known	254	feet per mi

Parameter Code	Parameter Description	Value	Unit
POPDENS	Basin Population Density	105	persons per square mile

Peak-Flow Statistics Parameters [Peak Unglaciated Piedmont Region 2009 5167]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.26	square miles	0.25	779
STORAGE	Percent Storage	7.8	percent	0.23	32
CSL10_85	Stream Slope 10 and 85 Method	254	feet per mi	4.31	191
POPDENS	Basin Population Density	105	persons per square mile	83	11084

Peak-Flow Statistics Disclaimers [Peak Unglaciated Piedmont Region 2009 5167]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors

Peak-Flow Statistics Flow Report [Peak Unglaciated Piedmont Region 2009 5167]

Statistic	Value	Unit
2 Year Peak Flood	88.5	ft^3/s
5 Year Peak Flood	153	ft^3/s
10 Year Peak Flood	205	ft^3/s
25 Year Peak Flood	279	ft^3/s
50 Year Peak Flood	340	ft^3/s
100 Year Peak Flood	408	ft^3/s
500 Year Peak Flood	580	ft^3/s

Peak-Flow Statistics Citations

Worksheet for M-96.31 STA 2+39_2YR_PIPE

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.01400	ft/ft
Discharge	88.50	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	286.00
0+35	286.00
0+40	282.80
0+41	282.40
0+44	280.70
0+49	279.89
0+55	281.20
0+59	282.90
0+63	284.00
1+00	286.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 286.00)	(1+00, 286.00)	0.050

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	2.15	ft
Elevation Range	279.89 to 286.00 ft	
Flow Area	21.29	ft²

Worksheet for M-96.31 STA 2+39_2YR_PIPE

Results

Wetted Perimeter		16.56	ft
Hydraulic Radius		1.29	ft
Top Width		15.79	ft
Normal Depth		2.15	ft
Critical Depth		1.75	ft
Critical Slope		0.03760	ft/ft
Velocity		4.16	ft/s
Velocity Head		0.27	ft
Specific Energy		2.42	ft
Froude Number		0.63	
Flow Type	Subcritical		

GVF Input Data

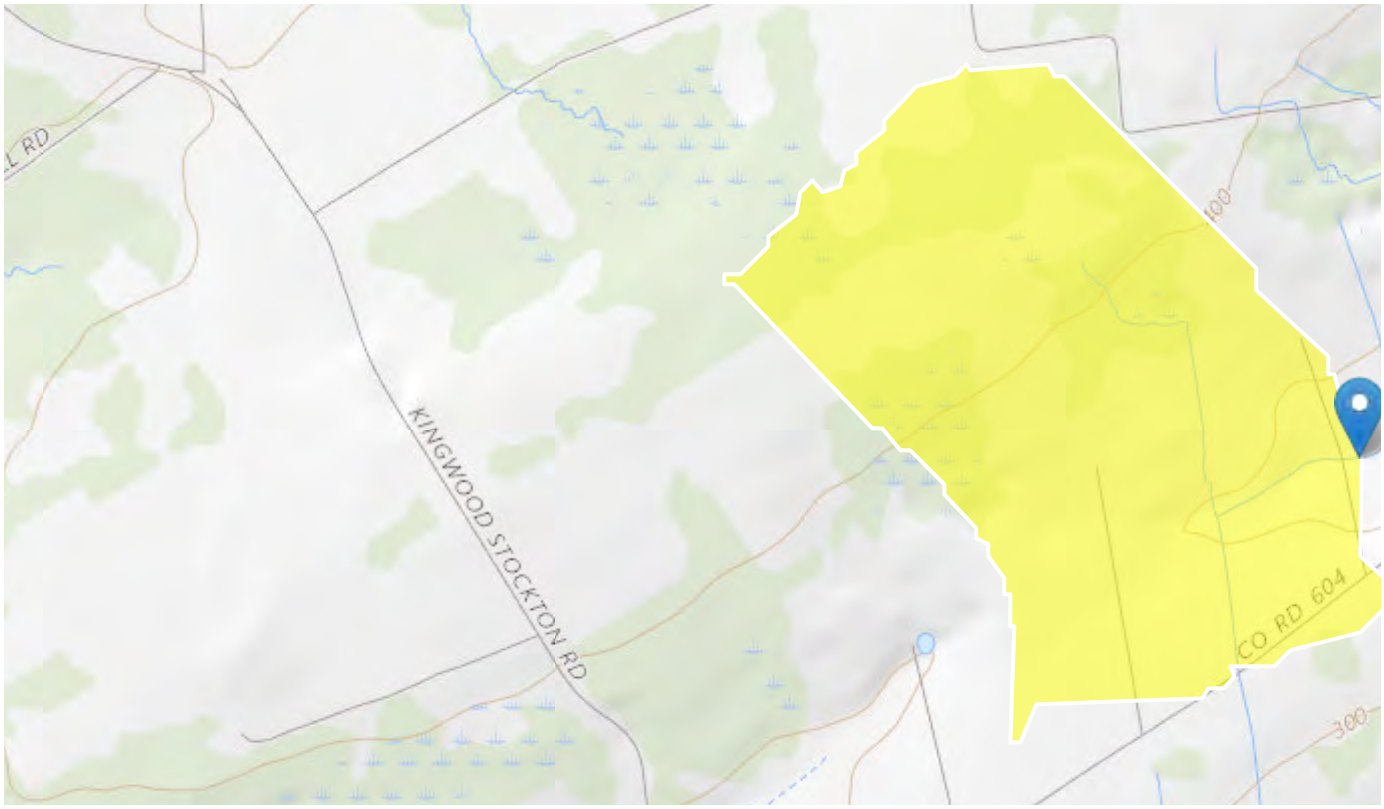
Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	2.15	ft
Critical Depth	1.75	ft
Channel Slope	0.01400	ft/ft
Critical Slope	0.03760	ft/ft

MP96.34R2

Region ID: NJ
Workspace ID: NJ20190222173048241000
Clicked Point (Latitude, Longitude): 40.43813, -74.97542
Time: 2019-02-22 12:31:01 -0500



Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	0.31	square miles
STORAGE	Percentage of area of storage (lakes ponds reservoirs wetlands)	7.48	percent
CSL10_85	Change in elevation divided by length between points 10 and 85 percent of distance along main channel to basin divide - main channel method not known	260	feet per mi

Parameter Code	Parameter Description	Value	Unit
POPDENS	Basin Population Density	105	persons per square mile

Peak-Flow Statistics Parameters [Peak Unglaciated Piedmont Region 2009 5167]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.31	square miles	0.25	779
STORAGE	Percent Storage	7.48	percent	0.23	32
CSL10_85	Stream Slope 10 and 85 Method	260	feet per mi	4.31	191
POPDENS	Basin Population Density	105	persons per square mile	83	11084

Peak-Flow Statistics Disclaimers [Peak Unglaciated Piedmont Region 2009 5167]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors

Peak-Flow Statistics Flow Report [Peak Unglaciated Piedmont Region 2009 5167]

Statistic	Value	Unit
2 Year Peak Flood	102	ft^3/s
5 Year Peak Flood	176	ft^3/s
10 Year Peak Flood	235	ft^3/s
25 Year Peak Flood	321	ft^3/s
50 Year Peak Flood	391	ft^3/s
100 Year Peak Flood	469	ft^3/s
500 Year Peak Flood	668	ft^3/s

Peak-Flow Statistics Citations

Worksheet for MP-96.34_STA4+71_BRIDGE_2YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.01600	ft/ft
Discharge	102.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	280.00
0+15	280.00
0+40	277.70
0+50	275.57
0+57	278.85
1+00	280.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 280.00)	(1+00, 280.00)	0.045

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	2.56	ft
Elevation Range	275.57 to 280.00 ft	
Flow Area	22.97	ft²
Wetted Perimeter	20.97	ft
Hydraulic Radius	1.10	ft
Top Width	20.15	ft
Normal Depth	2.56	ft

Worksheet for MP-96.34_STA4+71_BRIDGE_2YR

Results

Critical Depth		2.25	ft
Critical Slope		0.03056	ft/ft
Velocity		4.44	ft/s
Velocity Head		0.31	ft
Specific Energy		2.87	ft
Froude Number		0.73	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	2.56	ft
Critical Depth	2.25	ft
Channel Slope	0.01600	ft/ft
Critical Slope	0.03056	ft/ft

MP 96.75R2

Region ID:	NJ
Workspace ID:	NJ20180402123638202000
Clicked Point (Latitude, Longitude):	40.43314, -74.97130
Time:	2018-04-02 08:36:52 -0400

Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	0.037	square miles
STORAGE	Percentage of area of storage (lakes ponds reservoirs wetlands)	4.69	percent
CSL10_85	Change in elevation divided by length between points 10 and 85 percent of distance along main channel to basin divide - main channel method not known	623	feet per mi
POPDENS	Basin Population Density	105	persons per square mile

Peak-Flow Statistics Parameters [Peak Unglaciated Piedmont Region 2009 5167]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.037	square miles	0.25	779
STORAGE	Percent Storage	4.69	percent	0.23	32
CSL10_85	Stream Slope 10 and 85 Method	623	feet per mi	4.31	191
POPDENS	Basin Population Density	105	persons per square mile	83	11084

Peak-Flow Statistics Disclaimers [Peak Unglaciated Piedmont Region 2009 5167]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors

Peak-Flow Statistics Flow Report [Peak Unglaciated Piedmont Region 2009 5167]

Statistic	Value	Unit
2 Year Peak Flood	26.1	ft^3/s
5 Year Peak Flood	47.1	ft^3/s
10 Year Peak Flood	64.3	ft^3/s
25 Year Peak Flood	89.6	ft^3/s
50 Year Peak Flood	111	ft^3/s
100 Year Peak Flood	135	ft^3/s
500 Year Peak Flood	197	ft^3/s

Peak-Flow Statistics Citations

Watson, K.M.,and Schopp, R.D.,2009, Methodology for estimation of flood magnitude and frequency for New Jersey streams, U.S. Geological Survey Scientific Investigations Report 2009-5167, 51 p. (http://pubs.usgs.gov/sir/2009/5167/)

Worksheet for MP-96.75R2 STA0+25_2YR_PIPE

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.01300	ft/ft
Discharge	26.10	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	160.00
0+20	158.70
0+30	158.10
0+51	156.97
0+58	158.00
1+00	158.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 160.00)	(1+00, 158.00)	0.050

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.99	ft
Elevation Range	156.97 to 160.00 ft	
Flow Area	12.33	ft²
Wetted Perimeter	25.00	ft
Hydraulic Radius	0.49	ft
Top Width	24.90	ft
Normal Depth	0.99	ft

Worksheet for MP-96.75R2 STA0+25_2YR_PIPE

Results

Critical Depth	0.77	ft
Critical Slope	0.05037	ft/ft
Velocity	2.12	ft/s
Velocity Head	0.07	ft
Specific Energy	1.06	ft
Froude Number	0.53	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.99	ft
Critical Depth	0.77	ft
Channel Slope	0.01300	ft/ft
Critical Slope	0.05037	ft/ft

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↑195ft
MAP
03/12/19
N
13:09:11
LOG
-00.6°
-18.4°
EXTRAS
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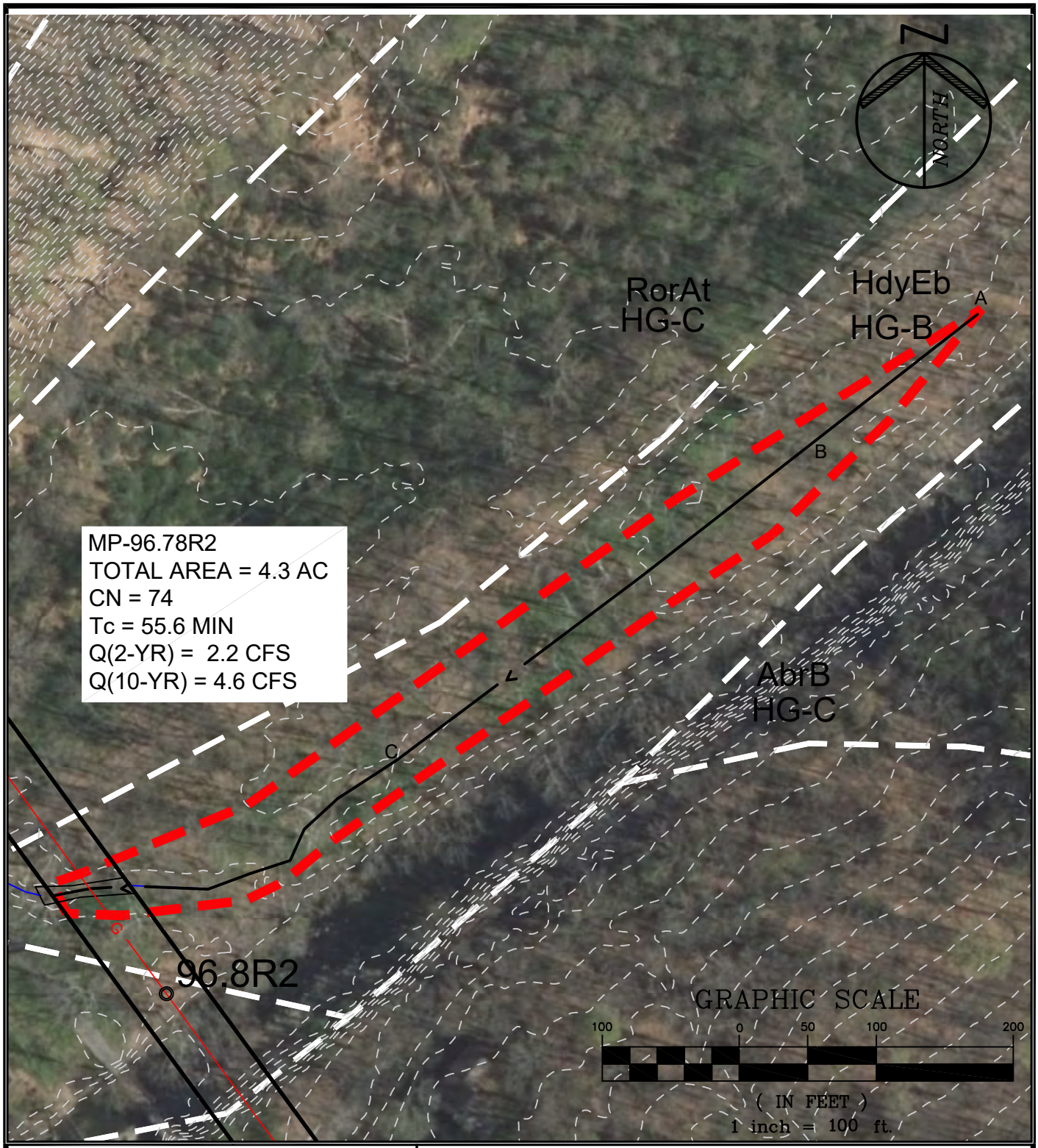

PAULUS, SOKOLOWSKI AND SARTOR, LLC.

1433 ROUTE 34
SUITE A4
WALL, NEW JERSEY 07727
PHONE: (848) 206-2626

CERTIFICATE OF AUTHORIZATION NO. 24GA28032700

PROJECT TITLE

PENNEAST PIPELINE

HUNTERDON AND MERCER COUNTY, NJ

SHEET TITLE

STREAM CROSSING DRAINAGE AREA MP-96.78R2

PROJ. NO.: 05516.0001	DRN. BY: JPS	SCALE: 1"=100'
DATE: 05/23/19	CK'D BY: WS	

FILE NAME: P:\05516\0001\DWGs\CADC-Civil\Plotdwgs\Drainage Area Maps\05516\001-Stream_DA_MP85.4-98.9-WAL.dwg\MP 96.78 LAST EDIT: 05/30/2019 - 01:14:27 PM LOGIN: jmcgowan@

PROJECT:	PennEast	JOB NO. 5516.0001	
		SHEET	DATE:4/9/2019
		BY:	IK
SUBJECT:	Tc Calculations	CHK'D	

Time of Concentration calculations with the application of the SCS TR-55 methodology.

Watershed or Subarea Designation: DA 96.78

Area 4.3 AC

SHEET FLOW

Segment ID		A-B			
Surface Description (Table 3-1)		WOODS			
Manning's Coefficient, n (Table 3-1)		0.400			
Flow Length, L (total <= 150)	(ft)	150			
Two Year Rainfall, P	(in)	3.4			
Land Slope, s	(ft/ft)	0.005			
Computed Tt = 0.007 (nL)^0.8 / P^0.5*s^0.4	(hrs)	0.839			0.839

SHALLOW CONCENTRATED FLOW

Segment ID		B-C			
Surface Description (paved or unpaved)		UNPAVED			
Flow Length, L	(ft)	385			
Watercourse slope, s	(ft/ft)	0.010			
Average Velocity, V (Figure 3-1)	(ft/s)	1.6			
Computed Tt = L / 3600V	(hrs)	0.067			0.067

CHANNEL FLOW

Segment ID		C-D			
Cross sectional Area, a	(sf)	12.00			
Wetted Perimeter, Pw	(ft)	14.47			
Hydraulic Radius, r =a/Pw	(ft)	0.829			
Channel Slope (ft/ft)	(ft/ft)	0.014			
Manning's Roughness Coefficient, n		0.040			
Velocity, V = 1.49r^(2/3)s^0.5 / n	(ft/s)	3.89			
Flow Length, L	(ft)	286			
Computed Tt = L / 3600V	(hrs)	0.020			0.020

Watershed or subarea Tc	0.926	hrs.
	55.6	min.

Use minimum Tc of 10 minutes

Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 05 / 23 / 2019

Hyd. No. 75

MP-96.78R2

Hydrograph type	= SCS Runoff	Peak discharge	= 2.150 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.70 hrs
Time interval	= 6 min	Hyd. volume	= 16,814 cuft
Drainage area	= 4.300 ac	Curve number	= 74.000
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 55.6 min
Total precip.	= 3.26 in	Distribution	= Custom
Storm duration	= C:\Users\IKuzmina\AppData\Local\Autodesk\C3D 2019\enu\HHApps\Hydrograp	Storm frequency	= 24 yrs

Hydrograph Discharge Table

(Printed values >= 1.00% of Qp.)

Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)
11.40	0.029	13.20	1.563	15.00	0.327	16.80	0.208
11.50	0.044	13.30	1.377	15.10	0.316	16.90	0.205
11.60	0.067	13.40	1.183	15.20	0.304	17.00	0.202
11.70	0.098	13.50	0.992	15.30	0.293	17.10	0.198
11.80	0.145	13.60	0.824	15.40	0.282	17.20	0.195
11.90	0.217	13.70	0.727	15.50	0.272	17.30	0.192
12.00	0.349	13.80	0.652	15.60	0.263	17.40	0.189
12.10	0.611	13.90	0.592	15.70	0.255	17.50	0.186
12.20	0.916	14.00	0.542	15.80	0.248	17.60	0.182
12.30	1.244	14.10	0.503	15.90	0.242	17.70	0.179
12.40	1.576	14.20	0.470	16.00	0.236	17.80	0.176
12.50	1.890	14.30	0.442	16.10	0.232	17.90	0.172
12.60	2.121	14.40	0.418	16.20	0.227	18.00	0.169
12.70	2.150	14.50	0.398	16.30	0.224	18.10	0.166
12.80	2.109	14.60	0.381	16.40	0.220	18.20	0.163
12.90	2.018	14.70	0.366	16.50	0.217	18.30	0.159
13.00	1.894	14.80	0.352	16.60	0.214	18.40	0.156
13.10	1.736	14.90	0.339	16.70	0.211	18.50	0.154

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Worksheet for MP 96.78R2 STA0+27_2YR_PIPE

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.02300	ft/ft
Discharge	2.20	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	158.00
0+36	158.00
0+45	157.00
0+49	155.12
0+55	156.20
0+70	158.00
1+00	158.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 158.00)	(1+00, 158.00)	0.050

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.56	ft
Elevation Range	155.12 to 158.00 ft	
Flow Area	1.17	ft²
Wetted Perimeter	4.33	ft
Hydraulic Radius	0.27	ft
Top Width	4.17	ft

Worksheet for MP 96.78R2 STA0+27_2YR_PIPE

Results

Normal Depth		0.56	ft
Critical Depth		0.47	ft
Critical Slope		0.06245	ft/ft
Velocity		1.88	ft/s
Velocity Head		0.06	ft
Specific Energy		0.62	ft
Froude Number		0.63	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.56	ft
Critical Depth	0.47	ft
Channel Slope	0.02300	ft/ft
Critical Slope	0.06245	ft/ft

+040.432523° / -074.969622°
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MAP
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N
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LOG
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263° S83W 4676mils TRUE
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1.0X

MP96.81R2

Region ID: NJ
Workspace ID: NJ20170808120336595000
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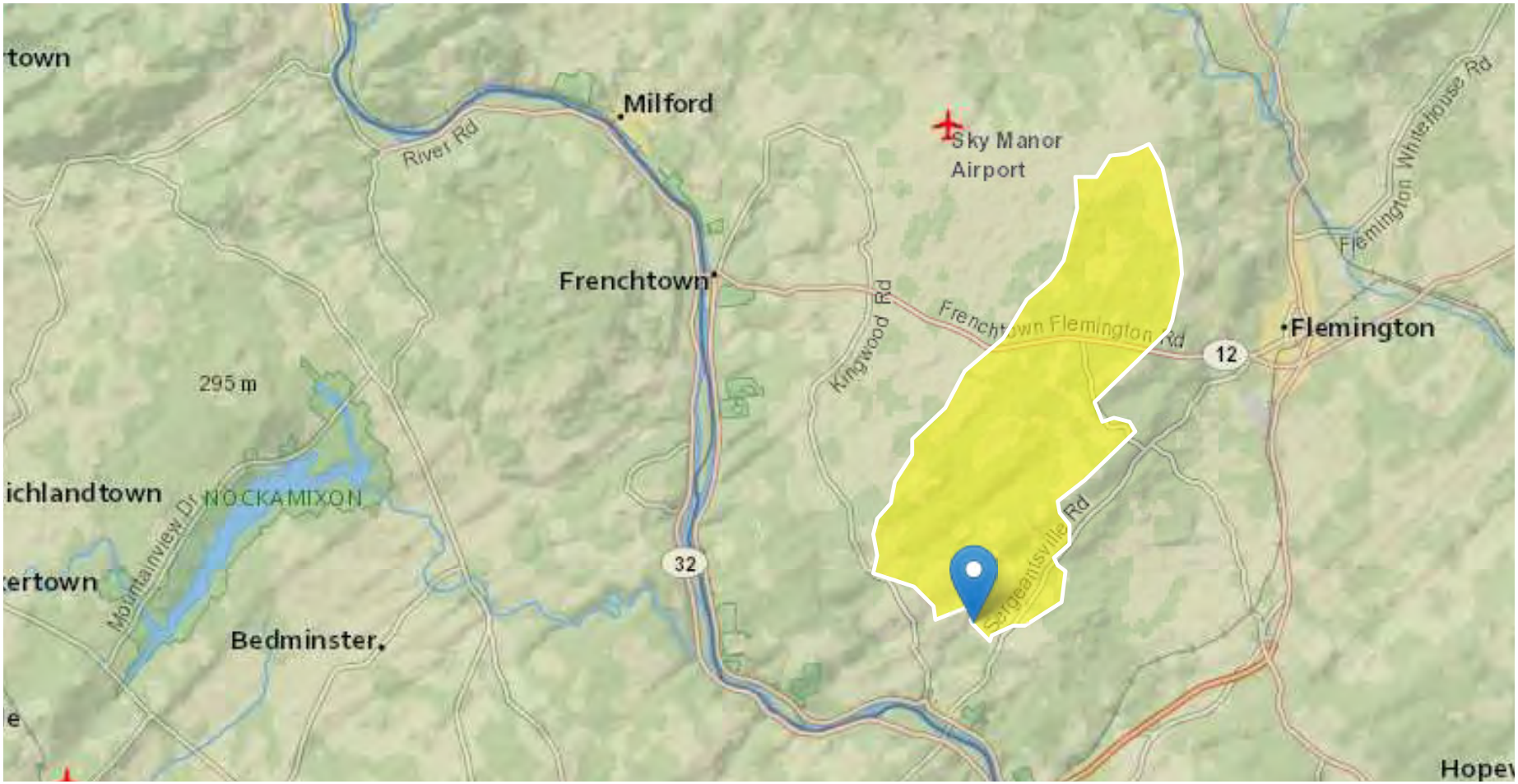

Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	24.2	square miles
STORAGE	Percentage of area of storage (lakes ponds reservoirs wetlands)	20.4	percent
CSL10_85	Change in elevation divided by length between points 10 and 85 percent of distance along main channel to basin divide - main channel method not known	35.9	feet per mi
POPDENS	Basin Population Density	129	persons per square mile

Peak-Flow Statistics Parameters [Peak Unglaciated Piedmont Region 2009 5167]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	24.2	square miles	0.25	779
STORAGE	Percent Storage	20.4	percent	0.23	32
CSL10_85	Stream Slope 10 and 85 Method	35.9	feet per mi	4.31	191
POPDENS	Basin Population Density	129	persons per square mile	83	11084

Peak-Flow Statistics Flow Report [Peak Unglaciated Piedmont Region 2009 5167]

PIl: Prediction Interval-Lower, PIu: Prediction Interval-Upper, SEp: Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	SEe	SEp	Equiv. Yrs.
2 Year Peak Flood	1610	ft^3/s	49	50.3	1
5 Year Peak Flood	2540	ft^3/s	49.4	50.9	2
10 Year Peak Flood	3230	ft^3/s	50.5	52.2	3

Statistic	Value	Unit	SEe	SEp	Equiv. Yrs.
25 Year Peak Flood	4180	ft^3/s	52.6	54.5	4
50 Year Peak Flood	4900	ft^3/s	54.7	56.8	5
100 Year Peak Flood	5730	ft^3/s	57.1	59.5	5
500 Year Peak Flood	7690	ft^3/s	63.9	66.3	6

Peak-Flow Statistics Citations

Watson, K.M.,and Schopp, R.D.,2009, Methodology for estimation of flood magnitude and frequency for New Jersey streams, U.S. Geological Survey Scientific Investigations Report 2009-5167, 51 p. (http://pubs.usgs.gov/sir/2009/5167/)

Worksheet for MP 96.81R2 STA0+25_2YR_PIPE

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.02300	ft/ft
Discharge	1610.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	158.00
0+47	153.96
0+86	156.70
0+92	160.00
0+96	162.00
1+00	164.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 158.00)	(1+00, 164.00)	0.050

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	4.10	ft
Elevation Range	153.96 to 164.00 ft	
Flow Area	204.77	ft²
Wetted Perimeter	88.88	ft
Hydraulic Radius	2.30	ft
Top Width	88.21	ft
Normal Depth	4.10	ft

Worksheet for MP 96.81R2 STA0+25_2YR_PIPE

Results

Critical Depth		3.94	ft
Critical Slope		0.02824	ft/ft
Velocity		7.86	ft/s
Velocity Head		0.96	ft
Specific Energy		5.06	ft
Froude Number		0.91	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	4.10	ft
Critical Depth	3.94	ft
Channel Slope	0.02300	ft/ft
Critical Slope	0.02824	ft/ft

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EXTRAS
197° S17W 3502mils TRUE
A-B
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1.0X

MP 97.34R2

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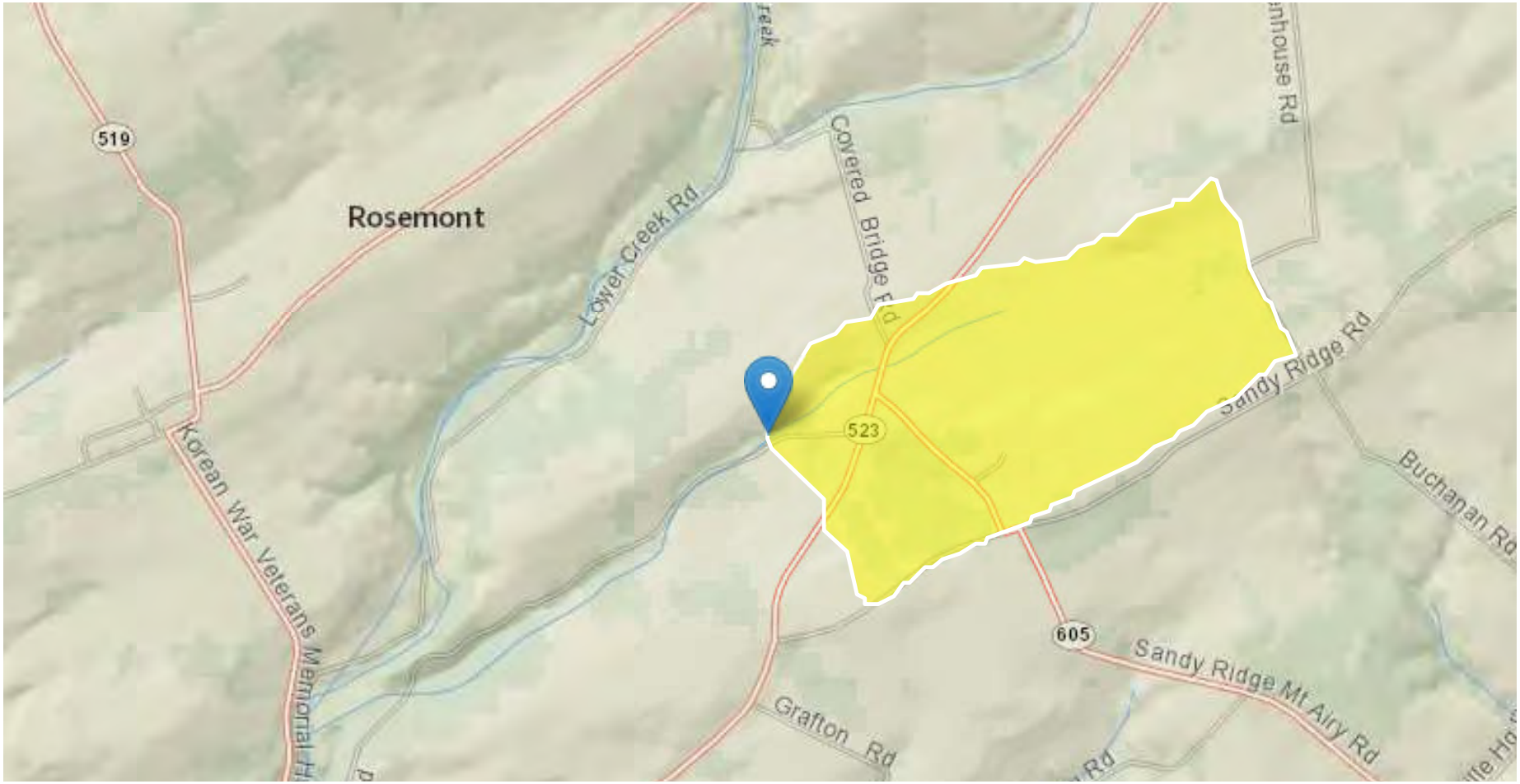
Workspace ID: NJ20170808121517226000
Clicked Point (Latitude, Longitude): 40.42612, -74.96485
Time: 2017-08-08 12:16:27 -0400



Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	0.62	square miles
STORAGE	Percentage of area of storage (lakes ponds reservoirs wetlands)	3.32	percent
CSL10_85	Change in elevation divided by length between points 10 and 85 percent of distance along main channel to basin divide - main channel method not known	75.7	feet per mi
POPDENS	Basin Population Density	142	persons per square mile

Peak-Flow Statistics Parameters [Peak Unglaciated Piedmont Region 2009 5167]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.62	square miles	0.25	779
STORAGE	Percent Storage	3.32	percent	0.23	32
CSL10_85	Stream Slope 10 and 85 Method	75.7	feet per mi	4.31	191
POPDENS	Basin Population Density	142	persons per square mile	83	11084

Peak-Flow Statistics Flow Report [Peak Unglaciated Piedmont Region 2009 5167]

PIl: Prediction Interval-Lower, PIu: Prediction Interval-Upper, SEp: Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	SEe	SEp	Equiv. Yrs.
2 Year Peak Flood	136	ft^3/s	49	50.3	1
5 Year Peak Flood	235	ft^3/s	49.4	50.9	2
10 Year Peak Flood	315	ft^3/s	50.5	52.2	3

Statistic	Value	Unit	SEe	SEp	Equiv. Yrs.
25 Year Peak Flood	430	ft^3/s	52.6	54.5	4
50 Year Peak Flood	524	ft^3/s	54.7	56.8	5
100 Year Peak Flood	630	ft^3/s	57.1	59.5	5
500 Year Peak Flood	902	ft^3/s	63.9	66.3	6

Peak-Flow Statistics Citations

Watson, K.M.,and Schopp, R.D.,2009, Methodology for estimation of flood magnitude and frequency for New Jersey streams, U.S. Geological Survey Scientific Investigations Report 2009-5167, 51 p. (http://pubs.usgs.gov/sir/2009/5167/)

Worksheet for MP-97.34_STA0+26_PIPE_2YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00200	ft/ft
Discharge	136.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	278.00
0+06	276.00
0+50	272.86
0+59	274.55
1+00	278.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 278.00)	(1+00, 278.00)	0.045

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	2.77	ft
Elevation Range	272.86 to 278.00 ft	
Flow Area	78.10	ft²
Wetted Perimeter	60.99	ft
Hydraulic Radius	1.28	ft
Top Width	60.69	ft
Normal Depth	2.77	ft
Critical Depth	1.65	ft

Worksheet for MP-97.34_STA0+26_PIPE_2YR

Results

Critical Slope		0.03173	ft/ft
Velocity		1.74	ft/s
Velocity Head		0.05	ft
Specific Energy		2.82	ft
Froude Number		0.27	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	2.77	ft
Critical Depth	1.65	ft
Channel Slope	0.00200	ft/ft
Critical Slope	0.03173	ft/ft

Worksheet for MP-97.34_STA0+16_BRIDGE_2YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00200	ft/ft
Discharge	136.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	276.00
0+06	276.00
0+41	273.70
0+50	272.79
0+60	274.70
1+00	278.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 276.00)	(1+00, 278.00)	0.045

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	2.92	ft
Elevation Range	272.79 to 278.00 ft	
Flow Area	78.66	ft²
Wetted Perimeter	62.09	ft
Hydraulic Radius	1.27	ft
Top Width	61.76	ft
Normal Depth	2.92	ft

Worksheet for MP-97.34_STA0+16_BRIDGE_2YR

Results

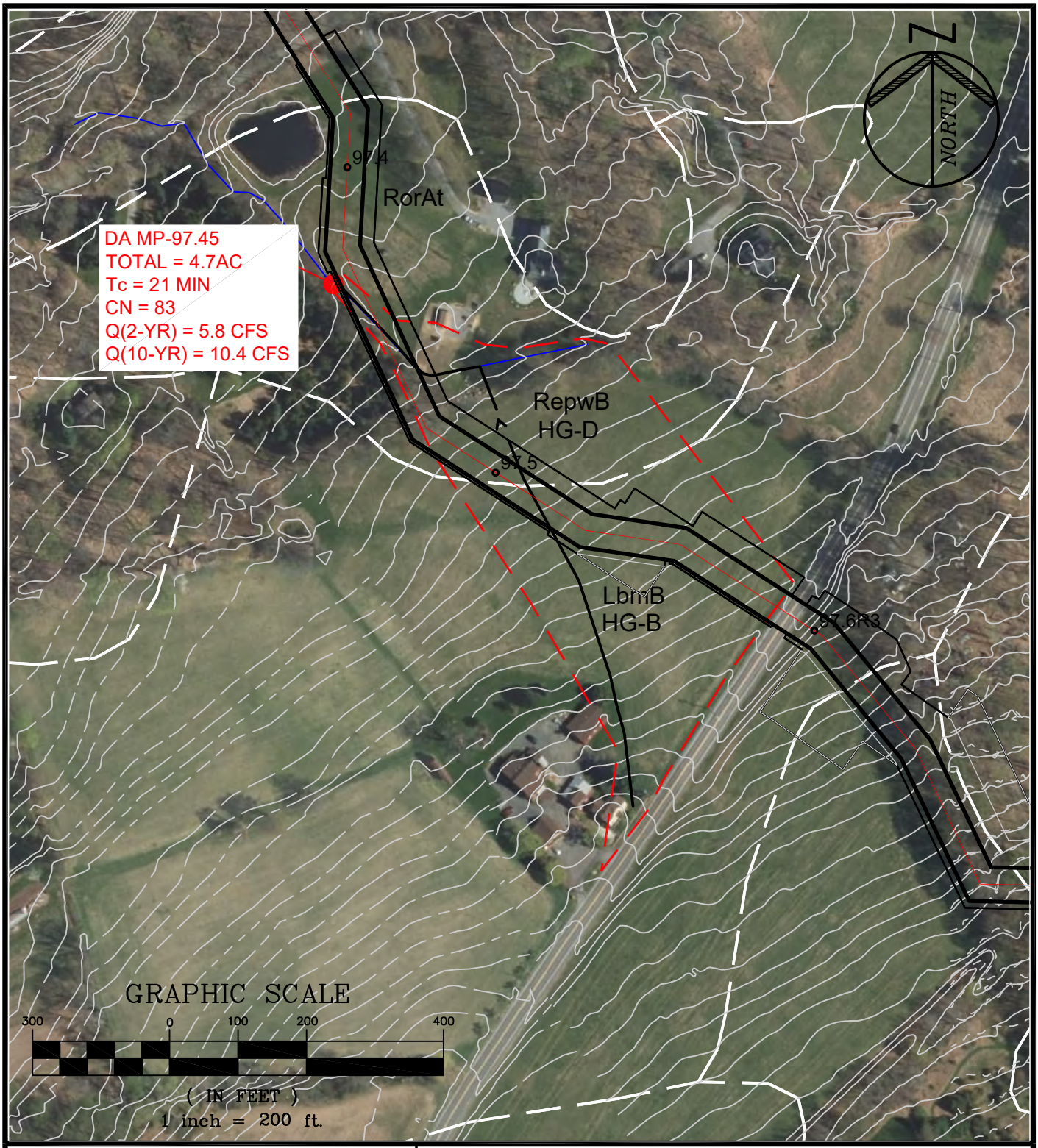
Critical Depth		1.80	ft
Critical Slope		0.03173	ft/ft
Velocity		1.73	ft/s
Velocity Head		0.05	ft
Specific Energy		2.97	ft
Froude Number		0.27	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	2.92	ft
Critical Depth	1.80	ft
Channel Slope	0.00200	ft/ft
Critical Slope	0.03173	ft/ft



PAULUS, SOKOLOWSKI AND SARTOR, LLC.

1433 ROUTE 34
SUITE A4
WALL, NEW JERSEY 07727
PHONE: (848) 206-2626

CERTIFICATE OF AUTHORIZATION NO. 24GA28032700

PROJECT TITLE

PENNEAST PIPELINE

HUNTERDON AND MERCER COUNTY, NJ

SHEET TITLE

STREAM CROSSING DRAINAGE AREA MP-97.45R2

PROJ. NO.: 05516.0001	DRN. BY: JPS	SCALE: 1"=200'
DATE: 05/23/19	CK'D BY: WS	

FILE NAME: P:\05516\0001\DWGs\CAD\C-Civil\Plotdwgs\Drainage Area Maps\05516\0001-Stream_DA_MP85.4-98.9-WAL.dwg\MP 97.45R2 LAST EDIT: 05/30/2019 - 01:39:24 PM LOGIN: jmcgowan@

Worksheet 2: Runoff curve number and runoff (Approximated)

Project	By	Date
PennEast	IK	22-Apr-19
Location	**Checked**	**Date**
Hunterdon County, NJ		

Check one: ☐ Present ☒ Developed | MP 97.45

1. Runoff curve number

Soil name and hydrologic group (appendix A)	Cover Description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN[1] Table 2-2	CN[1] Figure 2-3	CN[1] Figure 2-4	Area X acres / mi² / %	Product of CN x Area
Type C	Farmstead, Good Condition	82			2.94	241.08
Type D	Farmstead, Good Condition	86			1.76	151.36
1. Use only one CN source per line				Totals ➡	4.70	392.44

CN (weighted) = tot.prod. / tot. area = 392.44 / 4.70 = 83.5 ; Use CN ➡ **83**

2. Runoff

		Storm #1	Storm #2	Storm #3
Frequency……	yr			
Rainfall, P (24-hour)…….	in			
Runoff, Q……	in			

Use P and CN with table 2-1, figure 2-1, or equation 2-3 abd 2-4

PROJECT:	PennEast	JOB NO. 5516.0001	
		SHEET	DATE:4/22/2019
		BY:	IK
SUBJECT:	Tc Calculations	CHK'D	

Time of Concentration calculations with the application of the SCS TR-55 methodology.

Watershed or Subarea Designation: DA 97.45

Area 4.7 AC

SHEET FLOW

Segment ID		A-B			
Surface Description (Table 3-1)		WOODS			
Manning's Coefficient, n (Table 3-1)		0.400			
Flow Length, L (total <= 150)	(ft)	150			
Two Year Rainfall, P	(in)	3.4			
Land Slope, s	(ft/ft)	0.070			
Computed Tt = 0.007 (nL)^0.8 / P^0.5*s^0.4	(hrs)	0.292			0.292

SHALLOW CONCENTRATED FLOW

Segment ID		B-C			
Surface Description (paved or unpaved)		UNPAVED			
Flow Length, L	(ft)	535			
Watercourse slope, s	(ft/ft)	0.050			
Average Velocity, V (Figure 3-1)	(ft/s)	3.6			
Computed Tt = L / 3600V	(hrs)	0.041			0.041

CHANNEL FLOW

Segment ID		C-D			
Cross sectional Area, a	(sf)	2.75			
Wetted Perimeter, Pw	(ft)	4.70			
Hydraulic Radius, r =a/Pw	(ft)	0.585			
Channel Slope (ft/ft)	(ft/ft)	0.030			
Manning's Roughness Coefficient, n		0.040			
Velocity, V = 1.49r^(2/3)s^0.5 / n	(ft/s)	4.51			
Flow Length, L	(ft)	272			
Computed Tt = L / 3600V	(hrs)	0.017			0.017

Watershed or subarea Tc	0.350	hrs.
	21.0	min.

Use minimum Tc of 10 minutes

Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 05 / 23 / 2019

Hyd. No. 78

MP-97.45

Hydrograph type	= SCS Runoff	Peak discharge	= 5.775 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.30 hrs
Time interval	= 6 min	Hyd. volume	= 28,297 cuft
Drainage area	= 4.700 ac	Curve number	= 83.000
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 21.0 min
Total precip.	= 3.26 in	Distribution	= Custom
Storm duration	= C:\Users\IKuzmina\AppData\Local\Autodesk\C3D 2019\enu\HHApps\Hydrograp	Storm frequency	= 24

Hydrograph Discharge Table

(Printed values >= 1.00% of Qp.)

Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)
9.80	0.060	11.60	0.636	13.40	0.930	15.20	0.371
9.90	0.068	11.70	0.795	13.50	0.849	15.30	0.357
10.00	0.076	11.80	1.044	13.60	0.776	15.40	0.346
10.10	0.086	11.90	1.409	13.70	0.712	15.50	0.337
10.20	0.096	12.00	2.113	13.80	0.659	15.60	0.331
10.30	0.106	12.10	3.519	13.90	0.617	15.70	0.325
10.40	0.117	12.20	4.898	14.00	0.586	15.80	0.321
10.50	0.129	12.30	5.775	14.10	0.562	15.90	0.316
10.60	0.143	12.40	5.390	14.20	0.543	16.00	0.312
10.70	0.160	12.50	4.694	14.30	0.526	16.10	0.307
10.80	0.182	12.60	3.802	14.40	0.509	16.20	0.303
10.90	0.208	12.70	2.870	14.50	0.492	16.30	0.298
11.00	0.239	12.80	2.043	14.60	0.475	16.40	0.294
11.10	0.277	12.90	1.686	14.70	0.458	16.50	0.289
11.20	0.323	13.00	1.444	14.80	0.440	16.60	0.284
11.30	0.379	13.10	1.267	14.90	0.423	16.70	0.280
11.40	0.445	13.20	1.124	15.00	0.405	16.80	0.275
11.50	0.521	13.30	1.021	15.10	0.388	16.90	0.270

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Worksheet for MP-97.45_STA0+82_PIPE_2YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.04600	ft/ft
Discharge	5.80	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	292.00
0+47	290.30
0+50	290.49
0+51	290.50
0+60	290.40

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 292.00)	(0+60, 290.40)	0.045

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.29	ft
Elevation Range	290.30 to 292.00 ft	
Flow Area	2.99	ft²
Wetted Perimeter	20.81	ft
Hydraulic Radius	0.14	ft
Top Width	20.61	ft
Normal Depth	0.29	ft
Critical Depth	0.28	ft

Worksheet for MP-97.45_STA0+82_PIPE_2YR

Results

Critical Slope		0.05804	ft/ft
Velocity		1.94	ft/s
Velocity Head		0.06	ft
Specific Energy		0.35	ft
Froude Number		0.90	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.29	ft
Critical Depth	0.28	ft
Channel Slope	0.04600	ft/ft
Critical Slope	0.05804	ft/ft

+040.423136° / -074.962604°
↑ 242ft
MAP
03/22/19
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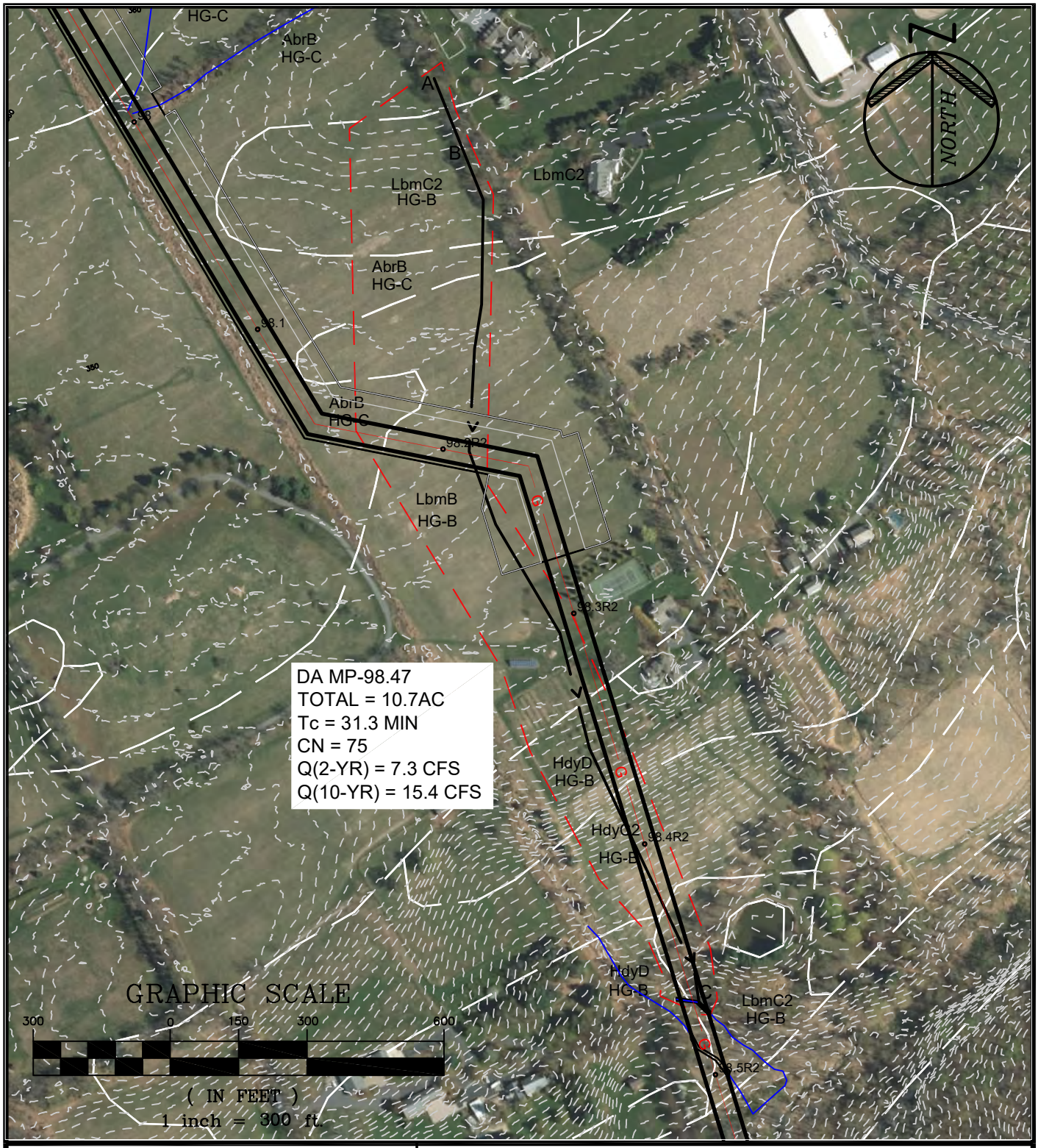

FILE NAME: P:\05516\0001\DWGs\CAD\C-Civil\Plotdwgs\Drainage Area Maps\05516\0001-Stream_DA_MP98.4-98.9-WAL.dwg\MP 98.47R2 LAST EDIT: 05/30/2019 - 01:52:38 PM LOGIN: jmcgowan@

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CERTIFICATE OF AUTHORIZATION NO. 24GA28032700

PROJECT TITLE

PENNEAST PIPELINE

HUNTERDON AND MERCER COUNTY, NJ

SHEET TITLE

STREAM CROSSING DRAINAGE AREA MP-98.47R2

PROJ. NO.: 05516.0001	DRN. BY: JPS	SCALE: 1"=300'
DATE: 05/23/19	CK'D BY: WS	

PROJECT:	PennEast	JOB NO. 5516.0001	
		SHEET	DATE:4/22/2019
		BY:	IK
SUBJECT:	Tc Calculations	CHK'D	

Time of Concentration calculations with the application of the SCS TR-55 methodology.

Watershed or Subarea Designation: DA 98.47

Area 10.7 AC

SHEET FLOW

Segment ID		A-B			
Surface Description (Table 3-1)		WOODS			
Manning's Coefficient, n (Table 3-1)		0.400			
Flow Length, L (total <= 150)	(ft)	150			
Two Year Rainfall, P	(in)	3.4			
Land Slope, s	(ft/ft)	0.040			
Computed Tt = 0.007 (nL)^0.8 / P^0.5*s^0.4	(hrs)	0.365			0.365

SHALLOW CONCENTRATED FLOW

Segment ID		B-C			
Surface Description (paved or unpaved)		UNPAVED			
Flow Length, L	(ft)	2007			
Watercourse slope, s	(ft/ft)	0.055			
Average Velocity, V (Figure 3-1)	(ft/s)	3.6			
Computed Tt = L / 3600V	(hrs)	0.155			0.155

CHANNEL FLOW

Segment ID		C-D			
Cross sectional Area, a	(sf)	3.00			
Wetted Perimeter, Pw	(ft)	4.80			
Hydraulic Radius, r =a/Pw	(ft)	0.625			
Channel Slope (ft/ft)	(ft/ft)	0.060			
Manning's Roughness Coefficient, n		0.040			
Velocity, V = 1.49r^(2/3)s^0.5 / n	(ft/s)	6.67			
Flow Length, L	(ft)	32			
Computed Tt = L / 3600V	(hrs)	0.001			0.001

Watershed or subarea Tc	0.521	hrs.
	31.3	min.

Use minimum Tc of 10 minutes

Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 05 / 23 / 2019

Hyd. No. 79

MP-98.47R2

Hydrograph type	= SCS Runoff	Peak discharge	= 7.296 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.40 hrs
Time interval	= 6 min	Hyd. volume	= 45,452 cuft
Drainage area	= 10.700 ac	Curve number	= 75.000
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 31.3 min
Total precip.	= 3.26 in	Distribution	= Custom
Storm duration	= C:\Users\IKuzmina\AppData\Local\Autodesk\C3D 2019\enu\HHApps\Hydrograp	Storm frequency	= 24 hrs

Hydrograph Discharge Table

(Printed values >= 1.00% of Qp.)

Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)
11.20	0.102	13.00	3.658	14.80	0.860	16.60	0.548
11.30	0.149	13.10	2.879	14.90	0.829	16.70	0.540
11.40	0.209	13.20	2.477	15.00	0.798	16.80	0.531
11.50	0.283	13.30	2.178	15.10	0.766	16.90	0.523
11.60	0.392	13.40	1.947	15.20	0.735	17.00	0.514
11.70	0.540	13.50	1.758	15.30	0.706	17.10	0.506
11.80	0.762	13.60	1.610	15.40	0.681	17.20	0.497
11.90	1.124	13.70	1.475	15.50	0.659	17.30	0.489
12.00	1.791	13.80	1.357	15.60	0.642	17.40	0.480
12.10	3.174	13.90	1.258	15.70	0.628	17.50	0.471
12.20	4.713	14.00	1.179	15.80	0.616	17.60	0.462
12.30	6.214	14.10	1.115	15.90	0.606	17.70	0.454
12.40	7.296	14.20	1.064	16.00	0.597	17.80	0.445
12.50	7.281	14.30	1.020	16.10	0.589	17.90	0.436
12.60	6.888	14.40	0.984	16.20	0.581	18.00	0.427
12.70	6.252	14.50	0.952	16.30	0.573	18.10	0.418
12.80	5.469	14.60	0.921	16.40	0.565	18.20	0.410
12.90	4.561	14.70	0.891	16.50	0.557	18.30	0.402

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Worksheet for MP-98.47R2_STA0+27_2YR_PIPE

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.03000	ft/ft
Discharge	7.30	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	262.00
0+13	260.00
0+35	258.00
0+48	256.00
0+50	254.82
0+52	256.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 262.00)	(0+52, 256.00)	0.050

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	1.11	ft
Elevation Range	254.82 to 262.00 ft	
Flow Area	2.29	ft²
Wetted Perimeter	4.68	ft
Hydraulic Radius	0.49	ft
Top Width	4.12	ft
Normal Depth	1.11	ft

Worksheet for MP-98.47R2_STA0+27_2YR_PIPE

Results

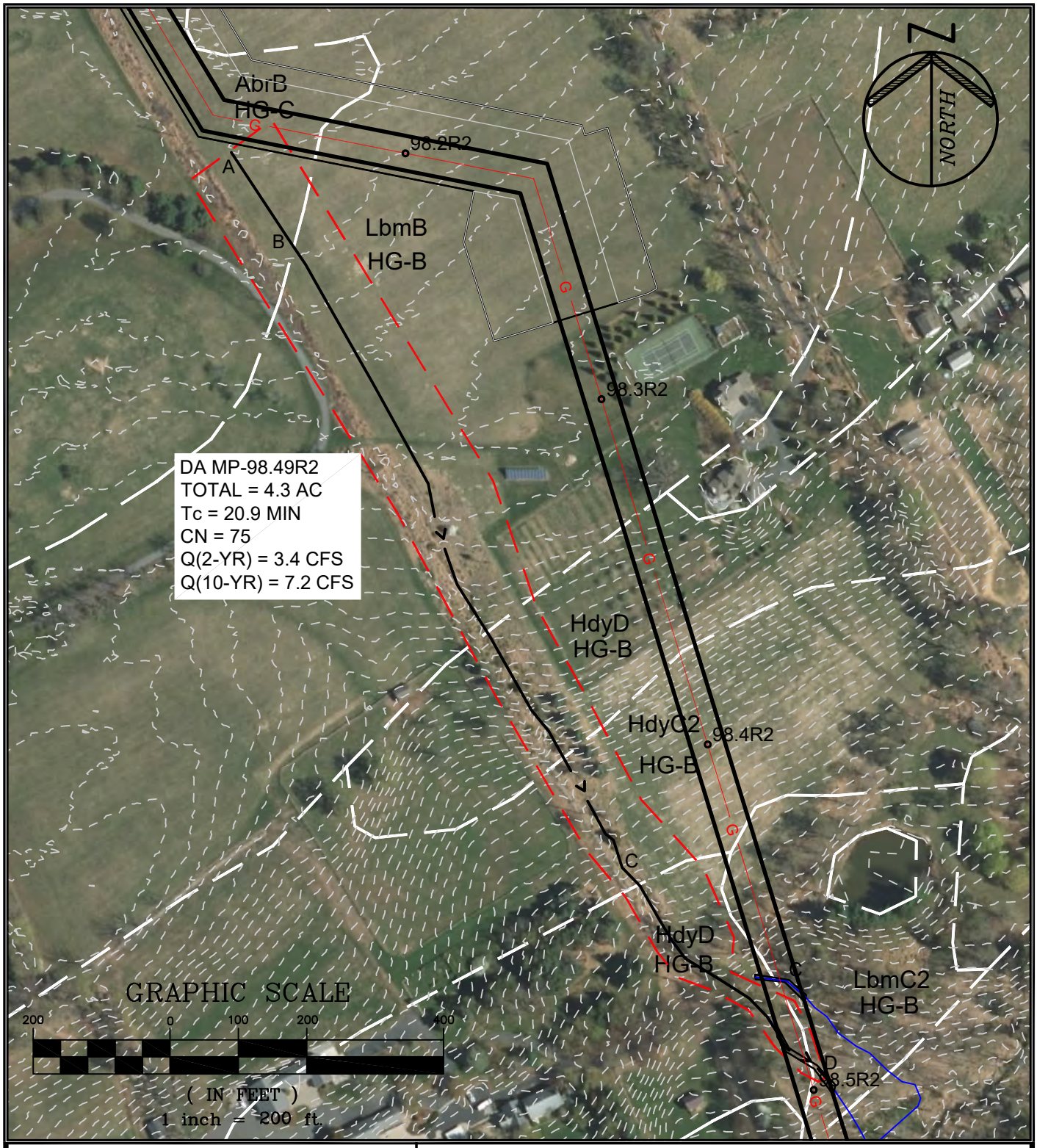
Critical Depth		0.99	ft
Critical Slope		0.05454	ft/ft
Velocity		3.19	ft/s
Velocity Head		0.16	ft
Specific Energy		1.27	ft
Froude Number		0.76	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.11	ft
Critical Depth	0.99	ft
Channel Slope	0.03000	ft/ft
Critical Slope	0.05454	ft/ft



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CERTIFICATE OF AUTHORIZATION NO. 24GA28032700

PROJECT TITLE

PENNEAST PIPELINE

HUNTERDON AND MERCER COUNTY, NJ

SHEET TITLE

STREAM CROSSING DRAINAGE AREA MP-98.49R2

PROJ. NO.: 05516.0001	DRN. BY: JPS	SCALE: 1"=200'
DATE: 05/23/19	CK'D BY: WS	

FILE NAME: P:\05516\0001\DWGs\CAD\C-Civil\Plotdwgs\Drainage Area Maps\05516\0001-Stream_DA_MP85.4-98.9-WAL.dwg\MP 98.49R2 LAST EDIT: 05/30/2019 - 01:56:57 PM LOGIN: jmcgowan@

PROJECT:	PennEast	JOB NO. 5516.0001	
		SHEET	DATE:4/22/2019
		BY:	IK
SUBJECT:	Tc Calculations	CHK'D	

Time of Concentration calculations with the application of the SCS TR-55 methodology.

Watershed or Subarea Designation: DA 98.49

Area 4.3 AC

SHEET FLOW

Segment ID		A-B			
Surface Description (Table 3-1)		GRASS			
Manning's Coefficient, n (Table 3-1)		0.150			
Flow Length, L (total <= 150)	(ft)	150			
Two Year Rainfall, P	(in)	3.4			
Land Slope, s	(ft/ft)	0.013			
Computed Tt = 0.007 (nL)^0.8 / P^0.5*s^0.4	(hrs)	0.261			0.261

SHALLOW CONCENTRATED FLOW

Segment ID		B-C			
Surface Description (paved or unpaved)		UNPAVED			
Flow Length, L	(ft)	1049			
Watercourse slope, s	(ft/ft)	0.065			
Average Velocity, V (Figure 3-1)	(ft/s)	4.0			
Computed Tt = L / 3600V	(hrs)	0.073			0.073

CHANNEL FLOW

Segment ID		C-D			
Cross sectional Area, a	(sf)	4.70			
Wetted Perimeter, Pw	(ft)	6.94			
Hydraulic Radius, r =a/Pw	(ft)	0.677			
Channel Slope (ft/ft)	(ft/ft)	0.084			
Manning's Roughness Coefficient, n		0.040			
Velocity, V = 1.49r^(2/3)s^0.5 / n	(ft/s)	8.33			
Flow Length, L	(ft)	438			
Computed Tt = L / 3600V	(hrs)	0.015			0.015

Watershed or subarea Tc	0.349	hrs.
	20.9	min.

Use minimum Tc of 10 minutes

Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 05 / 23 / 2019

Hyd. No. 80

MP-98.49

Hydrograph type	= SCS Runoff	Peak discharge	= 3.448 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.30 hrs
Time interval	= 6 min	Hyd. volume	= 17,712 cuft
Drainage area	= 4.300 ac	Curve number	= 75.000
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 20.9 min
Total precip.	= 3.26 in	Distribution	= Custom
Storm duration	= C:\Users\IKuzmina\AppData\Local\Autodesk\C3D 2019\enu\HHApps\Hydrograp	Shape factor	= 484

Hydrograph Discharge Table

(Printed values >= 1.00% of Qp.)

Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)
11.10	0.040	12.90	1.161	14.70	0.331	16.50	0.213
11.20	0.059	13.00	1.002	14.80	0.319	16.60	0.209
11.30	0.083	13.10	0.884	14.90	0.307	16.70	0.206
11.40	0.114	13.20	0.788	15.00	0.294	16.80	0.203
11.50	0.150	13.30	0.719	15.10	0.282	16.90	0.199
11.60	0.207	13.40	0.657	15.20	0.270	17.00	0.196
11.70	0.287	13.50	0.602	15.30	0.260	17.10	0.193
11.80	0.415	13.60	0.551	15.40	0.252	17.20	0.189
11.90	0.616	13.70	0.507	15.50	0.246	17.30	0.186
12.00	1.023	13.80	0.470	15.60	0.242	17.40	0.183
12.10	1.896	13.90	0.442	15.70	0.238	17.50	0.179
12.20	2.802	14.00	0.420	15.80	0.235	17.60	0.176
12.30	3.448	14.10	0.403	15.90	0.232	17.70	0.172
12.40	3.312	14.20	0.390	16.00	0.229	17.80	0.169
12.50	2.961	14.30	0.379	16.10	0.225	17.90	0.165
12.60	2.461	14.40	0.367	16.20	0.222	18.00	0.162
12.70	1.909	14.50	0.355	16.30	0.219	18.10	0.158
12.80	1.392	14.60	0.343	16.40	0.216	18.20	0.155

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Worksheet for MP-98.49R2_STA0+51_2YR_PIPE

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.05600	ft/ft
Discharge	3.40	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	250.00
0+47	249.90
0+50	249.08
0+53	249.40
1+00	250.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 250.00)	(1+00, 250.00)	0.045

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.43	ft
Elevation Range	249.08 to 250.00 ft	
Flow Area	1.73	ft²
Wetted Perimeter	13.61	ft
Hydraulic Radius	0.13	ft
Top Width	13.54	ft
Normal Depth	0.43	ft
Critical Depth	0.43	ft

Worksheet for MP-98.49R2_STA0+51_2YR_PIPE

Results

Critical Slope		0.05915	ft/ft
Velocity		1.97	ft/s
Velocity Head		0.06	ft
Specific Energy		0.49	ft
Froude Number		0.97	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.43	ft
Critical Depth	0.43	ft
Channel Slope	0.05600	ft/ft
Critical Slope	0.05915	ft/ft

MP 98.53R2

Region ID: NJ
Workspace ID: NJ20170808122423638000
Clicked Point (Latitude, Longitude): 40.41361, -74.95216
Time: 2017-08-08 12:25:27 -0400

Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	0.53	square miles
STORAGE	Percentage of area of storage (lakes ponds reservoirs wetlands)	3.8	percent
CSL10_85	Change in elevation divided by length between points 10 and 85 percent of distance along main channel to basin divide - main channel method not known	116	feet per mi
POPDENS	Basin Population Density	148	persons per square mile

Peak-Flow Statistics Parameters [Peak Unglaciated Piedmont Region 2009 5167]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.53	square miles	0.25	779
STORAGE	Percent Storage	3.8	percent	0.23	32
CSL10_85	Stream Slope 10 and 85 Method	116	feet per mi	4.31	191
POPDENS	Basin Population Density	148	persons per square mile	83	11084

Peak-Flow Statistics Flow Report [Peak Unglaciated Piedmont Region 2009 5167]

PIl: Prediction Interval-Lower, PIu: Prediction Interval-Upper, SEp: Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	SEe	SEp	Equiv. Yrs.
2 Year Peak Flood	134	ft^3/s	49	50.3	1
5 Year Peak Flood	232	ft^3/s	49.4	50.9	2
10 Year Peak Flood	311	ft^3/s	50.5	52.2	3

Worksheet for MP-98.53R2 STA 0.29_2YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.02100	ft/ft
Discharge	134.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	232.00
0+43	232.00
0+50	230.43
0+54	231.00
0+63	233.80
0+87	234.00
1+00	234.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 232.00)	(1+00, 234.00)	0.030

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	1.87	ft
Elevation Range	230.43 to 234.00 ft	
Flow Area	29.57	ft²
Wetted Perimeter	58.89	ft
Hydraulic Radius	0.50	ft
Top Width	58.19	ft

Worksheet for MP-98.53R2 STA 0.29_2YR

Results

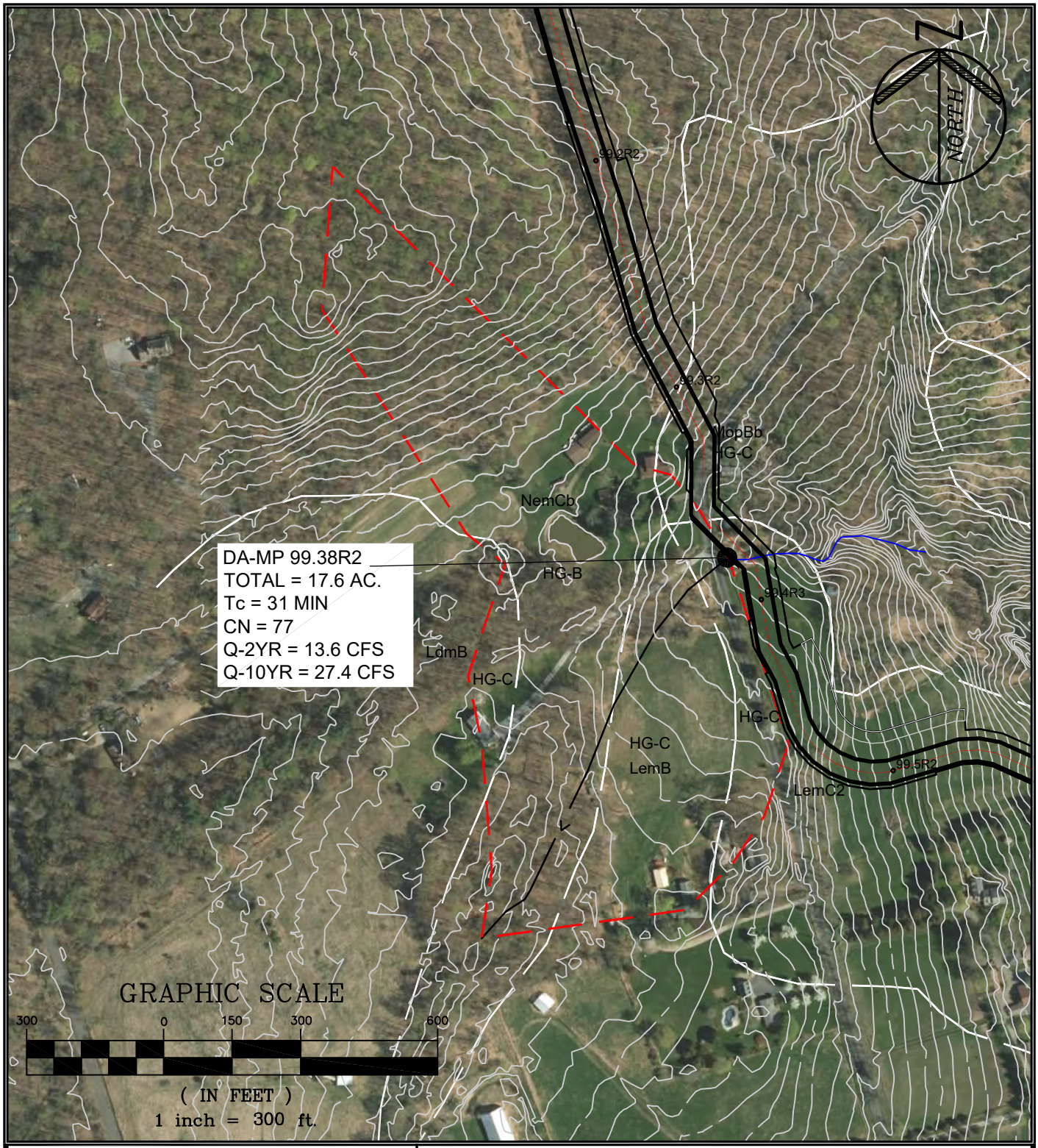
Normal Depth	1.87	ft
Critical Depth	1.91	ft
Critical Slope	0.01630	ft/ft
Velocity	4.53	ft/s
Velocity Head	0.32	ft
Specific Energy	2.19	ft
Froude Number	1.12	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.87	ft
Critical Depth	1.91	ft
Channel Slope	0.02100	ft/ft
Critical Slope	0.01630	ft/ft



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CERTIFICATE OF AUTHORIZATION NO. 24GA28032700

PROJECT TITLE

PENNEAST PIPELINE

HUNTERDON AND MERCER COUNTY, NJ

SHEET TITLE

STREAM CROSSING DRAINAGE AREA MP-99.38R2

PROJ. NO.: 05516.0001	DRN. BY: JPS	SCALE: 1"=300'
DATE: 05/23/19	CK'D BY: WS	

FILE NAME: P:\05516\0001\DWGs\CAD\C-Civil\Plotdwgs\Drainage Area Maps\05516\0001-Stream_DA_MP85.4-98.9-WAL.dwg\MP 99.38R2 LAST EDIT: 05/30/2019 - 01:34:39 PM LOGIN: jmcgowan@

Worksheet 2: Runoff curve number and runoff (Approximated)

Project	By	Date
PennEast	IK	11-Mar-19
Location	**Checked**	**Date**
Hunterdon County, NJ		

Check one: ☐ Present ☒ Developed | MP 99.38R2

1. Runoff curve number

Soil name and hydrologic group (appendix A)	Cover Description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN[1] Table 2-2	CN[1] Figure 2-3	CN[1] Figure 2-4	Area ☒ acres / ☐ mi² / ☐ %	Product of CN x Area
Type B	Farmstead, Good Condition	74			10.60	784.40
Type C	Farmstead, Good Condition	82			7.00	574.00
1. Use only one CN source per line				Totals ➡	17.60	1,358.40

CN (weighted) = tot.prod. / tot. area = 1,358.40 / 17.60 = 77.2 ; Use CN ➡ **77**

2. Runoff

		Storm #1	Storm #2	Storm #3
Frequency……	yr			
Rainfall, P (24-hour)…….	in			
Runoff, Q……	in			

Use P and CN with table 2-1, figure 2-1, or equation 2-3 abd 2-4

PROJECT:	PennEast	JOB NO. 5516.0001	
		SHEET	DATE: 03/10/2019
		BY:	IK
SUBJECT:	Tc Calculations	CHK'D	

Time of Concentration calculations with the application of the SCS TR-55 methodology.

Watershed or Subarea Designation: DA 99.38R2

Area 17.6 AC

SHEET FLOW

Segment ID		A-B			
Surface Description (Table 3-1)		WOODS			
Manning's Coefficient, n (Table 3-1)		0.400			
Flow Length, L (total <= 150)	(ft)	150			
Two Year Rainfall, P	(in)	3.4			
Land Slope, s	(ft/ft)	0.030			
Computed Tt = 0.007 (nL)^0.8 / P^0.5*s^0.4	(hrs)	0.410			0.410

SHALLOW CONCENTRATED FLOW

Segment ID		B-C	C-D		
Surface Description (paved or unpaved)		UNPAVED	PAVED		
Flow Length, L	(ft)	812	40		
Watercourse slope, s	(ft/ft)	0.022	0.020		
Average Velocity, V (Figure 3-1)	(ft/s)	2.2	2.6		
Computed Tt = L / 3600V	(hrs)	0.103	0.004		0.107

CHANNEL FLOW

Segment ID		C-D			
Cross sectional Area, a	(sf)	1.00			
Wetted Perimeter, Pw	(ft)	1.00			
Hydraulic Radius, r =a/Pw	(ft)	1.000			
Channel Slope (ft/ft)	(ft/ft)	1.000			
Manning's Roughness Coefficient, n		1.000			
Velocity, V = 1.49r^(2/3)s^0.5 / n	(ft/s)	1.49			
Flow Length, L	(ft)	0			
Computed Tt = L / 3600V	(hrs)	0.000			0.000

Watershed or subarea Tc	0.516	hrs.
	31.0	min.

Use minimum Tc of 10 minutes

Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 05 / 23 / 2019

Hyd. No. 62

MP-99.38R2

Hydrograph type	= SCS Runoff	Peak discharge	= 13.55 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.40 hrs
Time interval	= 6 min	Hyd. volume	= 82,675 cuft
Drainage area	= 17.600 ac	Curve number	= 77.000
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 31.0 min
Total precip.	= 3.26 in	Distribution	= Custom
Storm duration	= C:\Users\IKuzmina\AppData\Local\Autodesk\C3D 2019\enu\HHApps\Hydrograp	Storm frequency	= 24

Hydrograph Discharge Table

(Printed values >= 1.00% of Qp.)

Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)
10.90	0.155	12.70	11.39	14.50	1.672	16.30	1.002
11.00	0.208	12.80	9.904	14.60	1.619	16.40	0.987
11.10	0.274	12.90	8.211	14.70	1.564	16.50	0.973
11.20	0.355	13.00	6.545	14.80	1.510	16.60	0.958
11.30	0.455	13.10	5.123	14.90	1.455	16.70	0.943
11.40	0.580	13.20	4.397	15.00	1.399	16.80	0.928
11.50	0.730	13.30	3.861	15.10	1.343	16.90	0.913
11.60	0.945	13.40	3.446	15.20	1.289	17.00	0.898
11.70	1.236	13.50	3.108	15.30	1.238	17.10	0.883
11.80	1.668	13.60	2.844	15.40	1.193	17.20	0.868
11.90	2.362	13.70	2.604	15.50	1.155	17.30	0.853
12.00	3.617	13.80	2.394	15.60	1.124	17.40	0.838
12.10	6.164	13.90	2.217	15.70	1.099	17.50	0.822
12.20	8.963	14.00	2.076	15.80	1.078	17.60	0.807
12.30	11.66	14.10	1.964	15.90	1.061	17.70	0.791
12.40	13.55	14.20	1.871	16.00	1.045	17.80	0.776
12.50	13.42	14.30	1.794	16.10	1.031	17.90	0.760
12.60	12.62	14.40	1.729	16.20	1.016	18.00	0.745

<<

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Worksheet for MP-99.38_STA0+63_PIPE_2YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.04100	ft/ft
Discharge	13.60	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	256.00
0+43	255.00
0+50	254.21
0+52	255.60
0+80	258.00
1+00	258.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 256.00)	(1+00, 258.00)	0.045

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.87	ft
Elevation Range	254.21 to 258.00 ft	
Flow Area	4.20	ft²
Wetted Perimeter	12.43	ft
Hydraulic Radius	0.34	ft
Top Width	12.15	ft
Normal Depth	0.87	ft

Worksheet for MP-99.38_STA0+63_PIPE_2YR

Results

Critical Depth		0.86	ft
Critical Slope		0.04326	ft/ft
Velocity		3.24	ft/s
Velocity Head		0.16	ft
Specific Energy		1.04	ft
Froude Number		0.97	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.87	ft
Critical Depth	0.86	ft
Channel Slope	0.04100	ft/ft
Critical Slope	0.04326	ft/ft

Worksheet for MP-99.38_STA0_93_BRIDGE_2YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.04100	ft/ft
Discharge	13.60	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	256.00
0+05	256.00
0+44	253.50
0+50	253.39
0+56	254.40
1+00	256.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 256.00)	(1+00, 256.00)	0.045

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.48	ft
Elevation Range	253.39 to 256.00 ft	
Flow Area	4.54	ft²
Wetted Perimeter	15.14	ft
Hydraulic Radius	0.30	ft
Top Width	15.09	ft
Normal Depth	0.48	ft

Worksheet for MP-99.38_STA0_93_BRIDGE_2YR

Results

Critical Depth	0.47	ft
Critical Slope	0.04449	ft/ft
Velocity	3.00	ft/s
Velocity Head	0.14	ft
Specific Energy	0.62	ft
Froude Number	0.96	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.48	ft
Critical Depth	0.47	ft
Channel Slope	0.04100	ft/ft
Critical Slope	0.04449	ft/ft

MP-99.63R2

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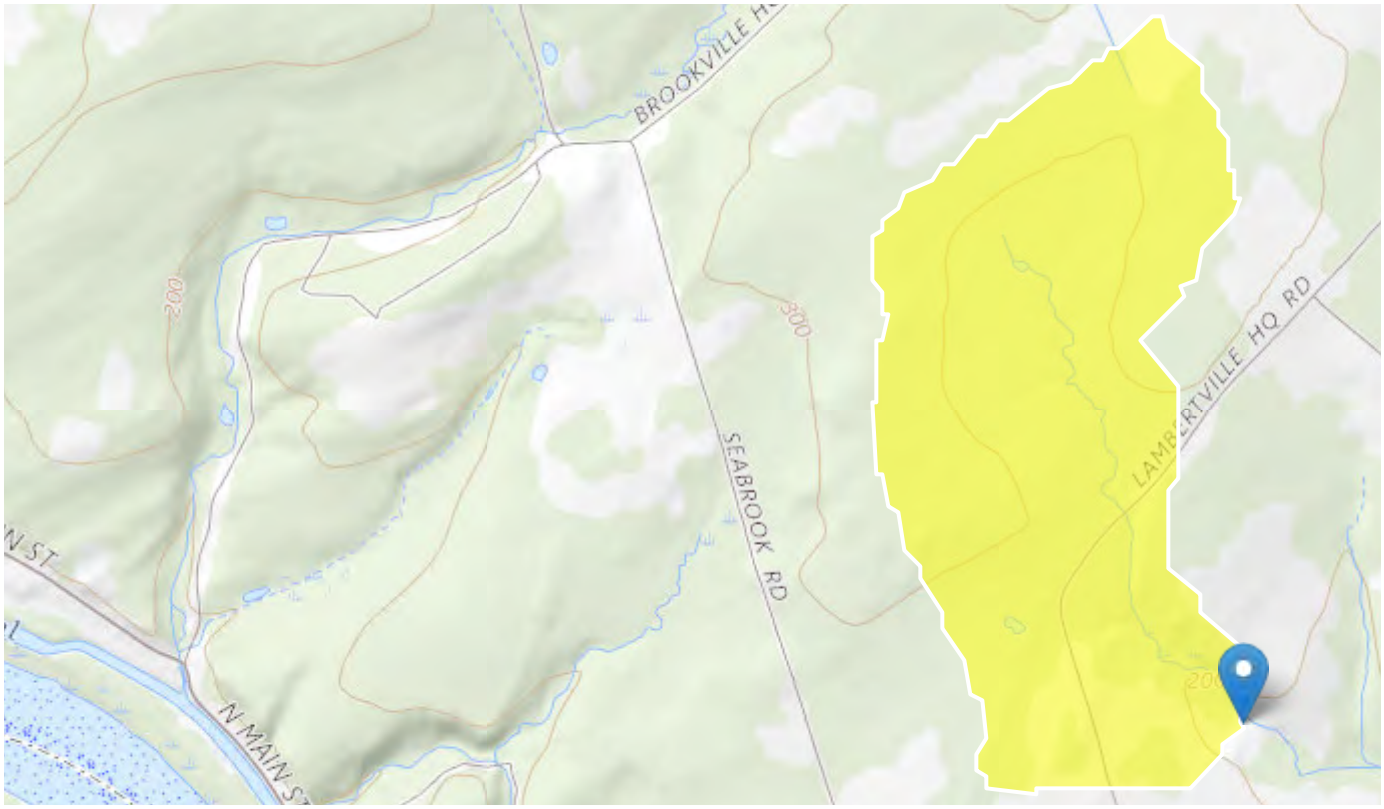

Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	0.26	square miles
STORAGE	Percentage of area of storage (lakes ponds reservoirs wetlands)	2.19	percent
CSL10_85	Change in elevation divided by length between points 10 and 85 percent of distance along main channel to basin divide - main channel method not known	128	feet per mi

Parameter Code	Parameter Description	Value	Unit
POPDENS	Basin Population Density	148	persons per square mile

Peak-Flow Statistics Parameters [Peak Unglaciated Piedmont Region 2009 5167]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.26	square miles	0.25	779
STORAGE	Percent Storage	2.19	percent	0.23	32
CSL10_85	Stream Slope 10 and 85 Method	128	feet per mi	4.31	191
POPDENS	Basin Population Density	148	persons per square mile	83	11084

Peak-Flow Statistics Flow Report [Peak Unglaciated Piedmont Region 2009 5167]

PIl: Prediction Interval-Lower, PIu: Prediction Interval-Upper, SEp: Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	SEp	Equiv. Yrs.
2 Year Peak Flood	82.2	ft^3/s	50.3	1
5 Year Peak Flood	145	ft^3/s	50.9	2
10 Year Peak Flood	197	ft^3/s	52.2	3
25 Year Peak Flood	272	ft^3/s	54.5	4
50 Year Peak Flood	335	ft^3/s	56.8	5
100 Year Peak Flood	406	ft^3/s	59.5	5
500 Year Peak Flood	590	ft^3/s	66.3	6

Peak-Flow Statistics Citations

Watson, K.M.,and Schopp, R.D.,2009, Methodology for estimation of flood magnitude and frequency for New Jersey streams, U.S. Geological Survey Scientific Investigations Report 2009-5167, 51 p. (http://pubs.usgs.gov/sir/2009/5167/)

Worksheet for MP-99.63_STA2+21_PIPE_2YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.03900	ft/ft
Discharge	82.20	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	182.00
0+02	182.00
0+31	178.00
0+44	175.40
0+50	174.20
0+55	176.20
0+78	180.00
1+00	182.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 182.00)	(1+00, 182.00)	0.045

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	1.89	ft
Elevation Range	174.20 to 182.00 ft	
Flow Area	13.49	ft²
Wetted Perimeter	14.94	ft
Hydraulic Radius	0.90	ft

Worksheet for MP-99.63_STA2+21_PIPE_2YR

Results

Top Width		14.41	ft
Normal Depth		1.89	ft
Critical Depth		1.97	ft
Critical Slope		0.03120	ft/ft
Velocity		6.09	ft/s
Velocity Head		0.58	ft
Specific Energy		2.47	ft
Froude Number		1.11	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.89	ft
Critical Depth	1.97	ft
Channel Slope	0.03900	ft/ft
Critical Slope	0.03120	ft/ft

Worksheet for MP-99.63_STA2+11_BRIDGE_2YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.03900	ft/ft
Discharge	82.20	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	182.00
0+02	182.00
0+32	178.00
0+50	174.34
0+55	177.00
0+71	180.00
0+94	182.00
1+00	182.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 182.00)	(1+00, 182.00)	0.045

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	1.95	ft
Elevation Range	174.34 to 182.00 ft	
Flow Area	13.24	ft²
Wetted Perimeter	14.26	ft
Hydraulic Radius	0.93	ft

Worksheet for MP-99.63_STA2+11_BRIDGE_2YR

Results

Top Width		13.61	ft
Normal Depth		1.95	ft
Critical Depth		2.03	ft
Critical Slope		0.03125	ft/ft
Velocity		6.21	ft/s
Velocity Head		0.60	ft
Specific Energy		2.54	ft
Froude Number		1.11	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.95	ft
Critical Depth	2.03	ft
Channel Slope	0.03900	ft/ft
Critical Slope	0.03125	ft/ft

MP 99.87R2

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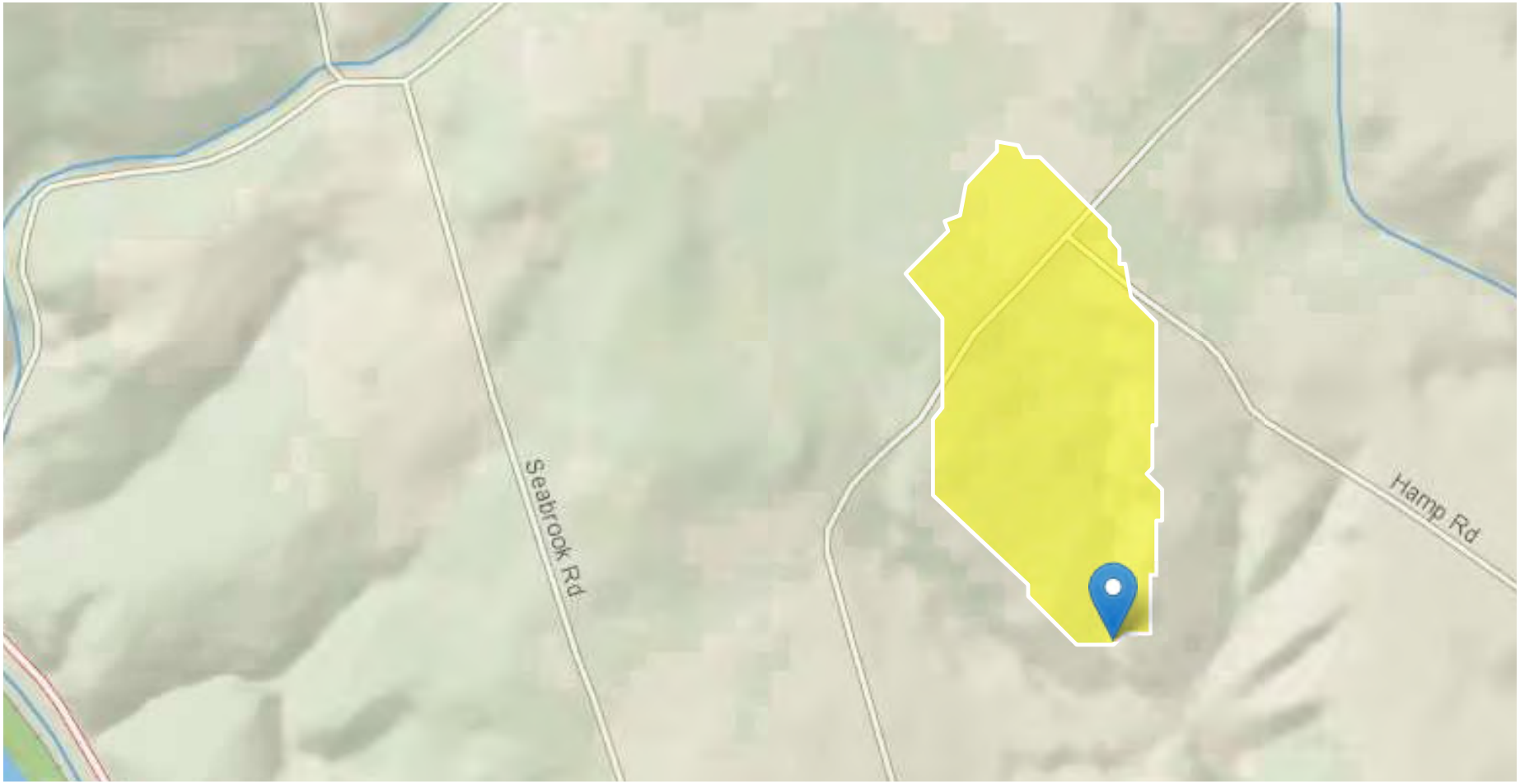


Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	0.12	square miles
STORAGE	Percentage of area of storage (lakes ponds reservoirs wetlands)	1.17	percent
CSL10_85	Change in elevation divided by length between points 10 and 85 percent of distance along main channel to basin divide - main channel method not known	268	feet per mi
POPDENS	Basin Population Density	148	persons per square mile

Peak-Flow Statistics Parameters [Peak Unglaciated Piedmont Region 2009 5167]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.12	square miles	0.25	779
STORAGE	Percent Storage	1.17	percent	0.23	32
CSL10_85	Stream Slope 10 and 85 Method	268	feet per mi	4.31	191
POPDENS	Basin Population Density	148	persons per square mile	83	11084

Peak-Flow Statistics Disclaimers [Peak Unglaciated Piedmont Region 2009 5167]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors

Peak-Flow Statistics Flow Report [Peak Unglaciated Piedmont Region 2009 5167]

Statistic	Value	Unit
2 Year Peak Flood	56.4	ft^3/s
5 Year Peak Flood	102	ft^3/s
10 Year Peak Flood	140	ft^3/s
25 Year Peak Flood	197	ft^3/s
50 Year Peak Flood	246	ft^3/s
100 Year Peak Flood	300	ft^3/s
500 Year Peak Flood	445	ft^3/s

Peak-Flow Statistics Citations

Watson, K.M.,and Schopp, R.D.,2009, Methodology for estimation of flood magnitude and frequency for New Jersey streams, U.S. Geological Survey Scientific Investigations Report 2009-5167, 51 p. (http://pubs.usgs.gov/sir/2009/5167/)

Worksheet for MP-99.87R2 STA 0+32_2YR_PIPE

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.05500	ft/ft
Discharge	56.40	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	156.00
0+37	156.00
0+44	155.00
0+49	154.72
0+55	155.55
0+59	158.00
0+77	166.00
0+92	168.00
1+00	170.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 156.00)	(1+00, 170.00)	0.050

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	1.07	ft
Elevation Range	154.72 to 170.00 ft	
Flow Area	10.99	ft²
Wetted Perimeter	17.39	ft

Worksheet for MP-99.87R2 STA 0+32_2YR_PIPE

Results

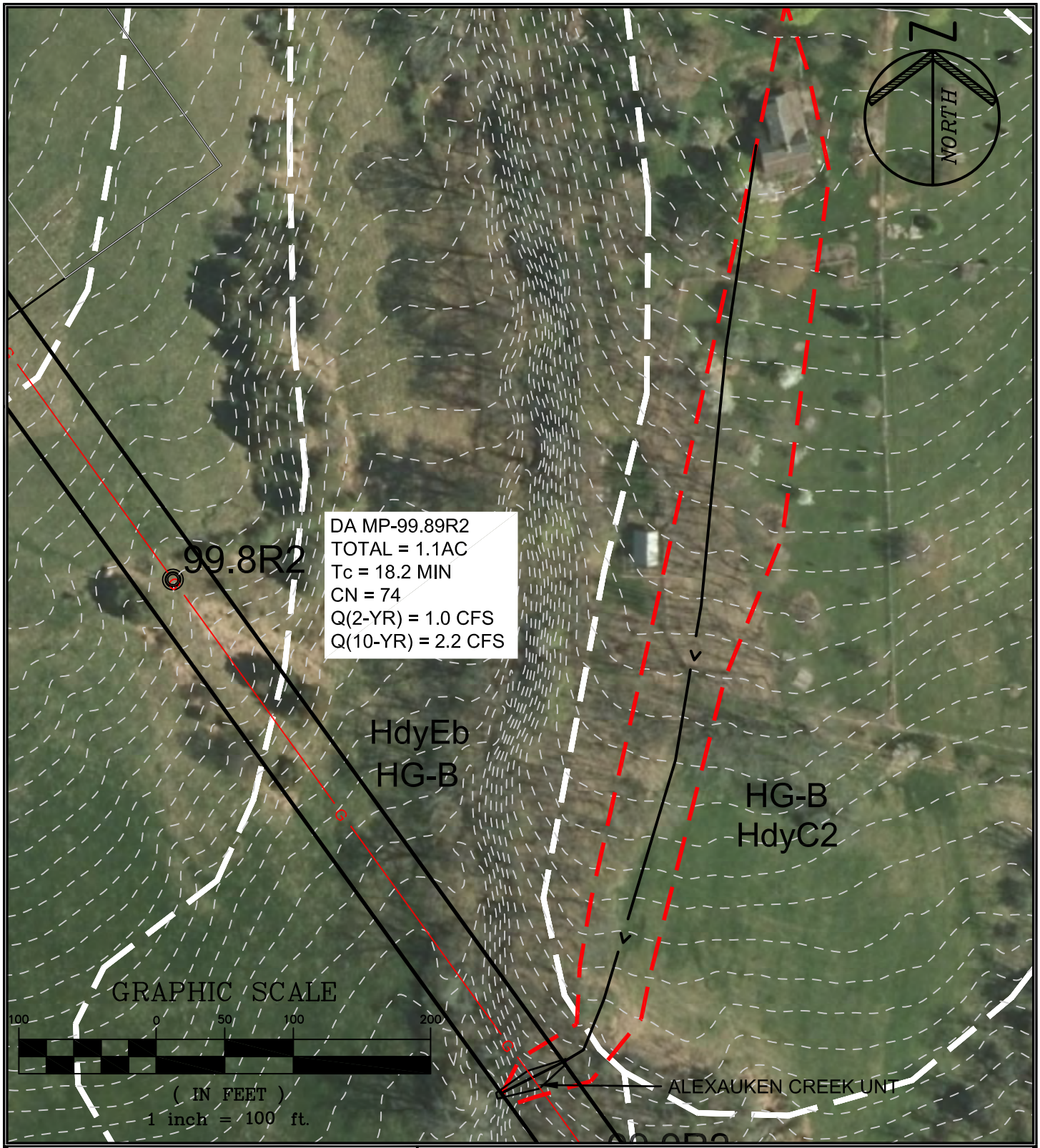
Hydraulic Radius		0.63	ft
Top Width		17.21	ft
Normal Depth		1.07	ft
Critical Depth		1.33	ft
Critical Slope		0.05390	ft/ft
Velocity		5.13	ft/s
Velocity Head		0.41	ft
Specific Energy		1.48	ft
Froude Number		1.13	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.07	ft
Critical Depth	1.33	ft
Channel Slope	0.05500	ft/ft
Critical Slope	0.05390	ft/ft



PAULUS, SOKOLOWSKI AND SARTOR, LLC.

1433 ROUTE 34
SUITE A4
WALL, NEW JERSEY 07727
PHONE: (848) 206-2626

CERTIFICATE OF AUTHORIZATION NO. 24GA28032700

PROJECT TITLE

PENNEAST PIPELINE

HUNTERDON AND MERCER COUNTY, NJ

SHEET TITLE

STREAM CROSSING DRAINAGE AREA MP 99.89R2

PROJ. NO.:	05516.0001	DRN. BY:	JPS	SCALE:	1"=100'
DATE:	05/23/19	CK'D BY:	WS		

FILE NAME: P:\05516\0001\DWGs\CAD\C-Civil\Plotdwgs\Drainage Area Maps\05516001-Stream_DA_MP100.8-114-WAL.dwg\MP 99.89R2 LAST EDIT: 06/13/2019 - 11:26:48 AM LOGIN: lkuzmina@

Worksheet 2: Runoff curve number and runoff (Approximated)

Project	By	Date
PennEast	IK	22-Apr-19
Location	**Checked**	**Date**
Hunterdon County, NJ		

Check one: ☐ Present ☒ Developed MP 99.89

1. Runoff curve number

Soil name and hydrologic group (appendix A)	Cover Description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN[1] Table 2-2	CN[1] Figure 2-3	CN[1] Figure 2-4	Area X acres mi² %	Product of CN x Area
Type B	Farmstead, Good Condition	74			1.10	81.40
				Totals ➡	1.10	81.40

1. Use only one CN source per line

CN (weighted) = tot.prod. / tot. area = 81.40 / 1.10 = 74.0 ; Use CN ➡ **74**

2. Runoff

		Storm #1	Storm #2	Storm #3
Frequency……	yr			
Rainfall, P (24-hour)…….	in			
Runoff, Q……	in			

Use P and CN with table 2-1, figure 2-1, or equation 2-3 abd 2-4

PROJECT:	PennEast	JOB NO. 5516.0001	
		SHEET	DATE:4/22/2019
		BY:	IK
SUBJECT:	Tc Calculations	CHK'D	

Time of Concentration calculations with the application of the SCS TR-55 methodology.

Watershed or Subarea Designation: DA 99.89R2

Area 1.1 AC

SHEET FLOW

Segment ID		A-B				
Surface Description (Table 3-1)		WOODS				
Manning's Coefficient, n (Table 3-1)		0.400				
Flow Length, L (total <= 150)	(ft)	150				
Two Year Rainfall, P	(in)	3.4				
Land Slope, s	(ft/ft)	0.087				
Computed Tt = 0.007 (nL)^0.8 / P^0.5*s^0.4	(hrs)	0.268				0.268

SHALLOW CONCENTRATED FLOW

Segment ID		B-C				
Surface Description (paved or unpaved)		UNPAVED				
Flow Length, L	(ft)	482				
Watercourse slope, s	(ft/ft)	0.070				
Average Velocity, V (Figure 3-1)	(ft/s)	4.0				
Computed Tt = L / 3600V	(hrs)	0.033				0.033

CHANNEL FLOW

Segment ID		C-D				
Cross sectional Area, a	(sf)	4.70				
Wetted Perimeter, Pw	(ft)	6.94				
Hydraulic Radius, r =a/Pw	(ft)	0.677				
Channel Slope (ft/ft)	(ft/ft)	0.187				
Manning's Roughness Coefficient, n		0.040				
Velocity, V = 1.49r^(2/3)s^0.5 / n	(ft/s)	12.42				
Flow Length, L	(ft)	107				
Computed Tt = L / 3600V	(hrs)	0.002				0.002

Watershed or subarea Tc	0.303	hrs.
	18.2	min.

Use minimum Tc of 10 minutes

Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 05 / 23 / 2019

Hyd. No. 81

MP-99.89

Hydrograph type	= SCS Runoff	Peak discharge	= 1.014 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.20 hrs
Time interval	= 6 min	Hyd. volume	= 4,033 cuft
Drainage area	= 1.100 ac	Curve number	= 74.000
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 18.2 min
Total precip.	= 3.26 in	Distribution	= Custom
Storm duration	= C:\Users\IKuzmina\AppData\Local\Autodesk\C3D 2019\enu\HHApps\Hydrograp	Storm frequency	= 24 yrs

Hydrograph Discharge Table

(Printed values >= 1.00% of Qp.)

Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)
11.20	0.014	13.00	0.194	14.80	0.070	16.60	0.048
11.30	0.021	13.10	0.176	14.90	0.067	16.70	0.047
11.40	0.030	13.20	0.159	15.00	0.064	16.80	0.046
11.50	0.040	13.30	0.145	15.10	0.062	16.90	0.045
11.60	0.058	13.40	0.134	15.20	0.059	17.00	0.045
11.70	0.087	13.50	0.124	15.30	0.057	17.10	0.044
11.80	0.127	13.60	0.113	15.40	0.056	17.20	0.043
11.90	0.201	13.70	0.104	15.50	0.056	17.30	0.042
12.00	0.363	13.80	0.098	15.60	0.055	17.40	0.041
12.10	0.741	13.90	0.095	15.70	0.054	17.50	0.041
12.20	1.014	14.00	0.092	15.80	0.054	17.60	0.040
12.30	0.879	14.10	0.090	15.90	0.053	17.70	0.039
12.40	0.651	14.20	0.087	16.00	0.052	17.80	0.038
12.50	0.433	14.30	0.084	16.10	0.051	17.90	0.037
12.60	0.352	14.40	0.081	16.20	0.051	18.00	0.037
12.70	0.282	14.50	0.079	16.30	0.050	18.10	0.036
12.80	0.241	14.60	0.076	16.40	0.049	18.20	0.035
12.90	0.211	14.70	0.073	16.50	0.048	18.30	0.035

Continues on next page...

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Worksheet for MP-99.89_STA0+26_2YR_PIPE

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.28700	ft/ft
Discharge	1.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	162.00
0+14	162.00
0+17	161.50
0+24	161.74
0+31	162.60
0+44	161.85

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 162.00)	(0+44, 161.85)	0.045

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.14	ft
Elevation Range	161.50 to 162.60 ft	
Flow Area	0.33	ft²
Wetted Perimeter	4.80	ft
Hydraulic Radius	0.07	ft
Top Width	4.79	ft
Normal Depth	0.14	ft

Worksheet for MP-99.89_STA0+26_2YR_PIPE

Results

Critical Depth		0.18	ft
Critical Slope		0.06558	ft/ft
Velocity		2.99	ft/s
Velocity Head		0.14	ft
Specific Energy		0.28	ft
Froude Number		2.00	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.14	ft
Critical Depth	0.18	ft
Channel Slope	0.28700	ft/ft
Critical Slope	0.06558	ft/ft

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MAP
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N
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LOG
-05
-02.6°
-14.0°
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EXTRAS
053° N53E 0942mils TRUE
ZERO
A-B
CAL
030
060
NIGHT
1.0 X
S

MP-100.00R2A

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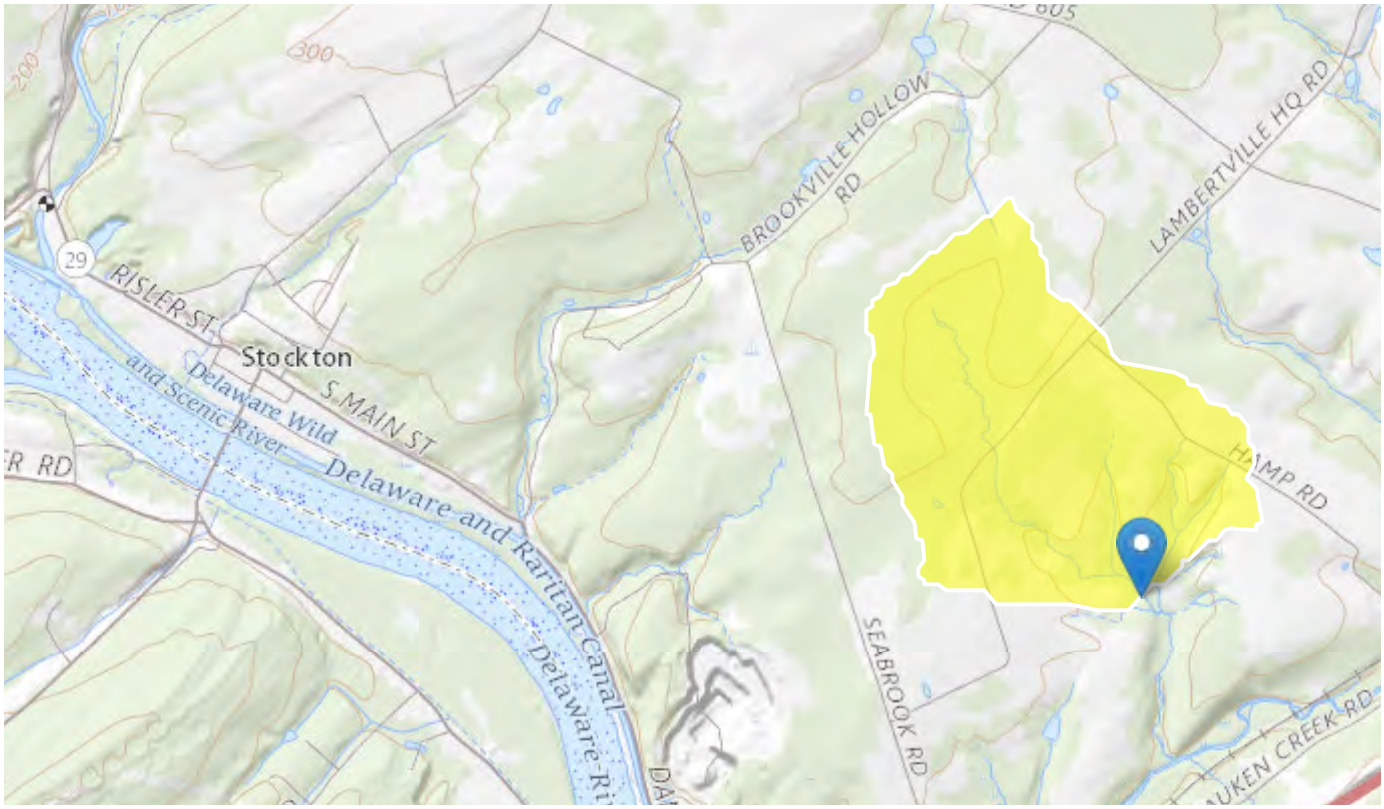

Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	0.52	square miles
STORAGE	Percentage of area of storage (lakes ponds reservoirs wetlands)	1.61	percent
CSL10_85	Change in elevation divided by length between points 10 and 85 percent of distance along main channel to basin divide - main channel method not known	167	feet per mi

Parameter Code	Parameter Description	Value	Unit
POPDENS	Basin Population Density	148	persons per square mile

Peak-Flow Statistics Parameters [Peak Unglaciated Piedmont Region 2009 5167]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.52	square miles	0.25	779
STORAGE	Percent Storage	1.61	percent	0.23	32
CSL10_85	Stream Slope 10 and 85 Method	167	feet per mi	4.31	191
POPDENS	Basin Population Density	148	persons per square mile	83	11084

Peak-Flow Statistics Flow Report [Peak Unglaciated Piedmont Region 2009 5167]

PIl: Prediction Interval-Lower, PIu: Prediction Interval-Upper, SEp: Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	SEp	Equiv. Yrs.
2 Year Peak Flood	150	ft^3/s	50.3	1
5 Year Peak Flood	264	ft^3/s	50.9	2
10 Year Peak Flood	358	ft^3/s	52.2	3
25 Year Peak Flood	498	ft^3/s	54.5	4
50 Year Peak Flood	614	ft^3/s	56.8	5
100 Year Peak Flood	746	ft^3/s	59.5	5
500 Year Peak Flood	1090	ft^3/s	66.3	6

Peak-Flow Statistics Citations

Watson, K.M.,and Schopp, R.D.,2009, Methodology for estimation of flood magnitude and frequency for New Jersey streams, U.S. Geological Survey Scientific Investigations Report 2009-5167, 51 p. (http://pubs.usgs.gov/sir/2009/5167/)

Worksheet for MP-100.00R2_A_STA5+24_PIPE_2YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.01100	ft/ft
Discharge	150.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	132.00
0+38	132.50
0+38	132.00
0+43	130.00
0+50	127.79
0+64	130.00
0+76	134.00
1+00	136.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 132.00)	(1+00, 136.00)	0.030

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	2.31	ft
Elevation Range	127.79 to 136.00 ft	
Flow Area	26.32	ft²
Wetted Perimeter	22.90	ft
Hydraulic Radius	1.15	ft

Worksheet for MP-100.00R2_A_STA5+24_PIPE_2YR

Results

Top Width		22.38	ft
Normal Depth		2.31	ft
Critical Depth		2.24	ft
Critical Slope		0.01298	ft/ft
Velocity		5.70	ft/s
Velocity Head		0.50	ft
Specific Energy		2.81	ft
Froude Number		0.93	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	2.31	ft
Critical Depth	2.24	ft
Channel Slope	0.01100	ft/ft
Critical Slope	0.01298	ft/ft

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MP-100.00R2B

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Workspace ID: NJ20190417171151384000
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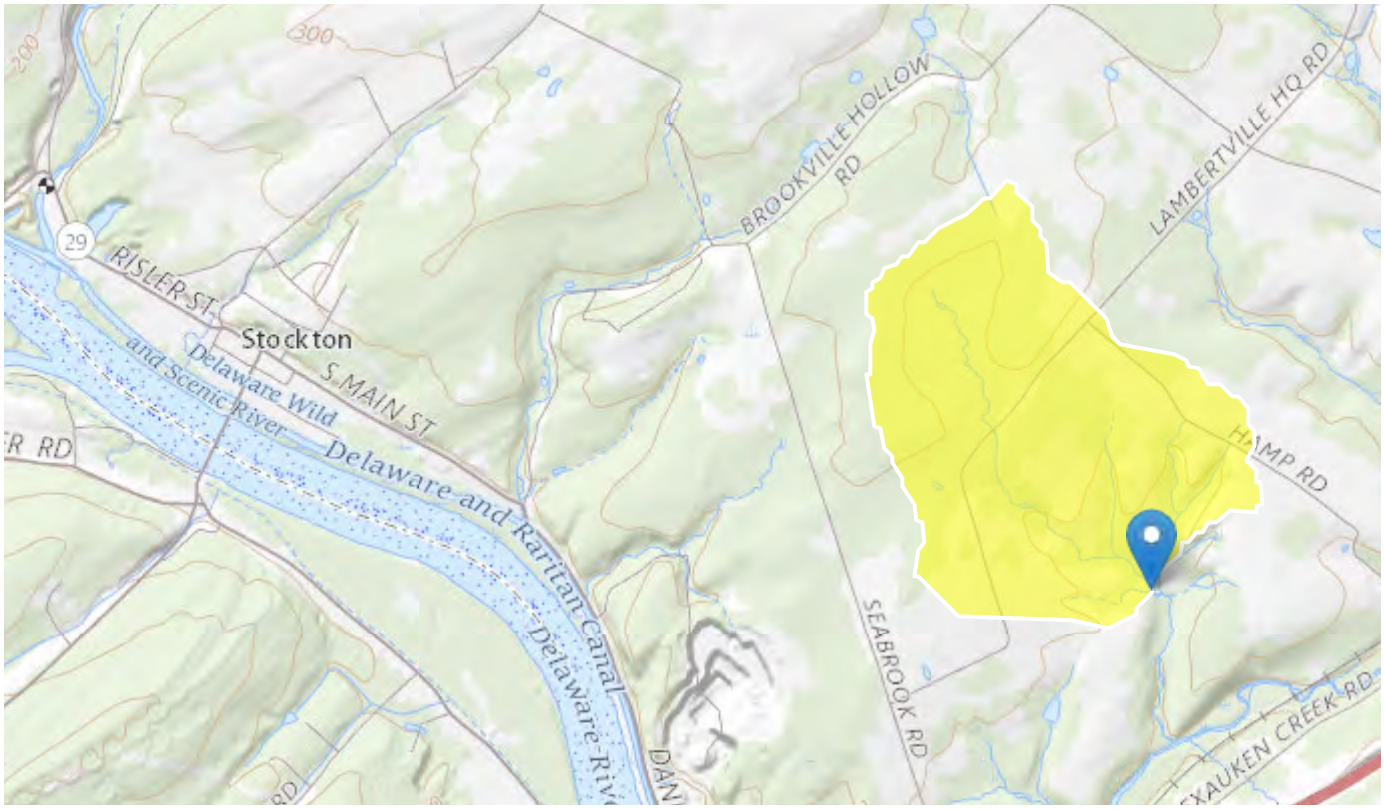

Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	0.56	square miles
STORAGE	Percentage of area of storage (lakes ponds reservoirs wetlands)	1.93	percent
CSL10_85	Change in elevation divided by length between points 10 and 85 percent of distance along main channel to basin divide - main channel method not known	171	feet per mi

Parameter Code	Parameter Description	Value	Unit
POPDENS	Basin Population Density	148	persons per square mile

Peak-Flow Statistics Parameters [Peak Unglaciated Piedmont Region 2009 5167]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.56	square miles	0.25	779
STORAGE	Percent Storage	1.93	percent	0.23	32
CSL10_85	Stream Slope 10 and 85 Method	171	feet per mi	4.31	191
POPDENS	Basin Population Density	148	persons per square mile	83	11084

Peak-Flow Statistics Flow Report [Peak Unglaciated Piedmont Region 2009 5167]

PIl: Prediction Interval-Lower, PIu: Prediction Interval-Upper, SEp: Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	SEp	Equiv. Yrs.
2 Year Peak Flood	158	ft^3/s	50.3	1
5 Year Peak Flood	278	ft^3/s	50.9	2
10 Year Peak Flood	376	ft^3/s	52.2	3
25 Year Peak Flood	521	ft^3/s	54.5	4
50 Year Peak Flood	641	ft^3/s	56.8	5
100 Year Peak Flood	778	ft^3/s	59.5	5
500 Year Peak Flood	1130	ft^3/s	66.3	6

Peak-Flow Statistics Citations

Watson, K.M.,and Schopp, R.D.,2009, Methodology for estimation of flood magnitude and frequency for New Jersey streams, U.S. Geological Survey Scientific Investigations Report 2009-5167, 51 p. (http://pubs.usgs.gov/sir/2009/5167/)

Worksheet for MP-100.00R2_B_STA6+53_PIPE_2YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.02300	ft/ft
Discharge	158.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	130.00
0+32	130.25
0+50	126.77
0+62	127.10
0+74	128.00
0+84	130.00
0+98	138.00
1+00	140.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 130.00)	(1+00, 140.00)	0.030

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	1.32	ft
Elevation Range	126.77 to 140.00 ft	
Flow Area	24.81	ft²
Wetted Perimeter	31.77	ft
Hydraulic Radius	0.78	ft

Worksheet for MP-100.00R2_B_STA6+53_PIPE_2YR

Results

Top Width		31.60	ft
Normal Depth		1.32	ft
Critical Depth		1.46	ft
Critical Slope		0.01373	ft/ft
Velocity		6.37	ft/s
Velocity Head		0.63	ft
Specific Energy		1.95	ft
Froude Number		1.27	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.32	ft
Critical Depth	1.46	ft
Channel Slope	0.02300	ft/ft
Critical Slope	0.01373	ft/ft

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MP-100.00R2C

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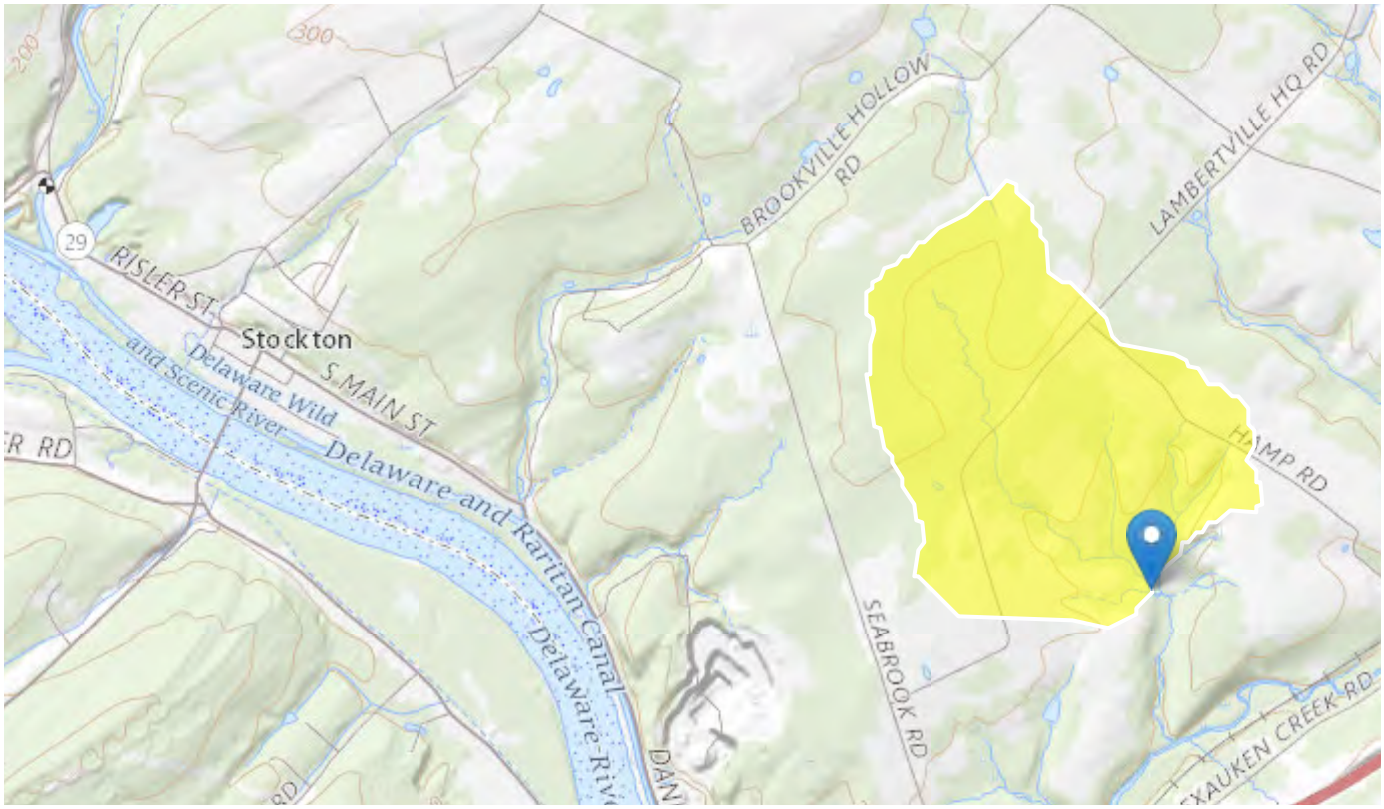

Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	0.56	square miles
STORAGE	Percentage of area of storage (lakes ponds reservoirs wetlands)	1.93	percent
CSL10_85	Change in elevation divided by length between points 10 and 85 percent of distance along main channel to basin divide - main channel method not known	171	feet per mi

Parameter Code	Parameter Description	Value	Unit
POPDENS	Basin Population Density	148	persons per square mile

Peak-Flow Statistics Parameters [Peak Unglaciated Piedmont Region 2009 5167]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.56	square miles	0.25	779
STORAGE	Percent Storage	1.93	percent	0.23	32
CSL10_85	Stream Slope 10 and 85 Method	171	feet per mi	4.31	191
POPDENS	Basin Population Density	148	persons per square mile	83	11084

Peak-Flow Statistics Flow Report [Peak Unglaciated Piedmont Region 2009 5167]

PIl: Prediction Interval-Lower, PIu: Prediction Interval-Upper, SEp: Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	SEp	Equiv. Yrs.
2 Year Peak Flood	158	ft^3/s	50.3	1
5 Year Peak Flood	278	ft^3/s	50.9	2
10 Year Peak Flood	376	ft^3/s	52.2	3
25 Year Peak Flood	521	ft^3/s	54.5	4
50 Year Peak Flood	641	ft^3/s	56.8	5
100 Year Peak Flood	778	ft^3/s	59.5	5
500 Year Peak Flood	1130	ft^3/s	66.3	6

Peak-Flow Statistics Citations

Watson, K.M.,and Schopp, R.D.,2009, Methodology for estimation of flood magnitude and frequency for New Jersey streams, U.S. Geological Survey Scientific Investigations Report 2009-5167, 51 p. (http://pubs.usgs.gov/sir/2009/5167/)

Worksheet for MP-100.00R2_C_STA7+13_PIPE_2YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.02900	ft/ft
Discharge	158.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	128.00
0+37	128.05
0+50	124.81
0+63	125.60
0+66	128.00
0+78	143.00
1+00	148.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 128.00)	(1+00, 148.00)	0.030

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	1.52	ft
Elevation Range	124.81 to 148.00 ft	
Flow Area	19.29	ft²
Wetted Perimeter	20.15	ft
Hydraulic Radius	0.96	ft
Top Width	19.69	ft

Worksheet for MP-100.00R2_C_STA7+13_PIPE_2YR

Results

Normal Depth	1.52	ft
Critical Depth	1.83	ft
Critical Slope	0.01282	ft/ft
Velocity	8.19	ft/s
Velocity Head	1.04	ft
Specific Energy	2.57	ft
Froude Number	1.46	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.52	ft
Critical Depth	1.83	ft
Channel Slope	0.02900	ft/ft
Critical Slope	0.01282	ft/ft

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MP 100.09R2

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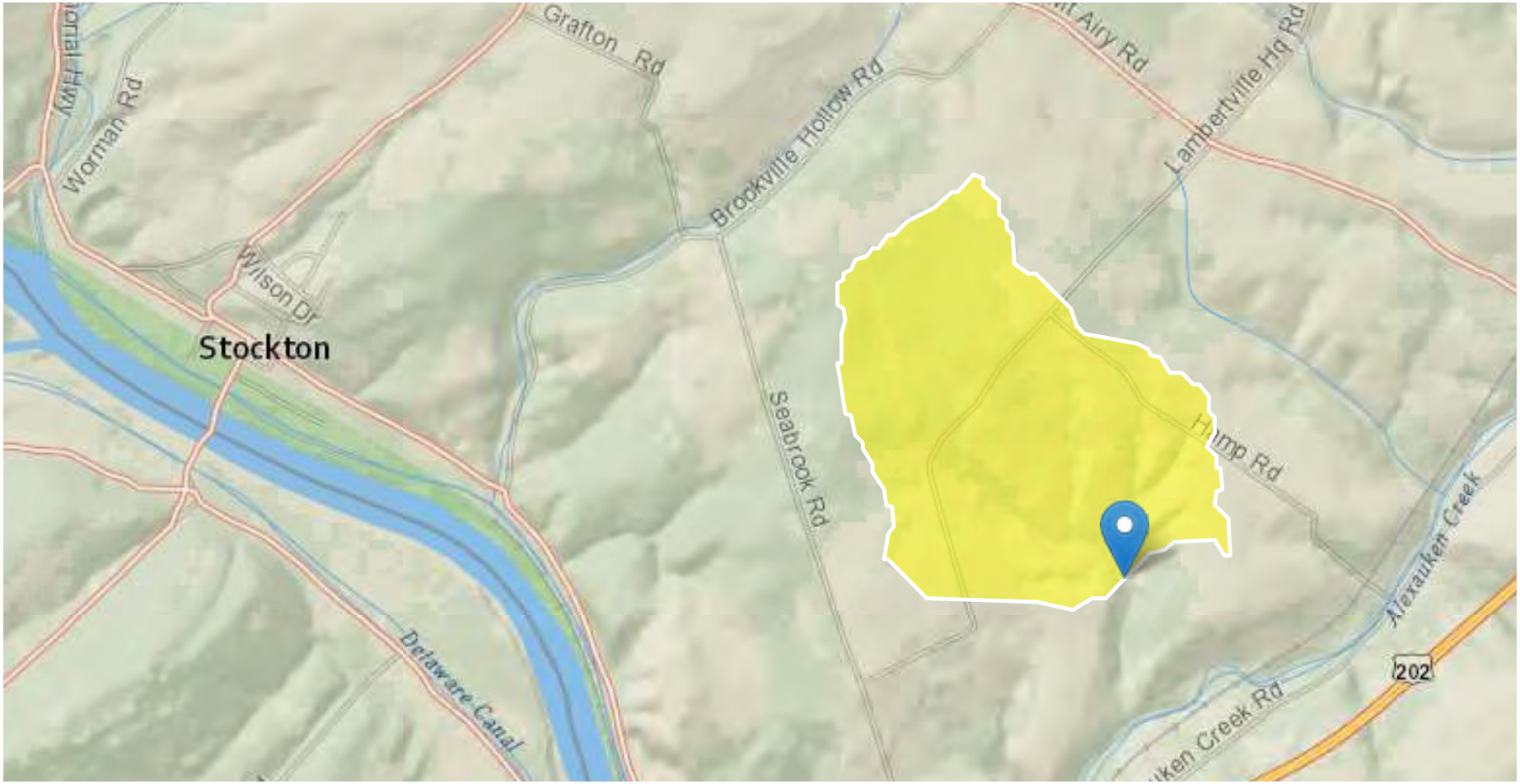

Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	0.58	square miles
STORAGE	Percentage of area of storage (lakes ponds reservoirs wetlands)	2.4	percent
CSL10_85	Change in elevation divided by length between points 10 and 85 percent of distance along main channel to basin divide - main channel method not known	171	feet per mi
POPDENS	Basin Population Density	148	persons per square mile

Peak-Flow Statistics Parameters [Peak Unglaciated Piedmont Region 2009 5167]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.58	square miles	0.25	779
STORAGE	Percent Storage	2.4	percent	0.23	32
CSL10_85	Stream Slope 10 and 85 Method	171	feet per mi	4.31	191
POPDENS	Basin Population Density	148	persons per square mile	83	11084

Peak-Flow Statistics Flow Report [Peak Unglaciated Piedmont Region 2009 5167]

PIl: Prediction Interval-Lower, Plu: Prediction Interval-Upper, SEp: Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	SEe	SEp	Equiv. Yrs.
2 Year Peak Flood	161	ft^3/s	49	50.3	1
5 Year Peak Flood	282	ft^3/s	49.4	50.9	2
10 Year Peak Flood	380	ft^3/s	50.5	52.2	3

Worksheet for MP-100.09R2_STA0+38_PIPE_2YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.02000	ft/ft
Discharge	161.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	122.00
0+31	120.60
0+50	117.69
0+63	120.25
0+94	122.00
1+00	122.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 122.00)	(1+00, 122.00)	0.045

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	2.33	ft
Elevation Range	117.69 to 122.00 ft	
Flow Area	31.48	ft²
Wetted Perimeter	27.46	ft
Hydraulic Radius	1.15	ft
Top Width	27.06	ft
Normal Depth	2.33	ft

Worksheet for MP-100.09R2_STA0+38_PIPE_2YR

Results

Critical Depth		2.17	ft
Critical Slope		0.02931	ft/ft
Velocity		5.11	ft/s
Velocity Head		0.41	ft
Specific Energy		2.73	ft
Froude Number		0.84	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	2.33	ft
Critical Depth	2.17	ft
Channel Slope	0.02000	ft/ft
Critical Slope	0.02931	ft/ft

MP 100.38R2

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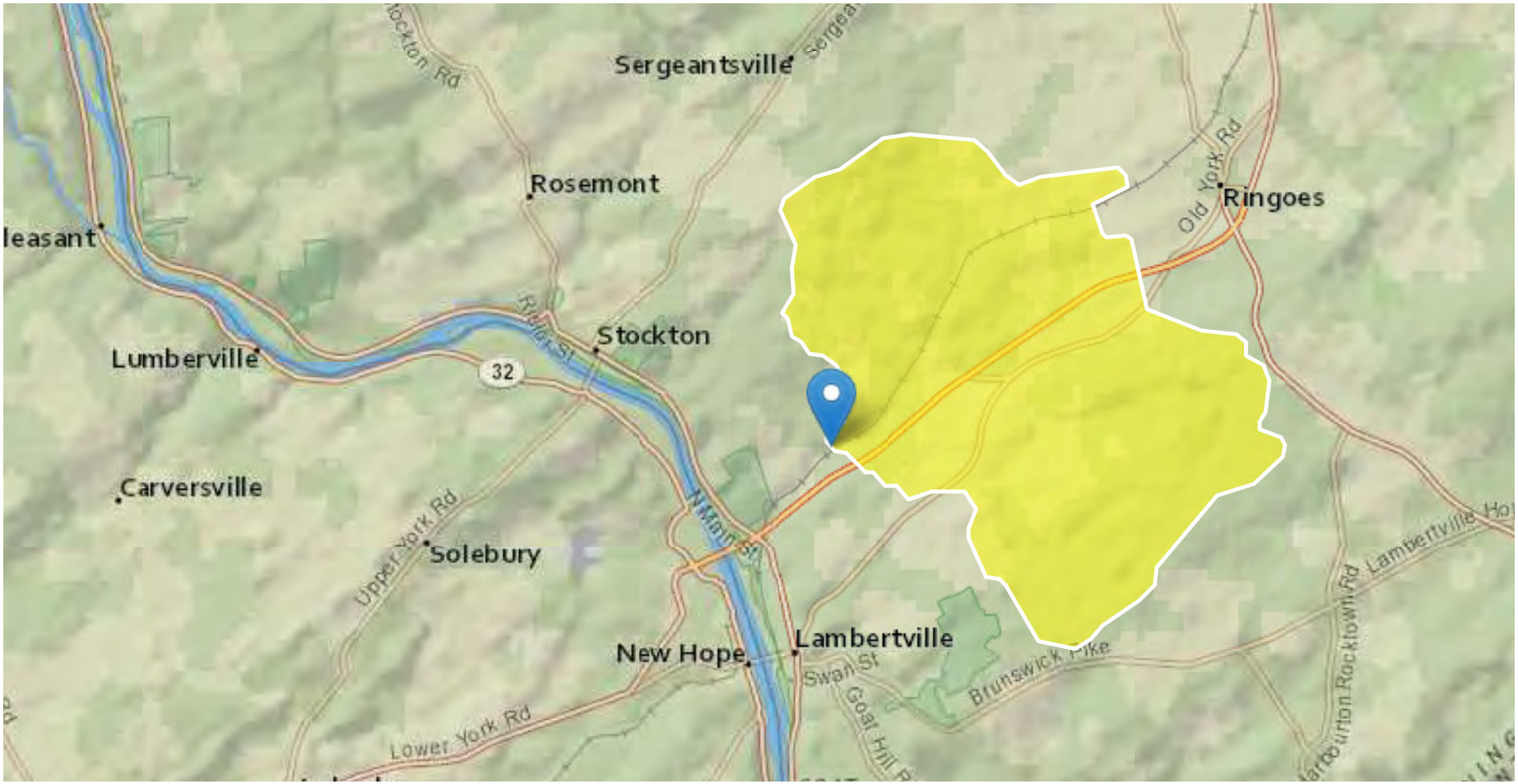


Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	13.1	square miles
STORAGE	Percentage of area of storage (lakes ponds reservoirs wetlands)	7.56	percent
CSL10_85	Change in elevation divided by length between points 10 and 85 percent of distance along main channel to basin divide - main channel method not known	51.9	feet per mi
POPDENS	Basin Population Density	141	persons per square mile

Peak-Flow Statistics Parameters [Peak Unglaciated Piedmont Region 2009 5167]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	13.1	square miles	0.25	779
STORAGE	Percent Storage	7.56	percent	0.23	32
CSL10_85	Stream Slope 10 and 85 Method	51.9	feet per mi	4.31	191
POPDENS	Basin Population Density	141	persons per square mile	83	11084

Peak-Flow Statistics Flow Report [Peak Unglaciated Piedmont Region 2009 5167]

PIl: Prediction Interval-Lower, PIu: Prediction Interval-Upper, SEp: Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	SEe	SEp	Equiv. Yrs.
2 Year Peak Flood	1180	ft^3/s	49	50.3	1
5 Year Peak Flood	1930	ft^3/s	49.4	50.9	2
10 Year Peak Flood	2510	ft^3/s	50.5	52.2	3

Worksheet for MP 100.38R2 STA0+25_2YR_PIPE

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.01600	ft/ft
Discharge	1180.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	90.00
0+21	89.90
0+54	85.26
0+82	91.00
1+00	92.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 90.00)	(1+00, 92.00)	0.050

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	5.32	ft
Elevation Range	85.26 to 92.00 ft	
Flow Area	183.22	ft²
Wetted Perimeter	81.70	ft
Hydraulic Radius	2.24	ft
Top Width	80.27	ft
Normal Depth	5.32	ft
Critical Depth	4.90	ft

Worksheet for MP 100.38R2 STA0+25_2YR_PIPE

Results

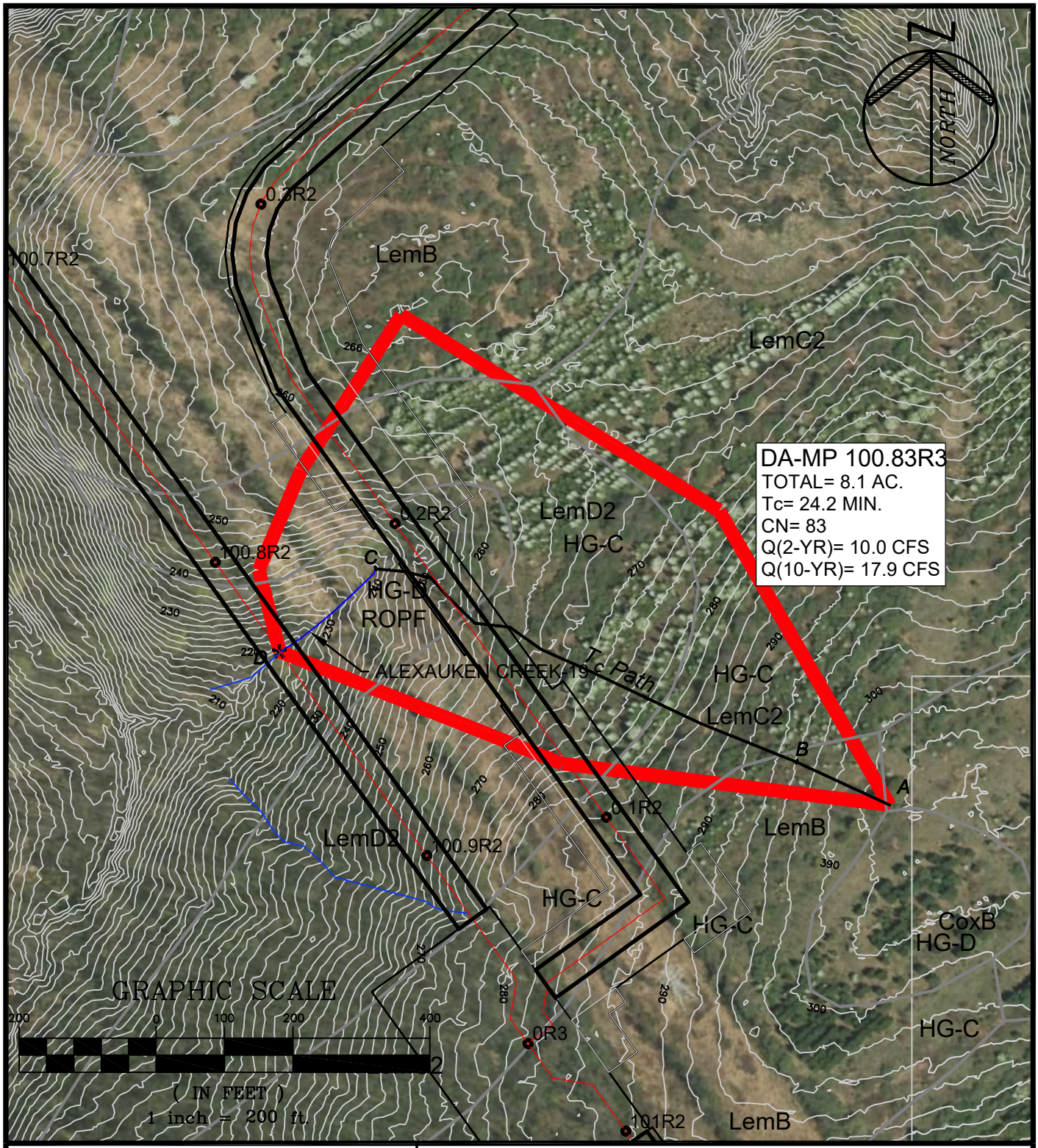
Critical Slope		0.02980	ft/ft
Velocity		6.44	ft/s
Velocity Head		0.64	ft
Specific Energy		5.96	ft
Froude Number		0.75	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	5.32	ft
Critical Depth	4.90	ft
Channel Slope	0.01600	ft/ft
Critical Slope	0.02980	ft/ft



PAULUS, SOKOLOWSKI AND SARTOR, LLC.

1433 ROUTE 34
SUITE A4
WALL, NEW JERSEY 07727
PHONE: (848) 206-2626

CERTIFICATE OF AUTHORIZATION NO. 24GA28032700

PROJECT TITLE

PENNEAST PIPELINE

HUNTERDON AND MERCER COUNTY, NJ

SHEET TITLE

STREAM CROSSING DRAINAGE AREA MP 100.83R2

PROJ. NO.: 05516.0001	DRN. BY: JPS	SCALE: 1"=200'
DATE: 05/23/19	CK'D BY: WS	

FILE NAME: P:\05516\0001\DWGs\CAD\C-Civil\Plotdwgs\Drainage Area Maps\05516\0001-Stream_DA_MP100.8-114-WAL.dwg\MP 100.83R2 LAST EDIT: 06/07/2019 - 04:24:50 PM LOGIN: jmcgowan@

Worksheet 2: Runoff curve number and runoff (Approximated)

Project	By	Date
PennEast	JPS	26-Feb-18
Location	**Checked**	**Date**
Hunterdon County, NJ		

Check one: ☐ Present ☒ Developed — MP 100.8

1. Runoff curve number

Soil name and hydrologic group (appendix A)	Cover Description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN[1] Table 2-2	CN[1] Figure 2-3	CN[1] Figure 2-4	Area ☒ acres / ☐ mi² / ☐ %	Product of CN x Area
Type C	Farmstead, Good Condition	82			6.60	541.20
Type D	Farmstead, Good Condition	86			1.50	129.00
1. Use only one CN source per line				Totals ➡	8.10	670.20

CN (weighted) = tot.prod. / tot. area = 670.20 / 8.10 = 82.7 ; Use CN ➡ **83**

2. Runoff

		Storm #1	Storm #2	Storm #3
Frequency……	yr			
Rainfall, P (24-hour)…….	in			
Runoff, Q……	in			

Use P and CN with table 2-1, figure 2-1, or equation 2-3 abd 2-4

PSS&	PROJECT: PennEast	JOB NO. 5516.0001	
		SHEET	DATE:2/12/2018
		BY:	JPS
	SUBJECT: Tc Calculations	CHK'D	

Time of Concentration calculations with the application of the SCS TR-55 methodology.

Watershed or Subarea Designation: DA 100.8

Area 8.1 AC

SHEET FLOW

Segment ID		A-B				
Surface Description (Table 3-1)		WOODS				
Manning's Coefficient, n (Table 3-1)		0.400				
Flow Length, L (total <= 150)	(ft)	150				
Two Year Rainfall, P	(in)	3.4				
Land Slope, s	(ft/ft)	0.047				
Computed Tt = 0.007 (nL)^0.8 / P^0.5*s^0.4	(hrs)	0.342				0.342

SHALLOW CONCENTRATED FLOW

Segment ID		B-C				
Surface Description (paved or unpaved)		UNPAVED				
Flow Length, L	(ft)	689				
Watercourse slope, s	(ft/ft)	0.084				
Average Velocity, V (Figure 3-1)	(ft/s)	4.0				
Computed Tt = L / 3600V	(hrs)	0.048				0.048

CHANNEL FLOW

Segment ID		C-D				
Cross sectional Area, a	(sf)	2.49				
Wetted Perimeter, Pw	(ft)	12.62				
Hydraulic Radius, r =a/Pw	(ft)	0.197				
Channel Slope (ft/ft)	(ft/ft)	0.105				
Manning's Roughness Coefficient, n		0.040				
Velocity, V = 1.49r^(2/3)s^0.5 / n	(ft/s)	4.09				
Flow Length, L	(ft)	186				
Computed Tt = L / 3600V	(hrs)	0.013				0.013

Watershed or subarea Tc	0.403	hrs.
	24.2	min.

Use minimum Tc of 10 minutes

Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Wednesday, 02 / 20 / 2019

Hyd. No. 25

DA 100.8

Hydrograph type	= SCS Runoff	Peak discharge	= 9.953 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.30 hrs
Time interval	= 6 min	Hyd. volume	= 48,767 cuft
Drainage area	= 8.100 ac	Curve number	= 83.000*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 24.2 min
Total precip.	= 3.26 in	Distribution	= Custom
Storm duration	= C:\Users\IKuzmina\AppData\Local\Autodesk\C3D 2019\enu\HHApps\Hydrograp		

* Composite (Area/CN) = [(6.600 x 82) + (1.500 x 86)] / 8.100

Hydrograph Discharge Table

(Printed values >= 1.00% of Qp.)

Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)
9.80	0.103	11.60	1.096	13.40	1.602	15.20	0.639
9.90	0.117	11.70	1.370	13.50	1.463	15.30	0.615
10.00	0.132	11.80	1.799	13.60	1.337	15.40	0.595
10.10	0.148	11.90	2.428	13.70	1.227	15.50	0.581
10.20	0.165	12.00	3.641	13.80	1.135	15.60	0.570
10.30	0.183	12.10	6.065	13.90	1.064	15.70	0.561
10.40	0.202	12.20	8.440	14.00	1.010	15.80	0.553
10.50	0.223	12.30	9.953	14.10	0.969	15.90	0.545
10.60	0.246	12.40	9.290	14.20	0.935	16.00	0.537
10.70	0.275	12.50	8.090	14.30	0.906	16.10	0.529
10.80	0.313	12.60	6.553	14.40	0.877	16.20	0.522
10.90	0.359	12.70	4.946	14.50	0.848	16.30	0.514
11.00	0.413	12.80	3.521	14.60	0.818	16.40	0.506
11.10	0.478	12.90	2.906	14.70	0.789	16.50	0.498
11.20	0.556	13.00	2.489	14.80	0.759	16.60	0.490
11.30	0.653	13.10	2.184	14.90	0.729	16.70	0.482
11.40	0.767	13.20	1.937	15.00	0.698	16.80	0.474
11.50	0.897	13.30	1.760	15.10	0.668	16.90	0.466

Continues on next page...

Worksheet for M-100.83R2 STA 2+26_2YR_PIPE

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.04000	ft/ft
Discharge	10.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	226.00
0+04	226.00
0+31	222.00
0+47	220.80
0+51	215.96
0+61	220.00
0+97	222.00
1+00	224.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 226.00)	(1+00, 224.00)	0.045

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	1.22	ft
Elevation Range	215.96 to 226.00 ft	
Flow Area	2.39	ft²
Wetted Perimeter	4.74	ft
Hydraulic Radius	0.50	ft

Worksheet for M-100.83R2 STA 2+26_2YR_PIPE

Results

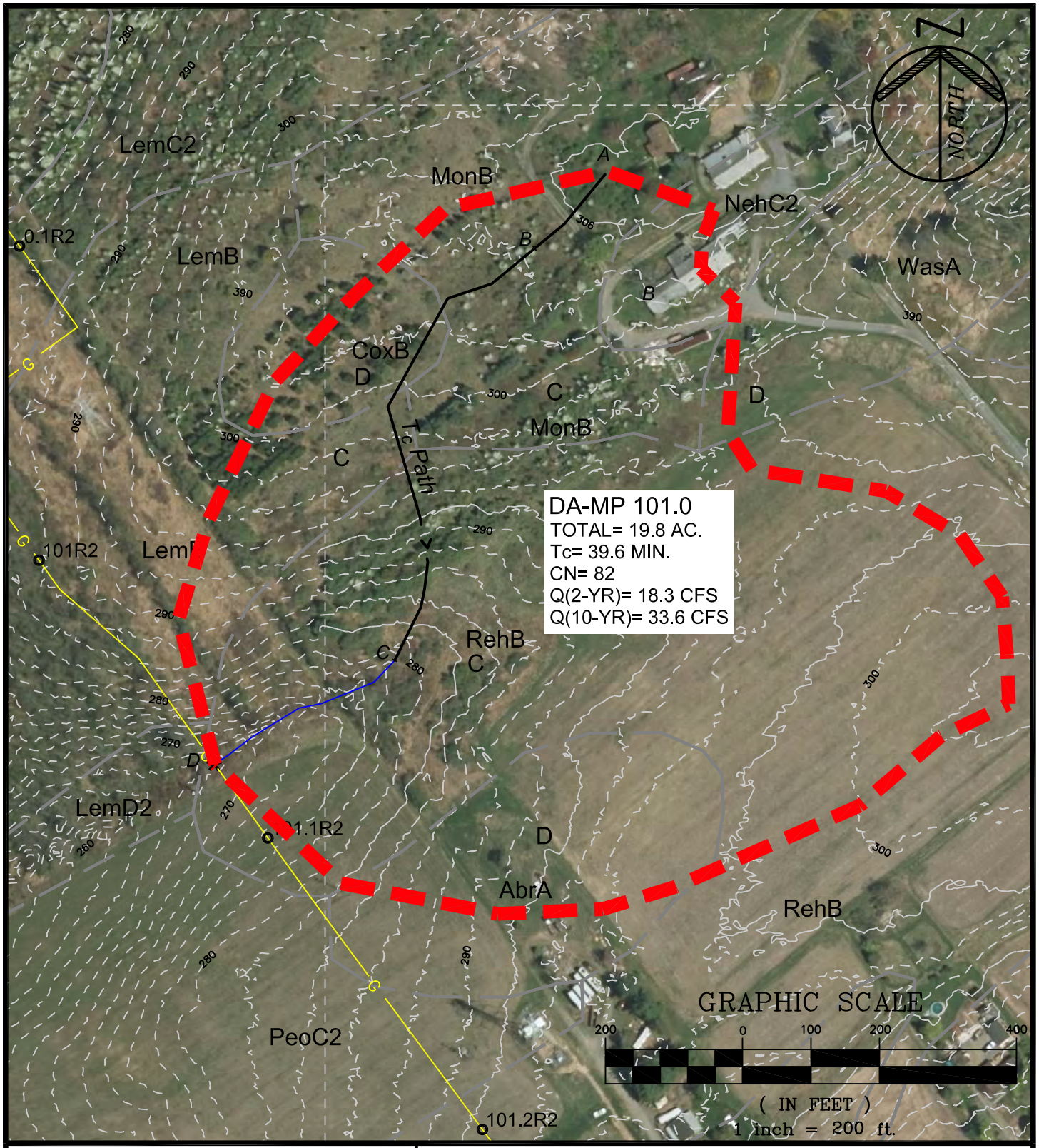
Top Width		3.93	ft
Normal Depth		1.22	ft
Critical Depth		1.19	ft
Critical Slope		0.04514	ft/ft
Velocity		4.18	ft/s
Velocity Head		0.27	ft
Specific Energy		1.49	ft
Froude Number		0.94	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.22	ft
Critical Depth	1.19	ft
Channel Slope	0.04000	ft/ft
Critical Slope	0.04514	ft/ft



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CERTIFICATE OF AUTHORIZATION NO. 24GA28032700

PROJECT TITLE

PENNEAST PIPELINE

HUNTERDON AND MERCER COUNTY, NJ

SHEET TITLE

STREAM CROSSING DRAINAGE AREA MP 101.0

PROJ. NO.:	05516.0001	DRN. BY:	JPS	SCALE:	1"=200'
DATE:	XX/XX/XX	CK'D BY:	WS	SHT. NO.:	XXOF XX

FILE NAME: P:\05516\0001\DWGs\CAD\C-Civil\Plotdwgs\Drainage Area Maps\05516001-Stream_DA_MP100.8-114-WAL.dwg\MP 101 LAST EDIT: 05/23/2018 - 02:02:45 PM LOGIN: lkuzmina@

Worksheet 2: Runoff curve number and runoff (Approximated)

Project	By	Date
PennEast	JPS	26-Feb-18
Location	**Checked**	**Date**
Hunterdon County, NJ		

Check one: ☐ Present ☒ Developed | MP 101.0

1. Runoff curve number

Soil name and hydrologic group (appendix A)	Cover Description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN[1] Table 2-2	CN[1] Figure 2-3	CN[1] Figure 2-4	Area ☒ acres ☐ mi² ☐ %	Product of CN x Area
Type B	Farmstead, Good Condition	74			0.68	50.32
Type C	Farmstead, Good Condition	82			15.93	1,306.26
Type D	Farmstead, Good Condition	86			3.19	274.34
				Totals ➡	19.80	1,630.92

1. Use only one CN source per line

CN (weighted) = tot.prod. / tot. area = 1,630.92 / 19.80 = 82.4 ; Use CN ➡ **82**

2. Runoff

		Storm #1	Storm #2	Storm #3
Frequency……	yr			
Rainfall, P (24-hour)…….	in			
Runoff, Q……	in			

Use P and CN with table 2-1, figure 2-1, or equation 2-3 abd 2-4

PSS&	PROJECT: PennEast	JOB NO. 5516.0001	
		SHEET	DATE:2/12/2018
		BY:	JPS
	SUBJECT: Tc Calculations	CHK'D	

Time of Concentration calculations with the application of the SCS TR-55 methodology.

Watershed or Subarea Designation: DA 101.0

Area 18.3 AC

SHEET FLOW

Segment ID		A-B				
Surface Description (Table 3-1)		WOODS				
Manning's Coefficient, n (Table 3-1)		0.400				
Flow Length, L (total <= 150)	(ft)	150				
Two Year Rainfall, P	(in)	3.4				
Land Slope, s	(ft/ft)	0.013				
Computed Tt = 0.007 (nL)^0.8 / P^0.5*s^0.4	(hrs)	0.572				0.572

SHALLOW CONCENTRATED FLOW

Segment ID		B-C				
Surface Description (paved or unpaved)		UNPAVED				
Flow Length, L	(ft)	717				
Watercourse slope, s	(ft/ft)	0.037				
Average Velocity, V (Figure 3-1)	(ft/s)	3.0				
Computed Tt = L / 3600V	(hrs)	0.066				0.066

CHANNEL FLOW

Segment ID		C-D				
Cross sectional Area, a	(sf)	4.25				
Wetted Perimeter, Pw	(ft)	9.62				
Hydraulic Radius, r =a/Pw	(ft)	0.442				
Channel Slope (ft/ft)	(ft/ft)	0.034				
Manning's Roughness Coefficient, n		0.040				
Velocity, V = 1.49r^(2/3)s^0.5 / n	(ft/s)	3.98				
Flow Length, L	(ft)	308				
Computed Tt = L / 3600V	(hrs)	0.021				0.021

Watershed or subarea Tc	0.660	hrs.
	39.6	min.

Use minimum Tc of 10 minutes

Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Wednesday, 02 / 20 / 2019

Hyd. No. 27

DA 101.0

Hydrograph type	= SCS Runoff	Peak discharge	= 19.88 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.40 hrs
Time interval	= 6 min	Hyd. volume	= 117,589 cuft
Drainage area	= 19.800 ac	Curve number	= 82.000*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 39.6 min
Total precip.	= 3.26 in	Distribution	= Custom
Storm duration	= C:\Users\IKuzmina\AppData\Local\Autodesk\C3D2019\enu\HHApps\Hydrograp		

* Composite (Area/CN) = [(0.600 x 74) + (16.000 x 82) + (1.700 x 86)] / 19.800

Hydrograph Discharge Table

(Printed values >= 1.00% of Qp.)

Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)
10.00	0.211	11.80	3.215	13.60	3.748	15.40	1.543
10.10	0.244	11.90	4.301	13.70	3.425	15.50	1.493
10.20	0.280	12.00	6.190	13.80	3.143	15.60	1.453
10.30	0.319	12.10	9.866	13.90	2.906	15.70	1.420
10.40	0.361	12.20	13.80	14.00	2.718	15.80	1.392
10.50	0.405	12.30	17.47	14.10	2.568	15.90	1.368
10.60	0.454	12.40	19.88	14.20	2.444	16.00	1.347
10.70	0.511	12.50	19.41	14.30	2.341	16.10	1.328
10.80	0.580	12.60	18.01	14.40	2.254	16.20	1.309
10.90	0.665	12.70	16.06	14.50	2.178	16.30	1.290
11.00	0.766	12.80	13.80	14.60	2.106	16.40	1.271
11.10	0.888	12.90	11.29	14.70	2.034	16.50	1.251
11.20	1.036	13.00	8.878	14.80	1.961	16.60	1.232
11.30	1.215	13.10	6.864	14.90	1.888	16.70	1.212
11.40	1.433	13.20	5.862	15.00	1.815	16.80	1.193
11.50	1.688	13.30	5.127	15.10	1.741	16.90	1.173
11.60	2.048	13.40	4.562	15.20	1.669	17.00	1.153
11.70	2.523	13.50	4.103	15.30	1.602	17.10	1.133

Continues on next page...

Worksheet for MP-101.07R2 STA 0+76_2YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.03300	ft/ft
Discharge	19.90	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	272.00
0+14	270.00
0+39	267.00
0+53	263.71
0+63	268.40
1+00	270.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 272.00)	(1+00, 270.00)	0.045

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	1.21	ft
Elevation Range	263.71 to 272.00 ft	
Flow Area	4.80	ft²
Wetted Perimeter	8.36	ft
Hydraulic Radius	0.57	ft
Top Width	7.96	ft
Normal Depth	1.21	ft

Worksheet for MP-101.07R2 STA 0+76_2YR

Results

Critical Depth		1.18	ft
Critical Slope		0.03758	ft/ft
Velocity		4.14	ft/s
Velocity Head		0.27	ft
Specific Energy		1.47	ft
Froude Number		0.94	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.21	ft
Critical Depth	1.18	ft
Channel Slope	0.03300	ft/ft
Critical Slope	0.03758	ft/ft

Worksheet for MP-101.07R2 STA 1+01_2YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.03300	ft/ft
Discharge	19.90	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	270.00
0+14	268.00
0+38	266.30
0+50	263.50
0+53	262.95
0+56	264.50
0+57	266.00
0+64	267.60
1+00	270.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 270.00)	(1+00, 270.00)	0.045

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	1.14	ft
Elevation Range	262.95 to 270.00 ft	
Flow Area	4.78	ft²
Wetted Perimeter	8.28	ft

Worksheet for MP-101.07R2 STA 1+01_2YR

Results

Hydraulic Radius		0.58	ft
Top Width		7.90	ft
Normal Depth		1.14	ft
Critical Depth		1.11	ft
Critical Slope		0.03745	ft/ft
Velocity		4.16	ft/s
Velocity Head		0.27	ft
Specific Energy		1.41	ft
Froude Number		0.94	
Flow Type	Subcritical		

GVF Input Data

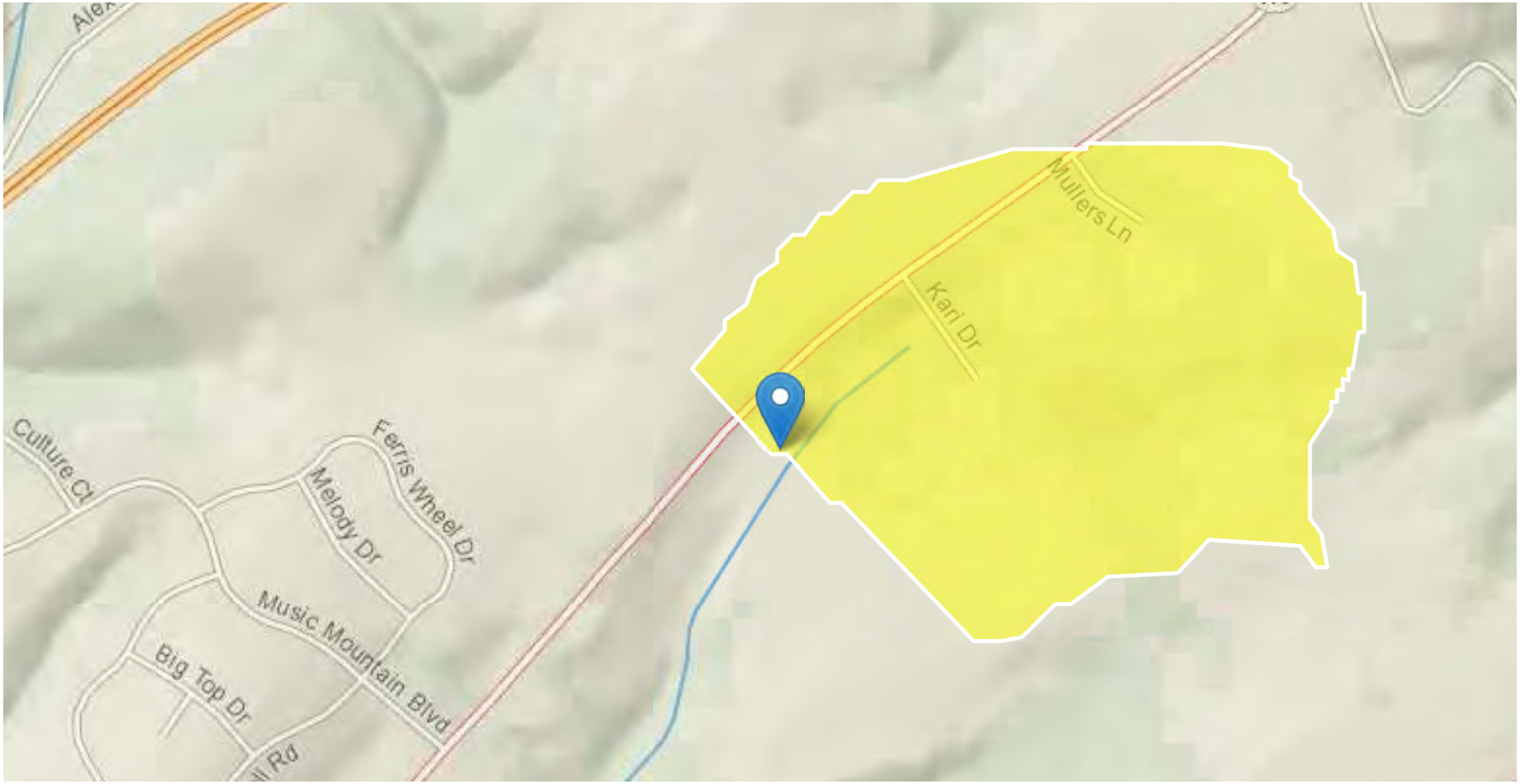
Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.14	ft
Critical Depth	1.11	ft
Channel Slope	0.03300	ft/ft
Critical Slope	0.03745	ft/ft

MP 101.38R2 101.38R2-MottMac

Region ID: NJ
Workspace ID: NJ20170809094022671000
Clicked Point (Latitude, Longitude): 40.38255, -74.92403
Time: 2017-08-09 09:41:23 -0400



Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	0.31	square miles
STORAGE	Percentage of area of storage (lakes ponds reservoirs wetlands)	0.96	percent
CSL10_85	Change in elevation divided by length between points 10 and 85 percent of distance along main channel to basin divide - main channel method not known	94.5	feet per mi
POPDENS	Basin Population Density	115	persons per square mile

Peak-Flow Statistics Parameters [Peak Unglaciated Piedmont Region 2009 5167]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.31	square miles	0.25	779
STORAGE	Percent Storage	0.96	percent	0.23	32
CSL10_85	Stream Slope 10 and 85 Method	94.5	feet per mi	4.31	191
POPDENS	Basin Population Density	115	persons per square mile	83	11084

Peak-Flow Statistics Flow Report [Peak Unglaciated Piedmont Region 2009 5167]

PIl: Prediction Interval-Lower, PIu: Prediction Interval-Upper, SEp: Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	SEe	SEp	Equiv. Yrs.
2 Year Peak Flood	86.4	ft^3/s	49	50.3	1
5 Year Peak Flood	156	ft^3/s	49.4	50.9	2
10 Year Peak Flood	213	ft^3/s	50.5	52.2	3

Statistic	Value	Unit	SEe	SEp	Equiv. Yrs.
25 Year Peak Flood	298	ft^3/s	52.6	54.5	4
50 Year Peak Flood	370	ft^3/s	54.7	56.8	5
100 Year Peak Flood	452	ft^3/s	57.1	59.5	5
500 Year Peak Flood	668	ft^3/s	63.9	66.3	6

Peak-Flow Statistics Citations

Watson, K.M.,and Schopp, R.D.,2009, Methodology for estimation of flood magnitude and frequency for New Jersey streams, U.S. Geological Survey Scientific Investigations Report 2009-5167, 51 p. (http://pubs.usgs.gov/sir/2009/5167/)

Worksheet for MP-101.38R2 STA 1+46_2YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.01120	ft/ft
Discharge	86.40	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	254.00
0+34	252.00
0+42	250.00
0+50	249.26
0+63	250.20
0+68	252.00
0+80	254.00
1+00	256.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 254.00)	(1+00, 256.00)	0.030

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	1.32	ft
Elevation Range	249.26 to 256.00 ft	
Flow Area	19.37	ft²
Wetted Perimeter	24.69	ft
Hydraulic Radius	0.78	ft

Worksheet for MP-101.38R2 STA 1+46_2YR

Results

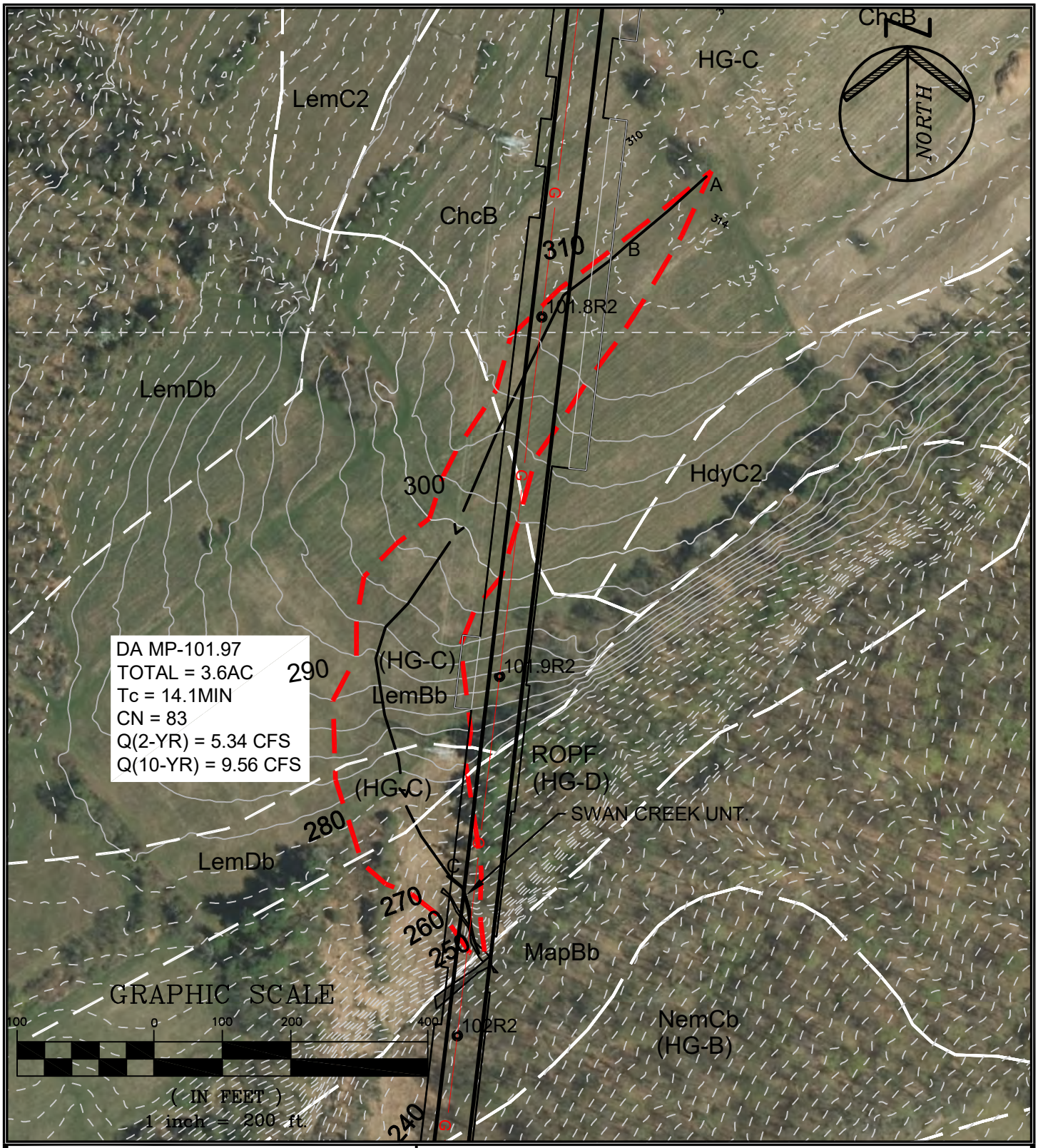
Top Width		24.49	ft
Normal Depth		1.32	ft
Critical Depth		1.25	ft
Critical Slope		0.01465	ft/ft
Velocity		4.46	ft/s
Velocity Head		0.31	ft
Specific Energy		1.63	ft
Froude Number		0.88	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.32	ft
Critical Depth	1.25	ft
Channel Slope	0.01120	ft/ft
Critical Slope	0.01465	ft/ft



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CERTIFICATE OF AUTHORIZATION NO. 24GA28032700

PROJECT TITLE

PENNEAST PIPELINE

HUNTERDON AND MERCER COUNTY, NJ

SHEET TITLE

STREAM CROSSING DRAINAGE AREA MP 101.97R2

PROJ. NO.:	05516.0001	DRN. BY:	JPS	SCALE:	1"=200'
DATE:	05/23/19	CK'D BY:	WS		

FILE NAME: P:\05516\0001\DWGs\CAD\C-Civil\Plotwgs\Drainage Area Maps\05516\0001-Stream_DA_MP100.8-114-WAL.dwg\MP 101.97 LAST EDIT: 07/19/2019 - 11:46:45 AM LOGIN: jmcgowan@

Worksheet 2: Runoff curve number and runoff (Approximated)

Project	By	Date
PennEast	IK	17-May-19
Location	**Checked**	**Date**
Hunterdon County, NJ		

Check one: ☐ Present ☒ Developed | MP 101.97

1. Runoff curve number

Soil name and hydrologic group (appendix A)	Cover Description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN[1] Table 2-2	CN[1] Figure 2-3	CN[1] Figure 2-4	Area X acres / mi² / %	Product of CN x Area
Type C	Farmstead, Good Condition	82			3.10	254.20
Type D	Farmstead, Good Condition	86			0.50	43.00
1. Use only one CN source per line				Totals ➡	3.60	297.20

CN (weighted) = tot.prod. / tot. area = 297.20 / 3.60 = 82.6 ; Use CN ➡ **83**

2. Runoff

		Storm #1	Storm #2	Storm #3
Frequency……	yr			
Rainfall, P (24-hour)…….	in			
Runoff, Q……	in			

Use P and CN with table 2-1, figure 2-1, or equation 2-3 abd 2-4

PROJECT:	PennEast	JOB NO. 5516.0001	
		SHEET	DATE:5/17/2019
		BY:	IK
SUBJECT:	Tc Calculations	CHK'D	

Time of Concentration calculations with the application of the SCS TR-55 methodology.

Watershed or Subarea Designation: DA 101.97

Area 3.6 AC

SHEET FLOW

Segment ID		A-B				
Surface Description (Table 3-1)		CULTIVATED				
Manning's Coefficient, n (Table 3-1)		0.060				
Flow Length, L (total <= 150)	(ft)	150				
Two Year Rainfall, P	(in)	3.4				
Land Slope, s	(ft/ft)	0.010				
Computed Tt = 0.007 (nL)^0.8 / P^0.5*s^0.4	(hrs)	0.139				0.139

SHALLOW CONCENTRATED FLOW

Segment ID		B-C				
Surface Description (paved or unpaved)		UNPAVED				
Flow Length, L	(ft)	1063				
Watercourse slope, s	(ft/ft)	0.044				
Average Velocity, V (Figure 3-1)	(ft/s)	3.2				
Computed Tt = L / 3600V	(hrs)	0.092				0.092

CHANNEL FLOW

Segment ID		C-D				
Cross sectional Area, a	(sf)	2.50				
Wetted Perimeter, Pw	(ft)	4.33				
Hydraulic Radius, r =a/Pw	(ft)	0.577				
Channel Slope (ft/ft)	(ft/ft)	0.220				
Manning's Roughness Coefficient, n		0.040				
Velocity, V = 1.49r^(2/3)s^0.5 / n	(ft/s)	12.11				
Flow Length, L	(ft)	127				
Computed Tt = L / 3600V	(hrs)	0.003				0.003

Watershed or subarea Tc	0.234	hrs.
	14.1	min.

Use minimum Tc of 10 minutes

Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 05 / 23 / 2019

Hyd. No. 89

MP-101.97

Hydrograph type	= SCS Runoff	Peak discharge	= 5.339 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.20 hrs
Time interval	= 6 min	Hyd. volume	= 20,319 cuft
Drainage area	= 3.600 ac	Curve number	= 83.000
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 14.1 min
Total precip.	= 3.26 in	Distribution	= Custom
Storm duration	= C:\Users\IKuzmina\AppData\Local\Autodesk\C3D 2019\enu\HHApps\Hydrograp	Storm frequency	= 24

Hydrograph Discharge Table

(Printed values >= 1.00% of Qp.)

Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)
9.90	0.057	11.70	0.762	13.50	0.540	15.30	0.244
10.00	0.064	11.80	1.007	13.60	0.493	15.40	0.239
10.10	0.071	11.90	1.430	13.70	0.453	15.50	0.236
10.20	0.079	12.00	2.293	13.80	0.426	15.60	0.233
10.30	0.087	12.10	4.162	13.90	0.410	15.70	0.229
10.40	0.095	12.20	5.339	14.00	0.398	15.80	0.226
10.50	0.104	12.30	4.441	14.10	0.386	15.90	0.223
10.60	0.116	12.40	3.157	14.20	0.374	16.00	0.219
10.70	0.133	12.50	2.015	14.30	0.362	16.10	0.216
10.80	0.154	12.60	1.615	14.40	0.349	16.20	0.213
10.90	0.178	12.70	1.282	14.50	0.337	16.30	0.210
11.00	0.205	12.80	1.083	14.60	0.325	16.40	0.206
11.10	0.237	12.90	0.943	14.70	0.312	16.50	0.203
11.20	0.280	13.00	0.862	14.80	0.299	16.60	0.200
11.30	0.331	13.10	0.778	14.90	0.287	16.70	0.196
11.40	0.389	13.20	0.700	15.00	0.274	16.80	0.193
11.50	0.452	13.30	0.638	15.10	0.261	16.90	0.189
11.60	0.573	13.40	0.586	15.20	0.251	17.00	0.186

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Worksheet for MP-101.97R2_STA0+45_PIPE_2YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.22000	ft/ft
Discharge	5.30	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	258.00
0+09	256.00
0+35	254.00
0+43	252.00
0+47	250.60
0+52	250.44
0+59	252.00
0+71	254.00
1+00	254.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 258.00)	(1+00, 254.00)	0.045

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.27	ft
Elevation Range	250.44 to 258.00 ft	
Flow Area	1.12	ft²
Wetted Perimeter	6.63	ft

Worksheet for MP-101.97R2_STA0+45_PIPE_2YR

Results

Hydraulic Radius		0.17	ft
Top Width		6.58	ft
Normal Depth		0.27	ft
Critical Depth		0.37	ft
Critical Slope		0.04735	ft/ft
Velocity		4.73	ft/s
Velocity Head		0.35	ft
Specific Energy		0.61	ft
Froude Number		2.02	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.27	ft
Critical Depth	0.37	ft
Channel Slope	0.22000	ft/ft
Critical Slope	0.04735	ft/ft

Worksheet for MP-101.97_STA0_94_BRIDGE_2YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.22000	ft/ft
Discharge	5.30	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	240.00
0+50	238.67
0+57	238.85
0+60	238.70

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 240.00)	(0+60, 238.70)	0.045

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.19	ft
Elevation Range	238.67 to 240.00 ft	
Flow Area	1.65	ft²
Wetted Perimeter	17.35	ft
Hydraulic Radius	0.10	ft
Top Width	17.18	ft
Normal Depth	0.19	ft
Critical Depth	0.24	ft
Critical Slope	0.05855	ft/ft

Worksheet for MP-101.97_STA0_94_BRIDGE_2YR

Results

Velocity		3.21	ft/s
Velocity Head		0.16	ft
Specific Energy		0.35	ft
Froude Number		1.83	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.19	ft
Critical Depth	0.24	ft
Channel Slope	0.22000	ft/ft
Critical Slope	0.05855	ft/ft

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MP 101.99R2

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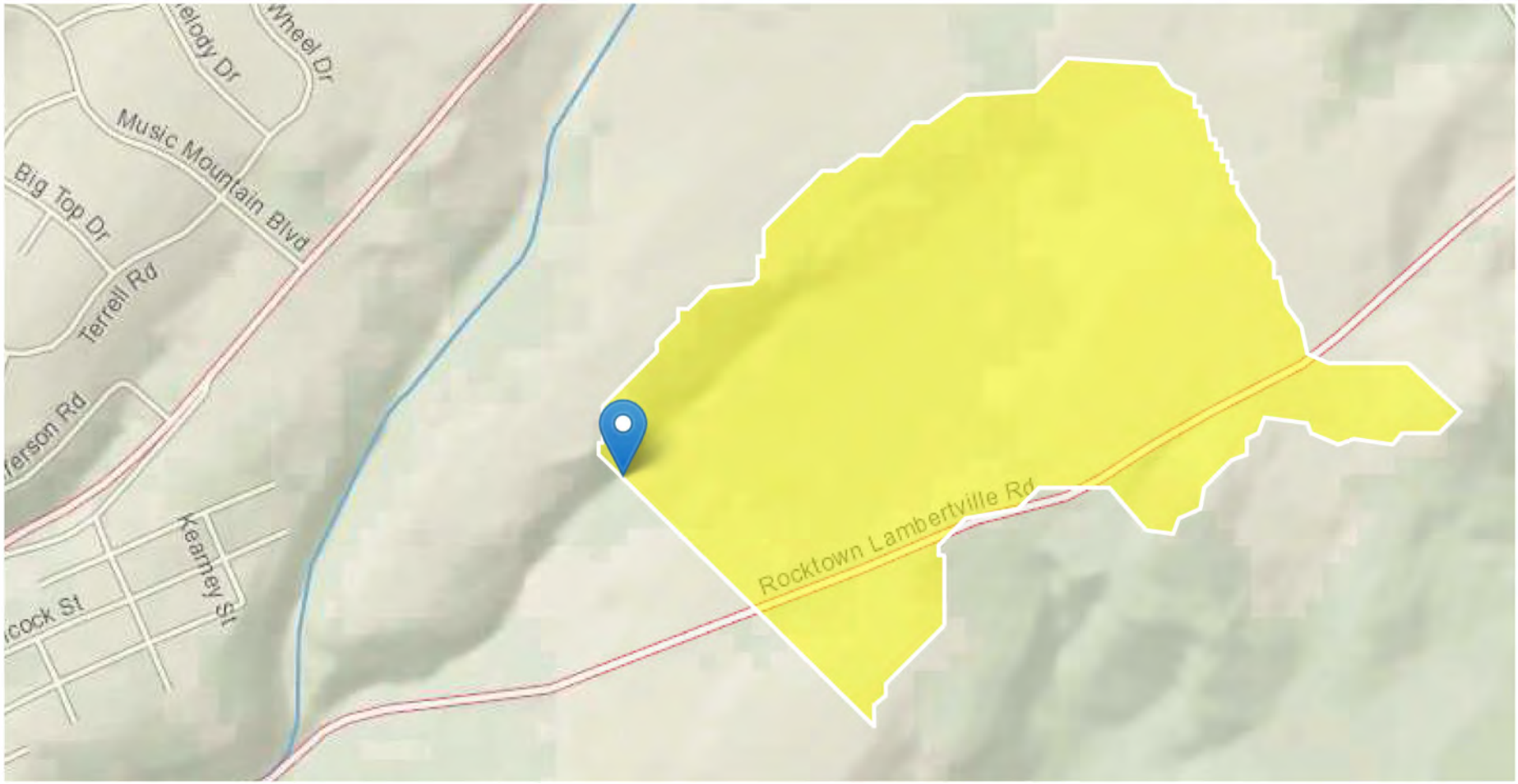
Time: 2017-08-09 09:51:21 -0400



Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	0.36	square miles
STORAGE	Percentage of area of storage (lakes ponds reservoirs wetlands)	13.7	percent
CSL10_85	Change in elevation divided by length between points 10 and 85 percent of distance along main channel to basin divide - main channel method not known	153	feet per mi
POPDENS	Basin Population Density	113	persons per square mile

Peak-Flow Statistics Parameters [Peak Unglaciated Piedmont Region 2009 5167]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.36	square miles	0.25	779
STORAGE	Percent Storage	13.7	percent	0.23	32
CSL10_85	Stream Slope 10 and 85 Method	153	feet per mi	4.31	191
POPDENS	Basin Population Density	113	persons per square mile	83	11084

Peak-Flow Statistics Flow Report [Peak Unglaciated Piedmont Region 2009 5167]

PIl: Prediction Interval-Lower, Plu: Prediction Interval-Upper, SEp: Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	SEe	SEp	Equiv. Yrs.
2 Year Peak Flood	97.7	ft^3/s	49	50.3	1
5 Year Peak Flood	165	ft^3/s	49.4	50.9	2
10 Year Peak Flood	218	ft^3/s	50.5	52.2	3

Worksheet for MP-101.99R2_STA0+49_2YR_PIPE

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.01700	ft/ft
Discharge	97.70	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	252.00
0+13	248.00
0+28	244.00
0+32	242.00
0+39	238.00
0+42	235.70
0+46	233.91
0+60	238.00
0+75	240.00
0+84	242.00
0+96	244.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 252.00)	(0+96, 244.00)	0.030

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	2.20	ft
Elevation Range	233.91 to 252.00 ft	

Worksheet for MP-101.99R2_STA0+49_2YR_PIPE

Results

Flow Area		14.46	ft²
Wetted Perimeter		13.51	ft
Hydraulic Radius		1.07	ft
Top Width		12.72	ft
Normal Depth		2.20	ft
Critical Depth		2.30	ft
Critical Slope		0.01342	ft/ft
Velocity		6.76	ft/s
Velocity Head		0.71	ft
Specific Energy		2.91	ft
Froude Number		1.12	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	2.20	ft
Critical Depth	2.30	ft
Channel Slope	0.01700	ft/ft
Critical Slope	0.01342	ft/ft

Worksheet for MP-101.99R2_STA0+14_2YR_BRIDGE

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.01700	ft/ft
Discharge	97.70	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	254.00
0+03	252.00
0+14	248.00
0+34	242.00
0+43	238.00
0+46	236.60
0+50	235.37
0+56	236.80
0+60	238.00
0+79	240.00
0+91	242.00
1+00	244.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 254.00)	(1+00, 244.00)	0.030

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	2.07	ft

Worksheet for MP-101.99R2_STA0+14_2YR_BRIDGE

Results

Elevation Range	235.37 to 254.00 ft		
Flow Area		14.83	ft²
Wetted Perimeter		14.38	ft
Hydraulic Radius		1.03	ft
Top Width		13.75	ft
Normal Depth		2.07	ft
Critical Depth		2.16	ft
Critical Slope		0.01336	ft/ft
Velocity		6.59	ft/s
Velocity Head		0.67	ft
Specific Energy		2.74	ft
Froude Number		1.12	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	2.07	ft
Critical Depth	2.16	ft
Channel Slope	0.01700	ft/ft
Critical Slope	0.01336	ft/ft

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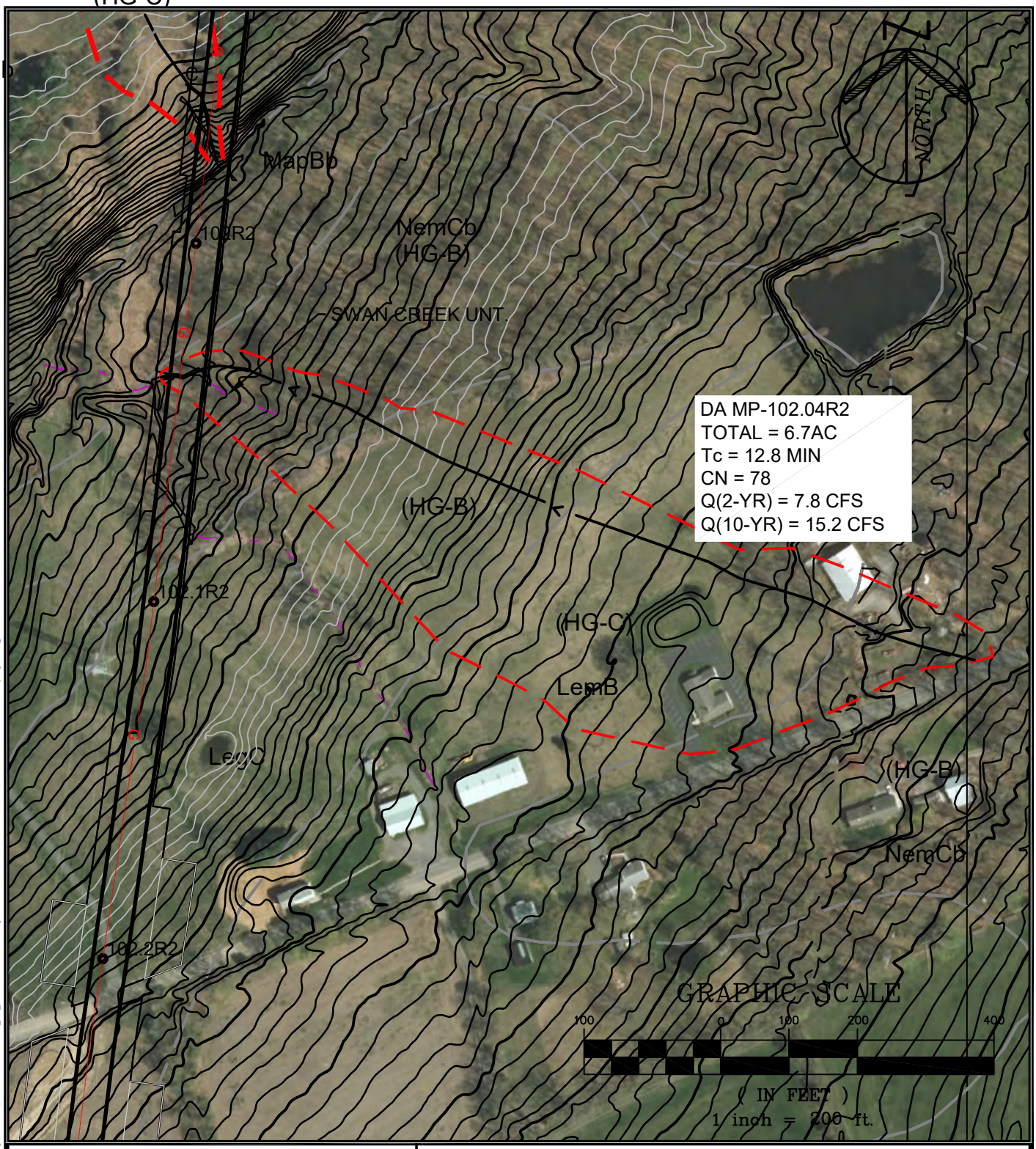

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CERTIFICATE OF AUTHORIZATION NO. 24GA28032700

PROJECT TITLE

PENNEAST PIPELINE

HUNTERDON AND MERCER COUNTY, NJ

SHEET TITLE

STREAM CROSSING DRAINAGE AREA MP 102.04R2

PROJ. NO.:	05516.0001	DRN. BY:	JPS	SCALE:	1"=200'
DATE:	05/23/19	CK'D BY:	WS		

FILE NAME: P:\05516\0001\DWGs\CAD\C-Civil\Plotdwgs\Drainage Area Maps\05516\0001-Stream_DA_MP100.8-114-WAL.dwg\MP 102.04R2 LAST EDIT: 06/07/2019 - 04:39:23 PM LOGIN: jmcgowan@

Worksheet 2: Runoff curve number and runoff (Approximated)

Project	By	Date
PennEast	IK	8-May-19
Location	**Checked**	**Date**
Hunterdon County, NJ		

Check one: ☐ Present ☒ Developed | MP 102.04

1. Runoff curve number

Soil name and hydrologic group (appendix A)	Cover Description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN[1] Table 2-2	CN[1] Figure 2-3	CN[1] Figure 2-4	Area ☒ acres / ☐ mi² / ☐ %	Product of CN x Area
Type C	Farmstead, Good Condition	82			3.25	266.50
Type B	Farmstead, Good Condition	74			3.45	255.30
				Totals ➡	6.70	521.80

1. Use only one CN source per line

CN (weighted) = tot.prod. / tot. area = 521.80 / 6.70 = 77.9 ; Use CN ➡ **78**

2. Runoff

		Storm #1	Storm #2	Storm #3
Frequency……	yr			
Rainfall, P (24-hour)…….	in			
Runoff, Q……	in			

Use P and CN with table 2-1, figure 2-1, or equation 2-3 abd 2-4

PROJECT:	PennEast	JOB NO. 5516.0001	
		SHEET	DATE: 05-08-19
		BY:	IK
SUBJECT:	Tc Calculations	CHK'D	

Time of Concentration calculations with the application of the SCS TR-55 methodology.

Watershed or Subarea Designation: DA 102.04

Area 6.7 AC

SHEET FLOW

Segment ID		A-B			
Surface Description (Table 3-1)		GRASS			
Manning's Coefficient, n (Table 3-1)		0.150			
Flow Length, L (total <= 150)	(ft)	150			
Two Year Rainfall, P	(in)	3.4			
Land Slope, s	(ft/ft)	0.067			
Computed Tt = 0.007 (nL)^0.8 / P^0.5*s^0.4	(hrs)	0.136			0.136

SHALLOW CONCENTRATED FLOW

Segment ID		B-C			
Surface Description (paved or unpaved)		UNPAVED			
Flow Length, L	(ft)	1069			
Watercourse slope, s	(ft/ft)	0.077			
Average Velocity, V (Figure 3-1)	(ft/s)	4.0			
Computed Tt = L / 3600V	(hrs)	0.074			0.074

CHANNEL FLOW

Segment ID		C-D			
Cross sectional Area, a	(sf)	3.75			
Wetted Perimeter, Pw	(ft)	5.70			
Hydraulic Radius, r =a/Pw	(ft)	0.658			
Channel Slope (ft/ft)	(ft/ft)	0.063			
Manning's Roughness Coefficient, n		0.045			
Velocity, V = 1.49r^(2/3)s^0.5 / n	(ft/s)	6.29			
Flow Length, L	(ft)	95			
Computed Tt = L / 3600V	(hrs)	0.004			0.004

Watershed or subarea Tc	0.214	hrs.
	12.8	min.

Use minimum Tc of 10 minutes

Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 05 / 23 / 2019

Hyd. No. 87

MP-102.04

Hydrograph type	= SCS Runoff	Peak discharge	= 7.778 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.20 hrs
Time interval	= 6 min	Hyd. volume	= 30,040 cuft
Drainage area	= 6.700 ac	Curve number	= 78.000
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 12.8 min
Total precip.	= 3.26 in	Distribution	= Custom
Storm duration	= C:\Users\IKuzmina\AppData\Local\Autodesk\C3D 2019\enu\HHApps\Hydrograp	Shape factor	= 484

Hydrograph Discharge Table

(Printed values >= 1.00% of Qp.)

Time -- Outflow (hrs cfs)		Time -- Outflow (hrs cfs)		Time -- Outflow (hrs cfs)		Time -- Outflow (hrs cfs)	
10.70	0.086	12.50	3.125	14.30	0.585	16.10	0.353
10.80	0.108	12.60	2.524	14.40	0.565	16.20	0.349
10.90	0.136	12.70	2.015	14.50	0.546	16.30	0.343
11.00	0.168	12.80	1.709	14.60	0.526	16.40	0.338
11.10	0.207	12.90	1.493	14.70	0.506	16.50	0.332
11.20	0.258	13.00	1.369	14.80	0.486	16.60	0.327
11.30	0.322	13.10	1.238	14.90	0.466	16.70	0.322
11.40	0.397	13.20	1.117	15.00	0.446	16.80	0.316
11.50	0.481	13.30	1.020	15.10	0.425	16.90	0.311
11.60	0.639	13.40	0.939	15.20	0.408	17.00	0.305
11.70	0.886	13.50	0.866	15.30	0.397	17.10	0.300
11.80	1.222	13.60	0.791	15.40	0.389	17.20	0.295
11.90	1.814	13.70	0.728	15.50	0.384	17.30	0.289
12.00	3.062	13.80	0.686	15.60	0.379	17.40	0.283
12.10	5.873	13.90	0.660	15.70	0.374	17.50	0.278
12.20	7.778	14.00	0.642	15.80	0.369	17.60	0.272
12.30	6.607	14.10	0.623	15.90	0.364	17.70	0.267
12.40	4.795	14.20	0.604	16.00	0.359	17.80	0.261

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Worksheet for MP-102.04R2_STA0+52_2YR_PIPE

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.04000	ft/ft
Discharge	7.80	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	242.00
0+47	241.70
0+50	241.35
0+52	242.40
0+67	244.00
1+00	246.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 242.00)	(1+00, 246.00)	0.045

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.55	ft
Elevation Range	241.35 to 246.00 ft	
Flow Area	4.60	ft²
Wetted Perimeter	35.56	ft
Hydraulic Radius	0.13	ft
Top Width	35.38	ft
Normal Depth	0.55	ft

Worksheet for MP-102.04R2_STA0+52_2YR_PIPE

Results

Critical Depth		0.53	ft
Critical Slope		0.05995	ft/ft
Velocity		1.69	ft/s
Velocity Head		0.04	ft
Specific Energy		0.60	ft
Froude Number		0.83	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.55	ft
Critical Depth	0.53	ft
Channel Slope	0.04000	ft/ft
Critical Slope	0.05995	ft/ft

Worksheet for MP-102.04R2_STA0+18_2YR_BRIDGE

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.04000	ft/ft
Discharge	7.80	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	248.00
0+02	248.00
0+40	245.00
0+46	244.50
0+50	244.50
0+57	244.60
0+64	244.70

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 248.00)	(0+64, 244.70)	0.045

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.26	ft
Elevation Range	244.50 to 248.00 ft	
Flow Area	3.77	ft²
Wetted Perimeter	21.51	ft
Hydraulic Radius	0.18	ft
Top Width	21.43	ft

Worksheet for MP-102.04R2_STA0+18_2YR_BRIDGE

Results

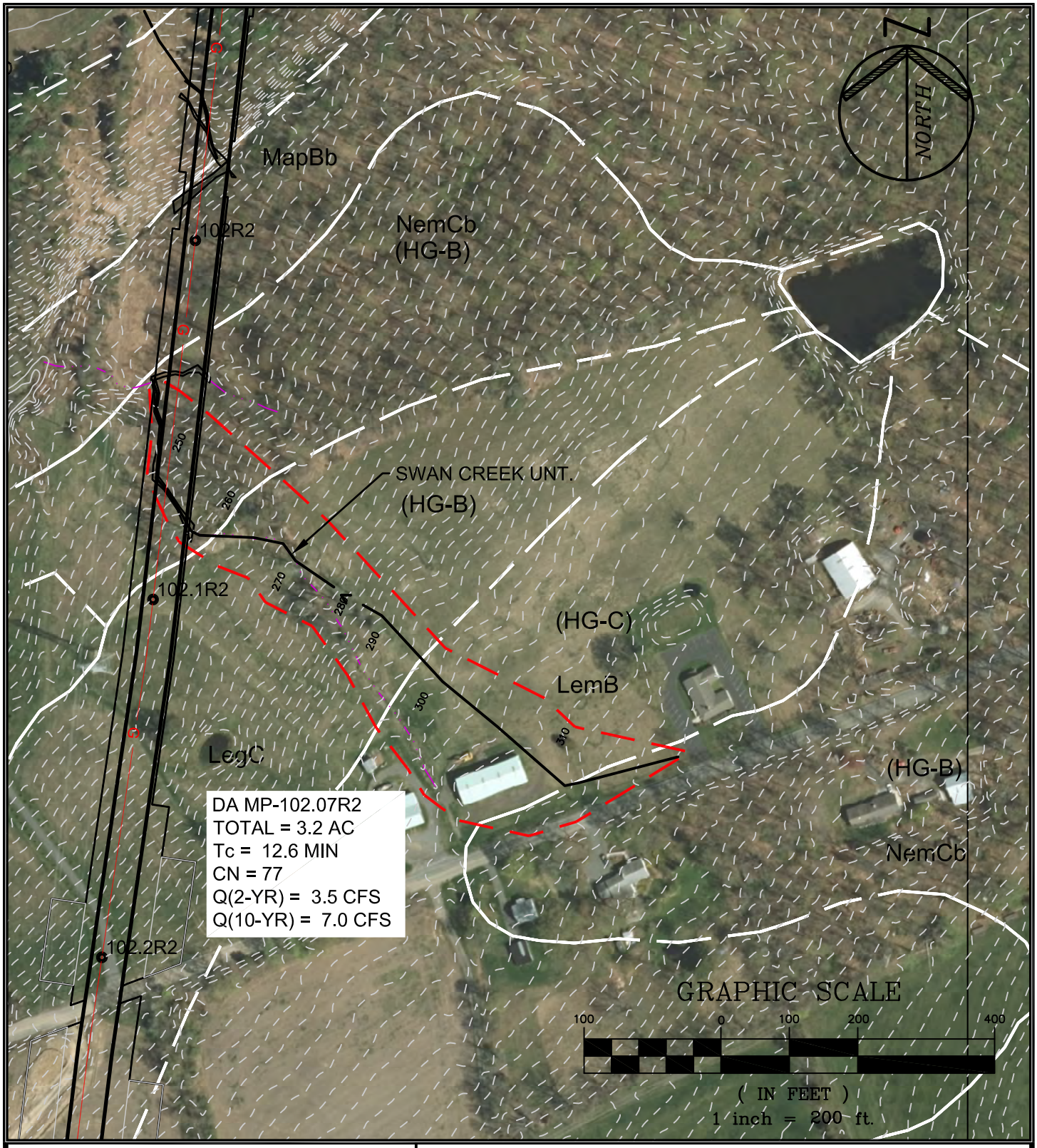
Normal Depth		0.26	ft
Critical Depth		0.25	ft
Critical Slope		0.05444	ft/ft
Velocity		2.07	ft/s
Velocity Head		0.07	ft
Specific Energy		0.33	ft
Froude Number		0.87	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.26	ft
Critical Depth	0.25	ft
Channel Slope	0.04000	ft/ft
Critical Slope	0.05444	ft/ft



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CERTIFICATE OF AUTHORIZATION NO. 24GA28032700

PROJECT TITLE

PENNEAST PIPELINE

HUNTERDON AND MERCER COUNTY, NJ

SHEET TITLE

STREAM CROSSING DRAINAGE AREA MP 102.07R2

PROJ. NO.:	05516.0001	DRN. BY:	JPS	SCALE:	1"=200'
DATE:	05/23/19	CK'D BY:	WS		

FILE NAME: P:\05516\0001\DWGs\CAD\C-Civil\Plotdwgs\Drainage Area Maps\05516001-Stream_DA_MP100.8-114-WAL.dwg\MP 102.05R2 LAST EDIT: 06/13/2019 - 01:39:54 PM LOGIN: IKuzmina@

Worksheet 2: Runoff curve number and runoff (Approximated)

Project	By	Date
PennEast	IK	8-May-19
Location	**Checked**	**Date**
Hunterdon County, NJ		

Check one: ☐ Present ☒ Developed | MP 102.07

1. Runoff curve number

Soil name and hydrologic group (appendix A)	Cover Description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN[1] Table 2-2	CN[1] Figure 2-3	CN[1] Figure 2-4	Area ☒ acres / ☐ mi² / ☐ %	Product of CN x Area
Type C	Farmstead, Good Condition	82			1.20	98.40
Type B	Farmstead, Good Condition	74			2.00	148.00
1. Use only one CN source per line				Totals ➡	3.20	246.40

CN (weighted) = tot.prod. / tot. area = 246.40 / 3.20 = 77.0 ; Use CN ➡ **77**

2. Runoff

		Storm #1	Storm #2	Storm #3
Frequency……	yr			
Rainfall, P (24-hour)…….	in			
Runoff, Q……	in			

Use P and CN with table 2-1, figure 2-1, or equation 2-3 abd 2-4

PROJECT:	PennEast	JOB NO. 5516.0001	
		SHEET	DATE: 05-08-19
		BY:	IK
SUBJECT:	Tc Calculations	CHK'D	

Time of Concentration calculations with the application of the SCS TR-55 methodology.

Watershed or Subarea Designation: DA 102.07

Area 3.2 AC

SHEET FLOW

Segment ID		A-B			
Surface Description (Table 3-1)		GRASS			
Manning's Coefficient, n (Table 3-1)		0.150			
Flow Length, L (total <= 150)	(ft)	150			
Two Year Rainfall, P	(in)	3.4			
Land Slope, s	(ft/ft)	0.047			
Computed Tt = 0.007 (nL)^0.8 / P^0.5*s^0.4	(hrs)	0.156			0.156

SHALLOW CONCENTRATED FLOW

Segment ID		B-C			
Surface Description (paved or unpaved)		UNPAVED			
Flow Length, L	(ft)	534			
Watercourse slope, s	(ft/ft)	0.077			
Average Velocity, V (Figure 3-1)	(ft/s)	4.0			
Computed Tt = L / 3600V	(hrs)	0.037			0.037

CHANNEL FLOW

Segment ID		C-D			
Cross sectional Area, a	(sf)	3.75			
Wetted Perimeter, Pw	(ft)	5.70			
Hydraulic Radius, r =a/Pw	(ft)	0.658			
Channel Slope (ft/ft)	(ft/ft)	0.074			
Manning's Roughness Coefficient, n		0.045			
Velocity, V = 1.49r^(2/3)s^0.5 / n	(ft/s)	6.81			
Flow Length, L	(ft)	408			
Computed Tt = L / 3600V	(hrs)	0.017			0.017

Watershed or subarea Tc	0.210	hrs.
	12.6	min.

Use minimum Tc of 10 minutes

Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 05 / 23 / 2019

Hyd. No. 88

MP-102.07

Hydrograph type	= SCS Runoff	Peak discharge	= 3.518 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.20 hrs
Time interval	= 6 min	Hyd. volume	= 13,665 cuft
Drainage area	= 3.200 ac	Curve number	= 77.000
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 12.6 min
Total precip.	= 3.26 in	Distribution	= Custom
Storm duration	= C:\Users\IKuzmina\AppData\Local\Autodesk\C3D 2019\enu\HHApps\Hydrograp	Shape factor	= 484

Hydrograph Discharge Table

(Printed values >= 1.00% of Qp.)

Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)
10.80	0.037	12.60	1.160	14.40	0.262	16.20	0.162
10.90	0.049	12.70	0.927	14.50	0.253	16.30	0.159
11.00	0.062	12.80	0.787	14.60	0.244	16.40	0.157
11.10	0.079	12.90	0.688	14.70	0.234	16.50	0.154
11.20	0.102	13.00	0.631	14.80	0.225	16.60	0.152
11.30	0.129	13.10	0.571	14.90	0.216	16.70	0.149
11.40	0.162	13.20	0.515	15.00	0.207	16.80	0.147
11.50	0.200	13.30	0.471	15.10	0.197	16.90	0.144
11.60	0.269	13.40	0.434	15.20	0.189	17.00	0.142
11.70	0.378	13.50	0.400	15.30	0.184	17.10	0.139
11.80	0.528	13.60	0.366	15.40	0.181	17.20	0.137
11.90	0.793	13.70	0.337	15.50	0.178	17.30	0.134
12.00	1.356	13.80	0.317	15.60	0.176	17.40	0.132
12.10	2.637	13.90	0.305	15.70	0.174	17.50	0.129
12.20	3.518	14.00	0.297	15.80	0.171	17.60	0.127
12.30	3.003	14.10	0.288	15.90	0.169	17.70	0.124
12.40	2.190	14.20	0.280	16.00	0.166	17.80	0.121
12.50	1.433	14.30	0.271	16.10	0.164	17.90	0.119

<<

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Worksheet for MP-102.07R2_STA0+67_2YR_PIPE

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.06500	ft/ft
Discharge	3.50	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	250.00
0+38	250.00
0+48	248.00
0+50	246.89
0+53	248.00
1+00	248.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 250.00)	(1+00, 248.00)	0.045

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.67	ft
Elevation Range	246.89 to 250.00 ft	
Flow Area	0.93	ft²
Wetted Perimeter	3.09	ft
Hydraulic Radius	0.30	ft
Top Width	2.78	ft
Normal Depth	0.67	ft

Worksheet for MP-102.07R2_STA0+67_2YR_PIPE

Results

Critical Depth		0.71	ft
Critical Slope		0.04802	ft/ft
Velocity		3.78	ft/s
Velocity Head		0.22	ft
Specific Energy		0.89	ft
Froude Number		1.15	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.67	ft
Critical Depth	0.71	ft
Channel Slope	0.06500	ft/ft
Critical Slope	0.04802	ft/ft

Worksheet for MP-102.07R2_STA0+19_2YR_BRIDGE

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.06500	ft/ft
Discharge	3.50	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	256.00
0+09	256.00
0+37	254.00
0+45	252.00
0+50	250.36
0+54	252.50
0+86	252.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 256.00)	(0+86, 252.00)	0.045

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.62	ft
Elevation Range	250.36 to 256.00 ft	
Flow Area	0.96	ft²
Wetted Perimeter	3.33	ft
Hydraulic Radius	0.29	ft
Top Width	3.08	ft

Worksheet for MP-102.07R2_STA0+19_2YR_BRIDGE

Results

Normal Depth		0.62	ft
Critical Depth		0.66	ft
Critical Slope		0.04758	ft/ft
Velocity		3.66	ft/s
Velocity Head		0.21	ft
Specific Energy		0.83	ft
Froude Number		1.16	
Flow Type	Supercritical		

GVF Input Data

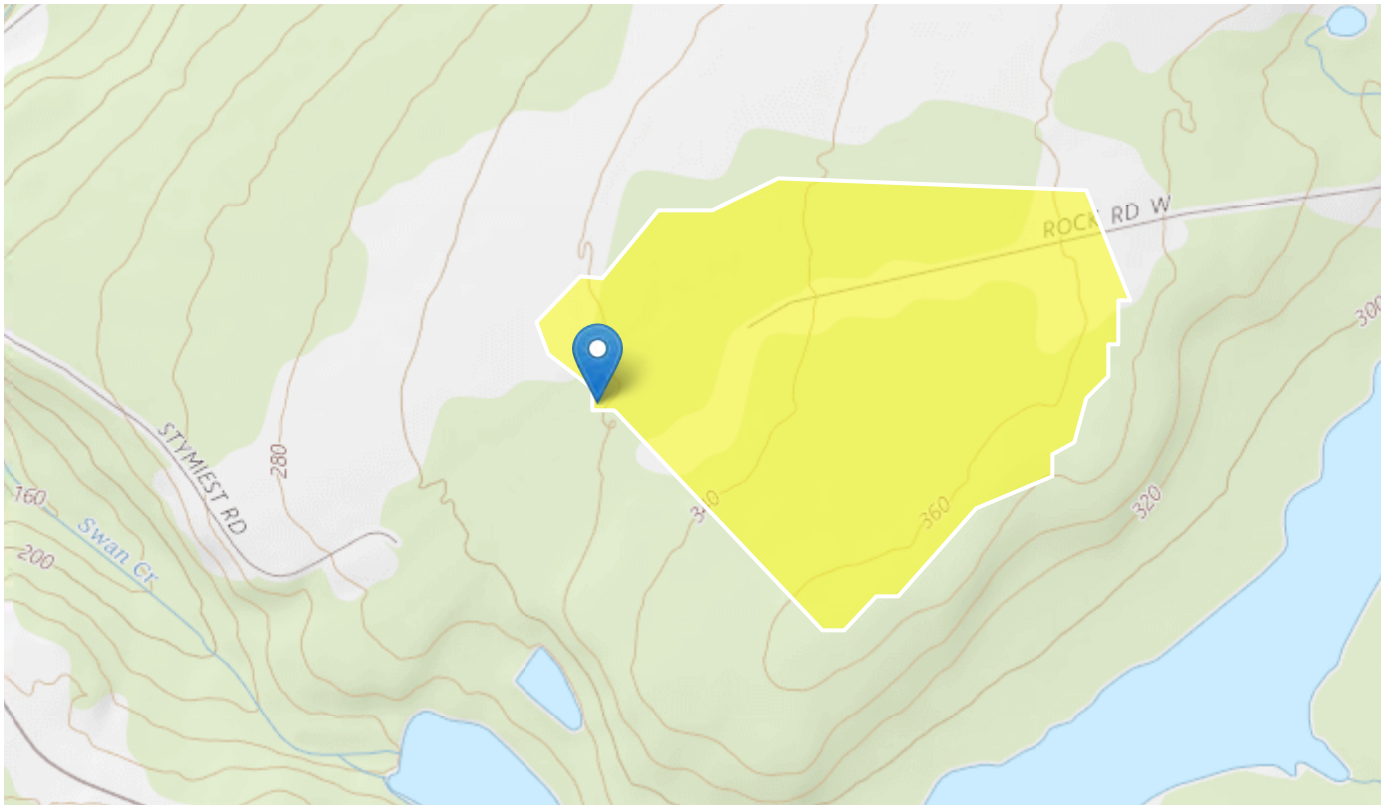
Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.62	ft
Critical Depth	0.66	ft
Channel Slope	0.06500	ft/ft
Critical Slope	0.04758	ft/ft

MP-102.56R2

Region ID: NJ
Workspace ID: NJ20180308172317805000
Clicked Point (Latitude, Longitude): 40.36586, -74.92592
Time: 2018-03-08 12:23:31 -0500



The South Carolina StreamStats application is testing LiDAR-derived data and streams for delineation. This is a beta version and QA/QC is incomplete. It may calculate basin characteristics and flow statistics incorrectly. Please verify the drainage areas and flow stats carefully. Use at your own risk

Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	0.0541	square miles
STORAGE	Percentage of area of storage (lakes ponds reservoirs wetlands)	0	percent

Parameter Code	Parameter Description	Value	Unit
CSL10_85	Change in elevation divided by length between points 10 and 85 percent of distance along main channel to basin divide - main channel method not known	171	feet per mi
POPDENS	Basin Population Density	103	persons per square mile

Peak-Flow Statistics Parameters [Peak Unglaciated Piedmont Region 2009 5167]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.0541	square miles	0.25	779
STORAGE	Percent Storage	0	percent	0.23	32
CSL10_85	Stream Slope 10 and 85 Method	171	feet per mi	4.31	191
POPDENS	Basin Population Density	103	persons per square mile	83	11084

Peak-Flow Statistics Disclaimers [Peak Unglaciated Piedmont Region 2009 5167]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors

Peak-Flow Statistics Flow Report [Peak Unglaciated Piedmont Region 2009 5167]

Statistic	Value	Unit
2 Year Peak Flood	27.6	ft^3/s
5 Year Peak Flood	51.9	ft^3/s
10 Year Peak Flood	72.9	ft^3/s
25 Year Peak Flood	105	ft^3/s
50 Year Peak Flood	133	ft^3/s
100 Year Peak Flood	165	ft^3/s
500 Year Peak Flood	251	ft^3/s

Worksheet for MP-102.56R2_STA0+32_PIPE-2YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.02900	ft/ft
Discharge	27.60	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	317.00
0+18	316.00
0+28	314.29
0+32	313.36
0+36	315.17
0+50	318.00

Roughness Segment Definitions

Start Station & Elevation	End Station & Elevation	Roughness Coefficient
(0+00, 317.00)	(0+50, 318.00)	0.040

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	1.35	ft
Elevation Range	313.36 to 318.00 ft	
Flow Area	6.01	ft²
Wetted Perimeter	9.70	ft
Hydraulic Radius	0.62	ft
Top Width	9.27	ft
Normal Depth	1.35	ft

Worksheet for MP-102.56R2_STA0+32_PIPE-2YR

Results

Critical Depth		1.36	ft
Critical Slope		0.02861	ft/ft
Velocity		4.59	ft/s
Velocity Head		0.33	ft
Specific Energy		1.68	ft
Froude Number		1.01	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.35	ft
Critical Depth	1.36	ft
Channel Slope	0.02900	ft/ft
Critical Slope	0.02861	ft/ft

Worksheet for MP-102.56R2_STA0+55_BRIDGE-2YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.02900	ft/ft
Discharge	27.60	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	317.00
0+16	316.00
0+33	312.83
0+34	312.65
0+37	312.29
0+47	316.00

Roughness Segment Definitions

Start Station & Elevation	End Station & Elevation	Roughness Coefficient
(0+00, 317.00)	(0+47, 316.00)	0.040

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	1.16	ft
Elevation Range	312.29 to 317.00 ft	
Flow Area	6.14	ft²
Wetted Perimeter	10.23	ft
Hydraulic Radius	0.60	ft
Top Width	9.91	ft
Normal Depth	1.16	ft

Worksheet for MP-102.56R2_STA0+55_BRIDGE-2YR

Results

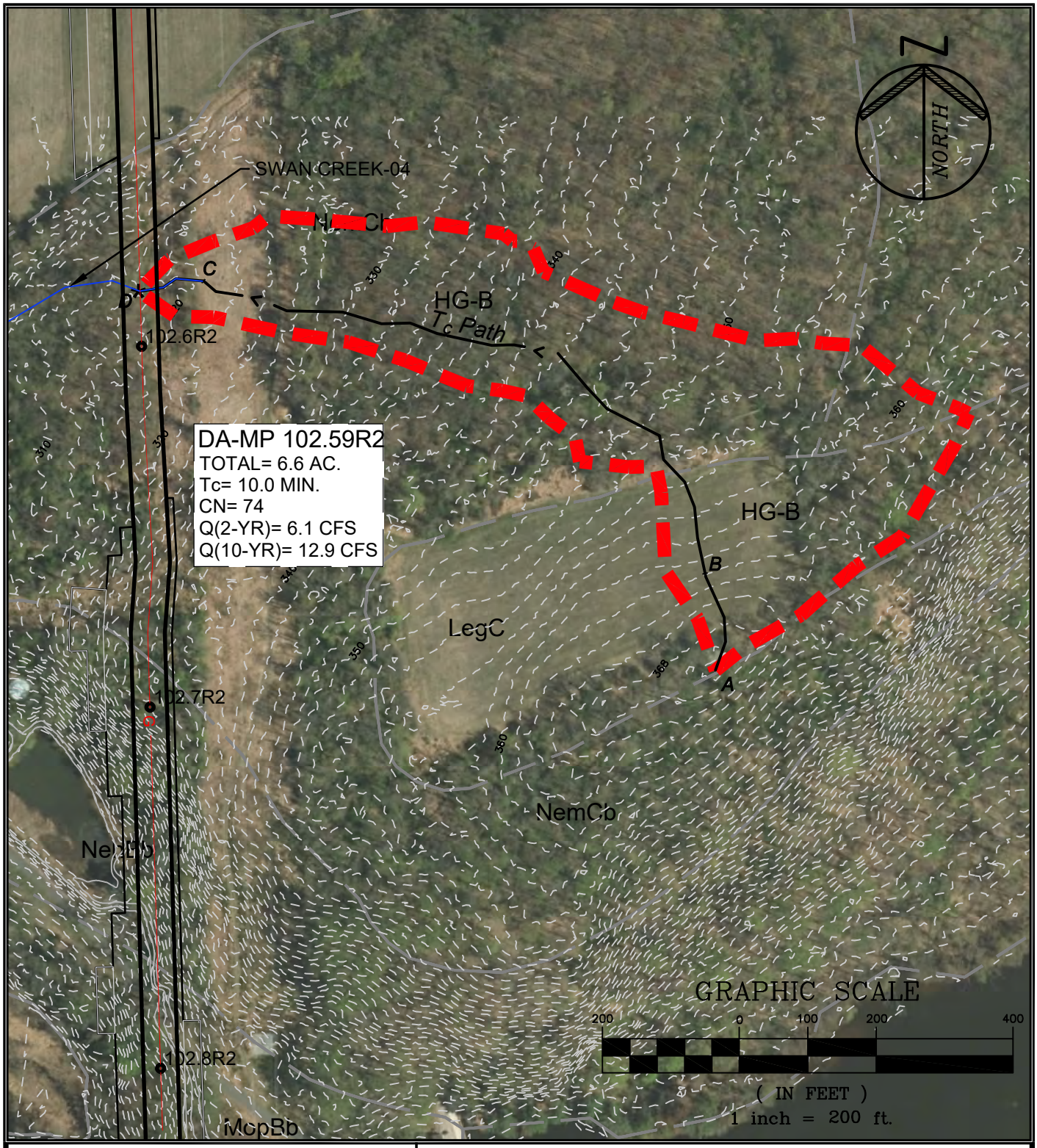
Critical Depth		1.17	ft
Critical Slope		0.02851	ft/ft
Velocity		4.50	ft/s
Velocity Head		0.31	ft
Specific Energy		1.48	ft
Froude Number		1.01	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.16	ft
Critical Depth	1.17	ft
Channel Slope	0.02900	ft/ft
Critical Slope	0.02851	ft/ft



PAULUS, SOKOLOWSKI AND SARTOR, LLC.

1433 ROUTE 34
SUITE A4
WALL, NEW JERSEY 07727
PHONE: (848) 206-2626

CERTIFICATE OF AUTHORIZATION NO. 24GA28032700

PROJECT TITLE

PENNEAST PIPELINE

HUNTERDON AND MERCER COUNTY, NJ

SHEET TITLE

STREAM CROSSING DRAINAGE AREA MP 102.59R2

PROJ. NO.:	05516.0001	DRN. BY:	JPS	SCALE:	1"=200'
DATE:	05/23/19	CK'D BY:	WS		

FILE NAME: P:\05516\0001\DWGs\CAD\C-Civil\Plotdwgs\Drainage Area Maps\05516\0001-Stream_DA_MP100.8-114-WAL.dwg\MP 102.59R2 LAST EDIT: 06/07/2019 - 04:48:38 PM LOGIN: jmcgowan@

Worksheet 2: Runoff curve number and runoff (Approximated)

Project	By	Date
PennEast	JPS	26-Feb-18
Location	**Checked**	**Date**
Hunterdon County, NJ		

Check one: ☐ Present ☒ Developed — MP 102.6

1. Runoff curve number

Soil name and hydrologic group (appendix A)	Cover Description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN[1] Table 2-2	CN[1] Figure 2-3	CN[1] Figure 2-4	Area (X / acres / mi² / %)	Product of CN x Area
Type B	Farmstead, Good Condition	74			6.60	488.40
				Totals ➡	6.60	488.40

1. Use only one CN source per line

CN (weighted) = tot.prod. / tot. area = 488.40 / 6.60 = 74.0 ; Use CN ➡ **74**

2. Runoff

		Storm #1	Storm #2	Storm #3
Frequency……	yr			
Rainfall, P (24-hour)…….	in			
Runoff, Q……	in			

Use P and CN with table 2-1, figure 2-1, or equation 2-3 abd 2-4

PSS&	PROJECT: PennEast	JOB NO. 5516.0001	
		SHEET	DATE:2/12/2018
		BY:	JPS
	SUBJECT: Tc Calculations	CHK'D	

Time of Concentration calculations with the application of the SCS TR-55 methodology.

Watershed or Subarea Designation: DA 102.6

Area 6.6 AC

SHEET FLOW

Segment ID		A-B			
Surface Description (Table 3-1)		CULTIVATED			
Manning's Coefficient, n (Table 3-1)		0.060			
Flow Length, L (total <= 150)	(ft)	150			
Two Year Rainfall, P	(in)	3.4			
Land Slope, s	(ft/ft)	0.053			
Computed Tt = 0.007 (nL)^0.8 / P^0.5*s^0.4	(hrs)	0.072			0.072

SHALLOW CONCENTRATED FLOW

Segment ID		B-C			
Surface Description (paved or unpaved)		UNPAVED			
Flow Length, L	(ft)	950			
Watercourse slope, s	(ft/ft)	0.044			
Average Velocity, V (Figure 3-1)	(ft/s)	3.2			
Computed Tt = L / 3600V	(hrs)	0.082			0.082

CHANNEL FLOW

Segment ID		C-D			
Cross sectional Area, a	(sf)	4.25			
Wetted Perimeter, Pw	(ft)	9.62			
Hydraulic Radius, r =a/Pw	(ft)	0.442			
Channel Slope (ft/ft)	(ft/ft)	0.041			
Manning's Roughness Coefficient, n		0.040			
Velocity, V = 1.49r^(2/3)s^0.5 / n	(ft/s)	4.38			
Flow Length, L	(ft)	98			
Computed Tt = L / 3600V	(hrs)	0.006			0.006

Watershed or subarea Tc	0.160	hrs.
	9.6	min.

Use minimum Tc of 10 minutes

Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Wednesday, 02 / 20 / 2019

Hyd. No. 30

DA 102.6

Hydrograph type	= SCS Runoff	Peak discharge	= 6.083 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.20 hrs
Time interval	= 6 min	Hyd. volume	= 24,195 cuft
Drainage area	= 6.600 ac	Curve number	= 74.000*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 10.0 min
Total precip.	= 3.26 in	Distribution	= Custom
Storm duration	= C:\Users\IKuzmina\AppData\Local\Autodesk\C3D2019\enu\HHApps\Hydrograp		

* Composite (Area/CN) = [(10.000 x 74)] / 6.600

Hydrograph Discharge Table

(Printed values >= 1.00% of Qp.)

Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)
11.20	0.086	13.00	1.163	14.80	0.421	16.60	0.285
11.30	0.127	13.10	1.054	14.90	0.404	16.70	0.281
11.40	0.179	13.20	0.953	15.00	0.387	16.80	0.276
11.50	0.239	13.30	0.872	15.10	0.369	16.90	0.272
11.60	0.348	13.40	0.804	15.20	0.354	17.00	0.267
11.70	0.519	13.50	0.742	15.30	0.345	17.10	0.263
11.80	0.765	13.60	0.679	15.40	0.339	17.20	0.258
11.90	1.208	13.70	0.625	15.50	0.334	17.30	0.253
12.00	2.176	13.80	0.590	15.60	0.330	17.40	0.248
12.10	4.443	13.90	0.568	15.70	0.326	17.50	0.243
12.20	6.083	14.00	0.553	15.80	0.321	17.60	0.239
12.30	5.277	14.10	0.537	15.90	0.317	17.70	0.234
12.40	3.908	14.20	0.521	16.00	0.313	17.80	0.229
12.50	2.596	14.30	0.505	16.10	0.308	17.90	0.224
12.60	2.112	14.40	0.489	16.20	0.304	18.00	0.219
12.70	1.695	14.50	0.472	16.30	0.299	18.10	0.214
12.80	1.444	14.60	0.455	16.40	0.295	18.20	0.210
12.90	1.265	14.70	0.438	16.50	0.290	18.30	0.208

Continues on next page...

Worksheet for MP 102.59R2 STA0+44_2YR_PIPE

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.04500	ft/ft
Discharge	6.10	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	316.00
0+40	316.00
0+48	315.06
0+53	316.25
1+00	320.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 316.00)	(1+00, 320.00)	0.030

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.49	ft
Elevation Range	315.06 to 320.00 ft	
Flow Area	1.50	ft²
Wetted Perimeter	6.20	ft
Hydraulic Radius	0.24	ft
Top Width	6.12	ft
Normal Depth	0.49	ft
Critical Depth	0.57	ft

Worksheet for MP 102.59R2 STA0+44_2YR_PIPE

Results

Critical Slope		0.02031	ft/ft
Velocity		4.08	ft/s
Velocity Head		0.26	ft
Specific Energy		0.75	ft
Froude Number		1.45	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.49	ft
Critical Depth	0.57	ft
Channel Slope	0.04500	ft/ft
Critical Slope	0.02031	ft/ft

Waterbody Name: Swan Creek UNT

Waterbody ID/LL ID: 040616_SQ_1006_EPH; 022417_RP_1005_E_MI/PE-HU-236.000

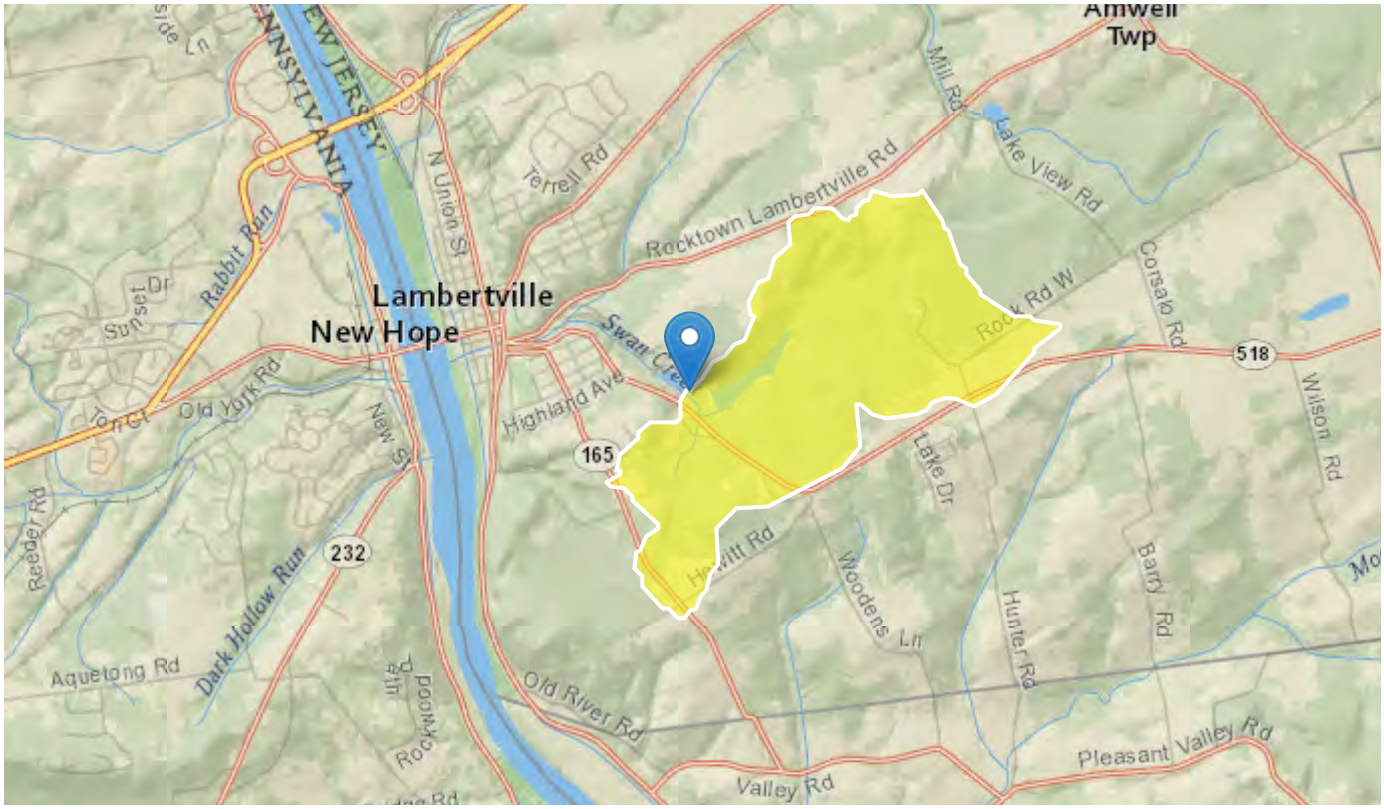
Observation Date: 4/6/2016 and 2/24/2017

County: Hunterdon

Description: A minor ephemeral stream flowing southeast between a palustrine forested wetland and upland forest. The banks are stable, and the bank width is approximately six feet. The streambed is predominantly clay, with some silt and gravel, and lesser amounts of sand and cobble. At the time of the assessment, the water depth was three inches.

MP-102.85R2

Region ID: NJ
Workspace ID: NJ20180308181728110000
Clicked Point (Latitude, Longitude): 40.36183, -74.92594
Time: 2018-03-08 13:17:44 -0500



The South Carolina StreamStats application is testing LiDAR-derived data and streams for delineation. This is a beta version and QA/QC is incomplete. It may calculate basin characteristics and flow statistics incorrectly. Please verify the drainage areas and flow stats carefully. Use at your own risk

Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	1.56	square miles
STORAGE	Percentage of area of storage (lakes ponds reservoirs wetlands)	19.9	percent

Parameter Code	Parameter Description	Value	Unit
CSL10_85	Change in elevation divided by length between points 10 and 85 percent of distance along main channel to basin divide - main channel method not known	57.8	feet per mi
POPDENS	Basin Population Density	103	persons per square mile

Peak-Flow Statistics Parameters [Peak Unglaciated Piedmont Region 2009 5167]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	1.56	square miles	0.25	779
STORAGE	Percent Storage	19.9	percent	0.23	32
CSL10_85	Stream Slope 10 and 85 Method	57.8	feet per mi	4.31	191
POPDENS	Basin Population Density	103	persons per square mile	83	11084

Peak-Flow Statistics Flow Report [Peak Unglaciated Piedmont Region 2009 5167]

PIl: Prediction Interval-Lower, PIu: Prediction Interval-Upper, SEp: Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	SEp	Equiv. Yrs.
2 Year Peak Flood	224	ft^3/s	50.3	1
5 Year Peak Flood	368	ft^3/s	50.9	2
10 Year Peak Flood	477	ft^3/s	52.2	3
25 Year Peak Flood	628	ft^3/s	54.5	4
50 Year Peak Flood	745	ft^3/s	56.8	5
100 Year Peak Flood	877	ft^3/s	59.5	5
500 Year Peak Flood	1200	ft^3/s	66.3	6

Peak-Flow Statistics Citations

Worksheet for MP-102.85_STA3+11_PIPE_2YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.07200	ft/ft
Discharge	224.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	258.00
0+13	258.00
0+30	255.70
0+50	255.05
0+64	255.10
0+71	256.00
0+92	258.00
1+00	258.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 258.00)	(1+00, 258.00)	0.045

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	1.01	ft
Elevation Range	255.05 to 258.00 ft	
Flow Area	31.69	ft²
Wetted Perimeter	44.46	ft
Hydraulic Radius	0.71	ft

Worksheet for MP-102.85_STA3+11_PIPE_2YR

Results

Top Width	44.37	ft
Normal Depth	1.01	ft
Critical Depth	1.24	ft
Critical Slope	0.03099	ft/ft
Velocity	7.07	ft/s
Velocity Head	0.78	ft
Specific Energy	1.79	ft
Froude Number	1.47	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.01	ft
Critical Depth	1.24	ft
Channel Slope	0.07200	ft/ft
Critical Slope	0.03099	ft/ft

Worksheet for MP-102.85_STA3+45_BRIDGE_2YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.07200	ft/ft
Discharge	224.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	256.00
0+20	254.00
0+27	252.75
0+50	252.01
0+59	252.90
1+00	258.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 256.00)	(1+00, 258.00)	0.045

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	1.28	ft
Elevation Range	252.01 to 258.00 ft	
Flow Area	29.83	ft²
Wetted Perimeter	38.23	ft
Hydraulic Radius	0.78	ft
Top Width	38.10	ft
Normal Depth	1.28	ft

Worksheet for MP-102.85_STA3+45_BRIDGE_2YR

Results

Critical Depth		1.54	ft
Critical Slope		0.03002	ft/ft
Velocity		7.51	ft/s
Velocity Head		0.88	ft
Specific Energy		2.16	ft
Froude Number		1.50	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.28	ft
Critical Depth	1.54	ft
Channel Slope	0.07200	ft/ft
Critical Slope	0.03002	ft/ft

MP- 102.88R2

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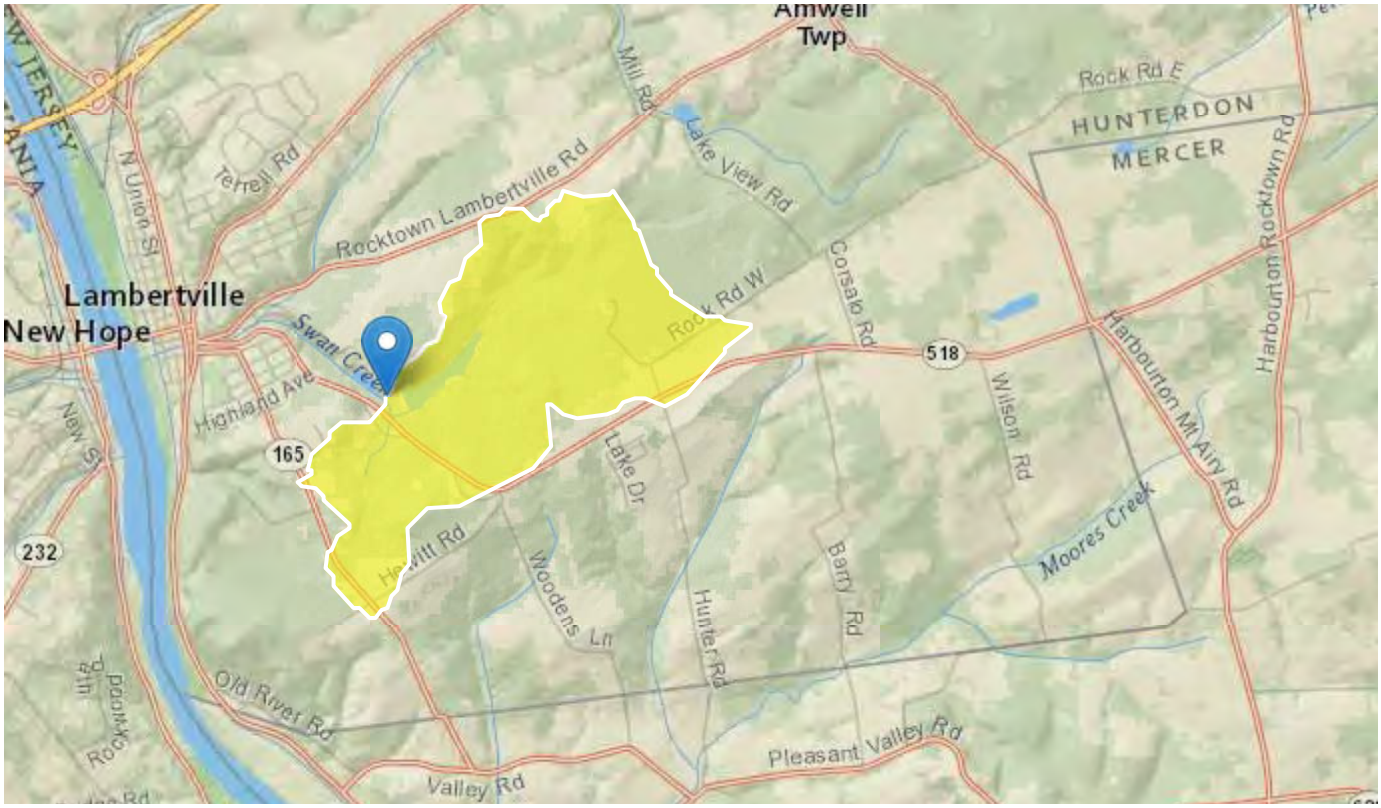

Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	1.55	square miles
STORAGE	Percentage of area of storage (lakes ponds reservoirs wetlands)	20	percent
CSL10_85	Change in elevation divided by length between points 10 and 85 percent of distance along main channel to basin divide - main channel method not known	58.4	feet per mi
POPDENS	Basin Population Density	103	persons per square mile

Peak-Flow Statistics Parameters [Peak Unglaciated Piedmont Region 2009 5167]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	1.55	square miles	0.25	779
STORAGE	Percent Storage	20	percent	0.23	32
CSL10_85	Stream Slope 10 and 85 Method	58.4	feet per mi	4.31	191
POPDENS	Basin Population Density	103	persons per square mile	83	11084

Peak-Flow Statistics Flow Report [Peak Unglaciated Piedmont Region 2009 5167]

PIl: Prediction Interval-Lower, PIu: Prediction Interval-Upper, SEp: Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	SEp	Equiv. Yrs.
2 Year Peak Flood	223	ft^3/s	50.3	1
5 Year Peak Flood	367	ft^3/s	50.9	2
10 Year Peak Flood	476	ft^3/s	52.2	3
25 Year Peak Flood	626	ft^3/s	54.5	4
50 Year Peak Flood	743	ft^3/s	56.8	5
100 Year Peak Flood	874	ft^3/s	59.5	5
500 Year Peak Flood	1190	ft^3/s	66.3	6

Peak-Flow Statistics Citations

Watson, K.M.,and Schopp, R.D.,2009, Methodology for estimation of flood magnitude and frequency for New Jersey streams, U.S. Geological Survey Scientific Investigations Report 2009-5167, 51 p. (http://pubs.usgs.gov/sir/2009/5167/)

Worksheet for MP-102.88MR2_STA4+16_PIPE_2YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.07310	ft/ft
Discharge	223.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	272.00
0+03	272.00
0+14	270.00
0+20	268.00
0+35	262.00
0+41	260.00
0+46	258.96
0+60	260.00
0+67	262.00
0+81	264.00
0+93	264.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 272.00)	(0+93, 264.00)	0.050

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	1.80	ft
Elevation Range	258.96 to 272.00 ft	

Worksheet for MP-102.88MR2_STA4+16_PIPE_2YR

Results

Flow Area		26.40	ft²
Wetted Perimeter		24.50	ft
Hydraulic Radius		1.08	ft
Top Width		24.14	ft
Normal Depth		1.80	ft
Critical Depth		2.11	ft
Critical Slope		0.03407	ft/ft
Velocity		8.45	ft/s
Velocity Head		1.11	ft
Specific Energy		2.90	ft
Froude Number		1.42	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.80	ft
Critical Depth	2.11	ft
Channel Slope	0.07310	ft/ft
Critical Slope	0.03407	ft/ft

Worksheet for MP-102.88MR2_STA4+45_BRIDGE_2YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.07310	ft/ft
Discharge	223.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	270.00
0+12	270.00
0+21	268.00
0+38	260.00
0+50	256.62
0+76	262.00
1+00	262.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 270.00)	(1+00, 262.00)	0.050

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	2.42	ft
Elevation Range	256.62 to 270.00 ft	
Flow Area	24.89	ft²
Wetted Perimeter	21.14	ft
Hydraulic Radius	1.18	ft
Top Width	20.56	ft

Worksheet for MP-102.88MR2_STA4+45_BRIDGE_2YR

Results

Normal Depth		2.42	ft
Critical Depth		2.80	ft
Critical Slope		0.03379	ft/ft
Velocity		8.96	ft/s
Velocity Head		1.25	ft
Specific Energy		3.67	ft
Froude Number		1.44	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	2.42	ft
Critical Depth	2.80	ft
Channel Slope	0.07310	ft/ft
Critical Slope	0.03379	ft/ft

MP 102.99R2

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Workspace ID: NJ20170809130737905000
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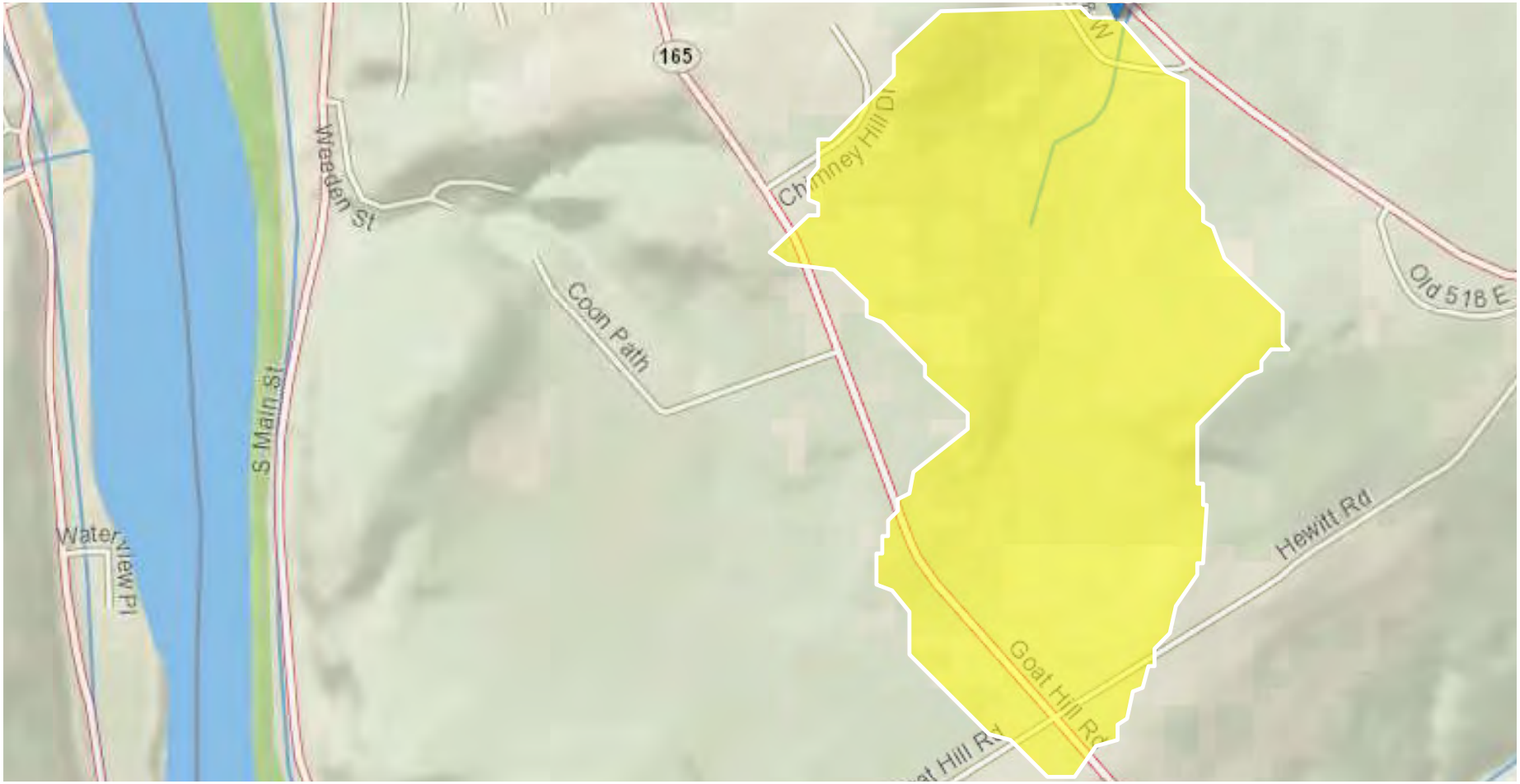
Time: 2017-08-09 13:09:15 -0400



Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	0.3	square miles
STORAGE	Percentage of area of storage (lakes ponds reservoirs wetlands)	21.5	percent
CSL10_85	Change in elevation divided by length between points 10 and 85 percent of distance along main channel to basin divide - main channel method not known	86.2	feet per mi
POPDENS	Basin Population Density	103	persons per square mile

Peak-Flow Statistics Parameters [Peak Unglaciated Piedmont Region 2009 5167]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.3	square miles	0.25	779
STORAGE	Percent Storage	21.5	percent	0.23	32
CSL10_85	Stream Slope 10 and 85 Method	86.2	feet per mi	4.31	191
POPDENS	Basin Population Density	103	persons per square mile	83	11084

Peak-Flow Statistics Flow Report [Peak Unglaciated Piedmont Region 2009 5167]

PIl: Prediction Interval-Lower, PIu: Prediction Interval-Upper, SEp: Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	SEe	SEp	Equiv. Yrs.
2 Year Peak Flood	71.2	ft^3/s	49	50.3	1
5 Year Peak Flood	119	ft^3/s	49.4	50.9	2
10 Year Peak Flood	156	ft^3/s	50.5	52.2	3

Worksheet for MP-102.99R2_STA0+25_2YR_PIPE

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.02000	ft/ft
Discharge	71.20	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	294.00
0+40	294.00
0+42	294.10
0+50	291.06
0+57	293.00
0+82	294.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 294.00)	(0+82, 294.00)	0.045

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	2.30	ft
Elevation Range	291.06 to 294.10 ft	
Flow Area	17.90	ft²
Wetted Perimeter	22.78	ft
Hydraulic Radius	0.79	ft
Top Width	22.10	ft
Normal Depth	2.30	ft

Worksheet for MP-102.99R2_STA0+25_2YR_PIPE

Results

Critical Depth		2.06	ft
Critical Slope		0.03267	ft/ft
Velocity		3.98	ft/s
Velocity Head		0.25	ft
Specific Energy		2.54	ft
Froude Number		0.78	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	2.30	ft
Critical Depth	2.06	ft
Channel Slope	0.02000	ft/ft
Critical Slope	0.03267	ft/ft

Worksheet for MP-102.99R2_STA0+43_2YR_BRIDGE

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.02000	ft/ft
Discharge	71.20	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	294.00
0+35	294.00
0+40	293.70
0+46	291.10
0+50	290.35
0+55	292.20
0+81	294.00
1+00	294.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 294.00)	(1+00, 294.00)	0.045

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	2.17	ft
Elevation Range	290.35 to 294.00 ft	
Flow Area	15.97	ft²
Wetted Perimeter	17.13	ft
Hydraulic Radius	0.93	ft

Worksheet for MP-102.99R2_STA0+43_2YR_BRIDGE

Results

Top Width		16.37	ft
Normal Depth		2.17	ft
Critical Depth		1.93	ft
Critical Slope		0.03160	ft/ft
Velocity		4.46	ft/s
Velocity Head		0.31	ft
Specific Energy		2.48	ft
Froude Number		0.80	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	2.17	ft
Critical Depth	1.93	ft
Channel Slope	0.02000	ft/ft
Critical Slope	0.03160	ft/ft

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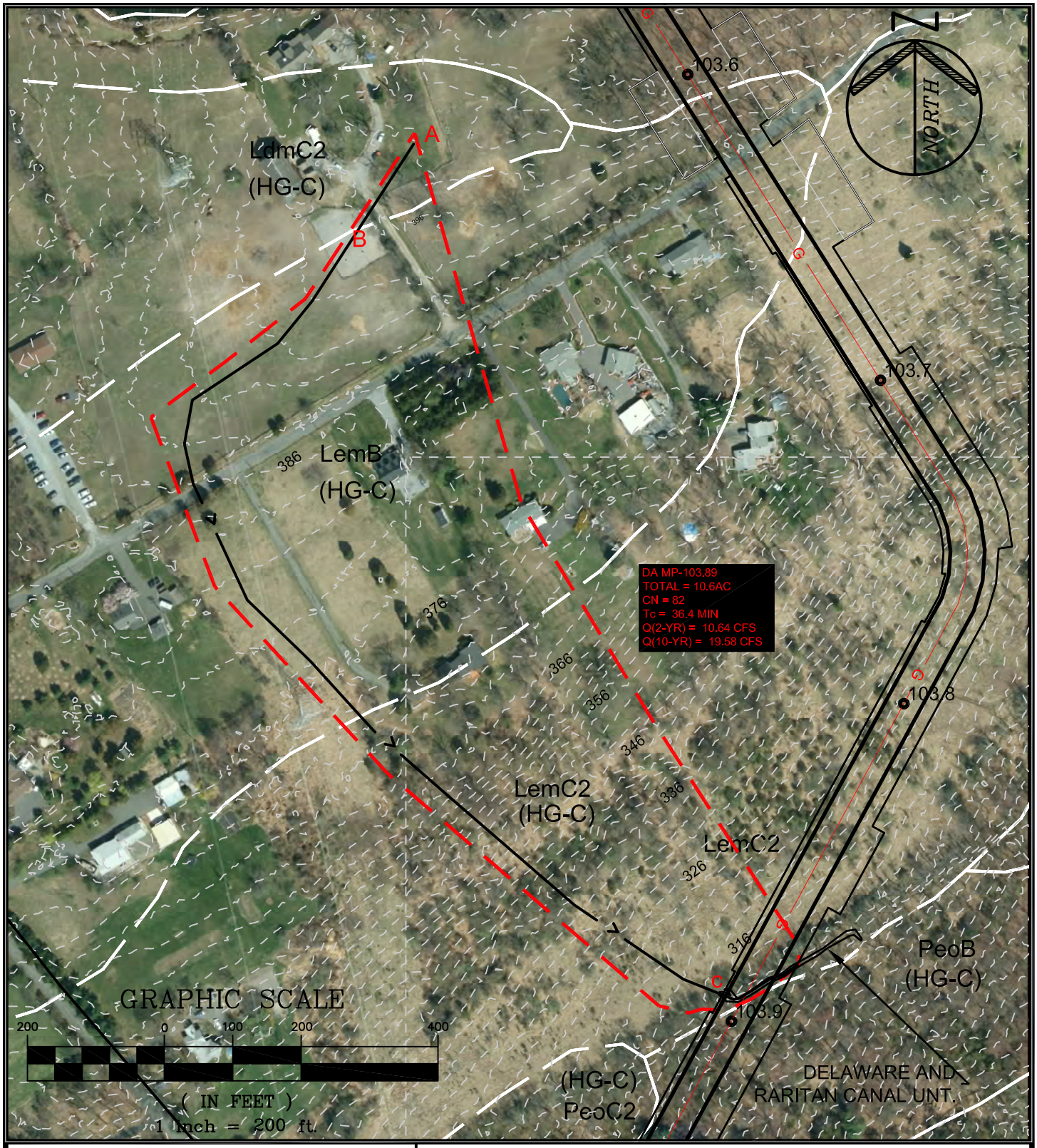

PAULUS, SOKOLOWSKI
AND SARTOR, LLC.

1433 ROUTE 34
SUITE A4
WALL, NEW JERSEY 07727
PHONE: (848) 206-2626

CERTIFICATE OF AUTHORIZATION NO. 24GA28032700

PROJECT TITLE

PENNEAST PIPELINE

HUNTERDON AND MERCER COUNTY, NJ

SHEET TITLE

STREAM CROSSING DRAINAGE AREA MP 103.89

PROJ. NO.:	05516.0001	DRN. BY:	JPS	SCALE:	1"=200'
DATE:	05/23/19	CK'D BY:	WS		

FILE NAME: P:\05516\0001\DWGs\CAD\C-Civil\Plotdwgs\Drainage Area Maps\05516001-Stream_DA_MP100.8-114-WAL.dwg\MP 103.88 LAST EDIT: 06/13/2019 - 02:05:18 PM LOGIN: lkizmina@

PROJECT:	PennEast	JOB NO. 5516.0001	
		SHEET	DATE:5/20/2019
		BY:	JM
SUBJECT:	Tc Calculations	CHK'D	

Time of Concentration calculations with the application of the SCS TR-55 methodology.

Watershed or Subarea Designation: DA 103.89

Area 10.6 AC

SHEET FLOW

Segment ID		A-B			
Surface Description (Table 3-1)		WOODS			
Manning's Coefficient, n (Table 3-1)		0.400			
Flow Length, L (total <= 150)	(ft)	150			
Two Year Rainfall, P	(in)	3.4			
Land Slope, s	(ft/ft)	0.020			
Computed Tt = 0.007 (nL)^0.8 / P^0.5*s^0.4	(hrs)	0.482			0.482

SHALLOW CONCENTRATED FLOW

Segment ID		B-C			
Surface Description (paved or unpaved)		UNPAVED			
Flow Length, L	(ft)	1566			
Watercourse slope, s	(ft/ft)	0.051			
Average Velocity, V (Figure 3-1)	(ft/s)	3.6			
Computed Tt = L / 3600V	(hrs)	0.121			0.121

CHANNEL FLOW

Segment ID		C-D			
Cross sectional Area, a	(sf)	9.00			
Wetted Perimeter, Pw	(ft)	12.32			
Hydraulic Radius, r =a/Pw	(ft)	0.731			
Channel Slope (ft/ft)	(ft/ft)	0.060			
Manning's Roughness Coefficient, n		0.040			
Velocity, V = 1.49r^(2/3)s^0.5 / n	(ft/s)	7.40			
Flow Length, L	(ft)	130			
Computed Tt = L / 3600V	(hrs)	0.005			0.005

Watershed or subarea Tc	0.607	hrs.
	36.4	min.

Use minimum Tc of 10 minutes

Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 05 / 23 / 2019

Hyd. No. 95

MP-103.89

Hydrograph type	= SCS Runoff	Peak discharge	= 10.64 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.40 hrs
Time interval	= 6 min	Hyd. volume	= 62,952 cuft
Drainage area	= 10.600 ac	Curve number	= 82.000
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 34.9 min
Total precip.	= 3.26 in	Distribution	= Custom
Storm duration	= C:\Users\IKuzmina\AppData\Local\Autodesk\C3D 2019\enu\HHApps\Hydrograp	Shape factor	= 484

Hydrograph Discharge Table

(Printed values >= 1.00% of Qp.)

Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)
10.00	0.113	11.80	1.721	13.60	2.006	15.40	0.826
10.10	0.131	11.90	2.303	13.70	1.834	15.50	0.800
10.20	0.150	12.00	3.314	13.80	1.683	15.60	0.778
10.30	0.171	12.10	5.282	13.90	1.556	15.70	0.760
10.40	0.193	12.20	7.387	14.00	1.455	15.80	0.745
10.50	0.217	12.30	9.353	14.10	1.375	15.90	0.733
10.60	0.243	12.40	10.64	14.20	1.309	16.00	0.721
10.70	0.274	12.50	10.39	14.30	1.253	16.10	0.711
10.80	0.311	12.60	9.641	14.40	1.207	16.20	0.701
10.90	0.356	12.70	8.598	14.50	1.166	16.30	0.691
11.00	0.410	12.80	7.386	14.60	1.127	16.40	0.680
11.10	0.475	12.90	6.046	14.70	1.089	16.50	0.670
11.20	0.554	13.00	4.753	14.80	1.050	16.60	0.659
11.30	0.651	13.10	3.675	14.90	1.011	16.70	0.649
11.40	0.767	13.20	3.138	15.00	0.971	16.80	0.638
11.50	0.904	13.30	2.745	15.10	0.932	16.90	0.628
11.60	1.096	13.40	2.442	15.20	0.894	17.00	0.617
11.70	1.351	13.50	2.197	15.30	0.858	17.10	0.607

<<

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Worksheet for MP-103.89_STA0+41_2YR_PIPE

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.05700	ft/ft
Discharge	10.64	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+41	312.00
0+50	311.51
0+53	312.30
0+64	314.00
1+00	316.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+41, 312.00)	(1+00, 316.00)	0.045

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.54	ft
Elevation Range	311.51 to 316.00 ft	
Flow Area	3.09	ft²
Wetted Perimeter	10.73	ft
Hydraulic Radius	0.29	ft
Top Width	10.59	ft
Normal Depth	0.54	ft
Critical Depth	0.57	ft

Worksheet for MP-103.89_STA0+41_2YR_PIPE

Results

Critical Slope		0.04433	ft/ft
Velocity		3.44	ft/s
Velocity Head		0.18	ft
Specific Energy		0.73	ft
Froude Number		1.12	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.54	ft
Critical Depth	0.57	ft
Channel Slope	0.05700	ft/ft
Critical Slope	0.04433	ft/ft

Worksheet for MP-103.89_STA1+08_2YR_BRIDGE

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.05700	ft/ft
Discharge	10.64	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	309.00
0+07	309.60
0+10	309.36
0+13	309.65
0+24	312.00
0+60	314.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 309.00)	(0+60, 314.00)	0.045

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.65	ft
Elevation Range	309.00 to 314.00 ft	
Flow Area	3.40	ft²
Wetted Perimeter	13.62	ft
Hydraulic Radius	0.25	ft
Top Width	12.92	ft
Normal Depth	0.65	ft

Worksheet for MP-103.89_STA1+08_2YR_BRIDGE

Results

Critical Depth		0.67	ft
Critical Slope		0.04873	ft/ft
Velocity		3.13	ft/s
Velocity Head		0.15	ft
Specific Energy		0.81	ft
Froude Number		1.07	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.65	ft
Critical Depth	0.67	ft
Channel Slope	0.05700	ft/ft
Critical Slope	0.04873	ft/ft

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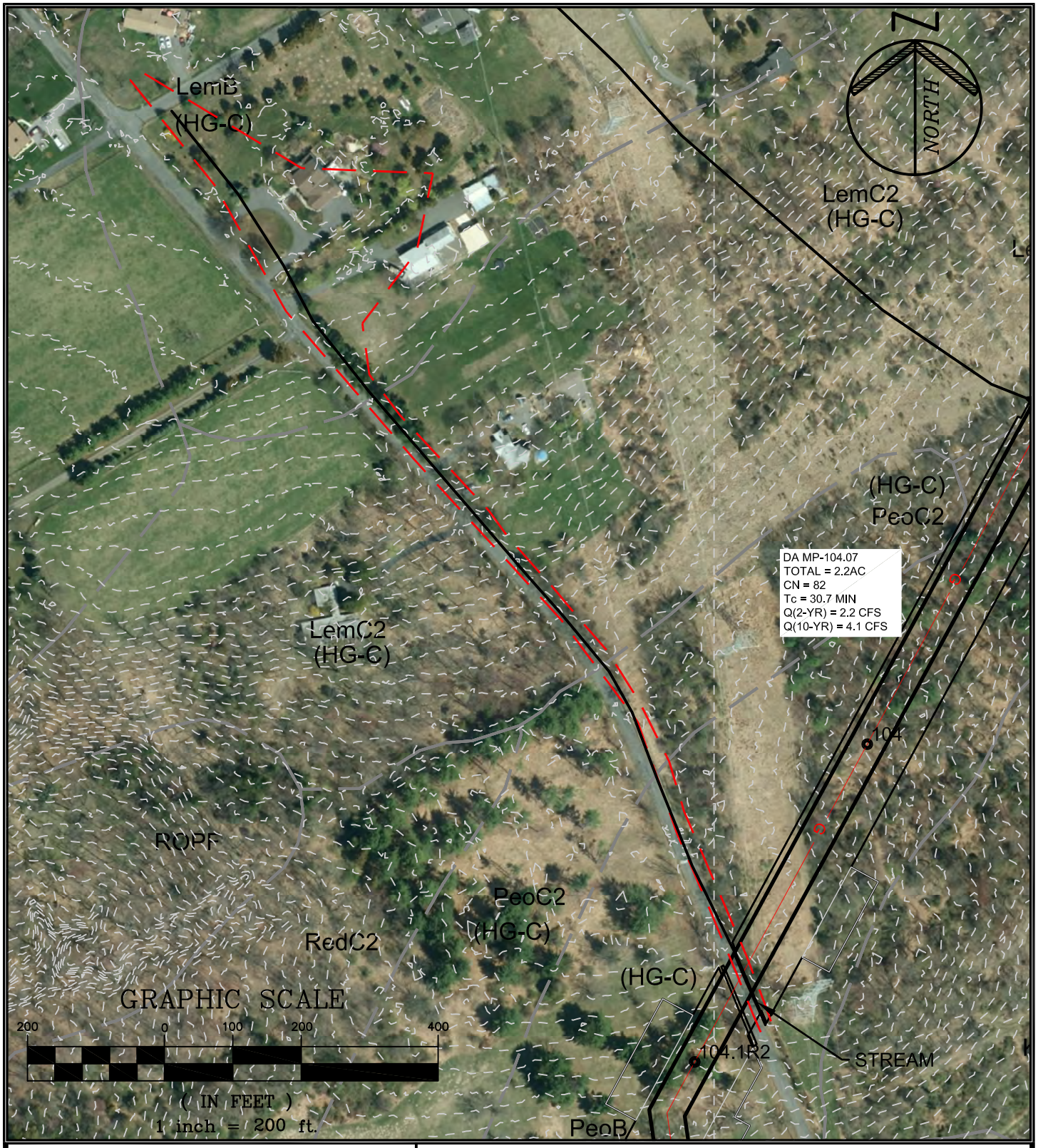

PAULUS, SOKOLOWSKI AND SARTOR, LLC.

1433 ROUTE 34
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CERTIFICATE OF AUTHORIZATION NO. 24GA28032700

PROJECT TITLE

PENNEAST PIPELINE

HUNTERDON AND MERCER COUNTY, NJ

SHEET TITLE

STREAM CROSSING DRAINAGE AREA MP 104.07

PROJ. NO.:	05516.0001	DRN. BY:	JPS	SCALE:	1"=200'
DATE:	05/23/19	CK'D BY:	WS		

FILE NAME: P:\05516\0001\DWGs\CAD\C-Civil\Plotdwgs\Drainage Area Maps\0551600001-Stream_DA_MP100.8-114-WAL.dwg\MP 104.07 LAST EDIT: 05/31/2019 - 05:28:12 PM LOGIN: lKizmina@

Worksheet 2: Runoff curve number and runoff (Approximated)

Project	By	Date
PennEast	IK	17-May-19
Location	**Checked**	**Date**
Hunterdon County, NJ		

Check one: ☐ Present ☒ Developed | MP 104.07

1. Runoff curve number

Soil name and hydrologic group (appendix A)	Cover Description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN[1] Table 2-2	CN[1] Figure 2-3	CN[1] Figure 2-4	Area ☒ acres / ☐ mi² / ☐ %	Product of CN x Area
Type C	Farmstead, Good Condition	82			2.20	180.40
				Totals ➡	2.20	180.40

1. Use only one CN source per line

CN (weighted) = tot.prod. / tot. area = 180.40 / 2.20 = 82.0 ; Use CN ➡ **82**

2. Runoff

		Storm #1	Storm #2	Storm #3
Frequency……	yr			
Rainfall, P (24-hour)…….	in			
Runoff, Q……	in			

Use P and CN with table 2-1, figure 2-1, or equation 2-3 abd 2-4

PROJECT:	PennEast	JOB NO. 5516.0001	
		SHEET	DATE:5/20/2019
		BY:	IK
SUBJECT:	Tc Calculations	CHK'D	

Time of Concentration calculations with the application of the SCS TR-55 methodology.

Watershed or Subarea Designation: DA 104.07

Area 2.2 AC

SHEET FLOW

Segment ID		A-B				
Surface Description (Table 3-1)		GRASS				
Manning's Coefficient, n (Table 3-1)		0.150				
Flow Length, L (total <= 150)	(ft)	150				
Two Year Rainfall, P	(in)	3.4				
Land Slope, s	(ft/ft)	0.005				
Computed Tt = 0.007 (nL)^0.8 / P^0.5*s^0.4	(hrs)	0.383				0.383

SHALLOW CONCENTRATED FLOW

Segment ID		B-C				
Surface Description (paved or unpaved)		UNPAVED				
Flow Length, L	(ft)	1340				
Watercourse slope, s	(ft/ft)	0.040				
Average Velocity, V (Figure 3-1)	(ft/s)	3.2				
Computed Tt = L / 3600V	(hrs)	0.116				0.116

CHANNEL FLOW

Segment ID		C-D				
Cross sectional Area, a	(sf)	1.38				
Wetted Perimeter, Pw	(ft)	4.19				
Hydraulic Radius, r =a/Pw	(ft)	0.329				
Channel Slope (ft/ft)	(ft/ft)	0.028				
Manning's Roughness Coefficient, n		0.045				
Velocity, V = 1.49r^(2/3)s^0.5 / n	(ft/s)	2.64				
Flow Length, L	(ft)	114				
Computed Tt = L / 3600V	(hrs)	0.012				0.012

Watershed or subarea Tc	0.511	hrs.
	30.7	min.

Use minimum Tc of 10 minutes

Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Friday, 05 / 31 / 2019

Hyd. No. 90

MP-104.07

Hydrograph type	= SCS Runoff	Peak discharge	= 2.209 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.40 hrs
Time interval	= 6 min	Hyd. volume	= 13,065 cuft
Drainage area	= 2.200 ac	Curve number	= 82.000
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 30.7 min
Total precip.	= 3.26 in	Distribution	= Custom
Storm duration	= C:\Users\IKuzmina\AppData\Local\Autodesk\C3D2019\enu\HHApps\Hydrograp		

Hydrograph Discharge Table

(Printed values >= 1.00% of Qp.)

Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)
10.00	0.023	11.80	0.357	13.60	0.416	15.40	0.171
10.10	0.027	11.90	0.478	13.70	0.381	15.50	0.166
10.20	0.031	12.00	0.688	13.80	0.349	15.60	0.161
10.30	0.035	12.10	1.096	13.90	0.323	15.70	0.158
10.40	0.040	12.20	1.533	14.00	0.302	15.80	0.155
10.50	0.045	12.30	1.941	14.10	0.285	15.90	0.152
10.60	0.050	12.40	2.209	14.20	0.272	16.00	0.150
10.70	0.057	12.50	2.156	14.30	0.260	16.10	0.148
10.80	0.064	12.60	2.001	14.40	0.250	16.20	0.145
10.90	0.074	12.70	1.784	14.50	0.242	16.30	0.143
11.00	0.085	12.80	1.533	14.60	0.234	16.40	0.141
11.10	0.099	12.90	1.255	14.70	0.226	16.50	0.139
11.20	0.115	13.00	0.986	14.80	0.218	16.60	0.137
11.30	0.135	13.10	0.763	14.90	0.210	16.70	0.135
11.40	0.159	13.20	0.651	15.00	0.202	16.80	0.133
11.50	0.188	13.30	0.570	15.10	0.193	16.90	0.130
11.60	0.228	13.40	0.507	15.20	0.185	17.00	0.128
11.70	0.280	13.50	0.456	15.30	0.178	17.10	0.126

<<

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Worksheet for MP-104.07MR2_STA0+32_PIPE_2YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.04767	ft/ft
Discharge	2.20	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	324.00
0+47	324.30
0+50	322.98
0+52	323.50
1+00	324.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 324.00)	(1+00, 324.00)	0.050

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.62	ft
Elevation Range	322.98 to 324.30 ft	
Flow Area	1.45	ft²
Wetted Perimeter	12.85	ft
Hydraulic Radius	0.11	ft
Top Width	12.62	ft
Normal Depth	0.62	ft
Critical Depth	0.59	ft

Worksheet for MP-104.07MR2_STA0+32_PIPE_2YR

Results

Critical Slope		0.07713	ft/ft
Velocity		1.52	ft/s
Velocity Head		0.04	ft
Specific Energy		0.66	ft
Froude Number		0.79	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.62	ft
Critical Depth	0.59	ft
Channel Slope	0.04767	ft/ft
Critical Slope	0.07713	ft/ft

Worksheet for MP-104.07MR2_STA0+90_BRIDGE_2YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.04767	ft/ft
Discharge	2.20	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	320.00
0+13	320.00
0+48	321.20
0+50	320.00
0+51	318.80
1+00	320.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 320.00)	(1+00, 320.00)	0.050

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.25	ft
Elevation Range	318.80 to 321.20 ft	
Flow Area	1.35	ft²
Wetted Perimeter	10.72	ft
Hydraulic Radius	0.13	ft
Top Width	10.62	ft
Normal Depth	0.25	ft

Worksheet for MP-104.07MR2_STA0+90_BRIDGE_2YR

Results

Critical Depth		0.23	ft
Critical Slope		0.07553	ft/ft
Velocity		1.63	ft/s
Velocity Head		0.04	ft
Specific Energy		0.30	ft
Froude Number		0.81	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.25	ft
Critical Depth	0.23	ft
Channel Slope	0.04767	ft/ft
Critical Slope	0.07553	ft/ft

+040.344513° / -074.923315°
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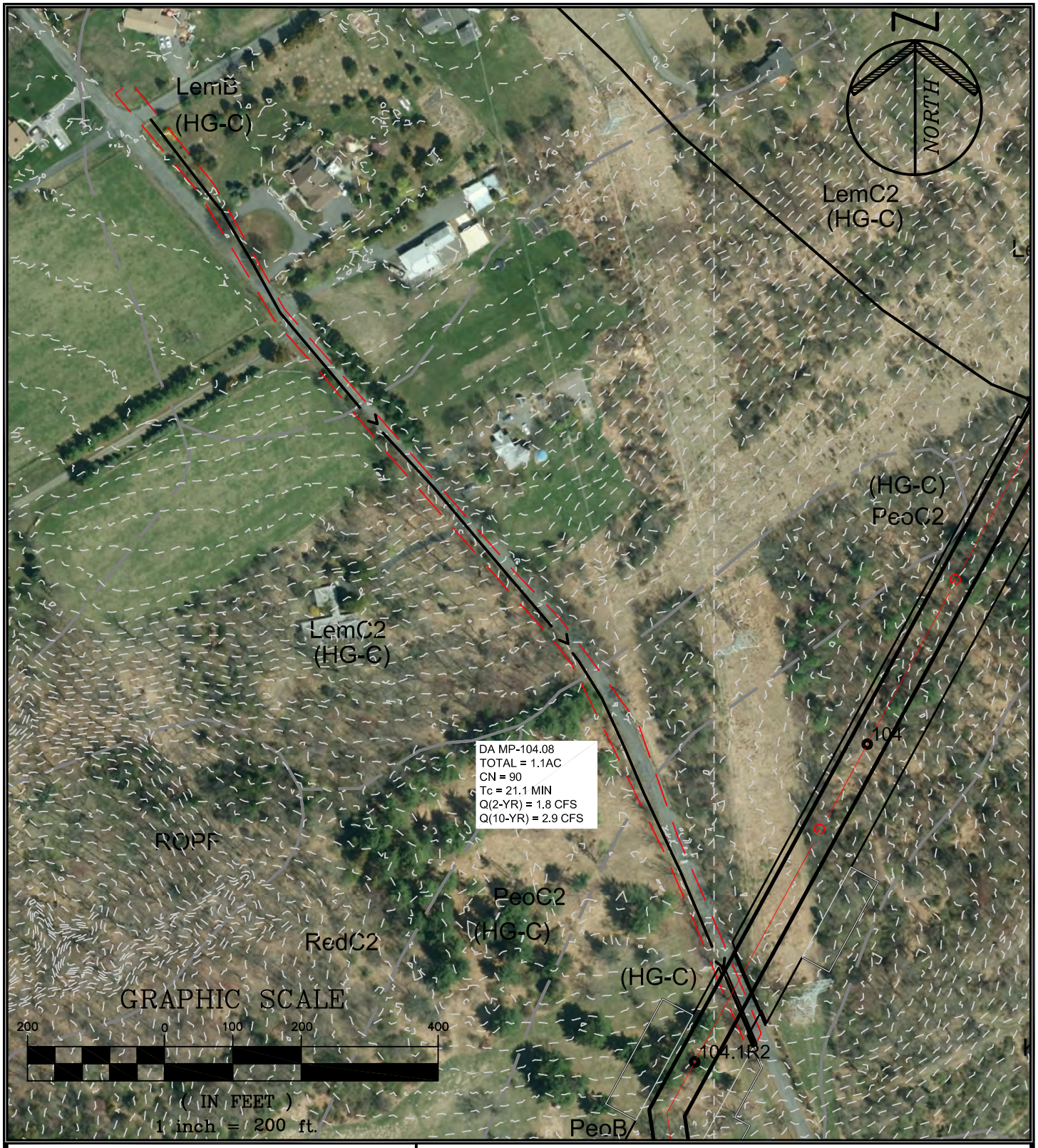

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CERTIFICATE OF AUTHORIZATION NO. 24GA28032700

PROJECT TITLE

PENNEAST PIPELINE

HUNTERDON AND MERCER COUNTY, NJ

SHEET TITLE

STREAM CROSSING DRAINAGE AREA MP 104.08

PROJ. NO.:	05516.0001	DRN. BY:	JPS	SCALE:	1"=200'
DATE:	05/23/19	CK'D BY:	WS		

FILE NAME: P:\05516\0001\DWGs\CAD\C-Civil\Plotdwgs\Drainage Area Maps\0551600001-Stream_DA_MP100.8-114-WAL.dwg\MP 104.08 LAST EDIT: 05/31/2019 - 05:06:39 PM LOGIN: lKizmina@

Worksheet 2: Runoff curve number and runoff (Approximated)

Project	By	Date
PennEast	IK	17-May-19
Location	**Checked**	**Date**
Hunterdon County, NJ		

Check one: ☐ Present ☒ Developed | MP 104.08

1. Runoff curve number

Soil name and hydrologic group (appendix A)	Cover Description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN[1] Table 2-2	CN[1] Figure 2-3	CN[1] Figure 2-4	Area ☒ acres / ☐ mi² / ☐ %	Product of CN x Area
Type C	Farmstead, Good Condition	82			0.58	47.56
	Impervious	98			0.52	50.96
				Totals ➡	1.10	98.52

1. Use only one CN source per line

CN (weighted) = tot.prod. / tot. area = 98.52 / 1.10 = 89.6 ; Use CN ➡ **90**

2. Runoff

		Storm #1	Storm #2	Storm #3
Frequency……	yr			
Rainfall, P (24-hour)…….	in			
Runoff, Q……	in			

Use P and CN with table 2-1, figure 2-1, or equation 2-3 abd 2-4

PROJECT:	PennEast	JOB NO. 5516.0001	
		SHEET	DATE:5/20/2019
		BY:	IK
SUBJECT:	Tc Calculations	CHK'D	

Time of Concentration calculations with the application of the SCS TR-55 methodology.

Watershed or Subarea Designation: DA 104.08

Area 1.1 AC

SHEET FLOW

Segment ID		A-B				
Surface Description (Table 3-1)		GRASS				
Manning's Coefficient, n (Table 3-1)		0.150				
Flow Length, L (total <= 150)	(ft)	150				
Two Year Rainfall, P	(in)	3.4				
Land Slope, s	(ft/ft)	0.017				
Computed Tt = 0.007 (nL)^0.8 / P^0.5*s^0.4	(hrs)	0.235				0.235

SHALLOW CONCENTRATED FLOW

Segment ID		B-C				
Surface Description (paved or unpaved)		PAVED				
Flow Length, L	(ft)	868				
Watercourse slope, s	(ft/ft)	0.050				
Average Velocity, V (Figure 3-1)	(ft/s)	4.6				
Computed Tt = L / 3600V	(hrs)	0.052				0.052

CHANNEL FLOW

Segment ID		C-D				
Cross sectional Area, a	(sf)	1.38				
Wetted Perimeter, Pw	(ft)	4.19				
Hydraulic Radius, r =a/Pw	(ft)	0.329				
Channel Slope (ft/ft)	(ft/ft)	0.028				
Manning's Roughness Coefficient, n		0.045				
Velocity, V = 1.49r^(2/3)s^0.5 / n	(ft/s)	2.64				
Flow Length, L	(ft)	608				
Computed Tt = L / 3600V	(hrs)	0.064				0.064

Watershed or subarea Tc	0.351	hrs.
	21.1	min.

Use minimum Tc of 10 minutes

Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 05 / 23 / 2019

Hyd. No. 90

MP-104.07

Hydrograph type	= SCS Runoff	Peak discharge	= 1.801 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.30 hrs
Time interval	= 6 min	Hyd. volume	= 8,881 cuft
Drainage area	= 1.100 ac	Curve number	= 90.000
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 21.1 min
Total precip.	= 3.26 in	Distribution	= Custom
Storm duration	= C:\Users\IKuzmina\AppData\Local\Autodesk\C3D 2019\enu\HHApps\Hydrograp	Storm frequency	= 24

Hydrograph Discharge Table

(Printed values >= 1.00% of Qp.)

Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)
8.00	0.018	9.80	0.050	11.60	0.264	13.40	0.257
8.10	0.019	9.90	0.054	11.70	0.318	13.50	0.235
8.20	0.020	10.00	0.057	11.80	0.403	13.60	0.214
8.30	0.021	10.10	0.061	11.90	0.522	13.70	0.196
8.40	0.023	10.20	0.065	12.00	0.745	13.80	0.181
8.50	0.024	10.30	0.069	12.10	1.171	13.90	0.169
8.60	0.025	10.40	0.073	12.20	1.571	14.00	0.161
8.70	0.026	10.50	0.077	12.30	1.801	14.10	0.154
8.80	0.028	10.60	0.082	12.40	1.649	14.20	0.148
8.90	0.029	10.70	0.089	12.50	1.411	14.30	0.144
9.00	0.030	10.80	0.098	12.60	1.122	14.40	0.139
9.10	0.032	10.90	0.108	12.70	0.830	14.50	0.134
9.20	0.033	11.00	0.120	12.80	0.581	14.60	0.129
9.30	0.035	11.10	0.135	12.90	0.476	14.70	0.124
9.40	0.038	11.20	0.152	13.00	0.405	14.80	0.120
9.50	0.041	11.30	0.173	13.10	0.354	14.90	0.115
9.60	0.044	11.40	0.197	13.20	0.313	15.00	0.110
9.70	0.047	11.50	0.223	13.30	0.284	15.10	0.105

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Worksheet for MP-104.08MR2_STA0+41_PIPE_2YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.05896	ft/ft
Discharge	1.80	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	324.00
0+17	324.00
0+48	322.20
0+50	321.51
0+52	321.90
1+00	322.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 324.00)	(1+00, 322.00)	0.050

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.45	ft
Elevation Range	321.51 to 324.00 ft	
Flow Area	1.76	ft²
Wetted Perimeter	33.04	ft
Hydraulic Radius	0.05	ft
Top Width	32.93	ft
Normal Depth	0.45	ft

Worksheet for MP-104.08MR2_STA0+41_PIPE_2YR

Results

Critical Depth		0.44	ft
Critical Slope		0.09835	ft/ft
Velocity		1.02	ft/s
Velocity Head		0.02	ft
Specific Energy		0.47	ft
Froude Number		0.78	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.45	ft
Critical Depth	0.44	ft
Channel Slope	0.05896	ft/ft
Critical Slope	0.09835	ft/ft

Worksheet for MP-104.08MR2_STA0+99_BRIDGE_2YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.05890	ft/ft
Discharge	1.80	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	320.00
0+22	320.00
0+47	318.80
0+50	317.85
0+52	319.00
0+55	320.00
0+67	320.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 320.00)	(0+67, 320.00)	0.050

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.53	ft
Elevation Range	317.85 to 320.00 ft	
Flow Area	0.64	ft²
Wetted Perimeter	2.68	ft
Hydraulic Radius	0.24	ft
Top Width	2.46	ft

Worksheet for MP-104.08MR2_STA0+99_BRIDGE_2YR

Results

Normal Depth		0.53	ft
Critical Depth		0.52	ft
Critical Slope		0.06414	ft/ft
Velocity		2.79	ft/s
Velocity Head		0.12	ft
Specific Energy		0.65	ft
Froude Number		0.96	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.53	ft
Critical Depth	0.52	ft
Channel Slope	0.05890	ft/ft
Critical Slope	0.06414	ft/ft

PREFS
+040.344526° / -074.923371°
↑342ft
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12:53:06
LOG
-04.2°
-30.4°
EXTRAS
171° S09E 3040mils TRUE
ZERO
A-B
CAL
150
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NIGHT
1.0X

MP 104.62R2

Region ID: NJ
Workspace ID: NJ20180402140413663000
Clicked Point (Latitude, Longitude): 40.33827, -74.91904
Time: 2018-04-02 10:04:27 -0400

Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	0.0327	square miles
STORAGE	Percentage of area of storage (lakes ponds reservoirs wetlands)	0	percent
CSL10_85	Change in elevation divided by length between points 10 and 85 percent of distance along main channel to basin divide - main channel method not known	319	feet per mi
POPDENS	Basin Population Density	154	persons per square mile

Peak-Flow Statistics Parameters [Peak Unglaciated Piedmont Region 2009 5167]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.0327	square miles	0.25	779
STORAGE	Percent Storage	0	percent	0.23	32
CSL10_85	Stream Slope 10 and 85 Method	319	feet per mi	4.31	191

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
POPDENS	Basin Population Density	154	persons per square mile	83	11084

Peak-Flow Statistics Disclaimers [Peak Unglaciated Piedmont Region 2009 5167]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors

Peak-Flow Statistics Flow Report [Peak Unglaciated Piedmont Region 2009 5167]

Statistic	Value	Unit
2 Year Peak Flood	23.2	ft^3/s
5 Year Peak Flood	43.6	ft^3/s
10 Year Peak Flood	61.3	ft^3/s
25 Year Peak Flood	88.2	ft^3/s
50 Year Peak Flood	112	ft^3/s
100 Year Peak Flood	138	ft^3/s
500 Year Peak Flood	211	ft^3/s

Peak-Flow Statistics Citations

Watson, K.M.,and Schopp, R.D.,2009, Methodology for estimation of flood magnitude and frequency for New Jersey streams, U.S. Geological Survey Scientific Investigations Report 2009-5167, 51 p. (http://pubs.usgs.gov/sir/2009/5167/)

Worksheet for MP-104.62R2_STA0+75_PIPE_2YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.05300	ft/ft
Discharge	23.20	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	168.00
0+06	166.00
0+14	164.00
0+33	160.00
0+43	156.00
0+46	155.00
0+50	153.92
0+52	156.00
0+55	158.00
0+64	160.00
0+83	162.00
0+97	164.00
1+00	164.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 168.00)	(1+00, 164.00)	0.050

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Worksheet for MP-104.62R2_STA0+75_PIPE_2YR

Results

Normal Depth		1.36	ft
Elevation Range	153.92 to 168.00 ft		
Flow Area		4.60	ft²
Wetted Perimeter		7.28	ft
Hydraulic Radius		0.63	ft
Top Width		6.59	ft
Normal Depth		1.36	ft
Critical Depth		1.39	ft
Critical Slope		0.04648	ft/ft
Velocity		5.04	ft/s
Velocity Head		0.39	ft
Specific Energy		1.75	ft
Froude Number		1.06	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.36	ft
Critical Depth	1.39	ft
Channel Slope	0.05300	ft/ft
Critical Slope	0.04648	ft/ft

Worksheet for MP-104.62R2_STA0+60_BRIDGE_10YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.05300	ft/ft
Discharge	61.30	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	168.00
0+08	166.00
0+17	164.00
0+31	162.00
0+39	160.00
0+46	156.70
0+50	154.38
0+54	155.60
0+65	160.00
0+95	164.00
1+00	164.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 168.00)	(1+00, 164.00)	0.050

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	1.97	ft
Elevation Range	154.38 to 168.00 ft	

Worksheet for MP-104.62R2_STA0+60_BRIDGE_10YR

Results

Flow Area		9.35	ft²
Wetted Perimeter		9.98	ft
Hydraulic Radius		0.94	ft
Top Width		9.11	ft
Normal Depth		1.97	ft
Critical Depth		2.08	ft
Critical Slope		0.04008	ft/ft
Velocity		6.55	ft/s
Velocity Head		0.67	ft
Specific Energy		2.63	ft
Froude Number		1.14	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.97	ft
Critical Depth	2.08	ft
Channel Slope	0.05300	ft/ft
Critical Slope	0.04008	ft/ft

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MP104.79R2

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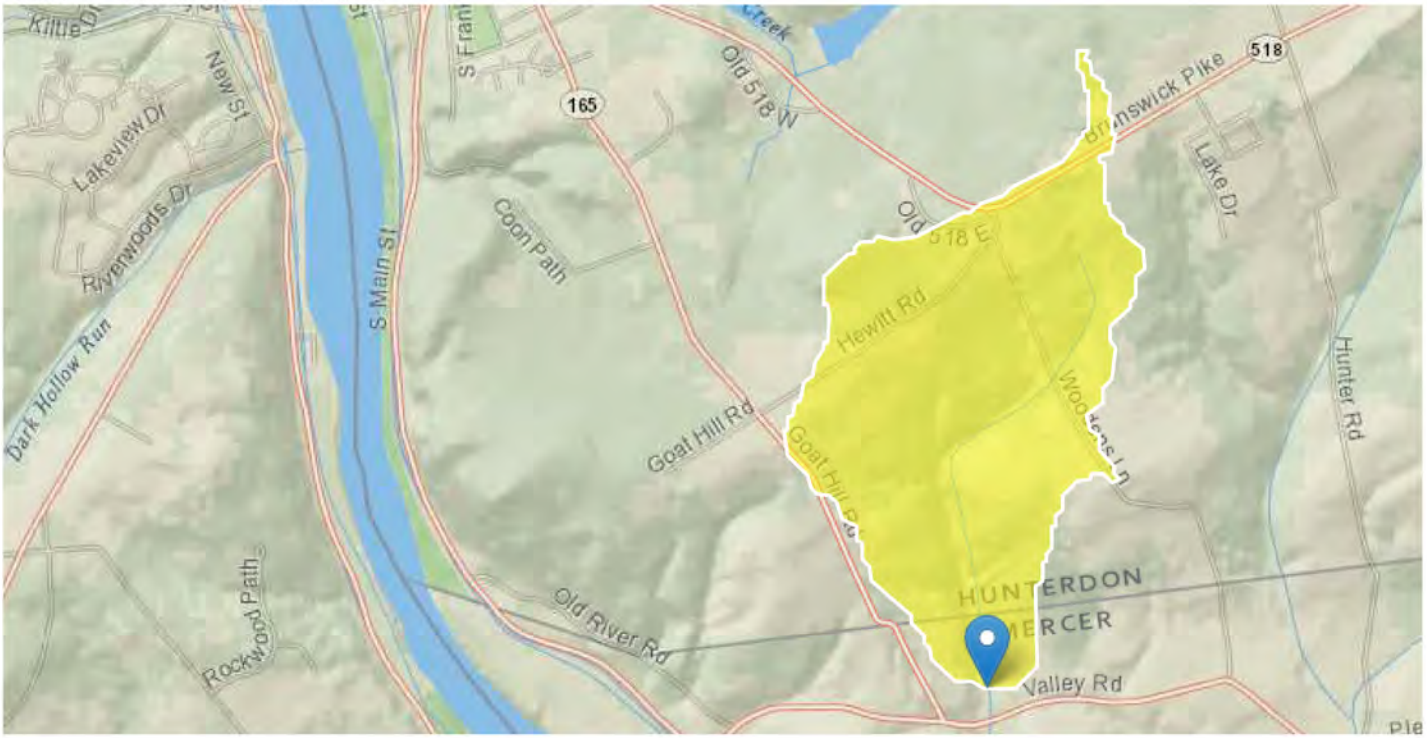

Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	0.72	square miles
STORAGE	Percentage of area of storage (lakes ponds reservoirs wetlands)	1.86	percent
CSL10_85	Change in elevation divided by length between points 10 and 85 percent of distance along main channel to basin divide - main channel method not known	200	feet per mi
POPDENS	Basin Population Density	110	persons per square mile

Peak-Flow Statistics Parameters [Peak Unglaciated Piedmont Region 2009 5167]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.72	square miles	0.25	779
STORAGE	Percent Storage	1.86	percent	0.23	32
CSL10_85	Stream Slope 10 and 85 Method	200	feet per mi	4.31	191
POPDENS	Basin Population Density	110	persons per square mile	83	11084

Peak-Flow Statistics Disclaimers [Peak Unglaciated Piedmont Region 2009 5167]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors

Peak-Flow Statistics Flow Report [Peak Unglaciated Piedmont Region 2009 5167]

Statistic	Value	Unit
2 Year Peak Flood	192	ft^3/s
5 Year Peak Flood	339	ft^3/s
10 Year Peak Flood	460	ft^3/s
25 Year Peak Flood	639	ft^3/s
50 Year Peak Flood	790	ft^3/s
100 Year Peak Flood	961	ft^3/s
500 Year Peak Flood	1410	ft^3/s

Peak-Flow Statistics Citations

Watson, K.M.,and Schopp, R.D.,2009, Methodology for estimation of flood magnitude and frequency for New Jersey streams, U.S. Geological Survey Scientific Investigations Report 2009-5167, 51 p. (http://pubs.usgs.gov/sir/2009/5167/)

Worksheet for MP-104.79R2_STA0+59_2YR_PIPE

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.03000	ft/ft
Discharge	192.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	114.00
0+37	111.00
0+50	105.60
0+60	108.70
0+72	112.00
0+77	114.00
0+86	120.00
0+90	122.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 114.00)	(0+90, 122.00)	0.050

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	3.20	ft
Elevation Range	105.60 to 122.00 ft	
Flow Area	28.47	ft²
Wetted Perimeter	18.99	ft
Hydraulic Radius	1.50	ft

Worksheet for MP-104.79R2_STA0+59_2YR_PIPE

Results

Top Width		17.85	ft
Normal Depth		3.20	ft
Critical Depth		3.12	ft
Critical Slope		0.03412	ft/ft
Velocity		6.74	ft/s
Velocity Head		0.71	ft
Specific Energy		3.90	ft
Froude Number		0.94	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	3.20	ft
Critical Depth	3.12	ft
Channel Slope	0.03000	ft/ft
Critical Slope	0.03412	ft/ft

Worksheet for MP-104.79R2_STA0+35_2YR_BRIDGE

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.03000	ft/ft
Discharge	192.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	114.00
0+37	113.00
0+50	106.45
0+61	109.30
0+73	114.00
0+85	122.00
0+88	124.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 114.00)	(0+88, 124.00)	0.050

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	3.16	ft
Elevation Range	106.45 to 124.00 ft	
Flow Area	28.38	ft²
Wetted Perimeter	18.84	ft
Hydraulic Radius	1.51	ft
Top Width	17.65	ft

Worksheet for MP-104.79R2_STA0+35_2YR_BRIDGE

Results

Normal Depth		3.16	ft
Critical Depth		3.09	ft
Critical Slope		0.03421	ft/ft
Velocity		6.76	ft/s
Velocity Head		0.71	ft
Specific Energy		3.87	ft
Froude Number		0.94	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	3.16	ft
Critical Depth	3.09	ft
Channel Slope	0.03000	ft/ft
Critical Slope	0.03421	ft/ft

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MP 105.30R2

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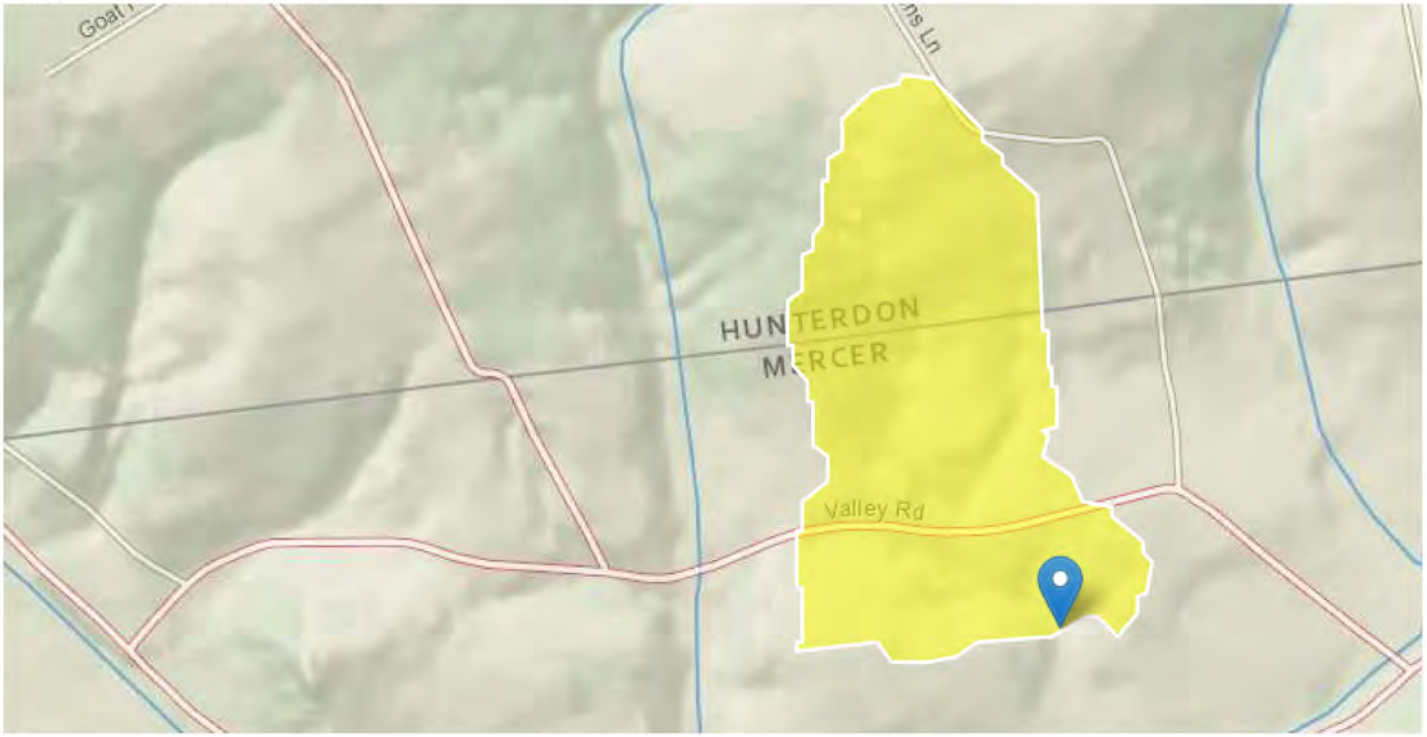

Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	0.21	square miles
STORAGE	Percentage of area of storage (lakes ponds reservoirs wetlands)	0.71	percent
CSL10_85	Change in elevation divided by length between points 10 and 85 percent of distance along main channel to basin divide - main channel method not known	295	feet per mi
POPDENS	Basin Population Density	172	persons per square mile

Peak-Flow Statistics Parameters [Peak Unglaciated Piedmont Region 2009 5167]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.21	square miles	0.25	779
STORAGE	Percent Storage	0.71	percent	0.23	32
CSL10_85	Stream Slope 10 and 85 Method	295	feet per mi	4.31	191
POPDENS	Basin Population Density	172	persons per square mile	83	11084

Peak-Flow Statistics Disclaimers [Peak Unglaciated Piedmont Region 2009 5167]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors

Peak-Flow Statistics Flow Report [Peak Unglaciated Piedmont Region 2009 5167]

Statistic	Value	Unit
2 Year Peak Flood	90.9	ft^3/s
5 Year Peak Flood	164	ft^3/s
10 Year Peak Flood	226	ft^3/s
25 Year Peak Flood	318	ft^3/s
50 Year Peak Flood	396	ft^3/s
100 Year Peak Flood	485	ft^3/s
500 Year Peak Flood	721	ft^3/s

Peak-Flow Statistics Citations

Watson, K.M.,and Schopp, R.D.,2009, Methodology for estimation of flood magnitude and frequency for New Jersey streams, U.S. Geological Survey Scientific Investigations Report 2009-5167, 51 p. (http://pubs.usgs.gov/sir/2009/5167/)

Worksheet for MP-105.30R2 STA 1+25_2YR_PIPE

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.01000	ft/ft
Discharge	90.90	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	80.00
0+09	78.00
0+43	76.00
0+49	75.30
0+57	79.80
0+64	80.00
1+00	84.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 80.00)	(1+00, 84.00)	0.045

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	2.07	ft
Elevation Range	75.30 to 84.00 ft	
Flow Area	29.81	ft²
Wetted Perimeter	33.61	ft
Hydraulic Radius	0.89	ft
Top Width	32.98	ft

Worksheet for MP-105.30R2 STA 1+25_2YR_PIPE

Results

Normal Depth	2.07	ft
Critical Depth	1.69	ft
Critical Slope	0.03369	ft/ft
Velocity	3.05	ft/s
Velocity Head	0.14	ft
Specific Energy	2.21	ft
Froude Number	0.57	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	2.07	ft
Critical Depth	1.69	ft
Channel Slope	0.01000	ft/ft
Critical Slope	0.03369	ft/ft

Worksheet for MP-105.30R2 STA 1+58_2YR_BRIDGE

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.01000	ft/ft
Discharge	90.90	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	82.00
0+06	80.00
0+18	78.00
0+52	75.26
0+58	78.00
1+00	80.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 82.00)	(1+00, 80.00)	0.045

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	1.97	ft
Elevation Range	75.26 to 82.00 ft	
Flow Area	28.15	ft²
Wetted Perimeter	29.10	ft
Hydraulic Radius	0.97	ft
Top Width	28.56	ft
Normal Depth	1.97	ft

Worksheet for MP-105.30R2 STA 1+58_2YR_BRIDGE

Results

Critical Depth		1.58	ft
Critical Slope		0.03274	ft/ft
Velocity		3.23	ft/s
Velocity Head		0.16	ft
Specific Energy		2.13	ft
Froude Number		0.57	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.97	ft
Critical Depth	1.58	ft
Channel Slope	0.01000	ft/ft
Critical Slope	0.03274	ft/ft

MP 105.68R2

Region ID: NJ
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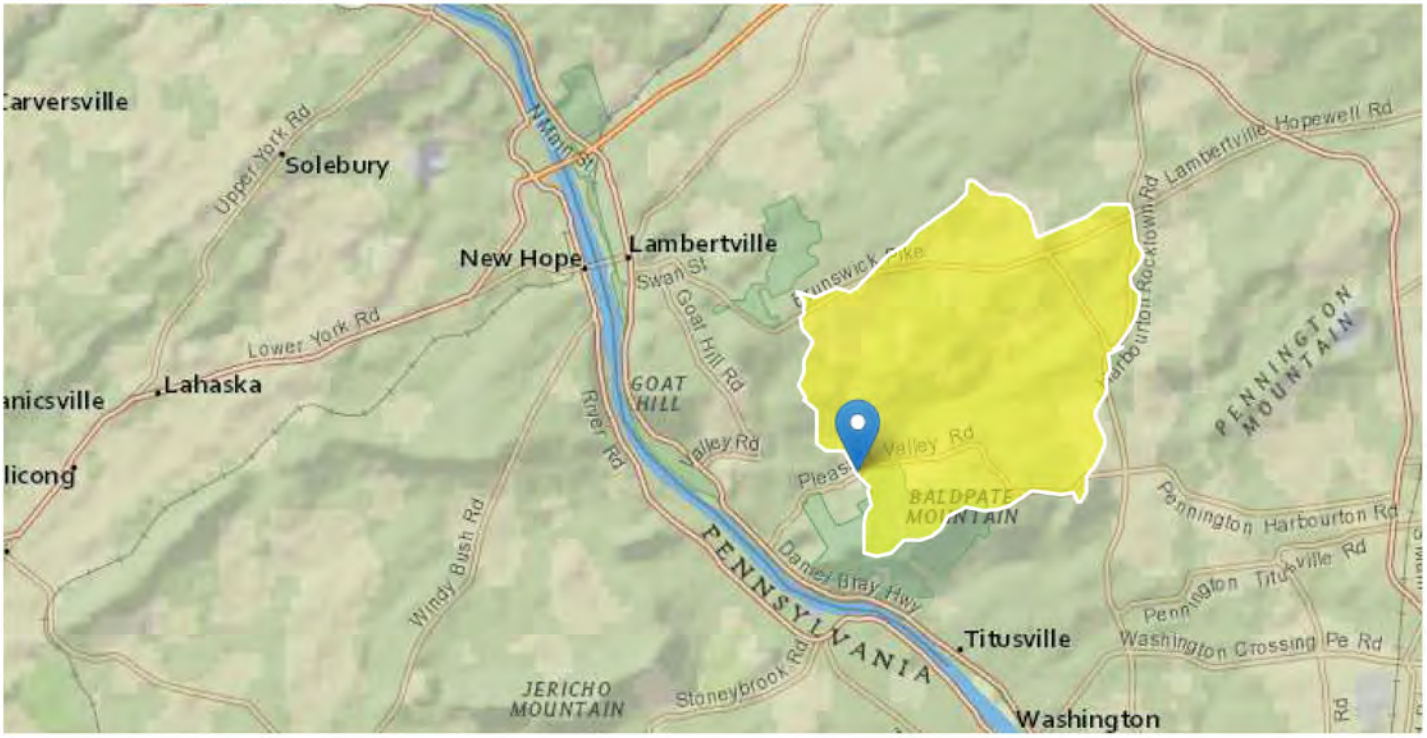

Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	8.21	square miles
STORAGE	Percentage of area of storage (lakes ponds reservoirs wetlands)	3.34	percent
CSL10_85	Change in elevation divided by length between points 10 and 85 percent of distance along main channel to basin divide - main channel method not known	80.9	feet per mi
POPDENS	Basin Population Density	150	persons per square mile

Peak-Flow Statistics Parameters [Peak Unglaciated Piedmont Region 2009 5167]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	8.21	square miles	0.25	779
STORAGE	Percent Storage	3.34	percent	0.23	32
CSL10_85	Stream Slope 10 and 85 Method	80.9	feet per mi	4.31	191
POPDENS	Basin Population Density	150	persons per square mile	83	11084

Peak-Flow Statistics Flow Report [Peak Unglaciated Piedmont Region 2009 5167]

PII: Prediction Interval-Lower, PIu: Prediction Interval-Upper, SEp: Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	SEe	SEp	Equiv. Yrs.
2 Year Peak Flood	971	ft^3/s	49	50.3	1
5 Year Peak Flood	1630	ft^3/s	49.4	50.9	2
10 Year Peak Flood	2150	ft^3/s	50.5	52.2	3

Statistic	Value	Unit	SEe	SEp	Equiv. Yrs.
25 Year Peak Flood	2910	ft^3/s	52.6	54.5	4
50 Yea	3520	ft^3/s	54.7	56.8	5
100 Year Peak Flood	4220	ft^3/s	57.1	59.5	5
500 Year Peak Flood	5990	ft^3/s	63.9	66.3	6

105.68R2

Peak-Flow Statistics Citations

Watson, K.M.,and Schopp, R.D.,2009, Methodology for estimation of flood magnitude and frequency for New Jersey streams, U.S. Geological Survey Scientific Investigations Report 2009-5167, 51 p. (http://pubs.usgs.gov/sir/2009/5167/)

Worksheet for MP-105.68R2_STA0+53_2YR_PIPE

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.01800	ft/ft
Discharge	971.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	72.00
0+18	72.30
0+50	70.36
0+82	74.60
1+00	78.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 72.00)	(1+00, 78.00)	0.030

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	2.86	ft
Elevation Range	70.36 to 78.00 ft	
Flow Area	110.74	ft²
Wetted Perimeter	73.06	ft
Hydraulic Radius	1.52	ft
Top Width	71.59	ft
Normal Depth	2.86	ft
Critical Depth	3.12	ft

Worksheet for MP-105.68R2_STA0+53_2YR_PIPE

Results

Critical Slope		0.01121	ft/ft
Velocity		8.77	ft/s
Velocity Head		1.19	ft
Specific Energy		4.06	ft
Froude Number		1.24	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	2.86	ft
Critical Depth	3.12	ft
Channel Slope	0.01800	ft/ft
Critical Slope	0.01121	ft/ft

Waterbody Name: Moore's Creek

Waterbody ID/LL ID: 060415_SQ_1002 & 1003_P_IN/PE-ME-013.000

Observation Date(s): 6/4/2015

County: Mercer

Description: An intermediate, perennial, east-flowing stream, which traverses forested habitat and a maintained utility right-of-way. The banks show some undercutting, and the bank width is approximately 40 feet. Cobble, gravel, sand, and silt comprise the streambed substrate. At the time of assessment, the water depth was between two and four inches.

MP-105.96R2

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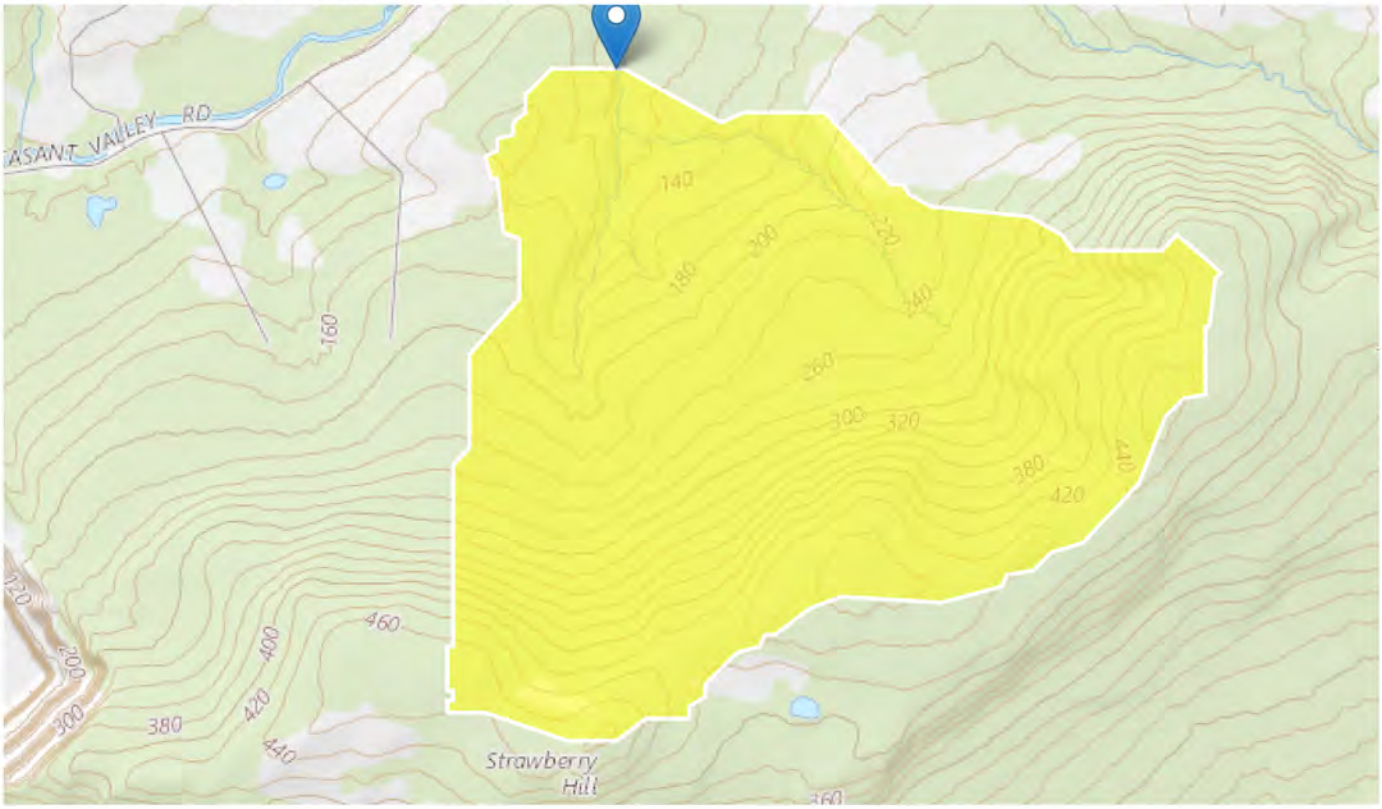


The South Carolina StreamStats application is testing LiDAR-derived data and streams for delineation. This is a beta version and QA/QC is incomplete. It may calculate basin characteristics and flow statistics incorrectly. Please verify the drainage areas and flow stats carefully. Use at your own risk

Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	0.43	square miles
STORAGE	Percentage of area of storage (lakes ponds reservoirs wetlands)	0.39	percent

Parameter Code	Parameter Description	Value	Unit
CSL10_85	Change in elevation divided by length between points 10 and 85 percent of distance along main channel to basin divide - main channel method not known	388	feet per mi
POPDENS	Basin Population Density	190	persons per square mile

Peak-Flow Statistics Parameters [Peak Unglaciated Piedmont Region 2009 5167]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.43	square miles	0.25	779
STORAGE	Percent Storage	0.39	percent	0.23	32
CSL10_85	Stream Slope 10 and 85 Method	388	feet per mi	4.31	191
POPDENS	Basin Population Density	190	persons per square mile	83	11084

Peak-Flow Statistics Disclaimers [Peak Unglaciated Piedmont Region 2009 5167]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors

Peak-Flow Statistics Flow Report [Peak Unglaciated Piedmont Region 2009 5167]

Statistic	Value	Unit
2 Year Peak Flood	171	ft^3/s
5 Year Peak Flood	308	ft^3/s
10 Year Peak Flood	423	ft^3/s
25 Year Peak Flood	597	ft^3/s
50 Year Peak Flood	746	ft^3/s
100 Year Peak Flood	916	ft^3/s
500 Year Peak Flood	1370	ft^3/s

Worksheet for MP-105.96R2_STA0+34_PIPE-2YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.02700	ft/ft
Discharge	171.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	107.00
0+07	101.92
0+13	101.30
0+18	101.61
0+25	104.00

Roughness Segment Definitions

Start Station & Elevation	End Station & Elevation	Roughness Coefficient
(0+00, 107.00)	(0+25, 104.00)	0.040

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	1.90	ft
Elevation Range	101.30 to 107.00 ft	
Flow Area	23.80	ft²
Wetted Perimeter	18.65	ft
Hydraulic Radius	1.28	ft
Top Width	17.92	ft
Normal Depth	1.90	ft
Critical Depth	2.00	ft

Worksheet for MP-105.96R2_STA0+34_PIPE-2YR

Results

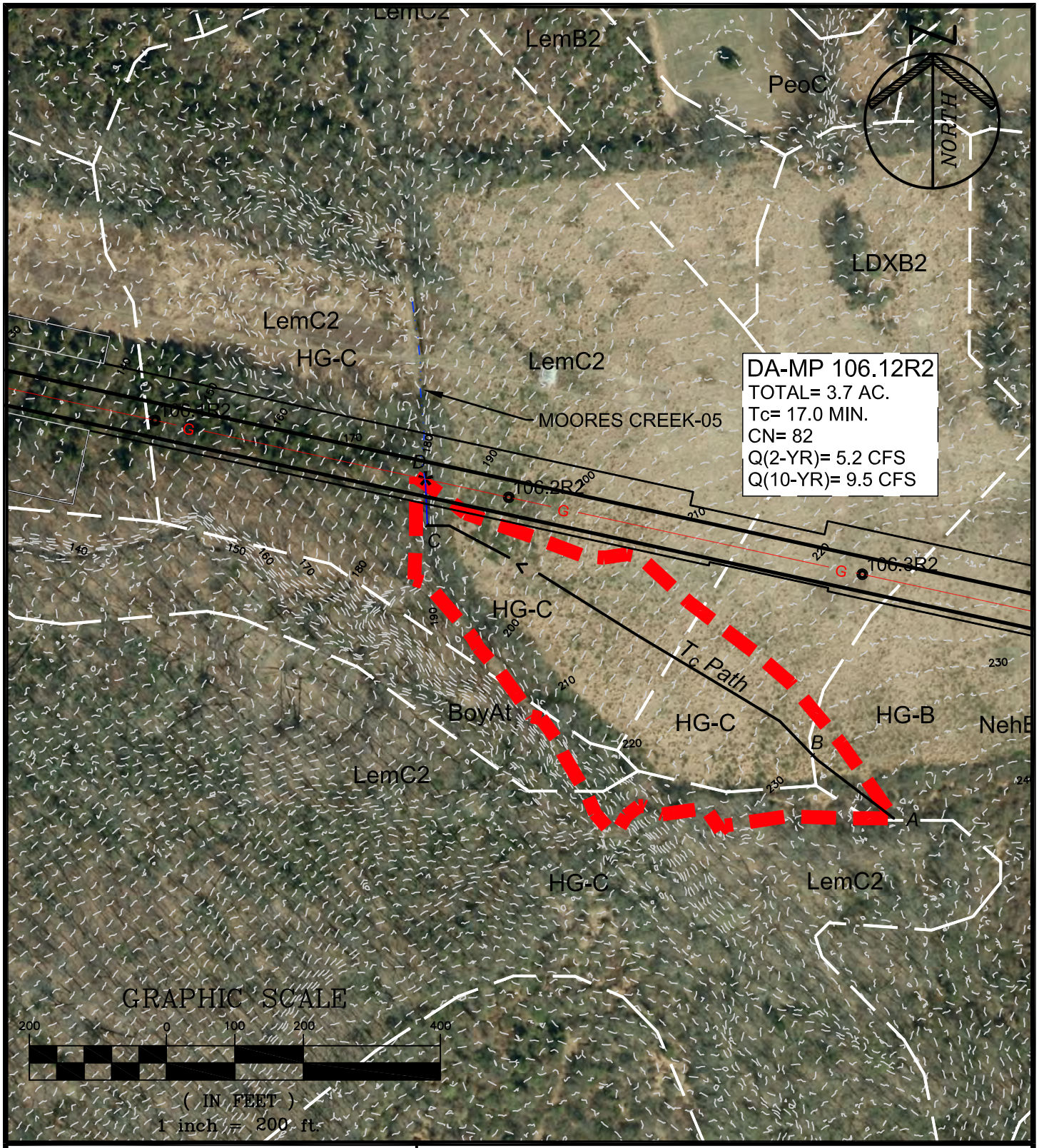
Critical Slope		0.02206	ft/ft
Velocity		7.18	ft/s
Velocity Head		0.80	ft
Specific Energy		2.70	ft
Froude Number		1.10	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.90	ft
Critical Depth	2.00	ft
Channel Slope	0.02700	ft/ft
Critical Slope	0.02206	ft/ft



PAULUS, SOKOLOWSKI AND SARTOR, LLC.

1433 ROUTE 34
SUITE A4
WALL, NEW JERSEY 07727
PHONE: (848) 206-2626

CERTIFICATE OF AUTHORIZATION NO. 24GA28032700

PROJECT TITLE

PENNEAST PIPELINE

HUNTERDON AND MERCER COUNTY, NJ

SHEET TITLE

STREAM CROSSING DRAINAGE AREA MP 106.12R2

PROJ. NO.:	05516.0001	DRN. BY:	JPS	SCALE:	1"=200'
DATE:	05/23/19	CK'D BY:	WS		

FILE NAME: P:\05516\0001\DWGs\CAD\C-Civil\Plotdwgs\Drainage Area Maps\05516\0001-Stream_DA_MP100.8-114-WAL.dwg\MP 106.1R2 LAST EDIT: 07/22/2019 - 11:21:21 AM LOGIN: jschoolling@

Worksheet 2: Runoff curve number and runoff (Approximated)

Project	By	Date
PennEast	JPS	26-Feb-18
Location	**Checked**	**Date**
Hunterdon County, NJ		

Check one: ☐ Present ☒ Developed | MP 106.1

1. Runoff curve number

Soil name and hydrologic group (appendix A)	Cover Description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN[1] Table 2-2	CN[1] Figure 2-3	CN[1] Figure 2-4	Area ☒ acres / ☐ mi² / ☐ %	Product of CN x Area
Type B	Farmstead, Good Condition	74			0.20	14.80
Type C	Farmstead, Good Condition	82			3.30	270.60
Type D	Farmstead, Good Condition	86			0.20	17.20
				Totals ➡	3.70	302.60

1. Use only one CN source per line

CN (weighted) = tot.prod. / tot. area = 302.60 / 3.70 = 81.8 ; Use CN ➡ **82**

2. Runoff

		Storm #1	Storm #2	Storm #3
Frequency……	yr			
Rainfall, P (24-hour)…….	in			
Runoff, Q……	in			

Use P and CN with table 2-1, figure 2-1, or equation 2-3 abd 2-4

PSS&	PROJECT: PennEast	JOB NO. 5516.0001	
		SHEET	DATE:2/12/2018
		BY:	JPS
	SUBJECT: Tc Calculations	CHK'D	

Time of Concentration calculations with the application of the SCS TR-55 methodology.

Watershed or Subarea Designation: DA 106.1

Area 82 AC

SHEET FLOW

Segment ID		A-B				
Surface Description (Table 3-1)		WOODS				
Manning's Coefficient, n (Table 3-1)		0.400				
Flow Length, L (total <= 150)	(ft)	150				
Two Year Rainfall, P	(in)	3.4				
Land Slope, s	(ft/ft)	0.110				
Computed Tt = 0.007 (nL)^0.8 / P^0.5*s^0.4	(hrs)	0.244				0.244

SHALLOW CONCENTRATED FLOW

Segment ID		B-C				
Surface Description (paved or unpaved)		UNPAVED				
Flow Length, L	(ft)	451				
Watercourse slope, s	(ft/ft)	0.076				
Average Velocity, V (Figure 3-1)	(ft/s)	4.0				
Computed Tt = L / 3600V	(hrs)	0.031				0.031

CHANNEL FLOW

Segment ID		C-D				
Cross sectional Area, a	(sf)	2.30				
Wetted Perimeter, Pw	(ft)	16.56				
Hydraulic Radius, r =a/Pw	(ft)	0.139				
Channel Slope (ft/ft)	(ft/ft)	0.056				
Manning's Roughness Coefficient, n		0.040				
Velocity, V = 1.49r^(2/3)s^0.5 / n	(ft/s)	2.36				
Flow Length, L	(ft)	68				
Computed Tt = L / 3600V	(hrs)	0.008				0.008

Watershed or subarea Tc	0.283	hrs.
	17.0	min.

Use minimum Tc of 10 minutes

Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Wednesday, 02 / 20 / 2019

Hyd. No. 33

DA 106.1

Hydrograph type	= SCS Runoff	Peak discharge	= 5.242 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.20 hrs
Time interval	= 6 min	Hyd. volume	= 19,976 cuft
Drainage area	= 3.700 ac	Curve number	= 82.000*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 17.0 min
Total precip.	= 3.26 in	Distribution	= Custom
Storm duration	= C:\Users\IKuzmina\AppData\Local\Autodesk\C3D2019\enu\HHApps\Hydrograp		

* Composite (Area/CN) = [(0.200 x 74) + (3.300 x 82) + (0.200 x 86)] / 3.700

Hydrograph Discharge Table

(Printed values >= 1.00% of Qp.)

Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)
10.10	0.058	11.90	1.370	13.70	0.453	15.50	0.237
10.20	0.065	12.00	2.217	13.80	0.427	15.60	0.233
10.30	0.073	12.10	4.063	13.90	0.410	15.70	0.230
10.40	0.081	12.20	5.242	14.00	0.398	15.80	0.227
10.50	0.090	12.30	4.377	14.10	0.386	15.90	0.223
10.60	0.101	12.40	3.124	14.20	0.374	16.00	0.220
10.70	0.117	12.50	2.002	14.30	0.362	16.10	0.217
10.80	0.136	12.60	1.607	14.40	0.350	16.20	0.214
10.90	0.159	12.70	1.277	14.50	0.337	16.30	0.210
11.00	0.184	12.80	1.080	14.60	0.325	16.40	0.207
11.10	0.215	12.90	0.940	14.70	0.313	16.50	0.204
11.20	0.256	13.00	0.860	14.80	0.300	16.60	0.200
11.30	0.304	13.10	0.776	14.90	0.288	16.70	0.197
11.40	0.361	13.20	0.699	15.00	0.275	16.80	0.194
11.50	0.421	13.30	0.637	15.10	0.262	16.90	0.190
11.60	0.537	13.40	0.586	15.20	0.251	17.00	0.187
11.70	0.720	13.50	0.540	15.30	0.244	17.10	0.184
11.80	0.958	13.60	0.493	15.40	0.240	17.20	0.180

Continues on next page...

Worksheet for MP-106.12R2_STA0+11_PIPE-2YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.09200	ft/ft
Discharge	3.70	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	154.00
0+03	153.85
0+06	153.62
0+10	154.00

Roughness Segment Definitions

Start Station & Elevation	End Station & Elevation	Roughness Coefficient
(0+00, 154.00)	(0+10, 154.00)	0.050

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.34	ft
Elevation Range	153.62 to 154.00 ft	
Flow Area	1.42	ft²
Wetted Perimeter	9.06	ft
Hydraulic Radius	0.16	ft
Top Width	9.03	ft
Normal Depth	0.34	ft
Critical Depth	0.36	ft
Critical Slope	0.06659	ft/ft

Worksheet for MP-106.12R2_STA0+11_PIPE-2YR

Results

Velocity		2.61	ft/s
Velocity Head		0.11	ft
Specific Energy		0.45	ft
Froude Number		1.16	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.34	ft
Critical Depth	0.36	ft
Channel Slope	0.09200	ft/ft
Critical Slope	0.06659	ft/ft

Worksheet for MP-106.12R2_STA0+77_BRIDGE-2YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.09200	ft/ft
Discharge	3.70	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	148.00
0+08	147.25
0+10	147.22
0+12	147.47
0+16	148.00

Roughness Segment Definitions

Start Station & Elevation	End Station & Elevation	Roughness Coefficient
(0+00, 148.00)	(0+16, 148.00)	0.050

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.30	ft
Elevation Range	147.22 to 148.00 ft	
Flow Area	1.30	ft²
Wetted Perimeter	7.33	ft
Hydraulic Radius	0.18	ft
Top Width	7.30	ft
Normal Depth	0.30	ft
Critical Depth	0.33	ft

Worksheet for MP-106.12R2_STA0+77_BRIDGE-2YR

Results

Critical Slope		0.06348	ft/ft
Velocity		2.85	ft/s
Velocity Head		0.13	ft
Specific Energy		0.43	ft
Froude Number		1.19	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.30	ft
Critical Depth	0.33	ft
Channel Slope	0.09200	ft/ft
Critical Slope	0.06348	ft/ft

PREFS
+040.333537° / -074.892140°
166ft
MAP
06/20/19
N
11.51:06
LOG
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-30
+03.5°
-26.0°
+05
-25
EXTRAS
336° N24W 5973mils TRUE
ZERO
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MP - 106.8R2

Region ID: NJ
Workspace ID: NJ20190702182251828000
Clicked Point (Latitude, Longitude): 40.33190, -74.87857
Time: 2019-07-02 14:23:20 -0400

Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	0.0404	square miles
STORAGE	Percentage of area of storage (lakes ponds reservoirs wetlands)	0	percent
CSL10_85	Change in elevation divided by length between points 10 and 85 percent of distance along main channel to basin divide - main channel method not known	80	feet per mi

Parameter Code	Parameter Description	Value	Unit
POPDENS	Basin Population Density	190	persons per square mile

General Disclaimers

Parameter values have been edited, computed flows may not apply.

Peak-Flow Statistics Parameters[Peak Unglaciated Piedmont Region 2009 5167]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.0404	square miles	0.25	779
STORAGE	Percent Storage	0	percent	0.23	32
CSL10_85	Stream Slope 10 and 85 Method	80	feet per mi	4.31	191
POPDENS	Basin Population Density	190	persons per square mile	83	11084

Peak-Flow Statistics Disclaimers[Peak Unglaciated Piedmont Region 2009 5167]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errorsOne or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors

Peak-Flow Statistics Flow Report[Peak Unglaciated Piedmont Region 2009 5167]

Statistic	Value	Unit
2 Year Peak Flood	19.7	ft^3/s
5 Year Peak Flood	36.7	ft^3/s
10 Year Peak Flood	51.1	ft^3/s
25 Year Peak Flood	72.8	ft^3/s
50 Year Peak Flood	91.5	ft^3/s

Statistic	Value	Unit
100 Year Peak Flood	112	ft^3/s
500 Year Peak Flood	169	ft^3/s

Peak-Flow Statistics Citations

Watson, K.M.,and Schopp, R.D.,2009, Methodology for estimation of flood magnitude and frequency for New Jersey streams, U.S. Geological Survey Scientific Investigations Report 2009-5167, 51 p. (http://pubs.usgs.gov/sir/2009/5167/)

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Application Version: 4.3.8

Worksheet for MP-106.80R2_STA0+49_PIPE-2YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.11300	ft/ft
Discharge	19.70	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	330.00
0+19	328.50
0+24	327.35
0+26	327.45
0+63	330.00

Roughness Segment Definitions

Start Station & Elevation	End Station & Elevation	Roughness Coefficient
(0+00, 330.00)	(0+63, 330.00)	0.045

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.60	ft
Elevation Range	327.35 to 330.00 ft	
Flow Area	3.82	ft²
Wetted Perimeter	12.07	ft
Hydraulic Radius	0.32	ft
Top Width	11.97	ft
Normal Depth	0.60	ft
Critical Depth	0.73	ft

Worksheet for MP-106.80R2_STA0+49_PIPE-2YR

Results

Critical Slope		0.04093	ft/ft
Velocity		5.16	ft/s
Velocity Head		0.41	ft
Specific Energy		1.01	ft
Froude Number		1.61	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.60	ft
Critical Depth	0.73	ft
Channel Slope	0.11300	ft/ft
Critical Slope	0.04093	ft/ft

Worksheet for MP-106.80R2_STA0+97_BRIDGE-2YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.11300	ft/ft
Discharge	19.70	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	326.00
0+08	324.00
0+33	322.72
0+36	321.12
0+40	322.13
0+61	324.00

Roughness Segment Definitions

Start Station & Elevation	End Station & Elevation	Roughness Coefficient
(0+00, 326.00)	(0+61, 324.00)	0.045

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.97	ft
Elevation Range	321.12 to 326.00 ft	
Flow Area	2.98	ft²
Wetted Perimeter	6.51	ft
Hydraulic Radius	0.46	ft
Top Width	6.16	ft
Normal Depth	0.97	ft

Worksheet for MP-106.80R2_STA0+97_BRIDGE-2YR

Results

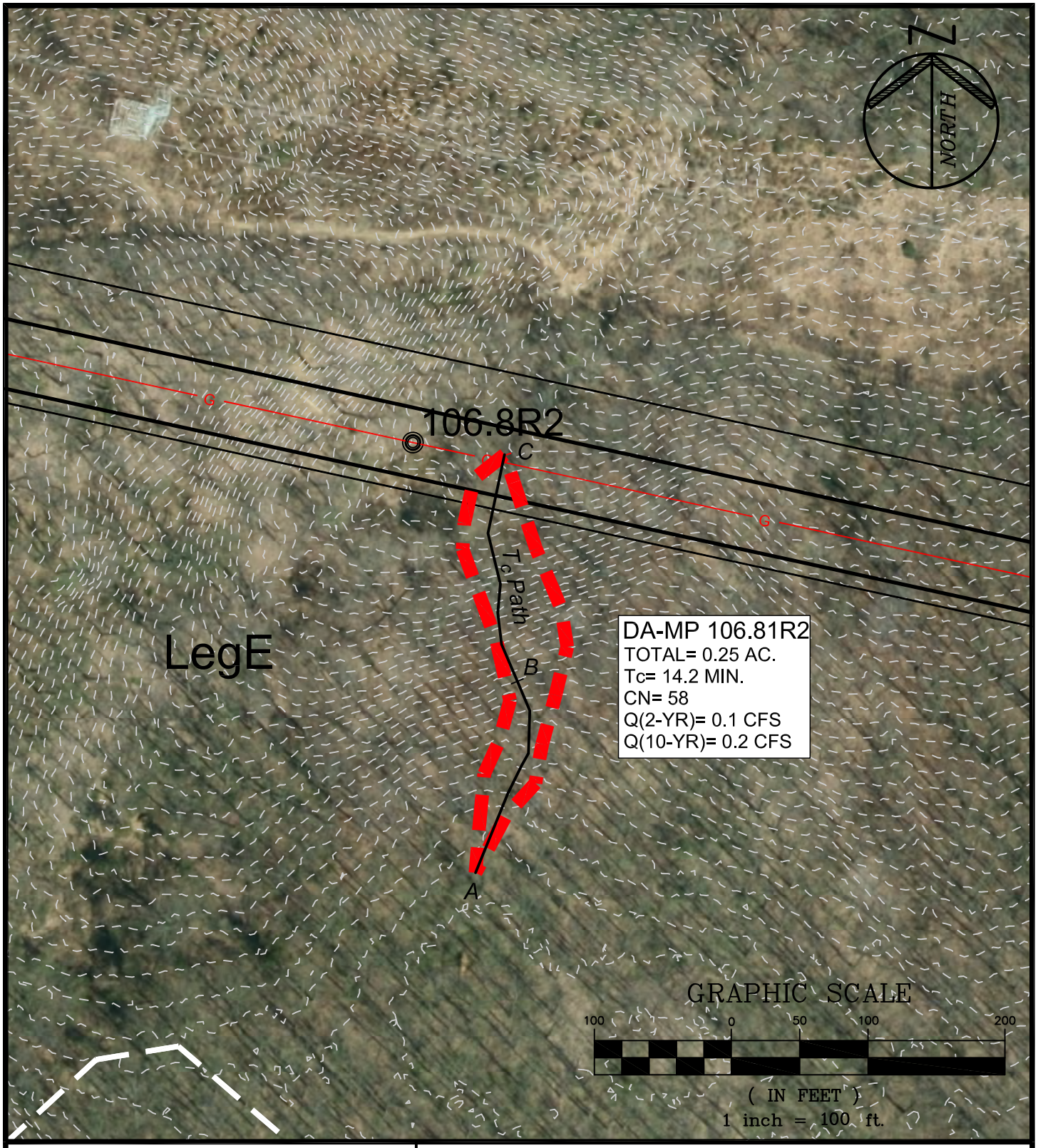
Critical Depth		1.21	ft
Critical Slope		0.03874	ft/ft
Velocity		6.60	ft/s
Velocity Head		0.68	ft
Specific Energy		1.65	ft
Froude Number		1.67	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.97	ft
Critical Depth	1.21	ft
Channel Slope	0.11300	ft/ft
Critical Slope	0.03874	ft/ft



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CERTIFICATE OF AUTHORIZATION NO. 24GA28032700

PROJECT TITLE

PENNEAST PIPELINE

HUNTERDON AND MERCER COUNTY, NJ

SHEET TITLE

STREAM CROSSING DRAINAGE AREA MP 106.81R2

PROJ. NO.:	05516.0001	DRN. BY:	JPS	SCALE:	1"=100'
DATE:	05/23/19	CK'D BY:	WS		

FILE NAME: P:\05516\0001\DWGs\CAD\C-Civil\Plotdwgs\Drainage Area Maps\05516001-Stream_DA_MP100.8-114-WAL.dwg\MP 106.81R2 LAST EDIT: 07/22/2019 - 11:43:18 AM LOGIN: jschooling@

Worksheet 2: Runoff curve number and runoff (Approximated)

Project	By	Date
PennEast	JPS	26-Feb-18
Location	**Checked**	**Date**
Hunterdon County, NJ		

Check one: ☐ Present ☒ Developed — MP 106.81

1. Runoff curve number

Soil name and hydrologic group (appendix A)	Cover Description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN[1] Table 2-2	CN[1] Figure 2-3	CN[1] Figure 2-4	Area ☒ acres ☐ mi² ☐ %	Product of CN x Area
Type B	Woods	58			0.25	14.50
				Totals ➡	0.25	14.50

1. Use only one CN source per line

CN (weighted) = tot.prod. / tot. area = 14.50 / 0.25 = 58.0 ; Use CN ➡ **58**

2. Runoff

		Storm #1	Storm #2	Storm #3
Frequency…….	yr			
Rainfall, P (24-hour)…….	in			
Runoff, Q……	in			

Use P and CN with table 2-1, figure 2-1, or equation 2-3 abd 2-4

PSS&	PROJECT: PennEast	JOB NO. 5516.0001	
		SHEET	DATE:2/12/2018
		BY:	JPS
	SUBJECT: Tc Calculations	CHK'D	

Time of Concentration calculations with the application of the SCS TR-55 methodology.

Watershed or Subarea Designation: DA 106.81

Area 0.25 AC

SHEET FLOW

Segment ID		A-B				
Surface Description (Table 3-1)		WOODS				
Manning's Coefficient, n (Table 3-1)		0.400				
Flow Length, L (total <= 150)	(ft)	150				
Two Year Rainfall, P	(in)	3.4				
Land Slope, s	(ft/ft)	0.147				
Computed Tt = 0.007 (nL)^0.8 / P^0.5*s^0.4	(hrs)	0.217				0.217

SHALLOW CONCENTRATED FLOW

Segment ID		B-C				
Surface Description (paved or unpaved)		UNPAVED				
Flow Length, L	(ft)	171				
Watercourse slope, s	(ft/ft)	0.026				
Average Velocity, V (Figure 3-1)	(ft/s)	2.5				
Computed Tt = L / 3600V	(hrs)	0.019				0.019

CHANNEL FLOW

Segment ID						
Cross sectional Area, a	(sf)					
Wetted Perimeter, Pw	(ft)					
Hydraulic Radius, r =a/Pw	(ft)					
Channel Slope (ft/ft)	(ft/ft)					
Manning's Roughness Coefficient, n						
Velocity, V = 1.49r^(2/3)s^0.5 / n	(ft/s)					
Flow Length, L	(ft)					
Computed Tt = L / 3600V	(hrs)					0.000

Watershed or subarea Tc	0.236	hrs.
	14.2	min.

Use minimum Tc of 10 minutes

Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 07 / 22 / 2019

Hyd. No. 1

MP 106.81

Hydrograph type	= SCS Runoff	Peak discharge	= 0.046 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.30 hrs
Time interval	= 6 min	Hyd. volume	= 323 cuft
Drainage area	= 0.250 ac	Curve number	= 58.000
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 14.2 min
Total precip.	= 3.31 in	Distribution	= Custom
Storm duration	= C:\Users\jschooling\AppData\Local\Autodesk\C3D2019\enu\HHApps\Hydrograp	Shape factor	= 484

Hydrograph Discharge Table

(Printed values >= 5.00% of Qp. Print interval = 3)

Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)
12.10	0.016	17.50	0.005	22.90	0.003
12.40	0.044	17.80	0.005	23.20	0.003
12.70	0.025	18.10	0.004	23.50	0.003
13.00	0.019	18.40	0.004	23.80	0.003
13.30	0.015	18.70	0.004	24.10	0.003
13.60	0.012	19.00	0.004		
13.90	0.010	19.30	0.004		
14.20	0.009	19.60	0.004		
14.50	0.009	19.90	0.004		
14.80	0.008	20.20	0.004		
15.10	0.007	20.50	0.004		
15.40	0.006	20.80	0.004		
15.70	0.006	21.10	0.004		
16.00	0.006	21.40	0.004		
16.30	0.006	21.70	0.003		
16.60	0.006	22.00	0.003		
16.90	0.005	22.30	0.003		
17.20	0.005	22.60	0.003		

...End

Worksheet for MP-106.81R2_STA0+24_PIPE-2YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.14100	ft/ft
Discharge	0.10	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	326.00
0+21	324.84
0+25	324.55
0+28	326.09

Roughness Segment Definitions

Start Station & Elevation	End Station & Elevation	Roughness Coefficient
(0+00, 326.00)	(0+28, 326.09)	0.050

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.10	ft
Elevation Range	324.55 to 326.09 ft	
Flow Area	0.07	ft²
Wetted Perimeter	1.41	ft
Hydraulic Radius	0.05	ft
Top Width	1.39	ft
Normal Depth	0.10	ft
Critical Depth	0.10	ft
Critical Slope	0.09974	ft/ft

Worksheet for MP-106.81R2_STA0+24_PIPE-2YR

Results

Velocity		1.47	ft/s
Velocity Head		0.03	ft
Specific Energy		0.13	ft
Froude Number		1.18	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.10	ft
Critical Depth	0.10	ft
Channel Slope	0.14100	ft/ft
Critical Slope	0.09974	ft/ft

Worksheet for MP-106.81R2_STA0+64_BRIDGE-2YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.14100	ft/ft
Discharge	0.10	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	320.00
0+06	319.83
0+11	319.92
0+22	322.00

Roughness Segment Definitions

Start Station & Elevation	End Station & Elevation	Roughness Coefficient
(0+00, 320.00)	(0+22, 322.00)	0.050

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.05	ft
Elevation Range	319.83 to 322.00 ft	
Flow Area	0.11	ft²
Wetted Perimeter	4.30	ft
Hydraulic Radius	0.02	ft
Top Width	4.30	ft
Normal Depth	0.05	ft
Critical Depth	0.05	ft
Critical Slope	0.12434	ft/ft

Worksheet for MP-106.81R2_STA0+64_BRIDGE-2YR

Results

Velocity		0.94	ft/s
Velocity Head		0.01	ft
Specific Energy		0.06	ft
Froude Number		1.06	
Flow Type	Supercritical		

GVF Input Data

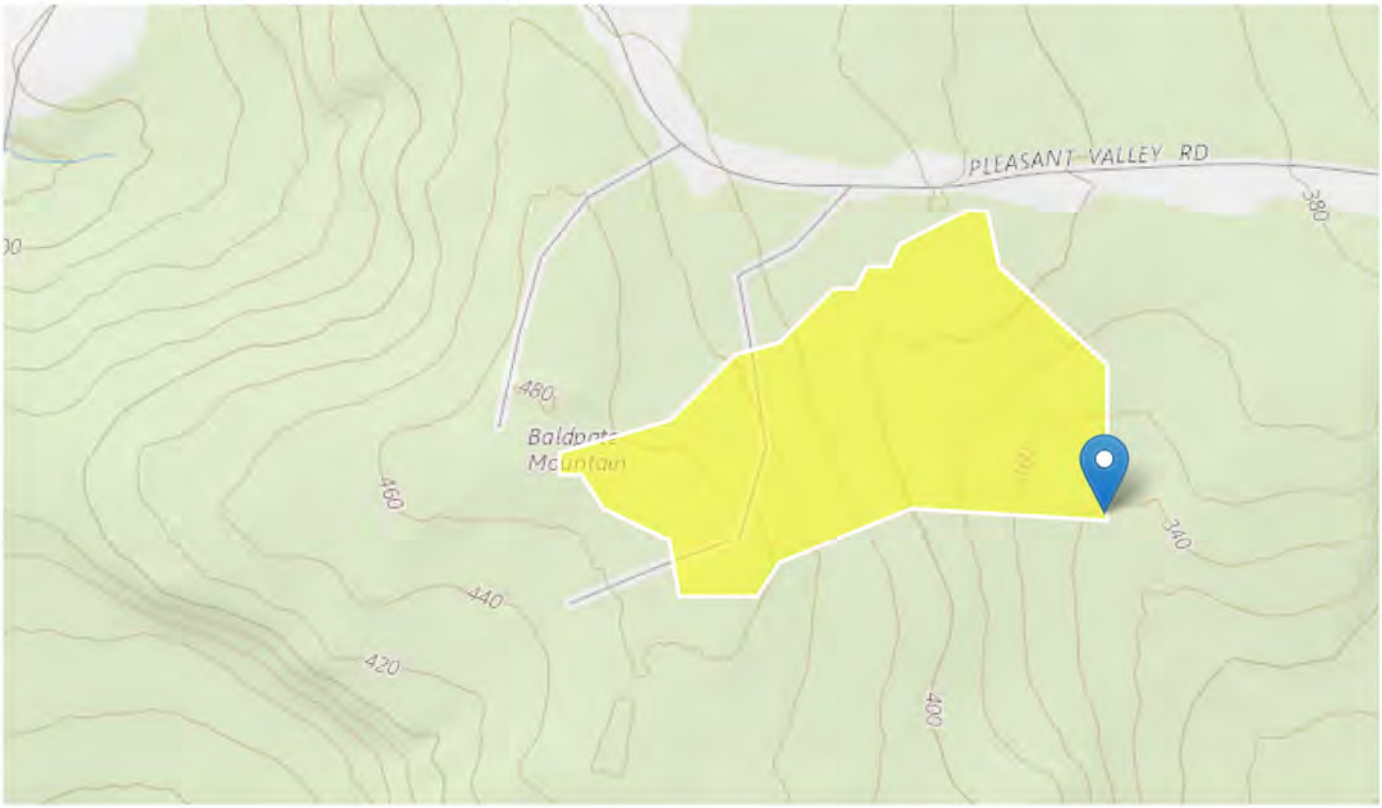
Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.05	ft
Critical Depth	0.05	ft
Channel Slope	0.14100	ft/ft
Critical Slope	0.12434	ft/ft

MP- 107.50R2

Region ID: NJ
Workspace ID: NJ20180309211508201000
Clicked Point (Latitude, Longitude): 40.32955, -74.86644
Time: 2018-03-09 16:15:22 -0500



The South Carolina StreamStats application is testing LiDAR-derived data and streams for delineation. This is a beta version and QA/QC is incomplete. It may calculate basin characteristics and flow statistics incorrectly. Please verify the drainage areas and flow stats carefully. Use at your own risk

Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	0.0355	square miles
STORAGE	Percentage of area of storage (lakes ponds reservoirs wetlands)	0	percent

Parameter Code	Parameter Description	Value	Unit
CSL10_85	Change in elevation divided by length between points 10 and 85 percent of distance along main channel to basin divide - main channel method not known	391	feet per mi
POPDENS	Basin Population Density	190	persons per square mile

Peak-Flow Statistics Parameters [Peak Unglaciated Piedmont Region 2009 5167]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.0355	square miles	0.25	779
STORAGE	Percent Storage	0	percent	0.23	32
CSL10_85	Stream Slope 10 and 85 Method	391	feet per mi	4.31	191
POPDENS	Basin Population Density	190	persons per square mile	83	11084

Peak-Flow Statistics Disclaimers [Peak Unglaciated Piedmont Region 2009 5167]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors

Peak-Flow Statistics Flow Report [Peak Unglaciated Piedmont Region 2009 5167]

Statistic	Value	Unit
2 Year Peak Flood	26.7	ft^3/s
5 Year Peak Flood	49.9	ft^3/s
10 Year Peak Flood	70	ft^3/s
25 Year Peak Flood	100	ft^3/s
50 Year Peak Flood	127	ft^3/s
100 Year Peak Flood	157	ft^3/s
500 Year Peak Flood	239	ft^3/s

Worksheet for MP-107.50R2_STA0+55_PIPE-2YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.03200	ft/ft
Discharge	26.70	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	346.28
0+03	344.71
0+05	346.07
0+35	348.00

Roughness Segment Definitions

Start Station & Elevation	End Station & Elevation	Roughness Coefficient
(0+00, 346.28)	(0+35, 348.00)	0.045

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	1.81	ft
Elevation Range	344.71 to 348.00 ft	
Flow Area	6.90	ft²
Wetted Perimeter	13.01	ft
Hydraulic Radius	0.53	ft
Top Width	11.96	ft
Normal Depth	1.81	ft
Critical Depth	1.75	ft
Critical Slope	0.04003	ft/ft

Worksheet for MP-107.50R2_STA0+55_PIPE-2YR

Results

Velocity		3.87	ft/s
Velocity Head		0.23	ft
Specific Energy		2.04	ft
Froude Number		0.90	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.81	ft
Critical Depth	1.75	ft
Channel Slope	0.03200	ft/ft
Critical Slope	0.04003	ft/ft

Worksheet for MP-107.50R2_STA0+17_BRIDGE-2YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.03200	ft/ft
Discharge	26.70	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	349.00
0+28	347.58
0+30	345.82
0+32	347.58
0+65	350.00

Roughness Segment Definitions

Start Station & Elevation	End Station & Elevation	Roughness Coefficient
(0+00, 349.00)	(0+65, 350.00)	0.045

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	2.15	ft
Elevation Range	345.82 to 350.00 ft	
Flow Area	7.96	ft²
Wetted Perimeter	18.58	ft
Hydraulic Radius	0.43	ft
Top Width	17.28	ft
Normal Depth	2.15	ft
Critical Depth	2.09	ft

Worksheet for MP-107.50R2_STA0+17_BRIDGE-2YR

Results

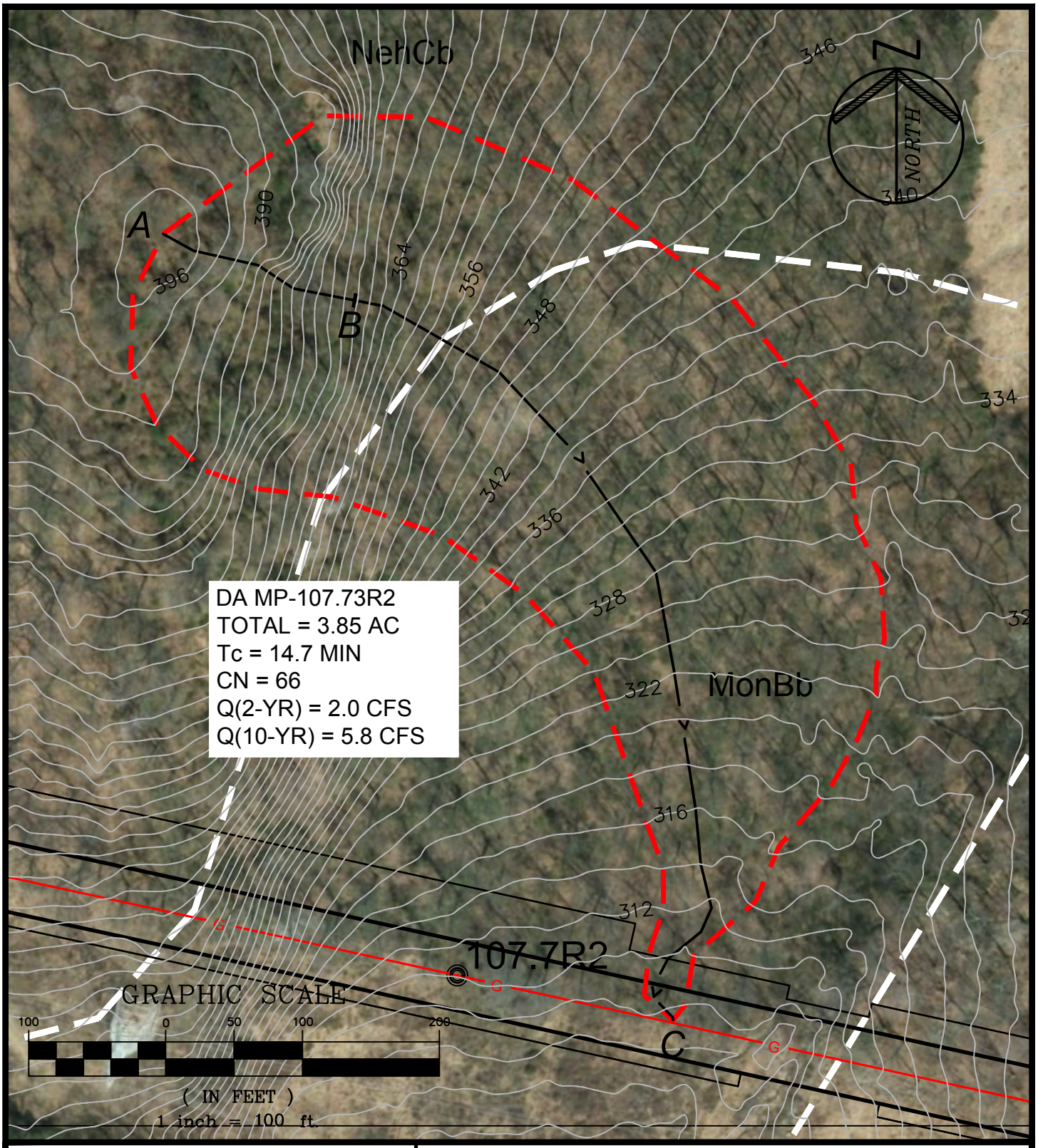
Critical Slope		0.04271	ft/ft
Velocity		3.36	ft/s
Velocity Head		0.17	ft
Specific Energy		2.33	ft
Froude Number		0.87	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	2.15	ft
Critical Depth	2.09	ft
Channel Slope	0.03200	ft/ft
Critical Slope	0.04271	ft/ft



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CERTIFICATE OF AUTHORIZATION NO. 24GA28032700

PROJECT TITLE

PENNEAST PIPELINE

HUNTERDON AND MERCER COUNTY, NJ

SHEET TITLE

STREAM CROSSING DRAINAGE AREA MP 107.73R2

PROJ. NO.: 05516.0001	DRN. BY: JPS	SCALE: 1"=100'
DATE: 05/23/19	CK'D BY: WS	

FILE NAME: P:\05516\0001\DWGs\CAD\C-Civil\Plotdwgs\Drainage Area Maps\05516\0001-Stream_DA_MP100.8-114-WAL.dwg\MP 107.73R2 LAST EDIT: 07/22/2019 - 11:54:10 AM LOGIN: jschooling@

Worksheet 2: Runoff curve number and runoff (Approximated)

Project	By	Date
PennEast	JPS	26-Feb-18
Location	**Checked**	**Date**
Hunterdon County, NJ		

Check one: ☐ Present ☒ Developed — MP 107.73R2

1. Runoff curve number

Soil name and hydrologic group (appendix A)	Cover Description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN[1] Table 2-2	CN[1] Figure 2-3	CN[1] Figure 2-4	Area ☒ acres ☐ mi² ☐ %	Product of CN x Area
Type B	Woods	58			1.37	79.46
Type C	Woods	70			2.48	173.60
1. Use only one CN source per line				Totals ➡	3.85	253.06

CN (weighted) = tot.prod. / tot. area = 253.06 / 3.85 = 65.7 ; Use CN ➡ **66**

2. Runoff

		Storm #1	Storm #2	Storm #3
Frequency…….	yr			
Rainfall, P (24-hour)…….	in			
Runoff, Q……	in			

Use P and CN with table 2-1, figure 2-1, or equation 2-3 abd 2-4

PSS&	PROJECT: PennEast	JOB NO. 5516.0001	
		SHEET	DATE:2/12/2018
		BY:	JPS
	SUBJECT: Tc Calculations	CHK'D	

Time of Concentration calculations with the application of the SCS TR-55 methodology.

Watershed or Subarea Designation: DA 107.73

Area 3.85 AC

SHEET FLOW

Segment ID		A-B				
Surface Description (Table 3-1)		WOODS				
Manning's Coefficient, n (Table 3-1)		0.400				
Flow Length, L (total <= 150)	(ft)	150				
Two Year Rainfall, P	(in)	3.4				
Land Slope, s	(ft/ft)	0.180				
Computed Tt = 0.007 (nL)^0.8 / P^0.5*s^0.4	(hrs)	0.200				0.200

SHALLOW CONCENTRATED FLOW

Segment ID		B-C				
Surface Description (paved or unpaved)		UNPAVED				
Flow Length, L	(ft)	657				
Watercourse slope, s	(ft/ft)	0.094				
Average Velocity, V (Figure 3-1)	(ft/s)	4.0				
Computed Tt = L / 3600V	(hrs)	0.046				0.046

CHANNEL FLOW

Segment ID						
Cross sectional Area, a	(sf)					
Wetted Perimeter, Pw	(ft)					
Hydraulic Radius, r =a/Pw	(ft)					
Channel Slope (ft/ft)	(ft/ft)					
Manning's Roughness Coefficient, n						
Velocity, V = 1.49r^(2/3)s^0.5 / n	(ft/s)					
Flow Length, L	(ft)					
Computed Tt = L / 3600V	(hrs)					0.000

Watershed or subarea Tc	0.246	hrs.
	14.7	min.

Use minimum Tc of 10 minutes

Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 07 / 22 / 2019

Hyd. No. 2

MP - 107.73

Hydrograph type	= SCS Runoff	Peak discharge	= 2.003 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.20 hrs
Time interval	= 6 min	Hyd. volume	= 9,162 cuft
Drainage area	= 3.850 ac	Curve number	= 66.000
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 14.7 min
Total precip.	= 3.31 in	Distribution	= Custom
Storm duration	= C:\Users\jschooling\AppData\Local\Autodesk\C3D2019\enu\HHApps\Hydrograp	Shape factor	= 484

Hydrograph Discharge Table

(Printed values >= 5.00% of Qp. Print interval = 3)

Time -- Outflow (hrs cfs)		Time -- Outflow (hrs cfs)	
11.90	0.171	17.30	0.114
12.20	2.003	17.60	0.107
12.50	1.023	17.90	0.101
12.80	0.593	*...End*	
13.10	0.442		
13.40	0.342		
13.70	0.268		
14.00	0.239		
14.30	0.219		
14.60	0.199		
14.90	0.177		
15.20	0.156		
15.50	0.148		
15.80	0.142		
16.10	0.137		
16.40	0.131		
16.70	0.126		
17.00	0.120		

<<

Worksheet for MP-107.73R2_STA0+47_BRIDGE-2YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.03500	ft/ft
Discharge	5.80	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	310.00
0+49	308.94
0+50	308.80
0+51	308.83
1+00	310.00

Roughness Segment Definitions

Start Station & Elevation	End Station & Elevation	Roughness Coefficient
(0+00, 310.00)	(1+00, 310.00)	0.050

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.35	ft
Elevation Range	308.80 to 310.00 ft	
Flow Area	3.72	ft²
Wetted Perimeter	25.03	ft
Hydraulic Radius	0.15	ft
Top Width	25.02	ft
Normal Depth	0.35	ft
Critical Depth	0.31	ft

Worksheet for MP-107.73R2_STA0+47_BRIDGE-2YR

Results

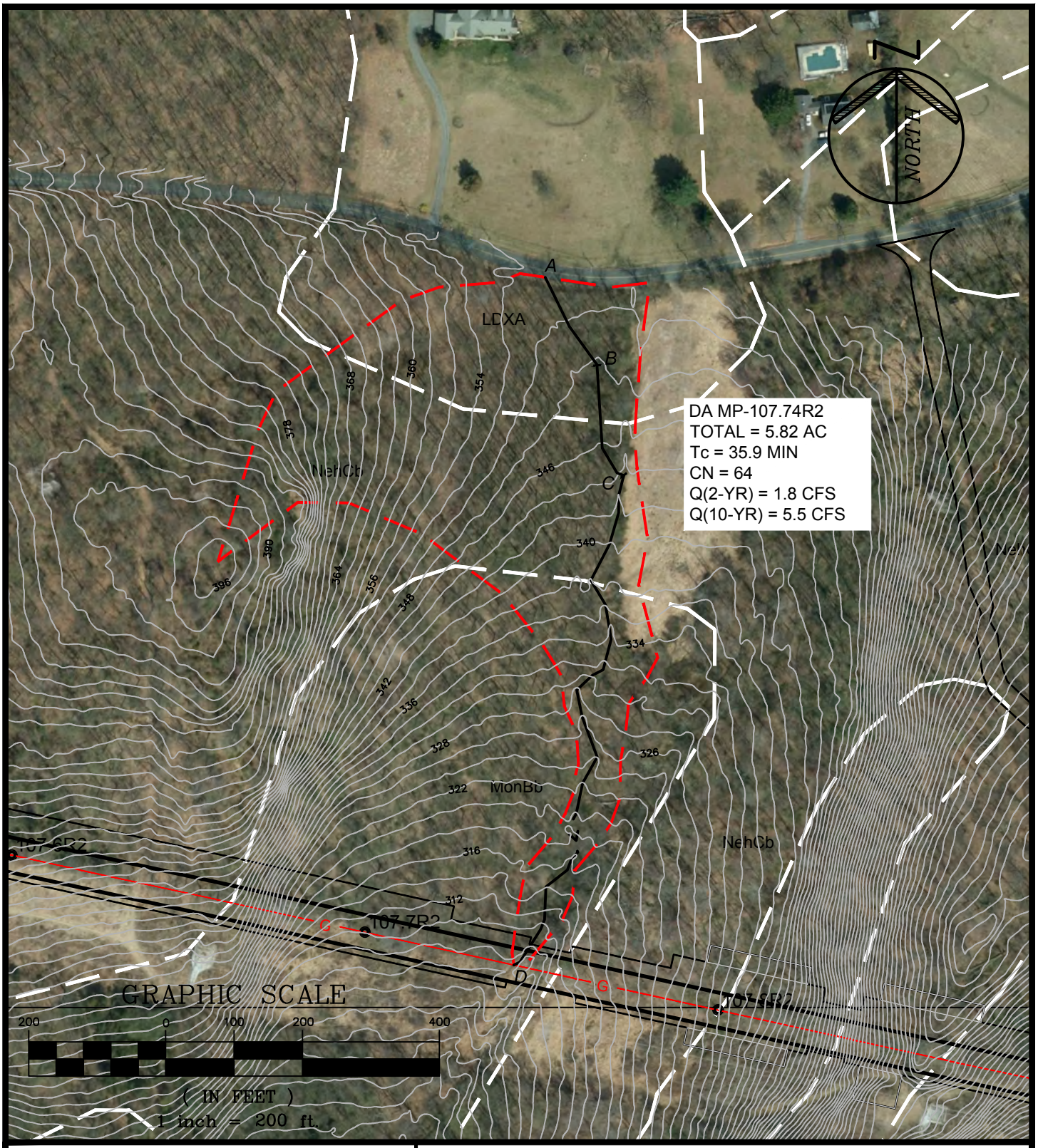
Critical Slope		0.07186	ft/ft
Velocity		1.56	ft/s
Velocity Head		0.04	ft
Specific Energy		0.39	ft
Froude Number		0.71	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.35	ft
Critical Depth	0.31	ft
Channel Slope	0.03500	ft/ft
Critical Slope	0.07186	ft/ft



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CERTIFICATE OF AUTHORIZATION NO. 24GA28032700

PROJECT TITLE

PENNEAST PIPELINE

HUNTERDON AND MERCER COUNTY, NJ

SHEET TITLE

STREAM CROSSING DRAINAGE AREA MP 107.74R2

PROJ. NO.:	05516.0001	DRN. BY:	JPS	SCALE:	1"=200'
DATE:	05/23/19	CK'D BY:	WS		

FILE NAME: P:\05516\0001\DWGs\CAD\C-Civil\Plotdwgs\Drainage Area Maps\05516\0001-Stream_DA_MP100.8-114-WAL.dwg\MP 107.74R2 LAST EDIT: 07/22/2019 - 11:54:52 AM LOGIN: jschooling@

Worksheet 2: Runoff curve number and runoff (Approximated)

Project	By	Date
PennEast	JPS	26-Feb-18
Location	**Checked**	**Date**
Hunterdon County, NJ		

Check one: ☐ Present ☒ Developed | MP 106.81

1. Runoff curve number

Soil name and hydrologic group (appendix A)	Cover Description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN[1] Table 2-2	CN[1] Figure 2-3	CN[1] Figure 2-4	Area ☒ acres ☐ mi² ☐ %	Product of CN x Area
Type B	Woods	58			2.91	168.78
Type C	Woods	70			2.91	203.70
				Totals ➡	5.82	372.48

1. Use only one CN source per line

CN (weighted) = tot.prod. / tot. area = 372.48 / 5.82 = 64.0 ; Use CN ➡ **64**

2. Runoff

		Storm #1	Storm #2	Storm #3
Frequency…….	yr			
Rainfall, P (24-hour)…….	in			
Runoff, Q……	in			

Use P and CN with table 2-1, figure 2-1, or equation 2-3 abd 2-4

PSS&	PROJECT: PennEast	JOB NO. 5516.0001	
		SHEET	DATE:2/12/2018
		BY:	JPS
	SUBJECT: Tc Calculations	CHK'D	

Time of Concentration calculations with the application of the SCS TR-55 methodology.

Watershed or Subarea Designation: DA 107.74

Area 5.82 AC

SHEET FLOW

Segment ID		A-B				
Surface Description (Table 3-1)		WOODS				
Manning's Coefficient, n (Table 3-1)		0.400				
Flow Length, L (total <= 150)	(ft)	150				
Two Year Rainfall, P	(in)	3.4				
Land Slope, s	(ft/ft)	0.020				
Computed Tt = 0.007 (nL)^0.8 / P^0.5*s^0.4	(hrs)	0.482				0.482

SHALLOW CONCENTRATED FLOW

Segment ID		B-C				
Surface Description (paved or unpaved)		UNPAVED				
Flow Length, L	(ft)	173				
Watercourse slope, s	(ft/ft)	0.023				
Average Velocity, V (Figure 3-1)	(ft/s)	2.2				
Computed Tt = L / 3600V	(hrs)	0.022				0.022

CHANNEL FLOW

Segment ID		C-D				
Cross sectional Area, a	(sf)	0.87				
Wetted Perimeter, Pw	(ft)	6.82				
Hydraulic Radius, r =a/Pw	(ft)	0.128				
Channel Slope (ft/ft)	(ft/ft)	0.045				
Manning's Roughness Coefficient, n		0.040				
Velocity, V = 1.49r^(2/3)s^0.5 / n	(ft/s)	2.00				
Flow Length, L	(ft)	804				
Computed Tt = L / 3600V	(hrs)	0.112				0.112

Watershed or subarea Tc	0.615	hrs.
	36.9	min.

Use minimum Tc of 10 minutes

Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 07 / 22 / 2019

Hyd. No. 3

MP - 107.74

Hydrograph type	= SCS Runoff	Peak discharge	= 1.745 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.60 hrs
Time interval	= 6 min	Hyd. volume	= 13,318 cuft
Drainage area	= 5.820 ac	Curve number	= 64.000
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 36.9 min
Total precip.	= 3.31 in	Distribution	= Custom
Storm duration	= C:\Users\jschooling\AppData\Local\Autodesk\C3D2019\enu\HHApps\Hydrograp	Shape factor	= 484

Hydrograph Discharge Table

(Printed values >= 5.00% of Qp. Print interval = 3)

Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)
12.00	0.119	17.40	0.178	22.80	0.112
12.30	1.242	17.70	0.169	23.10	0.110
12.60	1.745	18.00	0.160	23.40	0.107
12.90	1.346	18.30	0.151	23.70	0.105
13.20	0.815	18.60	0.144	24.00	0.103
13.50	0.596	18.90	0.141	*...End*	
13.80	0.469	19.20	0.139		
14.10	0.390	19.50	0.137		
14.40	0.348	19.80	0.135		
14.70	0.317	20.10	0.133		
15.00	0.286	20.40	0.131		
15.30	0.255	20.70	0.128		
15.60	0.233	21.00	0.126		
15.90	0.221	21.30	0.124		
16.20	0.213	21.60	0.122		
16.50	0.205	21.90	0.119		
16.80	0.196	22.20	0.117		
17.10	0.187	22.50	0.115		

<<

Worksheet for MP-107.74R2_STA0+79_PIPE-2YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.02000	ft/ft
Discharge	1.80	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	309.00
0+20	308.00
0+27	307.18
0+30	305.89
0+32	308.36

Roughness Segment Definitions

Start Station & Elevation	End Station & Elevation	Roughness Coefficient
(0+00, 309.00)	(0+32, 308.36)	0.045

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.71	ft
Elevation Range	305.89 to 309.00 ft	
Flow Area	0.86	ft²
Wetted Perimeter	2.88	ft
Hydraulic Radius	0.30	ft
Top Width	2.43	ft
Normal Depth	0.71	ft
Critical Depth	0.59	ft

Worksheet for MP-107.74R2_STA0+79_PIPE-2YR

Results

Critical Slope		0.05583	ft/ft
Velocity		2.09	ft/s
Velocity Head		0.07	ft
Specific Energy		0.78	ft
Froude Number		0.62	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.71	ft
Critical Depth	0.59	ft
Channel Slope	0.02000	ft/ft
Critical Slope	0.05583	ft/ft

Worksheet for MP-107.74R2_STA0+50_BRIDGE-2YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.02000	ft/ft
Discharge	1.80	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	310.00
0+49	308.14
0+50	306.90
0+54	308.82

Roughness Segment Definitions

Start Station & Elevation	End Station & Elevation	Roughness Coefficient
(0+00, 310.00)	(0+54, 308.82)	0.045

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.77	ft
Elevation Range	306.90 to 310.00 ft	
Flow Area	0.84	ft²
Wetted Perimeter	2.71	ft
Hydraulic Radius	0.31	ft
Top Width	2.18	ft
Normal Depth	0.77	ft
Critical Depth	0.63	ft
Critical Slope	0.05795	ft/ft

Worksheet for MP-107.74R2_STA0+50_BRIDGE-2YR

Results

Velocity		2.14	ft/s
Velocity Head		0.07	ft
Specific Energy		0.84	ft
Froude Number		0.61	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.77	ft
Critical Depth	0.63	ft
Channel Slope	0.02000	ft/ft
Critical Slope	0.05795	ft/ft

PREFS
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↑ 330ft
MAP
03/20/19
N
13:28:53
LOG
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+01.9°
+05
-14.3°
-20
-15
-10
EXTRAS
216° S36W 3840mils TRUE
ZERO
A-B
CAL
210
240
NIGHT
1.0 X
S

MP107.75R2

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Workspace ID: NJ20170811082832035000
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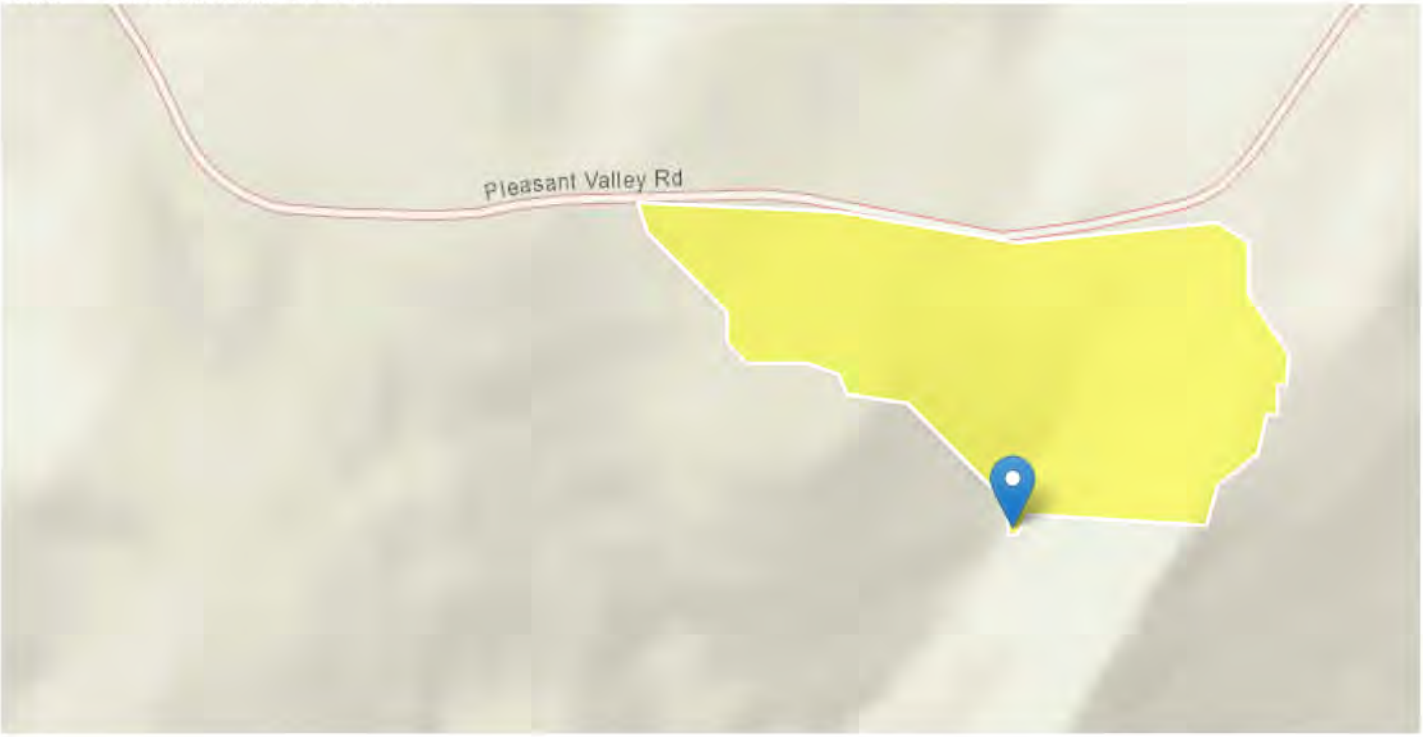
Time: 2017-08-11 08:29:34 -0400



Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	0.0489	square miles
STORAGE	Percentage of area of storage (lakes ponds reservoirs wetlands)	0	percent
CSL10_85	Change in elevation divided by length between points 10 and 85 percent of distance along main channel to basin divide - main channel method not known	217	feet per mi
POPDENS	Basin Population Density	191	persons per square mile

Peak-Flow Statistics Parameters [Peak Unglaciated Piedmont Region 2009 5167]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.0489	square miles	0.25	779
STORAGE	Percent Storage	0	percent	0.23	32
CSL10_85	Stream Slope 10 and 85 Method	217	feet per mi	4.31	191
POPDENS	Basin Population Density	191	persons per square mile	83	11084

Peak-Flow Statistics Disclaimers [Peak Unglaciated Piedmont Region 2009 5167]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors

Peak-Flow Statistics Flow Report [Peak Unglaciated Piedmont Region 2009 5167]

Statistic	Value	Unit
2 Year Peak Flood	29.3	ft^3/s
5 Year Peak Flood	54.5	ft^3/s
10 Year Peak Flood	76.1	ft^3/s
25 Year Peak Flood	109	ft^3/s
50 Year Peak Flood	137	ft^3/s
100 Year Peak Flood	169	ft^3/s
500 Year Peak Flood	256	ft^3/s

Peak-Flow Statistics Citations

Watson, K.M.,and Schopp, R.D.,2009, Methodology for estimation of flood magnitude and frequency for New Jersey streams, U.S. Geological Survey Scientific Investigations Report 2009-5167, 51 p. (http://pubs.usgs.gov/sir/2009/5167/)

Worksheet for MP-107.75R2_STA0+32_2YR_PIPE

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.05900	ft/ft
Discharge	29.30	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	308.00
0+38	308.00
0+47	306.50
0+49	305.86
0+53	306.70
0+57	308.00
0+65	310.00
0+99	312.00
1+00	312.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 308.00)	(1+00, 312.00)	0.045

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	1.12	ft
Elevation Range	305.86 to 312.00 ft	
Flow Area	5.59	ft²
Wetted Perimeter	10.60	ft

Worksheet for MP-107.75R2_STA0+32_2YR_PIPE

Results

Hydraulic Radius		0.53	ft
Top Width		10.33	ft
Normal Depth		1.12	ft
Critical Depth		1.22	ft
Critical Slope		0.03629	ft/ft
Velocity		5.24	ft/s
Velocity Head		0.43	ft
Specific Energy		1.54	ft
Froude Number		1.26	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.12	ft
Critical Depth	1.22	ft
Channel Slope	0.05900	ft/ft
Critical Slope	0.03629	ft/ft

Worksheet for MP-107.75R2_STA0+06_2YR_BRIDGE

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.05900	ft/ft
Discharge	29.30	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	308.00
0+39	308.00
0+48	308.20
0+50	307.59
0+53	308.00
0+70	312.00
0+91	314.00
1+00	316.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 308.00)	(1+00, 316.00)	0.045

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.61	ft
Elevation Range	307.59 to 316.00 ft	
Flow Area	10.74	ft²
Wetted Perimeter	54.12	ft
Hydraulic Radius	0.20	ft

Worksheet for MP-107.75R2_STA0+06_2YR_BRIDGE

Results

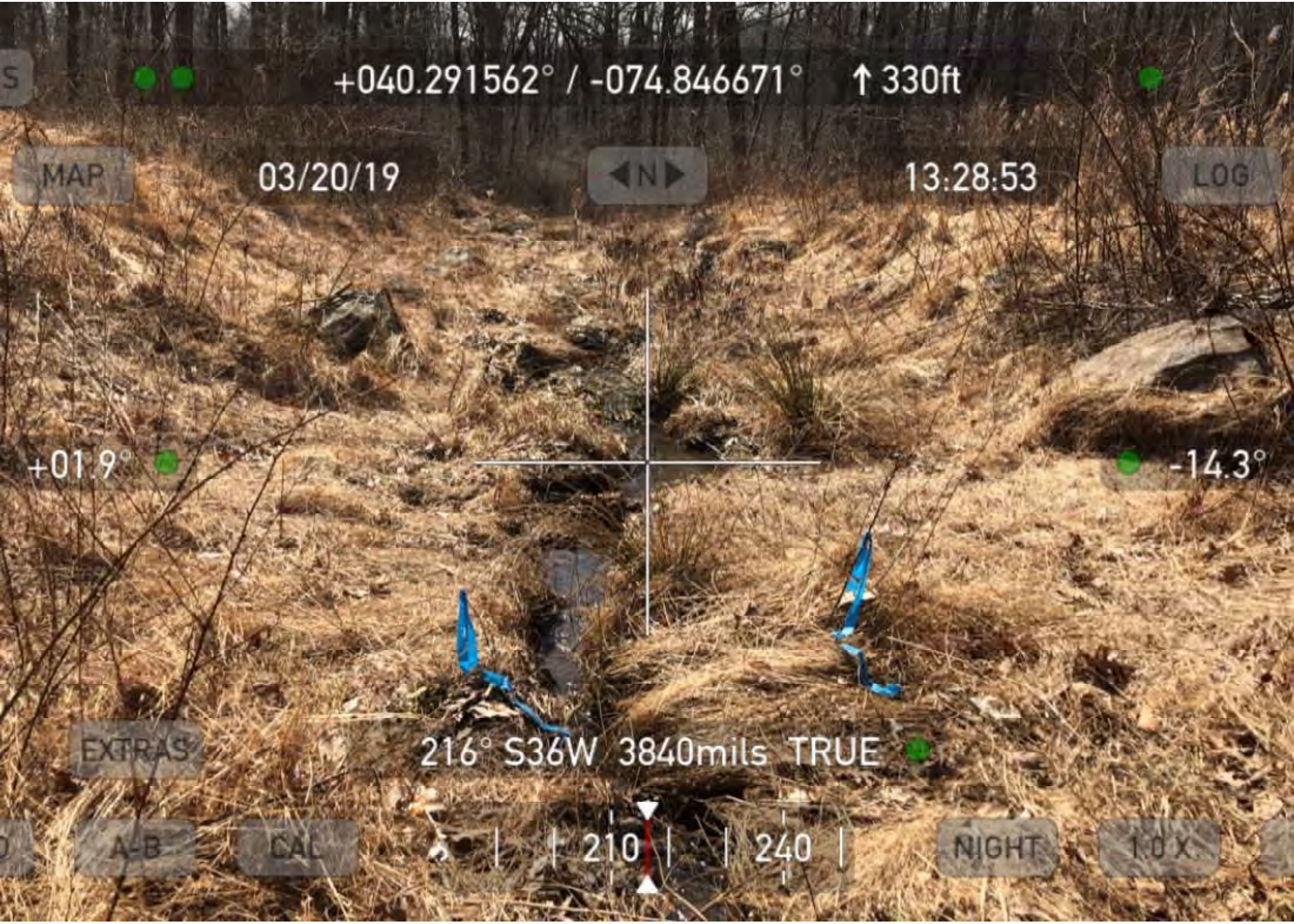
Top Width		53.77	ft
Normal Depth		0.61	ft
Critical Depth		0.62	ft
Critical Slope		0.05012	ft/ft
Velocity		2.73	ft/s
Velocity Head		0.12	ft
Specific Energy		0.73	ft
Froude Number		1.08	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.61	ft
Critical Depth	0.62	ft
Channel Slope	0.05900	ft/ft
Critical Slope	0.05012	ft/ft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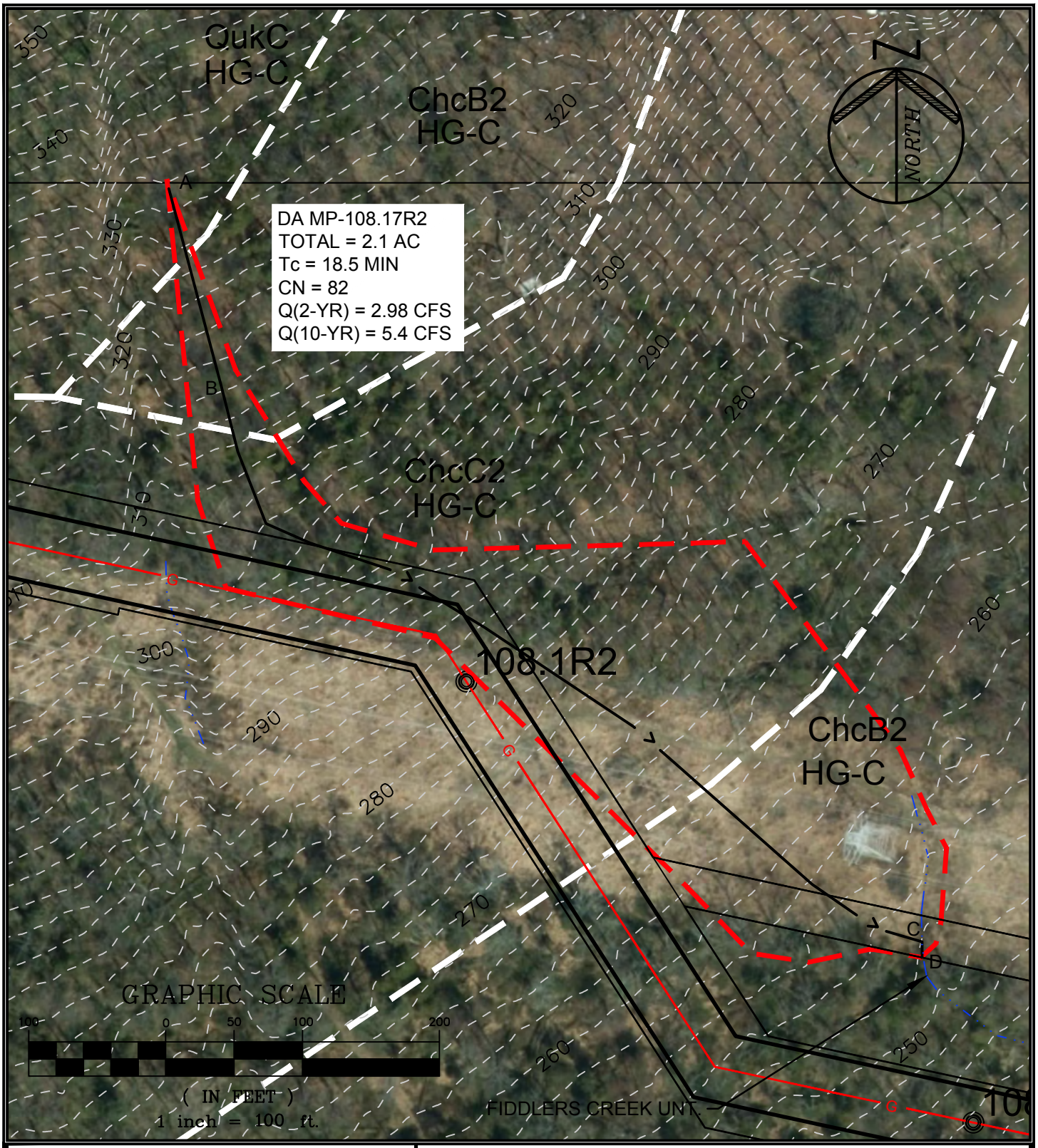

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CERTIFICATE OF AUTHORIZATION NO. 24GA28032700

PROJECT TITLE

PENNEAST PIPELINE

HUNTERDON AND MERCER COUNTY, NJ

SHEET TITLE

STREAM CROSSING DRAINAGE AREA MP 108.17R2

PROJ. NO.:	05516.0001	DRN. BY:	JPS	SCALE:	1"=100'
DATE:	05/23/19	CK'D BY:	WS		

FILE NAME: P:\05516\0001\DWGs\CAD\C-Civil\Plotdwgs\Drainage Area Maps\055160001-Stream_DA_MP100.8-114-WAL.dwg\MP 108.13R LAST EDIT: 06/20/2019 - 11:29:57 AM LOGIN: IKuzmina@

Worksheet 2: Runoff curve number and runoff (Approximated)

Project	By	Date
PennEast	IK	24-Apr-19
Location	**Checked**	**Date**
Hunterdon County, NJ		

Check one: ☐ Present ☒ Developed | MP 108.17R2

1. Runoff curve number

Soil name and hydrologic group (appendix A)	Cover Description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN[1] Table 2-2	CN[1] Figure 2-3	CN[1] Figure 2-4	Area ☒ acres / ☐ mi² / ☐ %	Product of CN x Area
Type C	Farmstead	82			8.92	731.44
Type B	Farmstead	74			1.29	95.46
Type D	Farmstead	86			0.59	50.74
1. Use only one CN source per line				**Totals** ➡	10.80	877.64

CN (weighted) = tot.prod. / tot. area = 877.64 / 10.80 = 81.3 ; **Use CN** ➡ **81**

2. Runoff

		Storm #1	Storm #2	Storm #3
Frequency…….	yr			
Rainfall, P (24-hour)…….	in			
Runoff, Q……	in			

Use P and CN with table 2-1, figure 2-1, or equation 2-3 abd 2-4

PSS&	PROJECT: PennEast	JOB NO. 5516.0001	
		SHEET	DATE:4/24/2019
		BY:	IK
	SUBJECT: Tc Calculations	CHK'D	

Time of Concentration calculations with the application of the SCS TR-55 methodology.

Watershed or Subarea Designation: DA 108.17R2 AR

Area 2.1 AC

SHEET FLOW

Segment ID		A-B				
Surface Description (Table 3-1)		WOODS				
Manning's Coefficient, n (Table 3-1)		0.400				
Flow Length, L (total <= 150)	(ft)	150				
Two Year Rainfall, P	(in)	3.4				
Land Slope, s	(ft/ft)	0.093				
Computed Tt = 0.007 (nL)^0.8 / P^0.5*s^0.4	(hrs)	0.260				0.260

SHALLOW CONCENTRATED FLOW

Segment ID		B-C				
Surface Description (paved or unpaved)		UNPAVED				
Flow Length, L	(ft)	679				
Watercourse slope, s	(ft/ft)	0.094				
Average Velocity, V (Figure 3-1)	(ft/s)	4.0				
Computed Tt = L / 3600V	(hrs)	0.047				0.047

CHANNEL FLOW

Segment ID		C-D				
Cross sectional Area, a	(sf)	2.30				
Wetted Perimeter, Pw	(ft)	4.13				
Hydraulic Radius, r =a/Pw	(ft)	0.557				
Channel Slope (ft/ft)	(ft/ft)	0.047				
Manning's Roughness Coefficient, n		0.045				
Velocity, V = 1.49r^(2/3)s^0.5 / n	(ft/s)	4.86				
Flow Length, L	(ft)	12				
Computed Tt = L / 3600V	(hrs)	0.001				0.001

Watershed or subarea Tc	0.308	hrs.
	18.5	min.

Use minimum Tc of 10 minutes

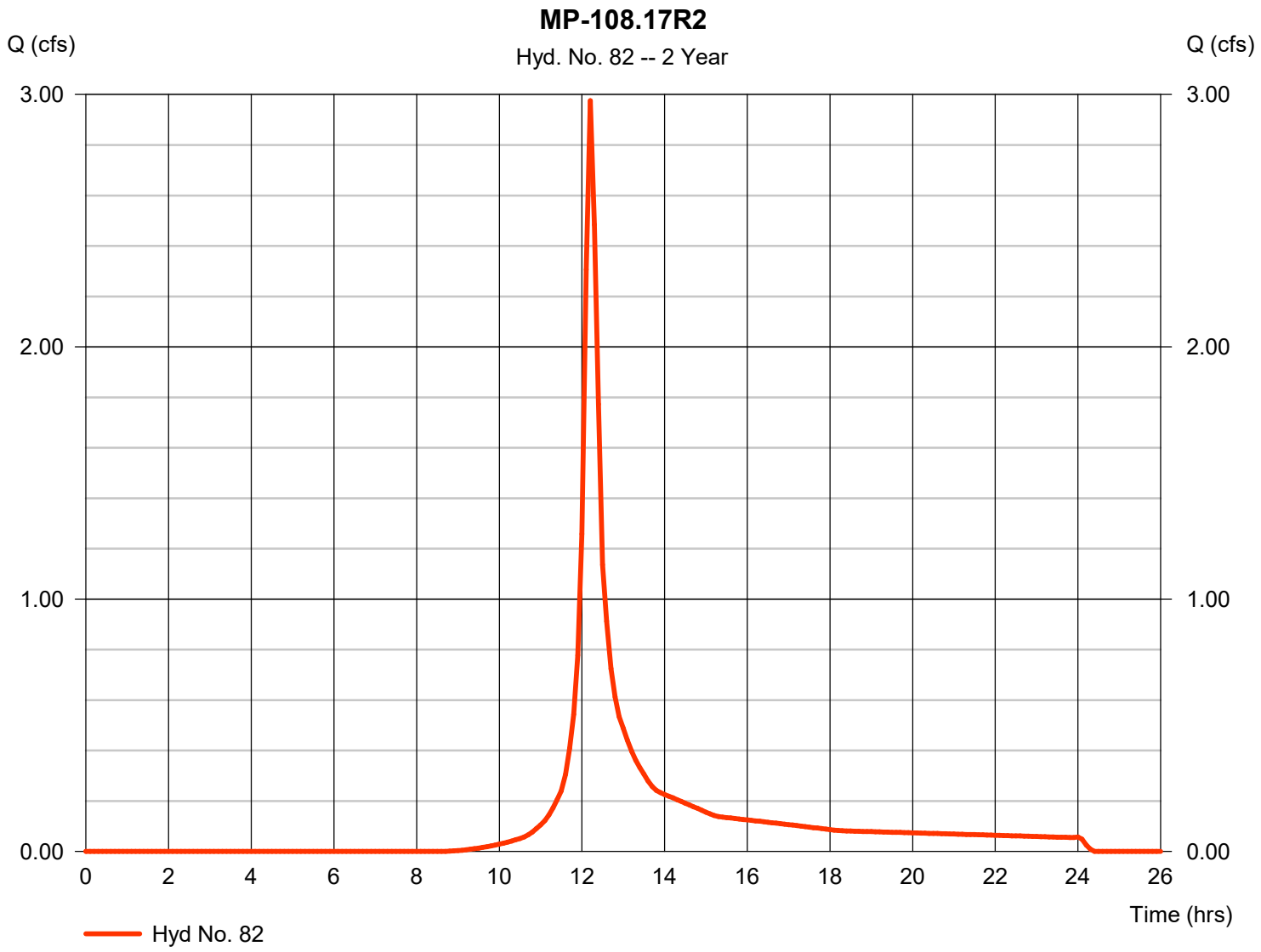
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Friday, 07 / 19 / 2019

Hyd. No. 82

MP-108.17R2

Hydrograph type	= SCS Runoff	Peak discharge	= 2.975 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.20 hrs
Time interval	= 6 min	Hyd. volume	= 11,338 cuft
Drainage area	= 2.100 ac	Curve number	= 82
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 18.50 min
Total precip.	= 3.26 in	Distribution	= Custom
Storm duration	= C:\Users\IKuzmina\AppData\Local\Autodesk\C3D 2019\enu\AHHApps\Hydrograph	Shape factor	= 484



Worksheet for MP-108.13R2_STA0+17_2YR_BRIDGE-AR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.04900	ft/ft
Discharge	2.98	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	254.00
0+13	254.00
0+48	251.25
0+50	250.90
0+51	251.80

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 254.00)	(0+51, 251.80)	0.045

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.56	ft
Elevation Range	250.90 to 254.00 ft	
Flow Area	1.15	ft²
Wetted Perimeter	5.43	ft
Hydraulic Radius	0.21	ft
Top Width	5.22	ft
Normal Depth	0.56	ft
Critical Depth	0.55	ft

Worksheet for MP-108.13R2_STA0+17_2YR_BRIDGE-AR

Results

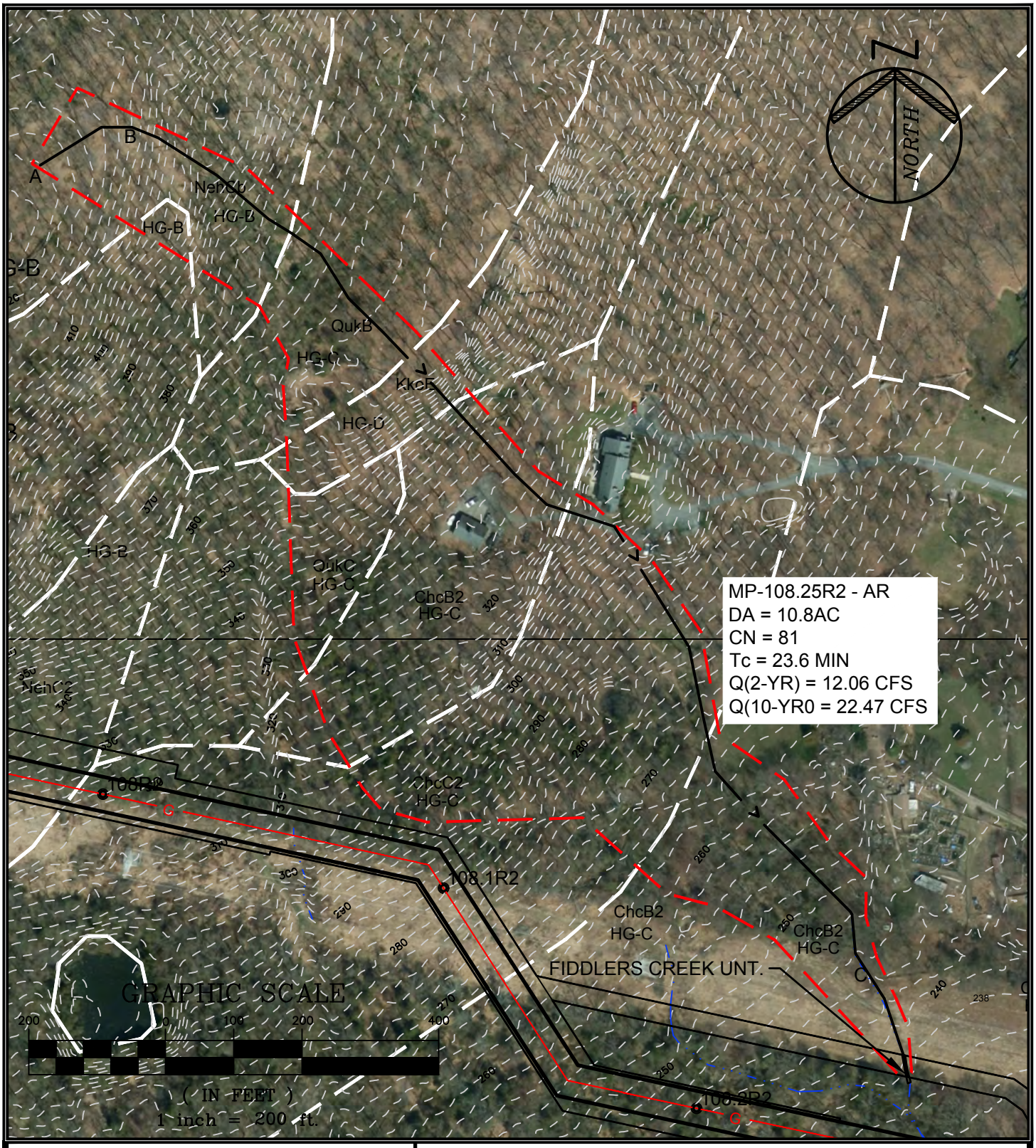
Critical Slope		0.05160	ft/ft
Velocity		2.60	ft/s
Velocity Head		0.10	ft
Specific Energy		0.66	ft
Froude Number		0.98	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.56	ft
Critical Depth	0.55	ft
Channel Slope	0.04900	ft/ft
Critical Slope	0.05160	ft/ft



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CERTIFICATE OF AUTHORIZATION NO. 24GA28032700

PROJECT TITLE

PENNEAST PIPELINE

HUNTERDON AND MERCER COUNTY, NJ

SHEET TITLE

STREAM CROSSING DRAINAGE AREA MP 108.25R2-AR

PROJ. NO.:	05516.0001	DRN. BY:	JPS	SCALE:	1"=200'
DATE:	05/23/19	CK'D BY:	WS		

FILE NAME: P:\05516\0001\DWGs\CAD\C-Civil\Plotdwgs\Drainage Area Maps\055160001-Stream_DA_MP100.8-114-WAL.dwg\MP 108.26AR LAST EDIT: 06/20/2019 - 11:15:55 AM LOGIN: IKuzmina@

PROJECT:	PennEast	JOB NO. 5516.0001	
		SHEET	DATE:4/24/2019
		BY:	IK
SUBJECT:	Tc Calculations	CHK'D	

Time of Concentration calculations with the application of the SCS TR-55 methodology.

Watershed or Subarea Designation: DA 108.25AR2

Area 10.8 AC

SHEET FLOW

Segment ID		A-B				
Surface Description (Table 3-1)		WOODS				
Manning's Coefficient, n (Table 3-1)		0.400				
Flow Length, L (total <= 150)	(ft)	150				
Two Year Rainfall, P	(in)	3.4				
Land Slope, s	(ft/ft)	0.067				
Computed Tt = 0.007 (nL)^0.8 / P^0.5*s^0.4	(hrs)	0.297				0.297

SHALLOW CONCENTRATED FLOW

Segment ID		B-C				
Surface Description (paved or unpaved)		UNPAVED				
Flow Length, L	(ft)	1618				
Watercourse slope, s	(ft/ft)	0.100				
Average Velocity, V (Figure 3-1)	(ft/s)	5.4				
Computed Tt = L / 3600V	(hrs)	0.083				0.083

CHANNEL FLOW

Segment ID		C-D				
Cross sectional Area, a	(sf)	6.90				
Wetted Perimeter, Pw	(ft)	9.70				
Hydraulic Radius, r =a/Pw	(ft)	0.711				
Channel Slope (ft/ft)	(ft/ft)	0.039				
Manning's Roughness Coefficient, n		0.045				
Velocity, V = 1.49r^(2/3)s^0.5 / n	(ft/s)	5.21				
Flow Length, L	(ft)	255				
Computed Tt = L / 3600V	(hrs)	0.014				0.014

Watershed or subarea Tc	0.394	hrs.
	23.6	min.

Use minimum Tc of 10 minutes

Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 05 / 23 / 2019

Hyd. No. 97

MP-108.14R2 AR

Hydrograph type	= SCS Runoff	Peak discharge	= 12.06 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.30 hrs
Time interval	= 6 min	Hyd. volume	= 59,448 cuft
Drainage area	= 10.800 ac	Curve number	= 81.000
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 23.6 min
Total precip.	= 3.26 in	Distribution	= Custom
Storm duration	= C:\Users\IKuzmina\AppData\Local\Autodesk\C3D2019\enu\HHApps\Hydrograph		

Hydrograph Discharge Table

(Printed values >= 1.00% of Qp.)

Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)
10.20	0.131	12.00	4.230	13.80	1.432	15.60	0.723
10.30	0.152	12.10	7.194	13.90	1.343	15.70	0.711
10.40	0.174	12.20	10.13	14.00	1.275	15.80	0.702
10.50	0.197	12.30	12.06	14.10	1.223	15.90	0.692
10.60	0.224	12.40	11.33	14.20	1.182	16.00	0.682
10.70	0.257	12.50	9.920	14.30	1.145	16.10	0.672
10.80	0.298	12.60	8.082	14.40	1.109	16.20	0.662
10.90	0.349	12.70	6.138	14.50	1.072	16.30	0.652
11.00	0.409	12.80	4.394	14.60	1.035	16.40	0.643
11.10	0.482	12.90	3.635	14.70	0.998	16.50	0.632
11.20	0.571	13.00	3.119	14.80	0.960	16.60	0.622
11.30	0.681	13.10	2.740	14.90	0.922	16.70	0.612
11.40	0.813	13.20	2.433	15.00	0.884	16.80	0.602
11.50	0.964	13.30	2.213	15.10	0.846	16.90	0.592
11.60	1.196	13.40	2.016	15.20	0.810	17.00	0.582
11.70	1.516	13.50	1.842	15.30	0.779	17.10	0.572
11.80	2.020	13.60	1.684	15.40	0.755	17.20	0.562
11.90	2.770	13.70	1.547	15.50	0.736	17.30	0.551

Continues on next page...

Worksheet for MP-108.25R2_STA0+16_2YR_BRIDGE

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.04800	ft/ft
Discharge	12.06	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	238.00
0+44	238.00
0+48	237.70
0+50	236.80
0+52	237.45
0+57	238.00
0+65	238.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 238.00)	(0+65, 238.00)	0.045

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	1.04	ft
Elevation Range	236.80 to 238.00 ft	
Flow Area	3.34	ft²
Wetted Perimeter	9.50	ft
Hydraulic Radius	0.35	ft
Top Width	9.18	ft

Worksheet for MP-108.14R2_STA0+16_2YR_BRIDGE

Results

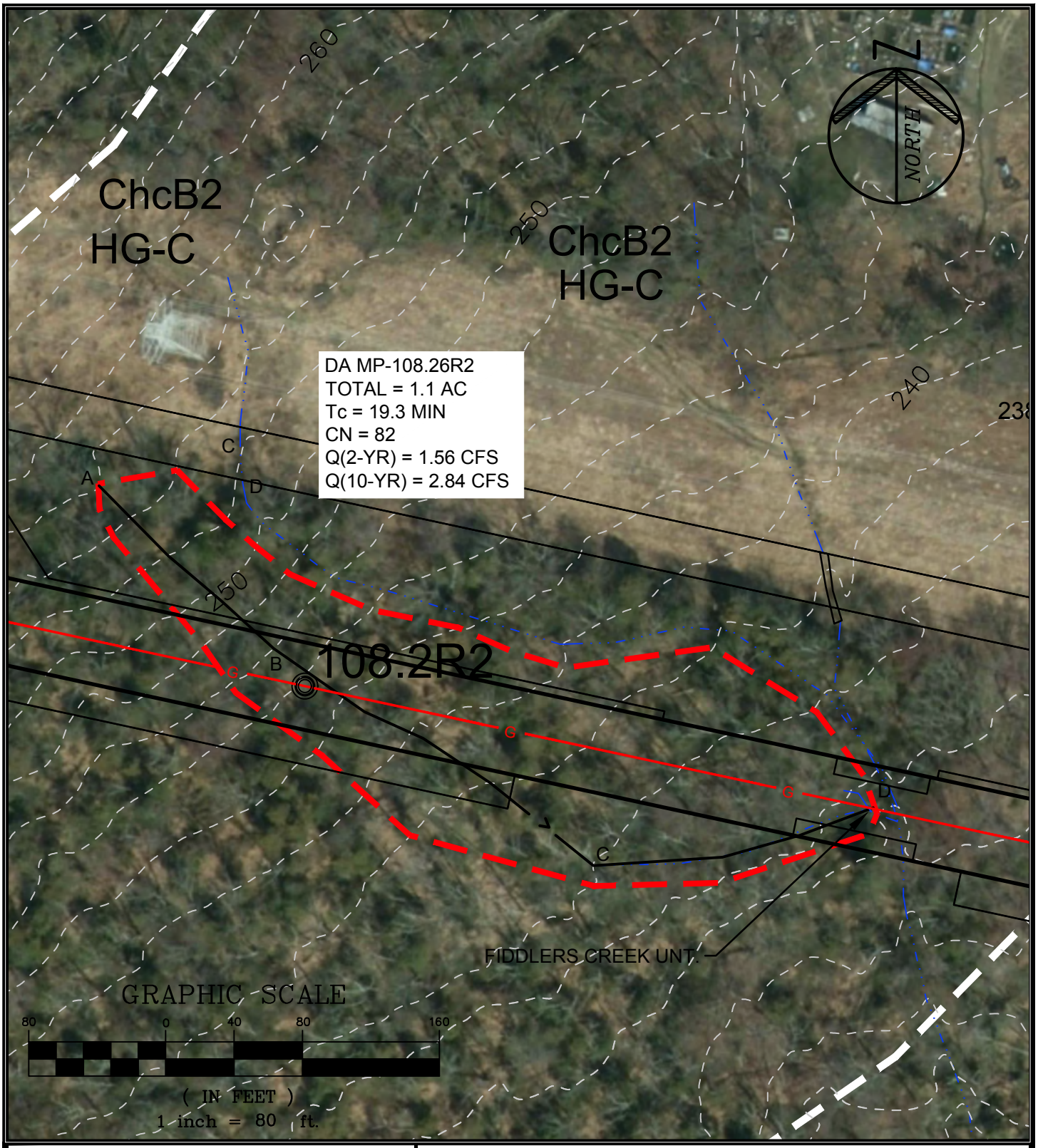
Normal Depth		1.04	ft
Critical Depth		1.06	ft
Critical Slope		0.04310	ft/ft
Velocity		3.61	ft/s
Velocity Head		0.20	ft
Specific Energy		1.25	ft
Froude Number		1.05	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.04	ft
Critical Depth	1.06	ft
Channel Slope	0.04800	ft/ft
Critical Slope	0.04310	ft/ft



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CERTIFICATE OF AUTHORIZATION NO. 24GA28032700

PROJECT TITLE

PENNEAST PIPELINE

HUNTERDON AND MERCER COUNTY, NJ

SHEET TITLE

STREAM CROSSING DRAINAGE AREA MP 108.26R2

PROJ. NO.:	05516.0001	DRN. BY:	JPS	SCALE:	1"=80'
DATE:	05/23/19	CK'D BY:	WS		

FILE NAME: P:\05516\0001\DWGs\CAD\C-Civil\Plotdwgs\Drainage Area Maps\055160001-Stream_DA_MP100.8-114-WAL.dwg\MP 108.26R LAST EDIT: 06/20/2019 - 11:23:45 AM LOGIN: IKuzmina@

PROJECT:	PennEast	JOB NO. 5516.0001	
		SHEET	DATE:4/24/2019
		BY:	IK
SUBJECT:	Tc Calculations	CHK'D	

Time of Concentration calculations with the application of the SCS TR-55 methodology.

Watershed or Subarea Designation: DA 108.26R2

Area 1.1 AC

SHEET FLOW

Segment ID		A-B			
Surface Description (Table 3-1)		WOODS			
Manning's Coefficient, n (Table 3-1)		0.400			
Flow Length, L (total <= 150)	(ft)	150			
Two Year Rainfall, P	(in)	3.4			
Land Slope, s	(ft/ft)	0.073			
Computed Tt = 0.007 (nL)^0.8 / P^0.5*s^0.4	(hrs)	0.287			0.287

SHALLOW CONCENTRATED FLOW

Segment ID		B-C			
Surface Description (paved or unpaved)		UNPAVED			
Flow Length, L	(ft)	216			
Watercourse slope, s	(ft/ft)	0.042			
Average Velocity, V (Figure 3-1)	(ft/s)	3.2			
Computed Tt = L / 3600V	(hrs)	0.019			0.019

CHANNEL FLOW

Segment ID		C-D			
Cross sectional Area, a	(sf)	3.80			
Wetted Perimeter, Pw	(ft)	5.78			
Hydraulic Radius, r =a/Pw	(ft)	0.657			
Channel Slope (ft/ft)	(ft/ft)	0.015			
Manning's Roughness Coefficient, n		0.045			
Velocity, V = 1.49r^(2/3)s^0.5 / n	(ft/s)	3.07			
Flow Length, L	(ft)	171			
Computed Tt = L / 3600V	(hrs)	0.015			0.015

Watershed or subarea Tc	0.321	hrs.
	19.3	min.

Use minimum Tc of 10 minutes

Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 05 / 23 / 2019

Hyd. No. 83

MP-108.26R2

Hydrograph type	= SCS Runoff	Peak discharge	= 1.559 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.20 hrs
Time interval	= 6 min	Hyd. volume	= 5,939 cuft
Drainage area	= 1.100 ac	Curve number	= 82.000
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 19.3 min
Total precip.	= 3.26 in	Distribution	= Custom
Storm duration	= C:\Users\IKuzmina\AppData\Local\Autodesk\C3D2019\enu\HHApps\Hydrograp	Storm frequency	= 24

Hydrograph Discharge Table

(Printed values >= 1.00% of Qp.)

Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)
10.10	0.017	11.90	0.407	13.70	0.135	15.50	0.070
10.20	0.019	12.00	0.659	13.80	0.127	15.60	0.069
10.30	0.022	12.10	1.208	13.90	0.122	15.70	0.068
10.40	0.024	12.20	1.559	14.00	0.118	15.80	0.067
10.50	0.027	12.30	1.301	14.10	0.115	15.90	0.066
10.60	0.030	12.40	0.929	14.20	0.111	16.00	0.065
10.70	0.035	12.50	0.595	14.30	0.108	16.10	0.065
10.80	0.040	12.60	0.478	14.40	0.104	16.20	0.064
10.90	0.047	12.70	0.380	14.50	0.100	16.30	0.063
11.00	0.055	12.80	0.321	14.60	0.097	16.40	0.062
11.10	0.064	12.90	0.279	14.70	0.093	16.50	0.061
11.20	0.076	13.00	0.256	14.80	0.089	16.60	0.060
11.30	0.091	13.10	0.231	14.90	0.085	16.70	0.059
11.40	0.107	13.20	0.208	15.00	0.082	16.80	0.058
11.50	0.125	13.30	0.189	15.10	0.078	16.90	0.057
11.60	0.160	13.40	0.174	15.20	0.075	17.00	0.056
11.70	0.214	13.50	0.160	15.30	0.073	17.10	0.055
11.80	0.285	13.60	0.147	15.40	0.071	17.20	0.054

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Worksheet for MP-108.26MR2_STA0+14_PIPE_2YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.08600	ft/ft
Discharge	1.60	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	234.00
0+21	234.00
0+48	232.90
0+50	230.53
0+53	232.00
1+00	234.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 234.00)	(1+00, 234.00)	0.045

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.59	ft
Elevation Range	230.53 to 234.00 ft	
Flow Area	0.44	ft²
Wetted Perimeter	1.96	ft
Hydraulic Radius	0.23	ft
Top Width	1.52	ft
Normal Depth	0.59	ft

Worksheet for MP-108.26MR2_STA0+14_PIPE_2YR

Results

Critical Depth		0.62	ft
Critical Slope		0.06116	ft/ft
Velocity		3.60	ft/s
Velocity Head		0.20	ft
Specific Energy		0.79	ft
Froude Number		1.17	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.59	ft
Critical Depth	0.62	ft
Channel Slope	0.08600	ft/ft
Critical Slope	0.06116	ft/ft

Worksheet for MP-108.26MR2_STA0+24_BRIDGE_2YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.09247	ft/ft
Discharge	1.60	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	236.00
0+43	234.00
0+47	233.50
0+50	232.61
0+52	233.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 236.00)	(0+52, 233.00)	0.045

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.34	ft
Elevation Range	232.61 to 236.00 ft	
Flow Area	0.53	ft²
Wetted Perimeter	3.21	ft
Hydraulic Radius	0.16	ft
Top Width	3.13	ft
Normal Depth	0.34	ft
Critical Depth	0.38	ft

Worksheet for MP-108.26MR2_STA0+24_BRIDGE_2YR

Results

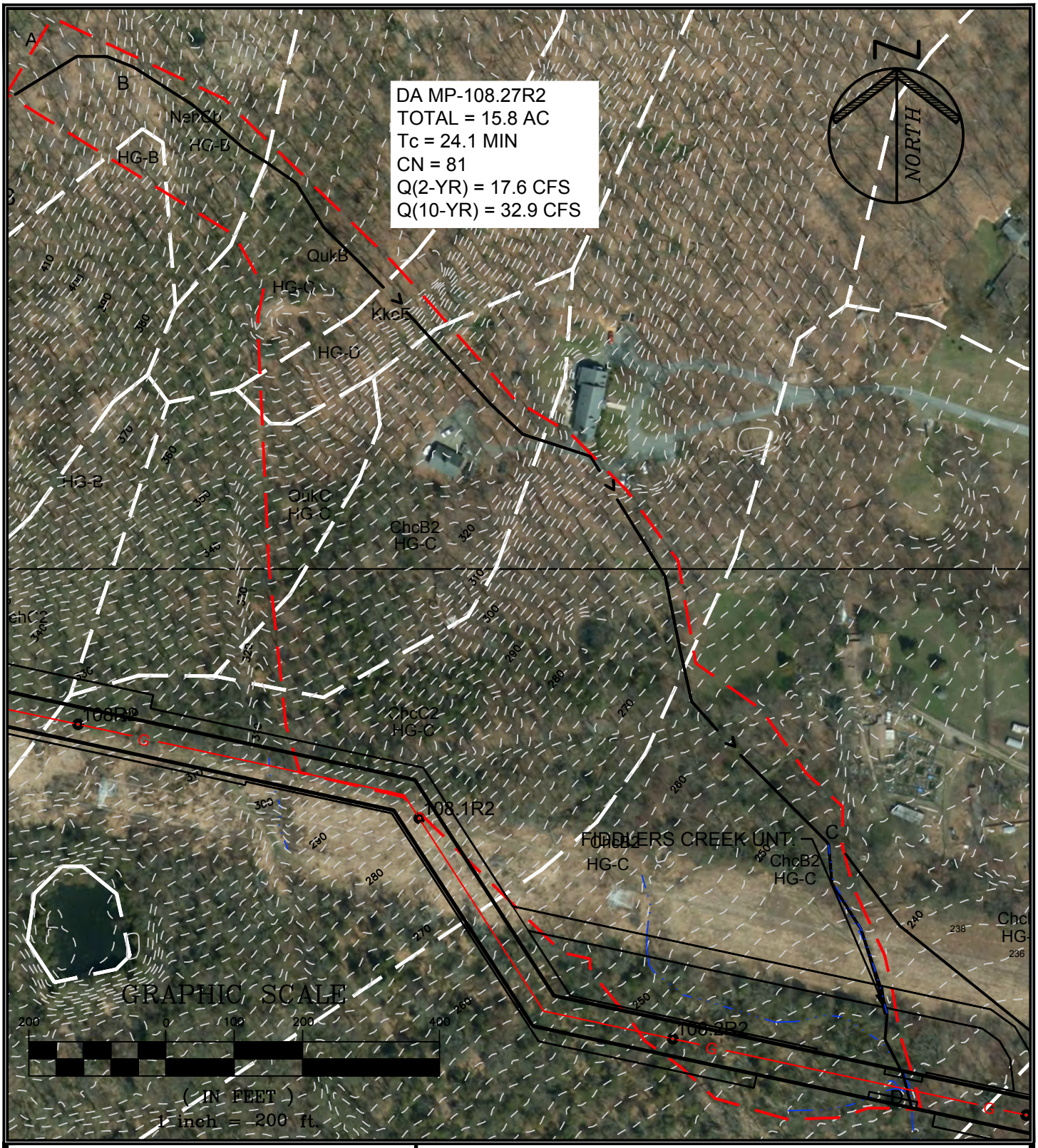
Critical Slope		0.05333	ft/ft
Velocity		3.02	ft/s
Velocity Head		0.14	ft
Specific Energy		0.48	ft
Froude Number		1.30	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.34	ft
Critical Depth	0.38	ft
Channel Slope	0.09247	ft/ft
Critical Slope	0.05333	ft/ft



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CERTIFICATE OF AUTHORIZATION NO. 24GA28032700

PROJECT TITLE

PENNEAST PIPELINE

HUNTERDON AND MERCER COUNTY, NJ

SHEET TITLE

STREAM CROSSING DRAINAGE AREA MP 108.27R2

PROJ. NO.: 05516.0001	DRN. BY: JPS	SCALE: 1"=200'
DATE: 05/23/19	CK'D BY: WS	

FILE NAME: P:\05516\0001\DWGs\CAD\C-Civil\Plotdwgs\Drainage Area Maps\055160001-Stream_DA_MP100.8-114-WAL.dwg\MP 108.27R LAST EDIT: 06/19/2019 - 05:52:38 PM LOGIN: IKuzmina@

Worksheet 2: Runoff curve number and runoff (Approximated)

Project	By	Date
PennEast	IK	24-Apr-19
Location	**Checked**	**Date**
Hunterdon County, NJ		

Check one: ☐ Present ☒ Developed — MP 108.27R2

1. Runoff curve number

Soil name and hydrologic group (appendix A)	Cover Description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN[1] Table 2-2	CN[1] Figure 2-3	CN[1] Figure 2-4	Area ☒ acres / ☐ mi² / ☐ %	Product of CN x Area
Type C	FARMSTEADS	82			13.92	1,141.44
Type B	FARMSTEADS	74			1.29	95.46
Type D	FARMSTEADS	86			0.59	50.74
				Totals ➡	15.80	1,287.64

1. Use only one CN source per line

CN (weighted) = tot.prod. / tot. area = 1,287.64 / 15.80 = 81.5 ; Use CN ➡ **81**

2. Runoff

		Storm #1	Storm #2	Storm #3
Frequency……	yr			
Rainfall, P (24-hour)…….	in			
Runoff, Q……	in			

Use P and CN with table 2-1, figure 2-1, or equation 2-3 abd 2-4

PROJECT:	PennEast	JOB NO. 5516.0001	
		SHEET	DATE:4/24/2019
		BY:	IK
SUBJECT:	Tc Calculations	CHK'D	

Time of Concentration calculations with the application of the SCS TR-55 methodology.

Watershed or Subarea Designation: DA 108.27R2

Area 15.8 AC

SHEET FLOW

Segment ID		A-B				
Surface Description (Table 3-1)		WOODS				
Manning's Coefficient, n (Table 3-1)		0.400				
Flow Length, L (total <= 150)	(ft)	150				
Two Year Rainfall, P	(in)	3.4				
Land Slope, s	(ft/ft)	0.067				
Computed Tt = 0.007 (nL)^0.8 / P^0.5*s^0.4	(hrs)	0.297				0.297

SHALLOW CONCENTRATED FLOW

Segment ID		B-C				
Surface Description (paved or unpaved)		UNPAVED				
Flow Length, L	(ft)	1618				
Watercourse slope, s	(ft/ft)	0.100				
Average Velocity, V (Figure 3-1)	(ft/s)	5.4				
Computed Tt = L / 3600V	(hrs)	0.083				0.083

CHANNEL FLOW

Segment ID		C-D				
Cross sectional Area, a	(sf)	6.90				
Wetted Perimeter, Pw	(ft)	9.70				
Hydraulic Radius, r =a/Pw	(ft)	0.711				
Channel Slope (ft/ft)	(ft/ft)	0.039				
Manning's Roughness Coefficient, n		0.045				
Velocity, V = 1.49r^(2/3)s^0.5 / n	(ft/s)	5.21				
Flow Length, L	(ft)	413				
Computed Tt = L / 3600V	(hrs)	0.022				0.022

Watershed or subarea Tc	0.402	hrs.
	24.1	min.

Use minimum Tc of 10 minutes

Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 05 / 23 / 2019

Hyd. No. 84

MP-108.27R2

Hydrograph type	= SCS Runoff	Peak discharge	= 17.64 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.30 hrs
Time interval	= 6 min	Hyd. volume	= 86,970 cuft
Drainage area	= 15.800 ac	Curve number	= 81.000
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 24.1 min
Total precip.	= 3.26 in	Distribution	= Custom
Storm duration	= C:\Users\IKuzmina\AppData\Local\Autodesk\C3D 2019\enu\HHApps\Hydrograp	Storm frequency	= 24 hrs

Hydrograph Discharge Table

(Printed values >= 1.00% of Qp.)

Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)
10.20	0.192	12.00	6.189	13.80	2.094	15.60	1.057
10.30	0.222	12.10	10.52	13.90	1.964	15.70	1.041
10.40	0.254	12.20	14.83	14.00	1.865	15.80	1.026
10.50	0.288	12.30	17.64	14.10	1.789	15.90	1.012
10.60	0.327	12.40	16.57	14.20	1.729	16.00	0.997
10.70	0.375	12.50	14.51	14.30	1.676	16.10	0.983
10.80	0.436	12.60	11.82	14.40	1.622	16.20	0.969
10.90	0.511	12.70	8.979	14.50	1.569	16.30	0.954
11.00	0.599	12.80	6.428	14.60	1.514	16.40	0.940
11.10	0.705	12.90	5.318	14.70	1.460	16.50	0.925
11.20	0.836	13.00	4.563	14.80	1.405	16.60	0.910
11.30	0.997	13.10	4.009	14.90	1.349	16.70	0.895
11.40	1.190	13.20	3.560	15.00	1.294	16.80	0.881
11.50	1.410	13.30	3.237	15.10	1.238	16.90	0.866
11.60	1.749	13.40	2.950	15.20	1.185	17.00	0.851
11.70	2.218	13.50	2.695	15.30	1.140	17.10	0.836
11.80	2.956	13.60	2.464	15.40	1.104	17.20	0.821
11.90	4.053	13.70	2.263	15.50	1.077	17.30	0.806

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Worksheet for MP-108.27MR2_STA0+25_PIPE_2YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.09130	ft/ft
Discharge	17.60	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	234.00
0+05	234.00
0+45	231.90
0+51	229.69
0+54	233.30
1+00	232.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 234.00)	(1+00, 232.00)	0.050

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	1.26	ft
Elevation Range	229.69 to 234.00 ft	
Flow Area	2.97	ft²
Wetted Perimeter	5.53	ft
Hydraulic Radius	0.54	ft
Top Width	4.70	ft
Normal Depth	1.26	ft

Worksheet for MP-108.27MR2_STA0+25_PIPE_2YR

Results

Critical Depth	1.41	ft
Critical Slope	0.05078	ft/ft
Velocity	5.93	ft/s
Velocity Head	0.55	ft
Specific Energy	1.81	ft
Froude Number	1.32	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.26	ft
Critical Depth	1.41	ft
Channel Slope	0.09130	ft/ft
Critical Slope	0.05078	ft/ft

Worksheet for MP-108.27MR2_STA0+25_PIPE_2YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.09130	ft/ft
Discharge	17.60	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	234.00
0+05	234.00
0+45	231.90
0+51	229.69
0+54	233.30
1+00	232.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 234.00)	(1+00, 232.00)	0.050

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	1.26	ft
Elevation Range	229.69 to 234.00 ft	
Flow Area	2.97	ft²
Wetted Perimeter	5.53	ft
Hydraulic Radius	0.54	ft
Top Width	4.70	ft
Normal Depth	1.26	ft

Worksheet for MP-108.27MR2_STA0+25_PIPE_2YR

Results

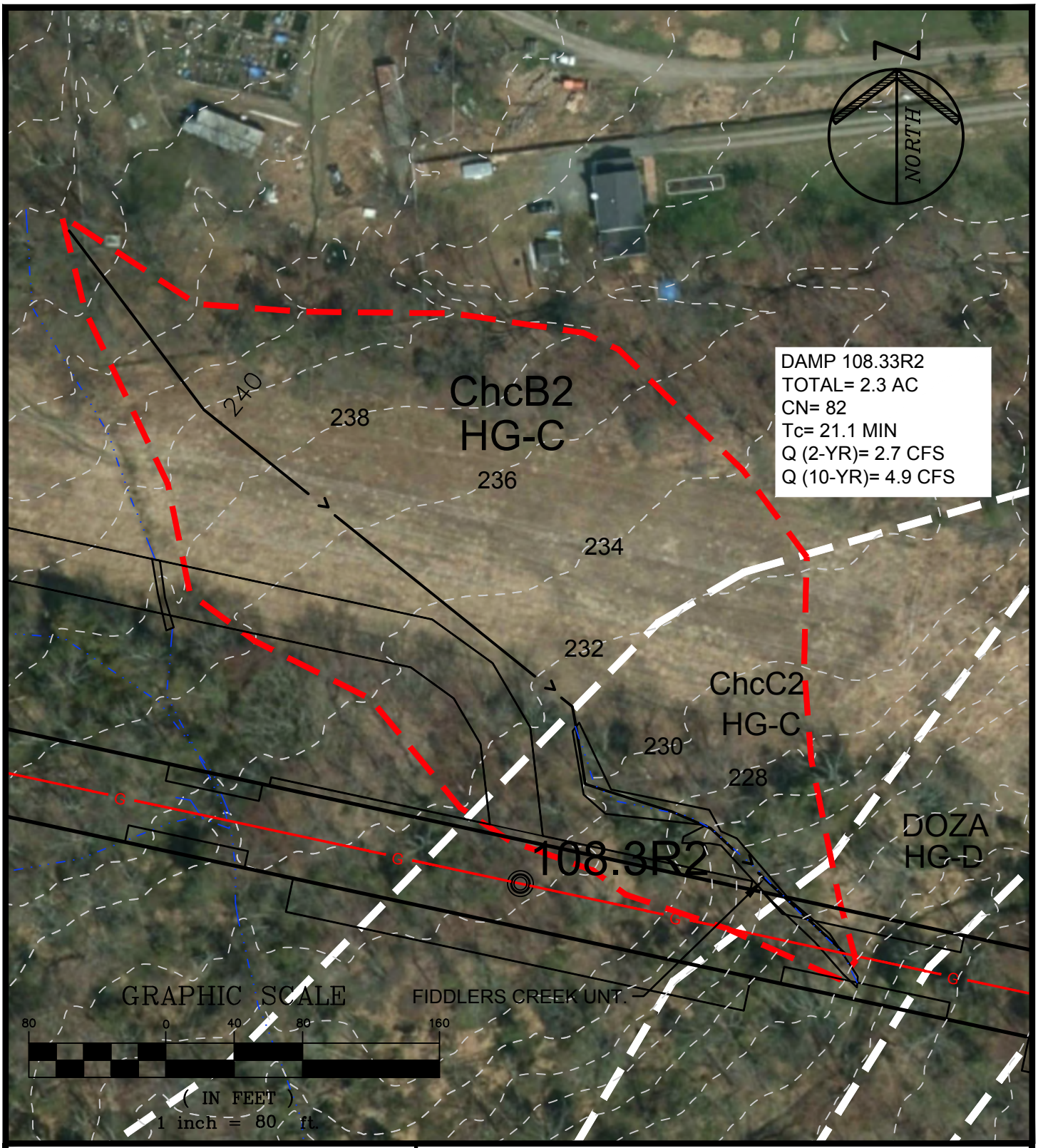
Critical Depth	1.41	ft
Critical Slope	0.05078	ft/ft
Velocity	5.93	ft/s
Velocity Head	0.55	ft
Specific Energy	1.81	ft
Froude Number	1.32	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.26	ft
Critical Depth	1.41	ft
Channel Slope	0.09130	ft/ft
Critical Slope	0.05078	ft/ft



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CERTIFICATE OF AUTHORIZATION NO. 24GA28032700

PROJECT TITLE

PENNEAST PIPELINE

HUNTERDON AND MERCER COUNTY, NJ

SHEET TITLE

STREAM CROSSING DRAINAGE AREA MP 108.33R2

PROJ. NO.: 05516.0001	DRN. BY: JPS	SCALE: 1"=80'
DATE: 05/23/19	CK'D BY: WS	

FILE NAME: P:\05516\0001\DWGs\CAD\C-Civil\Plotdwgs\Drainage Area Maps\055160001-Stream_DA_MP100.8-114-WAL.dwg\MP 108.33R2 LAST EDIT: 06/19/2019 - 05:07:49 PM LOGIN: lKuzmina@

Worksheet 2: Runoff curve number and runoff (Approximated)

Project	By	Date
PennEast	JM	21-May-19
Location	**Checked**	**Date**
Hunterdon County, NJ		

Check one: ☐ Present ☒ Developed | MP 108.33R2

1. Runoff curve number

Soil name and hydrologic group (appendix A)	Cover Description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN[1] Table 2-2	CN[1] Figure 2-3	CN[1] Figure 2-4	Area ☒ acres ☐ mi² ☐ %	Product of CN x Area
Type C	Farmstead, Good Condition	82			2.25	184.17
Type D	Farmstead, Good Condition	86			0.05	4.30
1. Use only one CN source per line				Totals ➡	2.30	188.47

CN (weighted) = tot.prod. / tot. area = 188.47 / 2.30 = 81.9 ; Use CN ➡ **82**

2. Runoff

		Storm #1	Storm #2	Storm #3
Frequency……	yr			
Rainfall, P (24-hour)…….	in			
Runoff, Q……	in			

Use P and CN with table 2-1, figure 2-1, or equation 2-3 abd 2-4

PROJECT:	PennEast	JOB NO. 5516.0001	
		SHEET	DATE:5/21/2019
		BY:	JM
SUBJECT:	Tc Calculations	CHK'D	

Time of Concentration calculations with the application of the SCS TR-55 methodology.

Watershed or Subarea Designation: DA 108.33R2

Area 2.3 AC

SHEET FLOW

Segment ID		A-B				
Surface Description (Table 3-1)		WOODS				
Manning's Coefficient, n (Table 3-1)		0.400				
Flow Length, L (total <= 150)	(ft)	150				
Two Year Rainfall, P	(in)	3.4				
Land Slope, s	(ft/ft)	0.053				
Computed Tt = 0.007 (nL)^0.8 / P^0.5*s^0.4	(hrs)	0.326				0.326

SHALLOW CONCENTRATED FLOW

Segment ID		B-C				
Surface Description (paved or unpaved)		UNPAVED				
Flow Length, L	(ft)	273				
Watercourse slope, s	(ft/ft)	0.036				
Average Velocity, V (Figure 3-1)	(ft/s)	3.0				
Computed Tt = L / 3600V	(hrs)	0.025				0.025

CHANNEL FLOW

Segment ID		C-D				
Cross sectional Area, a	(sf)	6.00				
Wetted Perimeter, Pw	(ft)	8.47				
Hydraulic Radius, r =a/Pw	(ft)	0.708				
Channel Slope (ft/ft)	(ft/ft)	0.500				
Manning's Roughness Coefficient, n		0.400				
Velocity, V = 1.49r^(2/3)s^0.5 / n	(ft/s)	2.09				
Flow Length, L	(ft)	232				
Computed Tt = L / 3600V	(hrs)	b				0.000

Watershed or subarea Tc	0.351	hrs.
	21.1	min.

Use minimum Tc of 10 minutes

Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 05 / 23 / 2019

Hyd. No. 92

MP-108.33

Hydrograph type	= SCS Runoff	Peak discharge	= 2.696 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.30 hrs
Time interval	= 6 min	Hyd. volume	= 13,245 cuft
Drainage area	= 2.300 ac	Curve number	= 82.000
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 21.1 min
Total precip.	= 3.26 in	Distribution	= Custom
Storm duration	= C:\Users\IKuzmina\AppData\Local\Autodesk\C3D 2019\enu\HHApps\Hydrograp	Storm frequency	= 24

Hydrograph Discharge Table

(Printed values >= 1.00% of Qp.)

Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)
10.00	0.028	11.80	0.470	13.60	0.369	15.40	0.165
10.10	0.033	11.90	0.639	13.70	0.339	15.50	0.161
10.20	0.037	12.00	0.966	13.80	0.314	15.60	0.158
10.30	0.042	12.10	1.626	13.90	0.294	15.70	0.155
10.40	0.047	12.20	2.276	14.00	0.279	15.80	0.153
10.50	0.052	12.30	2.696	14.10	0.268	15.90	0.151
10.60	0.058	12.40	2.524	14.20	0.259	16.00	0.149
10.70	0.066	12.50	2.204	14.30	0.251	16.10	0.147
10.80	0.076	12.60	1.791	14.40	0.243	16.20	0.145
10.90	0.088	12.70	1.356	14.50	0.235	16.30	0.142
11.00	0.102	12.80	0.968	14.60	0.226	16.40	0.140
11.10	0.119	12.90	0.800	14.70	0.218	16.50	0.138
11.20	0.139	13.00	0.686	14.80	0.210	16.60	0.136
11.30	0.165	13.10	0.602	14.90	0.202	16.70	0.134
11.40	0.195	13.20	0.534	15.00	0.193	16.80	0.131
11.50	0.229	13.30	0.486	15.10	0.185	16.90	0.129
11.60	0.282	13.40	0.442	15.20	0.177	17.00	0.127
11.70	0.355	13.50	0.404	15.30	0.170	17.10	0.125

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Worksheet for MP-108.33MR2_STA2+15_PIPE_2YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.08900	ft/ft
Discharge	2.70	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	220.00
0+46	218.50
0+50	217.27
0+54	218.30
1+00	218.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 220.00)	(1+00, 218.00)	0.045

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.45	ft
Elevation Range	217.27 to 220.00 ft	
Flow Area	0.76	ft²
Wetted Perimeter	3.52	ft
Hydraulic Radius	0.22	ft
Top Width	3.41	ft
Normal Depth	0.45	ft
Critical Depth	0.50	ft

Worksheet for MP-108.33MR2_STA2+15_PIPE_2YR

Results

Critical Slope		0.04901	ft/ft
Velocity		3.55	ft/s
Velocity Head		0.20	ft
Specific Energy		0.64	ft
Froude Number		1.32	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.45	ft
Critical Depth	0.50	ft
Channel Slope	0.08900	ft/ft
Critical Slope	0.04901	ft/ft

Worksheet for MP-108.33MR2_STA2+31_BRIDGE_2YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.08900	ft/ft
Discharge	2.70	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	220.00
0+46	218.70
0+50	217.27
0+54	218.30
1+00	218.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 220.00)	(1+00, 218.00)	0.045

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.46	ft
Elevation Range	217.27 to 220.00 ft	
Flow Area	0.75	ft²
Wetted Perimeter	3.41	ft
Hydraulic Radius	0.22	ft
Top Width	3.28	ft
Normal Depth	0.46	ft
Critical Depth	0.51	ft

Worksheet for MP-108.33MR2_STA2+31_BRIDGE_2YR

Results

Critical Slope		0.04894	ft/ft
Velocity		3.59	ft/s
Velocity Head		0.20	ft
Specific Energy		0.66	ft
Froude Number		1.32	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.46	ft
Critical Depth	0.51	ft
Channel Slope	0.08900	ft/ft
Critical Slope	0.04894	ft/ft

MP108.34R2

Region ID: NJ
Workspace ID: NJ20170811084456519000
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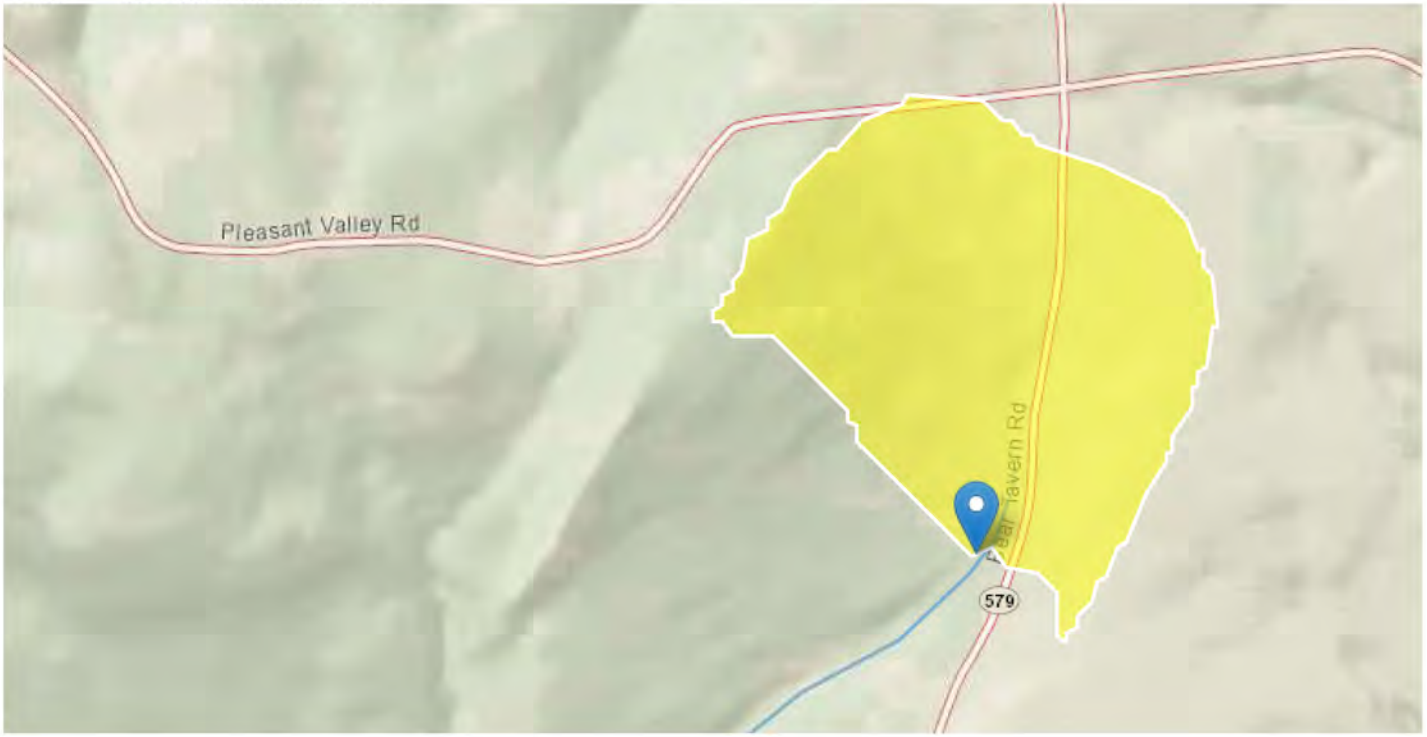

Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	0.24	square miles
STORAGE	Percentage of area of storage (lakes ponds reservoirs wetlands)	7.45	percent
CSL10_85	Change in elevation divided by length between points 10 and 85 percent of distance along main channel to basin divide - main channel method not known	146	feet per mi
POPDENS	Basin Population Density	190	persons per square mile

Peak-Flow Statistics Parameters [Peak Unglaciated Piedmont Region 2009 5167]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.24	square miles	0.25	779
STORAGE	Percent Storage	7.45	percent	0.23	32
CSL10_85	Stream Slope 10 and 85 Method	146	feet per mi	4.31	191
POPDENS	Basin Population Density	190	persons per square mile	83	11084

Peak-Flow Statistics Disclaimers [Peak Unglaciated Piedmont Region 2009 5167]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors

Peak-Flow Statistics Flow Report [Peak Unglaciated Piedmont Region 2009 5167]

Statistic	Value	Unit
2 Year Peak Flood	78.3	ft^3/s
5 Year Peak Flood	134	ft^3/s
10 Year Peak Flood	177	ft^3/s
25 Year Peak Flood	240	ft^3/s
50 Year Peak Flood	290	ft^3/s
100 Year Peak Flood	346	ft^3/s
500 Year Peak Flood	485	ft^3/s

Peak-Flow Statistics Citations

Watson, K.M.,and Schopp, R.D.,2009, Methodology for estimation of flood magnitude and frequency for New Jersey streams, U.S. Geological Survey Scientific Investigations Report 2009-5167, 51 p. (http://pubs.usgs.gov/sir/2009/5167/)

Worksheet for MP-108.34_STA0+74_PIPE_2YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.01200	ft/ft
Discharge	78.30	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	220.00
0+42	218.00
0+46	218.00
0+50	213.52
0+65	215.10
0+68	216.00
1+00	218.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 220.00)	(1+00, 218.00)	0.050

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	2.09	ft
Elevation Range	213.52 to 220.00 ft	
Flow Area	22.12	ft²
Wetted Perimeter	19.52	ft
Hydraulic Radius	1.13	ft
Top Width	18.42	ft

Worksheet for MP-108.34_STA0+74_PIPE_2YR

Results

Normal Depth		2.09	ft
Critical Depth		1.68	ft
Critical Slope		0.04068	ft/ft
Velocity		3.54	ft/s
Velocity Head		0.19	ft
Specific Energy		2.29	ft
Froude Number		0.57	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	2.09	ft
Critical Depth	1.68	ft
Channel Slope	0.01200	ft/ft
Critical Slope	0.04068	ft/ft

Worksheet for MP-108.34_STA0+84_BRIDGE_2YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.01200	ft/ft
Discharge	78.30	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	220.00
0+37	218.00
0+44	217.20
0+50	213.24
0+58	215.30
0+65	216.00
1+00	218.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 220.00)	(1+00, 218.00)	0.050

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	2.79	ft
Elevation Range	213.24 to 220.00 ft	
Flow Area	23.00	ft²
Wetted Perimeter	21.51	ft
Hydraulic Radius	1.07	ft
Top Width	20.42	ft

Worksheet for MP-108.34_STA0+84_BRIDGE_2YR

Results

Normal Depth		2.79	ft
Critical Depth		2.23	ft
Critical Slope		0.03944	ft/ft
Velocity		3.40	ft/s
Velocity Head		0.18	ft
Specific Energy		2.97	ft
Froude Number		0.57	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	2.79	ft
Critical Depth	2.23	ft
Channel Slope	0.01200	ft/ft
Critical Slope	0.03944	ft/ft

MP-108.74R2

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Workspace ID: NJ20190306202411960000
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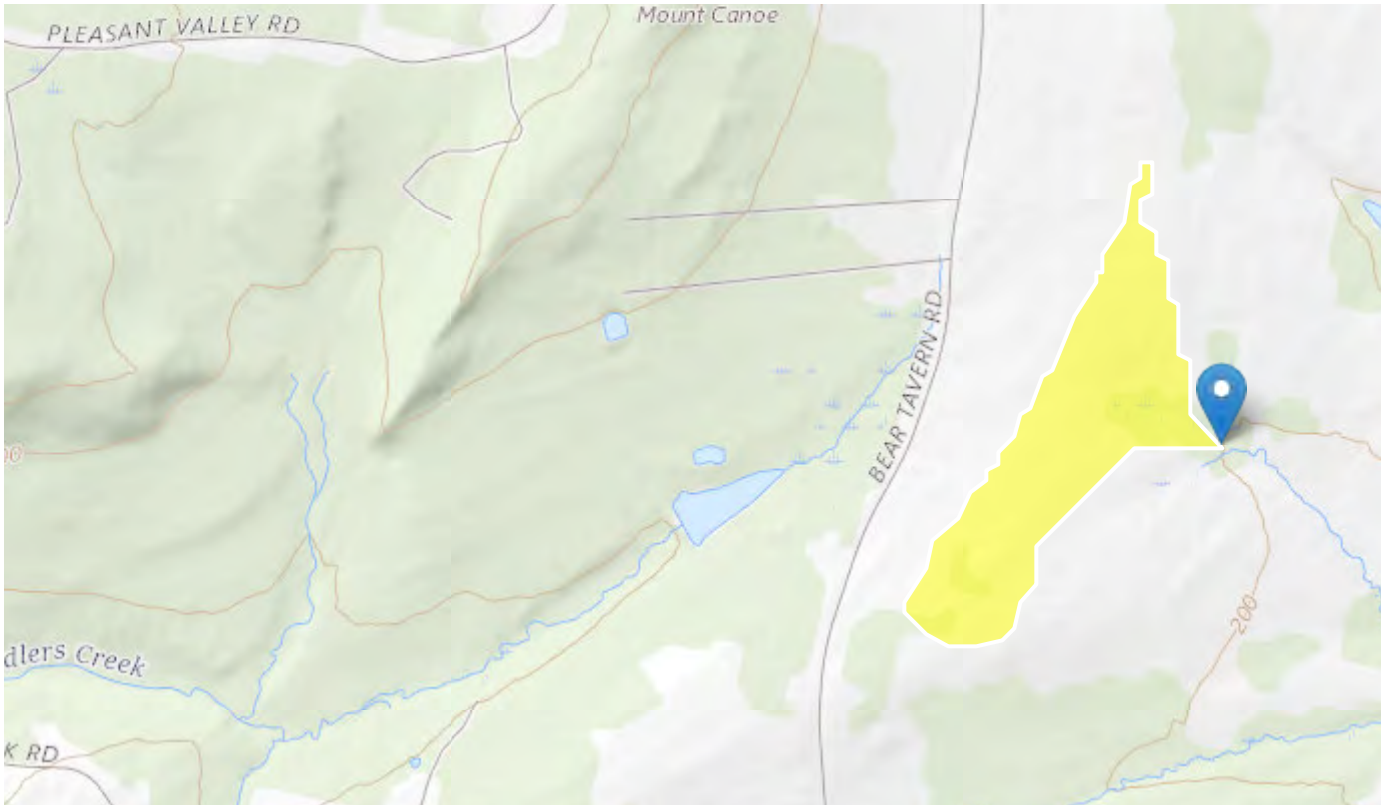
Time: 2019-03-06 15:24:25 -0500



Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	0.0622	square miles
STORAGE	Percentage of area of storage (lakes ponds reservoirs wetlands)	5.65	percent
CSL10_85	Change in elevation divided by length between points 10 and 85 percent of distance along main channel to basin divide - main channel method not known	131	feet per mi

Parameter Code	Parameter Description	Value	Unit
POPDENS	Basin Population Density	190	persons per square mile

Peak-Flow Statistics Parameters [Peak Unglaciated Piedmont Region 2009 5167]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.0622	square miles	0.25	779
STORAGE	Percent Storage	5.65	percent	0.23	32
CSL10_85	Stream Slope 10 and 85 Method	131	feet per mi	4.31	191
POPDENS	Basin Population Density	190	persons per square mile	83	11084

Peak-Flow Statistics Disclaimers [Peak Unglaciated Piedmont Region 2009 5167]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors

Peak-Flow Statistics Flow Report [Peak Unglaciated Piedmont Region 2009 5167]

Statistic	Value	Unit
2 Year Peak Flood	27.9	ft^3/s
5 Year Peak Flood	48.9	ft^3/s
10 Year Peak Flood	65.5	ft^3/s
25 Year Peak Flood	89.3	ft^3/s
50 Year Peak Flood	109	ft^3/s
100 Year Peak Flood	130	ft^3/s
500 Year Peak Flood	185	ft^3/s

Peak-Flow Statistics Citations

Worksheet for MP-108.74_STA0+92_PIPE_2YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.02600	ft/ft
Discharge	27.90	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	204.00
0+10	202.00
0+33	200.00
0+43	198.00
0+47	196.70
0+54	196.28
0+58	197.00
1+00	200.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 204.00)	(1+00, 200.00)	0.045

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.96	ft
Elevation Range	196.28 to 204.00 ft	
Flow Area	8.19	ft²
Wetted Perimeter	15.98	ft
Hydraulic Radius	0.51	ft

Worksheet for MP-108.74_STA0+92_PIPE_2YR

Results

Top Width		15.82	ft
Normal Depth		0.96	ft
Critical Depth		0.88	ft
Critical Slope		0.03803	ft/ft
Velocity		3.41	ft/s
Velocity Head		0.18	ft
Specific Energy		1.14	ft
Froude Number		0.84	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.96	ft
Critical Depth	0.88	ft
Channel Slope	0.02600	ft/ft
Critical Slope	0.03803	ft/ft

Worksheet for MP-108.74_STA1+08_BRIDGE_2YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.02600	ft/ft
Discharge	27.90	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	202.00
0+25	200.00
0+37	198.00
0+45	196.20
0+50	196.18
1+00	198.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 202.00)	(1+00, 198.00)	0.045

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.65	ft
Elevation Range	196.18 to 202.00 ft	
Flow Area	9.92	ft²
Wetted Perimeter	25.84	ft
Hydraulic Radius	0.38	ft
Top Width	25.76	ft
Normal Depth	0.65	ft

Worksheet for MP-108.74_STA1+08_BRIDGE_2YR

Results

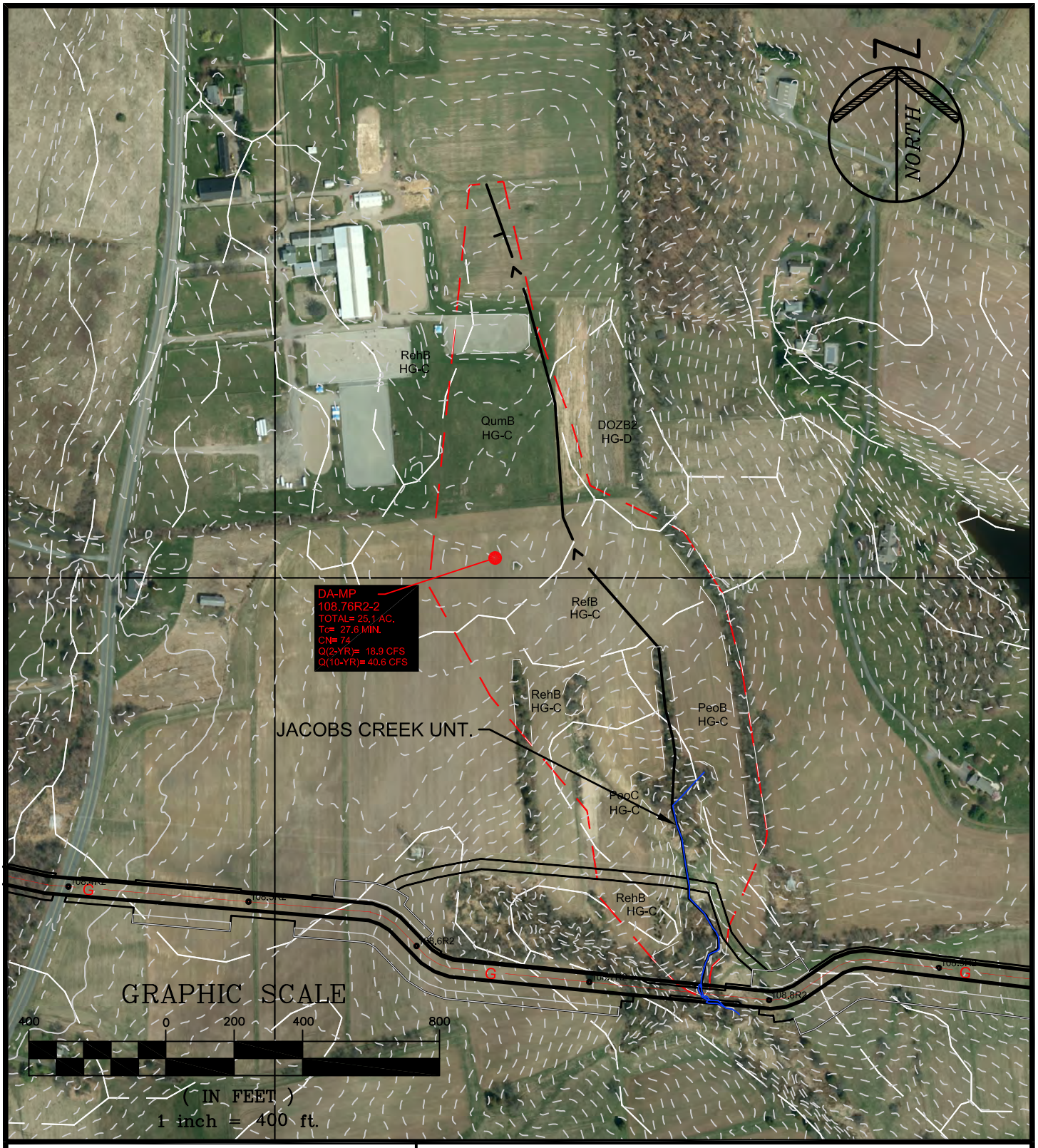
Critical Depth		0.58	ft
Critical Slope		0.04201	ft/ft
Velocity		2.81	ft/s
Velocity Head		0.12	ft
Specific Energy		0.77	ft
Froude Number		0.80	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.65	ft
Critical Depth	0.58	ft
Channel Slope	0.02600	ft/ft
Critical Slope	0.04201	ft/ft



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PAULUS, SOKOLOWSKI AND SARTOR, LLC.

1433 ROUTE 34
SUITE A4
WALL, NEW JERSEY 07727
PHONE: (848) 206-2626

CERTIFICATE OF AUTHORIZATION NO. 24GA28032700

PROJECT TITLE

PENNEAST PIPELINE

HUNTERDON AND MERCER COUNTY, NJ

SHEET TITLE

STREAM CROSSING DRAINAGE AREA MP 108.76R2

PROJ. NO.:	05516.0001	DRN. BY:	JPS	SCALE:	1"=400'
DATE:	05/23/19	CK'D BY:	WS		

Worksheet 2: Runoff curve number and runoff (Approximated)

Project	By	Date
PennEast	IK	27-Mar-19
Location	**Checked**	**Date**
Hunterdon County, NJ		

Check one: ☐ Present ☒ Developed | MP 108.76R2

1. Runoff curve number

Soil name and hydrologic group (appendix A)	Cover Description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN[1] Table 2-2	CN[1] Figure 2-3	CN[1] Figure 2-4	Area ☒ acres ☐ mi² ☐ %	Product of CN x Area
Type C	WOODS	70			3.90	273.00
Type C	PASTURE	74			20.21	1,495.54
Type C	IMPERVIOUS	98			0.56	54.88
Type D	PASTURE	80			0.43	34.40
1. Use only one CN source per line				Totals ➡	25.10	1,857.82

CN (weighted) = tot.prod. / tot. area = 1,857.82 / 25.10 = 74.0 ; Use CN ➡ **74**

2. Runoff

		Storm #1	Storm #2	Storm #3
Frequency……	yr			
Rainfall, P (24-hour)…….	in			
Runoff, Q……	in			

Use P and CN with table 2-1, figure 2-1, or equation 2-3 abd 2-4

PROJECT:	PennEast	JOB NO. 5516.0001	
		SHEET	DATE: 03/27/2019
		BY:	IK
SUBJECT:	Tc Calculations	CHK'D	

Time of Concentration calculations with the application of the SCS TR-55 methodology.

Watershed or Subarea Designation: DA 108.76R2

Area 25.1AC

SHEET FLOW

Segment ID		A-B				
Surface Description (Table 3-1)		GRASS				
Manning's Coefficient, n (Table 3-1)		0.150				
Flow Length, L (total <= 150)	(ft)	150				
Two Year Rainfall, P	(in)	3.4				
Land Slope, s	(ft/ft)	0.017				
Computed Tt = 0.007 (nL)^0.8 / P^0.5*s^0.4	(hrs)	0.235				0.235

SHALLOW CONCENTRATED FLOW

Segment ID		B-C				
Surface Description (paved or unpaved)		UNPAVED				
Flow Length, L	(ft)	1797				
Watercourse slope, s	(ft/ft)	0.027				
Average Velocity, V (Figure 3-1)	(ft/s)	2.5				
Computed Tt = L / 3600V	(hrs)	0.200				0.200

CHANNEL FLOW

Segment ID		C-D				
Cross sectional Area, a	(sf)	9.70				
Wetted Perimeter, Pw	(ft)	8.67				
Hydraulic Radius, r =a/Pw	(ft)	1.119				
Channel Slope (ft/ft)	(ft/ft)	0.036				
Manning's Roughness Coefficient, n		0.045				
Velocity, V = 1.49r^(2/3)s^0.5 / n	(ft/s)	6.77				
Flow Length, L	(ft)	620				
Computed Tt = L / 3600V	(hrs)	0.025				0.025

Watershed or subarea Tc	0.460	hrs.
	27.6	min.

Use minimum Tc of 10 minutes

Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 05 / 23 / 2019

Hyd. No. 65

MP-108.76R2

Hydrograph type	= SCS Runoff	Peak discharge	= 18.90 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.30 hrs
Time interval	= 6 min	Hyd. volume	= 98,150 cuft
Drainage area	= 25.100 ac	Curve number	= 74.000
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 27.6 min
Total precip.	= 3.26 in	Distribution	= Custom
Storm duration	= C:\Users\IKuzmina\AppData\Local\Autodesk\C3D2019\enu\HHApps\Hydrograp	Shape factor	= 484

Hydrograph Discharge Table

(Printed values >= 1.00% of Qp.)

Time -- Outflow (hrs cfs)		Time -- Outflow (hrs cfs)		Time -- Outflow (hrs cfs)		Time -- Outflow (hrs cfs)	
11.20	0.208	13.00	5.618	14.80	1.801	16.60	1.183
11.30	0.331	13.10	4.962	14.90	1.732	16.70	1.165
11.40	0.489	13.20	4.426	15.00	1.662	16.80	1.146
11.50	0.683	13.30	4.039	15.10	1.592	16.90	1.128
11.60	0.981	13.40	3.692	15.20	1.525	17.00	1.109
11.70	1.407	13.50	3.383	15.30	1.468	17.10	1.090
11.80	2.092	13.60	3.101	15.40	1.424	17.20	1.072
11.90	3.176	13.70	2.854	15.50	1.390	17.30	1.052
12.00	5.393	13.80	2.647	15.60	1.365	17.40	1.033
12.10	10.21	13.90	2.487	15.70	1.345	17.50	1.013
12.20	15.24	14.00	2.366	15.80	1.327	17.60	0.994
12.30	18.90	14.10	2.273	15.90	1.310	17.70	0.975
12.40	18.23	14.20	2.200	16.00	1.292	17.80	0.955
12.50	16.37	14.30	2.135	16.10	1.274	17.90	0.936
12.60	13.66	14.40	2.070	16.20	1.256	18.00	0.916
12.70	10.64	14.50	2.004	16.30	1.239	18.10	0.897
12.80	7.787	14.60	1.937	16.40	1.221	18.20	0.878
12.90	6.502	14.70	1.869	16.50	1.202	18.30	0.862

<<

Continues on next page...

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Worksheet for MP 108.76R2 STA0+20_2YR_PIPE

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.03600	ft/ft
Discharge	18.90	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	196.00
0+41	194.00
0+47	191.70
0+49	191.46
0+53	191.70
0+68	194.00
1+00	196.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 196.00)	(1+00, 196.00)	0.045

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.76	ft
Elevation Range	191.46 to 196.00 ft	
Flow Area	5.01	ft²
Wetted Perimeter	10.72	ft
Hydraulic Radius	0.47	ft
Top Width	10.55	ft

Worksheet for MP 108.76R2 STA0+20_2YR_PIPE

Results

Normal Depth		0.76	ft
Critical Depth		0.75	ft
Critical Slope		0.03881	ft/ft
Velocity		3.77	ft/s
Velocity Head		0.22	ft
Specific Energy		0.98	ft
Froude Number		0.97	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.76	ft
Critical Depth	0.75	ft
Channel Slope	0.03600	ft/ft
Critical Slope	0.03881	ft/ft

Worksheet for MP-108.76_STA0+34_BRIDGE_2YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.03600	ft/ft
Discharge	18.90	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	192.00
0+41	192.00
0+47	191.60
0+50	191.25
0+52	191.50
0+57	192.00
0+71	194.00
1+00	196.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 192.00)	(1+00, 196.00)	0.045

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.83	ft
Elevation Range	191.25 to 196.00 ft	
Flow Area	9.85	ft²
Wetted Perimeter	58.07	ft
Hydraulic Radius	0.17	ft

Worksheet for MP-108.76_STA0+34_BRIDGE_2YR

Results

Top Width		57.91	ft
Normal Depth		0.83	ft
Critical Depth		0.80	ft
Critical Slope		0.05581	ft/ft
Velocity		1.92	ft/s
Velocity Head		0.06	ft
Specific Energy		0.88	ft
Froude Number		0.82	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.83	ft
Critical Depth	0.80	ft
Channel Slope	0.03600	ft/ft
Critical Slope	0.05581	ft/ft

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LOG
+01.8°
-27.3°
EXTRAS
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150
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NIGHT
1.0 X

MP109.13R2

Region ID: NJ
Workspace ID: NJ20170811091051875000
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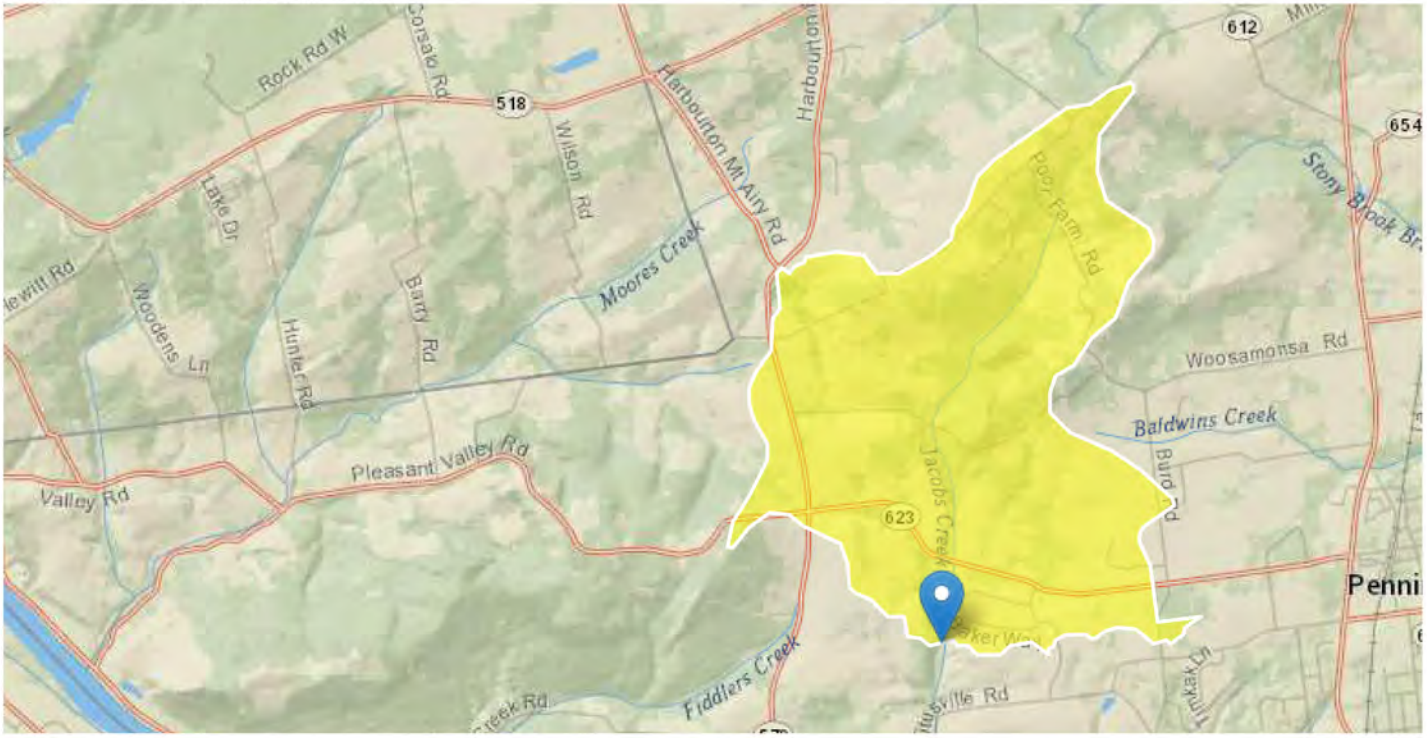
Time: 2017-08-11 09:12:03 -0400



Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	3.59	square miles
STORAGE	Percentage of area of storage (lakes ponds reservoirs wetlands)	2.12	percent
CSL10_85	Change in elevation divided by length between points 10 and 85 percent of distance along main channel to basin divide - main channel method not known	70.8	feet per mi
POPDENS	Basin Population Density	206	persons per square mile

Peak-Flow Statistics Parameters [Peak Unglaciated Piedmont Region 2009 5167]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	3.59	square miles	0.25	779
STORAGE	Percent Storage	2.12	percent	0.23	32
CSL10_85	Stream Slope 10 and 85 Method	70.8	feet per mi	4.31	191
POPDENS	Basin Population Density	206	persons per square mile	83	11084

Peak-Flow Statistics Flow Report [Peak Unglaciated Piedmont Region 2009 5167]

PII: Prediction Interval-Lower, PIu: Prediction Interval-Upper, SEp: Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	SEe	SEp	Equiv. Yrs.
2 Year Peak Flood	534	ft^3/s	49	50.3	1
5 Year Peak Flood	907	ft^3/s	49.4	50.9	2
10 Year Peak Flood	1200	ft^3/s	50.5	52.2	3

Statistic	Value	Unit	SEe	SEp	Equiv. Yrs.
25 Year Peak Flood	1640	ft^3/s	52.6	54.5	4
50 Year Peak Flood	1990	ft^3/s	54.7	56.8	5
100 Year Peak Flood	2390	ft^3/s	57.1	59.5	5
500 Year Peak Flood	3420	ft^3/s	63.9	66.3	6

Peak-Flow Statistics Citations

Watson, K.M.,and Schopp, R.D.,2009, Methodology for estimation of flood magnitude and frequency for New Jersey streams, U.S. Geological Survey Scientific Investigations Report 2009-5167, 51 p. (http://pubs.usgs.gov/sir/2009/5167/)

Worksheet for MP-109.13R2 STA1+42_2YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00800	ft/ft
Discharge	534.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	138.00
0+32	138.00
0+44	136.80
0+48	133.85
0+50	133.66
0+51	133.90
0+57	134.50
0+87	136.00
1+00	136.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 138.00)	(1+00, 136.00)	0.030

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	3.18	ft
Elevation Range	133.66 to 138.00 ft	
Flow Area	90.23	ft²
Wetted Perimeter	58.45	ft

Worksheet for MP-109.13R2 STA1+42_2YR

Results

Hydraulic Radius		1.54	ft
Top Width		56.41	ft
Normal Depth		3.18	ft
Critical Depth		2.98	ft
Critical Slope		0.01218	ft/ft
Velocity		5.92	ft/s
Velocity Head		0.54	ft
Specific Energy		3.72	ft
Froude Number		0.83	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	3.18	ft
Critical Depth	2.98	ft
Channel Slope	0.00800	ft/ft
Critical Slope	0.01218	ft/ft

Worksheet for MP-109.13_STA1+53_BRIDGE_2YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00800	ft/ft
Discharge	534.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	138.00
0+39	138.00
0+45	137.00
0+50	133.69
0+58	134.65
0+89	136.00
1+00	136.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 138.00)	(1+00, 136.00)	0.030

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	3.22	ft
Elevation Range	133.69 to 138.00 ft	
Flow Area	89.32	ft²
Wetted Perimeter	56.98	ft
Hydraulic Radius	1.57	ft
Top Width	55.05	ft

Worksheet for MP-109.13_STA1+53_BRIDGE_2YR

Results

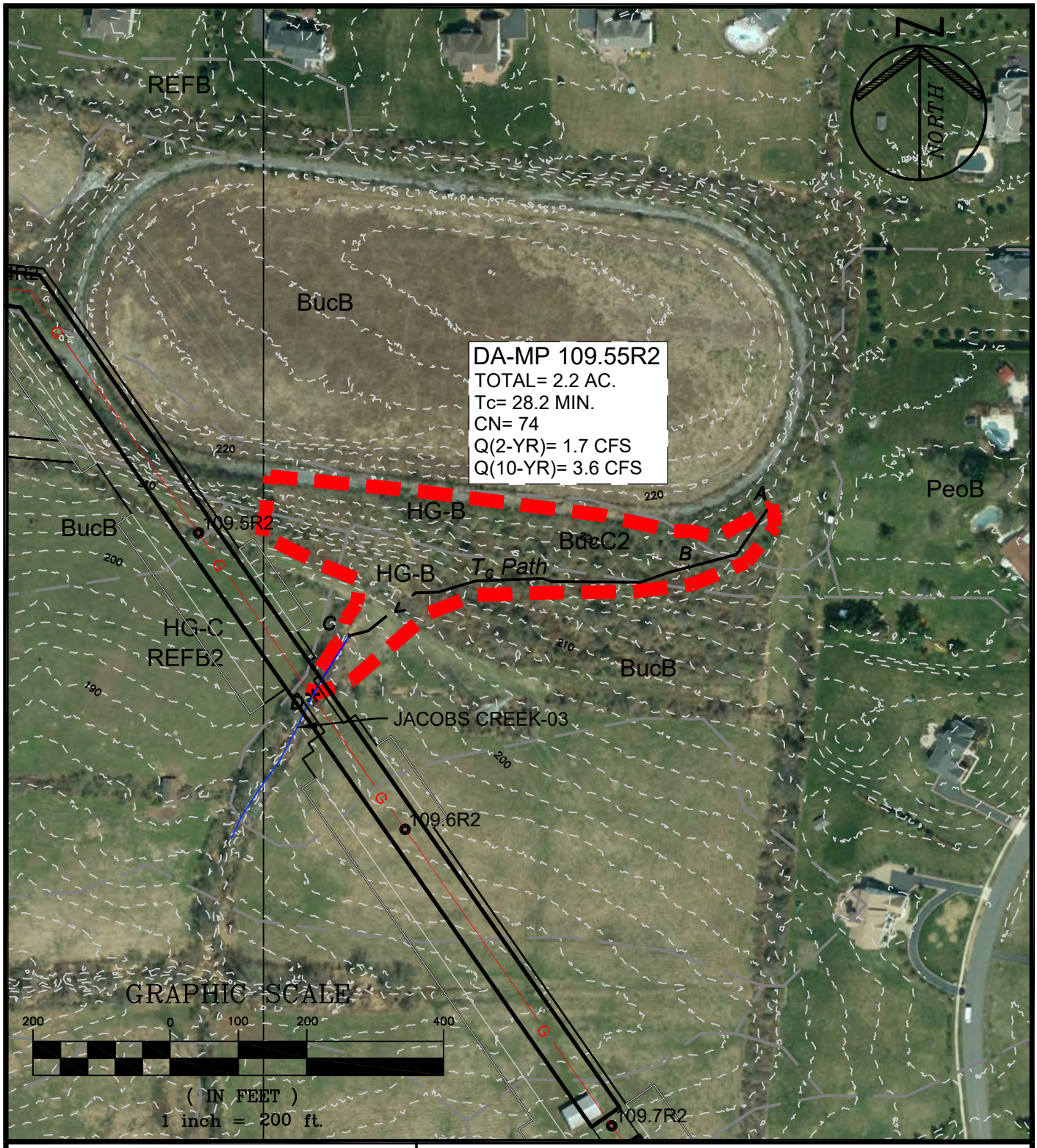
Normal Depth		3.22	ft
Critical Depth		3.02	ft
Critical Slope		0.01210	ft/ft
Velocity		5.98	ft/s
Velocity Head		0.56	ft
Specific Energy		3.77	ft
Froude Number		0.83	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	3.22	ft
Critical Depth	3.02	ft
Channel Slope	0.00800	ft/ft
Critical Slope	0.01210	ft/ft



FILE NAME: P:\05516\0001\DWGs\CAD\C-Civil\Plotdwgs\Drainage Area Maps\05516\0001-Stream_DA_MP100.8-114-WAL.dwgMP 109.55R2 LAST EDIT: 06/10/2019 - 10:06:43 AM LOGIN: jmcgowan@

PAULUS, SOKOLOWSKI AND SARTOR, LLC.

1433 ROUTE 34
SUITE A4
WALL, NEW JERSEY 07727
PHONE: (848) 206-2626

CERTIFICATE OF AUTHORIZATION NO. 24GA28032700

PROJECT TITLE

PENNEAST PIPELINE

HUNTERDON AND MERCER COUNTY, NJ

SHEET TITLE

STREAM CROSSING DRAINAGE AREA MP 109.55R2

PROJ. NO.: 05516.0001	DRN. BY: JPS	SCALE: 1"=200'
DATE: 05/23/19	CK'D BY: WS	

Worksheet 2: Runoff curve number and runoff (Approximated)

Project	By	Date
PennEast	JPS	26-Feb-18
Location	**Checked**	**Date**
Hunterdon County, NJ		

Check one: ☐ Present ☒ Developed — MP 109.55

1. Runoff curve number

Soil name and hydrologic group (appendix A)	Cover Description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN[1] Table 2-2	CN[1] Figure 2-3	CN[1] Figure 2-4	Area ☒ acres / ☐ mi² / ☐ %	Product of CN x Area
Type B	Farmstead, Good Condition	74			2.10	155.40
Type C	Farmstead, Good Condition	82			0.10	8.20
1. Use only one CN source per line				Totals ➡	2.20	163.60

CN (weighted) = tot.prod. / tot. area = 163.60 / 2.20 = 74.4 ; Use CN ➡ **74**

2. Runoff

		Storm #1	Storm #2	Storm #3
Frequency……	yr			
Rainfall, P (24-hour)…….	in			
Runoff, Q……	in			

Use P and CN with table 2-1, figure 2-1, or equation 2-3 abd 2-4

PSS&	PROJECT: PennEast	JOB NO. 5516.0001	
		SHEET	DATE:2/12/2018
		BY:	JPS
	SUBJECT: Tc Calculations	CHK'D	

Time of Concentration calculations with the application of the SCS TR-55 methodology.

Watershed or Subarea Designation: DA 109.55

Area 2.2 AC

SHEET FLOW

Segment ID		A-B			
Surface Description (Table 3-1)		WOODS			
Manning's Coefficient, n (Table 3-1)		0.400			
Flow Length, L (total <= 150)	(ft)	150			
Two Year Rainfall, P	(in)	3.4			
Land Slope, s	(ft/ft)	0.030			
Computed Tt = 0.007 (nL)^0.8 / P^0.5*s^0.4	(hrs)	0.410			0.410

SHALLOW CONCENTRATED FLOW

Segment ID		B-C			
Surface Description (paved or unpaved)		UNPAVED			
Flow Length, L	(ft)	524			
Watercourse slope, s	(ft/ft)	0.042			
Average Velocity, V (Figure 3-1)	(ft/s)	3.2			
Computed Tt = L / 3600V	(hrs)	0.045			0.045

CHANNEL FLOW

Segment ID		C-D			
Cross sectional Area, a	(sf)	0.80			
Wetted Perimeter, Pw	(ft)	6.08			
Hydraulic Radius, r =a/Pw	(ft)	0.132			
Channel Slope (ft/ft)	(ft/ft)	0.039			
Manning's Roughness Coefficient, n		0.040			
Velocity, V = 1.49r^(2/3)s^0.5 / n	(ft/s)	1.90			
Flow Length, L	(ft)	103			
Computed Tt = L / 3600V	(hrs)	0.015			0.015

Watershed or subarea Tc	0.470	hrs.
	28.2	min.

Use minimum Tc of 10 minutes

Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Wednesday, 02 / 20 / 2019

Hyd. No. 35

DA 109.55

Hydrograph type	= SCS Runoff	Peak discharge	= 1.656 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.30 hrs
Time interval	= 6 min	Hyd. volume	= 8,603 cuft
Drainage area	= 2.200 ac	Curve number	= 74.000*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 28.2 min
Total precip.	= 3.26 in	Distribution	= Custom
Storm duration	= C:\Users\IKuzmina\AppData\Local\Autodesk\C3D2019\enu\HHApps\Hydrograp		

* Composite (Area/CN) = [(2.100 x 74) + (0.100 x 82)] / 2.200

Hydrograph Discharge Table

(Printed values >= 1.00% of Qp.)

Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)
11.20	0.018	13.00	0.492	14.80	0.158	16.60	0.104
11.30	0.029	13.10	0.435	14.90	0.152	16.70	0.102
11.40	0.043	13.20	0.388	15.00	0.146	16.80	0.100
11.50	0.060	13.30	0.354	15.10	0.140	16.90	0.099
11.60	0.086	13.40	0.324	15.20	0.134	17.00	0.097
11.70	0.123	13.50	0.297	15.30	0.129	17.10	0.096
11.80	0.183	13.60	0.272	15.40	0.125	17.20	0.094
11.90	0.278	13.70	0.250	15.50	0.122	17.30	0.092
12.00	0.473	13.80	0.232	15.60	0.120	17.40	0.091
12.10	0.895	13.90	0.218	15.70	0.118	17.50	0.089
12.20	1.336	14.00	0.207	15.80	0.116	17.60	0.087
12.30	1.656	14.10	0.199	15.90	0.115	17.70	0.085
12.40	1.598	14.20	0.193	16.00	0.113	17.80	0.084
12.50	1.435	14.30	0.187	16.10	0.112	17.90	0.082
12.60	1.197	14.40	0.181	16.20	0.110	18.00	0.080
12.70	0.932	14.50	0.176	16.30	0.109	18.10	0.079
12.80	0.682	14.60	0.170	16.40	0.107	18.20	0.077
12.90	0.570	14.70	0.164	16.50	0.105	18.30	0.076

Continues on next page...

Worksheet for MP-109.55_STA2+00_PIPE_2YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.04800	ft/ft
Discharge	1.70	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	194.00
0+42	194.30
0+46	193.60
0+49	191.50
0+53	194.50
1+00	196.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 194.00)	(1+00, 196.00)	0.045

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.60	ft
Elevation Range	191.50 to 196.00 ft	
Flow Area	0.58	ft²
Wetted Perimeter	2.28	ft
Hydraulic Radius	0.26	ft
Top Width	1.93	ft
Normal Depth	0.60	ft

Worksheet for MP-109.55_STA2+00_PIPE_2YR

Results

Critical Depth		0.59	ft
Critical Slope		0.05553	ft/ft
Velocity		2.91	ft/s
Velocity Head		0.13	ft
Specific Energy		0.74	ft
Froude Number		0.93	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.60	ft
Critical Depth	0.59	ft
Channel Slope	0.04800	ft/ft
Critical Slope	0.05553	ft/ft

Worksheet for MP-109.55_STA2+11_BRIDGE_2YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.04800	ft/ft
Discharge	1.70	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	194.00
0+40	194.00
0+43	193.80
0+46	193.10
0+50	190.89
0+54	193.70
0+57	194.05
1+00	194.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 194.00)	(1+00, 194.00)	0.045

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.59	ft
Elevation Range	190.89 to 194.05 ft	
Flow Area	0.59	ft²
Wetted Perimeter	2.31	ft
Hydraulic Radius	0.25	ft

Worksheet for MP-109.55_STA2+11_BRIDGE_2YR

Results

Top Width		1.99	ft
Normal Depth		0.59	ft
Critical Depth		0.58	ft
Critical Slope		0.05466	ft/ft
Velocity		2.90	ft/s
Velocity Head		0.13	ft
Specific Energy		0.72	ft
Froude Number		0.94	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.59	ft
Critical Depth	0.58	ft
Channel Slope	0.04800	ft/ft
Critical Slope	0.05466	ft/ft

MP-110.21R2

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Workspace ID: NJ20180312141942659000
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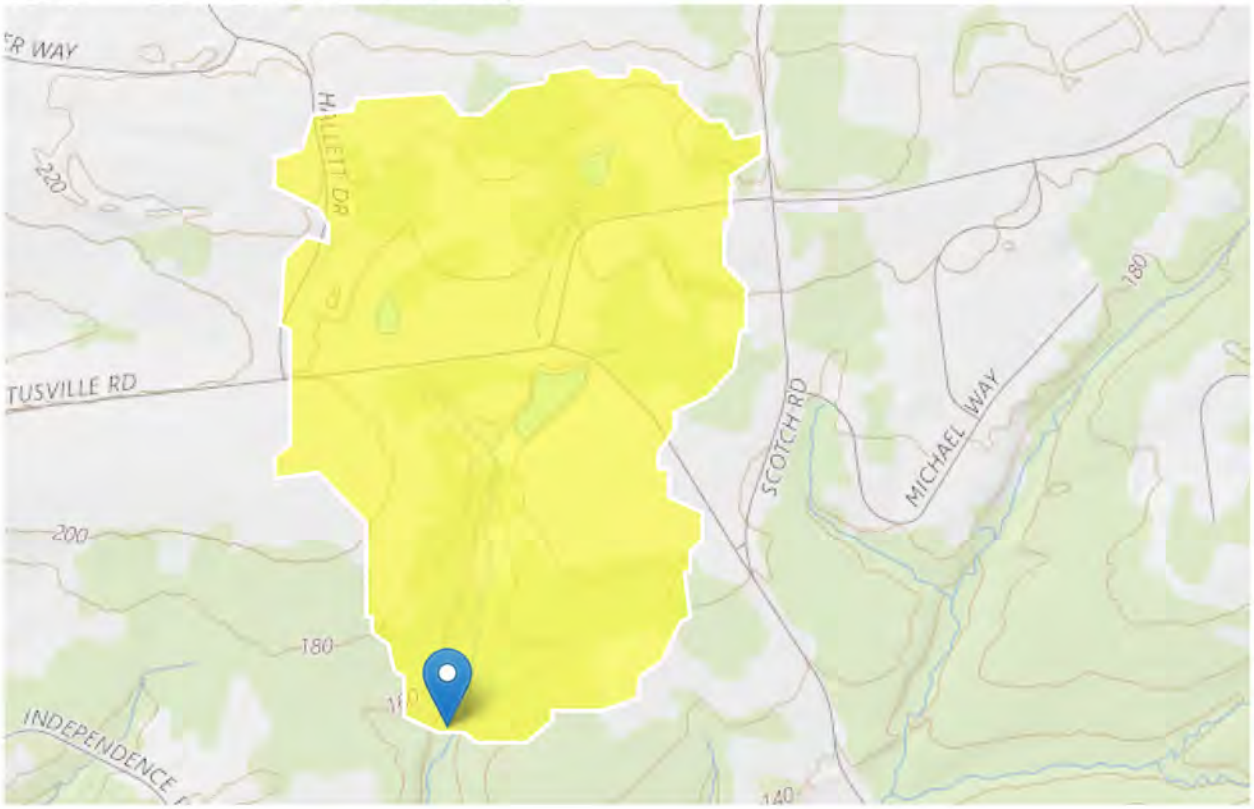
Time: 2018-03-12 10:19:58 -0400



The South Carolina StreamStats application is testing LiDAR-derived data and streams for delineation. This is a beta version and QA/QC is incomplete. It may calculate basin characteristics and flow statistics incorrectly. Please verify the drainage areas and flow stats carefully. Use at your own risk

Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	0.3	square miles
STORAGE	Percentage of area of storage (lakes ponds reservoirs wetlands)	4.58	percent

Worksheet for MP-110.21R2_STA0+27_2YR_PIPE

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.01400	ft/ft
Discharge	89.60	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	134.00
0+42	132.40
0+52	129.31
0+58	131.10
0+75	134.00
1+00	140.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 134.00)	(1+00, 140.00)	0.030

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	2.18	ft
Elevation Range	129.31 to 140.00 ft	
Flow Area	15.42	ft²
Wetted Perimeter	15.62	ft
Hydraulic Radius	0.99	ft
Top Width	14.98	ft
Normal Depth	2.18	ft

Worksheet for MP-110.21R2_STA0+27_2YR_PIPE

Results

Critical Depth		2.19	ft
Critical Slope		0.01372	ft/ft
Velocity		5.81	ft/s
Velocity Head		0.52	ft
Specific Energy		2.70	ft
Froude Number		1.01	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	2.18	ft
Critical Depth	2.19	ft
Channel Slope	0.01400	ft/ft
Critical Slope	0.01372	ft/ft

Worksheet for MP-110.21R2_STA0+60_2YR_BRIDGE

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.01400	ft/ft
Discharge	89.60	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	134.00
0+06	134.00
0+43	131.60
0+52	128.76
0+57	130.30
0+69	132.00
0+86	136.00
0+96	138.00
1+00	140.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 134.00)	(1+00, 140.00)	0.030

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	2.15	ft
Elevation Range	128.76 to 140.00 ft	
Flow Area	15.91	ft²
Wetted Perimeter	16.88	ft

Worksheet for MP-110.21R2_STA0+60_2YR_BRIDGE

Results

Hydraulic Radius		0.94	ft
Top Width		16.29	ft
Normal Depth		2.15	ft
Critical Depth		2.15	ft
Critical Slope		0.01385	ft/ft
Velocity		5.63	ft/s
Velocity Head		0.49	ft
Specific Energy		2.64	ft
Froude Number		1.00	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	2.15	ft
Critical Depth	2.15	ft
Channel Slope	0.01400	ft/ft
Critical Slope	0.01385	ft/ft

MP110.47R3

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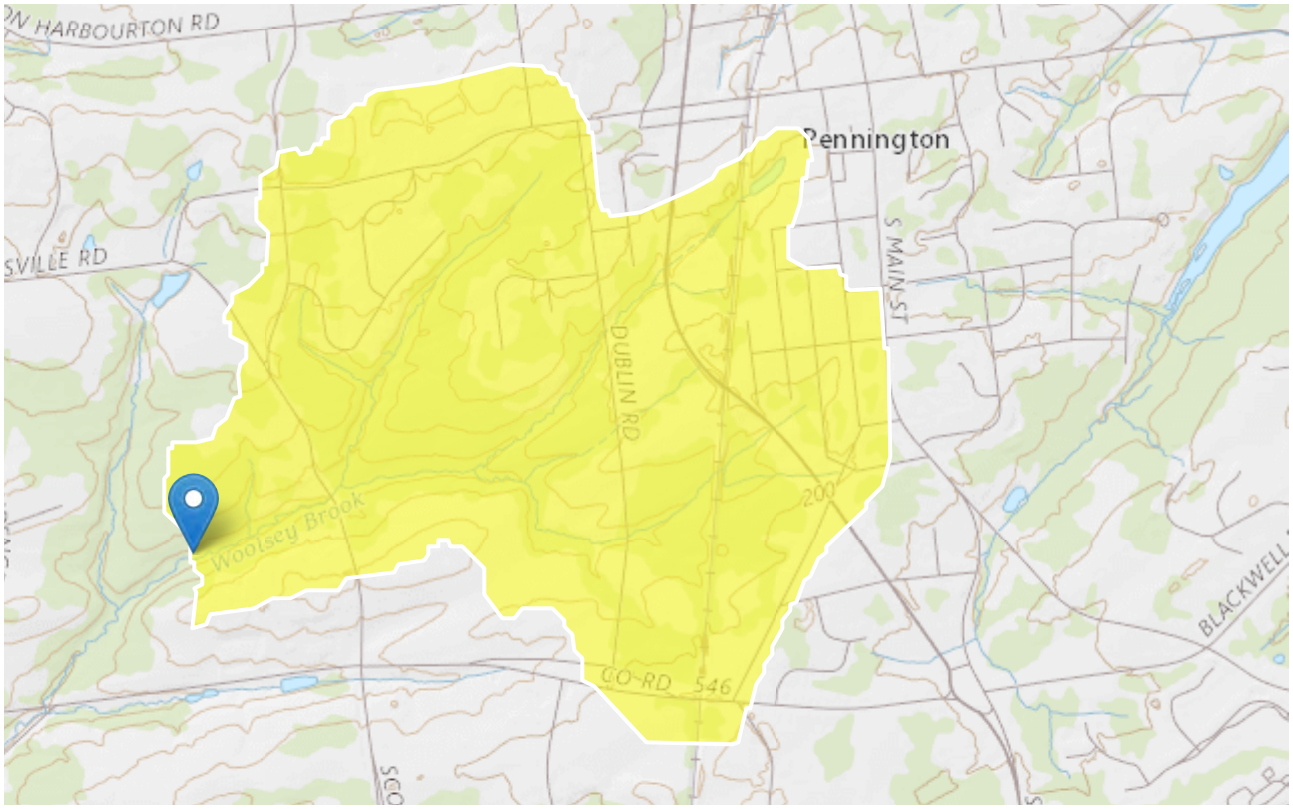
Workspace ID: NJ20180228180926810000
Clicked Point (Latitude, Longitude): 40.31254, -74.81998
Time: 2018-02-28 13:09:41 -0500



The South Carolina StreamStats application is testing LiDAR-derived data and streams for delineation. This is a beta version and QA/QC is incomplete. It may calculate basin characteristics and flow statistics incorrectly. Please verify the drainage areas and flow stats carefully. Use at your own risk

Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	1.6	square miles
STORAGE	Percentage of area of storage (lakes ponds reservoirs wetlands)	2.11	percent

Parameter Code	Parameter Description	Value	Unit
CSL10_85	Change in elevation divided by length between points 10 and 85 percent of distance along main channel to basin divide - main channel method not known	51.1	feet per mi
POPDENS	Basin Population Density	568	persons per square mile

Peak-Flow Statistics Parameters [Peak Unglaciated Piedmont Region 2009 5167]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	1.6	square miles	0.25	779
STORAGE	Percent Storage	2.11	percent	0.23	32
CSL10_85	Stream Slope 10 and 85 Method	51.1	feet per mi	4.31	191
POPDENS	Basin Population Density	568	persons per square mile	83	11084

Peak-Flow Statistics Flow Report [Peak Unglaciated Piedmont Region 2009 5167]

PIl: Prediction Interval-Lower, PIu: Prediction Interval-Upper, SEp: Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	SEp	Equiv. Yrs.
2 Year Peak Flood	304	ft^3/s	50.3	1
5 Year Peak Flood	509	ft^3/s	50.9	2
10 Year Peak Flood	671	ft^3/s	52.2	3
25 Year Peak Flood	902	ft^3/s	54.5	4
50 Year Peak Flood	1090	ft^3/s	56.8	5
100 Year Peak Flood	1300	ft^3/s	59.5	5
500 Year Peak Flood	1820	ft^3/s	66.3	6

Peak-Flow Statistics Citations

Watson, K.M.,and Schopp, R.D.,2009, Methodology for estimation of flood magnitude and frequency for New Jersey streams, U.S. Geological Survey Scientific Investigations Report 2009-5167, 51 p. (http://pubs.usgs.gov/sir/2009/5167/)

Worksheet for MP-110.47_STA0+56_2YR_PIPE

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00700	ft/ft
Discharge	304.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	111.40
0+29	109.90
0+40	107.37
0+67	112.00
0+90	114.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 111.40)	(0+90, 114.00)	0.030

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	3.31	ft
Elevation Range	107.37 to 114.00 ft	
Flow Area	61.00	ft²
Wetted Perimeter	46.26	ft
Hydraulic Radius	1.32	ft
Top Width	45.68	ft
Normal Depth	3.31	ft
Critical Depth	2.98	ft

Worksheet for MP-110.47_STA0+56_2YR_PIPE

Results

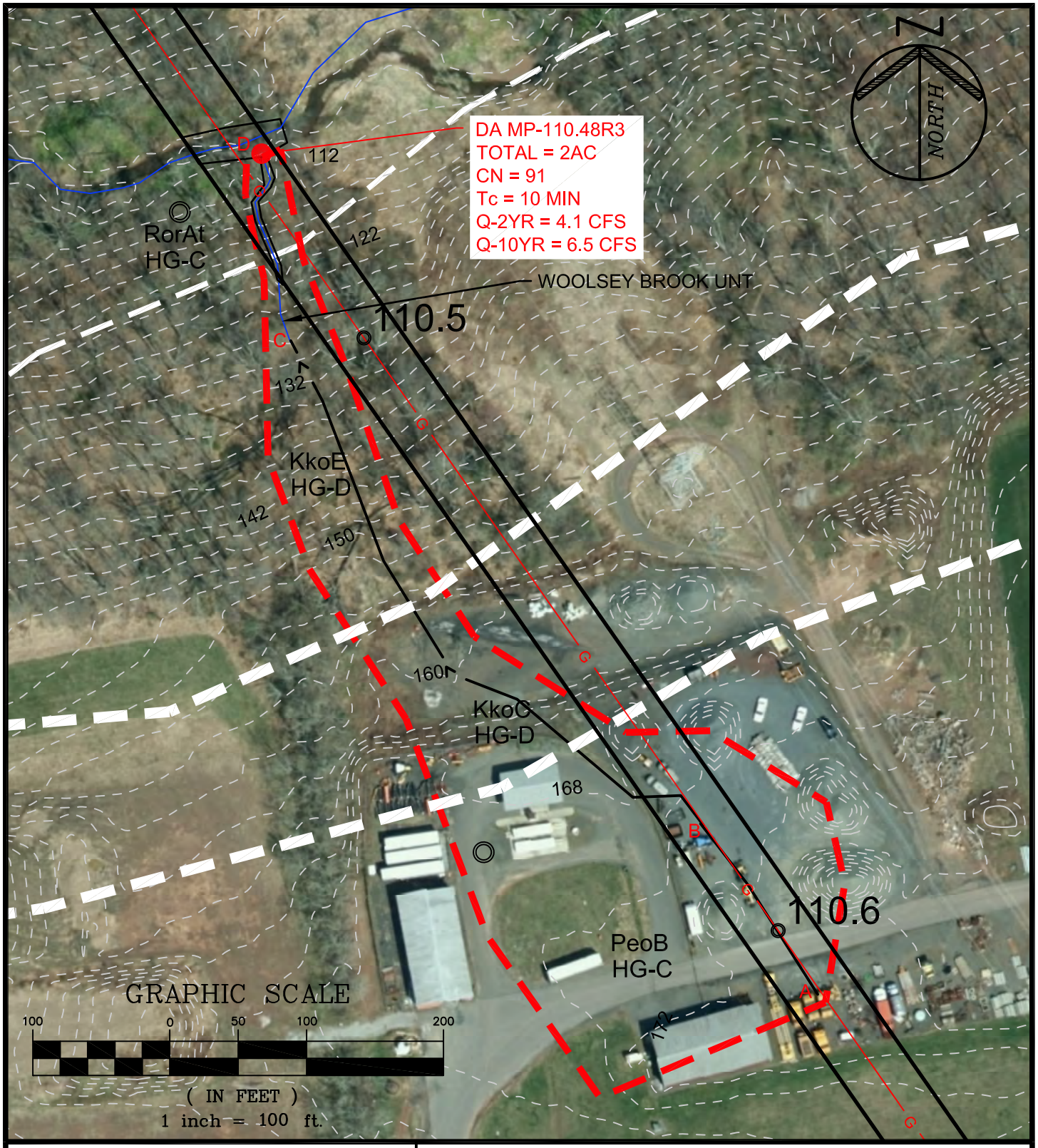
Critical Slope		0.01236	ft/ft
Velocity		4.98	ft/s
Velocity Head		0.39	ft
Specific Energy		3.69	ft
Froude Number		0.76	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	3.31	ft
Critical Depth	2.98	ft
Channel Slope	0.00700	ft/ft
Critical Slope	0.01236	ft/ft



PAULUS, SOKOLOWSKI AND SARTOR, LLC.

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SUITE A4
WALL, NEW JERSEY 07727
PHONE: (848) 206-2626

CERTIFICATE OF AUTHORIZATION NO. 24GA28032700

PROJECT TITLE

PENNEAST PIPELINE

HUNTERDON AND MERCER COUNTY, NJ

SHEET TITLE

STREAM CROSSING DRAINAGE AREA MP 110.48R3

PROJ. NO.:	05516.0001	DRN. BY:	JPS	SCALE:	1"=100'
DATE:	05/23/19	CK'D BY:	WS		

FILE NAME: P:\05516\0001\DWGs\CAD\C-C\ltPlotdwgs\Drainage Area Maps\05516001-Stream_DA_MP100.8-114-WAL.dwg\MP 110.48R2 LAST EDIT: 06/18/2019 - 11:58:08 AM LOGIN: IKuzniina@

Worksheet 2: Runoff curve number and runoff (Approximated)

Project	By	Date
PennEast	IK	11-Mar-19
Location	**Checked**	**Date**
Hunterdon County, NJ		

Check one: ☐ Present ☒ Developed | MP 110.48R3

1. Runoff curve number

Soil name and hydrologic group (appendix A)	Cover Description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN[1] Table 2-2	CN[1] Figure 2-3	CN[1] Figure 2-4	Area ☒ acres ☐ mi² ☐ %	Product of CN x Area
Type C	WOODS	70			0.05	3.50
Type C	FARMSTEADS/GRASS	82			0.21	17.22
Type D	WOODS	77			0.40	31.03
TYPE C & D	IMPERVIOUS	98			1.34	131.32
				Totals ➡	2.00	183.07

1. Use only one CN source per line

CN (weighted) = tot.prod. / tot. area = 183.07 / 2.00 = 91.4 ; Use CN ➡ **91**

2. Runoff

		Storm #1	Storm #2	Storm #3
Frequency……	yr			
Rainfall, P (24-hour)…….	in			
Runoff, Q……	in			

Use P and CN with table 2-1, figure 2-1, or equation 2-3 abd 2-4

PROJECT:	PennEast	JOB NO. 5516.0001	
		SHEET	DATE: 03/10/2019
		BY:	IK
SUBJECT:	Tc Calculations	CHK'D	

Time of Concentration calculations with the application of the SCS TR-55 methodology.

Watershed or Subarea Designation: DA 110.48R3

Area 2 AC

SHEET FLOW

Segment ID		A-B			
Surface Description (Table 3-1)		PAVEMENT			
Manning's Coefficient, n (Table 3-1)		0.011			
Flow Length, L (total <= 150)	(ft)	150			
Two Year Rainfall, P	(in)	3.4			
Land Slope, s	(ft/ft)	0.013			
Computed Tt = 0.007 (nL)^0.8 / P^0.5*s^0.4	(hrs)	0.032			0.032

SHALLOW CONCENTRATED FLOW

Segment ID		B-C	C-D		
Surface Description (paved or unpaved)		PAVED	UNPAVED		
Flow Length, L	(ft)	276	95		
Watercourse slope, s	(ft/ft)	0.047	0.137		
Average Velocity, V (Figure 3-1)	(ft/s)	4.4	5.6		
Computed Tt = L / 3600V	(hrs)	0.018	0.005		0.022

CHANNEL FLOW

Segment ID		C-D			
Cross sectional Area, a	(sf)	3.50			
Wetted Perimeter, Pw	(ft)	5.60			
Hydraulic Radius, r =a/Pw	(ft)	0.625			
Channel Slope (ft/ft)	(ft/ft)	0.125			
Manning's Roughness Coefficient, n		0.030			
Velocity, V = 1.49r^(2/3)s^0.5 / n	(ft/s)	12.84			
Flow Length, L	(ft)	144			
Computed Tt = L / 3600V	(hrs)	0.003			0.003

Watershed or subarea Tc	0.058	hrs.
	3.5	min.

Use minimum Tc of 10 minutes

Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 05 / 23 / 2019

Hyd. No. 63

MP-110.48R3

Hydrograph type	= SCS Runoff	Peak discharge	= 4.052 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.20 hrs
Time interval	= 6 min	Hyd. volume	= 15,754 cuft
Drainage area	= 2.000 ac	Curve number	= 91.000
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 10.0 min
Total precip.	= 3.26 in	Distribution	= Custom
Storm duration	= C:\Users\IKuzmina\AppData\Local\Autodesk\C3D 2019\enu\HHApps\Hydrograp	Storm frequency	= 24 hrs

Hydrograph Discharge Table

(Printed values >= 1.00% of Qp.)

Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)
8.00	0.041	9.80	0.106	11.60	0.581	13.40	0.391
8.10	0.043	9.90	0.112	11.70	0.744	13.50	0.360
8.20	0.045	10.00	0.119	11.80	0.944	13.60	0.328
8.30	0.047	10.10	0.126	11.90	1.281	13.70	0.300
8.40	0.049	10.20	0.134	12.00	1.938	13.80	0.283
8.50	0.052	10.30	0.141	12.10	3.291	13.90	0.271
8.60	0.054	10.40	0.149	12.20	4.052	14.00	0.263
8.70	0.056	10.50	0.157	12.30	3.277	14.10	0.255
8.80	0.059	10.60	0.168	12.40	2.264	14.20	0.246
8.90	0.061	10.70	0.185	12.50	1.405	14.30	0.238
9.00	0.064	10.80	0.207	12.60	1.114	14.40	0.230
9.10	0.067	10.90	0.231	12.70	0.878	14.50	0.221
9.20	0.071	11.00	0.257	12.80	0.738	14.60	0.213
9.30	0.076	11.10	0.288	12.90	0.639	14.70	0.205
9.40	0.081	11.20	0.327	13.00	0.582	14.80	0.196
9.50	0.087	11.30	0.374	13.10	0.523	14.90	0.188
9.60	0.093	11.40	0.425	13.20	0.470	15.00	0.179
9.70	0.099	11.50	0.477	13.30	0.427	15.10	0.171

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Worksheet for MP-110.48R2_STA0+68_2YR_PIPE

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.13700	ft/ft
Discharge	4.10	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	112.35
0+08	112.60
0+09	112.44
0+17	114.00
0+60	120.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 112.35)	(0+60, 120.00)	0.045

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.27	ft
Elevation Range	112.35 to 120.00 ft	
Flow Area	1.33	ft²
Wetted Perimeter	10.43	ft
Hydraulic Radius	0.13	ft
Top Width	10.13	ft
Normal Depth	0.27	ft
Critical Depth	0.31	ft

Worksheet for MP-110.48R2_STA0+68_2YR_PIPE

Results

Critical Slope		0.05568	ft/ft
Velocity		3.09	ft/s
Velocity Head		0.15	ft
Specific Energy		0.42	ft
Froude Number		1.50	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.27	ft
Critical Depth	0.31	ft
Channel Slope	0.13700	ft/ft
Critical Slope	0.05568	ft/ft

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+01.8°
-26.1°
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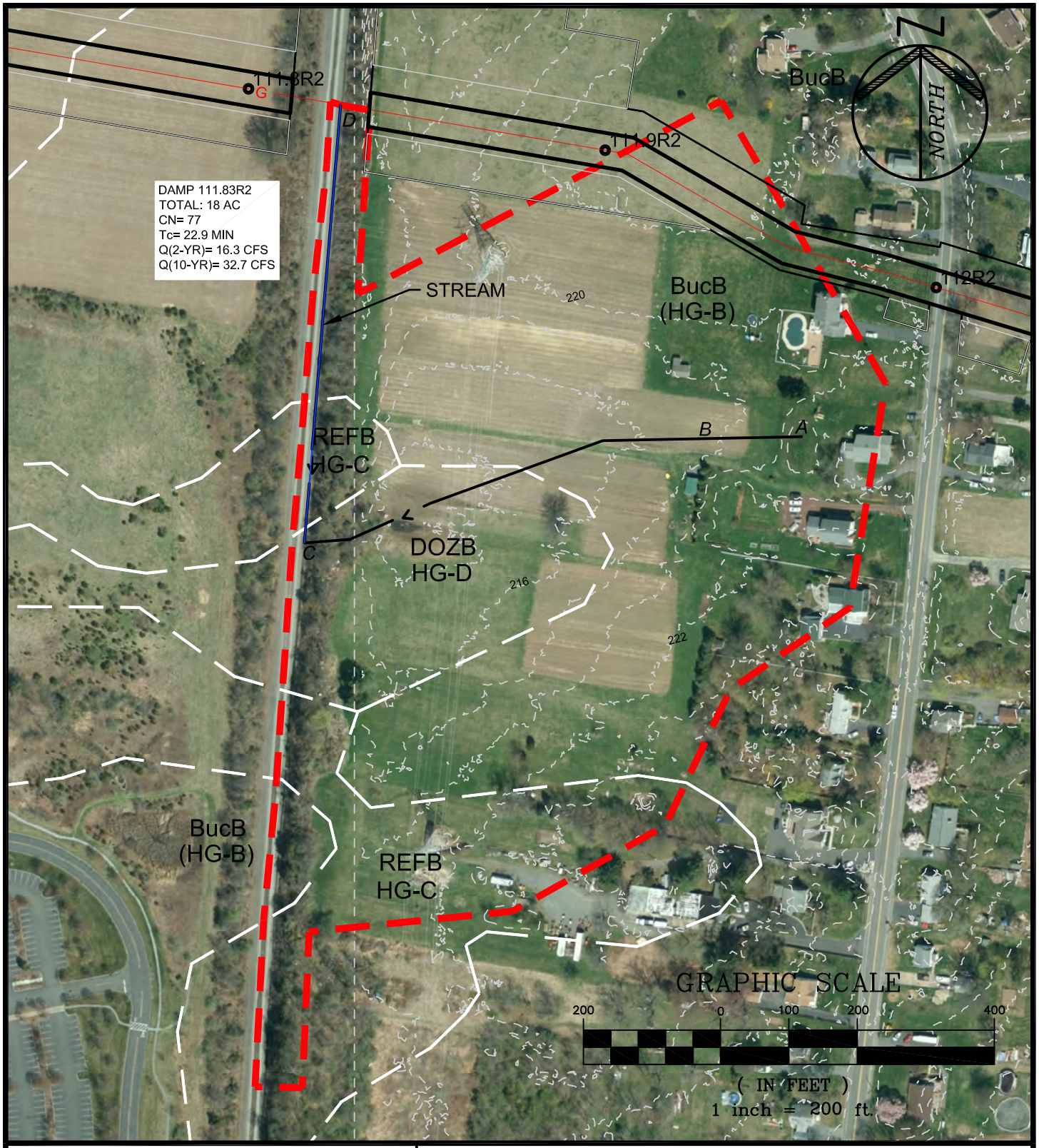

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CERTIFICATE OF AUTHORIZATION NO. 24GA28032700

PROJECT TITLE

PENNEAST PIPELINE

HUNTERDON AND MERCER COUNTY, NJ

SHEET TITLE

STREAM CROSSING DRAINAGE AREA MP 111.83R2

PROJ. NO.:	05516.0001	DRN. BY:	JPS	SCALE:	1"=200'
DATE:	05/23/19	CK'D BY:	WS		

FILE NAME: P:\05516\0001\DWGs\CAD\C-Civil\Plotdwgs\Drainage Area Maps\05516\0001-Stream_DA_MP100.8-114-WAL.dwg\MP 111.83R2 LAST EDIT: 06/18/2019 - 11:38:12 AM LOGIN: IKuzniina@

Worksheet 2: Runoff curve number and runoff (Approximated)

Project	By	Date
PennEast	IK	31-May-18
Location	**Checked**	**Date**
Hunterdon County, NJ		

Check one: [X] Present [ ] Developed — MP 111.8

1. Runoff curve number

Soil name and hydrologic group (appendix A)	Cover Description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN[1] Table 2-2	CN[1] Figure 2-3	CN[1] Figure 2-4	Area [X] acres [ ] mi² [ ] %	Product of CN x Area
Type B	Farmstead, Good Condition	74			12.20	902.80
Type C	Farmstead, Good Condition	82			3.05	250.10
Type D	Farmstead, Good Condition	86			2.75	236.50
				Totals ➡	18.00	1,389.40

1. Use only one CN source per line

CN (weighted) = tot.prod. / tot. area = 1,389.40 / 18.00 = 77.2 ; Use CN ➡ **77**

2. Runoff

		Storm #1	Storm #2	Storm #3
Frequency……	yr			
Rainfall, P (24-hour)…….	in			
Runoff, Q……	in			

Use P and CN with table 2-1, figure 2-1, or equation 2-3 abd 2-4

PSS&	PROJECT: PennEast	JOB NO. 5516.0001	
		SHEET	DATE:5/31/2018
		BY:	IK
	SUBJECT: Tc Calculations	CHK'D	

Time of Concentration calculations with the application of the SCS TR-55 methodology.

Watershed or Subarea Designation: DA 111.83

Area 18 AC

SHEET FLOW

Segment ID		A-B				
Surface Description (Table 3-1)		GRASS				
Manning's Coefficient, n (Table 3-1)		0.150				
Flow Length, L (total <= 150)	(ft)	150				
Two Year Rainfall, P	(in)	3.4				
Land Slope, s	(ft/ft)	0.033				
Computed Tt = 0.007 (nL)^0.8 / P^0.5*s^0.4	(hrs)	0.180				0.180

SHALLOW CONCENTRATED FLOW

Segment ID		B-C				
Surface Description (paved or unpaved)		UNPAVED				
Flow Length, L	(ft)	536				
Watercourse slope, s	(ft/ft)	0.009				
Average Velocity, V (Figure 3-1)	(ft/s)	1.4				
Computed Tt = L / 3600V	(hrs)	0.108				0.108

CHANNEL FLOW

Segment ID		C-D				
Cross sectional Area, a	(sf)	6.00				
Wetted Perimeter, Pw	(ft)	8.47				
Hydraulic Radius, r =a/Pw	(ft)	0.708				
Channel Slope (ft/ft)	(ft/ft)	0.005				
Manning's Roughness Coefficient, n		0.040				
Velocity, V = 1.49r^(2/3)s^0.5 / n	(ft/s)	2.09				
Flow Length, L	(ft)	708				
Computed Tt = L / 3600V	(hrs)	0.094				0.094

Watershed or subarea Tc	0.381	hrs.
	22.9	min.

Use minimum Tc of 10 minutes

Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 04 / 1 / 2019

Hyd. No. 1

MP-111.83R2

Hydrograph type	= SCS Runoff	Peak discharge	= 16.25 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.30 hrs
Time interval	= 6 min	Hyd. volume	= 81,992 cuft
Drainage area	= 18.000 ac	Curve number	= 77.000
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 22.9 min
Total precip.	= 3.26 in	Distribution	= Custom
Storm duration	= C:\Users\IKuzmina\AppData\Local\Autodesk\C3D2019\enu\HHApps\Hydrograp		

Hydrograph Discharge Table

(Printed values >= 1.00% of Qp.)

Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)
10.90	0.213	12.70	8.725	14.50	1.588	16.30	0.975
11.00	0.279	12.80	6.322	14.60	1.534	16.40	0.960
11.10	0.359	12.90	5.257	14.70	1.480	16.50	0.945
11.20	0.460	13.00	4.528	14.80	1.425	16.60	0.930
11.30	0.588	13.10	3.989	14.90	1.370	16.70	0.916
11.40	0.744	13.20	3.551	15.00	1.314	16.80	0.901
11.50	0.928	13.30	3.235	15.10	1.258	16.90	0.886
11.60	1.211	13.40	2.953	15.20	1.205	17.00	0.871
11.70	1.609	13.50	2.702	15.30	1.159	17.10	0.856
11.80	2.242	13.60	2.474	15.40	1.124	17.20	0.841
11.90	3.212	13.70	2.275	15.50	1.097	17.30	0.826
12.00	5.148	13.80	2.108	15.60	1.077	17.40	0.810
12.10	9.220	13.90	1.979	15.70	1.060	17.50	0.795
12.20	13.37	14.00	1.881	15.80	1.046	17.60	0.780
12.30	16.25	14.10	1.806	15.90	1.032	17.70	0.764
12.40	15.48	14.20	1.746	16.00	1.017	17.80	0.749
12.50	13.74	14.30	1.694	16.10	1.003	17.90	0.734
12.60	11.33	14.40	1.641	16.20	0.989	18.00	0.718

<<

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Worksheet for MP-111.83R2_STA2+00_2YR_PIPE

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00200	ft/ft
Discharge	16.30	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	206.00
0+01	204.00
0+39	204.00
0+49	204.00
0+49	200.34
0+50	200.34
0+51	200.50
0+52	202.00
0+59	204.00
0+68	212.00
0+75	216.00
0+80	218.00
1+00	218.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 206.00)	(1+00, 218.00)	0.030

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Worksheet for MP-111.83R2_STA2+00_2YR_PIPE

Results

Normal Depth		2.37	ft
Elevation Range	200.34 to 218.00 ft		
Flow Area		7.96	ft²
Wetted Perimeter		8.97	ft
Hydraulic Radius		0.89	ft
Top Width		5.72	ft
Normal Depth		2.37	ft
Critical Depth		1.13	ft
Critical Slope		0.02339	ft/ft
Velocity		2.05	ft/s
Velocity Head		0.07	ft
Specific Energy		2.43	ft
Froude Number		0.31	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	2.37	ft
Critical Depth	1.13	ft
Channel Slope	0.00200	ft/ft
Critical Slope	0.02339	ft/ft

Waterbody Name: Uncoded Tributary

Waterbody ID: 090817_DK_1002_E_MI/PE-ME-049.000

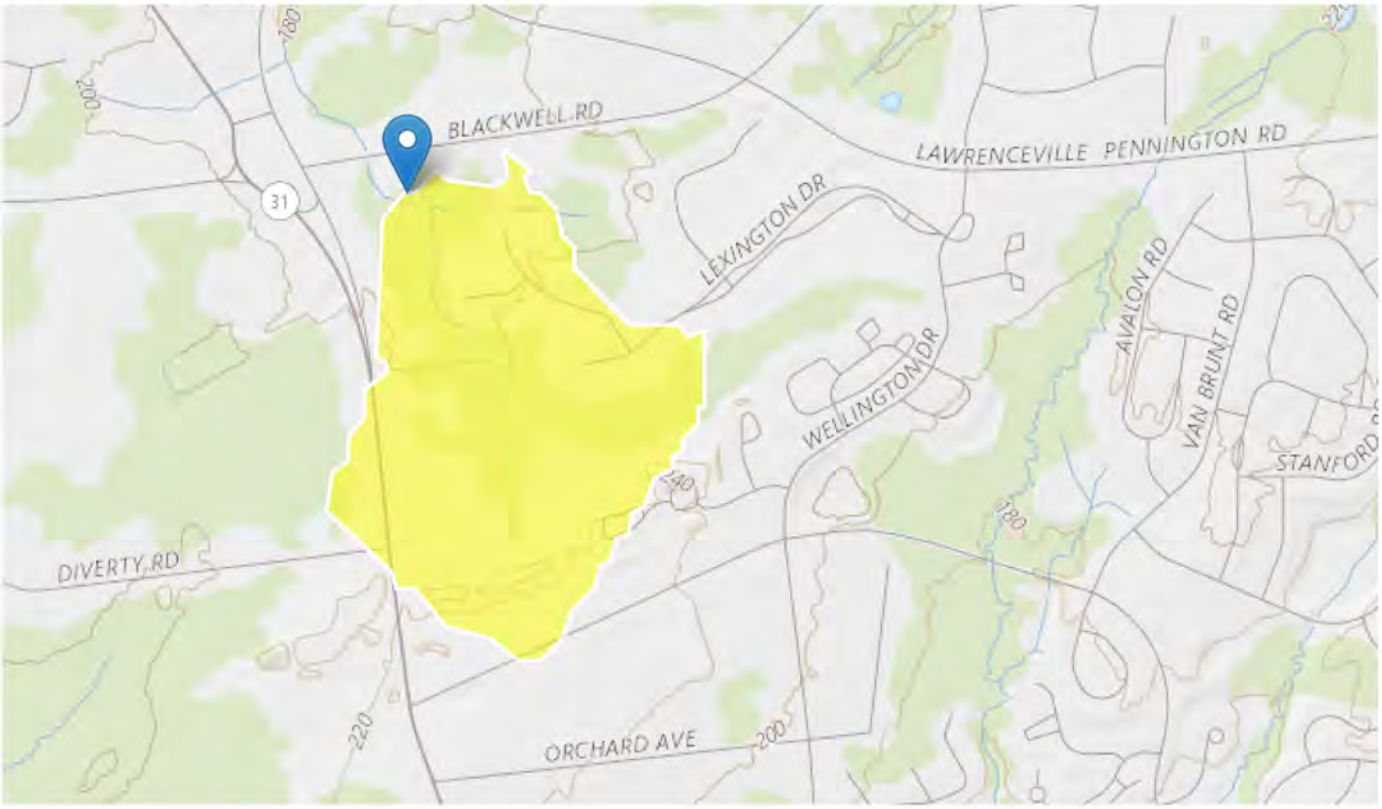
Observation Date(s): 09/08/17 and 4/13/16

County: Mercer

Description: A minor ephemeral ditch flowing north parallel to an existing railroad line. The bank width is approximately 3 to 5 feet and the water depth was three inches at the time of the site visit. The streambed substratum was made up of cobble, gravel, and minor amounts of clay.

MP 112.85R2

Region ID: NJ
Workspace ID: NJ20180312144309075000
Clicked Point (Latitude, Longitude): 40.30768, -74.78376
Time: 2018-03-12 10:43:23 -0400



The South Carolina StreamStats application is testing LiDAR-derived data and streams for delineation. This is a beta version and QA/QC is incomplete. It may calculate basin characteristics and flow statistics incorrectly. Please verify the drainage areas and flow stats carefully. Use at your own risk

Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	0.15	square miles
STORAGE	Percentage of area of storage (lakes ponds reservoirs wetlands)	20.6	percent

Parameter Code	Parameter Description	Value	Unit
CSL10_85	Change in elevation divided by length between points 10 and 85 percent of distance along main channel to basin divide - main channel method not known	48.3	feet per mi
POPDENS	Basin Population Density	576	persons per square mile

Peak-Flow Statistics Parameters [Peak Unglaciated Piedmont Region 2009 5167]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.15	square miles	0.25	779
STORAGE	Percent Storage	20.6	percent	0.23	32
CSL10_85	Stream Slope 10 and 85 Method	48.3	feet per mi	4.31	191
POPDENS	Basin Population Density	576	persons per square mile	83	11084

Peak-Flow Statistics Disclaimers [Peak Unglaciated Piedmont Region 2009 5167]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors

Peak-Flow Statistics Flow Report [Peak Unglaciated Piedmont Region 2009 5167]

Statistic	Value	Unit
2 Year Peak Flood	45.5	ft^3/s
5 Year Peak Flood	74	ft^3/s
10 Year Peak Flood	94.8	ft^3/s
25 Year Peak Flood	123	ft^3/s
50 Year Peak Flood	144	ft^3/s
100 Year Peak Flood	168	ft^3/s
500 Year Peak Flood	223	ft^3/s

Worksheet for MP-112.85R2 STA 2+60_2YR_PIPE

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.01600	ft/ft
Discharge	45.50	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	190.00
0+30	190.00
0+48	189.80
0+50	188.31
0+57	189.90
1+00	190.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 190.00)	(1+00, 190.00)	0.030

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	1.78	ft
Elevation Range	188.31 to 190.00 ft	
Flow Area	20.81	ft²
Wetted Perimeter	100.94	ft
Hydraulic Radius	0.21	ft
Top Width	100.00	ft
Normal Depth	1.78	ft

Worksheet for MP-112.85R2 STA 2+60_2YR_PIPE

Results

Critical Depth		1.76	ft
Critical Slope		0.02325	ft/ft
Velocity		2.19	ft/s
Velocity Head		0.07	ft
Specific Energy		1.86	ft
Froude Number		0.84	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.78	ft
Critical Depth	1.76	ft
Channel Slope	0.01600	ft/ft
Critical Slope	0.02325	ft/ft

Worksheet for MP-112.85R2 STA 2+12_2YR_BRIDGE

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.01600	ft/ft
Discharge	45.50	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	190.00
0+45	189.65
0+50	188.18
0+54	190.10
1+00	190.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 190.00)	(1+00, 190.00)	0.030

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	1.80	ft
Elevation Range	188.18 to 190.10 ft	
Flow Area	15.90	ft²
Wetted Perimeter	51.56	ft
Hydraulic Radius	0.31	ft
Top Width	50.98	ft
Normal Depth	1.80	ft
Critical Depth	1.77	ft

Worksheet for MP-112.85R2 STA 2+12_2YR_BRIDGE

Results

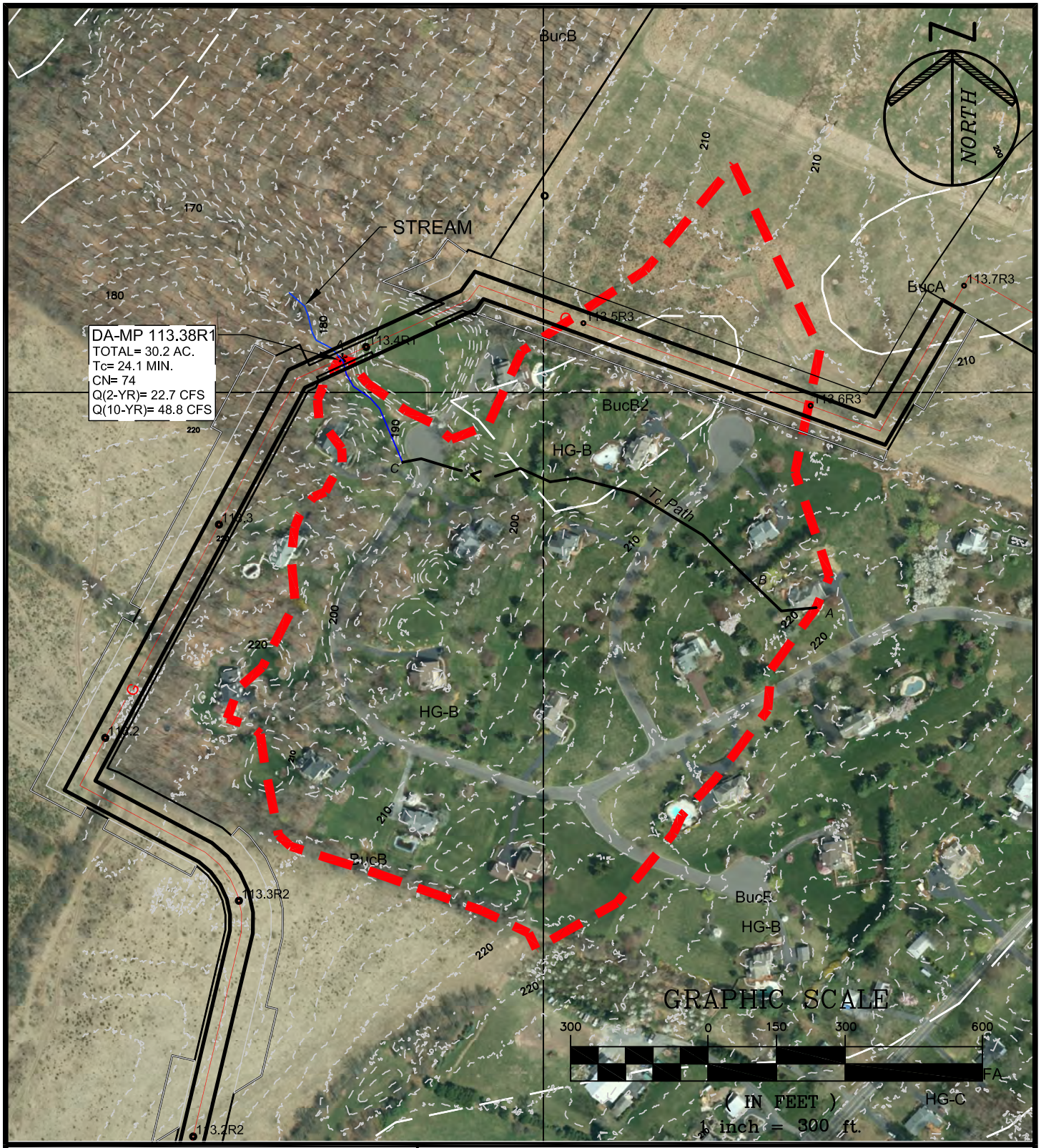
Critical Slope		0.01976	ft/ft
Velocity		2.86	ft/s
Velocity Head		0.13	ft
Specific Energy		1.92	ft
Froude Number		0.90	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.80	ft
Critical Depth	1.77	ft
Channel Slope	0.01600	ft/ft
Critical Slope	0.01976	ft/ft



PAULUS, SOKOLOWSKI AND SARTOR, LLC.

1433 ROUTE 34
SUITE A4
WALL, NEW JERSEY 07727
PHONE: (848) 206-2626

CERTIFICATE OF AUTHORIZATION NO. 24GA28032700

PROJECT TITLE

PENNEAST PIPELINE

HUNTERDON AND MERCER COUNTY, NJ

SHEET TITLE

STREAM CROSSING DRAINAGE AREA MP 113.38R1

PROJ. NO.:	05516.0001	DRN. BY:	JPS	SCALE:	1"=300'
DATE:	05/23/19	CK'D BY:	WS		

FILE NAME: P:\05516\0001\DWGs\CAD\C-Civil\Plotdwgs\Drainage Area Maps\05516001-Stream_DA_MP100.8-114-WAL.dwg\MP 113.38R1 LAST EDIT: 06/13/2019 - 03:41:53 PM LOGIN: IKuzmina@

Worksheet 2: Runoff curve number and runoff (Approximated)

Project	By	Date
PennEast	JPS	26-Feb-18
Location	**Checked**	**Date**
Hunterdon County, NJ		

Check one: ☐ Present ☒ Developed | MP 113.38R1

1. Runoff curve number

Soil name and hydrologic group (appendix A)	Cover Description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN[1] Table 2-2	CN[1] Figure 2-3	CN[1] Figure 2-4	Area ☒ acres / ☐ mi² / ☐ %	Product of CN x Area
Type B	Farmstead, Good Condition	74			30.20	2,234.80
				Totals ➡	30.20	2,234.80

1. Use only one CN source per line

CN (weighted) = tot.prod. / tot. area = 2,234.80 / 30.20 = 74.0 ; Use CN ➡ **74**

2. Runoff

		Storm #1	Storm #2	Storm #3
Frequency……	yr			
Rainfall, P (24-hour)…….	in			
Runoff, Q……	in			

Use P and CN with table 2-1, figure 2-1, or equation 2-3 abd 2-4

PSS&	PROJECT: PennEast	JOB NO. 5516.0001	
		SHEET	DATE:2/12/2018
		BY:	JPS
	SUBJECT: Tc Calculations	CHK'D	

Time of Concentration calculations with the application of the SCS TR-55 methodology.

Watershed or Subarea Designation: DA 113.38R1

Area 30.2 AC

SHEET FLOW

Segment ID		A-B				
Surface Description (Table 3-1)		GRASS				
Manning's Coefficient, n (Table 3-1)		0.240				
Flow Length, L (total <= 150)	(ft)	150				
Two Year Rainfall, P	(in)	3.4				
Land Slope, s	(ft/ft)	0.027				
Computed Tt = 0.007 (nL)^0.8 / P^0.5*s^0.4	(hrs)	0.284				0.284

SHALLOW CONCENTRATED FLOW

Segment ID		B-C				
Surface Description (paved or unpaved)		UNPAVED				
Flow Length, L	(ft)	867				
Watercourse slope, s	(ft/ft)	0.028				
Average Velocity, V (Figure 3-1)	(ft/s)	2.5				
Computed Tt = L / 3600V	(hrs)	0.096				0.096

CHANNEL FLOW

Segment ID		C-D				
Cross sectional Area, a	(sf)	6.78				
Wetted Perimeter, Pw	(ft)	23.38				
Hydraulic Radius, r =a/Pw	(ft)	0.290				
Channel Slope (ft/ft)	(ft/ft)	0.044				
Manning's Roughness Coefficient, n		0.040				
Velocity, V = 1.49r^(2/3)s^0.5 / n	(ft/s)	3.42				
Flow Length, L	(ft)	270				
Computed Tt = L / 3600V	(hrs)	0.022				0.022

Watershed or subarea Tc	0.402	hrs.
	24.1	min.

Use minimum Tc of 10 minutes

Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Wednesday, 02 / 20 / 2019

Hyd. No. 36

DA 113.38R1

Hydrograph type	= SCS Runoff	Peak discharge	= 22.74 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.30 hrs
Time interval	= 6 min	Hyd. volume	= 118,093 cuft
Drainage area	= 30.200 ac	Curve number	= 74.000*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 24.1 min
Total precip.	= 3.26 in	Distribution	= Custom
Storm duration	= C:\Users\IKuzmina\AppData\Local\Autodesk\C3D 2019\enu\HHApps\Hydrograp		

* Composite (Area/CN) = [(30.200 x 74)] / 30.200

Hydrograph Discharge Table

(Printed values >= 1.00% of Qp.)

Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)
11.20	0.251	13.00	6.760	14.80	2.167	16.60	1.424
11.30	0.398	13.10	5.970	14.90	2.084	16.70	1.402
11.40	0.588	13.20	5.326	15.00	2.000	16.80	1.379
11.50	0.822	13.30	4.860	15.10	1.915	16.90	1.357
11.60	1.181	13.40	4.443	15.20	1.835	17.00	1.334
11.70	1.693	13.50	4.070	15.30	1.766	17.10	1.312
11.80	2.517	13.60	3.731	15.40	1.713	17.20	1.289
11.90	3.822	13.70	3.433	15.50	1.673	17.30	1.266
12.00	6.488	13.80	3.185	15.60	1.643	17.40	1.243
12.10	12.29	13.90	2.993	15.70	1.618	17.50	1.219
12.20	18.34	14.00	2.847	15.80	1.597	17.60	1.196
12.30	22.74	14.10	2.735	15.90	1.576	17.70	1.173
12.40	21.94	14.20	2.647	16.00	1.554	17.80	1.150
12.50	19.69	14.30	2.569	16.10	1.533	17.90	1.126
12.60	16.43	14.40	2.491	16.20	1.512	18.00	1.103
12.70	12.80	14.50	2.411	16.30	1.490	18.10	1.079
12.80	9.369	14.60	2.330	16.40	1.469	18.20	1.056
12.90	7.824	14.70	2.249	16.50	1.446	18.30	1.037

Continues on next page...

Worksheet for MP-113.38_STA0+25_PIPE_2YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.03300	ft/ft
Discharge	22.70	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	196.00
0+45	182.10
0+50	181.95
0+52	182.10
0+70	186.00
0+75	188.00
0+81	190.00
1+00	190.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 196.00)	(1+00, 190.00)	0.050

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.78	ft
Elevation Range	181.95 to 196.00 ft	
Flow Area	6.39	ft²
Wetted Perimeter	11.99	ft
Hydraulic Radius	0.53	ft

Worksheet for MP-113.38_STA0+25_PIPE_2YR

Results

Top Width		11.82	ft
Normal Depth		0.78	ft
Critical Depth		0.71	ft
Critical Slope		0.04673	ft/ft
Velocity		3.55	ft/s
Velocity Head		0.20	ft
Specific Energy		0.97	ft
Froude Number		0.85	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.78	ft
Critical Depth	0.71	ft
Channel Slope	0.03300	ft/ft
Critical Slope	0.04673	ft/ft

Worksheet for MP-113.38_STA0+35_BRIDGE_2YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.03300	ft/ft
Discharge	22.70	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	186.00
0+46	181.85
0+50	181.66
0+54	182.20
0+73	184.00
0+89	190.00
1+00	190.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 186.00)	(1+00, 190.00)	0.050

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.82	ft
Elevation Range	181.66 to 190.00 ft	
Flow Area	7.48	ft²
Wetted Perimeter	17.74	ft
Hydraulic Radius	0.42	ft
Top Width	17.66	ft

Worksheet for MP-113.38_STA0+35_BRIDGE_2YR

Results

Normal Depth		0.82	ft
Critical Depth		0.76	ft
Critical Slope		0.05006	ft/ft
Velocity		3.04	ft/s
Velocity Head		0.14	ft
Specific Energy		0.96	ft
Froude Number		0.82	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.82	ft
Critical Depth	0.76	ft
Channel Slope	0.03300	ft/ft
Critical Slope	0.05006	ft/ft

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+00.4°
-18.0°
EXTRAS
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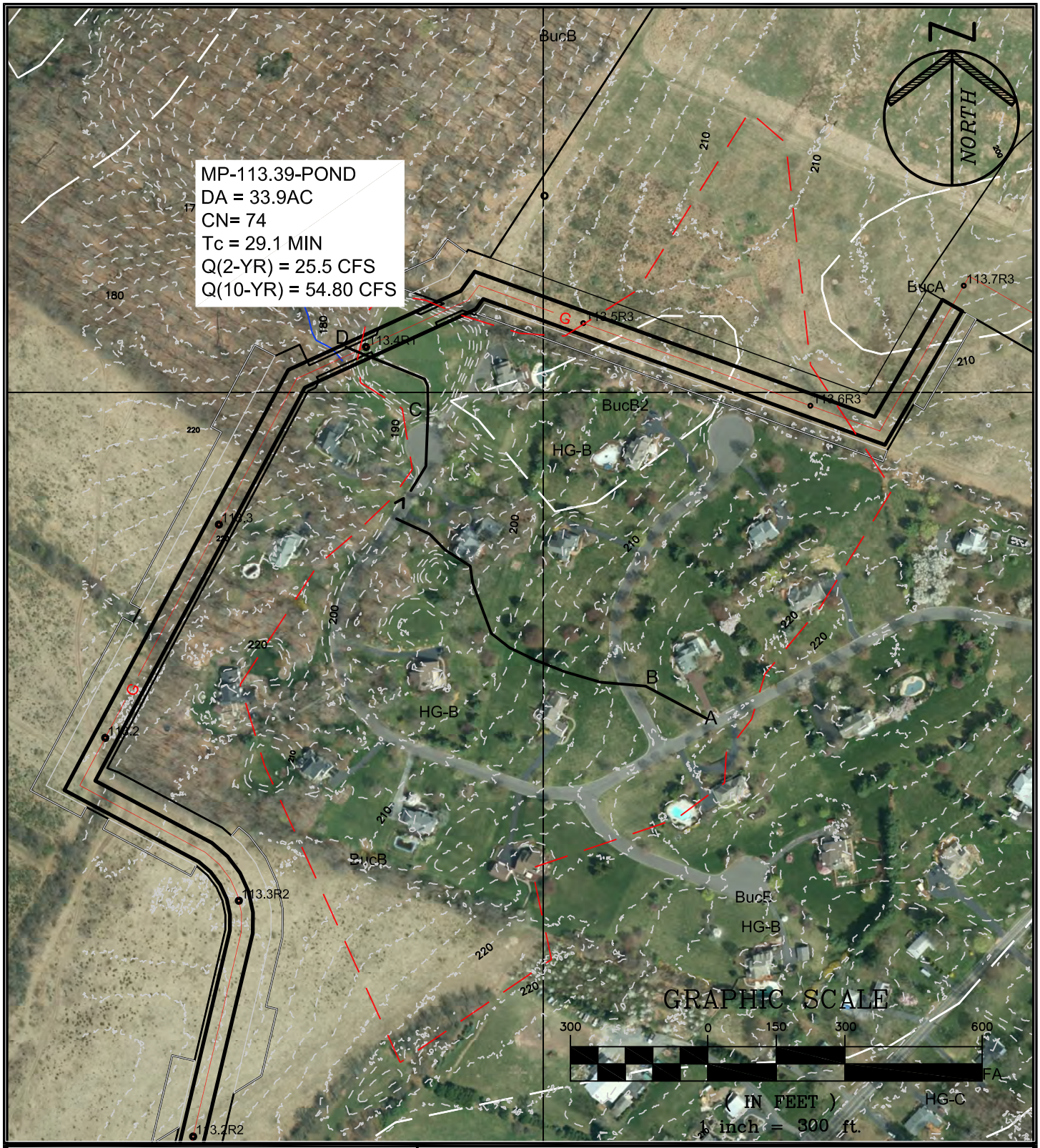

PAULUS, SOKOLOWSKI AND SARTOR, LLC.

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CERTIFICATE OF AUTHORIZATION NO. 24GA28032700

PROJECT TITLE

PENNEAST PIPELINE

HUNTERDON AND MERCER COUNTY, NJ

SHEET TITLE

STREAM CROSSING DRAINAGE AREA MP 113.39R1-POND

PROJ. NO.:	05516.0001	DRN. BY:	JPS	SCALE:	1"=300'
DATE:	05/23/19	CK'D BY:	WS		

FILE NAME: P:\05516\0001\DWGs\CAD\C-Civil\Plotdwgs\Drainage Area Maps\05516001-Stream_DA_MP100.8-114-WAL.dwg\MP 113.39-POND LAST EDIT: 06/18/2019 - 11:07:19 AM LOGIN:IKuzmina@

PROJECT:	PennEast	JOB NO. 5516.0001	
		SHEET	DATE:05-23-19
		BY:	JM
SUBJECT:	Tc Calculations	CHK'D	

Time of Concentration calculations with the application of the SCS TR-55 methodology.

Watershed or Subarea Designation: DA 113.39-POND

Area 33.9 AC

SHEET FLOW

Segment ID		A-B			
Surface Description (Table 3-1)		GRASS			
Manning's Coefficient, n (Table 3-1)		0.150			
Flow Length, L (total <= 150)	(ft)	150			
Two Year Rainfall, P	(in)	3.4			
Land Slope, s	(ft/ft)	0.006			
Computed Tt = 0.007 (nL)^0.8 / P^0.5*s^0.4	(hrs)	0.356			0.356

SHALLOW CONCENTRATED FLOW

Segment ID		B-C			
Surface Description (paved or unpaved)		UNPAVED			
Flow Length, L	(ft)	989			
Watercourse slope, s	(ft/ft)	0.030			
Average Velocity, V (Figure 3-1)	(ft/s)	2.8			
Computed Tt = L / 3600V	(hrs)	0.098			0.098

CHANNEL FLOW

Segment ID		CD			
Cross sectional Area, a	(sf)	165.00			
Wetted Perimeter, Pw	(ft)	220.02			
Hydraulic Radius, r =a/Pw	(ft)	0.750			
Channel Slope (ft/ft)	(ft/ft)	0.007			
Manning's Roughness Coefficient, n		0.045			
Velocity, V = 1.49r^(2/3)s^0.5 / n	(ft/s)	2.29			
Flow Length, L	(ft)	253			
Computed Tt = L / 3600V	(hrs)	0.031			0.031

Watershed or subarea Tc	0.485	hrs.
	29.1	min.

Use minimum Tc of 10 minutes

Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 05 / 23 / 2019

Hyd. No. 96

MP-113.39-POND

Hydrograph type	= SCS Runoff	Peak discharge	= 25.52 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.30 hrs
Time interval	= 6 min	Hyd. volume	= 132,561 cuft
Drainage area	= 33.900 ac	Curve number	= 74.000
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 29.1 min
Total precip.	= 3.26 in	Distribution	= Custom
Storm duration	= C:\Users\IKuzmina\AppData\Local\Autodesk\C3D 2019\enu\HHApps\Hydrograp	Storm frequency	= 24 yrs

Hydrograph Discharge Table

(Printed values >= 1.00% of Qp.)

Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)
11.20	0.282	13.00	7.588	14.80	2.432	16.60	1.598
11.30	0.446	13.10	6.702	14.90	2.339	16.70	1.573
11.40	0.660	13.20	5.978	15.00	2.245	16.80	1.548
11.50	0.922	13.30	5.455	15.10	2.150	16.90	1.523
11.60	1.325	13.40	4.987	15.20	2.060	17.00	1.497
11.70	1.901	13.50	4.569	15.30	1.983	17.10	1.472
11.80	2.826	13.60	4.188	15.40	1.923	17.20	1.447
11.90	4.290	13.70	3.854	15.50	1.877	17.30	1.421
12.00	7.283	13.80	3.575	15.60	1.844	17.40	1.395
12.10	13.79	13.90	3.359	15.70	1.816	17.50	1.369
12.20	20.59	14.00	3.195	15.80	1.793	17.60	1.343
12.30	25.52	14.10	3.070	15.90	1.769	17.70	1.317
12.40	24.62	14.20	2.971	16.00	1.744	17.80	1.290
12.50	22.10	14.30	2.884	16.10	1.721	17.90	1.264
12.60	18.44	14.40	2.796	16.20	1.697	18.00	1.238
12.70	14.36	14.50	2.706	16.30	1.673	18.10	1.211
12.80	10.52	14.60	2.616	16.40	1.649	18.20	1.186
12.90	8.782	14.70	2.525	16.50	1.623	18.30	1.164

<<

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Worksheet for MP-113.39_STA0+00_PIPE_2YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00500	ft/ft
Discharge	25.50	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	184.00
0+17	184.00
0+49	184.40
0+50	182.49
0+51	185.25
0+73	188.00
1+00	188.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 184.00)	(1+00, 188.00)	0.030

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	1.93	ft
Elevation Range	182.49 to 188.00 ft	
Flow Area	16.20	ft²
Wetted Perimeter	53.78	ft
Hydraulic Radius	0.30	ft
Top Width	50.91	ft

Worksheet for MP-113.39_STA0+00_PIPE_2YR

Results

Normal Depth		1.93	ft
Critical Depth		1.79	ft
Critical Slope		0.02324	ft/ft
Velocity		1.57	ft/s
Velocity Head		0.04	ft
Specific Energy		1.97	ft
Froude Number		0.49	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.93	ft
Critical Depth	1.79	ft
Channel Slope	0.00500	ft/ft
Critical Slope	0.02324	ft/ft

Worksheet for MP-113.39_STA0+12_BRIDGE_2YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00500	ft/ft
Discharge	25.50	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	186.00
0+31	186.00
0+42	183.60
0+50	181.25
0+58	183.10
0+70	184.00
1+00	184.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 186.00)	(1+00, 184.00)	0.030

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	1.54	ft
Elevation Range	181.25 to 186.00 ft	
Flow Area	8.87	ft²
Wetted Perimeter	11.90	ft
Hydraulic Radius	0.74	ft
Top Width	11.49	ft

Worksheet for MP-113.39_STA0+12_BRIDGE_2YR

Results

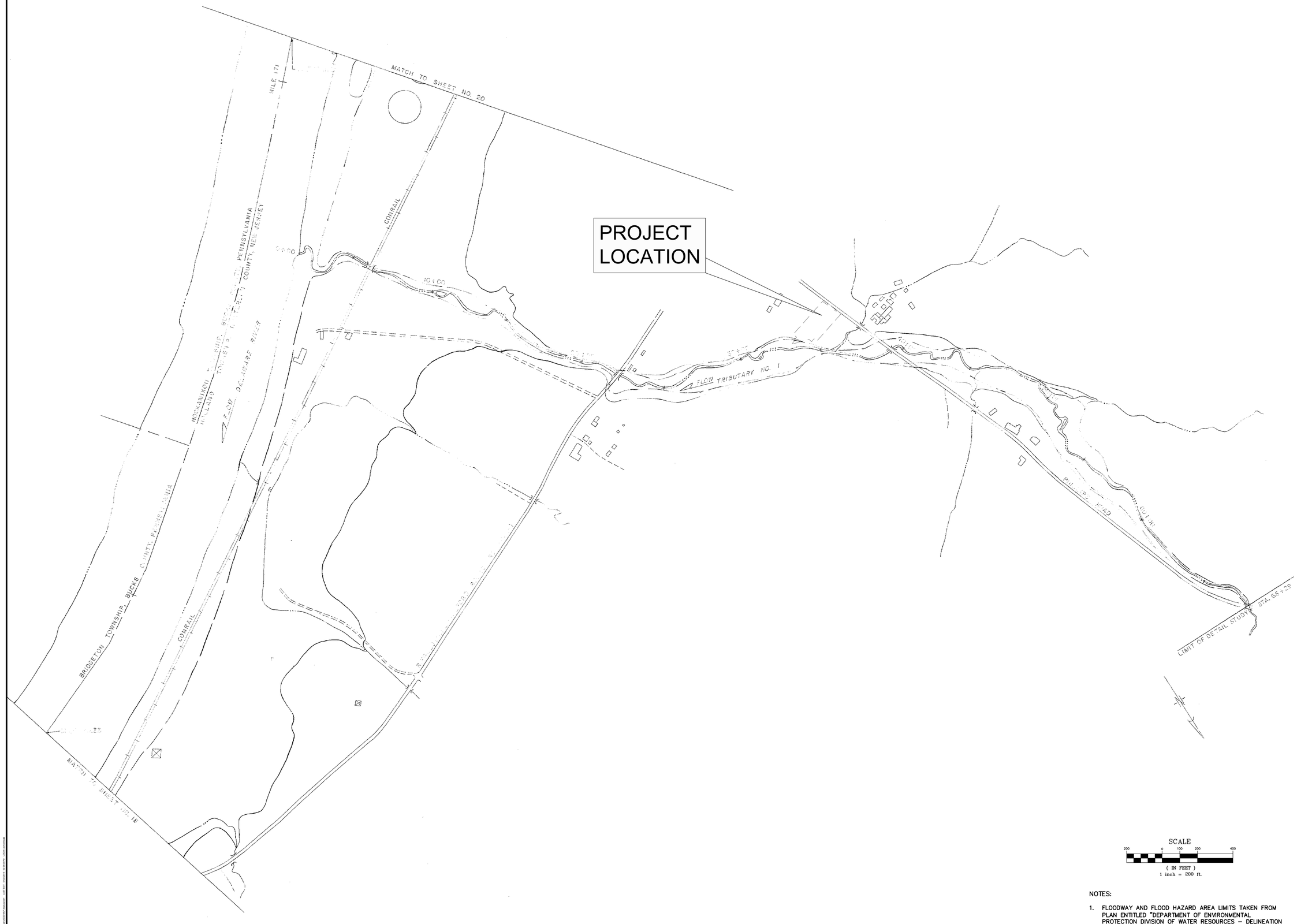
Normal Depth		1.54	ft
Critical Depth		1.24	ft
Critical Slope		0.01613	ft/ft
Velocity		2.88	ft/s
Velocity Head		0.13	ft
Specific Energy		1.67	ft
Froude Number		0.58	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.54	ft
Critical Depth	1.24	ft
Channel Slope	0.00500	ft/ft
Critical Slope	0.01613	ft/ft



SCALE

200 0 100 200 400

(IN FEET)
1 inch = 200 ft.

NOTES:

1. FLOODWAY AND FLOOD HAZARD AREA LIMITS TAKEN FROM PLAN ENTITLED "DEPARTMENT OF ENVIRONMENTAL PROTECTION DIVISION OF WATER RESOURCES – DELINEATION OF FLOODWAY AND FLOOD HAZARD AREA FOR THE DELAWARE RIVER TRIBUTARY NO. 1 (STA. 0+00 TO STA. 68+29)," PREPARED BY MICHAEL BAKER, JR. INC., DATED 1978.

REV. / ISSUE	DATE	DESCRIPTION

CONSULTANT

CONSULTANT

ORIENTATION / KEY PLAN

CLIENT

PAULUS, SOKOLOWSKI AND SARTOR, LLC.
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WALL, NJ 07727
PHONE: (848) 206-2626
CERTIFICATE OF AUTHORIZATION NO. 24GA28032700

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WILLIAM SALMON, P.E.
PROFESSIONAL ENGINEER
N.J. LIC. NO. 41319

SIGNATURE DATE

PROJECT

PENNEAST PIPELINE PROJECT
GILBERT LATERAL

BLOCK 20, LOT 10
HOLLAND TOWNSHIP, HUNTERDON COUNTY, NEW JERSEY

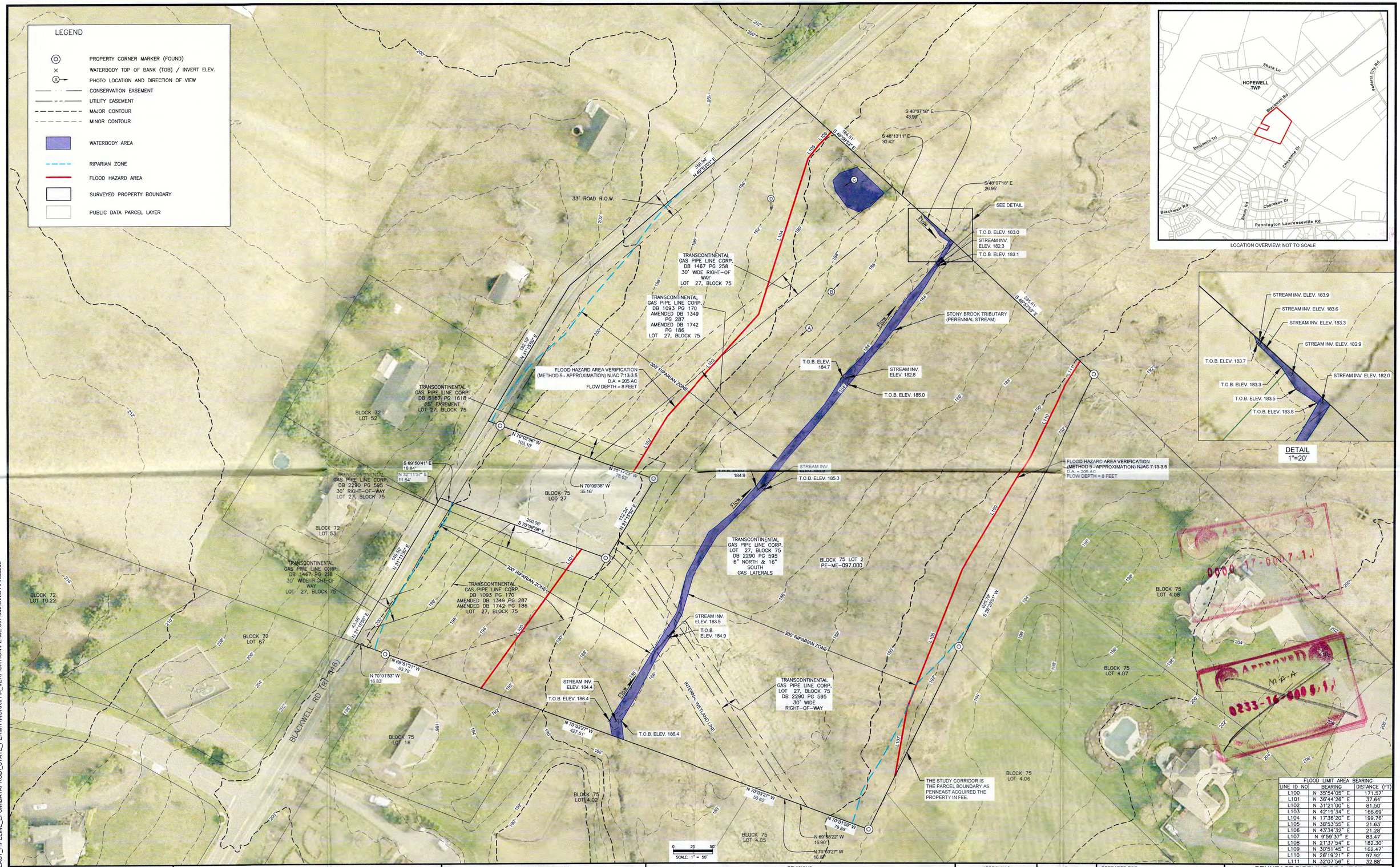
SHEET TITLE

DELINEATION OF FLOODWAY AND FLOOD HAZARD AREA

PROJECT NO.: 05516-0001	DRAWN BY: JPS
SCALE: 1"=200'	CHECKED BY: WS
DATE: 4/9/2019	SHEET 1 OF 1

SHEET NO.

FIG. 5



FLOOD LIMIT AREA BEARING		
LINE ID NO	BEARING	DISTANCE (FT)
L100	N 35°54'05" E	171.57'
L101	N 36°44'26" E	37.64'
L102	N 31°21'00" E	81.50'
L103	N 42°19'34" E	166.69'
L104	N 17°36'20" E	199.76'
L105	N 38°53'55" E	21.63'
L106	N 43°34'32" E	21.28'
L107	N 9°59'37" E	83.47'
L108	N 21°37'54" E	182.30'
L109	N 30°51'45" E	162.47'
L110	N 26°19'21" E	97.92'
L111	N 32°07'56" E	32.88'

WILLIAM A. DIBARTOLO JR.
PROFESSIONAL LAND SURVEYOR NJ LIC. 24GS04331200

5/12/17

GENERAL NOTES:
1. THE COORDINATE SYSTEM IS N.J.S.P.C.S. (NAD83) AND THE VERTICAL DATUM IS NAVD88.
2. THIS PLAN IS NOT A BOUNDARY SURVEY BASED UPON N.J.S.A. 45:8-28(E), N.J.A.C. 13:40-1.3:40-5.1. PROPERTY LINES FOR THE SUBJECT PARCEL OF THIS PLAN ARE BASED ON FIELD SURVEYS PERFORMED BY MOTT MACDONALD BETWEEN 2016 AND THE DATE ON THIS PLAN. OTHER EASEMENTS SHOWN ARE FOR REFERENCE ONLY.
3. AERIAL PHOTOGRAPHY SHOWN ON THIS PLAN IS FROM A MARCH 2015 AERIAL FLYOVER ACQUIRED BY PENNEAST FROM PICTOMETRY.
4. TOPOGRAPHY SHOWN ON THIS PLAN IS FROM 2015 AERIAL FLYOVER ACQUIRED BY PENNEAST FROM PICTOMETRY AND CIVIL SURVEY CONDUCTED BY MOTT MACDONALD BETWEEN JUNE 2016 AND THE DATE OF THIS PLAN.
5. FEATURES SHOWN OUTSIDE OF THE STUDY CORRIDOR ARE BASED ON PUBLICALLY AVAILABLE INFORMATION, UNLESS OTHERWISE NOTED ON THE PLAN.
6. WETLAND AND STREAM LIMITS WERE FIELD DELINEATED BY AMY S. GREENE ENVIRONMENTAL CONSULTANTS INC., UNLESS OTHERWISE NOTED ON THE PLAN.

SITE SPECIFIC NOTES:
1. THE INTENT OF THIS PLAN IS TO DEPICT STATE OPEN WATERS, RIPARIAN ZONES AND FLOOD HAZARD AREAS WITHIN PENNEAST'S FEE PROPERTY. THIS PLAN SHALL NOT BE USED FOR CONVEYANCE OF LAND OR CONSTRUCTION PURPOSES.
2. THE SUBJECT PROPERTY IS DESCRIBED IN DEED BOOK 6238 AND PAGE 943.
3. THE FLOOD HAZARD AREA & RIPARIAN ZONE VERIFICATION REQUEST IS FOR THE AREA WITHIN PENNEAST'S FEE PROPERTY.
4. STONY BROOK TRIBUTARY IS A PERENNIAL STREAM AND WAS FIELD LOCATED ON 10/27/16.
5. ALL OR A PORTION OF THIS SITE LIES IN A FLOOD HAZARD AREA. CERTAIN ACTIVITIES IN FLOOD HAZARD AREAS ARE REGULATED BY THE NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION (NJDEP) PURSUANT TO THE FLOOD HAZARD AREA CONTROL ACT (N.J.S.A. 58:16A-50 ET SEQ.). THESE ACTIVITIES FIRST REQUIRE A PERMIT. CONTACT THE DIVISION OF LAND USE REGULATION AT (609) 777-0454 FOR MORE INFORMATION PRIOR TO ANY CONSTRUCTION ONSITE.
6. THE CONVERSION TO NGVD29 AT THIS SITE IS NAVD88+0.68 PER US ARMY CORPS OF ENGINEERS CORPSCON SOFTWARE, VERSION 6.0.1.
7. FLOOD HAZARD AREA VERIFICATION (METHOD 5) PREPARED BY WILLIAM DAJNON OF PSE&G IN REPORT TITLED, "NJDEP FLOOD HAZARD AREA VERIFICATION ENGINEER'S REPORT" DATED JANUARY 2017.

REFERENCE DRAWINGS

DWG. NO.	TITLE

REVISIONS

NO.	REVISIONS	DATE	DRAWN	CK	APPR
1	REVISED PLAN PER NJDEP COMMENTS	4/26/17	JJL	MDN	WAD
2	REVISED PLAN PER NJDEP COMMENTS	5/11/17	WAH	MDN	WAD

APPROVALS

DRAWN BY	DATE
MM	01/2017
CHECKED BY	DATE
MM	01/2017
ENG. APPROVAL	DATE
P.M. APPROVAL	DATE

CLIENT APPROVAL

DATE

N

PREPARED FOR

PennEast PIPELINE

PENNEAST PIPELINE PROJECT

FLOOD HAZARD AREA
& RIPARIAN ZONE VERIFICATION PLAN
PARCEL PE-ME-097.000
BLOCK 75 LOT 2
TOWNSHIP OF HOPEWELL
MERCER COUNTY, NEW JERSEY

SCALE	DRAWING NO.	REVISION
1"=50'	PE-ME-097.000_FHA	2

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